Preliminary Engineering Report (FINAL)

East Side Street and Drainage Improvements

City of West University Place, Texas

October 20, 2021



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Executive Summary

1.1 Statement of Problem

HT&J, LLC previously performed a citywide drainage study for the City of West University Place that identified a new 50-year level of service (removal of structural flooding for a 50-year storm event). This study provided recommendations for the upsizing of the storm sewer facilities to achieve the identified level of service. Based on the findings presented in the HT&J drainage study, the report identified sections of storm sewer for replacement to be included in the East Side Street and Drainage Improvements project.

1.2 Drainage Recommendation

Due to the close proximity and maturity of the existing trees along the project area, the proposed drainage improvements will be installed under the roadway. The proposed alignment was chosen based on minimizing conflicts with public utility (water and sanitary sewer) and private utilities (telephone, power, gas, and cable). The HT&J Drainage Study provided the sizing for the new storm sewer improvements. Due to the limited available detention in the area to mitigate the potential impacts from the drainage improvements, HDR incorporated inline flow control devices. These inline flow control devices must remain in place until the City is able to secure 58.51 acre-feet of detention for the additional runoff conveyed in the proposed improvements.

1.3 Street Alignment Identification

The City reviewed the possibility of increasing the width of the existing roadways identified in this project. This would allow safer street parking and vehicular traffic movements. As previously discussed, the project area is heavily treed and the expansion of the roadway would significantly increase the potential impacts to the health of the existing trees along the project area. The footprint of the proposed roadway improvements will be restricted to the footprint of the existing paving except for Duke Street on the block between Buffalo Speedway and Vanderbilt Street. Considering only one block of street widening was determined to be unfeasible, it was not recommended to pursue this option further.

1.4 Findings from Phase 1 PER Activities

A site topographical survey of the right-of-way plus 20 feet outside the right-of-way was conducted for the project area.

Land use in the project area consists primarily of single-family residences with direct vehicle access to the streets. All of the roadways in the project area are reinforced concrete pavement. Because the project area is heavily treed, the proposed storm sewer within the project area is proposed under the roadway section. The proposed storm alignment was reviewed by an urban forester to provide a preliminary general tree assessment of potential impacts to trees due to construction activities.

A geotechnical investigation was conducted to evaluate soil and water conditions within the project area and provided recommendations for the proposed paving sections. The geotechnical investigation recommended a standard paving section of 9” thick reinforced

concrete on 8” thick lime-stabilized subgrade for University Boulevard, Rice Boulevard, and Wakeforest Avenue since the streets were classified as minor arterials or major collectors. An 8” thick reinforced concrete on 8” thick lime-stabilized subgrade section was recommended for Duke Street since this is a residential road. Paving will be replaced in full roadway sections and will match the width of the existing street.

Potential utility conflicts were identified for the proposed storm sewer and paving, and detailed utility conflict matrices were prepared for each street within the project area. A utility contact list has been compiled as part of the coordination efforts with local utility operators and owners.

As of the date of this report, a new storm sewer trunk main is being installed along Buffalo Speedway and is scheduled for completion in 2023. The proposed storm sewer improvements along University Boulevard and Duke Street will tie into the Buffalo Speedway system. The proposed pipe identified in the HT&J Drainage Report and associated junction structures will be change-ordered into the Buffalo Speedway project to prevent having to replace both intersections twice. The Buffalo Speedway drainage system is anticipated to be completed by the start of construction for the project delineated within this PER.

1.5 Recommended Project

The recommended drainage improvements include full width pavement replacement:

University Boulevard - Buffalo Speedway to Kirby Drive
Remove existing storm sewer system and replace with a 60” reinforced concrete pipe (RCP) under westbound lane.

Duke Street- Buffalo Speedway to Kirby Drive
Remove existing storm sewer system and replace with a 60” RCP under centerline of roadway.

Wakeforest Avenue - Pemberton Drive to University Boulevard
Remove existing storm sewer and replace with 36” to 48” RCP under the Wakeforest Avenue northbound lane.

Wakeforest Avenue - University Boulevard to Georgetown Street
Install 36” to 48” RCP under the southbound lane.

Rice Boulevard - Fordham Street and Kirby Drive
Rehabilitate the existing 36” RCP along north side with cured-in-place pipe.

Per HT&J, the model stated 58.56 acre-feet is needed for detention. HDR performed a cursory review of the model and verified that 58.51 acre-feet of storage would be required which is consistent with the results provided by HT&J. However, due to a lack of viable space for detention in proximity to the project area, flow control devices were deemed a more practical solution. To mitigate the proposed drainage improvements to the downstream receiving system, four flow control devices were considered at four locations:

1. 24” diameter east of the intersection of University Blvd and Buffalo Speedway.
2. 24” diameter east of the intersection of Duke Street and Buffalo Speedway.
3. 24” diameter west of the intersection of University and Wakeforest Avenue.
4. 24” diameter west of the intersection of University and Kirby Drive.

1.6 Opinion of Probable Construction Cost

The engineer’s Opinion of Probable Construction Costs (OPCC) for this project are split into five parts, by street. Detailed Opinions of Probable Construction Costs for this project can be found in **Appendix H.** This includes full width pavement replacement.

Introduction

2.1 Project Location

The project is located on the east side of the City of West University Place, bounded between Kirby Drive and Buffalo Speedway to the east and west, and between Plumb Street and Duke Street to the north and south. This area can be found on Key Map grids 532A, B, E and F for Harris County, Texas. **Appendix A** identifies the project location within the City limits.

The proposed improvements (street and/or drainage) are recommended for the following streets:

- University Boulevard from Buffalo Speedway to Kirby Drive
- Duke Street from Buffalo Speedway to Wakeforest Avenue
- Wakeforest Avenue from Plumb Street to Pemberton Drive
- Rice Boulevard from Wakeforest Avenue to Kirby Drive

2.2 Project Purpose

The purpose of this Preliminary Engineering Report (PER) is to evaluate the project, identify potential solutions and provide recommendations concerning drainage and paving improvements within the project area designated by the City of West University Place (City). This report will identify key issues which will influence selection of the recommended storm sewer alignment, sizing water control devices to mitigate potential impact to the downstream drainage systems, providing an engineer's Opinion of Probable Construction Costs, identifying potential tree impacts, evaluating solutions on possible conflicts with existing utilities, and coordination with various entities such as utility companies.

2.3 Problem Description

HT&J, LLC completed a Citywide drainage study in February 2021, which modeled and analyzed the conditions of the City's existing drainage system. It identified a new 50-year level of service that removed structural flooding in the project area for a 50-year storm event. Since there is limited detention within the City's limits, the proposed storm sewer system will need to mitigate drainage impacts to the receiving drainage system with water control devices until stormwater detention options are identified and become available.

Based on the results of the hydraulic modeling performed as part of the drainage study, HT&J recommended pipe sizes for proposed drainage improvements so that the drainage system can achieve the new level of service. HDR Engineering, Inc. has been contracted to provide preliminary engineering design for the proposed storm sewer alignment along University Boulevard, Duke Street, Rice Boulevard, and Wakeforest Avenue to the east of Buffalo Speedway. Our scope was to mitigate potential impact to the downstream drainage systems and verify that there were no increases to the water surface elevations from these improvements by incorporating and sizing water control devices (restrictors) to mitigate these impacts. Flow control devices installed in the proposed drainage system will be similar in design to those used on the Buffalo Speedway project (masonry blocks with

metal plate for easy removal) when detention is available. The entirety of the project area lies within the 100-year and 500-year floodplains, as shown on FEMA's FIRM Map panel 48201C0860L.

Figure 1 shows the project area, with the recommended pipe sizes from the HT&J Drainage Study shown on the applicable streets.

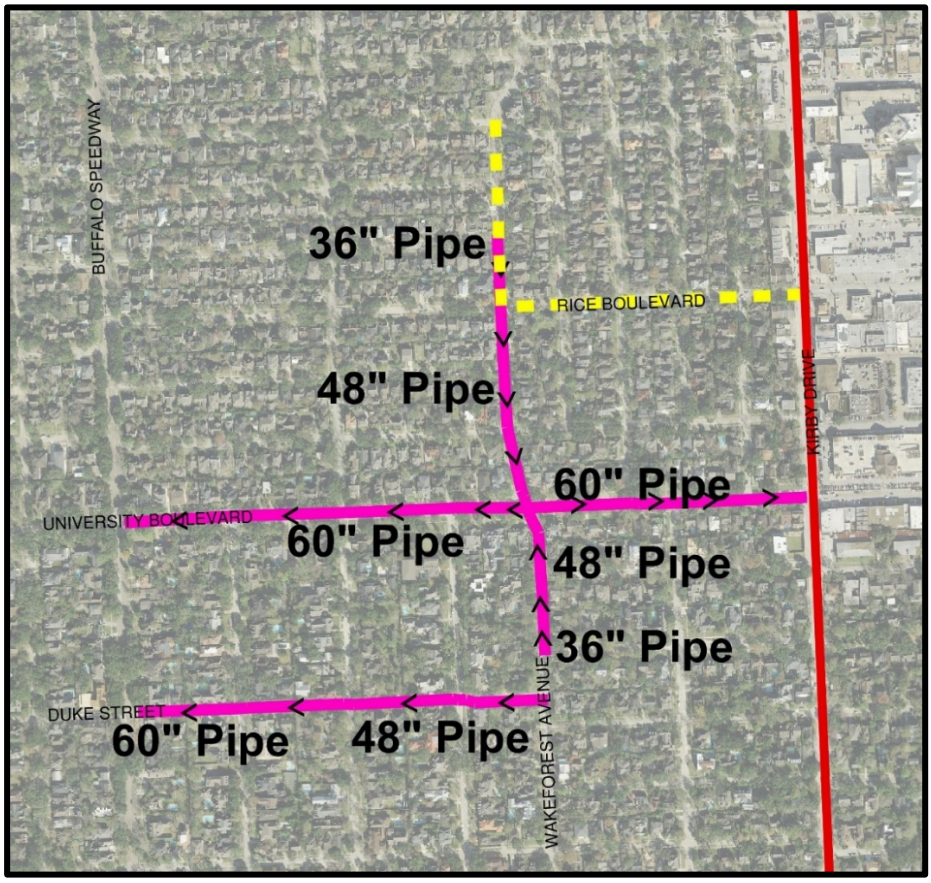


Figure 1. Project Area Showing Recommended Pipe Sizes from HT&J Hydraulic Model.

2.4 Existing Conditions

2.4.1 Land Use

Land use in the project area consists primarily of single-family residences with direct vehicle access to the streets. There are two multi-family complexes located near the Rice Boulevard-Kirby Street intersection on the east side of the project area. There are no commercial or industrial properties in the project area. The existing project area is heavily treed; during the route topographical survey, it was noted that many large-diameter trees were located within the street rights-of-way.

2.4.2 Existing Roadway Conditions

Table 1 shows a summary of the roadways within the project area. All the roadways in the project area are reinforced concrete pavement with curb and gutter.

Table 1. Roadway Summary.

	Lanes	Direction	Roadway Width	Right-of-Way Width
University Boulevard	2	East/West	40 ft	100 ft
Duke Street	2	East/West	25 ft	50 ft
Rice Boulevard	2	East/West	30 ft	50 ft
Wakeforest Avenue	2	North/South	30 ft	60 ft

It is not anticipated that the proposed improvements will require any acquisition of additional right-of-way during the course of the project.

University Boulevard is a two-lane road with side street parking. The roadway consists of approximately 8" thick reinforced concrete pavement with curb and gutter and was reconstructed approximately 15 years ago. The roadway appears to be in satisfactory condition.

Duke Street is a two-lane road. The roadway consists of approximately 6" thick reinforced concrete pavement with curb and gutter and was reconstructed approximately 15 years ago. The roadway appears to be in satisfactory condition.

Wakeforest Avenue south of University Boulevard is a two-lane road. The roadway consists of approximately 6" thick reinforced concrete pavement with curb and gutter and was reconstructed approximately 15 years ago. The roadway appears to be in satisfactory condition.

Wakeforest Avenue north of University Boulevard is a two-lane road. The roadway consists of approximately 7" thick reinforced concrete pavement with curb and gutter. The section from University Boulevard to Rice Boulevard was reconstructed approximately 30 years ago and appears to be in fair condition. The section between Rice Boulevard and Plumb Street appears to be the original pavement and poor condition. There is also a pavement strip along Wakeforest Avenue in this section where sanitary sewer improvements were made.

Rice Boulevard is a two-lane road. The roadway consists of approximately 6.5" thick reinforced concrete pavement with curb and gutter. The section between Wakeforest Avenue and Kirby Drive appears to be the original pavement and poor condition. Only the four intersections between Wakeforest Avenue and Kirby Drive have been reconstructed and appeared to be in fair condition.

Based on the pavement assessment, Wakeforest Avenue from Rice Boulevard to Plumb Street and Rice Boulevard from Wakeforest Avenue to Kirby Drive is recommended for pavement replacement for the full pavement width.

2.4.3 Existing Drainage

Existing drainage within the project area consists of curb and gutter streets that drain into inlets and an underground storm sewer system. Figure 2 shows the layout and sizing of

the existing storm sewer facilities within the project area, with the streets identified within the scope of the project highlighted in green.

Based on the hydraulic modeling done by HT&J, LLC, the storm sewer pipes within the project area will need to be upsized in order for the City to achieve the new level of service as identified in their drainage report.



Figure 2. Existing Storm Sewer in the Project Area.

A. University Boulevard

A storm sewer trunk main (variable diameter, 36”-48” reinforced concrete pipe (RCP) and 5’x3’ reinforced concrete box (RCB)) runs under the westbound lane of University Boulevard. This storm sewer trunk main collects drainage from intersecting side streets. According to record drawings for the project area, there also exists an abandoned 36” storm sewer located behind the curb along the north side of the right-of-way. At Wakeforest Avenue, the drainage system is interconnected and the storm sewer to the west is sloped towards Buffalo Speedway trunk main and the storm sewer to the east is sloped toward Kirby Drive trunk main (which is owned and operated by the City of Houston).

It was noted that the 5’x3’ RCB storm sewer located between Buffalo Speedway and Vanderbilt Street was installed in the past 15 years at the same time when the street was reconstructed; given its age and the expected useful life of similar RCBs, it can be reasonably assumed that the box culvert is still in good condition.

B. Duke Street

An existing 5'x3' RCB storm sewer line runs under the centerline of Duke Street between Buffalo Speedway and Brompton Street. This existing storm sewer line was installed under the center of the roadway because of the active 12" force main under the eastbound lane and 12" sanitary sewer under the westbound lane. This system ties into the Buffalo Speedway drainage system.

At the Duke-Brompton intersection, the storm sewer alignment shifts to underneath the eastbound lane. There is a storm sewer siphon underneath the Brompton intersection consisting of two parallel pipes (an 18" RCP and a 24" RCP) that accommodates the 36" sanitary sewer main that runs down the centerline of Brompton Street. Past Brompton Street, the storm sewer continues underneath Duke Street's eastbound lane to the Duke-Wakeforest intersection.

It was noted that the storm sewer located under Duke Street was installed in the past 15 years at the same time when the street was reconstructed; given its age and the expected useful life of similar reinforced concrete pipes, it can be reasonably assumed that the pipe is still in good condition.

C. Wakeforest Avenue

South of University Boulevard, a 24" to 30" storm sewer line runs under the northbound lane of Wakeforest Avenue and ties into the University Boulevard storm sewer trunk main. This storm sewer was installed in the past 15 years at the same time when the street was reconstructed.

North of University Boulevard, the existing 18" storm sewer is located behind the curb to the west side of the right-of-way; this storm sewer line runs south from Georgetown-Wakeforest intersection and ties into the University Boulevard trunk main. This storm sewer was not replaced when the street was reconstructed.

D. Rice Boulevard

A 24" storm sewer line runs under the westbound lane of Rice Boulevard between Charlotte Street and Fordham Street. At the Rice-Fordham intersection, this 24" storm sewer outfalls into a 36" storm sewer that runs north-south along Fordham Street. This 36" storm sewer turns east at Rice Boulevard runs behind the curb on the north side of the road before it outfalls into the City of Houston trunk line along Kirby Drive.

From the HT&J's model, there are no proposed storm sewer to be replaced along Rice Boulevard. Since this street is recommended for pavement replacement, the City performed closed-circuit television videos (CCTV) to verify the condition of the storm sewer. The 24" storm sewer generally appears to be in fair condition. The 36" storm sewer pipe sections televised from Fordham to Kirby appears to be exhibiting signs of longitudinal cracking at the tops of the pipes. It is therefore recommended that this section be rehabilitated via cured-in-place pipe (CIPP) as discussed with City staff. A Recommendation Report was provided to the City on June 24, 2021.

The existing storm sewer size and location, existing public utilities (water and sanitary sewer), intersection and driveway locations are shown on the Preliminary Layouts in **Appendix D**.

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Findings from Phase I PER Activities

3.1 Site Survey

A site topographical survey was conducted for the project area. All features and improvements within the public rights-of-way and 20 ft outside that boundary (as per City of Houston standards) were identified and recorded, including lot lines, visible underground structures including manholes, inlets and junction boxes, trees, signs, fences, pedestrian crossings, and special paving and landscaping.

HDR researched the available record drawings and provided to the surveyor. The surveyor also performed the Texas One Call prior to beginning survey. The survey included existing water mains, service lines and appurtenances, sanitary sewer and storm sewer lines, telephone, power, gas, and cable information.

A Right-of-Way Map and Survey Control Map signed and sealed by a registered surveyor are shown in **Appendix B**.

3.2 Utilities Research

As part of our due diligence, HDR coordinated with both private and public utility providers. Research on previous record drawings and geographic information system (GIS) for storm sewer, sanitary sewer and water line locations were performed to provide information on public utilities. Discussion with staff was also held to verify any field modification that may have been previously performed as part of a routine City maintenance project. Potential conflicts were identified and line items for relocations and conflict structures are included in the engineer's opinion of probable construction cost.

A utility contact list can be found in **Appendix F-1.**

3.3 Utility Conflicts

Typical of any construction project that involves storm sewer construction, there will be conflicts with existing public and private utilities. These utility companies have been contacted and their respective utilities have been shown accordingly in the plans.

CenterPoint (power and gas), AT&T (telephone and fiber optic conduits), Comcast (internet and fiber optic conduits), Lumen/CenturyLink (fiber optic conduits), MCI/Verizon (internet and fiber optic conduits), and Zayo (fiber optic conduits) were contacted with regards to the utilities they own or operate within the project area. There are no transmission pipelines located within the project area.

The City of West University Place owns and operates the water and sanitary sewer utilities within the project area. Potential conflicts with water service and sanitary service leads were identified throughout the project area. It is recommended that the City begin early coordination with AT&T for this project due to the timeframe required for relocations.

The detailed Utility Conflict Plan of each of the four streets are shown in **Appendix F-2.** Utility conflict matrices can be found for each street within the project area in **Appendices F-3 through F-6.** Since profile views are not prepared for the proposed storm sewer alignment, all conflicts are noted as potential conflicts.

3.4 Geotechnical Investigation

A geotechnical investigation was performed to provide an engineering report describing soil stratigraphy, groundwater conditions, storm sewer bedding and backfill, trench safety, existing and proposed pavement thickness and subgrade treatment. For the investigation, sixteen (16) soil borings were taken within the project area, each to a depth of 15 feet, and standard laboratory tests were conducted on the soil samples collected from the borings. It was determined that there were no documented geologic faults across the project alignments. Free water was observed during drilling operations at six (6) of the bore locations.

The geotechnical report issued for this project can be found in **Appendix E.**

3.5 Flow Control Device Sizing

The Drainage Study performed by HT&J did not include any mitigation efforts for the additional runoff that would be conveyed by the proposed storm sewer improvements to the two outfall systems at Kirby Drive on the east boundary and Poor Farm Ditch on the south boundary of the project area. The information from the HT&J report and model stated 58.56 acre-feet is needed to mitigate the impacts of the proposed improvements to the receiving systems. HDR performed a cursory review of the original model and provided comments back to HT&J. HT&J issued an amendment to the Drainage Study and an updated model to address HDR's comments. HDR re-evaluated the new model's existing conditions versus the proposed conditions with the identified improvements and verified that 58.51 acre-feet of storage would be required to mitigate the impact identified to the receiving drainage systems. This is consistent with the original results provided by HT&J.

Currently there is no available detention that can be acquired by the City to mitigate these impacts. Therefore, flow control devices were considered at four locations in West University Place East Side.

To optimize the size of the flow control devices, multiple iterations of the proposed XP-SWMM model were run to identify the sizing at each respective location which allowed for maximum possible flood reduction in East Side streets without exceeding the peak discharge of the existing conditions hydrographs. HDR determined that a 24" pipe or an equivalent sized flow control devices at several locations provided the maximum benefit while remaining within the limits of the existing conditions hydrographs' peaks for the 10-, 50-, and 100-year storm events.

Based on the results of this analysis, HDR recommends flow control devices equivalent in size to the specified diameters at the following locations:

- 24" Pipe at Location 1, east of intersection of Duke Street and Buffalo Speedway.
- 24" Pipe at Location 2, east of intersection of University Blvd and Buffalo Speedway.
- 24" Pipe at Location 3, west of intersection of University Blvd and Wakeforest Avenue.
- 24" Pipe at Location 4, west of intersection of University Blvd and Kirby Drive.

The proposed improvements with the above identified inline flow control devices provides sufficient mitigation for the proposed improvements to the drainage system where no additional off-site detention will be required to mitigate impacts to downstream drainage

systems. However, if the City acquires the required 58.51 acre-ft of off-site detention, the inline flow control devices can be removed. This will allow the new drainage system to function at its full capacity and meet the City's new level of service.

A drainage memo summarizing the analysis conducted by HDR Engineering, Inc. for the sizing of flow control devices can be found in **Appendix G.**

3.6 Permits and Licenses

HDR coordinated with local governmental agencies and utilities on this project. No permits or licenses were required from HCFCD, TxDOT, TPDES or utility owners during the preliminary design phase. Coordination may be required with the City of Houston if the storm sewer is rehabilitated along Rice Boulevard to the manhole located in the Kirby drive intersection. The proposed storm sewer along University Street will tie within the City of West University Place right-of-way limits at Kirby Drive.

3.7 Tree/Landscaping Impacts

The existing project areas are heavily treed. It is the City's intention to protect as many of these trees as possible by limiting the impacts to them during the construction phase. To mitigate the potential of damaging the trees, Jeff Hanawalt with Yellowstone Landscaping who had been contracted to perform urban forestry services on the project walked the project area. Mr. Hanawalt performed the tree assessment and recommended zero curb cutback with no liming behind the curbs or driveways to minimize impacts to the trees in the project area. A tree protection plan will be developed during the final design phase.

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Preliminary Design Analysis

4.1 Drainage

4.1.1 Drainage Design Criteria

During the HT&J Drainage Study, the City of West University Place elected to increase the City's standard level of service for its storm sewer systems. The new level of service provides a 50-year level of service (the removal of structural flooding in the project area in a 50-year storm event).

4.1.2 Proposed Drainage Improvements

A. Inlets and Laterals

During the preliminary design phase, it was determined that many of the inlet laterals within the project area are undersized and do not have the capacity to convey the collected runoff from the inlets. For reference, the minimum pipe size required to convey the runoff volume for a single standard BB inlet is 18"; two BB inlets would require a minimum pipe size of 24". All undersized inlet leads will be upsized to 24" within the project area. As per standard practice, all inlets along the project area will be replaced.

B. Proposed Alignment

Based on the review of all information collected on the locations of public utilities (storm sewer, sanitary sewer, and water lines) and private utilities (telephone, power, gas, and cable), the proposed storm sewer alignment is recommended to minimize conflicts.

i. University Boulevard

Currently, the City has an active force main located under the eastbound lane of University Boulevard. To avoid the any disruption to the City sanitary sewer collection systems, the proposed storm sewer trunk line will be installed under the westbound lane. The existing storm sewer will be removed and replaced with 60" RCP throughout the entire length between Buffalo Speedway to Kirby Drive.

The plan layout of the storm sewer along University Street can be found **Appendix C-1.**

ii. Duke Street

There is an active 12" force main under the eastbound lane and a gravity sanitary sewer under the westbound lane. The proposed 60" storm sewer will be installed in the same location as the existing storm sewer under the centerline of the road. Past Brompton Street, the storm sewer continues underneath Duke Street's eastbound lane to the Wakeforest intersection.

With a deeper tie in for the proposed storm sewer at the new Buffalo Speedway storm sewer trunk main, HDR will evaluate if the proposed storm sewer can go under the existing 36" sanitary sewer at Brompton during final design when profile

is completed at that time. This will allow the City to remove an inverted siphon at that location and improve the flow characteristics for the storm sewer.

The plan layout of the storm sewer along Duke Street can be found **Appendix C-2.**

iii. Wakeforest Avenue, South of University

Underneath the southbound lane there is a gravity sanitary sewer line and an AT&T 4-MTD (multiduct). To limit the potential for conflicts in this area, the proposed storm sewer will be installed in the same location as the existing storm sewer underneath the northbound lane of Wakeforest Avenue to the south of University Boulevard. The proposed storm sewer will range in size from 36” (at the upstream end near the Pemberton intersection) to 48” (at the downstream end at the outfall into the University Boulevard trunk line).

The plan layout of the storm sewer along the southern section of Wakeforest Avenue between Pemberton Street and University Boulevard can be found **Appendix C-4.**

iv. Wakeforest Avenue, North of University

A sanitary sewer is currently located under the northbound lane of Wakeforest Avenue. The proposed storm sewer alignment is located under the southbound lane of the roadway. The proposed storm sewer will run between University Boulevard and Georgetown Street, matching the limits of the existing storm sewer. The existing storm sewer is located behind the back of curb under trees. The City is still evaluating the option to either abandon and grout the line or use the pipe as a conduit for future utilities.

The proposed storm sewer will range in size from 36” (at the upstream end starting from the Georgetown Street intersection) to 48” (at the downstream end at the outfall into the University Boulevard trunk line).

The plan layout of the storm sewer along the northern section of Wakeforest Avenue between University Boulevard and Plumb Street can be found **Appendix C-4.**

v. Rice Boulevard

It is recommended that approximately 445 LF of the existing 36” storm sewer line along the north side of Rice Boulevard be rehabilitated with cured-in-place pipe between Fordham Street and Rice Boulevard, based on review of CCTV inspection tapes. The locations of the proposed storm sewer rehabilitation are included in the recommendation letter found in **Appendix C-3.**

Inlet and inlet laterals along Rice Boulevard will be replaced.

vi. Connection to Buffalo Speedway

As of the date of this report, a new storm sewer trunk main is being installed along Buffalo Speedway and is scheduled for completion in 2023. The proposed storm sewer improvements along University Boulevard and Duke Street will tie into the Buffalo Speedway system. The proposed pipe identified in the HT&J Drainage Report and associated junction structures will be change-ordered into the Buffalo

Speedway project to prevent having to replace both intersections twice. The Buffalo Speedway drainage system is anticipated to be completed by the start of construction for the project delineated within this PER.

4.2 Paving

The existing pavement within the project area is depressed concrete curb and gutter roadway. Generally, paving replacement will be from back of curb to back of curb, unless indicated otherwise on the plans. Driveways will be removed and replaced up to the face of the sidewalk. At intersections, paving will be replaced up to the header joints of the cross streets. It is recommended that the final proposed paving elevations generally match the existing paving elevations, so that existing sheet flow patterns can be maintained and limit the potential impacts to structural tree roots under paving. The proposed paving section will also match the width of the existing pavement to limit the impact to trees during construction.

Table 2 provides the thicknesses of the proposed pavement sections for the streets within the scope of the project. These are based on recommendations from the geotechnical report that is attached in **Appendix E** and pavement standards utilized by City of Houston and Harris County for comparable roadway classifications. Based on soil conditions form the borings, the geotechnical report indicated 6% lime. A lime determination test will be performed during construction prior to pavement replacement to verify the percentage of lime required.

Table 2. Recommended Paving Sections.

Roadway	Classification	Pavement Course	Pavement Thickness (in)
University Boulevard	Minor Arterial	Reinforced Concrete	9
		6% Lime-Stabilized Subgrade	8
Wakeforest Avenue	Major Collector	Reinforced Concrete	9
		6% Lime-Stabilized Subgrade	8
Duke Street	Local Residential	Reinforced Concrete	8
		6% Lime-Stabilized Subgrade	8
Rice Boulevard	Major Collector	Reinforced Concrete	9
		6% Lime-Stabilized Subgrade	8

The typical sections of the roadways and the proposed storm sewer locations in the project area are shown in **Appendix C.**

4.3 Pavement Widening Considerations

The City had asked HDR to evaluate whether there are any streets that could be widened. A field meeting was held with the City staff, City's urban forester, HDR and HDR's urban forester on July 29, 2021 to see what tree impacts there would be with pavement widening on the four streets. From the meeting, it was determined that street widening was not

feasible along University Boulevard, Rice Boulevard, and Wakeforest Avenue due to the close proximity and maturity of trees within the right-of-way. On Wakeforest Avenue, a sidewalk was constructed adjacent to the curb due to the numerous trees located within the west ROW. There are also power poles and overhead lines on the east side of Wakeforest Avenue and along the south side of Rice Boulevard that will need to be relocated if widening was proposed. Also, it was noted that University Boulevard, Rice Boulevard, and Wakeforest Avenue were also wider than the City of Houston 28' standard width.

However, it was determined that Duke Street could be widened by 3 feet on the south side between Buffalo Speedway and Vanderbilt Street because there are no trees along that one block at the time of this study. The remainder of the street had impacts to the trees associated with widening the streets lining the right-of-way. Considering only one block of street widening, it was determined to be unfeasible, and it not recommended to pursue this option further.

4.4 Relocation of Private Utilities

HDR has coordinated with CenterPoint Energy, AT&T, Comcast, Lumen/CenturyLink, MCI/Verizon, and Zayo regarding their existing utilities located in the proposed limits of construction, and utility location maps were received from each entity. It was determined that Lumen/CenturyLink and Zayo did not own or operate any utilities within the project area.

In addition to receiving utility location maps, a Texas One-Call was performed prior to survey. This process requires each entity to identify their facilities with markings on site which allows the surveyors to record the locations of all utility locations.

During the preliminary design of the proposed drainage system, potential utility conflicts were identified. A full list of potential utility conflicts is provided in the table in **Appendix F.**

Once the City decides to proceed with final design phase, additional investigation will be performed. The final design will include profiling the existing utility information and proposed storm sewer system to determine conflicts. Drawings would be submitted to the utility companies for their review and a conflict analysis will be performed. If the private utility is in conflict, then the relocation process begins. Depending on the utility, it may take several months for relocation. Therefore, early coordination and communication is key so that the relocation can be completed prior to construction to minimize delays to the project.

4.5 Water Line Replacement

Existing water lines within the identified project area that cross the proposed storm sewer will be required to be adjusted. Based on recommendations provided in the City's Water System Assessment, water lines smaller than 6" diameter will need to be replaced with 6" lines. This recommendation was included as part of the project so that future water line replacement projects will not necessitate the replacement of relatively new paving.

4.6 Traffic Calming Measures

Currently, the City and Traffic Engineers, Inc. (TEI) are looking at traffic calming measures for the project area. Traffic calming measures will be incorporated into the final design phase.

4.7 Construction Sequencing

One lane of traffic will remain open during construction on each of the streets to provide residents and emergency vehicles with access at all times. While detailed construction phasing and traffic control plans are not within the scope of this phase of the project, these will be included as part of the final design phase of the project. It is important to understand that there will be times when residents will have limited access to their driveways during construction.

5 Opinion of Probable Construction Costs

The engineer's Opinion of Probable Construction Costs for this project are prepared by street. Detailed Opinions of Probable Construction Costs for this project can be found in **Appendix H.** This includes full width pavement replacement.

The full width pavement replacement construction cost estimate is shown in Table 3 for each street. It is anticipated construction not expected to start until 2023 or 2024. Therefore, HDR included an escalation factor (5% per year for two years) for inflation. Detailed Opinions of Probable Construction Costs for this project can be found in **Appendix H.**

Table 3. Opinion of Probable Construction Costs

Street	Type of Improvements	Opinion of Probable Construction Costs
University Boulevard	Paving and Drainage	$5,268,000.00
Duke Street	Paving and Drainage	$2,710,000.00
Rice Boulevard	Paving and Drainage	$1,859,000.00
Wakeforest Avenue (N of University)	Paving and Drainage	$2,411,000.00
Wakeforest Avenue (S of University)	Paving and Drainage	$992,000.00
	Total:	**$13,240,000.00**

6 Conclusions and Recommendations

It is recommended that the East Side Paving and Drainage Improvements project proceed forward into the final design phase with the following recommendations:

6.1 Drainage

The drainage recommendations as part of this project are shown below:

- Install 60” RCP under University Boulevard westbound lane from to Buffalo Speedway to Kirby Drive.
- Install 60” RCP under Duke Street under centerline of roadway.
- Install 36” to 48” RCP under Wakeforest Avenue northbound lane from Pemberton Drive to University Boulevard.
- Install 36” to 48” RCP under Wakeforest Avenue southbound lane from University Boulevard to Georgetown Street
- Rehabilitate 36” RCP along north side of Rice Boulevard between Fordham Street and Kirby Drive with cured-in-place pipe

Four (4) flow control devices have been identified to mitigate potential impacts from the proposed improvements to the downstream receiving drainage system.

Associated inlets along the aforementioned streets in the project area will be replaced; undersized inlet laterals will be replaced with 24” RCP where there is depth.

6.2 Pavement

The paving recommendation for this project included reinforced concrete to match the existing width of the paving section on lime-stabilized subgrade. The proposed paving elevations will generally match the existing.

The City would like to replace the street to a full width for a uniform look for the streets and to limit the age difference in the adjacent paving sections.

It was determined that street widening was not feasible for this project due potential impact to the numerous trees, with the exception of a potential 3-foot widening of Duke Street between Buffalo Speedway and Vanderbilt Street. Given the limitations of the widening to just one block, it was not recommended to pursue this any further.

6.3 Water Line

Potential public utility conflicts were identified during the preliminary design phase, and line items have been included for relocations and conflict structures. At crossings with the proposed storm sewer alignment, the water lines will be replaced to comply with the City’s Water System Assessment.

6.4 Opinion of Probable Construction Cost

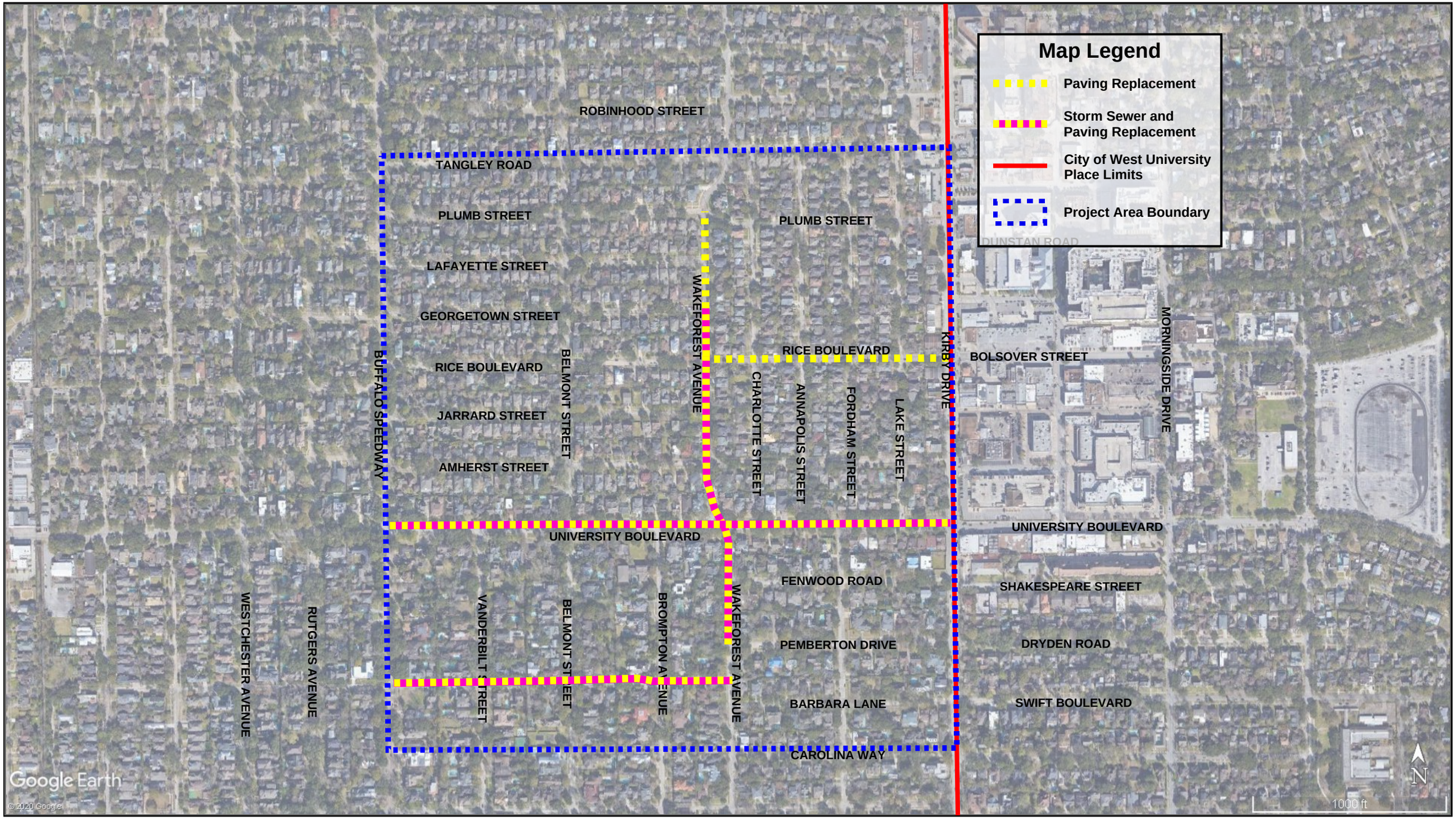
The engineer's Opinion of Probable Construction Costs for this project are split into five parts, by street. Detailed Opinions of Probable Construction Costs for this project can be found in **Appendix H.** This includes full width pavement replacement.

6.5 Schedule

Findings of the PER were presented to Council at a workshop on September 20, 2021. It is anticipated that design phase of this project will begin in fourth quarter of 2021. The City anticipates taking out bonds to fund this project in late 2022 to early 2023 with construction anticipated to start in 2023 or 2024.

A

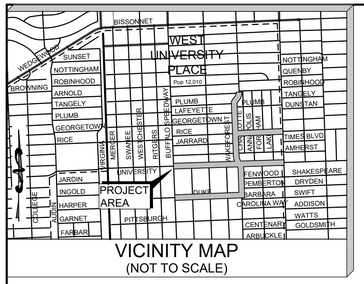
Appendix A – Project Location Map



Appendix A - Project Location

B

Appendix B – Area Right-of-Way Map and Survey Control Map



VICINITY MAP
(NOT TO SCALE)

GRAPHIC SCALE

200 0 100 200

1 inch = 200 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
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3. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD88 - 2001 ADJUSTMENT (GEOID18) GPS OBSERVATIONS AND HAVE BEEN ADJUSTED TO GEOID99 PER BENCHMARK NOTE.
4. THIS TRACT LIES IN ZONE "X" (UNSHADED), DESIGNATED AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLA", ZONE "X" (SHADED), DESIGNATED AS "AREAS OF THE 0.2% ANNUAL CHANCE FLOOD; AREAS OF THE 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FORM 1% ANNUAL CHANCE FLOOD", AND ZONE "AE", DEFINED AS "SPECANIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 0.1% ANNUAL CHANCE FLOOD EVENT, WHERE THE BASE FLOOD ELEVATIONS ARE DETERMINED", AS PER THE NATIONAL FLOOD INSURANCE PROGRAM FIRM COMMUNITY PANEL NUMBER 48201C0860L, LATEST AVAILABLE PUBLISHED REVISION DATED JUNE 18, 2017. THE BASE FLOOD ELEVATION IS 47.9 FEET.
5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
9. FENCES & TREES SHOWN HEREON ARE GRAPHIC, WITH DIMENSIONED TIES SHOWN AT SPECIFIC LOCATIONS WHERE THEY WERE PHYSICALLY MEASURED; THE FENCE LINES MAY MEANDER BETWEEN SAID LOCATIONS.
10. BURIED UTILITIES HAVE BEEN ROUTED BY CONNECTING VISIBLE SURFACE APPURTENANCES IN COMBINATION WITH RECORD DRAWING LOCATIONS. THERE MAY EXIST ADDITIONAL, BURIED UTILITIES WHICH HAVE NOT BEEN FIELD VERIFIED AND/OR REFERENCEDAR HEREON. THE CONTRACTOR SHOULD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES BEFORE COMMENCING CONSTRUCTION.

SYMBOL LEGEND

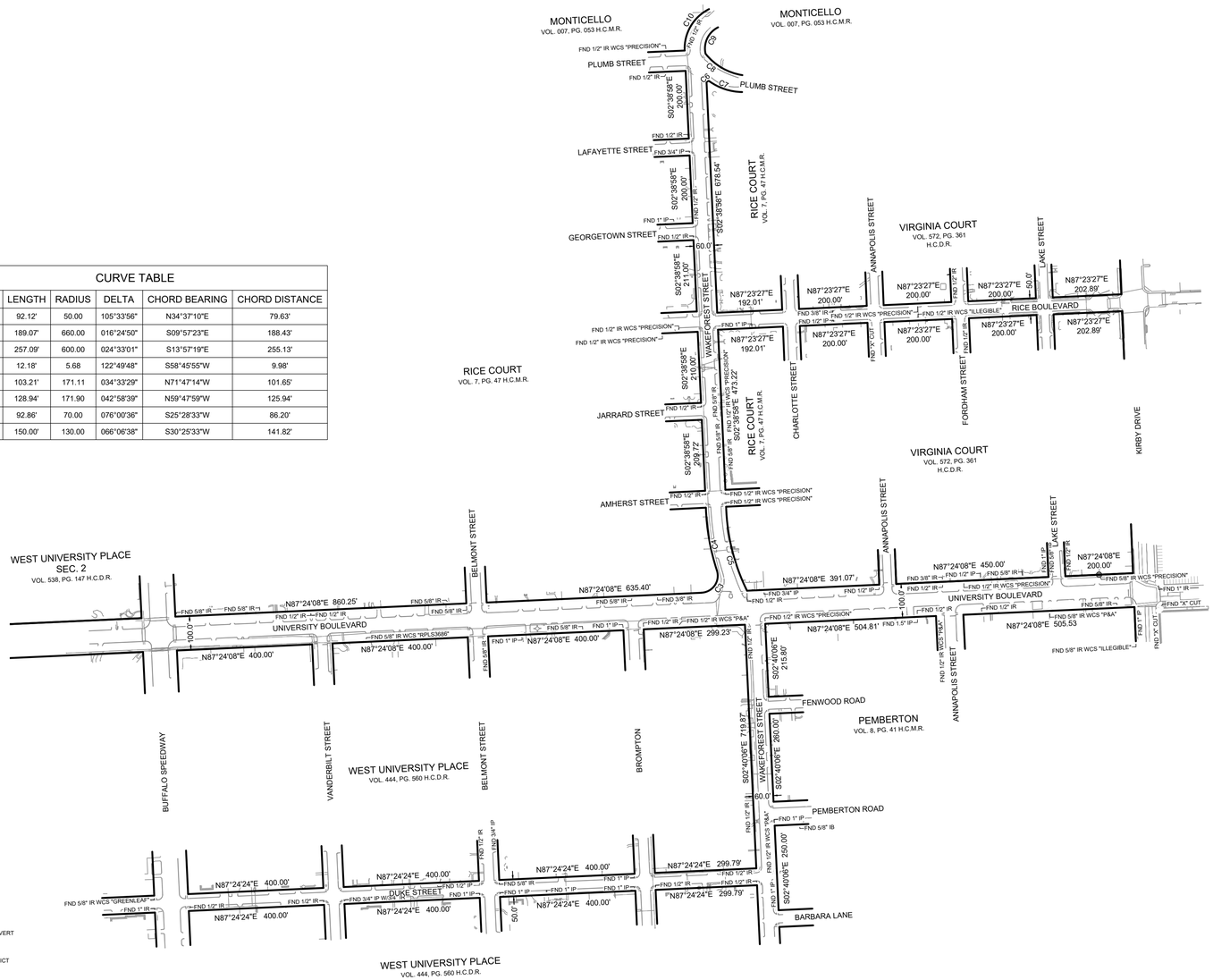
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
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- POWER POLE
- CT POWER POLE W/ CONDUIT
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- PVC RISER
- S SANITARY MANHOLE
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- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

CURVE TABLE					
CURVE No.	LENGTH	RADIUS	DELTA	CHORD BEARING	CHORD DISTANCE
C3	92.12'	50.00	105°33'56"	N34°37'10"E	79.63'
C4	189.07'	660.00	016°24'50"	S09°57'23"E	188.43'
C5	257.09'	600.00	024°33'01"	S13°57'19"E	255.13'
C6	12.18'	5.68	122°49'48"	S58°45'55"W	9.98'
C7	103.21'	171.11	034°33'29"	N71°47'14"W	101.65'
C8	128.94'	171.90	042°58'39"	N59°47'59"W	125.94'
C9	92.86'	70.00	076°00'36"	S25°28'33"W	86.20'
C10	150.00'	130.00	066°06'38"	S30°25'33"W	141.82'

ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W/	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.

I HEREBY CERTIFY THAT THIS PLAT CORRECTLY REPRESENTS A SURVEY MADE ON THE GROUND UNDER MY SUPERVISION ON MARCH 12, 2021, AND THAT SAID SURVEY COMPLIES WITH THE CURRENT TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS FOR LAND SURVEYS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC & UTILITY SURVEY AND A CATEGORY 1B, CONDITION II BOUNDARY/RIGHT-OF-WAY SURVEY.

STATE OF TEXAS · REGISTERED · JOEL D. HILLER · 5522 · PROFESSIONAL LAND SURVEYOR

Joel D. Hiller
Registered Professional
Land Surveyor
Texas Registration No. 5522

Appendix B-1 - Area Right-of-Way Map

NO.	REVISIONS	DATE	NAME
1	REMOVE "FOR INTERIM REVIEW" NOTE	7/9/21	SP

PROJECT TITLE: STREET & DRAINAGE IMPROVEMENTS PROGRAM
CITY OF WEST UNIVERSITY PLACE, TEXAS
SHEET DESCRIPTION: RIGHT-OF-WAY EXHIBIT
CONTROL SHEET
JOB NO: 5-0066-2101
DATE: 4-9-2021
SCALE: 1" = 200'
DRAWN BY: SP/SS/MG
CK'D BY: GM

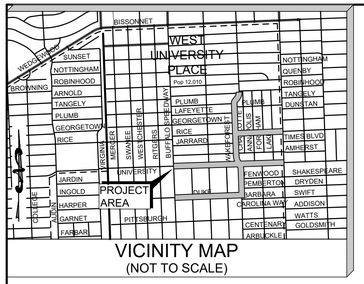
City of West University Place

MBCO ENGINEERING & SURVEYING
1505 Highway 6 South, Suite 180
Houston, Texas 77077
713-739-7744
TSPLS Firm # 10194112

P.E. SERIAL No.
NUMBER
DATE:

SHEET NO:
1 / 26

N:\500 - SURVEY DEPARTMENT\HDR_0066\5-0066-2101 - West University\06.03_Drawings\5-0066-2101_West University (Survey Control Maps).dwg



GRAPHIC SCALE

200 0 100 200

1 inch = 200 ft.

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SYMBOL LEGEND

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- BENCHMARK
- BOLLARD / POST
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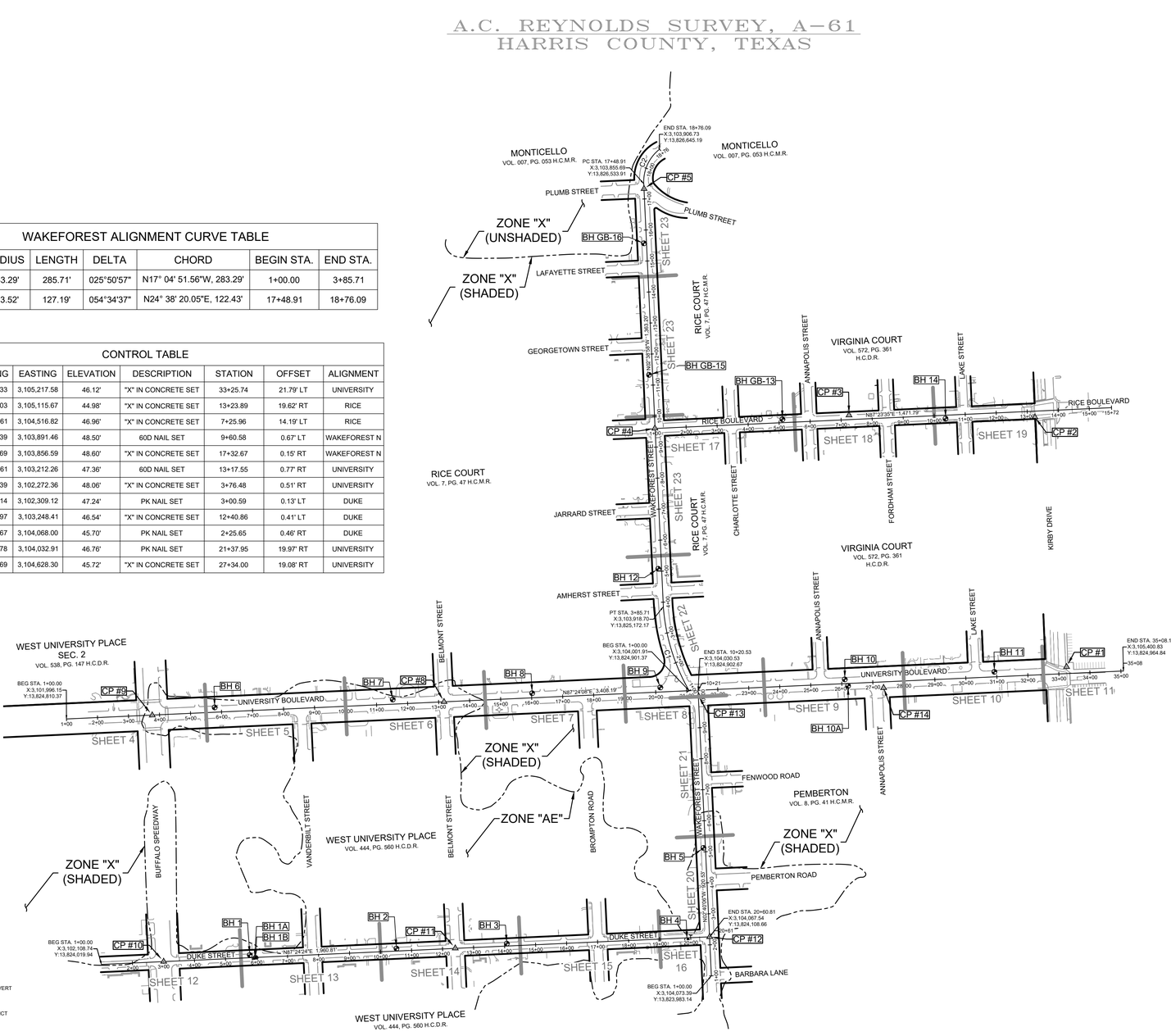
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(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

WAKEFOREST ALIGNMENT CURVE TABLE						
CURVE No.	RADIUS	LENGTH	DELTA	CHORD	BEGIN STA.	END STA.
C1	633.29'	285.71'	025°50'57"	N17° 04' 51.56"W, 283.29'	1+00.00	3+85.71
C2	133.52'	127.19'	054°34'37"	N24° 38' 20.05"E, 122.43'	17+48.91	18+76.09

CONTROL TABLE							
POINT No.	NORTHING	EASTING	ELEVATION	DESCRIPTION	STATION	OFFSET	ALIGNMENT
1	13,824,978.33	3,105,217.58	46.12'	"X" IN CONCRETE SET	33+25.74	21.79' LT	UNIVERSITY
2	13,825,782.03	3,105,115.67	44.98'	"X" IN CONCRETE SET	13+23.89	19.62' RT	RICE
3	13,825,788.61	3,104,516.82	46.96'	"X" IN CONCRETE SET	7+25.96	14.19' LT	RICE
4	13,825,746.39	3,103,891.46	48.50'	60D NAIL SET	9+60.58	0.67' LT	WAKEFOREST N
5	13,826,517.69	3,103,856.59	48.60'	"X" IN CONCRETE SET	17+32.67	0.15' RT	WAKEFOREST N
8	13,824,865.61	3,103,212.26	47.36'	60D NAIL SET	13+17.55	0.77' RT	UNIVERSITY
9	13,824,822.39	3,102,272.36	48.06'	"X" IN CONCRETE SET	3+76.48	0.51' RT	UNIVERSITY
10	13,824,029.14	3,102,309.12	47.24'	PK NAIL SET	3+00.59	0.13' LT	DUKE
11	13,824,071.97	3,103,248.41	46.54'	"X" IN CONCRETE SET	12+40.86	0.41' LT	DUKE
12	13,824,108.67	3,104,068.00	45.70'	PK NAIL SET	2+25.65	0.46' RT	DUKE
13	13,824,882.78	3,104,032.91	46.76'	PK NAIL SET	21+37.95	19.97' RT	UNIVERSITY
14	13,824,910.69	3,104,628.30	45.72'	"X" IN CONCRETE SET	27+34.00	19.08' RT	UNIVERSITY

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.

BOREHOLE TABLE			
Raw Description	Northing	Easting	Elevation
BOREHOLE 1	13,824,050.22	3,102,586.75	46.71
BOREHOLE 1A	13,824,038.11	3,102,601.98	46.84
BOREHOLE 1B	13,824,040.90	3,102,605.17	46.90
BOREHOLE 2	13,824,071.03	3,103,059.21	46.52
BOREHOLE 3	13,824,086.91	3,103,414.52	46.30
BOREHOLE 4	13,824,097.80	3,103,995.00	45.17
BOREHOLE 5	13,824,394.97	3,104,047.97	45.70
BOREHOLE 6	13,824,847.59	3,102,473.56	46.90
BOREHOLE 7	13,824,872.81	3,103,047.14	47.07
BOREHOLE 8	13,824,893.14	3,103,496.16	47.12
BOREHOLE 9	13,824,911.75	3,103,908.95	46.46
BOREHOLE 10	13,824,937.77	3,104,503.15	45.51
BOREHOLE 10A	13,824,916.98	3,104,513.79	45.67
BOREHOLE 11	13,824,962.07	3,104,985.09	45.93
BOREHOLE 12	13,825,293.94	3,103,902.40	47.73
BOREHOLE 14	13,825,777.67	3,104,827.79	45.95
BOREHOLE GB-13	13,825,775.26	3,104,302.25	47.69
BOREHOLE GB-15	13,825,918.55	3,103,872.77	47.84
BOREHOLE GB-16	13,826,342.10	3,103,856.04	48.32

I HEREBY CERTIFY THAT THIS PLAT CORRECTLY REPRESENTS A SURVEY MADE ON THE GROUND UNDER MY SUPERVISION ON MARCH 12, 2021, AND THAT SAID SURVEY COMPLIES WITH THE CURRENT TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS FOR LAND SURVEYS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC & UTILITY SURVEY AND A CATEGORY 1B, CONDITION II BOUNDARY/RIGHT-OF-WAY SURVEY.

STATE OF TEXAS · REGISTERED · JOEL D. HILLER · 5522 · PROFESSIONAL · LAND SURVEYOR

Joel D. Hiller
Registered Professional
Land Surveyor
Texas Registration No. 5522

Appendix B-2 - Survey Control Map

NO.	REVISIONS	DATE	NAME
1	REMOVE "FOR INTERIM REVIEW" NOTE	7/9/21	SP

PROJECT TITLE: STREET & DRAINAGE IMPROVEMENTS PROGRAM
CITY OF WEST UNIVERSITY PLACE, TEXAS
SHEET DESCRIPTION: OVERALL CONTROL EXHIBIT
CONTROL SHEET
JOB NO: 5-0066-2101
DATE: 4-9-2021
SCALE: 1" = 200'
DRAWN BY: SP/SS/MG
CK'D BY: GM

City of West University Place

MBCO ENGINEERING & SURVEYING
1505 Highway 6 South, Suite 180
Houston, Texas 77077
713-739-7744
TSPLS Firm # 10194112

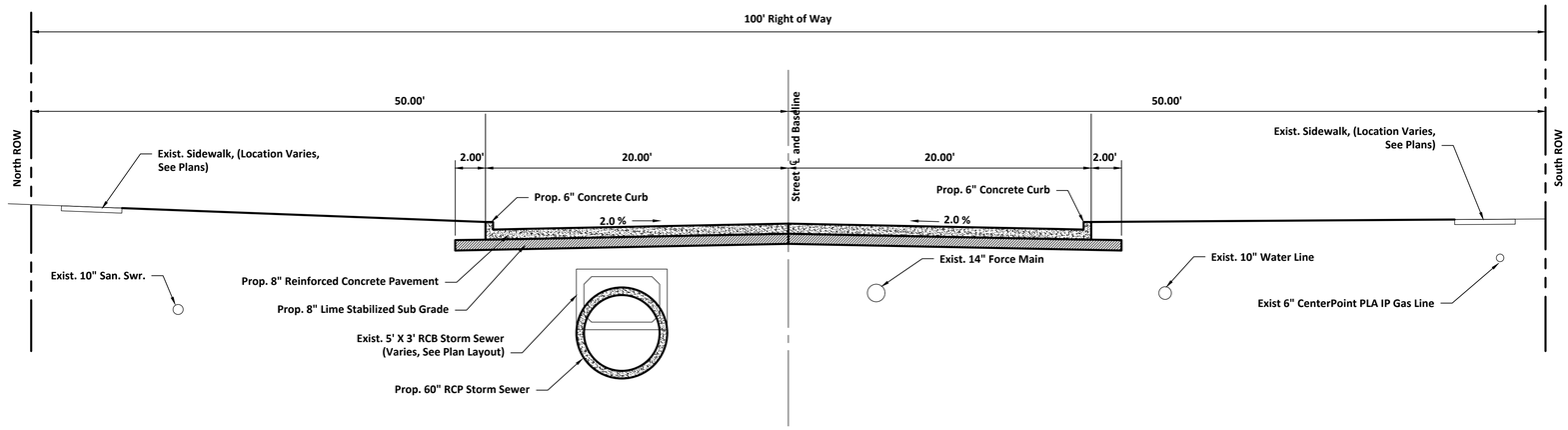
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NUMBER
DATE:

SHEET NO: 2 / 26

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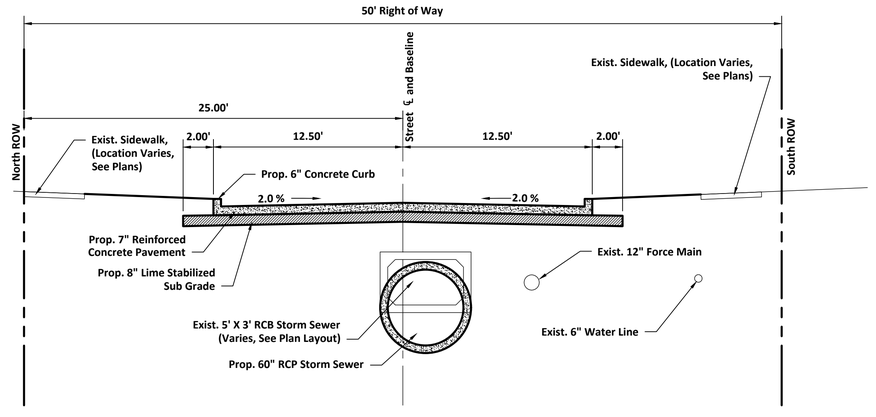
C

Appendix C – Typical Roadway Sections



1 University Blvd. Typical Section

Scale: 1" = 5'



2 Duke St. Typical Section

Scale: 1" = 5'

PROJECT MANAGER John Peterson, PE, CFM

ISSUE DATE DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Typical Section - University Blvd and Duke St.

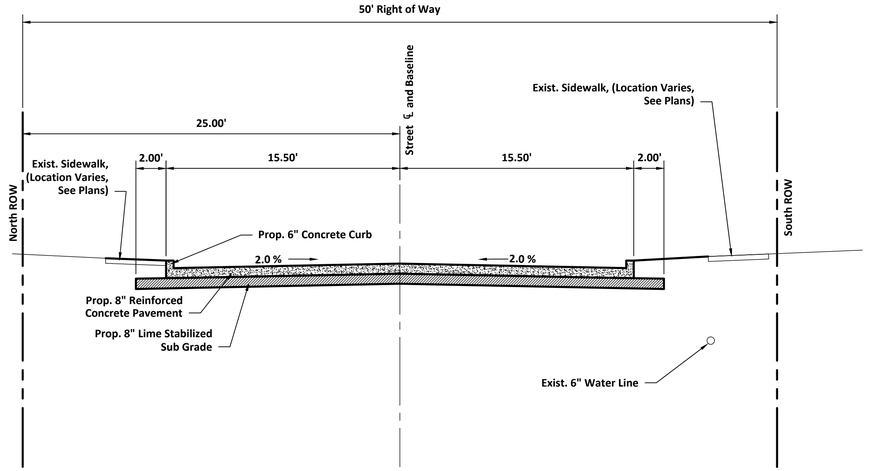
Appendix C - Typical Roadway Sections

0 1" 2"

FILENAME

SCALE

SHEET 2 of 26



3 Rice Blvd. Typical Section

Scale: 1" = 5'

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Typical Section - Rice Ave.

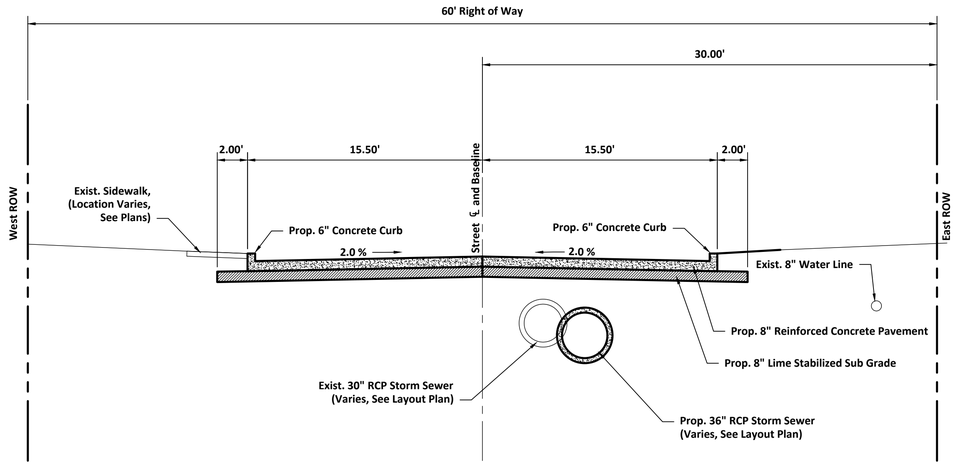
Appendix C - Typical Roadway Sections

0 1" 2"

FILENAME

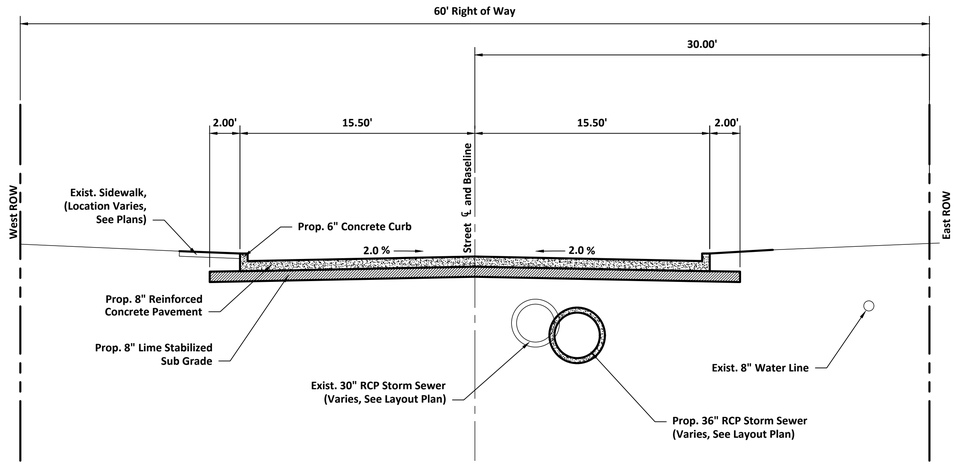
SCALE

SHEET 3 of 26



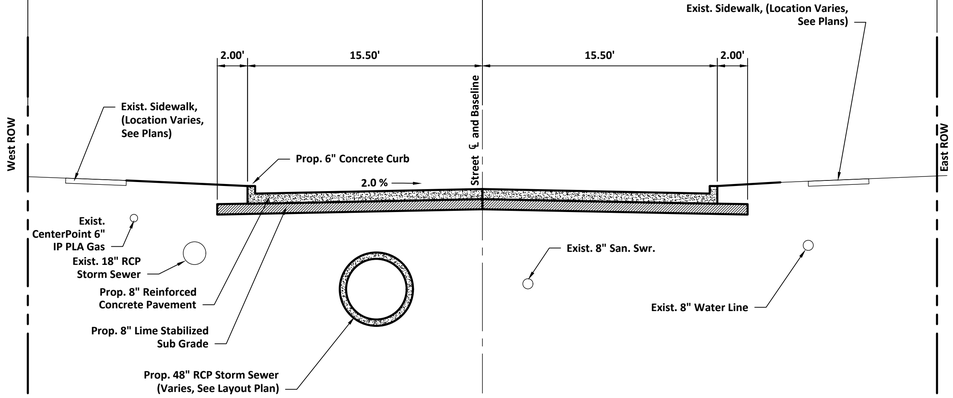
4 Wakeforest Ave. South of University Blvd. Typical Section Sta. 3+71 to Sta. 9+23

Scale: 1" = 5'



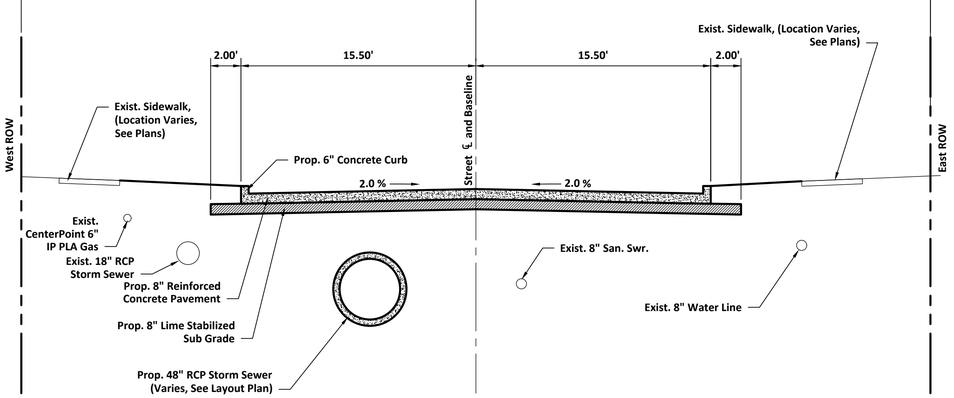
5 Wakeforest Ave. South of University Blvd. Typical Section Sta. 9+23 to Sta. 10+00

Scale: 1" = 5'



6 Wakeforest Ave. North of University Blvd. Typical Section Sta. 1+33 to Sta.9+29

Scale: 1" = 5'



7 Wakeforest Ave. North of University Blvd. Typical Section Sta. 9+29 to Sta. 17+77

Scale: 1" = 5'

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Typical Section - Wakeforest Ave.

Appendix C - Typical Roadway Sections

0 1" 2"

FILENAME

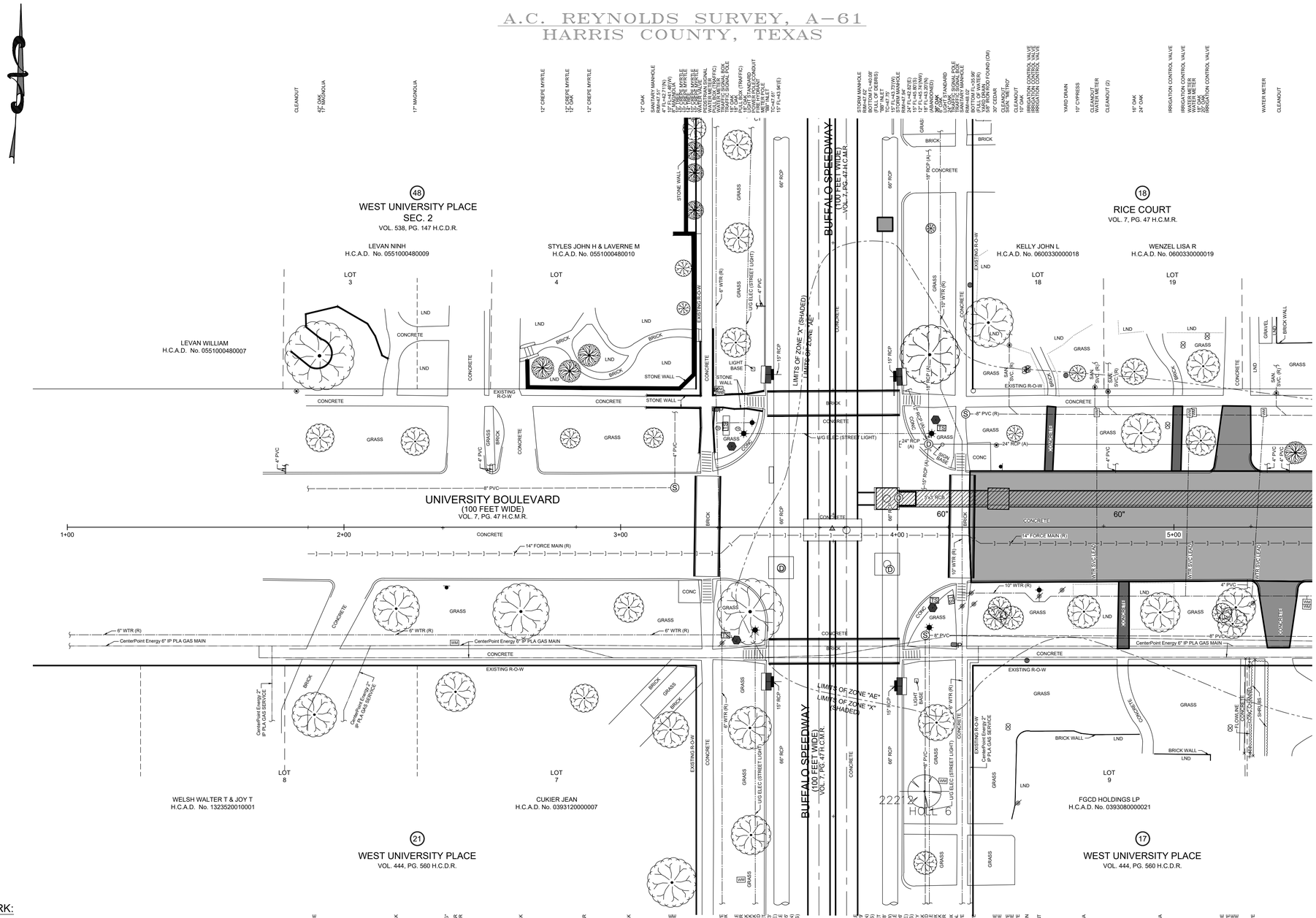
SCALE

SHEET 4 of 26

D

Appendix D – Preliminary Layouts

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
2. BEARINGS SHOWN HEREON BASED ON TEXAS COORDINATE SYSTEM OF 1983 (NAD83), SOUTH CENTRAL ZONE (No. 4204).
3. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD88 - 2001 ADJUSTMENT (GEOID18) GPS OBSERVATIONS AND HAVE BEEN ADJUSTED TO GEOID99 PER BENCHMARK NOTE.
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5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
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SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- C1 POWER POLE W/ CONDUIT
- T POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.

ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PGL	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 0+00 to Sta. 5+50

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 5 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TP TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
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- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
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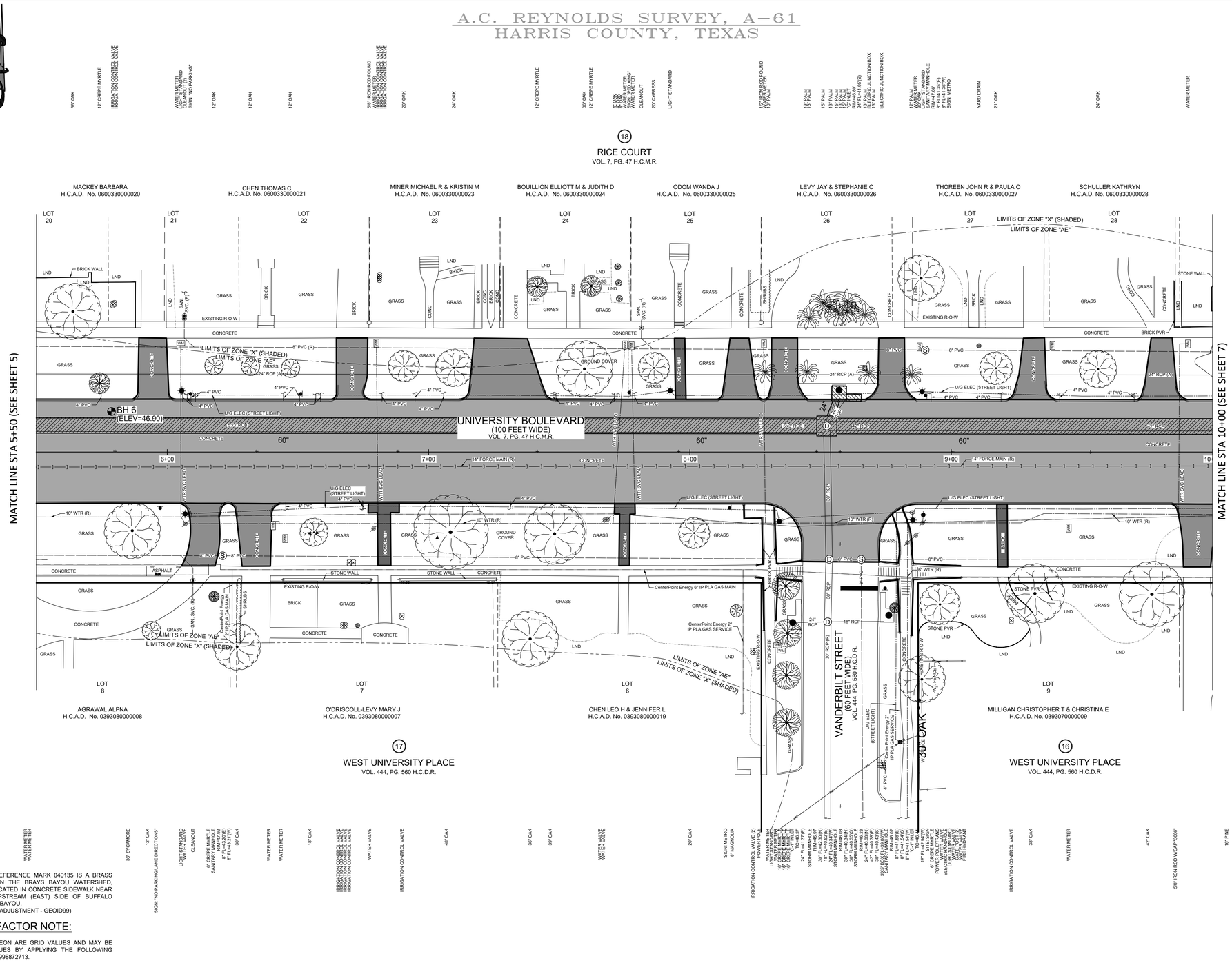
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A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W/	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

		PROJECT MANAGER John Peterson, PE, CFM
ISSUE	**DATE**	**DESCRIPTION**
		PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 5+50 to Sta. 10+00

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 6 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

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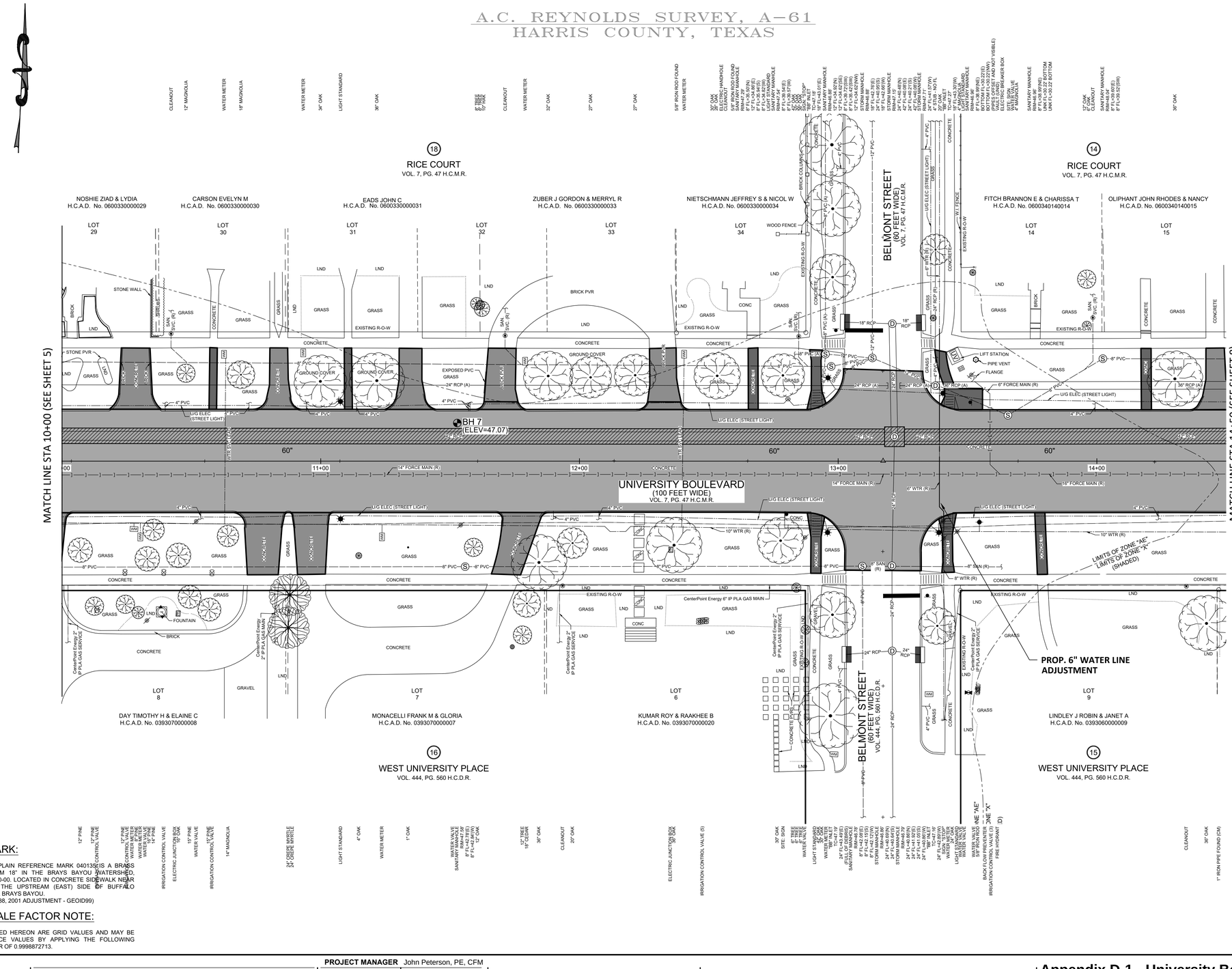
- BACK FLOW PREVENTER
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- BENCHMARK
- BOLLARD / POST
- BORE HOLE
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- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
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- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
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- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 04013G IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
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No.	NUMBER
OHE	OVERHEAD ELECTRIC
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PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 10+00 to Sta. 14+50

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 7 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

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SYMBOL LEGEND

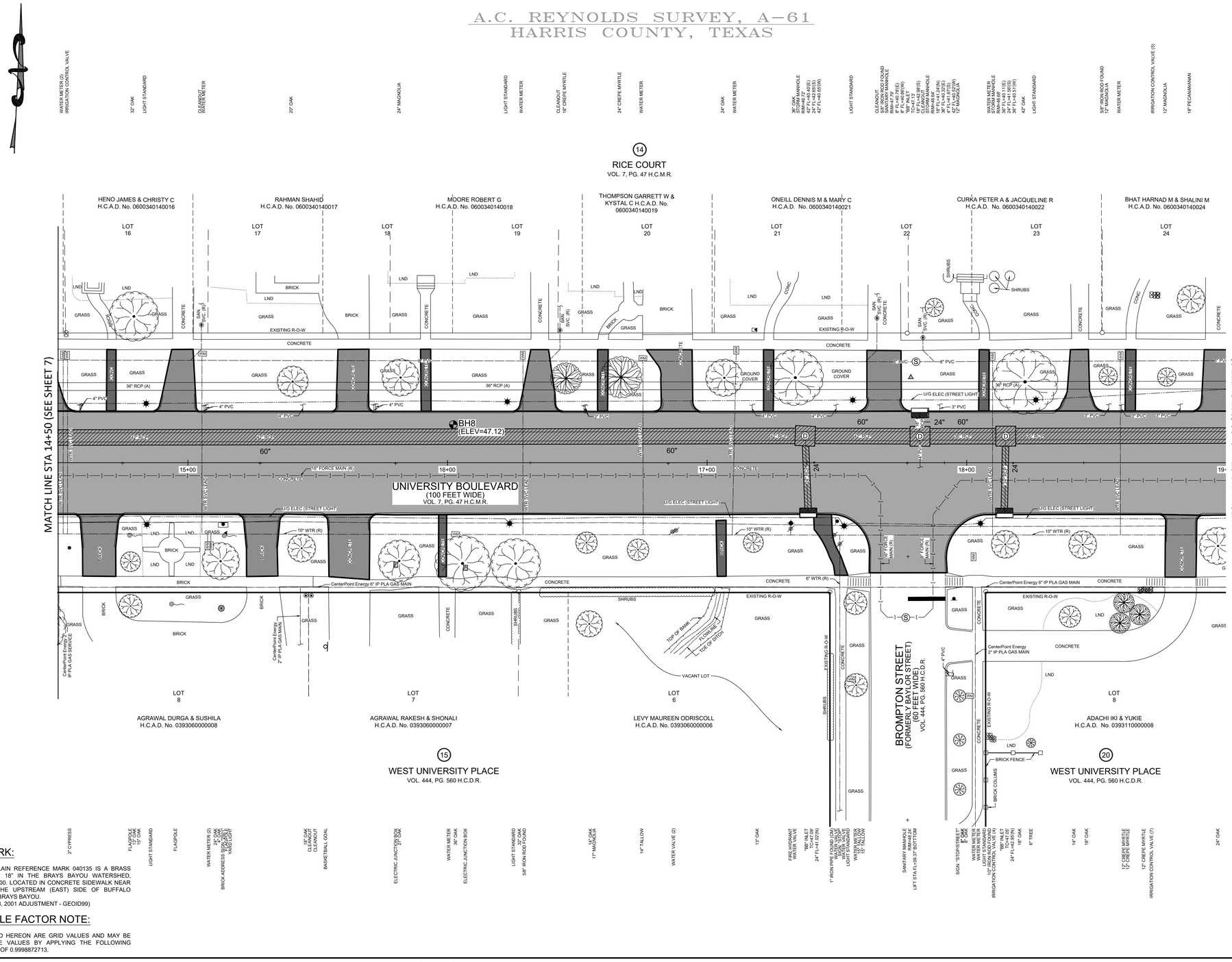
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- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TP TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OHE OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
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IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
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R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 14+50 to Sta. 19+00

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 8 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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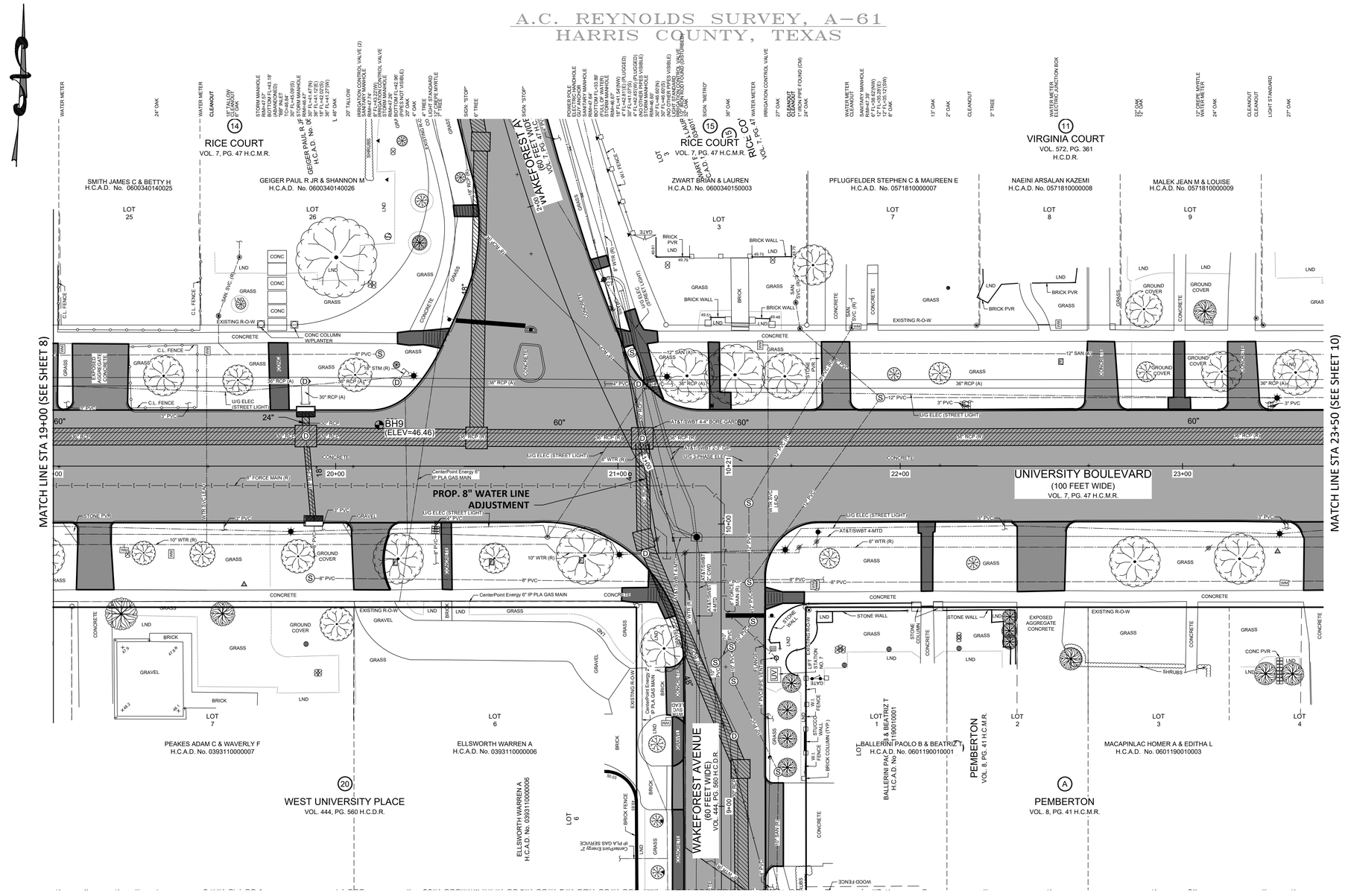
- BACK FLOW PREVENTER
- BB INLET
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- SIGN (SEE DESCRIPTION)
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- BUSH
- TRASH CAN
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- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
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- WOOD FENCE
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PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements
University Blvd. Sta. 19+00 to Sta. 23+50

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 9 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

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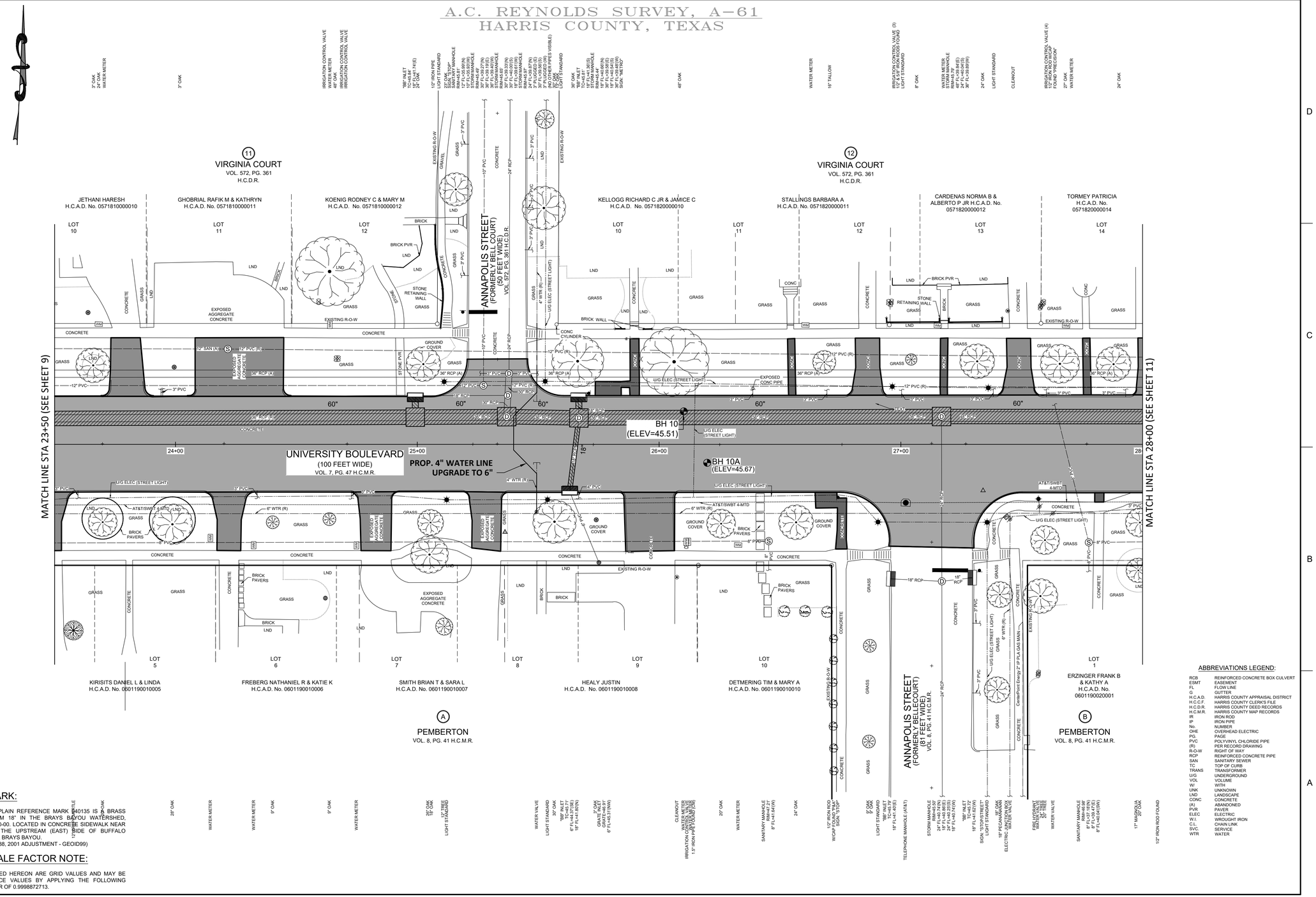
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- CAMERA
- CLEAN OUT
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PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements
University Blvd. Sta. 23+50 to Sta. 28+00

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

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SCALE

SHEET 10 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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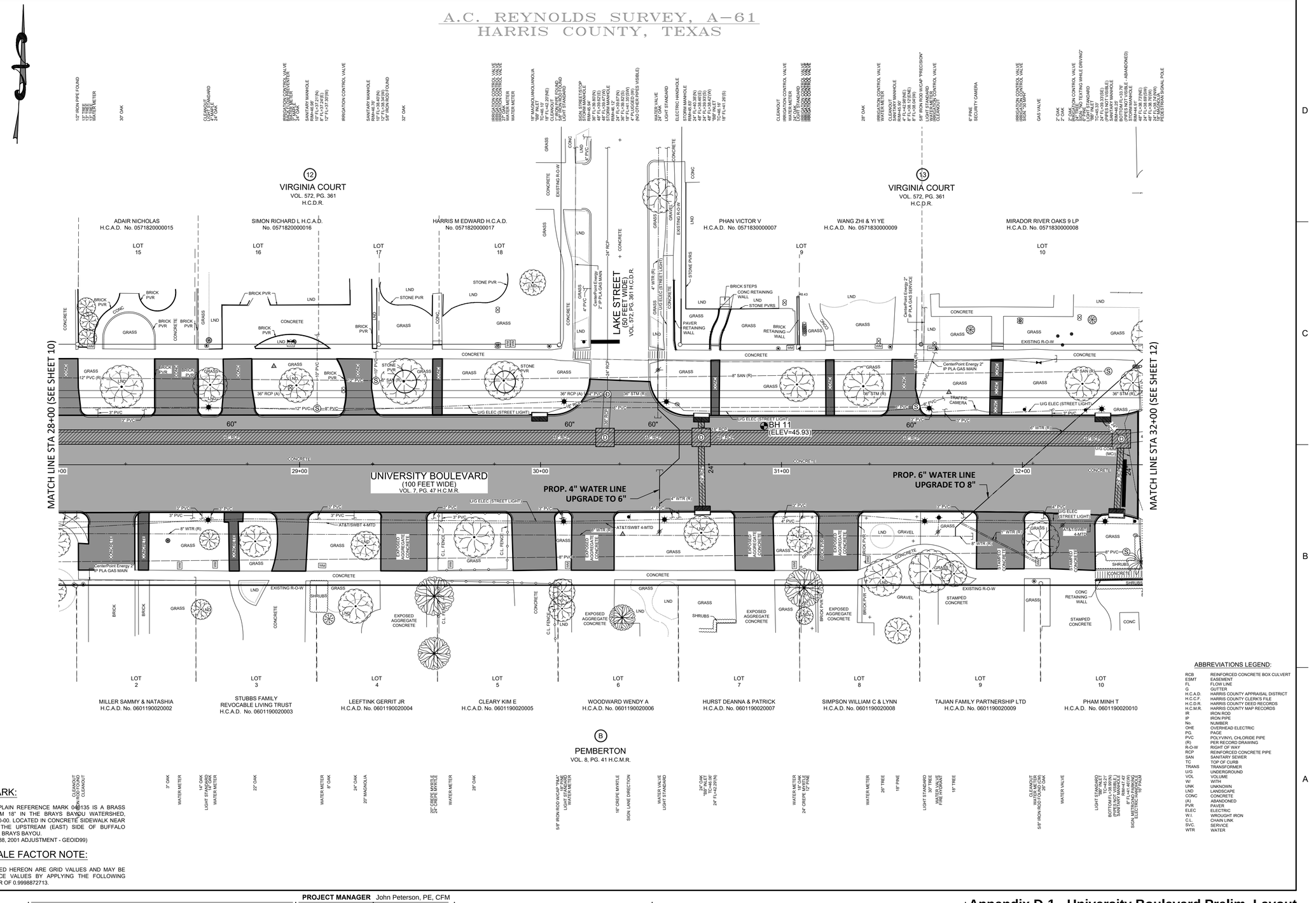
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- CABLE MARKER
- CAMERA
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- GAS VALVE
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ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 28+00 to Sta. 32+50

Appendix D-1 - University Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 11 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
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6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
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SYMBOL LEGEND

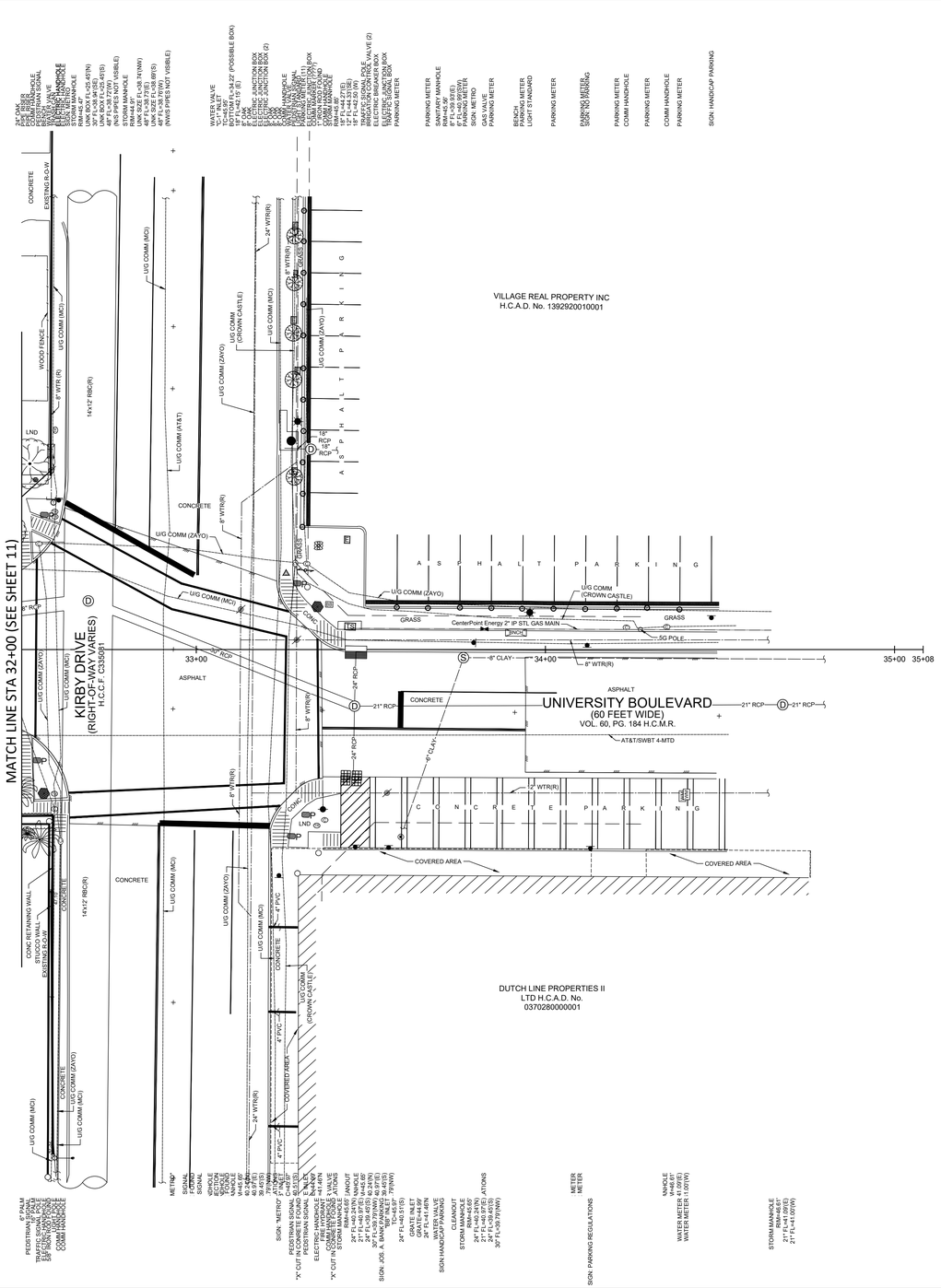
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- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
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- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
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- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.


MATCH LINE STA 32+00 (SEE SHEET 11)
KIRBY DRIVE
(RIGHT-OF-WAY VARIES)
H.C.C.F. G335081
UNIVERSITY BOULEVARD
(60 FEET WIDE)
VOL. 60, PG. 184 H.C.M.R.
VILLAGE REAL PROPERTY INC
H.C.A.D. No. 1392920010001
DUTCH LINE PROPERTIES II
LTD H.C.A.D. No.
0370280000001
ASPHALT PARKING
CONCRETE
GRASS
COVERED AREA
33+00
34+00
35+00
35+08
CenterPoint Energy 2" IP STL GAS MAIN
5G POLE
AT&T/SWBT 4-MTD
14'x12' RBC(R)
24" WTR(R)
8" WTR(R)
6" WTR(R)
4" PVC
21" RCP
24" RCP
18" RCP
WOOD FENCE
CONC RETAINING WALL
STUCCO WALL
EXISTING 4-SW
U/G COMM (MCI)
U/G COMM (ZAYO)
U/G COMM (AT&T)
U/G COMM (CROWN CASTLE)
U/G COMM (CENTERPOINT)
U/G COMM (SWBT)
U/G COMM (COMCAST)
U/G COMM (TWC)
U/G COMM (ATMOS)
U/G COMM (ENTERGY)
U/G COMM (AEP)
U/G COMM (CITY OF HOUSTON)
U/G COMM (HOUSTON LIGHTING & POWER)
U/G COMM (CENTERPOINT ENERGY)
U/G COMM (CENTERPOINT ENERGY-HOUSTON ELECTRIC)
U/G COMM (CENTERPOINT ENERGY-RESCO)
U/G COMM (CENTERPOINT ENERGY-MINNEGASCO)
U/G COMM (CENTERPOINT ENERGY-ARKLA)
U/G COMM (CENTERPOINT ENERGY-ENTEX

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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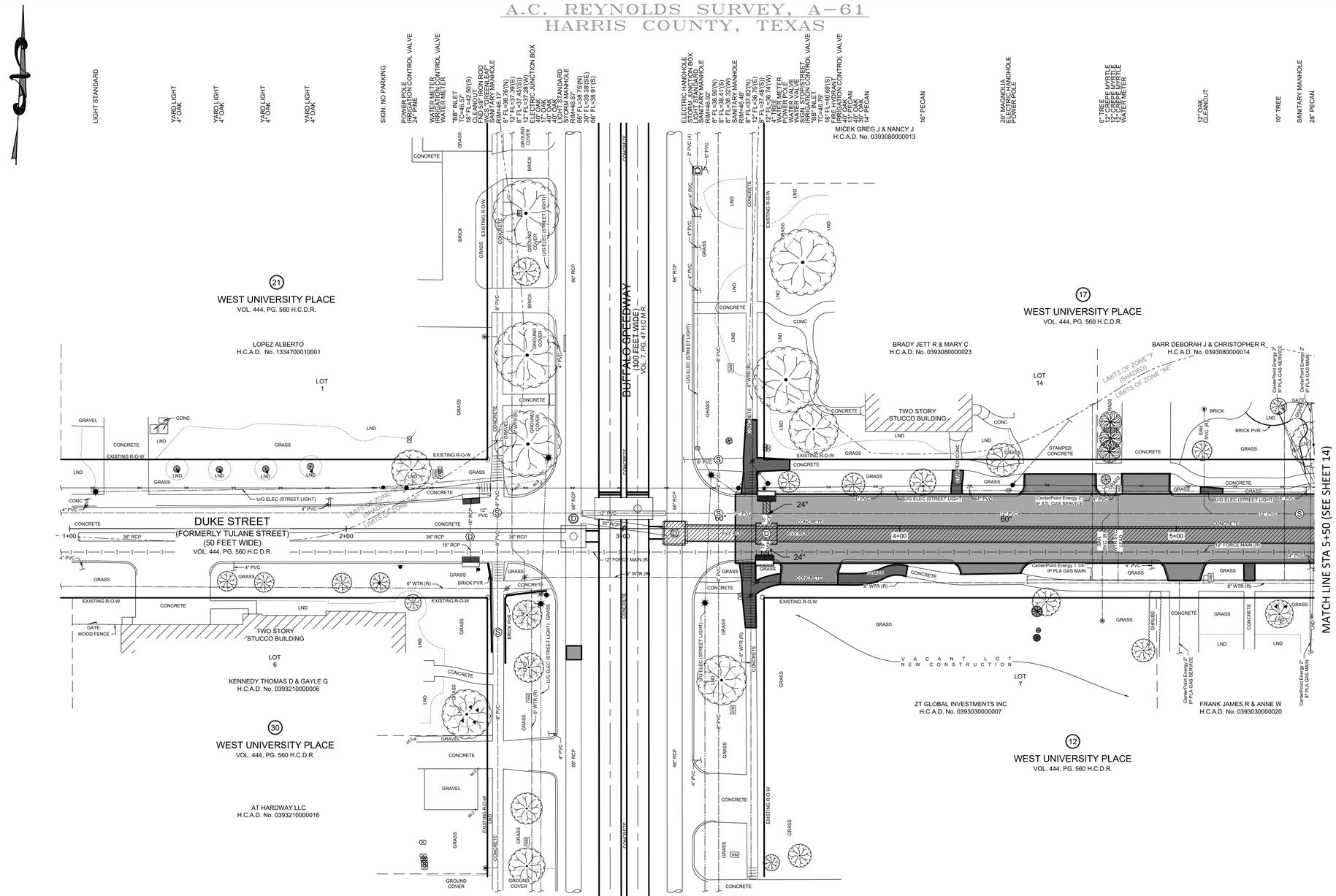
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- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
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- SERVICE POLE
- SIGN (SEE DESCRIPTION)
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- TREE (SEE DESCRIPTION)
- TREE PALM
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- WM WATER METER
- WATER VALVE
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- WOOD FENCE
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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Duke St. Sta. 0+00 to Sta. 5+50

Appendix D-2 - Duke Street Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 13 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

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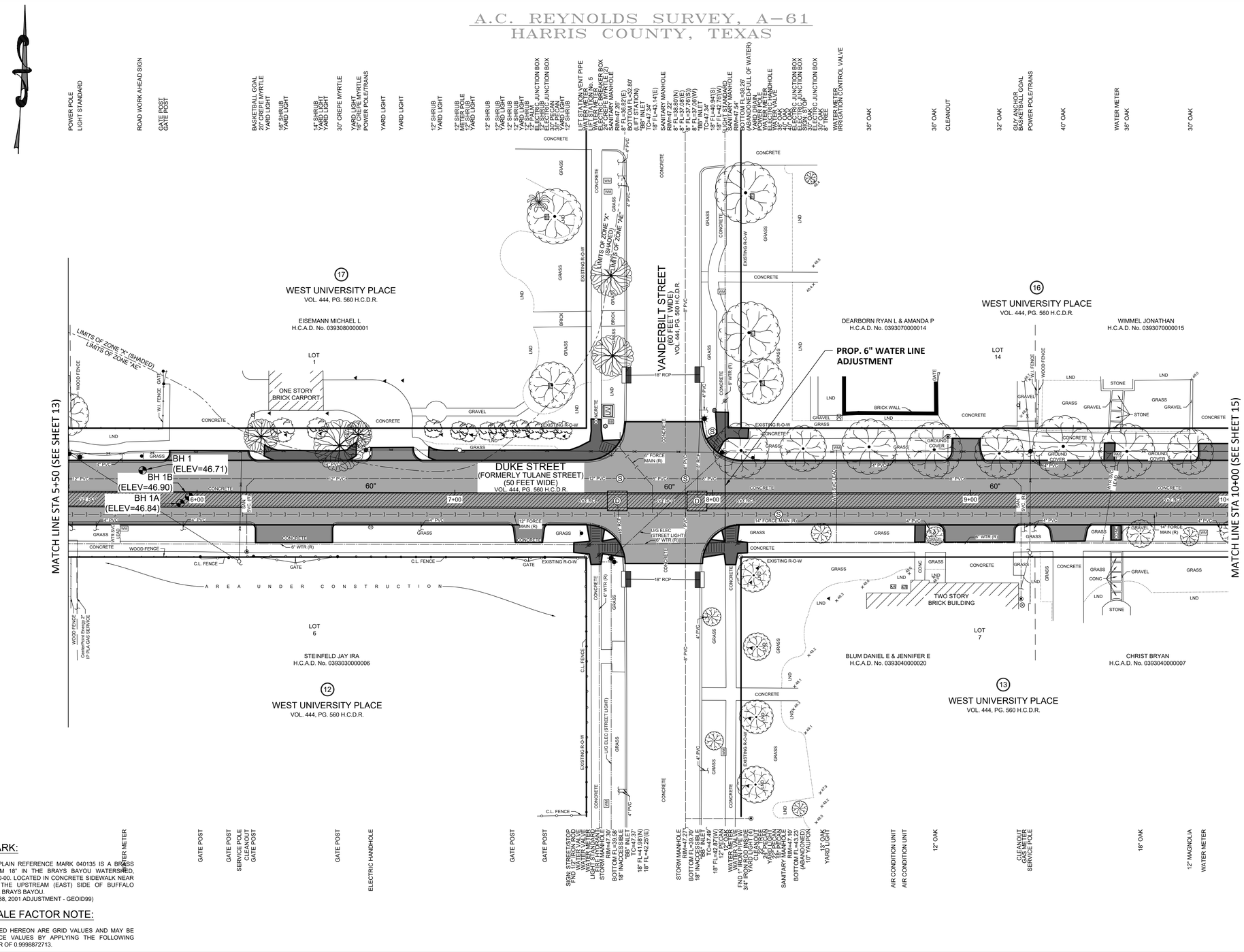
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SITE BENCHMARK:

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SAN	SANITARY SEWER
TC	TOP OF CURB
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U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
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CONC	CONCRETE
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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Duke St. Sta. 5+50 to Sta. 10+00

Appendix D-2 - Duke Street Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 14 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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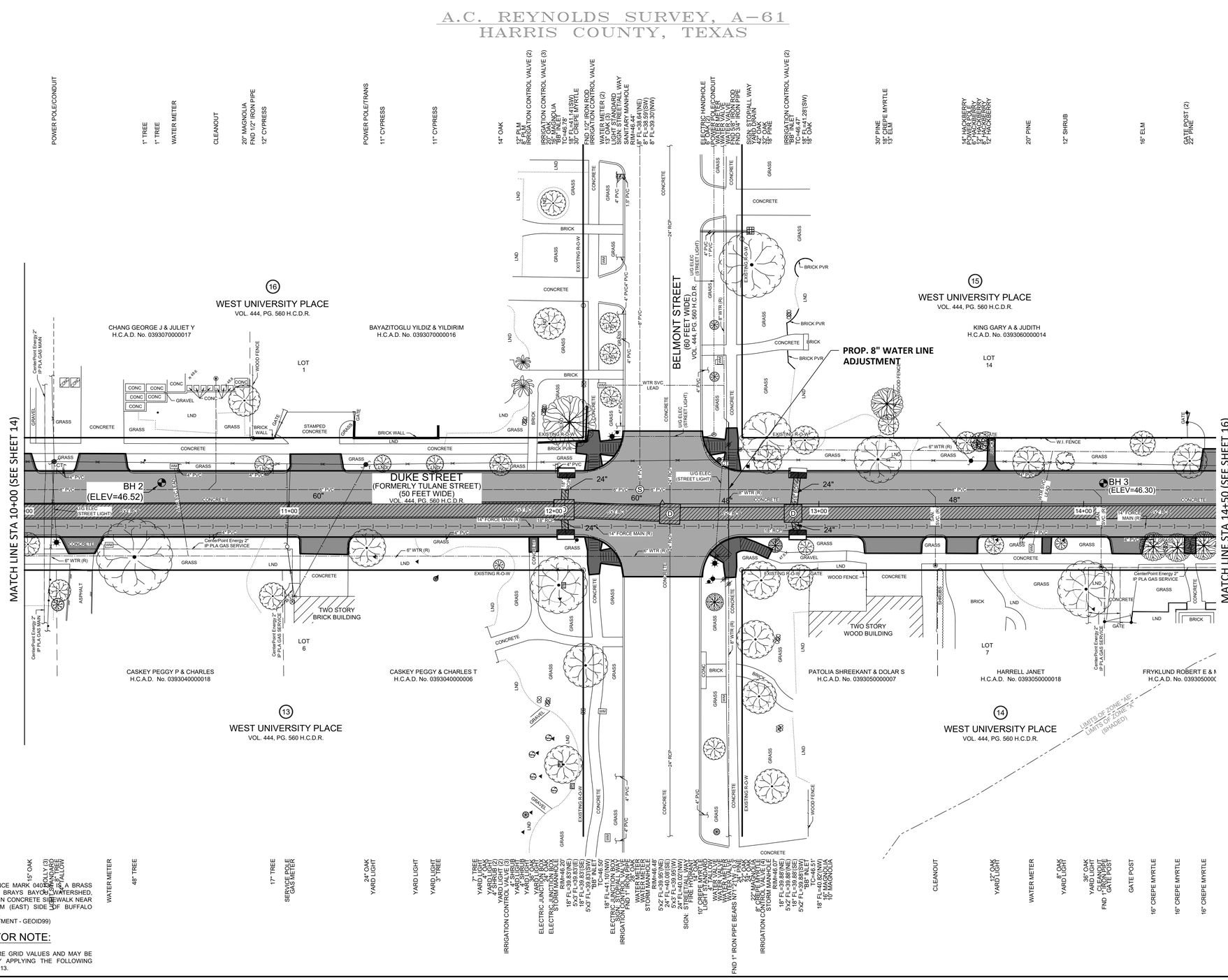
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H.C.D.R.	HARRIS COUNTY DEED RECORDS
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No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
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(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
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C.L.	CHAIN LINK
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WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Duke St. Sta. 10+00 to Sta. 14+50

Appendix D-2 - Duke Street Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 15 of 26

A.C. REYNOLDS SURVEY, A–61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

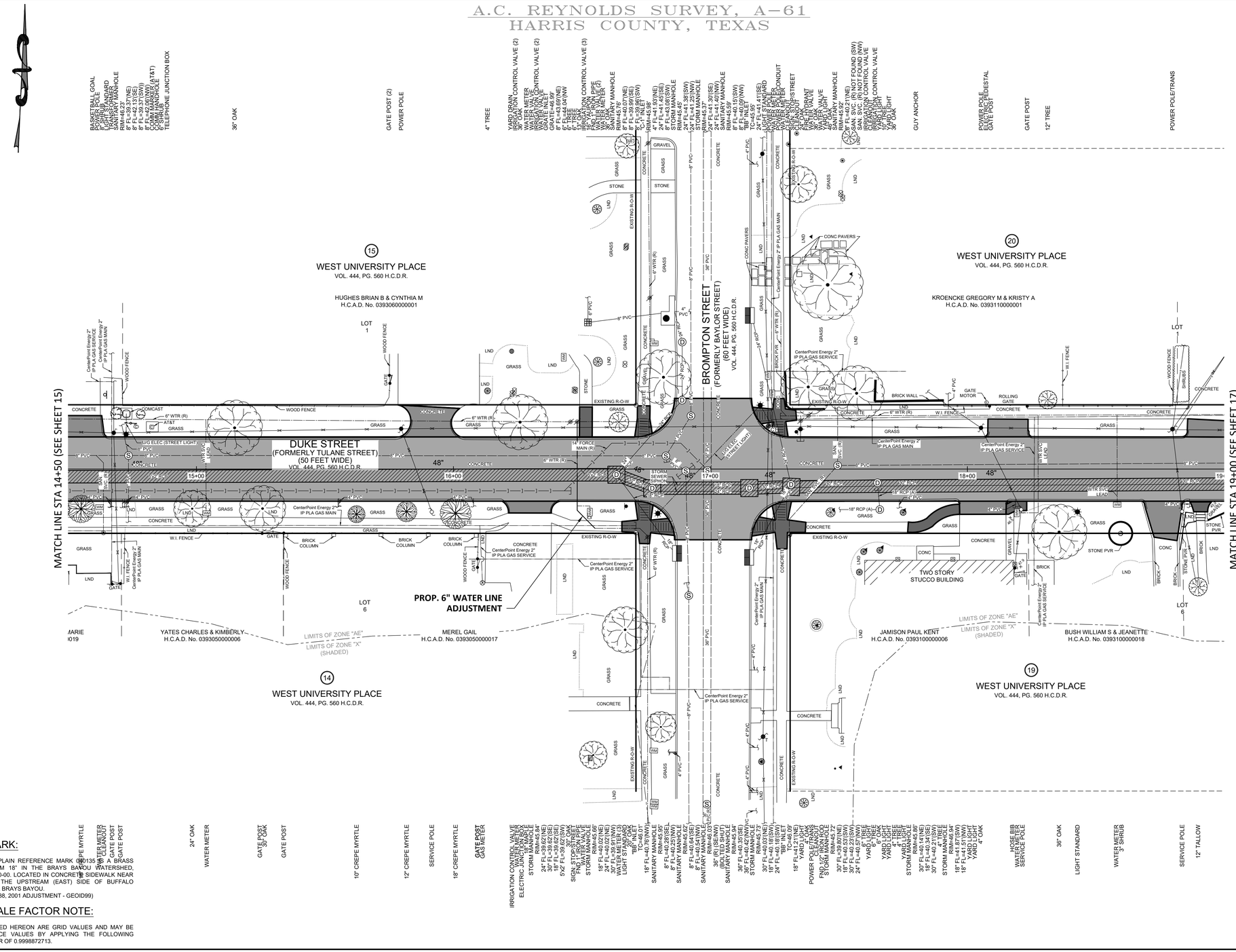
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- BENCHMARK
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- BB BREAKER BOX
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- CLEAN OUT
- CREPE MYRTLE
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- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK NO 135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.


MATCH LINE STA 14+50 (SEE SHEET 15)
MATCH LINE STA 19+00 (SEE SHEET 17)
DUKE STREET
(FORMERLY TULANE STREET)
(50 FEET WIDE)
VOL. 444, PG. 560 H.C.D.R.
BROMPTON STREET
(FORMERLY BAYLOR STREET)
(60 FEET WIDE)
VOL. 444, PG. 560 H.C.D.R.
15 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
20 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
14 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
19 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
HUGHES BRIAN B & CYNTHIA M H.C.A.D. No. 0393060000001
KROENCKE GREGORY M & KRISTY A H.C.A.D. No. 0393110000001
YATES CHARLES & KIMBERLY H.C.A.D. No. 0393050000006
MEREL GAIL H.C.A.D. No. 0393050000017
JAMISON PAUL KENT H.C.A.D. No. 0393100000006
BUSH WILLIAM S & JEANETTE H.C.A.D. No. 0393100000018
PROP. 6" WATER LINE ADJUSTMENT
TWO STORY STUCCO BUILDING
LIMITS OF ZONE "AE"
LIMITS OF ZONE "X" (SHADED)
15+00
16+00
17+00
18+00
19+
48"
24"
30"
18" RCP (A)
6" WTR (R)
4" PVC
8" PVC
12" PVC
36" PVC
CONCRETE
GRASS
STONE
GRAVEL
LND
EXISTING R-O-W
W.I. FENCE
WOOD FENCE
BRICK WALL
ROLLING GATE
GATE MOTOR
CONC PAVERS
BRICK COLUMN
CenterPoint Energy 2" IP PLA GAS MAIN
CenterPoint Energy 2" IP PLA GAS SERVICE
STORM SEWER SYPHON
STORM MANHOLE #8
STORM MANHOLE #7
STORM MANHOLE #6
STORM MANHOLE #5
STORM MANHOLE #4
STORM MANHOLE #3
STORM MANHOLE #2
STORM MANHOLE #1
SANITARY MANHOLE #1
SANITARY MANHOLE #2
SANITARY MANHOLE #3
SANITARY MANHOLE #4
SANITARY MANHOLE #5
SANITARY MANHOLE #6
SANITARY MANHOLE #7
SANITARY MANHOLE #8
SANITARY MANHOLE #9
SANITARY MANHOLE #10
SANITARY MANHOLE #11
SANITARY MANHOLE #12
SANITARY MANHOLE #13
SANITARY MANHOLE

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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SYMBOL LEGEND

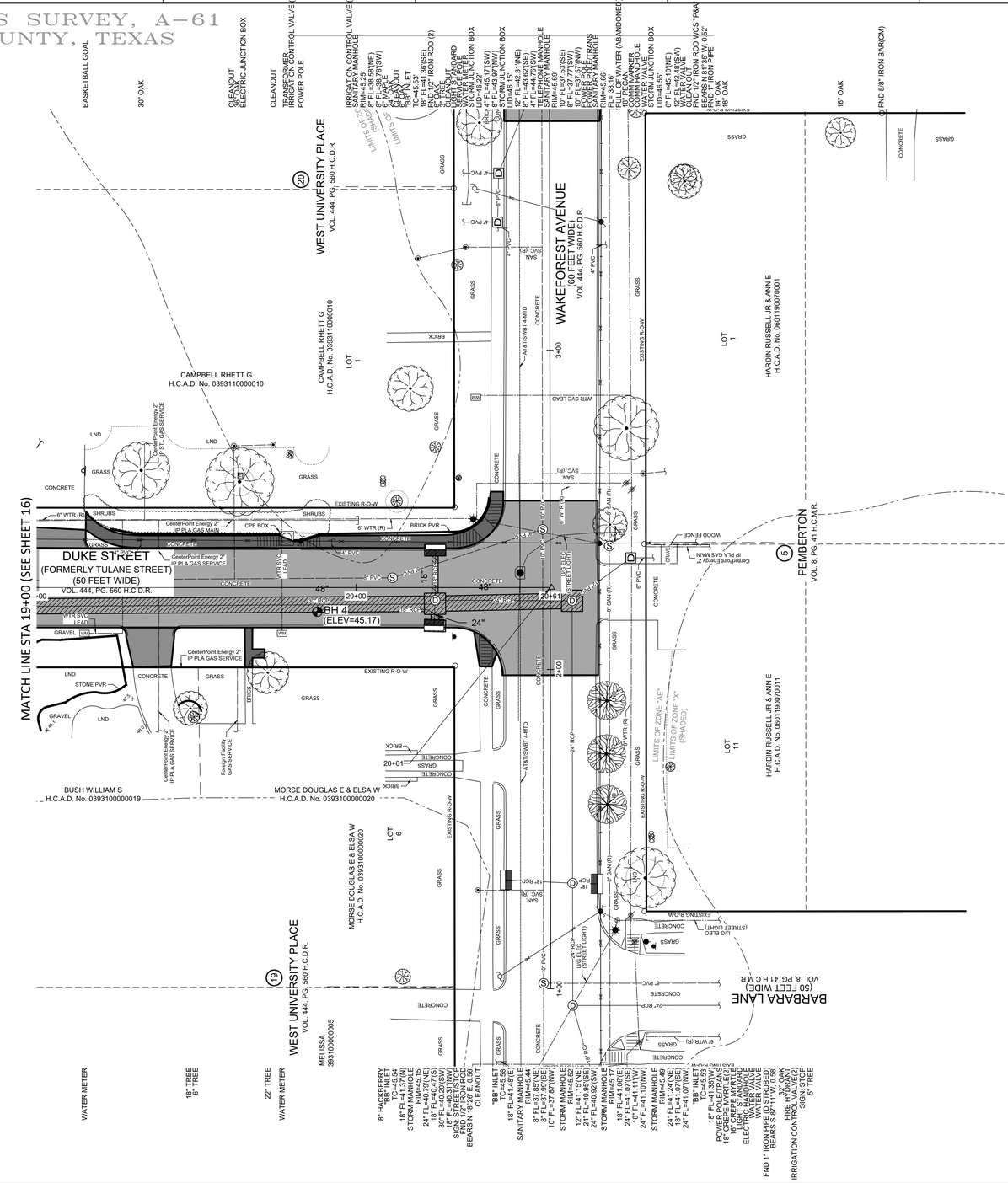
- BACK FLOW PREVENTER
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SITE BENCHMARK:

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ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Duke St. Sta. 19+00 to Sta. 20+61

Appendix D-2 - Duke Street Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 17 of 26

A.C. REYNOLDS SURVEY, A–61
HARRIS COUNTY, TEXAS

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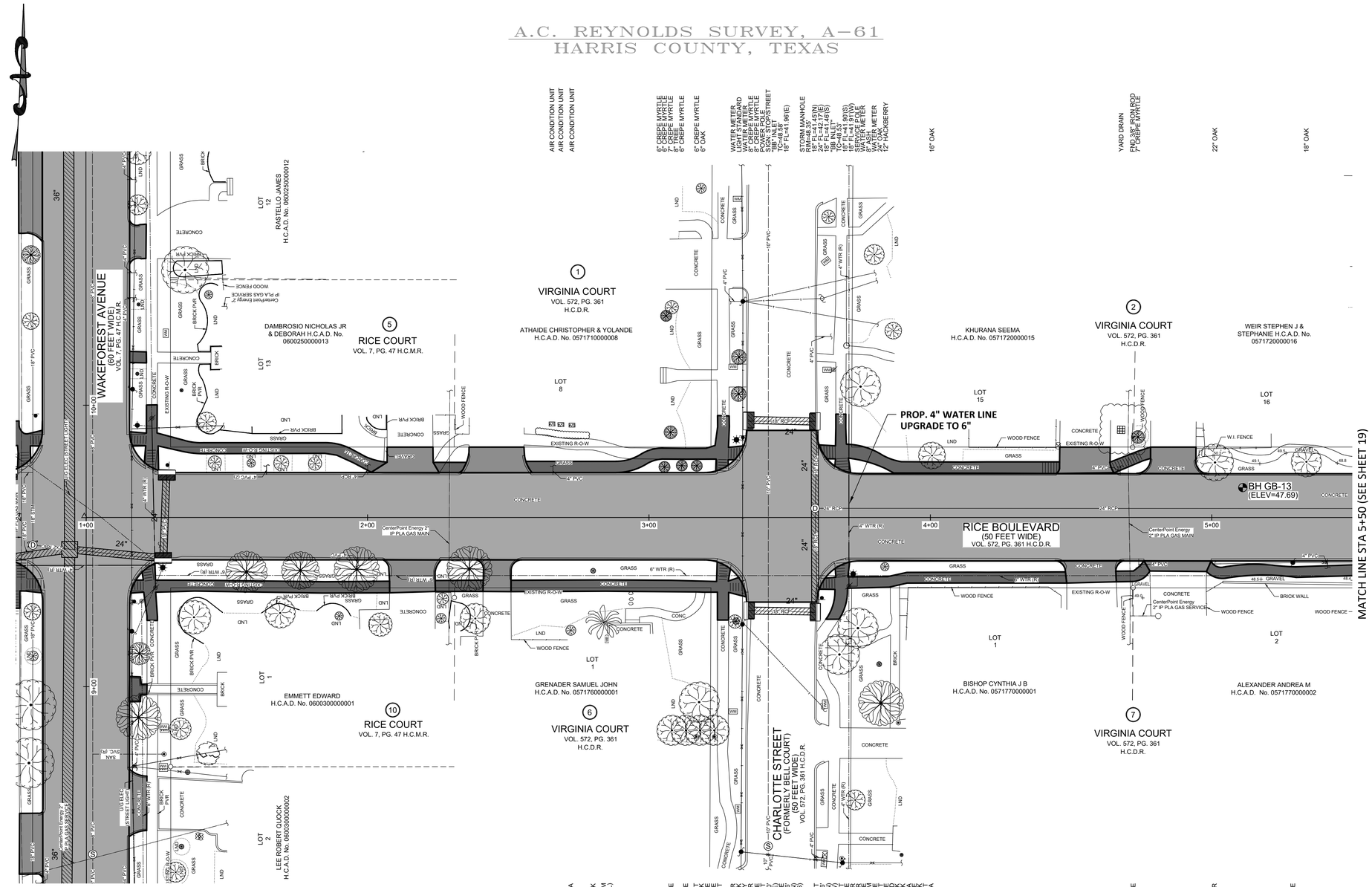
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C.L.	CHAIN LINK
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WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Rice Blvd. Sta. 0+00 to Sta. 5+50

Appendix D-3 - Rice Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 18 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

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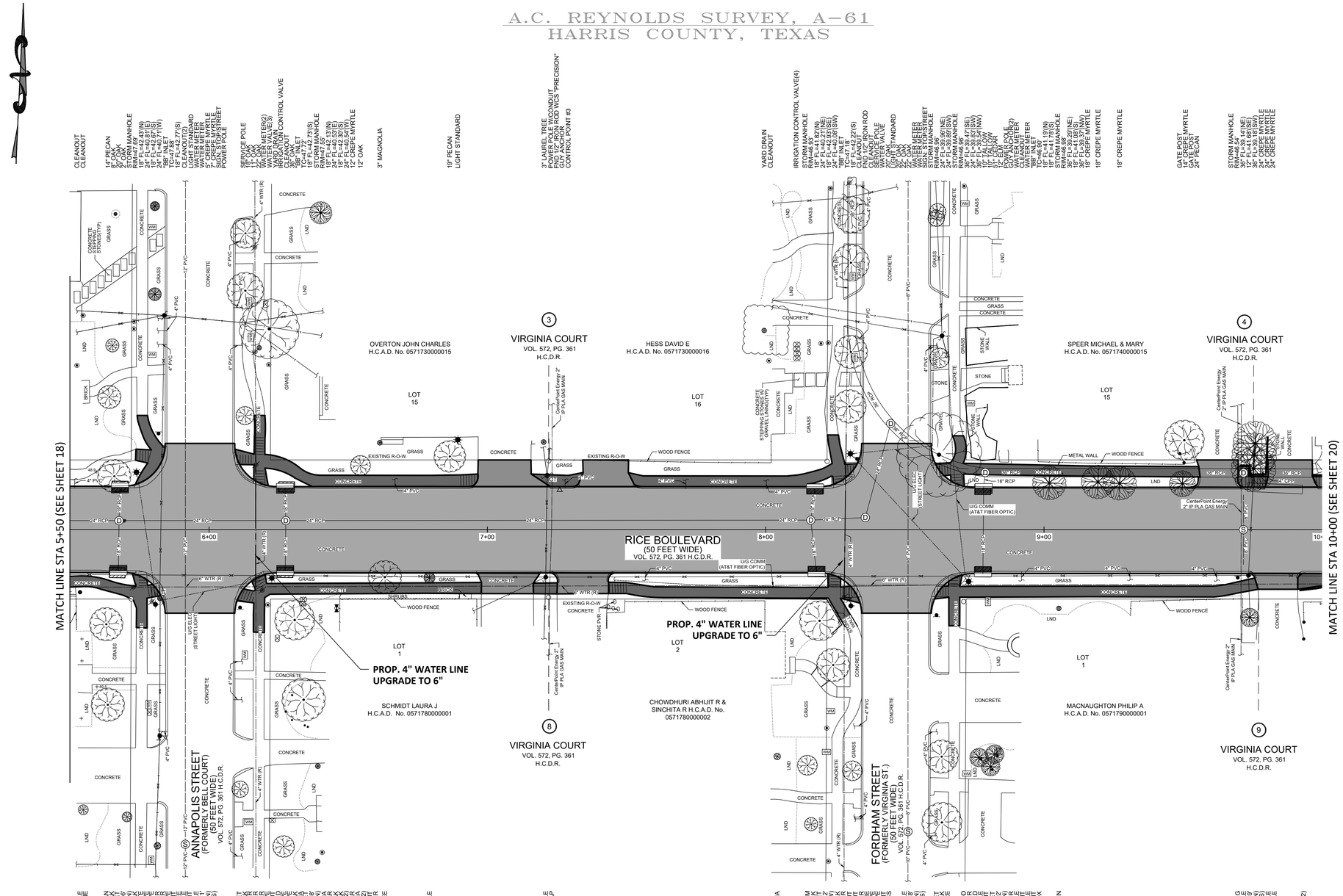
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- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK G140135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
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U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Rice Blvd. Sta. 5+50 to Sta. 10+00

Appendix D-3 - Rice Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 19 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
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5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
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SYMBOL LEGEND

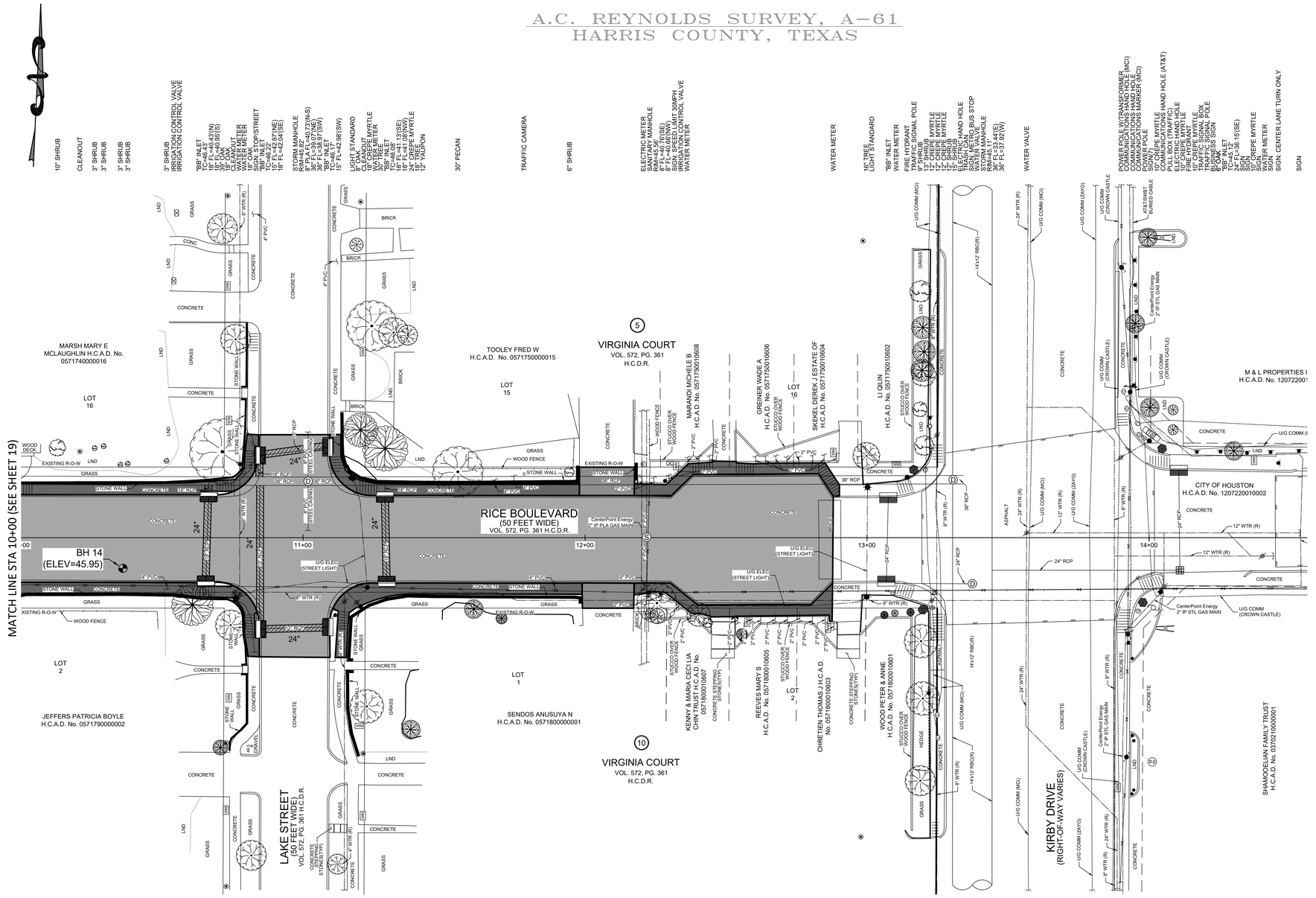
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
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- COMMUNICATIONS HANDHOLE
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- LIGHT STANDARD
- METER POLE
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- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
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- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

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ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
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H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
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IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
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TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Rice Blvd. Sta. 10+00 to Sta. 14+50

Appendix D-3 - Rice Boulevard Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 20 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

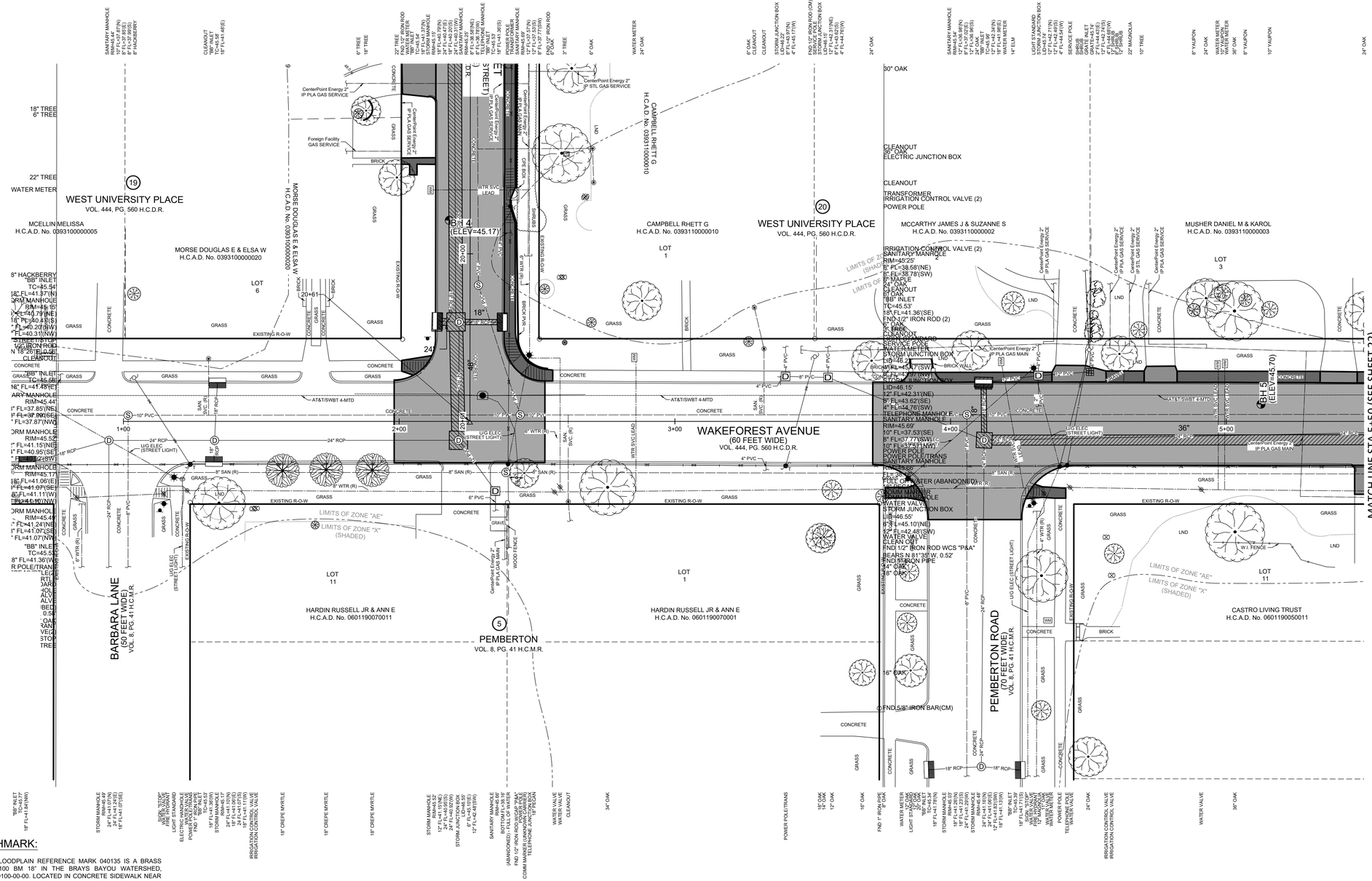
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
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- LIGHT STANDARD
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- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
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SITE BENCHMARK:

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No.	NUMBER
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PG.	PAGE
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SAN	SANITARY SEWER
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PVR	PAVER
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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER	John Peterson, PE, CFM
PROJECT NUMBER	10283919

ISSUE DATE DESCRIPTION

West University Place Drainage Improvements

S. Wakeforest St. Sta. 0+00 to Sta. 5+50

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 21 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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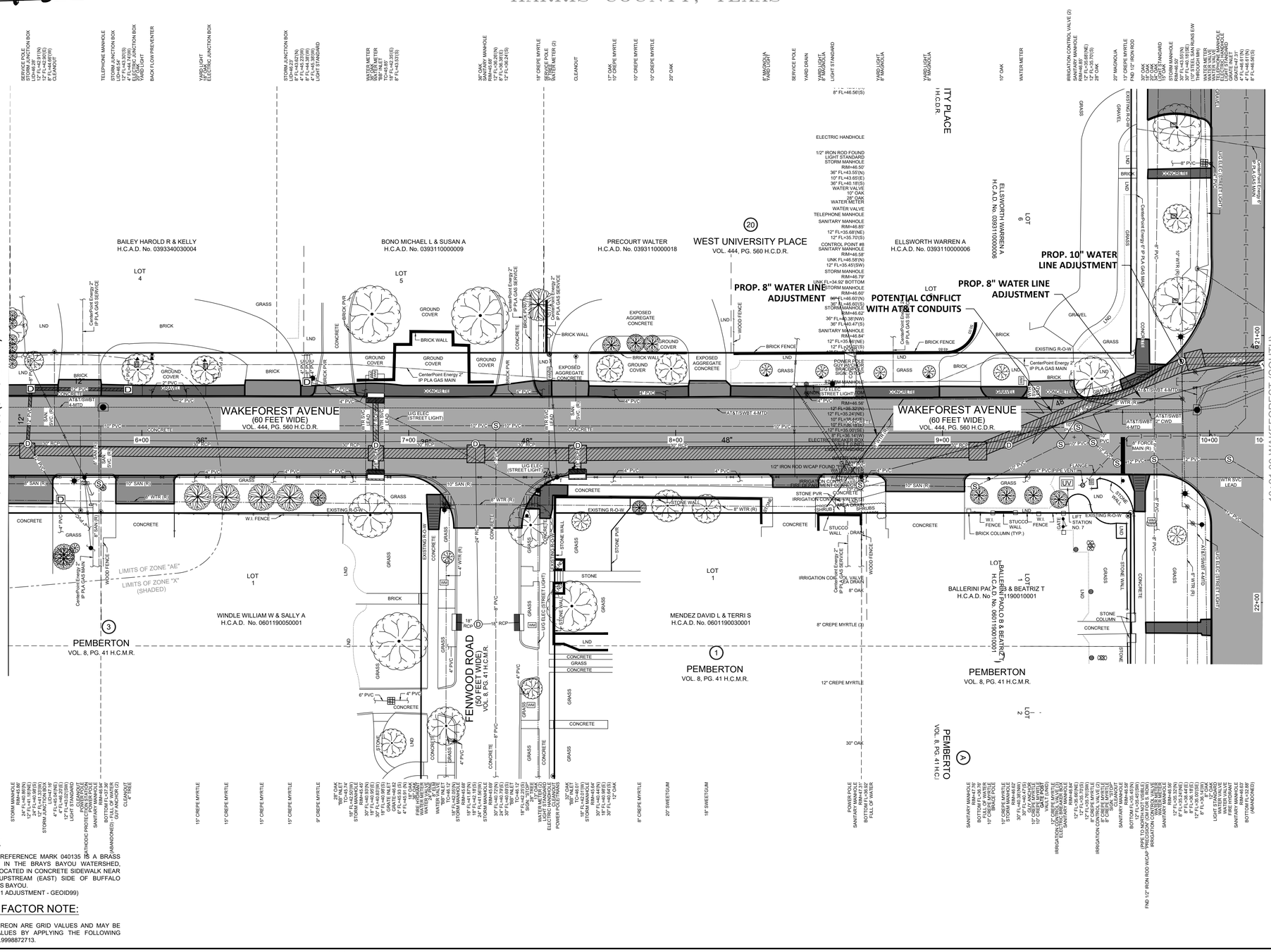
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
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- CAMERA
- CLEAN OUT
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- PVC RISER
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- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
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- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
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SITE BENCHMARK:

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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements
S. Wakeforest St. Sta. 5+50 to Sta. 10+00

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 22 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

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NOTES:

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SYMBOL LEGEND

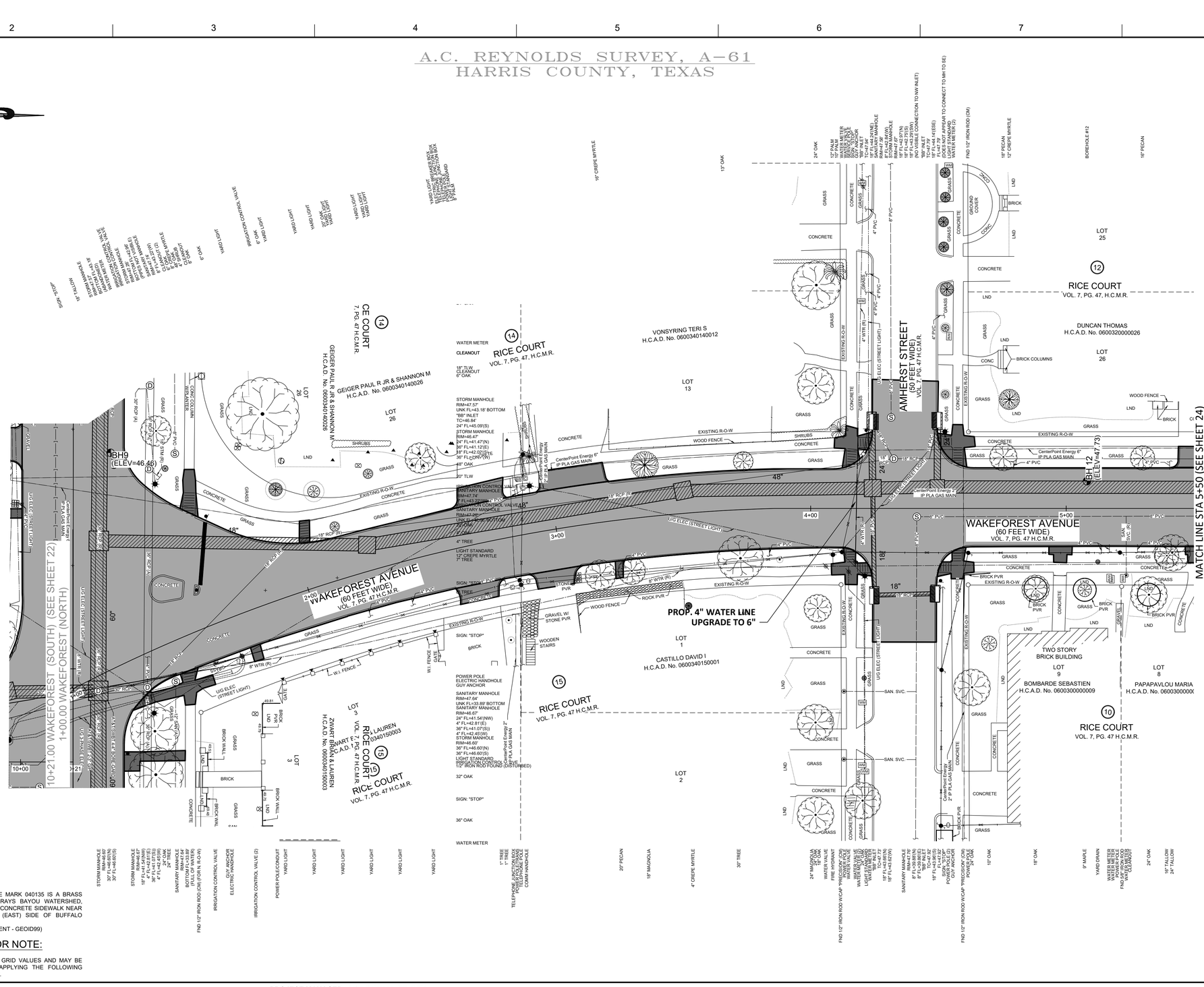
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
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SITE BENCHMARK:

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ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
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UG	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements
N. Wakeforest St. Sta. 1+00 to Sta.5+50

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 23 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

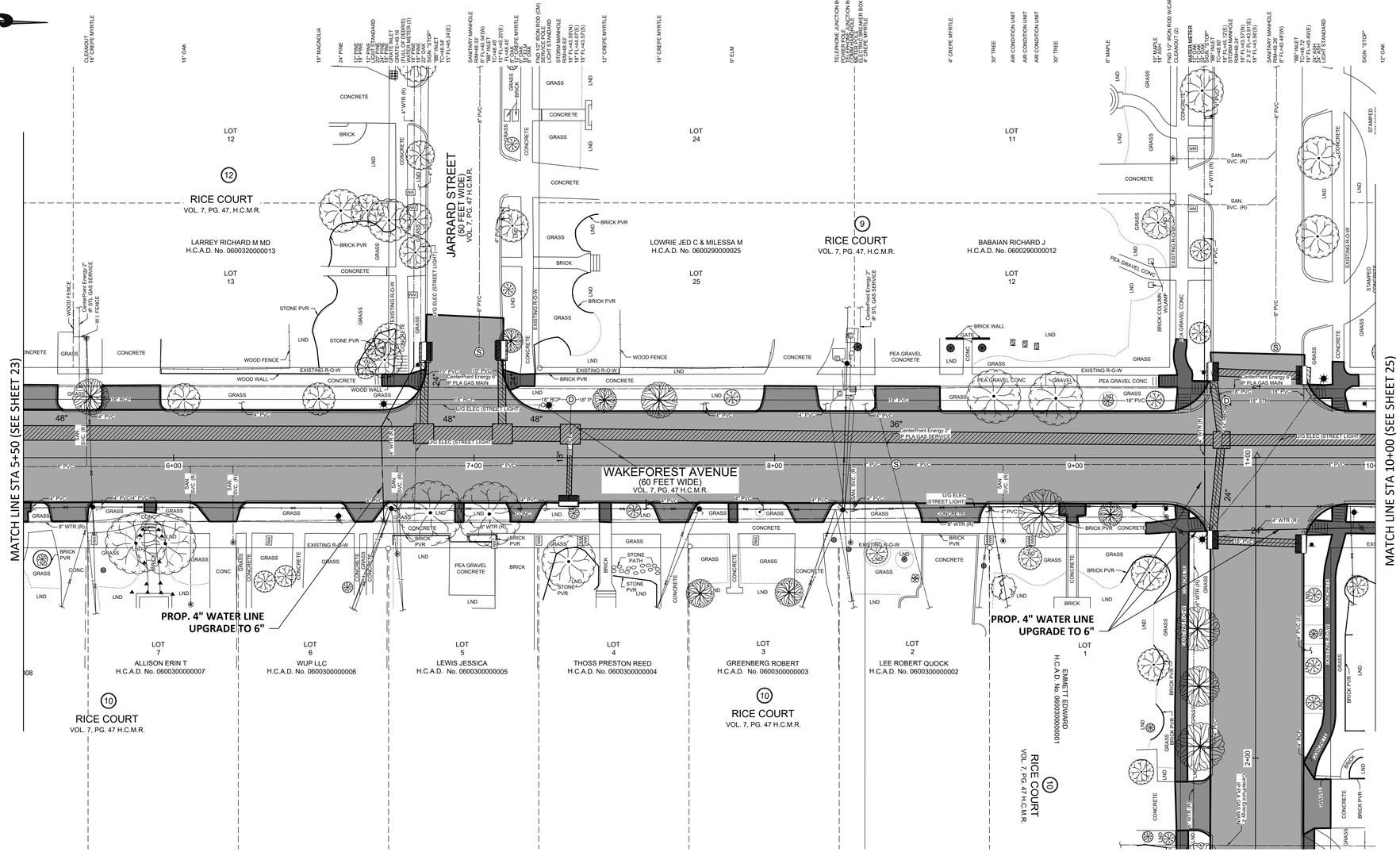
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NOTES:

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SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
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C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

N. Wakeforest St Sta. 5+50 to 10+00

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 24 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

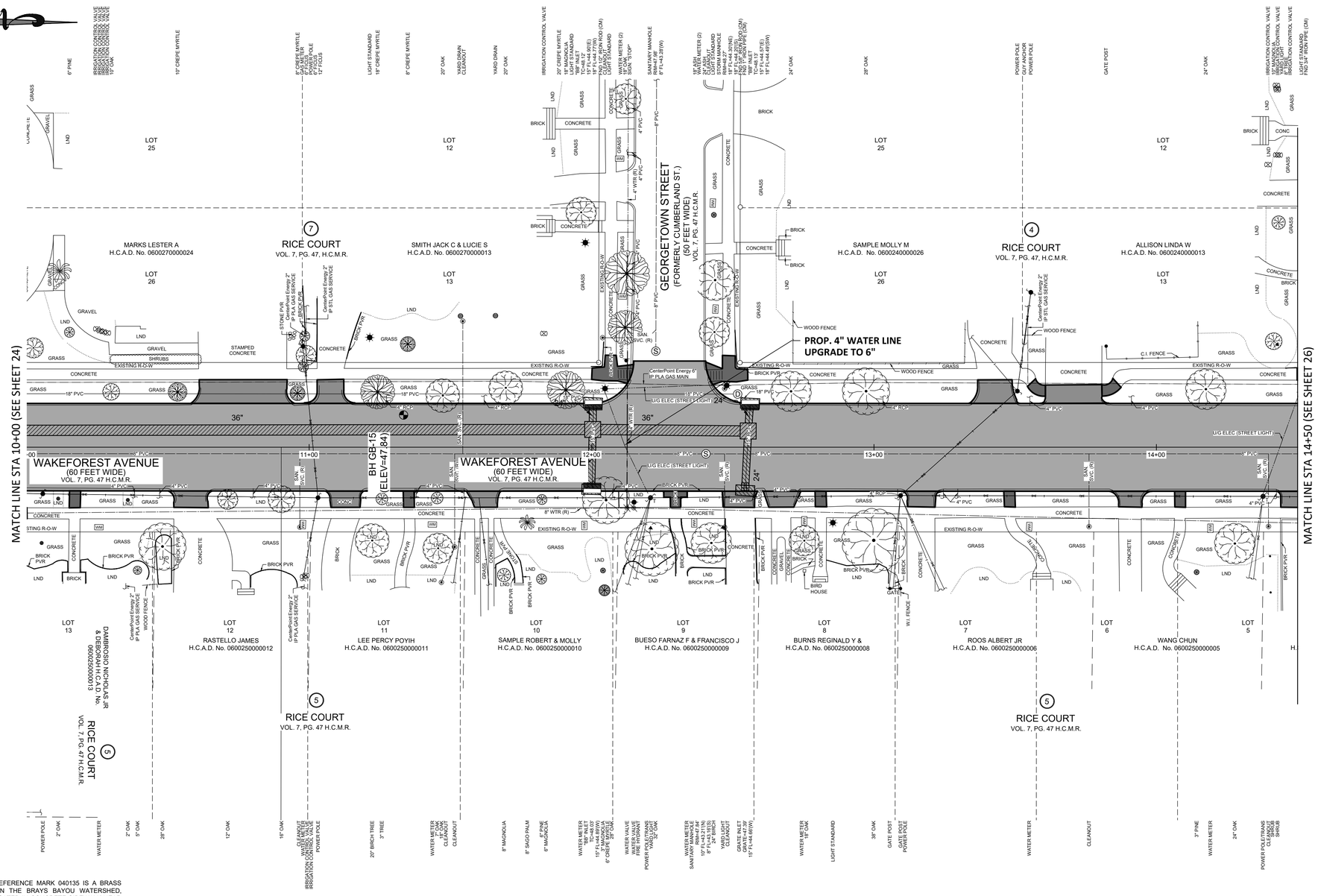
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- PVC RISER
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- LIGHT POLE
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- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
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- CHAINLINK FENCE
- OVERHEAD TELEPHONE
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- WOOD FENCE
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WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements
N. Wakeforest St. Sta. 10+00 to Sta. 14+50

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 25 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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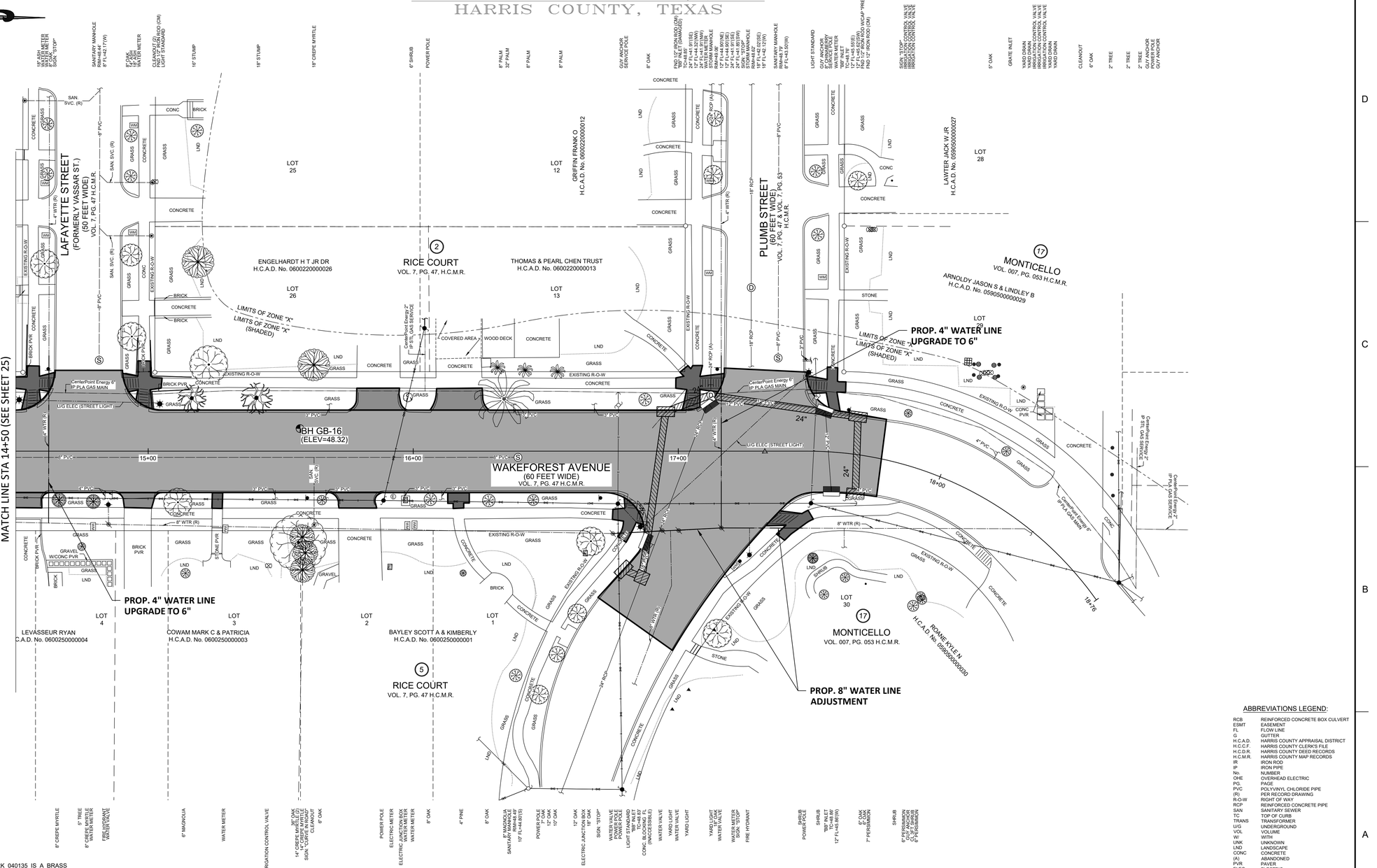
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- POWER POLE W/ TRNSFRM
- PVC RISER
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- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
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ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

N. Wakeforest St. Sta.14+50 to Sta. 19+00

Appendix D-4 - Wakeforest Avenue Prelim. Layout

0 1" 2"

FILENAME

SCALE

SHEET 26 of 26

E

Appendix E – Geotechnical Report from Geotest Engineering

GEOTECHNICAL INVESTIGATION
PW20-07 EAST STREET AND DRAINAGE IMPROVEMENTS
CITY OF WEST UNIVERSITY PLACE, TEXAS

REPORT NO. 1140261101

Prepared for:

HDR, INC.

Houston, Texas

Submitted by:

GEOTEST ENGINEERING, INC.

Houston, Texas

Key Map No. 532 A, B, E, F.

GEOTEST ENGINEERING, INC.

Geotechnical Engineers & Materials Testing

5600 Bintliff Drive Houston, Texas 77036 Telephone: (713) 266-0588
Fax: (713) 266-2977

Report No. 1140261101
October 18, 2021

Mr. John Peterson, P.E., CFM
Project Manager
HDR, Inc.
4828 Loop Central Drive, Suite 800
Houston, TX 77081

Reference: Geotechnical Investigation
PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

Dear Mr. Peterson:

Presented herein is the final geotechnical investigation report for the referenced project. A draft report was submitted to you on May 10, 2021. This final report supersedes all previously submitted reports, transmittals, e-mails, etc. for the referenced project. This investigation was authorized by Subconsultant Agreement between HDR Inc., and Geotest Engineering Inc., dated January 21, 2021, and effective as of January 28, 2021, by accepting our proposal No. 1140512199 dated October 30, 2021.

We appreciate this opportunity to be of service to you. Please call us when we can be of further assistance.

Sincerely,
GEOTEST ENGINEERING, INC.
TBPE Registration No. F-410

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EXECUTIVE SUMMARY

A geotechnical investigation was performed for the design and construction paving and storm sewer replacement within the City of West University Place (West U). The project is located in a residential area and is bounded by Carolina Way to the South, Buffalo Speedway to the west, Tangley Road to the north and Kirby Drive to the east. The details of the project description are provided in Section 1.3 of this report.

The purposes of this investigation were to evaluate soil and water level conditions and to provide geotechnical recommendations for the proposed reconstruction of various streets for the PW20-07 East Street and Drainage improvements project. This investigation included drilling and sampling sixteen (16) soil borings to depths ranging from 2 feet to 15 feet, performing laboratory tests on soil samples recovered from the borings, performing engineering analyses and developing geotechnical recommendations and preparing a geotechnical report.

The principal findings and conclusions developed from this investigation are as follows:

- Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults, no documented faults cross the project alignments. The nearest faults are the Memorial Park faults, which is located approximately 4 miles northeast of the project alignment from Wakeforest Avenue. Hence, a Phase-I Geological Fault Study is not warranted for this project.

- The existing pavement as obtained in the soil borings GB-1 through GB-16 consists of 6 to 8.5 inches of concrete over 0 to 11.25 inches of lime stabilized clay, silty sand, limestone, shell fragments, and clay mix base. The details of the existing pavement thickness at each of the boring location are summarized in Section 4.3 of this report.

- The subsurface soils beneath the pavement, as encountered in borings GB-2 through GB-16 consist of cohesive soils and cohesive soils underlain by cohesionless soils to the explored depth of 15 feet. The cohesive soils consist of soft to hard gray, gray and brown, and yellowish brown and gray fat clay, fat clay with sand, sandy fat clay, lean clay, lean clay with sand and sandy lean clay. Cohesionless consisting of loose to medium dense

gray and brown silty sand, silty clayey sand, poorly graded sand with silt, and clayey sand was encountered at depths ranging from 8 to 14 feet in borings GB-2 through GB-6, GB-10A, GB-11, and GB-14.

- During drilling operations, free water was first encountered at depths ranging from 12 feet to 15 feet in borings GB-2 through GB-6, and GB-10A drilled for this investigation. The water level, measured 20 minutes after water was first encountered, was at depths ranging from 7.1 feet to 9.0 feet in these borings. No water was encountered in borings GB-1, GB-7 through GB-9, GB-11 through GB-16 drilled for this investigation.

- All excavation operations for utilities should be carried out in accordance with OSHA standards and the City of Houston Standard Specifications. The backfill for utilities should be designed and constructed in accordance with City of Houston Standard Specification No. 02317.

- The recommended pavement sections for various streets included in the project are provided in Section 5.4 of this report.

1.0 INTRODUCTION

1.1 General

The City of West University Place selected HDR, Inc., (Engineer), to perform engineering services for the design of PW20-07 East Street and Drainage Improvements project in West University Place, Texas. HDR, Inc. (HDR), retained Geotest Engineering, Inc. (Consultant) as a part of the design team to perform geotechnical investigation for the above project.

1.2 Authorization

This investigation was authorized by Subconsultant Agreement between HDR Inc., and Geotest Engineering Inc., dated January 21, 2021, and effective as of January 28, 2021, by accepting our proposal No. 1140512199 dated October 30, 2021.

1.3 Location and Description of Project

The project is comprised of paving and storm sewer replacement within the City of West University Place (West U). The project is located in a residential area and is bounded by Carolina Way to the South, Buffalo Speedway to the west, Tangley Road to the north and Kirby Drive to the east, within the Key Map Page and Grids 532 A, B, E, F. The proposed improvements (street and/or drainage) will be performed on the following streets:

- Duke Street from Buffalo Speedway to Wakeforest Avenue.
- University Boulevard from Buffalo Speedway to Kirby Drive
- Wakeforest Avenue from Plumb Street to Pemberton Drive
- Rice Boulevard from Wakeforest Avenue to Kirby Drive

The actual size and the actual depth of the proposed storm sewer are not known at the time of preparation of this report. However, based on preliminary information, it is our understanding that the maximum depth of utilities will be 10 feet, except near the intersection of Duke Street and Buffalo Speedway, where it will be approximately 13 feet deep. All the utilities will be constructed by open cut method of construction. The vicinity map of the project location is shown on Figure 1.

1.4 Purpose and Scope

The purposes of this investigation were to evaluate soil and water level conditions along the various streets and to provide geotechnical recommendations for the design and construction of the proposed paving and utilities improvements project. The scope of this investigation consisted of the following:

- Cored existing pavement to determine existing pavement thickness, and for boring access.
- Drilled and sampled a total sixteen (16) borings each to depths ranging from 2 feet to 15 feet.
- Performed appropriate laboratory tests in accordance with ASTM procedures on selected samples to develop engineering properties of soils.
- Reviewed available fault information to determine known active faults that may impact design and construction of the proposed street improvements.
- Performed engineering analyses to develop geotechnical recommendations for pavement design (concrete pavement) including subgrade stabilization, pavement point repair (where needed), bedding and backfill for storm sewers, and drainage structures, ground water control and trench safety requirements for open cut construction and construction considerations.
- Prepared a geotechnical investigation report including all field data, laboratory test data and geotechnical recommendations.

2.0 FIELD INVESTIGATION

2.1 General

After obtaining the utilities clearance of the proposed sixteen (16) marked borings in the field, the borings were drilled to the explored depths utilizing a truck mounted drilling rig. Pavement Coring was performed at each boring location to measure the existing pavement thickness and to access the subsurface soils. Traffic control devices and personnel were utilized during coring and drilling to maintain safety of the drilling crew and the public. All the drilling and sampling were performed in accordance with appropriate ASTM procedures.

2.2 Geotechnical Borings

Subsurface conditions for the project alignments were explored by drilling and sampling sixteen (16) soil borings (designated as GB-1 through GB-16) each to depths ranging from 2 feet to 15 feet. The approximate boring locations are shown on Figure 2, Plan of Borings. During the field investigation, hard obstruction was encountered at a depth of 2 feet in boring GB-1 and three (3) offset boring locations GB-1A, GB-1B and GB-1C, and the boring was terminated at 2 feet depth. Hard obstruction was encountered at a depth of 2 feet in boring GB-10, and the boring was offset to location of boring GB-10A and drilled to the proposed depth of 15 feet. Survey information (Northing and Easting coordinates and ground surface elevation) of completed borings were provided to us by HDR. The survey information of completed borings is summarized in Table 1.

In general, samples were obtained continuously to a depth of 15 feet. Cohesive soils were obtained with a 3-inch thin-walled tube sampler in general accordance with ASTM D1587, and cohesionless soils were sampled with a 2-inch split-barrel sampler in according with ASTM D1586. Each sample was removed from the sampler in the field, carefully examined and then logged by an experienced soils technician. Suitable portions of each sample were sealed and packaged for transportation to Geotest's Laboratory. The shear strength of cohesive soil samples was estimated using a pocket penetrometer in the field. Driving resistances for the split-barrel samples were recorded as "Blows per Foot" on the boring logs. All the borings were grouted with cement-

bentonite grout after completion of drilling and obtaining the water level measurements.

Detailed descriptions of the soils encountered in the borings are given on the boring logs presented on Figures A-1 through A-16 in Appendix A. A key to symbols and terms used on boring logs is given on Figure A-17 in Appendix A.

2.3 Piezometer Installation

No piezometers were installed for this investigation.

3.0 LABORATORY TESTING

The laboratory testing program was designed to evaluate the pertinent physical properties and shear strength characteristics of the subsurface soils. Classification tests were performed on selected samples to aid in soil classification. All the tests were performed in accordance with ASTM Standards.

Undrained shear strengths of selected cohesive samples were measured by unconsolidated undrained (UU) triaxial compression tests (ASTM D2850). The results of the UU triaxial compression tests are plotted on the boring logs as solid squares. The shear strength of cohesive samples was measured in the field with a calibrated pocket penetrometer and also in the laboratory with a Torvane. The shear strength values obtained from the penetrometer and Torvane are plotted on the boring logs as open circles and triangles, respectively.

Measurements of moisture content and dry unit weight were taken for each UU triaxial compression test sample. Moisture content (ASTM D2216) measurements were also made on other samples to define the moisture profile at each boring location. Liquid and plastic limit tests (ASTM D4318) and percent passing No. 200 sieves (ASTM D1140) were performed on appropriate samples. Sieve analysis (ASTM D6913) tests were performed on selected cohesionless samples.

The results of all tests are tabulated or summarized on the boring logs presented on Figures A-1 through A-16 in Appendix A. The summary of laboratory tests is also presented in a tabular form on Figures B-1 through B-16 in Appendix B. The grain size distribution curves are presented on Figures B-17 and B-18.

4.0 SUBSURFACE CONDITIONS

4.1 Geology

The project area lies in the Beaumont Formation. The clays and sands of the Beaumont Formation are over-consolidated as a result of desiccation from frequent rising and lowering of the sea level and the groundwater table. Consequently, clays of this formation have moderate to high shear strength and relatively low compressibility. The sands of the Beaumont Formation are typically very fine and often silty. Further, there is occasional evidence in the Houston area of the occurrence of cemented material (sandstone and siltstone) deposits within the Beaumont Formation.

4.2 General Fault Information

A review of information in the Geotest library, relating to known surface and subsurface geologic faults in the general project area was undertaken. The available information consisted of U.S. Geological Survey and NASA maps, open file reports and information contained in our files relating to geologic faults in the project area.

Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults, no documented faults cross the project alignments. The nearest faults are the Memorial Park faults, which is located approximately 4-miles northeast of the project alignment from Wakeforest Avenue. Hence, a Phase-I Geological Fault Study is not warranted for this project.

4.3 Existing Pavement

The existing pavement as obtained in the soil borings GB-1 through GB-16 consists of 6 to 8.5 inches of concrete over 0 to 11.25 inches of Lime Stabilized Clay, Silty Sand, limestone, shell fragments, and clay mix base.

The details of the existing pavement thickness at each of the boring locations are summarized below:

Street	Boring Nos.	Concrete Thickness (inches)	Base	Total (inches)
Duke Street	GB-1	7.0	6.5-inch Lime Stabilized Clay	13.5
	GB-2	6.5	5.0-inch Lime Stabilize Clay with Limestone	11.5
	GB-3	6.25	4.75-inch Lime Stabilized Clay	11.0
	GB-4	6.25	9.25-inch Lime Stabilized Sandy Clay	15.5
Wakeforest Avenue	GB-5	6.0	11.0-inch Stabilized Clay and Sand mix	17.0
University Boulevard	GB-6	6.5	4.5-inch Lime Stabilized Clay	11.0
	GB-7	8.5	3.0-inch Shell fragments and sand	11.5
	GB-8	7.75	--	7.75
	GB-9	8.0	5.0-inch clay and gravel mix	13.0
	GB-10	8.25	11.25 Lime Stabilized Clay	19.5
	GB-10A	8.25	11.25-inch Lime Stabilized Clay	19.5
	GB-11	7.25	3.75-inch Lime Stabilized Clay	11.0
Wakeforest Avenue	GB-12	7.0	8.0-inch Silty Sand, shell fragments and gravel mix	15.0
Rice Boulevard	GB-13	6.5	5.5-inch Silty Sand, shell fragments and clay mix	12.0
	GB-14	6.5	5.5-inch Silty Sand and clay mix	12.0
Wakeforest Avenue	GB-15	7.0	3.0-inch Silty Sand	10.0
	GB-16	7.5	4.5-inch Silty Sand	12.0

4.4 Soils Stratigraphy

Based on the subsurface soils encountered in the boreholes, four (4) boring log profiles were developed and are presented on Figures 3.1 through 3.4. To the left of each boring shown on the profile is an indication of the consistency or density of each stratum. More than one consistency for an individual stratum indicates that the consistency is different at different depths within the stratum. For cohesive soils, consistency is related to the undrained shear strength of the soil. To the right of each boring shown on the profile is the overall classification of the soil contained within each stratum. The symbols and abbreviations used on the boring log profiles are given on Figure 4. The soil classification is based on ASTM Standards.

The subsurface soils beneath the pavement, as encountered in borings GB-2 through GB-16, and as shown on the boring log profiles 3.1 through 3.4 along the various streets, consist of cohesive soils and cohesive soils underlain by cohesionless soils to the explored depth of 15 feet. The cohesive soils

consist of soft to hard gray, gray and brown, and yellowish brown and gray fat clay, fat clay with sand, sandy fat clay, lean clay, lean clay with sand and sandy lean clay. Cohesionless consisting of loose to medium dense gray and brown silty sand, poorly graded sand with silt, and clayey sand was encountered at depths ranging from 8 to 14 feet in borings GB-2, through GB-6, GB-10A, GB-11, and GB-14.

The fat clay, fat clay with sand, and a sandy fat clay are of high plasticity with liquid limits ranging from 50 to 66 and plasticity indices ranging from 29 to 39. The lean clay, lean clay with sand and sandy lean clay are of medium to high plasticity with liquid limits ranging from 31 to 48 and plasticity indices ranging from 14 to 27. The fines content (percent passing No. 200 sieve) of fat clay and lean clay ranged from 89.9 to 93.2 percent, the fines content of the fat clay with sand and lean clay with sand ranged from 70.0 to 81.7 percent, and the fines content of sandy lean clay and sandy fat clay ranged from 50.2 to 69.9 percent. The fines content of clayey sand and silty sand ranges from 15.5 to 30.9 percent, and the fines content of poorly graded sand with silt ranges from 8.6 to 10.3 percent.

4.5 Water Levels

During drilling operations, free water was first encountered at depths ranging from 12 feet to 15 feet in borings GB-2 through GB-6, and GB-10A drilled for this investigation. The water level, measured 20 minutes after water was first encountered, was at depths ranging from 7.1 feet to 9.0 feet in these borings. No water was encountered in borings GB-1, GB-7 through GB-9, GB-11 through GB-16 drilled for this investigation. A summary of the water level conditions as observed in the borings and piezometers are given below:

Boring No.	**Water Level Encountered During Drilling, feet**			
	First Encountered		**20 Minutes After First Encountered**	
	Depth	**Elevation**	**Depth**	**Elevation**
GB-2	15.0	31.52	8.2	38.32

Boring No.	Water Level Encountered During Drilling, feet			
	First Encountered		20 Minutes After First Encountered	
	Depth	Elevation	Depth	Elevation
GB-3	14.0	32.30	7.9	38.4
GB-4	15.0	30.17	8.0	37.17
GB-5	14.0	31.70	8.7	37.00
GB-6	14.0	32.90	7.1	39.80
GB-10A	12.0	33.67	9.0	36.67

However, it should be noted that various environmental and man-made factors such as amount of precipitation, nearby subsurface construction activities, and change in area drainage can substantially influence the groundwater level.

4.6 Environmental Concerns

No environmental concerns were observed in the borings drilled for this investigation.

5.0 ENGINEERING ANALYSES AND RECOMMENDATIONS

5.1 General

A geotechnical investigation was performed for the design and construction paving and storm sewer replacement within the City of West University Place (West U). The project is located in a residential area and is bounded by Carolina Way to the South, Buffalo Speedway to the west, Tangley Road to the north and Kirby Drive to the east. The details of the project description are provided in Section 1.3 of this report.

5.2 Trench Excavation

Based on the information provided to us, we understand that the project includes drainage improvements along Duke Street, University Boulevard, Wakeforest Avenue (Rice Boulevard to Georgetown Street), and the proposed storm sewer will be installed by open cut method of construction. The following subsections provide information for the design and construction of the storm sewer by open cut method of installation.

5.2.1 Geotechnical Parameters. Based on the soil conditions revealed by the borings GB-1 through GB-12, and GB-15 where drainage improvements are proposed, geotechnical parameters were developed for the design of open cut installation. The design parameters are provided in Table 2. For design, the water level should be assumed to be at the ground surface since this condition may exist after a heavy rain or flooding.

5.2.2 Excavation Stability. The open excavation may be shored or laid back to a stable slope or supported by some other equivalent means used to provide safety for workers and adjacent structures, if any. The excavating operations should be in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and the City of Houston Standard Specification.

- Excavation Shallower Than 5 Feet – For excavations that are less than 5 feet, the need for protection should be evaluated by a competent person to examine the ground for any indication of potential cave-in. When any indication of hazardous ground movement or

potential cave-in is anticipated during construction, adequate protective system should be provided for all excavation even if excavations are shallower than 5 feet.

- Excavations Deeper Than 5 Feet - Excavations that are deeper than 5 feet should be sloped, shored, sheeted, braced or laid back to a stable slope or supported by some other equivalent means or protection such that workers are not exposed to moving ground or cave-ins. The slopes and shoring should be in accordance with the trench safety requirements as per OSHA Standards. The following items provide design criteria for excavation stability.

  (i) OSHA Soil Type. Based on the soil conditions revealed by borings drilled for this investigation and the assumed water level to be at ground surface, OSHA soil type "C" should be used for determination of allowable maximum slope and/or the design of shoring along the alignments for the full proposed depth of open excavation. For shoring deeper than 20 feet, an engineering evaluation is required.

  (ii) Excavation Support Earth Pressure. Based on the subsurface conditions indicated by our field investigation and laboratory testing results, excavation support earth pressure diagrams are developed and presented on Figures 5.1 and 5.2. This pressure diagram can be used for the design of temporary trench bracing. For a trench box, a lateral earth pressure resulting from an equivalent fluid with a unit weight of 97 pcf can be used. The effects of any surcharge loads at the ground surface should be added to the computed lateral earth pressures. A surcharge load, q, will typically result in a lateral load equal to 0.5 q. The above value of equivalent fluid pressure is based on assumption that the groundwater level is near the ground surface, since these conditions may exist after a heavy rain or flooding.

  (iii) Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the water level within the retained soils and the water level at the interior of the trench excavation. For cuts in cohesive soils as predominantly encountered in the borings, the bottom stability can be evaluated as outlined on Figure 6. However, in cohesionless soils (such as silty sand, poorly graded sand with

silt, and clayey sand) as encountered in borings GB-2, through GB-6, GB-10A, and GB-11, at the invert or within 3 feet of invert depth, the excavation should be done after dewatering to avoid bottom stability problems, if the excavation is planned after a heavy rainfall event.

5.2.3 Water Level Control. Excavations for the proposed utilities will encounter water seepage to varying degrees depending upon the water level conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed utilities installation, the excavations will be predominantly in cohesive soils. In general, for cohesive soils as predominantly encountered in the borings for a maximum excavation depth of 13 feet, water may be managed by collection in excavation bottom sumps for pumped disposal. However, for excavations near borings GB-2, through GB-6, GB-10A, and GB-11, where cohesionless soils were encountered near the invert or within 3 feet of invert, dewatering may be required, if the excavations are planned after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet and deep wells below 15 feet depth may be required to lower the water level to at least 3 feet below the bottom of excavation. The dewatering system should be pumping well ahead of time before excavation starts so that a steady state condition (groundwater elevation at least 3 feet below the proposed excavation bottom) is achieved.

It is recommended that the actual water level conditions should be verified by the contractor at the time of construction and that water level control be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

5.2.4 Bedding and Backfill for Utilities. In general, excavation and backfill for utilities should be designed and constructed in accordance with the City of Houston Standard Specification Section 02317, Subsection 3.09 and 3.10 “Excavation and Backfill for Utilities”, and Section 02320 "Utility Backfill Materials".

Bedding and backfill for storm sewer should be in accordance with City of Houston Standard Specification Section 02317 and Drawing No. 02317-03.

5.3 Structures

5.3.1 Description. The structure associated with this project will be proposed manholes for the proposed storm sewers. The proposed manholes for storm sewers will be placed at maximum depths of 13 feet below existing grade.

5.3.2 Foundation Conditions. Based on the soil conditions revealed by the borings, the manholes bottom will be in firm to very stiff fat clay, fat clay with sand, lean clay with sand and sandy lean clay, and medium dense silty sand and poorly graded sand with silt.

5.3.3 Foundation Design Recommendations. The following items provide recommendations and design criteria for construction of the new manholes.

- Allowable Bearing Pressures. The mat foundation for supporting the new manholes placed at a maximum depth of 13 feet [into firm to very stiff fat clay, fat clay with sand, lean clay with sand and sandy lean clay, and medium dense silty sand and poorly graded sand with silt] should be designed for an allowable (net) bearing pressure as detailed below.

Alignment	**Closest Boring**	**Appx. Manhole Bottom Depth (feet)**	**Net Allowable Bearing Pressure (psf)**
Duke Street	GB-1 thru GB-4	10 to 13	1,250
University Boulevard	GB-6 thru GB-11	10 to 13	2,000
Wakeforest Avenue	GB-5, GB-12, GB-15	10 to 13	2,500

The allowable bearing pressures include a safety factor of 2.0.

The above recommendations assume that the final bearing surfaces consist of undisturbed natural soils and that underlying semi-transmissive zones are properly pressure-relieved and stable undisturbed bearing surfaces are attained.

- Bottom Stability. Bottom stability is described earlier in Section 5.2.2 under Excavation Stability.

- Lateral Earth Pressure. The pressure diagrams presented on Figures 5.1 and 5.2 can be used for the design of braced excavation. The lateral earth pressure diagrams presented on Figures 7.1 and 7.2 is applicable for the design of the permanent walls.

- Hydrostatic Uplift Resistance. Structures extending below the water level should be designed to resist uplift pressure resulting from excess piezometric head. Design uplift pressures should be computed based on the assumption that the water table is at ground surface. To resist the hydrostatic uplift at the bottom of the structure, one of the following sources of resistance can be utilized in each of the designs.

  a. Dead weight of structure,
  b. Weight of soil above base extensions plus weight of structure, or
  c. Soil-wall friction plus dead weight of structure.

  The uplift force and resistance to uplift should be computed as detailed on Figure 8. In determining the configuration and dimensions of the structure using one of the approaches presented on Figure 8, the following factors of safety are recommended.

  a. Dead weight of concrete structure, $S_{f1} = 1.10$,
  b. Weight of soil (backfill) above base extension, $S_{f2} = 1.5$, and
  c. Soil-wall friction, $S_{f3} = 3.0$.

  Friction resistance should be discounted for the upper 5 feet, since this zone is affected by seasonal moisture changes.

5.3.4 Protection of Below Grade Structures. The design of the proper means for protection of below grade structures will depend upon the potential of the aggressivity or corrosivity of soil and groundwater properties. Aggressivity testing was not within the scope of this investigation. The design of the protection of below grade structures is beyond the scope of services for this investigation.

5.3.5 Water Level Control During Construction. Water level control should be in accordance with Section 5.2.3 of this report.

5.3.6 Structure Backfill. Excavations for the proposed structures should be backfilled in accordance with the City of Houston Standard Specifications, Section 02316, "Excavation and Backfill for Structures."

5.4 Pavement Structure Design

The scope for the project includes paving replacement along Wakeforest Avenue (from Plumb to Pemberton), Rice Boulevard (from Wakeforest Avenue to Kirby Drive), University Boulevard (from Buffalo Speedway to Kirby Drive), and Duke Street (from Buffalo Speedway to Wakeforest Avenue). Based on the information provided by City, Wakeforest Avenue and Rice Boulevard are Major Collector streets, University Boulevard is a minor arterial, and Duke Street is a local residential street. The pavement design presented below was developed in accordance with "AASHTO Guide for Design of Pavement Structures," 1993 Edition.

5.4.1 Design Parameters

Subgrade Soil Properties. California Bearing Ratio (CBR) tests were not within the scope of this project. Therefore, the roadbed soil resilient modulus is estimated based on physical properties and strength characteristics of the natural subgrade soils. Based on the physical properties and strength characteristics of the natural subgrade soils obtained from laboratory tests, the effective roadbed soil resilient modulus (M_R) was estimated to be about 1,941 psi interpolated from CBR value of 1.0, which is based on in situ liquid limits of surficial soils. Based on an estimated resilient modulus of 8-inch lime-stabilized subgrade, the effective modulus of subgrade reaction (k) is estimated to be about 49 pci.

Traffic Data. For the Major Collector roadways included in the project including Wakeforest Avenue and Rice Boulevard, a traffic data of 2.6×10^6 kips ESAL (W18) over a 50-year design period was utilized for the pavement design. This traffic

loading is estimated based on a daily traffic volume of 2,336 vehicles at 2600 Rice Boulevard from a 24-hour weekday count conducted on March 13, 2020, as provided to us by HDR. A distribution of approximately 98% passenger cars, 2% buses and single-unit trucks and 1 garbage truck per day were assumed for the project alignment. No traffic count was available along Duke Street (Local Residential Street). The pavement design calculation backup is provided in Appendix C.

Other Design Parameters. Other design parameters used in the development of rigid pavement thickness are given below:

Material Properties of Concrete:

Modulus of Elasticity of Concrete (E_c): 3,604,997 psi

Mean value of Modulus of Rupture of Concrete after 28 days (S'_c): 630 psi (based on compressive strength of 4,000 psi)

Load Transfer coefficient (J): 2.7

Drainage coefficient (C_d): 1.2

Overall Standard Deviation (S_o): 0.35

Reliability Level (R): 95% (Major Collector)
80% (Local Residential)

Serviceability Index

Initial (P_o): 4.5

Terminal (P_t): 2.5 (Major Collector)
2.0 (Local Residential)

Reinforcement Variables

Allowable Working Stress (f_s): 60,000 psi (grade 60 steel)

Friction Factor (F): 1.8

5.4.2 Recommended Pavement Section

Based on the information provided by IDS Engineering Group (IDS) (letter by IDS dated October 8, 2021 attached in Appendix C) for the 50-year design life, the following standard pavement sections are recommended for all Major Collectors and Minor Arterials.

Roadway	**Pavement Course**	**Pavement Thickness, inches**
Rice Boulevard/ Wake Forest Avenue /University Boulevard	Reinforced Concrete	9
	6% Lime-stabilized subgrade	8

Subsequently for the above pavement section for Major Collectors, a reliability level of 95% and a terminal serviceability index of 2.5, a total traffic volume is estimated (back calculated) to be 8.5 x 10^6 – 18 kips ESAL (W18) over a 50-year design period. Based on the traffic count information provided by the City, Geotest has verified the pavement section. The recommended standard pavement section meets or exceeds the estimated pavement section based on the traffic data. If the traffic estimated is different than the above-mentioned traffic, the pavement sections along Rice Boulevard, Wake Forest Avenue and University Boulevard will need to be evaluated and revised.

Local Residential Street

No traffic count was available along the residential street (Duke Street) alignment, and the recommended standard pavement section as provided by the City of West University Place is as given below:

Roadway	**Pavement Course**	**Pavement Thickness, inches**
Duke Street	Reinforced Concrete	8
	6% Lime-stabilized subgrade	8

Subsequently for the above pavement section for Local/Residential street, a reliability level of 80% and a terminal serviceability index of 2.0, a total traffic volume is estimated (back calculated) to be 9.8 x 10^6 – 18 kips ESAL (W18) over a 50-year design period. If the traffic estimated is different than the above-mentioned traffic, the pavement section along Duke street will need to be evaluated and revised.

Based on the reinforcement variables and recommended pavement section, the required longitudinal and transverse reinforcing steel (No. 5, Grade 60 Steel) can be determined for concrete pavement per Table 1 of City of Houston Drawing No. 02751-01.

5.4.3 Preparation of Pavement Subgrade

Based on the field and laboratory test data, the subgrade soils below the existing pavement along various streets included in the project consists of high to very high plasticity lean clay with sand, fat clay, and fat clay with sand. These soils have high to very high-volume change potential. Hence, lime stabilization of the subgrade soils will be required to reduce the swelling and shrinkage potential, to accelerate the construction and provide a stable platform on which to construct the pavement sections. The subgrade soils should be stabilized with 6 percent lime (by dry weight of soil) to a depth of at least 8 inches along all the neighborhood streets in the project. This corresponds to approximately 38 pounds of lime per square yard based on a dry unit weight of 106 pcf. The actual percentages of lime should be confirmed by laboratory tests at the time of construction. It should be noted that quantity of lime was estimated based on the dry unit weight determined from the specific boring locations only.

Subgrade preparation for the proposed pavement after removing the existing pavement including the existing base (to natural subgrade level) should consist of stripping, proof-rolling, backfilling and stabilization. The following procedures for subgrade preparation are recommended:

1. Strip the exposed soils after demolition of pavement to achieve grade. In isolated areas where soft, compressible, or very loose soils are encountered, additional stripping may be required. In these areas, the existing soft soils/compressible or loose soils should be removed and replaced with select fill material prior to stabilization.

2. After stripping, the exposed surface should be proof-rolled with a minimum of 3 passes of a 30-ton pneumatic-tired roller or a partially loaded truck utilizing a tire contact pressure of approximately 90 psi. The purpose of the proof-rolling operation is to identify if any rutting develops or any underlying zones or pockets of soft soils exist, so these weak materials can be removed and replaced.

3. Lime stabilization of cohesive subgrade should be performed in accordance with City of Houston Standard Specification No. 02336, "Lime-Stabilized Subgrade." Should raising the subgrade level be required to achieve grade, select fill material should be utilized.

5.4.4 Select Fill

Should any select fill be required to raise the grade it should consist of lean clay or sandy lean clay with a liquid limit less than 40 and a plasticity index between 8 and 20. The select fill should be compacted at moisture content within three percent above optimum to reduce swelling potential of the compacted fill. The fill material should be placed in loose lifts not exceeding eight inches and should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698. The structural fill pad should extend to at least two feet outside the paving area. The surficial fat clay is not suitable for structural fill unless stabilized with sufficient lime.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Water Level Control

Excavations for the proposed utilities will encounter water seepage to varying degrees depending upon the water level conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed utilities installation, the excavations will be predominantly in cohesive soils. In general, for cohesive soils as predominantly encountered in the borings for a maximum excavation depth of 13 feet, water may be managed by collection in excavation bottom sumps for pumped disposal. However, for excavations near borings GB-2, through GB-6, GB-10A, and GB-11, where cohesionless soils were encountered near invert or within 3 feet of invert, dewatering may be required, if the excavations are planned after a heavy rainfall event. Dewatering such as vacuum well points up to 15 feet and deep wells below 15 feet depth may be required to lower the water level to at least 3 feet below the bottom of excavation. The dewatering system should be pumping well ahead of time before excavation starts so that a steady state condition (groundwater elevation at least 3 feet below the proposed excavation bottom) is achieved.

It is recommended that the actual water level conditions should be verified by the contractor at the time of construction and that water level control be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

6.2 Influence of Open Cut Excavation on Adjacent Structures

Based on the information available to us, the open cut excavation for the proposed storm sewer is generally along streets. Underground utilities and adjacent structures to the excavations should be properly protected during excavations and monitored during and after the excavation.

7.0 LIMITATIONS

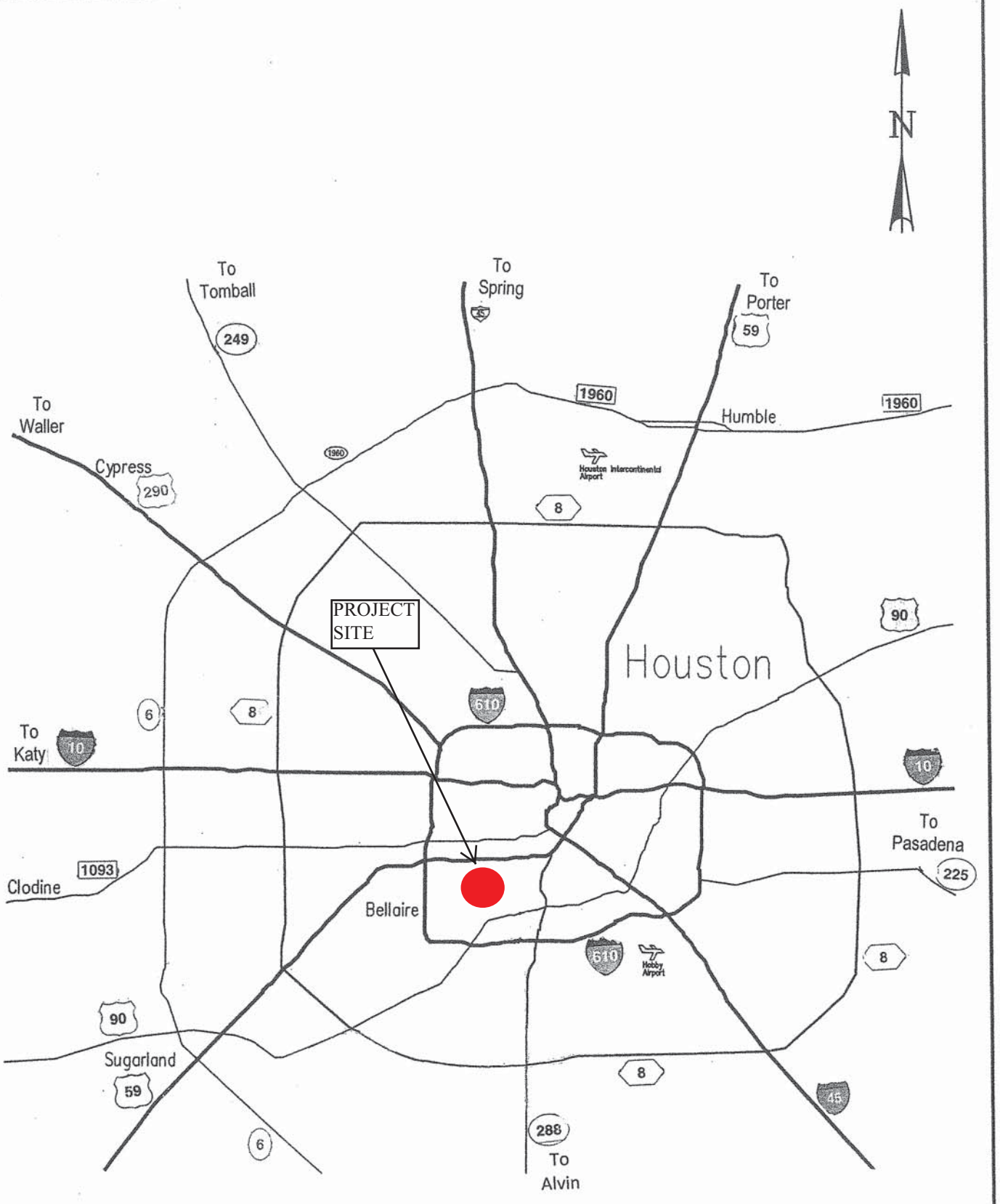
The description of subsurface conditions and the design information contained in this report are based on the soil borings made at the time of drilling at specific locations. However, some variation in soil conditions may occur between soil borings. Should any subsurface conditions other than those described in our boring logs be encountered, Geotest should be immediately notified so that further investigation and supplemental recommendations can be provided. The depth of the water level may vary with changes in environmental conditions such as frequency and magnitude of rainfall. The stratification lines on the log of borings represent the approximate boundaries between soil types, however, the transition between soil types may be more gradual than depicted.

This report has been prepared for the exclusive use of City of West University Place, Texas, and HDR, Inc., for the PW20-07 East Street and Drainage improvements project. This report shall not be reproduced without the written permission of Geotest Engineering, Inc., the City of West University Place or HDR, Inc.

ILLUSTRATIONS

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Plan of Borings	2
Boring Log Profile	3.1 thru 3.4
Symbols and Abbreviations Used on Boring Log Profile	4
Excavation Support Earth Pressure	5.1 and 5.2
Stability of Bottom for Braced Cut	6
Lateral Earth Pressure Diagram for Permanent Wall	7.1 and 7.2
Uplift Pressure and Resistance	8

Job No. 1140261101

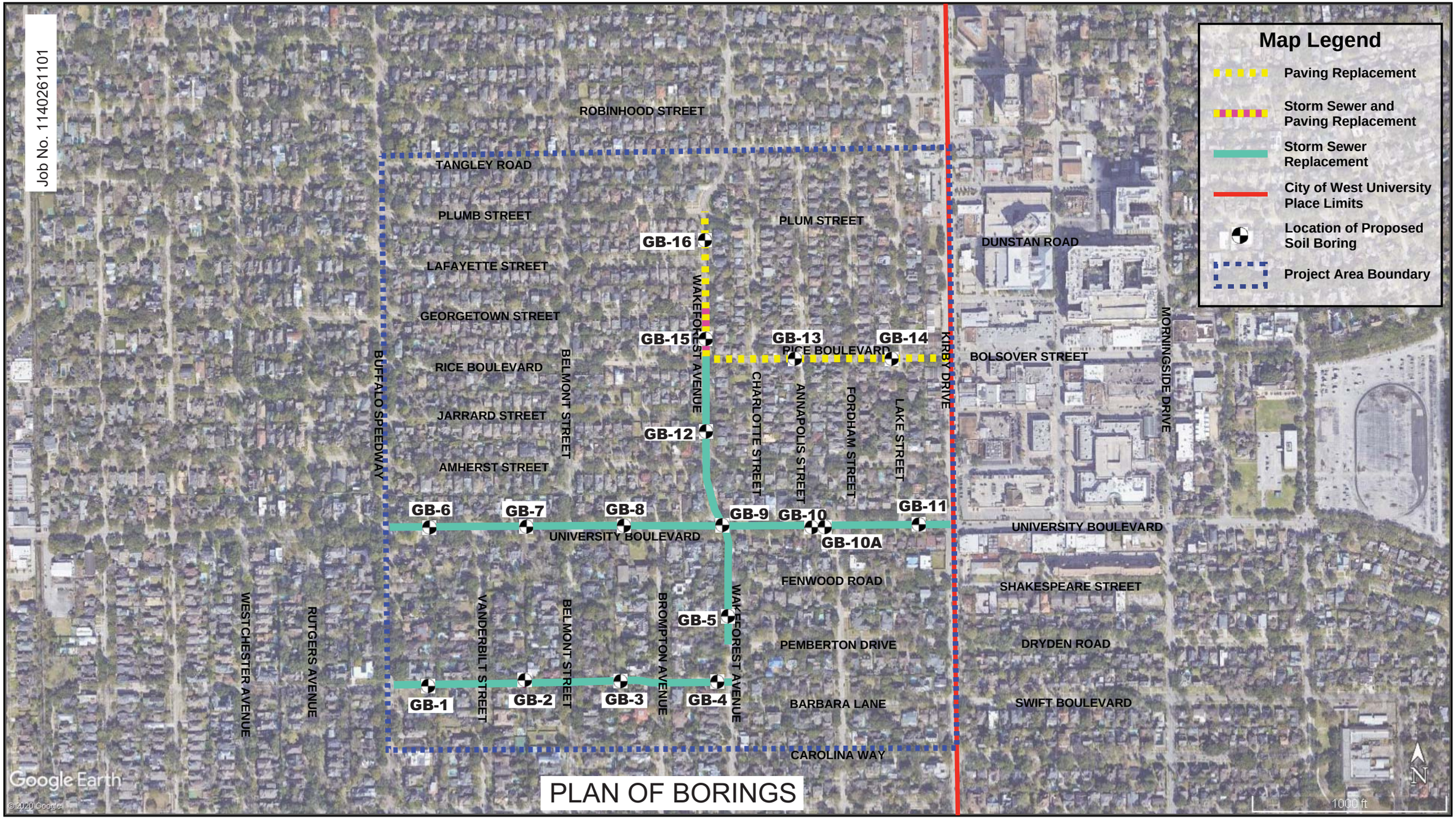


VICINITY MAP

(NOT TO SCALE)

Geotest Engineering, Inc.

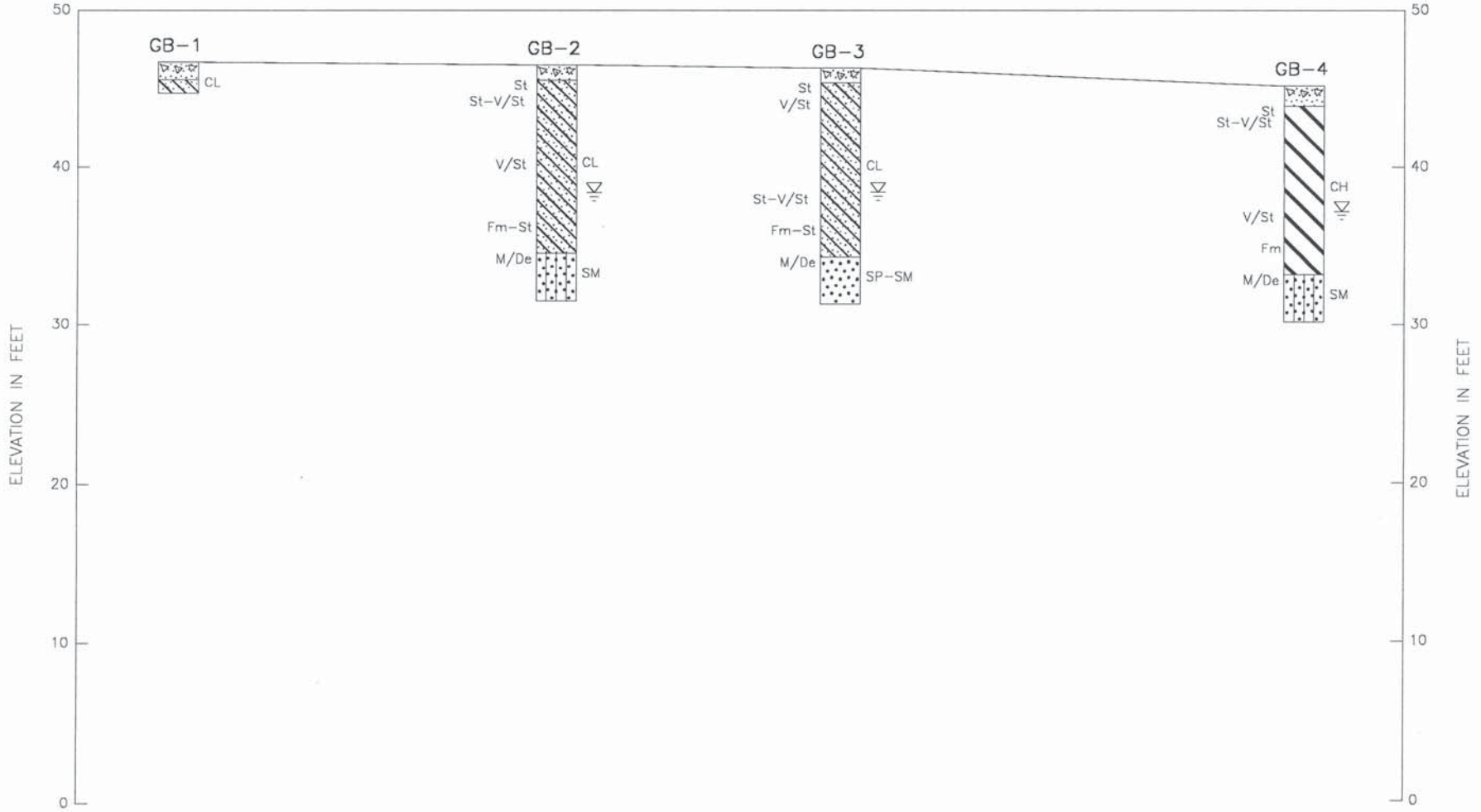
FIGURE 1



PLAN OF BORINGS

FIGURE 2

Job No. 114026101



GENERAL NOTES:

1. See Figure 2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 3 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by HDR, Inc.

BORING LOG PROFILE

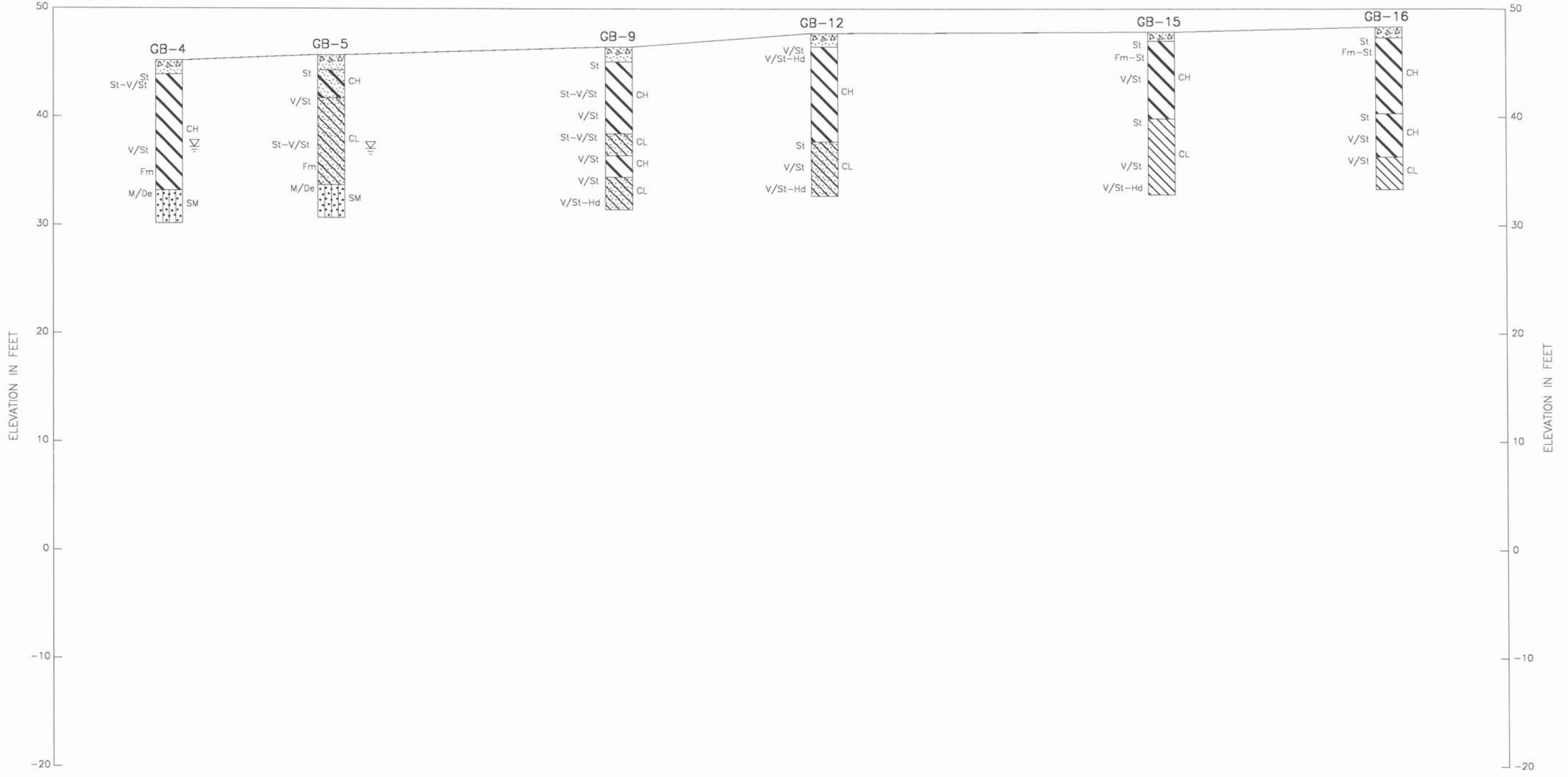
DUKE STREET

0 100 200 300 400

HORIZONTAL SCALE IN FEET

Geotest Engineering, Inc.

FIGURE 3.1



GENERAL NOTES:

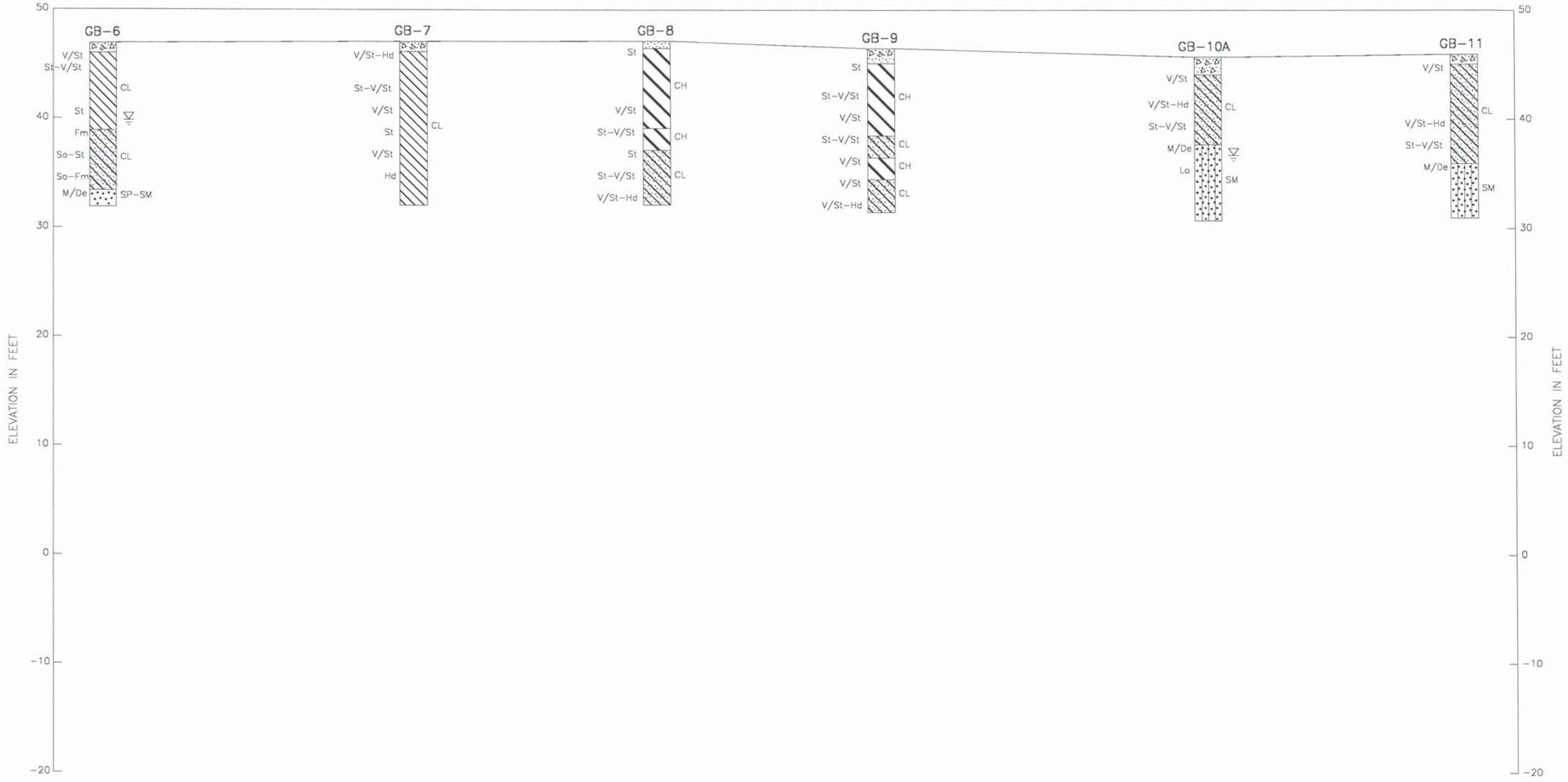
1. See Figure 2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 3 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by HDR, Inc.

BORING LOG PROFILE

WAKEFOREST AVENUE

0 100 200 300 400

HORIZONTAL SCALE IN FEET



GENERAL NOTES:

1. See Figure 2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 3 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by HDR, Inc.

BORING LOG PROFILE

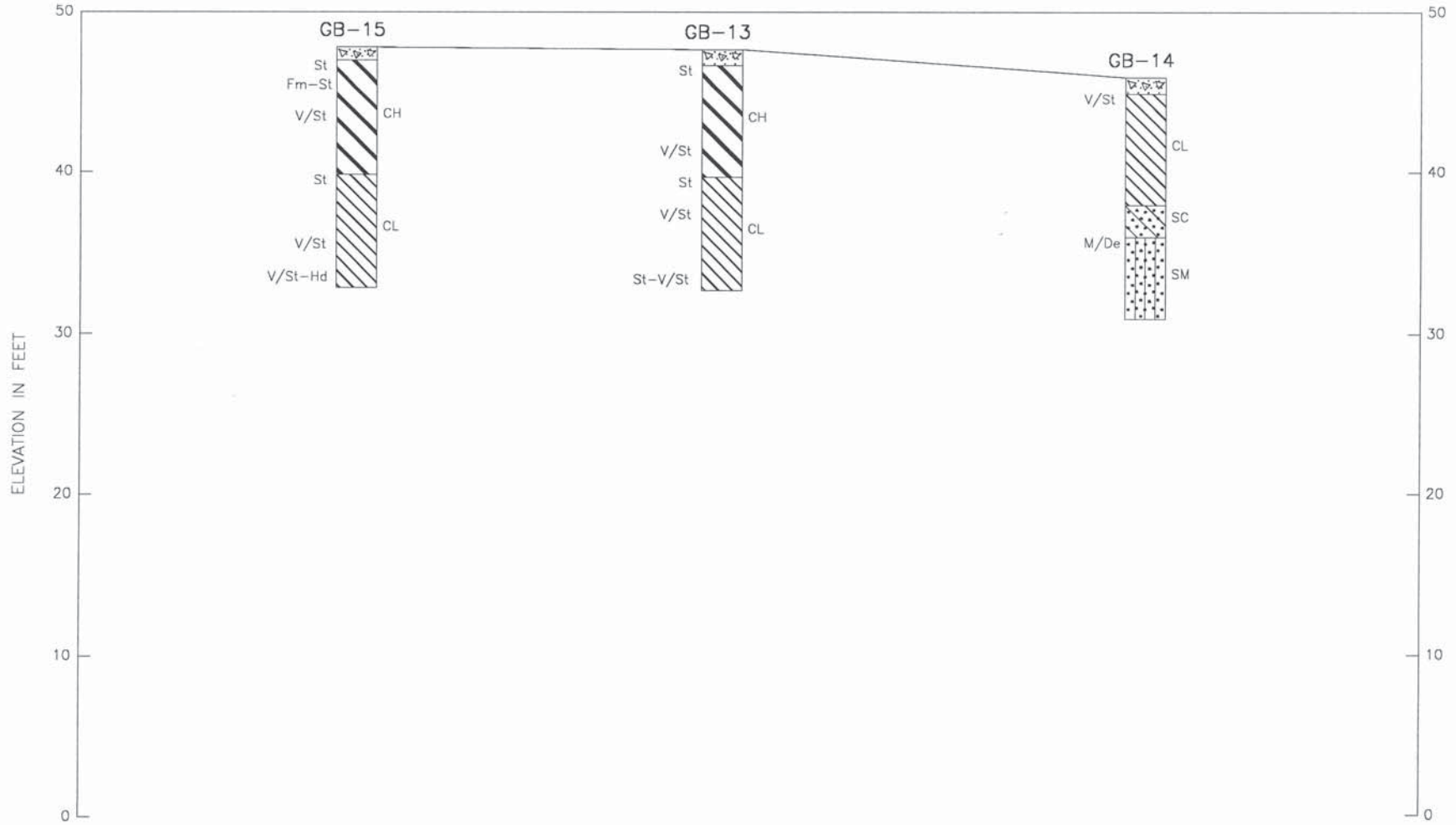
UNIVERSITY BOULEVARD

0 100 200 300 400

HORIZONTAL SCALE IN FEET

Job No. 1140261101

Geotest Engineering, Inc.



GENERAL NOTES:

1. See Figure 2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 3 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by HDR, Inc.

BORING LOG PROFILE

RICE BOULEVARD

0 100 200 300 400

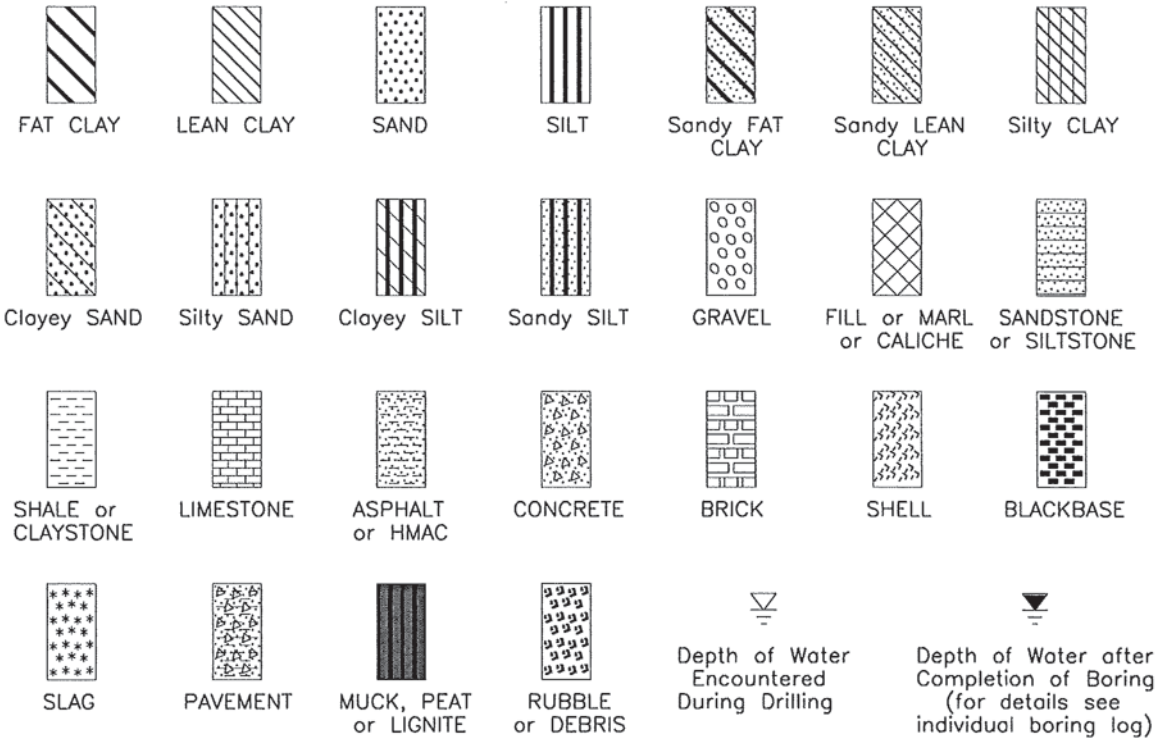
HORIZONTAL SCALE IN FEET

FIGURE 3.4

Job No. 1140261101

SYMBOLS AND ABBREVIATIONS USED ON BORING LOG PROFILE

LEGEND



ABBREVIATIONS USED FOR CONSISTENCY/DENSITY

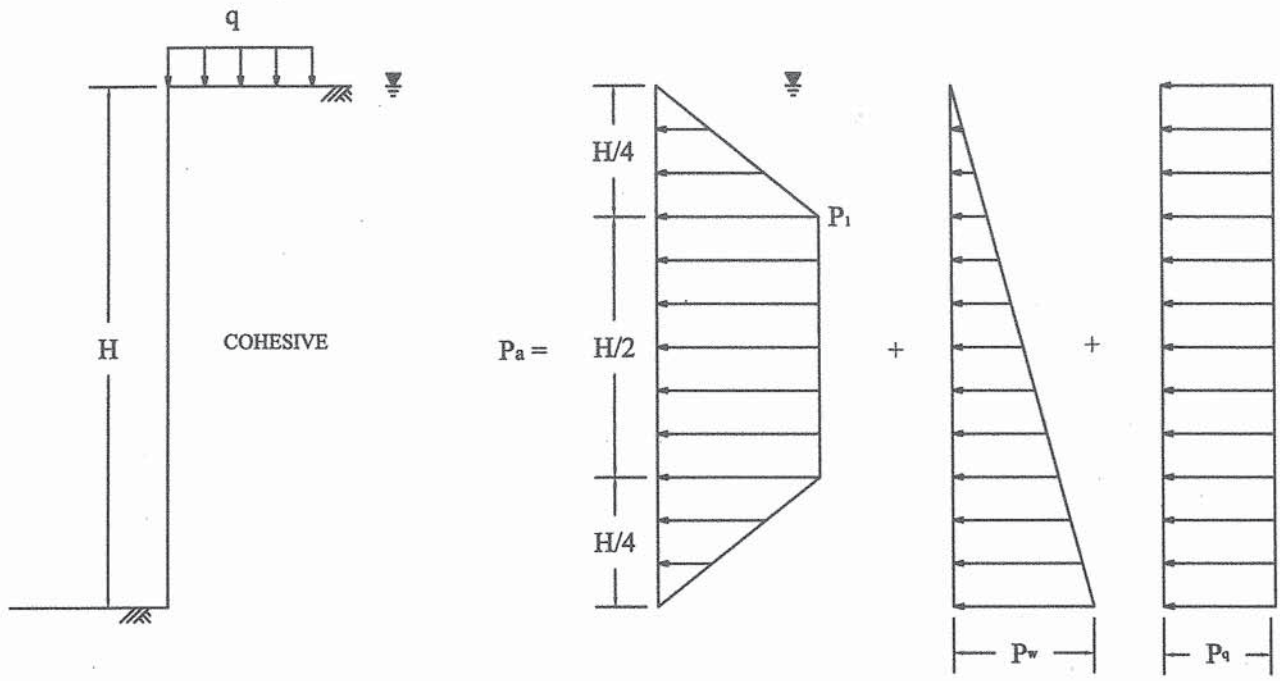
COHESIVE SOILS

V/So	:	Very Soft
So	:	Soft
Fm	:	Firm
M/St	:	Medium Stiff
St	:	Stiff
V/St	:	Very Stiff
Hd	:	Hard
V/Hd	:	Very Hard

COHESIONLESS SOILS

V/Lo	:	Very Loose
Lo	:	Loose
S/Co	:	Slightly Compact
Co	:	Compact
M/De	:	Medium Dense
De	:	Dense
V/De	:	Very Dense

Job No. 1140261101



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

BRACED WALL

For $\gamma H/c \leq 4$

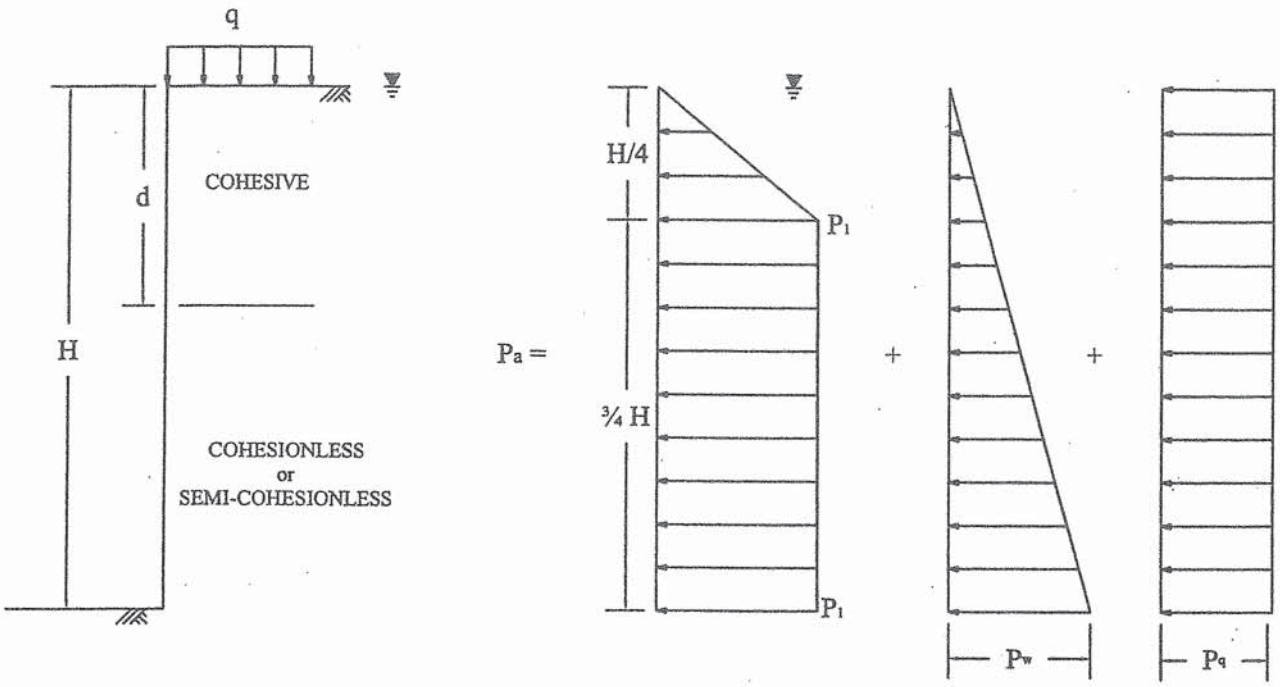
$P_1 = 0.3\ \gamma_c' H$
$P_w = \gamma_w H = 62.4 H$
$P_q = 0.5\ q$

Where:

γ_c' = Submerged unit weight of cohesive soil, pcf;
γ_w = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
P_a = Lateral pressure, psf;
P_1 = Active earth pressure, psf;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Depth of braced excavation, feet
c = Shear strength of cohesion soil, psf;

EXCAVATION SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

$$\gamma'_{avg} = \frac{\gamma_c' \, d + \gamma_s' \, (H-d)}{H}$$

BRACED WALL

$P_1 = 0.3 \, \gamma'_{avg} \, H$
$P_w = 62.4 \, H$
$P_q = 0.5 \, q$

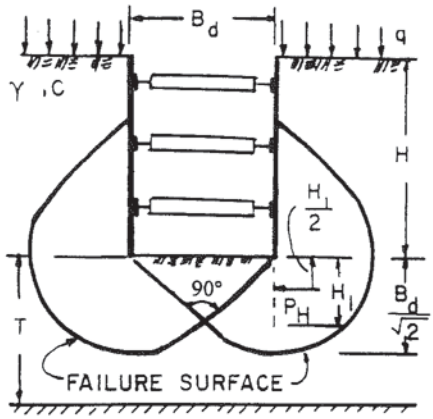
Where:

γ_c' = Submerged unit weight of cohesive soil, pcf;
γ_s' = Submerged unit weight of cohesionless soil, pcf;
γ'_{avg} = Average submerged unit weight of soils, pcf;
q = Surcharge load at surface, psf;
P_a = Lateral pressure, psf;
P_1 = Active earth pressure, psf;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Depth of braced excavation, feet

EXCAVATION SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL OVER COHESIONLESS OR SEMI-COHESIONLESS SOIL

CUT IN COHESIVE SOIL,
DEPTH OF COHESIVE SOIL UNLIMITED ($T > 0.7\ B_d$)
L = LENGTH OF CUT



If sheeting terminates at base of cut:

$$\text{Safety factor, } F_S = \frac{N_C C}{\gamma H + q}$$

N_C = Bearing capacity factor, which depends on dimensions of the excavation : B_d , L and H (use N_C from graph below)

C = Undrained shear strength of clay in failure zone beneath and surrounding base of cut

γ = Unit weight of soil (see Table 2)

q = Surface surcharge (assumed q = 500 psf)

If safety factor is less than 1.5, sheeting or soldier piles must be carried below the base of cut to insure stability - (see note)

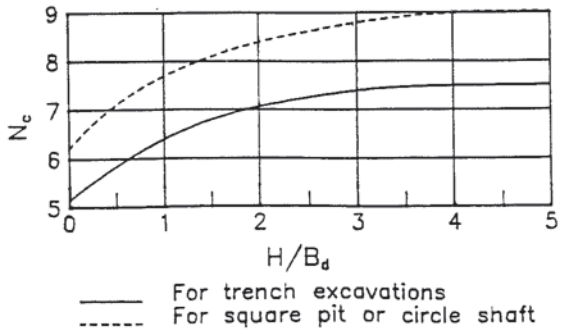
H_1 = Buried length = $\frac{B_d}{2} \geq 5$ feet

Note : If soldier piles are used, the center to center spacing should not exceed 3 times the width or diameter of soldier pile .

Force on buried length, P_H:

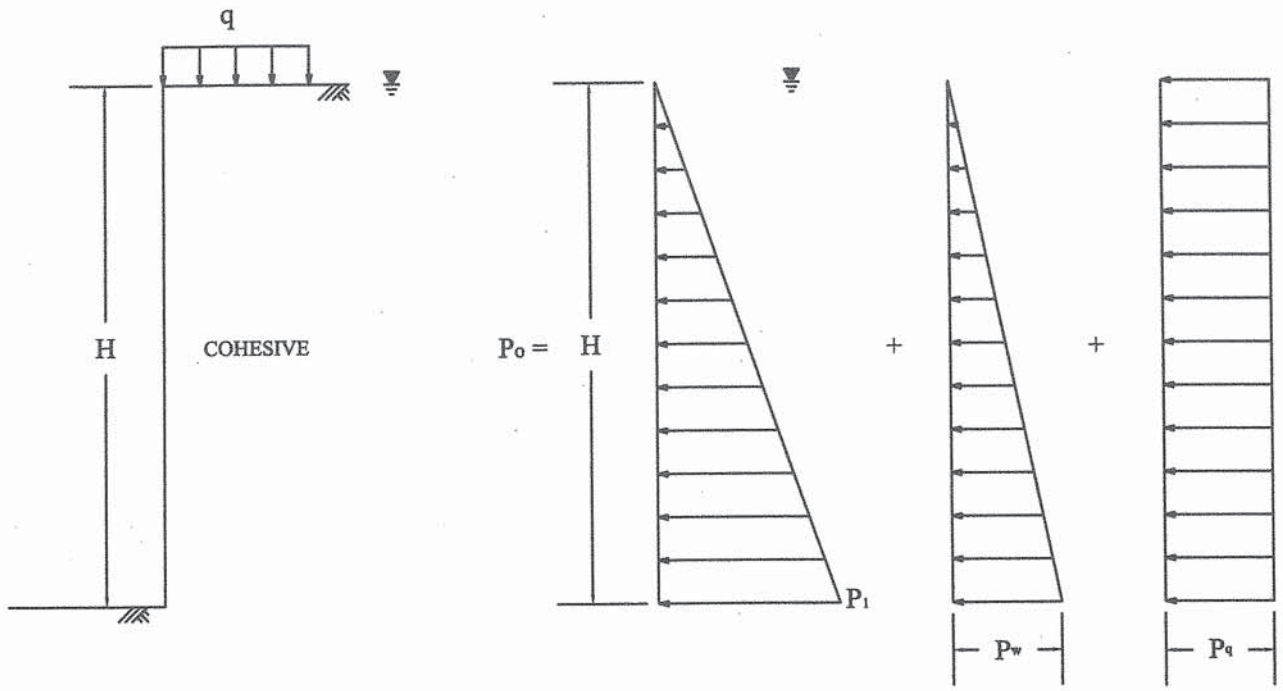
If $H_1 > \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 0.7\ (\gamma H B_d - 1.4CH - \pi C B_d)$ in lbs/ linear foot

If $H_1 < \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 1.5 H_1\ (\gamma H - \frac{1.4CH}{B_d} - \pi C)$ in lbs/ linear foot



STABILITY OF BOTTOM FOR BRACED CUT

Job No. 1140261101



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

$K_{oc} = 1.0$

PERMANENT WALL

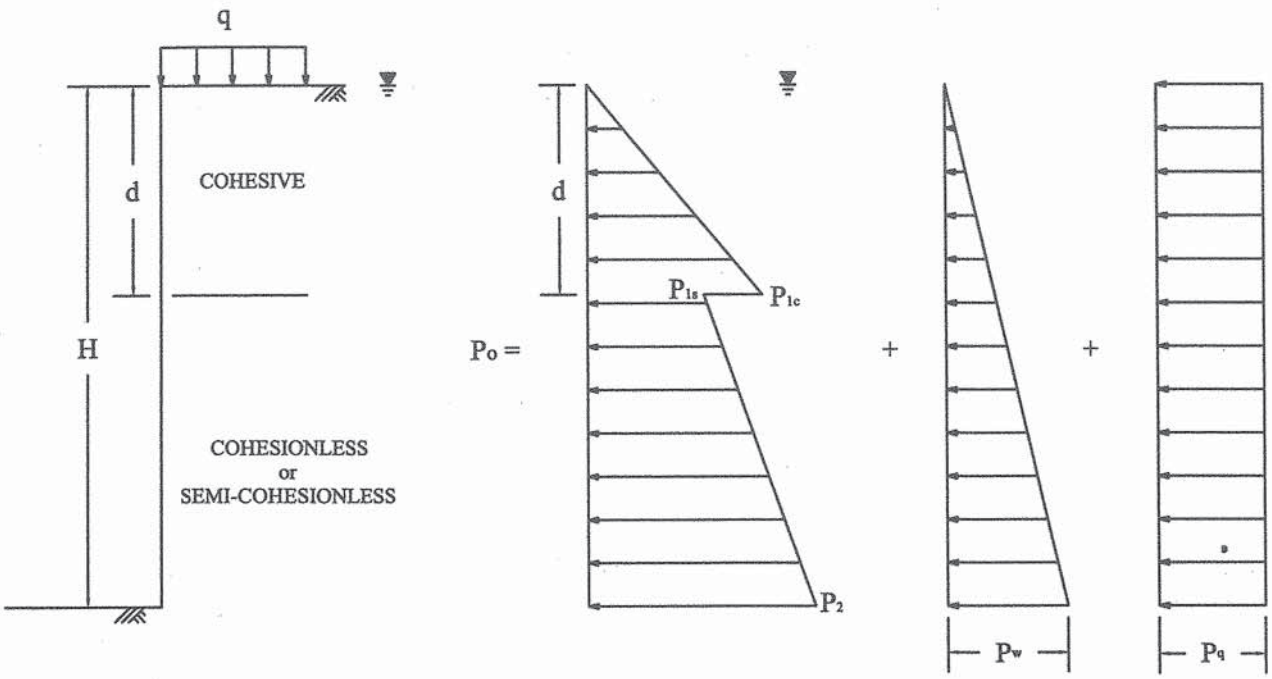
$P_1 = K_{oc}\,\gamma_c'\,H$
$P_w = \gamma_w\,H = 62.4\,H$
$P_q = 0.5\,q$

Where:

γ_c' = Submerged unit weight of cohesive soil, pcf;
K_{oc} = Coefficient of at-rest earth pressure in cohesive soil;
γ_w = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
P_o = Lateral pressure, psf;
P_1 = At-rest earth pressure, psf;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Depth of excavation, feet

LATERAL EARTH PRESSURE DIAGRAM FOR PERMANENT WALL

SUBMERGED COHESIVE SOIL



TYPICAL SOIL PARAMETERS

PERMANENT WALL

See Table 2 for typical values of soil parameters

$K_{oc} = 1.0$

$K_{os} = 1\text{-}\sin\phi_s$

$P_{1c} = \gamma_c' \, d \, K_{oc}$

$P_{1s} = \gamma_c' \, d \, K_{os}$

$P_2 = [\gamma_c' \, d + \gamma_s' \, (H-d)] \, K_{os}$

$P_w = \gamma_w \, H = 62.4 \, H$

$P_q = 0.5 \, q$

Where:

γ_c' = Submerged unit weight of cohesive soil, pcf;
γ_s' = Submerged unit weight of cohesionless or semi-cohesionless soil, pcf;
ϕ_s = Internal friction angle of cohesionless or semi-cohesionless soil, degree;
K_{oc} = Coefficient of at-rest earth pressure in cohesive soil;
K_{os} = Coefficient of at-rest earth pressure in cohesionless or semi-cohesionless soil;
γ_w = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
P_o = Lateral pressure, psf;
P_i, P_{ic}, P_{is} = At-rest earth pressure, psf; i = 1, 2;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Height of wall, feet

LATERAL EARTH PRESSURE DIAGRAM FOR PERMANENT WALL

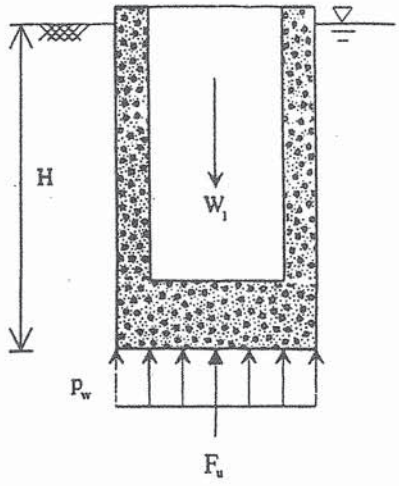
SUBMERGED COHESIVE SOIL OVER
COHESIONLESS OR SEMI-COHESIONLESS SOIL

Geotest Engineering, Inc.

FIGURE 7.2

Job No. 1140261101

(a) DEAD WEIGHT OF STRUCTURE

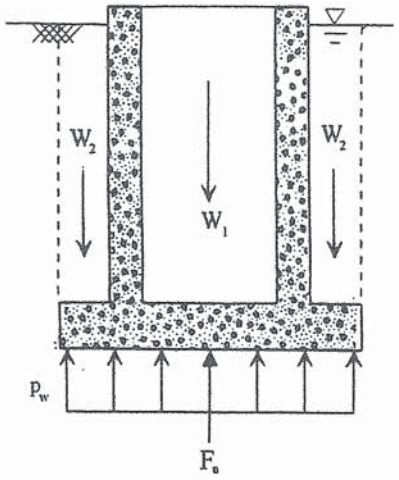


$p_w = H\gamma_w$

$F_u = A_b p_w$

$\frac{W_1}{Sf_1} = F_u$

(b) WEIGHT OF SOIL ABOVE BASE EXTENSION PLUS DEAD WEIGHT OF STRUCTURE

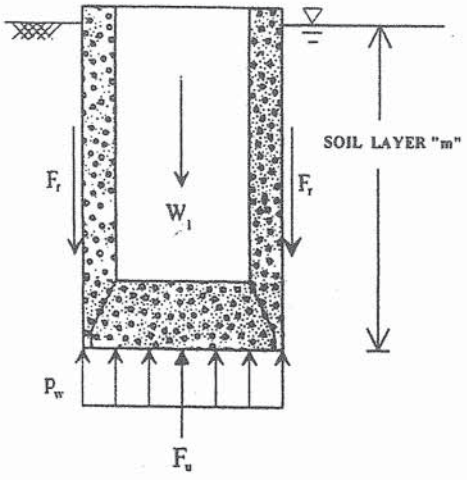


$p_w = H\gamma_w$

$F_u = A_b p_w$

$\frac{W_1}{Sf_1} + \frac{W_2}{Sf_2} = F_u$

(c) SOIL-WALL FRICTION PLUS DEAD WEIGHT OF STRUCTURE



$p_w = H\gamma_w$

$F_u = A_b p_w$

$\frac{W_1}{Sf_1} + \frac{F_r}{Sf_3} = F_u$

Predominantly Cohesive Soils, $F_r = \alpha\, c_m\, A_m$

Predominantly Cohesionless Soils, $F_r = p_m A_m K \tan \delta_m$

See Table 2 for typical values of soil parameters

Where:

A_b	=	area of base, sq. ft.
A_m	=	cylindrical surface area of layer "m" , sq. ft.
c_m	=	undrained cohesion of soil layer "m", psf.
F_u	=	hydrostatic uplift force, lbs.
F_r	=	frictional resistance, lbs.
H	=	height of buried structure, ft.
K	=	coefficient of lateral pressure = 0.5.
p_m	=	average overburden pressure for layer "m," psf.
p_w	=	hydrostatic uplift pressure, psf.
$Sf_{1,\,2,\,3}$	=	factor of safety.
W_1	=	dead weight of concrete structure, lbs.
W_2	=	weight of backfill above base extension, lbs.
α	=	cohesion reduction factor = 0.5.
δ_m	=	friction angle between soil layer "m" and concrete wall, degrees = 0.75 ϕ_m
ϕ_m	=	internal angle of friction of soil layer "m", degrees.
γ_w	=	unit weight of water = 62.4 pcf.

UPLIFT PRESSURE AND RESISTANCE

TABLES

	Table
Summary of Boring Information	1
Geotechnical Design Parameter Summary – Open-Cut Excavation.....	2

TABLE 1

SUMMARY OF BORING INFORMATION

Location/Street Name	Boring No.	Depth (feet)	Northing	Easting	Elevation (feet)
Duke Street	GB-1	2	13824050.22	3102586.75	46.71
	GB-2	15	13824071.03	3103059.21	46.52
	GB-3	15	13824086.91	3103414.52	46.30
	GB-4	15	13824097.80	3103995.00	45.17
Wakeforest Avenue	GB-5	15	13824394.97	3104047.97	45.70
University Boulevard	GB-6	15	13824847.59	3102473.56	46.90
	GB-7	15	13824872.81	3103047.14	47.07
	GB-8	15	13824893.14	3103496.16	47.12
	GB-9	15	13824911.75	3103908.95	46.46
	GB-10A	15	13824916.98	3104513.79	45.67
	GB-11	15	13824962.07	3104985.09	45.93
Wakeforest Avenue	GB-12	15	13825293.944	3103902.40	47.73
Rice Boulevard	GB-13	15	13825775.26	3104302.25	47.69
	GB-14	15	13825777.67	3104827.79	45.95
Wakeforest Avenue	GB-15	15	13825918.55	3103872.77	47.84
	GB-16	15	13826342.10	3103856.04	48.32

Note: The survey information is provided by HDR, Inc.

TABLE 2

GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION

Street	Boring Nos.	Stratigraphic Unit	Range of Depths, ft.	Wet** Unit Weight, γ, pcf	Submerged Unit Weight, γ', pcf	Undrained Cohesion, psf	Internal Friction Angle, φ, degree
Duke Street	GB-2 thru GB-4	Cohesive	*0-2	131	66	1,000	--
			2-6	131	66	1,200	--
			6-10	133	67	1,500	--
			10-12	133	67	500	--
		Cohesionless	12-15	118	56	--	30
Wakeforest Avenue	GB-5	Cohesive	*0-4	127	64	1,500	--
			4-10	128	64	2,000	--
			10-12	128	64	800	--
		Cohesionless	12-15	117	55	--	30
University Boulevard	GB-6	Cohesive	*0-6	131	66	2,500	--
			6-8	126	63	1,500	--
			8-14	126	63	800	--
		Cohesionless	14-15	120	58	--	30
	GB-7 thru GB-9	Cohesive	*0-6	135	67	1,500	--
			6-10	131	66	2,000	--
			10-15	132	66	1,500	--
	GB-10A	Cohesive	*0-8	130	65	2,200	--
		Cohesionless	8-15	115	53	--	30
	GB-11	Cohesive	*0-2	132	66	2,000	--
			2-8	132	66	3,500	--
			8-10	132	66	1,500	--
		Cohesionless	10-15	112	50	--	30
Wakeforest Avenue	GB-12 and GB-15	Cohesive	*0-12	134	67	1,000	--
			12-15	128	64	1,500	--

1. Cohesive soils include fat clay, fat clay with sand, sandy fat clay, lean clay, lean clay with sand and sandy lean clay.
* 0 feet – Below the pavement
** The wet unit weight is based on the average value for each layer, where more than one boring is used.

APPENDIX A

	Figure
Log of Borings	A-1 thru A-16
Symbols and Terms Used on Boring Logs	A-17

LOG OF BORING NO. GB–1

PROJECT : PW20–07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824050.22, E 3102586.75
Duke St.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : 46.71 FT.

DATE : 02–23–21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : –– TO –– FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL
46.7	0			7" Concrete over 6.5" Lime Stabilized Sandy Clay w/shell
45.6				
44.7				Brown and gray SANDY LEAN CLAY (CL)
	5			NOTE : GB–1A, GB–1B, and GB–1C encountered hard obstruction at 2 feet and borings were terminated.
	10			
	15			
	20			
	25			
	30			
	35			

STANDARD PENETRATION TEST, BLOWS PER FOOT
PERCENT PASSING NO. 200 SIEVE
DRY UNIT WEIGHT, PCF
NATURAL MOISTURE CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %
PLASTICITY INDEX, %

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED–UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A–1

LOG OF BORING NO. GB-2

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824071.03, E 3103059.21
Duke St.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 46.52 FT.

DATE : 02-10-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
46.5	0			6.5" Concrete over 5" Lime Stabilized Clay w/limestone				23.3			
45.6				Stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains		60.3	106	21.1	46	20	26
	5			-stiff to very stiff 2'-4'				20.4			
				-very stiff 6'-10'							
				-gray and yellowish brown 6'-12'				18.2			
	10			-firm to stiff 10'-12'		62.8	110	19.7	31	17	14
34.5				Medium dense gray SILTY SAND (SM)				20.0			
					15	15.5		21.0			
31.5	15				17			21.5			
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 8.2 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-2

LOG OF BORING NO. GB-3

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824086.91, E 3103414.52
Duke St.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 46.30 FT.

DATE : 02-10-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
46.3	0			6.25" Concrete over 4.75" Lime Stabilized Clay				24.9			
45.4								17.9			
				Stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains		68.2	112	18.3	50	21	29
	5			-very stiff 2'-8'				18.8			
				-stiff to very stiff 8'-10'				19.3			
	10			-firm to stiff 10'-12'		50.8	112	20.0	51	21	30
34.3								20.0			
				Medium dense gray POORLY GRADED SAND WITH SILT (SP-SM)	13	8.6		23.2			
31.3	15				16			23.0			
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 7.9 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-3

LOG OF BORING NO. GB-4

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824097.80, E 3103995.00
Duke St.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 45.17 FT.

DATE : 02-10-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
45.2	0			6.25" Concrete over 9.25" Lime Stabilized Sandy Clay							
43.9				Stiff brown and gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains -stiff to very stiff 2'-6'		76.3		9.9	55	23	32
	5							22.3			
						71.6	113	17.6	54	23	31
				-very stiff 8'-10'				19.4			
	10			-firm 10'-12'				19.3			
33.2								21.0			
				Medium dense brown and gray SILTY SAND (SM)	15	19.4		24.1			
30.2	15				22			28.4			
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 15.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 8.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-4

LOG OF BORING NO. GB-5

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824394.97, E 3104047.97
Wakeforest Ave.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 45.70 FT.

DATE : 02-10-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
45.7	0			6" Concrete over 11" Lime Stabilized Clay and Sand Mix				23.8			
44.3				Stiff dark gray SANDY FAT CLAY (CH) w/ferrous stains and sand seams		65.9	107	18.7	60	24	36
41.7	5			Very stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains -stiff to very stiff 8'-10'				18.4			
								19.4			
	10			-firm 10'-12'		50.4	108	18.5	48	21	27
33.7				Medium dense brown and gray SILTY SAND (SM)				18.1			
					16	24.2		22.2			
30.7	15				13			26.0			
	20										
	25										
	30										
	35										

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 8.7 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-5

LOG OF BORING NO. GB-6

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824847.59, E 3102473.56
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 46.90 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
46.9	0	6.5" Concrete over 4.5" Lime Stabilized Clay							
46.0		Very stiff brown and gray LEAN CLAY WITH SAND (CL) w/calcareous nodules and ferrous nodules and ferrous stains -stiff to very stiff 2'-4' -stiff 6'-8'		71.8	110	17.7 19.5 19.1 19.5	43	19	24
38.9	10	Firm brown and gray SANDY LEAN CLAY (CL) -w/ferrous nodules and ferrous stains 8'-10' -soft to stiff 10'-12' -soft to firm w/silty sand 12'-13.5'		69.0	104	21.0 21.9 19.2	34	17	17
33.4									
31.9	15	Medium dense gray POORLY GRADED SAND WITH SILT (SP-SM)	18	10.3		25.7			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 14.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 7.1 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-6

LOG OF BORING NO. GB-7

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824872.81, E 3103047.14
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 47.07 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
47.1	0	8.5" Concrete over 3" Shell and Clay Mix							
46.1		Very stiff to hard brown and gray LEAN CLAY WITH SAND (CL) w/calcareous and ferrous nodules and ferrous stains		72.4		18.8	47	20	27
					116	15.7			
	5	-stiff to very stiff 4'-6'				19.7			
		-very stiff 6'-8'							
		-stiff 8'-10'		78.7	111	18.6	46	20	26
	10	-very stiff 10'-12'				23.1			
		-hard 12'-15'				17.9			
						14.6			
32.1	15					14.6			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-7

LOG OF BORING NO. GB-8

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824893.14, E 3103496.16
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 47.12 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
47.1	0	7.75" Concrete							
46.5		Stiff brown and gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains				15.4			
				70.8	118	15.9	53	22	31
	5	-very stiff brown 6'-8'				20.3			
39.1						21.5			
		Stiff to very stiff gray and brown FAT CLAY (CH) w/calcareous and ferrous nodules and ferrous stains		93.0	106	23.8	58	23	35
37.1	10	Stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules		69.9		17.7	36	18	18
		-stiff to very stiff 12'-14'				17.5			
32.1	15	-very stiff to hard 14'-15'				16.1			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-8

LOG OF BORING NO. GB-9

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824911.75, E 3103908.95
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 46.46 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
46.5	0	8" Concrete over 5" Clay and Gravel Mix							
45.1		Stiff dark gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains				23.4			
	5	-stiff to very stiff 4'-6'		81.7	108	21.2	54	22	32
		-very stiff 6'-8'				13.9			
38.5		Stiff to very stiff brown and gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains				21.7			
36.5	10			66.8	117	16.7	32	16	16
34.5		Very stiff gray and brown FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains				19.4			
						16.0			
31.5	15	Very stiff yellowish brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains				15.4			
		-very stiff to hard 14'-15'							
	20								
	25								
	30								
	35								

SYMBOL
SAMPLES

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-9

LOG OF BORING NO. GB–10

PROJECT : PW20–07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824937.77, E 3104503.15
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 2.0 FT.

SURFACE ELEVATION : 45.51 FT.

DATE : 02–23–21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 2.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
45.5	0			8.25" Concrete over 11.25" Lime Stabilized Clay							
43.9											
43.5				Brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains							
	5										
				NOTE : Hit hard obstruction at 2' and boring was offset to boring GB–10A.							
	10										
	15										
	20										
	25										
	30										
	35										

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED–UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A–10

LOG OF BORING NO. GB-10A

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824916.98, E 3104513.79
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 45.67 FT.

DATE : 02-23-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 12.0 FT.
WET ROTARY : 12.0 TO 15.0 FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
45.7	0	8.25" Concrete over 11.25" Lime Stabilized Clay							
44.0		Very stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains		70.0		18.6	48	21	27
						16.6			
	5	-very stiff to hard 4'-6'							
		-stiff to very stiff 6'-8'		69.5	108	20.3	43	19	24
37.7						19.6			
		Medium dense brown and gray SILTY SAND (SM)							
	10	-loose 10'-13.5'	10	24.1		22.0			
			6			24.1			
			7			23.1			
30.7	15		18			22.3			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
▽: FREE WATER 1st ENCOUNTERED AT 12.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 9.0 FT.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-10A

LOG OF BORING NO. GB-11

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13824962.07, E 3104985.09
University Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 45.93 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
45.9	0	7.25" Concrete 3.75" Lime Stabilized Clay							
45.0		Very stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains		56.0		18.4	37	17	20
		-w/sand seams 4'-8'				17.4			
	5	-yellowish brown and gray 4'-10'		60.7	116	14.2	45	20	25
		-very stiff to hard 6'-8'				17.4			
		-stiff to very stiff 8'-10'							
35.9	10	Medium dense brown and gray SILTY SAND (SM)		50.2	112	16.5	32	17	15
			17	29.3		14.2			
			27			7.2			
30.9	15		22			14.2			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-11

LOG OF BORING NO. GB-12

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13825293.94, E 3103902.40
Wakeforest Ave.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 47.73 FT.

DATE : 02-10-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
47.7	0	7" Concrete over 8" Silty Sand Shell Fragments and Gravel Mix				17.6			
46.5		Very stiff brown and gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains -very stiff to hard 2'-4'		72.2	125	11.7	53	22	31
	5					18.5			
						20.5			
37.7	10	Stiff brown and gray SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules and ferrous stains -very stiff 12'-14' -very stiff to hard 14'-15'		79.2	114	16.8	58	23	35
				60.9		17.5	34	17	17
						16.5			
32.7	15					14.2			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-12

LOG OF BORING NO. GB-13

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13825775.26, E 3104302.25
Rice Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 47.69 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
47.7	0	6.5" Concrete 5.5" Silty Sand, Shell Fragments, Clay Mix				24.5			
46.7		Stiff brown and gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains		81.3	106	21.5	54	23	31
	5	-very stiff 6'-8'				21.5			
39.7		Stiff gray and brown LEAN CLAY (CL) w/calcareous nodules, ferrous stains, and sand seams		90.6	104	21.0	41	20	21
	10	-very stiff 10'-14'				24.8			
		-w/sand seams 12'-15'				23.0			
		-stiff to very stiff 14'-15'				14.9			
32.7	15					16.8			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-13

LOG OF BORING NO. GB-14

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13825777.67, E 3104827.79
Rice Blvd.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 45.95 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
46.0	0	6.5" Concrete over 5.5" Silty Sand and Clay Mix							
45.0		Very stiff brown and gray LEAN CLAY WITH SAND (CL) w/calcareous and ferrous nodules and ferrous stains				17.7			
	5			73.9	112	17.9	45	20	25
						19.3			
38.0		Brown CLAYEY SAND (SC) w/ferrous stains				13.6			
36.0	10	Medium dense brown and gray SILTY SAND (SM)		48.4	113	13.9	25	17	8
			14			16.0			
			22	30.9		11.7			
31.0	15		22			17.3			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-14

LOG OF BORING NO. GB-15

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13825918.55, E 3103872.77
Wakeforest Ave.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 47.84 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
47.8	0	7" Concrete over 3" Silty Sand							
47.0		Stiff brown and gray FAT CLAY (CH) w/calcareous and ferrous nodules and ferrous stains -firm to stiff 2'-4' -very stiff 4'-8'		89.9	90	26.8 31.2 27.4	66	27	39
39.8		Stiff brown and gray LEAN CLAY WITH SAND (CL) w/calcareous nodules and ferrous stains -very stiff 12'-14' -very stiff to hard 14'-15'		76.6	106	25.8 23.1 18.1 16.2 13.6	35	18	17
32.8	15								
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
○ HAND PENETROMETER
● UNCONFINED COMPRESSION
■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
△ TORVANE
0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-15

LOG OF BORING NO. GB-16

PROJECT : PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NO. : 1140261101

LOCATION : N 13826342.10, E 3103856.04
Wakeforest Ave.; See Plan of Borings (Figure 2)

COMPLETION DEPTH : 15.0 FT.

SURFACE ELEVATION : 48.32 FT.

DATE : 02-09-21

SAMPLER : Shelby Tube/Split Spoon
DRY AUGER : 0.0 TO 15.0 FT.
WET ROTARY : -- TO -- FT.

ELEVATION, FEET	DEPTH, FEET	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %
48.3	0	7.5" Concrete over 4.5" Silty Sand w/gravel							
47.3		Stiff brown and gray FAT CLAY WITH SAND (CH) w/calcareous and ferrous nodules and ferrous stains -firm to stiff 2'-4'				19.6			
	5			78.8	106	19.9	55	23	32
						19.9			
40.3		Stiff gray and reddish brown FAT CLAY (CH) w/calcareous and ferrous nodules an -very stiff 10'-12'				29.5			
	10			93.2	96	28.9	58	23	35
36.3		Very stiff brown and gray LEAN CLAY (CL) w/ferrous stains				20.4			
						19.3			
33.3	15					15.5			
	20								
	25								
	30								
	35								

UNDRAINED SHEAR STRENGTH, TSF
- ○ HAND PENETROMETER
- ● UNCONFINED COMPRESSION
- ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION
- △ TORVANE

0.5 1.0 1.5 2.0 2.5

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 15.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-16

Job No. 1140261101

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOL COLUMN)



Asphaltic Concrete | Fill | Gravel | Sand | SILT | FAT CLAY | LEAN CLAY | Sandy LEAN CLAY

Predominant type shown heavy

SAMPLER TYPES
(SHOWN IN SAMPLES COLUMN)



Pitcher Barrel | Nx Core | Shelby Tube | Piston | Split Spoon | No Recovery | Auger

TERMS DESCRIBING CONSISTENCY OR CONDITION

Basic Soil Type	Density or Consistency	Standard Penetration Resistance, (1) Blows/ft.	Unconfined Compressive Strength (q_u), (2) Tons/sq. ft.
Cohesionless	Very loose	Less than 4	Not applicable
	Loose	4 to <10	Not applicable
	Medium dense	10 to <30	Not applicable
	Dense	30 to <50	Not applicable
	Very dense	50 or greater	Not applicable
Cohesive	Very soft	Less than 2	Less than 0.25
	Soft	2 to <4	0.25 to <0.5
	Firm/Medium stiff	4 to <8	0.5 to <1.0
	Stiff	8 to <15	1.0 to <2.0
	Very stiff	15 to <30	2.0 to <4.0
	Hard	30 or greater	4 or greater

(1) Number of blows from 140-lb. weight falling 30-in. to drive 2-in. OD, 1-3/8-in. ID, split barrel sampler (ASTM D1586)

(2) q_u may also be approximated using a pocket penetrometer

TERMS CHARACTERIZING SOIL STRUCTURE

Parting: -paper thin in size Seam: -1/8" to 3" thick Layer: -greater than 3"

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	- composed of thin layers of varying color and texture.
Interbedded	- composed of alternate layers of different soil types.
Calcareous	- containing appreciable quantities of calcium carbonate.
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing.
Flocculated	- pertaining to cohesive soils that exhibit a loose knit or flakey structure.

APPENDIX B

	Figure
Summary of Laboratory Test Results	B-1 thru B-16
Grain Size Distribution Curves	B-17 and B-18

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-1	2	1.1	2.0	UD												2.25	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-1

SUMMARY OF LABORATORY TEST RESULTS

CEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-2	2	0**	2.0	UD		23.3									0.55	0.50	Sandy Lean Clay
	3	2.0	4.0	UD		21.1	106	46	20	26	60.3		0.72	0.29	1.13	1.13	Sandy Lean Clay
	4	4.0	6.0	UD		20.4									0.80	0.88	Sandy Lean Clay
	5	6.0	8.0	UD		18.2									1.13	1.38	Sandy Lean Clay
	6	8.0	10.0	UD		19.7	110	31	17	14	62.8		1.07	0.65	1.00	1.25	Sandy Lean Clay
	7	10.0	12.0	UD		20.0									0.40	0.50	Sandy Lean Clay
	8	12.0	13.5	SS	15	21.0					15.5						Silty Sand
	9	13.5	15.0	SS	17	21.5											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-2

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-3	1	0.0	0.9	UD		24.9											Concrete
	2	0.9	2.0	UD		17.9									0.75	0.75	Sandy Lean Clay
	3	2.0	4.0	UD		18.3	112	50	21	29	68.2		1.27	0.29	1.00	1.13	Sandy Lean Clay
	4	4.0	6.0	UD		18.8									1.00	1.13	Sandy Lean Clay
	5	6.0	8.0	UD		19.3									1.25	1.50	Sandy Lean Clay
	6	8.0	10.0	UD		20.0	112	51	21	30	50.8		0.97	0.65	0.75	1.25	Sandy Lean Clay
	7	10.0	12.0	UD		20.0									0.50	0.38	Sandy Lean Clay
	8	12.0	13.5	SS	13	23.2					8.6						Poorly graded Sand w/Silt
	9	13.5	15.0	SS	16	23.0											Poorly graded Sand w/Silt

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-3

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-4	2	1.3	2.0	UD		9.9		55	23	32	76.3				0.75	0.75	Fat Clay w/Sand
	3	2.0	4.0	UD		22.3									1.00	0.88	Fat Clay w/Sand
	4	4.0	6.0	UD		17.6	113	54	23	31	71.6		0.95	0.43	1.25	1.25	Fat Clay w/Sand
	5	6.0	8.0	UD		19.4									0.75	0.63	Fat Clay w/Sand
	6	8.0	10.0	UD		19.3									1.00	1.38	Fat Clay w/Sand
	7	10.0	12.0	UD		21.0									0.20	0.25	Fat Clay w/Sand
	8	12.0	13.5	SS	15	24.1					19.4						Silty Sand
	9	13.5	15.0	SS	22	28.4											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-4

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-5	2	1.4	2.0	UD		23.8									0.80	0.75	Sandy Fat Clay
	3	2.0	4.0	UD		18.7	107	60	24	36	65.9		0.90	0.29	0.80	0.63	Sandy Fat Clay
	4	4.0	6.0	UD		18.4									1.25	1.25	Sandy Lean Clay
	5	6.0	8.0	UD		19.4									1.00	1.38	Sandy Lean Clay
	6	8.0	10.0	UD		18.5	108	48	21	27	50.4		0.96	0.65	0.75	1.50	Sandy Lean Clay
	7	10.0	12.0	UD		18.1									0.30	0.38	Sandy Lean Clay
	8	12.0	13.5	SS	16	22.2					24.2						Silty Sand
	9	13.5	15.0	SS	13	26.0											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-5

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-6	2	0.9	2.0	UD		17.7									1.13	1.50	Lean Clay w/Sand
	3	2.0	4.0	UD		19.5	110	43	19	24	71.8		1.23	0.29	0.75	0.88	Lean Clay w/Sand
	4	4.0	6.0	UD		19.1									1.13	1.50	Lean Clay w/Sand
	5	6.0	8.0	UD		19.5									0.75	0.75	Lean Clay w/Sand
	6	8.0	10.0	UD		21.0	104	34	17	17	69.0		0.40	0.50	0.35	0.25	Sandy Lean Clay
	7	10.0	12.0	UD		21.9									0.15	0.50	Sandy Lean Clay
	8	12.0	13.5	UD		19.2									0.10	0.25	Sandy Lean Clay
	9	13.5	15.0	SS	18	25.7					10.3						Poorly graded Sand w/Silt

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-6

SUMMARY OF LABORATORY TEST RESULTS

CEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-7	2	0**	2.0	UD		18.8		47	20	27	72.4				1.88	2.00	Lean Clay w/Sand
	3	2.0	4.0	UD		15.7	116						1.88	0.29	1.50	1.88	Lean Clay w/Sand
	4	4.0	6.0	UD		19.7									1.00	0.75	Lean Clay w/Sand
	5	6.0	8.0	UD		18.6	111	46	20	26	78.7		1.14	0.50	1.25	1.25	Lean Clay w/Sand
	6	8.0	10.0	UD		23.1									0.75	0.75	Lean Clay w/Sand
	7	10.0	12.0	UD		17.9									1.00	1.13	Lean Clay w/Sand
	8	12.0	14.0	UD		14.6									2.00	2.25	Lean Clay w/Sand
	9	14.0	15.0	UD		14.6									2.00	2.00	Lean Clay w/Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-7

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-8	2	0.6	2.0	UD		15.4									0.70	0.75	Fat Clay w/Sand
	3	2.0	4.0	UD		15.9	118	53	22	31	70.8		0.76	0.29	0.80	0.88	Fat Clay w/Sand
	4	4.0	6.0	UD		20.3									0.90	0.75	Fat Clay w/Sand
	5	6.0	8.0	UD		21.5									1.50	1.25	Fat Clay w/Sand
	6	8.0	10.0	UD		23.8	106	58	23	35	93.0		0.89	0.58	1.50	1.63	Fat Clay
	7	10.0	12.0	UD		17.7		36	18	18	69.9				0.50	0.63	Sandy Lean Clay
	8	12.0	14.0	UD		17.5									0.75	1.00	Sandy Lean Clay
	9	14.0	15.0	UD		16.1									1.00	2.00	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-8

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20–07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U–U)		TORVANE	POCKET PENE–TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB–9	2	1.4	2.0	UD		23.4									0.80	0.88	Fat Clay w/Sand
	3	2.0	4.0	UD		21.2	108	54	22	32	81.7		0.77	0.29	0.95	0.88	Fat Clay w/Sand
	4	4.0	6.0	UD		13.9									0.88	1.00	Fat Clay w/Sand
	5	6.0	8.0	UD		21.7									1.00	1.13	Fat Clay w/Sand
	6	8.0	10.0	UD		16.7	117	32	16	16	66.8		0.79	0.65	1.25	1.25	Sandy Lean Clay
	7	10.0	12.0	UD		19.4									1.00	1.25	Fat Clay w/Sand
	8	12.0	14.0	UD		16.0									1.25	1.38	Sandy Lean Clay
	9	14.0	15.0	UD		15.4									1.75	2.25	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx–DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B–9

SUMMARY OF LABORATORY TEST RESULTS

CEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-10A	2	1.6	2.0	UD		18.6		48	21	27	70.0				1.25	1.88	Sandy Lean Clay
	3	2.0	4.0	UD		16.6									1.00	1.50	Sandy Lean Clay
	4	4.0	6.0	UD		20.3	108	43	19	24	69.5		1.09	0.36	1.25	2.00	Sandy Lean Clay
	5	6.0	8.0	UD		19.6									0.88	1.38	Sandy Lean Clay
	6	8.5	10.0	SS	10	22.0					24.1						Silty Sand
	7	10.5	12.0	SS	6	24.1											Silty Sand
	8	12.0	13.5	SS	7	23.1											Silty Sand
	9	13.5	15.0	SS	18	22.3											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-10

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-11	2	0.9	2.0	UD		18.4		37	17	20	56.0				1.00	1.10	Sandy Lean Clay
	3	2.0	4.0	UD		17.4									1.50	1.88	Sandy Lean Clay
	4	4.0	6.0	UD		14.2	116	45	20	25	60.7		1.88	0.36	1.88	2.25	Sandy Lean Clay
	5	6.0	8.0	UD		17.4									1.63	2.00	Sandy Lean Clay
	6	8.0	10.0	UD		16.5	112	32	17	15	50.2		0.78	0.58	0.75	1.38	Sandy Lean Clay
	7	10.5	12.0	SS	17	14.2					29.3						Silty Sand
	8	12.0	13.5	SS	27	7.2											Silty Sand
	9	13.5	15.0	SS	22	14.2											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-11

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-12	2	1.3	2.0	UD		17.6									1.38	1.75	Lean Clay w/Sand
	3	2.0	4.0	UD		11.7	125	53	22	31	72.2		1.39	0.29	1.00	2.00	Lean Clay w/Sand
	4	4.0	6.0	UD		18.5									1.25	1.25	Lean Clay w/Sand
	5	6.0	8.0	UD		20.5									1.63	1.25	Lean Clay w/Sand
	6	8.0	10.0	UD		16.8	114	58	23	35	79.2		1.03	0.65	1.00	1.75	Lean Clay w/Sand
	7	10.0	12.0	UD		17.5		34	17	17	60.9				0.70	0.50	Sandy Lean Clay
	8	12.0	14.0	UD		16.5									1.50	1.25	Sandy Lean Clay
	9	14.0	15.0	UD		14.2									1.75	2.25	Sandy Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-12

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-13	2	1.0	2.0	UD		24.5									0.60	0.25	Fat Clay w/Sand
	3	2.0	4.0	UD		21.5	106	54	23	31	81.3		0.75	0.29	0.80	0.75	Fat Clay w/Sand
	4	4.0	6.0	UD		21.5									0.50	0.50	Fat Clay w/Sand
	5	6.0	8.0	UD		21.0									1.25	1.13	Fat Clay w/Sand
	6	8.0	10.0	UD		24.8	104	41	20	21	90.6		0.69	0.65	0.95	0.88	Lean Clay
	7	10.0	12.0	UD		23.0									1.25	1.25	Lean Clay
	8	12.0	14.0	UD		14.9									1.00	1.00	Lean Clay
	9	14.0	15.0	UD		16.8									0.75	1.00	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-13

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-14	2	1.0	2.0	UD		17.7									1.38	1.75	Lean Clay w/Sand
	3	2.0	4.0	UD		17.9	112	45	20	25	73.9		1.21	0.29	1.25	1.38	Lean Clay w/Sand
	4	4.0	6.0	UD		19.3									1.00	1.88	Lean Clay w/Sand
	5	6.0	8.0	UD		13.6									1.00	1.88	Lean Clay w/Sand
	6	8.0	10.0	UD		13.9	113	25	17	8	48.4		0.63	0.65	0.50	1.13	Clayey Sand
	7	10.5	12.0	SS	14	16.0											Silty Sand
	8	12.0	13.5	SS		11.7					30.9						Silty Sand
	9	13.5	15.0	SS	22	17.3											Silty Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-14

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-15	2	0.8	2.0	UD		26.8									0.70	0.50	Fat Clay
	3	2.0	4.0	UD		31.2	90	66	27	39	89.9		0.38	0.29	0.60	0.38	Fat Clay
	4	4.0	6.0	UD		27.4									0.70	0.63	Fat Clay
	5	6.0	8.0	UD		25.8									0.95	0.88	Fat Clay
	6	8.0	10.0	UD		23.1	106	35	18	17	76.6		0.79	0.65	0.80	0.50	Lean Clay w/Sand
	7	10.0	12.0	UD		18.1									0.75	0.75	Lean Clay w/Sand
	8	12.0	14.0	UD		16.2									1.25	1.88	Lean Clay w/Sand
	9	14.0	15.0	UD		13.6									1.50	2.13	Lean Clay w/Sand

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-15

SUMMARY OF LABORATORY TEST RESULTS

GEOTEST ENGINEERING, INC.

PROJECT NAME: PW20-07 East Street and Drainage Improvements
City of West University Place, Texas

PROJECT NUMBER: 1140261101

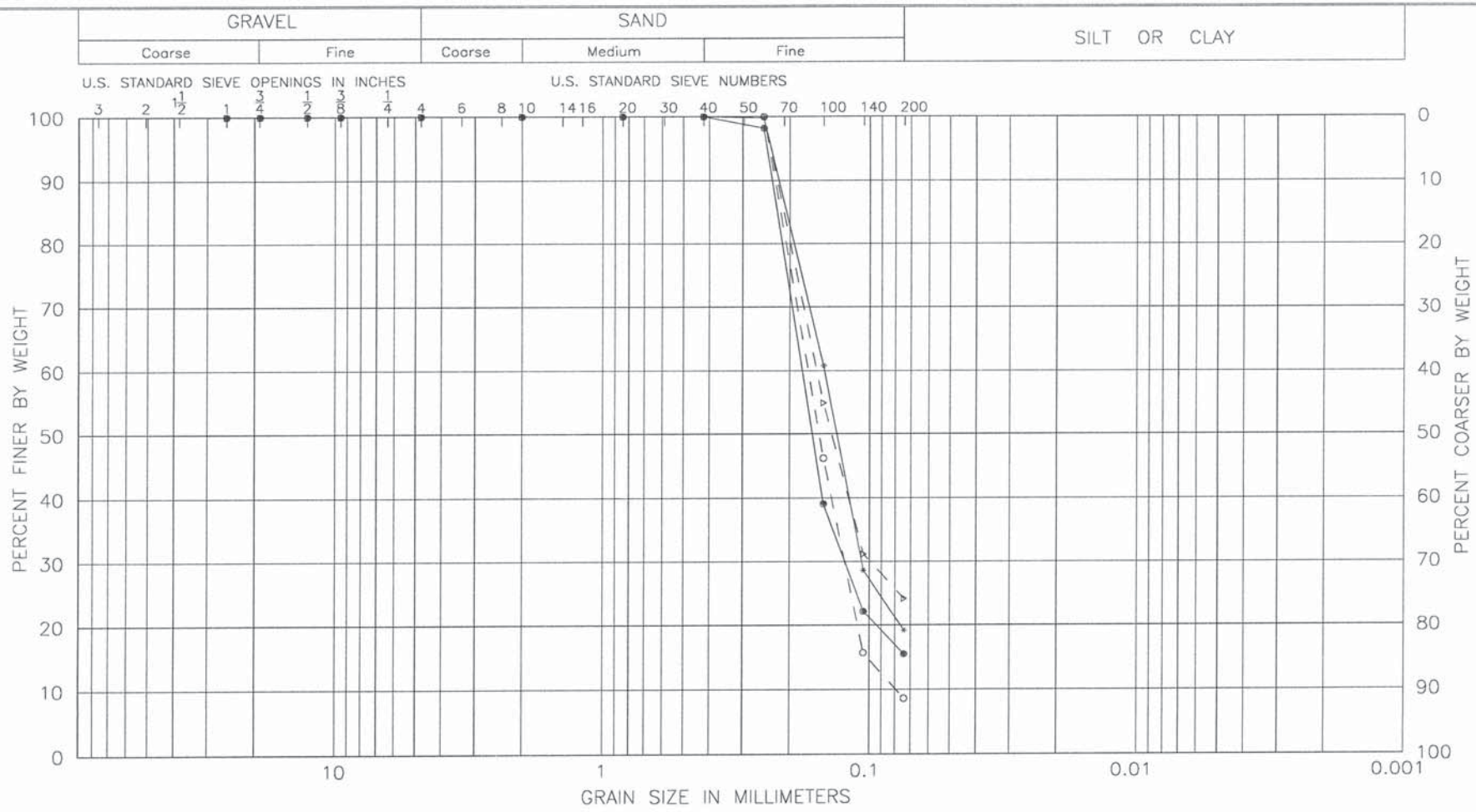
BORING NO.	SAMPLE				SPT (blows/ft.)	WATER CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS			PASSING NO. 200 SIEVE (%)	UNCONFINED COMPRESSION TEST	TRIAXIAL COMPRESSION TEST (U-U)		TORVANE	POCKET PENE-TROMETER	TYPE OF MATERIAL
	No.	Depth (ft.) Top	Depth (ft.) Bottom	Type				LL	PL	PI		Shear Strength (tsf)	Shear Strength (tsf)	Conf. Press. (tsf)	Shear Strength (tsf)	Shear Strength (tsf)	
GB-16	2	1.0	2.0	UD		19.6									0.85	0.88	Fat Clay w/Sand
	3	2.0	4.0	UD		19.9	106	55	23	32	78.8		0.42	0.29	0.85	0.88	Fat Clay w/Sand
	4	4.0	6.0	UD		19.9									0.70	0.88	Fat Clay w/Sand
	5	6.0	8.0	UD		29.5									0.70	0.75	Fat Clay w/Sand
	6	8.0	10.0	UD		28.9	96	58	23	35	93.2		0.82	0.65	0.95	0.88	Fat Clay
	7	10.0	12.0	UD		20.4									1.50	1.38	Fat Clay
	8	12.0	14.0	UD		19.3									1.25	1.00	Lean Clay
	9	14.0	15.0	UD		15.5									1.50	1.63	Lean Clay

LEGEND:
UD = UNDISTURBED SAMPLE, EXTRUDED IN FIELD
SS = SPLIT SPOON SAMPLE
AG = AUGER CUTTINGS
PB = PITCHER BARREL SAMPLE
Nx = Nx-DOUBBLE BARREL SAMPLE

SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index

FIGURE B-16

Job No. 1140261101



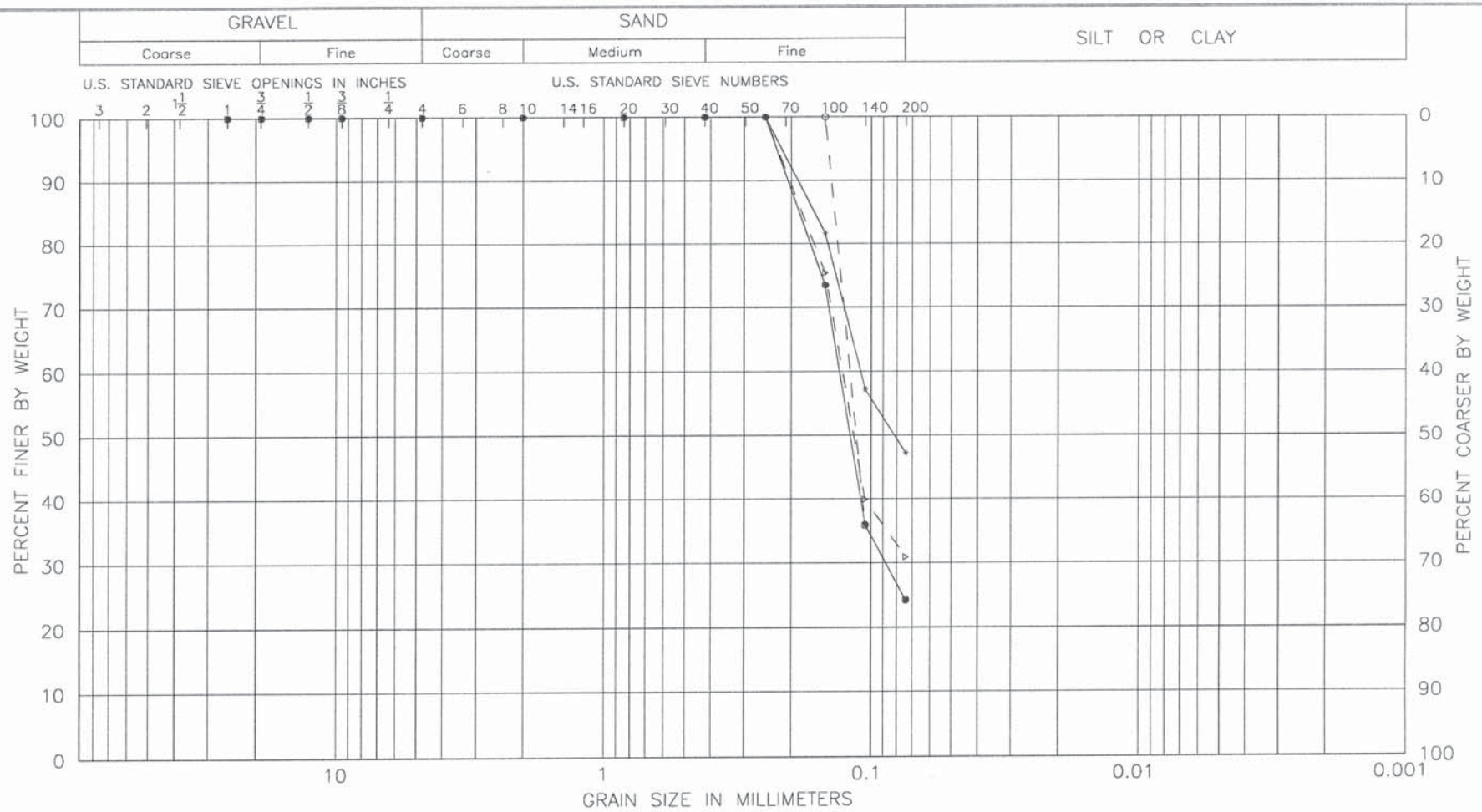
LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●	GB–2	S–8	12.0–13.5	Gray silty sand
○—○—○	GB–3	S–8	12.0–13.5	Gray silty sand
×—×—×	GB–4	S–8	12.0–13.5	Brown and gray silty sand
▷—▷—▷	GB–5	S–8	12.0–13.5	Brown and gray silty sand

GRAIN SIZE DISTRIBUTION CURVES

Geotest Engineering, Inc.

FIGURE B–17

Job No. 1140261101



LEGEND	BORING NO.	SAMPLE NO.	DEPTH FT.	SAMPLE DESCRIPTION
●—●—●—●	GB–10A	S–6	8.5–10.0	Brown and gray silty sand
○—○—○—○	GB–11	S–7	10.5–12.0	Brown and gray silty sand
×—×—×—×	GB–14	S–7	10.5–12.0	Brown and gray silty sand
▷—▷—▷—▷	GB–14	S–8	12.0–13.5	Brown and gray sandy silt

GRAIN SIZE DISTRIBUTION CURVES

Geolest Engineering, Inc.

FIGURE B–18

APPENDIX C

Pavement Design Calculations and Backup

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Agency: West University Placce
Company: HDR
Contractor: Geotest Engineering
Project Description: PW20- East Street and DRainage Improvements - Duke Street
Location: West University Place

Rigid Pavement Design/Evaluation

PCC Thickness	7.00	**inches**	**Load Transfer, J**	2.70	
Design ESALs	4,229,300		**Mod. Subgrade Reaction, k**	49	**psi/in**
Reliability	80.00	**percent**	**Drainage Coefficient, Cd**	1.20	
Overall Deviation	0.35		**Initial Serviceability**	4.50	
Modulus of Rupture	630	**psi**	**Terminal Serviceability**	2.00	
Modulus of Elasticity	3,604,997	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	1,941.5	**psi**
Resilient Modulus of the Subbase	20,000.0	**psi**
Subbase Thickness	8.00	**inches**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	1.0	

Modulus of Subgrade Reaction	49.40	**psi/in**

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Agency: West University Placce
Company: HDR
Contractor: Geotest Engineering
Project Description: PW20- East Street and DRainage Improvements - Rice Blvd
Location: West University Place

Rigid Pavement Design/Evaluation

PCC Thickness	7.44	**inches**	**Load Transfer, J**	2.70	
Design ESALs	2,584,644		**Mod. Subgrade Reaction, k**	49	**psi/in**
Reliability	95.00	**percent**	**Drainage Coefficient, Cd**	1.20	
Overall Deviation	0.35		**Initial Serviceability**	4.50	
Modulus of Rupture	630	**psi**	**Terminal Serviceability**	2.50	
Modulus of Elasticity	3,604,997	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	1,941.5	**psi**
Resilient Modulus of the Subbase	20,000.0	**psi**
Subbase Thickness	8.00	**inches**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	1.0	

Modulus of Subgrade Reaction	49.40	**psi/in**

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Agency: West University Placce
Company: HDR
Contractor: Geotest Engineering
Project Description: PW20- East Street and DRainage Improvements - Wakeforest Ave
Location: West University Place

Rigid Pavement Design/Evaluation

PCC Thickness	7.36	**inches**	**Load Transfer, J**	2.70	
Design ESALs	2,421,384		**Mod. Subgrade Reaction, k**	49	**psi/in**
Reliability	95.00	**percent**	**Drainage Coefficient, Cd**	1.20	
Overall Deviation	0.35		**Initial Serviceability**	4.50	
Modulus of Rupture	630	**psi**	**Terminal Serviceability**	2.50	
Modulus of Elasticity	3,604,997	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	1,941.5	**psi**
Resilient Modulus of the Subbase	20,000.0	**psi**
Subbase Thickness	8.00	**inches**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	1.0	

Modulus of Subgrade Reaction	49.40	**psi/in**

kpradeep@geotesteng.com

From: Le, Ngoc <Ngoc.Le@hdrinc.com>
Sent: Wednesday, April 21, 2021 10:03 AM
To: kpradeep@geotesteng.com
Cc: Naresh Kolli; mballagere; Peterson, John; Qu, Carol
Subject: RE: Street & Drainage East PER: draft report

Hi Krishna,

We have roadway classification for the streets below from the City:

Wakeforest: major collector
Rice Blvd: major collector
University Blvd: minor arterial
Duke: residential local street

The City does have some traffic counts on Rice so we can FW you once we receive it from the City.

I hope this helps,

Ngoc Kim Le, PE
Project Manager

D 713-576-3569 **M** 832-264-2395
hdrinc.com/follow-us

From: kpradeep@geotesteng.com <kpradeep@geotesteng.com>
Sent: Wednesday, April 21, 2021 8:42 AM
To: Le, Ngoc <Ngoc.Le@hdrinc.com>
Cc: Naresh Kolli <nkolli@geotesteng.com>; mballagere <mballagere@geotesteng.com>
Subject: RE: Street & Drainage East PER: draft report

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Ngoc,

Do we have any update on the requested traffic count information with vehicle distribution, and roadway classification (Residential/Collector) of Wakeforest Ave & Rice Blvd, to include in our pavement recommendations?

Regards,

Krishna M. Pradeep, E.I.T.
Geotest Engineering, Inc.
5600 Bintliff, Houston, Texas 77036

(O) 713.266.0588
(F) 713.266.2977

Rice 2600 : Midblock
Between : Annapolis and Fordham

Site: 000000000000
3/12/2020
Thursday

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	-	-	-
1:00 AM	-	-	-
2:00 AM	-	-	-
3:00 AM	-	-	-
4:00 AM	-	-	-
5:00 AM	-	-	-
6:00 AM	-	-	-
7:00 AM	-	-	-
8:00 AM	-	-	-
9:00 AM	-	-	-
10:00 AM	-	-	-
11:00 AM	-	-	-
12:00 PM	-	-	-
1:00 PM	-	-	-
2:00 PM	-	-	-
3:00 PM	7	1	8
4:00 PM	92	48	140
5:00 PM	0	0	0
6:00 PM	0	0	0
7:00 PM	0	0	0
8:00 PM	0	0	0
9:00 PM	0	0	0
10:00 PM	0	0	0
11:00 PM	0	0	0
Totals	99 (66.9%)	49 (33.1%)	148

Peak Hours

12:00 AM - 12:00 PM	-	-	-
Volume	-	-	-
12:00 PM - 12:00 AM	4:00 PM	4:00 PM	4:00 PM
Volume	92	48	140

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	0	0	0
1:00 AM	3	0	3
2:00 AM	3	0	3
3:00 AM	1	0	1
4:00 AM	0	1	1
5:00 AM	1	2	3
6:00 AM	8	18	26
7:00 AM	27	56	83
8:00 AM	42	108	150
9:00 AM	53	73	126
10:00 AM	75	77	152
11:00 AM	78	82	160
12:00 PM	102	104	206
1:00 PM	102	82	184
2:00 PM	97	83	180
3:00 PM	122	67	189
4:00 PM	134	61	195
5:00 PM	143	75	218
6:00 PM	107	62	169
7:00 PM	86	50	136
8:00 PM	41	23	64
9:00 PM	33	19	52
10:00 PM	18	5	23
11:00 PM	8	4	12
Totals	1284 (55.0%)	1052 (45.0%)	2336

Peak Hours

12:00 AM - 12:00 PM	11:00 AM	8:00 AM	11:00 AM
Volume	78	108	160
12:00 PM - 12:00 AM	5:00 PM	12:00 PM	5:00 PM
Volume	143	104	218

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	5	5	10
1:00 AM	1	3	4
2:00 AM	1	0	1
3:00 AM	3	1	4
4:00 AM	0	2	2
5:00 AM	2	1	3
6:00 AM	2	12	14
7:00 AM	19	22	41
8:00 AM	22	41	63
9:00 AM	50	57	107
10:00 AM	65	60	125
11:00 AM	85	87	172
12:00 PM	72	85	157
1:00 PM	82	78	160
2:00 PM	77	45	122
3:00 PM	52	47	99
4:00 PM	43	52	95
5:00 PM	56	37	93
6:00 PM	59	50	109
7:00 PM	51	45	96
8:00 PM	43	30	73
9:00 PM	18	13	31
10:00 PM	16	3	19
11:00 PM	7	4	11
Totals	831 (51.6%)	780 (48.4%)	1611

Peak Hours

12:00 AM - 12:00 PM	11:00 AM	11:00 AM	11:00 AM
Volume	85	87	172
12:00 PM - 12:00 AM	1:00 PM	12:00 PM	1:00 PM
Volume	82	85	160

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	2	3	5
1:00 AM	1	0	1
2:00 AM	2	0	2
3:00 AM	2	0	2
4:00 AM	2	1	3
5:00 AM	0	2	2
6:00 AM	3	4	7
7:00 AM	2	9	11
8:00 AM	14	20	34
9:00 AM	34	37	71
10:00 AM	28	32	60
11:00 AM	46	29	75
12:00 PM	43	50	93
1:00 PM	39	58	97
2:00 PM	46	32	78
3:00 PM	52	38	90
4:00 PM	53	42	95
5:00 PM	32	31	63
6:00 PM	45	35	80
7:00 PM	28	20	48
8:00 PM	21	17	38
9:00 PM	10	13	23
10:00 PM	3	2	5
11:00 PM	4	5	9
Totals	512 (51.6%)	480 (48.4%)	992

Peak Hours

12:00 AM - 12:00 PM	11:00 AM	9:00 AM	11:00 AM
Volume	46	37	75
12:00 PM - 12:00 AM	4:00 PM	1:00 PM	1:00 PM
Volume	53	58	97

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	2	2	4
1:00 AM	1	0	1
2:00 AM	2	0	2
3:00 AM	1	1	2
4:00 AM	0	1	1
5:00 AM	2	6	8
6:00 AM	2	14	16
7:00 AM	18	35	53
8:00 AM	32	49	81
9:00 AM	31	66	97
10:00 AM	44	50	94
11:00 AM	56	50	106
12:00 PM	70	60	130
1:00 PM	70	67	137
2:00 PM	62	53	115
3:00 PM	98	44	142
4:00 PM	83	41	124
5:00 PM	100	43	143
6:00 PM	62	39	101
7:00 PM	36	26	62
8:00 PM	26	17	43
9:00 PM	8	7	15
10:00 PM	9	8	17
11:00 PM	3	2	5
Totals	818 (54.6%)	681 (45.4%)	1499

Peak Hours

12:00 AM - 12:00 PM	11:00 AM	9:00 AM	11:00 AM
Volume	56	66	106
12:00 PM - 12:00 AM	5:00 PM	1:00 PM	5:00 PM
Volume	100	67	143

Daily Volume

Interval Start	Westbound	Eastbound	Combined
12:00 AM	1	1	2
1:00 AM	1	0	1
2:00 AM	0	0	0
3:00 AM	0	0	0
4:00 AM	0	1	1
5:00 AM	1	8	9
6:00 AM	0	15	15
7:00 AM	16	29	45
8:00 AM	21	61	82
9:00 AM	2	7	9
Totals	42 (25.6%)	122 (74.4%)	164

Peak Hours

12:00 AM - 12:00 PM	8:00 AM	8:00 AM	8:00 AM
Volume	21	61	82
12:00 PM - 12:00 AM	-	-	-
Volume	-	-	-

IDS
Engineering Group

October 8, 2021

City of West University Place
3826 Amherst Street
West University Place, Texas 77005

Attention: Mr. Gerardo Barrera, Public Works Director

Reference: Pavement Thickness Recommendations for City of West University Place

Dear Mr. Barrera:

At the request of the City, IDS Engineering Group offers the following recommendations for pavement and subgrade thickness for street reconstruction projects within the City. IDS has based these recommendations on review of the geotechnical reports prepared for the East and West Street & Drainage PERs by Geotech Engineering (West) and Geotest Engineering (East). IDS also reviewed pavement standards utilized by the City of Houston and Harris County for comparable roadway types. The recommendations should provide for 40 to 50 years of service.

IDS recommends pavement and subgrade thicknesses as follows:

- Major Collectors: **9-inch-thick** concrete pavement (example streets are Rice, Sunset, Wakeforest, Academy North)
- Minor Collectors: **8-inch-thick** concrete pavement (example streets are Community, West Point, Mercer, Belmont, Pittsburgh, Edloe and Academy South)
- Minor Arterials: **9-inch-thick** concrete pavement (example streets are Weslayan, Stella Link, University)
- Local Streets: **8-inch-thick** concrete pavement
- Subgrade: Minimum 8-inch-thick stabilized for all streets. Where possible place subgrade 1-foot beyond back of curb. Where trees and/or other obstructions are present use zero curb cutback.

These recommendations are for pavement thickness and minimum subgrade thickness. This information shall be utilized by the Engineer of Record for the basis of design of a project but does not relieve the Engineer of Record of the need to follow all applicable City design standards and project specific geotechnical recommendations for subgrade.

If you have any questions or comments, please call.

Sincerely,

Timothy E. Buscha, P.E., CFM
President

STATE OF TEXAS
TIMOTHY E. BUSCHA
82600
LICENSED
PROFESSIONAL ENGINEER
10/8/2021

\\fs3\Projects\2300\234800100 City Engineer for City of West U Place\Road\Pavement Thickness letter\Pavement and Subgrade Reccomendation Letter.docx

13430 Northwest Freeway, Suite 700, Houston, Texas 77040
TxEng Firm 2726 | TxSurv Firm 10110700
t 713.462.3178
idseg.com

infrastructure design solutions

F

Appendix F – Potential Utility Conflicts

West University East Side PER

Appendix F-1 - University Boulevard Utility Contact List

Utility Type	Utility Company	Design Subconsultant	Role	Contact Name	Address	Phone	Email
Telecomm	AT&T			James Manahl	6500 W. Loop South, Zone 1.3, Houston, TX 77401	713-918-0043	jm3107@att.net
Telecomm	AT&T (Cobb Fendley)			Kathy Tinney	6500 W. Loop South, Zone 1.3, Houston, TX 77401	713-305-4414	kt145j@att.com
Telecomm	AT&T (Cobb Fendley)		Project Coordinator	Rebecca Stiles	6500 W. Loop South, Zone 1.3, Houston, TX 77401	713-462-3342	rstiles@cobbfendley.com
Telecomm	MCI (Verizon)			Michael Mabe			michael.mabe@verizon.com
Telecomm	MCI (Verizon)			John Bachelder			john.bachelder@verizon.com
Gas/Electric	CenterPoint Energy		Engineering Specialist	Michael Brower	1111 Louisiana Street, 22nd Floor, Houston, TX 77002	888-519-9188 ext. 208	michael.brower@centerpointenergy.com
Gas	CenterPoint Energy			Marvin Schedule	1111 Louisiana Street, 22nd Floor, Houston, TX 77002	281-331-0500 x2	marvin.schedule@centerpointenergy.com
Electric	CenterPoint Energy			Cynthia Martinez	1111 Louisiana Street, 9th Floor, Houston, TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com
Electric	CenterPoint Energy			Robert Tinnin	1111 Louisiana Street, 9th Floor, Houston, TX 77002		robert.tinnin@centerpointenergy.com
Telecomm	Comcast		Construction Technician	Cleroy Adolphin	8590 W. Tidwell Road, Houston, TX 77040	713-637-5037	cleroy_adolphin@cable.comcast.com
Telecomm	Comcast		Construction Technician	Ramon Granados	8591 W. Tidwell Road, Houston, TX 77040	713-545-1613	ramon_granados@comcast.com
Telecomm	Comcast			Helbert Salandanan	7033 Airport Boulevard, Houston, TX 77061		helbert_salandanan@comcast.com
Telecomm	Zayo		Director OSP	Kevin Sewall	6630 Roxburgh Drive, Houston, TX 77041	817-665-8438	kevin.sewall@zayo.com
Telecomm	Zayo		Project Manager	Dean Lippe	6630 Roxburgh Drive, Houston, TX 77041	713-553-8377	dean.lippe@zayo.com
Telecomm	Lumen (CenturyLink)		Business Analyst - Relocations	Christopher Stuck			christopher.stuck@lumen.com
Sanitary Sewer	City of West University Place		Public Works Director	Gerardo Barrera	3826 Amherst, West University Place, TX 77005	713.662.5845	GBarrera@westutx.gov
Water	City of West University Place		Public Works Director	Gerardo Barrera	3826 Amherst, West University Place, TX 77005	713.662.5845	GBarrera@westutx.gov

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
2. BEARINGS SHOWN HEREON BASED ON TEXAS COORDINATE SYSTEM OF 1983 (NAD83), SOUTH CENTRAL ZONE (No. 4204).
3. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD88 - 2001 ADJUSTMENT (GEOID18) GPS OBSERVATIONS AND HAVE BEEN ADJUSTED TO GEOID99 PER BENCHMARK NOTE.
4. THIS TRACT LIES IN ZONE "X" (UNSHADED), DESIGNATED AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLA", ZONE "X" (SHADED), DESIGNATED AS "AREAS OF THE 0.2% ANNUAL CHANCE FLOOD; AREAS OF THE 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FORM 1% ANNUAL CHANCE FLOOD", AND ZONE "AE", DEFINED AS "SPECANIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 0.1% ANNUAL CHANCE FLOOD EVENT, WHERE THE BASE FLOOD ELEVATIONS ARE DETERMINED", AS PER THE NATIONAL FLOOD INSURANCE PROGRAM FIRM COMMUNITY PANEL NUMBER 4820102860L, LATEST AVAILABLE PUBLISHED REVISION DATED JUNE 18, 2017. THE BASE FLOOD ELEVATION IS 47.9 FEET.
5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
9. FENCES & TREES SHOWN HEREON ARE GRAPHIC, WITH DIMENSIONED TIES SHOWN AT SPECIFIC LOCATIONS WHERE THEY WERE PHYSICALLY MEASURED; THE FENCE LINES MAY MEANDER BETWEEN SAID LOCATIONS.
10. BURIED UTILITIES HAVE BEEN ROUTED BY CONNECTING VISIBLE SURFACE APPURTENANCES IN COMBINATION WITH RECORD DRAWING LOCATIONS. THERE MAY EXIST ADDITIONAL, BURIED UTILITIES WHICH HAVE NOT BEEN FIELD VERIFIED AND/OR REFERENCEDAR HEREON. THE CONTRACTOR SHOULD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES BEFORE COMMENCING CONSTRUCTION.

SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

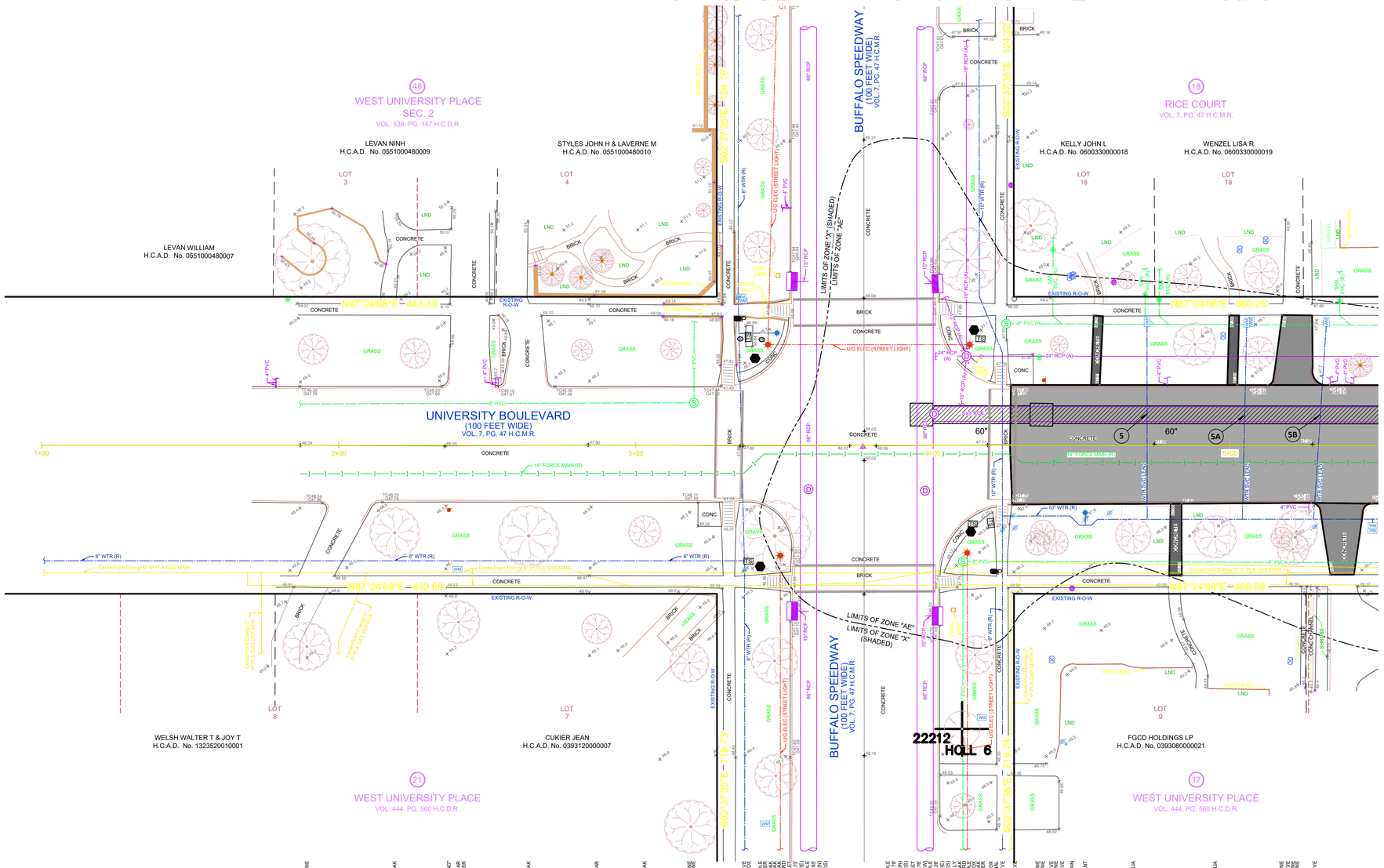
SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W/	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 0+00 to Sta. 5+50

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 5 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
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- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

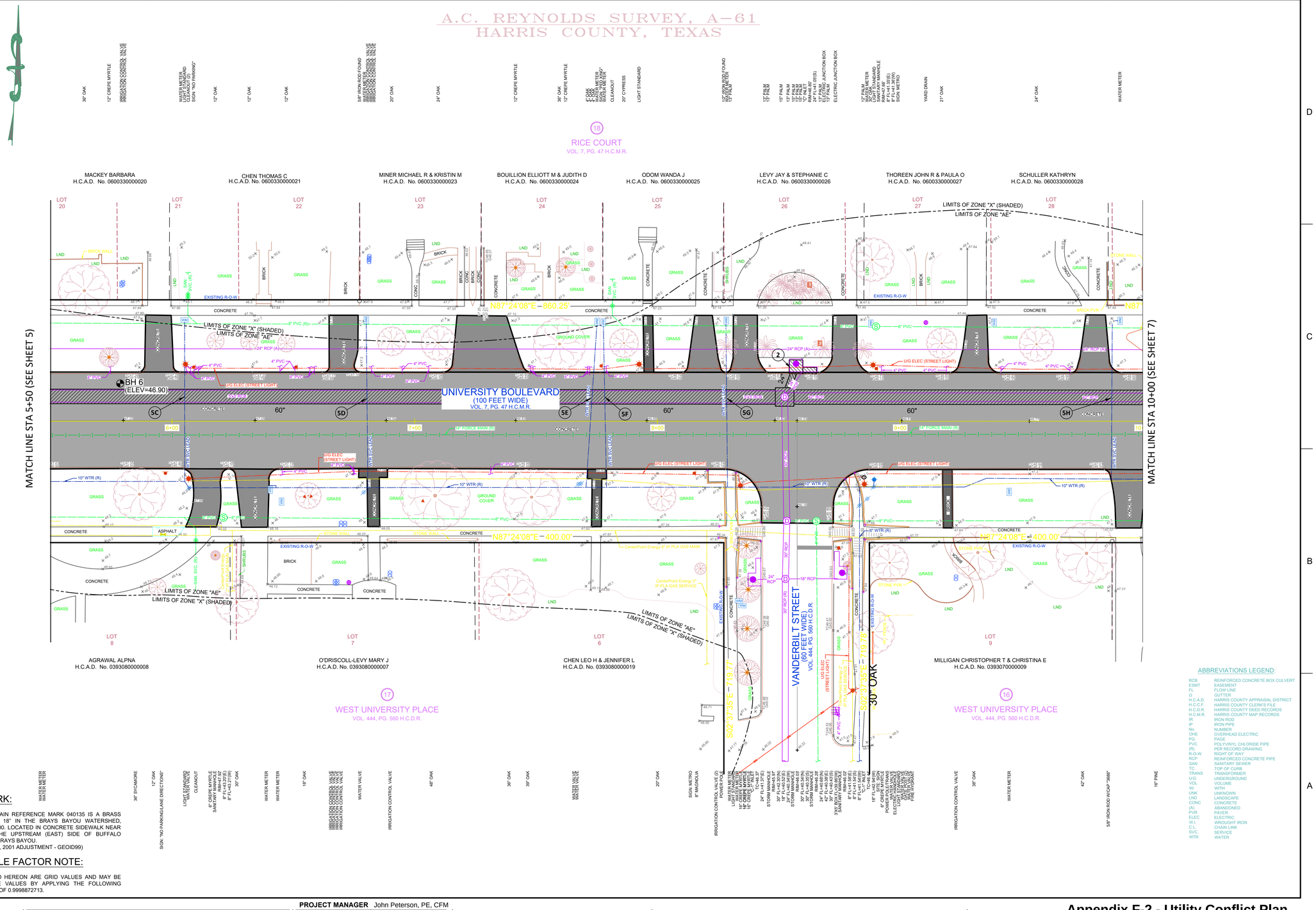
SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

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A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS



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ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PGL	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 5+50 to Sta. 10+00

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 6 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

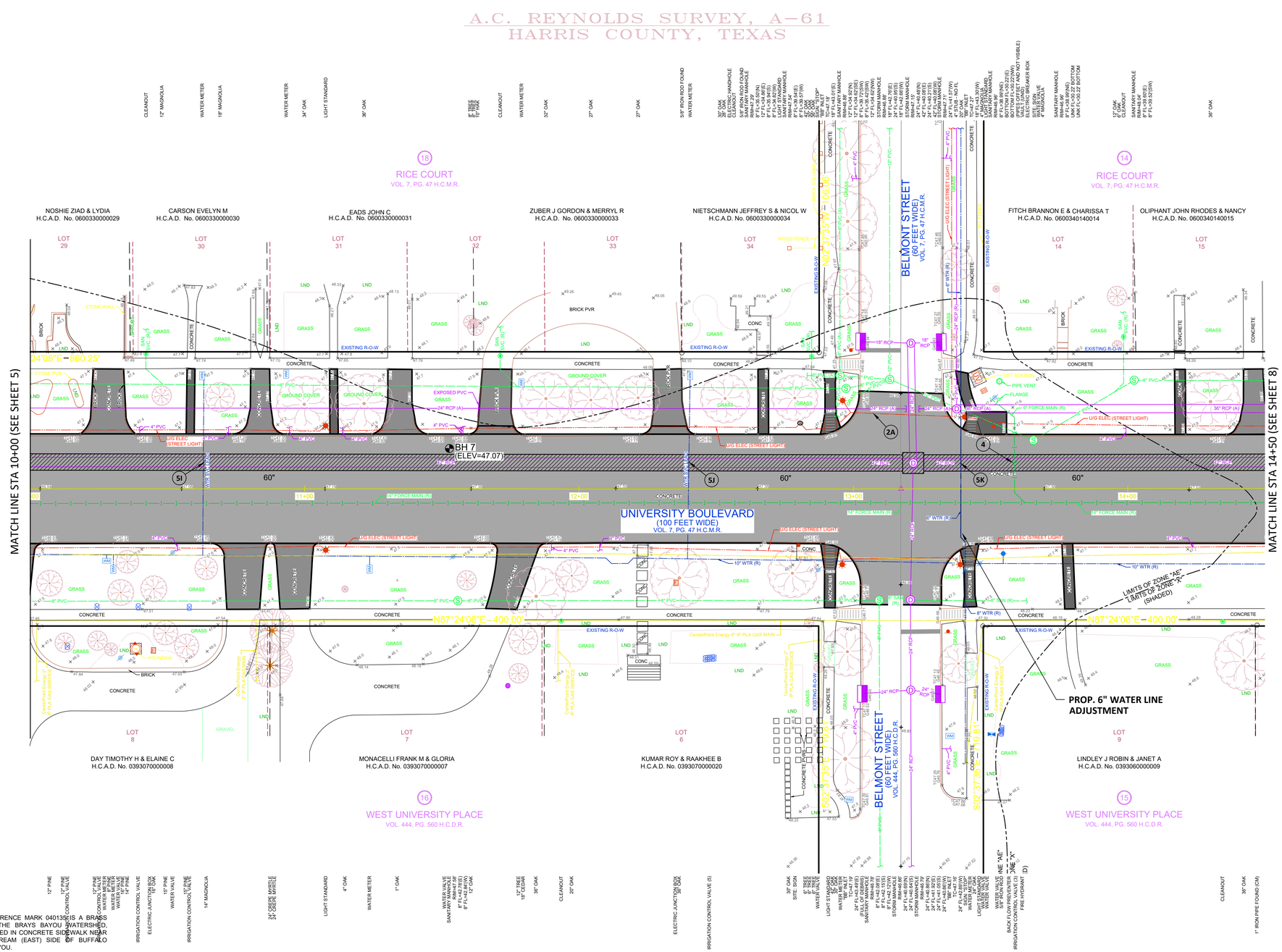
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
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- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
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- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 04013G IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.



PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

University Blvd. Sta. 10+00 to Sta. 14+50

0 1" 2"

FILENAME

SCALE

SHEET 7 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
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SYMBOL LEGEND

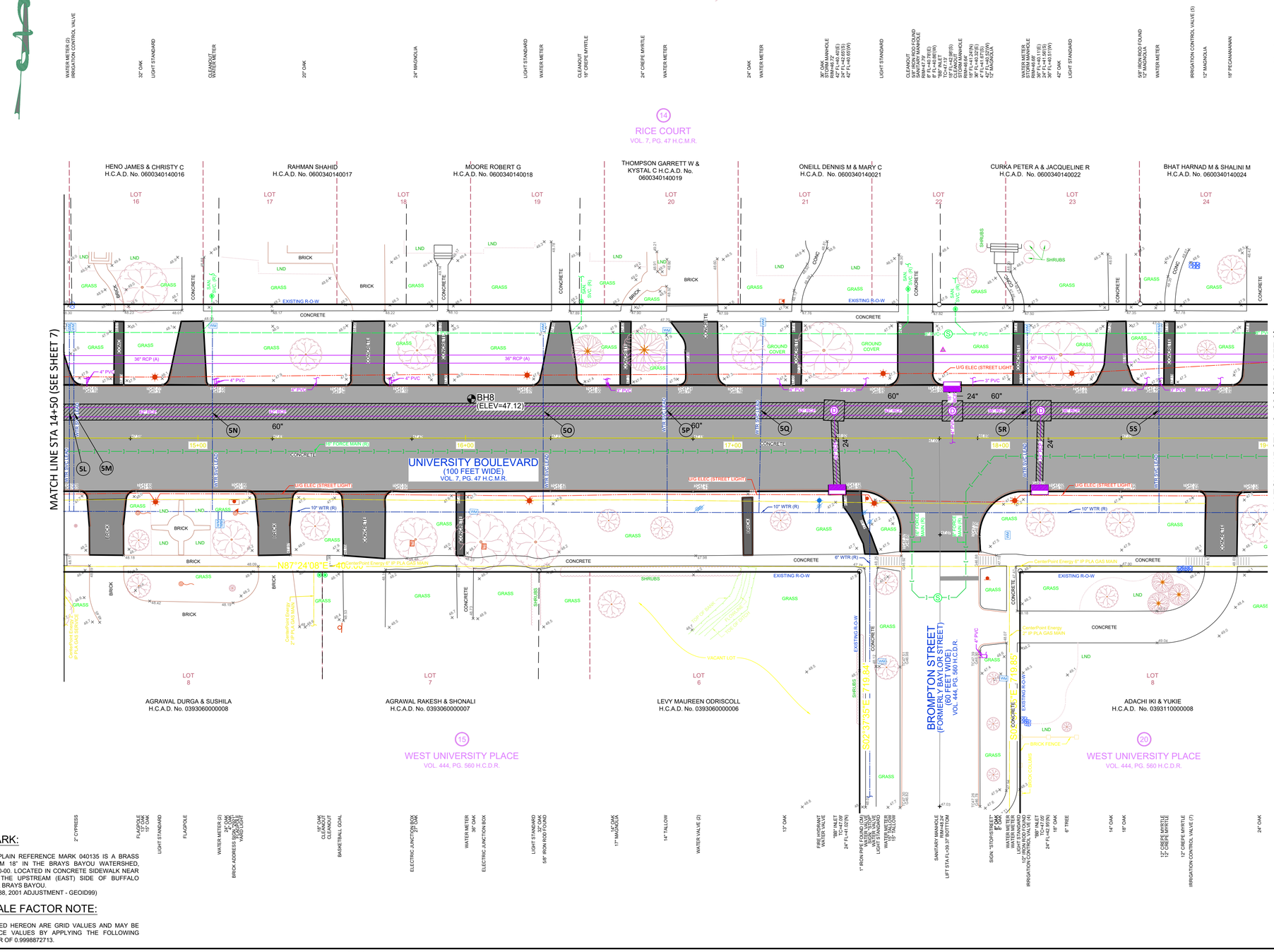
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- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
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- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
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- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
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- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
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U/G	UNDERGROUND
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W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
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PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 14+50 to Sta. 19+00

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 8 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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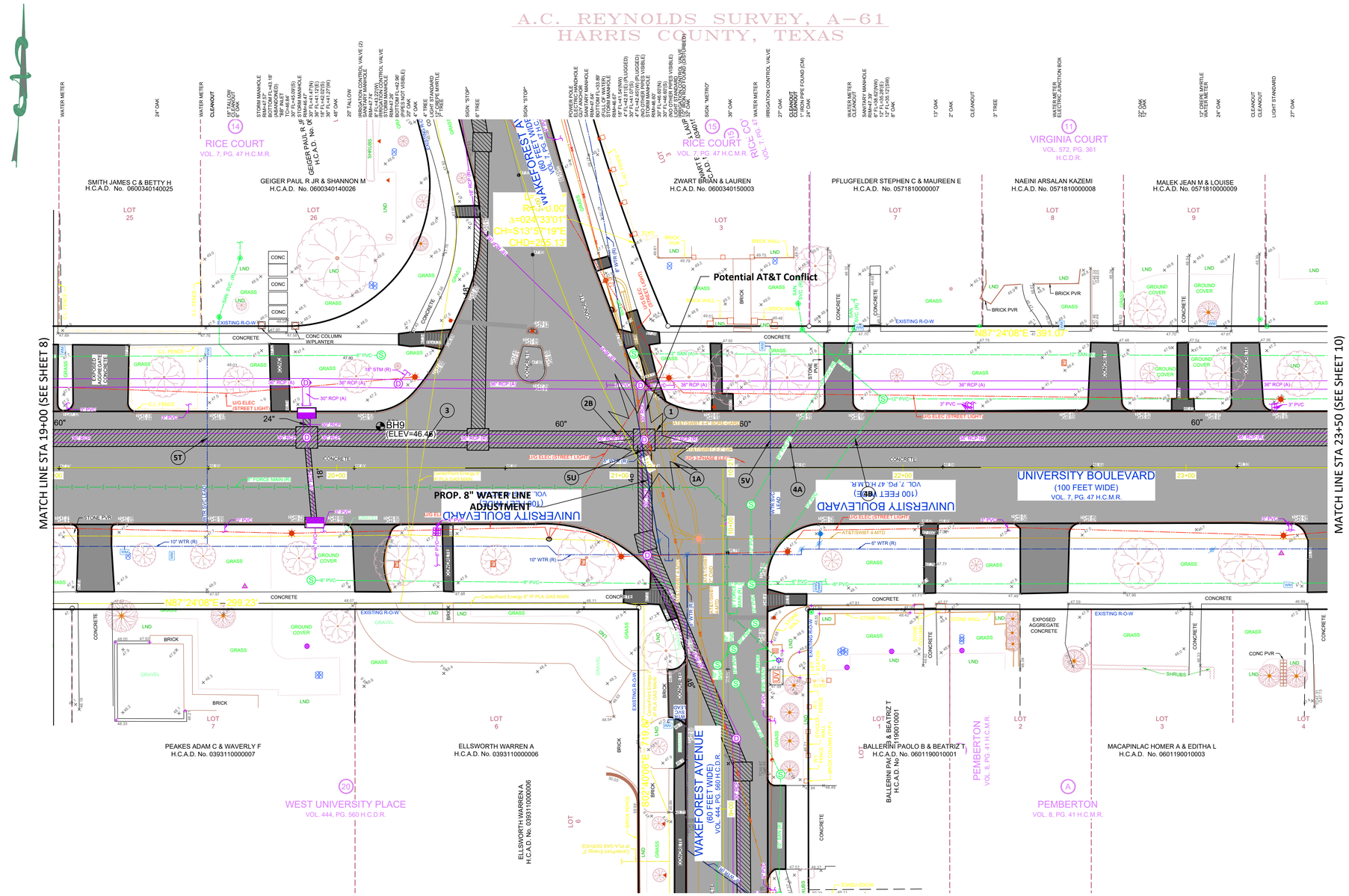
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- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
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- CHAINLINK FENCE
- OVERHEAD TELEPHONE
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- WOOD FENCE
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SITE BENCHMARK:

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CONC	CONCRETE
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PVR	PAVER
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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

University Blvd. Sta. 19+00 to Sta. 23+50

0 1" 2"

FILENAME

SCALE

SHEET 9 of 26

GRAPHIC SCALE

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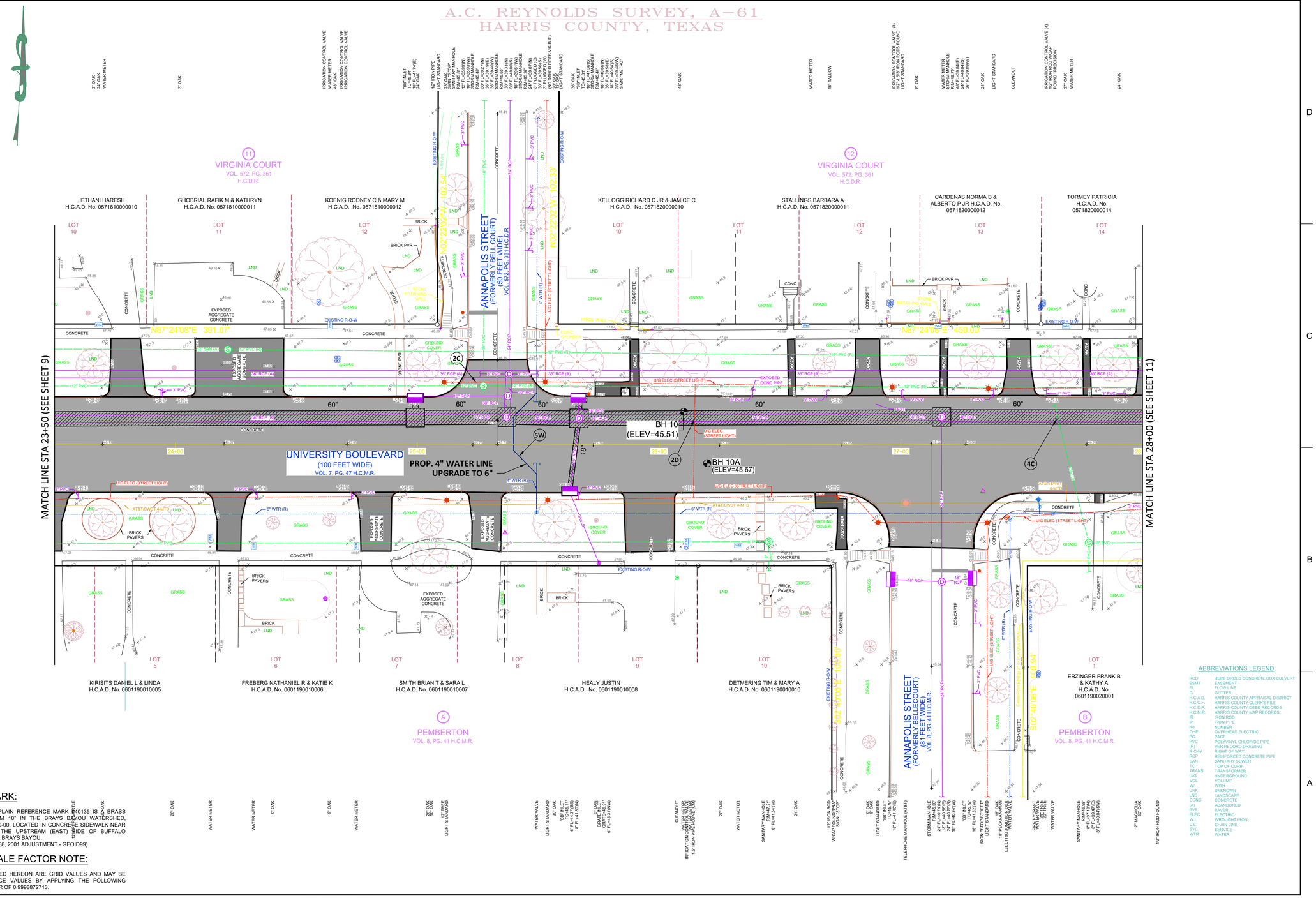
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- WOOD FENCE
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SITE BENCHMARK:

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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

University Blvd. Sta. 23+50 to Sta. 28+00

0 1" 2"

FILENAME

SCALE

SHEET 10 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

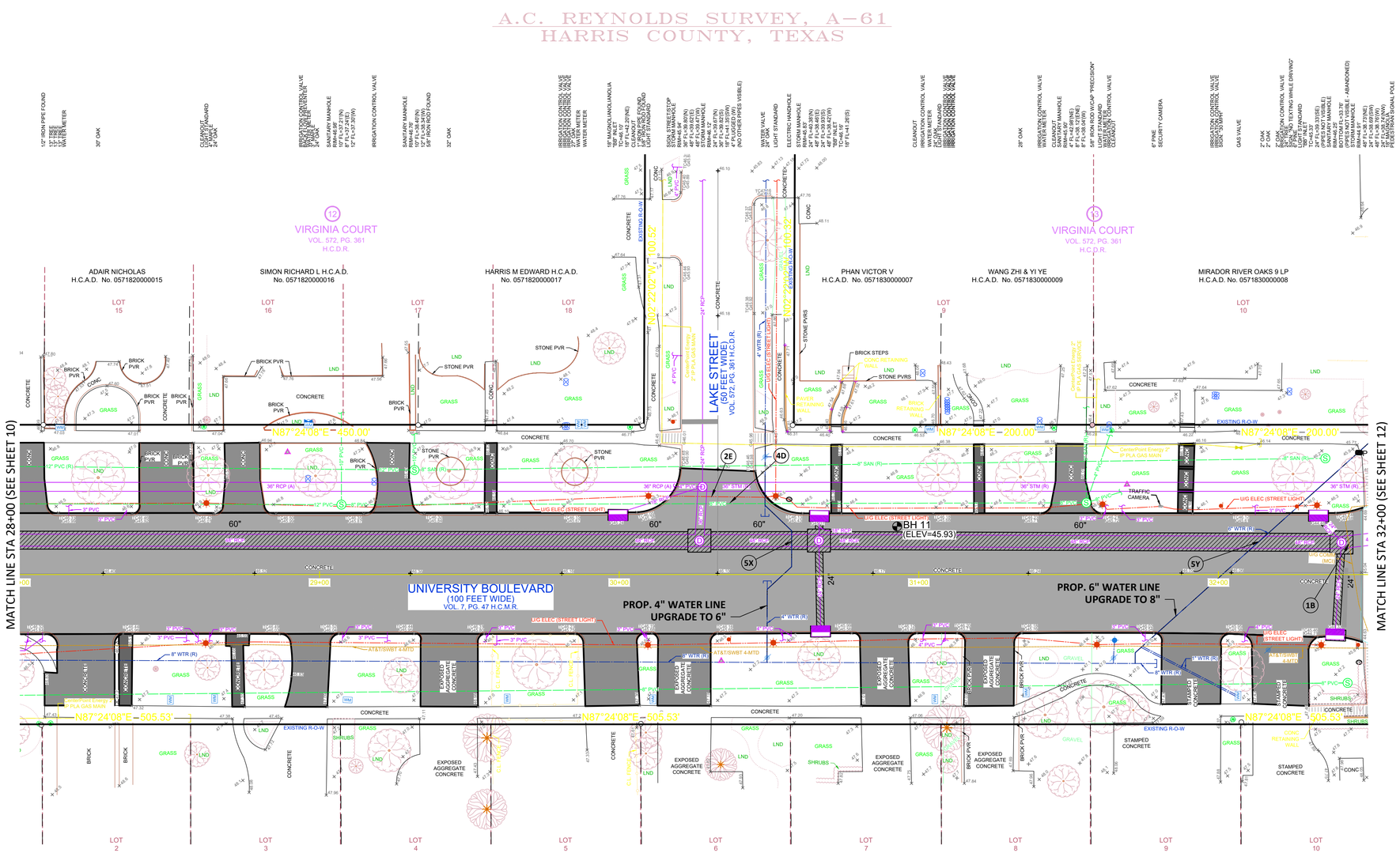
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SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- E ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE



LOT 2 — MILLER SAMMY & NATASHIA H.C.A.D. No. 0601190020002
LOT 3 — STUBBS FAMILY REVOCABLE LIVING TRUST H.C.A.D. No. 0601190020003
LOT 4 — LEEFTINK GERRIT JR H.C.A.D. No. 0601190020004
LOT 5 — CLEARY KIM E H.C.A.D. No. 0601190020005
LOT 6 — WOODWARD WENDY A H.C.A.D. No. 0601190020006
LOT 7 — HURST DEANNA & PATRICK H.C.A.D. No. 0601190020007
LOT 8 — SIMPSON WILLIAM C & LYNN H.C.A.D. No. 0601190020008
LOT 9 — TAJIAN FAMILY PARTNERSHIP LTD H.C.A.D. No. 0601190020009
LOT 10 — PHAM MINH T H.C.A.D. No. 0601190020010

B PEMBERTON VOL. 8, PG. 41 H.C.M.R.

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.

ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
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R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

University Blvd. Sta. 28+00 to Sta. 32+50

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 11 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

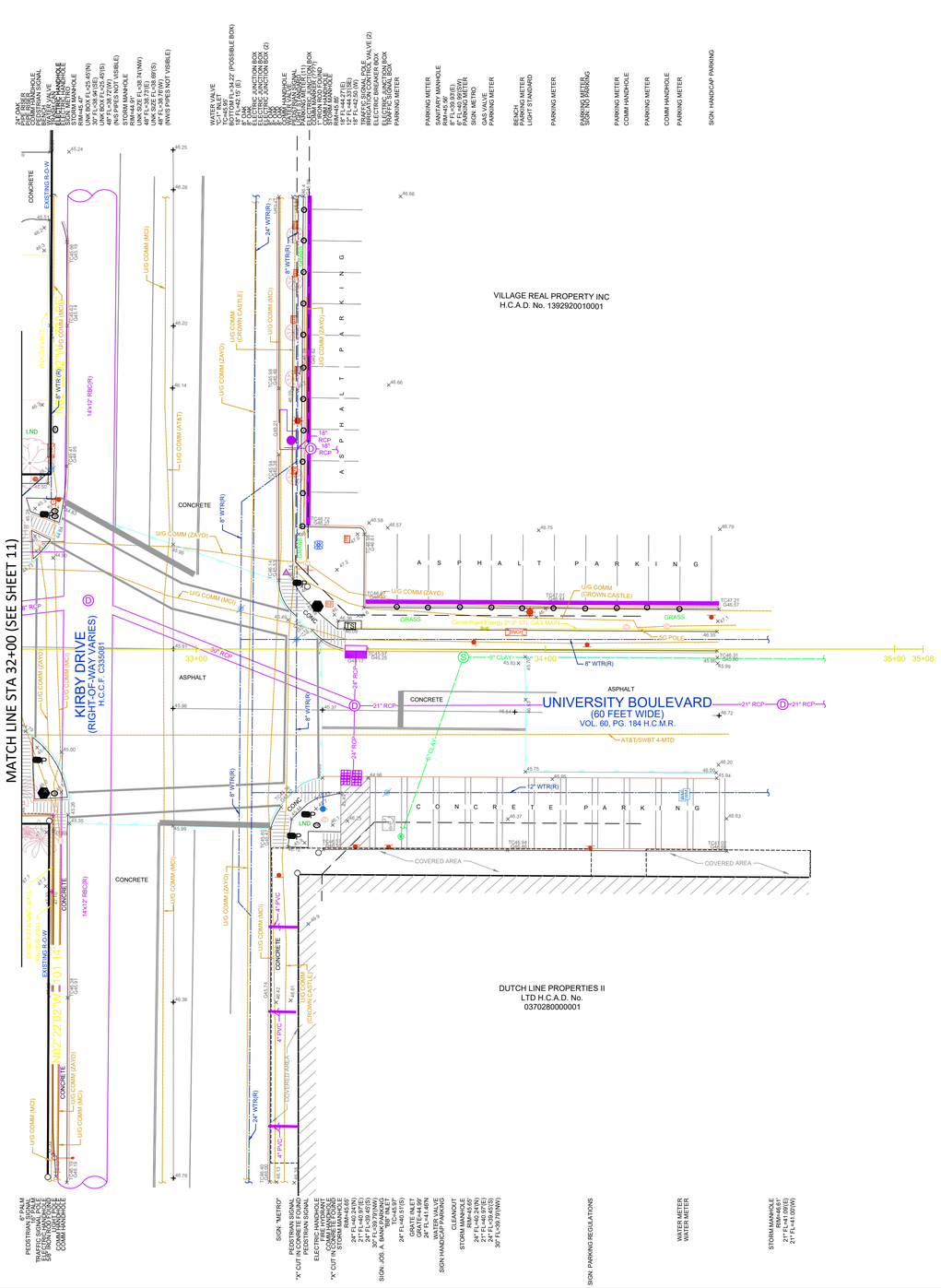
- BACK FLOW PREVENTER
- BB INLET
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- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
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- CREPE MYRTLE
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- FIRE HYDRANT
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- SIGN (SEE DESCRIPTION)
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- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
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- OVERHEAD TELEPHONE
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SITE BENCHMARK:

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W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	John Peterson, PE, CFM
PROJECT NUMBER	10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

University Blvd. Sta. 32+50 to Sta. 35+00

0 1" 2"

FILENAME

SCALE

SHEET 12 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

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NOTES:

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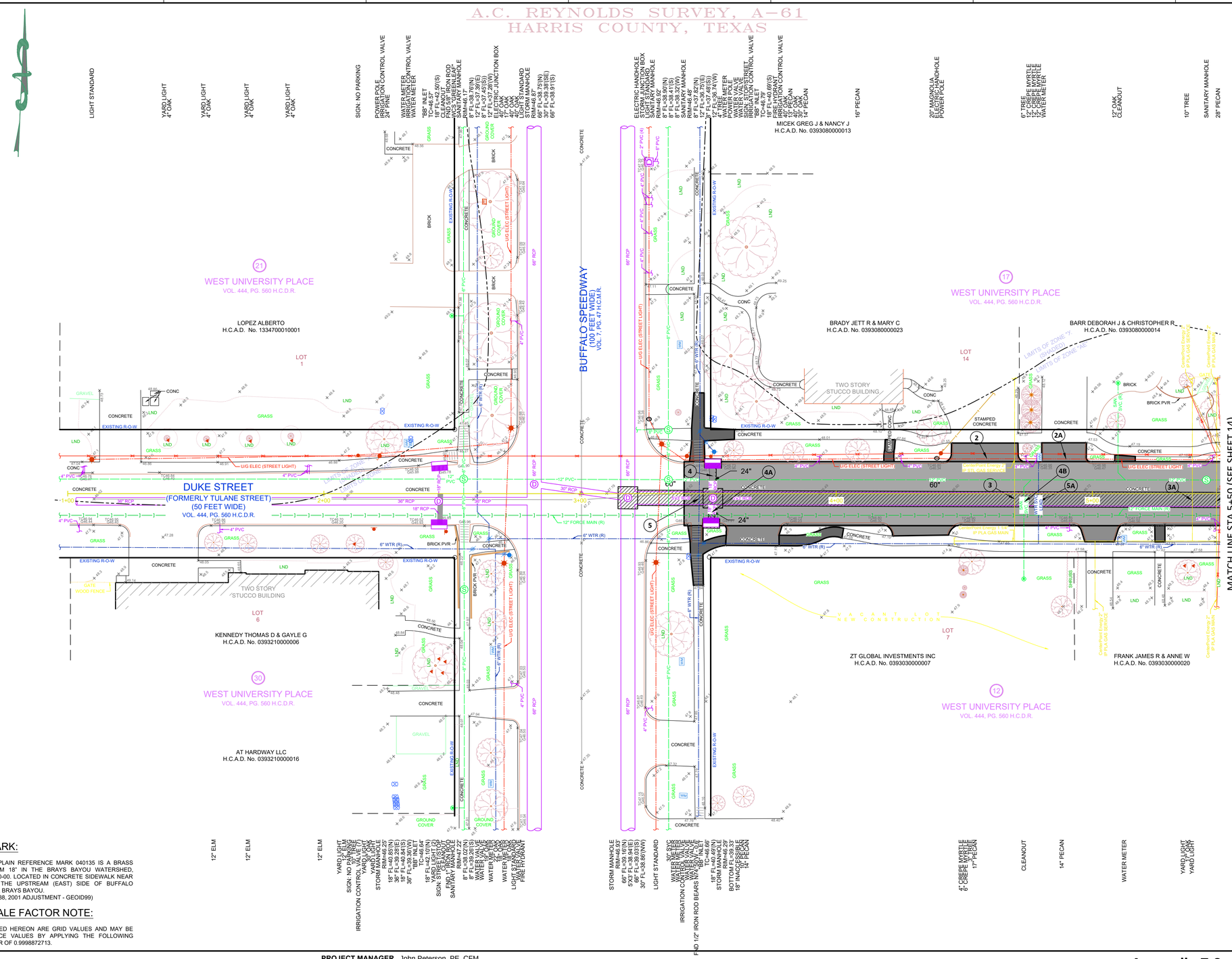
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WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

Duke St. Sta. 0+00 to Sta. 5+50

0 1" 2"

FILENAME

SCALE

SHEET 13 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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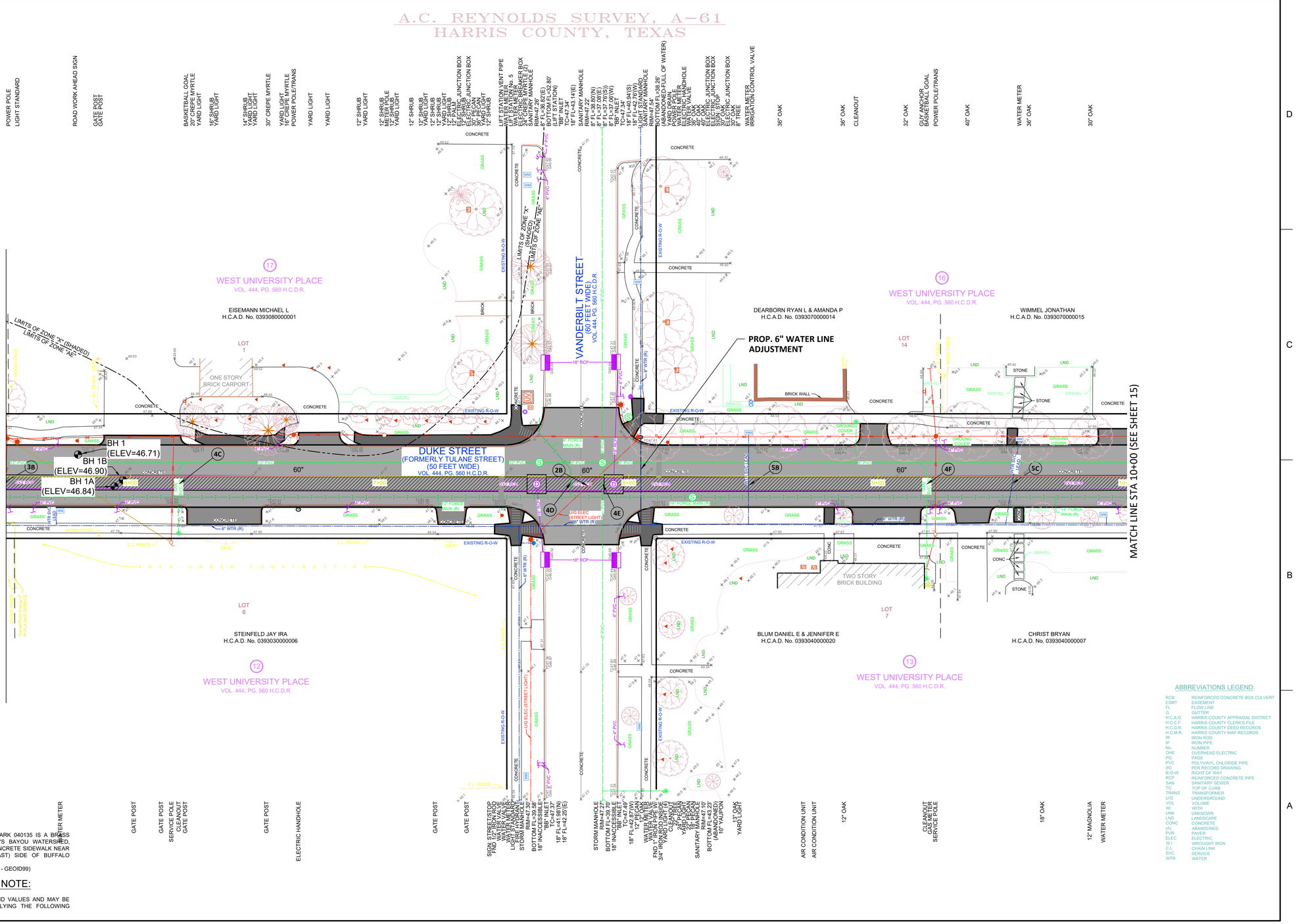
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MATCH LINE STA 5+50 (SEE SHEET 13)
MATCH LINE STA 10+00 (SEE SHEET 15)
VANDERBILT STREET (60 FEET WIDE) VOL. 444, PG. 560 H.C.D.R.
DUKE STREET (FORMERLY TULANE STREET) (50 FEET WIDE) VOL. 444, PG. 560 H.C.D.R.
17 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
16 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
12 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
13 WEST UNIVERSITY PLACE VOL. 444, PG. 560 H.C.D.R.
EISEMANN MICHAEL L H.C.A.D. No. 0393080000001
DEARBORN RYAN L & AMANDA P H.C.A.D. No. 0393070000014
WIMMEL JONATHAN H.C.A.D. No. 0393070000015
STEINFELD JAY IRA H.C.A.D. No. 0393030000006
BLUM DANIEL E & JENNIFER E H.C.A.D. No. 0393040000020
CHRIST BRYAN H.C.A.D. No. 0393040000007
PROP. 6" WATER LINE ADJUSTMENT
LIMITS OF ZONE "X" (SHADED)
LIMITS OF ZONE "AE"
ONE STORY BRICK CARPORT
TWO STORY BRICK BUILDING
BRICK WALL
STONE
A R E A U N D E R C O N S T R U C T I O N
BH 1 (ELEV=46.71)
BH 1B (ELEV=46.90)
BH 1A (ELEV=46.84)
LOT 1
LOT 6
LOT 7
LOT 14
60"
18" RCP
4" PVC
6" WTR (R)
2" WTR (R)
4" FORCE MAIN (R)
EXISTING R-O-W
C.L. FENCE
GATE
CONCRETE
GRASS
GRAVEL
LND
WOOD FENCE
BRICK
STONE
GROUND COVER
UG ELEC STREET LIGHT
SIGN, STREET/STOP
FND 1/2" IRON ROD
WATER VALVE
LIGHT STANDARD
STORM MANHOLE
BOTTOM FL=32.80'
18" INACCESSIBLE
"BB" INLET
TC=47.34'
18" FL=43.14(E)
18" FL=43.19(W)
SANITARY MANHOLE
RIM=47.22'
8" FL=38.80'(N)
8" FL=37.09'(E)
8" FL=37.78'(S)
8" FL=37.09'(W)
18" FL=40.34'(S)
18" FL=40.19'(W)
BOTTOM FL=38.26'
YARD DRAIN
WATER METER
WATER VALVE
45' OAK
30" OAK
ELECTRIC JUNCTION BOX
30" OAK
9" TREE
36" OAK
CLEANOUT
32" OAK
GUY ANCHOR
BASKETBALL GOAL
POWER POLE/TRANS
40" OAK
WATER METER
36" OAK
30" OAK
POWER POLE
LIGHT STANDARD
ROAD WORK AHEAD SIGN
GATE POST
GATE POST
BASKETBALL GOAL
20" CREPE MYRTLE
YARD LIGHT
16" SHRUB
YARD LIGHT
14" SHRUB
YARD LIGHT
30" CREPE MYRTLE
YARD LIGHT
30" CREPE MYRTLE
POWER POLE/TRANS
YARD LIGHT
YARD LIGHT
12" SHRUB
YARD LIGHT
12" SHRUB
12" SHRUB
12" SHRUB

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
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4. THIS TRACT LIES IN ZONE "X" (UNSHADED), DESIGNATED AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLA", ZONE "X" (SHADED), DESIGNATED AS "AREAS OF THE 0.2% ANNUAL CHANCE FLOOD; AREAS OF THE 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FORM 1% ANNUAL CHANCE FLOOD", AND ZONE "AE", DEFINED AS "SPECANIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 0.1% ANNUAL CHANCE FLOOD EVENT, WHERE THE BASE FLOOD ELEVATIONS ARE DETERMINED", AS PER THE NATIONAL FLOOD INSURANCE PROGRAM FIRM COMMUNITY PANEL NUMBER 4820102860L, LATEST AVAILABLE PUBLISHED REVISION DATED JUNE 18, 2017. THE BASE FLOOD ELEVATION IS 47.9 FEET.
5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
9. FENCES & TREES SHOWN HEREON ARE GRAPHIC, WITH DIMENSIONED TIES SHOWN AT SPECIFIC LOCATIONS WHERE THEY WERE PHYSICALLY MEASURED; THE FENCE LINES MAY MEANDER BETWEEN SAID LOCATIONS.
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SYMBOL LEGEND

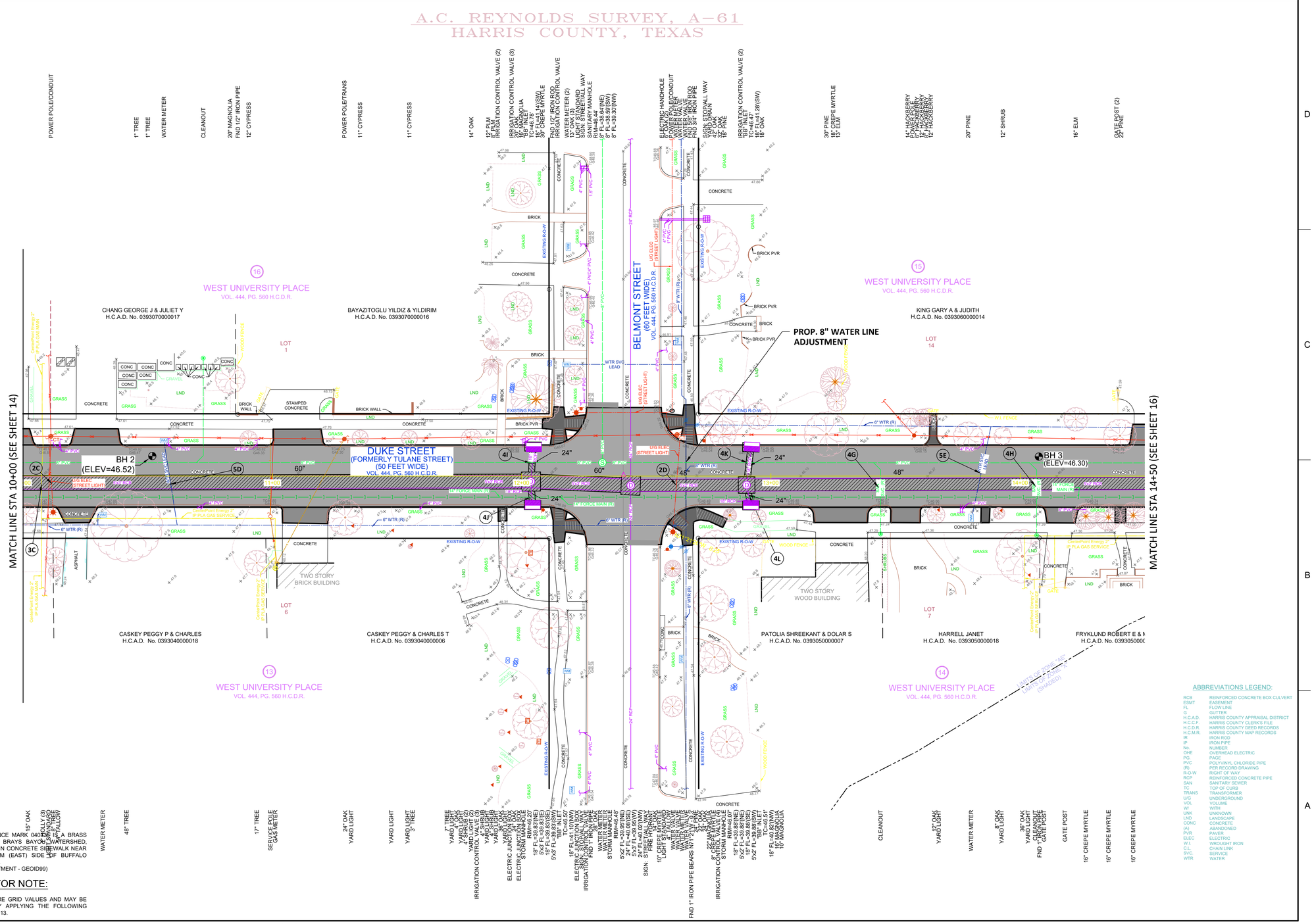
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 0401S "DUKE" A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
U/G	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

Duke St. Sta. 10+00 to Sta. 14+50

0 1" 2"

FILENAME

SCALE

SHEET 15 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

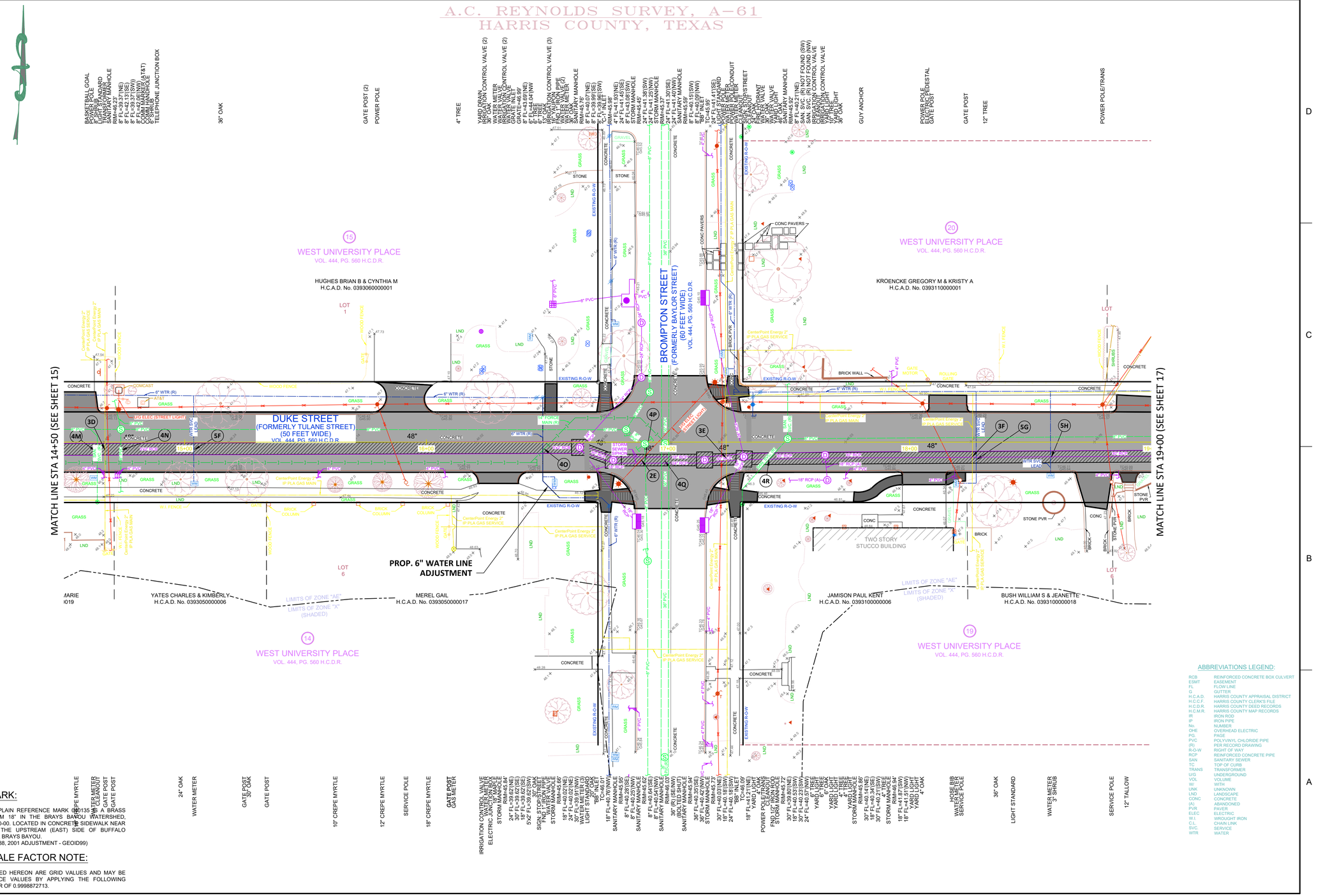
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK (RM) 130 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.


MATCH LINE STA 14+50 (SEE SHEET 15)
MATCH LINE STA 19+00 (SEE SHEET 17)
DUKE STREET
(FORMERLY TULANE STREET)
(50 FEET WIDE)
VOL. 444, PG. 560 H.C.D.R.
BROMPTON STREET
(FORMERLY BAYLOR STREET)
(60 FEET WIDE)
VOL. 444, PG. 560 H.C.D.R.
WEST UNIVERSITY PLACE
VOL. 444, PG. 560 H.C.D.R.
HUGHES BRIAN B & CYNTHIA M
H.C.A.D. No. 0393060000001
KROENCKE GREGORY M & KRISTY A
H.C.A.D. No. 0393110000001
YATES CHARLES & KIMBERLY
H.C.A.D. No. 0393050000006
MEREL GAIL
H.C.A.D. No. 0393050000017
JAMISON PAUL KENT
H.C.A.D. No. 0393100000006
BUSH WILLIAM S & JEANETTE
H.C.A.D. No. 0393100000018
PROP. 6" WATER LINE ADJUSTMENT
LIMITS OF ZONE "AE"
LIMITS OF ZONE "X" (SHADED)
TWO STORY STUCCO BUILDING
BRICK WALL
CONC PAVERS
WOOD FENCE
W.I. FENCE
CHAINLINK FENCE
STONE PVR
BRICK PVR
CONCRETE
STONE
GRASS
LND
GRAVEL
LOT 1
LOT 6
4P
4O
4Q
4R
3E
3F
5G
5H
3D
4M
4N
5F
2E
2F
2G
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2M
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8F
8G
8H

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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SYMBOL LEGEND

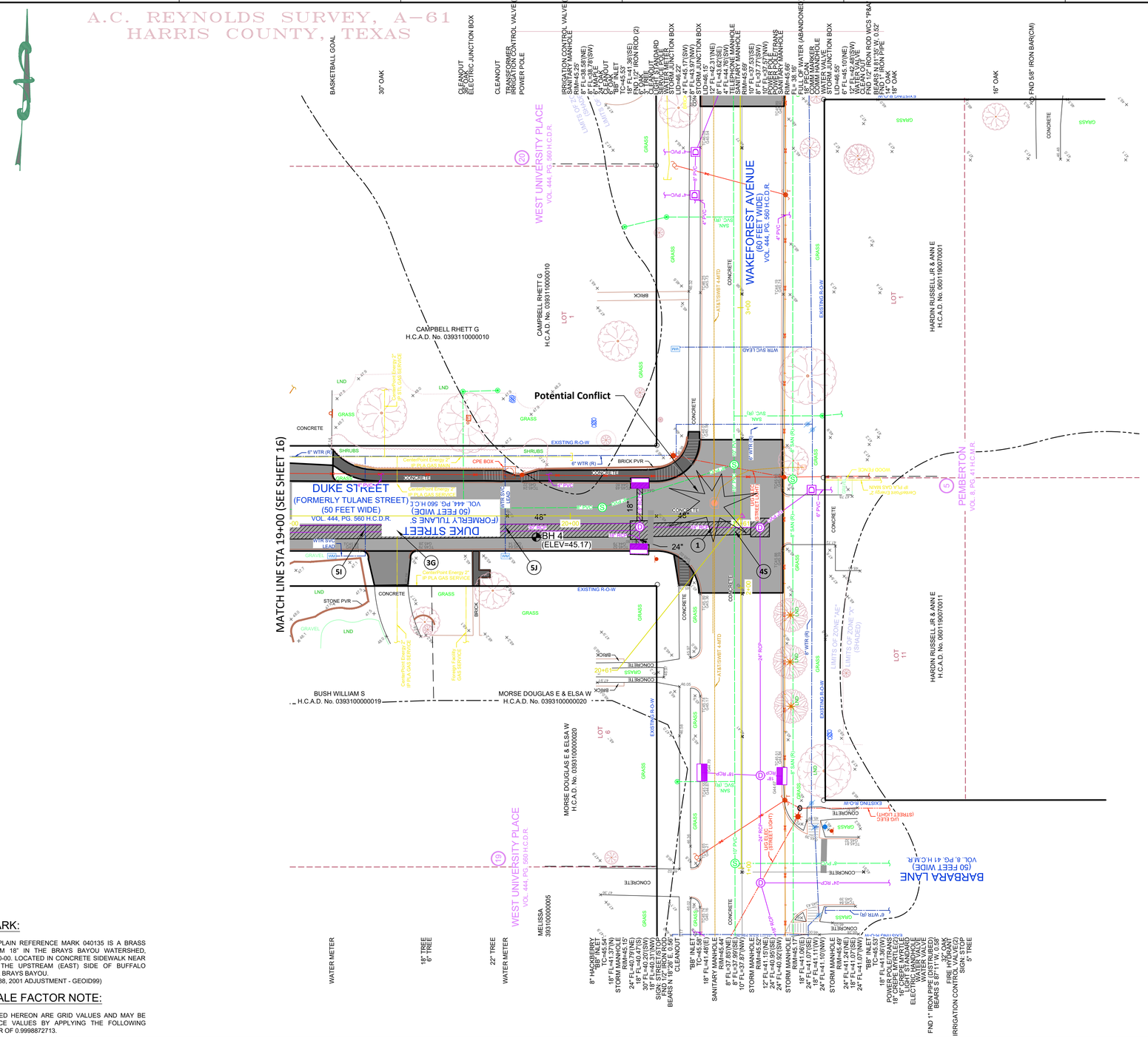
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
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- CABLE MARKER
- CAMERA
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- GAS VALVE
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- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
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- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TPB TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
UIG	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

Duke St. Sta. 19+00 to Sta. 20+61

0 1" 2"

FILENAME

SCALE

SHEET 17 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

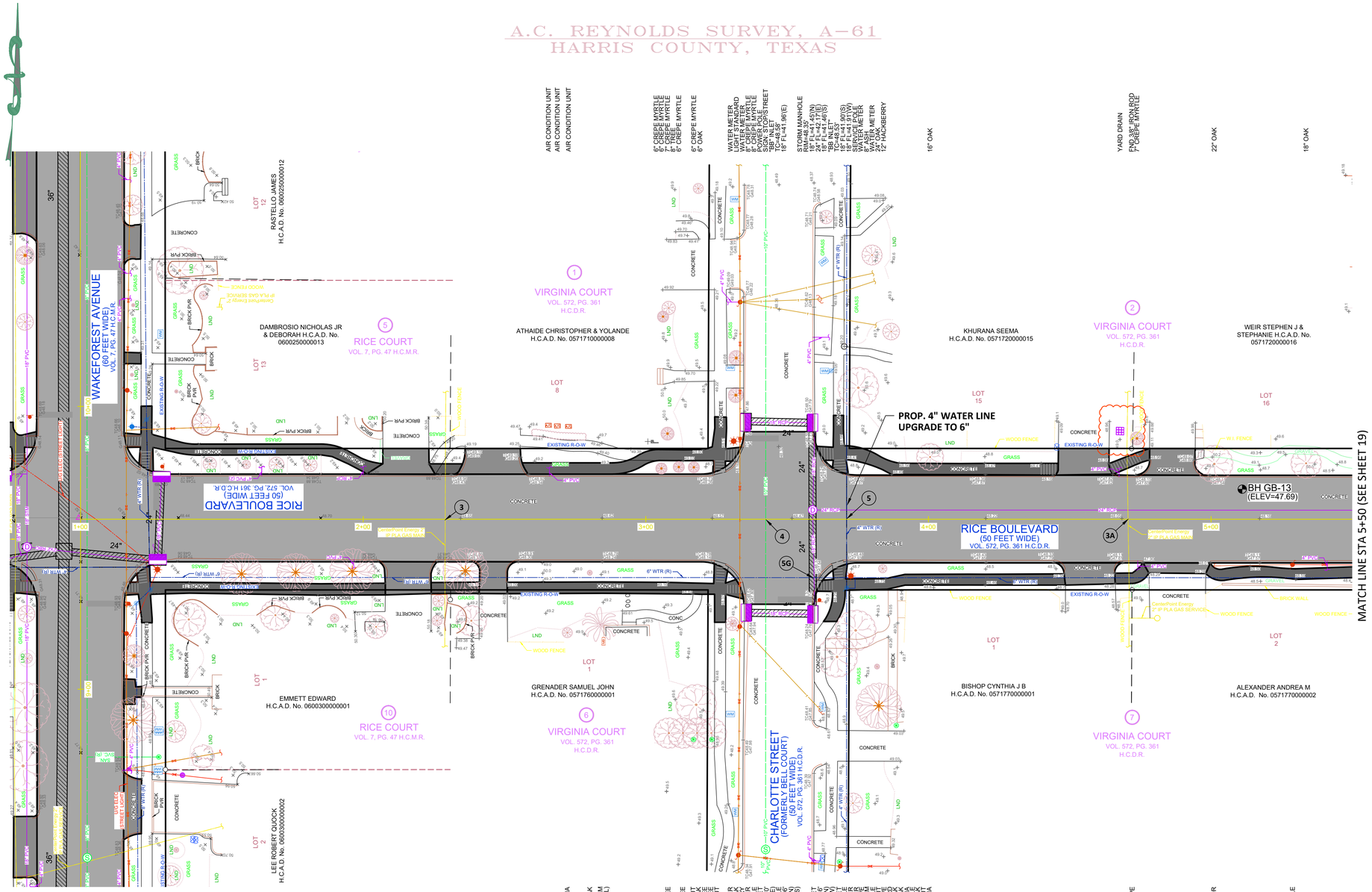
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5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
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SYMBOL LEGEND

- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- STORM MANHOLE
- BUSH
- TRASH CAN
- TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UNDERGROUND VAULT
- WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE



SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

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ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
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SVC.	SERVICE
WTR	WATER

		PROJECT MANAGER	John Peterson, PE, CFM
ISSUE	**DATE**	**DESCRIPTION**	**PROJECT NUMBER** 10283919

West University Place Drainage Improvements

Rice Blvd. Sta. 0+00 to Sta. 5+50

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 18 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

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- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
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- SIGN (SEE DESCRIPTION)
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- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TR TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
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- YARD DRAIN
- YARD LIGHT

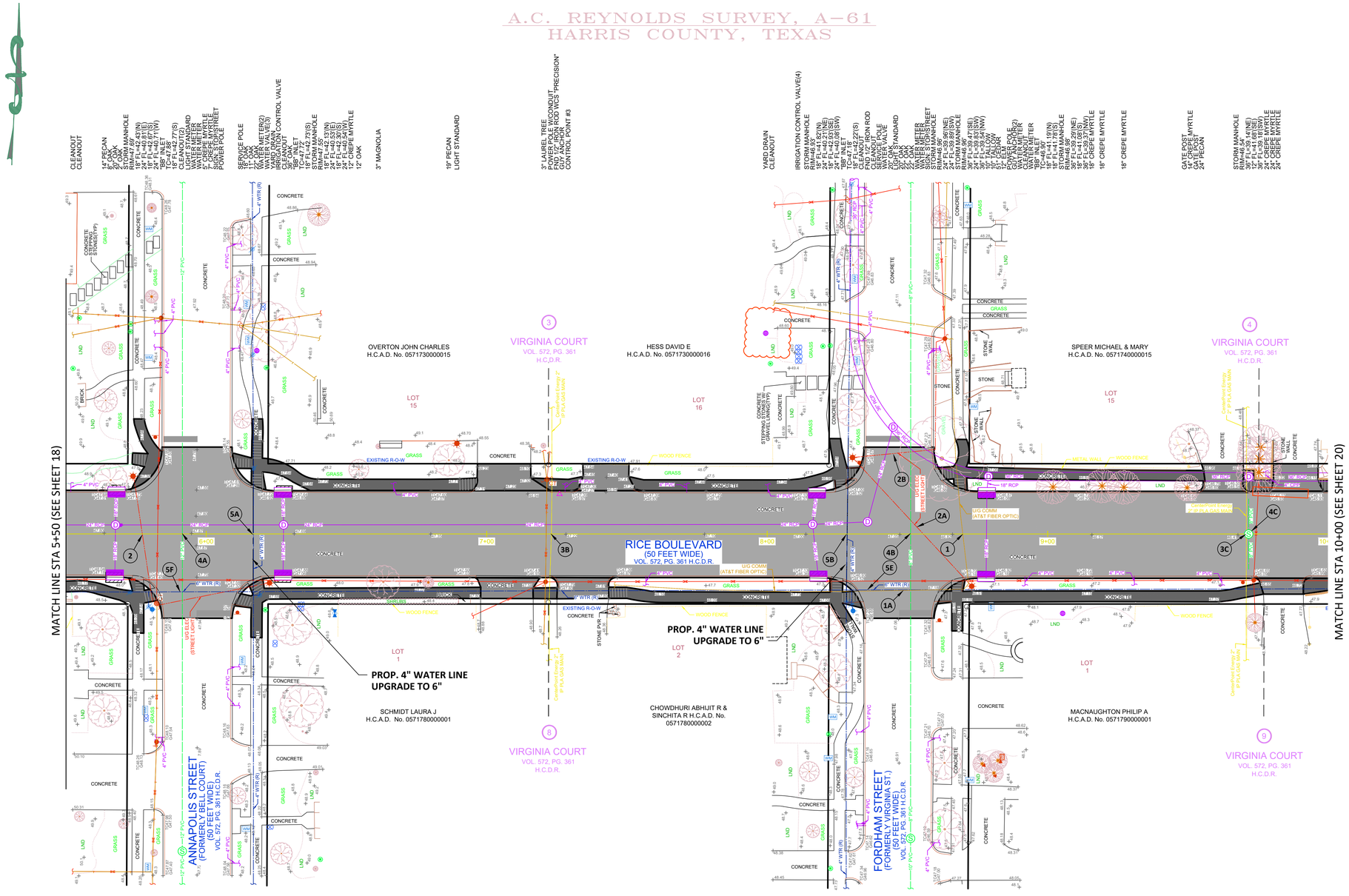
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

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WTR	WATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

Rice Blvd. Sta. 5+50 to Sta. 10+00

0 1" 2"

FILENAME

SCALE

SHEET 19 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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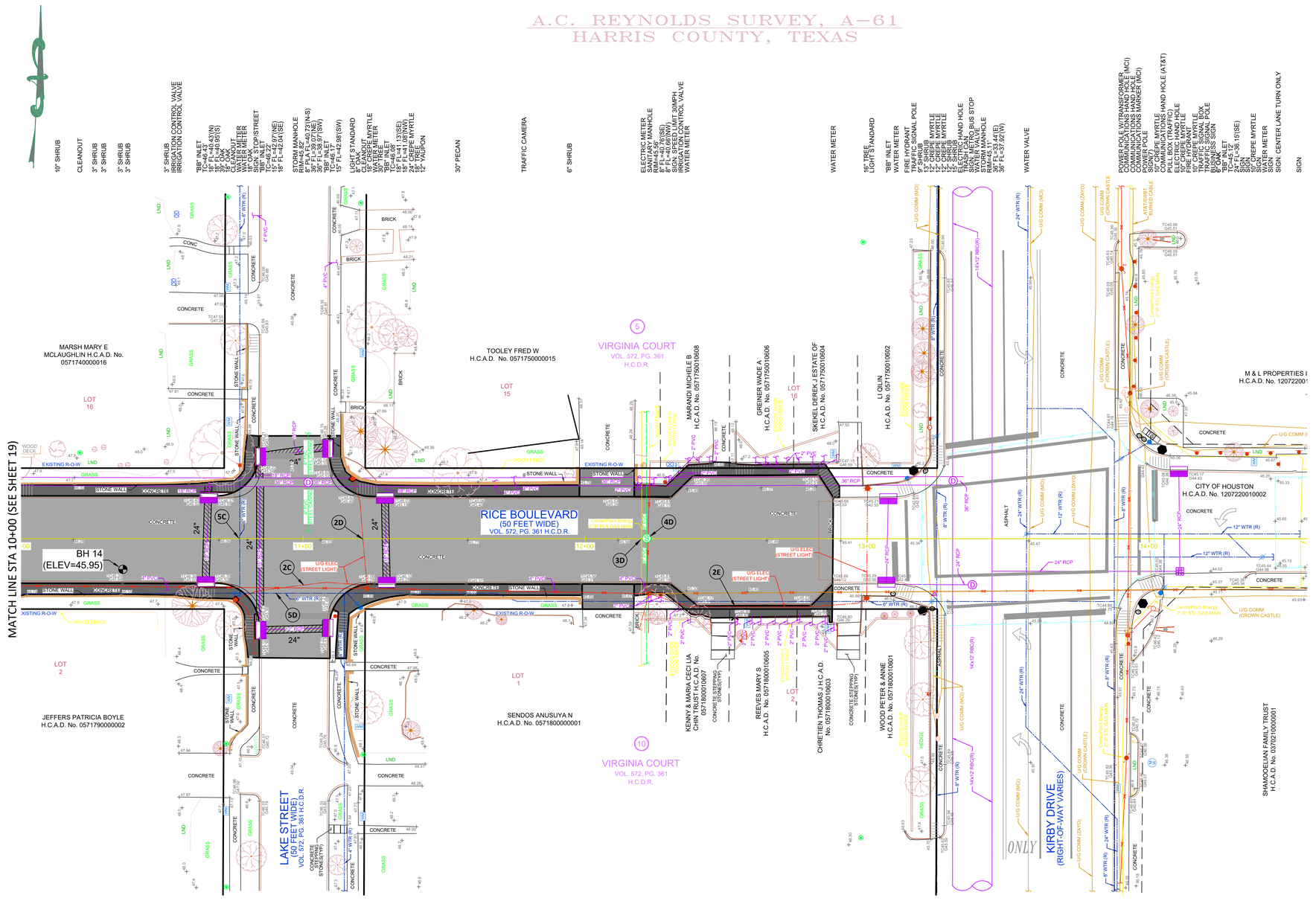
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PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

Rice Blvd. Sta. 10+00 to Sta. 14+50

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 20 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

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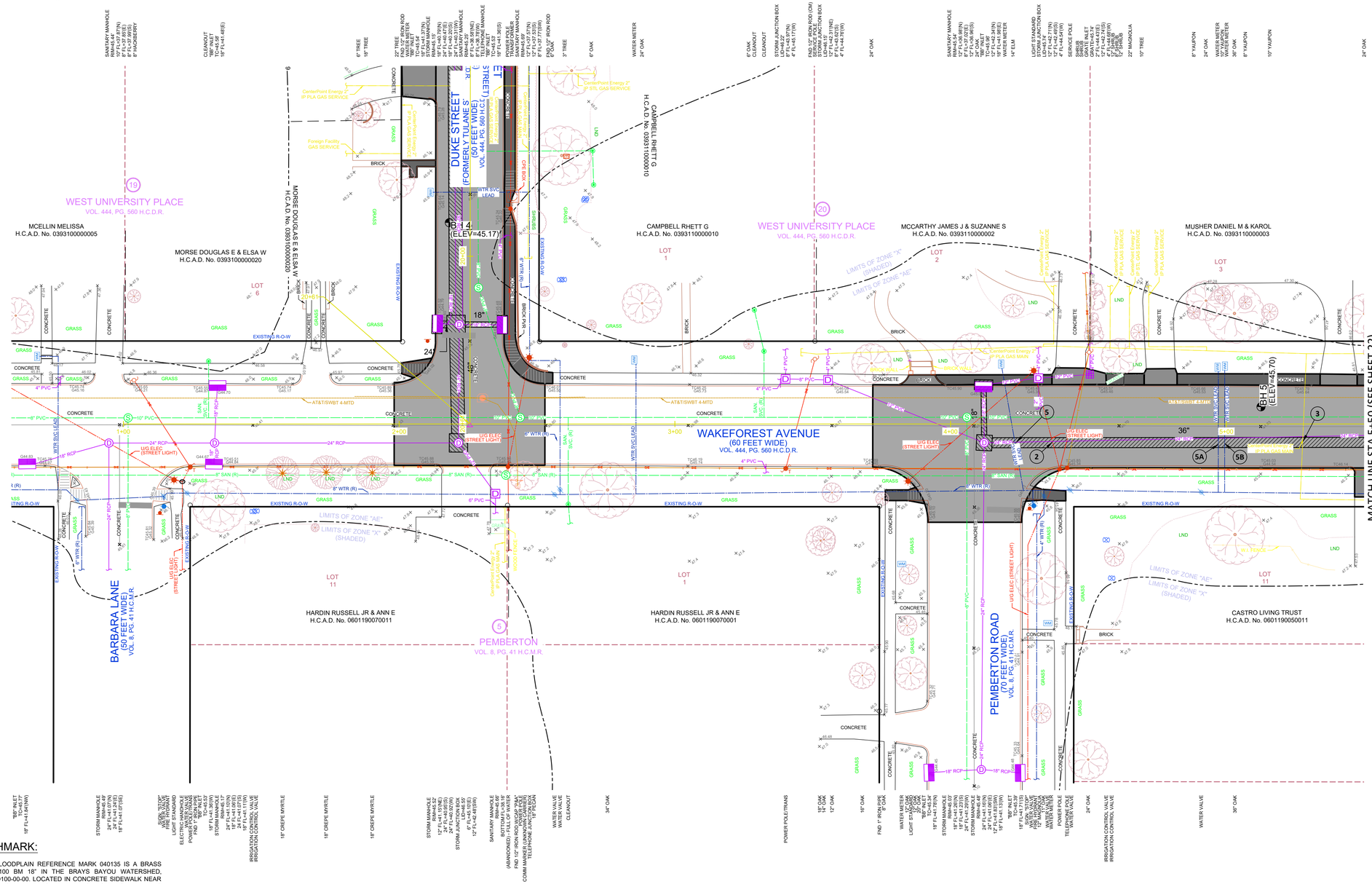
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PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

Appendix F-2 - Utility Conflict Plan

West University Place Drainage Improvements

S. Wakeforest St. Sta. 0+00 to Sta. 5+50

0 1" 2"

FILENAME

SCALE

SHEET 21 of 26

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

NOTES:

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5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
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SYMBOL LEGEND

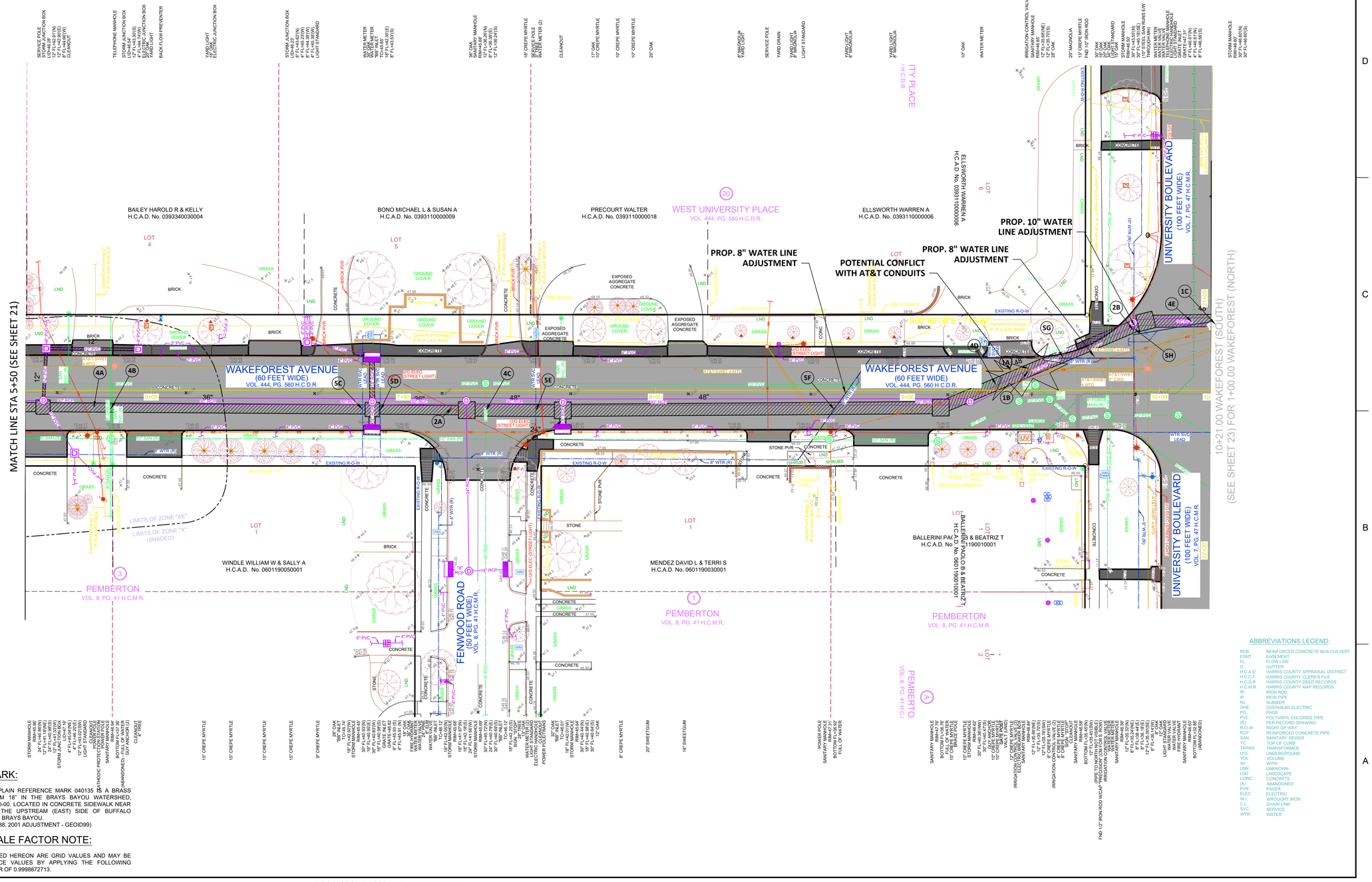
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TPB TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
UG	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements
S. Wakeforest St. Sta. 5+50 to Sta. 10+00

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 22 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

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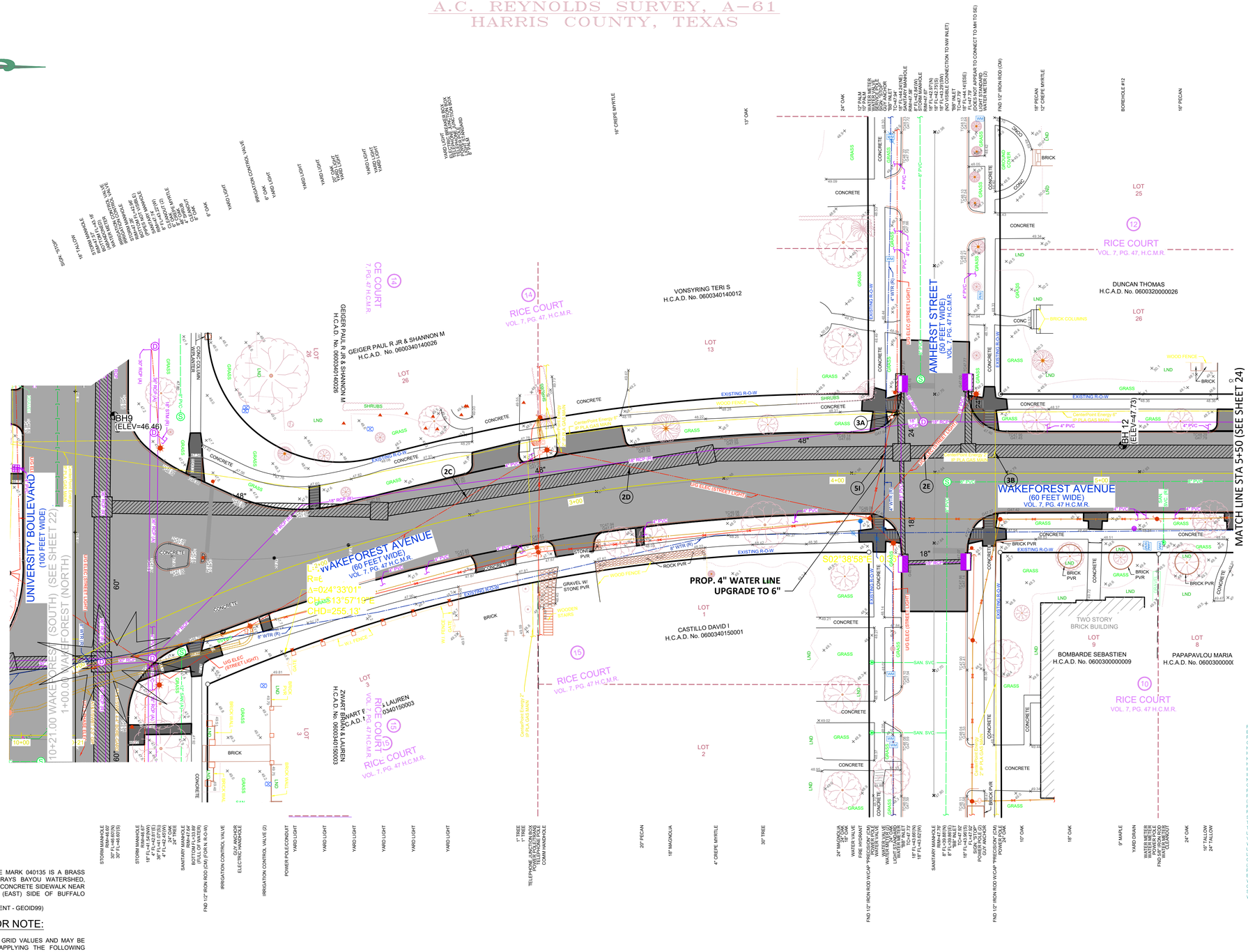
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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER John Peterson, PE, CFM

PROJECT NUMBER 10283919

West University Place Drainage Improvements
N. Wakeforest St. Sta. 1+00 to Sta.5+50

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 23 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

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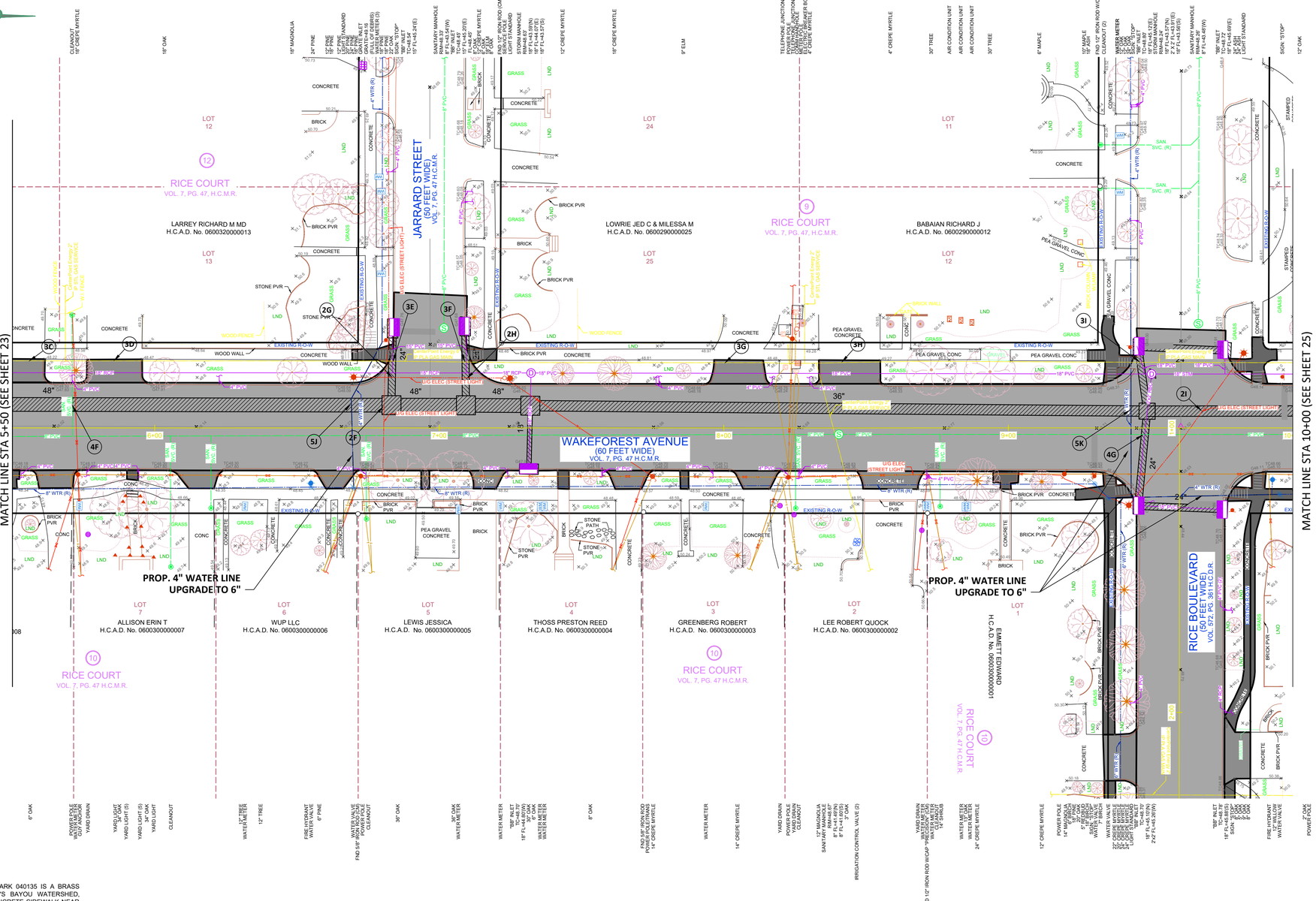
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PROJECT NUMBER 10283919

West University Place Drainage Improvements
N. Wakeforest St Sta. 5+50 to 10+00

Appendix F-2 - Utility Conflict Plan

0 1" 2"
FILENAME
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SHEET 24 of 26

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

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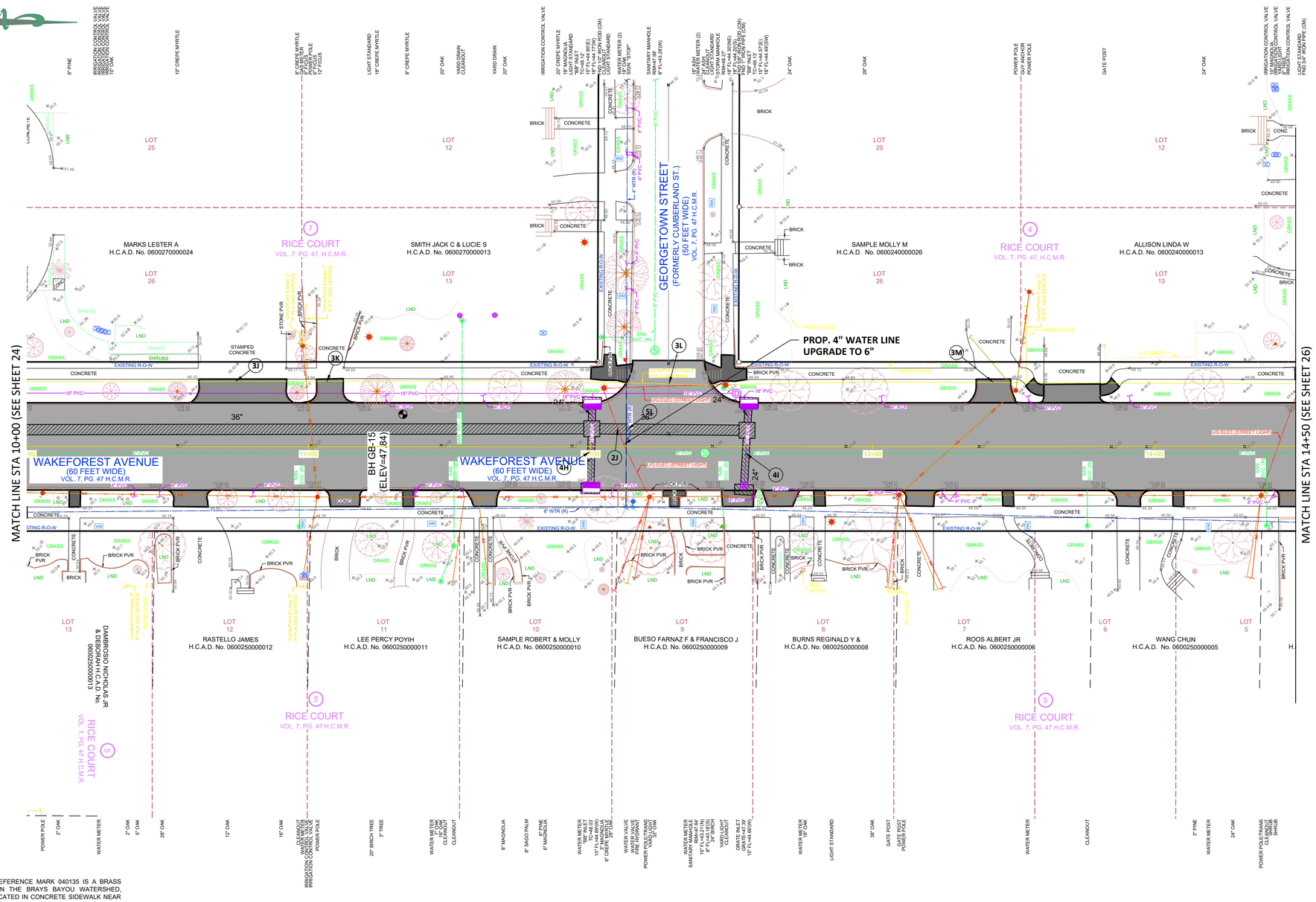
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MATCH LINE STA 10+00 (SEE SHEET 24)
MATCH LINE STA 14+50 (SEE SHEET 26)
WAKEFOREST AVENUE (60 FEET WIDE) VOL. 7, PG. 47 H.C.M.R.
GEORGETOWN STREET (FORMERLY CUMBERLAND ST.) (50 FEET WIDE) VOL. 7, PG. 47 H.C.M.R.
RICE COURT VOL. 7, PG. 47 H.C.M.R.
PROP. 4" WATER LINE UPGRADE TO 6"
BH GB-15 (ELEV=47.84)
MARKS LESTER A H.C.A.D. No. 0600270000024
SMITH JACK C & LUCIE S H.C.A.D. No. 0600270000013
SAMPLE MOLLY M H.C.A.D. No. 0600240000026
ALLISON LINDA W H.C.A.D. No. 0600240000013
DAMBROSIO NICHOLAS JR & DEBORAH H C.A.D. No. 0600250000013
RASTELLO JAMES H.C.A.D. No. 0600250000012
LEE PERCY POYIH H.C.A.D. No. 0600250000011
SAMPLE ROBERT & MOLLY H.C.A.D. No. 0600250000010
BUESO FARNAZ F & FRANCISCO J H.C.A.D. No. 0600250000009
BURNS REGINALD Y & H.C.A.D. No. 0600250000008
ROOS ALBERT JR H.C.A.D. No. 0600250000006
WANG CHUN H.C.A.D. No. 0600250000005
LOT 25
LOT 12
LOT 26
LOT 13
LOT 11
LOT 10
LOT 9
LOT 8
LOT 7
LOT 6
LOT 5
36"
24"
18" PVC
4" PVC
8" WTR (R)
6" PVC
EXISTING R-O-W
CONCRETE
GRASS
BRICK
BRICK PVR
WOOD FENCE
CHAIN LINK FENCE
UG ELEC (STREET LIGHT)
6" SAN SVC. (R)
6" SAN SVC. IN
6" SAN SVC. OUT
11+00
12+00
13+00
14+00
6" PVC
8" PVC
6" WTR (R)
4" PVC
4" WTR (R)
6" SAN SVC. (R)
6" SAN SVC. IN
6" SAN SVC. OUT

A.C. REYNOLDS SURVEY, A-61
HARRIS COUNTY, TEXAS

GRAPHIC SCALE

20 0 10 20

1 inch = 20 ft.

NOTES:

1. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE COMMITMENT. EASEMENTS AND RESTRICTIONS MAY EXIST WHICH ARE NOT REFERENCEDAR HEREON; NO ADDITIONAL RESEARCH REGARDING THE EXISTENCE OF EASEMENTS OR RESTRICTIONS OF RECORD HAS BEEN PERFORMED BY MBCO ENGINEERING LLC.
2. BEARINGS SHOWN HEREON BASED ON TEXAS COORDINATE SYSTEM OF 1983 (NAD83), SOUTH CENTRAL ZONE (No. 4204).
3. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD88 - 2001 ADJUSTMENT (GEOID18) GPS OBSERVATIONS AND HAVE BEEN ADJUSTED TO GEOID99 PER BENCHMARK NOTE.
4. THIS TRACT LIES IN ZONE "X" (UNSHADED), DESIGNATED AS "AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLA", ZONE "X" (SHADED), DESIGNATED AS "AREAS OF THE 0.2% ANNUAL CHANCE FLOOD; AREAS OF THE 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FORM 1% ANNUAL CHANCE FLOOD", AND ZONE "AE", DEFINED AS "SPECANIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 0.1% ANNUAL CHANCE FLOOD EVENT, WHERE THE BASE FLOOD ELEVATIONS ARE DETERMINED", AS PER THE NATIONAL FLOOD INSURANCE PROGRAM FIRM COMMUNITY PANEL NUMBER 48201C0860L, LATEST AVAILABLE PUBLISHED REVISION DATED JUNE 18, 2017. THE BASE FLOOD ELEVATION IS 47.9 FEET.
5. A ZONING REPORT WAS NOT PROVIDED AT THE TIME OF THIS SURVEY; HOWEVER, THERE IS NO ZONING IN THE CITY OF HOUSTON OR IN HARRIS COUNTY, TEXAS.
6. THERE ARE NO NATURAL DRAINAGE COURSES ON THE SUBJECT TRACT.
7. MINERAL RIGHTS AND/OR LEASE RIGHTS ARE NOT SURVEY RELATED AND THEREFORE NOT A PART OF THIS SURVEY.
8. SURFACE OR SUBSURFACE FAULTING, HAZARDOUS WASTE OR OTHER ENVIRONMENTAL ISSUES HAVE NOT BEEN ADDRESSED WITHIN THE SCOPE OF THIS SURVEY.
9. FENCES & TREES SHOWN HEREON ARE GRAPHIC, WITH DIMENSIONED TIES SHOWN AT SPECIFIC LOCATIONS WHERE THEY WERE PHYSICALLY MEASURED; THE FENCE LINES MAY MEANDER BETWEEN SAID LOCATIONS.
10. BURIED UTILITIES HAVE BEEN ROUTED BY CONNECTING VISIBLE SURFACE APPURTENANCES IN COMBINATION WITH RECORD DRAWING LOCATIONS. THERE MAY EXIST ADDITIONAL, BURIED UTILITIES WHICH HAVE NOT BEEN FIELD VERIFIED AND/OR REFERENCEDAR HEREON. THE CONTRACTOR SHOULD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES BEFORE COMMENCING CONSTRUCTION.

SYMBOL LEGEND

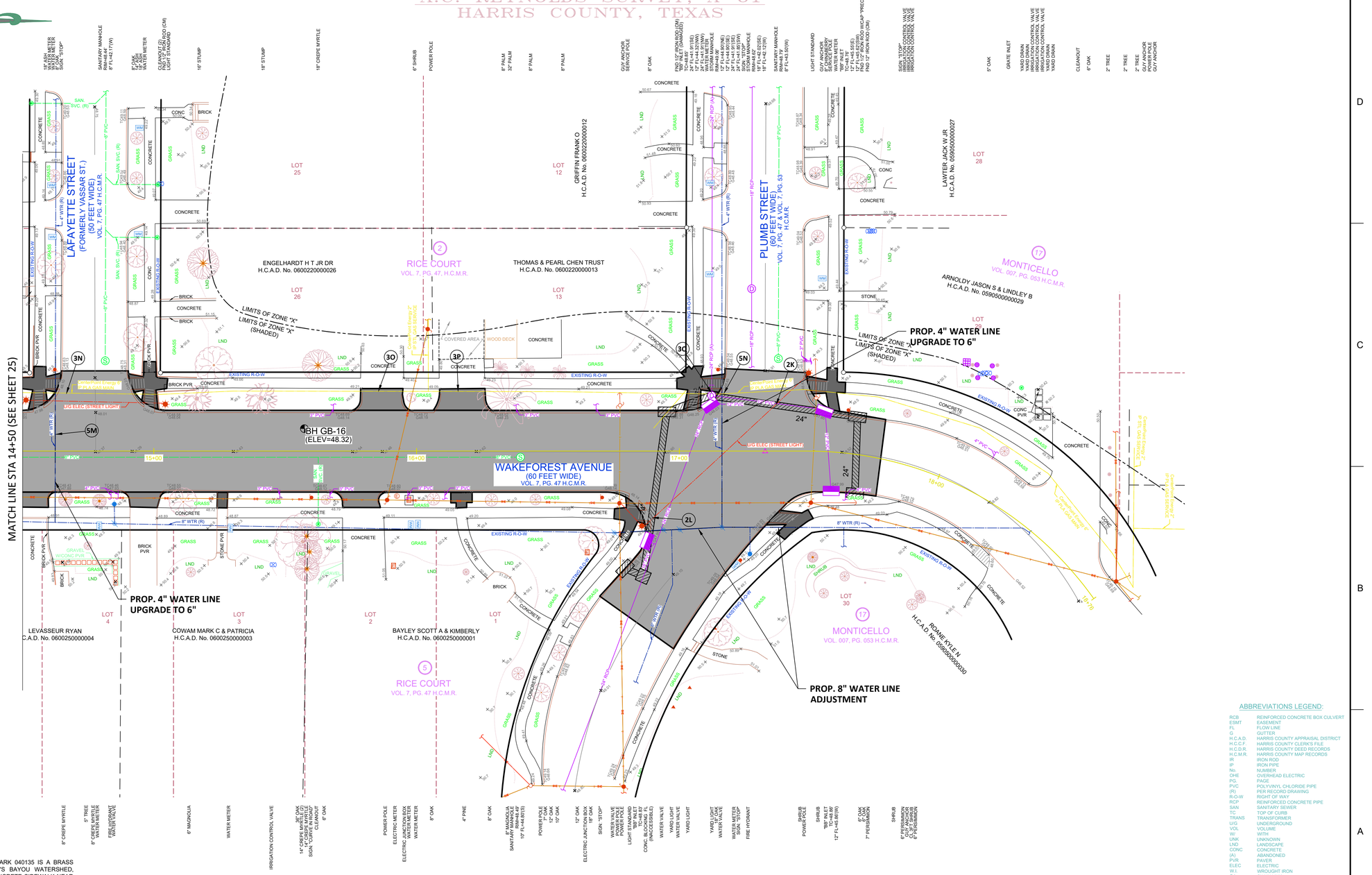
- BACK FLOW PREVENTER
- BB INLET
- BENCHMARK
- BOLLARD / POST
- BORE HOLE
- BRACE POLE
- BB BREAKER BOX
- "C1" INLET
- CABLE MARKER
- CAMERA
- CLEAN OUT
- CREPE MYRTLE
- ELECTRIC JUNCTION BOX
- FIRE HYDRANT
- FLAG POLE
- GAS VALVE
- GRATE INLET
- GUY ANCHOR
- C COMMUNICATIONS HANDHOLE
- IRRIGATION CONTROL VALVE
- FOUND IRON ROD / NAIL / "X" (SEE DESCRIPTION)
- LIGHT STANDARD
- METER POLE
- PED SIGNAL
- PARKING METER
- POWER POLE
- POWER POLE W/ CONDUIT
- POWER POLE W/ TRNSFRM
- PVC RISER
- S SANITARY MANHOLE
- SWBT/ATT MANHOLE
- SERVICE POLE
- SIGN (SEE DESCRIPTION)
- LIGHT POLE
- D STORM MANHOLE
- BUSH
- TRASH CAN
- TS TRAFFIC CONTROL BOX
- TRAFFIC SIGNAL POLE
- TPB TRAFFIC PULL BOX
- TREE (SEE DESCRIPTION)
- TREE PALM
- UV UNDERGROUND VAULT
- WM WATER METER
- WATER VALVE
- YARD DRAIN
- YARD LIGHT
- CHAINLINK FENCE
- OVERHEAD TELEPHONE
- OVERHEAD ELECTRIC
- WOOD FENCE
- WROUGHT IRON FENCE

SITE BENCHMARK:

HARRIS COUNTY FLOODPLAIN REFERENCE MARK 040135 IS A BRASS DISK STAMPED "D100 BM 18" IN THE BRAYS BAYOU WATERSHED, STREAM NUMBER D100-00-00. LOCATED IN CONCRETE SIDEWALK NEAR METAL GUARDRAIL ON THE UPSTREAM (EAST) SIDE OF BUFFALO SPEEDWAY BRIDGE OVER BRAYS BAYOU.
ELEVATION = 49.48 (NAVD88, 2001 ADJUSTMENT - GEOID99)

COMBINED SCALE FACTOR NOTE:

COORDINATE REFERENCED HEREON ARE GRID VALUES AND MAY BE CONVERTED TO SURFACE VALUES BY APPLYING THE FOLLOWING COMBINED SCALE FACTOR OF 0.9998872713.



ABBREVIATIONS LEGEND:

RCB	REINFORCED CONCRETE BOX CULVERT
ESMT	EASEMENT
FL	FLOW LINE
G	GUTTER
H.C.A.D.	HARRIS COUNTY APPRAISAL DISTRICT
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
H.C.M.R.	HARRIS COUNTY MAP RECORDS
IR	IRON ROD
IP	IRON PIPE
No.	NUMBER
OHE	OVERHEAD ELECTRIC
PG.	PAGE
PVC	POLYVINYL CHLORIDE PIPE
(R)	PER RECORD DRAWING
R-O-W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
SAN	SANITARY SEWER
TC	TOP OF CURB
TRANS	TRANSFORMER
UG	UNDERGROUND
VOL	VOLUME
W	WITH
UNK	UNKNOWN
LND	LANDSCAPE
CONC	CONCRETE
(A)	ABANDONED
PVR	PAVER
ELEC	ELECTRIC
W.I.	WROUGHT IRON
C.L.	CHAIN LINK
SVC.	SERVICE
WTR	WATER

PROJECT MANAGER John Peterson, PE, CFM

ISSUE	DATE	DESCRIPTION

PROJECT NUMBER 10283919

West University Place Drainage Improvements

N. Wakeforest St. Sta.14+50 to Sta. 19+00

Appendix F-2 - Utility Conflict Plan

0 1" 2"

FILENAME

SCALE

SHEET 26 of 26

West University East Side PER

October 2021

Appendix F-3 - University Boulevard Utility Conflict Matrix

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
Telephone																			
1	4-4" Bore Gard	AT&T	Crossing	21+11	21+11	Storm Sewer	Critical Locate											Potential	
1A	2-3" GIP	AT&T	Crossing	21+18	21+18	Storm Sewer	Critical Locate											Potential	
1B	U/G Comm	MCI	Crossing	32+44	32+44	Storm Sewer												Potential	
Power																			
2	UG Elec. Street Light	CenterPoint	Crossing	8+56	8+56	Storm Sewer												Potential	
2A	UG Elec. Street Light	CenterPoint	Crossing	13+19	13+19	Roadway												Potential	
2B	UG Elec. Street Light	CenterPoint	Crossing	20+98	20+98	Storm Sewer												Potential	
2C	UG Elec. Street Light	CenterPoint	Longitudinal	25+20	25+47	Roadway												Potential	
2D	UG Elec. Street Light	CenterPoint	Crossing	26+14	26+14	Storm Sewer												Potential	
2E	UG Elec. Street Light	CenterPoint	Longitudinal	30+16	30+50	Roadway												Potential	
Natural Gas																			
3	6" IP PLA Gas Main	CenterPoint	Crossing	20+30	20+30	Storm Sewer												Potential	
Sanitary Sewer																			
4	6" Force Main	West University Place	Crossing	13+58	13+58	Storm Sewer												Potential	
4A	12" PVC San Swr	West University Place	Crossing	21+58	21+58	Storm Sewer												Potential	
4B	12" PVC San Swr	West University Place	Crossing	21+82	21+82	Storm Sewer												Potential	
4C	8" PVC San Swr	West University Place	Crossing	27+64	27+64	Storm Sewer												Potential	
4D	8" PVC San Swr	West University Place	Longitudinal	30+14	30+51	Roadway												Potential	
Water																			
5	Wtr Svc Lead	West University Place	Crossing	4+71	4+71	Storm Sewer												Potential	
5A	Wtr Svc Lead	West University Place	Crossing	5+03	5+03	Storm Sewer												Potential	
5B	Wtr Svc Lead	West University Place	Crossing	5+30	5+30	Storm Sewer												Potential	
5C	Wtr Svc Lead	West University Place	Crossing	6+05	6+05	Storm Sewer												Potential	
5D	Wtr Svc Lead	West University Place	Crossing	6+79	6+79	Storm Sewer												Potential	
5E	Wtr Svc Lead	West University Place	Crossing	7+71	7+71	Storm Sewer												Potential	
5F	Wtr Svc Lead	West University Place	Crossing	7+77	7+77	Storm Sewer												Potential	
5G	Wtr Svc Lead	West University Place	Crossing	8+29	8+29	Storm Sewer												Potential	
5H	Wtr Svc Lead	West University Place	Crossing	9+86	9+86	Storm Sewer												Potential	
5I	Wtr Svc Lead	West University Place	Crossing	10+62	10+62	Storm Sewer												Potential	
5J	Wtr Svc Lead	West University Place	Crossing	12+40	12+40	Storm Sewer												Potential	
5K	6" Water	West University Place	Crossing	13+39	13+39	Storm Sewer	Line Adjustmant											Potential	
5L	Wtr Svc Lead	West University Place	Crossing	14+51	14+51	Storm Sewer												Potential	
5M	Wtr Svc Lead	West University Place	Crossing	14+54	14+54	Storm Sewer												Potential	
5N	Wtr Svc Lead	West University Place	Crossing	15+04	15+04	Storm Sewer												Potential	

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
5O	Wtr Svc Lead	West University Place	Crossing	16+28	16+28	Storm Sewer												Potential	
5P	Wtr Svc Lead	West University Place	Crossing	16+74	16+74	Storm Sewer												Potential	
5Q	Wtr Svc Lead	West University Place	Crossing	17+09	17+09	Storm Sewer												Potential	
5R	Wtr Svc Lead	West University Place	Crossing	18+10	18+10	Storm Sewer												Potential	
5S	Wtr Svc Lead	West University Place	Crossing	18+59	18+59	Storm Sewer												Potential	
5T	Wtr Svc Lead	West University Place	Crossing	19+53	19+53	Storm Sewer												Potential	
5U	8" Water	West University Place	Crossing	21+06	21+06	Storm Sewer	Line Adjustment											Potential	
5V	Wtr Svc Lead	West University Place	Crossing	21+53	21+53	Storm Sewer												Potential	
5W	4" Water	West University Place	Crossing	25+39	25+39	Storm Sewer	Line Upgrade to 6"											Potential	
5X	4" Water	West University Place	Crossing	30+56	30+56	Storm Sewer	Line Upgrade to 6"											Potential	
5Y	6" Water	West University Place	Crossing	32+12	32+12	Storm Sewer	Line Upgrade to 8"											Potential	

Confirmed Conflicts	**0**	YES
Potential Conflicts	**38**	POTENTIAL
Cleared Conflicts	**0**	NO

West University PER

October 2021

Appendix F-4 - Duke Street Utility Conflict Matrix

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
Telephone																			
1	4-MTD	AT&T	Crossing	20+51	20+51	Storm Sewer	Critical Locate											Potential	
Power																			
2	UG Elec. Street Light	CenterPoint	Longitudinal	4+41	4+71	Driveway												Potential	
2A	UG Elec. Street Light	CenterPoint	Longitudinal	4+79	4+98	Driveway												Potential	
2B	UG Elec. Street Light	CenterPoint	Crossing	7+84	7+84	Storm Sewer												Potential	
2C	UG Elec. Street Light	CenterPoint	Crossing	10+10	10+10	Storm Sewer												Potential	
2D	UG Elec. Street Light	CenterPoint	Crossing	12+62	12+62	Storm Sewer												Potential	
2E	UG Elec. Street Light	CenterPoint	Crossing	16+88	16+88	Storm Sewer												Potential	
Natural Gas																			
3	2" IP STL Gas Main	CenterPoint	Crossing	4+69	4+69	Storm Sewer												Potential	
3A	2" IP PLA Gas Main	CenterPoint	Crossing	5+39	5+39	Storm Sewer												Potential	
3B	2" IP PLA Gas Main	CenterPoint	Crossing	5+48	5+48	Storm Sewer												Potential	
3C	2" IP PLA Gas Main	CenterPoint	Crossing	10+08	10+08	Storm Sewer												Potential	
3D	2" IP PLA Gas Main	CenterPoint	Crossing	14+65	14+65	Storm Sewer												Potential	
3E	2" IP PLA Gas Main	CenterPoint	Crossing	17+23	17+23	Storm Sewer												Potential	
3F	2" IP PLA Gas Main	CenterPoint	Crossing	18+25	18+25	Storm Sewer												Potential	
3G	2" IP PLA Gas Main	CenterPoint	Crossing	19+37	19+37	Storm Sewer												Potential	
Sanitary Sewer																			
4	12" PVC San Swr	West University Place	Crossing	3+50	3+50	Storm Sewer												Potential	
4A	12" Force Main	West University Place	Crossing	3+50	3+50	Storm Sewer												Potential	
4B	4" PVC San Svc.	West University Place	Crossing	4+73	4+73	Storm Sewer												Potential	
4C	4" PVC San Svc.	West University Place	Crossing	6+18	6+18	Storm Sewer												Potential	
4D	6" Force Main	West University Place	Crossing	7+76	7+76	Storm Sewer												Potential	
4E	8" PVC San Swr	West University Place	Crossing	7+89	7+89	Storm Sewer												Potential	
4F	4" PVC San Svc.	West University Place	Crossing	9+18	9+18	Storm Sewer												Potential	
4G	4" PVC San Svc.	West University Place	Crossing	13+45	13+45	Storm Sewer												Potential	
4H	4" PVC San Svc.	West University Place	Crossing	14+05	14+05	Storm Sewer												Potential	
4I	8" PVC San Swr	West University Place	Crossing	12+03	12+03	Storm Sewer												Potential	
4J	14" Force Main	West University Place	Crossing	12+03	12+03	Storm Sewer												Potential	
4K	8" PVC San Swr	West University Place	Crossing	12+90	12+90	Storm Sewer												Potential	
4L	14" Force Main	West University Place	Crossing	12+90	12+90	Storm Sewer												Potential	
4M	4" PVC San Svc.	West University Place	Crossing	14+62	14+62	Storm Sewer												Potential	
4N	8" PVC San Swr	West University Place	Crossing	14+74	14+74	Storm Sewer												Potential	

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
4O	14" Force Main	West University Place	Crossing	16+49	16+49	Storm Sewer												Potential	
4P	8" PVC San Swr	West University Place	Crossing	16+90	16+90	Storm Sewer												Potential	
4Q	36" PVC San Swr	West University Place	Crossing	16+98	16+98	Storm Sewer												Potential	
4R	4" PVC San Svc.	West University Place	Crossing	17+41	17+41	Storm Sewer												Potential	
4S	10" PVC San Swr.	West University Place	Crossing	20+15	20+15	Storm Sewer												Potential	
Water																			
5	6" Water	West University Place	Crossing	3+46	3+46	Storm Sewer												Potential	
5A	Wtr Svc Lead	West University Place	Crossing	4+78	4+78	Storm Sewer												Potential	
5B	Wtr Svc Lead	West University Place	Crossing	8+49	8+49	Storm Sewer												Potential	
5C	Wtr Svc Lead	West University Place	Crossing	9+53	9+53	Storm Sewer												Potential	
5D	Wtr Svc Lead	West University Place	Crossing	10+58	10+58	Storm Sewer												Potential	
5E	Wtr Svc Lead	West University Place	Crossing	13+83	13+83	Storm Sewer												Potential	
5F	Wtr Svc Lead	West University Place	Crossing	15+04	15+04	Storm Sewer												Potential	
5G	Wtr Svc Lead	West University Place	Crossing	18+27	18+27	Storm Sewer												Potential	
5H	Wtr Svc Lead	West University Place	Crossing	18+58	18+58	Storm Sewer												Potential	
5I	Wtr Svc Lead	West University Place	Crossing	19+27	19+27	Storm Sewer												Potential	
5J	Wtr Svc Lead	West University Place	Crossing	19+76	19+76	Storm Sewer												Potential	

Confirmed Conflicts	**0**	YES
Potential Conflicts	**45**	POTENTIAL
Cleared Conflicts	**0**	NO

West University East Side PER

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Appendix F-5 - Rice Boulevard Utility Conflict Matrix

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
Telephone																			
1	U/G Comm Fiber Optic	AT&T	Crossing	8+70	8+70	Roadway												Potential	
1A	U/G Comm Fiber Optic	AT&T	Longitudinal	8+30	8+60	Roadway												Potential	
Power																			
2	UG Elec. Street Light	CenterPoint	Crossing	5+75	5+75	Roadway												Potential	
2A	UG Elec. Street Light	CenterPoint	Crossing	8+50	8+50	Roadway												Potential	
2B	UG Elec. Street Light	CenterPoint	Longitudinal	8+30	8+60	Roadway												Potential	
2C	UG Elec. Street Light	CenterPoint	Crossing	10+78	11+17	Roadway												Potential	
2D	UG Elec. Street Light	CenterPoint	Crossing	11+21	11+21	Roadway												Potential	
2E	UG Elec. Street Light	CenterPoint	Longitudinal	12+36	12+83	Roadway												Potential	
Natural Gas																			
3	2" IP PLA Gas Main	CenterPoint	Crossing	2+29	2+29	Roadway												Potential	
3A	2" IP PLA Gas Main	CenterPoint	Crossing	4+70	4+70	Roadway												Potential	
3B	2" IP PLA Gas Main	CenterPoint	Crossing	7+22	7+22	Roadway												Potential	
3C	2" IP PLA Gas Main	CenterPoint	Crossing	9+69	9+69	Roadway												Potential	
3D	2" IP PLA Gas Main	CenterPoint	Crossing	12+19	12+19	Roadway												Potential	
Sanitary Sewer																			
4	10" PVC San Swr	West University Place	Crossing	3+41	3+41	Roadway												Potential	
4A	12" PVC San Svc.	West University Place	Crossing	5+90	5+90	Roadway												Potential	
4B	8" PVC San Swr	West University Place	Crossing	8+50	8+50	Roadway												Potential	
4C	8" PVC San Swr	West University Place	Crossing	9+72	9+72	Roadway												Potential	
4D	8" PVC San Swr	West University Place	Crossing	12+20	12+20	Roadway												Potential	
Water																			
5	4" Water	West University Place	Crossing	3+70	3+70	Roadway	Line upgrade to 6"											Potential	
5A	4" Water	West University Place	Crossing	6+15	6+15	Roadway	Line upgrade to 6"											Potential	
5B	4" Water	West University Place	Crossing	8+25	8+25	Roadway	Line upgrade to 6"											Potential	
5C	6" Water	West University Place	Crossing	10+75	10+75	Roadway												Potential	
5D	6" Water	West University Place	Longitudinal	10+74	11+12	Roadway												Potential	
5E	6" Water	West University Place	Longitudinal	8+30	8+64	Roadway												Potential	
5F	6" Water	West University Place	Longitudinal	5+80	6+11	Roadway												Potential	
5G	8" Water	West University Place	Crossing	3+58	3+58	Storm Sewer												Potential	

Confirmed Conflicts	**0**	YES
Potential Conflicts	**24**	POTENTIAL
Cleared Conflicts	**0**	NO

West University East Side PER

October 2021

Appendix F-6 - Wakeforest Avenue Utility Conflict Matrix

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
Telephone																			
1A	4-MTD	AT&T	Crossing	9+48	9+48	Storm Sewer	Critical Locate											Potential	
1B	2" CWD	AT&T	Crossing	9+48	9+48	Storm Sewer	Critical Locate											Potential	
1C	4-MTD	AT&T	Crossing	10+21	10+21	Storm Sewer	Critical Locate											Potential	
Power																			
2	UG Elec. Street Light	CenterPoint	Crossing	4+36	4+36	Storm Sewer												Potential	
2A	UG Elec. Street Light	CenterPoint	Crossing	7+19	7+19	Storm Sewer												Potential	
2B	UG Elec. Street Light	CenterPoint	Crossing	9+90	9+90	Storm Sewer												Potential	
2C	UG Elec. Street Light	CenterPoint	Crossing	2+57	2+57	Storm Sewer												Potential	
2D	UG Elec. Street Light	CenterPoint	Crossing	3+21	3+21	Storm Sewer												Potential	
2E	UG Elec. Street Light	CenterPoint	Crossing	4+34	4+34	Storm Sewer												Potential	
2F	UG Elec. Street Light	CenterPoint	Crossing	6+80	6+80	Storm Sewer												Potential	
2G	UG Elec. Street Light	CenterPoint	Longitudinal	6+76	7+17	Storm Sewer												Potential	
2H	UG Elec. Street Light	CenterPoint	Crossing	7+09	7+09	Storm Sewer												Potential	
2I	UG Elec. Street Light	CenterPoint	Crossing	9+64	9+64	Storm Sewer												Potential	
2J	UG Elec. Street Light	CenterPoint	Crossing	12+09	12+09	Storm Sewer												Potential	
2K	UG Elec. Street Light	CenterPoint	Crossing	17+36	17+36	Storm Sewer												Potential	
2L	UG Elec. Street Light	CenterPoint	Crossing	17+00	17+00	Storm Sewer												Potential	
Natural Gas																			
3	2" IP PLA Gas Main	CenterPoint	Crossing	5+27	5+27	Storm Sewer												Potential	
3A	6" IP PLA Gas Main	CenterPoint	Crossing	4+23	4+23	Storm Sewer												Potential	
3B	2" IP PLA Gas Main	CenterPoint	Crossing	4+60	4+60	Storm Sewer												Potential	
3C	6" IP PLA Gas Main	CenterPoint	Longitudinal	5+44	5+61	Driveway												Potential	
3D	6" IP PLA Gas Main	CenterPoint	Longitudinal	5+76	5+95	Driveway												Potential	
3E	6" IP PLA Gas Main	CenterPoint	Crossing	6+83	6+83	Storm Sewer												Potential	
3F	6" IP PLA Gas Main	CenterPoint	Crossing	7+10	7+10	Storm Sewer												Potential	
3G	6" IP PLA Gas Main	CenterPoint	Longitudinal	7+96	8+14	Driveway												Potential	
3H	6" IP PLA Gas Main	CenterPoint	Longitudinal	8+33	8+54	Driveway												Potential	
3I	6" IP PLA Gas Main	CenterPoint	Crossing	9+46	9+46	Storm Sewer												Potential	
3J	6" IP PLA Gas Main	CenterPoint	Longitudinal	10+61	10+92	Driveway												Potential	
3K	6" IP PLA Gas Main	CenterPoint	Longitudinal	11+02	11+12	Driveway												Potential	
3L	6" IP PLA Gas Main	CenterPoint	Longitudinal	12+13	12+41	Roadway												Potential	
3M	6" IP PLA Gas Main	CenterPoint	Longitudinal	13+36	13+49	Driveway												Potential	
3N	6" IP PLA Gas Main	CenterPoint	Longitudinal	14+63	14+93	Roadway												Potential	

Conflict #	Utility Type	Utility Owner	Location (Crossing/ Longitudinal/ Point etc.)	Start Station	End Station	Conflict Type	Comments	Calculation Sources	Existing Grade Elevation	Proposed Grade Elevation	Grade Change	Bottom of Pavement/Base Elevation	Bottom of Storm Sewer / Structure Elevation	Cut/Fill to bottom of pavement / drainage/ structure (-/+)	Top of Pipe Elevation	Vertical Clearance Amount	Horizontal Clearance Amount	Conflict	ACTION
3O	6" IP PLA Gas Main	CenterPoint	Longitudinal	15+78	15+94	Driveway												Potential	
3P	6" IP PLA Gas Main	CenterPoint	Longitudinal	16+08	16+25	Driveway												Potential	
3Q	6" IP PLA Gas Main	CenterPoint	Crossing	17+10	17+10	Storm Sewer												Potential	
Sanitary Sewer																			
4A	4" PVC San Svc.	West University Place	Crossing	5+77	5+77	Storm Sewer												Potential	
4B	8" PVC San Swr	West University Place	Crossing	5+83	5+83	Storm Sewer												Potential	
4C	8" PVC San Swr	West University Place	Crossing	7+32	7+32	Storm Sewer												Potential	
4D	10" PVC San Swr	West University Place	Crossing	9+34	9+34	Storm Sewer												Potential	
4E	8" Force Main	West University Place	Crossing	10+13	10+13	Storm Sewer												Potential	
4F	4" PVC San Svc.	West University Place	Crossing	5+71	5+71	Storm Sewer												Potential	
4G	8" PVC San Swr	West University Place	Crossing	9+48	9+48	Storm Sewer												Potential	
4H	8" PVC San Swr	West University Place	Crossing	12+00	12+00	Storm Sewer												Potential	
4I	8" PVC San Swr	West University Place	Crossing	12+55	12+55	Storm Sewer												Potential	
Water																			
5	Wtr Svc Lead	West University Place	Crossing	4+22	4+22	Storm Sewer												Potential	
5A	Wtr Svc Lead	West University Place	Crossing	4+95	4+95	Storm Sewer												Potential	
5B	Wtr Svc Lead	West University Place	Crossing	5+00	5+00	Storm Sewer												Potential	
5C	Wtr Svc Lead	West University Place	Crossing	6+84	6+84	Storm Sewer												Potential	
5D	Wtr Svc Lead	West University Place	Crossing	6+90	6+90	Storm Sewer												Potential	
5E	Wtr Svc Lead	West University Place	Crossing	7+52	7+52	Storm Sewer												Potential	
5F	8" Water	West University Place	Crossing	8+70	8+70	Storm Sewer	Line Adjustment											Potential	
5G	8" Water	West University Place	Crossing	9+61	9+61	Storm Sewer	Line Adjustment											Potential	
5H	10" Water	West University Place	Crossing	9+89	9+89	Storm Sewer	Line Adjustment											Potential	
5I	4" Water	West University Place	Crossing	4+18	4+18	Storm Sewer	Line Adjustment to 6"											Potential	
5J	4" Water	West University Place	Crossing	6+69	6+69	Storm Sewer	Line Adjustment to 6"											Potential	
5K	4" Water	West University Place	Crossing	9+45	9+45	Storm Sewer	Line Adjustment to 6"											Potential	
5L	4" Water	West University Place	Crossing	12+12	12+12	Storm Sewer	Line Adjustment to 6"											Potential	
5M	4" Water	West University Place	Crossing	15+63	15+63	Storm Sewer	Line Adjustment to 6"											Potential	
5N	4" Water	West University Place	Crossing	17+16	17+16	Storm Sewer	Line Adjustment to 6"											Potential	

Confirmed Conflicts	**0**	YES
Potential Conflicts	**55**	POTENTIAL
Cleared Conflicts	**0**	NO

G

Appendix G – Drainage Memo

Memo

Date:	Tuesday, October 19, 2021
Project:	10283919 – East Side Street and Drainage Improvements
To:	Gerardo Barrera, City of West University Place Public Works Director
From:	Jeremy Blevins, PE, CFM
Subject:	Flow Control Device Sizing for East Side Street and Drainage Improvements



HDR ENGINEERING, INC.
TEXAS REGISTERED FIRM F-754

The following memo summarizes the analysis conducted by HDR Engineering, Inc. for the sizing of flow control devices to be included in the City of West University Place (City) East Side street and drainage improvements. The flow control devices mitigate the downstream impacts of the proposed improvements within the Buffalo Speedway and Kirby Drive drainage systems without detention requirements.

Existing Conditions Model

HT&J, LLC provided an existing conditions XP-SWMM model to HDR for the City of West University Place. HDR verified the storm sewer flow lines and sizing in this model according to record drawings for the project area. Based on HDR's review, HT&J modified this model and sent an updated version which included a more accurate representation of the south outfall to Poor Farm Ditch.

However, neither existing model included drainage improvements to the Buffalo Speedway trunk line recommended in HDR's previous study for the City. These improvements, which are currently under construction, were shown to have no impact and were granted an Interpose No Objection (INO) letter by the HCFCD. While no impacts were shown, it was necessary to distinguish between changes in model results associated with these previously recommended improvements to Buffalo Speedway and potential impacts associated with the current proposed improvements in West University Place East Side. Therefore, the Buffalo Speedway improvements were added to the updated existing conditions model. This final version of the existing conditions model was used for the analysis described in this memo. Ponding maps for the final existing conditions model can be found in **Exhibit 1**, **Exhibit 2**, **Exhibit 3**, and **Exhibit 4** for the 2-, 10-, 50-, and 100-year storm events, respectively.

Proposed Improvements Model

The proposed model provided by HT&J included improvements to each drainage system within West University Place, including significant improvements in the western portion of the City. To isolate the impacts of the improvements in the East Side of the City, a new model was created from the finalized existing conditions model which included the updated Buffalo Speedway trunk line. Only the East Side improvements within the area of focus for this study were added to the finalized existing conditions model, including upsizing existing storm sewer along Duke Street, University Boulevard, and Wakeforest Avenue.

In addition to upsizing the storm sewer per HT&J recommendations, HDR tied the new 60" RCP along Duke Street to the improved section of RCB along Buffalo Speedway, whose invert at that location was approximately 4 ft lower than the existing line on Buffalo Speedway. By matching the Duke Street storm sewer's invert to this lower invert elevation, storm sewer elevations along Duke Street could be lowered to eliminate the siphon at the intersection of Duke Street and Brompton Road while maintaining an equivalent slope. University Boulevard's connections remained the same for existing and proposed scenarios, tying into the original 66" RCP along Buffalo Speedway and the 14' x 12' RCB along Kirby Drive. A map of the proposed improvements included for the model in this analysis can be found in **Exhibit 5**.

Impacts from the proposed improvements were observed at the project area's two outfall locations, Kirby Drive on the east boundary and Poor Farm Ditch on the south boundary. To mitigate adverse impacts with stormwater detention, **58.51 acre-feet** of storage would be required. However, due to a lack of viable space for detention in proximity to the project area, flow control devices were deemed a more practical solution. Installation of these flow control devices was considered at four locations in West University Place East Side:

- Location 1, east of the intersection of Duke Street and Buffalo Speedway
- Location 2, east of the intersection of University Boulevard and Buffalo Speedway
- Location 3, west of the intersection of University Boulevard and Wakeforest Drive
- Location 4, west of the intersection of University Boulevard and Kirby Drive.

Pipe and overland flows were computed using XP-SWMM at the two previously mentioned outfalls to compare existing and proposed runoff hydrographs for each scenario. The locations of the flow control devices, as well as the locations used to compare runoff values for the project area, can be found in **Exhibit 5**.

Results

To optimize the size of the flow control devices at Locations 1-4, multiple iterations of the proposed XP-SWMM model were run to identify the sizing at each respective location which allowed for maximum possible flood reduction in East Side streets without exceeding the peak discharge of the existing conditions hydrographs. HDR determined that a 24" pipe or hydraulic equivalent at each location provided the maximum benefit while remaining within the limits of the existing conditions hydrographs' peaks for the 10-, 50-, and 100-year storm events.

The 24" pipes or hydraulic equivalents at Locations 1 and 2 actually prevented backflow from entering the project area from Buffalo Speedway, since flow was shown to move eastward along the length of University Boulevard and Duke Street. The tailwater condition at the model's southeast outfall along Kirby Drive was set to the top of the existing RCB, which could be an underestimate and thus contribute to flow transfer from Buffalo Speedway to the east. However, the East Side topography does show lower elevations in the southeast portion of the project area, indicating that this flow transfer could be reasonable. Furthermore, a model trial was run in which the tailwater condition was raised to the curb inlet, roughly 12 ft higher, and backflow was still observed moving toward Kirby Drive during the peak of the storm events. At Locations 3

and 4, the 24" pipes or hydraulic equivalents limit discharge to the Kirby Drive system to pre-project levels.

Figure 1 and **Figure 2** show the comparison of the 100-year runoff hydrographs for existing and proposed conditions at the Kirby Drive and Poor Farm Ditch outfalls, respectively. These hydrographs and others showing results for the remaining storm events (2-, 10-, and 50-year) can be found in **Appendix A**. As shown in the attached hydrographs, the 2-year storm event is the only scenario for each outfall where the proposed hydrographs slightly exceed existing conditions, but because the storm sewer in place is sized for the 50-year event such that runoff is held within the ROW of the streets, the impact of these increases is negligible.

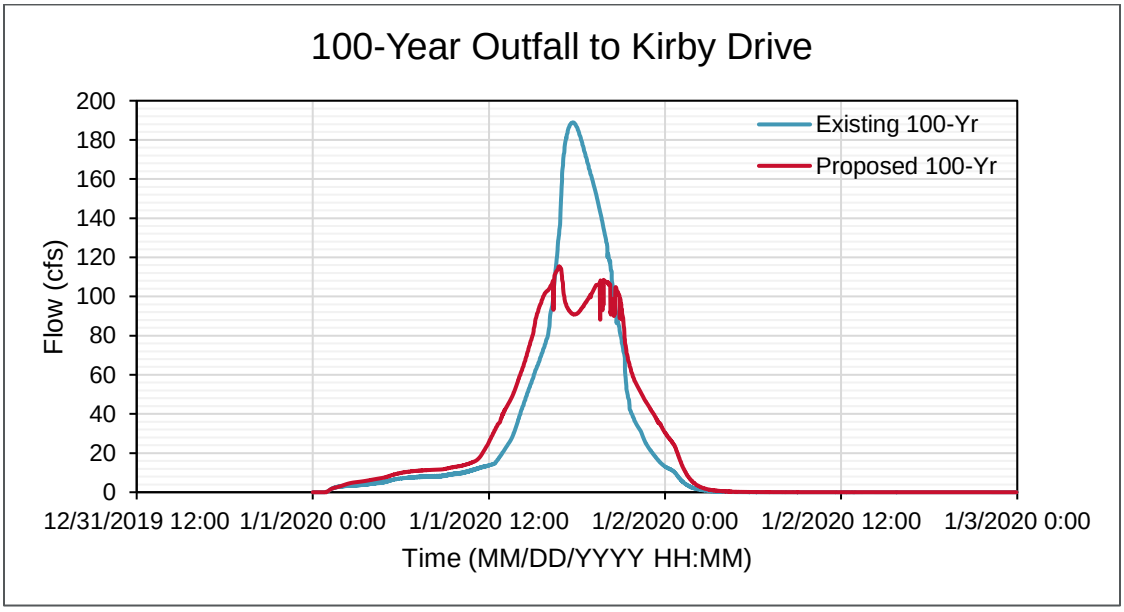


Figure 1: Existing vs. Proposed Hydrographs at Kirby Drive for the 100-Year Storm

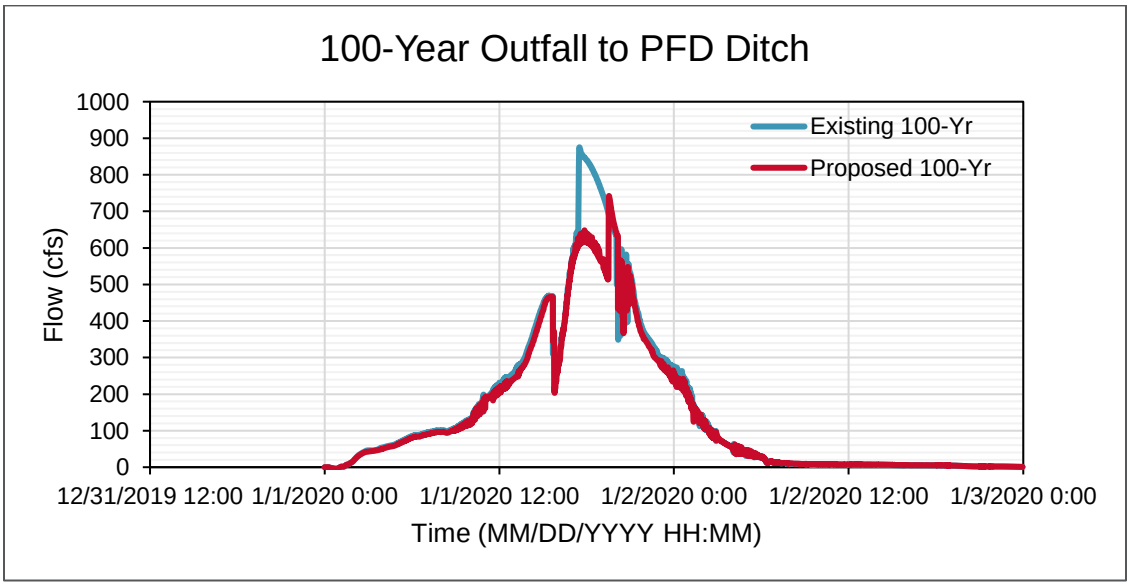


Figure 2: Existing vs. Proposed Hydrographs at Poor Farm Ditch for the 100-Year Storm

Given these additions to the proposed model, updated ponding maps were generated for the proposed improvements. The inundation maps for the 2-, 10-, 50-, and 100-year storm events are provided in **Exhibit 6**, **Exhibit 7**, **Exhibit 8**, and **Exhibit 9**, respectively. **Table 1** shows the maximum ponding at significant locations in the project area, which are shown in **Figure 3**. As shown, reductions in ponding are still provided despite the installation of the flow control devices.

Table 1: Comparison of Maximum WSE at Select Intersections

Node Name and Description	Storm Event	Existing Conditions Ponding (ft)	Proposed Improvements Ponding (ft)	Difference from Existing (ft)
Node 2: University and Wakeforest	100-Year	0.82	0.43	-0.39
	50-Year	0.62	0.25	-0.37
	10-Year	0.31	0	-0.31
	2-Year	0	0	0
Node 11: University and Annapolis	100-Year	1.31	1.07	-0.24
	50-Year	1.05	0.84	-0.21
	10-Year	0.45	0.44	-0.01
	2-Year	0	0	0
Node 26: Fenwood and Wakeforest	100-Year	1.65	1.38	-0.27
	50-Year	1.45	1.21	-0.24
	10-Year	1.17	0.97	-0.20
	2-Year	0.59	0.24	-0.35
Node 199: Duke and Belmont	100-Year	1.57	1.09	-0.48
	50-Year	1.33	0.86	-0.48
	10-Year	1.01	0.69	-0.32
	2-Year	0.44	0.35	-0.10
Node 209: University and Vanderbilt	100-Year	2.22	1.76	-0.46
	50-Year	1.99	1.54	-0.45
	10-Year	1.61	1.36	-0.25
	2-Year	0.89	0.65	-0.24
Node 482: Rice and Wakeforest	100-Year	0.91	0.76	-0.14
	50-Year	0.75	0.45	-0.31
	10-Year	0.53	0	-0.53
	2-Year	0.35	0	-0.35

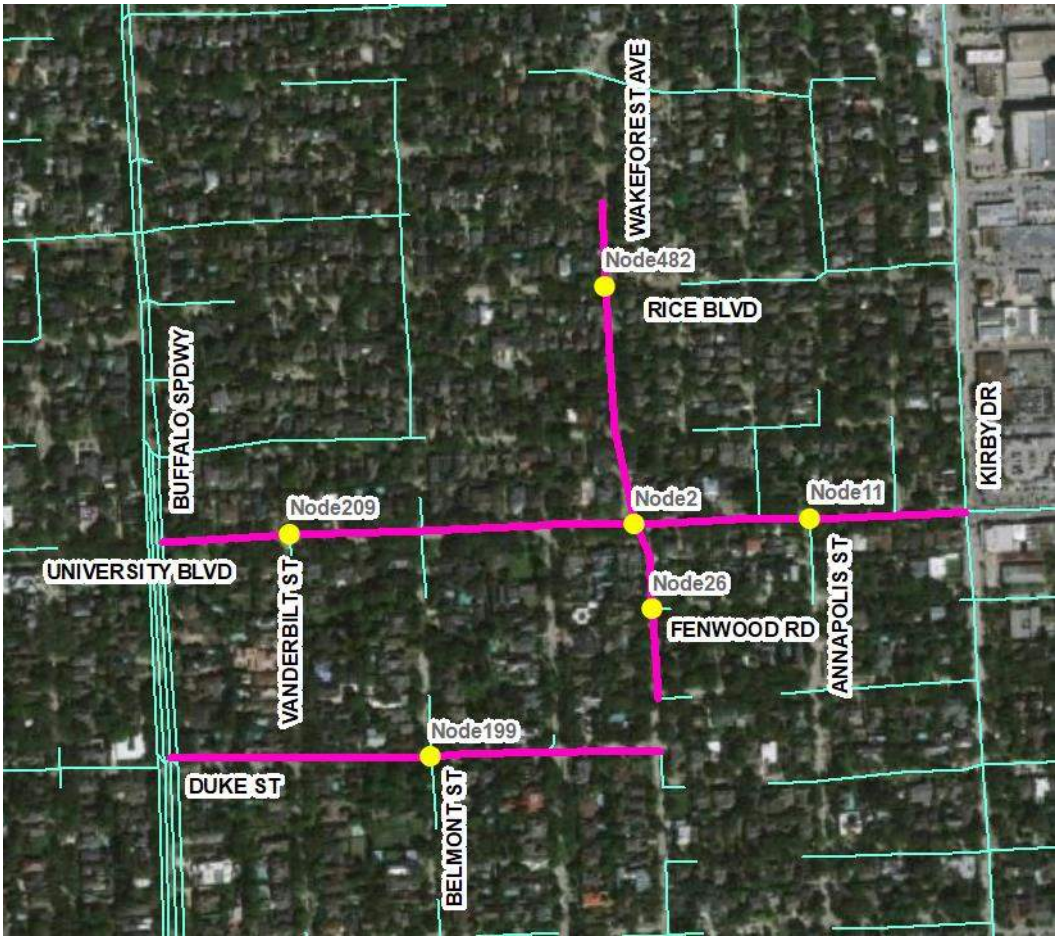


Figure 3: Locations Used for Ponding Comparison

Recommendations

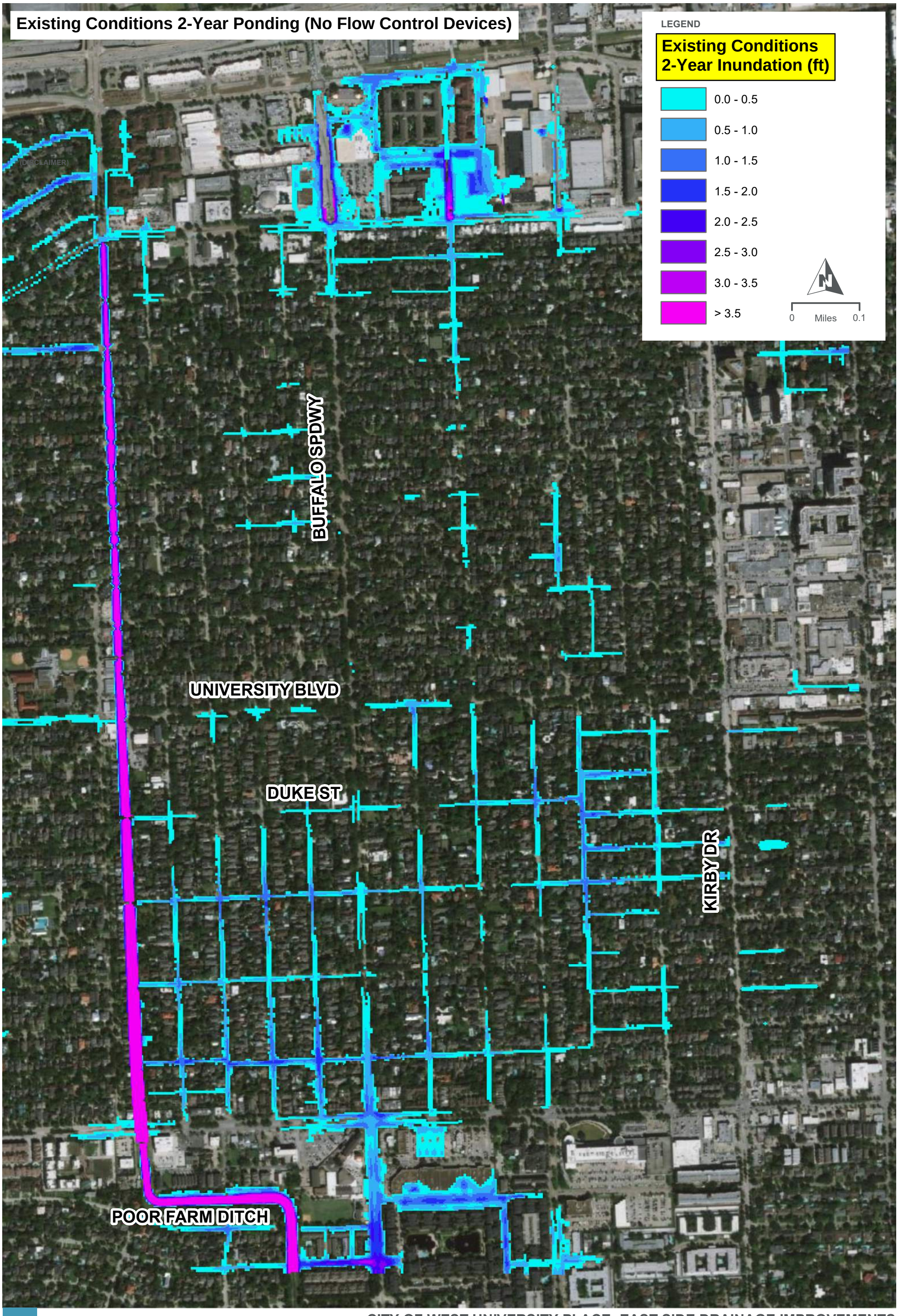
Based on the results of this analysis, HDR recommends flow control devices hydraulically equivalent to the specified diameters at the following locations (see **Exhibit 5**):

- 24” Pipe or Hydraulic Equivalent at Location 1, east of intersection of Duke and Buffalo
- 24” Pipe or Hydraulic Equivalent at Location 2, east of intersection of University and Buffalo
- 24” Pipe or Hydraulic Equivalent at Location 3, west of intersection of University and Wakeforest
- 24” Pipe or Hydraulic Equivalent at Location 4, west of intersection of University and Kirby

The proposed flow control devices in the City of West University Place East Side reduce the proposed peak discharge rate to less than existing, which offsets the need for stormwater detention at this time. Should sufficient stormwater detention be acquired in the future, a detailed analysis of the operation of that detention basin should be completed to assess the potential for even greater flood risk reduction provided by removal of the flow control devices.

Exhibits

Existing Conditions 2-Year Ponding (No Flow Control Devices)



CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

EXISTING CONDITIONS: 2-YEAR PONDING

EXHIBIT 1

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 7/30/2021

Existing Conditions 10-Year Ponding (No Flow Control Devices)

LEGEND

Existing Conditions 10-Year Inundation (ft)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- > 3.5

N

0 Miles 0.1

BUFFALO SPDWY

UNIVERSITY BLVD

DUKE ST

KIRBY DR

POOR FARM DITCH

CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

EXISTING CONDITIONS: 10-YEAR PONDING

EXHIBIT 2

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 7/30/2021

Existing Conditions 50-Year Ponding (No Flow Control Devices)

LEGEND

Existing Conditions 50-Year Inundation (ft)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- > 3.5

N

0 Miles 0.1

(DISCLAIMER)

BUFFALO SPDWY

UNIVERSITY BLVD

DUKE ST

KIRBY DR

POOR FARM DITCH

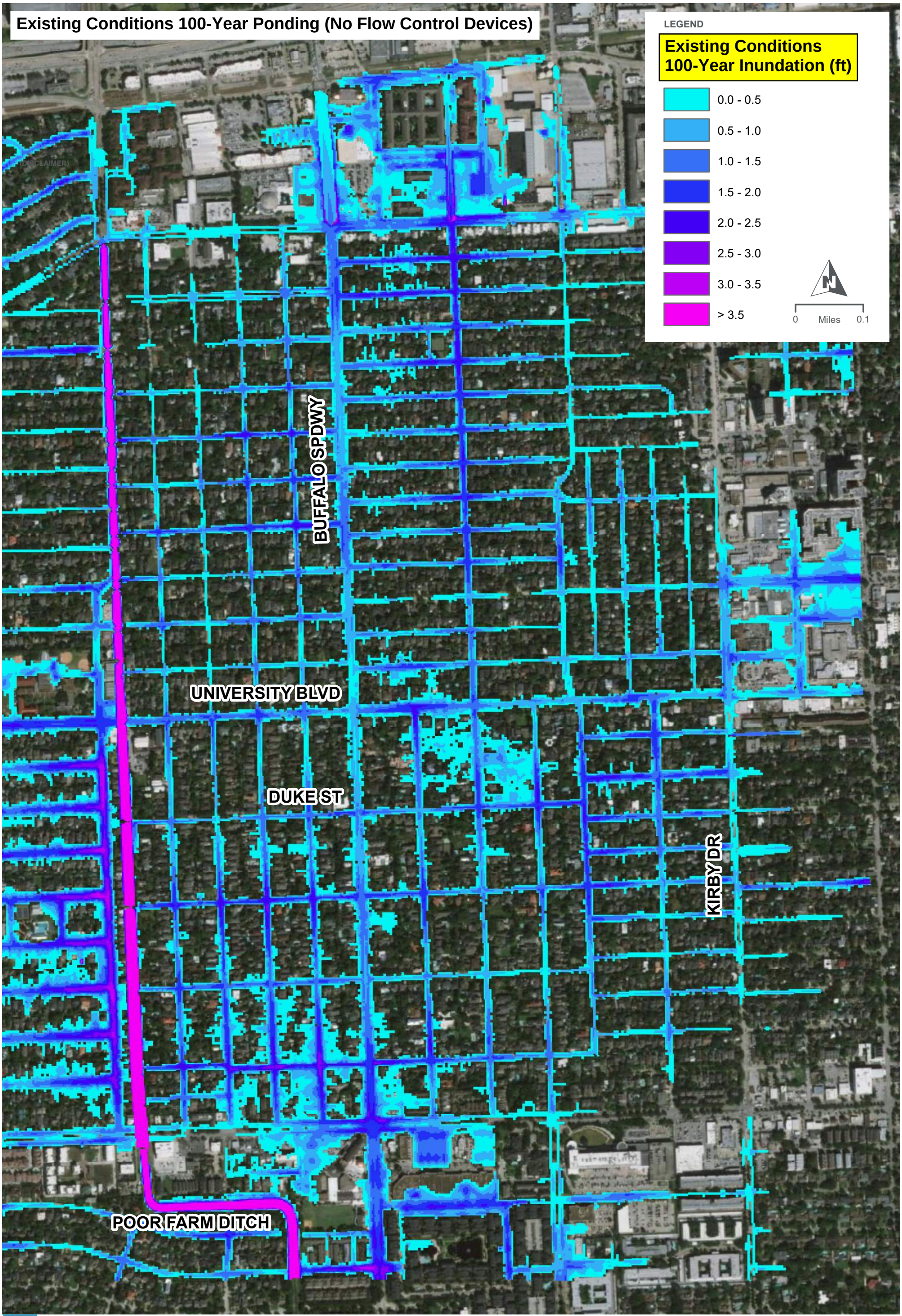
CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

EXISTING CONDITIONS: 50-YEAR PONDING

EXHIBIT 3

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Existing Conditions 100-Year Ponding (No Flow Control Devices)

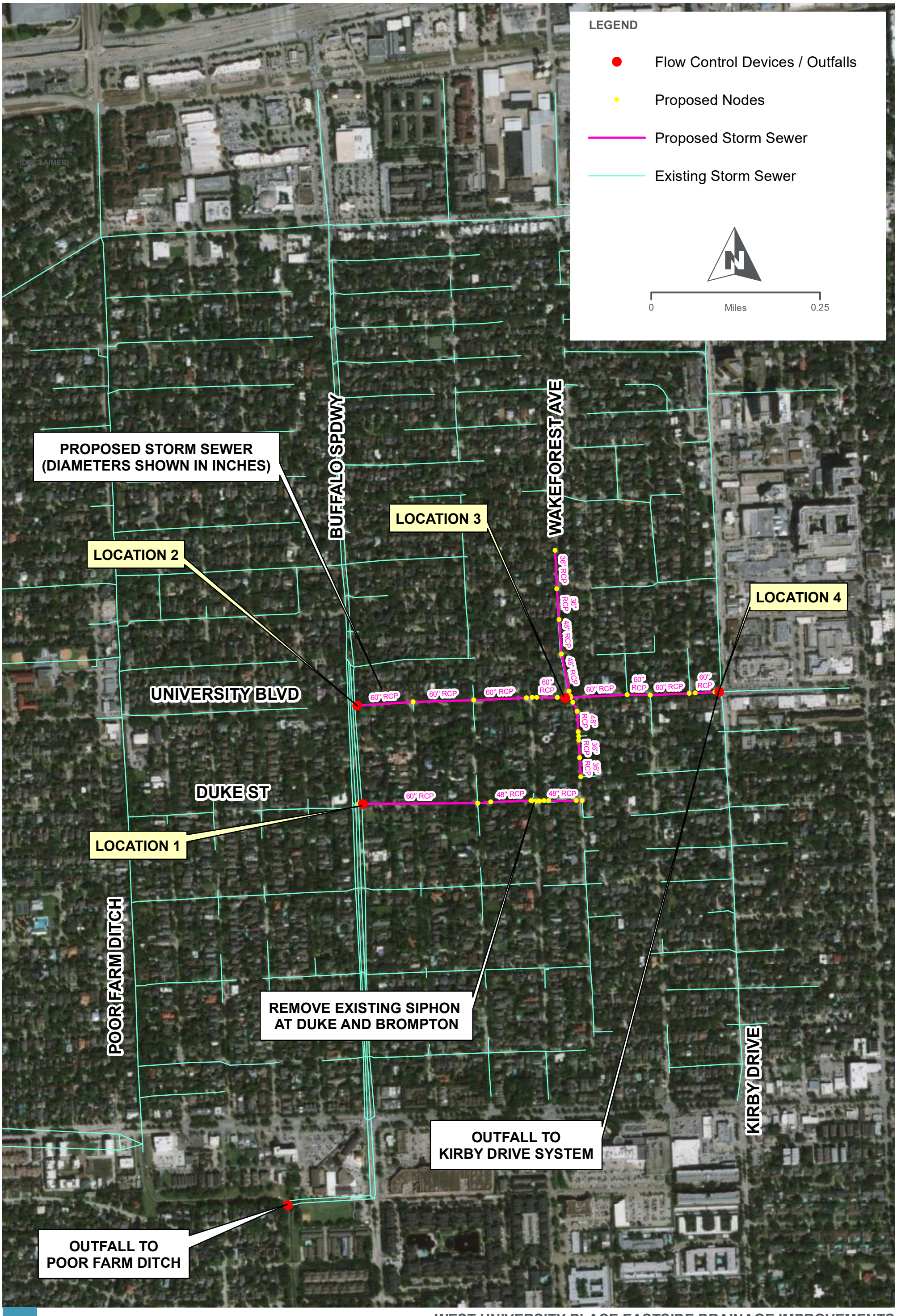


CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

EXISTING CONDITIONS: 100-YEAR PONDING

EXHIBIT 4

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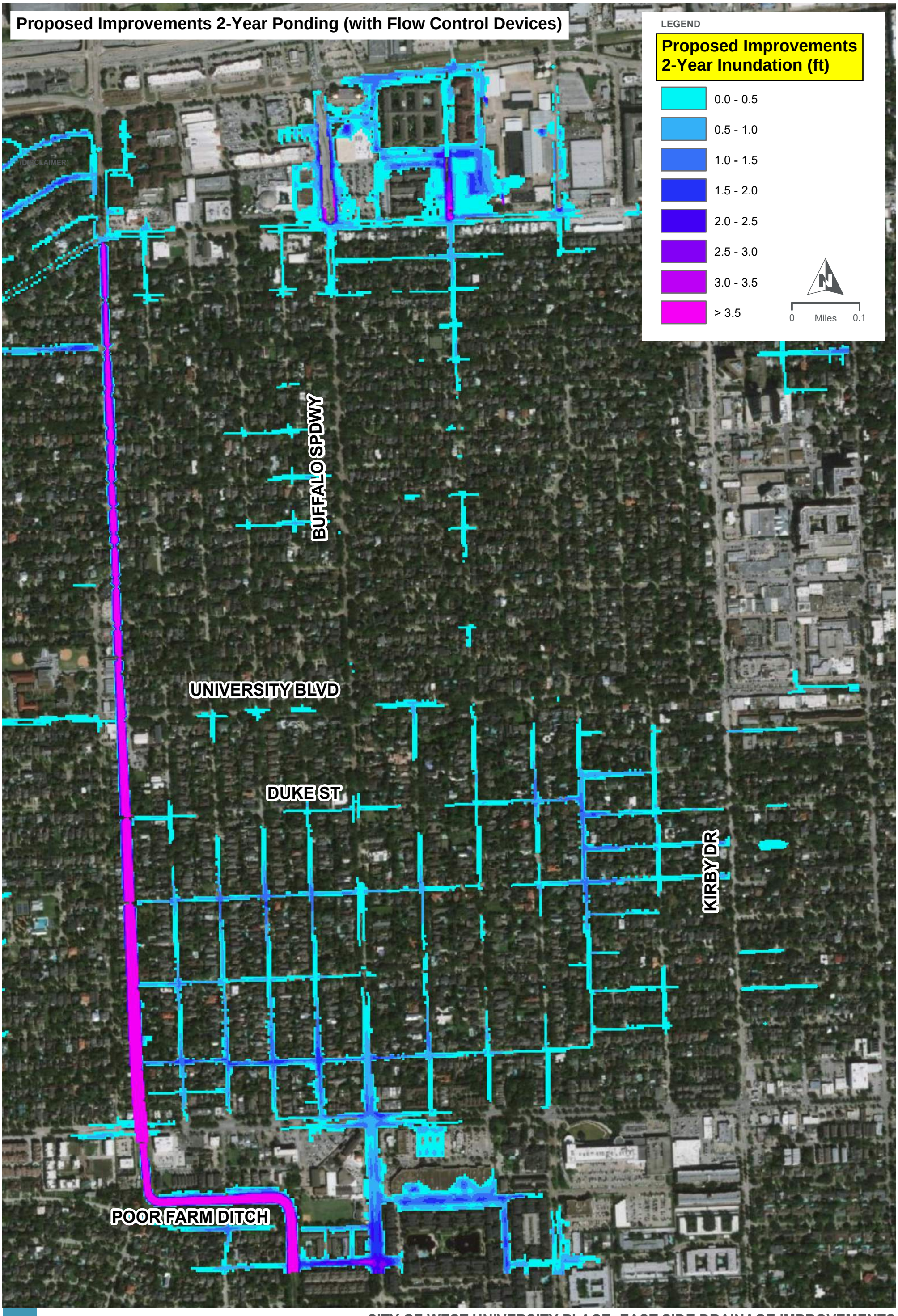
WEST UNIVERSITY PLACE EASTSIDE DRAINAGE IMPROVEMENTS

PROJECT LAYOUT

EXHIBIT 5

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\PROJECTLAYOUTMAPV2.MXD - USER: THHENRY - DATE: 10/18/2021

Proposed Improvements 2-Year Ponding (with Flow Control Devices)



CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

PROPOSED IMPROVEMENTS: 2-YEAR PONDING

EXHIBIT 6

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 8/11/2021

Proposed Improvements 10-Year Ponding (with Flow Control Devices)

LEGEND

Proposed Improvements 10-Year Inundation (ft)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- > 3.5

N

0 Miles 0.1

BUFFALO SPDWY

UNIVERSITY BLVD

DUKE ST

KIRBY DR

POOR FARM DITCH

CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

PROPOSED IMPROVEMENTS: 10-YEAR PONDING

EXHIBIT 7

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 8/11/2021

Proposed Improvements 50-Year Ponding (with Flow Control Devices)

LEGEND

Proposed Improvements 50-Year Inundation (ft)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- > 3.5

N

0 Miles 0.1

BUFFALO SPDWY

UNIVERSITY BLVD

DUKE ST

KIRBY DR

POOR FARM DITCH

CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

PROPOSED IMPROVEMENTS: 50-YEAR PONDING

EXHIBIT 8

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 8/11/2021

Proposed Improvements 100-Year Ponding (with Flow Control Devices)

LEGEND

Proposed Improvements 100-Year Inundation (ft)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- > 3.5

N

0 Miles 0.1

BUFFALO SPDWY

UNIVERSITY BLVD

DUKE ST

KIRBY DR

POOR FARM DITCH

CITY OF WEST UNIVERSITY PLACE: EAST SIDE DRAINAGE IMPROVEMENTS

PROPOSED IMPROVEMENTS: 100-YEAR PONDING

EXHIBIT 9

PATH: Q:\HOUSTON_PROJECTS\WEST_UNIVERSITY_EAST_SIDE\03_GIS\MAPDOCS\DRAFT\INUNDATIONMAPSV2.MXD - USER: THHENRY - DATE: 8/11/2021

Appendix A: Existing and Proposed Hydrographs

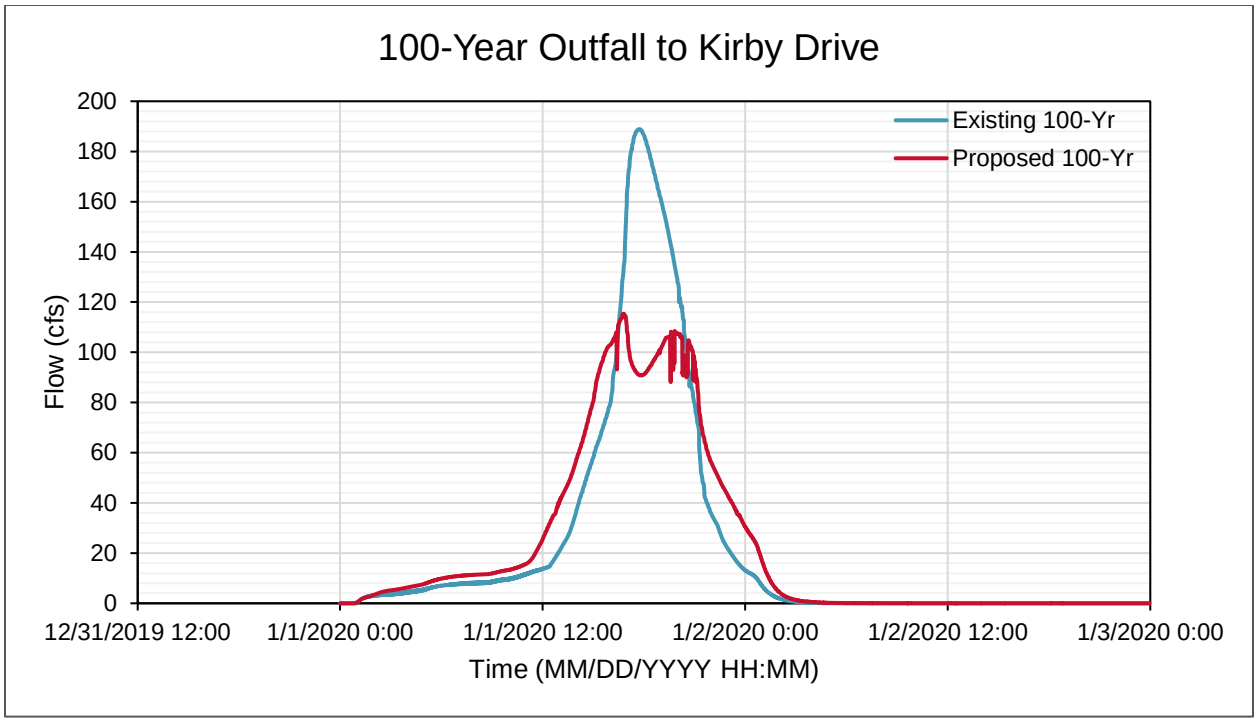


Figure 4: Existing vs. Proposed Hydrographs at Kirby Drive for the 100-Year Storm

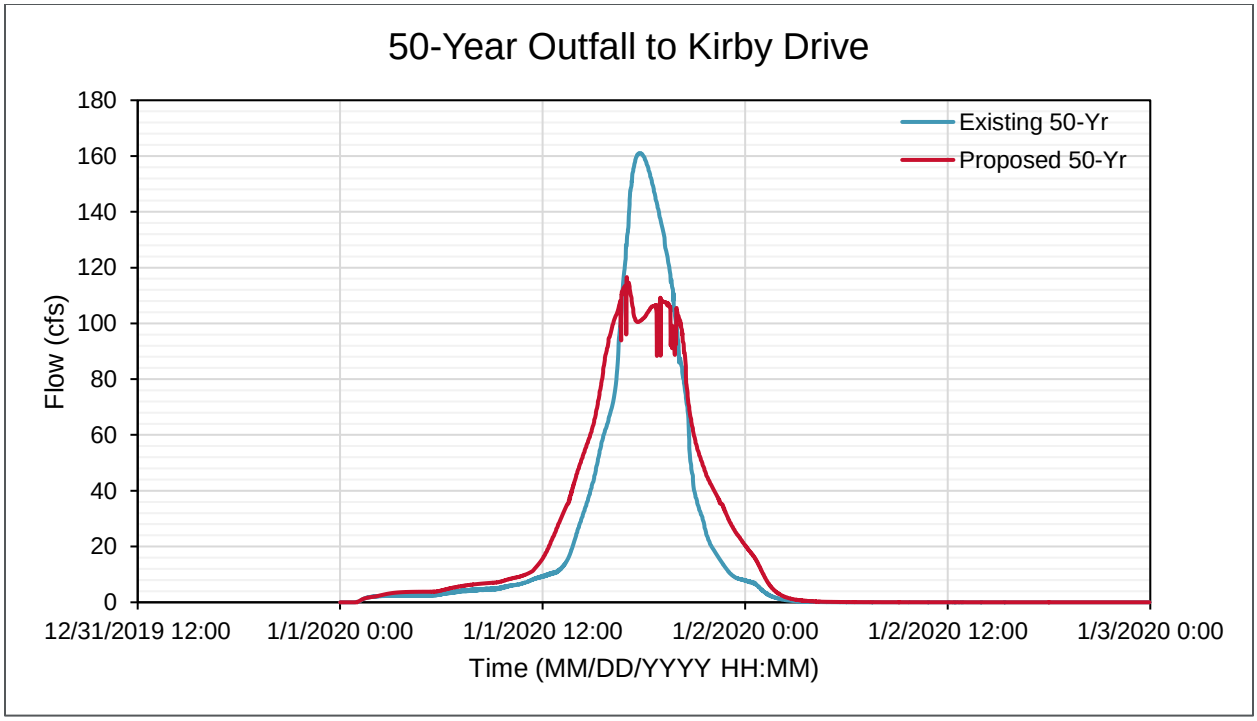


Figure 5: Existing vs. Proposed Hydrographs at Kirby Drive for the 50-Year Storm

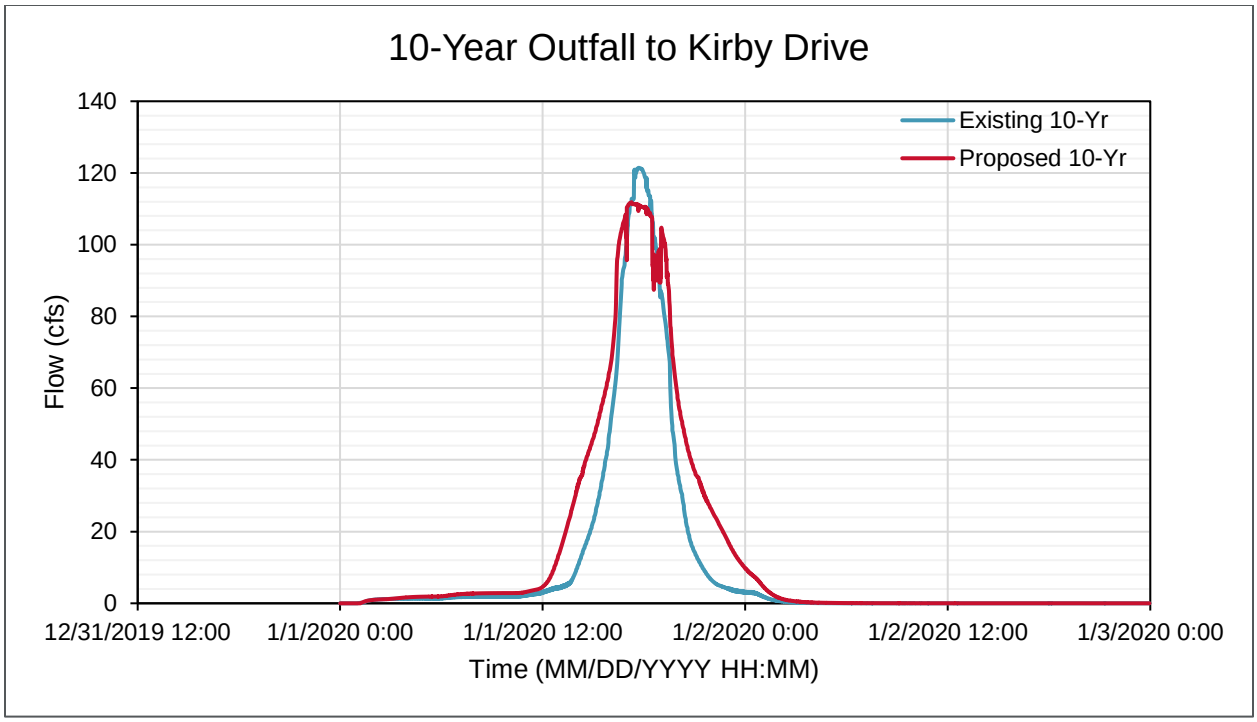


Figure 6: Existing vs. Proposed Hydrographs at Kirby Drive for the 10-Year Storm

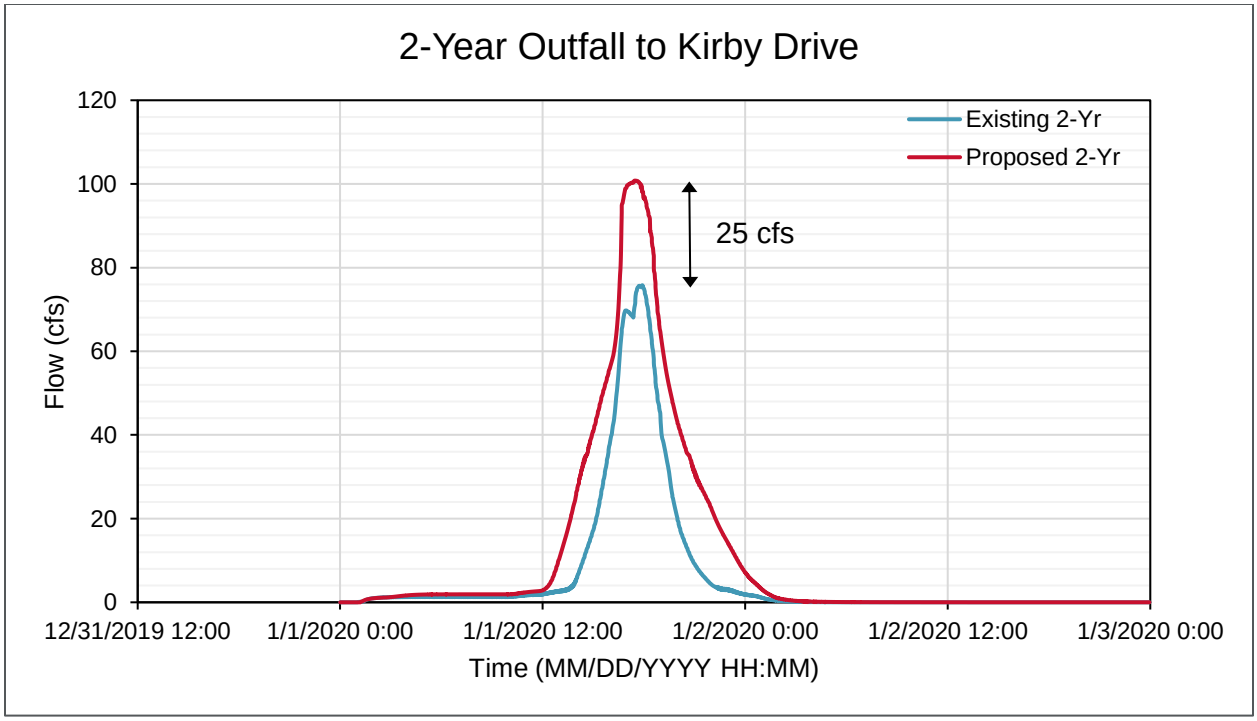


Figure 7: Existing vs. Proposed Hydrographs at Kirby Drive for the 2-Year Storm

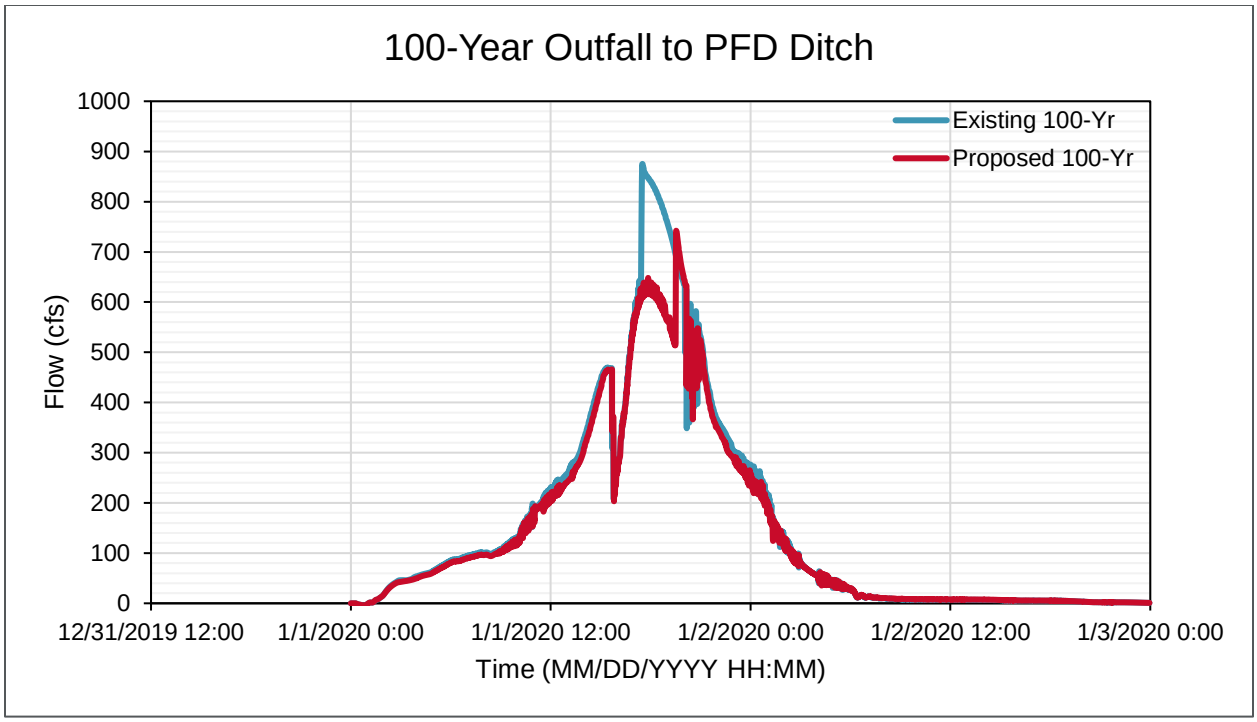


Figure 8: Existing vs. Proposed Hydrographs at Poor Farm Ditch for the 100-Year Storm

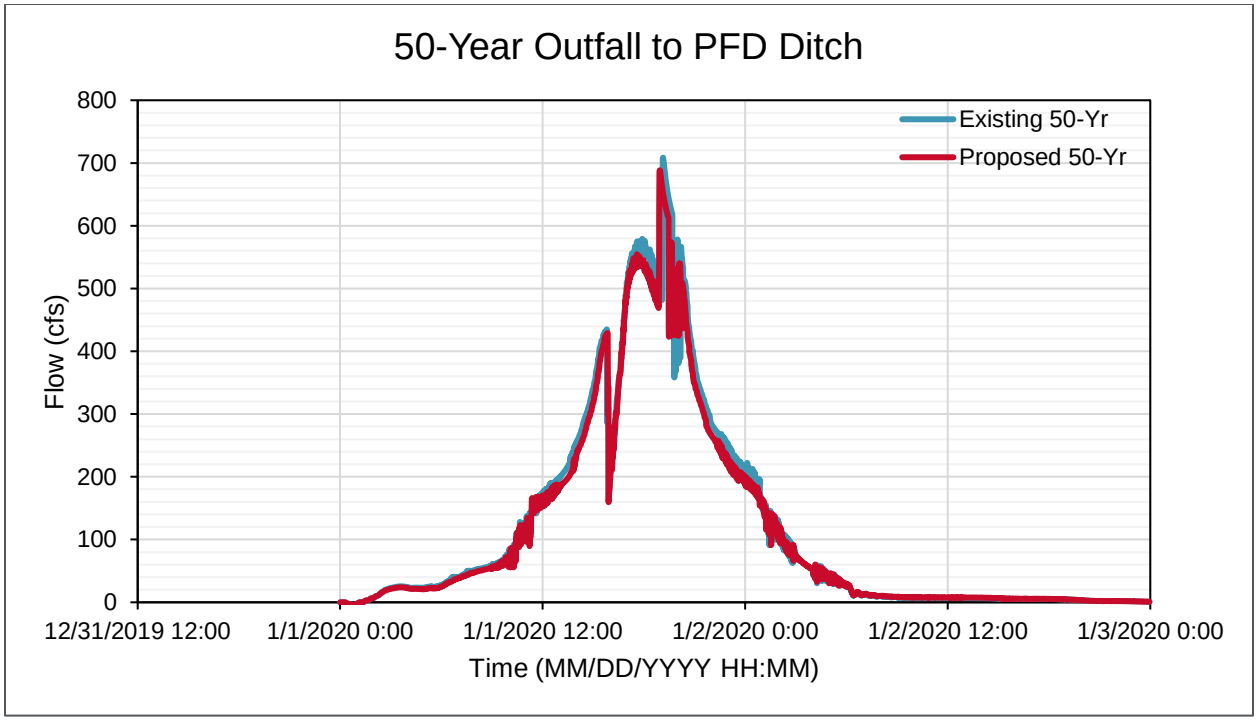


Figure 9: Existing vs. Proposed Hydrographs at Poor Farm Ditch for the 50-Year Storm

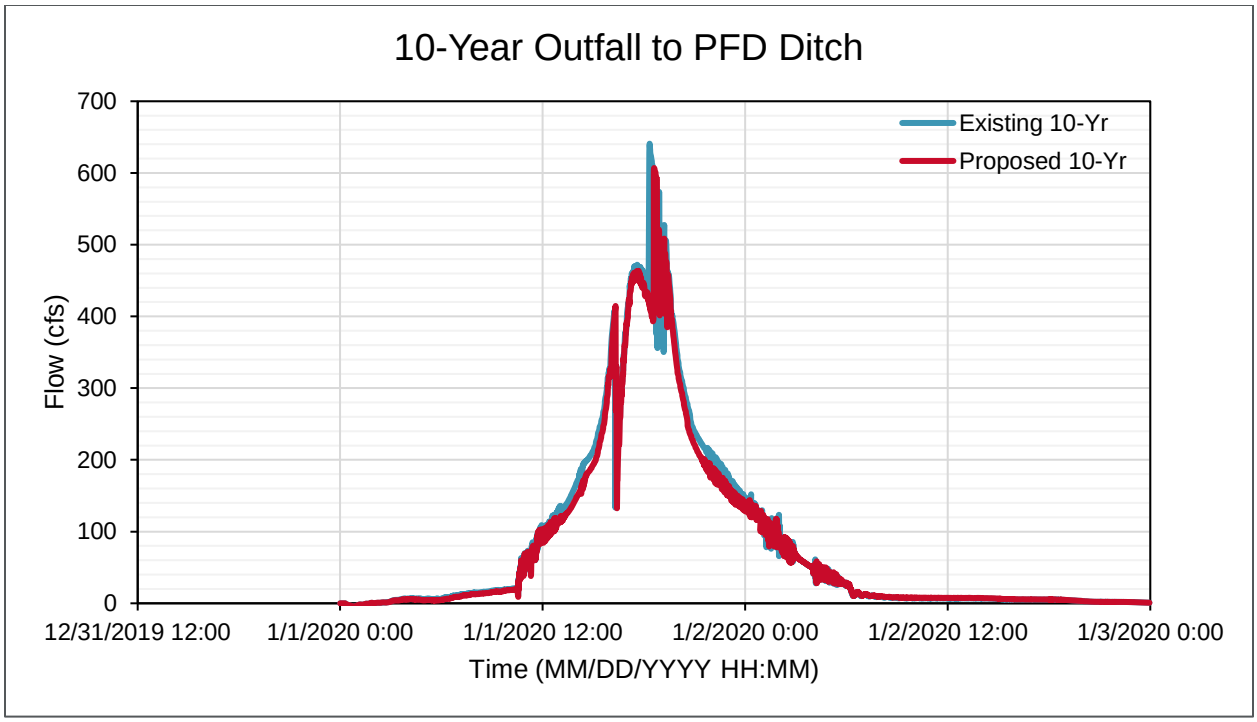


Figure 10: Existing vs. Proposed Hydrographs at Poor Farm Ditch for the 10-Year Storm

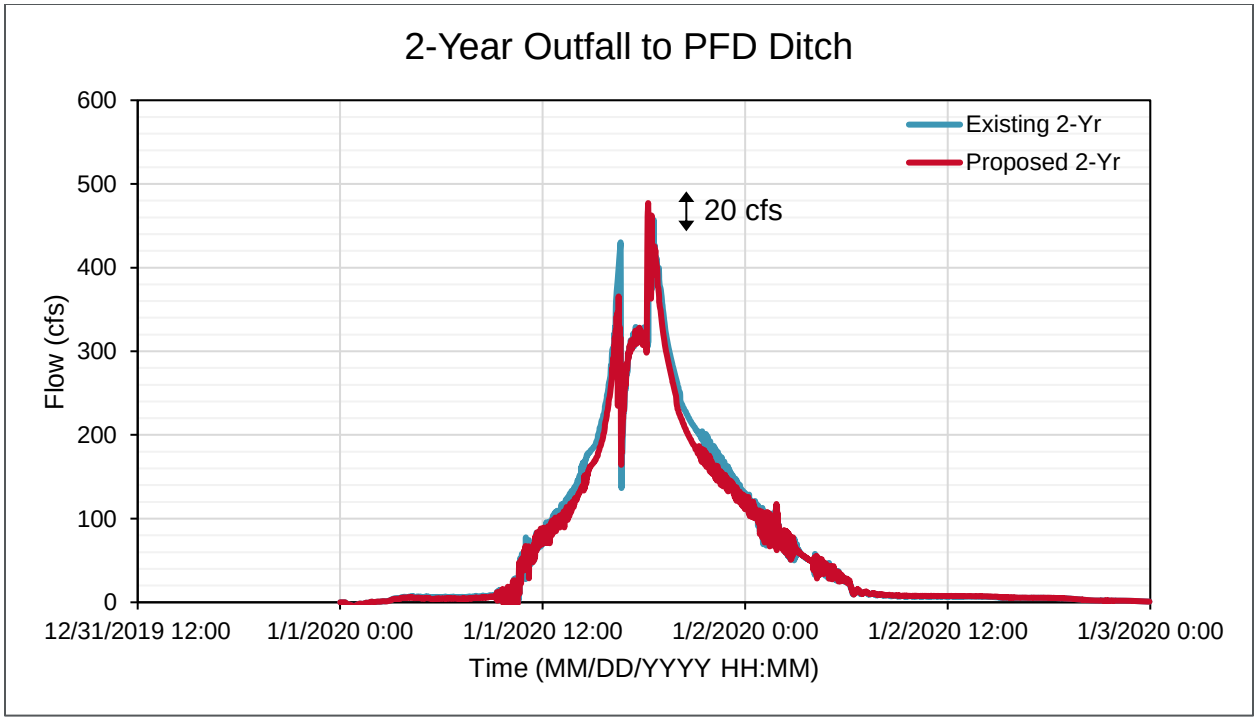


Figure 11: Existing vs. Proposed Hydrographs at Poor Farm Ditch for the 2-Year Storm

H

Appendix H – Opinion of Probable Construction Costs

East Side Paving and Drainage Improvements

City of West University Place

Opinion of Probable Construction Costs - Full Roadway Width Replacement

HDR Job No. 10283919

	STREET	TYPE OF IMPROVEMENTS	COST
1	University Boulevard	Paving and Drainage	$ 5,268,000.00
2	Duke Street	Paving and Drainage	$ 2,710,000.00
3	Rice Boulevard	Paving and Drainage	$ 1,859,000.00
4	Wakeforest Avenue (N of University)	Paving and Drainage	$ 2,411,000.00
5	Wakeforest Avenue (S of University)	Paving and Drainage	$ 992,000.00
		Total:	**$ 13,240,000.00**

*Full width pavement on University Blvd, Wakeforest Avenue, Duke Street and Rice Boulevard. There are limited drainge improvements along Rice Blvd, but rehabilitation of existing 36" storm sewer from Fordham to Kirby Drive is recommended.

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**Any opinion of construction costs prepared by HDR is supplied for the general guidance of the Client only. Since HDR has no control over competitive bidding or market conditions, HDR cannot guarantee the accuracy of such opinions as compared to contract bids or actual costs to Client.

Appendix H - Opinions of Probable Construction Costs

East Side Paving and Drainage Improvements

City of West University Place

University Boulevard from Buffalo Speedway to Kirby (Full Roadway Replacement)

Opinion of Probable Costs

HDR Job No. 10283919

OPINION OF PROBABLE CONSTRUCTION COSTS

Item	Item Description	Unit	Quantity	Unit Price	Cost
GENERAL ITEMS					
1	Traffic Control	L.S.	1	***$80,000.00***	***$80,000.00***
2	Tree Protection Plan	L.S.	1	***$95,000.00***	***$95,000.00***
3	SWP3 Plan	L.S.	1	***$10,000.00***	***$10,000.00***
4	Supplemental Items	L.S.	1	***$125,000.00***	***$125,000.00***
				General Items Total:	***$310,000.00***
PAVING ITEMS					
5	Remove and dispose of existing concrete pavement and base material, complete in place, the sum of:	S.Y.	14,000	***$15.00***	***$210,000.00***
6	9" reinforced concrete pavement, complete in place, the sum of:	S.Y.	14,000	***$85.00***	***$1,190,000.00***
7	8" lime stabilized subgrade, complete in place, the sum of:	S.Y.	15,500	***$6.00***	***$93,000.00***
8	Lime for stablized subgrade (6% by dry weight), complete in place, the sum of:	TON	400	***$200.00***	***$80,000.00***
9	6" concrete curb, complete in place, the sum of:	L.F.	4,500	***$5.00***	***$22,500.00***
10	ADA-compliant concrete curb ramp, complete in place, the sum of:	EA.	9	***$2,000.00***	***$18,000.00***
11	Remove and replace 6" thick reinforced concrete driveway, including proof rolling, level up sand, and full depth saw cut, complete in place, the sum of:	S.Y.	2,600	***$85.00***	***$221,000.00***
12	Remove and replace 4" thick reinforced concrete walkway, complete in place, the sum of:	S.Y.	4,700	***$10.00***	***$47,000.00***
13	Remove, store, and reset existing traffic sign, complete in place, the sum of:	EA.	14	***$300.00***	***$4,200.00***
14	Concrete paving header with undercut (Type I), complete in place, the sum of:	LF	320	***$25.00***	***$8,000.00***
15	Temporary driveways, complete in place, the sum of:	EA.	63	***$800.00***	***$50,400.00***
16	24" wide solid white Type I reflective pavement markers (thermoplastic), complete in place, the sum of:	L.F.	15	***$11.50***	***$172.50***
17	12" wide solid Type I reflective pavement markers (thermoplastic), complete in place, the sum of:	L.F.	38	***$5.50***	***$209.00***
				Paving Items Total:	***$1,944,481.50***
DRAINAGE ITEMS					
18	Remove and dispose of existing 5'x3' RCB storm sewer, complete in place, the sum of:	L.F.	450	***$50.00***	***$22,500.00***
19	Remove and dispose of existing RCP storm sewer, complete in place, the sum of:	L.F.	2,400	***$35.00***	***$84,000.00***
20	Remove and dispose of existing inlet laterals, complete in place, the sum of:	L.F.	90	***$20.00***	***$1,800.00***
21	Remove and dispose of existing storm sewer inlet/manhole, complete in place, the sum of:	EA.	27	***$500.00***	***$13,500.00***
21	18" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	85	***$124.00***	***$10,540.00***
22	24" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	110	***$125.00***	***$13,750.00***
23	60" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	2,760	***$350.00***	***$966,000.00***
24	Type BB Inlet, including bedding and backfill, complete in place, the sum of:	E.A.	14	***$3,500.00***	***$49,000.00***
25	7'x7' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	16	***$9,000.00***	***$144,000.00***
26	Trench safety for all storm sewers greater than 5' deep, complete in place, the sum of:	L.F.	2,960	***$1.00***	***$2,960.00***
				Drainage Items Total:	***$1,308,050.00***
UTILITY ITEMS					
27	Water line adjustment to 6", including all water line appurtenances, complete in place, the sum of:	E.A.	3	***$15,000.00***	***$45,000.00***
28	Water line adjustment to 8", including all water line appurtenances, complete in place, the sum of:	E.A.	2	***$18,000.00***	***$36,000.00***
29	Sanitary sewer conflict box, complete in place, the sum of:	E.A.	4	***$8,000.00***	***$32,000.00***
				Utility Items Total:	***$113,000.00***

General Items Total:	***$310,000.00***
Paving Items Total:	***$1,944,481.50***
Drainage Items Total:	***$1,308,050.00***
Utility Items Total:	***$113,000.00***
Total Construction Cost	***$3,675,531.50***
Miscellaneous Items (30%):	***$1,102,660.00***
Opinion of Probable Construction Cost (with 5% Escalation Factor):	***$5,268,000.00***

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Appendix H - Opinions of Probable Construction Costs

East Side Paving and Drainage Improvements

City of West University Place

Duke Street from Buffalo Speedway to Wakeforest (Full Roadway Replacement)

Opinion of Probable Construction Costs

HDR Job No. 10283919

OPINION OF PROBABLE CONSTRUCTION COSTS

Item	Item Description	Unit	Quantity	Unit Price	Cost
GENERAL ITEMS					
1	Traffic Control	L.S.	1	***$55,000.00***	***$55,000.00***
2	Tree Protection Plan	L.S.	1	***$95,000.00***	***$95,000.00***
3	SWP3 Plan	L.S.	1	***$7,500.00***	***$7,500.00***
4	Supplemental Items	L.S.	1	***$75,000.00***	***$75,000.00***
				General Items Total:	***$232,500.00***
PAVING ITEMS					
5	Remove and dispose of existing concrete pavement and base material, complete in place, the sum of:	S.Y.	5,200	***$15.00***	***$78,000.00***
6	8" reinforced concrete pavement, complete in place, the sum of:	S.Y.	5,200	***$80.00***	***$416,000.00***
7	8" lime stabilized subgrade, complete in place, the sum of:	S.Y.	5,800	***$6.00***	***$34,800.00***
8	Lime for stablized subgrade (6% by dry weight), complete in place, the sum of:	TON	175	***$200.00***	***$35,000.00***
9	6" concrete curb, complete in place, the sum of:	L.F.	2,600	***$5.00***	***$13,000.00***
10	ADA-compliant concrete curb ramp, complete in place, the sum of:	EA.	25	***$2,000.00***	***$50,000.00***
11	Remove and replace 6" thick reinforced concrete driveway, including proof rolling, level up sand, and full depth saw cut, complete in place, the sum of:	S.Y.	460	***$85.00***	***$39,100.00***
12	Remove and replace 4" thick reinforced concrete sidewalk/walkway, complete in place, the sum of:	S.F.	5,700	***$10.00***	***$57,000.00***
13	Remove, store, and reset existing traffic sign, complete in place, the sum of:	EA.	8	***$300.00***	***$2,400.00***
14	Concrete paving header with undercut (Type I), complete in place, the sum of:	LF	265	***$25.00***	***$6,625.00***
15	Temporary driveways, complete in place, the sum of:	EA.	29	***$800.00***	***$23,200.00***
				Paving Items Total:	***$755,125.00***
DRAINAGE ITEMS					
16	Remove and dispose of existing RCB storm sewer, complete in place, the sum of:	L.F.	1,350	***$50.00***	***$67,500.00***
17	Remove and dispose of existing RCP storm sewer, complete in place, the sum of:	L.F.	440	***$35.00***	***$15,400.00***
18	Remove and dispose of existing inlet laterals, complete in place, the sum of:	L.F.	48	***$20.00***	***$960.00***
19	Remove and dispose of existing storm sewer inlet/manhole, complete in place, the sum of:	EA.	19	***$500.00***	***$9,500.00***
20	24" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	70	***$125.00***	***$8,750.00***
21	48" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	830	***$280.00***	***$232,400.00***
22	60" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	930	***$350.00***	***$325,500.00***
23	Type BB Inlet, including bedding and backfill, complete in place, the sum of:	E.A.	8	***$3,500.00***	***$28,000.00***
24	7'x7' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	13	***$9,000.00***	***$117,000.00***
25	Trench safety for all storm sewers greater than 5' deep, complete in place, the sum of:	L.F.	1,830	***$1.00***	***$1,830.00***
				Drainage Items Total:	***$806,840.00***
UTILITY ITEMS					
26	Water line adjustment to 6", including all water line appurtenances, complete in place, the sum of:	E.A.	2	***$15,000.00***	***$30,000.00***
27	Water line adjustment to 8", including all water line appurtenances, complete in place, the sum of:	E.A.	1	***$18,000.00***	***$18,000.00***
28	Sanitary sewer conflict box, complete in place, the sum of:	E.A.	6	***$8,000.00***	***$48,000.00***
				Utility Items Total:	***$96,000.00***

General Items Total:	***$232,500.00***
Paving Items Total:	***$755,125.00***
Drainage Items Total:	***$806,840.00***
Utility Items Total:	***$96,000.00***
Total Construction Cost	***$1,890,465.00***
Miscellaneous Items (30%):	***$567,140.00***
Opinion of Probable Construction Cost (with 5% Escalation Factor):	***$2,710,000.00***

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Appendix H - Opinions of Probable Construction Costs

East Side Paving and Drainage Improvements

City of West University Place

Rice Boulevard from Wakeforest to Kirby (Full Roadway Replacement)

Opinion of Probable Construction Costs

HDR Job No. 10283919

OPINION OF PROBABLE CONSTRUCTION COSTS

Item	Item Description	Unit	Quantity	Unit Price	Cost
GENERAL ITEMS					
1	Traffic Control	L.S.	1	***$52,500.00***	***$52,500.00***
2	Tree Protection Plan	L.S.	1	***$80,000.00***	***$80,000.00***
3	SWP3 Plan	L.S.	1	***$7,500.00***	***$7,500.00***
4	Supplemental Items	L.S.	1	***$65,000.00***	***$65,000.00***
				General Items Total:	***$205,000.00***
PAVING ITEMS					
5	Remove and dispose of existing concrete pavement and base material, complete in place, the sum of:	S.Y.	4,580	***$15.00***	***$68,700.00***
6	9" reinforced concrete pavement, complete in place, the sum of:	S.Y.	4,600	***$85.00***	***$391,000.00***
7	8" lime stabilized subgrade, complete in place, the sum of:	S.Y.	5,100	***$6.00***	***$30,600.00***
8	Lime for stablized subgrade (6% by dry weight), complete in place, the sum of:	TON	140	***$200.00***	***$28,000.00***
9	6" concrete curb, complete in place, the sum of:	L.F.	1,700	***$5.00***	***$8,500.00***
10	ADA-compliant concrete curb ramp, complete in place, the sum of:	EA.	34	***$2,000.00***	***$68,000.00***
11	Remove and replace 6" thick reinforced concrete driveway, including proof rolling, level up sand, and full depth saw cut, complete in place, the sum of:	S.Y.	325	***$85.00***	***$27,625.00***
12	Remove and replace 4" thick reinforced concrete sidewalk/walkway, complete in place, the sum of:	S.F.	7,600	***$10.00***	***$76,000.00***
13	Remove, store, and reset existing traffic sign, complete in place, the sum of:	EA.	9	***$300.00***	***$2,700.00***
14	Concrete paving header with undercut (Type I), complete in place, the sum of:	LF	250	***$25.00***	***$6,250.00***
15	Temporary driveways, complete in place, the sum of:	EA.	17	***$800.00***	***$13,600.00***
16	24" wide solid white Type I reflective pavement markers (thermoplastic), complete in place, the sum	L.F.	70	***$11.50***	***$805.00***
17	Brick pavers, complete in place, the sum of:	S.Y.	225	***$200.00***	***$45,000.00***
				Paving Items Total:	***$766,780.00***
DRAINAGE ITEMS					
18	Remove and dispose of existing RCP storm sewer, complete in place, the sum of:	L.F.	290	***$35.00***	***$10,150.00***
19	Remove and dispose of existing inlet laterals, complete in place, the sum of:	L.F.	290	***$20.00***	***$5,800.00***
20	Remove and dispose of existing storm sewer inlet/manhole, complete in place, the sum of:	EA.	22	***$500.00***	***$11,000.00***
21	24" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	290	***$125.00***	***$ 36,250.00***
22	Type BB Inlet, including bedding and backfill, complete in place, the sum of:	E.A.	22	***$3,500.00***	***$77,000.00***
23	36" cured-in-place pipe, complete in place, the sum of:	L.F.	445	***$225.00***	***$100,125.00***
24	Pipe connection to existing storm sewer system, complete in place, the sum of:	E.A.	1	***$2,500.00***	***$2,500.00***
25	Trench safety for all storm sewers greater than 5' deep, complete in place, the sum of:	L.F.	290	***$1.00***	***$290.00***
				Drainage Items Total:	***$243,115.00***
UTILITY ITEMS					
26	Water line adjustment to 6", including all water line appurtenances, complete in place, the sum of:	E.A.	3	***$15,000.00***	***$45,000.00***
27	Sanitary sewer conflict box, complete in place, the sum of:	E.A.	1	***$8,000.00***	***$8,000.00***
28	Adjust existing manhole rim and cover to grade, complete in place, the sum of:	E.A.	2	***$850.00***	***$1,700.00***
29	Remove abandoned sanitary sewer line, complete in place, the sum of:	L.F.	10	***$35.00***	***$350.00***
30	Remove existing sanitary sewer manhole, complete in place, the sum of:	EA.	1	***$500.00***	***$500.00***
31	Perform 36" point repair, complete in place, the sum of:	L.F.	12	***$2,160.00***	***$25,920.00***
				Utility Items Total:	***$81,470.00***
				General Items Total:	***$205,000.00***
				Paving Items Total:	***$766,780.00***
				Drainage Items Total:	***$243,115.00***
				Utility Items Total:	***$81,470.00***
				Total Construction Cost	***$1,296,365.00***
				Miscellaneous Items (30%):	***$388,910.00***
				Opinion of Probable Construction Cost (with 5% Escalation Factor):	***$1,859,000.00***

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East Side Paving and Drainage Improvements

City of West University Place

Wakeforest Avenue from Plumb to University (Full Roadway Replacement)

Opinion of Probable Construction Costs

HDR Job No. 10283919

OPINION OF PROBABLE CONSTRUCTION COSTS

Item	Item Description	Unit	Quantity	Unit Price	Cost
GENERAL ITEMS					
1	Traffic Control	L.S.	1	***$50,000.00***	***$50,000.00***
2	Tree Protection Plan	L.S.	1	***$45,000.00***	***$45,000.00***
3	SWP3 Plan	L.S.	1	***$7,500.00***	***$7,500.00***
4	Supplemental Items	L.S.	1	***$70,000.00***	***$70,000.00***
				General Items Total:	***$172,500.00***
PAVING ITEMS					
5	Remove and dispose of existing concrete pavement and base material, complete in place, the sum of:	S.Y.	6,600	***$15.00***	***$99,000.00***
6	9" reinforced concrete pavement, complete in place, the sum of:	S.Y.	6,600	***$85.00***	***$561,000.00***
7	8" lime stabilized subgrade, complete in place, the sum of:	S.Y.	7,300	***$6.00***	***$43,800.00***
8	Lime for stablized subgrade (6% by dry weight), complete in place, the sum of:	TON	196	***$200.00***	***$39,200.00***
9	6" concrete curb, complete in place, the sum of:	L.F.	2,700	***$5.00***	***$13,500.00***
10	ADA-compliant concrete curb ramp, complete in place, the sum of:	EA.	30	***$2,000.00***	***$60,000.00***
11	Remove and replace 6" thick reinforced concrete driveway, including proof rolling, level up sand, and full depth saw cut, complete in place, the sum of:	S.Y.	415	***$85.00***	***$35,275.00***
12	Remove and replace 4" thick reinforced concrete sidewalk/walkway, complete in place, the sum of:	S.F.	1,600	***$10.00***	***$16,000.00***
13	Remove, store, and reset existing traffic sign, complete in place, the sum of:	EA.	10	***$300.00***	***$3,000.00***
14	Concrete paving header with undercut (Type I), complete in place, the sum of:	LF	270	***$25.00***	***$6,750.00***
15	Temporary driveways, complete in place, the sum of:	EA.	31	***$800.00***	***$24,800.00***
16	24" wide solid white Type I reflective pavement markers (thermoplastic), complete in place, the sum of:	L.F.	28	***$11.50***	***$322.00***
				Paving Items Total:	***$902,647.00***
DRAINAGE ITEMS					
17	Remove and dispose of existing inlet laterals, complete in place, the sum of:	L.F.	250	***$20.00***	***$5,000.00***
18	Remove and dispose of existing storm sewer inlet/manhole, complete in place, the sum of:	EA.	14	***$500.00***	***$7,000.00***
19	24" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	490	***$125.00***	***$61,250.00***
20	36" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	530	***$180.00***	***$95,400.00***
21	48" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	620	***$280.00***	***$173,600.00***
22	Type BB Inlet, including bedding and backfill, complete in place, the sum of:	E.A.	17	***$3,500.00***	***$59,500.00***
23	5'x5' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	3	***$6,500.00***	***$19,500.00***
24	6'x6' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	6	***$7,500.00***	***$45,000.00***
25	Trench safety for all storm sewers greater than 5' deep, complete in place, the sum of:	L.F.	1,560	***$1.00***	***$1,560.00***
				Drainage Items Total:	***$467,810.00***
UTILITY ITEMS					
26	Water line adjustment to 6", including all water line appurtenances, complete in place, the sum of:	E.A.	7	***$15,000.00***	***$105,000.00***
27	Water line adjustment to 8", including all water line appurtenances, complete in place, the sum of:	E.A.	1	***$18,000.00***	***$18,000.00***
28	Sanitary sewer conflict box, complete in place, the sum of:	E.A.	2	***$8,000.00***	***$16,000.00***
				Utility Items Total:	***$139,000.00***

General Items Total:	***$172,500.00***
Paving Items Total:	***$902,647.00***
Drainage Items Total:	***$467,810.00***
Utility Items Total:	***$139,000.00***
Total Construction Cost	***$1,681,957.00***
Miscellaneous Items (30%):	***$504,588.00***
Opinion of Probable Construction Cost (with 5% Escalation Factor):	***$2,411,000.00***

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East Side Paving and Drainage Improvements

City of West University Place

Wakeforest Avenue from Pemberton to University (Full Roadway Replacement)

Opinion of Probable Construction Costs

HDR Job No. 10283919

OPINION OF PROBABLE CONSTRUCTION COSTS

Item	Item Description	Unit	Quantity	Unit Price	Cost
GENERAL ITEMS					
1	Traffic Control	L.S.	1	***$20,000.00***	***$20,000.00***
2	Tree Protection Plan	L.S.	1	***$30,000.00***	***$30,000.00***
3	SWP3 Plan	L.S.	1	***$4,500.00***	***$4,500.00***
4	Supplemental Items	L.S.	1	***$25,000.00***	***$25,000.00***
				General Items Total:	***$79,500.00***
PAVING ITEMS					
5	Remove and dispose of existing concrete pavement and base material, complete in place, the sum	S.Y.	2,100	***$15.00***	***$31,500.00***
6	9" reinforced concrete pavement, complete in place, the sum of:	S.Y.	2,100	***$85.00***	***$178,500.00***
7	8" lime stabilized subgrade, complete in place, the sum of:	S.Y.	2,300	***$6.00***	***$13,800.00***
8	Lime for stablized subgrade (6% by dry weight), complete in place, the sum of:	TON	65	***$200.00***	***$13,000.00***
9	6" concrete curb, complete in place, the sum of:	L.F.	900	***$5.00***	***$4,500.00***
10	ADA-compliant concrete curb ramp, complete in place, the sum of:	EA.	6	***$2,000.00***	***$12,000.00***
11	Remove and replace 6" thick reinforced concrete driveway, including proof rolling, level up sand, and full depth saw cut, complete in place, the sum of:	S.Y.	240	***$85.00***	***$20,400.00***
12	Remove and replace 4" thick reinforced concrete sidewalk/walkway, complete in place, the sum of:	S.F.	1,760	***$10.00***	***$17,600.00***
13	Remove, store, and reset existing traffic sign, complete in place, the sum of:	EA.	2	***$300.00***	***$600.00***
14	Concrete paving header with undercut (Type I), complete in place, the sum of:	LF	95	***$25.00***	***$2,375.00***
15	Temporary driveways, complete in place, the sum of:	EA.	13	***$800.00***	***$10,400.00***
				Paving Items Total:	***$304,675.00***
DRAINAGE ITEMS					
16	Remove and dispose of existing RCP storm sewer, complete in place, the sum of:	L.F.	630	***$35.00***	***$22,050.00***
17	Remove and dispose of existing inlet laterals, complete in place, the sum of:	L.F.	50	***$20.00***	***$1,000.00***
18	18" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	50	***$124.00***	***$6,200.00***
19	36" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	315	***$180.00***	***$56,700.00***
20	48" RCP Storm Sewer, including bedding and backfill, complete in place, the sum of:	L.F.	320	***$280.00***	***$89,600.00***
21	Type BB Inlet, including bedding and backfill, complete in place, the sum of:	E.A.	4	***$3,500.00***	***$14,000.00***
22	5'x5' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	3	***$6,500.00***	***$19,500.00***
23	6'x6' junction box, including bedding and backfill, complete in place, the sum of:	E.A.	4	***$7,500.00***	***$30,000.00***
24	Trench safety for all storm sewers greater than 5' deep, complete in place, the sum of:	L.F.	680	***$1.00***	***$680.00***
				Drainage Items Total:	***$239,730.00***
UTILITY ITEMS					
25	Water line adjustment to 8", including all water line appurtenances, complete in place, the sum of:	E.A.	2	***$18,000.00***	***$36,000.00***
26	Sanitary sewer conflict box, complete in place, the sum of:	E.A.	4	***$8,000.00***	***$32,000.00***
				Utility Items Total:	***$68,000.00***

General Items Total:	***$79,500.00***
Paving Items Total:	***$304,675.00***
Drainage Items Total:	***$239,730.00***
Utility Items Total:	***$68,000.00***
Total Construction Cost	***$691,905.00***
Miscellaneous Items (30%):	***$207,572.00***
Opinion of Probable Construction Cost (with 5% Escalation Factor):	***$992,000.00***

**These estimates are presented for planning purposes only and are subject to change as the project progresses. This estimate includes a 5% escalation factor for two years.*

***Any opinion of construction costs prepared by HDR is supplied for the general guidance of the Client only. Since HDR has no control over competitive bidding or market conditions, HDR cannot guarantee the accuracy of such opinions as compared to contract bids or actual costs to Client.*