STUDY REPORT

for
Ravensway South Subdivision
Drainage Improvements - 2018

Prepared For:
HARRIS COUNTY
PRECINCT 3
UPIN: **19103MF14A01**

Prepared By:

Binkley & Barfield consulting engineers

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MAY 2022

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED PROFESSIONAL ENGINEER

Tommy V. Cromer
5/31/2022

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EXECUTIVE SUMMARY

The Ravensway South Subdivision, built in the 1970s, encompasses approximately 67 acres of single-family residential properties. It is located in the White Oak Bayou watershed in Precinct 3 of Harris County, Texas, as shown in **Exhibit 4.1**. The subdivision is located on the north side of Cypress North Houston Road, just east of its intersection with Huffmeister Road. The subdivision consists of concrete curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into an existing trunkline storm sewer in Cypress North Houston Road, which then outfalls into E133-00-00.

The scope of services for this report includes summarizing the findings of data collection and field investigations associated with the project, presenting three alternative options, developing an opinion of probable construction cost for each alternative, and making a recommendation for the proposed improvements. The team established for the project included Costello, Inc. for drainage and Landtech, Inc. for surveying.

The subdivision is reported to have experienced structural flooding in approximately 16 homes during Hurricane Harvey, with approximately 11 of those experiencing flooding in previous major storm events. Existing conditions within the project area are typical of older subdivisions that have been insufficiently maintained and have not been upgraded to meet current standards of rainfall intensity.

This Study Report outlines the findings by Binkley & Barfield, Inc. for the Ravensway South Subdivision Drainage Improvements Project. Three alternatives were evaluated and presented in this report. Alternative 1 is recommended and includes replacing storm sewer pipes along Raven South Drive and tributary runs along Shaft Drive and Birdcall Lane. Extensions to the existing tributary runs along Nevermore Drive, Ravens Caw Drive, Raven Roost Drive, Blackbird Drive, and Ravenwing Drive are proposed to reduce gutter ponding along those streets during the 50% annual exceedance probability (AEP) design event. Additionally, all Type B-B inlets are proposed to have the plates replaced with inlet grates to increase inlet capacity and help reduce ponding depths/widths.

Proposed improvements for Alternative 1 are shown in the plan and profile drawings in **Exhibit 4.6**. The proposed typical roadway cross sections are presented in **Exhibit 4.5**.

The proposed improvements will increase the level of service of the pipes and inlets to a 50% AEP (2-year) design level, as required in the Harris County design criteria. However, due to the restricted capacity of the downstream systems in Cypress North Houston Road and the E133-00-00 outfall channel, a 1% AEP (100-year) level of service cannot be achieved without significant downstream improvements, as discussed in Alternatives 2 and 3.

The recommended improvement cost for Alternative 1 is estimated to be $3,539,000, without contingency.

1.0 INTRODUCTION

1.1 Authorization

Binkley & Barfield, Inc. (BBI) was authorized to proceed with engineering services on behalf of the Harris County Engineering Department (HCED), administered by the Recovery and Resiliency Division for Drainage Improvements to the Ravensway South Subdivision. BBI was given notice to proceed on June 30, 2021, under UPIN# 19103MF14A01 to provide drainage improvements consisting of storm sewer systems along neighborhood streets in the Ravensway South Subdivision.

1.2 Location

The Ravensway South Subdivision is located in western Harris County on the north side of Cypress North Houston Road, just east of its intersection with Huffmeister Road, as shown in **Exhibit 4.1**. The subdivision is in Harris County Precinct 3 and is operated by Timberlake Improvement District. The total area of the Ravensway South Subdivision is approximately 67 acres.

The project is located in the White Oak Bayou watershed and lies within a Zone X (Unshaded) area. It is reported that 16 structures within this subdivision experienced flooding during Hurricane Harvey. Additionally, it is reported that 11 of these homes experienced multiple structural flooding incidents in previous events, ranging from Tropical Storm Allison (2001) to the Tax Day flood in 2016.

1.3 Purpose and Scope

The purpose of this Study Report is to present the findings from the engineering investigations and reports, which gave the recommendations for drainage improvements to alleviate the existing flooding that occurs in the Ravensway South Subdivision. Three alternatives were studied and evaluated in this report

The proposed improvements for the recommended Alternative 1 include replacing trunkline storm sewer pipes along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft Drive and Birdcall Lane. Extensions to the existing tributary runs along Nevermore Drive, Ravens Caw Drive, Raven Roost Drive, Blackbird Drive, and Ravenwing Drive are also proposed to reduce gutter ponding along those streets during the 50% AEP design event. Additionally, all Type B-B inlets are proposed to have the plates replaced with inlet grates to increase inlet capacity and help reduce ponding depths/widths.

The scope of the Study Report consists of the following and will summarize the findings for each assessment, analysis, or investigation:

- Review and analysis of the existing conditions
- Drainage Impact Analysis
- Utility conflict coordination list
- Right-of-way alignment and topographic survey
- Preliminary cost estimates

1.4 Existing Conditions

The project is in Harris County, Precinct 3. The existing conditions are as follows:

The Ravensway South Subdivision is comprised of neighborhood streets, typically with two-lane concrete pavement, 28-feet wide, with curb and gutter back-to-back, and existing inlets and storm sewer drainage which serves an area of approximately 67 acres. Streets with this configuration include Raven South Drive, Birdcall Lane, Ravens Mate Drive, Ravenwing Drive, Cypress North Houston Road, Ravens Caw Drive, Raven Roost Drive, Raven Flight Drive, Blackbird Drive, Shaft Drive, Nevermore Drive, and Crow Court Drive.

- Typical right-of-way (ROW) is 60-feet.
- There are CenterPoint (CNP) gas lines within the existing neighborhood ROW.
- Existing overhead and buried electric, and fiber lines.
- There are multiple driveways and mailboxes on both sides or the roadway.
- There is a 12-inch public water line, and 8-inch and 10-inch sanitary utilities provided in the ROW of the roadway.

1.5 Project Milestones

The milestones and approval dates are listed below:

- Notice to proceed was issued on June 30, 2021, under UPIN# 19103MF14A01 by HCED.

- A Topographic Survey (TSPS Category 6, Condition 2) and Right-of-Way Survey (TSPS Category 1B, Condition 2) of the streets and utility easements were performed by Landtech, Inc. starting in July 2022 and was accepted by HCED on September 9, 2021.

- The Drainage Impact Analysis was prepared by Costello, Inc. in February 2022 and was assigned project number 2111020168. A Letter of No Objection was sent by HCFCD on March 7, 2022.

- Final plan set, cost estimate, and bid form will be submitted in July 2022 and should be approved in August 2022.

- Final study report will be submitted May 23, 2022, and should be approved in July 2022.

2.0 STUDIES AND DESIGN INFORMATION

2.1 Survey and Design Information

A Topographic Survey (TSPS Category 6, Condition 2) and Right-of-Way Survey (TSPS Category 1B, Condition 2) of the streets and utility easements were performed by Landtech, Inc. The survey was accepted by HCED on September 9, 2021. The surveys performed are as described below.

- Raven South Drive – approximately 2,500 feet
- Birdcall Lane – approximately 1,450 feet
- Ravens Mate Drive – approximately 370 feet
- Ravenwing Drive – approximately 820 feet
- Cypress North Houston Road – approximately 50 feet
- Ravens Caw Drive – approximately 700 feet
- Raven Roost Drive – approximately 850 feet
- Raven Flight Drive – approximately 50 feet
- Blackbird Drive – approximately 800 feet
- Shaft Drive – approximately 1,820 feet
- Nevermore Drive – approximately 1,270 feet
- Crow Court Drive – approximately 1,150 feet

The survey of ROW, top of curb, gutter, and centerline pavement elevations at the high and low points in the remaining street ROWs in Ravensway South Subdivision were obtained. The survey also included inlet and outlet, water surface, bottom of basin, and high bank elevations. See **Exhibit 4.7** for the ROW and topographic survey.

The Category 6, Condition II survey includes:

- Establish horizontal and vertical control based on Texas state plane coordinates, south central zone, Horizontal Datum: NAD 83, 2001 Adjustment. Vertical Datum will be based on NAVD 88, 2001 Adjustment.
- Establish existing ROW along Proposed Storm Sewer Route
- Collect cross-sections of ditches and streets extending five feet beyond the PUE in the subject area at a maximum spacing of one hundred feet.
- Collect topographic drainage detail of all driveways, street intersections and walkways crossing the ditches within the subdivision.
- Provide stormwater and invert elevations along the existing roadside ditch routes.
- Tie in Level B SUE underground utility markings.

The survey also includes existing ROW maps (Exhibit X) following Category 1B, Condition II requirements and the corresponding control point map.

2.2 Utilities and Conflict

The proposed project site contains multiple potential utility conflicts along neighborhood streets within Ravensway South Subdivision. Existing utilities are shown on the plan and profile drawings, and a Utility Conflict Table was prepared, summarizing the locations of conflict with existing utilities are shown below. See **Exhibit 4.8** for additional detail.

- CenterPoint Gas lines
  A 1 ¼" - 2" IP plastic gas line runs along Raven South behind the east and west back of curb. There is a possible conflict between these cables and the proposed storm sewer and pavement / sidewalk removal.

- CenterPoint underground electric
  CenterPoint electric lines feeding existing light poles run perpendicular to Raven South and cross from the west ROW to the light poles which are located behind the west back of curb. There is a possible conflict between these cables and the proposed storm sewer and sidewalk removal.

- AT&T Texas / SWBT cable
  A 12" AT&T / SWBT duct bank and cables runs along Ravens South Drive behind the east and west back of curb. There is a possible conflict between these cables and the proposed storm sewer and pavement / sidewalk removal.

- Comcast
  A Comcast underground cable is located along Raven South behind the east and west back of curb. There is a possible conflict between these cables and the proposed storm sewer and pavement / sidewalk removal.

- Timberlake Improvement District
  An 8"-12" waterline and an 8" sanitary sewer are located along Raven South behind the east and west back of curb. There is a possible conflict between these utilities and the proposed storm sewer and pavement / sidewalk removal.

2.3 Drainage Study

The Drainage Impact Analysis was prepared by Costello, Inc. in February 2022 as shown in **Appendix 5.1** and was assigned project number 2111020168. A Letter of No Objection was sent by HCFCD on March 7, 2022.

2.3.1 Existing Flooding History

The crown of Cypress North Houston Road pavement is approximately 2 feet above the natural ground/top of curb elevations in the Ravensway South Subdivision. The limited capacity and large drainage area tributary to the Cypress North Houston Road northern roadside ditch does not provide a level of service for rainfall events which exceed the existing storm sewer capacities, as would be required under current design criteria. This drainage configuration creates ponding conditions along the southern end of Raven South, which causes access issues in moderate localized events and potential structural flooding in larger localized events and during larger watershed-wide events.

2.3.2 Existing Storm Sewer Computations

The existing condition storm sewer network within the Ravensway South subdivision and along Cypress North Houston Road from E133-00-00 to Huffmeister Road was simulated using a spreadsheet analysis. The spreadsheet first computes Rational Method peak flows for the 50% AEP design event, the associated headlosses along each reach of the system, and compares the resulting Hydraulic Grade Line (HGL) and gutter elevations for compliance with the design criteria. The 50% AEP analysis also includes computations of the ponding width (spread) and ponding depths in the gutters and at the storm sewer curb inlets. The rainfall data used for this analysis is the Harris County Region 3 Atlas 14 Intensity-Duration-Frequency (IDF) data from the 2019 PCPM, as required in the CoH IDM and the 2019 Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure (HC Regs).

The spreadsheet then computes 1% AEP peak flows, HGL elevations, and compares those results to the natural ground elevations at the street right-of-way line for compliance with the design criteria. The spreadsheet also computes 10% AEP peak flows, HGL elevations, and compares those results to the gutter elevations and natural ground elevations at the street right-of-way line. The results of the existing condition 50% AEP hydraulic analysis indicate that the HGL elevations along Raven South Drive exceed the gutter elevations by as much as 2.5 feet for all of the storm sewer reaches upstream of Ravens Roost Drive and all of the tributary systems along the side streets throughout the subdivision. This indicates that the existing storm sewer system is not in compliance with the current 50% AEP event hydraulic profile criterion.

Additionally, the 1% AEP results indicate that the HGL elevations greatly exceed the natural ground at right-of way elevations throughout the system. The HGL elevations as computed, while unrealistically high, indicates that the pipe system is unable to meet the current 1% AEP design criteria. This result is expected since this system was designed and constructed circa 1978, well before the more modern design criteria for 1% AEP storm sewer design requirements. An analysis of the 1% AEP sheet flow and inlet capacities was performed in order to determine whether the existing inlets have the capability of conveying the computed 1% AEP runoff from the drainage area tributary to each inlet location, independent of the HGL conditions created by the pipe system serving the inlets. Refer to **Appendix A** for the full Drainage Impact Analysis and additional information. HCFCD issued an INO letter for this analysis on March 3, 2022, and is included as **Appendix B**.

3.0 PROPOSED IMPROVEMENTS AND RECOMMENDATION

The focus of this project is to improve drainage and reduce structural flood risk within The Ravensway subdivision by replacing and upsizing the existing storm sewer system.

3.1 Proposed Typical Sections

Refer to **Exhibit 4.4** for additional detail.

- **Raven South Drive from Raven Flight Drive to South to Raven Roost Drive**
  - The proposed storm sewer will be installed along the east side of the road behind the back of curb while the existing is removed.
  - The existing sidewalk and the east roadbed will be replaced
  - The west side of the road will not be disturbed

- **Raven South Drive from Raven Roost Drive to Scamp Drive**
  - The proposed storm sewer will be installed along the west side of the road behind the back of curb while the existing is removed.
  - The existing sidewalk and the west roadbed will be replaced
  - The east side of the road will not be disturbed

- **Ravenwing Drive, Blackbird Drive, Raven Flight Drive, Raven Roost Drive, Raven Caw Drive, Birdcall Lane, Nevermore Drive, Shaft Drive**
  - The proposed storm sewer will be installed along the south side of the road behind the back of curb while the existing is removed.
  - The existing sidewalk and a portion of the west roadbed will be replaced
  - The north side of the road will not be disturbed

3.2 Design Recommendation

In addition to the recommended design, two other alternatives were evaluated but ultimately not recommended. The second alternative included designing storm sewer improvements only within the Ravensway South Subdivision, which would lower the 1% AEP Atlas 14 HGL elevations to provide a future level of service throughout the system's service area assuming downstream improvements are made. The third alternative included improvements of the storm sewer trunkline along Cypress North Houston between Raven South and the outfall into E133-00-00 to lower the headlosses in the trunkline to allow the storm sewer improvements to meet the design criteria. Neither of these provided enough benefit so the original Alternative 1 described below was selected for the proposed improvements and design of this project.

In order to reduce the headlosses throughout the Ravensway South internal storm sewer system for the 50% AEP design event, thus bringing the proposed system into compliance with the current 50% AEP design criteria, certain reaches of storm sewer are proposed to be improved. The improvements include:

- Replacing a reach of existing 30, 48, 54, and 60-inch pipes along Raven South Drive with 66-inch RCP.
- Replacing the existing 30 and 36-inch pipes along Shaft Drive with 42-inch RCP.
- Replacing the existing 30 and 36-inch pipes along Birdcall Lane with 36 and 42-inch RCP.

- Extending the storm sewer systems along Nevermore Drive, Ravens Caw Drive, Raven Roost Drive, Blackbird Drive, and Ravenwing with 24-inch RCP, with an additional pair of inlets-on-grade to reduce the initial drainage areas to those gutter runs, thus reducing ponding widths along those streets.
- Adding a pair of inlets-on-grade along Birdcall Lane and Raven Flight Drive to reduce the drainage areas to the existing gutter runs which exceeded allowable ponding widths, thus reducing ponding widths along those streets.
- Replacing the solid plate covers on all B-B inlets with grate covers to increase inlet capacities.
- Replacing the existing C-1 inlet pairs at the intersections of Blackbird Drive and Ravenwing Drive with C-2 inlets to reduce ponding widths and maximize the sheet flow interception capacity at these two locations.

Refer to **Appendix A** for the full Drainage Impact Analysis for additional information.

3.3 Project Benefits

Below are the benefits of proposed improvements:

- Upgrades subdivision to 2-year capacity with Atlas 14 rainfall
- Within project scope outlined in engineering agreements
- Relatively low cost, similar to recommendation from previous study
- No detention mitigation required; outflow rate reduced
- Improves safety, roads passable more quickly after rainfall
- Neighborhood disruption during construction is minimized

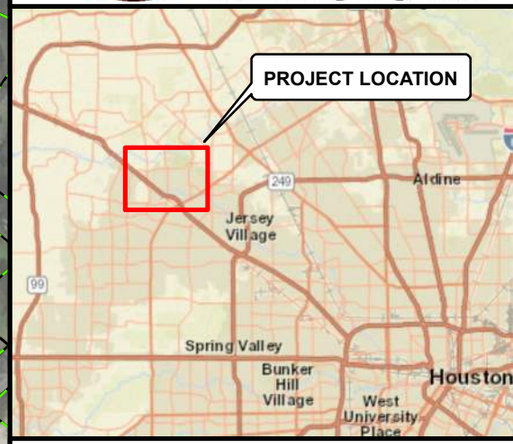
3.4 Construction Cost Estimate

The preliminary construction cost estimate for this project is $3,539,000.
Refer to **Exhibit 4.9** for detailed construction cost estimate.

EXHIBITS

EXHIBIT 4.1
LOCATION MAPS

Binkley & Barfield
consulting engineers



N

0 175 350 700

Feet

SHAFT DR
RAVENSONG DR
SCAMP DR
RAVENSWAY CENTER DR
NEVERMORE DR
RAVENS CHASE LN
BIRDCALL LN
RAVENS MATE DR
RAVENS CAW DR
RAVEN SOUTH DR
DRAKE HOLLOW LN
RAVEN ROOST DR
RAVEN FLIGHT DR
BLACK BIRD DR
CROW CT
WESTOVER DR
RAVEN WING DR
HUFFMEISTER RD
CYPRESS NORTH HOUSTON RD

LEGEND

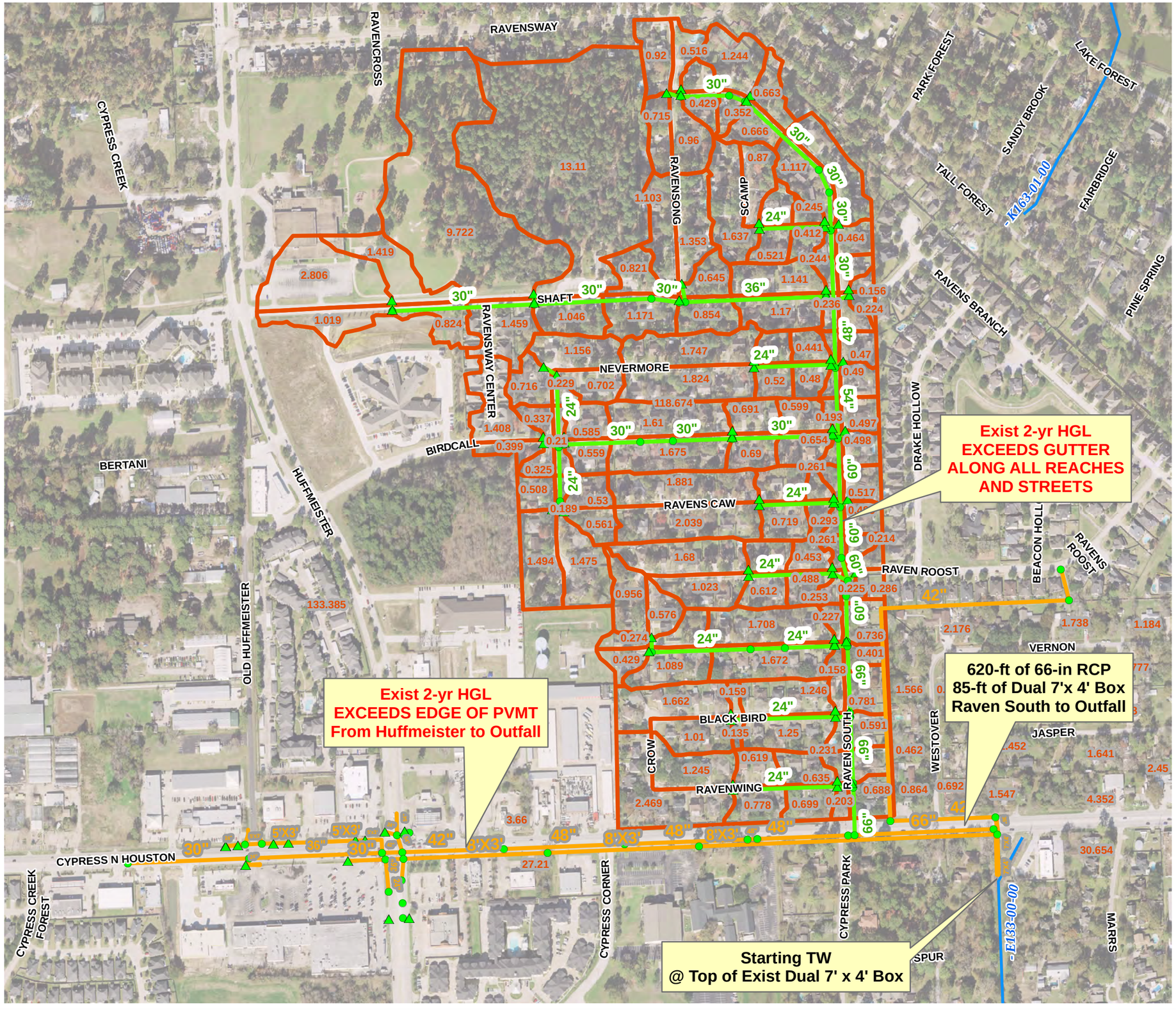
- Ravensway South Boundary
- Parcels

HARRIS COUNTY PRECINCT 3
RAVENSWAY SOUTH SUBDIVISION
UPIN 19103MF14701

PROJECT LOCATION MAP

JULY 2021

EXHIBIT 4.2
OFFSITE DRAINAGE AREA MAP



N

0 400

Feet

1 in = 400 ft

Legend

- RavenSouth_Storm
- Offsite_Storm

Costello

Costello, Inc.
Engineering and Surveying
TBPE Firm Registration No. 280

HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN19103MF14701

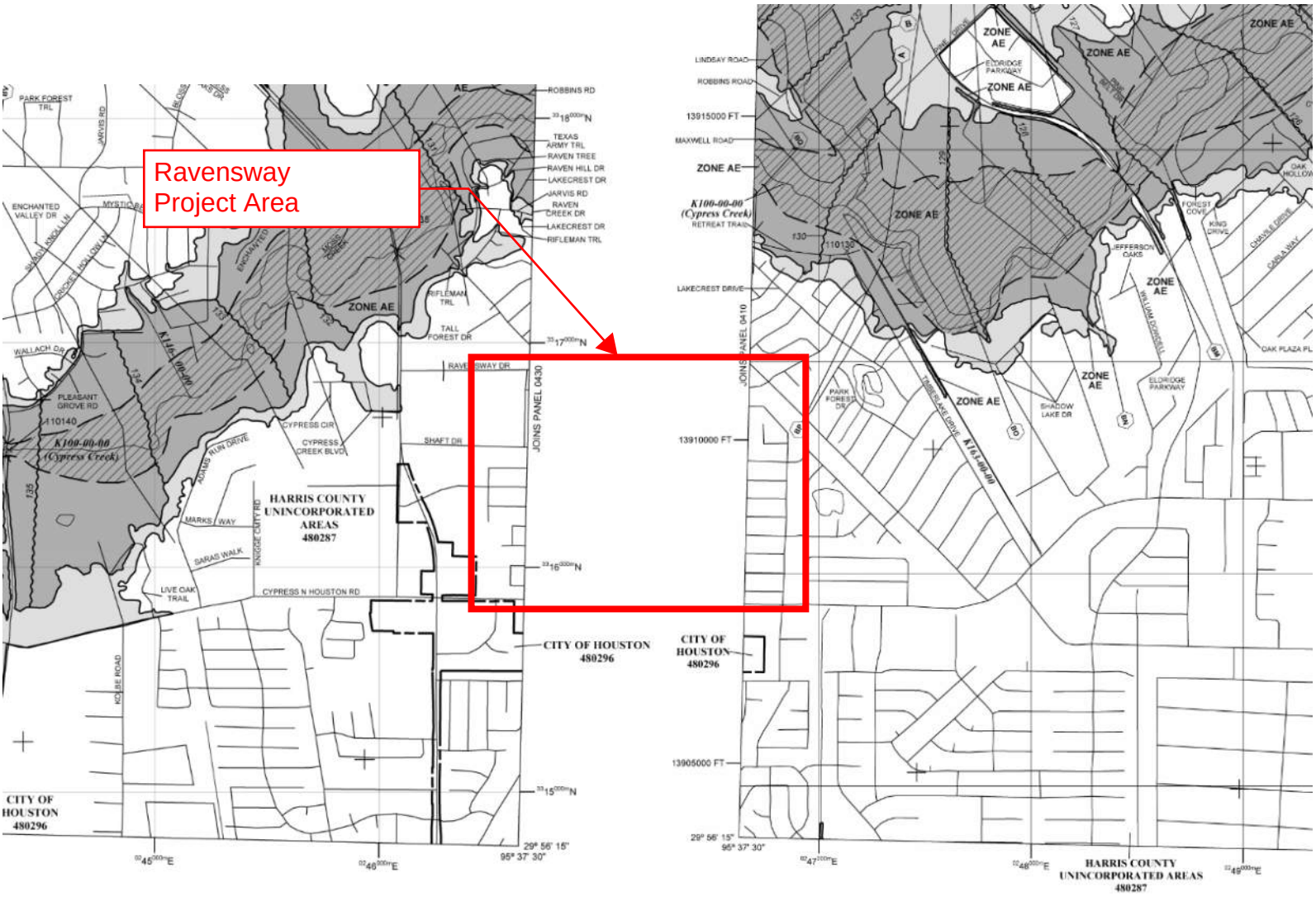
EXISTING DRAINAGE AREA & SYSTEM LAYOUT MAP

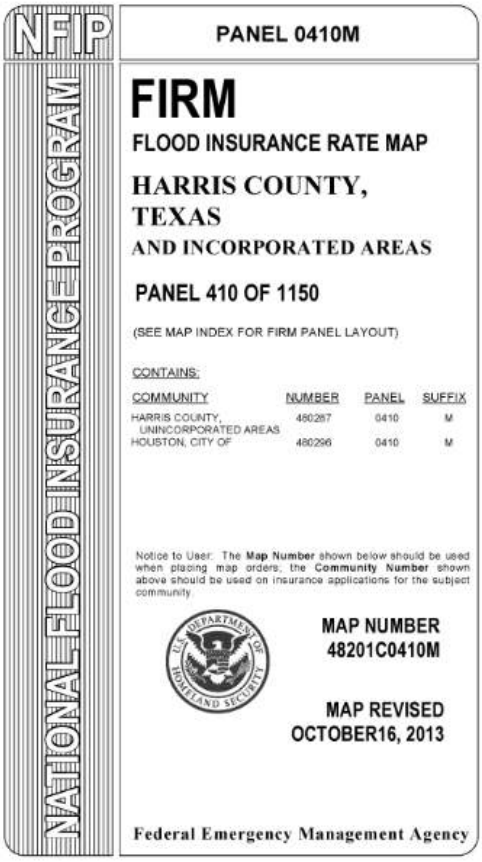
JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

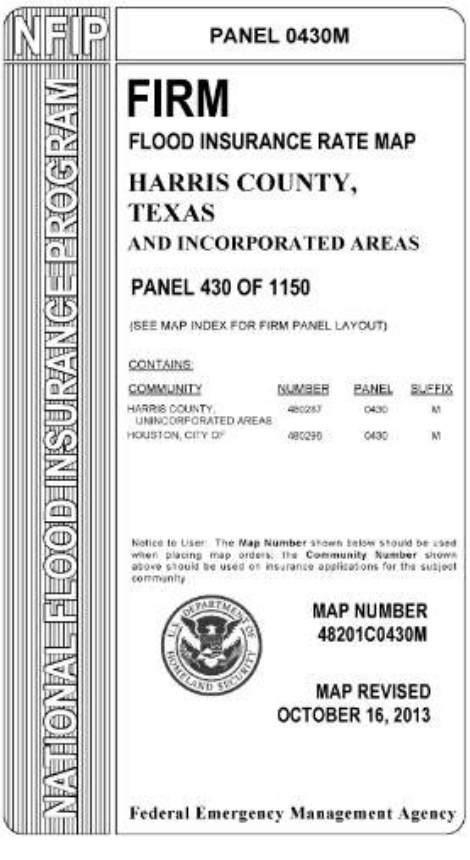
EXHIBIT 2

Date Saved: 2/15/2022 4:47:32 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\2-Exist DA Map.mxd

EXHIBIT 4.3
FLOODPLAIN MAP


Ravensway
Project Area
ZONE AE
HARRIS COUNTY
UNINCORPORATED
AREAS
480287
CITY OF HOUSTON
480296
JOINS PANEL 0430
JOINS PANEL 0410
K100-00-00
(Cypress Creek)
K145-00-00
13915000 FT
13910000 FT
13905000 FT
29° 56' 15"
95° 37' 30"


NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0410M
FIRM
FLOOD INSURANCE RATE MAP
HARRIS COUNTY, TEXAS
AND INCORPORATED AREAS
PANEL 410 OF 1150
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
HARRIS COUNTY, UNINCORPORATED AREAS 480287 0410 M
HOUSTON, CITY OF 480296 0410 M
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
48201C0410M
MAP REVISED
OCTOBER16, 2013
Federal Emergency Management Agency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NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0430M
FIRM
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HARRIS COUNTY, TEXAS
AND INCORPORATED AREAS
PANEL 430 OF 1150
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
HARRIS COUNTY, UNINCORPORATED AREAS 480287 0430 M
HOUSTON, CITY OF 480296 0430 M
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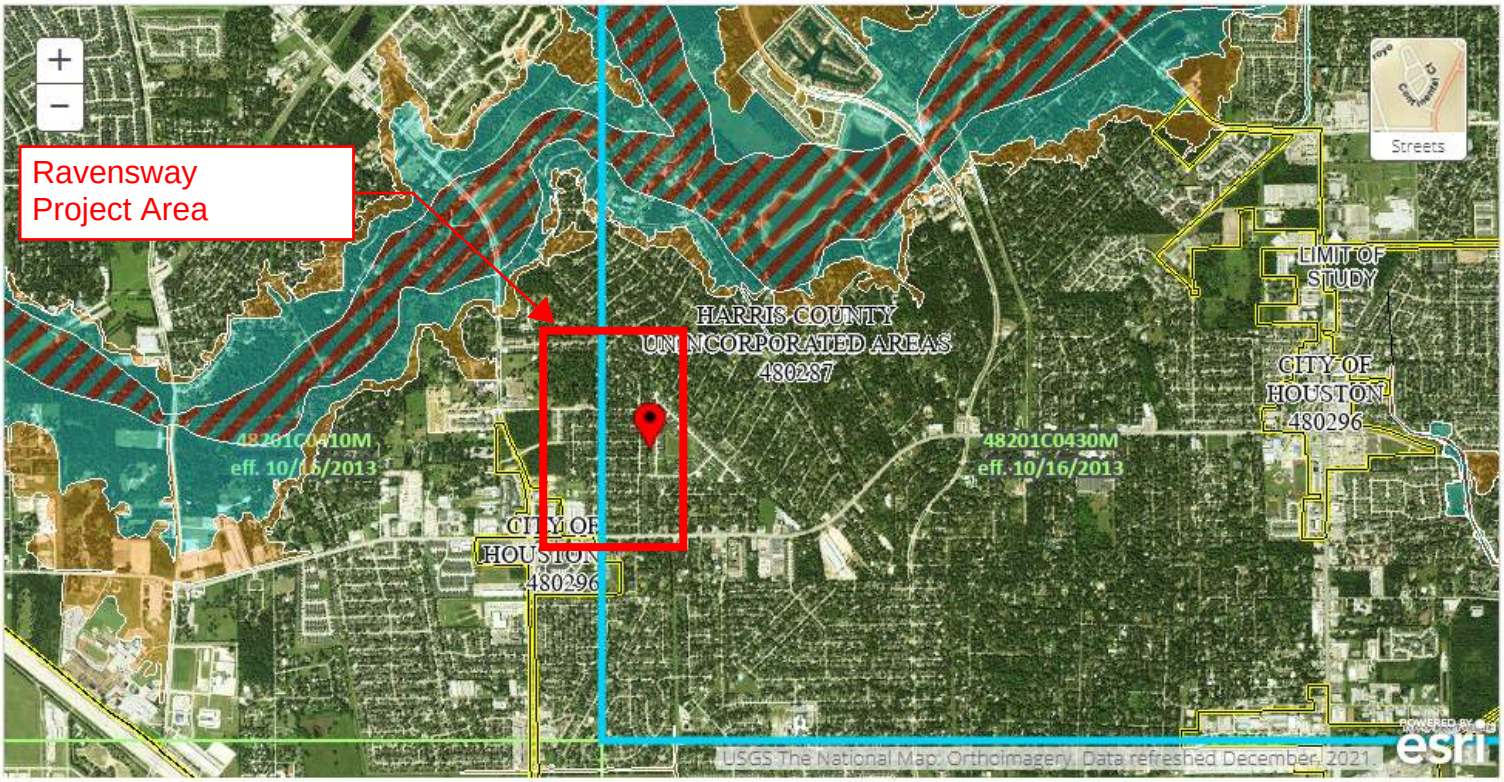
Federal Emergency Management Agency



PIN
- Approximate location based on user input and does not represent an authoritative property location

MAP PANELS
- Selected FloodMap Boundary
- Digital Data Available
- No Digital Data Available
- Unmapped

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*
- Otherwise Protected Area
- Coastal Barrier Resource System Area

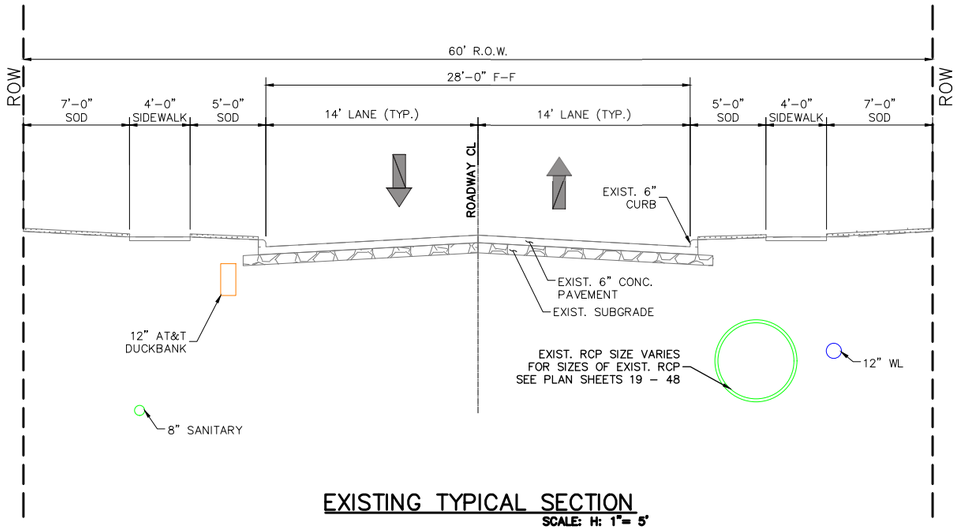
SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

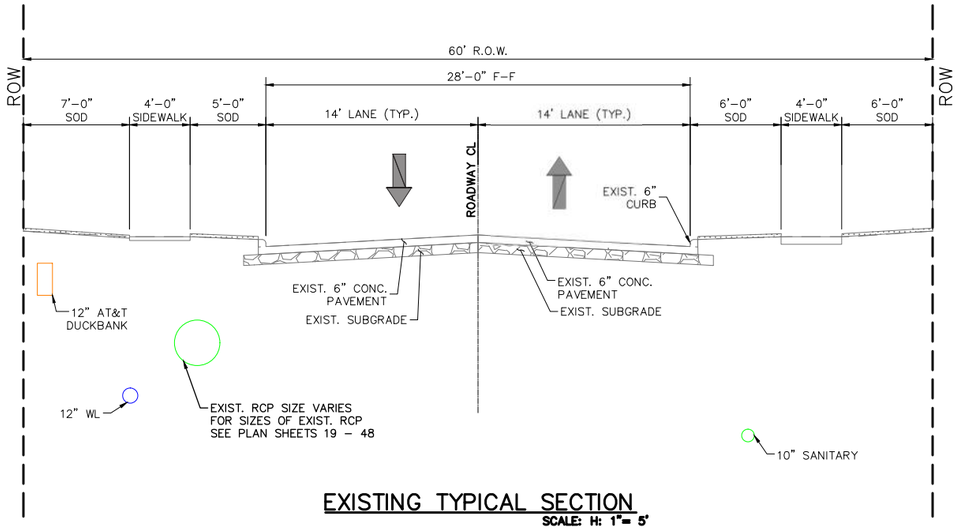
EXHIBIT 4.4
EXISTING TYPICAL CROSS SECTIONS



EXISTING TYPICAL SECTION

SCALE: H: 1"= 5'

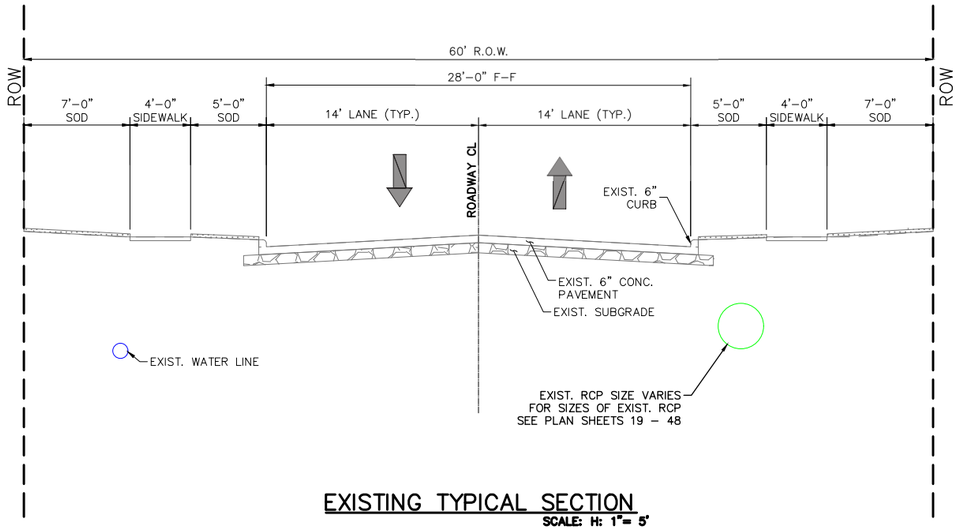
STREET NAME	STATION LIMITS
RAVEN SOUTH DRIVE	STA: 12+80 TO STA: 15+32



EXISTING TYPICAL SECTION

SCALE: H: 1"= 5'

STREET NAME	STATION LIMITS
RAVEN SOUTH DRIVE	STA: 16+27 TO STA: 29+82



EXISTING TYPICAL SECTION

SCALE: H: 1"= 5'

STREET NAME	STATION LIMITS
RAVENWING DRIVE	STA: 5+83 TO STA: 13+25
BLACKBIRD DRIVE	STA: 1+50 TO STA: 3+25
RAVEN FLIGHT DRIVE	STA: 1+80 TO STA: 4+60
RAVEN ROOST DRIVE	STA: 9+15 TO STA: 12+80
RAVEN CAW DRIVE	STA: 10+70 TO STA: 13+39
BIRDCALL LANE	STA: 5+42 TO STA: 16+74
NEVERMORE DRIVE	STA: 24+23 TO STA: 13+50
SHAFT DRIVE	STA: 6+67 TO STA: 25+10

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

HARRIS COUNTY ENGINEERING DEPARTMENT

HARRIS COUNTY 1836 TEXAS

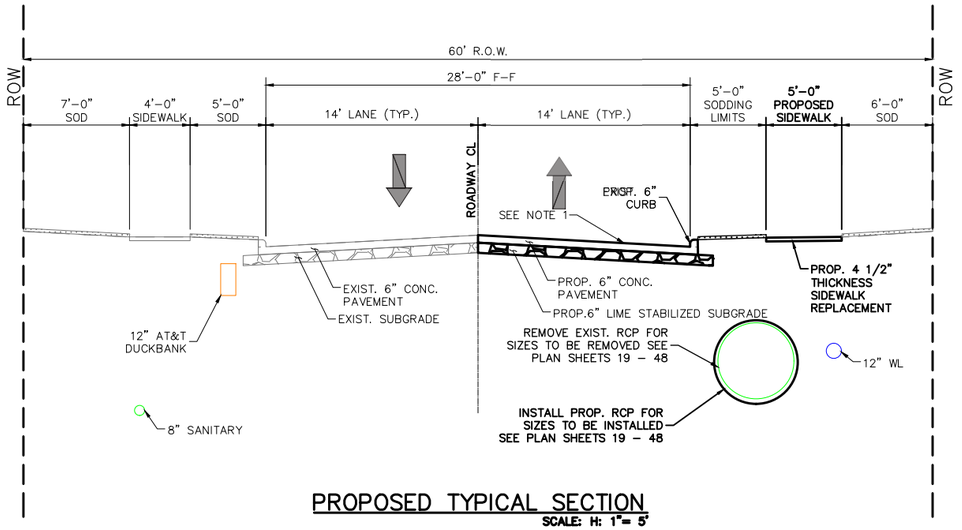
Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	EXISTING TYPICAL SECTIONS
DRAWN BY: JCM	DATE: 02/18/2022
DESIGN BY: JCM	SCALE: HORIZ: 1"=5' VERT: 1"=1'
	SHEET NO: 6 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-GENERAL-TYPICAL SECTION.dwg

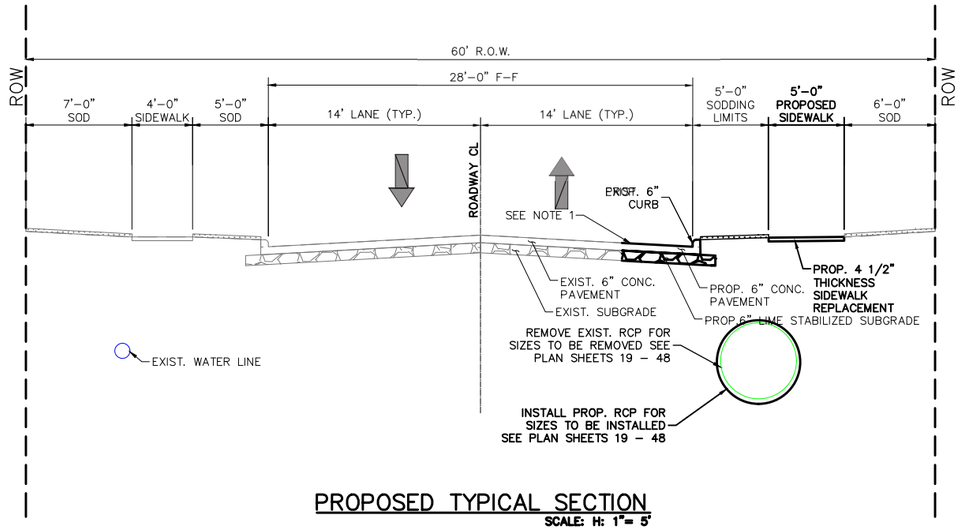
EXHIBIT 4.5
PROPOSED TYPICAL SECTIONS



PROPOSED TYPICAL SECTION

SCALE: H: 1"= 5'

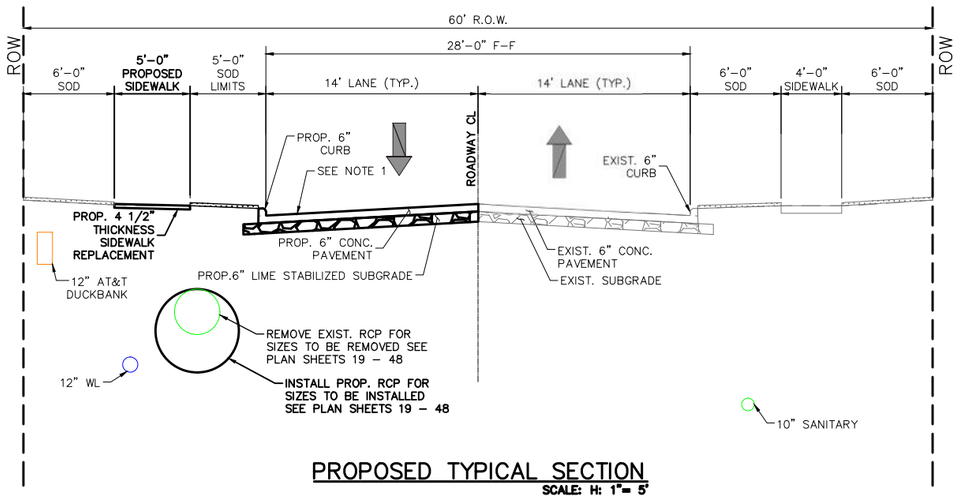
STREET NAME	STATION LIMITS
RAVEN SOUTH DRIVE	STA: 12+80 TO STA: 15+32



PROPOSED TYPICAL SECTION

SCALE: H: 1"= 5'

STREET NAME	STATION LIMITS
RAVENWING DRIVE	STA: 5+83 TO STA: 13+25
BLACKBIRD DRIVE	STA: 1+50 TO STA: 3+25
RAVEN FLIGHT DRIVE	STA: 1+80 TO STA: 4+60
RAVEN ROOST DRIVE	STA: 9+15 TO STA: 12+80
RAVEN CAW DRIVE	STA: 10+70 TO STA: 13+39
BIRDCALL LANE	STA: 5+42 TO STA: 16+74
NEVERMORE DRIVE	STA: 24+23 TO STA: 13+50
SHAFT DRIVE	STA: 6+67 TO STA: 25+10



PROPOSED TYPICAL SECTION

SCALE: H: 1"= 5'

STREET NAME	STATION LIMITS
RAVEN SOUTH DRIVE	STA: 16+27 TO STA: 29+82

NOTES:

1. FOR PROPOSED PAVEMENT REPLACEMENT LIMITS AND SODDING LIMITS SEE PLAN SHEETS 19 – 48.
2. CONTRACTOR TO AVOID DAMAGE TO ANY AND ALL EXISTING UTILITIES WHILE IN THE AREA DURING CONSTRUCTION ACTIVITIES.
3. FOR DEPTHS OF EACH LAYER OF MATERIAL REPLACED REFER TO PAVEMENT DETAILS ON SHEETS 52 –53.

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
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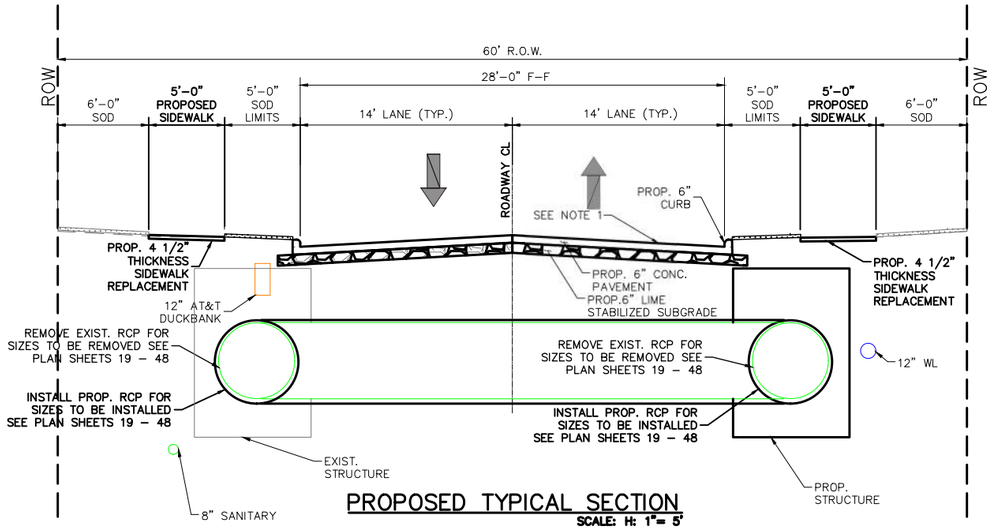
STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC. TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PROPOSED TYPICAL SECTION (1 OF 2)
DRAWN BY: JCM
DESIGN BY: JCM
SCALE: HORIZ: 1"=5' VERT: 1"=1'
DATE: 02/18/2022
SHEET NO: 7 / 99

J:_HCP3\210000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-GENERAL-TYPICAL SECTION.dwg



PROPOSED TYPICAL SECTION

SCALE: H: 1"= 5'

STREET NAME – STATION LIMITS

RAVEN SOUTH DRIVE – STA: 15+32 TO STA: 16+23

NOTES:

1. FOR PROPOSED PAVEMENT REPLACEMENT LIMITS AND SODDING LIMITS SEE PLAN SHEETS 19 – 48.
2. CONTRACTOR TO AVOID DAMAGE TO ANY AND ALL EXISTING UTILITIES WHILE IN THE AREA DURING CONSTRUCTION ACTIVITIES.
3. FOR DEPTHS OF EACH LAYER OF MATERIAL REPLACED REFER TO PAVEMENT DETAILS ON SHEETS 52 –53.

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

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PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PROPOSED TYPICAL SECTIONS (2 OF 2)
DRAWN BY: JCM	DATE: 02/18/2022
DESIGN BY: JCM	SCALE: HORIZ: 1"=5' VERT: 1"=1'
	SHEET NO: 8 / 99

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EXHIBIT 4.6
ROADWAY PLAN AND PROFILE

FOR CONTINUATION OF RAVENWING DRIVE
SEE SHEET 28

MATCHLINE B-L STA. 9+00 SEE SHEET 20

PROP. 36" RCP
PROP. TYPE C-2 CURB INLET (15')
STA: 6+81.96 OFF: 43.03 LT
PROP. 24" RCP
PROP. 5' DIA STORM MANHOLE
STA: 6+75.04 OFF: 43.07 LT
42 LF
MATCH EXIST. SDWK.
STA. 6+54.73, OFF: 21.95' LT
MATCH EXIST. SDWK.
STA. 6+46.61, OFF: 24.06' LT
PROP. 24" RCP
PROP. TYPE C-2 CURB INLET (15')
STA: 7+11.96 OFF: 42.85 LT
MATCH EXIST. SDWK.
STA. 7+18.84, OFF: 45.26' LT
MATCH EXIST. SDWK.
STA. 7+41.49, OFF: 19.02' LT
PROP. 36" RCP
13+00
MATCH EXIST. SDWK.
STA. 6+63.00, OFF: 20.52' RT
27 LF
REMOVE AND REPLACE PAVEMENT
TO EXIST. CONCRETE ELEV.
SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY
PROP. 8' DIA STORM MANHOLE
STA: 6+78.12 OFF: 19.11 RT
2-EXIST. 66" STM TO
CONNECT TO PROP. MANHOLE
REMOVE AND REPLACE PAVEMENT
TO EXIST. CONCRETE ELEV.
SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY
STA 6+96.71 C-ALIGN-ROAD-RAVEN S DR =
STA 13+06.10 C-ALIGN-ROAD-RAVENWING DR
MATCH EXIST. SDWK.
STA. 6+97.37, OFF: 20.22' RT
EP: 13+50.00
N2° 11' 00.00"W
1062.394'
RAVENS SOUTH DRIVE
60' R.O.W.
13303 RAVENWING DR
13302 RAVENWING DR
12002 RAVEN SOUTH DR
12006 RAVEN SOUTH DR
12010 RAVEN SOUTH DR
12014 RAVEN SOUTH DR
12018 RAVEN SOUTH DR

LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

CYPRESS NORTH HOUSTON ROAD
100' ROW
CL CYPRESS NORTH HOUSTON ROAD
RAVENWING DRIVE
50' ROW
CL RAVENWING DR
EXIST. GROUND @ R.O.W. (RT)
EXIST. GROUND @ R.O.W. (LT)
EXIST. ROAD CL
EXIST. 12" WATER PIPE
EXIST. 66" RCP
196 LF @ 0.00%
ST FL: 121.41
END FL: 121.41
PROP. 24" RCP
30 LF @ 1.55%
ST FL: 125.66
END FL: 125.19
EXIST. 66" RCP STRM
12 LF @ 0.16%
START FL: 121.64
END FL: 121.61
EXIST. HGL
PROP. HGL
EXIST. 66" RCP
274 LF @ 0.07%
ST FL: 121.82
END FL: 121.64
EXIST. 8" SAN SWR
EXIST. STM. MH
FL(IN): 121.41 (66" RCP) N
EXIST. SAN. MH SSWR
FL(OUT): 123.29 8" N
FL(OUT): 125.19 8" W
PROP. 5' DIA STORM MANHOLE
STA: 6+75.04 OFF: 43.07 L
RIM: 130.07
FL(IN): 123.98 (36" RCP W)
FL(IN): 125.18 (24" RCP N)
FL(OUT): 123.98 (36" RCP E)
PROP. 8' DIA STORM MANHOLE
STA: 6+78.12 OFF: 19.11 R
RIM: 129.91
FL(IN): 123.92 (36" RCP W)
FL(IN): 120.75 (66" RCP N)
FL(OUT): 120.65 (66" RCP S)
EXIST. STM. MH
FL(IN): 121.61 (66" RCP) N
FL(IN): 123.91 (24" RCP) W
FL(OUT): 121.41 (66" RCP) S
EXIST. STM. MH
FL(IN): 121.64 (66" RCP) N
FL(OUT): 121.64 (66" RCP) S
PROP. TYPE C-2 CURB INLET (15')
STA: 6+81.96 OFF: 43.03 L
RIM: 129.19
FL(IN): 125.19 (24" RCP N)
FL(OUT): 125.19 (24" RCP S)
PROP. TYPE C-2 CURB INLET (15')
STA: 7+11.96 OFF: 42.85 L
RIM: 129.15
FL(OUT): 125.66 (24" RCP S)
EXIST. SAN. MH SSWR
FL(IN): 122.35 8" S
FL(OUT): 122.35 8" N

NO.	REVISIONS	DATE	NAME

HARRIS COUNTY ENGINEERING DEPARTMENT

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Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROFILE – RAVEN S DR
DRAWN BY: JCM	STA 4+00 TO STA 9+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	19 / 99

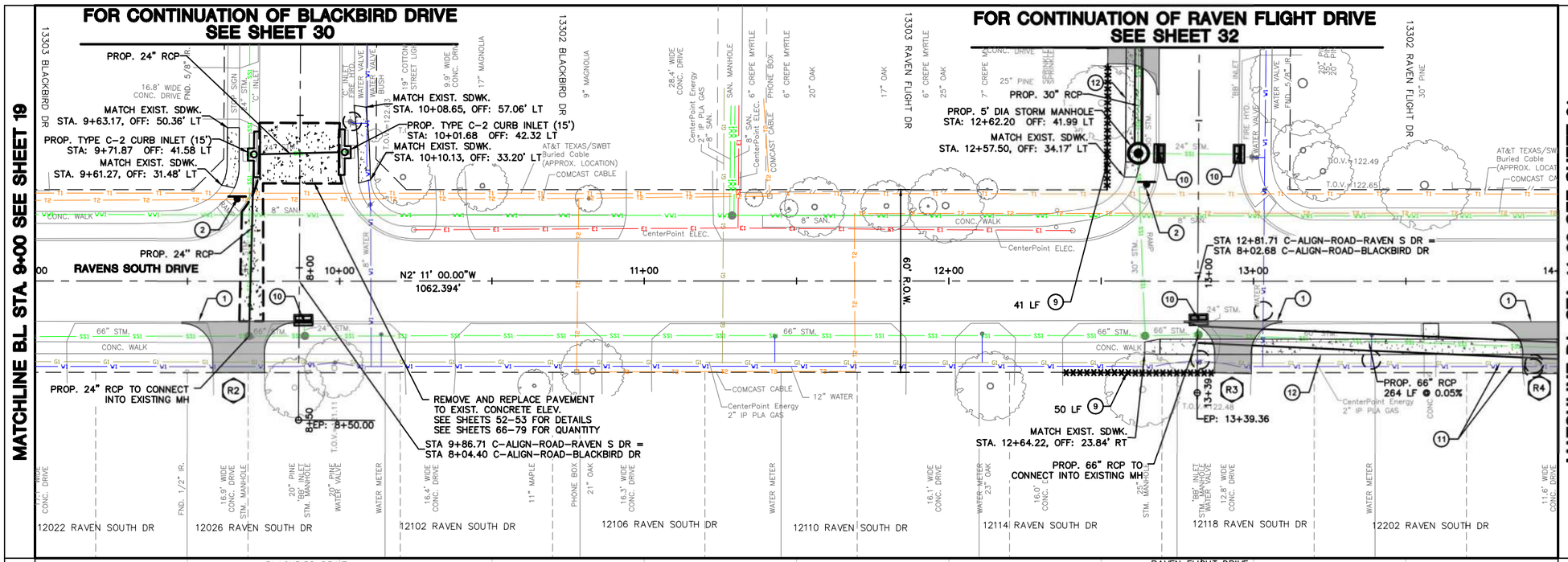
J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-RAVENS S DR.dwg

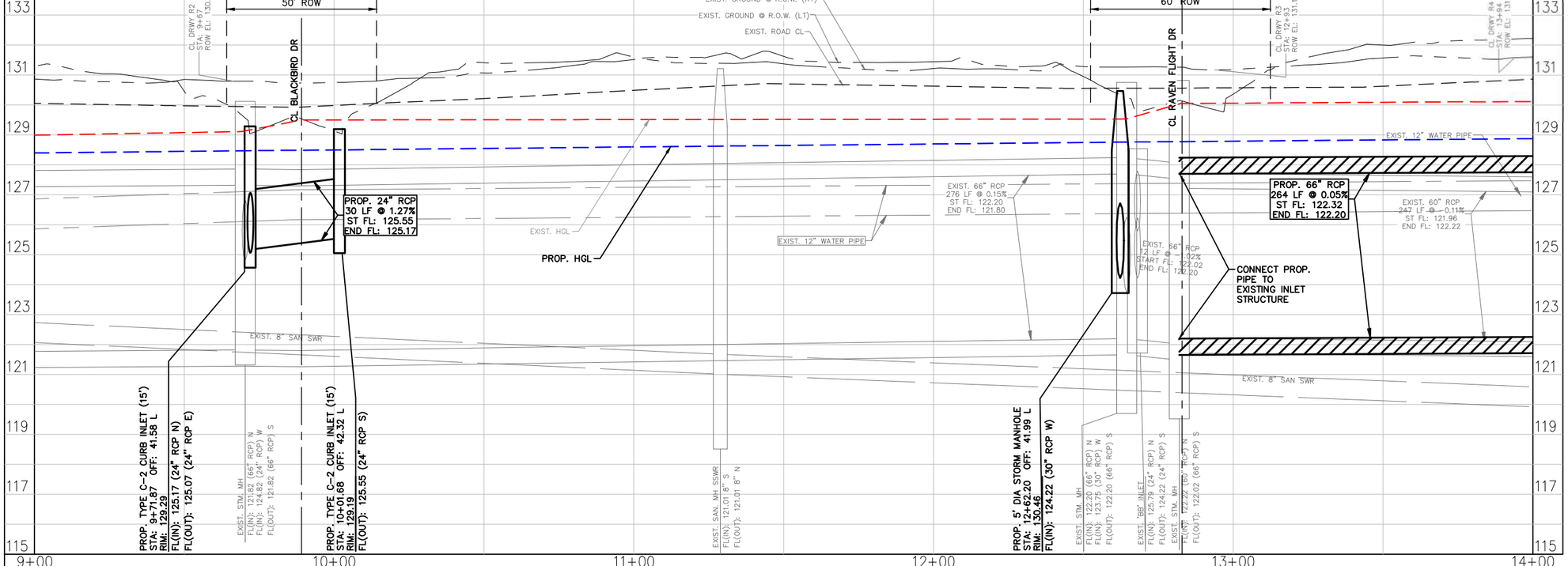
MATCHLINE B.L. STA. 9+00 SEE SHEET 19

FOR CONTINUATION OF BLACKBIRD DRIVE
SEE SHEET 30

FOR CONTINUATION OF RAVEN FLIGHT DRIVE
SEE SHEET 32

MATCHLINE B.L. STA. 14+00 SEE SHEET 21





LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

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STATE OF TEXAS
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BINKLEY & BARFIELD INC. TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROFILE – RAVEN S DR

DRAWN BY:		DATE:
JCM	STA 9+00 TO STA 14+00	02/18/2022
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'	SHEET NO: 20 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-RAVENS S DR.dwg

MATCHLINE B.L STA. 14+00 SEE SHEET 20

MATCHLINE B.L STA. 19+00 SEE SHEET 22

FOR CONTINUATION OF RAVEN ROOST DRIVE SEE SHEET 34

FOR CONTINUATION OF RAVEN CAW DRIVE SEE SHEET 36

EXIST. 24" RCP TO CONNECT INTO PROPOSED MH

PROP. 5' DIA STORM MANHOLE STA: 15+39.11 OFF: 0.38 RT RIM: 130.78 FL(IN)= 124.50 (24" RCP)

L=54.146, R=300.223 Δ=10.3333

N2° 11' 00.00"W 1062.394'

PROP. 66" RCP 264 LF @ 0.05%

PROP. 8' DIA STORM MANHOLE STA: 15+49.64 OFF: 18.69 RT RIM: 130.63 FL(IN)= 122.32 (66" RCP) FL(IN)= 125.58 (24" RCP) FL(OUT)= 122.32 (66" RCP) FL(OUT)= 124.62 (24" RCP)

PROP. 24" RCP 20 LF @ 1.54%

PROP. 5' DIA STORM MANHOLE STA: 15+57.61 OFF: 37.11 RT RIM: 131.09 FL(OUT)= 125.89 (24" RCP)

EXIST. 24" RCP TO CONNECT INTO PROPOSED MH

PROP. 24" RCP 21 LF @ 0.55%

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52–53 FOR DETAILS SEE SHEETS 66–79 FOR QUANTITY

MATCH EXIST. SDWK. STA. 16+05.17, OFF: 23.87' LT

PROP. 8' DIA STORM MANHOLE STA: 16+27.29 OFF: 17.04 LT RIM: 130.92 FL(IN)= 122.36 (66" RCP) FL(OUT)= 122.37 (66" RCP)

PROP. 66" RCP 85 LF @ 0.06%

MATCH EXIST. SDWK. STA. 15+65.51, OFF: 44.71' RT

STA 15+77.92 C–ALIGN–ROAD–RAVEN S DR = STA 13+16.90 C–ALIGN–ROAD–RAVEN ROOST DR

PROP. 66" RCP 208 LF @ 0.05%

MATCH EXIST. SDWK. STA. 18+88.45, OFF: 42.32' LT

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52–53 FOR DETAILS SEE SHEETS 66–79 FOR QUANTITY

MATCH EXIST. SDWK. STA. 18+44.47, OFF: 52.10' LT

PROP. 10' DIA STORM MANHOLE STA: 18+36.82 OFF: 18.42 LT RIM: 131.07 FL(IN)= 122.48 (66" RCP) FL(OUT)= 122.47 (66" RCP)

2–EXIST. 24" RCP TO CONNECT INTO PROPOSED MH

STA 18+68.62 C–ALIGN–ROAD–RAVEN S DR = STA 16+91.35 C–ALIGN–ROAD–RAVEN CAW

PC: 14+62.39

PT: 15+18.24

PC: 16+06.30

PT: 16+58.62

L=52.320, R=299.769 Δ=10.0000

PC: 14+00.00

PT: 17+50.00

67 LF

37 LF

46 LF

34 LF

60' R.O.W.

RAVENS SOUTH DRIVE

12206 RAVEN SOUTH DR

12210 RAVEN SOUTH DR

12302 RAVEN SOUTH DR

12306 RAVEN SOUTH DR

12310 RAVEN SOUTH DR

13303 RAVEN ROOST DR

13302 RAVEN ROOST DR

13303 RAVENS CAW DR

LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE

PROP. STORM PIPES

PROP. CONCRETE DRIVEWAY

PROP. 5' SIDEWALK

PROP. MANHOLE

PROP. JUNCTION BOX

PROP. TYPE BB INLET

PROP. TYPE C INLET

PROP. TYPE C–1 INLET

PROP. TYPE C–2 INLET

EXIST. ROAD CL

EXIST. GROUND @ R.O.W. (LT)

EXIST. GROUND @ R.O.W. (RT)

EXIST. AT&T CONDUIT

EXIST. COMCAST CABLE

EXIST. GAS LINE

EXIST. ELECTRIC LINE

EXIST. WATER LINE

EXIST. STORM LINE

EXIST. SANITARY LINE

RAVEN ROOST DRIVE 50' ROW

RAVENS CAW DRIVE 50' ROW

CL RAVEN ROOST DR

CL RAVENS CAW DR

PROP. 66" RCP 264 LF @ 0.05% ST FL: 122.32 END FL: 122.20

EXIST. 60" RCP 247 LF @ –0.11% ST FL: 121.96 END FL: 122.22

EXIST. 8" WATER PIPE

PROP. 66" RCP 85 LF @ 0.06% ST FL: 122.37 END FL: 122.32

EXIST. 60" RCP 93 LF @ 0.39% START FL: 122.50 END FL: 122.31

PROP. 66" RCP 208 LF @ 0.05% ST FL: 122.47 END FL: 122.36

EXIST. HGL

PROP. HGL

EXIST. 60" RCP 201 LF @ 0.00% START FL: 122.67 END FL: 122.67

EXIST. 12" WATER PIPE

PROP. 66" RCP 290 LF @ 0.05% ST FL: 122.62 END FL: 122.48

COVER: 2.6'

EXIST. 8" SAN SWR

EXIST. 10" SAN SWR

PROP. 8' DIA STORM MANHOLE STA: 15+49.64 OFF: 18.69 R RIM: 130.63 FL(IN): 122.32 (66" RCP N) FL(IN): 125.58 (24" RCP E) FL(OUT): 122.32 (66" RCP S) FL(OUT): 124.62 (24" RCP W)

PROP. 8' DIA STORM MANHOLE STA: 16+27.29 OFF: 17.04 L RIM: 130.92 FL(IN): 122.36 (66" RCP N) FL(OUT): 122.37 (66" RCP S)

PROP. 10' DIA STORM MANHOLE STA: 18+36.82 OFF: 18.42 L RIM: 131.07 FL(IN): 122.48 (66" RCP N) FL(OUT): 122.47 (66" RCP S)

EXIST. SAN. MH SSWR FL(IN): 119.81 8" S FL(OUT): 119.81 8" N

EXIST. 6' DIA MH FL(IN): 122.67 (60" RCP) N FL(IN): 124.51 (24" RCP) NW FL(IN): 125.41 (24" RCP) NE FL(OUT): 121.96 (60" RCP) S

EXIST. SAN. MH SSWR FL(IN): 119.42 8" S FL(OUT): 119.42 8" NE

EXIST. 6' DIA MH FL(IN): 122.67 (60" RCP) N FL(OUT): 122.50 (60" RCP) S

EXIST. SAN. MH SSWR FL(IN): 116.69 10" S FL(OUT): 120.39 8" W FL(OUT): 118.79 8" W

EXIST. 8' DIA MH FL(IN): 22.67 (60" RCP) N FL(IN): 24.97 (24" RCP) NW FL(OUT): 122.67 (60" RCP) S FL(OUT): 125.17 (24" RCP) NE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
1			
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5			

HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVEN S DR
DRAWN BY: JCM	STA 14+00 TO STA 19+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 21 / 99	

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MATCHLINE B.L. STA. 19+00 SEE SHEET 21

MATCHLINE B.L. STA 24+00 SEE SHEET 23

FOR CONTINUATION OF BIRDCALL LANE SEE SHEET 40

PROP. 5' DIA STORM MANHOLE STA: 21+32.60 OFF: 63.61 LT
PROP. 48" RCP
PROP. 5' DIA STORM MANHOLE STA: 21+26.76 OFF: 40.72 LT
PROP. 48" RCP
PROP. 8' DIA STORM MANHOLE STA: 21+26.74 OFF: 21.32 LT RIM: 131.70
FL(IN)= 122.61 (66" RCP)
FL(IN)= 123.30 (48" RCP)
FL(IN)= 126.61 (24" RCP)
FL(OUT)= 122.62 (66" RCP)

PROP. 66" RCP 290 LF @ 0.05%
N1° 51' 00.00"W 841.379'

RAVENS SOUTH DRIVE

PROP. 24" RCP

PROP. 4' DIA STORM MANHOLE STA: 21+32.60 OFF: 5.81 LT RIM: 131.20
FL(OUT)= 126.95 (24" RCP)

EXIST. 24" RCP TO CONNECT INTO PROPOSED MH

9 45 LF

MATCH EXIST. SDWK. STA. 21+73.02, OFF: 51.40' LT

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52–53 FOR DETAILS SEE SHEETS 66–79 FOR QUANTITY

9 64 LF

PROP. 66" RCP 283 LF @ 0.05%

9 140 LF

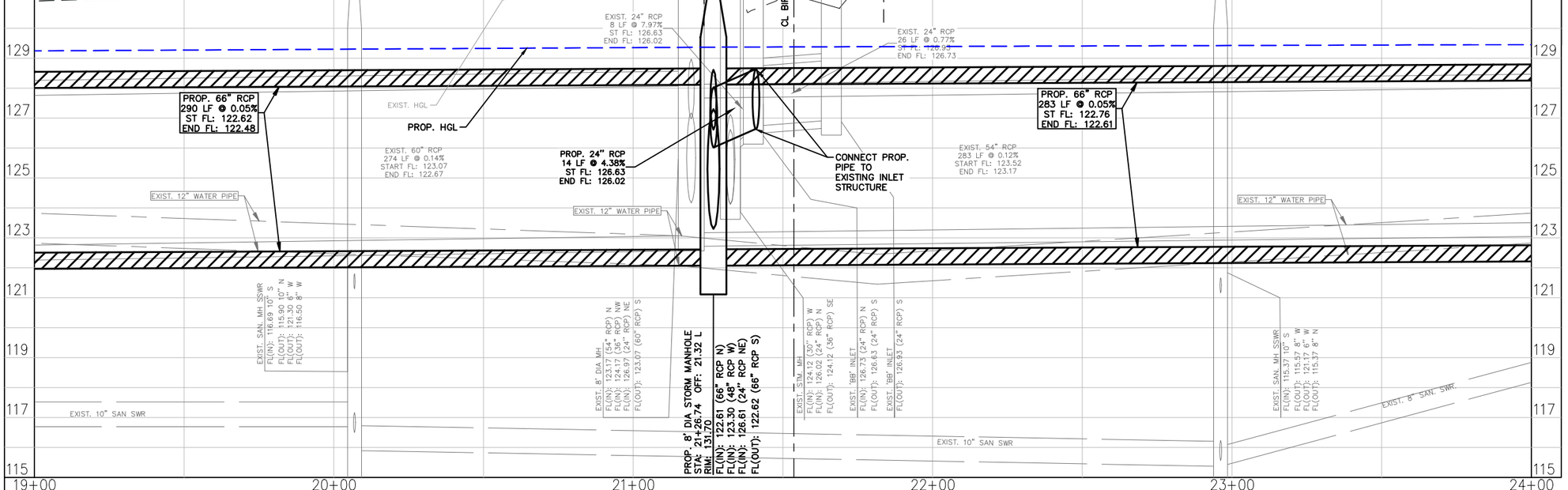
STA 21+53.62 C–ALIGN–ROAD–RAVEN S DR = STA 16+91.35 C–ALIGN–ROAD–BIRDCALL LN

60' R.O.W.

T.P: 17+25.00

13302 RAVENS CAW DR
13303 BIRDCALL LN
13302 BIRDCALL LN
13303 NEVERMORE DR

12402 RAVEN SOUTH DR
12406 RAVEN SOUTH DR
12410 RAVEN SOUTH DR
12414 RAVEN SOUTH DR
12502 RAVEN SOUTH DR
12506 RAVEN SOUTH DR
12510 RAVEN SOUTH DR



LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
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TOMMY V. CROMER
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PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN S DR
DRAWN BY: JCM
STA 19+00 TO STA 24+00
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 22 / 99

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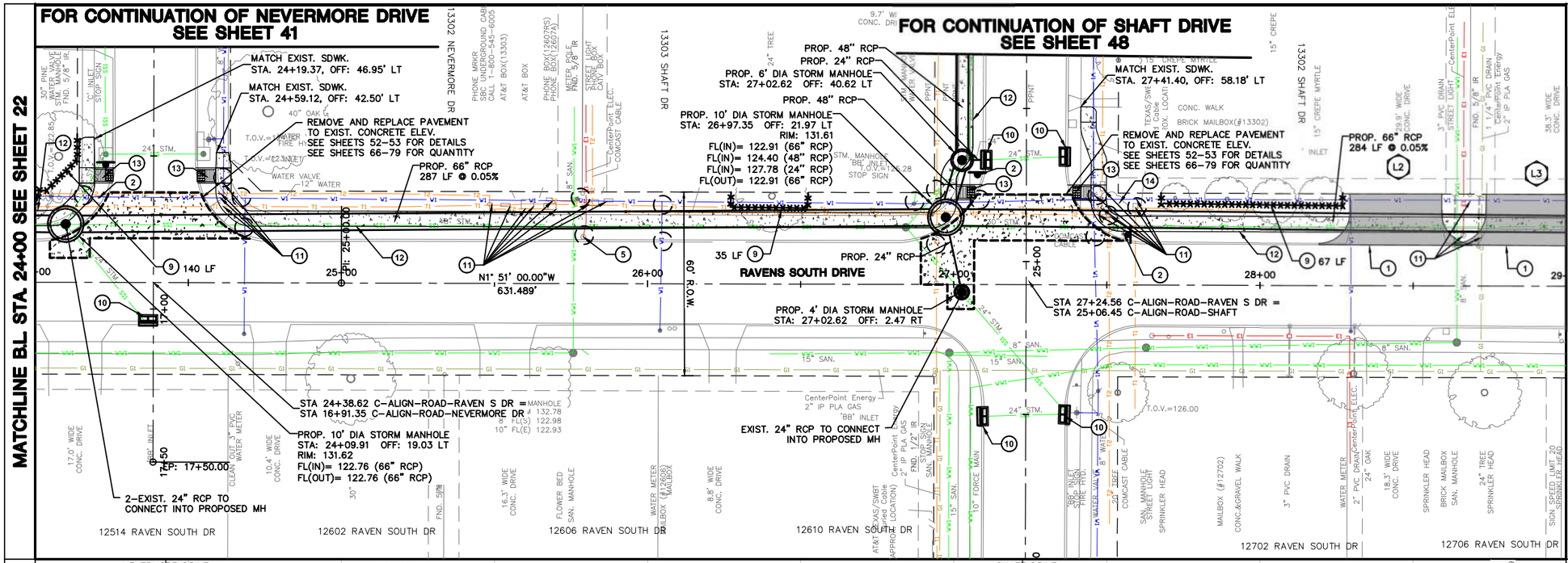

LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
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NO.	REVISIONS	DATE	NAME

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STATE OF TEXAS
TOMMY V. CROMER
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PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVEN S DR
DRAWN BY: JCM	STA 24+00 TO STA 29+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	23 / 99

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MATCHLINE B.L STA. 29+00 SEE SHEET 23

13303 SCAMP DR

12803 RAVEN SOUTH DR

12811 RAVEN SOUTH DR

MATCHLINE B.L STA. 32+00 SEE SHEET 26

SCAMP DRIVE

CONC. WALK MAILBOX(#13303)

PROP. 66" RCP

3" PVC DRAIN

MATCH EXIST. SDWK
STA. 29+90.44, OFF: 46.43' LT
T.O.V.=125.69
T.O.V.=125.84

PROP. 7' DIA STORM MANHOLE
STA: 29+81.19 OFF: 19.66 LT
RIM: 131.80
FL(OUT)= 123.05 (66" RCP)

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV.
SEE SHEETS 52–53 FOR DETAILS
SEE SHEETS 66–79 FOR QUANTITY

'C' INLET

24" STM.

30" STM.

12" WATER

RAVENS SOUTH DRIVE

30+00

N1° 51' 00.00"W
631.489'

31+00

PC: 31+31.49

D=44.9786
L=117.754, R=150.000

2–EXIST. 24" RCP TO CONNECT INTO PROPOSED MH

10" FORCE MAIN

CenterPoint Energy
2" IP PLA GAS

CONC. WALK MAILBOX (#12710)

18" PALM

10.3' WIDE CONC. DRIVE

FND. 1/2" IR

3" PVC DRAIN

WATER METER

SPRINKLER VALVE

MAILBOX (#12714)

CONC. WALK

'BB' INLET

SPRINKLER HEAD

9.8' WIDE CONC. DRIVE

FND. 5/8" IR

CenterPoint ELEC.

STREET LIGHT

30" PINE

MAILBOX (#12802)

CONC. WALK

9.2' WIDE CONC. DRIVE

12710 RAVEN SOUTH DR

12714 RAVEN SOUTH DR

12802 RAVEN SOUTH DR

12806 RAVEN SOUTH DR

12810 RAVEN SOUTH DR



LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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1			
2			
3			
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HARRIS COUNTY ENGINEERING DEPARTMENT

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Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN S DR
DRAWN BY: JCM
STA 29+00 TO STA 32+00
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 24 / 99

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20' 0' 20'

SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
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8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
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11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
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NOTES:

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NO.	REVISIONS	DATE	NAME
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BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROFILE – RAVEN S DR
DRAWN BY: JCM	STA 32+00 TO STA 36+50 — DATE: 02/18/2022
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: NA — SHEET NO: 25 / 99



20' 0' 20'

SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
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PROP. MANHOLE
PROP. JUNCTION BOX
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NOTES:

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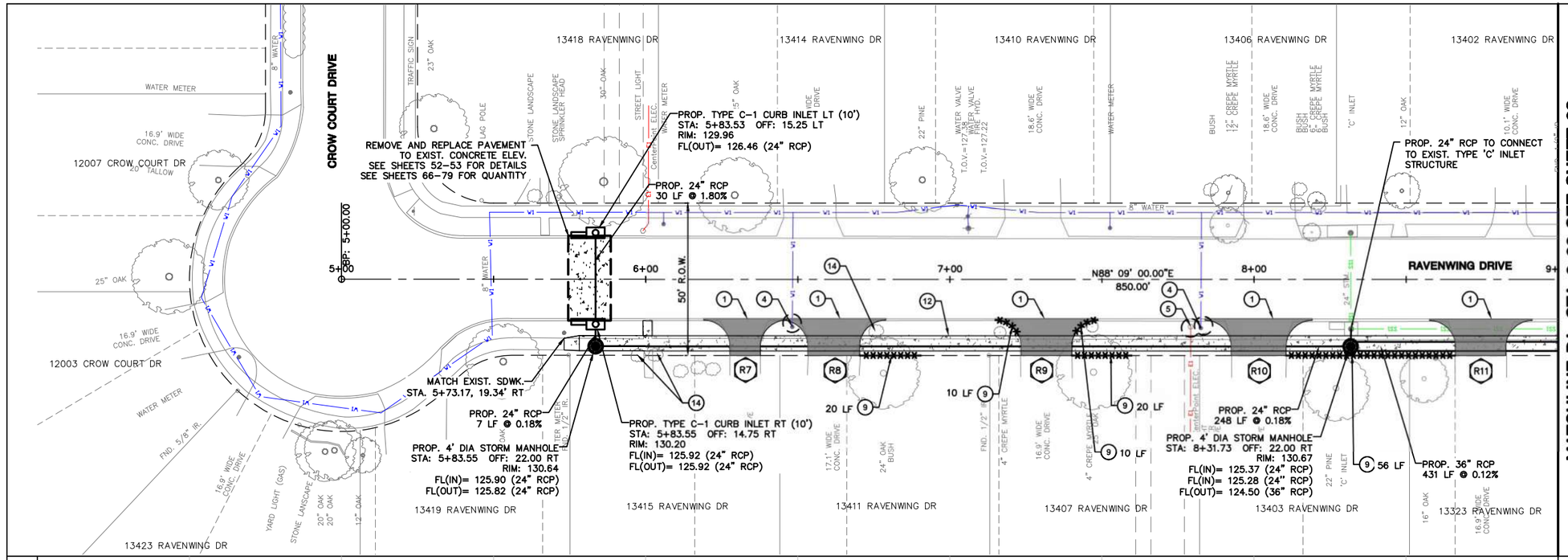
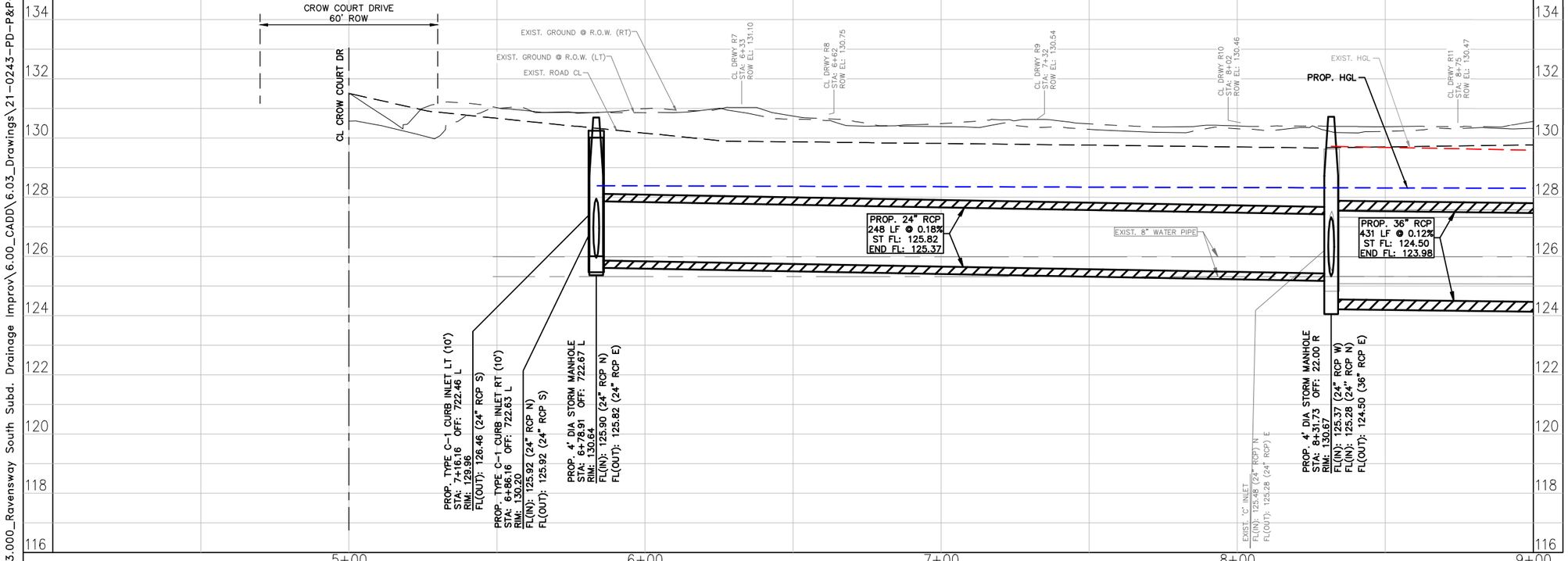
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN S DR
DRAWN BY: JCM
STA 36+50 TO STA 40+30
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: NA
SHEET NO: 26 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-RAVENS S DR.dwg





LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
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2			
3			
4			
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HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS TOMMY V. CROMER 97594 LICENSED PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVENWING DR
DRAWN BY: JCM	STA 5+00 TO STA 9+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	27 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

J:\HCP3\210000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

MATCHLINE B.L. STA. 9+00 SEE SHEET 27

13318 RAVENWING DR | 13314 RAVENWING DR | 13310 RAVENWING DR | 13306 RAVENWING DR | 13302 RAVENWING DR

RAVENWING DRIVE

N88° 09' 00.00"E 850.00' | N88° 09' 00.00"E 850.00'

50' R.O.W.

10+00 | 11+00 | 12+00

PROP. 36" RCP
431 LF @ 0.12%

19 LF | 27 LF | 21 LF

13319 RAVENWING DR | 13315 RAVENWING DR | 13311 RAVENWING DR | 13307 RAVENWING DR | 13303 RAVENWING DR

BRICK COLUMN 2X2 TYP.

PROP. TYPE C-2 CURB INLET (15')
STA: 12+63.16 OFF: 15.00 LT
RIM: 129.15
FL(OUT)= 125.66 (24" RCP)

MATCH EXIST. SDWK.
STA. 12+60.72, 21.86' LT

PROP. 24" RCP
30 LF @ 1.55%

REMOVE AND REPLACE PAVEMENT
TO EXIST. CONCRETE ELEV.
SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY

PROP. TYPE C-2 CURB INLET (15')
STA: 12+63.16 OFF: 15.00 RT
RIM: 129.10
FL(IN)= 125.19 (24" RCP)
FL(OUT)= 125.19 (24" RCP)

PROP. 24" RCP
7 LF @ 0.18%

PROP. 5' DIA STORM MANHOLE
STA: 12+63.16 OFF: 21.92 RT
RIM: 130.07
FL(IN)= 123.98 (36" RCP)
FL(IN)= 125.18 (24" RCP)
FL(OUT)= 123.98 (36" RCP)

FOR CONTINUATION OF RAVEN SOUTH DRIVE SEE SHEET 19

60' R.O.W.

MATCH EXIST. SDWK.
STA. 12+86.82, 44.66' LT

STA 13+06.10 C-ALIGN-ROAD-RAVENWING DR =
STA 6+96.71 C-ALIGN-ROAD-RAVEN S DR

REMOVE AND REPLACE PAVEMENT
TO EXIST. CONCRETE ELEV.
SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY

2-EXIST. 66" RCP TO
CONNECT TO PROP. MANHOLE

PROP. 8' DIA STORM MANHOLE
STA: 13+25.32 OFF: 18.47 RT
RIM: 129.91
FL(IN)= 123.92 (36" RCP)
FL(IN)= 120.75 (66" RCP)
FL(OUT)= 120.65 (66" RCP)

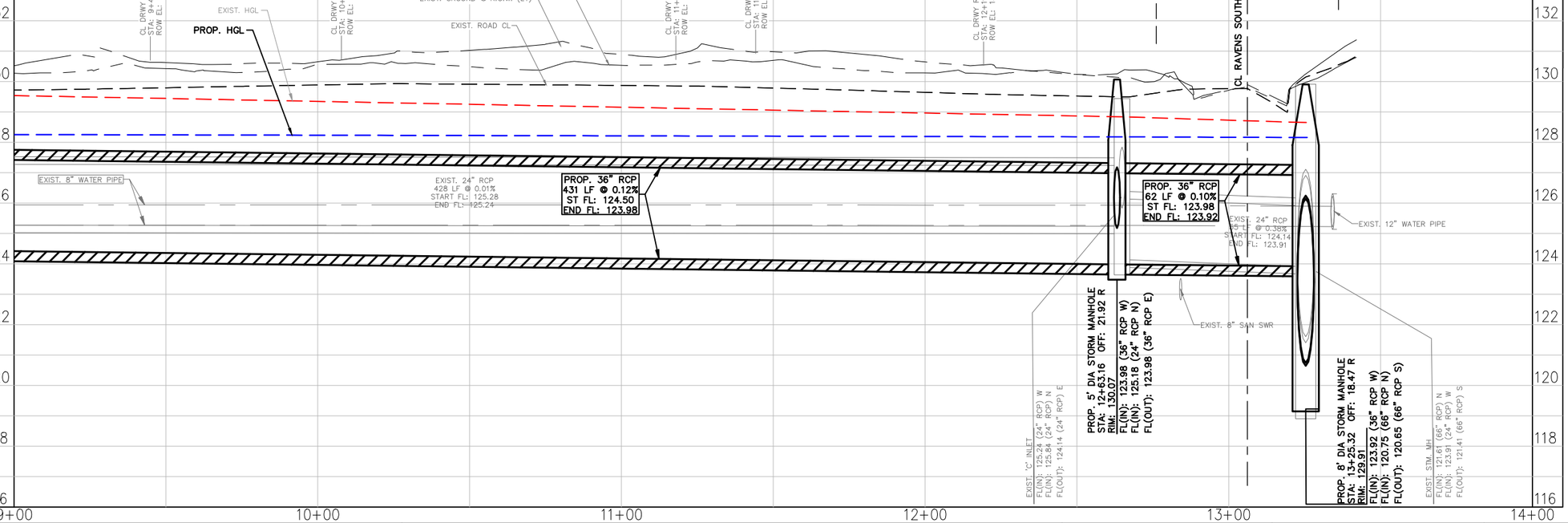
PROP. 36" RCP
62 LF @ 0.10%

7+00 | 13+00 | 13+50 EP: 13+50.00

RAVENS SOUTH DRIVE

12014 | 12010 RAVEN SOUTH DR | 12006 RAVEN SOUTH DR

FOR CONTINUATION OF RAVEN SOUTH DRIVE SEE SHEET 19



20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRICAL LINE
EXIST. WATER LINE
EXIST. STORM LINE
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NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
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6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
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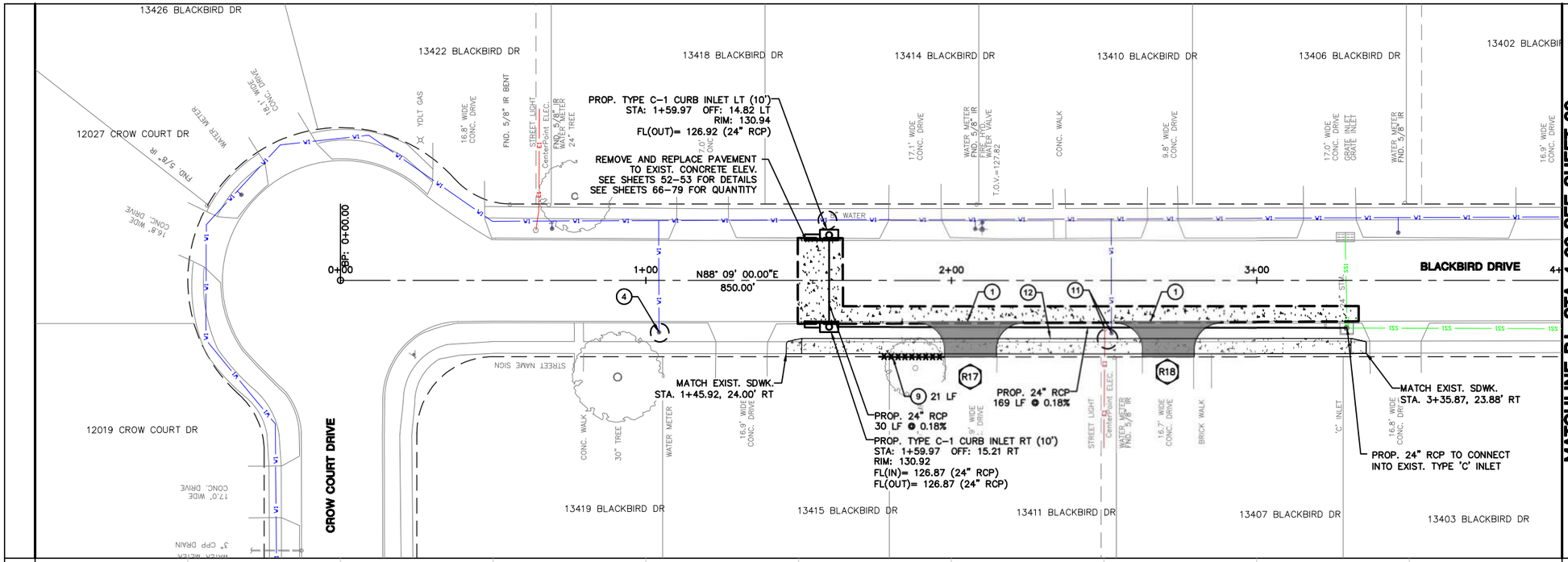
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVENWING DR
DRAWN BY: JCM	STA 9+00 TO STA 14+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 28 / 99	



20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

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2. REMOVE AND REINSTALL SIGN
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6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
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XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

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PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
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02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – BLACKBIRD DR
DRAWN BY: JCM	STA 0+00 TO STA 4+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	29 / 99

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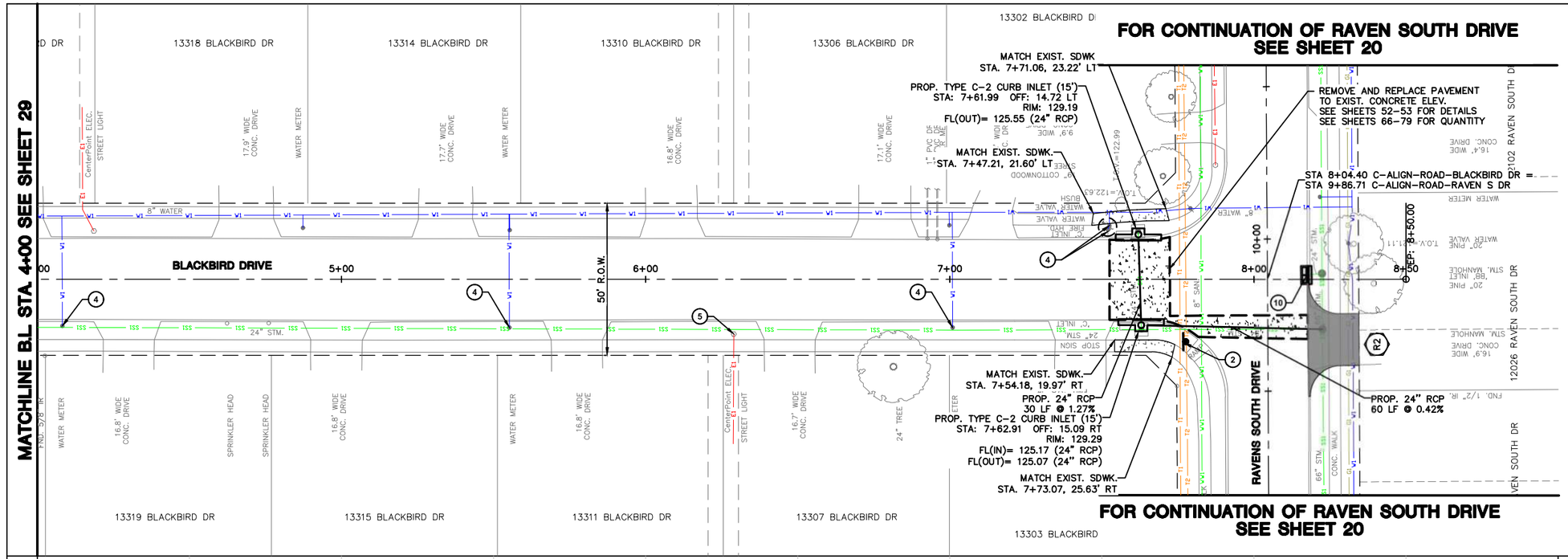

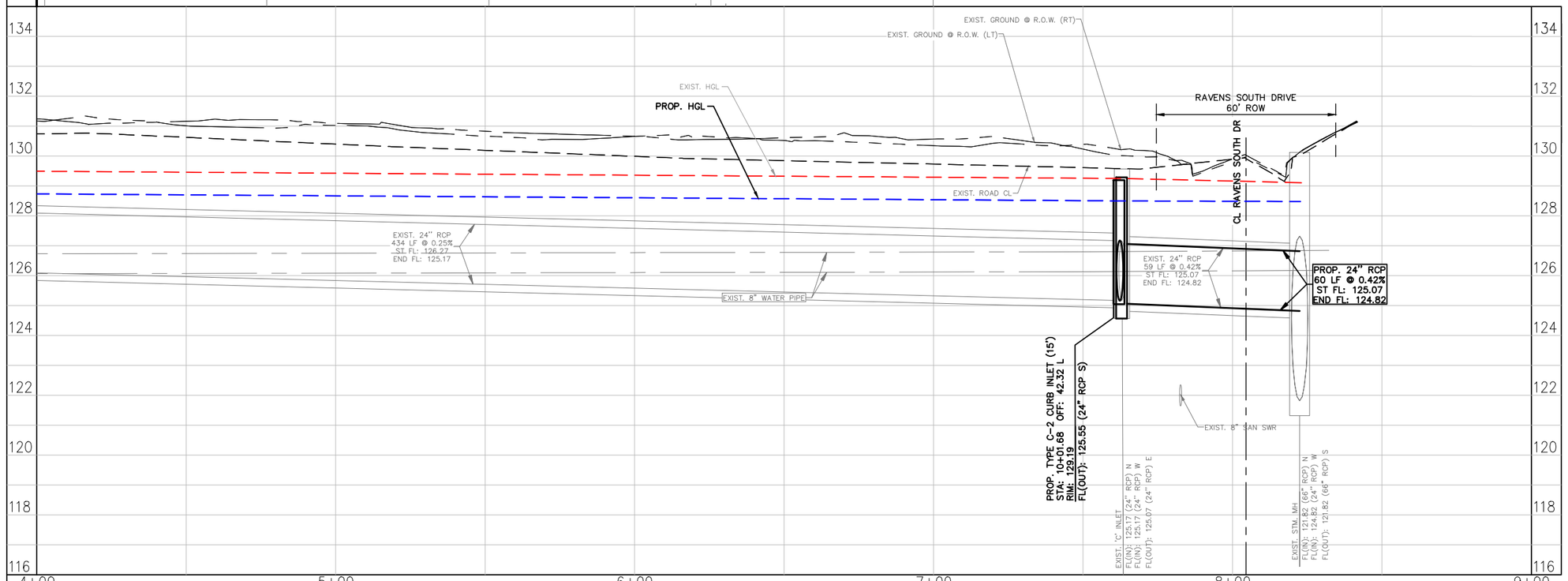

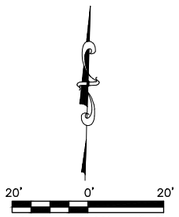

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
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NOTES:

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3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – BLACKBIRD DR
DRAWN BY: JCM	STA 4+00 TO STA 9+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	30 / 99

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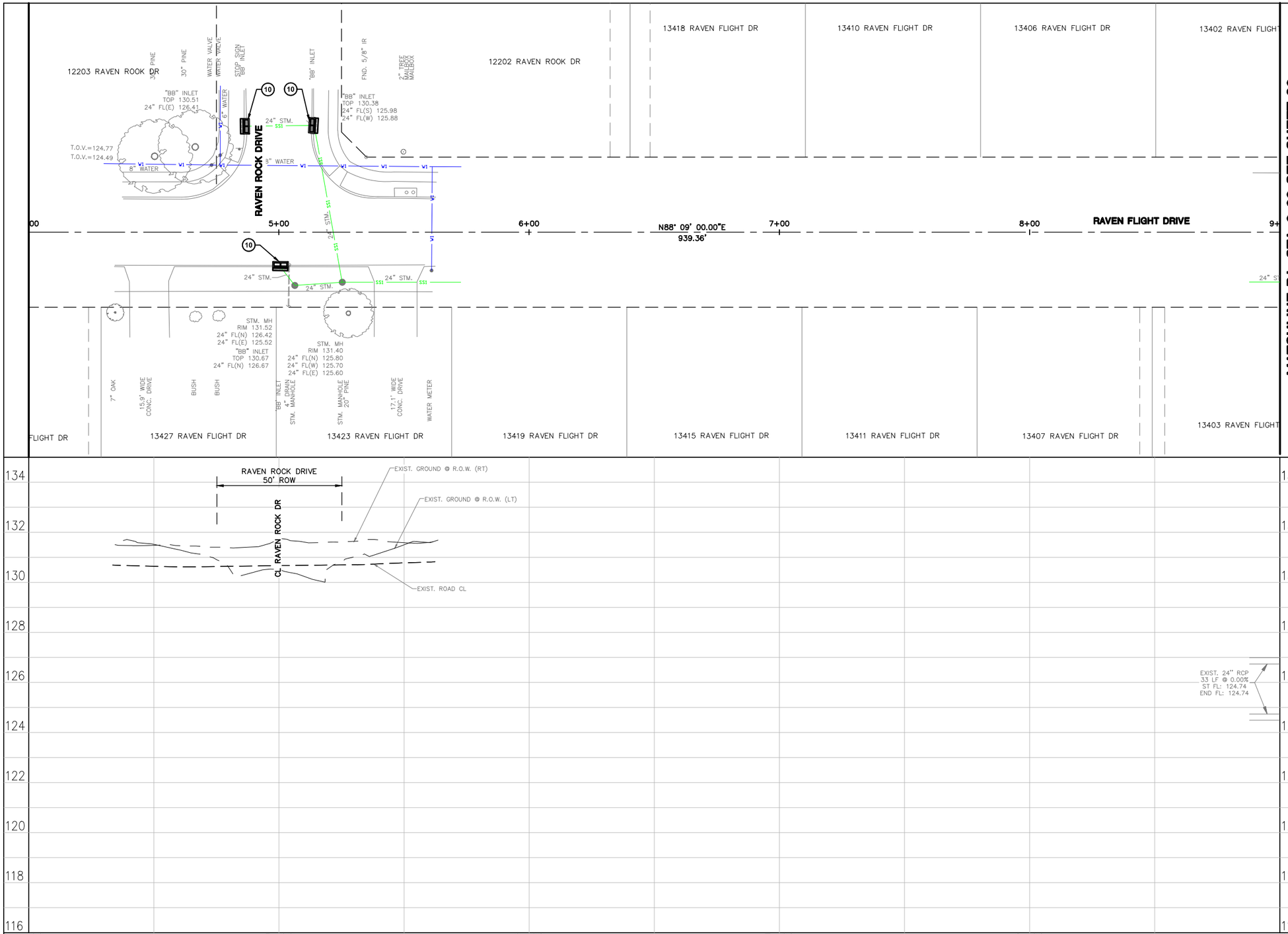



LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
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XX. PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

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PROP. TREE PROTECTION FENCE
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TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENTS – 2018	
SHEET DESCRIPTION:	PLAN & PROF – RAVEN FLIGHT DR	
DRAWN BY: JCM	STA 4+00 TO STA 9+00	DATE: 02/18/2022
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'	SHEET NO: 31 / 99

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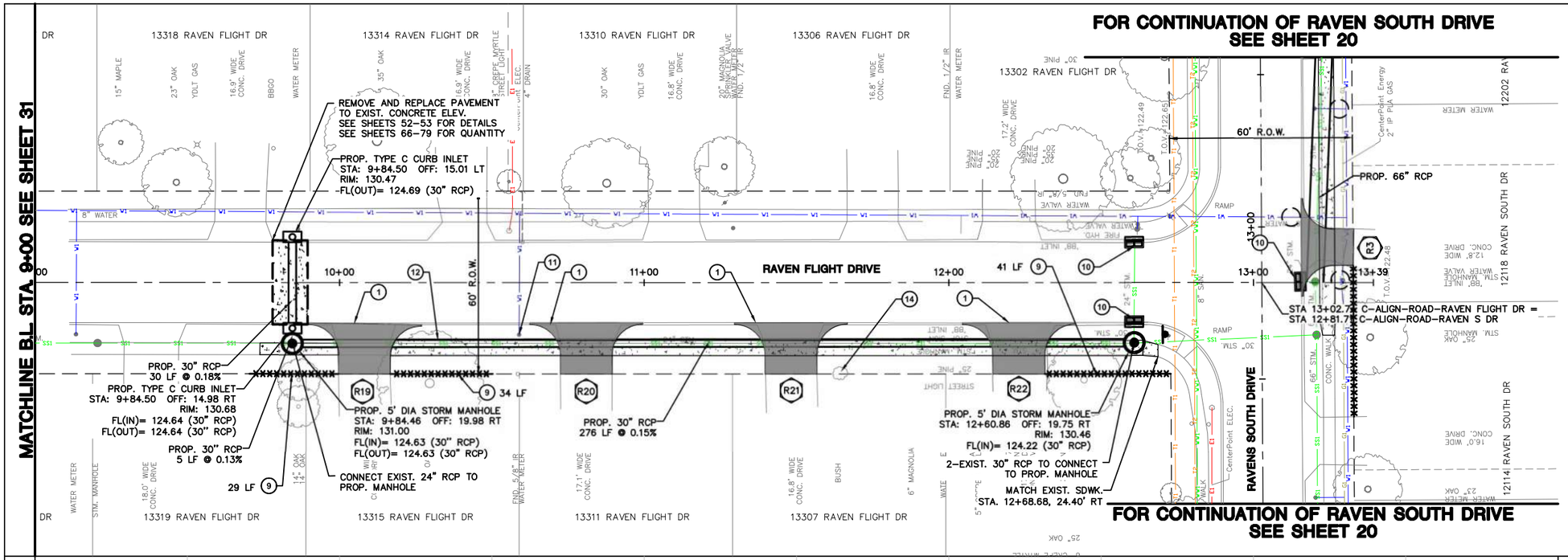

LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
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9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
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14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
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BINKLEY & BARFIELD INC. TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN FLIGHT DR
STA 9+00 TO STA 13+00

DRAWN BY:	SCALE:	DATE:
JCM	HORIZ: 1"=20' VERT: 1"=2'	02/18/2022
DESIGN BY: AJM		SHEET NO: 32 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

13422 RAVEN ROOST DR | 13418 RAVEN ROOST DR | 13414 RAVEN ROOST DR | 13410 RAVEN ROOST DR | 13406 RAVEN ROOST DR | 13402 RAVEN ROOST DR | 13318 RAVEN ROOST DR

RAVEN ROCK DRIVE

RAVEN ROOST DRIVE

12210 RAVEN ROOK DR

13415 RAVEN ROOST DR | 13411 RAVEN ROOST DR | 13407 RAVEN ROOST DR | 13403 RAVEN ROOST DR | 13319 RAVEN ROOST DR

BP: 5+00.00

N88° 09' 00.00"E
900.00'

PROP. TYPE C-1 CURB INLET LT (10')
STA: 7+52.50 OFF: 15.00 LT
RIM: 130.87
FL(OUT)= 126.15 (24" RCP)

PROP. 24" RCP
31 LF @ 2.01%

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV.
SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY

PROP. TYPE C-1 CURB INLET RT (10')
STA: 7+52.50 OFF: 15.50 RT
RIM: 130.69
FL(IN)= 125.54 (24" RCP)
FL(OUT)= 125.98 (24" RCP)

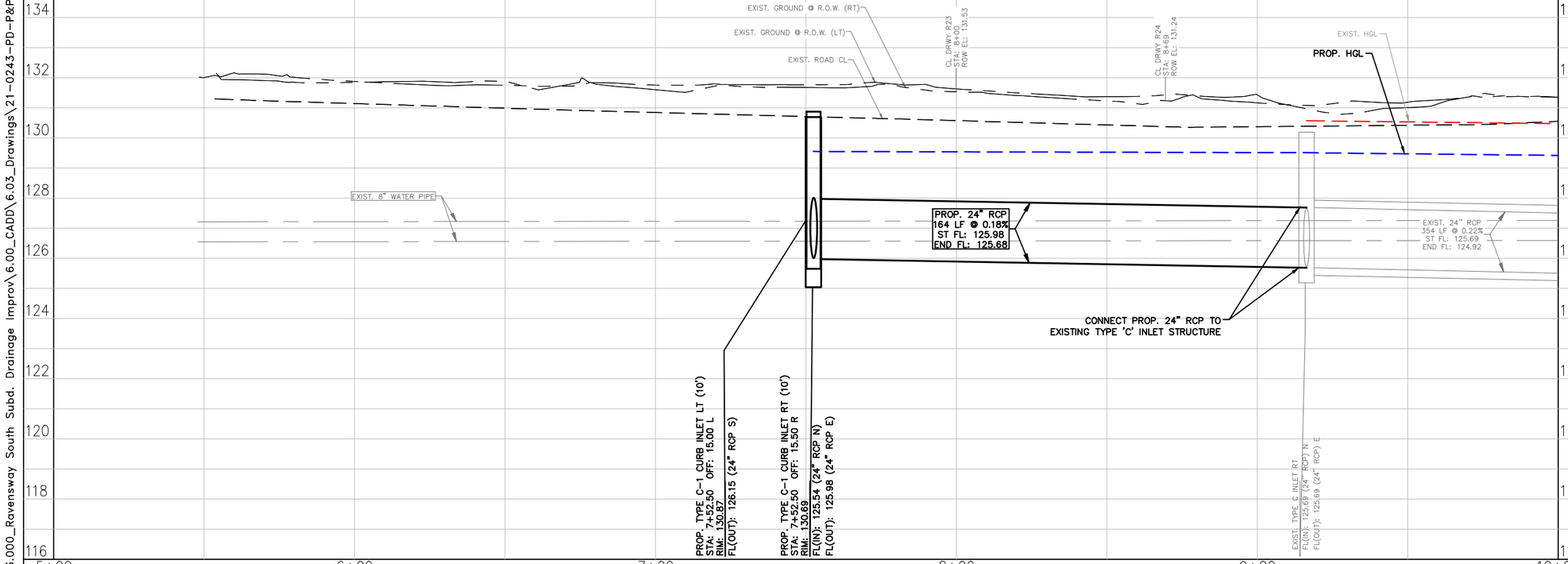
9 40 LF

9 28 LF

PROP. 24" RCP
164 LF @ 0.18%

PROP. 24" RCP TO CONNECT TO EXIST. TYPE 'C' INLET STRUCTURE

MATCHLINE BL STA 10+00 SEE SHEET 34



LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

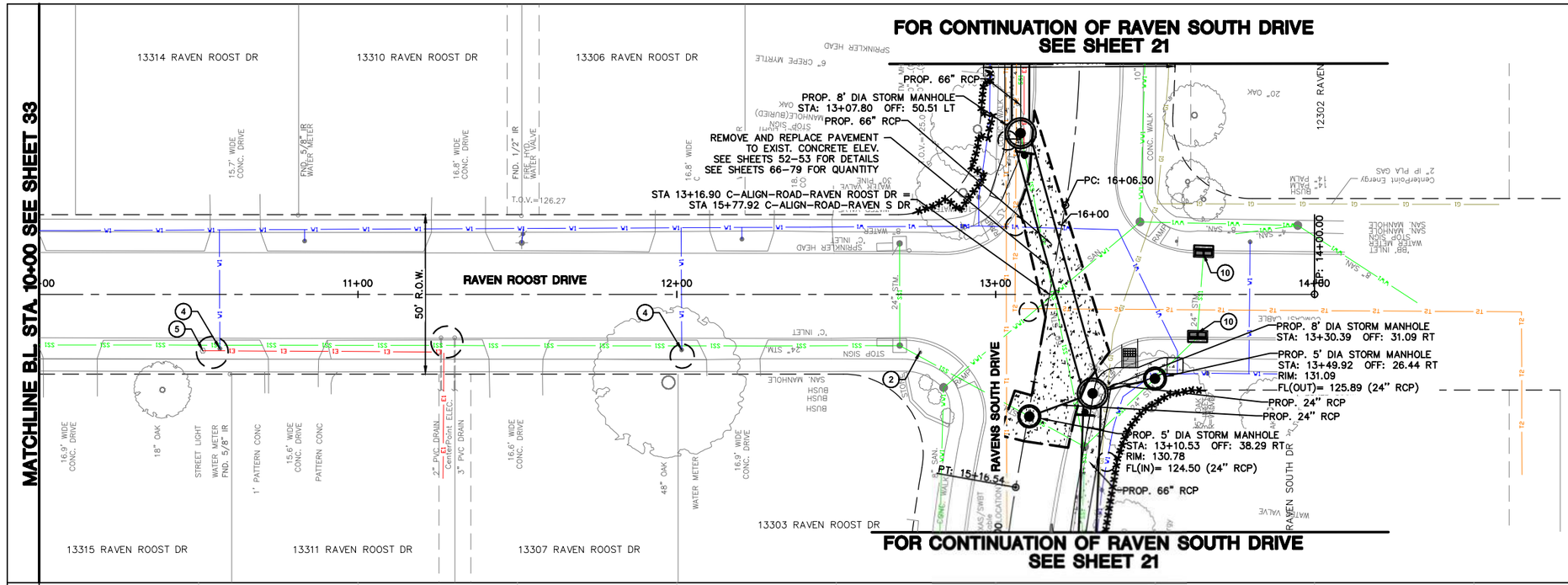
NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

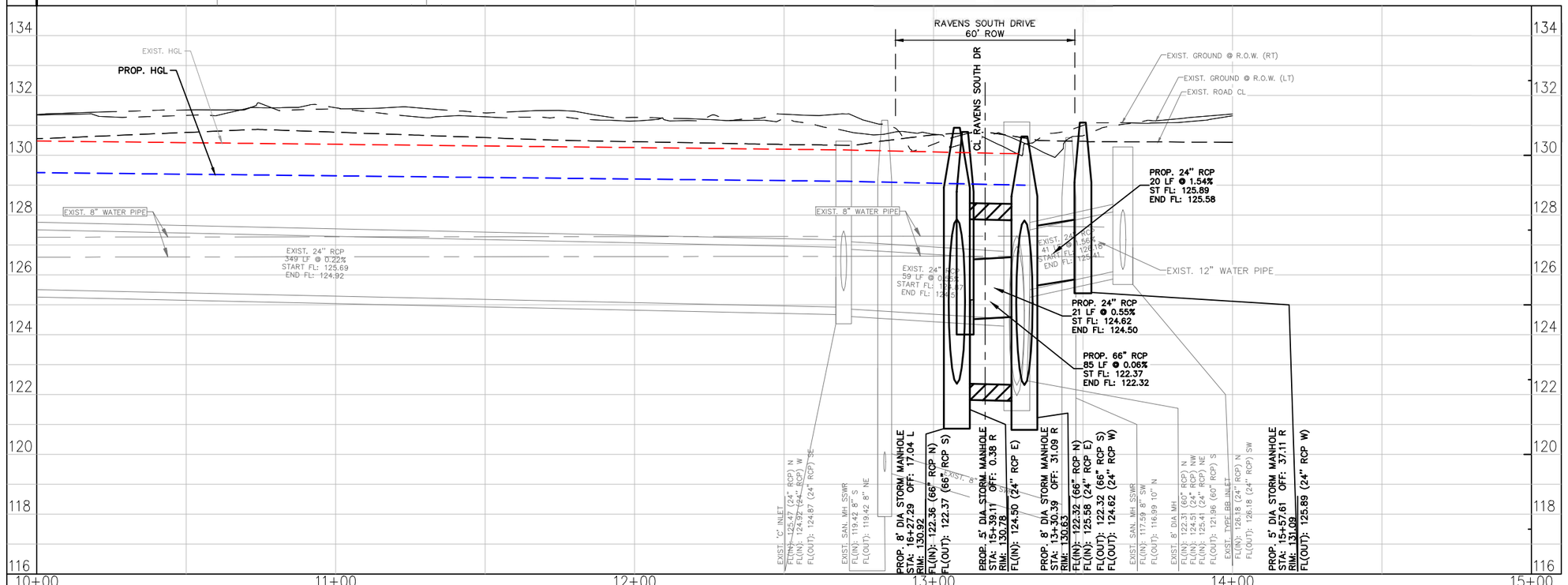
HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN ROOST DR
DRAWN BY: JCM
STA 5+00 TO STA 10+00
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 33 / 99





LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
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NOTES:

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6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
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02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – RAVEN ROOST DR
DRAWN BY: JCM
STA 10+00 TO STA 14+00
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 34 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg



MATCHLINE B.L STA. 9+00 SEE SHEET 36

20' 0' 20'

SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
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CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
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PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
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EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
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EXIST. COMCAST CABLE
EXIST. GAS LINE
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BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVEN CAW DR
DRAWN BY: JCM	STA 4+00 TO STA 9+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: NA
SHEET NO: 35 / 99	

MATCHLINE B.L STA. 9+00 SEE SHEET 35

MATCHLINE B.L STA. 14+00 SEE SHEET 37

13410 RAVENS CAW DR | 13406 RAVENS CAW DR | 13402 RAVENS CAW DR | 13330 RAVENS CAW DR | 13326 RAVENS CAW DR | 13322 RAVENS CAW DR | 13318 RAVENS CAW DR | 13314

PROP. TYPE C–1 CURB INLET LT (10')
STA: 10+70.03 OFF: 15.50 LT
RIM: 131.11
FL(OUT)= 126.46 (24" RCP)

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV.
SEE SHEETS 52–53 FOR DETAILS
SEE SHEETS 66–79 FOR QUANTITY

PROP. 24" RCP
31 LF @ 0.18%

RAVENS CAW DRIVE

N88° 09' 00.00"E
1350.00'

MATCH EXIST. SDWK.
STA. 10+54.57, 20.05' RT

PROP. TYPE C–1 CURB INLET RT (10')
STA: 10+70.03 OFF: 15.25 RT
RIM: 130.87
FL(IN)= 126.40 (24" RCP)
FL(OUT)= 126.40 (24" RCP)

PROP. 24" RCP
7 LF @ 0.18%

PROP. 4' DIA STORM MANHOLE
STA: 10+70.03 OFF: 22.00 RT
RIM: 131.84
FL(IN)= 126.39 (24" RCP)
FL(OUT)= 126.39 (24" RCP)

PROP. 24" RCP
272 LF @ 0.18%

50' R.O.W.

PROP. 24" RCP
6 LF @ 0.18%

51 LF

36 LF

PROP. 4' DIA STORM MANHOLE
STA: 13+42.29 OFF: 22.00 RT
RIM: 130.93
FL(IN)= 125.90 (24" RCP)
FL(OUT)= 125.90 (24" RCP)

MATCH EXIST. SDWK.
STA. 13+54.63, 23.80' RT

13411 RAVENS CAW DR | 13407 RAVENS CAW DR | 13403 RAVENS CAW DR | 13331 RAVENS CAW DR | 13327 RAVENS CAW DR | 13323 RAVENS CAW DR | 13319 RAVENS CAW DR | 13315

EXIST. GROUND @ R.O.W. (RT)
EXIST. GROUND @ R.O.W. (LT)
EXIST. ROAD CL
EXIST. HGL
PROP. HGL

CL DRWY R25 STA: 11+17 ROW EL: 131.73
CL DRWY R26 STA: 11+88 ROW EL: 131.52
CL DRWY R27 STA: 12+57 ROW EL: 131.20
CL DRWY R28 STA: 13+26 ROW EL: 131.26

PROP. 24" RCP
272 LF @ 0.18%
ST FL: 126.39
END FL: 125.90

EXIST. 8" WATER PIPE

EXIST. 24" RCP
301 LF @ 0.12%
START FL: 125.84
END FL: 125.47

CONNECT PROP. 24" RCP TO
EXISTING TYPE 'C' INLET STRUCTURE

PROP. TYPE C–1 CURB INLET LT (10')
STA: 18+84.12 OFF: 621.32 L
RIM: 131.11
FL(OUT): 126.46 (24" RCP S)

PROP. TYPE C–1 CURB INLET RT (10')
STA: 10+70.03 OFF: 15.25 R
RIM: 130.87
FL(IN): 126.40 (24" RCP N)
FL(OUT): 126.40 (24" RCP S)

PROP. 4' DIA STORM MANHOLE
STA: 18+46.62 OFF: 621.32 L
RIM: 131.84
FL(IN): 126.39 (24" RCP N)
FL(OUT): 126.39 (24" RCP E)

PROP. 4' DIA STORM MANHOLE
STA: 18+45.62 OFF: 349.06 L
RIM: 130.93
FL(IN): 125.90 (24" RCP W)
FL(OUT): 125.90 (24" RCP N)

EXIST. TYPE C INLET RT
FL(IN): 125.69 (24" RCP) N
FL(OUT): 125.84 (24" RCP) E

9+00 | 10+00 | 11+00 | 12+00 | 13+00 | 14+00

20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
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EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
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EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
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NOTES:

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2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
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NO.	REVISIONS	DATE	NAME

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02/18/2022

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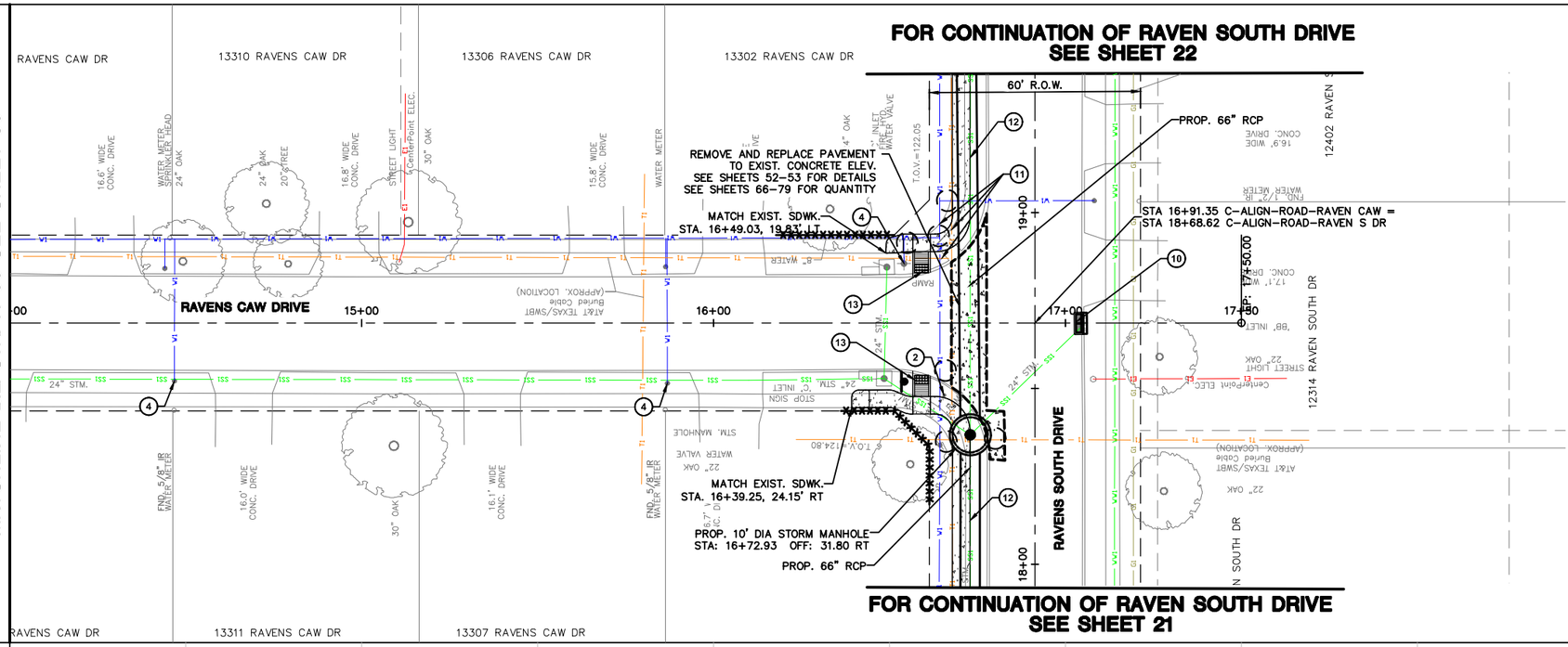
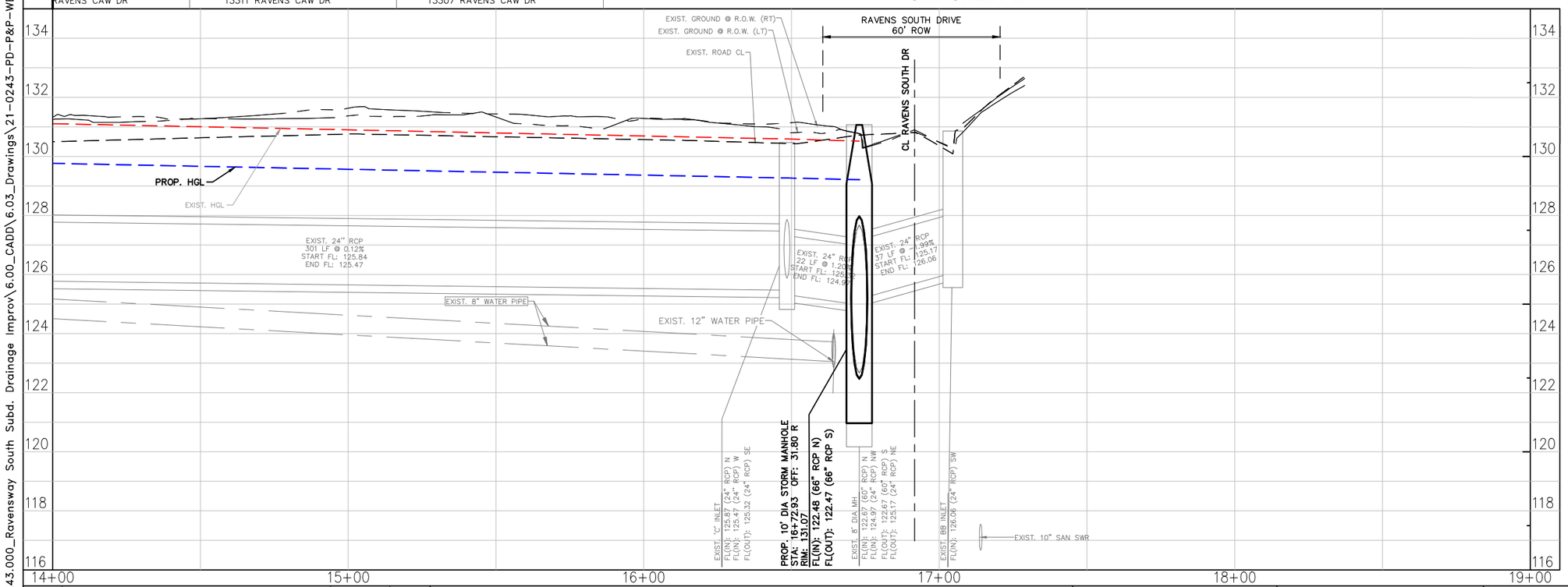
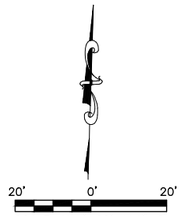
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVEN CAW DR
DRAWN BY: JCM	STA 9+00 TO STA 14+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 36 / 99	

MATCHLINE B.L STA. 14+00 SEE SHEET 36





LEGEND



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2. REMOVE AND REINSTALL SIGN
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4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
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XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

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PROP. TYPE C-1 INLET
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EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
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NOTES:

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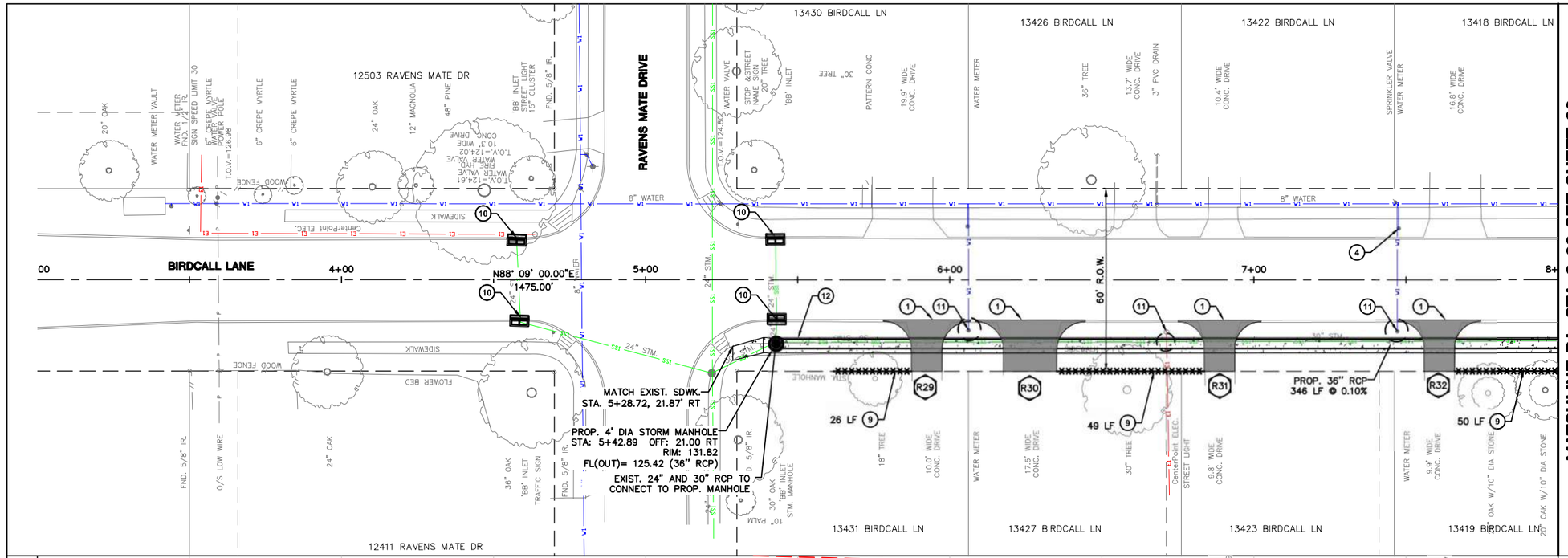
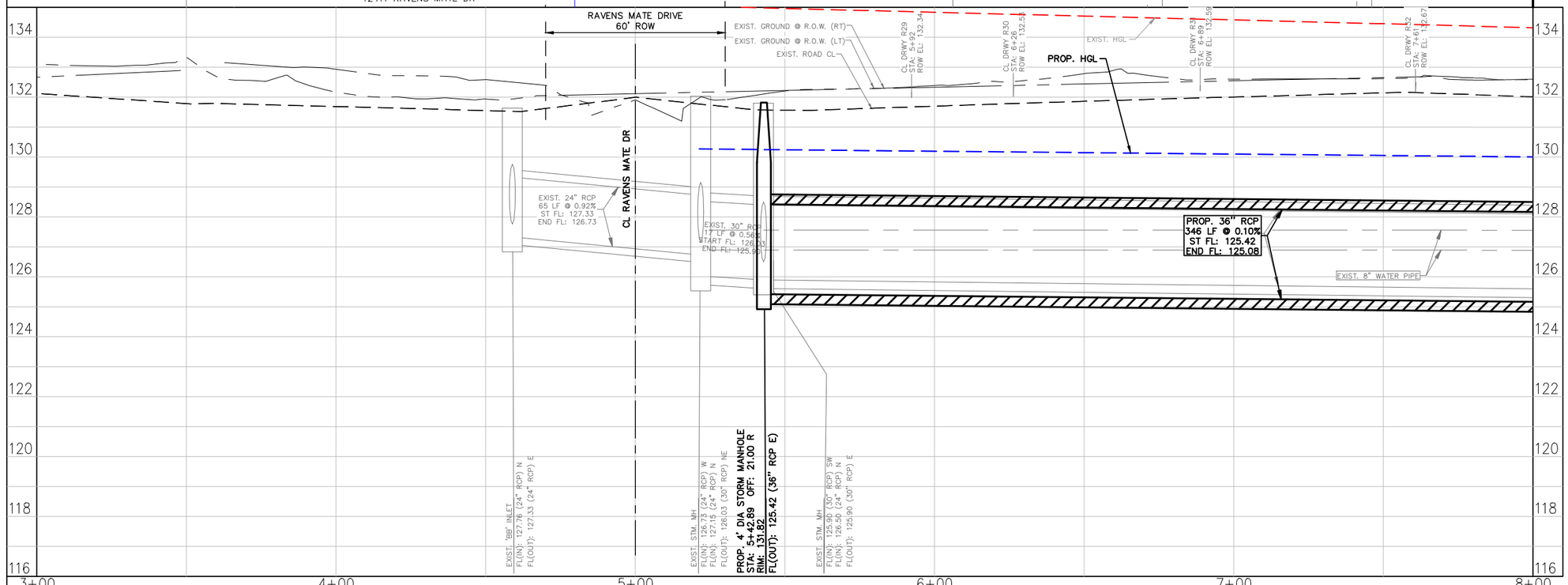
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – RAVEN CAW DR
DRAWN BY: JCM	STA 14+00 TO STA 17+50
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	37 / 99

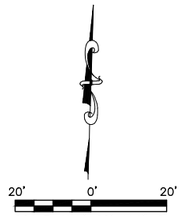
J:_HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

MATCHLINE B-L STA. 8+00 SEE SHEET 39





LEGEND



1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX. PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – BIRDCALL LN
DRAWN BY: JCM	STA 3+00 TO STA 8+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	38 / 99

MATCHLINE B.L. STA. 8+00 SEE SHEET 38

MATCHLINE B.L. STA. 13+00 SEE SHEET 40

13414 BIRDCALL LN | 13410 BIRDCALL LN | 13406 BIRDCALL LN | 13402 BIRDCALL LN | 13330 BIRDCALL LN | 13326 BIRDCALL LN | 13322 BIRDCALL LN

BIRDCALL LANE

N88° 09' 00.00"E
1475.00'

60' R.O.W.

PROP. 24" RCP
30 LF @ 2.01%

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV.
SEE SHEETS 52–53 FOR DETAILS
SEE SHEETS 66–79 FOR QUANTITY

PROP. TYPE C–1 CURB INLET LT (10')
STA: 9+96.00 OFF: 14.58 LT
RIM: 131.58
FL(OUT)= 126.94 (24" RCP)

PROP. 36" RCP
346 LF @ 0.10%

29 LF

50 LF

PROP. 5' DIA STORM MANHOLE
STA: 8+89.00 OFF: 21.00 RT
RIM: 132.06
FL(IN)= 125.08 (36" RCP)
FL(OUT)= 124.58 (42" RCP)

49 LF

PROP. 42" RCP
107 LF @ 0.10%

PROP. TYPE C–1 CURB INLET RT (10')
STA: 9+96.00 OFF: 15.26 RT
RIM: 131.33
FL(IN)= 126.34 (24" RCP)
FL(OUT)= 126.34 (24" RCP)

52 LF

PROP. 24" RCP
6 LF @ 0.18%

PROP. 5' DIA STORM MANHOLE
STA: 9+96.00 OFF: 21.00 RT
RIM: 131.62
FL(IN)= 124.47 (42" RCP)
FL(IN)= 126.33 (24" RCP)
FL(OUT)= 124.47 (42" RCP)

PROP. 42" RCP
242 LF @ 0.10%

35 LF

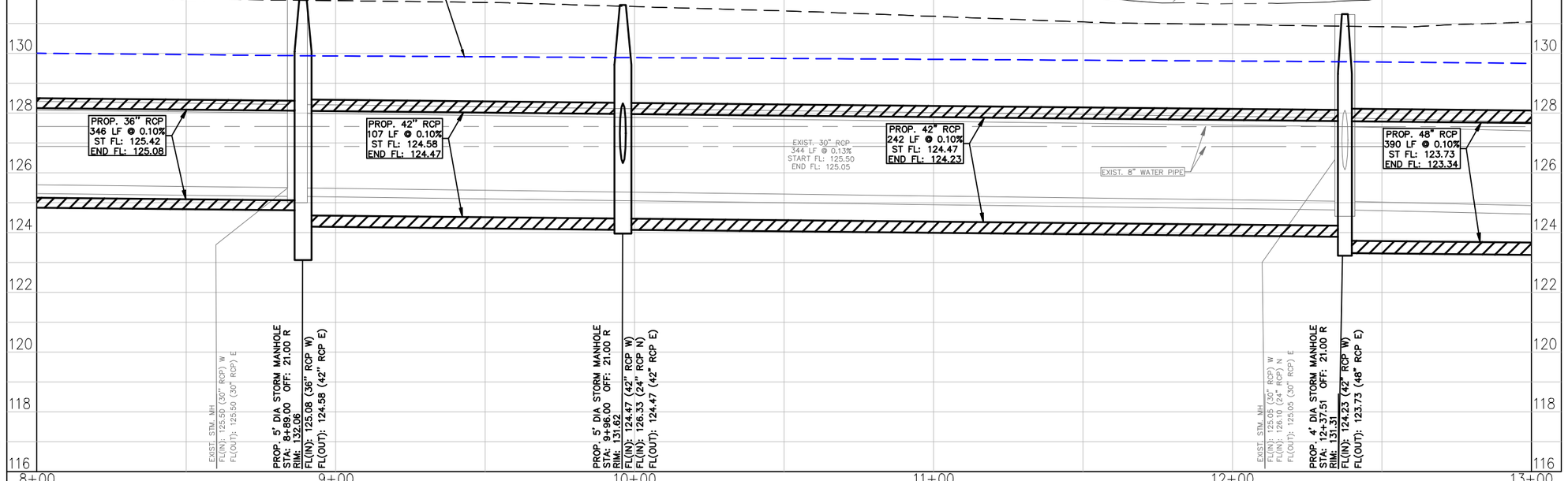
PROP. 4' DIA STORM MANHOLE
STA: 12+37.51 OFF: 21.00 RT
RIM: 131.31
FL(IN)= 124.23 (42" RCP)
FL(OUT)= 123.73 (48" RCP)

EXIST. 24" AND 30" RCP TO CONNECT TO PROP. MANHOLE

PROP. 48" RCP
390 LF @ 0.10%

31 LF

13415 BIRDCALL LN | 13411 BIRDCALL LN | 13407 BIRDCALL LN | 13403 BIRDCALL LN | 13331 BIRDCALL LN | 13327 BIRDCALL LN | 13323 BIRDCALL LN



20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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NO.	REVISIONS	DATE	NAME

HARRIS COUNTY
ENGINEERING DEPARTMENT

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Texas Registration Number F-257
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STATE OF TEXAS
TOMMY V. CROMER
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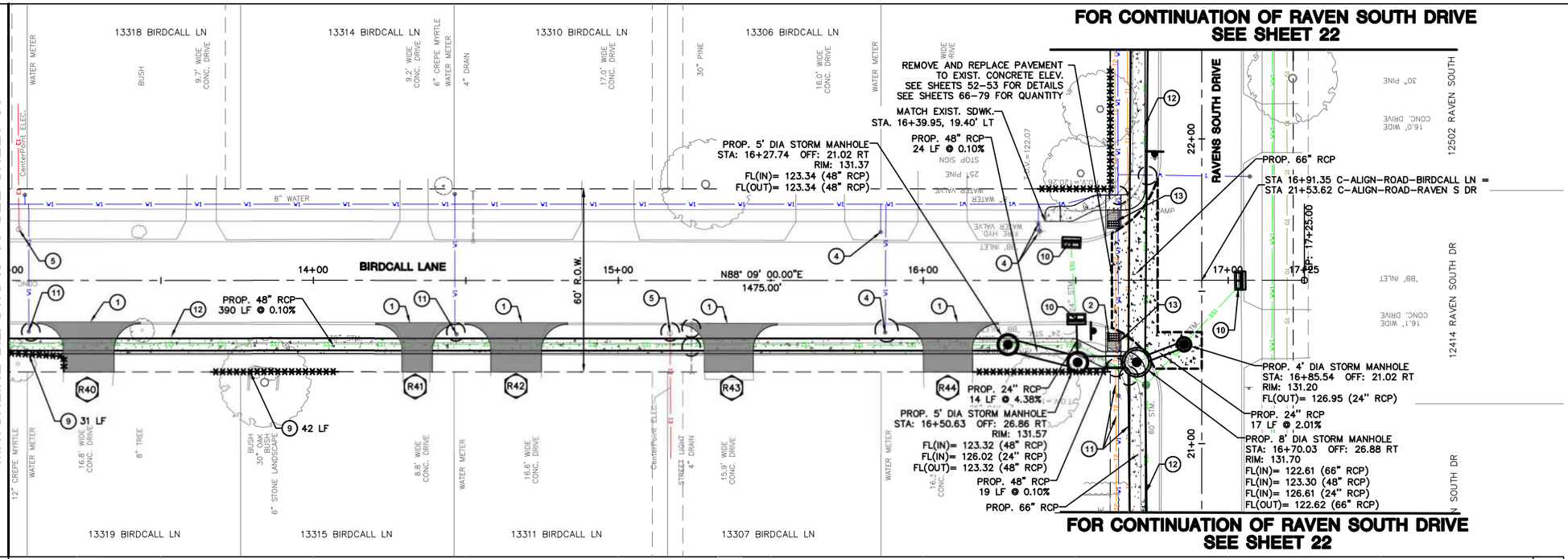
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – BIRDCALL LN
DRAWN BY: JCM	STA 8+00 TO STA 13+00
DESIGN BY: AJM	SCALE: HORIZ: 1" = 20' VERT: 1" = 2'
DATE:	02/18/2022
SHEET NO:	39 / 99



LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
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10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

20' 0' 20'
SCALE H:1"=20', V:1"=2'

NOTES:

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6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
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STATE OF TEXAS
TOMMY V. CROMER
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BINKLEY & BARFIELD INC
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – BIRDCALL LN
DRAWN BY: JCM	STA 13+00 TO STA 18+00
DESIGN BY: AJM	SCALE: HORIZ: 1" = 20' VERT: 1" = 2'
DATE:	02/18/2022
SHEET NO:	40 / 99

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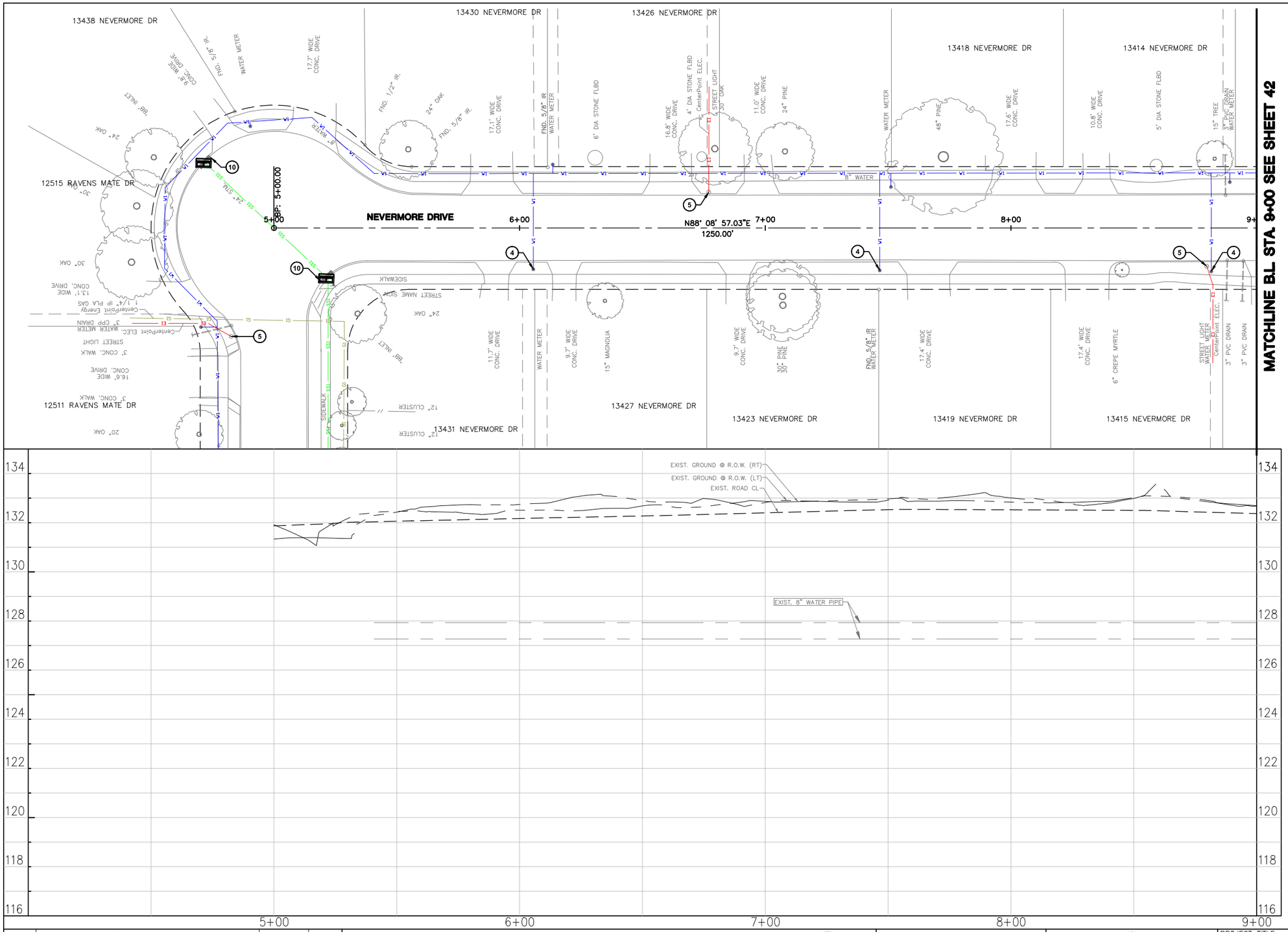

LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
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9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE

PROP. STORM PIPES

PROP. CONCRETE DRIVEWAY

PROP. 5' SIDEWALK

PROP. MANHOLE

PROP. JUNCTION BOX

PROP. TYPE BB INLET

PROP. TYPE C INLET

PROP. TYPE C–1 INLET

PROP. TYPE C–2 INLET

EXIST. ROAD CL

EXIST. GROUND @ R.O.W. (LT)

EXIST. GROUND @ R.O.W. (RT)

EXIST. AT&T CONDUIT

EXIST. COMCAST CABLE

EXIST. GAS LINE

EXIST. ELECTRIC LINE

EXIST. WATER LINE

EXIST. STORM LINE

EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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STATE OF TEXAS
TOMMY V. CROMER
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LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS – 2018		
SHEET DESCRIPTION: PLAN & PROF – NEVERMORE DR		
DRAWN BY: JCM	STA 5+00 TO STA 9+00	DATE: 02/18/2022
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'	SHEET NO: 41 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

MATCHLINE B.L STA. 9+00 SEE SHEET 41

MATCHLINE B.L STA. 14+00 SEE SHEET 43

13410 NEVERMORE DR | 13406 NEVERMORE DR | 13402 NEVERMORE DR | 13330 NEVERMORE DR | 13326 NEVERMORE DR | 13322 NEVERMORE DR | 13318 NEVERMORE DR

13411 NEVERMORE DR | 13407 NEVERMORE DR | 13403 NEVERMORE DR | 13331 NEVERMORE DR | 13327 NEVERMORE DR | 13323 NEVERMORE DR | 13319 NEVERMORE DR

NEVERMORE DRIVE

50' R.O.W.

N88° 08' 57.03"E
1250.00'

PROP. TYPE C-1 CURB INLET LT (10')
STA: 12+10.03 OFF: 15.24 LT
RIM: 131.31
FL(OUT)= 127.76 (24" RCP)

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52-53 FOR DETAILS
SEE SHEETS 66-79 FOR QUANTITY

PROP. 24" RCP TO CONNECT TO EXIST. TYPE 'C' INLET

PROP. 24" RCP
30 LF @ 0.34%

PROP. 24" RCP
6 LF @ 0.18%

PROP. 24" RCP
132 LF @ 0.18%

PROP. 24" RCP
7 LF @ 0.18%

MATCH EXIST. SDWK.
STA. 11+94.48, 23.49' RT

PROP. TYPE C-1 CURB INLET RT (10')
STA: 12+10.03 OFF: 14.92 RT
RIM: 131.54
FL(IN)= 127.66 (24" RCP)
FL(OUT)= 127.58 (24" RCP)

PROP. 4' DIA STORM MANHOLE
STA: 12+10.03 OFF: 22.00 RT
RIM: 132.65
FL(IN)= 127.56 (24" RCP)
FL(OUT)= 127.50 (24" RCP)

PROP. 4' DIA STORM MANHOLE
STA: 13+41.82 OFF: 22.00 RT
RIM: 132.35
FL(IN)= 127.27 (24" RCP)
FL(OUT)= 127.15 (24" RCP)

MATCH EXIST. SDWK.
STA. 13+55.46, 23.50' RT

35 LF

R45 | R46

EXIST. 8" WATER PIPE

CONNECT PROP. 24" RCP TO EXISTING TYPE 'C' INLET STRUCTURE

PROP. 24" RCP
132 LF @ 0.18%
ST FL: 127.50
END FL: 127.27

EXIST. 24" RCP
308 LF @ 0.47%
ST FL: 127.50
END FL: 126.05

PROP. HGL

EXIST. HGL

CL DRWY R45
STA: 12+49
ROW EL: 131.86

CL DRWY R46
STA: 13+19
ROW EL: 131.61

PROP. TYPE C-1 CURB INLET RT (10')
STA: 24+23.69 OFF: 481.32 L
RIM: 131.54
FL(IN): 127.66 (24" RCP N)
FL(OUT): 127.58 (24" RCP S)

PROP. TYPE C-1 CURB INLET LT (10')
STA: 24+53.86 OFF: 481.32 L
RIM: 131.31
FL(OUT): 127.76 (24" RCP S)

PROP. 4' DIA STORM MANHOLE
STA: 24+16.62 OFF: 481.32 L
RIM: 132.65
FL(IN): 127.56 (24" RCP N)
FL(OUT): 127.50 (24" RCP E)

PROP. 4' DIA STORM MANHOLE
STA: 24+16.62 OFF: 349.53 L
RIM: 132.35
FL(IN): 127.27 (24" RCP W)
FL(OUT): 127.15 (24" RCP N)

EXIST. TYPE C INLET LT
FL(IN): 127.50 (24" RCP) N
FL(OUT): 127.50 (24" RCP) E

9+00 | 10+00 | 11+00 | 12+00 | 13+00 | 14+00

134 | 132 | 130 | 128 | 126 | 124 | 122 | 120 | 118 | 116

EXIST. GROUND @ R.O.W. (RT)
EXIST. GROUND @ R.O.W. (LT)
EXIST. ROAD CL

20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
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8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
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12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX. PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

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2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

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NO.	REVISIONS	DATE	NAME

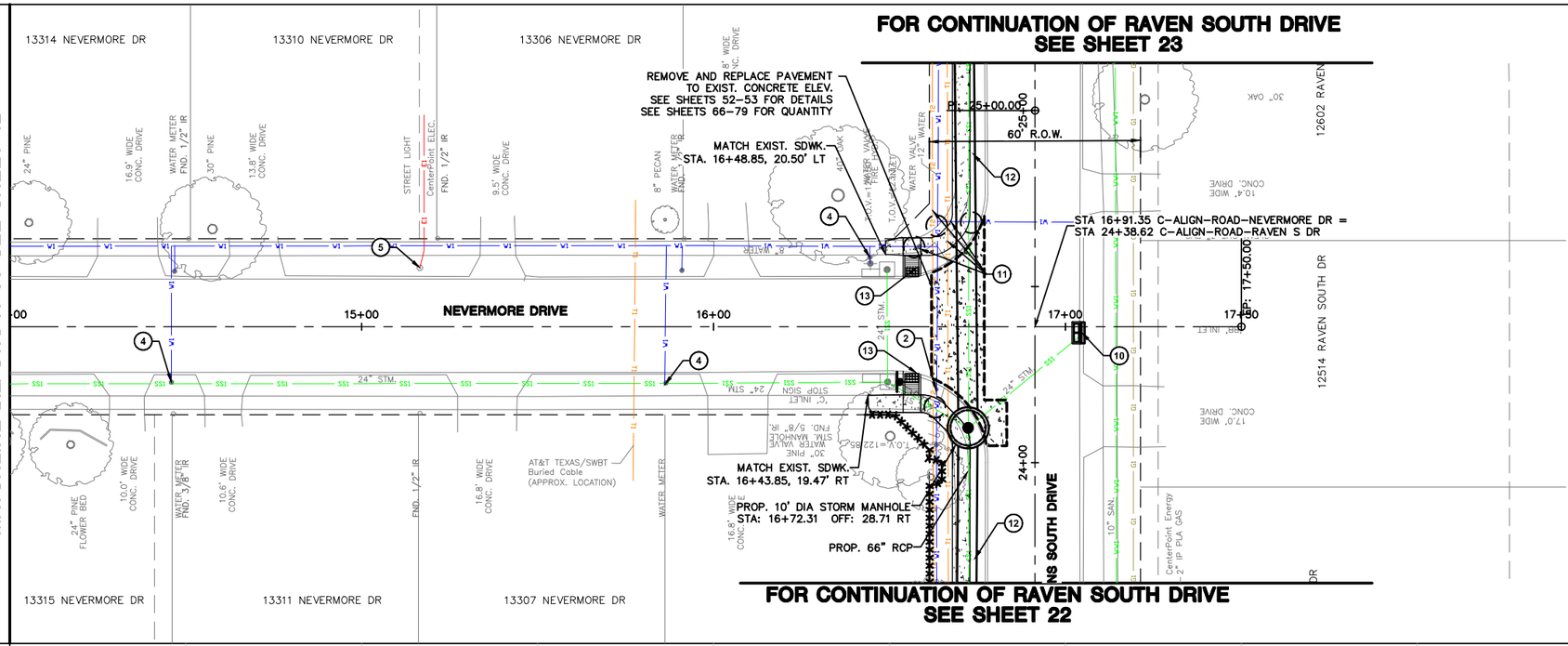
HARRIS COUNTY ENGINEERING DEPARTMENT

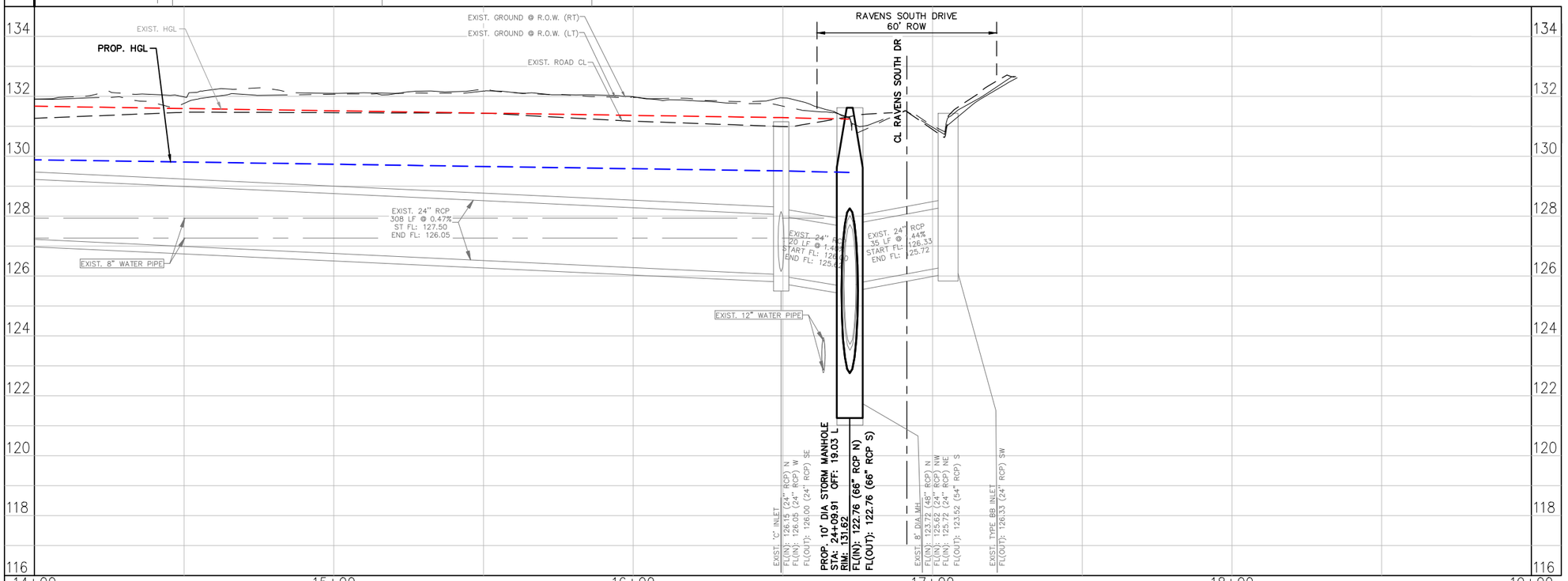
Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – NEVERMORE DR
DRAWN BY: JCM	STA 9+00 TO STA 14+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 42 / 99	

MATCHLINE B.L. STA. 14+00 SEE SHEET 42





LEGEND

SCALE H:1"=20', V:1"=2'

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY
ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION: PLAN & PROF – NEVERMORE DR
DRAWN BY: JCM
STA 14+00 TO STA 17+ 50
DATE: 02/18/2022
DESIGN BY: AJM
SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 43 / 99

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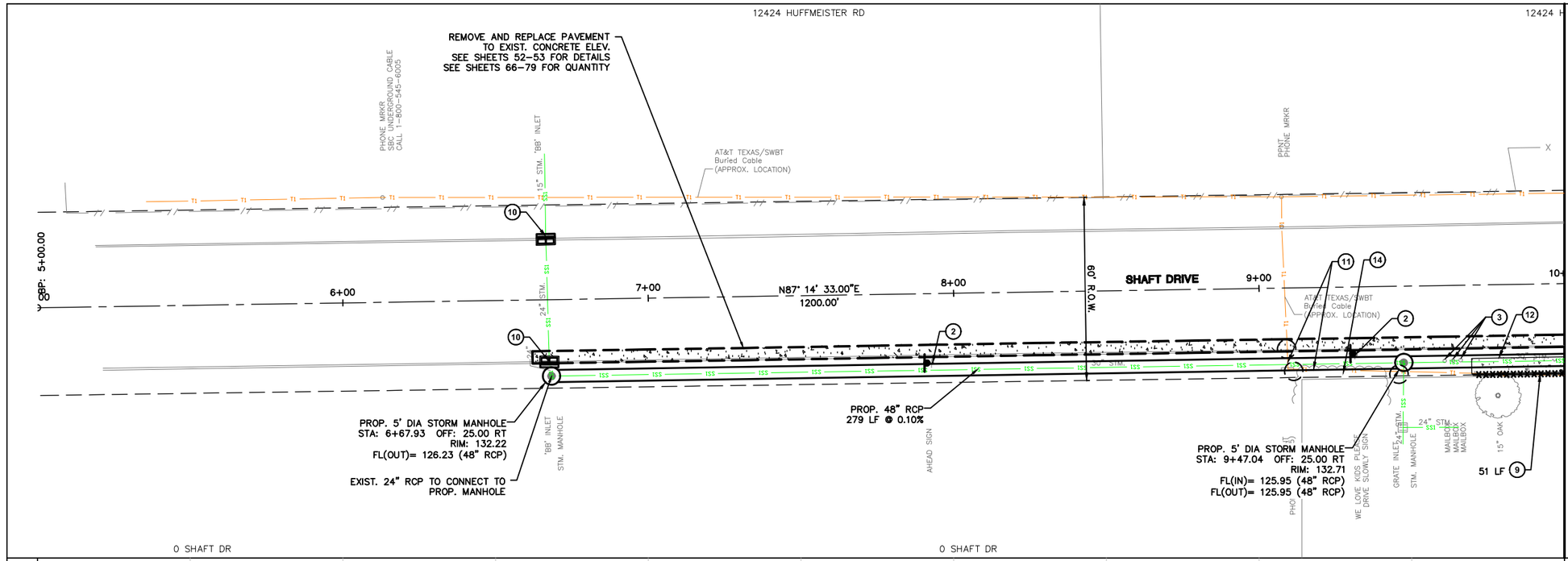

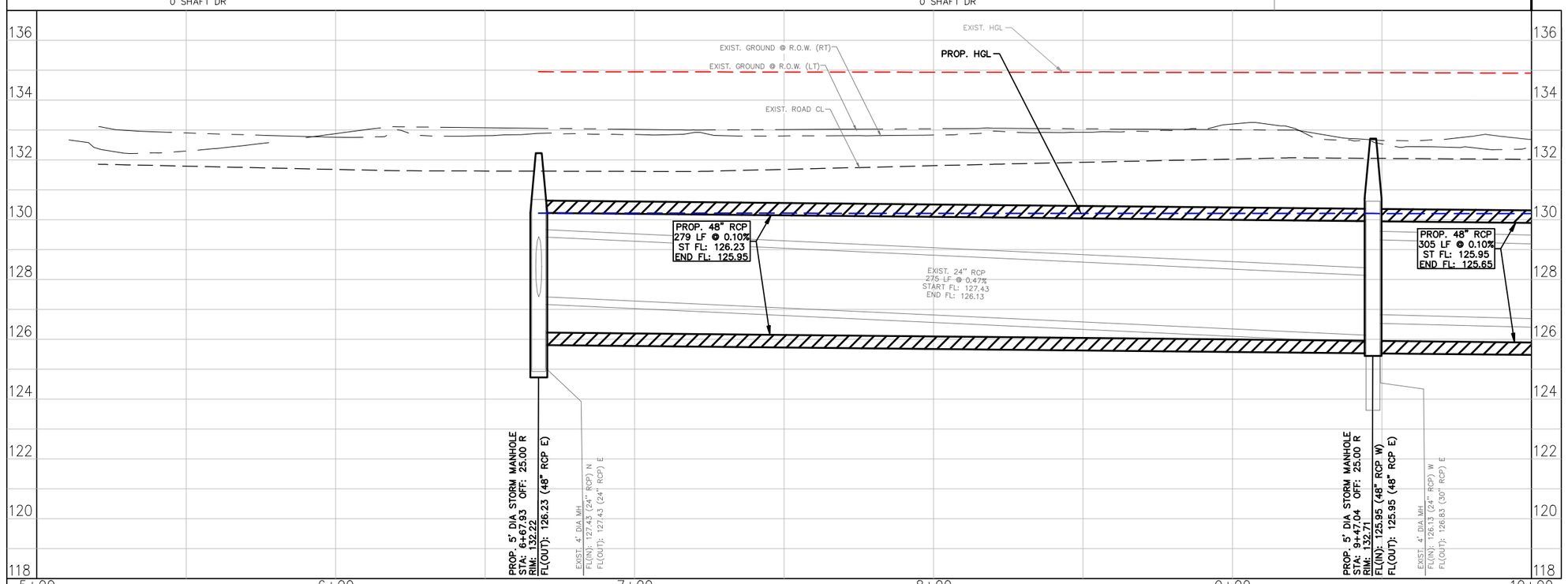

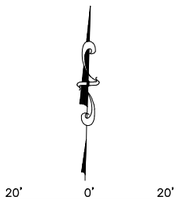

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
1			
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HARRIS COUNTY ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – SHAFT DR
DRAWN BY: JCM	STA 5+00 TO STA 10+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	44 / 99

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MATCHLINE B.L. STA. 10+00 SEE SHEET 44

MATCHLINE B.L. STA. 15+00 SEE SHEET 46

HUFFMEISTER RD

12424 HUFFMEISTER RD

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52–53 FOR DETAILS SEE SHEETS 66–79 FOR QUANTITY

PROP. 5' DIA STORM MANHOLE
STA: 12+51.82 OFF: 25.00 RT
RIM: 131.52
FL(IN)= 125.65 (48" RCP)
FL(OUT)= 125.65 (48" RCP)

T.O.V.=129.29

AT&T TEXAS/SWBT Buried Cable (APPROX. LOCATION)

8" WATER

SHAFT DRIVE

N87° 14' 33.00"E 1200.00'

11+00 12+00 13+00 14+00

60' R.O.W.

CONC. DRIVE

RAVENSWAY CENTER DRIVE

51 LF

58 LF

25 LF

PROP. 48" RCP
305 LF @ 0.10%

EXIST. 24" RCP TO CONNECT TO PROP. MANHOLE

PROP. 48" RCP
400 LF @ 0.09%

12602 RAVENSWAY CENTER DR

13507 SHAFT DR

13503 SHAFT DR

13427 SHAFT DR

13423 SHAFT DR

R47 R48 R49 R50



LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

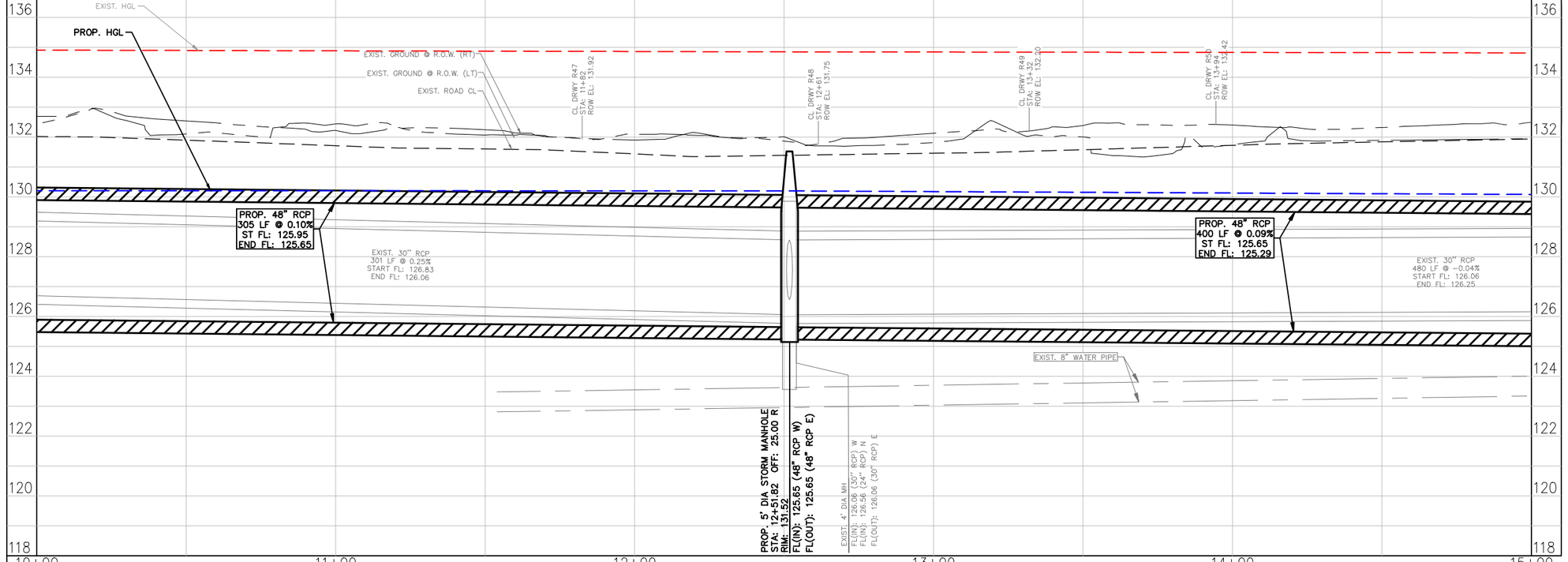
CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
PROP. TYPE C–2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.



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NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – SHAFT DR
DRAWN BY: JCM	STA 10+00 TO STA 15+00
DATE: 02/18/2022	
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
SHEET NO: 45 / 99	

MATCHLINE B.L STA. 15+00 SEE SHEET 45

MATCHLINE B.L STA. 20+00 SEE SHEET 47

REMOVE AND REPLACE PAVEMENT TO EXIST. CONCRETE ELEV. SEE SHEETS 52-53 FOR DETAILS SEE SHEETS 66-79 FOR QUANTITY

12703 RAVENSONG DR

13330 SHAFT DR

RAVENSONG DRIVE

SHAFT DRIVE

N87° 14' 33.00"E 1200.00'

PROP. 48" RCP 400 LF @ 0.09%

PROP. 5' DIA STORM MANHOLE STA: 16+51.73 OFF: 25.00 RT RIM: 132.09 FL(IN)= 125.29 (48" RCP) FL(OUT)= 125.29 (48" RCP)

PROP. 48" RCP 101 LF @ 0.14%

PROP. 5' DIA STORM MANHOLE STA: 17+57.39 OFF: 22.91 RT RIM: 131.94 FL(IN)= 125.14 (48" RCP) FL(OUT)= 125.14 (48" RCP)

PROP. 48" RCP 86 LF @ 0.10%

PROP. TYPE C CURB INLET (5') STA: 18+42.94 OFF: 14.38 RT RIM: 131.38 FL(OUT)= 128.13 (24" RCP)

PROP. 6' DIA STORM MANHOLE STA: 18+42.39 OFF: 21.60 RT RIM: 131.78 FL(IN)= 125.06 (48" RCP) FL(IN)= 128.12 (24" RCP) FL(OUT)= 125.06 (48" RCP)

PROP. TYPE C CURB INLET (5') STA: 18+80.11 OFF: 15.01 RT RIM: 131.40 FL(OUT)= 128.15 (24" RCP)

PROP. 48" RCP 40 LF @ 0.12%

PROP. 24" RCP 6 LF @ 0.18%

PROP. 24" RCP 7 LF @ 0.18%

95 LF

PROP. 5' DIA STORM MANHOLE STA: 18+80.11 OFF: 21.00 RT RIM: 131.92 FL(IN)= 125.01 (48" RCP) FL(IN)= 128.14 (24" RCP) FL(OUT)= 125.01 (48" RCP)

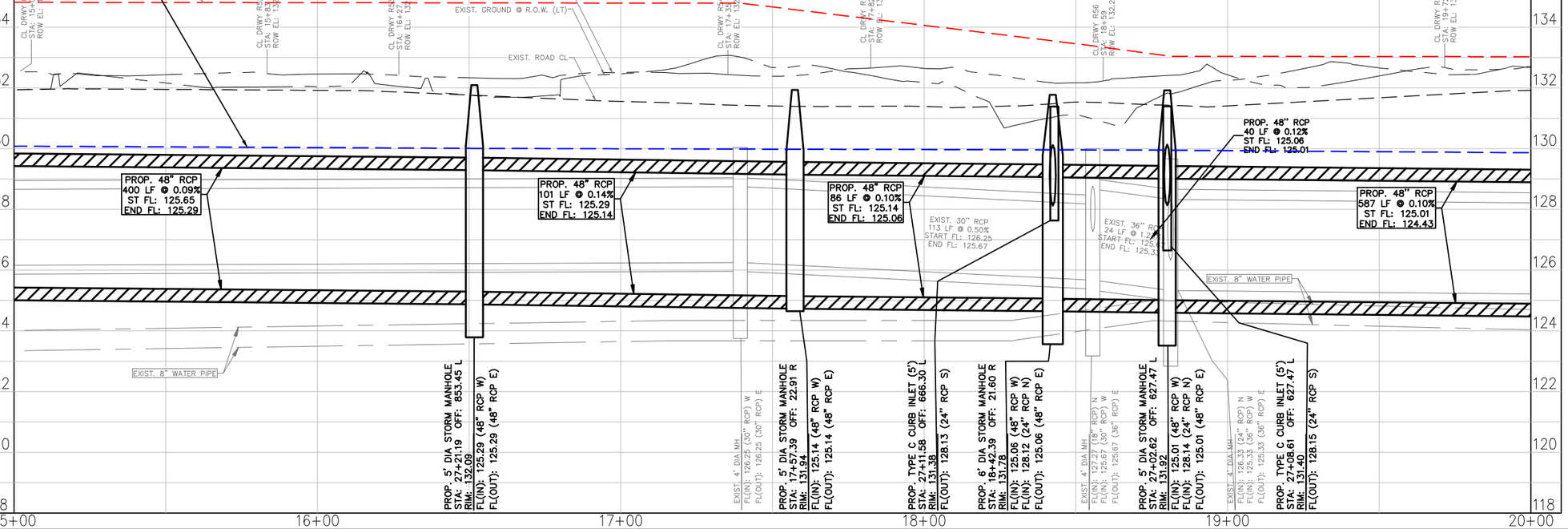
PROP. 48" RCP 587 LF @ 0.10%

T.O.V.=127.83

13415 SHAFT DR

13411 SHAFT DR

19 SHAFT DR



20' 0' 20'

SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE

PROP. STORM PIPES

PROP. CONCRETE DRIVEWAY

PROP. 5' SIDEWALK

PROP. MANHOLE

PROP. JUNCTION BOX

PROP. TYPE BB INLET

PROP. TYPE C INLET

PROP. TYPE C-1 INLET

PROP. TYPE C-2 INLET

EXIST. ROAD CL

EXIST. GROUND @ R.O.W. (LT)

EXIST. GROUND @ R.O.W. (RT)

EXIST. AT&T CONDUIT

EXIST. COMCAST CABLE

EXIST. GAS LINE

EXIST. ELECTRIC LINE

EXIST. WATER LINE

EXIST. STORM LINE

EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS TOMMY V. CROMER 97594 LICENSED PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC. TBPE FIRM NUMBER F-257

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION

DRAINAGE IMPROVEMENTS – 2018

SHEET DESCRIPTION: PLAN & PROF – SHAFT DR

DRAWN BY: JCM

STA 15+00 TO STA 20+00

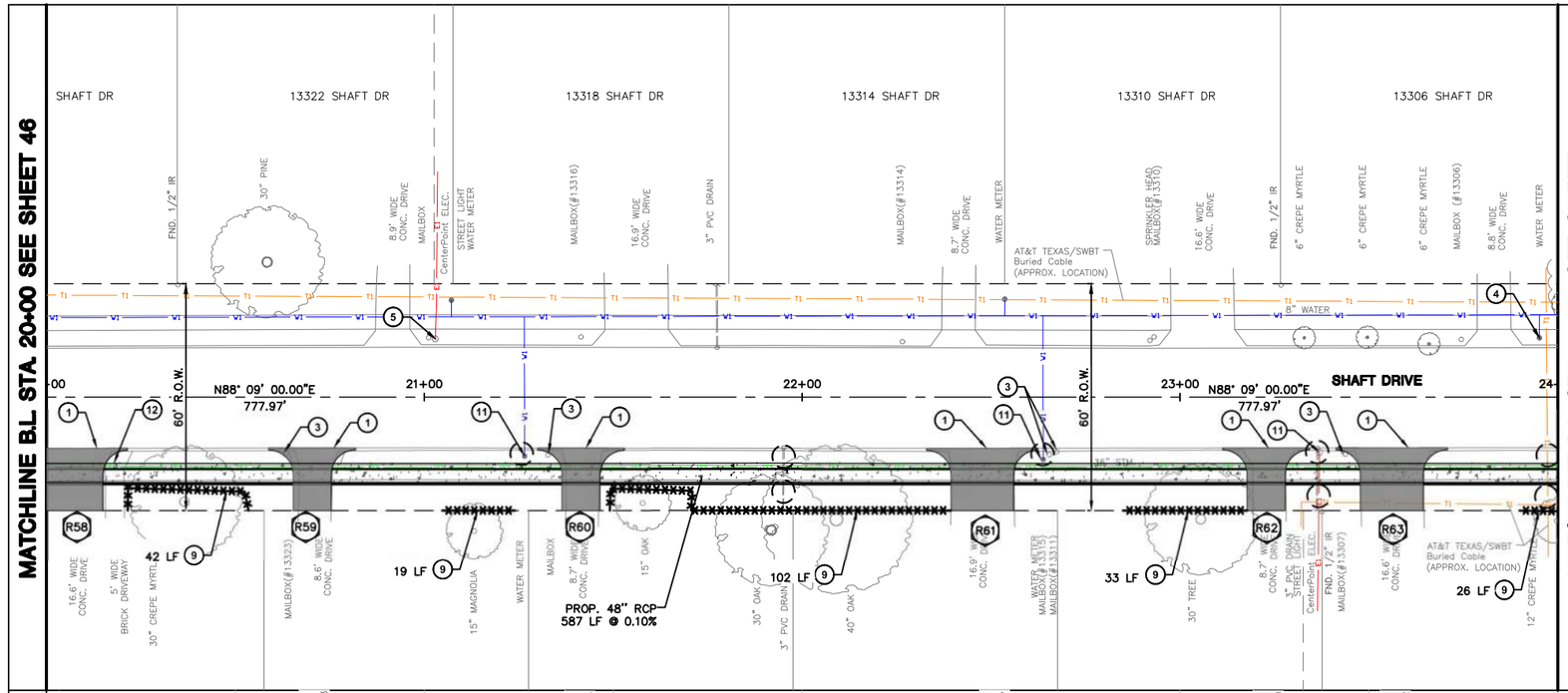
DATE: 02/18/2022

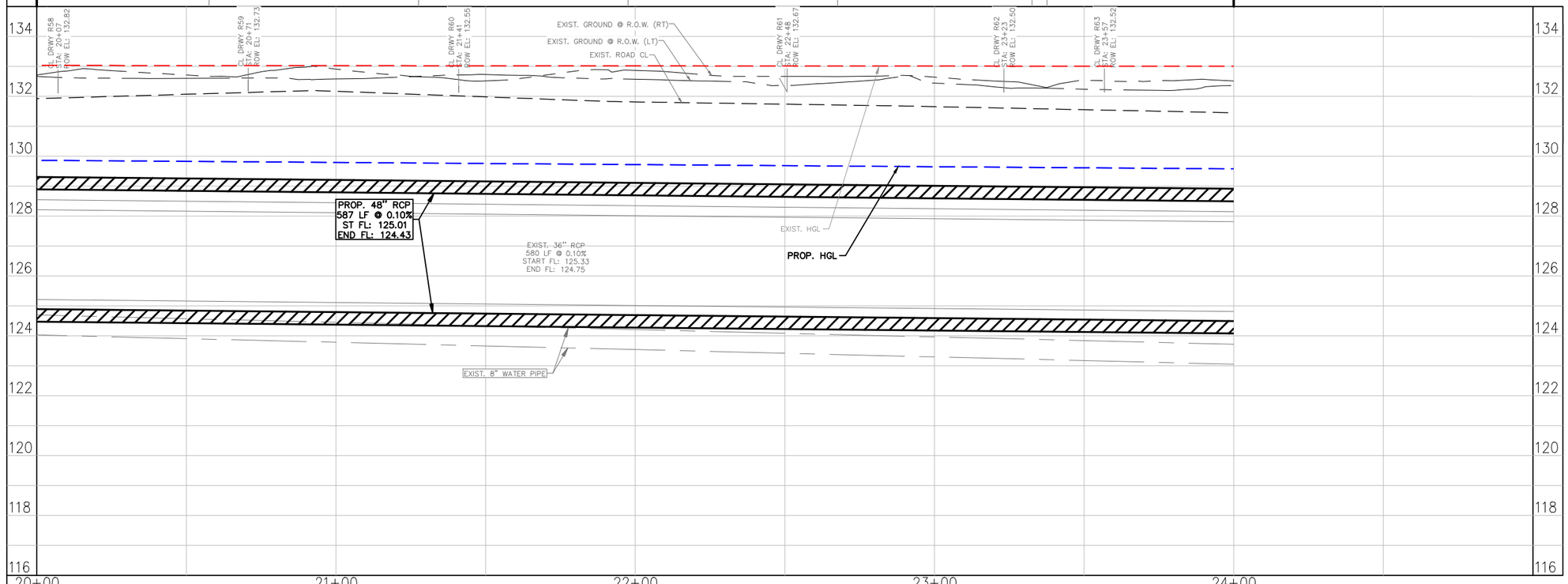
DESIGN BY: AJM

SCALE: HORIZ: 1"=20' VERT: 1"=2'

SHEET NO: 46 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg







LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56–57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B–B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49–50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C–1 INLET
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EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
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EXIST. AT&T CONDUIT
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NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME

HARRIS COUNTY ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
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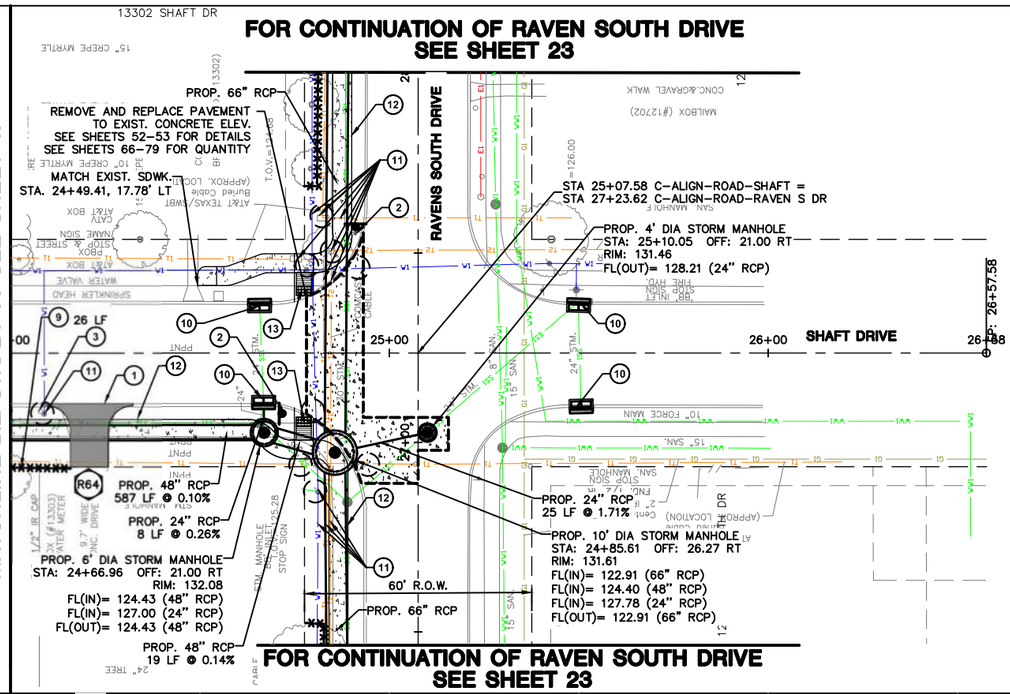
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

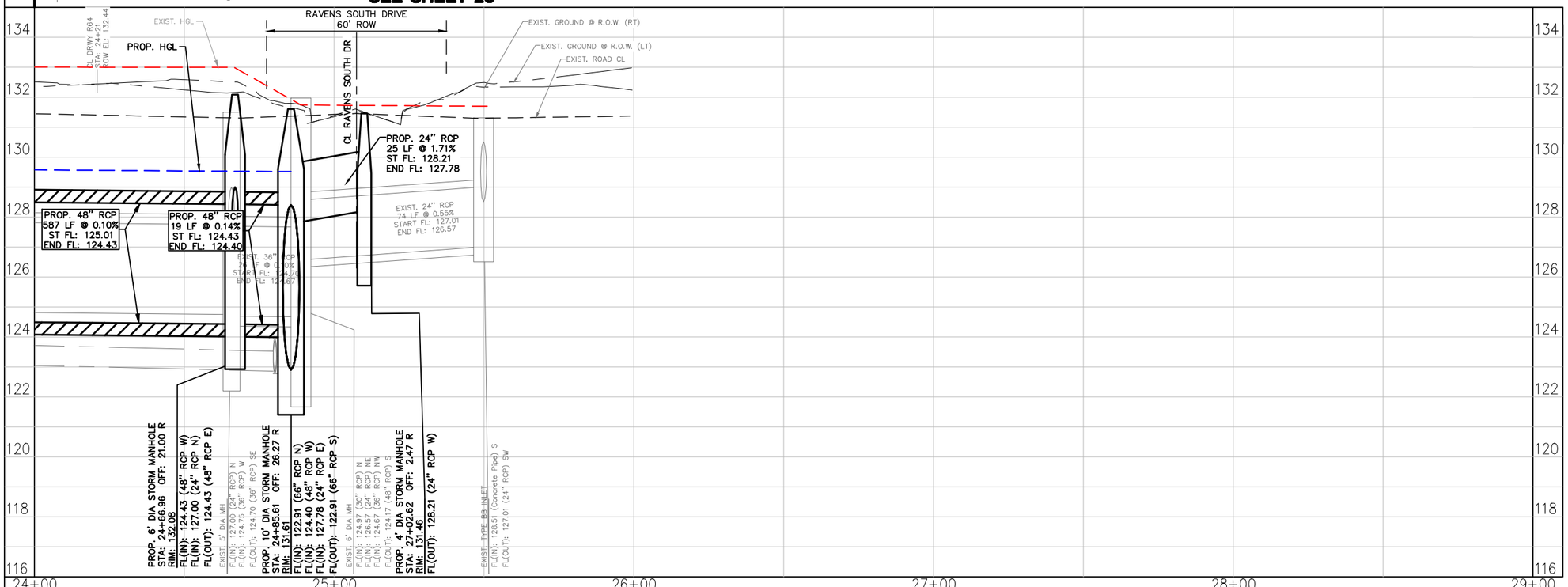
STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
02/18/2022
BINKLEY & BARFIELD INC.
TBPE FIRM NUMBER F-257

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – SHAFT DR
DRAWN BY: JCM	STA 20+00 TO STA 24+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
DATE:	02/18/2022
SHEET NO:	47 / 99

J:\HCP3\2100000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

MATCHLINE B.L STA. 24+00 SEE SHEET 47





20' 0' 20'
SCALE H:1"=20', V:1"=2'

LEGEND

1. REMOVE AND REPLACE CONCRETE DRIVEWAY
2. REMOVE AND REINSTALL SIGN
3. MAILBOX – SEE NOTE 3
4. WATER METER, VALVE, AND FIRE HYDRANT – PROTECT IN PLACE
5. POWER POLE – SEE NOTES 4 AND 5
6. TELEPHONE PEDESTAL – SEE NOTE 5
7. METER POLE – SEE NOTE 5
8. ELECTRIC JUNCTION BOX – SEE NOTE 5
9. TREE PROTECTION FENCING AND PRUNING SEE SHEETS 56-57 FOR DETAIL
10. REMOVE AND REPLACE EXISTING PLATES ON EXISTING B-B INLET WITH GRATES SEE SHEET 59 FOR DETAIL
11. EXIST. UTILITIES (LIGHT POLES, WATER, SANITARY, OR FIBER) TO BE RELOCATED BY OTHERS
12. PROP. 5' SIDEWALK (TYP) SEE SHEET 54 FOR DETAIL
13. PROP. TYPE 7 RAMP (TYP) SEE SHEET 55 FOR DETAIL
14. TREE/BUSH TO BE REMOVED

XX PROP. DRIVEWAY SEE SHEETS 49-50 FOR DRIVEWAY SCHEDULE

CRITICAL LOCATE

PROPOSED REINSTALLATION OF SIGN

PROP. TREE PROTECTION FENCE
PROP. STORM PIPES
PROP. CONCRETE DRIVEWAY
PROP. 5' SIDEWALK
PROP. MANHOLE
PROP. JUNCTION BOX
PROP. TYPE BB INLET
PROP. TYPE C INLET
PROP. TYPE C-1 INLET
PROP. TYPE C-2 INLET
EXIST. ROAD CL
EXIST. GROUND @ R.O.W. (LT)
EXIST. GROUND @ R.O.W. (RT)
EXIST. AT&T CONDUIT
EXIST. COMCAST CABLE
EXIST. GAS LINE
EXIST. ELECTRIC LINE
EXIST. WATER LINE
EXIST. STORM LINE
EXIST. SANITARY LINE

NOTES:

1. FOR DRIVEWAY REPLACEMENT DETAILS SEE SHEETS 51.
2. FOR PIPE BEDDING DETAIL SEE SHEET 58.
3. EXIST. MAILBOX TO BE PROTECTED IN PLACE. IF CONSTRUCTION REQUIRES A MAILBOX TO BE REMOVED, CONTRACTOR TO COORDINATE WITH THE POST OFFICE ON MAINTAINING MAIL DELIVERY SERVICES TO RESIDENTS DURING CONSTRUCTION. ALL MAILBOXES IN THE PROJECT AREA ARE CLUSTER MAILBOXES.
4. EXIST. POWER POLES MAY HAVE ELECTRICAL CONDUIT AND GUY WIRE ATTACHED.
5. PROTECT IN PLACE – CONTRACTOR IS TO COORDINATE WITH AT&T AND CENTER POINT FOR DETAILS PRIOR TO CONSTRUCTION IF RELOCATION IS REQUIRED.
6. FOR CONCRETE REPLACEMENT, CONTRACTOR TO IDENTIFY BEST LOCATION FOR SAW CUTS AND UTILIZE CONSTRUCTION JOINTS AS MUCH AS POSSIBLE.

NO.	REVISIONS	DATE	NAME
1			
2			
3			
4			
5			

HARRIS COUNTY
ENGINEERING DEPARTMENT

Binkley & Barfield, Inc.
consulting engineers
Texas Registration Number F-257
1710 Seamist Drive Houston, Texas 77008 (713) 869-3433

STATE OF TEXAS
TOMMY V. CROMER
97594
LICENSED
PROFESSIONAL ENGINEER
BINKLEY & BARFIELD INC
TBPE FIRM NUMBER F-257
02/18/2022

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENTS – 2018
SHEET DESCRIPTION:	PLAN & PROF – SHAFT DR
DRAWN BY: JCM	STA 24+00 TO STA 27+00
DESIGN BY: AJM	SCALE: HORIZ: 1"=20' VERT: 1"=2'
	DATE: 02/18/2022
	SHEET NO: 48 / 99

J:\HCP3\210000243.000_Ravensway South Subd. Drainage Improv\6.00_CADD\6.03_Drawings\21-0243-PD-P&P-WEST TO EAST STREETS.dwg

EXHIBIT 4.7
ROW AND TOPOGRAPHIC SURVEY

INDEX OF DRAWINGS

SHEET	DESCRIPTION
1	COVER SHEET
2	CONTROL SHEET
3-4	3-TIE SHEET
5	INDEX SHEET
6-29	TOPOGRAPHIC SURVEY SHEET

HARRIS COUNTY ENGINEERING DEPARTMENT

RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS TOPOGRAPHIC SURVEY

PRECINCT 3
HARRIS COUNTY, TEXAS
UPIN 19103MF14701

RODNEY ELLIS
COMMISSIONER — PRECINCT 1

ADRIAN GARCIA
COMMISSIONER — PRECINCT 2

MICHAEL POST
COUNTY AUDITOR

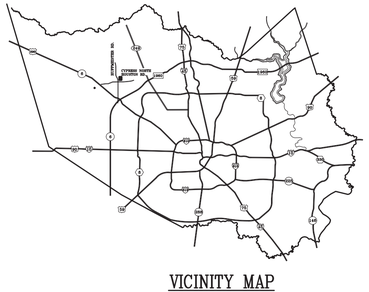
LINA HIDALGO
COUNTY JUDGE

TOM S. RAMSEY, P.E.
COMMISSIONER — PRECINCT 3

R. JACK CAGLE
COMMISSIONER — PRECINCT 4

JOHN R. BLOUNT, P.E.
COUNTY ENGINEER

PROJECT LOCATION
KEY MAPS # 368K,L,Q.

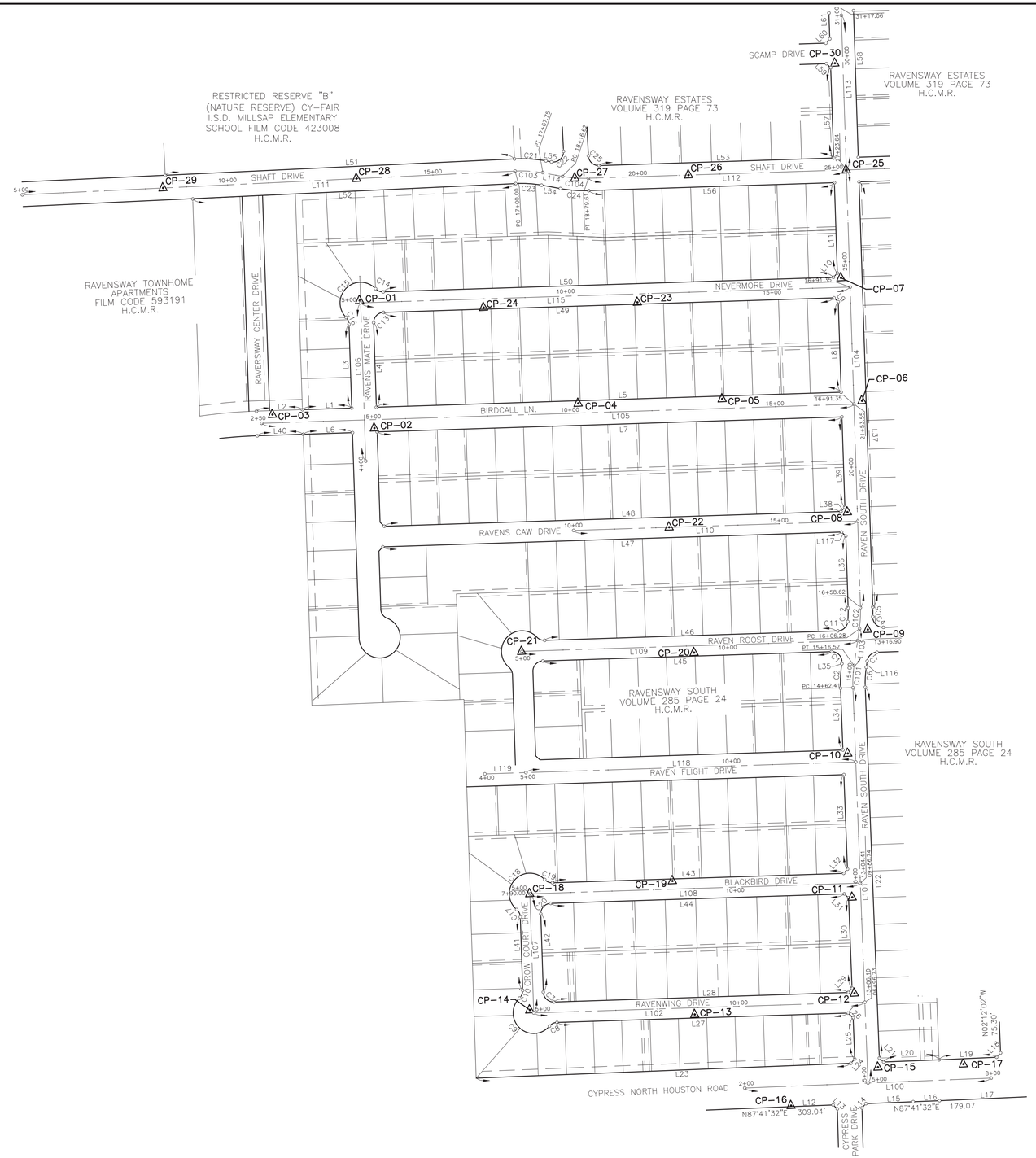


VICINITY MAP
N.T.S.



NOVEMBER 2021

LANDTECH, INC.
2525 North Loop West Suite 300
Houston, Texas 77008
(713) 861-7068
TxBPELS REG. NO. 10019100

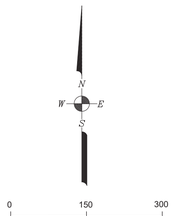


CURVE TABLE					
Curve	Radius	Length	Delta	Chord	Chord Bear.
C1	25.00'	43.63'	100°00'00"	38.30'	S41°51'00"E
C2	330.00'	59.52'	10°20'00"	59.44'	S02°59'00"W
C3	25.00'	39.27'	90°00'00"	35.36'	N46°51'00"W
C4	25.00'	39.27'	90°00'00"	35.36'	N43°09'00"E
C5	25.00'	41.03'	94°02'23"	36.58'	N44°49'49"W
C6	270.00'	48.69'	10°20'00"	48.63'	N02°59'00"E
C7	25.00'	34.91'	80°00'00"	32.14'	N48°09'00"E
C8	25.00'	21.03'	48°11'23"	20.41'	S64°03'19"W
C9	50.00'	162.65'	186°22'46"	99.85'	N46°51'00"W
C10	25.00'	21.03'	48°11'23"	20.41'	N22°14'41"E
C11	25.00'	21.03'	48°11'23"	20.41'	N25°56'41"W
C12	50.00'	162.65'	186°22'46"	99.85'	N43°09'00"E
C13	25.00'	21.03'	48°11'23"	20.41'	S67°45'19"E
C14	25.00'	21.03'	48°11'23"	20.41'	S67°45'19"E
C15	50.00'	157.97'	181°01'23"	100.00'	N45°49'41"E
C16	25.00'	18.69'	42°50'00"	18.26'	N23°16'00"W
C17	25.00'	21.03'	48°11'23"	20.41'	N25°56'41"W
C18	50.00'	162.65'	186°22'46"	99.85'	N43°09'00"E
C19	25.00'	21.03'	48°11'23"	20.41'	S67°45'19"E
C20	25.00'	39.27'	90°00'00"	35.36'	N43°09'00"E
C21	342.39'	76.82'	12°51'15"	76.65'	S86°29'26"E
C22	25.00'	44.92'	102°56'19"	39.11'	N48°42'43"E
C23	282.39'	63.35'	12°51'15"	63.22'	S86°30'55"E
C24	330.00'	69.28'	12°01'41"	69.15'	S85°49'58"E
C25	25.00'	38.87'	89°05'33"	35.07'	S47°18'13"E
C101	300.00'	54.11'	10°20'00"	54.03'	N02°59'00"E
C102	300.00'	52.36'	10°00'00"	52.29'	N03°09'00"E
C103	300.00'	67.75'	12°56'19"	67.60'	S86°17'18"E
C104	300.00'	62.99'	12°01'52"	62.88'	S85°50'04"E

BASELINE STATION TABLE		
STATION	SURFACE NORTH	SURFACE EAST
BIRDCALL LANE		
2+50.00	13,910,216.24	3,036,584.21
21+53.64	13,910,262.77	3,038,024.81
BLACKBIRD DRIVE		
5+00.00	13,909,071.70	3,037,236.51
13+04.41	13,909,097.67	3,038,040.50
CROW CT. DR.		
5+00.00	13,908,781.85	3,037,245.87
7+90.00	13,909,071.70	3,037,236.51
CYPRESS NORTH HOUSTON RD		
2+00.00	13,908,599.19	3,037,759.29
8+00.00	13,908,623.38	3,038,358.80
NEVERMORE DRIVE		
5+00.00	13,910,509.16	3,036,824.88
16+91.35	13,910,547.62	3,038,015.61
RAVEN ROOST DRIVE		
5+00.00	13,909,661.39	3,037,217.47
13+16.86	13,909,687.76	3,038,033.90
RAVEN SOUTH DRIVE		
5+00.00	13,908,611.29	3,038,059.05
14+62.41	13,909,573.00	3,038,022.38
15+16.52	13,909,626.96	3,038,025.19
16+06.28	13,909,715.82	3,038,037.92
16+58.64	13,909,768.03	3,038,040.79
31+00.00	13,911,208.64	3,037,994.26
RAVENS MATE DR		
4+00.00	13,910,124.37	3,036,837.31
5+00.00	13,910,224.31	3,036,834.08
8+50.00	13,910,574.13	3,036,822.78
RAVENWING DR		
5+00.00	13,908,781.85	3,037,245.87
13+06.10	13,908,807.87	3,038,051.55
RAVENS CAW DRIVE		
5+00.00	13,909,955.60	3,037,343.02
16+91.35	13,909,977.92	3,038,034.01
SHAFT DRIVE		
5+00.00	13,910,772.05	3,036,001.88
17+00.00	13,910,829.79	3,037,200.49
17+67.75	13,910,825.41	3,037,267.96
18+16.62	13,910,816.77	3,037,316.06
18+79.61	13,910,812.20	3,037,378.77
26+00.00	13,910,835.46	3,038,098.78
RAVEN FLIGHT DRIVE		
4+00.00	13,909,363.31	3,037,127.00
13+02.74	13,909,392.45	3,038,029.27

LINE TABLE		
LINE	BEARING	DISTANCE
L1	N88°09'00"E	119.99'
L2	S88°09'00"W	111.88'
L3	N01°51'00"W	204.01'
L4	N01°51'00"W	205.00'
L5	S88°09'00"W	1131.35'
L6	N88°09'00"E	119.99'
L7	N88°09'00"E	1131.35'
L8	S01°51'00"E	220.00'
L9	S46°51'00"E	14.14'
L10	N43°09'00"E	14.14'
L11	N01°51'00"W	220.00'
L12	N87°36'02"E	54.13'
L13	S47°30'51"E	14.19'
L14	N42°29'09"E	14.08'
L15	N87°41'32"E	115.02'
L16	N87°41'32"E	64.05'
L17	N87°26'29"E	211.95'
L18	N42°37'14"E	14.19'
L19	N87°26'29"E	140.04'
L20	S87°43'43"W	135.01'
L21	N47°13'38"W	14.13'
L22	N02°11'00"W	902.68'
L23	N87°43'43"E	911.98'
L24	N42°46'21"E	14.15'
L25	N02°11'00"W	100.00'
L26	N47°25'50"W	17.52'
L27	S88°09'00"W	707.90'
L28	S88°09'00"W	715.95'
L29	S42°59'00"W	14.10'
L30	S02°11'00"E	220.00'
L31	S47°01'00"E	14.18'
L32	N42°59'00"E	14.10'
L33	N02°11'00"W	230.00'
L34	S02°11'00"E	150.50'
L35	S08°09'00"W	0.95'
L36	S01°51'00"E	175.00'
L37	N01°51'00"W	1035.00'
L38	S43°09'00"W	14.14'
L39	S01°51'00"E	220.00'
L40	S88°09'00"W	111.88'
L41	N01°51'00"W	178.20'
L42	N01°51'00"W	190.00'
L43	N88°09'00"E	708.37'
L44	N88°09'00"E	714.56'
L45	N88°09'00"E	702.19'
L46	N88°09'00"E	696.29'
L47	N88°09'00"E	1116.35'
L48	S88°09'00"W	1111.35'
L49	N88°13'02"E	99.37'
L50	N88°09'00"E	1095.45'
L51	N87°19'37"E	850.37'
L52	N87°19'37"E	786.30'
L53	S88°09'00"W	571.03'
L54	S79°49'08"E	46.54'
L55	S79°49'08"E	13.75'
L56	S88°09'00"W	597.97'
L57	S01°51'00"E	220.00'
L58	N01°51'00"W	356.93'
L59	N46°51'00"W	14.14'
L60	S43°09'00"W	14.14'
L61	S01°51'00"E	63.12'
L100	N87°41'21"E	600.00'
L101	N02°11'00"W	962.41'
L102	N88°09'00"E	806.10'
L103	N88°09'00"E	89.76'
L104	N01°51'00"W	1065.00'
L105	N88°09'00"E	1441.35'
L106	N01°51'00"W	450.00'
L107	N01°51'00"W	290.00'
L108	N88°09'00"E	804.41'
L109	N88°09'00"E	816.86'
L110	N88°09'00"E	691.35'
L111	N87°14'33"E	1200.00'
L112	N88°09'00"E	627.97'
L113	N01°51'00"W	376.36'
L114	S79°49'08"E	48.87'
L115	N88°09'00"E	1191.35'
L116	N08°09'00"E	15.27'
L117	S46°51'00"E	14.14'
L118	N88°09'00"E	802.69'
L119	N88°09'00"E	100.05'

SURVEY CONTROL POINTS							
CP	STATION	OFFSET	BASELINE	SURFACE NORTH	SURFACE EAST	ELEV	DESCRIPTION
1	7+90.68	2.08 LT	RAVENS MATE	13,910,514.77	3,036,822.62	131.76	CUT "X" IN CONCRETE
2	5+23.65	20.59 RT	BIRDCALL	13,910,204.50	3,036,858.38	131.31	CUT "X" IN CONCRETE
3	2+77.01	20.34 LT	BIRDCALL	13,910,237.44	3,036,610.55	132.69	SET 3/8" IR W/LANDTECH CAP
4	10+21.13	23.44 LT	BIRDCALL	13,910,264.57	3,037,354.18	131.85	CUT "X" IN CONCRETE
5	13+71.70	23.08 LT	BIRDCALL	13,910,275.52	3,037,704.59	132.02	CUT "X" IN CONCRETE
6	21+61.15	20.10 RT	RAVEN SOUTH	13,910,270.93	3,038,044.66	131.78	CUT "X" IN CONCRETE
7	24+61.52	21.36 LT	RAVEN SOUTH	13,910,569.80	3,037,993.52	131.35	CUT "X" IN CONCRETE
8	18+91.74	23.99 LT	RAVEN SOUTH	13,910,000.24	3,038,009.29	130.76	CUT "X" IN CONCRETE
9	16+07.64	20.73 RT	RAVEN SOUTH	13,909,714.32	3,038,058.64	130.53	SET 3/8" IR W/LANDTECH CAP
10	13+02.95	18.33 LT	RAVEN SOUTH	13,909,412.96	3,038,010.14	129.99	CUT "X" IN CONCRETE
11	9+52.79	20.90 LT	RAVEN SOUTH	13,909,062.95	3,038,020.92	130.21	CUT "X" IN CONCRETE
12	7+19.45	24.44 LT	RAVEN SOUTH	13,908,829.65	3,038,026.26	129.97	CUT "X" IN CONCRETE
13	8+91.57	16.48 RT	RAVENWING	13,908,778.02	3,037,637.77	129.98	SET 3/8" IR W/LANDTECH CAP
14	5+07.27	9.18 LT	CROW CT	13,908,788.82	3,037,236.46	131.30	CUT "X" IN CONCRETE
15	5+37.44	25.98 RT	RAVEN SOUTH	13,908,649.69	3,038,083.58	131.15	CUT "X" IN CONCRETE
16	3+11.05	47.47 RT	CYPRESS NORTH	13,908,556.24	3,037,872.16	131.55	SET 3/8" IR W/LANDTECH CAP
17	7+33.89	36.41 LT	CYPRESS NORTH	13,908,657.10	3,038,291.28	131.62	MAG NAIL
18	7+89.91	0.13 LT	CROW CT	13,909,071.61	3,037,236.38	132.45	CUT "X" IN CONCRETE
19	8+47.79	20.02 LT	BLACKBIRD	13,909,102.94	3,037,583.47	131.36	CUT "X" IN CONCRETE
20	9+18.39	16.63 RT	RAVEN ROOST	13,909,658.27	3,037,636.18	130.22	CUT "X" IN CONCRETE
21	4+99.35	0.31 RT	RAVEN ROOST	13,909,661.06	3,037,216.83	131.56	CUT "X" IN CONCRETE
22	12+32.66	0.25 LT	RAVENS CAW	13,909,963.36	3,037,575.55	130.66	CUT "X" IN CONCRETE
23	11+73.02	20.46 RT	NEVERMORE	13,910,510.44	3,037,498.21	132.00	CUT "X" IN CONCRETE
24	7+98.74	21.12 RT	NEVERMORE	13,910,497.70	3,037,124.15	132.89	CUT "X" IN CONCRETE
25	27+23.39	0.09 LT	RAVEN SOUTH	13,910,832.23	3,038,006.33	131.70	SET COTTON SPINDLE
26	21+23.76	0.05 LT	SHAFT	13,910,820.13	3,037,622.79	132.08	CUT "X" IN CONCRETE
27	18+47.05	0.32 RT	SHAFT	13,910,812.60	3,037,346.21	131.50	CUT "X" IN CONCRETE
28	13+14.07	0.31 LT	SHAFT	13,910,811.53	3,036,815.00	131.45	CUT "X" IN CONCRETE
29	8+42.81	0.13 LT	SHAFT	13,910,788.67	3,036,344.29	131.92	CUT "X" IN CONCRETE
30	29+83.89	19.29 LT	RAVEN SOUTH	13,911,091.97	3,037,978.73	131.66	CUT "X" IN CONCRETE
1000				13,913,663.33	3,035,381.05	133.38	HCFCD RM 110135 - NEW PRELI



SCALE: 1" = 150' (22"X34" SHEET)
1" = 300' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

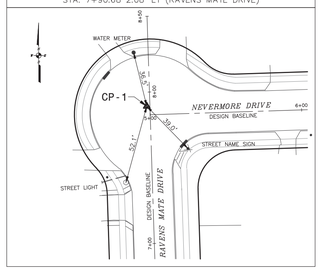
LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENT PROJECT
SHEET DESCRIPTION:	**CONTROL MAP SHEET**
DRAWN BY:	UPIN 19103MF14701
CK'D BY:	SCALE:

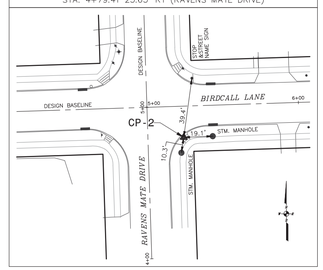
CIVIL STANDARD
DATE:
SHEET NO: 2 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

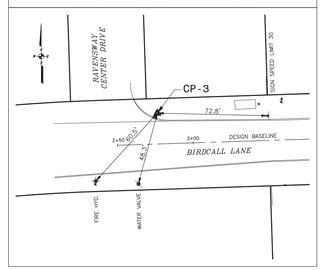
CONTROL POINT 1
CUT "X" IN CONCRETE
STA. 4+97.92 5.69' LT (NEVERMORE DRIVE)
STA. 7+90.68 2.08' LT (RAVENS MATE DRIVE)



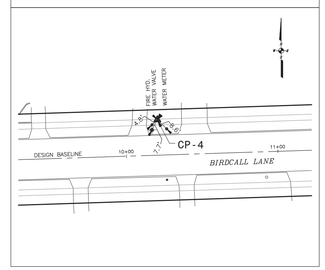
CONTROL POINT 2
CUT "X" IN CONCRETE
STA. 5+23.65 20.59' RT (BIRDCALL LANE)
STA. 4+79.41 23.65' RT (RAVENS MATE DRIVE)



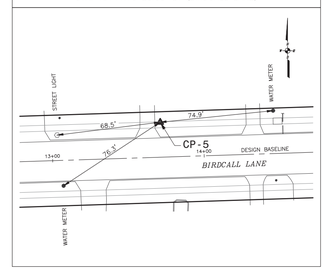
CONTROL POINT 3
SET 3/8"Rw/LANDTECH CAP
STA. 2+77.01 20.34' LT (BIRDCALL LANE)



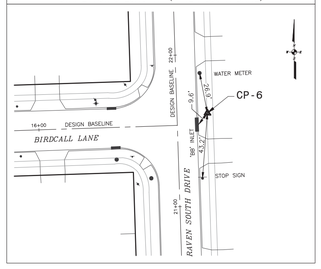
CONTROL POINT 4
CUT "X" IN CONCRETE
STA. 10+21.13 23.44' LT (BIRDCALL LANE)



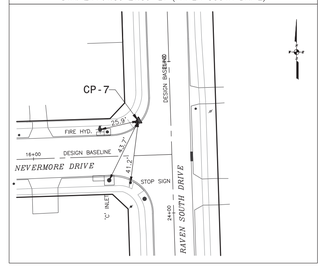
CONTROL POINT 5
CUT "X" IN CONCRETE
STA. 13+71.70 23.08' LT (BIRDCALL LANE)



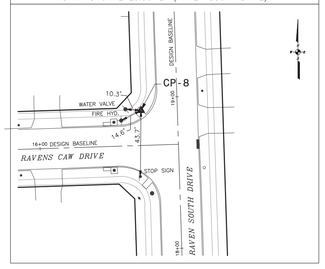
CONTROL POINT 6
CUT "X" IN CONCRETE
STA. 17+11.45 7.51' LT (BIRDCALL LANE)
STA. 21+61.13 20.10' RT (RAVEN SOUTH DRIVE)



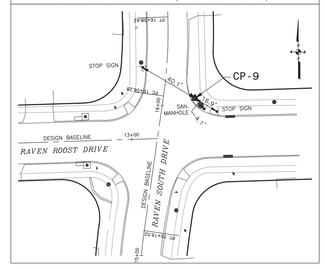
CONTROL POINT 7
CUT "X" IN CONCRETE
STA. 16+69.99 22.88' LT (NEVERMORE DRIVE)
STA. 24+61.50 21.36' LT (RAVEN SOUTH DRIVE)



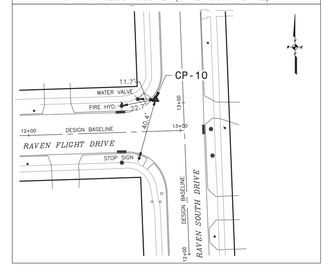
CONTROL POINT 8
CUT "X" IN CONCRETE
STA. 16+67.36 23.10' LT (RAVENS CAW DRIVE)
STA. 18+91.72 23.99' LT (RAVEN SOUTH DRIVE)



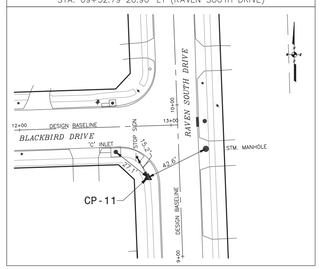
CONTROL POINT 9
SET 3/8"Rw/LANDTECH CAP
STA. 13+42.49 25.75' LT (RAVEN ROOST DRIVE)
STA. 16+07.68 20.73' RT (RAVEN SOUTH DRIVE)



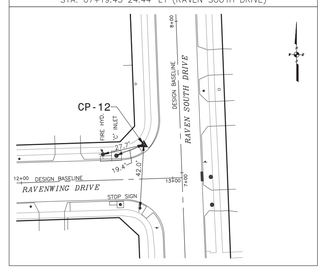
CONTROL POINT 10
CH=10 CUT "X" IN CONCRETE
STA. 12+84.29 21.11' LT (RAVEN FLIGHT DRIVE)
STA. 13+02.95 18.33' LT (RAVEN SOUTH DRIVE)



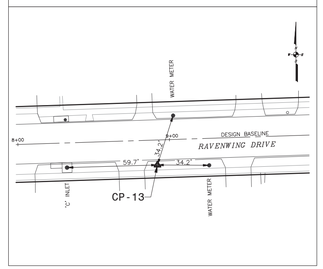
CONTROL POINT 11
CUT "X" IN CONCRETE
STA. 12+83.71 34.06' RT (BLACKBIRD DRIVE)
STA. 09+52.79 20.90' LT (RAVEN SOUTH DRIVE)



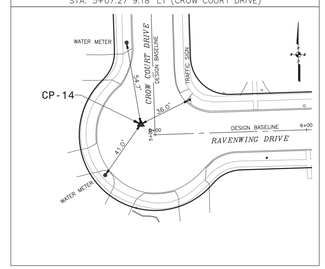
CONTROL POINT 12
CUT "X" IN CONCRETE
STA. 12+81.53 22.58' LT (RAVENWING DRIVE)
STA. 07+19.45 24.44' LT (RAVEN SOUTH DRIVE)



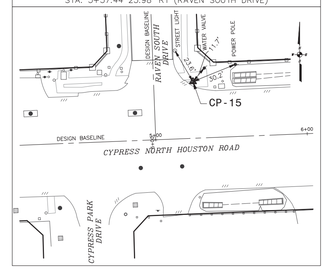
CONTROL POINT 13
SET 3/8"Rw/LANDTECH CAP
STA. 8+91.57 16.48' RT (RAVENWING DRIVEI)



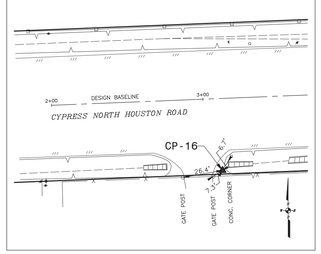
CONTROL POINT 14
CUT "X" IN CONCRETE
STA. 4+90.82 7.27' LT (RAVENWING DRIVE)
STA. 5+07.27 9.18' LT (CROW COURT DRIVE)



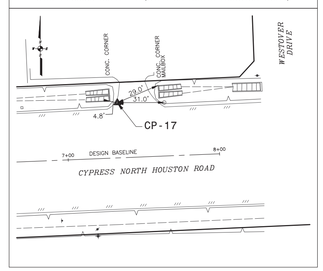
CONTROL POINT 15
CUT "X" IN CONCRETE
STA. 5+26.06 37.39' LT (CYPRESS NORTH HOUSTON ROAD)
STA. 5+37.44 25.98' RT (RAVEN SOUTH DRIVE)



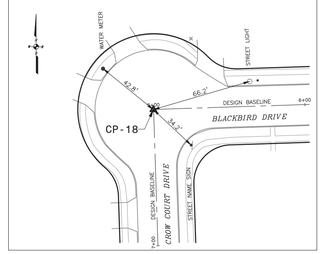
CONTROL POINT 16
SET 3/8"Rw/LANDTECH CAP
STA. 03+11.05 47.47' RT (CYPRESS NORTH HOUSTON ROAD)



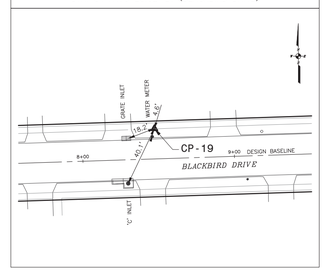
CONTROL POINT 17
SET MAG NAIL
STA. 7+33.89 36.41' LT (CYPRESS NORTH HOUSTON ROAD)



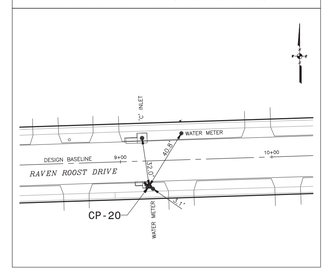
CONTROL POINT 18
CUT "X" IN CONCRETE
STA. 4+99.85 0.09' RT (BLACKBIRD DRIVE)
STA. 7+89.91 0.13' LT (CROW COURT DRIVE)



CONTROL POINT 19
CUT "X" IN CONCRETE
STA. 8+47.79 20.02' LT (BLACKBIRD DRIVE)



CONTROL POINT 20
CUT "X" IN CONCRETE
STA. 9+18.39 16.63' RT (RAVEN ROOST DRIVE)



STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENT PROJECT
SHEET DESCRIPTION:	**CONTROL POINT SWING TIES SHEET**
DRAWN BY:	UPIN 19103MF14701
CK'D BY:	SCALE:

CIVIL STANDARD

DATE:

SHEET NO: 3 / 29

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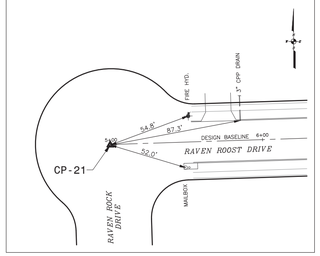
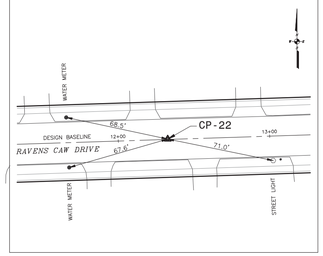
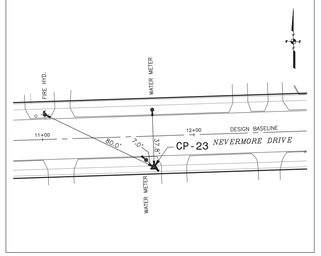
CONTROL POINT 21
CUT "X" IN CONCRETE
STA. 4+99.35 0.31' RT (RAVEN ROOST DRIVE)



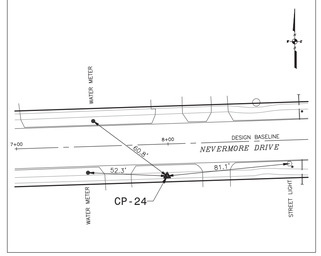
CONTROL POINT 22
CUT "X" IN CONCRETE
STA. 12+32.66 0.25' LT (RAVENS CAW DRIVE)



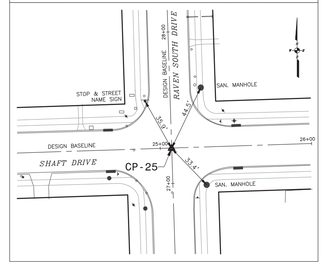
CONTROL POINT 23
CUT "X" IN CONCRETE
STA. 11+73.02 20.46' RT (NEVERMORE DRIVE)



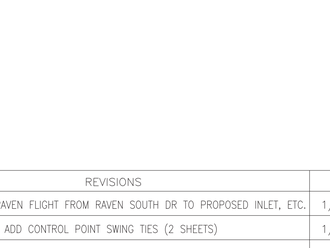
CONTROL POINT 24
CUT "X" IN CONCRETE
STA. 7+98.74 21.12' RT (NEVERMORE DRIVE)



CONTROL POINT 25
SET COTTON SPINDLE
STA. 25+07.50 0.25' RT (SHAFT DRIVE)
STA. 27+23.39 0.09' LT (RAVEN SOUTH DRIVE)



CONTROL POINT 26
CUT "X" IN CONCRETE
STA. 21+23.76 0.05' LT (SHAFT DRIVE.)



CONTROL POINT 27
CUT "X" IN CONCRETE
STA. 18+47.05 0.32' RT (SHAFT DRIVE.)



CONTROL POINT 28
CUT "X" IN CONCRETE
STA. 13+14.07 0.31' LT (SHAFT DRIVE.)



CONTROL POINT 29
CUT "X" IN CONCRETE
STA. 8+42.81 0.13' LT (SHAFT DRIVE.)



CONTROL POINT 30
CUT "X" IN CONCRETE
STA. 29+83.89 19.29' LT (RAVEN SOUTH DRIVE)



THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION
DRAINAGE IMPROVEMENT PROJECT
CIVIL STANDARD
SHEET DESCRIPTION: **CONTROL POINT SWING TIES SHEET**
DRAWN BY: UPIN 19103MF14701
DATE:
CK'D BY:
SCALE:
SHEET NO: 4 / 29

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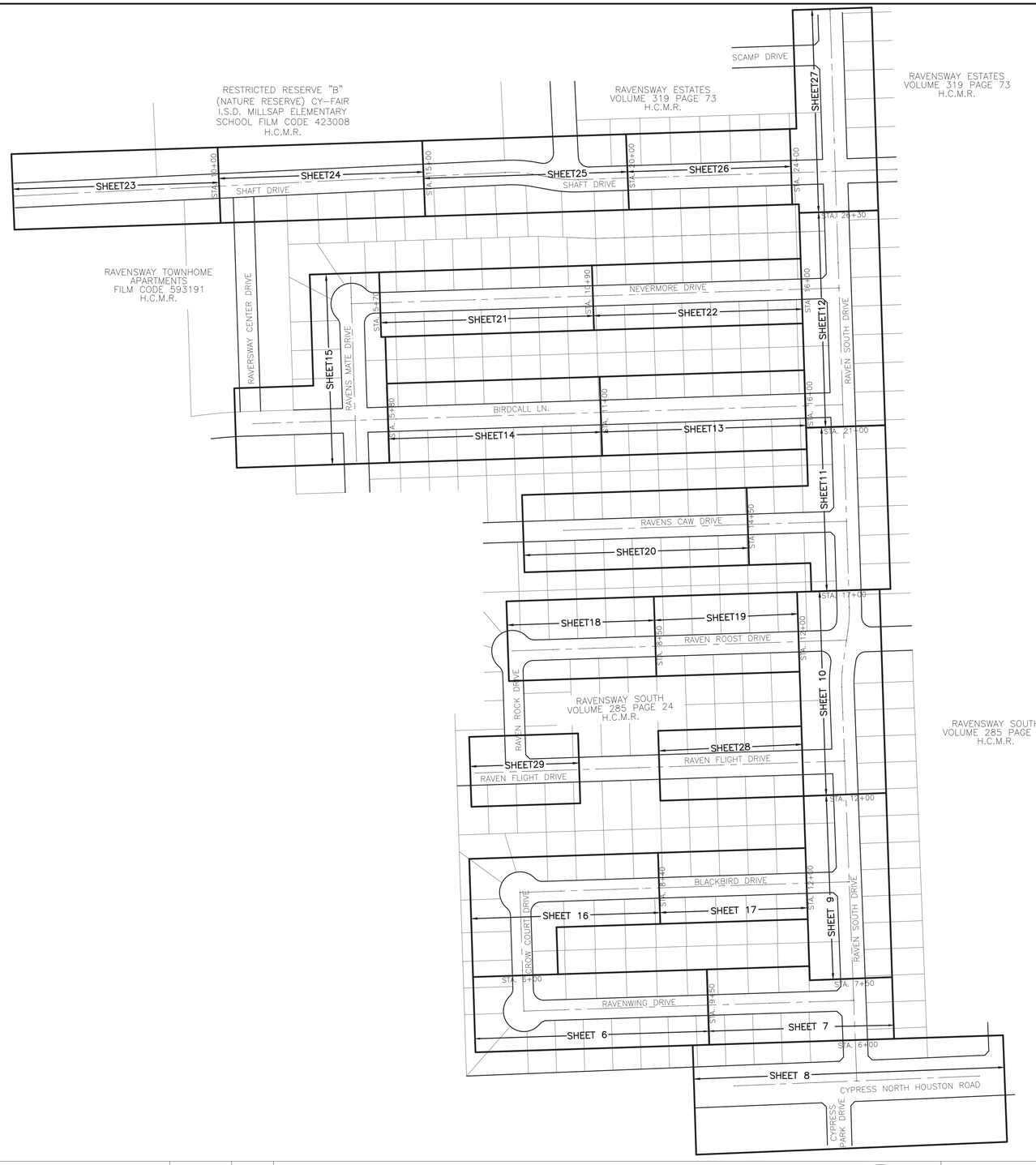

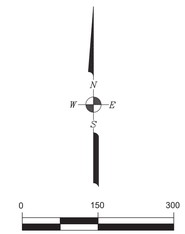

SCALE: 1" = 150' (22"X34" SHEET)
1" = 300' (11"X17" SHEET)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY 1836 TEXAS

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**INDEX SHEET**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 5 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

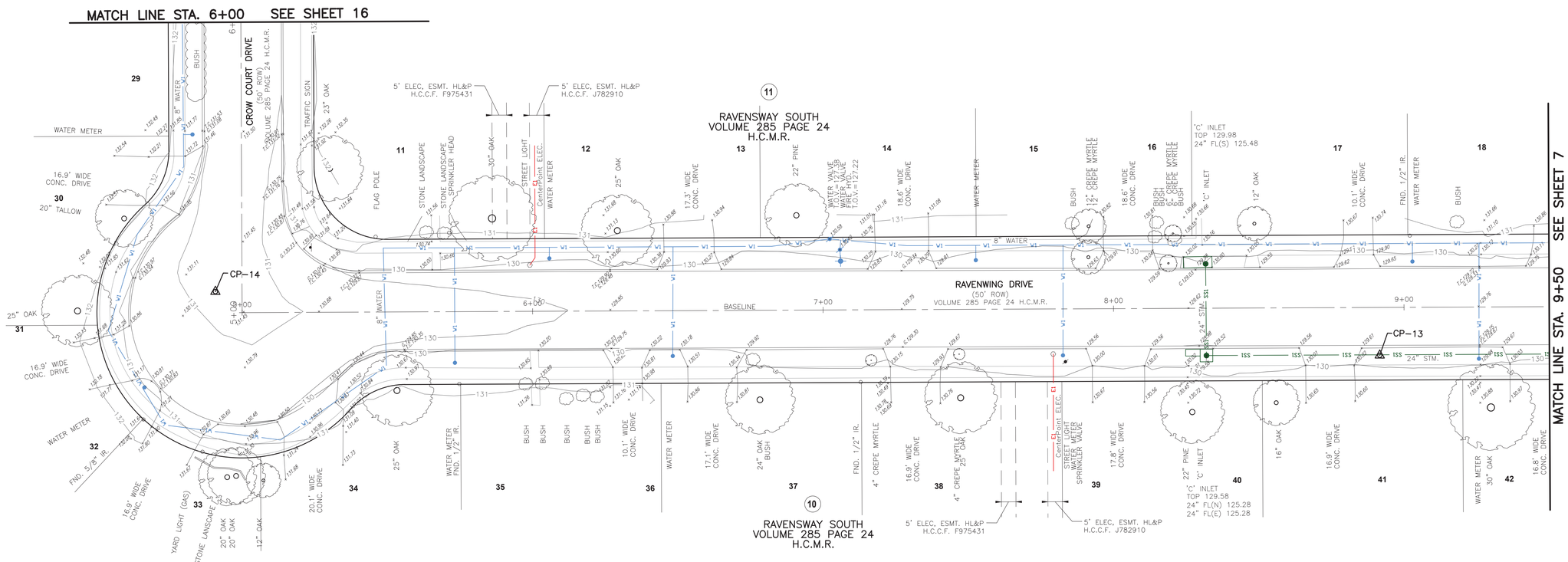
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

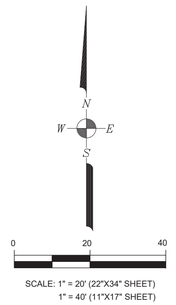
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-13	13,908,778.02	3,037,637.77	129.98	SET 3/8" I.R. w/LANDTECH CAP
CP-14	13,908,788.82	3,037,236.46	131.30	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVENWING DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 6 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1 WW1
STORM SEWER		SS1

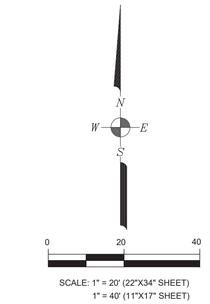
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-12	13,908,829.65	3,038,026.26	129.97	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



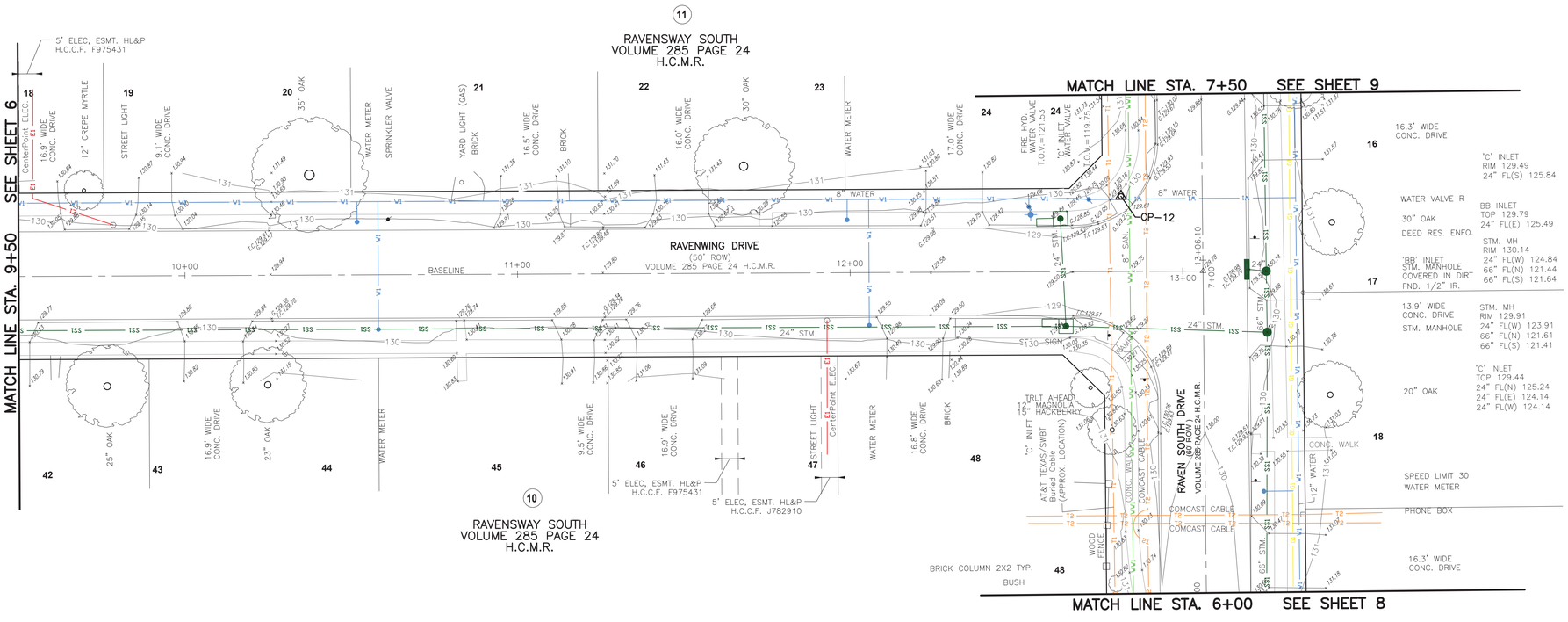
SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV088), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00).
ELEV= 133.38 (NAV088, GEOID12B)





THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

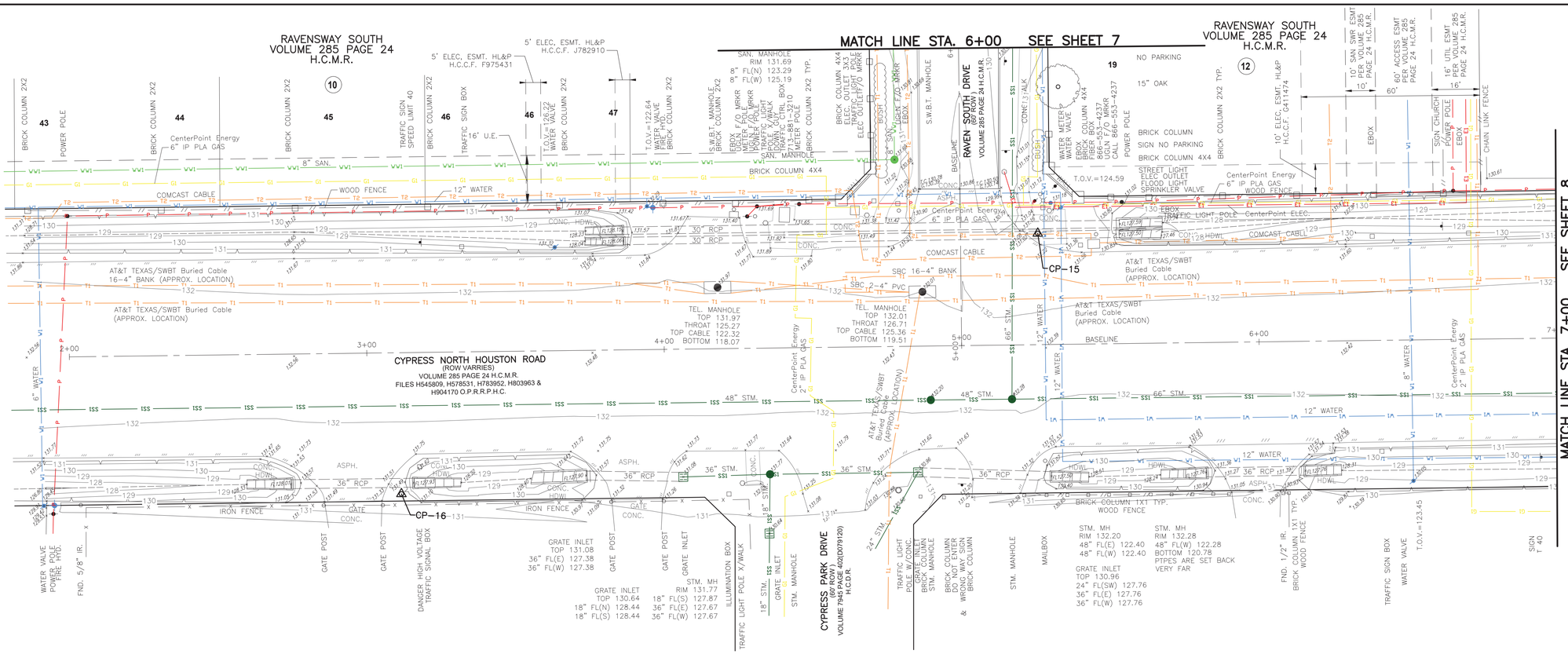
NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

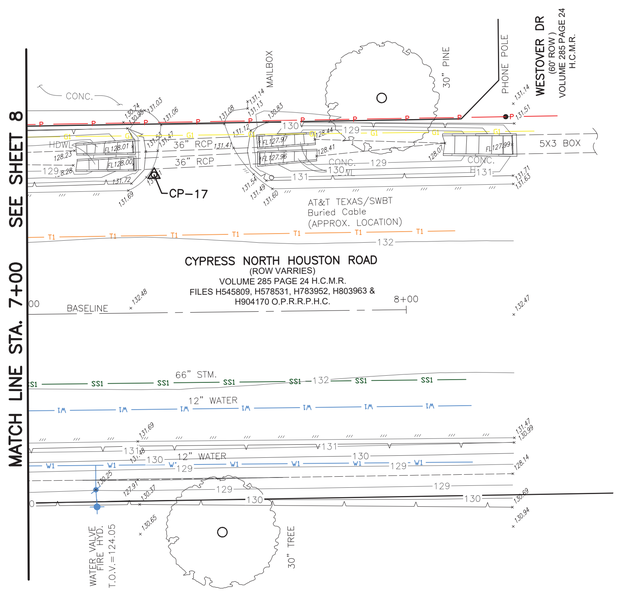
HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION		
	DRAINAGE IMPROVEMENT PROJECT		CIVIL STANDARD
SHEET DESCRIPTION:	RAVENWING DRIVE & RAVEN SOUTH DRIVE		
DRAWN BY:	UPIN 19103MF14701	DATE:	
CK'D BY:	SCALE:	SHEET NO:	7 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg





UTILITY		LINE STYLE
AT&T		T1 — T1
COMCAST		T2 — T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 — E1
	GAS	G1 — G1
WATER		W1 — W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	———
UTILITY EASEMENT	– – – – –
WATER LINE EASEMENT	– – – – –
LOT	———

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-15	13,908,649.69	3,038,083.58	131.15	CUT "X" IN CONCRETE
CP-16	13,908,556.24	3,037,872.16	131.55	SET 3/8"IR. w/LANDTECH CAP
CP-17	13,908,657.10	3,038,291.28	131.62	SET MAG NAIL

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

NOTES:

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3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
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2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	RAVEN SOUTH DRIVE CYPRESS NORTH HOUSTON ROAD	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 8 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-11	13,909,062.95	3,038,020.92	130.21	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
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H.C.D.R.	HARRIS COUNTY DEED RECORDS
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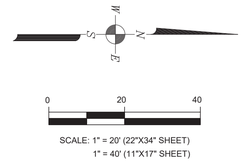
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



NOTES:

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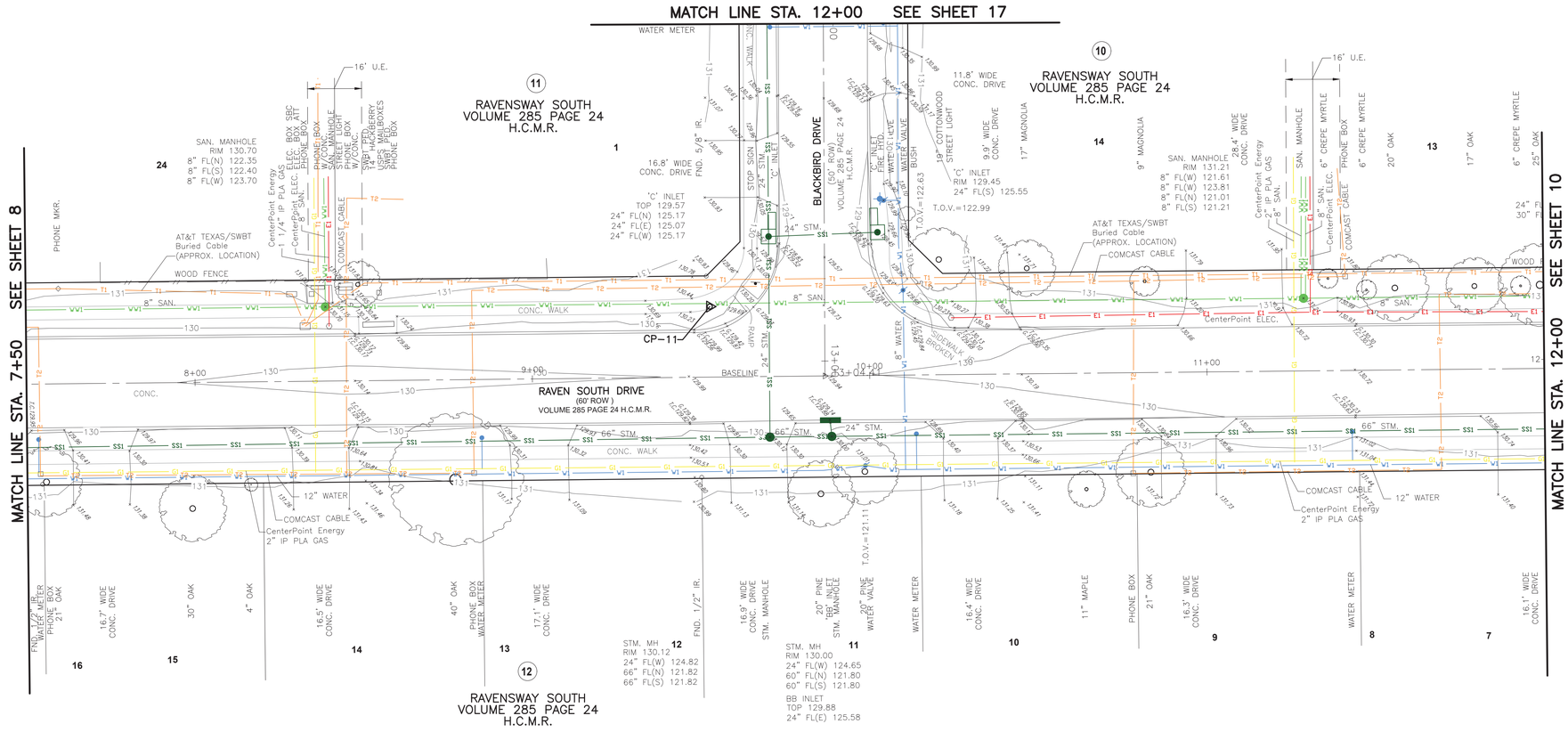
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00). ELEV= 133.38 (NAVD88, GEOID12B)





THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVEN SOUTH DRIVE & BLACKBIRD DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 9 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

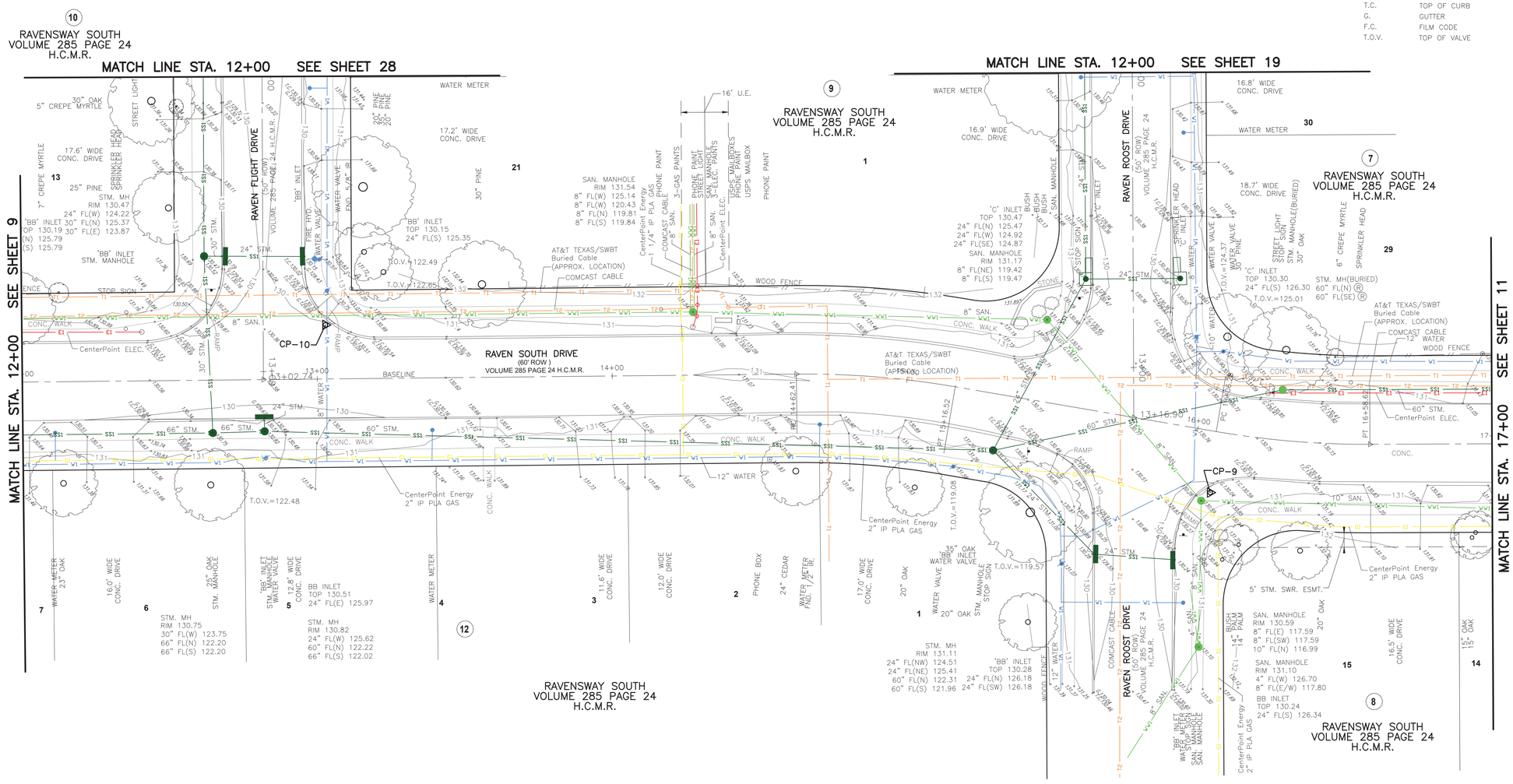
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-9	13,909,714.32	3,038,058.64	130.53	SET 3/8"IR. w/LANDTECH CAP
CP-10	13,909,412.96	3,038,010.14	129.99	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



NOTES:

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3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

STATE OF TEXAS REGISTERED TO PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

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HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	RAVEN ROOST DRIVE RAVEN SOUTH DRIVE & RAVEN FLIGHT DRIVE	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 10 / 29

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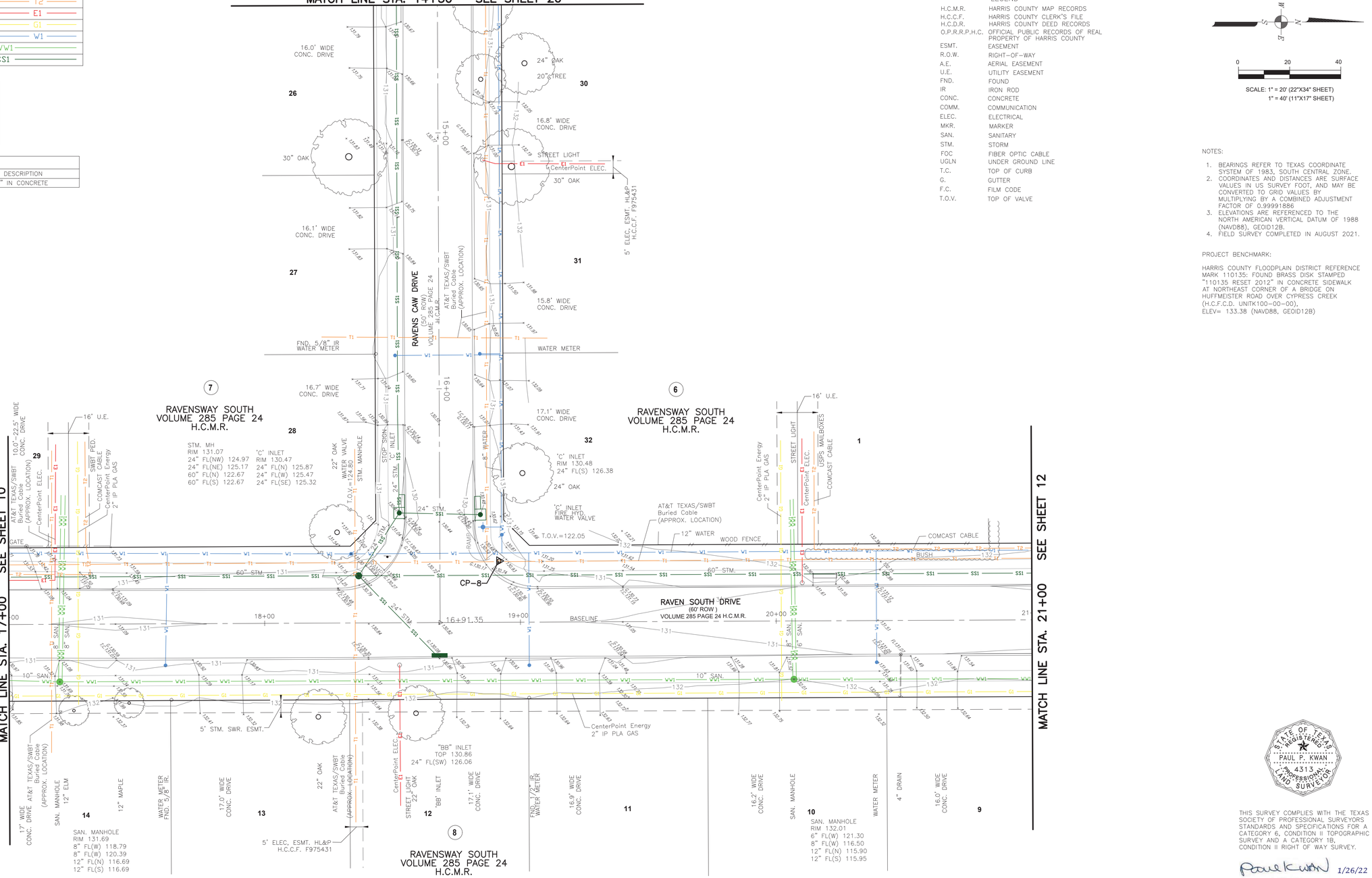
UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT–OF–WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE				
POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP–8	13,910,000.24	3,038,009.29	130.76	CUT "X" IN CONCRETE



LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT–OF–WAY
A.E.	AERIAL EASEMENT
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FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

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4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100–00–00). ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

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HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENT PROJECT
SHEET DESCRIPTION:	RAVEN ROOST DRIVE RAVEN SOUTH DRIVE & RAVEN FLIGHT DRIVE
DRAWN BY:	UPIN 19103MF14701
CK'D BY:	SCALE:

CIVIL STANDARD

DATE:

SHEET NO: 11 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-6	13,910,270.93	3,038,044.66	131.78	CUT "X" IN CONCRETE
CP-7	13,910,569.80	3,037,993.52	131.35	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
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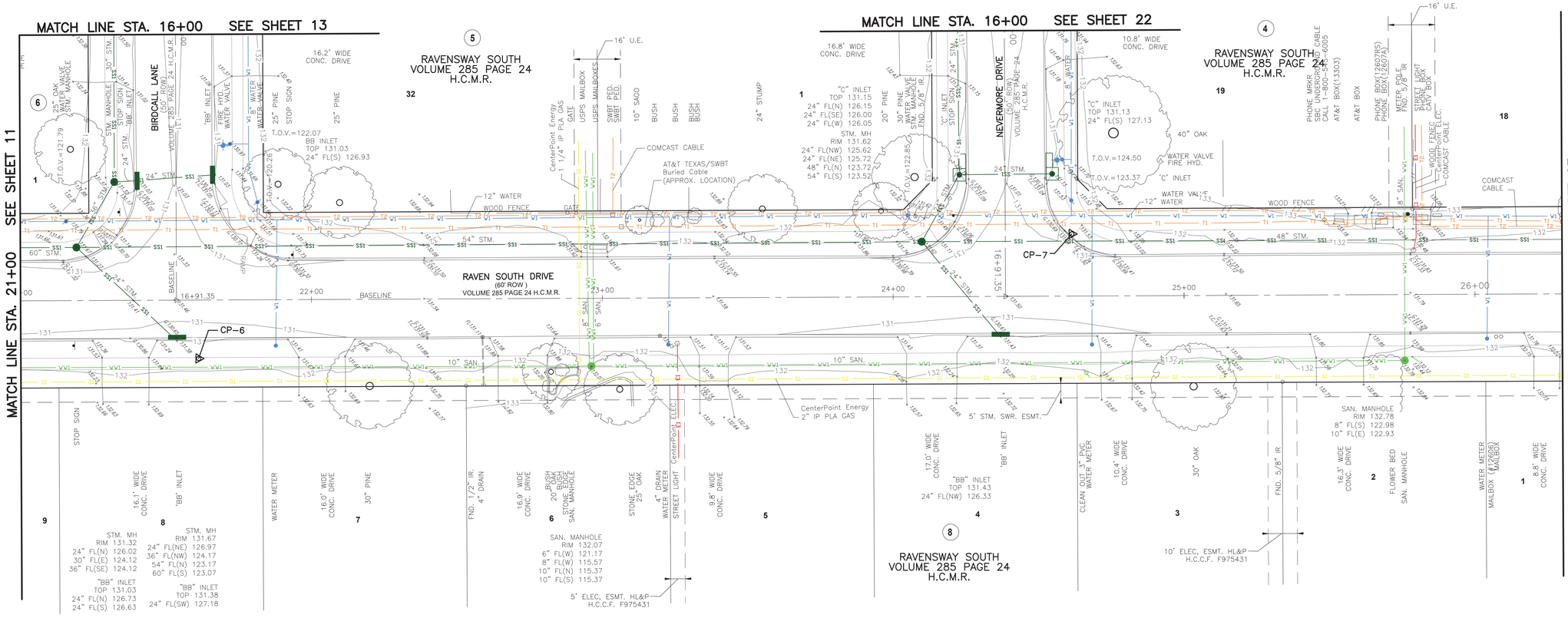
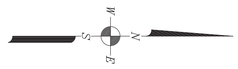
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





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PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

HARRIS COUNTY 1836 TEXAS

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE: RAVENSWAY SOUTH SUBDIVISION

DRAINAGE IMPROVEMENT PROJECT — CIVIL STANDARD

SHEET DESCRIPTION: **RAVEN SOUTH DRIVE & BIRDCALL LANE NEVERMORE DRIVE**

DRAWN BY: UPIN 19103MF14701 — DATE:

CK'D BY: — SCALE: — SHEET NO: 12 / 29

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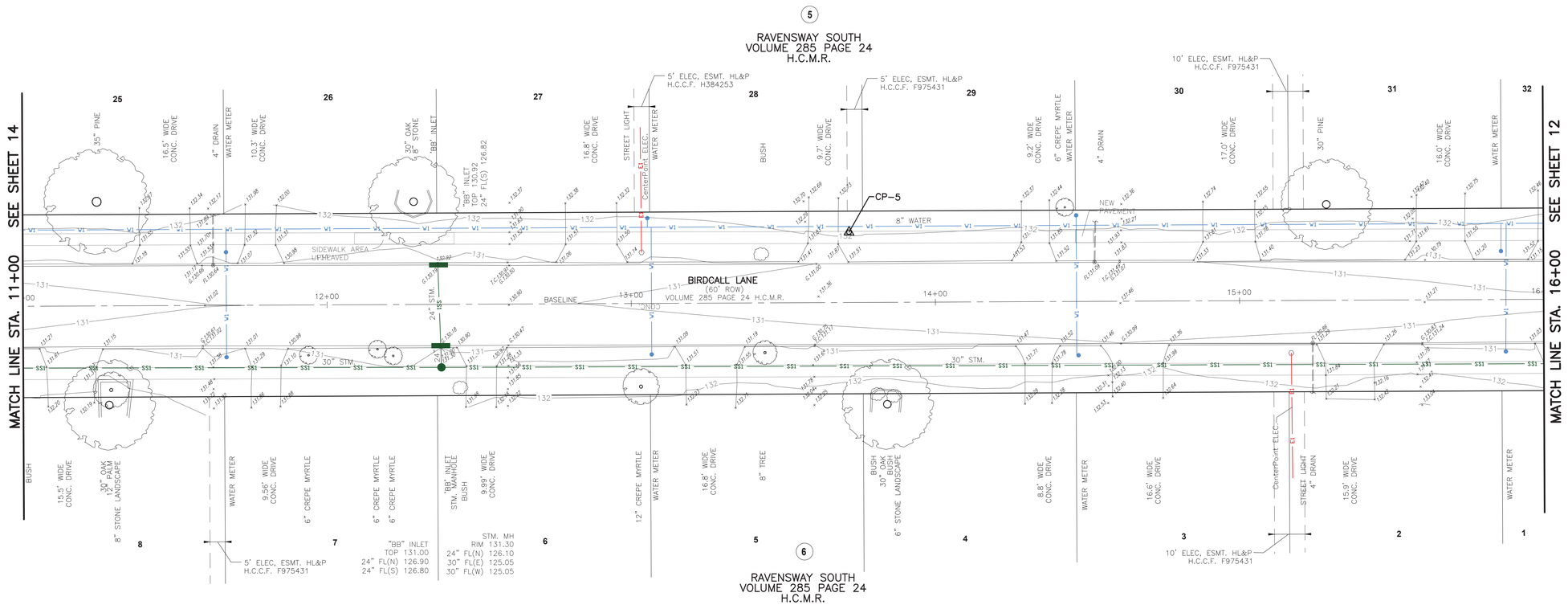
UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

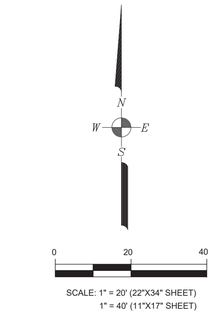
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE				
POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-5	13,910,275.52	3,037,704.59	132.02	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**BIRDCALL LANE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 13 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

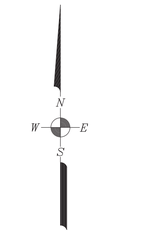
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-4	13,910,264.57	3,037,354.18	131.85	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



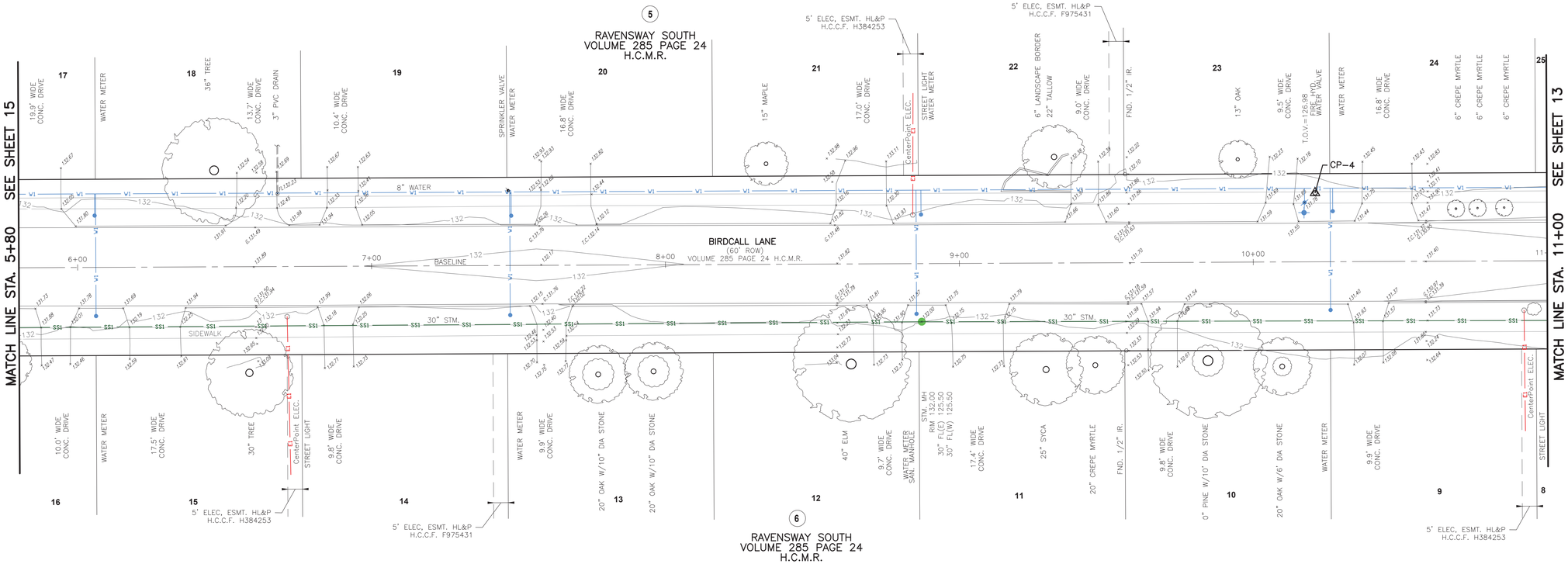
SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV088), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00). ELEV= 133.38 (NAV088, GEOID12B)





THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION		
	DRAINAGE IMPROVEMENT PROJECT		CIVIL STANDARD
SHEET DESCRIPTION:	BIRDCALL LANE		
DRAWN BY:	UPIN 19103MF14701	DATE:	
CK'D BY:	SCALE:	SHEET NO:	14 / 29

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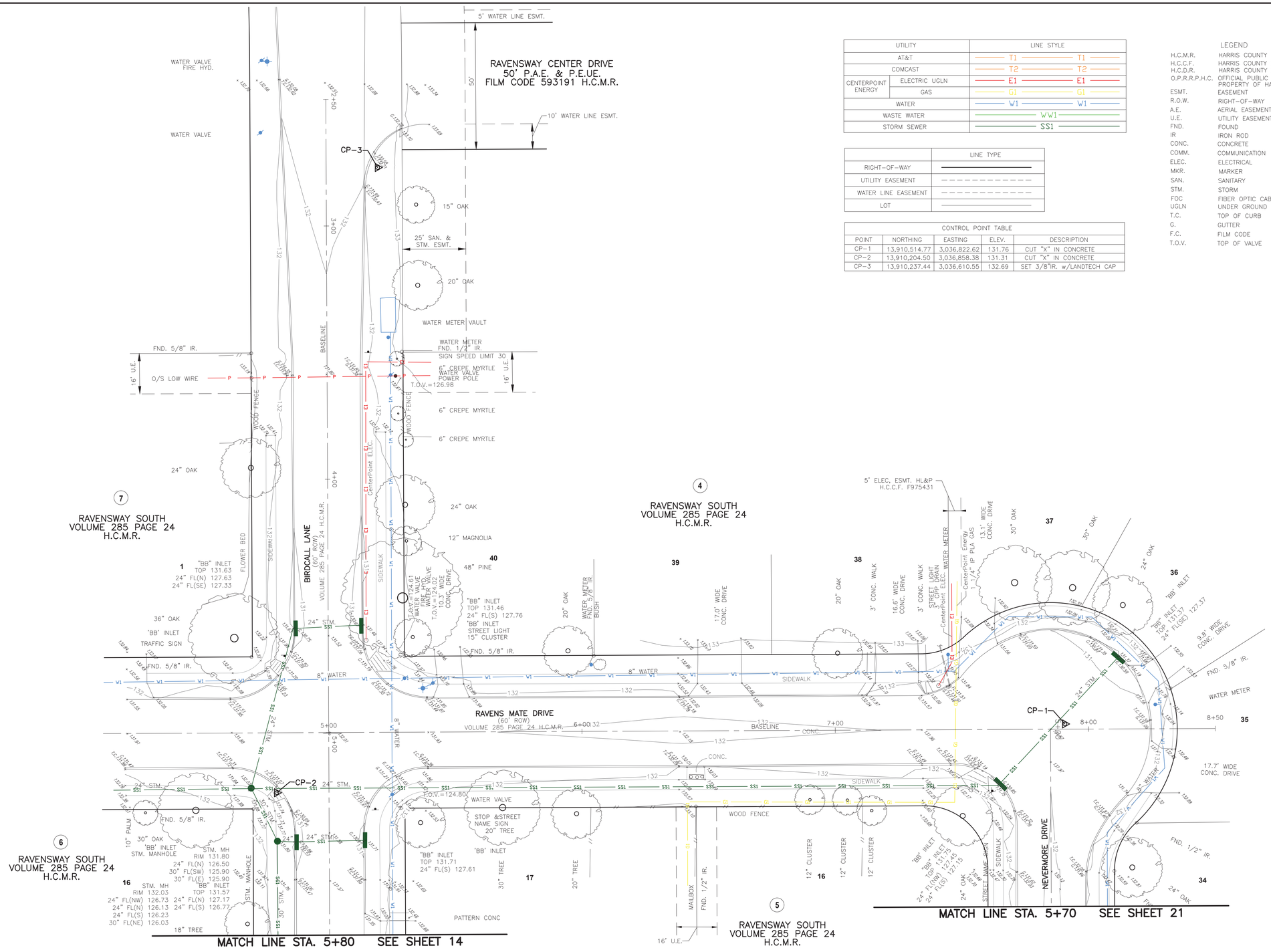

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-1	13,910,514.77	3,036,822.62	131.76	CUT "X" IN CONCRETE
CP-2	13,910,204.50	3,036,858.38	131.31	CUT "X" IN CONCRETE
CP-3	13,910,237.44	3,036,610.55	132.69	SET 3/8"IR. w/LANDTECH CAP

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION
	DRAINAGE IMPROVEMENT PROJECT
SHEET DESCRIPTION:	RAVENS MATE DRIVE & BIRDCALL LANE
DRAWN BY:	UPIN 19103MF14701
CK'D BY:	SCALE:

CIVIL STANDARD

DATE:

SHEET NO: 15 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

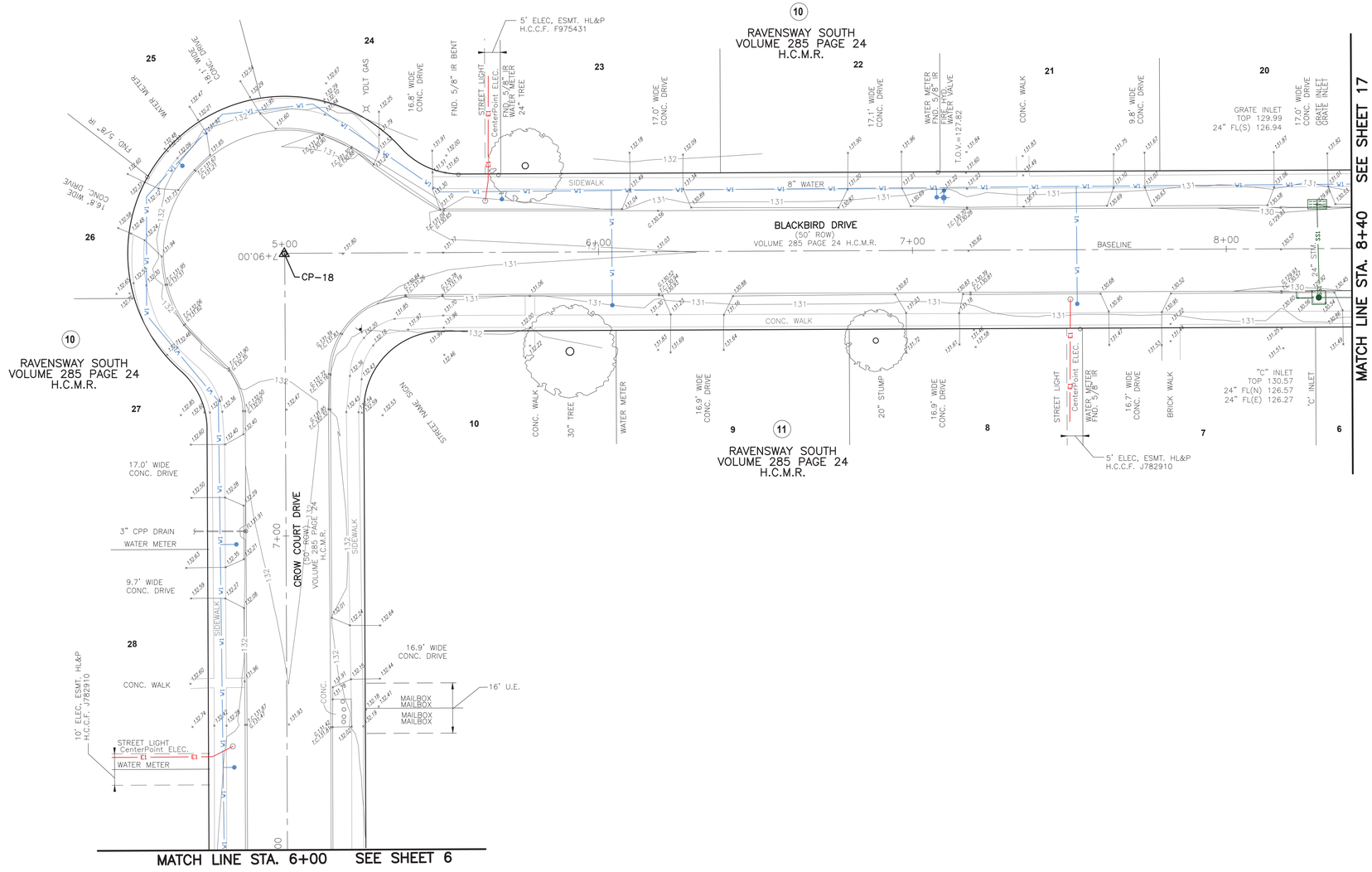
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

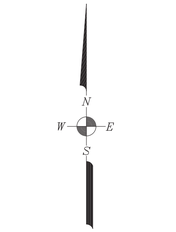
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-18	13,909,071.61	3,037,9236.38	132.45	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**BLACKBIRD DRIVE & CROW COURT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 16 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

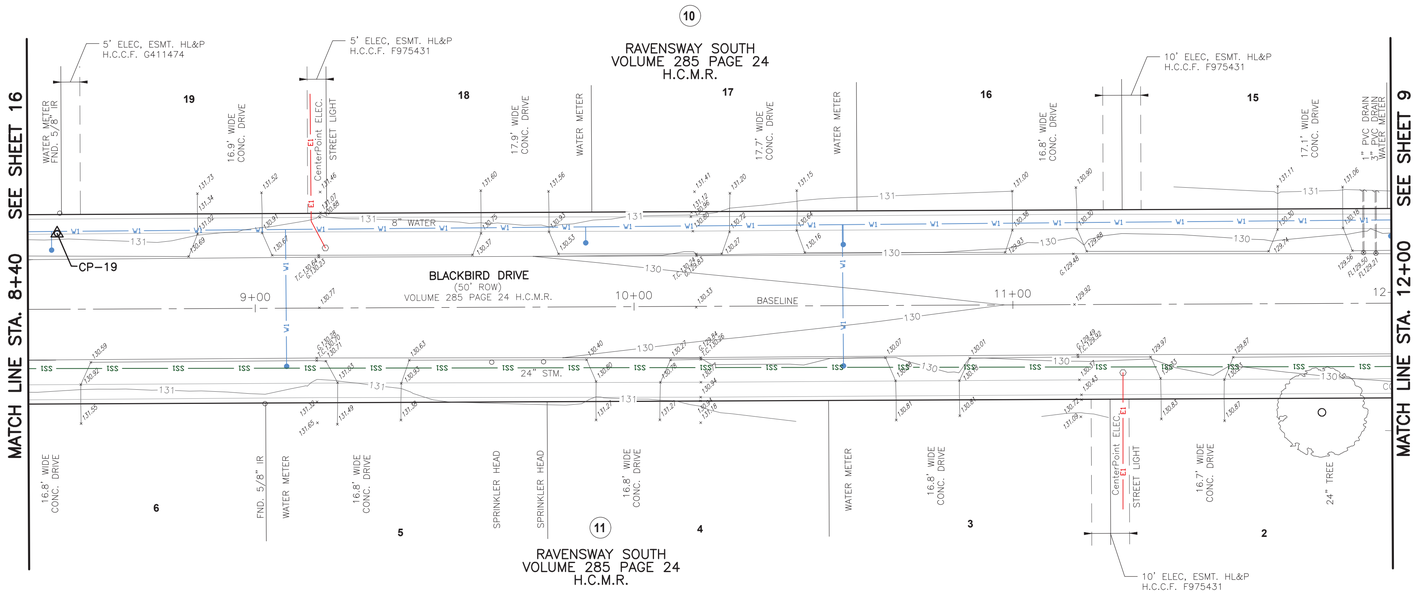
	LINE TYPE
RIGHT-OF-WAY	———
UTILITY EASEMENT	– – – – – –
WATER LINE EASEMENT	– – – – – –
LOT	———

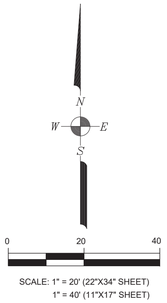
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-19	13,909,102.94	3,037,583.47	131.36	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**BLACKBIRD DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 17 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 — T1
COMCAST		T2 — T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 — E1
	GAS	G1 — G1
WATER		W1 — W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	———
UTILITY EASEMENT	– – – – – –
WATER LINE EASEMENT	– – – – – –
LOT	———

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-21	13,909,661.06	3,037,216.83	131.56	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

N
W E
S

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

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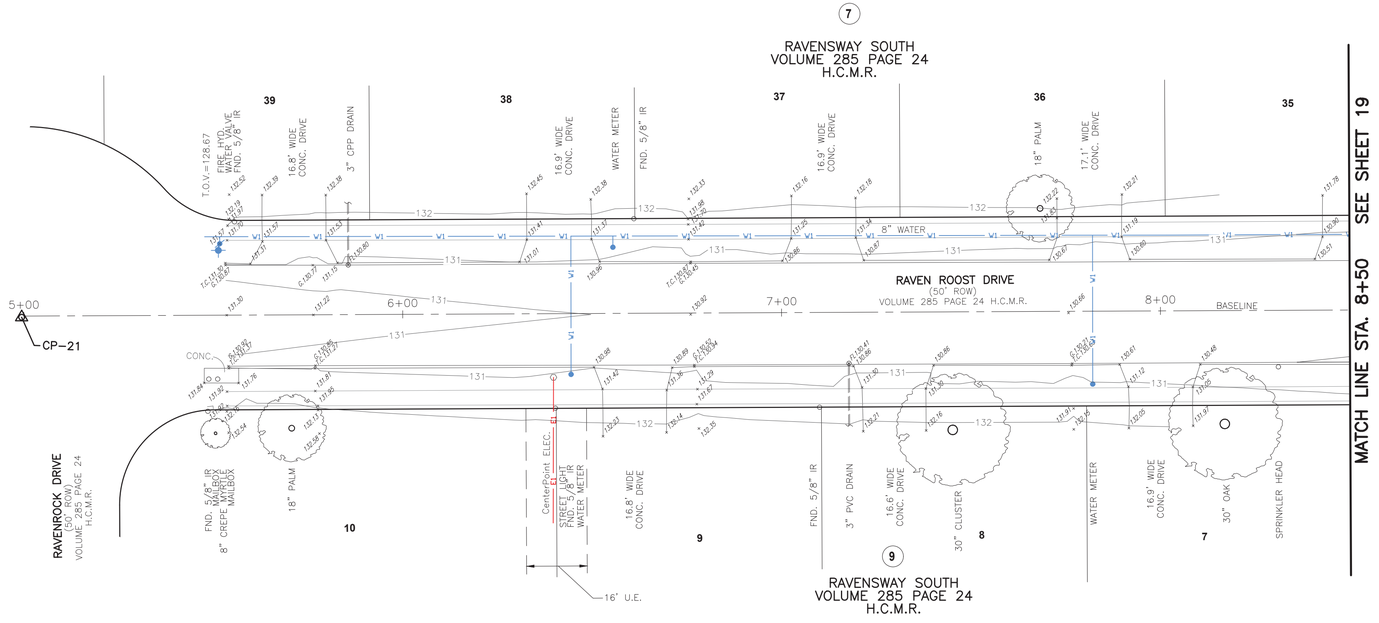
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)





THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVEN ROOST DRIVE & RAVENROCK DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 18 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

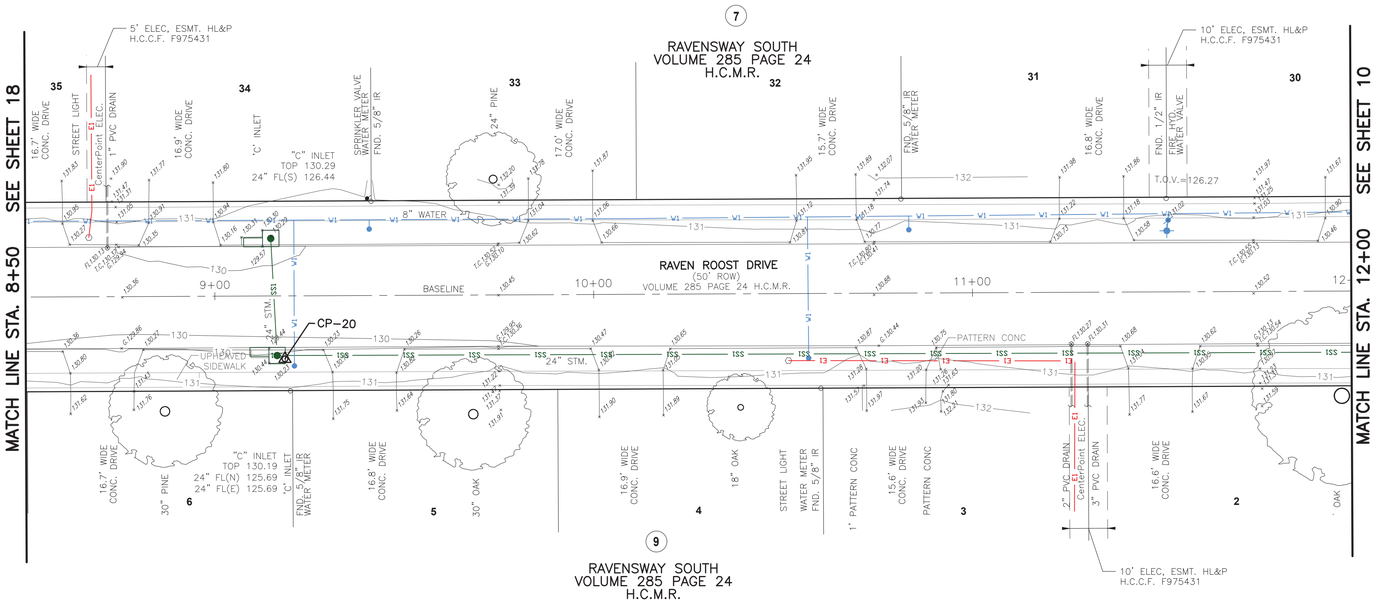
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

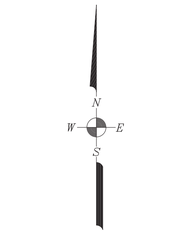
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-20	13,909,658.27	3,037,636.18	130.22	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
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2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION		
	DRAINAGE IMPROVEMENT PROJECT		CIVIL STANDARD
SHEET DESCRIPTION:	**RAVEN ROOST DRIVE**		
DRAWN BY:	UPIN 19103MF14701		DATE:
CK'D BY:	SCALE:		SHEET NO: 19 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

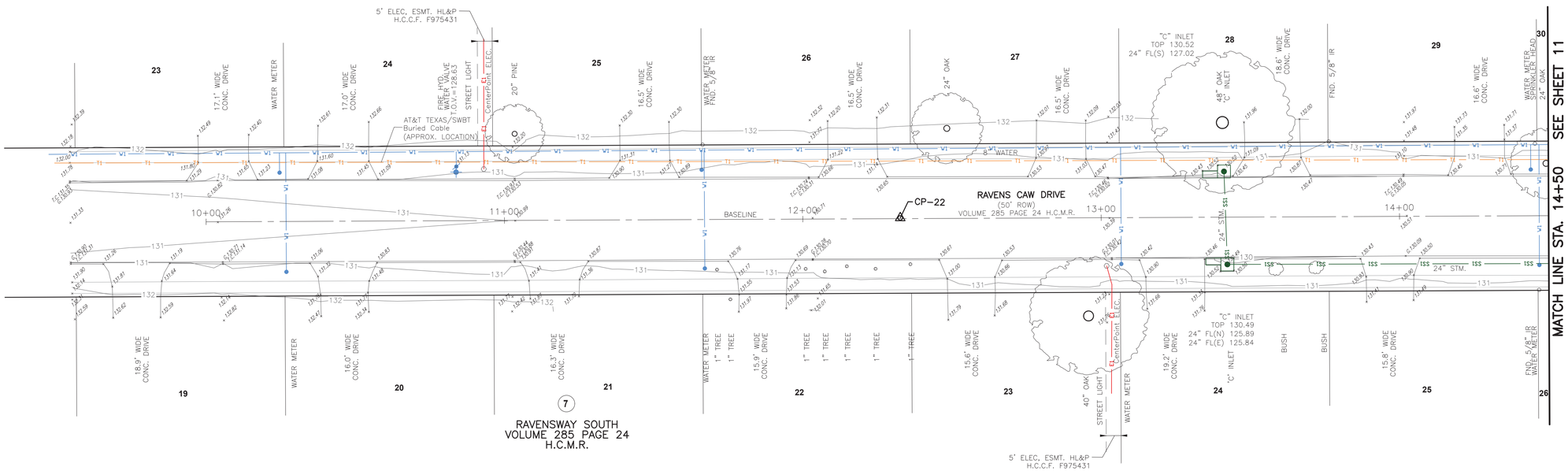
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

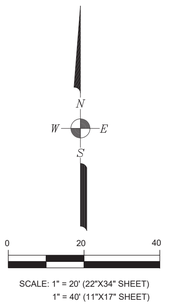
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-22	13,909,963.36	3,037,575.55	130.66	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.
3			
4			
5			

HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVENS CAW DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 20 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

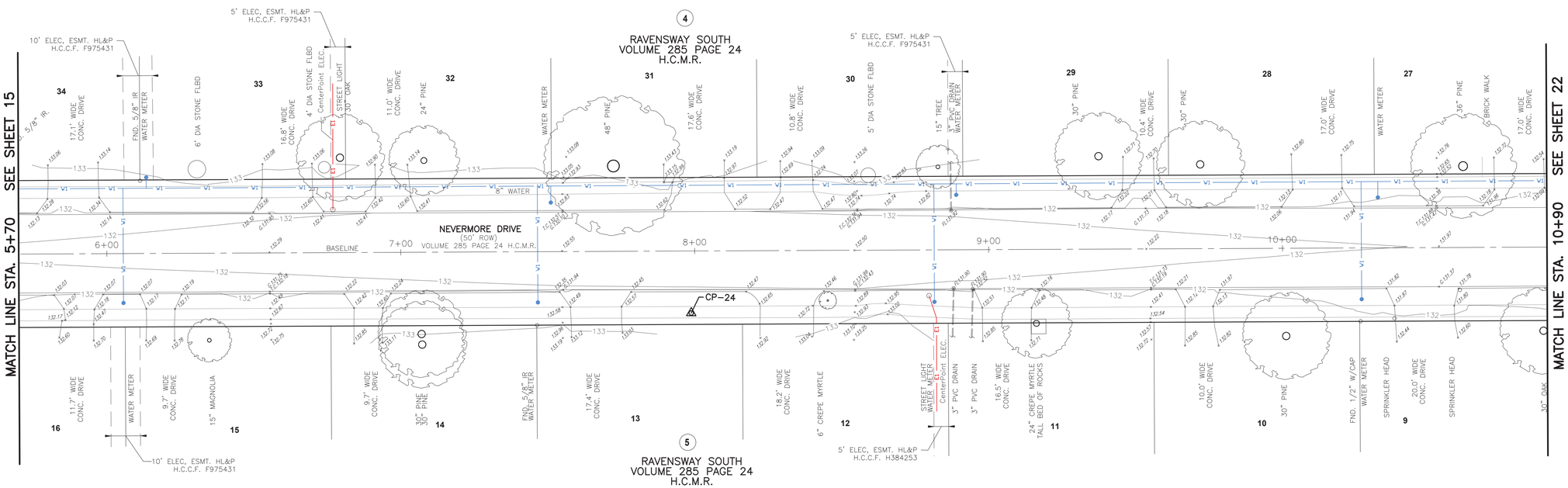
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

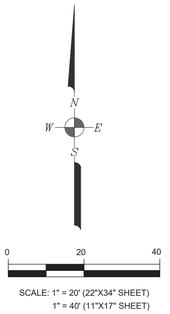
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-24	13,910,497.70	3,037,124.15	132.89	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00). ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

HARRIS COUNTY 1836 TEXAS

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**NEVERMORE DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 21 / 29

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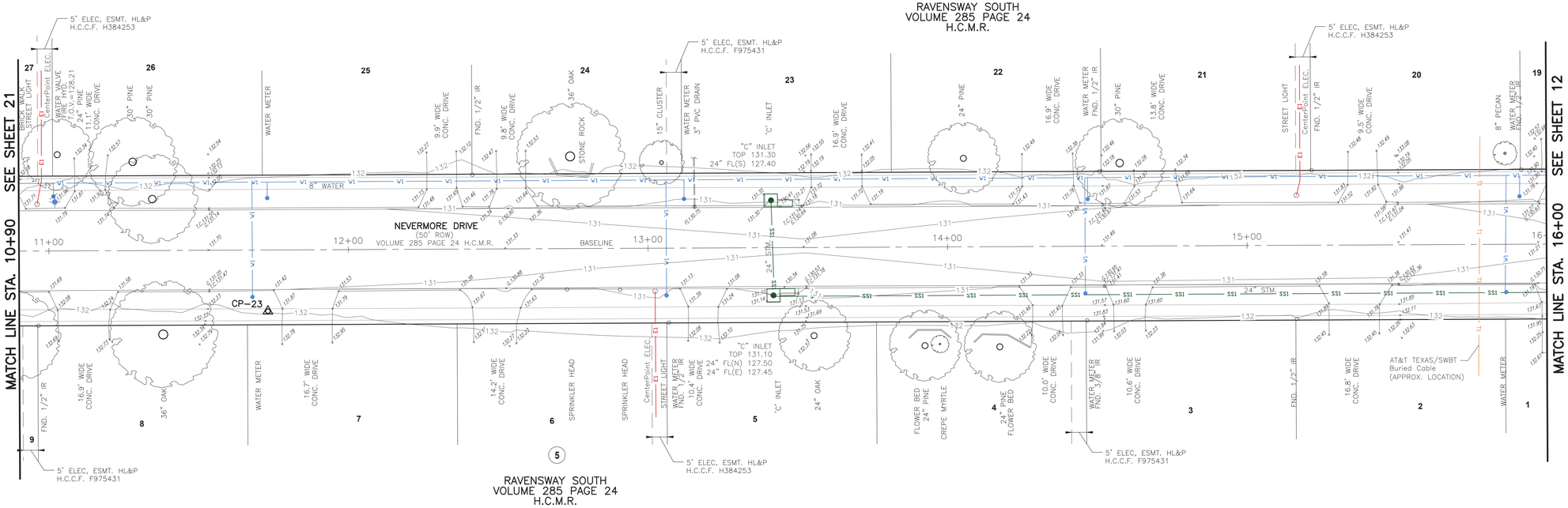
UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

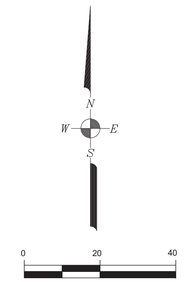
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE				
POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-23	13,910,510.44	3,037,498.21	132.00	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

1. BEARINGS REFER TO TEXAS COORDINATE SYSTEM OF 1983, SOUTH CENTRAL ZONE.
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

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HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**NEVERMORE DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 22 / 29

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UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-29	13,910,788.67	3,036,344.29	131.92	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

N
W E
S

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

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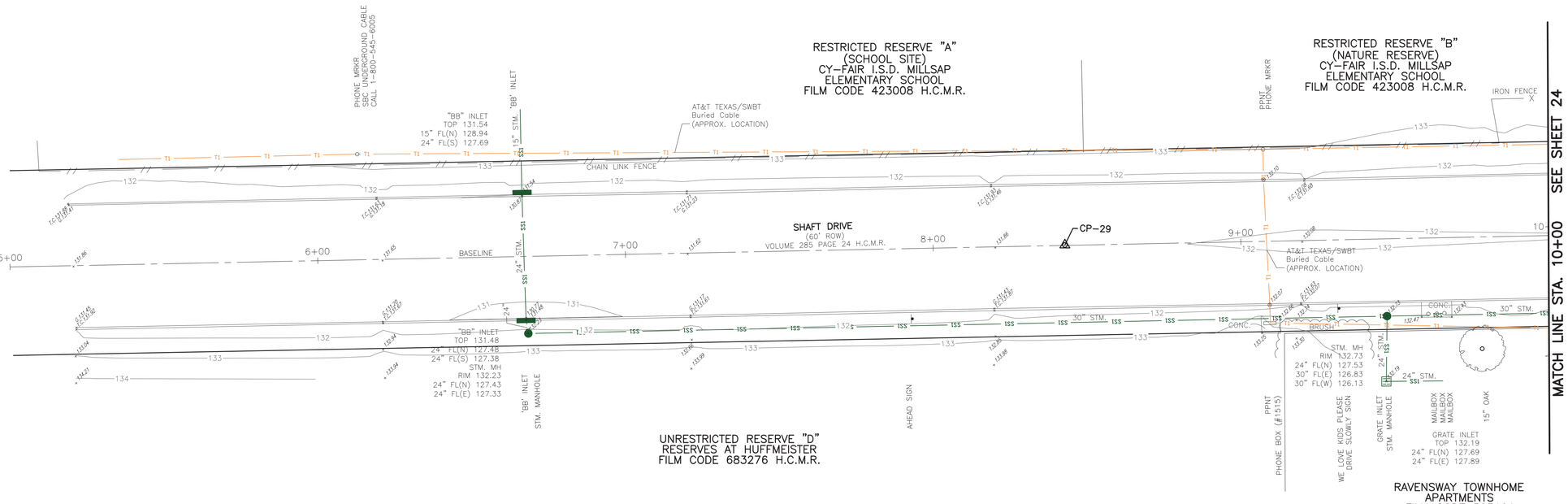
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV088), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00). ELEV= 133.38 (NAV088, GEOID12B)



STATE OF TEXAS
REGISTERED TO
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**SHAFT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 23 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

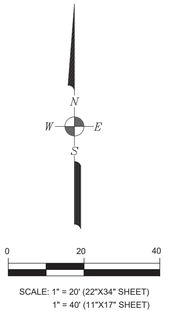
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-28	13,910,811.53	3,036,815.00	131.45	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

NOTES:

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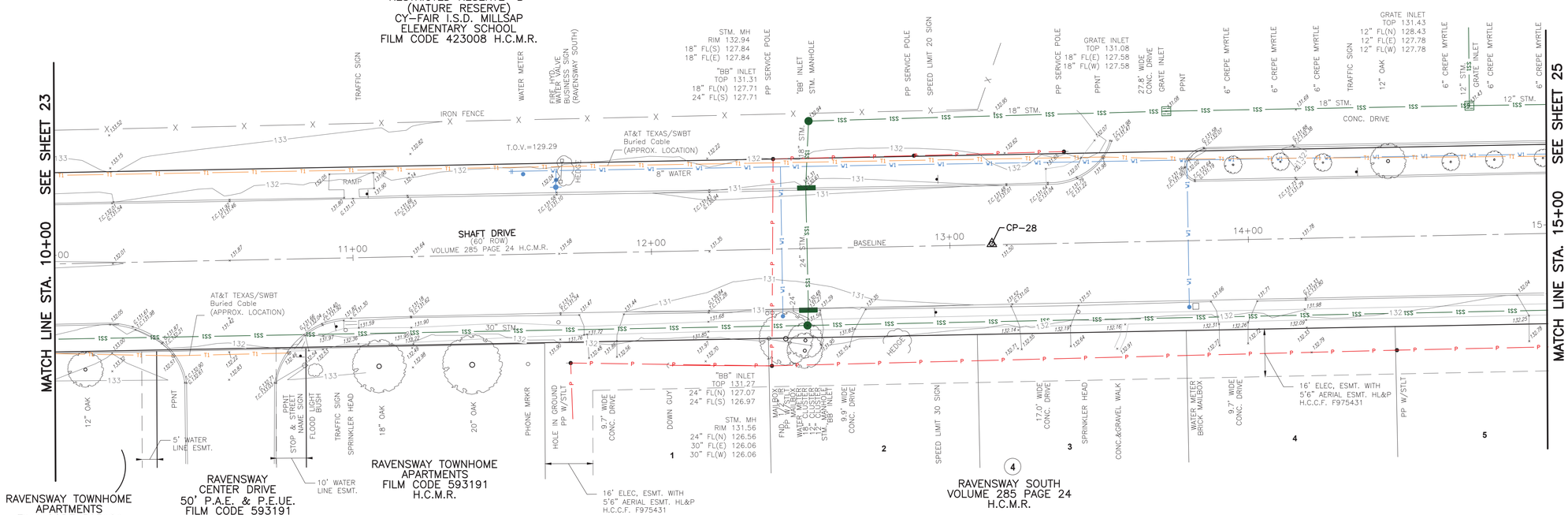
2. COORDINATES AND DISTANCES ARE SURFACE VALUES IN US SURVEY FOOT, AND MAY BE CONVERTED TO GRID VALUES BY MULTIPLYING BY A COMBINED ADJUSTMENT FACTOR OF 0.99991886
3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00).
ELEV= 133.38 (NAVD88, GEOID12B)

RESTRICTED RESERVE "B"
(NATURE RESERVE)
CY-FAIR I.S.D. MILLSAP
ELEMENTARY SCHOOL
FILM CODE 423008 H.C.M.R.



STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
1	ADD RAVEN FLIGHT FROM RAVEN SOUTH DR TO PROPOSED INLET, ETC.	1/13/22	R.F.
2	ADD CONTROL POINT SWING TIES (2 SHEETS)	1/26/22	R.F.

HARRIS COUNTY ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**SHAFT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 24 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

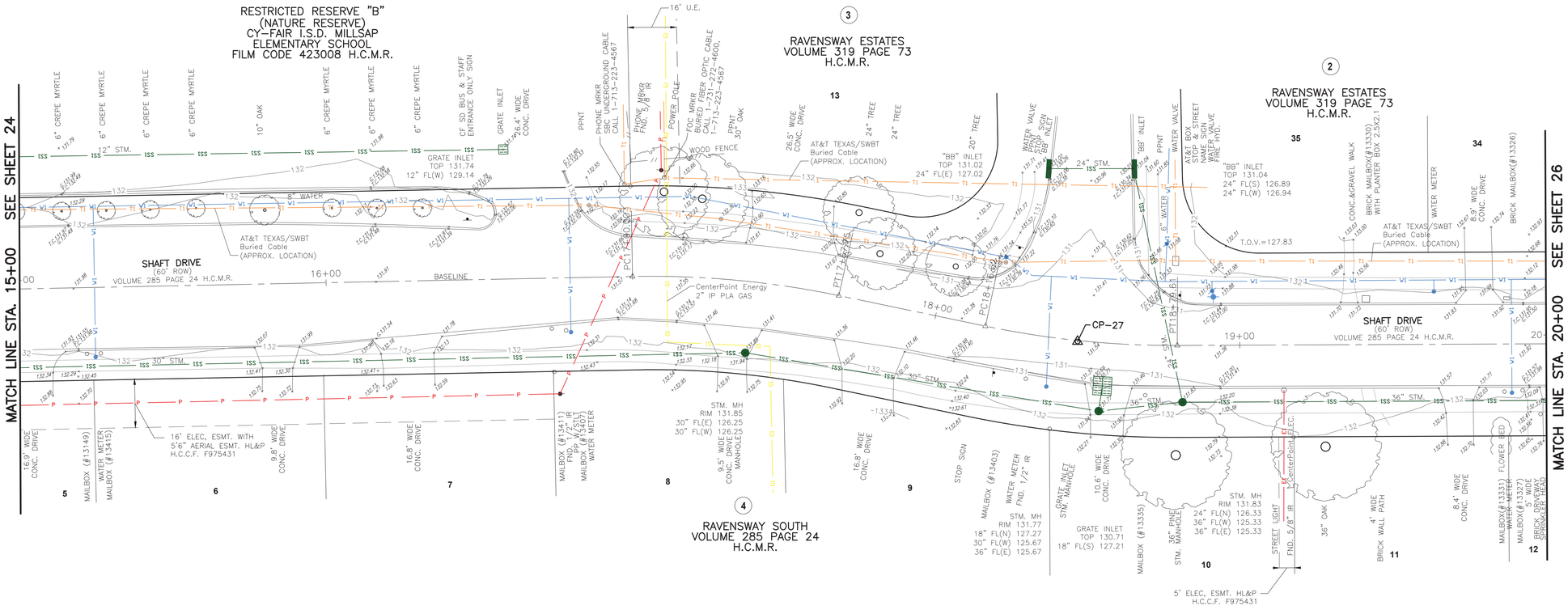
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-27	13,910,812.60	3,037,346.21	131.50	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE



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3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00).
ELEV= 133.38 (NAVD88, GEOID12B)

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
1" = 40' (11"X17" SHEET)

STATE OF TEXAS
REGISTERED
PAUL P. KWAN
4313
PROFESSIONAL
LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

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HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**SHAFT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 25 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

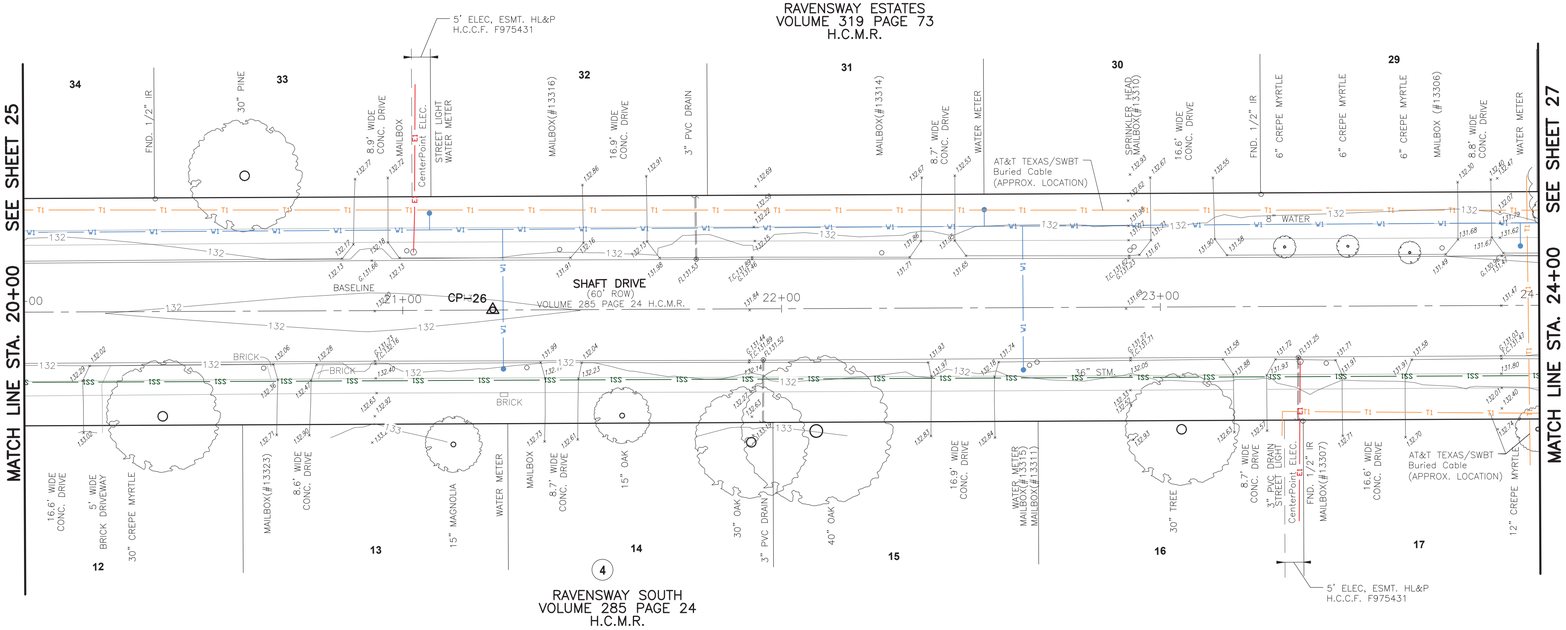
	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

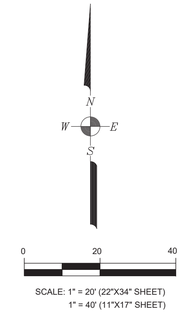
CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-26	13,910,820.13	3,037,622.79	132.08	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





SCALE: 1" = 20' (22"X34" SHEET)
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NOTES:

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3. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), GEOID12B.
4. FIELD SURVEY COMPLETED IN AUGUST 2021.

PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)

STATE OF TEXAS REGISTERED PAUL P. KWAN 4313 PROFESSIONAL LAND SURVEYOR

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**SHAFT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 26 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 T1
COMCAST		T2 T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 E1
	GAS	G1 G1
WATER		W1 W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	
UTILITY EASEMENT	
WATER LINE EASEMENT	
LOT	

CONTROL POINT TABLE

POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
CP-25	13,910,832.23	3,038,006.33	131.70	SET COTTON SPINDLE
CP-30	13,911,091.97	3,037,978.73	131.66	CUT "X" IN CONCRETE

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
H.C.D.R.	HARRIS COUNTY DEED RECORDS
O.P.R.R.P.H.C.	OFFICIAL PUBLIC RECORDS OF REAL PROPERTY OF HARRIS COUNTY
ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
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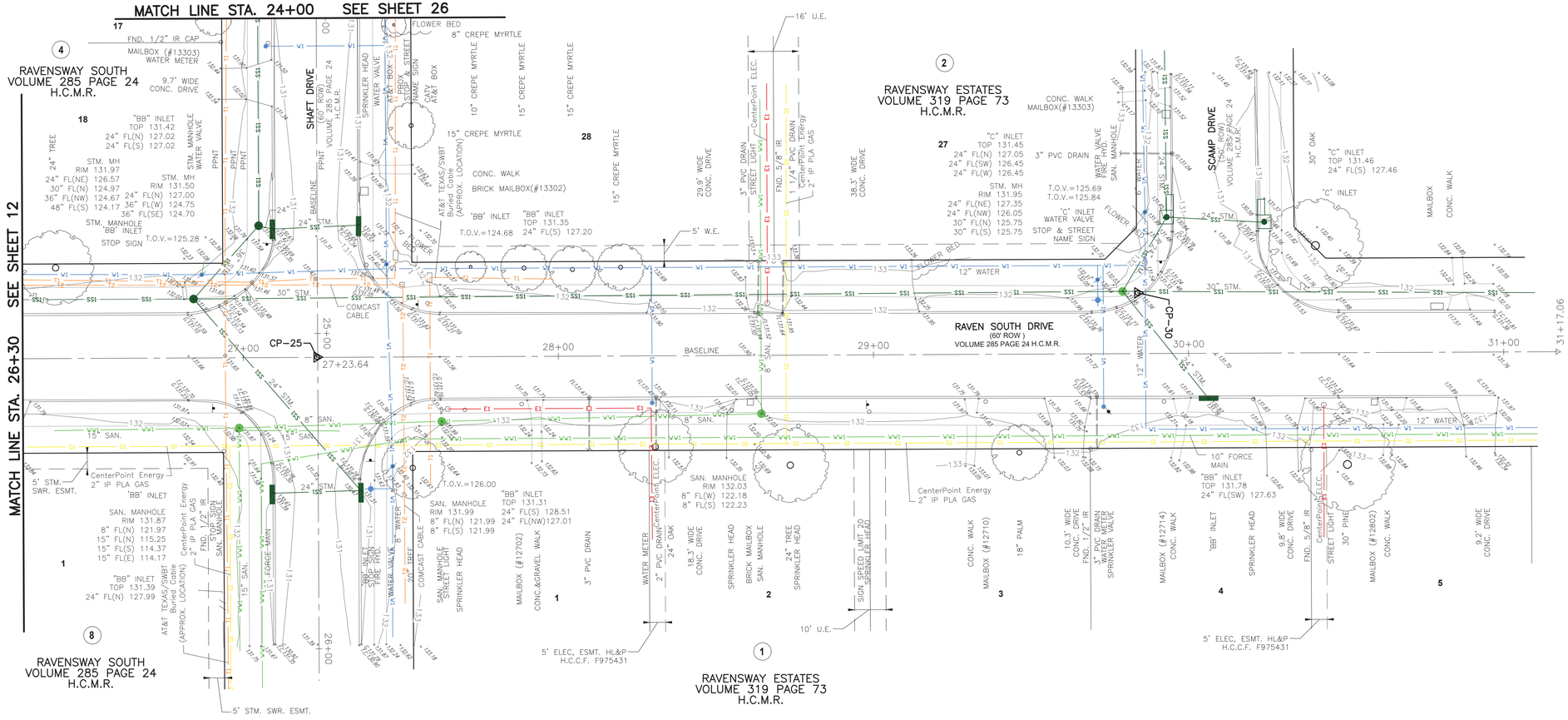



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HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**SHAFT DRIVE & RAVEN SOUTH DRIVE SCAMP DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 27 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 — T1
COMCAST		T2 — T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 — E1
	GAS	G1 — G1
WATER		W1 — W1
WASTE WATER		WW1
STORM SEWER		SS1

	LINE TYPE
RIGHT-OF-WAY	———
UTILITY EASEMENT	– – – – – –
WATER LINE EASEMENT	– – – – – –
LOT	———

LEGEND

H.C.M.R.	HARRIS COUNTY MAP RECORDS
H.C.C.F.	HARRIS COUNTY CLERK'S FILE
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ESMT.	EASEMENT
R.O.W.	RIGHT-OF-WAY
A.E.	AERIAL EASEMENT
U.E.	UTILITY EASEMENT
FND.	FOUND
IR	IRON ROD
CONC.	CONCRETE
COMM.	COMMUNICATION
ELEC.	ELECTRICAL
MKR.	MARKER
SAN.	SANITARY
STM.	STORM
FOC	FIBER OPTIC CABLE
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE

N
W E
S

0 20 40

SCALE: 1" = 20' (22"X34" SHEET)
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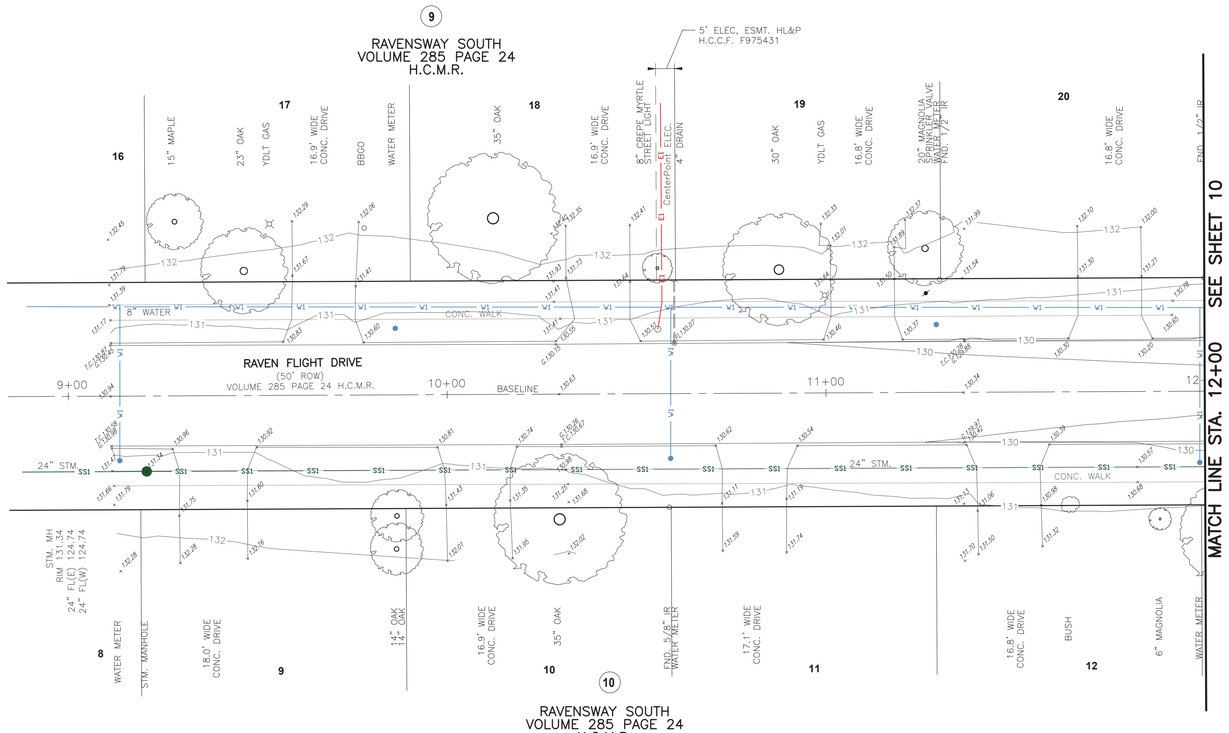
PROJECT BENCHMARK:

HARRIS COUNTY FLOODPLAIN DISTRICT REFERENCE MARK 110135: FOUND BRASS DISK STAMPED "110135 RESET 2012" IN CONCRETE SIDEWALK AT NORTHEAST CORNER OF A BRIDGE ON HUFFMEISTER ROAD OVER CYPRESS CREEK (H.C.F.C.D. UNITK100-00-00), ELEV= 133.38 (NAVD88, GEOID12B)



RAVENSWAY SOUTH
VOLUME 285 PAGE 24
H.C.M.R.

THIS SURVEY COMPLIES WITH THE TEXAS SOCIETY OF PROFESSIONAL SURVEYORS STANDARDS AND SPECIFICATIONS FOR A CATEGORY 6, CONDITION II TOPOGRAPHIC SURVEY AND A CATEGORY 1B, CONDITION II RIGHT OF WAY SURVEY.

Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

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HARRIS COUNTY
ENGINEERING DEPARTMENT

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVEN FLIGHT DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 28 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

UTILITY		LINE STYLE
AT&T		T1 — T1
COMCAST		T2 — T2
CENTERPOINT ENERGY	ELECTRIC UGLN	E1 — E1
	GAS	G1 — G1
WATER		W1 — W1
WASTE WATER		WW1 — WW1
STORM SEWER		SS1 — SS1

	LINE TYPE
RIGHT-OF-WAY	———
UTILITY EASEMENT	– – – – – –
WATER LINE EASEMENT	– – – – – –
LOT	———

LEGEND

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A.E.	AERIAL EASEMENT
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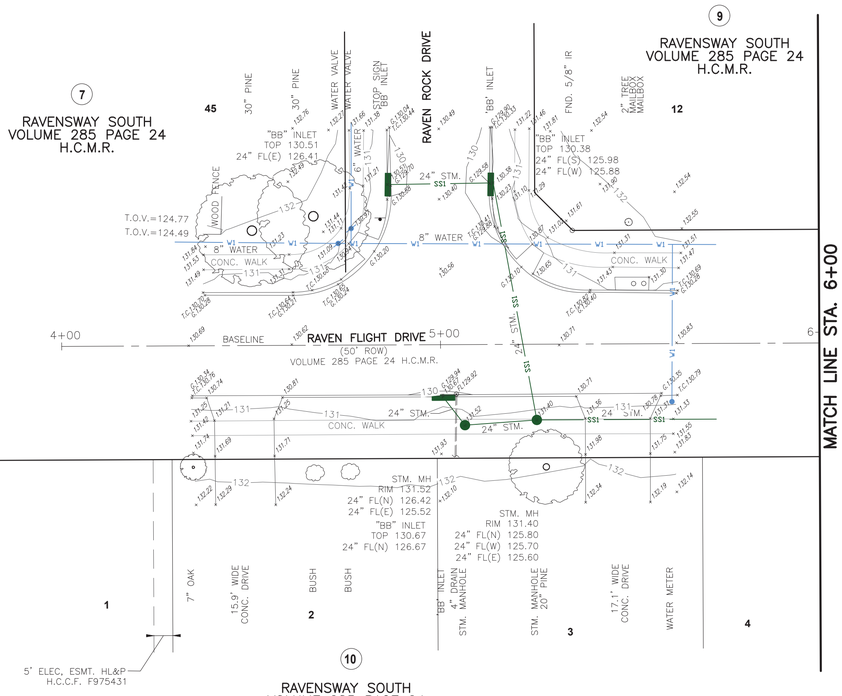
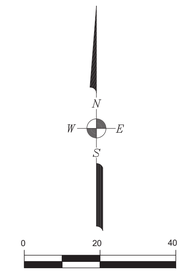
UGLN	UNDER GROUND LINE
T.C.	TOP OF CURB
G.	GUTTER
F.C.	FILM CODE
T.O.V.	TOP OF VALVE





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PROJECT BENCHMARK:

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Paul Kwan 1/26/22

PAUL KWAN, R.P.L.S. NO. 4313

NO.	REVISIONS	DATE	NAME
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HARRIS COUNTY
ENGINEERING DEPARTMENT

HARRIS COUNTY TEXAS 1836

LANDTECH
2525 North Loop West, Suite 300,
Houston, Texas 77008
T: 713-861-7068 F: 713-861-4131
TBPELS Registration No. 10019100

PROJECT TITLE:	RAVENSWAY SOUTH SUBDIVISION	
	DRAINAGE IMPROVEMENT PROJECT	CIVIL STANDARD
SHEET DESCRIPTION:	**RAVEN FLIGHT DRIVE & RAVEN ROCK DRIVE**	
DRAWN BY:	UPIN 19103MF14701	DATE:
CK'D BY:	SCALE:	SHEET NO: 29 / 29

S:\2021\2120088 Ravensway South\CADD\Ravensway South TOPO Survey.dwg

EXHIBIT 4.8
UTILITY CONFLICT TABLES

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment? Yes/No	Conflict Yes/No	Probed Yes/No	SUE Yes/No	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
1	6+54	6+86	LT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer and Pavement Removal	TBD	TBD	TBD
2	6+54	6+86	LT	8" Sanitary Sewer	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer and Pavement Removal	TBD	TBD	TBD
3	6+54	6+86	LT	Underground Cable	Comcast	No	Yes	No	No	Cory Thomas		832-317-2849	cthoma014@cable.comcast.com	Conflicts with Proposed Storm Sewer and Pavement Removal	TBD	TBD	TBD
4	6+78		RT	2" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		2" Gas encroaches proposed pavement and installation of proposed manhole	TBD	TBD	TBD
5	6+78		RT	12" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10376 Stella Link Road Houston, TX 77025	713-942-2699	glg@as-engineers.com	12" Water line potentially in conflict with proposed manhole	TBD	TBD	TBD
6	12+81	15+44	RT	12" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	12" Water line potentially in conflict with proposed storm line	TBD	TBD	TBD
7	12+81	15+44	RT	2" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		2" Gas potentially in conflict with proposed storm line	TBD	TBD	TBD
8	13+03		RT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10378 Stella Link Road Houston, TX 77025	713-942-2701	glg@as-engineers.com	8" Water line potentially in conflict with proposed storm line	TBD	TBD	TBD
9	13+38		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10378 Stella Link Road Houston, TX 77025	713-942-2701	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
10	14+23		RT	1-1/4" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		1-1/4" Gas potentially in conflict with proposed storm line	TBD	TBD	TBD
11	14+70		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10378 Stella Link Road Houston, TX 77025	713-942-2701	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
12	14+73	28+00	RT,LT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701

13	15+73	17+32	RT,LT	Underground Cable	Comcast	No	Yes	No	No	Cory Thomas		832-317-2849	cthoma014@cable.comcast.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
14	15+78		RT	8" Sanitary Sewer	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
15	15+99		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
16	16+00	29+82	LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10378 Stella Link Road Houston, TX 77025	713-942-2701	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
17	16+24	17+18	LT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
18	16+24		LT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer Manhole	TBD	TBD	TBD
19	17+17		LT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
20	17+20		LT	8" Sanitary Sewer	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
21	17+21		LT	8" Sanitary Sewer	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
22	17+27		LT	2" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		2" Gas potentially in conflict with proposed storm line	TBD	TBD	TBD
23	17+62		LT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
24	18+35		LT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
25	19+04		LT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
26	20+02		LT	2" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		2" Gas potentially in conflict with proposed storm line	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021

Project Limits: Ravensway South Subdivision

UPIN No. 19103MF14701

27	20+06		LT	8" Sanitary Sewer	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021

Project Limits: Ravensway South Subdivision

UPIN No. 19103MF14701

Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment? Yes/No	Conflict Yes/No	Probed Yes/No	SUE Yes/No	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								
1	1+60		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Potentially in conflict with proposed storm inlet	TBD	TBD	TBD
2	2+50		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
3	2+50		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
4	2+52		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
5	7+62		RT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter and hydrant potentially in conflict with proposed storm inlet	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easement?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								
1	7+52		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Potentially in conflict with proposed storm inlet	TBD	TBD	TBD
2	7+82		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
3	9+21		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								
1	10+84		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter and hydrant potentially in conflict with proposed storm sewer	TBD	TBD	TBD
1	10+70		LT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Potential Conflict with Proposed Storm Inlet	TBD	TBD	TBD
2	10+70		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter and hydrant potentially in conflict with proposed storm inlet	TBD	TBD	TBD
3	11+67		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
4	13+02		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Michael Brower	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-845-6654	txmaprequest@CenterPoint energy.com michael.brower@CenterPointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
5	13+02		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
6	13+07		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								
1	6+06		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
2	6+71		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
3	6+71		LT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
4	7+47		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
5	8+85		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
6	9+96		LT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Potentially in conflict with proposed storm inlet	TBD	TBD	TBD
7	10+27		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
8	10+92		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
9	10+92		LT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
10	11+67		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
11	13+07		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
12	14+46		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
13	15+16		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021

Project Limits: Ravensway South Subdivision

UPIN No. 19103MF14701

14	15+16		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
15	15+87		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment? Yes/No	Conflict Yes/No	Probed Yes/No	SUE Yes/No	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
1	13+06		RT	8" Water	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Potential Conflict with Proposed Storm Inlet	TBD	TBD	TBD
2	13+02		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
3	13+02		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
4	13+06		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701
Consultant Name/Project Mgr: BBI/Tommy V. Cromer, P.E.

No.	Beginning Station	End Station	Offset	Utility Type	Owner	Is facility located in an easment?	Conflict	Probed	SUE	Contact Name	Address	Phone No.	Email	Describe Conflict (if applicable)	Est. Cost	Reloc. Start Date	Reloc. Com. Date
						Yes/No	Yes/No	Yes/No	Yes/No								
1	9+09	10+78	RT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
2	12+44		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
3	13+80		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
4	15+24		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
5	16+76	16+88	RT	Overhead Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Overhead lines and power pole may have a potential conflict on Proposed Storm Sewer	TBD	TBD	TBD
6	16+80		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
7	17+11	17+48	RT	2" IP PLA Gas	CenterPoint Energy Gas	No	Yes	No	No	Utility Coordinating Committee		800-545-6005		2" Gas potentially in conflict with proposed storm line	TBD	TBD	TBD
8	18+39		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
9	19+14		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Existing Power pole and utilities potentially in conflict with Proposed Storm Sewer	TBD	TBD	TBD
10	19+14		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
11	19+89		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
12	21+26		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD
13	21+95		RT	Storm	Timberlake Improvement District (Local Home Owner)	No	Yes	No	No					Existing Yard drain is in conflict with Proposed Storm sewer	TBD	TBD	TBD
14	22+64		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

Utility Contact/Conflict Table

Project Name: Ravensway South Subdivision Drainage Improvements -2021
Project Limits: Ravensway South Subdivision
UPIN No. 19103MF14701

15	23+32	24+85	RT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
16	23+36		RT	Storm	Timberlake Improvement District (Local Home Owner)	No	Yes	No	No					Existing Yard drain is in conflict with Proposed Storm sewer	TBD	TBD	TBD
17	23+32	25+10	RT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
18	23+37		RT	Underground Electric	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Existing Power pole and utilities potentially in conflict with Proposed Storm Sewer	TBD	TBD	TBD
19	23+37		RT	Light Pole	CenterPoint Energy Electrical	No	Yes	No	No	Cynthia Martinez	1111 Louisiana St. CNPT-2278C Houston,TX 77002	713-207-6555	cindy.martinez@centerpointenergy.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
20	23+98		RT	Buried Cable	AT&T Texas	No	Yes	No	No	Christopher Carrasco		832-396-4217	cc1255@att.com	Conflicts with Proposed Storm Sewer	TBD	TBD	TBD
21	24+09		RT	Water Line Service Connection	Timberlake Improvement District	No	Yes	No	No	Gerald Gehman, PE	10377 Stella Link Road Houston, TX 77025	713-942-2700	glg@as-engineers.com	Water meter potentially in conflict with proposed storm sewer	TBD	TBD	TBD

EXHIBIT 4.9
CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE

Project: RAVENSWAY SOUTH SUB. DRAINAGE IMPROVEMENTS
Limit From: CYPRESS NORTH HOUSTON ROAD
Limit To: RAVENSWAY SOUTH SUBD.
Proj Length: 5,100'
Precinct: 3
UPIN: 19103MF14701
Job No: This is the number available when advertising project
Prepared By: Binkley & Barfield, Inc.
Date: 02/17/22

Summary of Estimate		
Stage:		Final
Total Amount for DRAINAGE:		$2,840,022.00
Total Amount for ROADWAY:		$698,985.00
Total Amount for XXX:		$0.00
Total Amount for XXX:		$0.00
Grant Total Amount:		$3,539,007.00
Contingencies:	0%	$0.00
Grand Total Project:		$3,539,007.00

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
A	SITE PREPARATION AND EARTHWORK					
1	Drawing	Project Sign	EA	2	$1,000.00	$2,000.00
2	102	Tree & Bush Removal (0" - 12" Dia.)	EA	12	$1,200.00	$14,400.00
3	501	Tree Protection, Including Pruning, Protection Fencing, Trimming of Roots, and all other appurtenances	LS	1	$10,000.00	$10,000.00
4	104	Remove & Dispose Old Concrete Roadway (All Thicknesses)	SY	1,750	$15.00	$26,250.00
5	104	Remove & Dispose Old Concrete Driveways (All Thicknesses)	SY	1,700	$20.00	$34,000.00
6	104	Remove & Dispose Old Concrete Sidewalks (All Thicknesses)	SY	2,300	$12.00	$27,600.00
7	104	Removing Old Concrete (Curb)	LF	1,600	$3.00	$4,800.00
8	110	Roadway Excavation Including 3" Topsoil	CY	425	$25.00	$10,625.00
9	465	Remove and Dispose of Existing Concrete or Metal Pipe (All Sizes)	LF	5,542	$15.00	$83,130.00
10	495	Removing Old Structures – Inlets & Manholes (All Depths, All Types)	EA	25	$800.00	$20,000.00
11	500	Remove & Relocate Traffic Signs and Roadway Signs	EA	16	$1,000.00	$16,000.00
12	561	Video Recording Construction	LS	1	$1,500.00	$1,500.00
					Subtotal of Item A	**$250,305.00**
B	PAVING					
13	500	Remove & Relocate Mail Boxes	LS	22	$1,200.00	$26,400.00
14	220	Prepare and Compact 6" Lime Stabilized Subgrade	SY	1,995	$7.00	$13,965.00
15	221	Hydrated Lime (Ty A) (Slurry)	TON	36	$220.00	$7,920.00
16	360	Concrete Pavement (6")	SY	1,750	$70.00	$122,500.00
17	530	Reinforced Concrete Curb (Doweled)	LF	1,600	$4.50	$7,200.00
18	530	Reinforced Concrete Driveways (6") - High Early Strength Concrete	SY	1,900	$140.00	$266,000.00
19	530	Concrete Sidewalks, Including Ramps (5' width, 4" thick)	SY	3,400	$75.00	$255,000.00
					Subtotal of Item B	**$698,985.00**
C	STORM SEWER					
20	429	Trench Safety System (5' to 10') [INCLUDES SHEET PILING AS REQ'D]	LF	6,386	$2.00	$12,772.00
21	429	Trench Safety System (10' to 15') [INCLUDES SHEET PILING AS REQ'D]	LF	388	$5.00	$1,940.00
22	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (24")	LF	1,384	$135.00	$186,840.00
23	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (30")	LF	306	$175.00	$53,550.00
24	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (36")	LF	839	$210.00	$176,190.00
25	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (42")	LF	349	$275.00	$95,975.00
26	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (48")	LF	2,208	$350.00	$772,800.00
27	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (66")	LF	1,718	$500.00	$859,000.00
28	471	Precast Concrete Standard Manhole (All Depths) 4' DIA	EA	8	$4,000.00	$32,000.00
29	471	Precast Concrete Standard Manhole (All Depths) 5' DIA	EA	14	$5,500.00	$77,000.00
30	471	Precast Concrete Standard Manhole (All Depths) 6' DIA	EA	2	$6,500.00	$13,000.00
31	471	Precast Concrete Standard Manhole (All Depths) 7' DIA	EA	1	$7,500.00	$7,500.00
32	471	Precast Concrete Standard Manhole (All Depths) 8' DIA	EA	4	$8,500.00	$34,000.00
33	471	Precast Concrete Standard Manhole (All Depths) 10' DIA	EA	3	$10,500.00	$31,500.00
34	472	Remove and Replace Plates with Grates on Existing Type B-B Inlets	EA	39	$400.00	$15,600.00

CONSTRUCTION COST ESTIMATE

Project: RAVENSWAY SOUTH SUB. DRAINAGE IMPROVEMENTS
Limit From: CYPRESS NORTH HOUSTON ROAD
Limit To: RAVENSWAY SOUTH SUBD.
Proj Length: 5,100'
Precinct: 3
UPIN: 19103MF14701
Job No: This is the number available when advertising project
Prepared By: Binkley & Barfield, Inc.
Date: 02/17/22

Summary of Estimate		
Stage:		Final
Total Amount for DRAINAGE:		$2,840,022.00
Total Amount for ROADWAY:		$698,985.00
Total Amount for XXX:		$0.00
Total Amount for XXX:		$0.00
Grant Total Amount:		$3,539,007.00
Contingencies:	0%	$0.00
Grand Total Project:		$3,539,007.00

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
35	472	Type C Curb Inlet (5')	EA	4	$5,500.00	$22,000.00
36	472	Type C-1 Curb Inlet (10')	EA	10	$7,000.00	$70,000.00
37	472	Type C-2 Curb Inlet (15')	EA	4	$8,500.00	$34,000.00
					Subtotal of Item C	**$2,495,667.00**
D	**TRAFFIC CONTROL PLAN**					
38	671	Traffic Control - Barricades, Barriers, Barrels, Cones, and Signing	MO	4	$8,500.00	$34,000.00
					Subtotal of Item D	**$34,000.00**
E	**SIGNING AND PAVEMENT MARKINGS**					
39	624	Aluminum Signs (Ground Mounted)- Furnish & Install	EA	2	$250.00	$500.00
					Subtotal of Item E	**$500.00**
F	**STORM WATER POLLUTION PREVENTION PLAN**					
40	162	Sodding for Erosion Control (Various Widths)	SY	750	$5.00	$3,750.00
41	719	Inlet Protection Barrier (Stage 1, With Fiber Rolls; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	EA	50	$100.00	$5,000.00
42	730	Concrete Truck Washout Structures (60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LS	1	$800.00	$800.00
43	751	SWPPP Inspection and Maintenance (Min. Bid - $6,000.)	MO	4	$6,000.00	$24,000.00
					Subtotal of Item F	**$33,550.00**
G	**** EXTRA WORK ITEMS**					
44	559	Construction Safety Fence	LF	500	$3.00	$1,500.00
45	672	Off-Duty Uniformed Peace Office - As Directed by Engineer (Min. Bid $45/HR)	HR	100	$45.00	$4,500.00
46	SS8006	Electrical Riser Relocation for Property Owner (Customer Owned) Connection to CenterPoint Energy Electrical Server; Single-Phase, 120 Volt, 3-Wire Electrical Service	LF	200	$50.00	$10,000.00
47	SS8006	Electrical Riser Relocation for Property Owner (Customer Owned) Connection to CenterPoint Energy Electrical Service; Three-Phase, (Commercial Customer) Electrical Service	LF	200	$50.00	$10,000.00
					Subtotal of Item G	**$26,000.00**

CONSTRUCTION COST ESTIMATE - Alt #2

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$5,507,335.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$5,507,335.00**
Contingencies:	**25%**	**$1,376,833.75**
Grand Total Project:		**$6,884,168.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
A	**SITE PREPARATION AND EARTHWORK**					
1	Drawing	Project Sign	EA	4.00	$1,000.00	$4,000.00
2	102	Clearing and Grubbing	AC	10.00	$3,000.00	$30,000.00
3	102	Tree Removal (0" - 12" Dia.)	EA	12.00	$1,200.00	$14,400.00
4	102	Tree Removal (12" - 24" Dia.)	EA	12.00	$1,800.00	$21,600.00
5	102	Tree Removal (24"+ Dia.)	EA	6.00	$2,000.00	$12,000.00
6	104	Removing Old Concrete (Pavement)	SY	4,500.00	$8.00	$36,000.00
7	104	Removing Old Concrete (Driveway)	SY	2,000.00	$20.00	$40,000.00
8	104	Removing Old Concrete (Sidewalk)	SY	2,300.00	$12.00	$27,600.00
9	104	Removing Old Concrete (Curb)	LF	1,600.00	$3.00	$4,800.00
10	110	Roadway Excavation Including 3" Topsoil	CY	675.00	$25.00	$16,875.00
11	465	Remove and Dispose of Existing Concrete or Metal Pipe (All Sizes)	LF	6,441.00	$15.00	$96,615.00
12	495	Removing Old Structures – Inlets (All Depths)	EA	25.00	$800.00	$20,000.00
13	500	Remove & Relocate Mail Boxes	LS	1.00	$4,000.00	$4,000.00
14	500	Remove & Relocate Traffic Signs and Roadway Signs	LS	1.00	$1,000.00	$1,000.00
15	500	Tree Protection	LS	1.00	$30,000.00	$30,000.00
16	561	Video Recording Construction	LS	1.00	$1,500.00	$1,500.00
					Subtotal of Item A	**$360,390.00**
B	**PAVING**					
17	220	Lime Stabilized Subgrade (6" Depth)	SY	3,300.00	$7.00	$23,100.00
18	221	Hydrated Lime (Ty A) (Slurry)	TON	80.00	$220.00	$17,600.00
19	360	Concrete Pavement (6")	SY	3,000.00	$70.00	$210,000.00
20	530	Reinforced Concrete Curb (6")	LF	5,000.00	$4.50	$22,500.00
	530	Reinforced Concrete Driveways (6") - High Early Strength Concrete	SY	2,000.00	$140.00	$280,000.00
1	530	Reinforced Concrete Sidewalks (4-1/2")	SY	3,000.00	$75.00	$225,000.00
2	530	Curb Ramp	SY	75.00	$70.00	$5,250.00
					Subtotal of Item B	**$783,450.00**
C	**STORM SEWER**					
3	429	Trench Safety System (5' to 10') [INCLUDES SHEET PILING AS REQ'D]	LF	5,070.00	$3.00	$15,210.00
4	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (24")	LF	1,060.00	$135.00	$143,100.00
5	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (30")	LF	820.00	$175.00	$143,500.00
6	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (36")	LF	1,314.00	$210.00	$275,940.00
7	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (42")	LF	2,495.00	$275.00	$686,125.00
8	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (48")	LF	625.00	$350.00	$218,750.00
9	471	Precast Concrete Standard Manhole (5 ft ≤ Depth ≤ 10 ft) on BC	EA	24.00	$8,000.00	$192,000.00
10	471	Precast Concrete Standard Manhole (All Depths)	EA	8.00	$5,000.00	$40,000.00
11	472	Remove and Replace with Grates on Existing Type B-B Inlets	EA	42.00	$400.00	$16,800.00
12	472	Type C-1 Inlet	EA	14.00	$7,000.00	$98,000.00
13	472	Type C-2 Inlet	EA	4.00	$8,500.00	$34,000.00
14	480	Precast RCB (10' x 6')	LF	2,300.00	$1,000.00	$2,300,000.00

CONSTRUCTION COST ESTIMATE - Alt #2

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$5,507,335.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$5,507,335.00**
Contingencies:	**25%**	**$1,376,833.75**
Grand Total Project:		**$6,884,168.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
					Subtotal of Item C	**$4,163,425.00**
D	**TRAFFIC CONTROL PLAN**					
15	671	Traffic Control - Barricades, Barriers, Barrels, Cones, and Signing	MO	12.00	$8,500.00	$102,000.00
16	673	Temporary Pipe Under Driveway for Installing-Maintaining and Removal	LF	200.00	$20.00	$4,000.00
					Subtotal of Item D	**$106,000.00**
E	**SIGNING AND PAVEMENT MARKINGS**					
17	624	Aluminum Signs (Ground Mounted)- Furnish & Install	EA	10.00	$250.00	$2,500.00
					Subtotal of Item E	**$2,500.00**
F	**STORM WATER POLLUTION PREVENTION PLAN**					
18	162	Sodding for Erosion Control (Various Widths)	SY	2,500.00	$4.00	$10,000.00
19	708	Filter Fabric Fence (60% of unit cost for furnish and installation and 40% of unit cost for removal)	LF	1,000.00	$1.20	$1,200.00
20	719	Inlet Protection Barrier (Stage 1, With Fiber Rolls; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	EA	12.00	$100.00	$1,200.00
21	724	Stabilized Construction Access (Type 1-Rock; 60% of unit cost for furnish and installation, and 40% of unit cost for removal))	SY	8.00	$15.00	$120.00
22	730	Concrete Truck Washout Structures (60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LS	1.00	$1,000.00	$1,000.00
23	750	Rock Filter Dam (Type 1; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LF	1.00	$50.00	$50.00
24	751	SWPPP Inspection and Maintenance (Min. Bid - $6,000.)	MO	12.00	$6,000.00	$72,000.00
					Subtotal of Item F	**$85,570.00**
G	**** EXTRA WORK ITEMS**					
25	559	Construction Safety Fence	LF	200.00	$3.00	$600.00
26	672	Off-Duty Uniformed Peace Office - As Directed by Engineer (Min. Bid $45/HR)	HR	120.00	$45.00	$5,400.00
					Subtotal of Item G	**$6,000.00**

CONSTRUCTION COST ESTIMATE - Alt #3

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$19,795,663.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$19,795,663.00**
Contingencies:	**25%**	**$4,948,915.75**
Grand Total Project:		**$24,744,578.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
A	**SITE PREPARATION AND EARTHWORK**					
1	Drawing	Project Sign	EA	1.00	$1,000.00	$1,000.00
2	102	Clearing and Grubbing	AC	10.00	$3,000.00	$30,000.00
3	102	Tree Removal (0" - 12" Dia.)	EA	12.00	$1,200.00	$14,400.00
4	102	Tree Removal (12" - 24" Dia.)	EA	12.00	$1,800.00	$21,600.00
5	102	Tree Removal (24"+ Dia.)	EA	6.00	$2,000.00	$12,000.00
6	104	Removing Old Concrete (Pavement)	SY	4,500.00	$8.00	$36,000.00
7	110	Roadway Excavation Including 3" Topsoil	CY	675.00	$10.00	$6,750.00
8	465	Remove and Dispose of Existing Concrete or Metal Pipe (All Sizes)	LF	6,441.00	$13.00	$83,733.00
9	495	Removing Old Structures – Inlets (All Depths)	EA	18.00	$1,000.00	$18,000.00
10	500	Remove & Relocate Mail Boxes	LS	1.00	$4,000.00	$4,000.00
11	500	Remove & Relocate Traffic Signs and Roadway Signs	LS	1.00	$4,000.00	$4,000.00
12	561	Video Recording Construction	LS	1.00	$1,500.00	$1,500.00
					Subtotal of Item A	**$232,983.00**
B	**PAVING**					
13	220	Lime Stabilized Subgrade (8" Depth)	SY	3,300.00	$3.00	$9,900.00
14	221	Hydrated Lime (Ty A) (Slurry)	TON	80.00	$190.00	$15,200.00
15	360	Concrete Pavement (7")	SY	3,000.00	$65.00	$195,000.00
16	530	Reinforced Concrete Curb (6")	LF	5,000.00	$2.00	$10,000.00
17	530	Reinforced Concrete Sidewalks (4-1/2")	SY	3,000.00	$80.00	$240,000.00
18	530	Curb Ramp	SY	75.00	$70.00	$5,250.00
					Subtotal of Item B	**$475,350.00**
C	**STORM SEWER**					
19	429	Trench Safety System (5' to 10') [INCLUDES SHEET PILING AS REQ'D]	LF	6,445.00	$2.00	$12,890.00
20	480	Precast RCB (6' x 12')	LF	6,445.00	$1,100.00	$7,089,500.00
21	471	Precast Concrete Standard Manhole (All Depths) 6' DIA	EA	5.00	$5,500.00	$27,500.00
22	471	Precast Concrete Standard Manhole (All Depths) 7' DIA	EA	7.00	$6,500.00	$45,500.00
23	472	Type BB Inlet	EA	5.00	$5,000.00	$25,000.00
24	472	Type C Inlet	EA	5.00	$5,000.00	$25,000.00
					Subtotal of Item C	**$7,225,390.00**
D	**TRAFFIC CONTROL PLAN**					
25	671	Traffic Control - Barricades, Barriers, Barrels, Cones, and Signing	MO	6.00	$8,000.00	$48,000.00
26	673	Temporary Pipe Under Driveway for Installing-Maintaining and Removal	LF	200.00	$20.00	$4,000.00
					Subtotal of Item D	**$52,000.00**
E	**SIGNING AND PAVEMENT MARKINGS**					
27	624	Aluminum Signs (Ground Mounted)- Furnish & Install	EA	0.00	$250.00	$0.00
					Subtotal of Item E	**$0.00**
F	**STORM WATER POLLUTION PREVENTION PLAN**					
28	162	Sodding for Erosion Control (Various Widths)	SY	2,500.00	$4.00	$10,000.00

CONSTRUCTION COST ESTIMATE - Alt #3

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$19,795,663.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$19,795,663.00**
Contingencies:	**25%**	**$4,948,915.75**
Grand Total Project:		**$24,744,578.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
29	708	Filter Fabric Fence (60% of unit cost for furnish and installation and 40% of unit cost for removal)	LF	1,000.00	$1.20	$1,200.00
30	719	Inlet Protection Barrier (Stage 1, With Fiber Rolls; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	EA	12.00	$100.00	$1,200.00
31	724	Stabilized Construction Access (Type 1-Rock; 60% of unit cost for furnish and installation, and 40% of unit cost for removal))	SY	8.00	$15.00	$120.00
32	730	Concrete Truck Washout Structures (60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LS	1.00	$1,000.00	$1,000.00
33	750	Rock Filter Dam (Type 1; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LF	1.00	$50.00	$50.00
34	751	SWPPP Inspection and Maintenance (Min. Bid - $6,000.)	MO	6.00	$6,000.00	$36,000.00
					Subtotal of Item F	**$49,570.00**
G	**** EXTRA WORK ITEMS**					
35	559	Construction Safety Fence	LF	200.00	$3.00	$600.00
36	672	Off-Duty Uniformed Peace Office - As Directed by Engineer (Min. Bid $45/HR)	HR	120.00	$45.00	$5,400.00
					Subtotal of Item G	**$6,000.00**

APPENDICES

APPENDIX 5.1
DRAINAGE IMPACT ANALYSIS



DRAINAGE IMPACT ANALYSIS

FOR

RAVENSWAY SOUTH SUBDIVISION

DRAINAGE IMPROVEMENTS PROJECT

PRECINCT 3

(UPIN 19103MF14701)

WITHIN THE WHITE OAK BAYOU WATERSHED

PREPARED FOR:

BINKLEY & BARFIELD, INC.

&

HARRIS COUNTY ENGINEERING DEPARTMENT

RECOVERY & RESILIENCY DIVISION

FEBRUARY 2022

CI JOB NO. 2018287-HCE-40-002

DRAINAGE IMPACT ANALYSIS
FOR
RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS PROJECT
PRECINCT 3
(UPIN 19103MF14701)
WITHIN THE WHITE OAK BAYOU WATERSHED
HARRIS COUNTY, TEXAS

PREPARED FOR:

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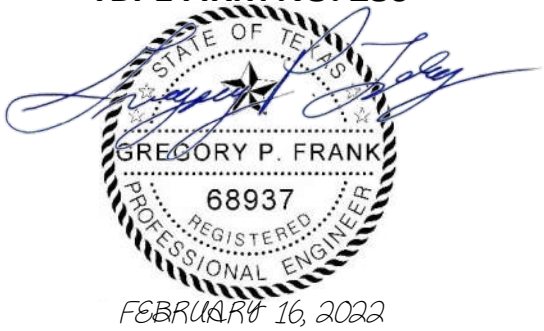

FEBRUARY 16, 2022

EXECUTIVE SUMMARY

The purpose of this report is to present the results of the hydrologic and hydraulic drainage impact analysis of the proposed storm sewer improvements within the Ravensway South subdivision, which encompasses approximately 67 acres of single-family residential properties, located in the White Oak Bayou watershed in Precinct 3 of Harris County, Texas. The subdivision is located on the north side of Cypress-N. Houston Road, just east of its intersection with Huffmeister Road.

The subdivision consists of concrete curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into and existing trunkline storm sewer in Cypress-North Houston Road, which then outfall into E133-00-00.

The subdivision is reported to have experienced structural flooding in approximately 16 homes during Hurricane Harvey, with approximately 11 of those experiencing flooding in previous major storm events.

A hydraulic analysis (spreadsheet based) of the existing storm sewers, gutter runs and inlets was performed which indicates that the existing system does not provide a 50% AEP Atlas 14 (2-year) level of service as required in the current HCED criteria.

Proposed improvements include replacing trunkline storms sewer pipes along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft and Birdcall. Extensions of the existing tributary runs along Nevermore, Ravens Caw, Raven Roost, Blackbird and Raven Wing are also proposed to reduce gutter ponding along those streets during the 50% AEP design event. Additionally, all Type B-B inlets are proposed to have the plates replaced with inlet grates to increase inlet capacity and help reduce ponding depths/widths.

Review of the spreadsheet analysis results (**Appendices A & B**) indicates that the proposed 50% AEP storm sewer computations provide decreased hydraulic grade line (HGL) elevations within the pipes, without increasing the computed peak flow rates, when compared to existing conditions. The improved storm sewers and inlets will provide reduced ponding depths throughout the subdivision for the 50% AEP design event.

The proposed improvements will increase the level of service of the pipes and inlets to a 50% AEP (2-year) design level, as required in the Harris County design criteria. However, due to the restricted capacity of the downstream systems in Cypress-N. Houston and the E133-00-00 outfall channel, a 1% AEP (100-year) level of service cannot be achieved without significant downstream improvements, as discussed in Alternatives 2 and 3.

The proposed improvements do not increase the HGL elevations within or adjacent to the project areas, nor do the improvements increase the computed discharge rates into the receiving systems. Based on these results and within the constraints and limitations of the methodologies used, the

proposed improvements described in this report will cause no adverse hydrologic impacts at the outfall point into E133-00-00 for the 50%, 10%, 1% Atlas 14 rainfall events analyzed, thus, it can be reasonably concluded that the downstream flood hazard conditions along E133-00-00, including areas within the City of Houston in this sub-watershed, will not be increased due to the implementation of this project.

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I. INTRODUCTION

A. PURPOSE

The purpose of this report is to present the results of the hydrologic and hydraulic drainage impact analysis of the proposed storm sewer improvements within the Ravensway South subdivision, which encompasses approximately 67 acres of single-family residential properties, located in the White Oak Bayou watershed in Precinct 3 of Harris County, Texas.

B. SCOPE

The scope of this analysis includes a drainage impact analysis of the proposed storm sewer and inlet improvements within the Ravensway South subdivision. The design of the storm sewer and inlet improvements will be based on the current Atlas 14 rainfall data available from the Harris County Flood Control District (HCFCD) Policies and Procedures Manual (PCPM) and the Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure (HC Regs), effective July 19, 2019, and the 2020 City of Houston Infrastructure Design Manual (IDM). The drainage impact analysis will address the potential impacts the proposed improvements may have on the 50%, 10% and 1% Annual Exceedance Probability (AEP) events in the storm sewers and streets and will incorporate mitigating design elements in order to ensure that no adverse hydrologic impacts will be caused by the project for those events analyzed.

The impact analysis, performed by Costello, Inc. (CI) will include a hydraulic analysis of the existing and proposed storm sewer pipes and inlets, to determine pre- and post-project hydraulic profiles along the subject storm sewers and streets. Given the constraints of this project area, described in more detail below, it is anticipated that significant offsite channel and detention improvements would be required to reduce the floodplain extents and depth for events in excess of the 50% AEP event. Preliminary design concepts for the analysis of these alternatives are presented for comparison.

This analysis was performed in conjunction with Binkley & Barfield, Inc. (BBI), the prime consultant to the Harris County Engineering Department (HCED) Recovery and Resiliency Division (RRD) for this project. BBI provided conceptual design guidance throughout the analysis process and preliminary construction cost estimates for each alternative investigated.

C. STUDY AREA

The study area is generally the Ravensway South subdivision, located within Precinct 3 of Harris County, within the White Oak Bayou watershed. The subject area is bounded by existing commercial development on the west, residential subdivisions on the north and east, and Cypress-N. Houston Road on the south. **Exhibit 1** depicts the location of the subject tract. The existing storm sewers in Raven South Drive convey flows to an existing storm sewer trunkline tie-in in Cypress-N. Houston Road which outfalls into E133-00-00. **Exhibit 2** depicts the existing outfall location, drainage area delineations and

drainage system components pertinent to this analysis. Natural ground elevations range from 135 to 129 feet within the study area.

D. PREVIOUS STUDIES

This analysis utilized certain information from the previous report entitled *"Subdivision Drainage Assessment, Ravensway South Subdivision, Precinct 3, Harris County, Texas"*, dated July 23, 2019, prepared by Costello, Inc. (CI) as the basis for this analysis.

E. EXISTING FLOODPLAIN STATUS AND FLOODING HISTORY

The existing 67-acre subdivision lies within a Zone X (Unshaded) area, as shown on **Exhibit 3**. It is reported that 16 structures within this subdivision experienced flooding during Hurricane Harvey. Additionally, it is reported that 11 of these homes experienced multiple structural flooding incidents in previous events, ranging from Tropical Storm Allison (2001) to Tax Day 2016.

F. COMPUTER PROGRAMS

The existing and proposed hydraulic analyses were performed using Excel spreadsheets, specifically developed for this analysis and system layout.

G. DATUM ADJUSTMENT

Field surveys were performed by LandTech, Inc. to provide existing topography of the streets, storm sewers and other pertinent features for use in the analysis and design of the project. The elevations used in this study are referenced to the 1988 North American Vertical Datum (NAVD), Geoid 12B, to be consistent with the datum for the 2018 TNRIS Coastal LiDAR dataset. The "As-Built" construction plans for the existing storm sewers and street paving are referenced to the Harris County 1973 Datum as shown on Sheet 2 of 22 from the plans entitled *"Water Distribution System, Sanitary Sewage Collection System, and Storm Sewers and Paving to Serve Ravensway South "AS BUILTS""*, prepared by Coulson & Associates Engineers, Inc., dated December 1979. The construction plans for the project entitled *"Cypress North Houston Road from Huffmeister Road to Westgate Drive, Paving and Drainage Improvements"*, prepared by Costello Inc., dated April 9, 2009, are referenced to the 1988 NAVD, 2001 Adjustment. **An adjustment factor of 0.28 feet between the 88 NAVD, '01 and Geoid 12B datums was established by Landtech (subtract 0.28 from plan elevations to achieve Geoid 12B elevations)**.

In order to adjust the original HC '73 Adjustment "as-built" elevations to the Geoid 12B datum the elevations of the manholes surveyed for this project were compared to the plan elevations to establish a computed average difference which could be applied to all of the original plan flowline and top of curb elevations. **This adjustment factor was computed to be -4.28 feet ('73 to Geoid 12B)**.

All natural ground elevations at or near the existing right of way lines were obtained from the Geoid 12B LiDAR.

II. DESIGN CONSIDERATIONS

A. GENERAL METHODOLOGY AND CRITERIA

The improvements for this project will potentially include improved storm sewer trunklines and inlets would potentially increase the capacity of the system at the outfall point into Cypress-N. Houston. In order to compensate for these potential increases in flow, several reaches of the existing storm trunklines were investigated for improvements which would increase the pipe capacities, decreasing the pipe velocities, which increase the computed Times of Concentration (Tc) within the system, thus producing computed runoff flows into the Cypress-N. Houston trunkline at or below existing flow rates.

These computations will utilize spreadsheet computations of the existing and proposed storm sewer systems to compare the hydraulic grade lines (HGL) at each inlet/manhole location against the gutter and natural ground at right of way (ROW) elevations for the 50% (2-year) 10% (10-year) and 1% AEP (100-year) Atlas 14 rainfall intensities. The current City of Houston (CoH) storm sewer criteria and analysis methodologies, as presented in Chapter 9 of the IDM, were incorporated into the analysis. This methodology requires that the 50% AEP HGL is maintained below the gutter elevations at each inlet location and that the 1% AEP HGL is maintained below the natural ground elevation at the ROW at each inlet and at the downstream high point in the street profile. Additionally, the 50% AEP ponding width (spread) in the gutters and at the inlets are required to not exceed the centerline of the street at all locations. There are no established 10% AEP guidelines for HGL vs gutter or natural ground elevations, however, comparisons will be made as an additional data point for consideration.

Given the limited outfall capacity of the existing Ravensway South and Cypress-N. Houston storm sewer systems and the lack of available hydraulic models of E133-00-00, as identified in the *Subdivision Drainage Assessment* performed by CI, dated July 2019, it is apparent that in order to provide significant improvement to the flood protection level of service provided to this subdivision, downstream improvements along E133-00-00 and possibly along Cypress-N. Houston would be necessary. These types of capital improvement projects are outside of the scope of the subdivision drainage improvement project for which this analysis is performed.

Within the scope of potential improvement projects which can be of benefit to the subdivision, the analyses described in the following sections were performed. The analyses first assess the existing storm sewers within the subdivision and along Cypress-N. Houston which are tributary to the common outfall into E133-00-00 and the existing 50% AEP spread (inlet/gutter ponding widths) conditions. The analyses then assess potential storm sewer and inlet improvements to bring the storm sewers and inlets into compliance with the 50% AEP design criteria. Finally, alternative projects which could provide higher levels of service to the subdivision are evaluated for consideration of future capital improvement projects.

B. EXISTING FLOODING HISTORY

It is reported that sixteen (16) homes within Ravensway South subdivision experienced flooding during Hurricane Harvey, with eleven (11) of these homes also having experienced structural flooding in previous events, ranging from Tropical Storm Allison (2001) to Tax Day 2016. The majority of these homes are located along the most southerly street, Raven Wing, and also back up to the Cypress-N. Houston Road right of way. **Exhibit 4** depicts the LiDAR topography within the subdivision. As shown on that exhibit, the intersections of Raven Wing and Blackbird are the lowest, thus receive any excess sheet flow from the upper areas of the subdivision during moderate to heavy rainfall events. Additionally, the crown of Cypress-N. Houston pavement is approximately 2 feet above the natural ground/top of curb elevations surrounding these two intersections. The limited capacity and large drainage area tributary to the Cypress-N. Houston northern roadside ditch does not provide a level of service for rainfall events which exceed the existing storm sewer capacities, as would be required under current design criteria. This drainage configuration creates ponding conditions along the southern end of Raven South which causes access issues in moderate localized events and potential structural flooding in larger localized events and during larger watershed-wide events.

C. STORM SEWER COMPUTATIONS

1. EXISTING CONDITIONS

The existing condition storm sewer network, as shown on **Exhibit 2**, within the Ravensway South subdivision and along Cypress-N. Houston Road from E133-00-00 to Huffmeister Road was simulated using a spreadsheet analysis. The spreadsheet first computes Rational Method peak flows for the 50% AEP design event, the associated headlosses along each reach of the system, and compares the resulting Hydraulic Grade Line (HGL) and gutter elevations for compliance with the design criteria, presented in **Appendix A-1**. The 50% AEP analysis also includes computations of the ponding width (spread) and ponding depths in the gutters and at the storm sewer curb inlets. The rainfall data used for this analysis is the Harris County Region 3 Atlas 14 Intensity-Duration-Frequency (IDF) data from the 2019 PCPM, as required in the CoH IDM and the 2019 Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure (HC Regs), presented in **Appendix A-2**.

The spreadsheet then computes 1% AEP peak flows, HGL elevations, and compares those results to the natural ground elevations at the street right of way line for compliance with the design criteria, as shown in **Appendix A-3**. The spreadsheet also computes 10% AEP peak flows, HGL elevations, and compares those results to the gutter elevations and natural ground elevations at the street right of way line, as shown in **Appendices A-4, 5 and 6**.

As shown in **Appendix A-1** and on **Exhibit 5**, the results of the existing condition 50% AEP hydraulic analysis indicate that the HGL elevations along Raven South Drive exceed the gutter

elevations (purple lines) by as much as 2.5 feet for all of the storm sewer reaches upstream of Ravens Roost Drive and all of the tributary systems along the side streets throughout the subdivision. This indicates that the existing storm sewer system is **not** in compliance with the current 50% AEP event hydraulic profile criterion. As shown in **Appendix A-2**, several gutter runs exceed the allowable ponding width. These locations are shown on **Exhibit 5** (blue lines) and are generally associated with tributary drainage areas which exceed approximately 1.42 acres per gutter run, with longitudinal gutter slopes of 0.25%.

It should be noted that the existing condition flowline slopes within the internal Ravensway storm sewer system are computed using surveyed elevations. As shown in the spreadsheet, several reaches of pipe have apparent negative slopes. This causes the computations of Design Velocity and Design Capacity to indicate **#NUM!** error messages. The parameter of Design Velocity is checked in the storm sewer computations to ensure that under nominal flow conditions that the pipes can produce a velocity of at least 3 feet-per-second (fps), which is considered to be a minimum velocity for preventing long-term sediment build-up in the pipes. Design Capacity is a parameter that in no longer used to establish overall storm sewer efficiency. Since these two computations are not used to determine the actual capability of the system to provide the desired level or protection, and the actual computed velocities are well above the 3-fps minimum, based on the computed peak flows in those reaches where the error message is shown, these error messages can be ignored.

Additionally, the 1% AEP results indicate that the HGL elevations greatly exceed the natural ground at right of way elevations throughout the system. The HGL elevations shown in **Appendix A-3**, as computed, while unrealistically high, indicates that the pipe system is unable to meet the current 1% AEP design criteria. This result is expected since this system was designed and constructed circa 1978, well before the more modern design criteria for 1% AEP storm sewer design requirements.

An analysis of the 1% AEP sheet flow and inlet capacities was performed in order to determine whether the existing inlets have the capability of conveying the computed 1% AEP runoff from the drainage area tributary to each inlet location, independent of the HGL conditions created by the pipe system serving the inlets. The resulting inlet capacities are presented in **Appendix A-4**.

The 10% AEP flows and HGL elevations are computed as an intermediate frequency storm event for comparison with proposed conditions, described below, in order to ensure that computed discharge rates from the improved storm sewer system are not increased above existing conditions for a range of storm events. **Appendices A-5, 6 and 7** present the results of the 10% AEP analysis.

Table 1 lists the 1%, 10% and 50% AEP computed discharges at the storm sewer junction of the Ravensway South system and the northern Cypress-N. Houston trunkline, the junction with the southern trunkline and the outfall into E133-00-00 for comparison with the proposed condition discharges computed below. **Table 2** list the HGL elevations at key locations throughout the system for comparison with the proposed condition elevations computed below.

2. PROPOSED ALTERNATIVE 1 IMPROVEMENTS

In order to reduce the headlosses throughout the Ravensway South internal storm sewer system for the 50% AEP design event, thus bringing the proposed system into compliance with the current 50% AEP design criteria, certain reaches of storm sewer are proposed to be improved. **Appendices B-1 through 6** present the proposed storm sewer computations for the 50% AEP event. **Exhibit 6** depicts the locations of the proposed storm sewer improvements, along with proposed inlet improvements throughout the subdivision. The improvements include:

- Replacing a reach of existing 30, 48, 54 and 60-inch pipes along Raven South Drive with 66-inch RCP.
- Replacing the existing 30 and 36-inch pipes along Shaft Drive with 42-inch RCP.
- Replacing the existing 30 and 36-inch pipes along Birdcall Drive with 36 and 42-inch RCP.
- Extending the storm sewer systems along Nevermore, Ravens Caw, Raven Roost, Blackbird and Raven Wing with 24-inch RCP, with an additional pair of inlets-on-grade to reduce the initial drainage areas to those gutter runs, thus reducing ponding widths along those streets.
- Adding a pair of inlets-on-grade along Birdcall and Raven Flight to reduce the drainage areas to the existing gutter runs which exceeded allowable ponding widths, thus reducing ponding widths along those streets.
- Replacing the solid plate covers on all B-B inlets with grate covers to increase inlet capacities.
- Replacing the existing C-1 inlet pairs at the intersections of Blackbird and Raven Wing with C-2 inlets to reduce ponding widths and maximize the sheet flow interception capacity at these two locations.

The resulting peak flows at key locations throughout the system shown in **Table 1**, with the corresponding HGL elevations shown in **Table 2**.

D. COMPARISON OF RESULTS

A review of the results of the 50% AEP computations, as shown in **Appendix B-1**, indicates that the HGL elevations will be reduced below the gutter elevations for all reaches of the storm sewer system within

the Ravensway South study area. Further, as shown in **Appendix B-2**, the proposed additional inlet locations will reduce the 50% AEP ponding widths to be below the maximum allowable widths for all but three reaches of street gutter. Those three locations, shown on **Exhibit 6**, only exceed the allowable ponding depth at the street centerline by less than 0.001 feet (0.08 inches), therefore extending additional storm sewers along these reaches is not proposed. Additionally, the two most upstream gutter reaches along Shaft are shown to exceed the allowable ponding widths/depths. These two reaches receive runoff from the park areas to the north, which appear to be picked up by offsite interceptors, therefore those two reaches' computations do not reflect actual gutter ponding.

A review of the results of the proposed improvements 1% AEP computations, as shown in **Appendix B-3**, indicates that the HGL elevations will be significantly reduced, however will not be within the parameters stated in the design criteria. This is due to the fact that the downstream sections of the existing storm sewer, within Cypress-N. Houston, are not proposed to be improved in this project, therefore the downstream HGL are well above the natural ground elevations along Raven South Drive. While these results do not produce a fully criteria compliant system, the improved conveyance will reduce the ponding depths and duration of ponding in the subdivision streets during moderate rainfall events.

An analysis of the 1% AEP sheet flow and inlet capacities was performed in order to determine whether the proposed inlet improvements have the capability of conveying the computed 1% AEP runoff from the drainage area tributary to each inlet location, independent of the HGL conditions created by the pipe system serving the inlets. The resulting inlet capacities are presented in **Appendix B-4**.

The 10% AEP flows and HGL elevations are computed as an intermediate frequency storm event for comparison with proposed conditions, described below, in order to ensure that computed discharge rates from the improved storm sewer system are not increased above existing conditions for a range of storm events. **Appendices A-5, 6 and 7** present the results of the 10% AEP analysis.

A review of the results of the 1% and 10% AEP computations, as summarized in **Table 2**, indicates that the HGL elevations will be reduced significantly. However, since this storm sewer system was designed in accordance with pre-1983 criteria, the downstream reaches along Raven South and Cypress-N. Houston are not capable of conveying 1% AEP discharges away from that intersection to the outfall into E133-00-00. The reductions in HGL elevations indicate that the proposed improvements will provide an improved level of protection/service to the subdivision, however without significant downstream drainage improvements, discussed in more detail below, no significant reductions in the flooding potential within the subdivision, for events exceeding the 50% AEP, can be provided.

To further ensure that the proposed improvements do not cause an increase in the flooding potential within the subdivision or downstream to the outfall into E133-00-00, a comparison of the 1% and 10% AEP discharge rates at the Raven South tie-in into the Cypress- N. Houston north trunkline (CNH-1; MH1-6) was made. The results indicate reductions in computed discharges of approximately 36, 23 and 20 cfs for the 1%, 10% and 50% AEP events, respectively, as shown in **Table 1**. The corresponding HGL elevations

The above-described reductions in computed discharge rates and lowered HGL elevations for each of the storm frequencies analyzed indicate that no adverse hydrologic/hydraulic impacts will be caused by the implementation of this project for the 50%, 10% and 1% AEP, Atlas 14 storm events analyzed. Based on the results of this hydraulic analysis and within the constraints and limitations of this methodology, the proposed project will cause no adverse hydrologic impacts at the outfall point into E133-00-00 for the 50%, 10%, 1% Atlas 14 rainfall events analyzed. Based on the methodology used, it can be reasonably concluded that the downstream flood hazard conditions along E133-00-00, including areas within the City of Houston in this sub-watershed, will not be increased due to the implementation of this project.

A preliminary Engineer's Probable Construction Cost Estimate of the Alternative 1 storm sewer improvements is presented in **Attachment 1**.

E. ADDITIONAL ALTERNATIVES EVALUATED

Two additional alternative improvement concepts were evaluated to determine what types of future projects/analyses would be necessary to achieve significant improvements in the level of service provided to this subdivision.

1. ALTERNATIVE 2 - STORM SEWER TO PROVIDE FUTURE 1% AEP LEVEL OF SERVICE

This alternative would include designing storm sewer improvements **only** within the Ravensway South subdivision which would lower the 1% AEP Atlas 14 HGL elevations to provide a **future** level of service throughout the system's service area assuming downstream improvements are made, as described below. These Alternative 2 internal storm sewer improvements are shown on **Exhibit 7**. A preliminary Engineer's Probable Construction Cost Estimate of the storm sewer improvements is presented in **Attachment 2**.

As shown in **Appendix C-1, 2 and 3**, the resulting 50% AEP HGL elevations are significantly below gutter elevations due to the increased pipe capacities. The 1% AEP Atlas 14 HGL elevations are significantly reduced below the existing condition HGL elevations, however, are still well above the natural ground elevations, thus this design would not meet the 1% AEP

design criteria without additional improvements outside of the limits of the subdivision, as described below.

An analysis of the 1% AEP sheet flow and inlet capacities was performed in order to determine whether the proposed inlet improvements have the capability of conveying the computed 1% AEP runoff from the drainage area tributary to each inlet location, independent of the HGL conditions created by the pipe system serving the inlets. The resulting inlet capacities are presented in **Appendix C-4**.

As shown in **Appendix C-5, 6 and 7**, the resulting 10% AEP Atlas 14 HGL elevations are well above the gutter elevations, as expected, with the HGL elevations being contained below the natural ground at right of way for a majority of the reaches. This indicates that the system could provide a 10% level of service, with some ponding in the streets. As shown in **Table 1**, the computed discharges from the Ravensway South system are reduced slightly below the existing condition rates, thus indicating that this alternative would have no adverse impacts on the potential flooding conditions within or surrounding the project area.

Comparing Probable Construction Cost Estimate of over $10MM for this alternative to the estimate for Alternative 1 of approximately $3.3MM and given that the decreases in computed 1% AEP HGL elevations **do not** provide a 1% AEP level of service, this alternative is not recommended.

2. ALTERNATIVE 3 - E133-00-00 CHANNEL AND DETENTION IMPROVEMENTS

This alternative would include improvements of the storm sewer trunkline along Cypress-N. Houston between Raven South and the outfall into E133-00-00 to lower the headlosses in the trunkline to allow the storm sewer improvements to meet the design criteria described above. These improvements would significantly reduce the 1% AEP headlosses, thus would likely reduce the floodplain storage volume north of Cypress-N. Houston, which would likely cause a hydrologic impact downstream. Improvements along E133-00-00 would be necessary to provide adequate conveyance and detention capacity within E133-00-00 to ensure no downstream adverse impacts would be created by the combined projects. This alternative would require that a full subwatershed hydrologic and hydraulic analysis be performed.

Presently, it is unknown whether a hydraulic model of E133-00-00 exists from the ongoing MAAPnext project. With a full subwatershed analysis, an improvement plan for the subwatershed, including channel improvements and detention components, can then be developed which could improve the flooding conditions for the entire subwatershed and provide improved tailwater conditions for the Ravensway South/Cypress-N. Houston storm sewer systems. A potentially more comprehensive improvement plan, which could improve the

level of service within the subdivision, could then be evaluated. A preliminary Engineering Fee Estimate for such a subwatershed analysis and preliminary storm sewer design is presented in **Attachment 3**.

III. CONCLUSIONS AND RECOMMENDATIONS

The results of the hydrologic and hydraulic analyses for the Ravensway South Subdivision Improvement Project are summarized below:

A. CONCLUSIONS

- The existing storm sewer system within the Ravensway South subdivision was designed and constructed using pre-1983 design criteria which did not incorporate 50% AEP (2-year) inlet/gutter spread considerations, 1% AEP (100-year) pipe capacities, or 1% AEP sheet flow considerations.

- The existing system was analyzed using the current Atlas 14 rainfall data, the results of which indicate that the 50% and 1% AEP HGL elevations greatly exceed the allowable gutter and natural ground at right of way elevations, respectively. Thus, the existing pipe system **does not** comply with the current design criteria for subdivision drainage systems.

- The existing inlets generally provide capacity to convey the runoff tributary to the inlets, however several gutter runs indicate potential ponding widths which exceed the current criteria for ponding widths. These locations are caused by contributing drainage areas which exceed the gutters' capacity based on the flat longitudinal grades found in the subdivision.

- Under existing conditions, the Cypress-N. Houston Road storm sewers and roadside ditches (north side) create ponding conditions in small to moderate rainfall events, with structural flooding likely in larger area-wide events.

- Three alternative storm sewer improvement concepts were investigated:

    - Alternative 1: Improve storm sewers only within the Ravensway South subdivision to provide a 50% AEP level of protection, assuming no downstream improvements are made.

    - Alternative 2: Improve the storm sewers only within the Ravensway South subdivision to provide an increased level of protection from the storm sewers, assuming future downstream improvements would provide improved tailwater conditions to bring the internal system into compliance.

    - Alternative 3: Undertake a subwatershed analysis and improvement plan which would provide adequate downstream conveyance and detention capacity to allow

improvements to the internal and Cypress-N. Houston trunklines to bring both systems into compliance with current 1% AEP criteria.

- Alternates 2 and 3 are outside of the intended project scope of the subdivision improvement projects, therefore Alternative 1 was investigated in detail.

- The proposed Alternative 1 storm sewer improvements will provide reduced HGL elevations throughout the Ravensway South subdivision for the 50% AEP Atlas 14 event analyzed, thus bringing the proposed system into compliance with the 50% AEP Atlas 14 design criteria.

- The proposed storm sewer improvements **do not** provide sufficient HGL elevation reductions to bring the system into compliance with the 1% AEP Atlas 14 design criteria. However, the 1% AEP HGL elevations are reduced significantly, thus will provide an improved level of service to the subdivision for storm events in excess of the design event.

- Based on the results of this hydraulic analysis and within the constraints and limitations of this methodology, the proposed improvements described in this report will cause no adverse hydrologic impacts at the outfall point into E133-00-00 for the 50%, 10%, 1% Atlas 14 rainfall events analyzed, thus, it can be reasonably concluded that the downstream flood hazard conditions along E133-00-00, including areas within the City of Houston in this sub-watershed, will not be increased due to the implementation of this project.

B. RECOMMENDATIONS

- The HCED and HCFCD should consider the possibilities of performing a subwatershed project along E133-00-00 (Alternative 3), considering potential benefits to other tributary areas along Cypress-N. Houston Road and downstream along the channel.
- Should Alternative 3 prove to be infeasible at this time, proceed with the design and construction of Alternative 1 improvements.

IV. TABLES

TABLE 1
COMPUTED DISCHARGE COMPARISONS

MANHOLE / JUNCTION	COMPUTED 50% ATLAS 14 DISCHARGE (cfs)				
	Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)
A	133.51	112.65	-20.85	97.89	-35.61
CNH-1	143.22	120.86	-22.37	103.95	-39.28
CNH 2	188.23	168.49	-19.74	152.71	-35.52
CNH-3	188.23	168.49	-19.74	152.71	-35.52
E133	188.23	168.49	-19.74	168.06	-20.18

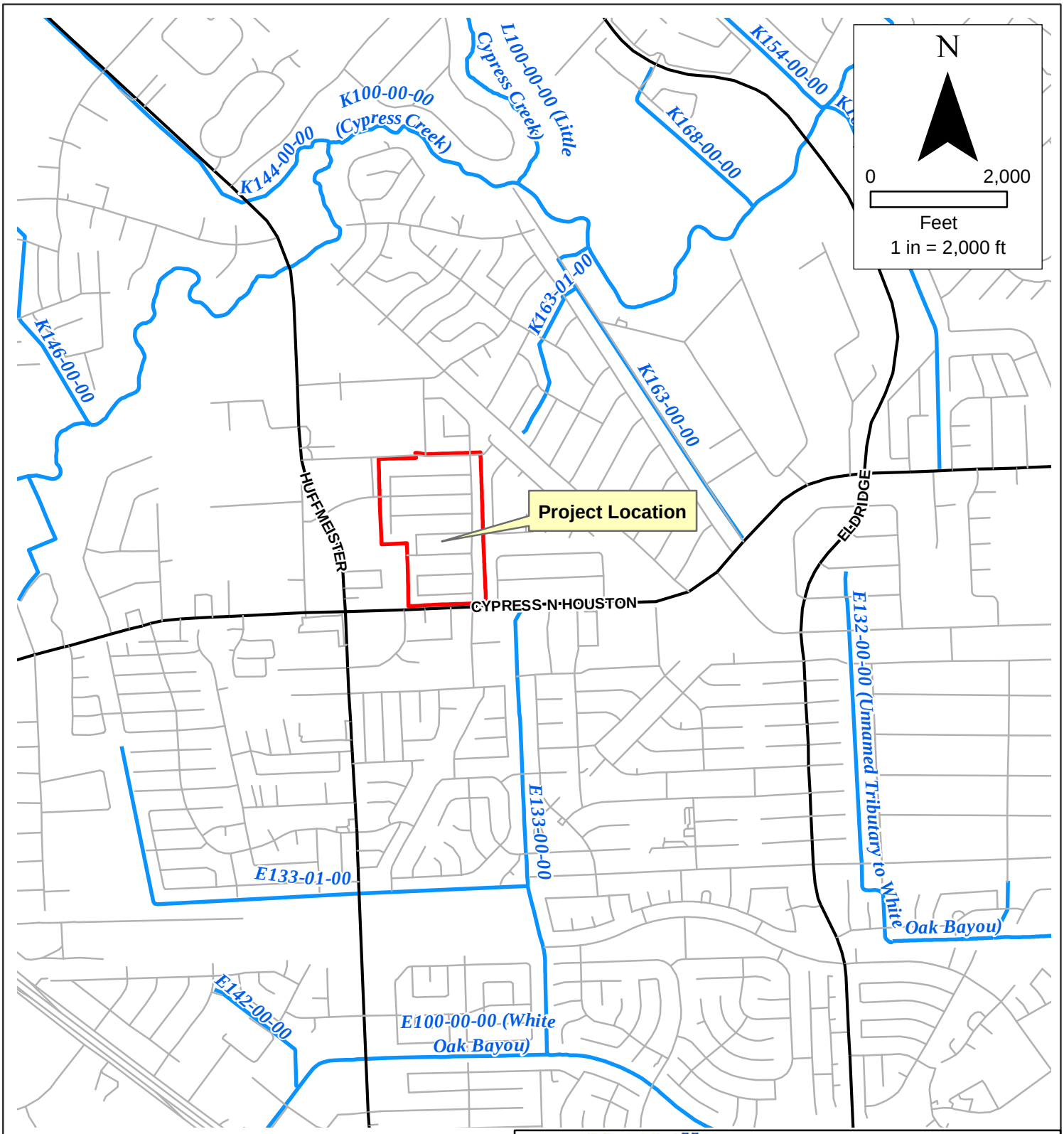
MANHOLE / JUNCTION	COMPUTED 10% ATLAS 14 DISCHARGE (cfs)				
	Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)
A	216.70	192.58	-24.12	170.98	-45.72
CNH-1	232.52	206.64	-25.87	183.00	-49.52
CNH 2	304.74	282.04	-22.69	259.72	-45.01
CNH-3	304.74	282.04	-22.69	259.72	-45.01
E133	304.74	282.04	-22.69	266.21	-38.52

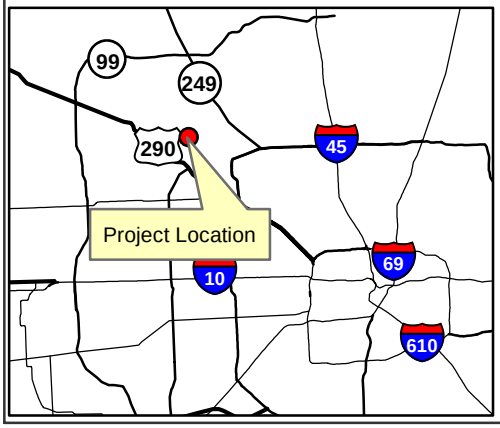
MANHOLE / JUNCTION	COMPUTED 1% ATLAS 14 DISCHARGE (cfs)				
	Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)
A	363.67	337.38	-26.29	316.69	-46.98
CNH-1	390.27	362.06	-28.21	339.76	-50.51
CNH 2	501.42	465.25	-36.17	436.64	-64.78
CNH-3	501.42	465.25	-36.17	436.64	-64.78
E133	501.42	465.25	-36.17	436.64	-64.78

TABLE 2
COMPUTED HYDRAULIC GRADE LINE ELEVATION COMPARISONS

MANHOLE / JUNCTION	LOCATION/ DESCRIPTION	50% AEP ATLAS 14 HGL ELEVATIONS (ft)					10% AEP ATLAS 14 HGL ELEVATIONS (ft)					1% AEP ATLAS 14 HGL ELEVATIONS (ft)				
		Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)	Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)	Existing Conditions	Proposed (Alt 1)	Delta (Alt 1 - Ex)	Alternative 2	Delta (Alt 2 - Ex)
Ravensway South Drive																
S.1.C	Raven Song Dr.	133.50	130.30	-3.19	129.27	-4.22	146.46	138.88	-7.58	132.39	-14.06	177.50	159.14	-18.36	147.29	-30.21
S		133.48	130.29	-3.19	129.26	-4.22	146.43	138.85	-7.58	132.36	-14.06	177.44	159.08	-18.36	147.22	-30.21
R		133.41	130.22	-3.19	129.19	-4.22	146.27	138.69	-7.58	132.21	-14.06	177.06	158.70	-18.36	146.84	-30.21
Q		133.39	130.20	-3.19	129.17	-4.22	146.22	138.64	-7.58	132.15	-14.06	176.93	158.57	-18.36	146.71	-30.21
P		132.97	129.78	-3.19	128.75	-4.22	145.27	137.69	-7.58	131.21	-14.06	174.56	156.20	-18.36	144.35	-30.21
O		132.89	129.69	-3.19	128.66	-4.22	145.08	137.50	-7.58	131.02	-14.06	174.09	155.73	-18.36	143.87	-30.21
N	Raven Park (Scamp)	132.73	129.53	-3.19	128.50	-4.22	144.72	137.14	-7.58	130.99	-13.73	173.18	154.82	-18.36	142.96	-30.21
M	Shaft Dr	131.70	129.52	-2.18	128.29	-3.41	142.26	137.10	-5.16	130.98	-11.28	166.81	154.72	-12.08	142.44	-24.36
L	Nevermore Dr	131.24	129.46	-1.78	128.15	-3.09	141.11	136.93	-4.18	130.97	-10.15	163.71	154.23	-9.49	142.39	-21.32
K	Birdcall Dr	130.90	129.37	-1.53	128.02	-2.89	140.27	136.70	-3.57	130.94	-9.33	161.44	153.55	-7.89	142.32	-19.12
J	Ravens Caw	130.52	129.21	-1.31	127.91	-2.61	139.32	136.24	-3.07	130.90	-8.41	158.82	152.19	-6.63	142.19	-16.63
H		130.20	129.07	-1.13	127.89	-2.31	138.49	135.85	-2.64	130.87	-7.62	156.55	151.01	-5.54	142.07	-14.48
G	Ravens Roost Dr	130.05	129.00	-1.04	127.88	-2.16	138.10	135.66	-2.44	130.85	-7.25	155.48	150.46	-5.02	142.02	-13.46
F.2		129.92	128.95	-0.97	127.88	-2.04	137.77	135.51	-2.26	130.84	-6.94	154.57	149.99	-4.58	141.97	-12.60
F		129.53	128.78	-0.75	127.86	-1.66	136.77	135.03	-1.74	130.80	-5.97	151.80	148.55	-3.25	141.84	-9.96
E	Ravens Flight Dr	129.50	128.76	-0.74	127.86	-1.64	136.70	134.97	-1.72	130.79	-5.91	151.59	148.37	-3.22	141.82	-9.77
D		129.13	128.50	-0.63	127.84	-1.29	135.73	134.21	-1.52	130.73	-5.01	148.90	146.06	-2.84	141.60	-7.30
C	Blackbird Dr	129.11	128.48	-0.62	127.84	-1.27	135.68	134.17	-1.51	130.72	-4.96	148.75	145.93	-2.82	141.59	-7.16
B		128.68	128.18	-0.50	127.82	-0.86	134.55	133.28	-1.27	130.65	-3.90	145.58	143.21	-2.38	141.33	-4.25
A	Raven Wing Dr	128.65	128.16	-0.49	127.81	-0.84	134.48	133.23	-1.26	130.64	-3.84	145.41	143.05	-2.35	141.32	-4.09
CNH-1	(North Trunkline)	128.29	127.90	-0.39	127.62	-0.67	133.52	132.47	-1.05	130.05	-3.48	142.70	140.73	-1.98	139.27	-3.43
CNH 2		126.54	126.50	-0.04	126.47	-0.07	129.15	129.01	-0.14	126.73	-2.42	130.33	130.08	-0.25	129.89	-0.44
CNH-3	(South Trunkline)	124.95	124.94	-0.01	124.94	-0.01	128.63	128.61	-0.03	125.01	-3.63	128.88	128.83	-0.05	128.79	-0.09
E133	Outfall into E133	124.90	124.90	0.00	124.90	0.00	128.50	128.50	0.00	124.90	-3.60	128.50	128.50	0.00	128.50	0.00
Shaft Drive																
M.9		134.92	130.22	-4.70	129.80	-5.12	149.93	138.91	-11.02	131.88	-18.05	186.80	159.78	-27.01	147.45	-39.35
M.8		134.85	130.21	-4.65	129.53	-5.32	149.80	138.89	-10.91	131.86	-17.94	186.47	159.73	-26.74	147.40	-39.07
M.7		134.79	130.20	-4.59	129.28	-5.51	149.65	138.87	-10.78	131.83	-17.81	186.10	159.67	-26.44	147.34	-38.77
M.5		133.39	130.01	-3.38	129.03	-4.36	146.33	138.39	-7.94	131.60	-14.73	177.52	158.37	-19.14	146.04	-31.47
M.4		133.04	129.96	-3.07	128.97	-4.07	145.51	138.28	-7.23	131.54	-13.97	175.38	158.05	-17.33	145.72	-29.66
M.3		133.00	129.95	-3.05	128.85	-4.15	145.43	138.25	-7.18	131.53	-13.90	175.17	157.97	-17.20	145.64	-29.53
M.2		131.74	129.53	-2.21	128.43	-3.31	142.36	137.14	-5.23	131.00	-11.36	167.07	154.82	-12.24	142.49	-24.58
M	@ Ravensway South	131.70	129.52	-2.18	128.42	-3.28	142.26	137.10	-5.16	130.98	-11.28	166.81	154.72	-12.08	142.44	-24.36
Birdcall Drive																
K.7		135.03	130.27	-4.76	129.09	-5.94	149.63	138.76	-10.87	131.96	-17.67	172.63	158.69	-13.95	145.30	-27.34
K.6		134.98	130.25	-4.72	128.93	-6.05	149.51	138.71	-10.80	131.92	-17.60	172.36	158.58	-13.78	145.19	-27.16
K.5		134.10	129.92	-4.18	128.73	-5.37	147.55	137.97	-9.58	131.60	-15.95	167.56	156.77	-10.79	144.42	-23.14
K.3		133.03	129.72	-3.31	128.31	-4.72	145.18	137.52	-7.67	131.32	-13.86	138.61	155.63	17.02	143.31	4.70
K.1		130.96	129.39	-1.56	128.15	-2.81	140.40	136.75	-3.65	130.97	-9.43	161.76	153.69	-8.08	142.39	-19.38
K	@ Ravensway South	130.90	129.37	-1.53	128.14	-2.76	140.27	136.70	-3.57	130.94	-9.33	161.44	153.55	-7.89	142.32	-19.12
Cypress-N. Houston @ Huffmeister Road Intersection																
MH 1-4	Cypress-N. Houston (North Trunkline)	130.55	130.43	-0.12	130.27	-0.27	140.46	140.18	-0.28	136.61	-3.85	158.73	158.19	-0.54	157.32	-1.40
MH 1-5	Cypress-N. Houston (North Trunkline)	129.71	129.49	-0.22	129.29	-0.42	137.89	137.33	-0.57	134.18	-3.71	152.79	151.72	-1.07	150.64	-2.16
CNH-1	@ Ravensway South (North Trunkline)	128.29	127.90	-0.39	127.62	-0.67	133.52	132.47	-1.05	130.05	-3.48	142.70	140.73	-1.98	139.27	-3.43
Cypress-N. Houston @ Huffmeister Road Intersection																
MH 2-1	Cypress-N. Houston (South Trunkline)	131.40	131.29	-0.12	131.24	-0.16	142.34	142.06	-0.28	138.84	-3.50	163.35	162.81	-0.54	162.58	-0.77
MH 2-2	Cypress-N. Houston (South Trunkline)	130.86	130.74	-0.12	130.70	-0.16	141.16	140.89	-0.28	137.66	-3.50	160.48	159.95	-0.54	159.71	-0.77
MH 1-3	Cypress-N. Houston (South Trunkline)	130.66	130.54	-0.12	130.50	-0.16	140.72	140.44	-0.28	137.22	-3.50	159.37	158.83	-0.54	158.60	-0.77
MH 2-3	Cypress-N. Houston (South Trunkline)	130.66	130.54	-0.12	130.49	-0.16	140.71	140.43	-0.28	137.21	-3.50	159.34	158.81	-0.54	158.58	-0.77
MH 2-4	Cypress-N. Houston (South Trunkline)	130.56	130.44	-0.12	130.40	-0.16	140.49	140.21	-0.28	136.99	-3.50	158.81	158.27	-0.54	158.04	-0.77
CNH-3	Cypress-N. Houston (South Trunkline)	124.95	124.94	-0.01	124.94	-0.01	128.63	128.61	-0.03	125.01	-3.63	128.88	128.83	-0.05	128.79	-0.09

V. EXHIBITS





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HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN 19103MF14701

LOCATION MAP

JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 1

Date Saved: 2/15/2022 4:46:26 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\1-Vicinity Map.mxd

Exist 2-yr HGL
EXCEEDS GUTTER
ALONG ALL REACHES
AND STREETS

Exist 2-yr HGL
EXCEEDS EDGE OF PVMT
From Huffmeister to Outfall

620-ft of 66-in RCP
85-ft of Dual 7'x 4' Box
Raven South to Outfall

Starting TW
@ Top of Exist Dual 7' x 4' Box

RAVENSWAY
RAVENCROSS
CYPRESS CREEK
PARK FOREST
LAKE FOREST
SANDY BROOK
TALL FOREST
FAIRBRIDGE
RAVENSONG
SCAMP
SHAFT
RAVENSWAY CENTER
NEVERMORE
BIRDCALL
BERTANI
HUFFMEISTER
OLD HUFFMEISTER
RAVENS BRANCH
PINE SPRING
DRAKE HOLLOW
RAVENS CAW
BEACON HOLL
RAVENS ROOST
RAVEN ROOST
VERNON
BLACK BIRD
CROW
RAVEN SOUTH
WESTOVER
JASPER
RAVENWING
CYPRESS N HOUSTON
CYPRESS CREEK FOREST
CYPRESS CORNER
CYPRESS PARK
SPUR
MARRS
- K163-01-00
- E133-00-00

N
0 400
Feet
1 in = 400 ft

Legend

- RavenSouth_Storm
- Offsite_Storm

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HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN19103MF14701

EXISTING DRAINAGE AREA & SYSTEM LAYOUT MAP

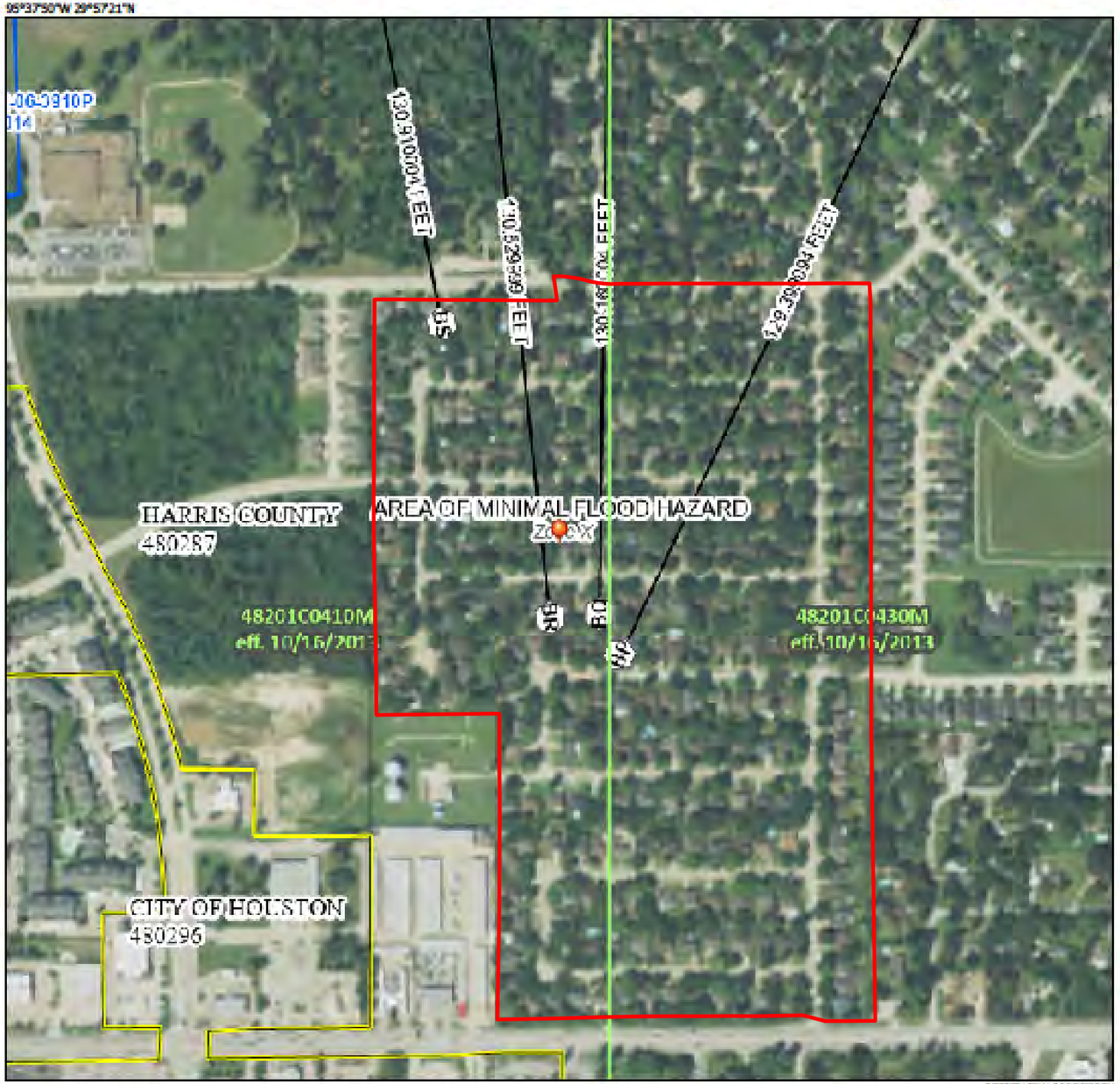
JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 2

Date Saved: 2/15/2022 4:47:32 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\2-Exist DA Map.mxd

National Flood Hazard Layer FIRMette

95°37'50"W 29°57'21"N



95°37'13"W 29°56'50"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- (1) Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/14/2021 at 6:05 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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RAVENSWAY SOUTH SUBDIVISION
UPIN 19103MF14701

FLOOD INSURANCE RATE MAP

JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 3

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Date Saved: 2/15/2022 4:50:09 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\4-Topo Map.mxd



Legend

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130.0000001 - 130.25	132.5000001 - 132.75	135.2500001 - 135.5
130.2500001 - 130.5	132.7500001 - 133	135.5000001 - 135.75
130.5000001 - 130.75	133.0000001 - 133.25	135.7500001 - 136
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131.0000001 - 131.25	133.5000001 - 133.75	136.2500001 - 136.5
	133.7500001 - 134	136.5000001 - 136.75

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RAVENSWAY SOUTH SUBDIVISION
UPIN 19103MF14701

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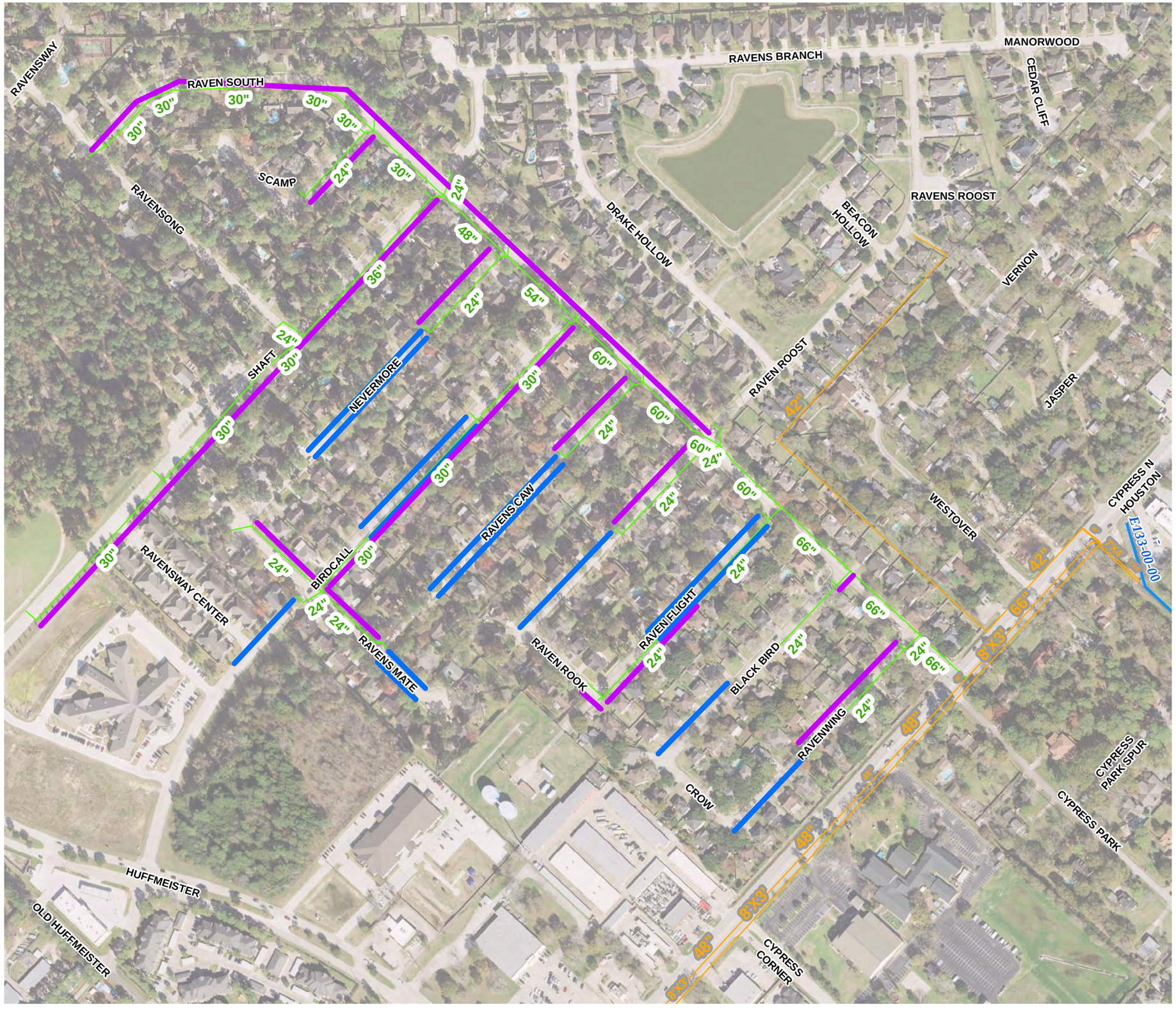
JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 4



N

0 300

Feet

1 in = 300 ft

Legend

Ravensway South Existing Storm Sewers

Fail_Mode

Gutter

Pipe HGL

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HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN19103MF14701

EXISTING STORM SEWER HGL & SPREAD RESULTS

JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 5

Date Saved: 2/15/2022 4:53:34 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\5-Exist Results.mxd

PROPOSED INLET & MANHOLE SCHEDULE
42 Each - Replace B-B Plates w/Grates
14 Each - Type C-1 Inlets (New Locations) w/24-inch Leads
4 Each - Type C-2 Inlets w/30-inch Leads

1 Each - Type "C" Manhole On Existing 66-inch RCP (Raven South)
1 Each - Type "C" Manhole On Existing 24-inch RCP (Raven Flight)
2 Each - Type "C" Manhole On Existing 30-inch RCP
7 Each Type "C" Manhole on Proposed 66-inch RCP
10 Each Type "C" Manhole on Proposed 42-inch RCP
1 Each Type "C" Manhole on Proposed 36-inch RCP

PROPOSED PIPE REPLACEMENT SCHEDULE
66-inch RCP - 1750 LF Raven South

42-inch RCP - 1820 LF Shaft Dr

36-inch RCP - 340 LF Birdcall Dr
42-inch RCP - 820 LF Birdcall Dr

30-inch RCP - 205 LF Raven Flight Dr

36-inch RCP - 65 LF Raven South @ Blackbird
36-inch RCP - 500 LF Raven Wing

24-inch RCP - 1060 LF Extensions @ Raven Wing, Blackbird, Raven Roost, Ravens Caw, Nevermore

N

0 300

Feet

1 in = 300 ft

Legend

- Ravensway South Existing Storm Sewers
- Proposed Storm Sewers
- Manholes

Proposed Inlets

- B-B w/Grate (Prop)
- C-1 (Exist)
- C-1 (Prop)
- C-2 (Prop)
- Double Grate (Driveway)
- Gutter Fails

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HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN19103MF14701

PROPOSED STORM SEWER & INLET IMPROVEMENTS

JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 6

Date Saved: 2/15/2022 5:06:22 PM V:\Harris County\Ravensway South\GIS\Report Exhibits\6-Proposed Storm_Inlets.mxd

PROPOSED PIPE REPLACEMENT SCHEDULE
10' x 6' RCB - 2300 LF Raven South
48-inch RCP - 160 LF Raven South

48-inch RCP - 25 LF Shaft Dr
42-inch RCP - 1800 LF Shaft Dr

36-inch RCP - 24 LF Birdcall Dr
42-inch RCP - 695 LF Birdcall Dr
48-inch RCP - 440 LF Birdcall Dr

36-inch RCP - 225 LF Raven Mate Dr

30-inch RCP - 340 LF Ravens Caw Dr

30-inch RCP - 70 LF Raven Roost Dr

30-inch RCP - 410 LF Raven Flight Dr
36-inch RCP - 400 LF Raven Flight Dr

36-inch RCP - 65 LF Blackbird Dr

36-inch RCP - 500 LF Raven Wing Dr

24-inch RCP - 1060 LF Extensions @ Raven Wing, Blackbird, Raven Roost, Ravens Caw, Nevermore

PROPOSED INLET SCHEDULE
42 Each - Replace B-B Plates w/Grates
14 Each - Type C-1 Inlets (New Locations) w/24-inch Leads
4 Each - Type C-2 Inlets w/30-inch Leads

N

0 300

Feet

1 in = 300 ft

Legend

- Ravensway South Existing Storm Sewers
- Alternative 2 Storm

Proposed Inlets

- B-B w/Grate (Prop)
- C-1 (Exist)
- C-1 (Prop)
- C-2 (Prop)
- Double Grate (Driveway)
- Gutter Fails

Costello

Costello, Inc.
Engineering and Surveying
TBPE Firm Registration No. 280

HCED SUBDIVISION DRAINAGE PROJECTS
RAVENSWAY SOUTH SUBDIVISION
UPIN19103MF14701

ALTERNATIVE 2 STORM SEWER & INLET IMPROVEMENTS

JOB NO.: 2018287-HCE-40-002	DATE: FEB 2022	BY: GPF

EXHIBIT 7

Date Saved: 2/18/2022 8:56:58 AM V:\Harris County\Ravensway South\GIS\Report Exhibits\7-Alt 2 Storm_Inlets.mxd

VI. APPENDICES

APPENDIX A-1
EXISTING CONDITIONS 50% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR - EXISTING CONDITIONS
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF14701)
Date : 02/14/2022
By : GPF
Reviewed By:

Select Rainfall Data: Atlas 14 HC Reg 3

COH I-D-F Coefficients: Return Freq (yr) = 2; b : 48.35; d : 0.7244; e : 0.9007; Peaking Factor C_f : 1.00

$i = b/(d+Tc)^e$ Initial $T_c = 10A^{0.17}/L^{0.5}$; 15 ; A=Drainage Area

$Q = C_f * C * A * I$

V_{MIN} in Pipe = 12.00 ft/s

V_{MAX} @ Outfall = 8.00 ft/s

Starting FL from LiDAR

Starting TW (Soffit) = @ Outfall

Fixed Curb Height @ inlet (ft) = 0.50

RUNOFF COEFFICIENTS (C) FOR DRAINAGE AREA DEVELOPMENT TYPES

	AL	BUSINESS DISTRICTS	PARKS & OPEN AREAS
	1/4 ac & Smaller Lots		
	0.55	0.80	0.18

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	2-year Computations Intensity "i" (in/hr)	2-year Computations Flow (cfs)
Raven Song Drive		S.1.C	S	A1-C-1&2	1.6349							
Raven South Drive		S	R	A1-A&B-1&2	2.2538							
Raven South Drive		R	Q									
Raven South Drive		Q	P	A3-A&B-1&2	2.9238							
Raven South Drive		P	O									
Raven South Drive		O	N									
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2	1.8846							
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2	1.0755							
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2	0.9607							
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2	0.9956							
Raven South Drive	Ravens Caw	J	H	A10-A-1&2	1.0017							
Raven South Drive		H	G									
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2	1.0228							
Raven South Drive		F.2	F									
Raven South Drive		F	E	A14-A-1&2	1.1371							
Raven South Drive	Ravens Flight Dr	E	D									
Raven South Drive		D	C	A16-A-1&2	1.3717							
Raven South Drive	Blackbird Dr	C	B									
Raven South Drive		B	A	A18-A-1&2	1.2100							
Cypress North Houst	Raven Wing Dr	A	CNH-1									
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2									
Cypress North Houston		CNH-2	CNH-3									
Cypress North Houst	(South Trunkline)	CNH-3	E133									
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2	3.4862							
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2	1.9712							
Shaft Drive		M.9	M.8	C1-A&B-1&2	1.8431	4.2248						
Shaft Drive		M.8	M.7									
Shaft Drive		M.7	M.5	C1-A&B-1&2	2.5051	22.8323						
Shaft Drive		M.5	M.4									
Shaft Drive		M.4	M.3	C4-A-1&2	2.0244							
Shaft Drive		M.3	M.2	C5-A&B-1&2	3.9219							
Shaft Drive		M.2	M	C6-A&B-1&2	2.7910							
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2	4.5239							
Nevermore Drive		L.1.A	L	D2-A&B-1&2	1.2770							
Birdcall Lane		K.7	K.6	E1-A&B-1&2	2.4690							
Birdcall Lane		K.6	K.5	E2-A&B-1&2	1.5307							
Birdcall Lane		K.5	K.3									
Birdcall Lane		K.3	K.1	E4-A&B-1&2	4.6657							
Birdcall Lane		K.1	K	E5-A&B-1&2	1.6504							
Ravens Mate Drive (N)		K.7.1	K.7	L1-A&B-1&2	2.8026							
Ravens Mate Drive (S)		K.7.2	K.7	K1-A&B-1&2	2.7541							
Ravens Mate Drive (S)		K.7.2.A	K.7.2	K1-C-1&2	2.0029							
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2	5.3142							
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2	1.0077							
Ravens Roost Drive		G.2.A	G.1.A	G1-A&B-1&2	3.8638							
Ravens Roost Drive		G.1.A	G	G2-A&B-1&2	1.4552							
Ravens Flight Drive		E.4	E.3	H1-A&B-1&2	2.3772							
Ravens Flight Drive		E.3	E.1									
Ravens Flight Drive		E.1	E	H3-A&B-1&2	3.7651							
Ravens Rook Drive		E.4.C	E.4	K1-C-1&2	1.5183							
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2	2.9666							
Blackbird Drive		C.1.A	C	I2-A&B-1&2	2.9466							
Raven Wing Drive		A.2.A	A.1,A	J1-A&B-1&2	5.1118							
Raven Wing Drive		A.1,A	A	J2-A&B-1&2	1.7690							
				Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4						0.4266		
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5							45.01		
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1							45.01		
				Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate								
Raven Roost (Lake)		RR	RR7		39.7800							
Raven Roost (Lake)		RR7	RR8									
Raven Roost (Lake)		RR8	CNH-3									
				Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes						0.2828		
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2		19.9300							
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3		3.5600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3		6.1200							
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4		2.8700							
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3		2.2900							
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4		19.9600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	10						53.13		

Street Name	Reach (ft)	No. of BBLs	Pipe Diameter (inches) or Span (ft)	X	Height (ft)	Pipe Type	Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{DES}) (fps)	Design Capacity (Q_{DES}) (cfs)
Raven Song Drive	60				24	RCP	0.013	3.14	0.500	**0.200**	3.2	10.12
Raven South Drive	200				30	RCP	0.013	4.91	0.625	**0.130**	3.0	14.79
Raven South Drive	70				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.71
Raven South Drive	428				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.70
Raven South Drive	86				30	RCP	0.013	4.91	0.625	**0.128**	3.0	14.67
Raven South Drive	165				30	RCP	0.013	4.91	0.625	**0.036**	1.6	7.76
Raven South Drive	285				30	RCP	0.013	4.91	0.625	**0.274**	4.4	21.46
Raven South Drive	285				48	RCP	0.013	12.57	1.000	**0.158**	4.5	57.08
Raven South Drive	285				54	RCP	0.013	15.90	1.125	**0.123**	4.3	68.91
Raven South Drive	285				60	RCP	0.013	19.63	1.250	**0.140**	5.0	97.57
Raven South Drive	200				60	RCP	0.013	19.63	1.250	**0.122**	4.6	90.98
Raven South Drive	95				60	RCP	0.013	19.63	1.250	**0.122**	4.6	90.98
Raven South Drive	68				60	RCP	0.013	19.63	1.250	**0.033**	2.4	47.03
Raven South Drive	208				60	RCP	0.013	19.63	1.250	**0.033**	2.4	47.03
Raven South Drive	25				66	RCP	0.013	23.76	1.375	**0.080**	4.0	94.98
Raven South Drive	272				66	RCP	0.013	23.76	1.375	**0.147**	5.4	128.78
Raven South Drive	15				66	RCP	0.013	23.76	1.375	**-0.133**	#NUM!	#NUM!
Raven South Drive	275				66	RCP	0.013	23.76	1.375	**0.138**	5.3	124.83
Raven South Drive	15				66	RCP	0.013	23.76	1.375	**0.200**	6.3	150.18
Cypress North Houst	200				66	RCP	0.013	23.76	1.375	**0.315**	7.9	188.47
Cypress North Houst	555				66	RCP	0.013	23.76	1.375	**0.114**	4.8	113.14
Cypress North Houston	65				66	RCP	0.013	23.76	1.375	**-1.062**	#NUM!	#NUM!
Cypress North Houst	85	2	7	X	4	RCB	0.013	54.22	1.327	**-0.071**	#NUM!	#NUM!
Raven Park Dr (Scamp Dr)	258				24	RCP	0.013	3.14	0.500	**0.221**	3.4	10.62
Raven Park Dr (Scamp Dr)	25				24	RCP	0.013	3.14	0.500	**2.800**	12.0	37.85
Shaft Drive	279				30	RCP	0.013	4.91	0.625	**0.179**	3.5	17.36
Shaft Drive	305				30	RCP	0.013	4.91	0.625	**0.023**	1.3	6.21
Shaft Drive	483				30	RCP	0.013	4.91	0.625	**-0.039**	#NUM!	#NUM!
Shaft Drive	120				30	RCP	0.013	4.91	0.625	**0.483**	5.8	28.52
Shaft Drive	25				36	RCP	0.013	7.07	0.750	**1.360**	11.0	77.78
Shaft Drive	590				36	RCP	0.013	7.07	0.750	**0.098**	3.0	20.91
Shaft Drive	15				36	RCP	0.013	7.07	0.750	**0.200**	4.2	29.83
Nevermore Drive	311				24	RCP	0.013	3.14	0.500	**0.450**	4.8	15.18
Nevermore Drive	25				24	RCP	0.013	3.14	0.500	**1.520**	8.9	27.89
Birdcall Lane	24				30	RCP	0.013	4.91	0.625	**0.542**	6.1	30.19
Birdcall Lane	315				30	RCP	0.013	4.91	0.625	**0.127**	3.0	14.62
Birdcall Lane	380				30	RCP	0.013	4.91	0.625	**0.118**	2.9	14.11
Birdcall Lane	415				30	RCP	0.013	4.91	0.625	**0.224**	4.0	19.42
Birdcall Lane	25				36	RCP	0.013	7.07	0.750	**-0.200**	#NUM!	#NUM!
Ravens Mate Drive (N)	288				24	RCP	0.013	3.14	0.500	**0.354**	4.3	13.46
Ravens Mate Drive (S)	216				24	RCP	0.013	3.14	0.500	**0.435**	4.8	14.92
Ravens Mate Drive (S)	48				24	RCP	0.013	3.14	0.500	**0.292**	3.9	12.22
Ravens Caw Drive	311				24	RCP	0.013	3.14	0.500	**0.119**	2.5	7.80
Ravens Caw Drive	25				24	RCP	0.013	3.14	0.500	**1.400**	8.5	26.77
Ravens Roost Drive	353				24	RCP	0.013	3.14	0.500	**0.218**	3.4	10.57
Ravens Roost Drive	70				24	RCP	0.013	3.14	0.500	**0.514**	5.2	16.22
Ravens Flight Drive	396				24	RCP	0.013	3.14	0.500	**0.376**	4.4	13.88
Ravens Flight Drive	345				24	RCP	0.013	3.14	0.500	**0.223**	3.4	10.68
Ravens Flight Drive	61				30	RCP	0.013	4.91	0.625	**0.197**	3.7	18.19
Ravens Rook Drive	14				24	RCP	0.013	3.14	0.500	**4.286**	14.9	46.83
Blackbird Drive	436				24	RCP	0.013	3.14	0.500	**0.252**	3.6	11.36
Blackbird Drive	61				24	RCP	0.013	3.14	0.500	**0.410**	4.6	14.48
Raven Wing Drive	436				24	RCP	0.013	3.14	0.500	**0.261**	3.7	11.57
Raven Wing Drive	61				24	RCP	0.013	3.14	0.500	**0.377**	4.4	13.89
Cypress-N. Houston (North Trunkline)	418				42	RCP	0.013	9.62	0.875	**0.129**	3.8	36.16
Cypress-N. Houston (North Trunkline)	1,448				48	RCP	0.013	12.57	1.000	**0.122**	4.0	50.22
Raven Roost (Lake)	1,787				42	RCP	0.013	9.62	0.875	**0.090**	3.1	30.18
Raven Roost (Lake)	459				42	RCP	0.013	9.62	0.875	**0.146**	4.0	38.44
Raven Roost (Lake)	69	2			36	RCP	0.013	14.14	0.750	**-0.275**	#NUM!	#NUM!
Cypress-N. Houston (South Trunkline)	499	5	X	3	RCB		0.013	14.11	0.977	**0.329**	6.5	91.12
Cypress-N. Houston (South Trunkline)	144	5	X	3	RCB		0.013	14.11	0.977	**0.566**	8.5	119.51
Cypress-N. Houston (South Trunkline)	25	5	X	3	RCB		0.013	14.11	0.977	**1.640**	14.4	203.44
Cypress-N. Houston (South Trunkline)	75	8	X	3	RCB		0.013	23.11	1.131	**1.240**	13.8	319.30
Cypress-N. Houston (South Trunkline)	2,450	8	X	3	RCB		0.013	23.11	1.131	**0.105**	4.0	93.05
Cypress-N. Houston (South Trunkline)	25				54	RCP	0.013	15.90	1.125	**4.680**	26.7	425.42
Cypress-N. Houston (South Trunkline)	52				42	RCP	0.013	9.62	0.875	**0.327**	6.0	57.53

Street Name	Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)
Raven Song Drive	0.12	**0.000**	**126.94**	**126.82**	128.94	128.82
Raven South Drive	0.26	**0.000**	**126.82**	**126.56**	129.32	129.06
Raven South Drive	0.09	**0.000**	**126.56**	**126.47**	129.06	128.97
Raven South Drive	0.55	**0.000**	**126.47**	**125.92**	128.97	128.42
Raven South Drive	0.11	**0.000**	**125.92**	**125.81**	128.42	128.31
Raven South Drive	0.06	**0.000**	**125.81**	**125.75**	128.31	128.25
Raven South Drive	0.78	**0.800**	**125.75**	**124.97**	128.25	127.47
Raven South Drive	0.45	**0.200**	**124.17**	**123.72**	128.17	127.72
Raven South Drive	0.35	**0.100**	**123.52**	**123.17**	128.02	127.67
Raven South Drive	0.40	**0.000**	**123.07**	**122.67**	128.07	127.67
Raven South Drive	0.24	**0.000**	**122.67**	**122.43**	127.67	127.43
Raven South Drive	0.12	**0.000**	**122.43**	**122.31**	127.43	127.31
Raven South Drive	0.02	**0.000**	**122.31**	**122.29**	127.31	127.29
Raven South Drive	0.07	**0.000**	**122.29**	**122.22**	127.29	127.22
Raven South Drive	0.02	**0.000**	**122.22**	**122.20**	127.72	127.70
Raven South Drive	0.40	**0.000**	**122.20**	**121.80**	127.70	127.30
Raven South Drive	-0.02	**0.000**	**121.80**	**121.82**	127.30	127.32
Raven South Drive	0.38	**-0.200**	**121.82**	**121.44**	127.32	126.94
Raven South Drive	0.03	**0.200**	**121.64**	**121.61**	127.14	127.11
Cypress North Houst	0.63	**0.000**	**121.41**	**120.78**	126.91	126.28
Cypress North Houst	0.63	**0.000**	**120.78**	**120.15**	126.28	125.65
Cypress North Houston	-0.69	**0.000**	**120.15**	**120.84**	125.65	126.34
Cypress North Houst	-0.06		**120.84**	**120.90**	124.84	124.90
Raven Park Dr (Scamp Dr)	0.57	**0.000**	**127.02**	**126.45**	129.02	128.45
Raven Park Dr (Scamp Dr)	0.70	**0.000**	**126.45**	**125.75**	128.45	127.75
Shaft Drive	0.50	**0.700**	**127.33**	**126.83**	129.83	129.33
Shaft Drive	0.07	**0.000**	**126.13**	**126.06**	128.63	128.56
Shaft Drive	-0.19	**0.000**	**126.06**	**126.25**	128.56	128.75
Shaft Drive	0.58	**0.000**	**126.25**	**125.67**	128.75	128.17
Shaft Drive	0.34	**0.000**	**125.67**	**125.33**	128.67	128.33
Shaft Drive	0.58	**0.050**	**125.33**	**124.75**	128.33	127.75
Shaft Drive	0.03	**0.500**	**124.70**	**124.67**	127.70	127.67
Nevermore Drive	1.40	**0.050**	**127.45**	**126.05**	129.45	128.05
Nevermore Drive	0.38	**2.100**	**126.00**	**125.62**	128.00	127.62
Birdcall Lane	0.13	**0.000**	**126.03**	**125.90**	128.53	128.40
Birdcall Lane	0.40	**0.000**	**125.90**	**125.50**	128.40	128.00
Birdcall Lane	0.45	**0.000**	**125.50**	**125.05**	128.00	127.55
Birdcall Lane	0.93	**0.000**	**125.05**	**124.12**	127.55	126.62
Birdcall Lane	-0.05	**1.100**	**124.12**	**124.17**	127.12	127.17
Ravens Mate Drive (N)	1.02	**0.100**	**127.15**	**126.13**	129.15	128.13
Ravens Mate Drive (S)	0.94	**0.109**	**127.08**	**126.14**	129.08	128.14
Ravens Mate Drive (S)	0.14	**0.000**	**127.22**	**127.08**	129.22	129.08
Ravens Caw Drive	0.37	**0.150**	**125.84**	**125.47**	127.84	127.47
Ravens Caw Drive	0.35	**2.300**	**125.32**	**124.97**	127.32	126.97
Ravens Roost Drive	0.77	**0.050**	**125.69**	**124.92**	127.69	126.92
Ravens Roost Drive	0.36	**2.200**	**124.87**	**124.51**	126.87	126.51
Ravens Flight Drive	1.49	**0.000**	**126.13**	**124.64**	128.13	126.64
Ravens Flight Drive	0.77	**0.000**	**124.64**	**123.87**	126.64	125.87
Ravens Flight Drive	0.12	**1.550**	**123.87**	**123.75**	126.37	126.25
Ravens Rook Drive	0.60	**0.000**	**126.73**	**126.13**	128.73	128.13
Blackbird Drive	1.10	**0.100**	**126.27**	**125.17**	128.27	127.17
Blackbird Drive	0.25	**3.000**	**125.07**	**124.82**	127.07	126.82
Raven Wing Drive	1.14	**0.000**	**125.28**	**124.14**	127.28	126.14
Raven Wing Drive	0.23	**2.500**	**124.14**	**123.91**	126.14	125.91
Cypress-N. Houston (North Trunkline)	0.54	**0.000**	**124.59**	**124.05**	128.09	127.55
Cypress-N. Houston (North Trunkline)	1.77	**1.500**	**124.05**	**122.28**	128.05	126.28
Raven Roost (Lake)	1.61	**0.000**	**122.93**	**121.32**	126.43	124.82
Raven Roost (Lake)	0.67	**0.000**	**121.32**	**120.65**	124.82	124.15
Raven Roost (Lake)	-0.19	**0.000**	**120.65**	**120.84**	123.65	123.84
Cypress-N. Houston (South Trunkline)	1.64	**0.000**	**127.22**	**125.58**	130.22	128.58
Cypress-N. Houston (South Trunkline)	0.82	**0.000**	**125.58**	**124.76**	128.58	127.76
Cypress-N. Houston (South Trunkline)	0.41	**0.000**	**124.76**	**124.35**	127.76	127.35
Cypress-N. Houston (South Trunkline)	0.93	**0.000**	**124.35**	**123.42**	127.35	126.42
Cypress-N. Houston (South Trunkline)	2.58	**0.000**	**123.42**	**120.84**	126.42	123.84
Cypress-N. Houston (South Trunkline)	1.17	**0.000**	**124.59**	**123.42**	129.09	127.92
Cypress-N. Houston (South Trunkline)	0.17	**0.000**	**124.76**	**124.59**	128.26	128.09

Street Name	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)
Raven Song Drive	1.05	Vel-OK	0.021	0.013	133.50	133.48
Raven South Drive	1.57	Vel-OK	0.035	0.071	133.48	133.41
Raven South Drive	1.57	Vel-OK	0.035	0.025	133.41	133.39
Raven South Drive	2.61	Vel-OK	0.097	0.417	133.39	132.97
Raven South Drive	2.61	Vel-OK	0.097	0.084	132.97	132.89
Raven South Drive	2.61	Vel-OK	0.097	0.161	132.89	132.73
Raven South Drive	5.02	Vel-OK	0.361	1.028	132.73	131.70
Raven South Drive	4.61	Vel-OK	0.163	0.464	131.70	131.24
Raven South Drive	4.24	Vel-OK	0.118	0.336	131.24	130.90
Raven South Drive	4.84	Vel-OK	0.133	0.379	130.90	130.52
Raven South Drive	5.33	Vel-OK	0.161	0.323	130.52	130.20
Raven South Drive	5.33	Vel-OK	0.161	0.153	130.20	130.05
Raven South Drive	5.74	Vel-OK	0.187	0.127	130.05	129.92
Raven South Drive	5.74	Vel-OK	0.187	0.389	129.92	129.53
Raven South Drive	4.76	Vel-OK	0.114	0.028	129.53	129.50
Raven South Drive	5.23	Vel-OK	0.137	0.372	129.50	129.13
Raven South Drive	5.25	Vel-OK	0.138	0.021	129.13	129.11
Raven South Drive	5.61	Vel-OK	0.157	0.432	129.11	128.68
Raven South Drive	5.62	Vel-OK	0.158	0.024	128.68	128.65
Cypress North Houst	6.03	Vel-OK	0.182	0.364	128.65	128.29
Cypress North Houst	7.92	Vel-OK	0.314	1.744	128.29	126.54
Cypress North Houston	7.92	Vel-OK	0.314	0.204	126.54	126.34
Cypress North Houst	3.47	Vel-OK	0.063	0.054	124.95	**124.90**
Raven Park Dr (Scamp Dr)	2.18	Vel-OK	0.091	0.236	133.02	132.78
Raven Park Dr (Scamp Dr)	3.28	Vel-OK	0.208	0.052	132.78	**132.73**
Shaft Drive	1.26	Vel-OK	0.023	0.063	134.92	134.85
Shaft Drive	1.26	Vel-OK	0.023	0.069	134.85	134.79
Shaft Drive	4.50	Vel-OK	0.290	1.400	134.79	133.39
Shaft Drive	4.50	Vel-OK	0.290	0.348	133.39	133.04
Shaft Drive	3.48	Vel-OK	0.136	0.034	133.04	133.00
Shaft Drive	4.37	Vel-OK	0.214	1.265	133.00	131.74
Shaft Drive	4.84	Vel-OK	0.263	0.039	131.74	**131.70**
Nevermore Drive	2.79	Vel-OK	0.150	0.468	131.76	131.29
Nevermore Drive	3.46	Vel-OK	0.231	0.058	131.29	**131.24**
Birdcall Lane	3.84	Vel-OK	0.211	0.051	135.03	134.98
Birdcall Lane	4.42	Vel-OK	0.279	0.880	134.98	134.10
Birdcall Lane	4.42	Vel-OK	0.279	1.062	134.10	133.03
Birdcall Lane	5.91	Vel-OK	0.501	2.078	133.03	130.96
Birdcall Lane	4.43	Vel-OK	0.221	0.055	130.96	**130.90**
Ravens Mate Drive (N)	1.77	Vel-OK	0.060	0.173	135.20	**135.03**
Ravens Mate Drive (S)	2.93	Vel-OK	0.166	0.358	135.38	**135.03**
Ravens Mate Drive (S)	1.28	Vel-OK	0.032	0.015	135.40	**135.38**
Ravens Caw Drive	3.26	Vel-OK	0.205	0.636	131.23	130.59
Ravens Caw Drive	3.76	Vel-OK	0.273	0.068	130.59	**130.52**
Ravens Roost Drive	2.40	Vel-OK	0.111	0.393	130.57	130.18
Ravens Roost Drive	3.16	Vel-OK	0.192	0.135	130.18	**130.05**
Ravens Flight Drive	2.42	Vel-OK	0.113	0.448	130.41	129.96
Ravens Flight Drive	2.42	Vel-OK	0.113	0.390	129.96	129.57
Ravens Flight Drive	2.77	Vel-OK	0.110	0.067	129.57	**129.50**
Ravens Rook Drive	0.98	Vel-OK	0.019	0.003	130.41	**130.41**
Blackbird Drive	1.87	Vel-OK	0.067	0.293	129.54	129.25
Blackbird Drive	3.45	Vel-OK	0.230	0.140	129.25	**129.11**
Raven Wing Drive	3.14	Vel-OK	0.190	0.829	129.67	128.84
Raven Wing Drive	4.05	Vel-OK	0.316	0.193	128.84	**128.65**
Cypress-N. Houston (North Trunkline)	4.68	Vel-OK	0.200	0.837	**130.55**	129.71
Cypress-N. Houston (North Trunkline)	3.58	Vel-OK	0.098	1.422	129.71	**128.29**
Raven Roost (Lake)	2.94	Vel-OK	0.079	1.414	126.76	125.35
Raven Roost (Lake)	2.94	Vel-OK	0.079	0.363	125.35	124.98
Raven Roost (Lake)	2.00	Vel-OK	0.045	0.031	124.98	**124.95**
Cypress-N. Houston (South Trunkline)	3.71	Vel-OK	0.108	0.541	131.40	130.86
Cypress-N. Houston (South Trunkline)	4.20	Vel-OK	0.139	0.201	130.86	130.66
Cypress-N. Houston (South Trunkline)	1.48	Vel-OK	0.017	0.004	**130.66**	130.66
Cypress-N. Houston (South Trunkline)	4.41	Vel-OK	0.126	0.095	130.66	130.56
Cypress-N. Houston (South Trunkline)	5.94	Vel-OK	0.229	5.607	130.56	**124.95**
Cypress-N. Houston (South Trunkline)	3.29	Vel-OK	0.071	0.018	**130.58**	**130.56**
Cypress-N. Houston (South Trunkline)	5.52	Vel-OK	0.279	0.145	130.69	**130.55**

Street Name	Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ inlets (ft)	2-year Design Check at Inlet Location
Raven Song Drive	**131.48**	130.98	**132.80**	2.518	HGL Too High
Raven South Drive	**131.18**	130.68	**132.20**	2.805	HGL Too High
Raven South Drive	**131.91**	131.41	**133.30**	2.005	HGL Too High
Raven South Drive	**131.73**	131.23	**132.80**	2.160	HGL Too High
Raven South Drive	**132.15**	131.65	**132.85**	1.323	HGL Too High
Raven South Drive	**131.90**	131.40	**132.70**	1.489	HGL Too High
Raven South Drive	**131.78**	131.28	**132.50**	1.447	HGL Too High
Raven South Drive	**131.31**	130.81	**132.50**	0.890	HGL Too High
Raven South Drive	**131.43**	130.93	**132.50**	0.306	HGL Too High
Raven South Drive	**131.38**	130.88	**132.20**	0.020	HGL Too High
Raven South Drive	**130.86**	130.36	**132.10**	0.162	HGL Too High
Raven South Drive	**130.82**	130.32	**131.40**	-0.121	OK
Raven South Drive	**130.24**	129.74	**131.50**	0.305	HGL Too High
Raven South Drive	**131.05**	130.55	**131.80**	-0.632	OK
Raven South Drive	**130.51**	130.01	**131.10**	-0.481	OK
Raven South Drive	**130.75**	130.25	**131.10**	-0.749	OK
Raven South Drive	**129.88**	129.38	**130.90**	-0.251	OK
Raven South Drive	**129.90**	129.40	**130.90**	-0.292	OK
Cypress North

APPENDIX A-2
EXISTING CONDITIONS 50% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR - EXISTING CONDITIONS
Project : HCED Suddivision Drainage Projects - Ravenswway South (UPIN 19103MF14701)
Date : 02/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
2	28.0	0.0208	Crown	0.33	1.00	13.00	0.271
3	41.0	0.0208	Crown	0.50	0.50	20.00	0.417
4	25.0	0.0208	Blvd	0.50	0.50	12.00	0.250
5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency = 2 yr
Override Inlet Time (Tc) (min) =
$T_{Spread}=1.243(Q_{Gutter}*N/S_x^{1.67}*S_x^{.5/3})^{3/8}$
$Y_{Gutter}*T_{Spread}*S_x$
Length of Curb Inlet Opening for Intercepting Total Q_{Gutter}
$L_T=0.6*Q^{0.42}*S_x^{0.3}*(1/(N*S_x))^{0.6}$
N-Value (Pavement) = 0.016 TxDOT Hydraulic Manual Table 4-8

INLET PONDING CALCULATIONS

$Q_{weir}=C_{weir}*L_{weir}*H^{1/2}$ C_{weir} = 2.60
$Q_{orif}=C_{orif}*A_{orif}*(2gH)^{1/2}$ C_{orif} = 0.60
$H_{weir}=(Q/(C*L))^{1/3}$
$H_{orif}=(Q/(C*A*Sqrt(2g)))^2$
$T_{Inlet}=H/S_x$

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Street Type	Pavement Width (B-B) (ft)	Cross-Slope (S_x) (ft/ft)	Street Type	Curb Height (ft)	Curb Width (ft)	Maximum Allowable Ponding Spread @ Inlets (ft)	Maximum Allowable Ponding Depth @ Inlets (ft)
Raven Song Drive		S.1.C	S	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		S	R	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		R	Q	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		Q	P	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		P	O	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		O	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Raven Park (Scamp)	N	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Shaft Dr	M	L	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Nevermore Dr	L	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Birdcall Dr	K	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Caw	J	H	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		H	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Roost Dr	G	F.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F.2	F	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Flight Dr	E	D	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		D	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Blackbird Dr	C	B	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		B	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	Raven Wing Dr	A	CNH-1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houston		CNH-2	CNH-3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(South Trunkline)	CNH-3	E133	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.1.A	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.9	M.8	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.8	M.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.7	M.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.5	M.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.4	M.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.3	M.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.2	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.2.A	L.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.1.A	L	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.7	K.6	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.6	K.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.5	K.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.3	K.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.1	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive (N)		K.7.1	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive (S)		K.7.2	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive (S)		K.7.2.A	K.7.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.2.A	J.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.1.A	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Roost Drive		G.2.A	G.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Roost Drive		G.1.A	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.4	E.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.3	E.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.1	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Rook Drive		E.4.C	E.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.2.A	C.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.1.A	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.2.A	A.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.1.A	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR	RR7	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR7	RR8	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR8	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

INLET #1 (FAR INLET)

Gutter Run 1

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.7150	**0.25**	24.43	3.80	1.49	10.59	0.22	-
0.5156	**0.25**	23.90	3.84	1.09	9.41	0.20	-
				No Inlet			-
1.2436	**0.25**	25.39	3.72	2.55	12.94	0.27	-
				No Inlet			-
				No Inlet			-
1.4209	**0.60**	25.64	3.70	2.89	11.52	0.24	-
0.3618	**0.25**	23.36	3.89	0.77	8.28	0.17	-
0.4702	**0.25**	23.76	3.86	1.00	9.10	0.19	-
0.4974	**0.25**	23.84	3.85	1.05	9.29	0.19	-
0.5169	**0.60**	23.90	3.84	1.09	7.99	0.17	-
				No Inlet			-
0.2972	**0.25**	23.08	3.91	0.64	7.71	0.16	-
				No Inlet			-
0.4009	**0.25**	23.51	3.88	0.85	8.59	0.18	-
				No Inlet			-
0.5908	**0.25**	24.11	3.82	1.24	9.89	0.21	-
				No Inlet			-
0.6880	**0.75**	24.36	3.80	1.44	8.50	0.18	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.8696	**0.25**	24.76	3.77	1.80	11.37	0.24	-
0.2450	**0.33**	22.81	3.94	0.53	6.82	0.14	-
2.8062	**0.25**	26.99	3.60	2.95	**13.68**	0.29	-
				No Inlet			-
9.7221	**0.32**	29.93	3.40	7.17	**18.21**	0.38	-
				No Inlet			-
1.1707	**0.25**	25.28	3.73	2.40	12.66	0.26	-
0.8212	**0.25**	24.66	3.78	1.71	11.14	0.23	-
1.1405	**0.25**	25.23	3.73	2.34	12.54	0.26	-
1.7472	**0.26**	26.03	3.67	3.53	**14.52**	0.30	-
0.4409	**0.40**	23.66	3.86	0.94	8.14	0.17	-
1.4076	**0.25**	25.62	3.70	2.87	**13.53**	0.28	-
0.1762	**0.25**	22.37	3.98	0.39	6.37	0.13	-
				No Inlet			-
1.6098	**0.25**	25.87	3.68	3.26	**14.20**	0.30	-
0.5994	**0.25**	24.14	3.82	1.26	9.94	0.21	-
0.7157	**0.25**	24.43	3.80	1.50	10.60	0.22	-
0.5607	**0.35**	24.03	3.83	1.18	9.11	0.19	-
1.4945	**0.25**	25.73	3.70	3.04	**13.82**	0.29	-
1.8808	**0.25**	26.18	3.66	3.79	**15.02**	0.31	-
0.2607	**0.25**	22.89	3.93	0.56	7.35	0.15	-
1.6803	**0.25**	25.96	3.68	3.40	**14.42**	0.30	-
0.4530	**0.25**	23.70	3.86	0.96	8.98	0.19	-
0.2745	**0.25**	22.96	3.92	0.59	7.49	0.16	-
				No Inlet			-
1.7081	**0.25**	25.99	3.68	3.45	**14.50**	0.30	-
0.4293	**0.25**	23.62	3.87	0.91	8.81	0.18	-
1.6622	**0.25**	25.94	3.68	3.36	**14.36**	0.30	-
1.2458	**0.25**	25.39	3.72	2.55	12.95	0.27	-
1.2452	**0.25**	25.39	3.72	2.55	12.94	0.27	-
0.6353	**0.29**	24.23	3.82	1.33	9.87	0.21	-

Gutter Run 2

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.9199	**0.25**	24.85	3.76	1.90	11.60	0.24	-
0.3491	**0.64**	23.31	3.89	0.75	6.85	0.14	-
				No Inlet			-
0.6625	**0.50**	24.30	3.81	1.39	9.05	0.19	-
				No Inlet			-
				No Inlet			-
0.4637	**0.25**	23.73	3.86	0.98	9.06	0.19	-
0.1560	**0.25**	22.21	3.99	0.34	6.10	0.13	-
0.4905	**0.25**	23.82	3.85	1.04	9.24	0.19	-
0.4982	**0.25**	23.85	3.85	1.05	9.30	0.19	-
0.4848	**0.25**	23.80	3.85	1.03	9.20	0.19	-
				No Inlet			-
0.2140	**0.25**	22.62	3.95	0.47	6.84	0.14	-
				No Inlet			-
0.7362	**0.45**	24.47	3.80	1.54	9.59	0.20	-
				No Inlet			-
0.7809	**0.70**	24.57	3.79	1.63	9.02	0.19	-
				No Inlet			-
0.5220	**0.25**	23.92	3.84	1.10	9.45	0.20	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.4591	**0.40**	23.72	3.86	0.97	8.26	0.17	-
1.1175	**0.25**	25.20	3.74	2.30	12.45	0.26	-
1.4186	**0.25**	25.64	3.70	1.54	10.70	0.22	-
				No Inlet			-
13.1102	**0.27**	30.73	3.35	9.52	**20.91**	0.44	-
				No Inlet			-
0.8537	**0.47**	24.73	3.77	1.77	10.05	0.21	-
1.1027	**0.25**	25.17	3.74	2.27	12.39	0.26	-
0.2445	**0.25**	22.80	3.94	0.53	7.18	0.15	-
0.4331	**0.25**	23.63	3.87	0.92	8.84	0.18	-
0.1548	**0.25**	22.20	3.99	0.34	6.08	0.13	-
0.3369	**0.25**	23.26	3.90	0.72	8.07	0.17	-
0.5854	**0.32**	24.10	3.83	1.23	9.41	0.20	-
				No Inlet			-
0.6909	**0.31**	24.37	3.80	1.45	10.05	0.21	-
0.1926	**0.25**	22.48	3.97	0.42	6.58	0.14	-
1.1560	**0.25**	25.26	3.73	2.37	12.60	0.26	-
1.4748	**0.25**	25.71	3.70	3.00	**13.76**	0.29	-
0.5084	**0.50**	23.88	3.84	1.08	8.22	0.17	-
0.6752	**0.25**	24.33	3.81	1.41	10.38	0.22	-
0.2361	**0.25**	22.76	3.94	0.51	7.09	0.15	-
0.5489	**0.40**	24.00	3.83	1.16	8.82	0.18	-
0.2610	**0.25**	22.89	3.93	0.56	7.35	0.15	-
0.9560	**0.44**	24.92	3.76	1.98	10.58	0.22	-
				No Inlet			-
0.2269	**0.45**	22.70	3.95	0.49	6.26	0.13	-
1.0890	**0.25**	25.15	3.74	2.24	12.33	0.26	-
0.1593	**0.31**	22.24	3.99	0.35	5.90	0.12	-
0.2194	**0.70**	22.66	3.95	0.48	5.69	0.12	-
0.6190	**0.25**	24.19	3.82	1.30	10.06	0.21	-
0.2317	**0.25**	22.73	3.94	0.50	7.04	0.15	-

Inlet 1 (Far)

Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (H) (ft)
B-B	Sag	24.85	3.76	3.38	7.25	0.15
B-B	Sag	23.90	3.84	1.83	0.77	0.02
					No Inlet	
B-B	Sag	25.39	3.72	3.90	9.17	0.19
					No Inlet	
					No Inlet	
B-B	Sag	25.64	3.70	3.84	8.93	0.19
B-B	Sag	23.36	3.89	1.11	Below Gut	-0.03
B-B	Sag	23.82	3.85	2.03	1.71	0.04
B-B	Sag	23.85	3.85	2.11	2.04	0.04
B-B	Sag	23.90	3.84	2.12	2.08	0.04
					No Inlet	
B-B	Sag	23.08	3.91	1.10	Below Gut	-0.03
					No Inlet	
B-B	Sag	24.47	3.80	2.37	3.20	0.07
					No Inlet	
B-B	Sag	24.57	3.79	2.86	5.20	0.11
					No Inlet	
B-B	Sag	24.36	3.80	2.53	3.86	0.08
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
C-1	Sag	24.76	3.77	2.76	elow Gut	-0.06
C-1	Sag	25.20	3.74	2.80	elow Gut	-0.05
B-B	Sag	26.99	3.60	4.45	11.10	0.23
					No Inlet	
B-B	Sag	30.73	3.35	16.58	122.81	2.56
					No Inlet	
B-B Grate	Sag	25.28	3.73	4.15	1.76	0.04
B-B	Sag	25.17	3.74	3.96	9.36	0.20
B-B	Sag	25.23	3.73	2.84	5.14	0.11
C-1	Sag	26.03	3.67	4.40	2.07	0.04
C-1	Sag	23.66	3.86	1.27	elow Gut	-0.08
B-B	Sag	25.62	3.70	3.55	7.89	0.16
B-B	Sag	24.10	3.83	1.60	elow Gut	-0.01
					No Inlet	
B-B	Sag	25.87	3.68	4.66	11.83	0.25
B-B	Sag	24.14	3.82	1.67	elow Gut	0.00
B-B	Sag	25.26	3.73	3.84	8.95	0.19
B-B	Sag	25.71	3.70	4.14	10.02	0.21
B-B	Sag	25.73	3.70	4.07	9.77	0.20
C-1	Sag	26.18	3.66	5.15	4.06	0.08
C-1	Sag	22.89	3.93	1.07	elow Gut	-0.08
C-1	Sag	25.96	3.68	4.51	2.36	0.05
C-1	Sag	23.70	3.86	1.52	elow Gut	-0.08
B-B	Sag	24.92	3.76	2.54	3.92	0.08
					No Inlet	
B-B	Sag	25.99	3.68	3.91	9.20	0.19
B-B	Sag	25.15	3.74	3.12	6.25	0.13
B-B Grate	Sag	25.94	3.68	3.69	0.71	0.01
C-1	Sag	25.39	3.72	3.00	elow Gut	-0.04
C-1	Sag	25.39	3.72	3.82	0.43	0.01
C-1	Sag	24.23	3.82	1.82	elow Gut	-0.07

INLET #2 (NEAR INLET)

Gutter Run 3

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				No Inlet			-
0.9598	**0.25**	24.93	3.76	1.98	11.78	0.25	-
				No Inlet			-
0.3517	**0.25**	23.32	3.89	0.75	8.19	0.17	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.3340	**0.25**	23.24	3.90	0.72	8.04	0.17	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2254	**0.25**	22.69	3.95	0.49	6.97	0.15	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
1.6365	**0.60**	25.91	3.68	3.31	12.12	0.25	-
0.4116	**0.33**	23.55	3.87	0.88	8.23	0.17	-
1.0193	**0.25**	25.03	3.75	1.12	9.50	0.20	-
				No Inlet			-
1.4587	**0.32**	25.69	3.70	1.17	9.22	0.19	-
				No Inlet			-
0.6447	**0.47**	24.26	3.81	1.35	9.08	0.19	-
1.1695	**0.25**	25.28	3.73	2.40	12.65	0.26	-
1.8237	**0.26**	26.12	3.67	3.68	**14.74**	0.31	-
0.4796	**0.40**	23.79	3.85	1.02	8.40	0.17	-
1.3995	**0.25**	23.51	3.88	0.85	8.58	0.18	-
0.2100	**0.25**	22.60	3.96	0.46	6.79	0.14	-
				No Inlet			-
1.6754	**0.25**	25.95	3.68	3.39	**14.40**	0.30	-
0.6535	**0.25**	24.28	3.81	1.37	10.26	0.21	-
0.2287	**0.25**	22.71	3.95	0.50	7.01	0.15	-
0.5301	**0.35**	23.94	3.84	1.12	8.93	0.19	-
				No Inlet			-
2.0390	**0.25**	26.34	3.65	4.09	**15.46**	0.32	-
0.2929	**0.25**	23.06	3.92	0.63	7.67	0.16	-
1.0229	**0.25**	25.04	3.75	2.11	12.06	0.25	-
0.4879	**0.25**	23.81	3.85	1.03	9.23	0.19	-
0.5709	**0.25**	24.06	3.83	1.20	9.77	0.20	-
				No Inlet			-
1.6720	**0.25**	25.95	3.68	3.38	**14.39**	0.30	-
				No Inlet			-
1.0105	**0.25**	25.02	3.75	2.08	12.00	0.25	-
1.2503	**0.37**	25.40	3.72	2.56	12.04	0.25	-
2.4692	**0.25**	26.73	3.62	4.92	**16.56**	0.35	-
0.6992	**0.29**	24.39	3.80	1.46	10.22	0.21	-

Gutter Run 4

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				No Inlet			-
0.4293	**0.64**	23.62	3.87	0.91	7.38	0.15	-
				No Inlet			-
0.6660	**0.50**	24.31	3.81	1.40	9.07	0.19	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2237	**0.25**	22.68	3.95	0.49	6.95	0.14	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2862	**0.25**	23.02	3.92	0.62	7.60	0.16	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.5210	**0.40**	23.92	3.84	1.10	8.65	0.18	-
0.1971	**0.25**	22.51	3.96	0.43	6.64	0.14	-
0.8238	**0.25**	24.66	3.78	0.91	8.80	0.18	-
				No Inlet			-
1.0464	**0.27**	25.08	3.75	0.85	8.45	0.18	-
				No Inlet			-
				No Inlet			-
1.3533	**0.25**	25.55	3.71	2.76	13.34	0.28	-
0.6447	**0.47**	24.26	3.81	1.35	9.08	0.19	-
1.1695	**0.25**	25.28	3.73	2.40	12.65	0.26	-
0.5199	**0.25**	23.91	3.84	1.10	9.44	0.20	-
0.2017	**0.25**	22.54	3.96	0.44	6.70	0.14	-
0.3250	**0.25**	23.20	3.90	0.70	7.96	0.17	-
0.5591	**0.32**	24.03	3.83	1.18	9.25	0.19	-
				No Inlet			-
0.6896	**0.31**	24.37	3.80	1.44	10.04	0.21	-
0.2049	**0.25**	22.56	3.96	0.45	6.73	0.14	-
0.7022	**0.25**	24.40	3.80	1.47	10.53	0.22	-
0.1885	**0.50**	22.45	3.97	0.41	5.74	0.12	-
				No Inlet			-
0.5370	**0.25**	24.64	3.06	0.44	6.30	0.14	-
0.2017	**0.25**	22.55	3.96	0.44	6.70	0.14	-
0.7784	**0.25**	24.57	3.79	1.62	10.92	0.23	-
0.2028	**0.75**	22.55	3.96	0.44	5.46	0.11	-

Inlet 2 (Near)

Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (H) (ft)
					No Inlet	
B-B	Sag	**24.93**	3.76	2.87	5.25	0.11

APPENDIX A-3
EXISTING CONDITIONS 1% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR - EXISTING CONDITIONS
Project : HCED Suddivision Drainage Projects - Ravenswway South (UPIN 19103MF14701)
Date : 02/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients	
Return Freq (yr)	100
b :	60.66
d :	4.44
e :	0.5797
Peaking Factor C_f :	1.00

$Q_{Allow}=C_{Wide}*W_{Front}*H_{AVG}^{1.5}$
Where W_{Front} = Width of Pavement to F/C; H_{AVG} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = **128.50**

Allowable 100-yr HGL Height Above T/C @ Location: **1.50** / **0.50**

C_{Wide} = **2.10**

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Elevations at D/S High Point in Street: Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	100-Year Analysis Calculations: Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity = i " (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	HGL Above(+) / Below(-) T/C @ D/S High (ft)	Check HGL or Act Gutter Depth vs. Nat Grnd @ ROW Locations	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
Raven Song Drive		**S.1.C**	**S**	**132.72**	132.72	132.22	**133.00**	**25.9**	25.9	8.39	7.54	2.40	Vel-OK	0.111	0.07	177.50	177.44	46.023	Increase Pipe Size	44.783	OK	0.422	Method 2 - OK
Raven South Drive		S	**R**	**132.72**	132.72	132.22	**133.00**	0.4	26.3	8.32	17.80	3.63	Vel-OK	0.188	0.38	177.44	177.06	46.256	Increase Pipe Size	44.716	OK	0.642	Method 2 - OK
Raven South Drive		R	**Q**	**132.72**	132.72	132.22	**133.00**	0.9	27.2	8.18	17.80	3.63	Vel-OK	0.188	0.13	177.06	176.93	45.149	Increase Pipe Size	44.339	OK	0.642	Method 2 - OK
Raven South Drive		Q	**P**	**132.72**	132.72	132.22	**133.00**	0.3	27.6	8.13	30.48	6.21	Vel-OK	0.552	2.36	176.93	174.56	45.197	Increase Pipe Size	44.207	Check Hi Spot	0.871	Method 2 - OK
Raven South Drive		P	**O**	**131.91**	131.91	131.41	**132.70**	1.1	28.7	7.97	30.48	6.21	Vel-OK	0.552	0.47	174.56	174.09	42.414	Increase Pipe Size	42.654	OK	0.871	Method 2 - OK
Raven South Drive		O	**N**	**131.91**	131.91	131.41	**132.70**	0.2	28.9	7.94	30.48	6.21	Vel-OK	0.552	0.91	174.09	173.18	42.189	Increase Pipe Size	42.179	OK	0.871	Method 2 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**132.05**	132.05	131.55	**132.40**	**28.4**	29.4	7.88	61.33	12.49	rease Pipe S	2.236	6.37	173.18	166.81	41.397	Increase Pipe Size	41.127	Check Lo Spot	1.328	Increase Pipe Size
Raven South Drive	**Shaft Dr**	M	**L**	**131.70**	131.70	131.20	**132.50**	**34.0**	34.0	7.32	149.60	11.90	Vel-OK	1.085	3.09	166.81	163.71	35.495	Increase Pipe Size	35.105	Check Lo Spot	2.327	Increase Pipe Size
Raven South Drive	**Nevermore Dr**	L	**K**	**132.07**	132.07	131.57	**132.30**	**28.9**	34.4	7.27	175.75	11.05	Vel-OK	0.799	2.28	163.71	161.44	32.284	Increase Pipe Size	31.644	Check Lo Spot	2.584	Increase Pipe Size
Raven South Drive	**Birdcall Dr**	K	**J**	**131.50**	131.50	131.00	**132.30**	**30.4**	34.8	7.23	249.65	12.71	rease Pipe S	0.919	2.62	161.44	158.82	30.058	Increase Pipe Size	29.938	Check Lo Spot	3.240	Increase Pipe Size
Raven South Drive	**Ravens Caw**	J	**H**	**131.01**	131.01	130.51	**131.80**	**29.2**	35.2	7.19	277.23	14.12	rease Pipe S	1.133	2.27	158.82	156.55	27.959	Increase Pipe Size	27.809	Check Lo Spot	3.475	Increase Pipe Size
Raven South Drive		H	**G**	**131.05**	131.05	130.55	**132.20**	0.2	35.4	7.16	277.23	14.12	rease Pipe S	1.133	1.08	156.55	155.48	25.733	Increase Pipe Size	25.503	Check Lo Spot	3.475	Increase Pipe Size
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**131.05**	131.05	130.55	**132.20**	**28.9**	35.5	7.15	300.78	15.32	rease Pipe S	1.334	0.91	155.48	154.57	25.236	Increase Pipe Size	24.426	Check Lo Spot	3.672	Increase Pipe Size
Raven South Drive		F.2	**F**	**130.63**	130.63	130.13	**132.20**	0.1	35.6	7.14	300.78	15.32	rease Pipe S	1.334	2.77	154.57	151.80	23.519	Increase Pipe Size	23.939	Check Lo Spot	3.672	Increase Pipe Size
Raven South Drive		F	**E**	**130.63**	130.63	130.13	**131.50**	0.2	35.8	7.12	303.93	12.79	rease Pipe S	0.819	0.20	151.80	151.59	21.285	Increase Pipe Size	21.165	Check Lo Spot	3.705	Increase Pipe Size
Raven South Drive	**Ravens Flight Dr**	E	**D**	**130.63**	130.63	130.13	**131.50**	**30.1**	35.9	7.12	333.77	14.05	rease Pipe S	0.988	2.69	151.59	148.90	20.840	Increase Pipe Size	20.960	Check Lo Spot	3.936	Increase Pipe Size
Raven South Drive		D	**C**	**130.15**	130.15	129.65	**131.00**	0.3	36.2	7.08	337.58	14.21	rease Pipe S	1.011	0.15	148.90	148.75	19.023	Increase Pipe Size	18.753	Check Lo Spot	3.975	Increase Pipe Size
Raven South Drive	**Blackbird Dr**	C	**B**	**130.15**	130.15	129.65	**131.00**	**28.9**	36.2	7.08	360.53	15.17	rease Pipe S	1.153	3.17	148.75	145.58	18.852	Increase Pipe Size	18.602	Check Lo Spot	4.147	Increase Pipe Size
Raven South Drive		B	**A**	**130.50**	130.50	130.00	**131.60**	0.3	36.5	7.05	363.67	15.31	rease Pipe S	1.173	0.18	145.58	145.41	15.792	Increase Pipe Size	15.082	Check Lo Spot	4.180	Increase Pipe Size
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**130.50**	130.50	130.00	**131.60**	**29.4**	36.5	7.05	390.27	16.43	rease Pipe S	1.351	2.70	145.41	142.70	15.606	Increase Pipe Size	14.906	Check Lo Spot	4.375	Increase Pipe Size
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**131.83**	131.83	131.33	**131.40**	**2.5**	36.7	7.03	**501.42**	21.10	rease Pipe S	2.230	12.37	142.70	130.33	12.075	Increase Pipe Size	10.875	Check Lo Spot	5.101	Increase Pipe Size
Cypress North Houston		CNH-2	**CNH-3**	**131.83**	131.83	131.33	**131.40**	0.4	37.2	6.99	501.42	21.10	rease Pipe S	2.230	1.45	130.33	128.88	-1.699	Method 1 - OK	-1.499	OK		Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**131.83**	131.83	131.33	**131.40**	**144.2**	144.2	3.34	**501.42**	9.25	ase Outfall	0.449	0.38	128.88	**128.50**	-2.948	Method 1 - OK	-2.948	OK		Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**131.75**	131.75	131.25	**132.50**	**27.5**	27.5	8.15	15.63	4.97	Vel-OK	0.477	1.23	174.69	173.46	43.472	Increase Pipe Size	42.942	OK	0.599	Method 2 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**131.94**	131.94	131.44	**132.40**	0.9	28.3	8.02	24.09	7.67	Vel-OK	1.134	0.28	173.46	**173.18**	42.010	Increase Pipe Size	41.520	OK	0.759	Method 2 - OK
Shaft Drive		**M.9**	**M.8**	**132.07**	132.07	131.57	**133.60**	**28.7**	28.7	7.97	14.13	2.88	Vel-OK	0.119	0.33	186.80	186.47	55.318	Increase Pipe Size	54.728	OK	0.569	Method 2 - OK
Shaft Drive		M.8	**M.7**	**131.98**	131.98	131.48	**133.20**	1.6	30.4	7.75	14.13	2.88	Vel-OK	0.119	0.36	186.47	186.10	54.396	Increase Pipe Size	54.486	OK	0.569	Method 2 - OK
Shaft Drive		M.7	**M.5**	**131.98**	131.98	131.48	**133.20**	1.8	32.1	7.53	54.69	11.14	Vel-OK	1.778	8.59	186.10	177.52	54.834	Increase Pipe Size	54.124	OK	1.238	Increase Pipe Size
Shaft Drive		M.5	**M.4**	**131.98**	131.98	131.48	**133.20**	0.7	32.8	7.45	54.69	11.14	Vel-OK	1.778	2.13	177.52	175.38	45.958	Increase Pipe Size	45.538	OK	1.238	Increase Pipe Size
Shaft Drive		M.4	**M.3**	**132.16**	132.16	131.66	**133.20**	0.2	33.0	7.43	62.19	8.80	Vel-OK	0.869	0.22	175.38	175.17	44.175	Increase Pipe Size	43.225	OK	1.347	Increase Pipe Size
Shaft Drive		M.3	**M.2**	**132.16**	132.16	131.66	**133.20**	0.0	33.1	7.42	78.15	11.06	Vel-OK	1.373	8.10	175.17	167.07	44.148	Increase Pipe Size	43.008	Check Hi Spot	1.547	Increase Pipe Size
Shaft Drive		M.2	**M**	**131.59**	131.59	131.09	**132.50**	0.9	34.0	7.32	88.33	12.50	rease Pipe S	1.754	0.26	167.07	**166.81**	35.718	Increase Pipe Size	35.478	Check Lo Spot	1.679	Increase Pipe Size
Nevermore Drive		**L.2.A**	**L.1.A**	**131.41**	131.41	130.91	**132.40**	**28.0**	28.0	8.06	20.07	6.39	Vel-OK	0.787	2.45	166.48	164.03	35.375	Increase Pipe Size	35.065	OK	0.682	Method 2 - OK
Nevermore Drive		L.1.A	**L**	**132.09**	132.09	131.59	**132.30**	0.8	28.9	7.95	25.36	8.07	Vel-OK	1.257	0.31	164.03	**163.71**	32.898	Increase Pipe Size	31.938	Check Hi Spot	0.780	Method 2 - OK
Birdcall Lane		**K.7**	**K.6**	**132.26**	132.26	131.76	**132.80**	**28.7**	28.7	7.97	43.97	8.96	Vel-OK	1.149	0.28	172.63	172.36	41.175	Increase Pipe Size	40.375	Check Hi Spot	1.063	Increase Pipe Size
Birdcall Lane		K.6	**K.5**	**132.26**	132.26	131.76	**132.80**	0.0	28.7	7.97	50.64	10.32	Vel-OK	1.524	4.80	172.36	167.56	40.789	Increase Pipe Size	40.099	Check Lo Spot	1.155	Increase Pipe Size
Birdcall Lane		K.5	**K.3**	**131.49**	131.49	130.99	**132.10**	0.5	29.3	7.90	50.64	10.32	Vel-OK	1.524	5.79	167.56	161.76	35.777	Increase Pipe Size	36.067	Check Hi Spot	1.155	Increase Pipe Size
Birdcall Lane		K.3	**K.1**	**131.49**	131.49	130.99	**132.10**	0.6	29.9	7.81	69.73	14.20	rease Pipe S	2.890	11.99	138.61	126.62	7.693	Increase Pipe Size	7.123	Check Lo Spot	1.413	Increase Pipe Size
Birdcall Lane		K.1	**K**	**131.52**	131.52	131.02	**132.30**	0.5	30.4	7.75	76.19	10.78	Vel-OK	1.305	0.33	161.76	161.44	30.734	Increase Pipe Size	30.244	Check Hi Spot	1.498	Increase Pipe Size
Ravens Mate Drive (N)		**K.7.1**	**K.7**	**132.09**	132.09	131.59	**132.80**	**27.0**	27.0	8.22	12.67	4.03	Vel-OK	0.314	0.90	173.54	**172.63**	42.168	Increase Pipe Size	41.448	OK	0.539	Method 2 - OK
Ravens Mate Drive (S)		**K.7.2**	**K.7**	**131.97**	131.97	131.47	**132.80**	**28.2**	28.2	8.05	21.06	6.70	Vel-OK	0.866	1.87	174.51	**172.63**	43.287	Increase Pipe Size	42.537	OK	0.700	Method 2 - OK
Ravens Mate Drive (S)		**K.7.2.A**	**K.7.2**	**132.22**	132.22	131.72	**132.80**	**26.3**	26.3	8.33	9.17	2.92	Vel-OK	0.164	0.08	174.58	**174.51**	43.066	Increase Pipe Size	42.366	OK	0.461	Method 2 - OK
Ravens Caw Drive		**J.2.A**	**J.1.A**	**130.75**	130.75	130.25	**131.70**	**28.4**	28.4	8.01	23.41	7.45	Vel-OK	1.071	3.33	162.52	159.19	32.031	Increase Pipe Size	31.771	OK	0.741	Method 2 - OK
Ravens Caw Drive		J.1.A	**J**	**131.01**	131.01	130.51	**131.80**	0.7	29.1	7.91	27.52	8.76	Vel-OK	1.480	0.37	159.19	**158.82**	28.719	Increase Pipe Size	28.179	OK	0.815	Method 2 - OK
Ravens Roost Drive		**G.2.A**	**G.1.A**	**130.80**	130.80	130.30	**131.70**	**27.7**	27.7	8.12	17.25	5.49	Vel-OK	0.581	2.05	158.27	156.22	28.081	Increase Pipe Size	27.471	OK	0.630	Method 2 - OK
Ravens Roost Drive		G.1.A	**G**	**131.09**	131.09	130.59	**132.20**	1.1	28.8	7.96	23.30	7.42	Vel-OK	1.061	0.74	156.22	**155.48**	25.919	Increase Pipe Size	25.129	OK	0.747	Method 2 - OK
Ravens Flight Drive		**E.4**	**E.3**	**130.83**	130.83	130.33	**132.25**	**27.7**	27.7	8.11	17.38	5.53	Vel-OK	0.591	2.34	156.36	154.02	25.929	Increase Pipe Size	25.529	OK	0.632	Method 2 - OK
Ravens Flight Drive		E.3	**E.1**	**130.62**	130.62	130.12	**131.50**	1.2	28.9	7.94	17.38	5.53	Vel-OK	0.591	2.04	154.02	151.98	22.961	Increase Pipe Size	23.401	OK	0.632	Method 2 - OK
Ravens Flight Drive		E.1	**E**	**130.63**	130.63	130.13	**131.50**	1.0	29.9	7.80	32.88	6.70	Vel-OK	0.643	0.39	151.98	**151.59**	21.832	Increase Pipe Size	21.352	OK	0.914	Method 2 - OK
Ravens Rook Drive		**E.4.C**	**E.4**	**131.47**	131.47	130.97	**132.25**	**25.8**	25.8	8.41	7.02	2.24	Vel-OK	0.096	0.01	156.37	**156.36**	25.643	Increase Pipe Size	24.903	OK	0.409	Method 2 - OK
Blackbird Drive		**C.2.A**	**C.1.A**	**130.64**	130.64	130.14	**131.30**	**27.1**	27.1	8.20	13.38	4.26	Vel-OK	0.350	1.53	151.08	149.55	21.086	Increase Pipe Size	20.436	OK	0.553	Method 2 - OK
Blackbird Drive		C.1.A	**C**	**130.15**	130.15	129.65	**131.00**	1.7	28.8	7.96	25.87	8.24	Vel-OK	1.308	0.80	149.55	**148.75**	20.100	Increase Pipe Size	19.400	OK	0.795	Method 2 - OK
Raven Wing Drive		**A.2.A**	**A.1.A**	**129.78**	129.78	129.28	**130.90**	**28.3**	28.3	8.02	22.56	7.18	Vel-OK	0.994	4.34	150.80	146.47	21.223	Increase Pipe Size	21.023	OK	0.726	Method 2 - OK
Raven Wing Drive		A.1,A	**A**	**130.50**	130.50	130.00	**131.60**	1.0	29.3	7.88	29.84	9.50	Vel-OK	1.739	1.06	146.47	**145.41**	17.027	Increase Pipe Size	15.967	OK	0.855	Method 2 - OK
				tage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.4864**						-0.175	-0.175					
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**131.83**	**132.60**	**132.60**	**132.60**				**119.90**	12.46	rease Pipe S	1.420	5.94	**158.73**	152.79	25.699	Increase Pipe Size	26.129	Check Lo Spot	1.528	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**131.83**	**131.40**	**131.40**	**131.40**				119.90	9.54	Vel-OK	0.697	10.09	152.79	**142.70**	20.763	Increase Pipe Size	21.393	Check Lo Spot	1.528	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**131.83**	**131.20**	**131.20**	**131.20**	**139.1**	139.1	3.41	74.56	7.75	Vel-OK	0.549	9.81	141.43	131.62	8.401	Increase Pipe Size	10.231	Check Lo Spot	1.179	Increase Pipe Size
Raven Roost (Lake)		RR7	**RR8**	**131.83**	**131.40**	**131.40**	**131.40**	3.8	143.0	3.36	74.56	7.75	Vel-OK	0.549	2.52	131.62	129.10	-0.412	Method 1 - OK	0.218	Check Lo Spot		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**131.83**	**131.40**	**131.40**	**131.40**	1.0	144.0	3.34	74.56	5.27	Vel-OK	0.312	0.22	129.10	**128.88**	-2.733	Method 1 - OK	-2.303	OK		Method 1 - OK
				entage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**												
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**133.13**	**132.60**	**132.60**	**132.60**	**31.9**	31.9	7.55	**120.42**	8.53	Vel-OK	0.575	2.87	163.35	160.48	29.821	Increase Pipe Size	30.751	Check Lo Spot	1.450	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**133.13**	**132.60**	**132.60**	**132.60**	1.0	32.9	7.44	139.77	9.90	Vel-OK	0.774	1.11	160.48	159.37	27.453	Increase Pipe Size	27.883	Check Lo Spot	1.589	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**133.13**	**132.60**	**132.60**	**132.60**	0.2	33.2	7.41	**49.63**	3.52	Vel-OK	0.098	0.02	159.37	159.34	26.339	Increase Pipe Size	26.769	Check Lo Spot	0.929	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**133.13**	**132.60**	**132.60**	**132.60**	0.1	33.3	7.40	**241.82**	10.46	Vel-OK	0.711	0.53	159.34	158.81	26.314	Increase Pipe Size	26.744	Check Lo Spot	2.183	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**133.13**	**131.40**	**131.40**	**131.40**	**32.0**	33.4	7.38	**316.92**	13.71	rease Pipe S	1.222	29.93	158.81	**128.88**	25.781	Increase Pipe Size	27.411	Check Lo Spot	2.532	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**131.83**	**132.60**	**132.60**	**132.60**	**31.9**	31.9	7.55	**120.59**	7.58	Vel-OK	0.376	0.09	**158.90**	**158.81**	25.875	Increase Pipe Size	26.305	Check Lo Spot	1.451	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**133.13**	**132.60**	**132.60**	**132.60**				**125.89**	13.08	rease Pipe S	1.566	0.81	159.54	**158.73**	26.514	Increase Pipe Size	26.944	Check Lo Spot	1.503	Increase Pipe Size

APPENDIX A-4
EXISTING CONDITIONS
1% AEP SHEET FLOW COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR - EXISTING CONDITIONS
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF14701)
Date : 02/14/2022
By : GPF
Reviewed By:

Under HGL Conditions Which Exceed NG Elevations @ ROW Inlet Capacities Are Computed Using
Minimum Head = Difference in Gutter Elevations between High Point and Inlet OR Maximum Allowable Ponding Depth

Maximum Allowable HGL above T/C Elev @ Inlets = 1.50
Maximum Allowable HGL above T/C Elev @ D/S High = 0.50

Assume Overflows at High Points is Weir Flow
$Q_{weir} = C_{weir} * L_{weir} * H^{3/2}$
$C_{weir} = 1.50$
$H_{weir} = (Q/(C*L))^{2/3}$

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Inlet Type	Sag or On-Grade	Number of Inlets @ Location	INLET LEADS: Inlet 1 (Far) to Inlet 2 (Near) Length (ft)	Inlet 1 (Far) to Inlet 2 (Near) Size (in)	Inlet 1 (Far) to Inlet 2 (Near) Pipe Type	Inlet 2 (Near) to MH Length (ft)	Inlet 2 (Near) to MH Size (in)	Inlet 2 (Near) to MH Pipe Type	Gutter Elev @ Inlets	Gutter Elev @ D/S High Point	Minimum NG Elev @ D/S High or Inlet	100-year HGL @ MH (ft)	100-year Headloss through Inlet Leads (ft) Inlet 1 (Far)	100-year Headloss through Inlet Leads (ft) Inlet 2 (Near)	Available Head for Inlet Flow Only (ft)	Inlet Capacity@ Available Head (cfs)	100-yr Local Runoff To Inlets (cfs)	Carry-Over from U/S High Point (cfs)	Total Flow @ Inlets (cfs)	Available Capacity or Overflow Contained	Critical Minimum NG Elev	Available Head @ Inlets (ft)	Capacity @ Available Head (cfs)	Cumulative Inlet Capacity	Sheet Flow @ Lowest Inlets (100yr-	Available Capacity Exceeds Sheet Flow
Raven Song Drive		**S.1.C**	**S**	B-B	Sag	1							130.98	132.22	132.80	177.50	-	-	1.24	11.45	7.70	-	7.70	**Cap-OK**	130.05	-	-			
Raven South Drive		S	**R**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	130.68	132.22	132.20	177.44	0.02	0.01	1.54	25.52	10.60	-	10.60	**Cap-OK**	130.05	-	-			
Raven South Drive		R	**Q**														-	-				-				-				
Raven South Drive		Q	**P**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	131.23	132.22	132.80	176.93	0.03	0.02	0.99	20.46	13.63	-	13.63	**Cap-OK**	130.05	-	-			
Raven South Drive		P	**O**														-	-				-				-				
Raven South Drive		O	**N**														-	-				-				-				
Raven South Drive	**Raven Park (Scamp)**	N	**M**	B-B	Sag	1				**36**	**24**	**RCP**	131.28	131.55	132.40	173.18	-	0.05	0.27	5.34	8.74	-	**8.74**	**Ovrfl-OK**	130.05	-	-			
Raven South Drive	**Shaft Dr**	M	**L**	B-B	Sag	2	**28**	**24**	**RCP**	**50**	**24**	**RCP**	130.81	131.20	132.50	166.81	0.04	0.27	0.39	12.84	5.22	3.40	**16.77**	**Ovrfl-OK**	130.05	-	-			
Raven South Drive	**Nevermore Dr**	L	**K**	B-B	Sag	1				**36**	**24**	**RCP**	130.93	131.57	132.30	163.71	-	0.05	0.64	8.23	4.62	3.93	**8.55**	**Ovrfl-OK**	130.05	-	-			
Raven South Drive	**Birdcall Dr**	K	**J**	B-B	Sag	1				**36**	**24**	**RCP**	130.88	131.00	132.20	161.44	-	0.02	0.12	3.56	4.78	0.32	**5.11**	**Ovrfl-OK**	130.05	-	-			
Raven South Drive	**Ravens Caw**	J	**H**	B-B	Sag	1				**36**	**24**	**RCP**	130.36	130.51	131.80	158.82	-	0.03	0.15	3.98	4.81	1.55	**6.35**	**Ovrfl-OK**	130.05	-	-			
Raven South Drive		H	**G**														-	-				2.37	-			-				
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	B-B	Sag	2	**28**	**24**	**RCP**	**25**	**24**	**RCP**	129.74	130.55	131.50	155.48	0.01	0.03	0.81	18.51	4.99	2.37	**7.37**	**Cap-OK**	130.05	0.81	18.51			
Raven South Drive		F.2	**F**														-	-				-				-				
Raven South Drive		F	**E**	B-B	Sag	1				**6**	**24**	**RCP**	130.01	130.13	131.10	151.80	-	0.01	0.12	3.56	5.40	-	**8.49**	**Ovrfl-OK**	130.05	0.12	3.56			
Raven South Drive	**Ravens Flight Dr**	E	**D**														-	-				4.93	-			-				
Raven South Drive		D	**C**	B-B	Sag	1				**6**	**24**	**RCP**	129.38	129.65	130.90	148.90	-	0.02	0.27	5.34	6.50	4.93	**11.43**	**Ovrfl-OK**	130.05	0.27	5.34			
Raven South Drive	**Blackbird Dr**	C	**B**														-	-				6.09	-			-				
Raven South Drive		B	**A**	B-B	Sag	1				**6**	**24**	**RCP**	129.29	130.00	130.05	145.58	-	0.02	0.71	8.66	5.75	6.09	**11.84**	**Ovrfl-OK**	130.05	0.71	8.66	**289.97**	**230.17**	**OK**
Cypress North Houst	**Raven Wing Dr**		**CNH-1**														-	-				3.18	-			-				
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**														-	-				3.18	-			-				
Cypress North Houston		CNH 2	**CNH-3**														-	-				3.18	-			-				
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**														-	-				3.18	-			-				
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	C-1	Sag	2	**28**	**24**	**RCP**				130.72	131.25	132.50	174.69	0.04	-	0.53	25.69	16.09	-	16.09	**Cap-OK**	130.05	-	-			
Raven Park Dr (Scamp Dr)		M.1.A	**N**	C-1	Sag	2	**28**	**24**	**RCP**	**25**	**24**	**RCP**	130.95	131.44	132.40	173.46	0.01	0.04	0.49	24.71	9.22	-	9.22	**Cap-OK**	130.05	-	-			
																						-								
Shaft Drive		**M.9**	**M.8**	B-B	Sag	2	**41**	**24**	**RCP**	**6**	**24**	**RCP**	130.98	131.57	133.60	186.80	0.04	0.02	0.59	15.80	14.58	-	14.58	**Cap-OK**	130.05	-	-			
Shaft Drive		M.8	**M.7**														-	-				-				-				
Shaft Drive		M.7	**M.5**	B-B	Sag	2	**41**	**30**	**RCP**	**6**	**30**	**RCP**	130.77	131.48	133.20	186.10	0.11	0.06	0.71	17.33	42.26	-	42.26	**ıcrease Inle**	130.05	-	-			
Shaft Drive		M.5	**M.4**														-	-				24.93	-			-				
Shaft Drive		M.4	**M.3**	B-B Grate	Sag	1				**6**	**24**	**RCP**	130.71	131.66	132.10	175.38	-	0.14	0.95	25.46	9.45	24.93	34.39	**Ovrfl-OK**	130.05	-	-			
Shaft Drive		M.3	**M.2**	B-B	Sag	2	**28**	**24**	**RCP**	**75**	**24**	**RCP**	130.52	131.66	132.20	175.17	0.10	1.08	1.14	21.96	18.22	8.93	27.15	**Ovrfl-OK**	130.05	-	-			
Shaft Drive		M.2	**M**	B-B	Sag	2	**28**	**24**	**RCP**	**14**	**24**	**RCP**	130.85	131.09	132.40	167.07	0.05	0.09	0.24	10.07	13.03	5.19	18.23	**Ovrfl-OK**	130.05	-	-			
																						8.15								
Nevermore Drive		**L.2.A**	**L.1.A**	C-1	Sag	2	**28**	**24**	**RCP**				130.60	130.91	132.20	166.48	0.06	-	0.31	19.65	20.79	-	20.79	**Ovrfl-OK**	130.05	-	-			
Nevermore Drive		L.1.A	**L**	C-1	Sag	2	**28**	**24**	**RCP**	**25**	**24**	**RCP**	130.63	131.59	132.10	164.03	0.01	0.03	0.96	34.58	6.14	1.14	7.28	**Cap-OK**	130.05	-	-			
																						-								
Birdcall Lane		**K.7**	**K.6**	B-B	Sag	2	**28**	**24**	**RCP**	**60**	**24**	**RCP**	130.96	131.76	132.80	172.63	0.02	0.15	0.80	18.39	11.45	-	**11.45**	**Cap-OK**	130.05	-	-			
Birdcall Lane		K.6	**K.5**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	131.07	131.76	132.20	172.36	0.01	0.01	0.69	17.08	7.32	-	7.32	**Cap-OK**	130.05	-	-			
Birdcall Lane		K.5	**K.3**														-	-				-				-				
Birdcall Lane		K.3	**K.1**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	130.42	130.99	131.80	138.61	0.06	0.05	0.57	15.53	21.51	-	21.51	**Ovrfl-OK**	130.05	-	-			
Birdcall Lane		K.1	**K**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	130.53	131.02	132.10	161.76	0.03	0.02	0.49	14.39	7.86	5.98	13.85	**Cap-OK**	130.05	-	-			
																						-								
Ravens Mate Drive (N)		**K.7.1**	**K.7**	B-B	Sag	2				**75**	**24**	**RCP**	130.87	131.59	132.80	173.54	-	0.25	0.72	17.45	13.09	-	13.09	**Cap-OK**	130.05	-	-			
																						-								
Ravens Mate Drive (S)		**K.7.2**	**K.7**	B-B	Sag	2	**28**	**24**	**RCP**	**25**	**24**	**RCP**	130.72	131.47	132.00	174.51	0.02	0.09	0.75	17.81	12.76	-	**13.43**	**Cap-OK**	130.05	-	-			
																						-								
Ravens Mate Drive (S)		**K.7.2.A**	**K.7.2**	B-B	Sag	1				**40**	**24**	**RCP**	131.02	131.72	132.60	174.58	-	0.07	0.70	8.60	9.27	-	9.27	**Ovrfl-OK**	130.05	-	-			
																						0.67								
Ravens Caw Drive		**J.2.A**	**J.1.A**	C-1	Sag	2	**28**	**24**	**RCP**				129.99	130.25	131.60	162.52	0.08	-	0.26	18.00	24.32	-	24.32	**Ovrfl-OK**	130.05	0.26	18.00			
Ravens Caw Drive		J.1.A	**J**	C-1	Sag	2	**28**	**24**	**RCP**				129.97	130.51	131.20	159.19	0.02	-	0.54	25.94	4.92	6.32	11.25	**Cap-OK**	130.05	0.54	25.94			
																						-								
Ravens Roost Drive		**G.2.A**	**G.1.A**	C-1	Sag	2	**28**	**24**	**RCP**				129.69	130.30	131.50	158.27	0.04	-	0.61	27.57	17.81	-	17.81	**Cap-OK**	130.05	0.61	27.57			
Ravens Roost Drive		G.1.A	**G**	C-1	Sag	2	**28**	**24**	**RCP**				129.80	130.59	131.30	156.22	0.01	-	0.79	31.37	7.00	-	7.00	**Cap-OK**	130.05	0.79	31.37			
																						-								
Ravens Flight Drive		**E.4**	**E.3**	B-B	Sag	2	**28**	**24**	**RCP**	**65**	**24**	**RCP**	129.93	130.33	132.10	156.36	0.02	0.16	0.40	13.01	11.18	-	**11.18**	**Cap-OK**	130.05	0.40	13.01			
Ravens Flight Drive		E.3	**E.1**														-	-				-				-				
Ravens Flight Drive		E.1	**E**	B-B	Sag	2	**28**	**24**	**RCP**	**6**	**24**	**RCP**	129.65	130.13	131.10	151.98	0.04	0.04	0.48	14.25	17.35	-	17.35	**Ovrfl-OK**	130.05	0.48	14.25			
																						3.10								
Ravens Rook Drive		**E.4.C**	**E.4**	B-B	Sag	1				**15**	**24**	**RCP**	130.23	130.97	132.10	156.37	-	0.01	0.74	8.84	7.11	-	7.11	**Cap-OK**	130.05	-	-			
																						-								
Blackbird Drive		**C.2.A**	**C.1.A**	B-B Grate	Sag	2	**28**	**24**	**RCP**				129.49	130.14	131.30	151.08	0.03	-	0.65	42.12	13.68	-	13.68	**Cap-OK**	130.05	0.65	42.12			
Blackbird Drive		C.1.A	**C**	C-1	Sag	2	**28**	**24**	**RCP**				128.95	129.65	130.60	149.55	0.03	-	0.70	29.53	13.73	-	13.73	**Cap-OK**	130.05	0.70	29.53			
																						-								
Raven Wing Drive		**A.2.A**	**A.1.A**	C-1	Sag	2	**28**	**24**	**RCP**				129.08	129.28	130.50	150.80	0.07	-	0.20	15.78	23.23	-	23.23	**Ovrfl-OK**	130.05	0.20	15.78			
Raven Wing Drive		A.1.A	**A**	C-1	Sag	2	**28**	**24**	**RCP**				128.94	130.00	130.70	146.47	0.03	-	1.06	36.34	8.41	7.44	15.85	**Cap-OK**	130.05	1.06	36.34			
																						-								

Cypress-N. Houston (North Trunkline)	**MH 1-4**	**MH 1-5**
Cypress-N. Houston (North Trunkline)	MH 1-5	**CNH-1**
Raven Roost (Lake)	**RR**	**RR7**
Raven Roost (Lake)	RR7	**RR8**
Raven Roost (Lake)	RR8	**CNH-3**
Cypress-N. Houston (South Trunkline)	**MH 2-1**	**MH 2-2**
Cypress-N. Houston (South Trunkline)	MH 2-2	**MH 1-3**
Cypress-N. Houston (South Trunkline)	MH 1-3	**MH 2-3**
Cypress-N. Houston (South Trunkline)	MH 2-3	**MH 2-4**
Cypress-N. Houston (South Trunkline)	MH 2-4	**CNH-3**
Cypress-N. Houston (South Trunkline)	**MH 1-4**	**MH 2-4**
Cypress-N. Houston (South Trunkline)	**MH 1-3**	**MH 1-4**

APPENDIX A-5
EXISTING CONDITIONS 10% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF14701)
Date : 2/14/2022
By : GPF
Reviewed By:

Select Rainfall Data
Atlas 14 HC Reg 3

COH I-D-F Coefficients	
Return Freq (yr)	10
b :	54.68
d :	6.96
e :	0.6623
Peaking Factor C_f :	1.00

i=b/(d+Tc)^e Q=C_f*C*A*I Initial T_c = 10A^0.1761 + 15

HYDRAULIC GRADE LINE COMPUTATIONS

V_{max} in Pipe = 12.00
V_{MAX} @ Outfall 8.00
Starting FL from LiDAR
Starting TW (Soffit) = @ Outfall
Fixed Curb Height @ Inlet (ft) 0.50

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	DRAINAGE AREA DEVELOPMENT AC 1/4 ac & Smaller Lots 0.55	BUSINESS DISTRICTS 0.80	PARKS & OPEN AREAS 0.18	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	10-year Computations Intensity " I " (in/hr)	10-year Computations Flow (cfs)	Reach (ft)	No. of BBLs	Pipe Diameter (inches) or Span (ft)	X	Pipe Diameter (inches) or Height (ft)	Pipe Type	Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{DES}) (fps)	Design Capacity (Q_{DES}) (cfs)	Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD})	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)	Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ Inlets (ft)	10-year Design Check at Inlet Location
Raven Song Drive		S.1.C	S	A1-C-1&2	1.6349			1.63	1.63	0.5500	0.90	25.9	25.9	5.41	4.87	60				24	RCP	0.013	3.14	0.500	0.200	3.2	10.12	0.12	0.000	126.94	126.82	128.94	128.82	1.55	Vel-OK	0.046	0.028	144.38	144.35	131.48	130.98	132.80	13.398	HGL Too High
Raven South Drive		S	R	A1-A&B-1&2	2.2538			2.25	3.89	0.5500	2.14	0.6	26.5	5.34	11.43	200				30	RCP	0.013	4.91	0.625	0.130	3.0	14.79	0.26	0.000	126.82	126.56	129.32	129.06	2.33	Vel-OK	0.078	0.155	144.35	144.19	131.18	130.68	132.20	13.671	HGL Too High
Raven South Drive		R	Q					-	3.89	0.5500	2.14	1.4	28.0	5.20	11.43	70				30	RCP	0.013	4.91	0.625	0.129	3.0	14.71	0.09	0.000	126.56	126.47	129.06	128.97	2.33	Vel-OK	0.078	0.054	144.19	144.14	131.91	131.41	133.30	12.785	HGL Too High
Raven South Drive		Q	P	A3-A&B-1&2	2.9238			2.92	6.81	0.5500	3.75	0.5	28.5	5.15	19.29	428				30	RCP	0.013	4.91	0.625	0.129	3.0	14.70	0.55	0.000	126.47	125.92	128.97	128.42	3.93	Vel-OK	0.221	0.946	144.14	143.19	131.73	131.23	132.80	12.911	HGL Too High
Raven South Drive		P	O					-	6.81	0.5500	3.75	1.8	30.3	4.98	19.29	86				30	RCP	0.013	4.91	0.625	0.128	3.0	14.67	0.11	0.000	125.92	125.81	128.42	128.31	3.93	Vel-OK	0.221	0.190	143.19	143.00	132.15	131.65	132.85	11.545	HGL Too High
Raven South Drive		O	N					-	6.81	0.5500	3.75	0.4	30.7	4.95	19.29	165				30	RCP	0.013	4.91	0.625	0.036	1.6	7.76	0.06	0.000	125.81	125.75	128.31	128.25	3.93	Vel-OK	0.221	0.365	143.00	142.64	131.90	131.40	132.70	11.605	HGL Too High
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2	1.8846			7.34	14.15	0.5500	7.78	28.9	31.4	4.89	38.05	285				30	RCP	0.013	4.91	0.625	0.274	4.4	21.46	0.78	0.800	125.75	124.97	128.25	127.47	7.75	Vel-OK	0.861	2.453	142.64	140.19	131.78	131.28	132.50	11.359	HGL Too High
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2	1.0755			41.22	55.37	0.3692	20.44	37.0	37.0	4.46	91.24	285				48	RCP	0.013	12.57	1.000	0.158	4.5	57.08	0.45	0.200	124.17	123.72	128.17	127.72	7.26	Vel-OK	0.403	1.150	140.19	139.04	131.31	130.81	132.50	9.376	HGL Too High
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2	0.9607			6.76	62.13	0.3889	24.16	29.4	37.7	4.42	106.79	285				54	RCP	0.013	15.90	1.125	0.123	4.3	68.91	0.35	0.100	123.52	123.17	128.02	127.67	6.71	Vel-OK	0.295	0.840	139.04	138.20	131.43	130.93	132.50	8.106	HGL Too High
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2	0.9956			18.87	81.01	0.4264	34.54	31.7	38.4	4.37	151.07	285				60	RCP	0.013	19.63	1.250	0.140	5.0	97.57	0.40	0.000	123.07	122.67	128.07	127.67	7.69	Vel-OK	0.336	0.959	138.20	137.24	131.38	130.88	132.20	7.316	HGL Too High
Raven South Drive	Ravens Caw	J	H	A10-A-1&2	1.0017			7.32	88.33	0.4367	38.57	29.6	39.0	4.33	167.19	200				60	RCP	0.013	19.63	1.250	0.122	4.6	90.98	0.24	0.000	122.67	122.43	127.67	127.43	8.51	Vel-OK	0.412	0.824	137.24	136.41	130.86	130.36	132.10	6.877	HGL Too High
Raven South Drive		G	G					-	88.33	0.4367	38.57	0.4	39.4	4.31	167.19	95				60	RCP	0.013	19.63	1.250	0.122	4.6	90.98	0.12	0.000	122.43	122.31	127.43	127.31	8.51	Vel-OK	0.412	0.391	136.41	136.02	130.82	130.32	131.40	6.093	HGL Too High
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2	1.0228			6.34	94.67	0.4443	42.06	29.6	39.6	4.30	180.80	68				60	RCP	0.013	19.63	1.250	0.033	2.4	47.03	0.02	0.000	122.31	122.29	127.31	127.29	9.21	Vel-OK	0.482	0.328	136.02	135.69	130.24	129.74	131.50	6.281	HGL Too High
Raven South Drive		F.2	F					-	94.67	0.4443	42.06	0.1	39.7	4.29	180.80	208				60	RCP	0.013	19.63	1.250	0.033	2.4	47.03	0.07	0.000	122.29	122.22	127.29	127.22	9.21	Vel-OK	0.482	1.002	135.69	134.69	131.05	130.55	131.80	5.144	HGL Too High
Raven South Drive		F	E	A14-A-1&2	1.1371			1.14	95.81	0.4455	42.68	0.4	40.1	4.27	182.20	25				66	RCP	0.013	23.76	1.375	0.080	4.0	94.98	0.02	0.000	122.22	122.20	127.72	127.70	7.67	Vel-OK	0.294	0.074	134.69	134.62	130.51	130.01	131.10	4.681	HGL Too High
Raven South Drive	Ravens Flight Dr	E	D					7.66	103.47	0.4532	46.90	31.4	40.1	4.27	200.03	272				66	RCP	0.013	23.76	1.375	0.147	5.4	128.78	0.40	0.000	122.20	121.80	127.70	127.30	8.42	Vel-OK	0.355	0.965	134.62	133.65	130.75	130.25	131.10	4.368	HGL Too High
Raven South Drive		D	C	A16-A-1&2	1.3717			1.37	104.84	0.4545	47.65	0.5	40.7	4.23	201.72	15				66	RCP	0.013	23.76	1.375	-0.133	#NUM!	#NUM!	-0.02	0.000	121.80	121.82	127.30	127.32	8.49	Vel-OK	0.361	0.054	133.65	133.60	129.88	129.38	130.90	4.273	HGL Too High
Raven South Drive	Blackbird Dr	C	B					5.91	110.75	0.4596	50.90	30.0	40.7	4.23	215.40	275				66	RCP	0.013	23.76	1.375	0.138	5.3	124.83	0.38	-0.200	121.82	121.44	127.32	126.94	9.07	Vel-OK	0.411	1.132	133.60	132.47	129.90	129.40	130.90	4.198	HGL Too High
Raven South Drive		B	A	A18-A-1&2	1.2100			1.21	111.96	0.4606	51.57	0.5	41.2	4.20	216.70	15				66	RCP	0.013	23.76	1.375	0.200	6.3	150.18	0.03	0.200	121.64	121.61	127.14	127.11	9.12	Vel-OK	0.416	0.062	132.47	132.40	129.79	129.29	130.05	3.177	HGL Too High
Cypress North Houst	Raven Wing Dr	A	CNH-1					6.88	118.84	0.4658	55.35	30.1	41.2	4.20	232.52	200				66	RCP	0.013	23.76	1.375	0.315	7.9	188.47	0.63	0.000	121.41	120.78	126.91	126.28	9.79	Vel-OK	0.479	0.959	132.40	131.45	129.80	129.30	130.05	3.105	HGL Too High
Cypress North Houst	(North Trunkline)	CNH-5	CNH 2					19.96	138.80	0.5138	71.32	4.2	41.6	4.18	304.74	555				66	RCP	0.013	23.76	1.375	0.114	4.8	113.14	0.63	0.000	120.78	120.15	126.28	125.65	12.83	rease Pipe S	0.823	4.570	131.45	126.88	130.63	130.13	132.20	1.316	HGL Too High
Cypress North Houston		CNH 2	CNH-3					-	138.80	0.5138	71.32	0.7	42.3	4.14	304.74	65				66	RCP	0.013	23.76	1.375	-1.062	#NUM!	#NUM!	-0.69	0.000	120.15	120.84	125.65	126.34	12.83	rease Pipe S	0.823	0.535	126.88	126.34	132.03	131.53	131.40	-4.655	OK
Cypress North Houst	(South Trunkline)	CNH-3	E133					74.55	213.35	0.5672	121.02	147.7	147.7	1.94	304.74	85	2	7	X	4	RCB	0.013	54.22	1.327	-0.071	#NUM!	#NUM!	-0.06		120.84	120.90	124.84	124.90	5.62	Vel-OK	0.166	0.141	125.04	124.90	131.83	131.33	131.40	-6.289	OK
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2	3.4862			3.49	3.49	0.5500	1.92	27.5	27.5	5.25	10.06	258				24	RCP	0.013	3.14	0.500	0.221	3.4	10.62	0.57	0.000	127.02	126.45	129.02	128.45	3.20	Vel-OK	0.198	0.510	143.26	142.75	131.22	130.72	132.50	12.546	HGL Too High
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2	1.9712			1.97	5.46	0.5500	3.00	1.3	28.8	5.12	15.36	25				24	RCP	0.013	3.14	0.500	2.800	12.0	37.85	0.70	0.000	126.45	125.75	128.45	127.75	4.89	Vel-OK	0.461	0.115	142.75	142.64	131.45	130.95	132.40	11.804	HGL Too High
Shaft Drive		M.9	M.8	C1-A&B-1&2	1.8431		4.2248	6.07	6.07	0.2924	1.77	28.7	28.7	5.12	9.09	279				30	RCP	0.013	4.91	0.625	0.179	3.5	17.36	0.50	0.700	127.33	126.83	129.83	129.33	1.85	Vel-OK	0.049	0.137	147.85	147.72	131.48	130.98	133.60	16.875	HGL Too High
Shaft Drive		M.8	M.7					-	6.07	0.2924	1.77	2.5	31.2	4.90	9.09	305				30	RCP	0.013	4.91	0.625	0.023	1.3	6.21	0.07	0.000	126.13	126.06	128.63	128.56	1.85	Vel-OK	0.049	0.150	147.72	147.57	132.07	131.57	133.60	16.148	HGL Too High
Shaft Drive		M.7	M.5	C1-A&B-1&2	2.5051		22.8323	25.34	31.41	0.2312	7.26	2.7	34.0	4.68	33.97	483				30	RCP	0.013	4.91	0.625	-0.039	#NUM!	#NUM!	-0.19	0.000	126.06	126.25	128.56	128.75	6.92	Vel-OK	0.686	3.312	147.57	144.26	131.27	130.77	133.40	16.798	HGL Too High
Shaft Drive		M.5	M.4					-	31.41	0.2312	7.26	1.2	35.2	4.59	33.97	120				30	RCP	0.013	4.91	0.625	0.483	5.8	28.52	0.58	0.000	126.25	125.67	128.75	128.17	6.92	Vel-OK	0.686	0.823	144.26	143.43	131.56	131.06	133.60	13.396	HGL Too High
Shaft Drive		M.4	M.3	C4-A-1&2	2.0244			2.02	33.43	0.2505	8.38	0.3	35.4	4.57	38.28	25				36	RCP	0.013	7.07	0.750	1.360	11.0	77.78	0.34	0.000	125.67	125.33	128.67	128.33	5.42	Vel-OK	0.329	0.082	143.43	143.35	131.21	130.71	132.10	12.723	HGL Too High
Shaft Drive		M.3	M.2	C5-A&B-1&2	3.9219			3.92	37.35	0.2820	10.53	0.1	35.5	4.57	48.08	590				36	RCP	0.013	7.07	0.750	0.098	3.0	20.91	0.58	0.050	125.33	124.75	128.33	127.75	6.80	Vel-OK	0.520	3.066	143.35	140.28	131.02	130.52	132.20	12.830	HGL Too High
Shaft Drive		M.2	M	C6-A&B-1&2	2.7910			2.79	40.14	0.3006	12.07	1.4	37.0	4.47	53.88	15				36	RCP	0.013	7.07	0.750	0.200	4.2	29.83	0.03	0.500	124.70	124.67	127.70	127.67	7.62	Vel-OK	0.653	0.098	140.28	140.19	131.35	130.85	132.40	9.434	HGL Too High
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2	4.5239			4.52	4.52	0.5500	2.49	28.0	28.0	5.19	12.91	311				24	RCP	0.013	3.14	0.500	0.450	4.8	15.18	1.40	0.050	127.45	126.05	129.45	128.05	4.11	Vel-OK	0.326	1.013	140.18	139.16	131.10	130.60	132.20	9.578	HGL Too High
Nevermore Drive		L.1.A	L	D2-A&B-1&2	1.2770			1.28	5.80	0.5500	3.19	1.3	29.3	5.07	16.17	25				24	RCP	0.013	3.14	0.500	1.520	8.9	27.89	0.38	2.100	126.00	125.62	128.00	127.62	5.15	Vel-OK	0.511	0.128	139.16	139.04	131.13	130.63	132.10	8.534	HGL Too High
Birdcall Lane		K.7	K.6	E1-A&B-1&2	2.4690			10.03	10.03	0.5500	5.52	29.0	29.0	5.10	28.12	24				30	RCP	0.013	4.91	0.625	0.542	6.1	30.19	0.13	0.000	126.03	125.90	128.53	128.40	5.73	Vel-OK	0.470	0.113	147.55	147.44	131.46	130.96	132.80	16.589	HGL Too High
Birdcall Lane		K.6	K.5	E2-A&B-1&2	1.5307			1.53	11.56	0.5500	6.36	0.1	29.1	5.09	32.37	315				30	RCP	0.013	4.91	0.625	0.127	3.0	14.62	0.40	0.000	125.90	125.50	128.40	128.00	6.59	Vel-OK	0.623	1.962	147.44	145.47	131.57	131.07	132.20	16.366	HGL Too High
Birdcall Lane		K.5	K.3					-	11.56	0.5500	6.36	0.8	29.9	5.02	32.37	380				30	RCP	0.013	4.91	0.625	0.118	2.9	14.11	0.45	0.000	125.50	125.05	128.00	127.55	6.59	Vel-OK	0.623	2.367	145.47	143.11	131.78	131.28	132.50	14.194	HGL Too High
Birdcall Lane		K.3	K.1	E4-A&B-1&2	4.6657			4.67	16.23	0.5500	8.92	1.0	30.8	4.93	44.03	415				30	RCP	0.013	4.91	0.625	0.224	4.0	19.42	0.93	0.000	125.05	124.12	127.55	126.62	8.97	Vel-OK	1.152	4.782	143.11	138.32	130.92	130.42	131.80	12.687	HGL Too High
Birdcall Lane		K.1	K	E5-A&B-1&2	1.6504			1.65	17.88	0.5500	9.83	0.8	31.6	4.87	47.86	25				36	RCP	0.013	7.07	0.750	-0.200	#NUM!	#NUM!	-0.05	1.100	124.12	124.17	127.12	127.17	6.77	Vel-OK	0.515	0.129	138.32	138.20	131.03	130.53	132.10	7.795	HGL Too High
Ravens Mate Drive		K.7.1	K.7	L1-A&B-1&2	2.8026			2.80	2.80	0.5500	1.54	27.0	27.0	5.30	8.16	288				24	RCP	0.013	3.14	0.500	0.354	4.3	13.46	1.02	0.100	127.15	126.13	129.15	128.13	2.60	Vel-OK	0.130	0.375	147.92	147.55	131.37	130.87	132.80	17.054	HGL Too High
Ravens Mate Drive		K.7.2	K.7	K1-A&B-1&2	2.7541			4.76	4.76	0.5500	2.62	28.2	28.2	5.18	13.55	216				24	RCP	0.013	3.14	0.500	0.435	4.8	14.92	0.94	0.109	127.08	126.14	129.08	128.14	4.31	Vel-OK	0.359	0.775	148.32	147.55	131.22	130.72	132.00	17.605	HGL Too High
Ravens Mate Drive		K.7.2.A	K.7.2	K1-C-1&2	2.0029			2.00	2.00	0.5500	1.10	26.3	26.3	5.37	5.91	48				24	RCP	0.013	3.14	0.500	0.292	3.9	12.22	0.14	0.000	127.22	127.08	129.22	129.08	1.88	Vel-OK	0.068	0.033	148.36	148.32	131.52	131.02	132.60	17.337	HGL Too High
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2	5.3142			5.31	5.31	0.5500	2.92	28.4	28.4	5.15	15.06	311				24	RCP	0.013	3.14	0.500	0.119	2.5	7.80	0.37	0.150	125.84	125.47	127.84	127.47	4.79	Vel-OK	0.443	1.379	138.77	137.39	130.49	129.99	131.60	8.776	HGL Too High
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2	1.0077			1.01	6.32	0.5500	3.48	1.1	29.5	5.05	17.56	25				24	RCP	0.013	3.14	0.500	1.400	8.5	26.77	0.35	2.300	125.32	124.97	127.32	126.97	5.59	Vel-OK	0.603	0.151	137.39	137.24	130.47	129.97	131.20	7.418	HGL Too High
Ravens Roost Drive		G.2.A	G.1.A	G1-A&B-1&2	3.8638			3.86	3.86	0.5500	2.13	27.7	27.7	5.23	11.10	353				24	RCP	0.013	3.14	0.500	0.218	3.4	10.57	0.77	0.050	125.69	124.92	127.69	126.92	3.53	Vel-OK	0.241	0.850	137.17	136.32	130.19	129.69	131.50	7.482	HGL Too High
Ravens Roost Drive		G.1.A	G	G2-A&B-1&2	1.4552			1.46	5.32	0.5500	2.93	1.7	29.4	5.07	14.82	70				24	RCP	0.013	3.14	0.500	0.514	5.2	16.22	0.36	2.200	124.87	124.51	126.87	126.51	4.72	Vel-OK	0.429	0.300	136.32	136.02	130.30	129.80	131.30	6.522	HGL Too High
Ravens Flight Drive		E.4	E.3	H1-A&B-1&2	2.3772			3.90	3.90	0.5500	2.14	27.7	27.7	5.22	11.19	396				24	RCP	0.013	3.14	0.500	0.376	4.4	13.88	1.49	0.000	126.13	124.64	128.13	126.64	3.56	Vel-OK	0.245	0.969	136.59	135.62	130.43	129.93	132.10	6.657	HGL Too High
Ravens Flight Drive		E.3	E.1					-	3.90	0.5500	2.14	1.9	29.6	5.05	11.19	345				24	RCP	0.013	3.14	0.500	0.223	3.4	10.68	0.77	0.000	124.64	123.87	126.64	125.87	3.56	Vel-OK	0.245	0.844	135.62	134.77	131.06	130.56	131.70	5.058	HGL Too High
Ravens Flight Drive		E.1	E	H3-A&B-1&2	3.7651			3.77	7.66	0.5500	4.21	1.6	31.2	4.90	20.66	61				30	RCP	0.013	4.91	0.625	0.197	3.7	18.19	0.12	1.550	123.87	123.75	126.37	126.25	4.21	Vel-OK	0.254	0.155	134.77	134.62	130.15	129.65	131.10	5.123	HGL Too High
Ravens Rook Drive		E.4.C	E.4	K1-C-1&2	1.5183			1.52	1.52	0.5500	0.84	25.8	25.8	5.43	4.53	14				24	RCP	0.013	3.14	0.500	4.286	14.9	46.83	0.60	0.000	126.73	126.13	128.73	128.13	1.44	Vel-OK	0.040	0.006	136.59	136.59	130.73	130.23	132.10	6.363	HGL Too High
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2	2.9666			2.97	2.97	0.5500	1.63	27.1	27.1	5.28	8.62	436				24	RCP	0.013	3.14	0.500	0.252	3.6	11.36	1.10	0.100	126.27	125.17	128.27	127.17	2.74	Vel-OK	0.145	0.633	134.55	133.92	129.99	129.49	131.50	5.060	HGL Too High
Blackbird Drive		C.1.A	C	I2-A&B-1&2	2.9466			2.95	5.91	0.5500	3.25	2.6	29.8	5.03	16.35	61				24	RCP	0.013	3.14	0.500	0.410	4.6	14.48	0.25	3.000	125.07	124.82	127.07	126.82	5.21	Vel-OK	0.523	0.319	133.92	133.60	129.45	128.95	130.60	4.967	HGL Too High
Raven Wing Drive		A.2.A	A.1.A	J1-A&B-1&2	5.1118			5.11	5.11	0.5500	2.81	28.3	28.3	5.16	14.51	436				24	RCP	0.013	3.14	0.500	0.261	3.7	11.57	1.14	0.000	125.28	124.14	127.28	126.14	4.62	Vel-OK	0.412	1.795	134.63	132.83	129.58	129.08	130.50	5.548	HGL Too High
Raven Wing Drive		A.1.A	A	J2-A&B-1&2	1.7690			1.77	6.88	0.5500	3.78	1.6	29.9	5.02	18.98	61				24	RCP	0.013	3.14	0.500	0.377	4.4	13.89	0.23	2.500	124.14	123.91	126.14	125.91	6.04	Vel-OK	0.704	0.429	132.83	132.40	129.44	128.94	130.70	3.894	HGL Too High
				Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4	0.4602																																						Percenta
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5										72.22			418			42	RCP	0.013	9.62	0.875	0.129	3.8	36.16	0.54	0.000	124.59	124.05	128.09	127.55	7.51	Vel-OK	0.515	2.154	137.26	135.11	133.03	133.45	133.45	3.810	HGL Too High
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1										72.22			1,448			48	RCP	0.013	12.57	1.000	0.122	4.0	50.22	1.77	1.500	124.05	122.28	128.05	126.28	5.75	Vel-OK	0.253	3.660	135.11	131.45	132.03	132.60	132.60	2.506	HGL Too High
				Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate																																					
Raven Roost (Lake)		RR	RR7		39.7800			39.78	39.78	0.5500	21.88	139.1	139.1	2.01	44.08	1,787				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	1.61	0.000	122.93	121.32	126.43	124.82	4.58	Vel-OK	0.192	3.430	129.43	126.00	133.03	130.40	130.40	-0.973	OK
Raven Roost (Lake)		RR7	RR8					-	39.78	0.5500	21.88	6.5	145.6	1.96	44.08	459				42	RCP	0.013	9.62	0.875	0.146	4.0	38.44	0.67	0.000	121.32	120.65	124.82	124.15	4.58	Vel-OK	0.192	0.881	126.00	125.12	132.03	130.65	130.65	-4.653	OK
Raven Roost (Lake)		RR8	CNH-3					-	39.78	0.5500	21.88	1.7	147.3	1.94	44.08	69	2			36	RCP	0.013	14.14	0.750	-0.275	#NUM!	#NUM!	-0.19	0.000	120.65	120.84	123.65	123.84	3.12	Vel-OK	0.109	0.075	125.12	125.04	131.83	131.40	131.40	-6.284	OK
				Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes	0.2828																																					Percen
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2		19.9300			19.93	19.93	0.8000	15.94	31.9	31.9	4.84	77.17	499	5	X	3	RCB	0.013	14.11	0.977	0.329	6.5	91.12	1.64	0.000	127.22	125.58	130.22	128.58	5.47	Vel-OK	0.236	1.177	139.14	137.96	133.53	132.60	132.60	6.541

APPENDIX A-6
EXISTING CONDITIONS 10% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF14701)
Date : 2/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
2	28.0	0.0208	Crown	0.33	1.00	13.00	0.271
3	41.0	0.0208	Crown	0.50	0.50	20.00	0.417
4	25.0	0.0208	Blvd	0.50	0.50	12.00	0.250
5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency = 10 yr
Override Inlet Time (Tc) (min) =
N-Value (Pavement) = 0.016 TxDOT Hydraulic Manual Table 4-8

$T_{Spread}=1.243(Q_{Gutter}*N/S_x^{1/2}*s_x^{5/3})^{3/8}$
$Y_{Gutter}*T_{Spread}*S_x$
Length of Curb Inlet Opening for Intercepting Total Q_{Gutter}
$L_T=0.6*Q^{0.42}*S_L^{0.3}*[1/(N*S_x)]^{0.6}$

INLET PONDING CALCULATIONS

$Q_{weir}=C_{weir}*L_{weir}*H^{1/2}$ C_{weir} = 2.60
$Q_{orif}=C_{orif}*A_{orif}*(2gH)^{1/2}$ C_{orif} = 0.60
$H_{weir}=(Q/(C*L))^{2/3}$
$H_{orif}=(Q/(C*A*Sqrt(2g)))^{2}$
$T_{Inlet}=H/S_x$

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Street Type	Pavement Width (B-B) (ft)	Cross-Slope (S_x) (ft/ft)	Street Type	Curb Height (ft)	Curb Width (ft)	Maximum Allowable Ponding Spread @ Inlets (ft)	Maximum Allowable Ponding Depth @ Inlets (ft)
Raven Song Drive		S.1.C	S	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		S	R	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		R	Q	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		Q	P	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		P	O	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		O	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Raven Park (Scamp)	N	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Shaft Dr	M	L	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Nevermore Dr	L	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Birdcall Dr	K	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Caw	J	H	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		H	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Roost Dr	G	F.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F.2	F	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Flight Dr	E	D	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		D	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Blackbird Dr	C	B	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		B	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	Raven Wing Dr	A	CNH-1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houston		CNH-2	CNH-3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(South Trunkline)	CNH-3	E133	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.1.A	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.9	M.8	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.8	M.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.7	M.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.5	M.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.4	M.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.3	M.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.2	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.2.A	L.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.1.A	L	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.7	K.6	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.6	K.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.5	K.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.3	K.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.1	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.1	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.2	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.2.A	K.7.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.2.A	J.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.1.A	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Roost Drive		G.2.A	G.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Roost Drive		G.1.A	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.4	E.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.3	E.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Flight Drive		E.1	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Rook Drive		E.4.C	E.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.2.A	C.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.1.A	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.2.A	A.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.1.A	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR	RR7	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR7	RR8	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR8	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

INLET #1 (FAR INLET)

Gutter Run 1

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.7150	**0.25**	24.43	5.58	2.19	12.24	0.25	-
0.5156	**0.25**	23.90	5.64	1.60	10.87	0.23	-
				No Inlet			-
				No Inlet			-
1.2436	**0.25**	25.39	5.47	3.74	14.95	0.31	-
				No Inlet			-
				No Inlet			-
1.4209	**0.60**	25.64	5.44	4.25	13.31	0.28	-
0.3618	**0.25**	23.36	5.71	1.14	9.56	0.20	-
0.4702	**0.25**	23.76	5.66	1.46	10.51	0.22	-
0.4974	**0.25**	23.84	5.65	1.55	10.73	0.22	-
0.5169	**0.60**	23.90	5.64	1.60	9.23	0.19	-
				No Inlet			-
0.2972	**0.25**	23.08	5.74	0.94	8.90	0.19	-
				No Inlet			-
0.4009	**0.25**	23.51	5.69	1.25	9.92	0.21	-
				No Inlet			-
0.5908	**0.25**	24.11	5.62	1.82	11.42	0.24	-
				No Inlet			-
0.6880	**0.75**	24.36	5.59	2.11	9.82	0.20	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.8696	**0.25**	24.76	5.54	2.65	13.13	0.27	-
0.2450	**0.33**	22.81	5.78	0.78	7.88	0.16	-
2.8062	**0.25**	26.99	5.30	4.35	15.81	0.33	-
				No Inlet			-
9.7221	**0.32**	29.93	5.01	10.56	21.06	0.44	-
				No Inlet			-
1.1707	**0.25**	25.28	5.48	3.53	14.62	0.30	-
0.8212	**0.25**	24.66	5.55	2.51	12.86	0.27	-
1.1405	**0.25**	25.23	5.49	3.44	14.49	0.30	-
1.7472	**0.26**	26.03	5.40	5.19	**16.77**	0.35	-
0.4409	**0.40**	23.66	5.67	1.38	9.40	0.20	-
1.4076	**0.25**	25.62	5.44	4.21	15.63	0.33	-
0.1762	**0.25**	22.37	5.84	0.57	7.36	0.15	-
				No Inlet			-
1.6098	**0.25**	25.87	5.41	4.79	**16.40**	0.34	-
0.5994	**0.25**	24.14	5.61	1.85	11.48	0.24	-
0.7157	**0.25**	24.43	5.58	2.20	12.24	0.26	-
0.5607	**0.35**	24.03	5.63	1.73	10.52	0.22	-
1.4945	**0.25**	25.73	5.43	4.46	15.97	0.33	-
1.8808	**0.25**	26.18	5.38	5.57	**17.35**	0.36	-
0.2607	**0.25**	22.89	5.77	0.83	8.49	0.18	-
1.6803	**0.25**	25.96	5.41	5.00	**16.66**	0.35	-
0.4530	**0.25**	23.70	5.67	1.41	10.37	0.22	-
0.2745	**0.25**	22.96	5.76	0.87	8.65	0.18	-
				No Inlet			-
1.7081	**0.25**	25.99	5.40	5.08	**16.76**	0.35	-
0.4293	**0.25**	23.62	5.68	1.34	10.17	0.21	-
1.6622	**0.25**	25.94	5.41	4.94	**16.59**	0.35	-
1.2458	**0.25**	25.39	5.47	3.75	14.95	0.31	-
1.2452	**0.25**	25.39	5.47	3.74	14.95	0.31	-
0.6353	**0.29**	24.23	5.60	1.96	11.40	0.24	-

Gutter Run 2

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.9199	**0.25**	24.85	5.53	2.80	13.40	0.28	-
0.3491	**0.64**	23.31	5.71	1.10	7.91	0.16	-
				No Inlet			-
				No Inlet			-
0.6625	**0.50**	24.30	5.59	2.04	10.45	0.22	-
				No Inlet			-
				No Inlet			-
0.4637	**0.25**	23.73	5.66	1.44	10.46	0.22	-
0.1560	**0.25**	22.21	5.86	0.50	7.04	0.15	-
0.4905	**0.25**	23.82	5.65	1.52	10.67	0.22	-
0.4982	**0.25**	23.85	5.65	1.55	10.74	0.22	-
0.4848	**0.25**	23.80	5.65	1.51	10.63	0.22	-
				No Inlet			-
0.2140	**0.25**	22.62	5.80	0.68	7.90	0.16	-
				No Inlet			-
0.7362	**0.45**	24.47	5.57	2.26	11.08	0.23	-
				No Inlet			-
0.7809	**0.70**	24.57	5.56	2.39	10.41	0.22	-
				No Inlet			-
0.5220	**0.25**	23.92	5.64	1.62	10.92	0.23	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.4591	**0.40**	23.72	5.66	1.43	9.54	0.20	-
1.1175	**0.25**	25.20	5.49	3.37	14.38	0.30	-
1.4186	**0.25**	25.64	5.44	2.26	12.37	0.26	-
				No Inlet			-
13.1102	**0.27**	30.73	4.94	14.03	24.19	0.50	-
				No Inlet			-
0.8537	**0.47**	24.73	5.54	2.60	11.61	0.24	-
1.1027	**0.25**	25.17	5.49	3.33	14.31	0.30	-
0.2445	**0.25**	22.80	5.78	0.78	8.29	0.17	-
0.4331	**0.25**	23.63	5.67	1.35	10.20	0.21	-
0.1548	**0.25**	22.20	5.86	0.50	7.02	0.15	-
0.3369	**0.25**	23.26	5.72	1.06	9.31	0.19	-
0.5854	**0.32**	24.10	5.62	1.81	10.87	0.23	-
				No Inlet			-
0.6909	**0.31**	24.37	5.59	2.12	11.61	0.24	-
0.1926	**0.25**	22.48	5.82	0.62	7.60	0.16	-
1.1560	**0.25**	25.26	5.48	3.49	14.56	0.30	-
1.4748	**0.25**	25.71	5.43	4.41	15.89	0.33	-
0.5084	**0.50**	23.88	5.64	1.58	9.50	0.20	-
0.6752	**0.25**	24.33	5.59	2.08	11.98	0.25	-
0.2361	**0.25**	22.76	5.78	0.75	8.19	0.17	-
0.5489	**0.40**	24.00	5.63	1.70	10.18	0.21	-
0.2610	**0.25**	22.89	5.77	0.83	8.49	0.18	-
0.9560	**0.44**	24.92	5.52	2.90	12.22	0.25	-
				No Inlet			-
0.2269	**0.45**	22.70	5.79	0.72	7.23	0.15	-
1.0890	**0.25**	25.15	5.50	3.29	14.25	0.30	-
0.1593	**0.31**	22.24	5.85	0.51	6.81	0.14	-
0.2194	**0.70**	22.66	5.80	0.70	6.57	0.14	-
0.6190	**0.25**	24.19	5.61	1.91	11.61	0.24	-
0.2317	**0.25**	22.73	5.79	0.74	8.13	0.17	-

Inlet 1 (Far)

Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (H) (ft)
B-B	Sag	24.85	5.53	4.97	12.88	0.27
B-B	Sag	23.90	5.64	2.68	4.49	0.09
					No Inlet	
					No Inlet	
B-B	Sag	25.39	5.47	5.73	15.35	0.32
					No Inlet	
					No Inlet	
					No Inlet	
B-B	Sag	25.64	5.44	5.64	15.06	0.31
B-B	Sag	23.36	5.71	1.63	elow Gut	0.00
B-B	Sag	23.82	5.65	2.99	5.71	0.12
B-B	Sag	23.85	5.65	3.09	6.13	0.13
B-B	Sag	23.90	5.64	3.11	6.19	0.13
					No Inlet	
B-B	Sag	23.08	5.74	1.61	elow Gut	-0.01
					No Inlet	
B-B	Sag	24.47	5.57	3.49	7.63	0.16
					No Inlet	
B-B	Sag	24.57	5.56	4.20	10.22	0.21
					No Inlet	
B-B	Sag	24.36	5.59	3.72	8.49	0.18
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
C-1	Sag	24.76	5.54	4.05	1.09	0.02
C-1	Sag	25.20	5.49	4.11	1.27	0.03
B-B	Sag	26.99	5.30	6.54	17.87	0.37
					No Inlet	
B-B	Sag	30.73	4.94	24.44	269.13	5.61
					No Inlet	
B-B Grate	Sag	25.28	5.48	6.10	5.78	0.12
B-B	Sag	25.17	5.49	5.81	15.61	0.33
B-B	Sag	25.23	5.49	4.18	10.16	0.21
C-1	Sag	26.03	5.40	6.47	7.36	0.15
C-1	Sag	23.66	5.67	1.86	elow Gut	-0.07
B-B	Sag	25.62	5.44	5.22	13.70	0.29
B-B	Sag	24.10	5.62	2.35	3.11	0.06
					No Inlet	
B-B	Sag	25.87	5.41	6.85	19.31	0.40
B-B	Sag	24.14	5.61	2.44	3.50	0.07
B-B	Sag	25.26	5.48	5.64	15.07	0.31
B-B	Sag	25.71	5.43	6.08	16.46	0.34
B-B	Sag	25.73	5.43	5.98	16.14	0.34
C-1	Sag	26.18	5.38	7.57	9.93	0.21
C-1	Sag	22.89	5.77	1.58	elow Gut	-0.08
C-1	Sag	25.96	5.41	6.63	7.74	0.16
C-1	Sag	23.70	5.67	2.23	elow Gut	-0.07
B-B	Sag	24.92	5.52	3.74	8.56	0.18
					No Inlet	
B-B	Sag	25.99	5.40	5.75	15.41	0.32
B-B	Sag	25.15	5.50	4.59	11.58	0.24
C-1	Sag	25.94	5.41	5.42	4.75	0.10
C-1	Sag	25.39	5.47	4.41	2.08	0.04
C-1	Sag	25.39	5.47	5.61	5.23	0.11
C-1	Sag	24.23	5.60	2.67	elow Gut	-0.06

INLET #2 (NEAR INLET)

Gutter Run 3

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.9598	**0.25**	24.93	5.52	2.91	13.61	0.28	-
				No Inlet			-
				No Inlet			-
0.3517	**0.25**	23.32	5.71	1.11	9.46	0.20	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.3340	**0.25**	23.24	5.72	1.05	9.29	0.19	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2254	**0.25**	22.69	5.79	0.72	8.05	0.17	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
1.6365	**0.60**	25.91	5.41	4.87	14.00	0.29	-
0.4116	**0.33**	23.55	5.68	1.29	9.51	0.20	-
1.0193	**0.25**	25.03	5.51	1.64	10.98	0.23	-
					No Inlet		-
1.4587	**0.32**	25.69	5.44	1.72	10.66	0.22	-
					No Inlet		-
					No Inlet		-
0.6447	**0.47**	24.26	5.60	1.99	10.49	0.22	-
1.1695	**0.25**	25.28	5.48	3.53	14.62	0.30	-
1.8237	**0.26**	26.12	5.39	5.40	**17.03**	0.35	-
0.4796	**0.40**	23.79	5.66	1.49	9.69	0.20	-
0.3995	**0.25**	23.51	5.69	1.25	9.91	0.21	-
0.2100	**0.25**	22.60	5.81	0.67	7.84	0.16	-
					No Inlet		-
1.6754	**0.25**	25.95	5.41	4.98	**16.64**	0.35	-
0.6535	**0.25**	24.28	5.60	2.01	11.84	0.25	-
0.2287	**0.25**	22.71	5.79	0.73	8.09	0.17	-
0.5301	**0.35**	23.94	5.64	1.64	10.31	0.21	-
					No Inlet		-
2.0390	**0.25**	26.34	5.36	6.02	**17.86**	0.37	-
0.2929	**0.25**	23.06	5.75	0.93	8.85	0.18	-
1.0229	**0.25**	25.04	5.51	3.10	13.93	0.29	-
0.4879	**0.25**	23.81	5.65	1.52	10.65	0.22	-
0.5709	**0.25**	24.06	5.62	1.77	11.28	0.23	-
					No Inlet		-
1.6720	**0.25**	25.95	5.41	4.97	**16.63**	0.35	-
1.0105	**0.25**	25.02	5.51	3.06	13.87	0.29	-
1.2503	**0.37**	25.40	5.47	3.76	13.91	0.29	-
2.4692	**0.25**	26.73	5.32	7.23	**19.14**	0.40	-
0.6992	**0.29**	24.39	5.58	2.15	11.80	0.25	-

Gutter Run 4

Drainage Area (ac)	T/C Grade (S_G) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				No Inlet			-
				No Inlet			-
0.4293	**0.64**	23.62	5.68	1.34	8.53	0.18	-
				No Inlet			-
				No Inlet			-
0.6660	**0.50**	24.31	5.59	2.05	10.47	0.22	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2237	**0.25**	22.68	5.79	0.71	8.03	0.17	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2862	**0.25**	23.02	5.75	0.91	8.78	0.18	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.5210	**0.40**	23.92	5.64	1.62	9.99	0.21	-
0.1971	**0.25**	22.51	5.82	0.63	7.67	0.16	-
0.8238	**0.25**	24.66	5.55	1.34	10.16	0.21	-
					No Inlet		-
1.0464	**0.27**	25.08	5.50	1.25	9.76	0.20	-
					No Inlet		-
					No Inlet		-
1.3533	**0.25**	25.55	5.45	4.06	15.41	0.32	-
0.2365	**0.25**	22.76	5.78	0.75	8.19	0.17	-
0.5199	**0.25**	23.91	5.64	1.61	10.90	0.23	-
0.2017	**0.25**	22.54	5.81	0.64	7.73	0.16	-

APPENDIX A-7
EXISTING CONDITIONS 10% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF14701)
Date : 2/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients	
Return Freq (yr)	10
b :	54.68
d :	6.96
e :	0.6623
Peaking Factor C_f :	1.00

$Q_{Allow}=C_{Allow}*W_{Pvmt}*H_{AVG}^{1.5}$
Where W_{Pvmt} = Width of Pavement to F/C, H_{AVG} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = 128.50

C_{Allow} = 2.10

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Elevations at D/S High Point in Street: Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	10-Year Analysis: Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity * 1" (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	Allowable 100-yr HGL Height Above T/C @ Location: HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	Check HGL or Act Gutter Depth vs. Nat Grnd @ ROW Locations	HGL Above(+) / Below(-) T/C @ D/S High (ft)	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
																		1.50		0.50			
Raven Song Drive		**S.1.C**	**S**	**132.72**	132.72	132.22	**133.00**	**25.9**	25.9	5.41	4.87	1.55	Vel-OK	0.046	0.03	146.46	146.43	14.977	Increase Pipe Size	OK	13.737	0.000	Method 2 - OK
Raven South Drive		S	**R**	**132.72**	132.72	132.22	**133.00**	0.6	26.5	5.34	11.43	2.33	Vel-OK	0.078	0.16	146.43	146.27	15.249	Increase Pipe Size	OK	13.709	0.000	Method 2 - OK
Raven South Drive		R	**Q**	**132.72**	132.72	132.22	**133.00**	1.4	28.0	5.20	11.43	2.33	Vel-OK	0.078	0.05	146.27	146.22	14.364	Increase Pipe Size	OK	13.554	0.000	Method 2 - OK
Raven South Drive		Q	**P**	**132.72**	132.72	132.22	**133.00**	0.5	28.5	5.15	19.29	3.93	Vel-OK	0.221	0.95	146.22	145.27	14.489	Increase Pipe Size	OK	13.499	0.000	Method 2 - OK
Raven South Drive		P	**O**	**131.91**	131.91	131.41	**132.70**	1.8	30.3	4.98	19.29	3.93	Vel-OK	0.221	0.19	145.27	145.08	13.123	Increase Pipe Size	OK	13.363	0.000	Method 2 - OK
Raven South Drive		O	**N**	**131.91**	131.91	131.41	**132.70**	0.4	30.7	4.95	19.29	3.93	Vel-OK	0.221	0.36	145.08	144.72	13.183	Increase Pipe Size	OK	13.173	0.000	Method 2 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**132.05**	132.05	131.55	**132.40**	**28.9**	31.4	4.89	38.05	7.75	Vel-OK	0.861	2.45	144.72	142.26	12.937	Increase Pipe Size	OK	12.667	0.000	Method 2 - OK
Raven South Drive	**Shaft Dr**	M	**L**	**131.70**	131.70	131.20	**132.50**	**37.0**	37.0	4.46	91.24	7.26	Vel-OK	0.403	1.15	142.26	141.11	10.955	Increase Pipe Size	OK	10.565	0.000	Method 2 - OK
Raven South Drive	**Nevermore Dr**	L	**K**	**132.07**	132.07	131.57	**132.30**	**29.4**	37.7	4.42	106.79	6.71	Vel-OK	0.295	0.84	141.11	140.27	9.685	Increase Pipe Size	OK	9.045	0.000	Method 2 - OK
Raven South Drive	**Birdcall Dr**	K	**J**	**131.50**	131.50	131.00	**132.30**	**31.7**	38.4	4.37	151.07	7.69	Vel-OK	0.336	0.96	140.27	139.32	8.894	Increase Pipe Size	OK	8.774	0.000	Method 2 - OK
Raven South Drive	**Ravens Caw**	J	**H**	**131.01**	131.01	130.51	**131.80**	**29.6**	39.0	4.33	167.19	8.51	Vel-OK	0.412	0.82	139.32	138.49	8.455	Increase Pipe Size	OK	8.305	0.000	Method 2 - OK
Raven South Drive		H	**G**	**131.05**	131.05	130.55	**132.20**	0.4	39.4	4.31	167.19	8.51	Vel-OK	0.412	0.39	138.49	138.10	7.671	Increase Pipe Size	OK	7.441	0.000	Method 2 - OK
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**131.05**	131.05	130.55	**132.20**	**29.6**	39.6	4.30	180.80	9.21	Vel-OK	0.482	0.33	138.10	137.77	7.860	Increase Pipe Size	OK	7.050	0.000	Method 2 - OK
Raven South Drive		F.2	**F**	**130.63**	130.63	130.13	**132.20**	0.1	39.7	4.29	180.80	9.21	Vel-OK	0.482	1.00	137.77	136.77	6.722	Increase Pipe Size	OK	7.142	0.000	Method 2 - OK
Raven South Drive		F	**E**	**130.63**	130.63	130.13	**131.50**	0.4	40.1	4.27	182.20	7.67	Vel-OK	0.294	0.07	136.77	136.70	6.260	Increase Pipe Size	OK	6.140	0.000	Method 2 - OK
Raven South Drive	**Ravens Flight Dr**	E	**D**	**130.63**	130.63	130.13	**131.50**	**31.4**	40.1	4.27	200.03	8.42	Vel-OK	0.355	0.97	136.70	135.73	5.946	Increase Pipe Size	OK	6.066	0.000	Method 2 - OK
Raven South Drive		D	**C**	**130.15**	130.15	129.65	**131.00**	0.5	40.7	4.23	201.72	8.49	Vel-OK	0.361	0.05	135.73	135.68	5.851	Increase Pipe Size	OK	5.581	0.000	Method 2 - OK
Raven South Drive	**Blackbird Dr**	C	**B**	**130.15**	130.15	129.65	**131.00**	**30.0**	40.7	4.23	215.40	9.07	Vel-OK	0.411	1.13	135.68	134.55	5.777	Increase Pipe Size	OK	5.527	0.000	Method 2 - OK
Raven South Drive		B	**A**	**130.50**	130.50	130.00	**131.60**	0.5	41.2	4.20	216.70	9.12	Vel-OK	0.416	0.06	134.55	134.48	4.755	Increase Pipe Size	OK	4.045	0.000	Method 2 - OK
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**130.50**	130.50	130.00	**131.60**	**30.1**	41.2	4.20	232.52	9.79	Vel-OK	0.479	0.96	134.48	133.52	4.683	Increase Pipe Size	OK	3.983	0.000	Method 2 - OK
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**131.83**	131.83	131.33	**131.40**	**3.8**	41.6	4.18	298.20	12.55	rease Pipe S	0.789	4.38	133.52	129.15	2.894	Increase Pipe Size	OK	1.694	-0.615	Method 2 - OK
Cypress North Houston		CNH-2	**CNH-3**	**131.83**	131.83	131.33	**131.40**	0.7	42.3	4.14	298.20	12.55	rease Pipe S	0.789	0.51	129.15	128.63	-2.882	Method 1 - OK	OK	-2.682		Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**131.83**	131.83	131.33	**131.40**	**147.7**	147.7	1.94	298.20	5.50	Vel-OK	0.159	0.13	128.63	**128.50**	-3.195	Method 1 - OK	OK	-3.195		Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**131.75**	131.75	131.25	**132.50**	**27.5**	27.5	5.25	10.06	3.20	Vel-OK	0.198	0.51	145.34	144.83	14.124	Increase Pipe Size	OK	13.594	0.000	Method 2 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**131.94**	131.94	131.44	**132.40**	1.3	28.8	5.12	15.36	4.89	Vel-OK	0.461	0.12	144.83	**144.72**	13.382	Increase Pipe Size	OK	12.892	0.000	Method 2 - OK
Shaft Drive		**M.9**	**M.8**	**132.07**	132.07	131.57	**133.60**	**28.7**	28.7	5.12	9.09	1.85	Vel-OK	0.049	0.14	149.93	149.80	18.453	Increase Pipe Size	OK	17.863	0.000	Method 2 - OK
Shaft Drive		M.8	**M.7**	**131.98**	131.98	131.48	**133.20**	2.5	31.2	4.90	9.09	1.85	Vel-OK	0.049	0.15	149.80	149.65	17.726	Increase Pipe Size	OK	17.816	0.000	Method 2 - OK
Shaft Drive		M.7	**M.5**	**131.98**	131.98	131.48	**133.20**	2.7	34.0	4.68	33.97	6.92	Vel-OK	0.686	3.31	149.65	146.33	18.376	Increase Pipe Size	OK	17.666	0.000	Method 2 - OK
Shaft Drive		M.5	**M.4**	**131.98**	131.98	131.48	**133.20**	1.2	35.2	4.59	33.97	6.92	Vel-OK	0.686	0.82	146.33	145.51	14.774	Increase Pipe Size	OK	14.354	0.000	Method 2 - OK
Shaft Drive		M.4	**M.3**	**132.16**	132.16	131.66	**133.20**	0.3	35.4	4.57	38.28	5.42	Vel-OK	0.329	0.08	145.51	145.43	14.301	Increase Pipe Size	OK	13.351	0.000	Method 2 - OK
Shaft Drive		M.3	**M.2**	**132.16**	132.16	131.66	**133.20**	0.1	35.5	4.57	48.08	6.80	Vel-OK	0.520	3.07	145.43	142.36	14.409	Increase Pipe Size	OK	13.269	0.000	Method 2 - OK
Shaft Drive		M.2	**M**	**131.59**	131.59	131.09	**132.50**	1.4	37.0	4.47	53.88	7.62	Vel-OK	0.653	0.10	142.36	**142.26**	11.012	Increase Pipe Size	OK	10.772	0.000	Method 2 - OK
Nevermore Drive		**L.2.A**	**L.1.A**	**131.41**	131.41	130.91	**132.40**	**28.0**	28.0	5.19	12.91	4.11	Vel-OK	0.326	1.01	142.26	141.24	11.156	Increase Pipe Size	OK	10.846	0.000	Method 2 - OK
Nevermore Drive		L.1.A	**L**	**132.09**	132.09	131.59	**132.30**	1.3	29.3	5.07	16.17	5.15	Vel-OK	0.511	0.13	141.24	**141.11**	10.112	Increase Pipe Size	OK	9.152	0.000	Method 2 - OK
Birdcall Lane		**K.7**	**K.6**	**132.26**	132.26	131.76	**132.80**	**29.0**	29.0	5.10	28.12	5.73	Vel-OK	0.470	0.11	149.63	149.51	18.167	Increase Pipe Size	OK	17.367	0.000	Method 2 - OK
Birdcall Lane		K.6	**K.5**	**132.26**	132.26	131.76	**132.80**	0.1	29.1	5.09	32.37	6.59	Vel-OK	0.623	1.96	149.51	147.55	17.944	Increase Pipe Size	OK	17.254	0.000	Method 2 - OK
Birdcall Lane		K.5	**K.3**	**131.49**	131.49	130.99	**132.10**	0.8	29.9	5.02	32.37	6.59	Vel-OK	0.623	2.37	147.55	145.18	15.772	Increase Pipe Size	OK	16.062	0.000	Method 2 - OK
Birdcall Lane		K.3	**K.1**	**131.49**	131.49	130.99	**132.10**	1.0	30.8	4.93	44.03	8.97	Vel-OK	1.152	4.78	145.18	140.40	14.265	Increase Pipe Size	OK	13.695	0.000	Method 2 - OK
Birdcall Lane		K.1	**K**	**131.52**	131.52	131.02	**132.30**	0.8	31.6	4.87	47.86	6.77	Vel-OK	0.515	0.13	140.40	**140.27**	9.373	Increase Pipe Size	OK	8.883	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.1**	**K.7**	**132.09**	132.09	131.59	**132.80**	**27.0**	27.0	5.30	8.16	2.60	Vel-OK	0.130	0.38	150.00	**149.63**	18.632	Increase Pipe Size	OK	17.912	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.2**	**K.7**	**131.97**	131.97	131.47	**132.80**	**28.2**	28.2	5.18	13.55	4.31	Vel-OK	0.359	0.77	150.40	**149.63**	19.183	Increase Pipe Size	OK	18.433	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**132.22**	132.22	131.72	**132.80**	**26.3**	26.3	5.37	5.91	1.88	Vel-OK	0.068	0.03	150.43	**150.40**	18.916	Increase Pipe Size	OK	18.216	0.000	Method 2 - OK
Ravens Caw Drive		**J.2.A**	**J.1.A**	**130.75**	130.75	130.25	**131.70**	**28.4**	28.4	5.15	15.06	4.79	Vel-OK	0.443	1.38	140.84	139.47	10.355	Increase Pipe Size	OK	10.095	0.000	Method 2 - OK
Ravens Caw Drive		J.1.A	**J**	**131.01**	131.01	130.51	**131.80**	1.1	29.5	5.05	17.56	5.59	Vel-OK	0.603	0.15	139.47	**139.32**	8.996	Increase Pipe Size	OK	8.456	0.000	Method 2 - OK
Ravens Roost Drive		**G.2.A**	**G.1.A**	**130.80**	130.80	130.30	**131.70**	**27.7**	27.7	5.23	11.10	3.53	Vel-OK	0.241	0.85	139.25	138.40	9.060	Increase Pipe Size	OK	8.450	0.000	Method 2 - OK
Ravens Roost Drive		G.1.A	**G**	**131.09**	131.09	130.59	**132.20**	1.7	29.4	5.07	14.82	4.72	Vel-OK	0.429	0.30	138.40	**138.10**	8.100	Increase Pipe Size	OK	7.310	0.000	Method 2 - OK
Ravens Flight Drive		**E.4**	**E.3**	**130.83**	130.83	130.33	**132.25**	**27.7**	27.7	5.22	11.19	3.56	Vel-OK	0.245	0.97	138.66	137.70	8.235	Increase Pipe Size	OK	7.835	0.000	Method 2 - OK
Ravens Flight Drive		E.3	**E.1**	**130.62**	130.62	130.12	**131.50**	1.9	29.6	5.05	11.19	3.56	Vel-OK	0.245	0.84	137.70	136.85	6.636	Increase Pipe Size	OK	7.076	0.000	Method 2 - OK
Ravens Flight Drive		E.1	**E**	**130.63**	130.63	130.13	**131.50**	1.6	31.2	4.90	20.66	4.21	Vel-OK	0.254	0.15	136.85	**136.70**	6.701	Increase Pipe Size	OK	6.221	0.000	Method 2 - OK
Ravens Rook Drive		**E.4.C**	**E.4**	**131.47**	131.47	130.97	**132.25**	**25.8**	25.8	5.43	4.53	1.44	Vel-OK	0.040	0.01	138.67	**138.66**	7.941	Increase Pipe Size	OK	7.201	0.000	Method 2 - OK
Blackbird Drive		**C.2.A**	**C.1.A**	**130.64**	130.64	130.14	**131.30**	**27.1**	27.1	5.28	8.62	2.74	Vel-OK	0.145	0.63	136.63	136.00	6.639	Increase Pipe Size	OK	5.989	0.000	Method 2 - OK
Blackbird Drive		C.1.A	**C**	**130.15**	130.15	129.65	**131.00**	2.6	29.8	5.03	16.35	5.21	Vel-OK	0.523	0.32	136.00	**135.68**	6.545	Increase Pipe Size	OK	5.845	0.000	Method 2 - OK
Raven Wing Drive		**A.2.A**	**A.1.A**	**129.78**	129.78	129.28	**130.90**	**28.3**	28.3	5.16	14.51	4.62	Vel-OK	0.412	1.79	136.71	134.91	7.127	Increase Pipe Size	OK	6.927	0.000	Method 2 - OK
Raven Wing Drive		A.1.A	**A**	**130.50**	130.50	130.00	**131.60**	1.6	29.9	5.02	18.98	6.04	Vel-OK	0.704	0.43	134.91	**134.48**	5.472	Increase Pipe Size	OK	4.412	0.000	Method 2 - OK
				ge of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.5026**				-0.071	-0.071							
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**131.83**	**132.60**	**132.60**	**132.60**				**78.89**	8.20	Vel-OK	0.615	2.57	**140.46**	137.89	7.431	Increase Pipe Size		7.861	0.513	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**131.83**	**131.40**	**131.40**	**131.40**				78.89	6.28	Vel-OK	0.302	4.37	137.89	**133.52**	5.861	Increase Pipe Size		6.491	0.513	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**131.83**	**131.20**	**131.20**	**131.20**	**139.1**	139.1	2.01	44.08	4.58	Vel-OK	0.192	3.43	133.02	129.59	-0.009	Method 1 - OK		1.821	0.000	Method 2 - OK
Raven Roost (Lake)		RR7	**RR8**	**131.83**	**131.40**	**131.40**	**131.40**	6.5	145.6	1.96	44.08	4.58	Vel-OK	0.192	0.88	129.59	128.71	-2.439	Method 1 - OK		-1.809		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**131.83**	**131.40**	**131.40**	**131.40**	1.7	147.3	1.94	44.08	3.12	Vel-OK	0.109	0.08	128.71	**128.63**	-3.120	Method 1 - OK		-2.690		Method 1 - OK
				-tage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**												
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**133.13**	**132.60**	**132.60**	**132.60**	**31.9**	31.9	4.84	**77.17**	5.47	Vel-OK	0.236	1.18	142.34	141.16	8.812	Increase Pipe Size		9.742	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**133.13**	**132.60**	**132.60**	**132.60**	1.5	33.5	4.72	88.67	6.28	Vel-OK	0.312	0.45	141.16	140.72	8.135	Increase Pipe Size		8.565	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**133.13**	**132.60**	**132.60**	**132.60**	0.4	33.8	4.69	**31.41**	2.23	Vel-OK	0.039	0.01	140.72	140.71	7.686	Increase Pipe Size		8.116	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**133.13**	**132.60**	**132.60**	**132.60**	0.2	34.0	4.67	**152.88**	6.62	Vel-OK	0.284	0.21	140.71	140.49	7.676	Increase Pipe Size		8.106	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**133.13**	**131.40**	**131.40**	**131.40**	**32.0**	34.2	4.66	**199.48**	8.63	Vel-OK	0.484	11.86	140.49	**128.63**	7.463	Increase Pipe Size		9.093	-0.346	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**131.83**	**132.60**	**132.60**	**132.60**	**31.9**	31.9	4.84	**77.28**	4.86	Vel-OK	0.154	0.04	**140.53**	**140.49**	7.502	Increase Pipe Size		7.932	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**133.13**	**132.60**	**132.60**	**132.60**				**79.67**	8.28	Vel-OK	0.627	0.33	140.79	**140.46**	7.757	Increase Pipe Size		8.187	0.000	Method 2 - OK

APPENDIX B-1
PROPOSED ALTERNATIVE 1 - 50% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103/MF147001)
Date : 2/14/2022
By : GPF
Reviewed By:

Select Rainfall Data
Atlas 14 HC Reg 3

COH I-D-F Coefficients

Return Freq (yr)	2
b :	48.35
d :	9.07
e :	0.7244
Peaking Factor C_f :	1.00

i=b/(d+Tc)^e Q=C_f*C*A*i
Initial T_c = 10A^0.1761 + 15 ; A=Drainage Area

HYDRAULIC GRADE LINE COMPUTATIONS

V_{MAX} in Pipe = 12.00
V_{MAX} @ Outfall 8.00
Starting TW (Soffit) = @ Outfall
Starting FL from LiDAR
Fixed Curb Height @ Inlet (ft) 0.50

DRAINAGE AREA DEVELOPMENT: AL 1/4 ac & Smaller Lots | BUSINESS DISTRICTS | PARKS & OPEN AREAS

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	0.55	0.80	0.18	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	2-year Computations Intensity " i " (in/hr)	2-year Computations Flow (cfs)
Raven Song Drive		S.1.C	S	A1-C-1&2	1.6349			1.63	1.63	0.5500	0.90	**25.9**	25.9	3.68	3.31
Raven South Drive		S	R	A1-A&B-1&2	2.2538			2.25	3.89	0.5500	2.14	0.9	26.9	3.61	7.72
Raven South Drive		R	Q					-	3.89	0.5500	2.14	2.1	29.0	3.46	7.72
Raven South Drive		Q	P	A3-A&B-1&2	2.9238			2.92	6.81	0.5500	3.75	0.7	29.7	3.42	12.80
Raven South Drive		P	O					-	6.81	0.5500	3.75	2.7	32.4	3.25	12.80
Raven South Drive		O	N					-	6.81	0.5500	3.75	0.5	33.0	3.22	12.80
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2	1.8846			**7.34**	14.15	**0.5500**	7.78	**29.6**	34.1	3.16	24.63
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2	1.0755			**41.22**	55.37	**0.3692**	20.44	**52.6**	52.6	2.44	49.93
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2	0.9607			6.76	62.13	**0.3889**	24.16	**30.8**	54.8	2.38	57.49
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2	0.9956			**18.87**	81.01	**0.4264**	34.54	**36.7**	58.2	2.33	80.40
Raven South Drive	Ravens Caw	J	H	A10-A-1&2	1.0017			**7.32**	88.33	**0.4367**	38.57	**31.4**	58.2	2.29	88.42
Raven South Drive		H	G					-	88.33	0.4367	38.57	0.9	59.1	2.27	88.42
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2	1.0228			**6.34**	94.67	**0.4443**	42.06	**31.4**	59.5	2.26	95.07
Raven South Drive		F.2	F					-	94.67	0.4443	42.06	0.3	59.8	2.25	95.07
Raven South Drive		F	E	A14-A-1&2	1.1371			1.14	95.81	0.4455	42.68	0.9	60.7	2.23	95.32
Raven South Drive	Ravens Flight Dr	E	D					**7.66**	103.47	**0.4532**	46.90	**33.3**	60.8	2.23	104.62
Raven South Drive		D	C	A16-A-1&2	1.3717			1.37	104.84	0.4545	47.65	1.0	61.8	2.21	105.18
Raven South Drive	Blackbird Dr	C	B					**5.91**	110.75	**0.4596**	50.90	**33.1**	61.9	2.21	112.30
Raven South Drive		B	A	A18-A-1&2	1.2100			1.21	111.96	0.4606	51.57	1.0	62.8	2.18	112.65
Cypress North Houst	Raven Wing Dr	A	CNH-1					**6.88**	118.84	**0.4658**	55.35	**35.9**	62.9	2.18	120.86
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2					**19.96**	138.80	**0.5138**	71.32	**6.4**	63.5	2.17	168.49
Cypress North Houston		CNH 2	CNH-3					-	138.80	0.5138	71.32	1.3	64.8	2.14	168.49
Cypress North Houst	(South Trunkline)	CNH-3	E133					**74.55**	213.35	**0.5672**	121.02	**152.4**	152.4	1.22	168.49
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2	3.4862			3.49	3.49	0.5500	1.92	**27.5**	27.5	3.57	6.84
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2	1.9712			1.97	5.46	0.5500	3.00	2.0	29.4	3.43	10.31
Shaft Drive		M.9	M.8	C1-A&B-1&2	1.8431		4.2248	6.07	6.07	0.2924	1.77	**28.7**	28.7	3.48	6.17
		M.8	M.7					-	6.07	0.2924	1.77	7.2	36.0	3.07	6.17
Shaft Drive		M.7	M.5	C1-A&B-1&2	2.5051		22.8323	25.34	31.41	0.2312	7.26	7.9	43.9	2.73	19.79
Shaft Drive		M.5	M.4					-	31.41	0.2312	7.26	3.9	47.8	2.59	19.79
Shaft Drive		M.4	M.3	C4-A-1&2	2.0244			2.02	33.43	0.2505	8.38	1.0	48.8	2.56	21.42
Shaft Drive		M.3	M.2	C5-A&B-1&2	3.9219			3.92	37.35	0.2820	10.53	0.2	49.0	2.55	26.87
Shaft Drive		M.2	M	C6-A&B-1&2	2.7910			2.79	40.14	0.3006	12.07	3.5	52.5	2.44	29.50
Nevermore Drive		L.3.A	L.2.A	D0-A&B-1	2.1818			2.18	2.18	0.5500	1.20	**26.5**	26.5	3.64	4.37
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2	2.3420			2.34	4.52	0.5500	2.49	2.3	28.8	3.48	8.65
Nevermore Drive		L.1.A	L	D2-A&B-1&2	1.2770			1.28	5.80	0.5500	3.19	1.9	30.7	3.36	10.70
Birdcall Lane		K.7	K.6	E1-A&B-1&2	2.4690			**10.03**	10.03	**0.5500**	5.52	**29.7**	29.7	3.42	18.85
Birdcall Lane		K.6	K.5	E2-A&B-1&2	1.5307			1.53	11.56	0.5500	6.36	0.2	29.9	3.41	21.66
Birdcall Lane		K.5	K.4					-	11.56	0.5500	6.36	1.7	31.6	3.30	21.66
Birdcall Lane		K.4	K.3	E3a-A&B-1	1.7913			1.79	13.35	0.5500	7.34	1.0	32.6	3.25	23.83
Birdcall Lane		K.3	K.1	E4-A&B-1&2	2.8743			2.87	16.22	0.5500	8.92	1.6	34.2	3.16	28.16
Birdcall Lane		K.1	K	E5-A&B-1&2	1.6504			1.65	17.88	0.5500	9.83	2.4	36.6	3.04	29.85
Ravens Mate Drive		K.7.1	K.7	L1-A&B-1&2	2.8026			2.80	2.80	0.5500	1.54	**27.0**	27.0	3.60	5.55
Ravens Mate Drive		K.7.2	K.7	K1-A&B-1&2	2.7541			**4.76**	4.76	**0.5500**	2.62	**28.2**	28.2	3.52	9.21
Ravens Mate Drive		K.7.2.A	K.7.2	K1-C-1&2	2.0029			2.00	2.00	0.5500	1.10	**26.3**	26.3	3.65	4.02
Ravens Caw Drive		J.3.A	J.2.A	F0-A&B-1	2.1602			2.16	2.16	0.5500	1.19	**26.5**	26.5	3.64	4.33
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2	3.1540			3.15	5.31	0.5500	2.92	3.2	29.7	3.42	10.00
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2	1.0077			1.01	6.32	0.5500	3.48	1.6	31.3	3.32	11.54
Raven Roost Drive		G.3.A	G.2.A	G0-A&B-1	1.6956			1.70	1.70	0.5500	0.93	**26.0**	26.0	3.68	3.43
Raven Roost Drive		G.2.A	G.1.A	G1-A&B-1&2	2.1683			2.17	3.86	0.5500	2.13	2.6	28.6	3.49	7.42
Raven Roost Drive		G.1.A	G	G2-A&B-1&2	1.4552			1.46	5.32	0.5500	2.93	2.5	31.1	3.33	9.75
Raven Rook Drive		E.4	E.3	H1-A&B-1&2	2.3772			**3.90**	3.90	**0.5500**	2.14	**27.7**	27.7	3.55	7.61
Raven Flight Drive		E.3	E.2					-	3.90	0.5500	2.14	2.7	30.4	3.37	7.61
Raven Flight Drive		E.2	E.1	H2a-A&B-1	2.1367			2.14	6.03	0.5500	3.32	1.0	31.4	3.31	10.99
Raven Flight Drive		E.1	E	H3-A&B-1&2	1.6284			1.63	7.66	0.5500	4.21	1.5	32.9	3.23	13.59
Raven Flight Drive		E.4.C	E.4	K1-C-1&2	1.5183			1.52	1.52	0.5500	0.84	**25.8**	25.8	3.69	3.08
Blackbird Drive		C.3.A	C.2.A	I0-A&B-1	1.5844			1.58	1.58	0.5500	0.87	**25.8**	25.8	3.69	3.21
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2	1.3823			1.38	2.97	0.5500	1.63	2.6	28.5	3.50	5.71
Blackbird Drive		C.1.A	C	I2-A&B-1&2	2.9466			2.95	5.91	0.5500	3.25	4.0	32.4	3.25	10.58
Raven Wing Drive		A.3.A	A.2.A	J0-A&B-1	1.8563			1.86	1.86	0.5500	1.02	**26.2**	26.2	3.66	3.74
Raven Wing Drive		A.2.A	A.1.A	J1-A&B-1&2	3.2555			3.26	5.11	0.5500	2.81	3.8	29.9	3.40	9.57
Raven Wing Drive		A.1.A	A	J2-A&B-1&2	1.7690			1.77	6.88	0.5500	3.78	5.4	35.3	3.10	11.73
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5	Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4									0.4514		47.63
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1												47.63
Raven Roost (Lake)		RR	RR7	Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate	39.7800			39.78	39.78	0.5500	21.88	**139.1**	139.1	1.29	28.30
Raven Roost (Lake)		RR7	RR8					-	39.78	0.5500	21.88	10.1	149.3	1.23	28.30
Raven Roost (Lake)		RR8	CNH-3					-	39.78	0.5500	21.88	2.6	151.9	1.22	28.30
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2	Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes	19.9300			19.93	19.93	0.8000	15.94	**31.9**	31.9	3.28	0.2828 **52.32**
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3		3.5600			3.56	23.49	0.8000	18.79	2.2	34.2	3.16	59.33
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3		6.1200			6.12	29.61	0.8000	23.69	0.6	34.8	3.13	20.95
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4		2.8700			2.87	32.48	0.8000	25.98	0.3	35.0	3.11	101.83
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3		2.2900			2.29	34.77	0.8000	27.82	**32.1**	35.3	3.10	135.87
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4		19.9600			19.96	19.96	0.8000	15.97	**31.9**	31.9	3.28	52.39
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4		10										53.13

Street Name	Cross Street	Reach (ft)	No. of BBLs	Pipe Diameter (inches) or Span (ft)	Pipe Diameter (inches) or X	Pipe Diameter (inches) or Height (ft)	Pipe Type	Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{des}) (fps)	Design Capacity (Q_{des}) (cfs)	Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)
Raven Song Drive		**60**				**24**	**RCP**	0.013	3.14	0.500	**0.200**	3.2	10.12	0.12	**0.000**	**126.94**	**126.82**	128.94	128.82
Raven South Drive		**200**				**30**	**RCP**	0.013	4.91	0.625	**0.130**	3.0	14.79	0.26	**0.000**	**126.82**	**126.56**	129.32	129.06
Raven South Drive		**70**				**30**	**RCP**	0.013	4.91	0.625	**0.129**	3.0	14.71	0.09	**0.000**	**126.56**	**126.47**	129.06	128.97
Raven South Drive		**428**				**30**	**RCP**	0.013	4.91	0.625	**0.129**	3.0	14.70	0.55	**0.000**	**126.47**	**125.92**	128.97	128.42
Raven South Drive		**86**				**30**	**RCP**	0.013	4.91	0.625	**0.128**	3.0	14.67	0.11	**0.000**	**125.92**	**125.81**	128.42	128.31
Raven South Drive		**165**				**30**	**RCP**	0.013	4.91	0.625	**0.036**	1.6	7.76	0.06	**2.690**	**125.81**	**125.75**	128.31	128.25
Raven South Drive	Raven Park (Scamp)	**285**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	123.06	122.92	128.56	128.42
Raven South Drive	Shaft Dr	**285**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.92	122.78	128.42	128.28
Raven South Drive	Nevermore Dr	**285**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.78	122.64	128.28	128.14
Raven South Drive	Birdcall Dr	**285**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.64	122.50	128.14	128.00
Raven South Drive	Ravens Caw	**200**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.10	**0.000**	122.50	122.40	128.00	127.90
Raven South Drive		**95**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.05	**0.000**	122.40	122.35	127.90	127.85
Raven South Drive	Ravens Roost Dr	**68**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.03	**0.000**	122.35	122.32	127.85	127.82
Raven South Drive		**208**				**66**	**RCP**	0.013	23.76	1.375	0.050	3.2	75.09	0.10	**0.000**	122.32	122.22	127.82	127.72
Raven South Drive		**25**				**66**	**RCP**	0.013	23.76	1.375	**0.080**	4.0	94.98	0.02	**0.000**	**122.22**	**122.20**	127.72	127.70
Raven South Drive	Ravens Flight Dr	**272**				**66**	**RCP**	0.013	23.76	1.375	**0.147**	5.4	128.78	0.40	**0.000**	**122.20**	**121.80**	127.70	127.30
Raven South Drive		**15**				**66**	**RCP**	0.013	23.76	1.375	**-0.133**	#NUM!	#NUM!	-0.02	**0.000**	**121.80**	**121.82**	127.30	127.32
Raven South Drive	Blackbird Dr	**275**				**66**	**RCP**	0.013	23.76	1.375	**0.138**	5.3	124.83	0.38	**-0.200**	**121.82**	**121.44**	127.32	126.94
Raven South Drive		**15**				**66**	**RCP**	0.013	23.76	1.375	**0.200**	6.3	150.18	0.03	**0.200**	**121.64**	**121.61**	127.14	127.11
Cypress North Houst	Raven Wing Dr	**200**				**66**	**RCP**	0.013	23.76	1.375	**0.315**	7.9	188.47	0.63	**0.000**	**121.41**	**120.78**	126.91	126.28
Cypress North Houst	(North Trunkline)	**555**				**66**	**RCP**	0.013	23.76	1.375	**0.114**	4.8	113.14	0.63	**0.000**	**120.78**	**120.15**	126.28	125.65
Cypress North Houston		**65**				**66**	**RCP**	0.013	23.76	1.375	**-1.062**	#NUM!	#NUM!	-0.69	**0.000**	**120.15**	**120.84**	125.65	126.34
Cypress North Houst	(South Trunkline)	**85**	2	7	X	4	**RCB**	0.013	54.22	1.327	**-0.071**	#NUM!	#NUM!	-0.06		**120.84**	**120.90**	124.84	124.90
Raven Park Dr (Scamp Dr)		**258**				**24**	**RCP**	0.013	3.14	0.500	**0.221**	3.4	10.62	0.57	**0.000**	**127.02**	**126.45**	129.02	128.45
Raven Park Dr (Scamp Dr)		**25**				**24**	**RCP**	0.013	3.14	0.500	**2.800**	12.0	37.85	0.70	**2.690**	**126.45**	**125.75**	128.45	127.75
Shaft Drive		**279**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.25	0.000	126.54	126.29	130.04	129.79
Shaft Drive		**305**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.27	0.000	126.29	126.02	129.79	129.52
Shaft Drive		**483**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.43	0.000	126.02	125.59	129.52	129.09
Shaft Drive		**120**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.11	0.000	125.59	125.48	129.09	128.98
Shaft Drive		**25**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.02	0.000	125.48	125.46	128.98	128.96
Shaft Drive		**590**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.53	0.000	125.46	124.93	128.96	128.43
Shaft Drive		**15**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.01	**2.000**	124.93	**124.92**	128.43	128.42
Nevermore Drive		**195**				**24**	**RCP**	0.013	3.14	0.500	0.180	3.1	9.60	0.35	0.000	127.80	127.45	129.80	129.45
Nevermore Drive		**311**				**24**	**RCP**	0.013	3.14	0.500	**0.450**	4.8	15.18	1.40	**0.050**	**127.45**	**126.05**	129.45	128.05
Nevermore Drive		**25**				**24**	**RCP**	0.013	3.14	0.500	**1.520**	8.9	27.89	0.38	**2.840**	**126.00**	**125.62**	128.00	127.62
Birdcall Lane		**24**				**36**	**RCP**	0.013	7.07	0.750	0.110	3.1	22.12	0.03	0.000	125.75	125.72	128.75	128.72
Birdcall Lane		**315**				**36**	**RCP**	0.013	7.07	0.750	0.110	3.1	22.12	0.35	**0.000**	125.72	125.37	128.72	128.37
Birdcall Lane		**135**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.12	0.000	125.37	125.25	128.87	128.75
Birdcall Lane		**245**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.22	0.000	125.25	125.03	128.75	128.53
Birdcall Lane		**415**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.37	0.000	125.03	124.66	128.53	128.16
Birdcall Lane		**25** 820.00				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	0.02	**2.000**	124.66	**124.64**	128.16	128.14
Ravens Mate Drive		**288**				**24**	**RCP**	0.013	3.14	0.500	**0.354**	4.3	13.46	1.02	**0.380**	**127.15**	**126.13**	129.15	128.13
Ravens Mate Drive		**216**				**24**	**RCP**	0.013	3.14	0.500	**0.435**	4.8	14.92	0.94	**0.389**	**127.08**	**126.14**	129.08	128.14
Ravens Mate Drive		**48**				**24**	**RCP**	0.013	3.14	0.500	**0.292**	3.9	12.22	0.14	**0.000**	**127.22**	**127.08**	129.22	129.08
Ravens Caw Drive		**265**				**24**	**RCP**	0.013	3.14	0.500	0.180	3.1	9.60	0.48	0.000	126.32	125.84	128.32	127.84
Ravens Caw Drive		**311**				**24**	**RCP**	0.013	3.14	0.500	**0.119**	2.5	7.80	0.37	**0.150**	**125.84**	**125.47**	127.84	127.47
Ravens Caw Drive		**25**				**24**	**RCP**	0.013	3.14	0.500	**1.400**	8.5	26.77	0.35	**2.470**	**125.32**	**124.97**	127.32	126.97
Raven Roost Drive		**170**				**24**	**RCP**	0.013	3.14	0.500	0.180	3.1	9.60	0.31	0.000	126.00	125.69	128.00	127.69
Raven Roost Drive		**353**				**24**	**RCP**	0.013	3.14	0.500	**0.218**	3.4	10.57	0.77	**0.050**	**125.69**	**124.92**	127.69	126.92
Raven Roost Drive		**70**				**24**	**RCP**	0.013	3.14	0.500	**0.514**	5.2	16.22	0.36	**2.160**	**124.87**	**124.51**	126.87	126.51
Raven Rook Drive		**396**				**24**	**RCP**	0.013	3.14	0.500	**0.376**	4.4	13.88	1.49	**0.000**	**126.13**	**124.64**	128.13	126.64
Raven Flight Drive		**142**				**24**	**RCP**	0.013	3.14	0.500	**0.223**	3.4	10.68	0.32	0.000	**124.64**	124.32	126.64	126.32
Raven Flight Drive		**203**				**30**	**RCP**	0.013	4.91	0.625	**0.223**	3.9	19.36	0.45	**0.000**	124.32	123.87	126.82	126.37
Raven Flight Drive		**61**				**30**	**RCP**	0.013	4.91	0.625	**0.197**	3.7	18.19	0.12	**1.550**	**123.87**	**123.75**	126.37	126.25
Raven Flight Drive		**14**				**24**	**RCP**	0.013	3.14	0.500	**4.286**	14.9	46.83	0.60	**0.000**	**126.73**	**126.13**	128.73	128.13
Blackbird Drive		**160**				**24**	**RCP**	0.013	3.14	0.500	0.180	3.1	9.60	0.29	0.000	126.56	126.27	128.56	128.27
Blackbird Drive		**436**				**24**	**RCP**	0.013	3.14	0.500	**0.252**	3.6	11.36	1.10	**0.100**	**126.27**	**125.17**	128.27	127.17
Blackbird Drive		**61**				**36**	**RCP**	0.013	7.07	0.750	**2.049**	13.5	95.48	1.25	**2.000**	**125.07**	**123.82**	128.07	126.82
Raven Wing Drive		**270**				**24**	**RCP**	0.013	3.14	0.500	0.180	3.1	9.60	0.49	1.000	126.11	125.62	128.11	127.62
Raven Wing Drive		**436**				**36**	**RCP**	0.013	7.07	0.750	0.110	3.1	22.12	0.48	0.000	124.62	124.14	127.62	127.14
Raven Wing Drive		**61**				**36**	**RCP**	0.013	7.07	0.750	**2.016**	13.4	94.71	1.23	**1.500**	**124.14**	**122.91**	127.14	125.91
Cypress-N. Houston (North Trunkline)																			
Cypress-N. Houston (North Trunkline)		**418**				**42**	**RCP**	0.013	9.62	0.875	**0.129**	3.8	36.16	0.54	**0.000**	**124.59**	**124.05**	128.09	127.55
		1,448				**48**	**RCP**	0.013	12.57	1.000	**0.122**	4.0	50.22	1.77	**1.500**	**124.05**	**122.28**	128.05	126.28
Raven Roost (Lake)		**1,787**				**42**	**RCP**	0.013	9.62	0.875	0.090	3.1	30.18	1.61	**0.000**	**122.93**	**121.32**	126.43	124.82
Raven Roost (Lake)		**459**				**42**	**RCP**	0.013	9.62	0.875	**0.146**	4.0	38.44	0.67	**0.000**	**121.32**	**120.65**	124.82	124.15
Raven Roost (Lake)		**69**	2			**36**	**RCP**	0.013	14.14	0.750	**-0.275**	#NUM!	#NUM!	-0.19	**0.000**	**120.65**	**120.84**	123.65	123.84
Cypress-N. Houston (South Trunkline)																			
Cypress-N. Houston (South Trunkline)		**499**	5	X	3		**RCB**	0.013	14.11	0.977	**0.329**	6.5	91.12	1.64	**0.000**	**127.22**	**125.58**	130.22	128.58
Cypress-N. Houston (South Trunkline)		**144**	5	X	3		**RCB**	0.013	14.11	0.977	**0.566**	8.5	119.51	0.82	**0.000**	**125.58**	**124.76**	128.58	127.76
Cypress-N. Houston (South Trunkline)		**25**	5	X	3		**RCB**	0.013	14.11	0.977	**1.640**	14.4	203.44	0.41	**0.000**	**124.76**	**124.35**	127.76	127.35
Cypress-N. Houston (South Trunkline)		**75**	8	X	3		**RCB**	0.013	23.11	1.131	**1.240**	13.8	319.30	0.93	**0.000**	**124.35**	**123.42**	127.35	126.42
Cypress-N. Houston (South Trunkline)		**2,450**	8	X	3		**RCB**	0.013	23.11	1.131	**0.105**	4.0	93.05	2.58	**0.000**	**123.42**	**120.84**	126.42	123.84
Cypress-N. Houston (South Trunkline)		**25**				**54**	**RCP**	0.013	15.90	1.125	**4.680**	26.7	425.42	1.17	**0.000**	**124.59**	**123.42**	129.09	127.92
Cypress-N. Houston (South Trunkline)		**52**				**42**	**RCP**	0.013	9.62	0.875	**0.327**	6.0	57.53	0.17	**0.000**	**124.76**	**124.59**	128.26	128.09

Street Name	Cross Street	Actual Velocity (V_{act}) (fps)	Velocity Check	Hydraulic Gradient Slope (s_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)	Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ Inlets (ft)	2-year Design Check at Inlet Location
Raven Song Drive		1.05	Vel-OK	0.021	0.013	130.30	130.29	**135.76**	135.26	**136.26**	-4.956	OK
Raven South Drive		1.57	Vel-OK	0.035	0.071	130.29	130.22	**135.46**	134.96	**135.96**	-4.669	OK
Raven South Drive		1.57	Vel-OK	0.035	0.025	130.22	130.20	**136.19**	135.69	**136.69**	-5.470	OK
Raven South Drive		2.61	Vel-OK	0.097	0.417	130.20	129.78	**136.01**	135.51	**136.51**	-5.315	OK
Raven South Drive		2.61	Vel-OK	0.097	0.084	129.78	129.69	**136.43**	135.93	**136.93**	-6.151	OK
Raven South Drive		2.61	Vel-OK	0.097	0.161	129.69	129.53	**136.18**	135.68	**136.68**	-5.985	OK
Raven South Drive	Raven Park (Scamp)	1.04	Vel-OK	0.005	0.015

APPENDIX B-2
PROPOSED ALTERNATIVE 1 - 50% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001
Date : 2/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	**28.0**	**0.0208**	**Crown**	**0.50**	**0.50**	13.50	0.281
2	**28.0**	**0.0208**	**Crown**	**0.33**	**1.00**	13.00	0.271
3	**41.0**	**0.0208**	**Crown**	**0.50**	**0.50**	20.00	0.417
4	**25.0**	**0.0208**	**Blvd**	**0.50**	**0.50**	12.00	0.250
5	**25.0**	**0.0208**	**Blvd**	**0.00**	**0.00**	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency = 2 yr
Override Inlet Time (Tc) (min) =
N-Value (Pavement) = **0.016** TxDOT Hydraulic Manual Table 4-8

T_{spread}=1.243(Q_{Gutter}*N/$S_x^{1.67}$$S_x^{.5}$)$^{3/8}$
Y_{Gutter}=T_{Spread}*S_x
Length of Curb Inlet Opening for Intercepting Total Q_{Gutter}
L_T=0.6*$Q^{0.42}$*$S_x^{0.3}$*(1/(N*S_x))$^{0.6}$
Efficiency = 1-(1-L_i/L_T)^1.8
Q_{Bypass} = Q_{Total}*(1-Eff)

INLET PONDING CALCULATIONS

Q_{Gutter} = C_{Gutter} * L_{Gutter} * $H^{1.5}$ — C_{Gutter}= **2.60**
H_{Gutter}=(Q/(C_{Gutter}*L_{Gutter}))$^{2/3}$
Q_{Orif} = C_{Orif} * A_{Gutter} *(2gH_{Gutter})$^{1/2}$ — C_{Orif}= **0.60**
H_{Orif}=(Q/(C_{Orif}*A*Sqrt(2g))^2
T_{Inlet}=H/S_x

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

PONDING WIDTH & GUTTER DEPTH CHECKS FOR DESIGN STORM

Pavement Cross Section Dimensions

INLET #1 (FAR INLET) — Gutter Run 1 / Gutter Run 2 / Inlet 1 (Far)

INLET #2 (NEAR INLET) — Gutter Run 3 / Gutter Run 4 / Inlet 2 (Near)

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Street Type	Pavement Width (B-B) (ft)	Cross-Slope (S_x) (ft/ft)	Street Type	Curb Height (ft)	Curb Width (ft)	Maximum Allowable Ponding Spread @ Inlets (ft)	Maximum Allowable Ponding Depth @ Inlets (ft)
Raven Song Drive		**S.1.C**	**S**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		S	**R**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		R	**Q**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		Q	**P**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		P	**O**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		O	**N**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Shaft Dr**	M	**L**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Nevermore Dr**	L	**K**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Birdcall Dr**	K	**J**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Caw**	J	**H**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		H	**G**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F.2	**F**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F	**E**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Flight Dr**	E	**D**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		D	**C**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Blackbird Dr**	C	**B**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		B	**A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houston		CNH 2	**CNH-3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		**M.9**	**M.8**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
		M.8	**M.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.7	**M.5**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.5	**M.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.4	**M.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.3	**M.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.2	**M**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		**L.3.A**	**L.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.2.A	**L.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.1.A	**L**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		**K.7**	**K.6**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.6	**K.5**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.5	**K.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.4	**K.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.3	**K.1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.1	**K**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.1**	**K.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.2**	**K.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		**J.3.A**	**J.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.2.A	**J.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.1.A	**J**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		**G.3.A**	**G.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.2.A	**G.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.1.A	**G**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Rook Drive		**E.4**	**E.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.3	**E.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.2	**E.1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.1	**E**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		**E.4.C**	**E.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		**C.3.A**	**C.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.2.A	**C.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.1.A	**C**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		**A.3.A**	**A.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.2.A	**A.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.1.A	**A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		**RR**	**RR7**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR7	**RR8**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR8	**CNH-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

INLET #1 (FAR INLET)

Gutter Run 1								Gutter Run 2								Inlet 1 (Far)							
Drainage Area (ac)	T/C Grade (S_{Tx}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)	Drainage Area (ac)	T/C Grade (S_{Tx}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)	Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (ft)	
0.7150	**0.25**	24.43	3.80	1.49	10.59	0.22	-	**0.9199**	**0.25**	24.85	3.76	1.90	11.60	0.24	-								
0.5156	**0.25**	23.90	3.84	1.09	9.41	0.20	-	**0.3491**	**0.64**	23.31	3.89	0.75	6.85	0.14	-	**B-B Grate**	Sag	24.85	3.76	3.38	0.01	0.00	
				No Inlet			-					No Inlet			-	**B-B Grate**	Sag	23.90	3.84	1.83	elow Gut	-0.04	
				No Inlet			-					No Inlet			-								
1.2436	**0.25**	25.39	3.72	2.55	12.94	0.27	-	**0.6625**	**0.50**	24.30	3.81	1.39	9.05	0.19	-	**B-B Grate**	Sag	25.39	3.72	3.90	1.20	0.02	
				No Inlet			-					No Inlet			-								
				No Inlet			-					No Inlet			-								
1.4209	**0.60**	25.64	3.70	2.89	11.52	0.24	-	**0.4637**	**0.25**	23.73	3.86	0.98	9.06	0.19	-	**B-B Grate**	Sag	25.64	3.70	3.84	1.06	0.02	
0.3618	**0.25**	23.36	3.89	0.77	8.28	0.17	-	**0.1560**	**0.25**	22.21	3.99	0.34	6.10	0.13	-	**B-B Grate**	Sag	23.36	3.89	1.11	elow Gut	-0.04	
0.4702	**0.25**	23.76	3.86	1.00	9.10	0.19	-	**0.4905**	**0.25**	23.82	3.85	1.04	9.24	0.19	-	**B-B Grate**	Sag	23.82	3.85	2.03	elow Gut	-0.04	
0.4974	**0.25**	23.84	3.85	1.05	9.29	0.19	-	**0.4982**	**0.25**	23.85	3.85	1.05	9.30	0.19	-	**B-B Grate**	Sag	23.85	3.85	2.11	elow Gut	-0.04	
0.5169	**0.60**	23.90	3.84	1.09	7.99	0.17	-	**0.4848**	**0.25**	23.80	3.85	1.03	9.20	0.19	-	**B-B Grate**	Sag	23.90	3.84	2.12	elow Gut	-0.04	
				No Inlet			-					No Inlet			-								
0.2972	**0.25**	23.08	3.91	0.64	7.71	0.16	-	**0.2140**	**0.25**	22.62	3.95	0.47	6.84	0.14	-	**B-B Grate**	Sag	23.08	3.91	1.10	elow Gut	-0.04	**0.2254**
				No Inlet			-					No Inlet			-								
0.4009	**0.25**	23.51	3.88	0.85	8.59	0.18	-	**0.7362**	**0.45**	24.47	3.80	1.54	9.59	0.20	-	**B-B Grate**	Sag	24.47	3.80	2.37	elow Gut	-0.03	
				No Inlet			-					No Inlet			-								
0.5908	**0.25**	24.11	3.82	1.24	9.89	0.21	-	**0.7809**	**0.70**	24.57	3.79	1.63	9.02	0.19	-	**B-B Grate**	Sag	24.57	3.79	2.86	elow Gut	-0.03	
				No Inlet			-					No Inlet			-								
0.6880	**0.75**	24.36	3.80	1.44	8.50	0.18	-	**0.5220**	**0.25**	23.92	3.84	1.10	9.45	0.20	-	**B-B Grate**	Sag	24.36	3.80	2.53	elow Gut	-0.03	
				No Inlet			-					No Inlet			-								
				No Inlet			-					No Inlet			-								
				No Inlet			-					No Inlet			-								
				No Inlet			-					No Inlet			-								
0.8696	**0.25**	24.76	3.77	1.80	11.37	0.24	-	**0.4591**	**0.40**	23.72	3.86	0.97	8.26	0.17	-	**C-1**	Sag	24.76	3.77	2.76	elow Gut	-0.06	**1.6365**
0.2450	**0.33**	22.81	3.94	0.53	6.82	0.14	-	**1.1175**	**0.25**	25.20	3.74	2.30	12.45	0.26	-	**C-1**	Sag	25.20	3.74	2.80	elow Gut	-0.05	**0.4116**
2.8062	**0.25**	26.99	3.60	2.95	**13.68**	0.29	-	**1.4186**	**0.25**	25.64	3.70	1.54	10.70	0.22	-	**B-B Grate**	Sag	26.99	3.60	4.45	2.41	0.05	**1.0193**
				No Inlet			-					No Inlet			-								
9.7221	**0.32**	29.93	3.40	7.17	**18.21**	0.38	-	**13.1102**	**0.27**	30.73	3.35	9.52	**20.91**	0.44	-	**B-B Grate**	Sag	30.73	3.35	16.58	22.63	0.47	**1.4587**
				No Inlet			-					No Inlet			-								
1.1707	**0.25**	25.28	3.73	2.40	12.66	0.26	-	**0.8537**	**0.47**	24.73	3.77	1.77	10.05	0.21	-	**B-B Grate**	Sag	25.28	3.73	4.15	1.76	0.04	
0.8212	**0.25**	24.66	3.78	1.71	11.14	0.23	-	**1.1027**	**0.25**	25.17	3.74	2.27	12.39	0.26	-	**B-B Grate**	Sag	25.17	3.74	3.96	1.32	0.03	**0.6447**
1.1405	**0.25**	25.23	3.73	2.34	12.54	0.26	-	**0.2445**	**0.25**	22.80	3.94	0.53	7.18	0.15	-	**B-B Grate**	Sag	25.23	3.73	2.84	elow Gut	-0.03	**1.1695**
1.0504	**0.26**	25.09	3.75	2.16	12.08	0.25	-									**C-1**	On-Grade	25.09	3.75	2.16	elow Gut	-0.07	**1.1314**
0.6968	**0.26**	24.38	3.80	**1.46**	10.42	0.22	-	**0.4331**	**0.25**	23.63	3.87	0.92	8.84	0.18	-	**C-1**	Sag	24.38	3.80	**2.36**	elow Gut	-0.07	**0.6922**
0.4409	**0.40**	23.66	3.86	0.94	8.14	0.17	-	**0.1548**	**0.25**	22.20	3.99	0.34	6.08	0.13	-	**B-B Grate**	Sag	23.66	3.86	1.27	elow Gut	-0.04	**0.4796**
1.4076	**0.25**	25.62	3.70	2.87	**13.53**	0.28	-	**0.3369**	**0.25**	23.26	3.90	0.72	8.07	0.17	-	**B-B Grate**	Sag	25.62	3.70	3.55	0.40	0.01	**0.3995**
0.1762	**0.25**	22.37	3.98	0.39	6.37	0.13	-	**0.5854**	**0.32**	24.10	3.83	1.23	9.41	0.20	-	**B-B Grate**	Sag	24.10	3.83	1.60	elow Gut	-0.04	**0.2100**
				No Inlet			-					No Inlet			-					No Inlet			
0.8789	**0.25**	24.78	3.77	1.82	11.41	0.24	-									**C-1**	On-Grade	24.78	3.77	1.82	elow Gut	-0.07	**0.9124**
0.7308	**0.25**	24.46	3.80	**1.53**	10.68	0.22	-	**0.6909**	**0.31**	24.37	3.80	1.45	10.05	0.21	-	**B-B Grate**	Sag	24.46	3.80	**2.97**	elow Gut	-0.02	**0.7630**
0.5994	**0.25**	24.14	3.82	1.26	9.94	0.21	-	**0.1926**	**0.25**	22.48	3.97	0.42	6.58	0.14	-	**B-B Grate**	Sag	24.14	3.82	1.67	elow Gut	-0.04	**0.6535**
0.7157	**0.25**	24.43	3.80	1.50	10.60	0.22	-	**1.1560**	**0.25**	25.26	3.73	2.37	12.60	0.26	-	**B-B Grate**	Sag	25.26	3.73	3.84	1.06	0.02	**0.2287**
0.5607	**0.35**	24.03	3.83	1.18	9.11	0.19	-	**1.4748**	**0.25**	25.71	3.70	3.00	**13.76**	0.29	-	**B-B Grate**	Sag	25.71	3.70	4.14	1.73	0.04	**0.5301**
1.4945	**0.25**	25.73	3.70	3.04	**13.82**	0.29	-	**0.5084**	**0.50**	23.88	3.84	1.08	8.22	0.17	-	**B-B Grate**	Sag	25.73	3.70	4.07	1.58	0.03	
																				No Inlet			
1.0595	**0.25**	25.10	3.74	2.18	12.21	0.25	-									**C-1**	On-Grade	25.10	3.74	2.18	elow Gut	-0.07	**1.1007**
0.8213	**0.25**	24.66	3.78	**1.71**	11.14	0.23	-	**0.6752**	**0.25**	24.33	3.81	1.41	10.38	0.22	-	**C-1**	Sag	24.66	3.78	**3.11**	elow Gut	-0.03	**0.9383**
0.2607	**0.25**	22.89	3.93	0.56	7.35	0.15	-	**0.2361**	**0.25**	22.76	3.94	0.51	7.09	0.15	-	**C-1**	Sag	22.89	3.93	1.07	elow Gut	-0.08	**0.2929**
1.1578	**0.25**	25.26	3.73	2.38	12.61	0.26	-									**C-1**	On-Grade	25.26	3.73	2.38	elow Gut	-0.07	**0.5378**
0.5226	**0.25**	23.92	3.84	**1.10**	9.46	0.20	-	**0.5489**	**0.40**	24.00	3.83	1.16	8.82	0.18	-	**C-1**	Sag	24.00	3.83	**2.26**	elow Gut	-0.07	**0.4851**
0.4530	**0.25**	23.70	3.86	0.96	8.98	0.19	-	**0.2610**	**0.25**	22.89	3.93	0.56	7.35	0.15	-	**C-1**	Sag	23.70	3.86	1.52	elow Gut	-0.08	**0.4879**
0.2745	**0.25**	22.96	3.92	0.59	7.49	0.16	-	**0.9560**	**0.44**	24.92	3.76	1.98	10.58	0.22	-	**B-B Grate**	Sag	24.92	3.76	2.54	elow Gut	-0.03	**0.5709**
				No Inlet			-					No Inlet			-					No Inlet			
1.0891	**0.25**	25.15	3.74	2.24	12.33	0.26	-									**C-1**	On-Grade	25.15	3.74	2.24	elow Gut	-0.07	**1.0476**
0.6190	**0.25**	24.19	3.82	**1.30**	10.06	0.21	-	**0.2269**	**0.45**	22.70	3.95	0.49	6.26	0.13	-	**B-B Grate**	Sag	24.19	3.82	**1.78**	elow Gut	-0.04	**0.6244**
0.4293	**0.25**	23.62	3.87	0.91	8.81	0.18	-	**1.0890**	**0.25**	25.15	3.74	2.24	12.33	0.26	-	**B-B Grate**	Sag	25.15	3.74	3.12	elow Gut	-0.01	
																				No Inlet			
1.1509	**0.25**	25.25	3.73	2.36	12.58	0.26	-									**C-1**	On-Grade	25.25	3.73	2.36	elow Gut	-0.07	**0.4335**
0.5114	**0.25**	23.89	3.84	**1.08**	9.38	0.20	-	**0.1593**	**0.31**	22.24	3.99	0.35	5.90	0.12	-	**C-1**	Sag	23.89	3.84	**1.42**	elow Gut	-0.08	**0.5770**
1.2458	**0.25**	25.39	3.72	2.55	12.95	0.27	-	**0.2194**	**0.70**	22.66	3.95	0.48	5.69	0.12	-	**C-2**	Sag	25.39	3.72	3.00	elow Gut	-0.07	**1.2503**
0.3309	**0.25**	23.23	3.90	0.71	8.01	0.17	-									**C-1**	On-Grade	23.23	3.90	0.71	elow Gut	-0.08	**1.5254**
0.9143	**0.25**	24.84	3.77	**1.89**	11.58	0.24	-	**0.6190**	**0.25**	24.19	3.82	1.30	10.06	0.21	-	**C-1**	Sag	24.84	3.77	**3.18**	elow Gut	-0.03	**0.9438**
0.6353	**0.29**	24.23	3.82	1.33	9.87	0.21	-	**0.2317**	**0.25**	22.73	3.94	0.50	7.04	0.15	-	**C-2**	Sag	24.23	3.82	1.82	elow Gut	-0.08	**0.6992**

INLET #2 (NEAR INLET)

Gutter Run 3								Gutter Run 4								Inlet 2 (Near)											
Drainage Area (ac)	T/C Grade (S_{Tx}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)	Drainage Area (ac)	T/C Grade (S_{Tx}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)	Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (ft)	
				No Inlet			-					No Inlet			-						

APPENDIX B-3
PROPOSED ALTERNATIVE 1 - 1% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147011
Date : 2/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients	
Return Freq (yr)	100
b :	60.66
d :	4.44
e :	0.5797
Peaking Factor C_k :	1.00

$Q_{design}=C_{equiv}*W_{PAVE}*H_{PAVE}^{1.5}$
Where W_{PAVE} = Width of Pavement to F/C; H_{PAVE} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = **128.50**

C_{equiv} = **2.10**

Allowable 100-yr HGL Height Above T/C @ Location: **1.50** / **0.50**

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity "i" (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	HGL Above(+) / Below(-) T/C @ D/S High (ft)	Check HGL or Act Gutter Depth vs. Nat Grnd @ ROW Locations	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
Raven Song Drive		**S.1.C**	**S**	**136.37**	136.37	135.87	**136.87**	25.9	25.9	8.39	7.54	2.40	Vel-OK	0.111	0.07	159.14	159.08	23.382	Increase Pipe Size	22.772	OK	0.422	Method 2 - OK
Raven South Drive		S	**R**	**136.37**	136.37	135.87	**136.87**	0.4	26.3	8.32	17.80	3.63	Vel-OK	0.188	0.38	159.08	158.70	23.616	Increase Pipe Size	22.706	OK	0.642	Method 2 - OK
Raven South Drive		R	**Q**	**137.00**	137.00	136.50	**137.50**	0.9	27.2	8.18	17.80	3.63	Vel-OK	0.188	0.13	158.70	158.57	22.509	Increase Pipe Size	21.699	OK	0.642	Method 2 - OK
Raven South Drive		Q	**P**	**137.00**	137.00	136.50	**137.50**	0.3	27.6	8.13	30.48	6.21	Vel-OK	0.552	2.36	158.57	156.20	22.557	Increase Pipe Size	21.567	OK	0.871	Method 2 - OK
Raven South Drive		P	**O**	**136.19**	136.19	135.69	**136.69**	1.1	28.7	7.97	30.48	6.21	Vel-OK	0.552	0.47	156.20	155.73	19.773	Increase Pipe Size	20.013	OK	0.871	Method 2 - OK
Raven South Drive		O	**N**	**136.19**	136.19	135.69	**136.69**	0.2	28.9	7.94	30.48	6.21	Vel-OK	0.552	0.91	155.73	154.82	19.548	Increase Pipe Size	19.538	OK	0.871	Method 2 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**136.19**	136.19	135.69	**136.69**	**28.4**	29.4	7.88	61.33	2.58	Vel-OK	0.033	0.10	154.82	154.72	18.977	Increase Pipe Size	18.627	Check Lo Spot	1.328	Increase Pipe Size
Raven South Drive	**Shaft Dr**	M	L	**136.19**	136.19	135.69	**136.69**	**38.6**	38.6	6.85	140.05	5.89	Vel-OK	0.174	0.50	154.72	154.23	19.202	Increase Pipe Size	18.532	Check Lo Spot	2.303	Increase Pipe Size
Raven South Drive	**Nevermore Dr**	L	K	**136.00**	136.00	135.50	**136.50**	**28.4**	39.4	6.78	163.75	6.89	Vel-OK	0.238	0.68	154.23	153.55	18.587	Increase Pipe Size	18.227	Check Lo Spot	2.554	Increase Pipe Size
Raven South Drive	**Birdcall Dr**	K	J	**136.00**	136.00	135.50	**136.50**	**31.6**	40.1	6.72	231.99	9.76	Vel-OK	0.477	1.36	153.55	152.19	17.909	Increase Pipe Size	17.549	Check Lo Spot	3.198	Increase Pipe Size
Raven South Drive	**Ravens Caw**	J	H	**135.51**	135.51	135.01	**136.01**	**28.6**	40.6	6.67	257.41	10.83	Vel-OK	0.588	1.18	152.19	151.01	17.049	Increase Pipe Size	16.679	Check Lo Spot	3.428	Increase Pipe Size
Raven South Drive		H	G	**135.47**	135.47	134.97	**135.97**	0.3	40.9	6.65	257.41	10.83	Vel-OK	0.588	0.56	151.01	150.46	15.713	Increase Pipe Size	15.543	Check Lo Spot	3.428	Increase Pipe Size
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**135.47**	135.47	134.97	**135.97**	**28.3**	41.0	6.64	279.06	11.75	Vel-OK	0.691	0.47	150.46	149.99	15.795	Increase Pipe Size	14.985	Check Lo Spot	3.620	Increase Pipe Size
Raven South Drive		F.2	**F**	**135.47**	135.47	134.97	**135.97**	0.1	41.1	6.63	279.06	11.75	Vel-OK	0.691	1.44	149.99	148.55	14.586	Increase Pipe Size	14.516	Check Lo Spot	3.620	Increase Pipe Size
Raven South Drive		F	E	**135.18**	135.18	134.68	**135.68**	0.3	41.4	6.60	281.81	11.86	Vel-OK	0.704	0.18	148.55	148.37	13.749	Increase Pipe Size	13.369	Check Lo Spot	3.651	Increase Pipe Size
Raven South Drive	**Ravens Flight Dr**	E	D	**135.18**	135.18	134.68	**135.68**	**30.1**	41.5	6.60	309.49	13.03	rease Pipe S	0.849	2.31	148.37	146.06	13.573	Increase Pipe Size	13.193	Check Lo Spot	3.878	Increase Pipe Size
Raven South Drive		D	C	**134.50**	134.50	134.00	**135.00**	0.3	41.8	6.57	313.10	13.18	rease Pipe S	0.869	0.13	146.06	145.93	11.893	Increase Pipe Size	11.563	Check Lo Spot	3.915	Increase Pipe Size
Raven South Drive	**Blackbird Dr**	C	B	**134.50**	134.50	134.00	**135.00**	**29.0**	41.8	6.57	334.39	14.07	rease Pipe S	0.992	2.73	145.93	143.21	11.762	Increase Pipe Size	11.432	Check Lo Spot	4.085	Increase Pipe Size
Raven South Drive		B	A	**135.24**	135.24	134.74	**135.74**	0.3	42.2	6.54	337.38	14.20	rease Pipe S	1.009	0.15	143.21	143.05	9.066	Increase Pipe Size	7.966	Check Lo Spot	4.116	Increase Pipe Size
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**135.24**	135.24	134.74	**135.74**	**30.3**	42.2	6.54	362.06	15.24	rease Pipe S	1.162	2.32	143.05	140.73	8.914	Increase Pipe Size	7.814	Check Lo Spot	4.308	Increase Pipe Size
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**136.50**	136.50	136.00	**135.50**	**2.4**	42.4	6.52	465.25	19.58	rease Pipe S	1.919	10.65	140.73	130.08	4.229	Increase Pipe Size	4.229	Check Lo Spot	4.926	Increase Pipe Size
Cypress North Houston		CNH 2	**CNH-3**	**136.50**	136.50	136.00	**135.50**	0.5	42.9	6.49	465.25	19.58	rease Pipe S	1.919	1.25	130.08	128.83	-6.424	Method 1 - OK	-6.424	OK		Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**136.50**	136.50	136.00	**135.50**	**144.2**	144.2	3.34	465.25	8.58	ease Outfall	0.387	0.33	128.83	**128.50**	-7.671	Method 1 - OK	-7.671	OK		Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**136.03**	136.03	135.53	**136.53**	**27.5**	27.5	8.15	15.63	4.97	Vel-OK	0.477	1.23	156.33	155.10	20.832	Increase Pipe Size	20.302	OK	0.599	Method 2 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**135.94**	135.94	135.44	**136.44**	0.9	28.3	8.02	24.09	7.67	Vel-OK	1.134	0.28	155.10	**154.82**	19.561	Increase Pipe Size	19.161	OK	0.759	Method 2 - OK
Shaft Drive		**M.9**	**M.8**	**136.45**	136.45	135.95	**136.95**	**28.7**	28.7	7.97	14.13	1.47	Vel-OK	0.020	0.06	159.78	159.73	24.043	Increase Pipe Size	23.333	OK	0.569	Method 2 - OK
		M.8	**M.7**	**136.52**	136.52	136.02	**137.02**	3.2	31.9	7.56	14.13	1.47	Vel-OK	0.020	0.06	159.73	159.67	23.688	Increase Pipe Size	23.208	OK	0.569	Method 2 - OK
Shaft Drive		M.7	**M.5**	**136.52**	136.52	136.02	**137.02**	3.5	35.4	7.17	52.06	5.41	Vel-OK	0.268	1.29	159.67	158.37	23.628	Increase Pipe Size	23.148	Check Lo Spot	1.231	Increase Pipe Size
Shaft Drive		M.5	**M.4**	**136.52**	136.52	136.02	**137.02**	1.5	36.9	7.02	52.06	5.41	Vel-OK	0.268	0.32	158.37	158.05	22.335	Increase Pipe Size	21.855	Check Lo Spot	1.231	Increase Pipe Size
Shaft Drive		M.4	**M.3**	**136.52**	136.52	136.02	**137.02**	0.4	37.2	6.98	58.47	6.08	Vel-OK	0.338	0.08	158.05	157.97	22.533	Increase Pipe Size	21.533	Check Lo Spot	1.336	Increase Pipe Size
Shaft Drive		M.3	**M.2**	**136.52**	136.52	136.02	**137.02**	0.1	37.3	6.97	73.46	7.64	Vel-OK	0.533	3.15	157.97	154.82	22.719	Increase Pipe Size	21.449	Check Lo Spot	1.533	Increase Pipe Size
Shaft Drive		M.2	**M**	**135.92**	135.92	135.42	**136.42**	1.3	38.6	6.85	82.70	8.60	Vel-OK	0.676	0.10	154.82	**154.72**	19.304	Increase Pipe Size	18.904	Check Lo Spot	1.662	Increase Pipe Size
Nevermore Drive		**L.3.A**	**L.2.A**	**135.90**	135.90	135.40	**136.40**	**26.5**	26.5	8.30	9.96	3.17	Vel-OK	0.194	0.38	157.42	157.04	21.510	Increase Pipe Size	21.520	OK	0.479	Method 2 - OK
Nevermore Drive		L.2.A	**L.1.A**	**135.90**	135.90	135.40	**136.40**	1.0	27.5	8.14	20.26	6.45	Vel-OK	0.802	2.50	157.04	154.55	21.642	Increase Pipe Size	21.142	OK	0.692	Method 2 - OK
Nevermore Drive		L.1.A	**L**	**135.74**	135.74	135.24	**136.24**	0.8	28.3	8.03	25.61	8.15	Vel-OK	1.282	0.32	154.55	**154.23**	19.207	Increase Pipe Size	18.807	OK	0.792	Method 2 - OK
Birdcall Lane		**K.7**	**K.6**	**136.50**	136.50	136.00	**137.00**	**28.7**	28.7	7.97	43.97	6.22	Vel-OK	0.435	0.10	158.69	158.58	22.827	Increase Pipe Size	22.187	Check Lo Spot	1.063	Increase Pipe Size
Birdcall Lane		K.6	**K.5**	**136.50**	136.50	136.00	**137.00**	0.1	28.8	7.96	50.63	7.16	Vel-OK	0.576	1.81	158.58	156.77	22.733	Increase Pipe Size	22.083	Check Lo Spot	1.155	Increase Pipe Size
Birdcall Lane		K.5	**K.4**	**135.86**	135.86	135.36	**136.36**	0.7	29.5	7.86	50.63	5.26	Vel-OK	0.253	0.34	156.77	156.43	20.628	Increase Pipe Size	20.908	Check Lo Spot	1.155	Increase Pipe Size
Birdcall Lane		K.4	**K.3**	**135.86**	135.86	135.36	**136.36**	0.4	29.9	7.81	57.32	5.96	Vel-OK	0.325	0.80	156.43	155.63	20.566	Increase Pipe Size	20.566	Check Lo Spot	1.258	Increase Pipe Size
Birdcall Lane		K.3	**K.1**	**135.86**	135.86	135.36	**136.36**	0.7	30.6	7.72	68.87	7.16	Vel-OK	0.469	1.94	155.63	153.69	20.381	Increase Pipe Size	19.771	Check Lo Spot	1.413	Increase Pipe Size
Birdcall Lane		K.1	**K**	**135.74**	135.74	135.24	**136.24**	1.0	31.6	7.60	74.68	7.76	Vel-OK	0.551	0.14	153.69	**153.55**	18.347	Increase Pipe Size	17.947	Check Lo Spot	1.498	Increase Pipe Size
Ravens Mate Drive		**K.7.1**	**K.7**	**136.50**	136.50	136.00	**137.00**	**27.0**	27.0	8.22	12.67	4.03	Vel-OK	0.314	0.90	159.59	**158.69**	23.951	Increase Pipe Size	23.091	OK	0.539	Method 2 - OK
Ravens Mate Drive		**K.7.2**	**K.7**	**136.25**	136.25	135.75	**136.75**	**28.2**	28.2	8.05	21.06	6.70	Vel-OK	0.866	1.87	160.56	**158.69**	25.058	Increase Pipe Size	24.308	OK	0.700	Method 2 - OK
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**136.50**	136.50	136.00	**137.00**	**26.3**	26.3	8.33	9.17	2.92	Vel-OK	0.164	0.08	160.64	**160.56**	24.837	Increase Pipe Size	24.137	OK	0.461	Method 2 - OK
Ravens Caw Drive		**J.3.A**	**J.2.A**	**135.25**	135.25	134.75	**135.75**	**26.5**	26.5	8.30	9.86	3.14	Vel-OK	0.190	0.50	156.47	155.96	21.059	Increase Pipe Size	21.219	OK	0.477	Method 2 - OK
Ravens Caw Drive		J.2.A	**J.1.A**	**135.25**	135.25	134.75	**135.75**	1.4	27.9	8.09	23.65	7.53	Vel-OK	1.093	3.40	155.96	152.57	21.215	Increase Pipe Size	20.715	OK	0.755	Method 2 - OK
Ravens Caw Drive		J.1.A	**J**	**135.24**	135.24	134.74	**135.74**	0.7	28.5	7.99	27.79	8.85	Vel-OK	1.509	0.38	152.57	**152.19**	17.726	Increase Pipe Size	17.326	OK	0.831	Method 2 - OK
Raven Roost Drive		**G.3.A**	**G.2.A**	**135.33**	135.33	134.83	**135.83**	**26.0**	26.0	8.38	7.81	2.49	Vel-OK	0.119	0.20	153.51	153.31	18.371	Increase Pipe Size	18.181	OK	0.429	Method 2 - OK
Raven Roost Drive		G.2.A	**G.1.A**	**135.33**	135.33	134.83	**135.83**	1.1	27.1	8.20	17.43	5.55	Vel-OK	0.594	2.10	153.31	151.21	18.599	Increase Pipe Size	17.979	OK	0.640	Method 2 - OK
Raven Roost Drive		G.1.A	**G**	**135.22**	135.22	134.72	**135.72**	1.1	28.2	8.05	23.54	7.49	Vel-OK	1.083	0.76	151.21	**150.46**	16.393	Increase Pipe Size	15.993	OK	0.759	Method 2 - OK
Raven Rook Drive		**E.4**	**E.3**	**135.11**	135.11	134.61	**135.61**	**27.7**	27.7	8.11	17.38	5.53	Vel-OK	0.591	2.34	152.77	150.43	18.058	Increase Pipe Size	17.658	OK	0.632	Method 2 - OK
Raven Flight Drive		E.3	**E.2**	**134.90**	134.90	134.40	**135.40**	1.2	28.9	7.94	17.38	5.53	Vel-OK	0.591	0.84	150.43	149.59	15.089	Increase Pipe Size	15.529	OK	0.632	Method 2 - OK
Raven Flight Drive		E.2	**E.1**	**134.90**	134.90	134.40	**135.40**	0.4	29.3	7.89	26.16	5.33	Vel-OK	0.407	0.83	149.59	148.76	14.601	Increase Pipe Size	14.691	OK	0.800	Method 2 - OK
Raven Flight Drive		E.1	**E**	**134.90**	134.90	134.40	**135.40**	0.6	30.0	7.80	32.87	6.70	Vel-OK	0.642	0.39	148.76	**148.37**	14.285	Increase Pipe Size	13.865	OK	0.914	Method 2 - OK
Raven Flight Drive		**E.4.C**	**E.4**	**135.75**	135.75	135.25	**136.25**	**25.8**	25.8	8.41	7.02	2.24	Vel-OK	0.096	0.01	152.78	**152.77**	17.771	Increase Pipe Size	17.031	OK	0.409	Method 2 - OK
Blackbird Drive		**C.3.A**	**C.2.A**	**135.16**	135.16	134.66	**135.66**	**25.8**	25.8	8.40	7.32	2.33	Vel-OK	0.105	0.17	147.72	147.56	12.355	Increase Pipe Size	12.565	OK	0.416	Method 2 - OK
Blackbird Drive		C.2.A	**C.1.A**	**135.16**	135.16	134.66	**135.66**	1.1	27.0	8.22	13.41	4.27	Vel-OK	0.352	1.53	147.56	146.02	12.587	Increase Pipe Size	12.397	OK	0.560	Method 2 - OK
Blackbird Drive		C.1.A	**C**	**134.44**	134.44	133.94	**134.94**	1.7	28.7	7.97	25.93	3.67	Vel-OK	0.151	0.09	146.02	**145.93**	12.185	Increase Pipe Size	11.585	OK	0.805	Method 2 - OK
Raven Wing Drive		**A.3.A**	**A.2.A**	**134.49**	134.49	133.99	**134.99**	**26.2**	26.2	8.35	8.53	2.71	Vel-OK	0.142	0.38	144.06	143.68	9.415	Increase Pipe Size	9.575	OK	0.446	Method 2 - OK
Raven Wing Drive		A.2.A	**A.1.A**	**134.49**	134.49	133.99	**134.99**	1.7	27.8	8.10	22.77	3.22	Vel-OK	0.117	0.51	143.68	143.17	9.721	Increase Pipe Size	9.191	OK	0.741	Method 2 - OK
Raven Wing Drive		A.1.A	**A**	**134.24**	134.24	133.74	**134.74**	2.3	30.1	7.79	29.47	4.17	Vel-OK	0.195	0.12	143.17	**143.05**	9.333	Increase Pipe Size	8.933	OK	0.872	Method 2 - OK
				Stage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.5078**				-0.175	-0.175							
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**136.50**	**135.50**	**135.50**	**135.50**				125.16	13.01	rease Pipe S	1.548	6.47	**158.19**	151.72	23.092	Increase Pipe Size	22.692	Check Lo Spot	1.557	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**136.50**	**135.50**	**135.50**	**135.50**				125.16	9.96	Vel-OK	0.759	10.99	151.72	**140.73**	15.223	Increase Pipe Size	16.223	Check Lo Spot	1.557	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**133.00**	**132.80**	**132.80**	**132.80**	**139.1**	139.1	3.41	74.56	7.75	Vel-OK	0.549	9.81	141.38	131.56	7.878	Increase Pipe Size	8.578	Check Lo Spot	1.179	Increase Pipe Size
Raven Roost (Lake)		RR7	**RR8**	**136.50**	**135.50**	**135.50**	**135.50**	3.8	143.0	3.36	74.56	7.75	Vel-OK	0.549	2.52	131.56	129.04	-1.435	Method 1 - OK	-3.935	OK		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	1.0	144.0	3.34	74.56	5.27	Vel-OK	0.312	0.22	129.04	**128.83**	-7.456	Method 1 - OK	-6.456	OK		Method 1 - OK
				Stage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**												
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**137.00**	**136.50**	**136.50**	**136.50**	**31.9**	31.9	7.55	**120.42**	8.53	Vel-OK	0.575	2.87	162.81	159.95	25.813	Increase Pipe Size	26.313	Check Lo Spot	1.450	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**135.10**	**134.80**	**134.80**	**134.80**	1.0	32.9	7.44	139.77	9.90	Vel-OK	0.774	1.11	159.95	158.83	22.946	Increase Pipe Size	25.146	Check Lo Spot	1.589	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**135.10**	**134.80**	**134.80**	**134.80**	0.2	33.2	7.41	**49.63**	3.52	Vel-OK	0.098	0.02	**158.83**	158.81	23.731	Increase Pipe Size	24.031	Check Lo Spot	0.929	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**135.10**	**134.80**	**134.80**	**134.80**	0.1	33.3	7.40	**241.82**	10.46	Vel-OK	0.711	0.53	158.81	158.27	23.707	Increase Pipe Size	24.007	Check Lo Spot	2.183	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	**32.0**	33.4	7.38	**314.34**	13.60	rease Pipe S	1.202	29.44	158.27	**128.83**	23.173	Increase Pipe Size	22.773	Check Lo Spot	2.521	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**136.50**	**135.50**	**135.50**	**135.50**	**31.9**	31.9	7.55	**120.59**	7.58	Vel-OK	0.376	0.09	**158.37**	**158.27**	23.267	Increase Pipe Size	22.867	Check Lo Spot	1.451	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**135.10**	**134.80**	**134.80**	**134.80**				**125.89**	13.08	rease Pipe S	1.566	0.81	159.01	**158.19**	23.906	Increase Pipe Size	24.206	Check Lo Spot	1.503	Increase Pipe Size

APPENDIX B-4
PROPOSED ALTERNATIVE 1
1% AEP SHEET FLOW COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001)
Date : 2/14/2022
By : GPF
Reviewed By:

Under HGL Conditions Which Exceed NG Elevations @ ROW Inlet Capacities Are Computed Using
Minimum Head = Difference in Gutter Elevations between High Point and Inlet OR Maximum Allowable Ponding Depth

Maximum Allowable HGL above T/C Elev @ Inlets = 1.50
Maximum Allowable HGL above T/C Elev @ D/S High = 0.50

Assume Overflows at High Points is Weir Flow
$Q_{weir} = C_{weir} * L_{weir} * H^{3/2}$
$C_{weir} =$ 1.50
$H_{weir} = (Q_i/(C_w * L))^{2/3}$

100-Year SHEET FLOW COMPUTATIONS

INDIVIDUAL INLET CAPACITY COMPUTATIONS

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Inlet Type	Sag or On-Grade	Number of Inlets @ Location	INLET LEADS Inlet 1 (Far) to Inlet 2 (Near) Length (ft)	Size (in)	Pipe Type	INLET LEADS Inlet 2 (Near) to MH Length (ft)	Size (in)	Pipe Type	Gutter Elev @ Inlets	Gutter Elev @ D/S High Point	Minimum NG Elev @ D/S High or Inlet	100-year HGL @ MH (ft)	100-year Headloss through Inlet Leads (ft) Inlet 1 (Far)	Inlet 2 (Near)	Available Head for Inlet Flow Only (ft)	Inlet Capacity@ Available Head (cfs)	100-yr Local Runoff To Inlets (cfs)	Carry-Over from U/S High Point (cfs)	Total Flow @ Inlets (cfs)	Available Capacity or Overflow Contained
Raven Song Drive		S.1.C	S	B-B Grate	Sag	1							135.26	135.87	136.26	159.14	-	-	0.61	20.40	7.70	-	7.70	Cap-OK
Raven South Drive		S	R	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.96	135.87	135.96	159.08	0.02	0.01	0.91	49.84	10.60	-	10.60	Cap-OK
Raven South Drive		R	Q														-	-				-		
Raven South Drive		Q	P	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	135.51	136.50	136.51	158.57	0.03	0.02	0.99	51.98	13.63	-	13.63	Cap-OK
Raven South Drive		P	O														-	-				-		
Raven South Drive		O	N														-	-				-		
Raven South Drive	Raven Park (Scamp)	N	M	B-B Grate	Sag	1				36	24	RCP	135.34	135.69	136.34	154.82	-	0.05	0.35	15.45	8.74	-	8.74	Cap-OK
Raven South Drive	Shaft Dr	M	L	B-B Grate	Sag	2	28	24	RCP	50	24	RCP	135.02	135.69	136.02	154.72	0.00	0.03	0.67	42.77	5.22	-	5.22	Cap-OK
Raven South Drive	Nevermore Dr	L	K	B-B Grate	Sag	1				36	24	RCP	135.14	135.50	136.14	154.23	-	0.02	0.36	15.67	4.62	-	4.62	Cap-OK
Raven South Drive	Birdcall Dr	K	J	B-B Grate	Sag	1				36	24	RCP	135.14	135.50	136.14	153.55	-	0.02	0.36	15.67	4.78	-	4.78	Cap-OK
Raven South Drive	Ravens Caw	J	H	B-B Grate	Sag	1				36	24	RCP	134.64	135.01	135.64	152.19	-	0.02	0.37	15.89	4.81	-	4.81	Cap-OK
Raven South Drive		H	G														-	-				-		
Raven South Drive	Ravens Roost Dr	G	F.2	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	134.16	134.97	135.16	150.46	0.00	0.01	0.81	47.02	4.99	-	4.99	Cap-OK
Raven South Drive		F.2	F														-	-				-		
Raven South Drive		F	E	B-B Grate	Sag	1				6	24	RCP	134.30	134.68	135.30	148.55	-	0.00	0.38	16.10	5.40	-	5.40	Cap-OK
Raven South Drive	Ravens Flight Dr	E	D														-	-				-		
Raven South Drive		D	C	B-B Grate	Sag	1				6	24	RCP	133.67	134.00	134.67	146.06	-	0.00	0.33	15.01	6.50	-	6.50	Cap-OK
Raven South Drive	Blackbird Dr	C	B														-	-				-		
Raven South Drive		B	A	B-B Grate	Sag	1				6	24	RCP	133.64	134.74	134.64	143.21	-	0.00	1.10	27.40	5.75	-	5.75	Cap-OK
Cypress North Houst	Raven Wing Dr	A	CNH-1														-	-				-		
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2														-	-				-		
Cypress North Houston		CNH 2	CNH-3														-	-				-		
Cypress North Houst	(South Trunkline)	CNH-3	E133														-	-				-		
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	C-1	Sag	2	28	24	RCP				135.00	135.53	136.00	156.33	0.04	-	0.53	25.69	16.09	-	16.09	Cap-OK
Raven Park Dr (Scamp Dr)		M.1.A	N	C-1	Sag	2	28	24	RCP	25	24	RCP	135.04	135.44	136.04	155.10	0.01	0.04	0.40	22.32	9.22	-	9.22	Cap-OK
Shaft Drive		M.9	M.8	B-B Grate	Sag	2	41	24	RCP	6	24	RCP	135.24	135.95	136.24	159.78	0.04	0.02	0.71	44.02	14.58	-	14.58	Cap-OK
Shaft Drive		M.8	M.7														-	-				-		
Shaft Drive		M.7	M.5	B-B Grate	Sag	2	41	30	RCP	6	30	RCP	135.54	136.02	136.54	159.67	0.11	0.06	0.48	36.20	42.26	-	42.26	Ovrfl-OK
Shaft Drive		M.5	M.4														-	-				6.06		
Shaft Drive		M.4	M.3	B-B Grate	Sag	1				6	24	RCP	135.02	136.02	136.02	158.05	-	0.03	1.00	26.12	9.45	6.06	15.52	Cap-OK
Shaft Drive		M.3	M.2	B-B Grate	Sag	2	28	24	RCP	75	24	RCP	134.75	136.02	135.75	157.97	0.05	0.49	1.27	58.88	18.22	-	18.22	Cap-OK
Shaft Drive		M.2	M	B-B Grate	Sag	2	28	24	RCP	14	24	RCP	135.02	135.42	136.02	154.82	0.02	0.05	0.40	33.04	13.03	-	13.03	Cap-OK
Nevermore Drive		L.3.A	L.2.A	C-1	On-Grade	2	28	24	RCP				135.41	135.40	136.40	157.42	0.01	-	-	-	10.20	-	10.20	Ovrfl-OK
Nevermore Drive		L.2.A	L.1.A	C-1	Sag	2	28	24	RCP				134.90	135.40	135.90	157.04	0.06	-	0.50	24.96	11.13	10.20	21.34	Cap-OK
Nevermore Drive		L.1.A	L	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	134.84	135.24	135.84	154.55	0.01	0.02	0.40	33.04	6.14	-	6.14	Cap-OK
Birdcall Lane		K-7	K.6	B-B Grate	Sag	2	28	24	RCP	60	24	RCP	135.36	136.00	136.36	158.69	0.02	0.15	0.64	41.80	11.45	-	11.45	Cap-OK
Birdcall Lane		K.6	K.5	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	135.35	136.00	136.35	158.58	0.01	0.01	0.65	42.12	7.32	-	7.32	Cap-OK
Birdcall Lane		K.5	K.4														-	-				-		
Birdcall Lane		K.4	K.3	C-1	On-Grade	2	28	24	RCP	6	24	RCP	135.36	135.36	136.36	156.43	0.01	0.01	-	-	8.44	-	8.44	Ovrfl-OK
Birdcall Lane		K.3	K.1	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.75	135.36	135.75	155.63	0.07	0.06	0.61	40.81	13.62	8.44	22.06	Cap-OK
Birdcall Lane		K.1	K	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.84	135.24	135.84	153.69	0.01	0.01	0.40	33.04	7.86	-	7.86	Cap-OK
Ravens Mate Drive		K-7.1	K.7	B-B Grate	Sag	2				75	24	RCP	135.14	136.00	136.14	159.59	-	0.25	0.86	48.45	13.09	-	13.09	Cap-OK
Ravens Mate Drive		K-7.2	K.7	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	135.00	135.75	136.00	160.56	0.02	0.08	0.75	45.25	12.76	-	12.76	Cap-OK
Ravens Mate Drive		K.7.2.A	K.7.2	B-B Grate	Sag	1				40	24	RCP	135.30	136.00	136.30	160.64	-	0.07	0.70	21.86	9.27	-	9.27	Cap-OK
Ravens Caw Drive		J.3.A	J.2.A	C-1	On-Grade	2	28	24	RCP				134.91	134.75	135.75	156.47	0.01	-	-	-	10.11	-	10.11	Ovrfl-OK
Ravens Caw Drive		J.2.A	J.1.A	C-1	Sag	2	28	24	RCP				134.25	134.75	135.25	155.96	0.09	-	0.50	24.96	14.84	10.11	24.95	Cap-OK
Ravens Caw Drive		J.1.A	J	C-1	Sag	2	28	24	RCP				134.34	134.74	135.34	152.57	0.00	-	0.40	22.32	4.92	-	4.92	Cap-OK
Raven Roost Drive		G.3.A	G.2.A	C-1	On-Grade	2	28	24	RCP				134.64	134.83	135.64	153.51	0.01	-	-	-	7.92	-	7.92	Ovrfl-OK
Raven Roost Drive		G.2.A	G.1.A	C-1	Sag	2	28	24	RCP				134.21	134.83	135.21	153.31	0.05	-	0.62	27.79	10.35	7.92	18.27	Cap-OK
Raven Roost Drive		G.1.A	G	C-1	Sag	2	28	24	RCP				134.32	134.72	135.32	151.21	0.01	-	0.40	22.32	7.00	-	7.00	Cap-OK
Raven Rook Drive		E.4	E.3	B-B Grate	Sag	2	28	24	RCP	65	24	RCP	134.21	134.61	135.21	152.77	0.02	0.16	0.40	33.04	11.18	-	11.18	Cap-OK
Raven Flight Drive		E.3	E.2														-	-				-		
Raven Flight Drive		E.2	E.1	C-1	On-Grade	2	28	24	RCP	6	24	RCP	134.49	134.40	135.40	149.59	0.01	0.01	-	-	10.00	-	10.00	Ovrfl-OK
Raven Flight Drive		E.1	E	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	133.98	134.40	134.98	148.76	0.04	0.04	0.42	33.86	7.77	10.00	17.77	Cap-OK
Raven Flight Drive		E.4.C	E.4	B-B Grate	Sag	1				15	24	RCP	134.51	135.25	135.51	152.78	-	0.01	0.74	22.47	7.11	-	7.11	Cap-OK
Blackbird Drive		C.3.A	C.2.A	C-1	On-Grade	2	28	24	RCP				134.87	134.66	135.66	147.72	0.01	-	-	-	7.40	-	7.40	Ovrfl-OK
Blackbird Drive		C.2.A	C.1.A	C-1	Sag	2	28	24	RCP				134.47	134.66	135.47	147.56	0.03	-	0.19	15.38	6.61	7.40	14.02	Cap-OK
Blackbird Drive		C.1.A	C	C-2	Sag	2	28	24	RCP				133.34	133.94	134.34	146.02	0.03	-	0.60	43.49	13.73	-	13.73	Cap-OK
Raven Wing Drive		A.3.A	A.2.A	C-1	On-Grade	2	28	24	RCP				134.15	133.99	134.99	144.06	0.01	-	-	-	8.59	-	8.59	Ovrfl-OK
Raven Wing Drive		A.2.A	A.1.A	C-1	Sag	2	28	24	RCP				133.46	133.99	134.46	143.68	0.08	-	0.53	25.69	15.32	8.59	23.91	Cap-OK
Raven Wing Drive		A.1.A	A	C-2	Sag	2	28	24	RCP				133.34	133.74	134.34	143.17	0.01	-	0.40	35.51	8.41	-	8.41	Cap-OK
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5																					
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1																					
Raven Roost (Lake)		RR	RR7																					
Raven Roost (Lake)		RR7	RR8																					
Raven Roost (Lake)		RR8	CNH-3																					
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2																					
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3																					
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3																					
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4																					
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3																					
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4																					
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4																					

LOWEST INLETS PONDING COMPUTATIONS

Critical Minimum NG Elev	Available Head @ Inlets (ft)	Capacity @ Available Head (cfs)	Cumulative Inlet Capacity	Sheet Flow @ Lowest Inlets (100yr-	Available Capacity Exceeds Sheet Flow
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
	-				
	-				
134.34	-	-			
134.34	-	-			
134.34	-	-			
134.34	-	-			
134.34	-	-			
	-				
134.34	0.81	47.02			
	-				
134.34	0.38	16.10			
	-				
134.34	0.33	15.01			
	-				
134.34	1.10	27.40	352.19	224.73	OK
	-				
	-				
	-				
134.34	-	-			
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
	-				
134.34	-	-			
	-				
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
134.34	-	-			
134.34	-	-			
134.34	0.50	24.96			
134.34	-	-			
134.34	-	-			
134.34	0.62	27.79			
134.34	0.40	22.32			
134.34	0.40	33.04			
	-				
134.34	-	-			
134.34	0.42	33.86			
134.34	-	-			
	-				
134.34	-	-			
134.34	-	-			
134.34	0.60	43.49			
134.34	-	-			
134.34	0.53	25.69			
134.34	0.40	35.51			

APPENDIX B-5
PROPOSED ALTERNATIVE 1 - 10% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001)
Date : 2/14/2022
By : GPF
Reviewed By:

Select Rainfall Data: Atlas 14 HC Reg 3

COH I-D-F Coefficients	
Return Freq (yr)	10
b :	54.68
d :	6.96
e :	0.6623
Peaking Factor C_f :	1.00

i=b/(d+Tc]^e Q=C_f*C*A*i
Initial T_c = 10A^0.1761 + 15 ; A=Drainage Area

HYDRAULIC GRADE LINE COMPUTATIONS

V_{MAX} in Pipe = 12.00
V_{MAX} @ Outfall = 8.00
Starting TW (Soffit) = @ Outfall
Fixed Curb Height @ Inlet (ft) = 0.50
Starting FL from LiDAR

DRAINAGE AREA DEVELOPMENT: AL 1/4 ac & Smaller Lots = 0.55; BUSINESS DISTRICTS = 0.80; PARKS & OPEN AREAS = 0.18

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	10-year Computations Intensity " i " (in/hr)	10-year Computations Flow (cfs)
Raven Song Drive		S.1.C	S	A1-C-1&2	1.6349							
Raven South Drive		S	R	A1-A&B-1&2	2.2538							
Raven South Drive		R	Q									
Raven South Drive		Q	P	A3-A&B-1&2	2.9238							
Raven South Drive		P	O									
Raven South Drive		O	N									
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2	1.8846							
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2	1.0755							
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2	0.9607							
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2	0.9956							
Raven South Drive	Ravens Caw	J	H	A10-A-1&2	1.0017							
Raven South Drive		H	G									
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2	1.0228							
Raven South Drive		F.2	F									
Raven South Drive		F	E	A14-A-1&2	1.1371							
Raven South Drive	Ravens Flight Dr	E	D									
Raven South Drive		D	C	A16-A-1&2	1.3717							
Raven South Drive	Blackbird Dr	C	B									
Raven South Drive		B	A	A18-A-1&2	1.2100							
Cypress North Houst	Raven Wing Dr	A	CNH-1									
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2									
Cypress North Houston		CNH 2	CNH-3									
Cypress North Houst	(South Trunkline)	CNH-3	E133									
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2	3.4862							
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2	1.9712							
Shaft Drive		M.9	M.8	C1-A&B-1&2	1.8431							
		M.8	M.7									
Shaft Drive		M.7	M.5	C1-A&B-1&2	2.5051							
Shaft Drive		M.5	M.4									
Shaft Drive		M.4	M.3	C4-A-1&2	2.0244							
Shaft Drive		M.3	M.2	C5-A&B-1&2	3.9219							
Shaft Drive		M.2	M	C6-A&B-1&2	2.7910							
Nevermore Drive		L.3.A	L.2.A	D0-A&B-1	2.1818							
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2	2.3420							
Nevermore Drive		L.1.A	K	D2-A&B-1&2	1.2770							
Birdcall Lane		K.7	K.6	E1-A&B-1&2	2.4690							
Birdcall Lane		K.6	K.5	E2-A&B-1&2	1.5307							
Birdcall Lane		K.5	K.4									
Birdcall Lane		K.4	K.3	E3a-A&B-1	1.7913							
Birdcall Lane		K.3	K.1	E4-A&B-1&2	2.8743							
Birdcall Lane		K.1	K	E5-A&B-1&2	1.6504							
Ravens Mate Drive		K.7.1	K.7	L1-A&B-1&2	2.8026							
Ravens Mate Drive		K.7.2	K.7	K1-A&B-1&2	2.7541							
Ravens Mate Drive		K.7.2.A	K.7.2	K1-C-1&2	2.0029							
Ravens Caw Drive		J.3.A	J.2.A	F0-A&B-1	2.1602							
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2	3.1540							
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2	1.0077							
Raven Roost Drive		G.3.A	G.2.A	G0-A&B-1	1.6956							
Raven Roost Drive		G.2.A	G.1.A	G1-A&B-1&2	2.1683							
Raven Roost Drive		G.1.A	G	G2-A&B-1&2	1.4552							
Raven Rook Drive		E.4	E.3	H1-A&B-1&2	2.3772							
Raven Flight Drive		E.3	E.2									
Raven Flight Drive		E.2	E.1	H2a-A&B-1	2.1367							
Raven Flight Drive		E.1	E	H3-A&B-1&2	1.6284							
Raven Flight Drive		E.4.C	E.4	K1-C-1&2	1.5183							
Blackbird Drive		C.3.A	C.2.A	I0-A&B-1	1.5844							
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2	1.3823							
Blackbird Drive		C.1.A	C	I2-A&B-1&2	2.9466							
Raven Wing Drive		A.3.A	A.2.A	J0-A&B-1	1.8563							
Raven Wing Drive		A.2.A	A.1.A	J1-A&B-1&2	3.2555							
Raven Wing Drive		A.1.A	A	J2-A&B-1&2	1.7690							
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5	Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4 = 0.4805						75.40		
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1							75.40		
Raven Roost (Lake)		RR	RR7	Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate	39.7800							
Raven Roost (Lake)		RR7	RR8									
Raven Roost (Lake)		RR8	CNH-3									
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2	Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes = 0.2828	19.9300							
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3		3.5600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3		6.1200							
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4		2.8700							
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3		2.2900							
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4		19.9600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	10								

Pipe Size, Length & Type Input Data								Pipe Hydraulic Data & Design Capacities						Pipe Elevation Data						10-year Design Computations						Elevations @ Inlet Location			10-year
			Pipe Diameter (inches) or																										
Reach (ft)	No. of BBLs	Span (ft)	X	Height (ft)	Pipe Type	Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{des}) (fps)	Design Capacity (Q_{des}) (cfs)	Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)	Actual Velocity (V_{act}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)	Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ Inlets (ft)	Design Check at Inlet Location
60				24	RCP	0.013	3.14	0.500	**0.200**	3.2	10.12	0.12	**0.000**	**126.94**	**126.82**	128.94	128.82	1.55	Vel-OK	0.046	0.028	137.12	137.09	**135.76**	135.26	**136.26**	1.860	HGL Too High
200				30	RCP	0.013	4.91	0.625	**0.130**	3.0	14.79	0.26	**0.000**	**126.82**	**126.56**	129.32	129.06	2.33	Vel-OK	0.078	0.155	137.09	136.94	**135.46**	134.96	**135.96**	2.132	HGL Too High
70				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.71	0.09	**0.000**	**126.56**	**126.47**	129.06	128.97	2.33	Vel-OK	0.078	0.054	136.94	136.88	**136.19**	135.69	**136.69**	1.247	HGL Too High
428				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.70	0.55	**0.000**	**126.47**	**125.92**	128.97	128.42	3.93	Vel-OK	0.221	0.946	136.88	135.94	**136.01**	135.51	**136.51**	1.373	HGL Too High
86				30	RCP	0.013	4.91	0.625	**0.128**	3.0	14.67	0.11	**0.000**	**125.92**	**125.81**	128.42	128.31	3.93	Vel-OK	0.221	0.190	135.94	135.75	**136.43**	135.93	**136.93**	0.007	HGL Too High
165				30	RCP	0.013	4.91	0.625	**0.036**	1.6	7.76	0.06	**2.690**	**125.81**	**125.75**	128.31	128.25	3.93	Vel-OK	0.221	0.365	135.75	135.38	**136.18**	135.68	**136.68**	0.067	HGL Too High
7.34	14.15	**0.5500**	7.78	**28.9**	31.4	4.89	38.05	**285**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	123.06	122.92	128.56	128.42	1.60	Vel-OK	0.013	0.037	135.38	135.35	**135.84**	135.34	**136.34**	0.042	HGL Too High
41.22	55.37	**0.3692**	20.44	**44.4**	44.4	4.02	82.26	**285**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.92	122.78	128.42	128.28	3.46	Vel-OK	0.060	0.171	135.35	135.17	**135.52**	135.02	**136.02**	0.325	HGL Too High
6.76	62.13	**0.3889**	24.16	**29.4**	45.8	3.95	95.54	**285**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.78	122.64	128.28	128.14	4.02	Vel-OK	0.081	0.231	135.17	134.94	**135.64**	135.14	**136.14**	0.034	HGL Too High
18.87	81.01	**0.4264**	34.54	**33.6**	47.0	3.90	134.59	**285**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.14	**0.000**	122.64	122.50	128.14	128.00	5.66	Vel-OK	0.161	0.458	134.94	134.49	**135.64**	135.14	**136.14**	-0.197	OK
7.32	88.33	**0.4367**	38.57	**29.8**	47.8	3.86	148.76	**200**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.10	**0.000**	122.50	122.40	128.00	127.90	6.26	Vel-OK	0.196	0.392	134.49	134.09	**135.14**	134.64	**135.64**	-0.154	OK
-	88.33	0.4367	38.57	0.5	48.4	3.83	148.76	**95**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.05	**0.000**	122.40	122.35	127.90	127.85	6.26	Vel-OK	0.196	0.186	134.09	133.91	**135.30**	134.80	**135.80**	-0.707	OK
6.34	94.67	**0.4443**	42.06	**29.7**	48.6	3.82	160.69	**68**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.03	**0.000**	122.35	122.32	127.85	127.82	6.76	Vel-OK	0.229	0.156	133.91	133.75	**134.66**	134.16	**135.16**	-0.253	OK
-	94.67	0.4443	42.06	0.2	48.8	3.81	160.69	**208**			**66**	RCP	0.013	23.76	1.375	0.050	3.2	75.09	0.10	**0.000**	122.32	122.22	127.82	127.72	6.76	Vel-OK	0.229	0.476	133.75	133.27	**135.40**	134.90	**135.90**	-1.149	OK
1.14	95.81	0.4455	42.68	0.5	49.3	3.79	161.77	**25**			**66**	RCP	0.013	23.76	1.375	**0.080**	4.0	94.98	0.02	**0.000**	**122.22**	**122.20**	127.72	127.70	6.81	Vel-OK	0.232	0.058	133.27	133.22	**134.80**	134.30	**135.30**	-1.025	OK
7.66	103.47	**0.4532**	46.90	**31.5**	49.4	3.79	177.61	**272**			**66**	RCP	0.013	23.76	1.375	**0.147**	5.4	128.78	0.40	**0.000**	**122.20**	**121.80**	127.70	127.30	7.48	Vel-OK	0.280	0.761	133.22	132.46	**134.80**	134.30	**135.30**	-1.083	OK
1.37	104.84	0.4545	47.65	0.6	50.0	3.76	179.19	**15**			**66**	RCP	0.013	23.76	1.375	**-0.133**	#NUM!	#NUM!	-0.02	**0.000**	**121.80**	**121.82**	127.30	127.32	7.54	Vel-OK	0.285	0.043	132.46	132.41	**134.17**	133.67	**134.67**	-1.214	OK
5.91	110.75	**0.4596**	50.90	**30.7**	50.0	3.76	191.35	**275**			**66**	RCP	0.013	23.76	1.375	**0.138**	5.3	124.83	0.38	**-0.200**	**121.82**	**121.44**	127.32	126.94	8.05	Vel-OK	0.325	0.893	132.41	131.52	**134.17**	133.67	**134.67**	-1.257	OK
1.21	111.96	0.4606	51.57	0.6	50.6	3.73	192.58	**15**			**66**	RCP	0.013	23.76	1.375	**0.200**	6.3	150.18	0.03	**0.200**	**121.64**	**121.61**	127.14	127.11	8.11	Vel-OK	0.329	0.049	131.52	131.47	**134.14**	133.64	**134.64**	-2.120	OK
6.88	118.84	**0.4658**	55.35	**30.7**	50.6	3.73	206.64	**200**			**66**	RCP	0.013	23.76	1.375	**0.315**	7.9	188.47	0.63	**0.000**	**121.41**	**120.78**	126.91	126.28	8.70	Vel-OK	0.379	0.757	131.47	130.71	**134.14**	133.64	**134.64**	-2.169	OK
19.96	138.80	**0.5138**	71.32	**4.0**	51.0	3.72	282.04	**555**			**66**	RCP	0.013	23.76	1.375	**0.114**	4.8	113.14	0.63	**0.000**	**120.78**	**120.15**	126.28	125.65	11.87	Vel-OK	0.705	3.915	130.71	126.80	**136.50**	136.00	**135.50**	-5.286	OK
-	138.80	0.5138	71.32	0.8	51.8	3.68	282.04	**65**			**66**	RCP	0.013	23.76	1.375	**-1.062**	#NUM!	#NUM!	-0.69	**0.000**	**120.15**	**120.84**	125.65	126.34	11.87	Vel-OK	0.705	0.459	126.80	126.34	**136.50**	136.00	**135.50**	-9.201	OK
74.55	213.35	**0.5672**	121.02	**147.7**	147.7	1.94	282.04	**85**	2	7 X 4	RCB	0.013	54.22	1.327	**-0.071**	#NUM!	#NUM!	-0.06		**120.84**	**120.90**	124.84	124.90	5.20	Vel-OK	0.142	0.121	125.02	124.90	**136.50**	136.00	**135.50**	-10.979	OK
3.49	3.49	0.5500	1.92	**27.5**	27.5	5.25	10.06	**258**			**24**	RCP	0.013	3.14	0.500	**0.221**	3.4	10.62	0.57	**0.000**	**127.02**	**126.45**	129.02	128.45	3.20	Vel-OK	0.198	0.510	136.01	135.50	**135.50**	135.00	**136.00**	1.007	HGL Too High
1.97	5.46	0.5500	3.00	1.3	28.8	5.12	15.36	**25**			**24**	RCP	0.013	3.14	0.500	**2.800**	12.0	37.85	0.70	**2.690**	**126.45**	**125.75**	128.45	127.75	4.89	Vel-OK	0.461	0.115	135.50	**135.38**	**135.54**	135.04	**136.04**	0.457	HGL Too High
6.07	6.07	0.2924	1.77	**28.7**	28.7	5.12	9.09	**279**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.25	0.000	126.54	126.29	130.04	129.79	0.94	Vel-OK	0.008	0.023	137.16	137.13	**135.74**	135.24	**136.24**	1.917	HGL Too High
-	6.07	0.2924	1.77	4.9	33.7	4.70	9.09	**305**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.27	0.000	126.29	126.02	129.79	129.52	0.94	Vel-OK	0.008	0.025	137.13	137.11	**136.04**	135.54	**136.54**	1.594	HGL Too High
25.34	31.41	0.2312	7.26	5.4	39.0	4.33	31.45	**483**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.43	0.000	126.02	125.59	129.52	129.09	3.27	Vel-OK	0.098	0.472	137.11	136.64	**136.04**	135.54	**136.54**	1.569	HGL Too High
-	31.41	0.2312	7.26	2.5	41.5	4.18	31.45	**120**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.11	0.000	125.59	125.48	129.09	128.98	3.27	Vel-OK	0.098	0.117	136.64	136.52	**136.04**	135.54	**136.54**	1.097	HGL Too High
2.02	33.43	0.2505	8.38	0.6	42.1	4.15	34.75	**25**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.02	0.000	125.48	125.46	128.98	128.96	3.61	Vel-OK	0.119	0.030	136.52	136.49	**135.52**	135.02	**136.02**	1.500	HGL Too High
3.92	37.35	0.2820	10.53	0.1	42.2	4.14	43.63	**590**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.53	0.000	125.46	124.93	128.96	128.43	4.54	Vel-OK	0.188	1.110	136.49	135.38	**135.25**	134.75	**135.75**	1.740	HGL Too High
2.79	40.14	0.3006	12.07	2.2	44.4	4.03	48.58	**15**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.01	**2.000**	124.93	**124.92**	128.43	128.42	5.05	Vel-OK	0.233	0.035	135.38	**135.35**	**135.52**	135.02	**136.02**	0.360	HGL Too High
2.18	2.18	0.5500	1.20	**26.5**	26.5	5.35	6.42	**195**			**24**	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.35	0.000	127.80	127.45	129.80	129.45	2.04	Vel-OK	0.081	0.157	136.47	136.31	**135.91**	135.41	**136.41**	1.061	HGL Too High
2.34	4.52	0.5500	2.49	1.6	28.1	5.19	12.91	**311**			**24**	RCP	0.013	3.14	0.500	**0.450**	4.8	15.18	1.40	**0.050**	**127.45**	**126.05**	129.45	128.05	4.11	Vel-OK	0.326	1.013	136.31	135.30	**135.40**	134.90	**135.90**	1.414	HGL Too High
1.28	5.80	0.5500	3.19	1.3	29.3	5.07	16.17	**25**			**24**	RCP	0.013	3.14	0.500	**1.520**	8.9	27.89	0.38	**2.840**	**126.00**	**125.62**	128.00	127.62	5.15	Vel-OK	0.511	0.128	135.30	**135.17**	**135.34**	134.84	**135.84**	0.462	HGL Too High
10.03	10.03	**0.5500**	5.52	**29.0**	29.0	5.10	28.12	**24**			**36**	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.03	0.000	125.75	125.72	128.75	128.72	3.98	Vel-OK	0.178	0.043	137.00	136.96	**135.86**	135.36	**136.36**	1.640	HGL Too High
1.53	11.56	0.5500	6.36	0.1	29.1	5.09	32.35	**315**			**36**	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.35	**0.000**	125.72	125.37	128.72	128.37	4.58	Vel-OK	0.235	0.741	136.96	136.22	**135.85**	135.35	**136.35**	1.607	HGL Too High
-	11.56	0.5500	6.36	1.1	30.2	4.98	32.35	**135**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.12	0.000	125.37	125.22	128.87	128.75	3.36	Vel-OK	0.103	0.140	136.22	136.08	**136.14**	135.64	**136.64**	0.576	HGL Too High
1.79	13.35	0.5500	7.34	0.7	30.9	4.93	36.17	**245**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.22	0.000	125.25	125.03	128.75	128.53	3.76	Vel-OK	0.129	0.317	136.08	135.76	**135.86**	135.36	**136.36**	0.716	HGL Too High
2.87	16.22	0.5500	8.92	1.1	32.0	4.83	43.14	**415**			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.37	0.000	125.03	124.66	128.53	128.16	4.48	Vel-OK	0.184	0.763	135.76	135.00	**135.25**	134.75	**135.75**	1.010	HGL Too High
1.65	17.88	0.5500	9.83	1.5	33.5	4.71	46.33	**25** (820.00)			**42**	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.02	**2.000**	124.66	**124.64**	128.16	128.14	4.82	Vel-OK	0.212	0.053	135.00	**134.94**	**135.34**	134.84	**135.84**	0.156	HGL Too High
2.80	2.80	0.5500	1.54	**27.0**	27.0	5.30	8.16	**288**			**24**	RCP	0.013	3.14	0.500	**0.354**	4.3	13.46	1.02	**0.380**	**127.15**	**126.13**	129.15	128.13	2.60	Vel-OK	0.130	0.375	137.37	**137.00**	**135.64**	135.14	**136.14**	2.235	HGL Too High
4.76	4.76	**0.5500**	2.62	**28.2**	28.2	5.18	13.55	**216**			**24**	RCP	0.013	3.14	0.500	**0.435**	4.8	14.92	0.94	**0.389**	**127.08**	**126.14**	129.08	128.14	4.31	Vel-OK	0.359	0.775	137.77	**137.00**	**135.50**	135.00	**136.00**	2.775	HGL Too High
2.00	2.00	0.5500	1.10	**26.3**	26.3	5.37	5.91	**48**			**24**	RCP	0.013	3.14	0.500	**0.292**	3.9	12.22	0.14	**0.000**	**127.22**	**127.08**	129.22	129.08	1.88	Vel-OK	0.068	0.033	137.81	**137.77**	**135.80**	135.30	**136.30**	2.507	HGL Too High
2.16	2.16	0.5500	1.19	**26.5**	26.5	5.35	6.36	**265**			**24**	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.48	0.000	126.32	125.84	128.32	127.84	2.02	Vel-OK	0.079	0.209	136.21	136.00	**135.41**	134.91	**135.91**	1.302	HGL Too High
3.15	5.31	0.5500	2.92	2.2	28.6	5.13	15.00	**311**			**24**	RCP	0.013	3.14	0.500	**0.119**	2.5	7.80	0.37	**0.150**	**125.84**	**125.47**	127.84	127.47	4.78	Vel-OK	0.440	1.368	136.00	134.64	**134.75**	134.25	**135.25**	1.753	HGL Too High
1.01	6.32	0.5500	3.48	1.1	29.7	5.03	17.50	**25**			**24**	RCP	0.013	3.14	0.500	**1.400**	8.5	26.77	0.35	**2.470**	**125.32**	**124.97**	127.32	126.97	5.57	Vel-OK	0.598	0.150	134.64	**134.49**	**134.84**	134.34	**135.34**	0.295	HGL Too High
1.70	1.70	0.5500	0.93	**26.0**	26.0	5.40	5.04	**170**			**24**	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.31	0.000	126.00	125.69	128.00	127.69	1.60	Vel-OK	0.050	0.084	135.14	135.06	**135.14**	134.64	**135.64**	0.500	HGL Too High
2.17	3.86	0.5500	2.13	1.8	27.7	5.22	11.09	**353**			**24**	RCP	0.013	3.14	0.500	**0.218**	3.4	10.57	0.77	**0.050**	**125.69**	**124.92**	127.69	126.92	3.53	Vel-OK	0.240	0.849	135.06	134.21	**134.71**	134.21	**135.21**	0.845	HGL Too High
1.46	5.32	0.5500	2.93	1.7	29.4	5.06	14.80	**70**			**24**	RCP	0.013	3.14	0.500	**0.514**	5.2	16.22	0.36	**2.160**	**124.87**	**124.51**	126.87	126.51	4.71	Vel-OK	0.428	0.300	134.21	**133.91**	**134.82**	134.32	**135.32**	-0.113	OK
3.90	3.90	**0.5500**	2.14	**27.7**	27.7	5.22	11.19	**396**			**24**	RCP	0.013	3.14	0.500	**0.376**	4.4	13.88	1.49	**0.000**	**126.13**	**124.64**	128.13	126.64	3.56	Vel-OK	0.245	0.969	135.02	134.05	**134.71**	134.21	**135.21**	0.808	HGL Too High
-	3.90	0.5500	2.14	1.9	29.6	5.05	11.19	**142**			**24**	RCP	0.013	3.14	0.500	**0.223**	3.4	10.68	0.32	0.000	**124.64**	124.32	126.64	126.32	3.56	Vel-OK	0.245	0.348	134.05	133.70	**135.34**	134.84	**135.84**	-0.791	OK
2.14	6.03	0.5500	3.32	0.7	30.2	4.99	16.54	**203**			**30**	RCP	0.013	4.91	0.625	**0.223**	3.9	19.36	0.45	**0.000**	124.32	123.87	126.82	126.37	3.37	Vel-OK	0.163	0.330	133.70	133.37	**134.99**	134.49	**135.49**	-0.789	OK
1.63	7.66	0.5500	4.21	1.0	31.2	4.90	20.64	**61**			**30**	RCP	0.013	4.91	0.625	**0.197**	3.7	18.19	0.12	**1.550**	**123.87**	**123.75**	126.37	126.25	4.21	Vel-OK	0.253	0.154	133.37	**133.22**	**134.48**	133.98	**134.98**	-0.609	OK
1.52	1.52	0.5500	0.84	**25.8**	25.8	5.43	4.53	**14**			**24**	RCP	0.013	3.14	0.500	**4.286**	14.9	46.83	0.60	**0.000**	**126.73**	**126.13**	128.73	128.13	1.44	Vel-OK	0.040	0.006	135.02	**135.02**	**135.01**	134.51	**135.51**	0.514	HGL Too High
1.58	1.58	0.5500	0.87	**25.8**	25.8	5.42	4.72	**160**			**24**	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.29	0.000	126.56	126.27	128.56	128.27	1.50	Vel-OK	0.044	0.070	133.14	133.07	**135.37**	134.87	**135.87**	-1.730	OK
1.38	2.97	0.5500	1.63	1.8	27.6	5.23	8.54	**436**			**24**	RCP	0.013	3.14	0.500	**0.252

APPENDIX B-6
PROPOSED ALTERNATIVE 1 - 10% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001
Date : 2/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
2	28.0	0.0208	Crown	0.33	1.00	13.00	0.271
3	41.0	0.0208	Crown	0.50	0.50	20.00	0.417
4	25.0	0.0208	Blvd	0.50	0.50	12.00	0.250
5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency = 10 yr
Override Inlet Time (Tc) (min) =
N-Value (Pavement) = 0.016 TxDOT Hydraulic Manual Table 4-8

$T_{spread}=1.243(Q_{Gutter}*N/S_x^{1.67}*S_x^{.5/1.5})^{3/8}$
$Y_{Gutter}=T_{Spread}*S_x$
$L_T=0.6*Q^{0.42}*S_x^{0.3}*(1/(N*S_x))^{0.6}$
Efficiency = 1-(1-L_i/L_T)^1.8
$Q_{Bypass}=Q_{Total}*(1-Eff)$

INLET PONDING CALCULATIONS

$Q_{Gutter}=C_{Gutter}*L_{Gutter}*H^{1.5}$
C_{Gutter}= 2.60
$H_{Gutter}=(Q/(C*L))^{2/3}$

$Q_{Orif}=C_{Orif}*A_{Orif}*(2gH)^{1/2}$
C_{Orif}= 0.60
$H_{Orif}=(Q/(C*A*Sqrt(2g))^2$
$T_{Inlet}=H/S_x$

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Street Type	Pavement Width (B-B) (ft)	Cross-Slope (S_x) (ft/ft)	Street Type	Curb Height (ft)	Curb Width (ft)	Maximum Allowable Ponding Spread @ Inlets (ft)	Maximum Allowable Ponding Depth @ Inlets (ft)
Raven Song Drive		S.1.C	S	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		S	R	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		R	Q	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		Q	P	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		P	O	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		O	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Raven Park (Scamp)	N	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Shaft Dr	M	L	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Nevermore Dr	L	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Birdcall Dr	K	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Caw	J	H	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		H	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Roost Dr	G	F.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F.2	F	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Ravens Flight Dr	E	D	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		D	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	Blackbird Dr	C	B	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		B	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	Raven Wing Dr	A	CNH-1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houston		CNH 2	CNH-3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	(South Trunkline)	CNH-3	E133	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.1.A	N	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.9	M.8	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
		M.8	M.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.7	M.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.5	M.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.4	M.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.3	M.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.2	M	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.3.A	L.2.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.2.A	L.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.1.A	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.7	K.6	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.6	K.5	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.5	K.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.4	K.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.3	K.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.1	K	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.1	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.2	K.7	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		K.7.2.A	K.7.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.3.A	J.2.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.2.A	J.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.1.A	J	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.3.A	G.2.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.2.A	G.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.1.A	G	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Rook Drive		E.4	E.3	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.3	E.2	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.2	E.1	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.1	E	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.4.C	E.4	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.3.A	C.2.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.2.A	C.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.1.A	C	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.3.A	A.2.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.2.A	A.1.A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.1.A	A	1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR	RR7	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR7	RR8	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR8	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

INLET #1 (FAR INLET)

Gutter Run 1

Drainage Area (ac)	T/C Grade (S_{xT}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.7150	**0.25**	24.43	5.58	2.19	12.24	0.25	-
0.5156	**0.25**	23.90	5.64	1.60	10.87	0.23	-
				No Inlet			-
				No Inlet			-
1.2436	**0.25**	25.39	5.47	3.74	14.95	0.31	-
				No Inlet			-
				No Inlet			-
1.4209	**0.60**	25.64	5.44	4.25	13.31	0.28	-
0.3618	**0.25**	23.36	5.71	1.14	9.56	0.20	-
0.4702	**0.25**	23.76	5.66	1.46	10.51	0.22	-
0.4974	**0.25**	23.84	5.65	1.55	10.73	0.22	-
0.5169	**0.60**	23.90	5.64	1.60	9.23	0.19	-
				No Inlet			-
0.2972	**0.25**	23.08	5.74	0.94	8.90	0.19	-
				No Inlet			-
0.4009	**0.25**	23.51	5.69	1.25	9.92	0.21	-
				No Inlet			-
0.5908	**0.25**	24.11	5.62	1.82	11.42	0.24	-
				No Inlet			-
0.6880	**0.75**	24.36	5.59	2.11	9.82	0.20	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.8696	**0.25**	24.76	5.54	2.65	13.13	0.27	-
0.2450	**0.33**	22.81	5.78	0.78	7.88	0.16	-
2.8062	**0.25**	26.99	5.30	4.35	**15.81**	0.33	-
				No Inlet			-
9.7221	**0.32**	29.93	5.01	10.56	**21.06**	0.44	-
				No Inlet			-
1.1707	**0.25**	25.28	5.48	3.53	14.62	0.30	-
0.8212	**0.25**	24.66	5.55	2.51	12.86	0.27	-
1.1405	**0.25**	25.23	5.49	3.44	14.49	0.30	-
1.0504	**0.26**	25.09	5.50	3.18	13.96	0.29	########
0.6968	**0.26**	#NAME?	#NAME?	########	#NAME?	#NAME?	########
0.4409	**0.40**	23.66	5.67	1.38	9.40	0.20	-
1.4076	**0.25**	25.62	5.44	4.21	**15.63**	0.33	-
0.1762	**0.25**	22.37	5.84	0.57	7.36	0.15	-
				No Inlet			-
0.8789	**0.25**	24.78	5.54	2.68	13.18	0.27	0.00
0.7308	**0.25**	24.46	5.57	**2.24**	12.34	0.26	-
0.5994	**0.25**	24.14	5.61	1.85	11.48	0.24	-
0.7157	**0.25**	24.43	5.58	2.20	12.24	0.26	-
0.5607	**0.35**	24.03	5.63	1.73	10.52	0.22	-
1.4945	**0.25**	25.73	5.43	4.46	**15.97**	0.33	-
1.0595	**0.25**	25.10	5.50	3.21	14.11	0.29	0.06
0.8213	**0.25**	24.66	5.55	**2.57**	12.98	0.27	-
0.2607	**0.25**	22.89	5.77	0.83	8.49	0.18	-
1.1578	**0.25**	25.26	5.48	3.49	14.56	0.30	0.12
0.5226	**0.25**	23.92	5.64	**1.74**	11.21	0.23	-
0.4530	**0.25**	23.70	5.67	1.41	10.37	0.22	-
0.2745	**0.25**	22.96	5.76	0.87	8.65	0.18	-
				No Inlet			-
1.0891	**0.25**	25.15	5.50	3.29	14.25	0.30	0.07
0.6190	**0.25**	24.19	5.61	**1.98**	11.78	0.25	-
0.4293	**0.25**	23.62	5.68	1.34	10.17	0.21	-
1.1509	**0.25**	25.25	5.48	3.47	14.53	0.30	0.11
0.5114	**0.25**	23.89	5.64	**1.70**	11.12	0.23	-
1.2458	**0.25**	25.39	5.47	3.75	14.95	0.31	-
0.3309	**0.25**	23.23	5.72	1.04	9.25	0.19	-
0.9143	**0.25**	24.84	5.53	**2.78**	13.37	0.28	-
0.6353	**0.29**	24.23	5.60	1.96	11.40	0.24	-
1.4076	**0.25**	25.62	5.44	4.21	**15.63**	0.33	-
0.1762	**0.25**	22.37	5.84	0.57	7.36	0.15	-
0.5854	**0.32**	24.10	5.62	1.81	10.87	0.23	-
				No Inlet			-
0.7607	**0.25**	24.78	5.54	2.68	13.18	0.27	0.00
0.6909	**0.31**	24.37	5.59	2.12	11.61	0.24	-
0.1926	**0.25**	22.48	5.82	0.62	7.60	0.16	-
1.1560	**0.25**	25.26	5.48	3.49	14.56	0.30	-
1.4748	**0.25**	25.71	5.43	4.41	**15.89**	0.33	-
0.5084	**0.50**	23.88	5.64	1.58	9.50	0.20	-
0.6752	**0.25**	24.33	5.59	2.08	11.98	0.25	-
0.2361	**0.25**	22.76	5.78	0.75	8.19	0.17	-
0.5489	**0.40**	24.00	5.63	1.70	10.18	0.21	-
0.2610	**0.25**	22.89	5.77	0.83	8.49	0.18	-
0.9560	**0.44**	24.92	5.52	2.90	12.22	0.25	-
				No Inlet			-
0.7809	**0.70**	24.57	5.56	2.39	10.41	0.22	-
0.5220	**0.25**	23.92	5.64	1.62	10.92	0.23	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.4591	**0.40**	23.72	5.66	1.43	9.54	0.20	-
1.1175	**0.25**	25.20	5.49	3.37	14.38	0.30	-
1.4186	**0.25**	25.64	5.44	2.26	12.37	0.26	-
				No Inlet			-
13.1102	**0.27**	30.73	4.94	14.03	**24.19**	0.50	-
				No Inlet			-
0.8537	**0.47**	24.73	5.54	2.60	11.61	0.24	-
1.1027	**0.25**	25.17	5.49	3.33	14.31	0.30	-
0.2445	**0.25**	22.80	5.78	0.78	8.29	0.17	-
0.4331	**0.25**	23.63	5.67	1.35	10.20	0.21	-
0.1548	**0.25**	22.20	5.86	0.50	7.02	0.15	-
0.3369	**0.25**	23.26	5.72	1.06	9.31	0.19	-
0.5854	**0.32**	24.10	5.62	1.81	10.87	0.23	-
				No Inlet			-
0.6909	**0.31**	24.37	5.59	2.12	11.61	0.24	-
0.1926	**0.25**	22.48	5.82	0.62	7.60	0.16	-
0.3369	**0.25**	23.26	5.72	1.06	9.31	0.19	-
0.5854	**0.32**	24.10	5.62	1.81	10.87	0.23	-

Inlet 1 (Far)

Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (ft)
B-B Grate	Sag	24.85	5.53	4.97	3.51	0.07
B-B Grate	Sag	23.90	5.64	2.68	elow Gut	-0.03
					No Inlet	
B-B Grate	Sag	25.39	5.47	5.73	5.06	0.11
					No Inlet	
					No Inlet	
					No Inlet	
B-B Grate	Sag	25.64	5.44	5.64	4.87	0.10
B-B Grate	Sag	23.36	5.71	1.63	elow Gut	-0.04
B-B Grate	Sag	23.82	5.65	2.99	elow Gut	-0.02
B-B Grate	Sag	23.85	5.65	3.09	elow Gut	-0.01
B-B Grate	Sag	23.90	5.64	3.11	elow Gut	-0.01
					No Inlet	
B-B Grate	Sag	23.08	5.74	1.61	elow Gut	-0.04
					No Inlet	
B-B Grate	Sag	24.47	5.57	3.49	0.24	0.01
					No Inlet	
B-B Grate	Sag	24.57	5.56	4.20	1.85	0.04
					No Inlet	
B-B Grate	Sag	24.36	5.59	3.72	0.78	0.02
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
B-B Grate	Sag	24.92	5.52	3.74	0.82	0.02
					No Inlet	
B-B Grate	Sag	24.57	5.56	4.20	1.85	0.04
					No Inlet	
B-B Grate	Sag	24.36	5.59	3.72	0.78	0.02
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
B-B Grate	Sag	24.92	5.52	3.74	0.82	0.02
					No Inlet	
B-B Grate	Sag	24.47	5.57	3.49	0.24	0.01
					No Inlet	
B-B Grate	Sag	24.57	5.56	4.20	1.85	0.04
					No Inlet	
B-B Grate	Sag	24.36	5.59	3.72	0.78	0.02
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
					No Inlet	
C-1	On-Grade	25.09	5.50	3.18	elow Gut	-0.03
C-1	Sag	#NAME?	########	########	#NAME?	#NAME?
B-B Grate	Sag	23.66	5.67	1.86	elow Gut	-0.04
B-B Grate	Sag	25.62	5.44	5.22	4.03	0.08
B-B Grate	Sag	24.10	5.62	2.35	elow Gut	-0.03
					No Inlet	
C-1	On-Grade	24.78	5.54	2.68	elow Gut	-0.06
B-B Grate	Sag	24.46	5.57	4.36	2.21	0.05
B-B Grate	Sag	24.14	5.61	2.44	elow Gut	-0.03
B-B Grate	Sag	25.26	5.48	5.64	4.88	0.10
B-B Grate	Sag	25.71	5.43	6.08	5.75	0.12
B-B Grate	Sag	25.73	5.43	5.98	5.55	0.12
C-1	On-Grade	25.10	5.50	3.21	elow Gut	-0.03
C-1	Sag	24.66	5.55	4.63	2.68	0.06
C-1	Sag	22.89	5.77	1.58	elow Gut	-0.08
C-1	On-Grade	25.26	5.48	3.49	elow Gut	-0.01
C-1	Sag	24.00	5.63	3.43	elow Gut	-0.01
C-1	Sag	23.70	5.67	2.23	elow Gut	-0.07
B-B Grate	Sag	24.92	5.52	3.74	0.82	0.02
C-1	On-Grade	25.15	5.50	3.29	elow Gut	-0.02
B-B Grate	Sag	24.19	5.61	2.68	elow Gut	-0.03
B-B Grate	Sag	25.15	5.50	4.59	2.71	0.06
C-1	On-Grade	25.25	5.48	3.47	elow Gut	-0.01
C-1	Sag	23.89	5.64	2.19	elow Gut	-0.07
C-2	Sag	25.39	5.47	4.41	elow Gut	-0.06
C-1	On-Grade	23.23	5.72	1.04	elow Gut	-0.08
C-1	Sag	24.84	5.53	4.66	2.78	0.06
C-2	Sag	24.23	5.60	2.67	elow Gut	-0.07

INLET #2 (NEAR INLET)

Gutter Run 3

Drainage Area (ac)	T/C Grade (S_{xT}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				change N value call			
				No Inlet			-
				No Inlet			-
0.9598	**0.25**	24.93	5.52	2.91	13.61	0.28	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.3340	**0.25**	23.24	5.72	1.05	9.29	0.19	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.2254	**0.25**	22.69	5.79	0.72	8.05	0.17	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
1.6365	**0.60**	25.91	5.41	4.87	14.00	0.29	-
0.4116	**0.33**	23.55	5.68	1.29	9.51	0.20	-
1.0193	**0.25**	25.03	5.51	1.64	10.98	0.23	-
				No Inlet			-
1.4587	**0.32**	25.69	5.44	1.72	10.66	0.22	-
				No Inlet			-
				No Inlet			-
0.6447	**0.47**	24.26	5.60	1.99	10.49	0.22	-
1.1695	**0.25**	25.28	5.48	3.53	14.62	0.30	-
1.1314	**0.26**	25.22	5.49	3.41	14.34	0.30	0.11
0.6922	**0.26**	24.37	5.59	**2.23**	12.23	0.25	-
0.4796	**0.40**	23.79	5.66	1.49	9.69	0.20	-
0.3995	**0.25**	23.51	5.69	1.25	9.91	0.21	-
0.2100	**0.25**	22.60	5.81	0.67	7.84	0.16	-
				No Inlet			-
0.9124	**0.25**	24.84	5.53	2.78	13.36	0.28	0.01
0.7630	**0.25**	24.53	5.57	**2.34**	12.54	0.26	-
0.6535	**0.25**	24.28	5.60	2.01	11.84	0.25	-
0.2287	**0.25**	22.71	5.79	0.73	8.09	0.17	-
0.5301	**0.35**	23.94	5.64	1.64	10.31	0.21	-
				No Inlet			-
0.1007	**0.25**	25.17	5.49	3.33	14.30	0.30	0.08
0.9383	**0.25**	24.89	5.53	**2.93**	13.64	0.28	-
0.2929	**0.25**	23.06	5.75	0.93	8.85	0.18	-
0.5378	**0.25**	23.97	5.63	1.67	11.04	0.23	-
0.4851	**0.25**	23.80	5.65	**1.51**	10.63	0.22	-
0.4879	**0.25**	23.81	5.65	1.52	10.65	0.22	-
0.5709	**0.25**	24.06	5.62	1.77	11.28	0.23	-
				No Inlet			-
				No Inlet			-
1.0476	**0.25**	25.08	5.50	3.17	14.05	0.29	0.05
0.6244	**0.25**	24.20	5.61	**1.98**	11.77	0.25	-
				No Inlet			-
0.4335	**0.25**	23.63	5.67	1.35	10.21	0.21	-
0.5770	**0.25**	24.08	5.62	**1.78**	11.32	0.24	-
1.2503	**0.37**	25.40	5.47	3.76	13.91	0.29	-
1.5254	**0.60**	25.77	5.43	4.55	13.65	0.28	0.88
0.9438	**0.25**	24.90	5.52	**3.74**	14.95	0.31	-
0.6992	**0.29**	24.39	5.58	2.15	11.80	0.25	-
0.3995	**0.25**	23.51	5.69	1.25	9.91	0.21	-
0.2100	**0.25**	22.60	5.81	0.67	7.84	0.16	-
				No Inlet			-
0.9124	**0.25**	24.84	5.53	2.78	13.36	0.28	0.01
0.7630	**0.25**	24.53	5.57	**2.34**	12.54	0.26	-
0.6535	**0.25**	24.28	5.60	2.01	11.84	0.25	-
0.2287	**0.25**	22.71	5.79	0.73	8.09	0.17	-
0.5301	**0.35**	23.94	5.64	1.64	10.31	0.21	-
				No Inlet			-
0.1007	**0.25**	25.17	5.49	3.33	14.30	0.30	0.08
0.9383	**0.25**	24.89	5.53	**2.93**	13.64	0.28	-
0.2929	**0.25**	23.06	5.75	0.93	8.85	0.18	-
0.5378	**0.25**	23.97	5.63	1.67	11.04	0.23	-
0.4851	**0.25**	23.80	5.65	**1.51**	10.63	0.22	-
0.4879	**0.25**	23.81	5.65	1.52	10.65	0.22	-

APPENDIX B-7
PROPOSED ALTERNATIVE 1 - 10% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147011
Date : 2/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients
Return Freq (yr): 10
b : 54.68
d : 6.96
e : 0.6623
Peaking Factor C_k : 1.00

$Q_{allow}=C_{allow}*W_{PAVE}*H_{AVG}^{1.5}$
Where W_{PAVE} = Width of Pavement to F/C; H_{AVG} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = 128.50

C_{allow} = 2.10

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Elevations at D/S High Point in Street: Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	10-Year Analysis: Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity "i" (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	Allowable 100-yr HGL Height Above T/C @ Location: 1.50 — HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	Check HGL or Act Gutter Depth vs. Nat Grnd @ ROW Locations: 0.50 — HGL Above(+) / Below(-) T/C @ D/S High (ft)	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
Raven Song Drive		**S.1.C**	**S**	**136.37**	136.37	135.87	**136.87**	25.9	25.9	5.41	4.87	1.55	Vel-OK	0.046	0.03	138.88	138.85	3.117	Increase Pipe Size	2.507	OK	0.000	Method 2 - OK
Raven South Drive		S	**R**	**136.37**	136.37	135.87	**136.87**	0.6	26.5	5.34	11.43	2.33	Vel-OK	0.078	0.16	138.85	138.69	3.389	Increase Pipe Size	2.479	OK	0.000	Method 2 - OK
Raven South Drive		R	**Q**	**137.00**	137.00	136.50	**137.50**	1.4	28.0	5.20	11.43	2.33	Vel-OK	0.078	0.05	138.69	138.64	2.504	Increase Pipe Size	1.694	OK	0.000	Method 2 - OK
Raven South Drive		Q	**P**	**137.00**	137.00	136.50	**137.50**	0.5	28.5	5.15	19.29	3.93	Vel-OK	0.221	0.95	138.64	137.69	2.629	Increase Pipe Size	1.639	OK	0.000	Method 2 - OK
Raven South Drive		P	**O**	**136.19**	136.19	135.69	**136.69**	1.8	30.3	4.98	19.29	3.93	Vel-OK	0.221	0.19	137.69	137.50	1.263	Method 1 - OK	1.503	OK	0.000	Method 2 - OK
Raven South Drive		O	**N**	**136.19**	136.19	135.69	**136.69**	0.4	30.7	4.95	19.29	3.93	Vel-OK	0.221	0.36	137.50	137.14	1.323	Method 1 - OK	1.313	OK	0.000	Method 2 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**136.19**	136.19	135.69	**136.69**	**28.9**	31.4	4.89	38.05	1.60	Vel-OK	0.013	0.04	137.14	137.10	1.298	Method 1 - OK	0.948	OK	0.000	Method 2 - OK
Raven South Drive	**Shaft Dr**	M	L	**136.19**	136.19	135.69	**136.69**	**44.4**	44.4	4.02	82.26	3.46	Vel-OK	0.060	0.17	137.10	136.93	1.582	Increase Pipe Size	0.912	OK	0.000	Method 2 - OK
Raven South Drive	**Nevermore Dr**	L	K	**136.00**	136.00	135.50	**136.50**	**29.4**	45.8	3.95	95.54	4.02	Vel-OK	0.081	0.23	136.93	136.70	1.291	Method 1 - OK	0.931	OK	0.000	Method 2 - OK
Raven South Drive	**Birdcall Dr**	K	J	**136.00**	136.00	135.50	**136.50**	**33.6**	47.0	3.90	134.59	5.66	Vel-OK	0.161	0.46	136.70	136.24	1.060	Method 1 - OK	0.700	OK	0.000	Method 2 - OK
Raven South Drive	**Ravens Caw**	J	H	**135.51**	135.51	135.01	**136.01**	**29.8**	47.8	3.86	148.76	6.26	Vel-OK	0.196	0.39	136.24	135.85	1.102	Method 1 - OK	0.732	OK	0.000	Method 2 - OK
Raven South Drive		H	G	**135.47**	135.47	134.97	**135.97**	0.5	48.4	3.83	148.76	6.26	Vel-OK	0.196	0.19	135.85	135.66	0.550	Method 1 - OK	0.380	Check Lo Spot		Method 1 - OK
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**135.47**	135.47	134.97	**135.97**	**29.7**	48.6	3.82	160.69	6.76	Vel-OK	0.229	0.16	135.66	135.51	1.003	Method 1 - OK	0.193	Check Lo Spot		Method 1 - OK
Raven South Drive		F.2	**F**	**135.47**	135.47	134.97	**135.97**	0.2	48.8	3.81	160.69	6.76	Vel-OK	0.229	0.48	135.51	135.03	0.108	Method 1 - OK	0.038	OK		Method 1 - OK
Raven South Drive		F	E	**135.18**	135.18	134.68	**135.68**	0.5	49.3	3.79	161.77	6.81	Vel-OK	0.232	0.06	135.03	134.97	0.231	Method 1 - OK	-0.149	OK		Method 1 - OK
Raven South Drive	**Ravens Flight Dr**	E	D	**135.18**	135.18	134.68	**135.68**	**31.5**	49.4	3.79	177.61	7.48	Vel-OK	0.280	0.76	134.97	134.21	0.173	Method 1 - OK	-0.207	OK		Method 1 - OK
Raven South Drive		D	C	**134.50**	134.50	134.00	**135.00**	0.6	50.0	3.76	179.19	7.54	Vel-OK	0.285	0.04	134.21	134.17	0.042	Method 1 - OK	-0.288	OK		Method 1 - OK
Raven South Drive	**Blackbird Dr**	C	B	**134.50**	134.50	134.00	**135.00**	**30.7**	50.0	3.76	191.35	8.05	Vel-OK	0.325	0.89	134.17	133.28	0.000	Method 1 - OK	-0.330	OK		Method 1 - OK
Raven South Drive		B	A	**135.24**	135.24	134.74	**135.74**	0.6	50.6	3.73	192.58	8.11	Vel-OK	0.329	0.05	133.28	133.23	-0.863	Method 1 - OK	-1.963	OK		Method 1 - OK
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**135.24**	135.24	134.74	**135.74**	**30.7**	50.6	3.73	206.64	8.70	Vel-OK	0.379	0.76	133.23	132.47	-0.913	Method 1 - OK	-2.013	OK		Method 1 - OK
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**136.50**	136.50	136.00	**135.50**	**3.6**	51.0	3.72	265.08	11.16	Vel-OK	0.623	3.46	132.47	129.01	-4.030	Method 1 - OK	-4.030	OK		Method 1 - OK
Cypress North Houston		CNH 2	**CNH-3**	**136.50**	136.50	136.00	**135.50**	0.8	51.8	3.68	265.08	11.16	Vel-OK	0.623	0.41	129.01	128.61	-7.488	Method 1 - OK	-7.488	OK		Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**136.50**	136.50	136.00	**135.50**	**147.7**	147.7	1.94	265.08	4.89	Vel-OK	0.126	0.11	128.61	**128.50**	-7.893	Method 1 - OK	-7.893	OK		Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**136.03**	136.03	135.53	**136.53**	**27.5**	27.5	5.25	10.06	3.20	Vel-OK	0.198	0.51	137.76	137.25	2.264	Increase Pipe Size	1.734	OK	0.000	Method 2 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**135.94**	135.94	135.44	**136.44**	1.3	28.8	5.12	15.36	4.89	Vel-OK	0.461	0.12	137.25	**137.14**	1.713	Increase Pipe Size	1.313	OK	0.000	Method 2 - OK
Shaft Drive		**M.9**	**M.8**	**136.45**	136.45	135.95	**136.95**	**28.7**	28.7	5.12	9.09	0.94	Vel-OK	0.008	0.02	138.91	138.89	3.173	Increase Pipe Size	2.463	OK	0.000	Method 2 - OK
		M.8	**M.7**	**136.52**	136.52	136.02	**137.02**	4.9	33.7	4.70	9.09	0.94	Vel-OK	0.008	0.02	138.89	138.87	2.850	Increase Pipe Size	2.370	OK	0.000	Method 2 - OK
Shaft Drive		M.7	**M.5**	**136.52**	136.52	136.02	**137.02**	5.4	39.0	4.33	31.45	3.27	Vel-OK	0.098	0.47	138.87	138.39	2.825	Increase Pipe Size	2.345	OK	0.000	Method 2 - OK
Shaft Drive		M.5	**M.4**	**136.52**	136.52	136.02	**137.02**	2.5	41.5	4.18	31.45	3.27	Vel-OK	0.098	0.12	138.39	138.28	2.353	Increase Pipe Size	1.873	OK	0.000	Method 2 - OK
Shaft Drive		M.4	**M.3**	**136.52**	136.52	136.02	**137.02**	0.6	42.1	4.15	34.75	3.61	Vel-OK	0.119	0.03	138.28	138.25	2.756	Increase Pipe Size	1.756	OK	0.000	Method 2 - OK
Shaft Drive		M.3	**M.2**	**136.52**	136.52	136.02	**137.02**	0.1	42.2	4.14	43.63	4.54	Vel-OK	0.188	1.11	138.25	137.14	2.996	Increase Pipe Size	1.726	OK	0.000	Method 2 - OK
Shaft Drive		M.2	**M**	**135.92**	135.92	135.42	**136.42**	2.2	44.4	4.03	48.58	5.05	Vel-OK	0.233	0.03	137.14	**137.10**	1.617	Increase Pipe Size	1.217	OK	0.000	Method 2 - OK
Nevermore Drive		**L.3.A**	**L.2.A**	**135.90**	135.90	135.40	**136.40**	**26.5**	26.5	5.35	6.42	2.04	Vel-OK	0.081	0.16	138.23	138.07	2.318	Increase Pipe Size	2.328	OK	0.000	Method 2 - OK
Nevermore Drive		L.2.A	**L.1.A**	**135.90**	135.90	135.40	**136.40**	1.6	28.1	5.19	12.91	4.11	Vel-OK	0.326	1.01	138.07	137.06	2.671	Increase Pipe Size	2.171	OK	0.000	Method 2 - OK
Nevermore Drive		L.1.A	K	**135.74**	135.74	135.24	**136.24**	1.3	29.3	5.07	16.17	5.15	Vel-OK	0.511	0.13	137.06	**136.93**	1.718	Increase Pipe Size	1.318	OK	0.000	Method 2 - OK
Birdcall Lane		**K.7**	**K.6**	**136.50**	136.50	136.00	**137.00**	**29.0**	29.0	5.10	28.12	3.98	Vel-OK	0.178	0.04	138.76	138.71	2.896	Increase Pipe Size	2.256	OK	0.000	Method 2 - OK
Birdcall Lane		K.6	**K.5**	**136.50**	136.50	136.00	**137.00**	0.1	29.1	5.09	32.35	4.58	Vel-OK	0.235	0.74	138.71	137.97	2.864	Increase Pipe Size	2.214	OK	0.000	Method 2 - OK
Birdcall Lane		K.5	**K.4**	**135.86**	135.86	135.36	**136.36**	1.1	30.2	4.98	32.35	3.36	Vel-OK	0.103	0.14	137.97	137.83	1.832	Increase Pipe Size	2.112	OK	0.000	Method 2 - OK
Birdcall Lane		K.4	**K.3**	**135.86**	135.86	135.36	**136.36**	0.7	30.9	4.93	36.17	3.76	Vel-OK	0.129	0.32	137.83	137.52	1.973	Increase Pipe Size	1.973	OK	0.000	Method 2 - OK
Birdcall Lane		K.3	**K.1**	**135.86**	135.86	135.36	**136.36**	1.1	32.0	4.83	43.14	4.48	Vel-OK	0.184	0.76	137.52	136.75	2.266	Increase Pipe Size	1.656	OK	0.000	Method 2 - OK
Birdcall Lane		K.1	K	**135.74**	135.74	135.24	**136.24**	1.5	33.5	4.71	46.33	4.82	Vel-OK	0.212	0.05	136.75	**136.70**	1.413	Method 1 - OK	1.013	OK	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.1**	**K.7**	**136.50**	136.50	136.00	**137.00**	**27.0**	27.0	5.30	8.16	2.60	Vel-OK	0.130	0.38	139.13	**138.76**	3.491	Increase Pipe Size	2.631	OK	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.2**	**K.7**	**136.25**	136.25	135.75	**136.75**	**28.2**	28.2	5.18	13.55	4.31	Vel-OK	0.359	0.77	139.53	**138.76**	4.031	Increase Pipe Size	3.281	OK	0.000	Method 2 - OK
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**136.50**	136.50	136.00	**137.00**	**26.3**	26.3	5.37	5.91	1.88	Vel-OK	0.068	0.03	139.56	**139.53**	3.764	Increase Pipe Size	3.064	OK	0.000	Method 2 - OK
Ravens Caw Drive		**J.3.A**	**J.2.A**	**135.25**	135.25	134.75	**135.75**	**26.5**	26.5	5.35	6.36	2.02	Vel-OK	0.079	0.21	137.97	137.76	2.559	Increase Pipe Size	2.719	OK	0.000	Method 2 - OK
Ravens Caw Drive		J.2.A	**J.1.A**	**135.25**	135.25	134.75	**135.75**	2.2	28.6	5.13	15.00	4.78	Vel-OK	0.440	1.37	137.76	136.39	3.009	Increase Pipe Size	2.509	OK	0.000	Method 2 - OK
Ravens Caw Drive		J.1.A	J	**135.24**	135.24	134.74	**135.74**	1.1	29.7	5.03	17.50	5.57	Vel-OK	0.598	0.15	136.39	**136.24**	1.552	Increase Pipe Size	1.152	OK	0.000	Method 2 - OK
Raven Roost Drive		**G.3.A**	**G.2.A**	**135.33**	135.33	134.83	**135.83**	**26.0**	26.0	5.40	5.04	1.60	Vel-OK	0.050	0.08	136.90	136.81	1.756	Increase Pipe Size	1.566	OK	0.000	Method 2 - OK
Raven Roost Drive		G.2.A	**G.1.A**	**135.33**	135.33	134.83	**135.83**	1.8	27.7	5.22	11.09	3.53	Vel-OK	0.240	0.85	136.81	135.96	2.102	Increase Pipe Size	1.482	OK	0.000	Method 2 - OK
Raven Roost Drive		G.1.A	G	**135.22**	135.22	134.72	**135.72**	1.7	29.4	5.06	14.80	4.71	Vel-OK	0.428	0.30	135.96	**135.66**	1.143	Method 1 - OK	0.743	OK	0.000	Method 2 - OK
Raven Rook Drive		**E.4**	**E.3**	**135.11**	135.11	134.61	**135.61**	**27.7**	27.7	5.22	11.19	3.56	Vel-OK	0.245	0.97	136.77	135.81	2.065	Increase Pipe Size	1.665	OK	0.000	Method 2 - OK
Raven Flight Drive		E.3	**E.2**	**134.90**	134.90	134.40	**135.40**	1.9	29.6	5.05	11.19	3.56	Vel-OK	0.245	0.35	135.81	135.46	0.466	Method 1 - OK	0.906	OK	0.000	Method 2 - OK
Raven Flight Drive		E.2	**E.1**	**134.90**	134.90	134.40	**135.40**	0.7	30.2	4.99	16.54	3.37	Vel-OK	0.163	0.33	135.46	135.13	0.468	Method 1 - OK	0.558	OK	0.000	Method 2 - OK
Raven Flight Drive		E.1	E	**134.90**	134.90	134.40	**135.40**	1.0	31.2	4.90	20.64	4.21	Vel-OK	0.253	0.15	135.13	**134.97**	0.648	Method 1 - OK	0.228	Check Lo Spot		Method 1 - OK
Raven Flight Drive		**E.4.C**	**E.4**	**135.75**	135.75	135.25	**136.25**	**25.8**	25.8	5.43	4.53	1.44	Vel-OK	0.040	0.01	136.78	**136.77**	1.770	Increase Pipe Size	1.030	OK	0.000	Method 2 - OK
Blackbird Drive		**C.3.A**	**C.2.A**	**135.16**	135.16	134.66	**135.66**	**25.8**	25.8	5.42	4.72	1.50	Vel-OK	0.044	0.07	134.90	134.83	-0.474	Method 1 - OK	-0.264	OK		Method 1 - OK
Blackbird Drive		C.2.A	**C.1.A**	**135.16**	135.16	134.66	**135.66**	1.8	27.6	5.23	8.54	2.72	Vel-OK	0.142	0.62	134.83	134.21	-0.143	Method 1 - OK	-0.333	OK		Method 1 - OK
Blackbird Drive		C.1.A	C	**134.44**	134.44	133.94	**134.94**	2.7	30.3	4.98	16.20	2.29	Vel-OK	0.059	0.04	134.21	**134.17**	0.366	Method 1 - OK	-0.234	OK		Method 1 - OK
Raven Wing Drive		**A.3.A**	**A.2.A**	**134.49**	134.49	133.99	**134.99**	**26.2**	26.2	5.38	5.50	1.75	Vel-OK	0.059	0.16	135.20	135.04	0.554	Method 1 - OK	0.714	OK	0.000	Method 2 - OK
Raven Wing Drive		A.2.A	**A.1.A**	**134.49**	134.49	133.99	**134.99**	2.6	28.7	5.12	14.41	4.59	Vel-OK	0.406	1.77	135.04	133.28	1.084	Method 1 - OK	0.554	OK	0.000	Method 2 - OK
Raven Wing Drive		A.1.A	A	**134.24**	134.24	133.74	**134.74**	1.6	30.3	4.98	18.84	2.67	Vel-OK	0.080	0.05	133.28	**133.23**	-0.564	Method 1 - OK	-0.964	OK		Method 1 - OK
				Stage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.5300**				-0.071	-0.071							
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**136.50**	**135.50**	**135.50**	**135.50**				**83.18**	8.65	Vel-OK	0.683	2.86	**140.18**	137.33	5.082	Increase Pipe Size	4.682	Check Lo Spot	0.540	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**136.50**	**135.50**	**135.50**	**135.50**				83.18	6.62	Vel-OK	0.335	4.86	137.33	**132.47**	0.825	Method 1 - OK	1.825	Check Lo Spot	0.540	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**133.00**	**132.80**	**132.80**	**132.80**	**139.1**	139.1	2.01	44.08	4.58	Vel-OK	0.192	3.43	132.99	129.56	-0.507	Method 1 - OK	0.193	Check Hi Spot		Method 1 - OK
Raven Roost (Lake)		RR7	**RR8**	**136.50**	**135.50**	**135.50**	**135.50**	6.5	145.6	1.96	44.08	4.58	Vel-OK	0.192	0.88	129.56	128.68	-3.437	Method 1 - OK	-5.937	OK		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	1.7	147.3	1.94	44.08	3.12	Vel-OK	0.109	0.08	128.68	**128.61**	-7.818	Method 1 - OK	-6.818	OK		Method 1 - OK
				Stage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**												
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**137.00**	**136.50**	**136.50**	**136.50**	**31.9**	31.9	4.84	**77.17**	5.47	Vel-OK	0.236	1.18	142.06	140.89	5.064	Increase Pipe Size	5.564	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**135.10**	**134.80**	**134.80**	**134.80**	1.5	33.5	4.72	88.67	6.28	Vel-OK	0.312	0.45	140.89	140.44	3.886	Increase Pipe Size	6.086	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**135.10**	**134.80**	**134.80**	**134.80**	0.4	33.8	4.69	**31.41**	2.23	Vel-OK	0.039	0.01	140.44	140.43	5.338	Increase Pipe Size	5.638	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**135.10**	**134.80**	**134.80**	**134.80**	0.2	34.0	4.67	**152.88**	6.62	Vel-OK	0.284	0.21	140.43	140.21	5.328	Increase Pipe Size	5.628	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	**32.0**	34.2	4.66	**197.37**	8.54	Vel-OK	0.474	11.61	140.21	**128.61**	5.115	Increase Pipe Size	4.715	OK	-0.404	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**136.50**	**135.50**	**135.50**	**135.50**	**31.9**	31.9	4.84	**77.28**	4.86	Vel-OK	0.154	0.04	**140.25**	**140.21**	5.153	Increase Pipe Size	4.753	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**135.10**	**134.80**	**134.80**	**134.80**				**79.67**	8.28	Vel-OK	0.627	0.33	140.51	**140.18**	5.408	Increase Pipe Size	5.708	Check Lo Spot	0.000	Method 2 - OK

APPENDIX C-1
PROPOSED ALTERNATIVE 2 - 50% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001)
Date : 2/14/2022
By : GPF
Reviewed By:

Select Rainfall Data: Atlas 14 HC Reg 3

COH I-D-F Coefficients

Return Freq (yr)	2
b :	48.35
d :	9.07
e :	0.7244
Peaking Factor C_f :	1.00

i=b/(d+Tc]^e Q=C_f*C*A*I_1

Initial T_c = 10A^0.1761 + 15 ; A=Drainage Area

V_{MAX} in Pipe = 12.00
V_{MAX} @ Outfall = 8.00
Starting FL from LiDAR
Starting TW (Soffit) = @ Outfall
Fixed Curb Height @ Inlet (ft) = 0.50

DRAINAGE AREA DEVELOPMENT: AL 1/4 ac & Smaller Lots = 0.55; BUSINESS DISTRICTS = 0.80; PARKS & OPEN AREAS = 0.18

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	2-year Computations Intensity " i " (in/hr)	2-year Computations Flow (cfs)
Raven Song Drive		S.1.C	S	A1-C-1&2	1.6349							
Raven South Drive		S	R	A1-A&B-1&2	2.2538							
Raven South Drive		R	Q									
Raven South Drive		Q	P	A3-A&B-1&2	2.9238							
Raven South Drive		P	O									
Raven South Drive		O	N									
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2	1.8846							
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2	1.0755							
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2	0.9607							
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2	0.9956							
Raven South Drive	Ravens Caw	J	H	A10-A-1&2	1.0017							
Raven South Drive		H	G									
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2	1.0228							
Raven South Drive		F.2	F									
Raven South Drive		F	E	A14-A-1&2	1.1371							
Raven South Drive	Ravens Flight Dr	E	D									
Raven South Drive		D	C	A16-A-1&2	1.3717							
Raven South Drive	Blackbird Dr	C	B									
Raven South Drive		B	A	A18-A-1&2	1.2100							
Cypress North Houst	Raven Wing Dr	A	CNH-1									
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2									
Cypress North Houston		CNH 2	CNH-3									
Cypress North Houst	(South Trunkline)	CNH-3	E133									
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2	3.4862							
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2	1.9712							
Shaft Drive		M.9	M.8	C1-A&B-1&2	1.8431							
Shaft Drive		M.8	M.7									
Shaft Drive		M.7	M.5	C1-A&B-1&2	2.5051							
Shaft Drive		M.5	M.4									
Shaft Drive		M.4	M.3	C4-A-1&2	2.0244							
Shaft Drive		M.3	M.2	C5-A&B-1&2	3.9219							
Shaft Drive		M.2	M	C6-A&B-1&2	2.7910							
Nevermore Drive		L.3.A	L.2.A	D0-A&B-1	2.1818							
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2	2.3420							
Nevermore Drive		L.1.A	L	D2-A&B-1&2	1.2770							
Birdcall Lane		K.7	K.6	E1-A&B-1&2	2.4690							
Birdcall Lane		K.6	K.5	E2-A&B-1&2	1.5307							
Birdcall Lane		K.5	K.4									
Birdcall Lane		K.4	K.3	E3a-A&B-1	1.7913							
Birdcall Lane		K.3	K.1	E4-A&B-1&2	2.8743							
Birdcall Lane		K.1	K	E5-A&B-1&2	1.6504							
Ravens Mate Drive		K.7.1	K.7	L1-A&B-1&2	2.8026							
Ravens Mate Drive		K.7.2	K.7	K1-A&B-1&2	2.7541							
Ravens Mate Drive		K.7.2.A	K.7.2	K1-C-1&2	2.0029							
Ravens Caw Drive		J.3.A	J.2.A	F0-A&B-1	2.1602							
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2	3.1540							
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2	1.0077							
Raven Roost Drive		G.3.A	G.2.A	G0-A&B-1	1.6956							
Raven Roost Drive		G.2.A	G.1.A	G1-A&B-1&2	2.1683							
Raven Roost Drive		G.1.A	G	G2-A&B-1&2	1.4552							
Raven Rook Drive		E.4	E.3	H1-A&B-1&2	2.3772							
Raven Flight Drive		E.3	E.2									
Raven Flight Drive		E.2	E.1	H2a-A&B-1	2.1367							
Raven Flight Drive		E.1	E	H3-A&B-1&2	1.6284							
Raven Flight Drive		E.4.C	E.4	K1-C-1&2	1.5183							
Blackbird Drive		C.3.A	C.2.A	I0-A&B-1	1.5844							
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2	1.3823							
Blackbird Drive		C.1.A	C	I2-A&B-1&2	2.9466							
Raven Wing Drive		A.3.A	A.2.A	J0-A&B-1	1.8563							
Raven Wing Drive		A.2.A	A.1.A	J1-A&B-1&2	3.2555							
Raven Wing Drive		A.1.A	A	J2-A&B-1&2	1.7690							
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5									
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1									
Raven Roost (Lake)		RR	RR7		39.7800							
Raven Roost (Lake)		RR7	RR8									
Raven Roost (Lake)		RR8	CNH-3									
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2		19.9300							
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3		3.5600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3		6.1200							
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4		2.8700							
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3		2.2900							
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4		19.9600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	10								

Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4 = 0.4622

Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate

Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes = 0.2828

Street Name	Reach (ft)	No. of BBLs	Pipe Diameter (inches) or Span (ft)	X	Height (ft)	Pipe Type	Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{des}) (fps)	Design Capacity (Q_{des}) (cfs)	Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)
Raven Song Drive	60				24	RCP	0.013	3.14	0.500	**0.200**	3.2	10.12	0.12	**0.000**	**126.94**	**126.82**	128.94	128.82
Raven South Drive	200				30	RCP	0.013	4.91	0.625	**0.130**	3.0	14.79	0.26	**0.000**	**126.82**	**126.56**	129.32	129.06
Raven South Drive	70				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.71	0.09	**0.000**	**126.56**	**126.47**	129.06	128.97
Raven South Drive	428				30	RCP	0.013	4.91	0.625	**0.129**	3.0	14.70	0.55	**0.000**	**126.47**	**125.92**	128.97	128.42
Raven South Drive	86				30	RCP	0.013	4.91	0.625	**0.128**	3.0	14.67	0.11	**0.000**	**125.92**	**125.81**	128.42	128.31
Raven South Drive	165				30	RCP	0.013	4.91	0.625	**0.036**	1.6	7.76	0.06	**1.130**	**125.81**	**125.75**	128.31	128.25
Raven South Drive	285				48	RCP	0.013	12.57	1.000	0.070	3.0	38.00	0.20	2.000	124.62	124.42	128.62	128.42
Raven South Drive	285	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.14	0.000	122.42	122.28	128.42	128.28
Raven South Drive	285	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.14	0.000	122.28	122.14	128.28	128.14
Raven South Drive	285	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.14	0.000	122.14	122.00	128.14	128.00
Raven South Drive	200	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.10	0.000	122.00	121.90	128.00	127.90
Raven South Drive	95	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.05	0.000	121.90	121.85	127.90	127.85
Raven South Drive	68	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.03	0.000	121.85	121.82	127.85	127.82
Raven South Drive	208	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.10	0.000	121.82	121.72	127.82	127.72
Raven South Drive	25	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.01	0.000	121.72	121.71	127.72	127.71
Raven South Drive	272	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.14	0.000	121.71	121.57	127.71	127.57
Raven South Drive	15	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.01	0.000	121.57	121.56	127.57	127.56
Raven South Drive	275	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.14	0.000	121.56	121.42	127.56	127.42
Raven South Drive	15	10	X	6	RCB		0.013	58.00	1.956	0.050	4.0	231.84	0.01	**0.000**	121.42	121.41	127.42	127.41
Cypress North Houst	200				66	RCP	0.013	23.76	1.375	**0.315**	7.9	188.47	0.63	**0.000**	**121.41**	**120.78**	126.91	126.28
Cypress North Houst	555				66	RCP	0.013	23.76	1.375	**0.114**	4.8	113.14	0.63	**0.000**	**120.78**	**120.15**	126.28	125.65
Cypress North Houston	65				66	RCP	0.013	23.76	1.375	**-1.062**	#NUM!	#NUM!	-0.69	**0.000**	**120.15**	**120.84**	125.65	126.34
Cypress North Houst	85	2	7	X	4	RCB	0.013	54.22	1.327	**-0.071**	#NUM!	#NUM!	-0.06		**120.84**	**120.90**	124.84	124.90
Raven Park Dr (Scamp Dr)	258				24	RCP	0.013	3.14	0.500	**0.221**	3.4	10.62	0.57	**0.000**	**127.02**	**126.45**	129.02	128.45
Raven Park Dr (Scamp Dr)	25				24	RCP	0.013	3.14	0.500	**2.800**	12.0	37.85	0.70	**1.130**	**126.45**	**125.75**	128.45	127.75
Shaft Drive	279				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.25	0.000	126.54	126.29	130.04	129.79
Shaft Drive	305				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.27	0.000	126.29	126.02	129.79	129.52
Shaft Drive	483				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.43	0.000	126.02	125.59	129.52	129.09
Shaft Drive	120				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.11	0.000	125.59	125.48	129.09	128.98
Shaft Drive	25				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.02	0.000	125.48	125.46	128.98	128.96
Shaft Drive	590				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.53	0.500	125.46	124.93	128.96	128.43
Shaft Drive	15				48	RCP	0.013	12.57	1.000	0.070	3.0	38.00	0.01	**2.000**	124.43	**124.42**	128.43	128.42
Nevermore Drive	195				24	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.35	0.000	127.80	127.45	129.80	129.45
Nevermore Drive	311				24	RCP	0.013	3.14	0.500	**0.450**	4.8	15.18	1.40	**0.050**	**127.45**	**126.05**	129.45	128.05
Nevermore Drive	25				24	RCP	0.013	3.14	0.500	**1.520**	8.9	27.89	0.38	**3.340**	**126.00**	**125.62**	128.00	127.62
Birdcall Lane	24				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.03	0.500	126.10	126.07	129.10	129.07
Birdcall Lane	315				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.28	0.000	125.57	125.29	129.07	128.79
Birdcall Lane	135				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.12	0.000	125.29	125.17	128.79	128.67
Birdcall Lane	245				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	0.22	0.500	125.17	124.95	128.67	128.45
Birdcall Lane	415				48	RCP	0.013	12.57	1.000	0.070	3.0	38.00	0.29	0.000	124.45	124.16	128.45	128.16
Birdcall Lane	25				48	RCP	0.013	12.57	1.000	0.070	3.0	38.00	0.02	**2.000**	124.16	**124.14**	128.16	128.14
Ravens Mate Drive	288				24	RCP	0.013	3.14	0.500	**0.354**	4.3	13.46	1.02	**0.030**	**127.15**	**126.13**	129.15	128.13
Ravens Mate Drive	216				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.24	**0.000**	126.34	**126.10**	129.34	129.10
Ravens Mate Drive	48				24	RCP	0.013	3.14	0.500	**0.292**	3.9	12.22	0.14	**0.739**	**127.22**	**127.08**	129.22	129.08
Ravens Caw Drive	265				24	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.48	0.500	126.91	126.43	128.91	128.43
Ravens Caw Drive	311				30	RCP	0.013	4.91	0.625	0.130	3.0	14.79	0.40	0.000	125.93	125.53	128.43	128.03
Ravens Caw Drive	25				30	RCP	0.013	4.91	0.625	0.130	3.0	14.79	0.03	**3.500**	125.53	**125.50**	128.03	128.00
Raven Roost Drive	170				24	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.31	0.000	126.00	125.69	128.00	127.69
Raven Roost Drive	353				24	RCP	0.013	3.14	0.500	**0.218**	3.4	10.57	0.77	**0.500**	**125.69**	**124.92**	127.69	126.92
Raven Roost Drive	70				30	RCP	0.013	4.91	0.625	0.130	3.0	14.79	0.09	**2.480**	124.42	**124.33**	126.92	126.83
Raven Rook Drive	396				30	RCP	0.013	4.91	0.625	0.130	3.0	14.79	0.51	0.500	124.71	124.20	127.21	126.70
Raven Flight Drive	142				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.16	0.000	123.70	123.54	126.70	126.54
Raven Flight Drive	203				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.22	0.000	123.54	123.32	126.54	126.32
Raven Flight Drive	61				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.07	**3.000**	123.32	**123.25**	126.32	126.25
Raven Flight Drive	14				24	RCP	0.013	3.14	0.500	**4.286**	14.9	46.83	0.60	**1.419**	**126.73**	**126.13**	128.73	128.13
Blackbird Drive	160				24	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.29	0.000	126.56	126.27	128.56	128.27
Blackbird Drive	436				24	RCP	0.013	3.14	0.500	**0.252**	3.6	11.36	1.10	**1.600**	**126.27**	**125.17**	128.27	127.17
Blackbird Drive	61				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.07	**1.940**	123.57	**123.50**	126.57	126.50
Raven Wing Drive	270				24	RCP	0.013	3.14	0.500	0.180	3.1	9.60	0.49	1.000	124.54	124.05	126.54	126.05
Raven Wing Drive	436				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.48	0.000	123.05	122.57	126.05	125.57
Raven Wing Drive	61				36	RCP	0.013	7.07	0.750	0.110	3.1	22.12	0.07	**2.500**	122.57	**122.50**	125.57	125.50
Cypress-N. Houston (North Trunkline)	418				42	RCP	0.013	9.62	0.875	**0.129**	3.8	36.16	0.54	**0.000**	**124.59**	**124.05**	128.09	127.55
Cypress-N. Houston (North Trunkline)	1,448				48	RCP	0.013	12.57	1.000	**0.122**	4.0	50.22	1.77	**1.500**	**124.05**	**122.28**	128.05	126.28
Raven Roost (Lake)	1,787				42	RCP	0.013	9.62	0.875	0.090	3.1	30.18	1.61	**0.000**	**122.93**	**121.32**	126.43	124.82
Raven Roost (Lake)	459				42	RCP	0.013	9.62	0.875	**0.146**	4.0	38.44	0.67	**0.000**	**121.32**	**120.65**	124.82	124.15
Raven Roost (Lake)	69	2			36	RCP	0.013	14.14	0.750	**-0.275**	#NUM!	#NUM!	-0.19	**0.000**	**120.65**	**120.84**	123.65	123.84
Cypress-N. Houston (South Trunkline)	499	5	X	3	RCB		0.013	14.11	0.977	**0.329**	6.5	91.12	1.64	**0.000**	**127.22**	**125.58**	130.22	128.58
Cypress-N. Houston (South Trunkline)	144	5	X	3	RCB		0.013	14.11	0.977	**0.566**	8.5	119.51	0.82	**0.000**	**125.58**	**124.76**	128.58	127.76
Cypress-N. Houston (South Trunkline)	25	5	X	3	RCB		0.013	14.11	0.977	**1.640**	14.4	203.44	0.41	**0.000**	**124.76**	**124.35**	127.76	127.35
Cypress-N. Houston (South Trunkline)	75	8	X	3	RCB		0.013	23.11	1.131	**1.240**	13.8	319.30	0.93	**0.000**	**124.35**	**123.42**	127.35	126.42
Cypress-N. Houston (South Trunkline)	2,450	8	X	3	RCB		0.013	23.11	1.131	**0.105**	4.0	93.05	2.58	**0.000**	**123.42**	**120.84**	126.42	123.84
Cypress-N. Houston (South Trunkline)	25				54	RCP	0.013	15.90	1.125	**4.680**	26.7	425.42	1.17	**0.000**	**124.59**	**123.42**	129.09	127.92
Cypress-N. Houston (South Trunkline)	52				42	RCP	0.013	9.62	0.875	**0.327**	6.0	57.53	0.17	**0.000**	**124.76**	**124.59**	128.26	128.09

Street Name	Actual Velocity (V_{act}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)	Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ Inlets (ft)	2-year Design Check at Inlet Location
Raven Song Drive											
Raven South Drive											
Raven South Drive											
Raven South Drive											
Raven South Drive											
Raven South Drive											
Raven South Drive	1.05	Vel-OK	0.021	0.013	129.27	129.26	**135.76**	135.26	**136.26**	-5.986	OK
Raven South Drive	1.57	Vel-OK	0.035	0.071	129.26	129.19	**135.46**	134.96	**135.96**	-5.699	OK
Raven South Drive	1.57	Vel-OK	0.035	0.025	129.19	129.17	**136.19**	135.69	**136.69**	-6.500	OK
Raven South Drive	2.61	Vel-OK	0.097	0.417	129.17	128.75	**136.01**	135.51	**136.51**	-6.345	OK
Raven South Drive	2.61	Vel-OK	0.097	0.084	128.75	128.66	**136.43**	135.93	**136.93**	-7.182	OK
Raven South Drive	2.61	Vel-OK	0.097	0.161	128.66	128.50	**136.18**	135.68	**136.68**	-7.015	OK
Raven South Drive	1.96	Vel-OK	0.029	0.084	128.50	128.42	**135.84**	135.34	**136.34**	-6.836	OK
Raven South Drive	0.86	Vel-OK	0.002	0.007	128.29	128.28	**135.52**	135.02	**136.02**	-6.733	OK
Raven South Drive	0.96	Vel-OK	0.003	0.008	128.15	128.14	**135.64**	135.14	**136.14**	-6.992	OK
Raven South Drive	1.30	Vel-OK	0.005	0.015	128.02	128.00	**135.64**	135.14	**136.14**	-7.125	OK
Raven South Drive	1.40	Vel-OK	0.006	0.012	127.91	127.90	**135.14**	134.64	**135.64**	-6.728	OK
Raven South Drive	1.40	Vel-OK	0.006	0.006	127.89	127.88	**135.30**	134.80	**135.80**	-6.911	OK
Raven South Drive	1.48	Vel-OK	0.007	0.005	127.88	127.88	**134.66**	134.16	**135.16**	-6.277	OK
Raven South Drive	1.48	Vel-OK	0.007	0.014	127.88	127.86	**135.40**	134.90	**135.90**	-7.022	OK
Raven South Drive	1.48	Vel-OK	0.007	0.002	127.86	127.86	**134.80**	134.30	**135.30**	-6.436	OK
Raven South Drive	1.60	Vel-OK	0.008	0.022	127.86	127.84	**134.80**	134.30	**135.30**	-6.437	OK
Raven South Drive	1.60	Vel-OK	0.008	0.001	127.84	127.84	**134.17**	133.67	**134.67**	-5.829	OK
Raven South Drive	1.69	Vel-OK	0.009	0.025	127.84	127.82	**134.17**	133.67	**134.67**	-5.830	OK
Raven South Drive	1.69	Vel-OK	0.009	0.001	127.82	127.81	**134.14**	133.64	**134.64**	-5.825	OK
Cypress North Houst	4.38	Vel-OK	0.096	0.192	127.81	127.62	**134.14**	133.64	**134.64**	-5.826	OK
Cypress North Houst	6.43	Vel-OK	0.207	1.148	127.62	126.47	**136.50**	136.00	**135.50**	-8.378	OK
Cypress North Houston	6.43	Vel-OK	0.207	0.134	126.47	126.34	**136.50**	136.00	**135.50**	-9.526	OK
Cypress North Houst	3.10	Vel-OK	0.050	0.043	124.94	124.90	**136.50**	136.00	**135.50**	-11.057	OK
Raven Park Dr (Scamp Dr)	2.18	Vel-OK	0.091	0.236	128.79	128.56	**135.50**	135.00	**136.00**	-6.208	OK
Raven Park Dr (Scamp Dr)	3.28	Vel-OK	0.208	0.052	128.56	**128.50**	**135.54**	135.04	**136.04**	-6.484	OK
Shaft Drive	0.64	Vel-OK	0.004	0.011	129.80	129.79	**135.74**	135.24	**136.24**	-5.439	OK
Shaft Drive	0.64	Vel-OK	0.004	0.011	129.53	129.52	**136.04**	135.54	**136.54**	-6.009	OK
Shaft Drive	2.06	Vel-OK	0.039	0.187	129.28	129.09	**136.04**	135.54	**136.54**	-6.263	OK
Shaft Drive	2.06	Vel-OK	0.039	0.046	129.03	128.98	**136.04**	135.54	**136.54**	-6.514	OK
Shaft Drive	2.23	Vel-OK	0.045	0.011	128.97	128.96	**135.52**	135.02	**136.02**	-6.049	OK
Shaft Drive	2.79	Vel-OK	0.071	0.421	128.85	128.43	**134.75**	**135.75**	**135.75**	-5.899	OK
Shaft Drive	2.35	Vel-OK	0.042	0.006	128.43	**128.42**	**135.52**	135.02	**136.02**	-6.594	OK
Nevermore Drive	1.39	Vel-OK	0.037	0.073	129.52	129.45	**135.91**	135.41	**136.41**	-5.887	OK
Nevermore Drive	2.75	Vel-OK	0.146	0.454	128.66	128.20	**135.40**	134.90	**135.90**	-6.242	OK
Nevermore Drive	3.41	Vel-OK	0.224	0.056	128.20	**128.15**	**135.34**	134.84	**135.84**	-6.636	OK
Birdcall Lane	2.61	Vel-OK	0.076	0.018	129.09	129.07	**135.86**	135.36	**136.36**	-6.272	OK
Birdcall Lane	2.20	Vel-OK	0.044	0.140	128.93	128.79	**135.85**	135.35	**136.35**	-6.420	OK
Birdcall Lane	2.20	Vel-OK	0.044	0.060	128.73	128.67	**136.14**	135.64	**136.64**	-6.910	OK
Birdcall Lane	2.40	Vel-OK	0.053	0.129	128.58	128.45	**135.86**	135.36	**136.36**	-6.781	OK
Birdcall Lane	2.17	Vel-OK	0.036	0.149	128.31	128.16	**135.25**	134.75	**135.75**	-6.441	OK
Birdcall Lane	2.28	Vel-OK	0.040	0.010	128.15	**128.14**	**135.34**	134.84	**135.84**	-6.690	OK
Ravens Mate Drive	1.77	Vel-OK	0.060	0.173	129.26	**129.09**	**135.64**	135.14	**136.14**	-5.878	OK
Ravens Mate Drive	1.30	Vel-OK	0.019	0.041	129.14	**129.10**	**135.50**	135.00	**136.00**	-5.859	OK
Ravens Mate Drive	1.28	Vel-OK	0.032	0.015	129.16	**129.14**	**135.80**	135.30	**136.30**	-6.144	OK
Ravens Caw Drive	1.38	Vel-OK	0.037	0.097	128.53	128.43	**135.41**	134.91	**135.91**	-6.383	OK
Ravens Caw Drive	2.04	Vel-OK	0.059	0.185	128.21	128.03	**134.75**	134.25	**135.25**	-6.035	OK
Ravens Caw Drive	2.31	Vel-OK	0.077	0.019	128.02	**128.00**	**134.84**	134.34	**135.34**	-6.321	OK
Raven Roost Drive	1.09	Vel-OK	0.023	0.039	128.34	128.30	**135.14**	134.64	**135.64**	-6.299	OK
Raven Roost Drive	2.36	Vel-OK	0.108	0.380	128.30	127.92	**134.71**	134.21	**135.21**	-5.908	OK
Raven Roost Drive	1.99	Vel-OK	0.057	0.040	127.92	**127.88**	**134.82**	134.32	**135.32**	-6.397	OK
Raven Rook Drive	1.55	Vel-OK	0.034	0.136	128.09	127.95	**134.71**	134.21	**135.21**	-6.120	OK
Raven Flight Drive	1.08

APPENDIX C-2
PROPOSED ALTERNATIVE 2 - 50% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravenswaay South (UPIN 19103MF147001
Date : 2/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
2	28.0	0.0208	Crown	0.33	1.00	13.00	0.271
3	41.0	0.0208	Crown	0.50	0.50	20.00	0.417
4	25.0	0.0208	Blvd	0.50	0.50	12.00	0.250
5	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency = 2 yr
Override Inlet Time (Tc) (min) =
N-Value (Pavement) = 0.016 TxDOT Hydraulic Manual Table 4-8

$T_{spread}=1.243(Q_{Gutter}*N/S_x^{1/2}*S_x^{5/3})^{3/8}$
$Y_{Gutter}=T_{Spread}*S_x$

Length of Curb Inlet Opening for Intercepting Total Q_{Gut}
$L_T=0.6*Q^{0.42}*S_x^{0.3}*(1/(N*S_x))^{0.6}$
Efficiency = 1-(1-L_t/L_T)^1.8
$Q_{Bypass}=Q_{Total}*(1-Eff)$

INLET PONDING CALCULATIONS

$Q_{weir}=C_{weir}*L_{weir}*H^{1.5}$
C_{weir}= 2.60
$H_{weir}=(Q/(C*L))^{2/3}$

$Q_{orif}=C_{orif}*A_{orif}*(2gH)^{1/2}$
C_{orif}= 0.60
$H_{orif}=(Q/(C*A*Sqrt(2g))^2$
$T_{Inlet}=H/S_x$

GUTTER SPREAD CALCULATIONS

INLET PONDING CALCULATIONS

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Street Type	Pavement Width (B-B) (ft)	Cross-Slope (S_x) (ft/ft)	Street Type	Curb Height (ft)	Curb Width (ft)	Maximum Allowable Ponding Spread @ Inlets (ft)	Maximum Allowable Ponding Depth @ Inlets (ft)
Raven Song Drive		**S.1.C**	**S**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		S	**R**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		R	**Q**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		Q	**P**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		P	**O**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		O	**N**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Shaft Dr**	M	**L**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Nevermore Dr**	L	**K**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Birdcall Dr**	K	**J**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Caw**	J	**H**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		H	**G**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F.2	**F**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		F	**E**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Ravens Flight Dr**	E	**D**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		D	**C**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive	**Blackbird Dr**	C	**B**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven South Drive		B	**A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houston		CNH 2	**CNH-3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		**M.9**	**M.8**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.8	**M.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.7	**M.5**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.5	**M.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.4	**M.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.3	**M.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Shaft Drive		M.2	**M**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		**L.3.A**	**L.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.2.A	**L.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Nevermore Drive		L.1.A	**L**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		**K.7**	**K.6**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.6	**K.5**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.5	**K.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.4	**K.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.3	**K.1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Birdcall Lane		K.1	**K**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.1**	**K.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.2**	**K.7**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		**J.3.A**	**J.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.2.A	**J.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Ravens Caw Drive		J.1.A	**J**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		**G.3.A**	**G.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.2.A	**G.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Roost Drive		G.1.A	**G**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Rook Drive		**E.4**	**E.3**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.3	**E.2**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.2	**E.1**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		E.1	**E**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Flight Drive		**E.4.C**	**E.4**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		**C.3.A**	**C.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.2.A	**C.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Blackbird Drive		C.1.A	**C**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		**A.3.A**	**A.2.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.2.A	**A.1.A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Raven Wing Drive		A.1.A	**A**	**1**	28.0	0.0208	Crown	0.50	0.50	13.50	0.281
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		**RR**	**RR7**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR7	**RR8**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Raven Roost (Lake)		RR8	**CNH-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**5**	25.0	0.0208	Blvd	0.00	0.00	12.00	0.250

INLET #1 (FAR INLET)

Gutter Run 1

Drainage Area (ac)	T/C Grade (S_{xT}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.7150	**0.25**	24.43	3.80	1.49	10.59	0.22	-
0.5156	**0.25**	23.90	3.84	1.09	9.41	0.20	-
				No Inlet			-
				No Inlet			-
1.2436	**0.25**	25.39	3.72	2.55	12.94	0.27	-
				No Inlet			-
				No Inlet			-
1.4209	**0.60**	25.64	3.70	2.89	11.52	0.24	-
0.3618	**0.25**	23.36	3.89	0.77	8.28	0.17	-
0.4702	**0.25**	23.76	3.86	1.00	9.10	0.19	-
0.4974	**0.25**	23.84	3.85	1.05	9.29	0.19	-
0.5169	**0.60**	23.90	3.84	1.09	7.99	0.17	-
				No Inlet			-
0.2972	**0.25**	23.08	3.91	0.64	7.71	0.16	-
				No Inlet			-
0.4009	**0.25**	23.51	3.88	0.85	8.59	0.18	-
				No Inlet			-
0.5908	**0.25**	24.11	3.82	1.24	9.89	0.21	-
				No Inlet			-
0.6880	**0.75**	24.36	3.80	1.44	8.50	0.18	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.8696	**0.25**	24.76	3.77	1.80	11.37	0.24	-
0.2450	**0.33**	22.81	3.94	0.53	6.82	0.14	-
2.8062	**0.25**	26.99	3.60	2.95	**13.68**	0.29	-
				No Inlet			-
9.7221	**0.32**	29.93	3.40	7.17	**18.21**	0.38	-
				No Inlet			-
1.1707	**0.25**	25.28	3.73	2.40	12.66	0.26	-
0.8212	**0.25**	24.66	3.78	1.71	11.14	0.23	-
1.1405	**0.25**	25.23	3.73	2.34	12.54	0.26	-
1.0504	**0.26**	25.09	3.75	2.16	12.08	0.25	-
0.6968	**0.26**	24.38	3.80	**1.46**	10.42	0.22	-
0.4409	**0.40**	23.66	3.86	0.94	8.14	0.17	-
1.4076	**0.25**	25.62	3.70	2.87	**13.53**	0.28	-
0.1762	**0.25**	22.37	3.98	0.39	6.37	0.13	-
				No Inlet			-
0.8789	**0.25**	24.78	3.77	1.82	11.41	0.24	-
0.7308	**0.25**	24.46	3.80	**1.53**	10.68	0.22	-
0.5994	**0.25**	24.14	3.82	1.26	9.94	0.21	-
0.7157	**0.25**	24.43	3.80	1.50	10.60	0.22	-
0.5607	**0.35**	24.03	3.83	1.18	9.11	0.19	-
1.4945	**0.25**	25.73	3.70	3.04	**13.82**	0.29	-
1.0595	**0.25**	25.10	3.74	2.18	12.21	0.25	-
0.8213	**0.25**	24.66	3.78	**1.71**	11.14	0.23	-
0.2607	**0.25**	22.89	3.93	0.56	7.35	0.15	-
1.1578	**0.25**	25.26	3.73	2.38	12.61	0.26	-
0.5226	**0.25**	23.92	3.84	**1.10**	9.46	0.20	-
0.4530	**0.25**	23.70	3.86	0.96	8.98	0.19	-
0.2745	**0.25**	22.96	3.92	0.59	7.49	0.16	-
				No Inlet			-
1.0891	**0.25**	25.15	3.74	2.24	12.33	0.26	-
0.6190	**0.25**	24.19	3.82	**1.30**	10.06	0.21	-
0.4293	**0.25**	23.62	3.87	0.91	8.81	0.18	-
1.1509	**0.25**	25.25	3.73	2.36	12.58	0.26	-
0.5114	**0.25**	23.89	3.84	**1.08**	9.38	0.20	-
1.2458	**0.25**	25.39	3.72	2.55	12.95	0.27	-
0.3309	**0.25**	23.23	3.90	0.71	8.01	0.17	-
0.9143	**0.25**	24.84	3.77	**1.89**	11.58	0.24	-
0.6353	**0.29**	24.23	3.82	1.33	9.87	0.21	-

Gutter Run 2

Drainage Area (ac)	T/C Grade (S_{xT}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
0.9199	**0.25**	24.85	3.76	1.90	11.60	0.24	-
0.3491	**0.64**	23.31	3.89	0.75	6.85	0.14	-
				No Inlet			-
				No Inlet			-
0.6625	**0.50**	24.30	3.81	1.39	9.05	0.19	-
				No Inlet			-
				No Inlet			-
0.4637	**0.25**	23.73	3.86	0.98	9.06	0.19	-
0.1560	**0.25**	22.21	3.99	0.34	6.10	0.13	-
0.4905	**0.25**	23.82	3.85	1.04	9.24	0.19	-
0.4982	**0.25**	23.85	3.85	1.05	9.30	0.19	-
0.4848	**0.25**	23.80	3.85	1.03	9.20	0.19	-
				No Inlet			-
0.2140	**0.25**	22.62	3.95	0.47	6.84	0.14	-
				No Inlet			-
0.7362	**0.45**	24.47	3.80	1.54	9.59	0.20	-
				No Inlet			-
0.7809	**0.70**	24.57	3.79	1.63	9.02	0.19	-
				No Inlet			-
0.5220	**0.25**	23.92	3.84	1.10	9.45	0.20	-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
0.4591	**0.40**	23.72	3.86	0.97	8.26	0.17	-
1.1175	**0.25**	25.20	3.74	2.30	12.45	0.26	-
1.4186	**0.25**	25.64	3.70	1.54	10.70	0.22	-
				No Inlet			-
13.1102	**0.27**	30.73	3.35	9.52	**20.91**	0.44	-
				No Inlet			-
0.8537	**0.47**	24.73	3.77	1.77	10.05	0.21	-
1.1027	**0.25**	25.17	3.74	2.27	12.39	0.26	-
0.2445	**0.25**	22.80	3.94	0.53	7.18	0.15	-
0.3369	**0.25**	23.26	3.90	0.72	8.07	0.17	-
0.5854	**0.32**	24.10	3.83	1.23	9.41	0.20	-
				No Inlet			-
				No Inlet			-
0.6909	**0.31**	24.37	3.80	1.45	10.05	0.21	-
0.1926	**0.25**	22.48	3.97	0.42	6.58	0.14	-
1.1560	**0.25**	25.26	3.73	2.37	12.60	0.26	-
1.4748	**0.25**	25.71	3.70	3.00	**13.76**	0.29	-
0.5084	**0.50**	23.88	3.84	1.08	8.22	0.17	-
0.6752	**0.25**	24.33	3.81	1.41	10.38	0.22	-
0.2361	**0.25**	22.76	3.94	0.51	7.09	0.15	-
0.5489	**0.40**	24.00	3.83	1.16	8.82	0.18	-
0.2610	**0.25**	22.89	3.93	0.56	7.35	0.15	-
0.9560	**0.44**	24.92	3.76	1.98	10.58	0.22	-
				No Inlet			-
0.2269	**0.45**	22.70	3.95	0.49	6.26	0.13	-
1.0890	**0.25**	25.15	3.74	2.24	12.33	0.26	-
0.1593	**0.31**	22.24	3.99	0.35	5.90	0.12	-
0.2194	**0.70**	22.66	3.95	0.48	5.69	0.12	-
0.6190	**0.25**	24.19	3.82	1.30	10.06	0.21	-
0.2317	**0.25**	22.73	3.94	0.50	7.04	0.15	-

Inlet 1 (Far)

Inlet Type	Sag or On-Grade	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Inlet} (cfs)	Ponding Width at Inlet (ft)	Ponding Depth in Gutter (ft)
B-B Grate	Sag	24.85	3.76	3.38	0.01	0.00
B-B Grate	Sag	23.90	3.84	1.83	elow Gut	-0.04
B-B Grate	Sag	25.39	3.72	3.90	1.20	0.02
B-B Grate	Sag	25.64	3.70	3.84	1.06	0.02
B-B Grate	Sag	23.36	3.89	1.11	elow Gut	-0.04
B-B Grate	Sag	23.82	3.85	2.03	elow Gut	-0.04
B-B Grate	Sag	23.85	3.85	2.11	elow Gut	-0.04
B-B Grate	Sag	23.90	3.84	2.12	elow Gut	-0.04
B-B Grate	Sag	23.08	3.91	1.10	elow Gut	-0.04
B-B Grate	Sag	24.47	3.80	2.37	elow Gut	-0.03
B-B Grate	Sag	24.57	3.79	2.86	elow Gut	-0.03
B-B Grate	Sag	24.36	3.80	2.53	elow Gut	-0.03
C-1	Sag	24.76	3.77	2.76	elow Gut	-0.06
C-1	Sag	25.20	3.74	2.80	elow Gut	-0.05
B-B Grate	Sag	26.99	3.60	4.45	2.41	0.05
B-B Grate	Sag	24.10	3.83	1.60	elow Gut	-0.04
B-B Grate	Sag	30.73	3.35	16.58	22.63	0.47
B-B Grate	Sag	25.28	3.73	4.15	1.76	0.04
B-B Grate	Sag	25.17	3.74	3.96	1.32	0.03
B-B Grate	Sag	25.23	3.73	2.84	elow Gut	-0.03
C-1	On-Grade	25.09	3.75	2.16	elow Gut	-0.07
C-1	Sag	24.38	3.80	**2.36**	elow Gut	-0.07
B-B Grate	Sag	23.66	3.86	1.27	elow Gut	-0.04
B-B Grate	Sag	25.62	3.70	3.55	0.40	0.01
B-B Grate	Sag	24.10	3.83	1.60	elow Gut	-0.04
C-1	On-Grade	24.78	3.77	1.82	elow Gut	-0.07
B-B Grate	Sag	24.46	3.80	**2.97**	elow Gut	-0.02
B-B Grate	Sag	24.14	3.82	1.67	elow Gut	-0.04
B-B Grate	Sag	25.26	3.73	3.84	1.06	0.02
B-B Grate	Sag	25.71	3.70	4.14	1.73	0.04
B-B Grate	Sag	25.73	3.70	4.07	1.58	0.03
C-1	On-Grade	25.10	3.74	2.18	elow Gut	-0.07
C-1	Sag	24.66	3.78	**3.11**	elow Gut	-0.03
C-1	Sag	22.89	3.93	1.07	elow Gut	-0.08
C-1	On-Grade	25.26	3.73	2.38	elow Gut	-0.07
C-1	Sag	24.00	3.83	**2.26**	elow Gut	-0.07
C-1	Sag	23.70	3.86	1.52	elow Gut	-0.08
B-B Grate	Sag	24.92	3.76	2.54	elow Gut	-0.03
C-1	On-Grade	25.15	3.74	2.24	elow Gut	-0.07
B-B Grate	Sag	24.19	3.82	**1.78**	elow Gut	-0.04
B-B Grate	Sag	25.15	3.74	3.12	elow Gut	-0.01
C-1	On-Grade	25.25	3.73	2.36	elow Gut	-0.07
C-1	Sag	23.89	3.84	**1.42**	elow Gut	-0.08
C-2	Sag	25.39	3.72	3.00	elow Gut	-0.07
C-1	On-Grade	23.23	3.90	0.71	elow Gut	-0.08
C-1	Sag	24.84	3.77	**3.18**	elow Gut	-0.03
C-2	Sag	24.23	3.82	1.82	elow Gut	-0.08

INLET #2 (NEAR INLET)

Gutter Run 3

Drainage Area (ac)	T/C Grade (S_{xT}) (%)	Inlet Time Tc (min)	Intensity (in/hr)	Q_{Gutter} (cfs)	Gutter Spread (ft)	Gutter Depth (ft)	Q_{Bypass} (cfs)
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-
				No Inlet			-

APPENDIX C-3
PROPOSED ALTERNATIVE 2 - 1% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 191038MF147011)
Date : 2/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients	
Return Freq (yr)	100
b :	60.66
d :	4.44
e :	0.5797
Peaking Factor C_k :	1.00

$Q_{Allow}=C_{Allow}*W_{Allow}*H_{Allow}^{1.5}$
Where W_{Allow} = Width of Pavement to F/C; H_{Allow} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = **128.50**

C_{Allow} = **2.10**

Allowable 100-yr HGL Height Above T/C @ Location: **1.50** / **0.50**

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Elevations at D/S High Point in Street: Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity "i" (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	HGL Above(+) / Below(-) T/C @ D/S High (ft)	Check HGL or Act Gutter Depth vs. Nat Grnd @ ROW Locations	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
Raven Song Drive		**S.1.C**	**S**	**136.37**	136.37	135.87	**136.87**	25.9	25.9	8.39	7.54	2.40	Vel-OK	0.111	0.07	147.29	147.22	11.528	Increase Pipe Size	10.918	OK	0.422	Method 2 - OK
Raven South Drive		S	**R**	**136.37**	136.37	135.87	**136.87**	0.4	26.3	8.32	17.80	3.63	Vel-OK	0.188	0.38	147.22	146.84	11.761	Increase Pipe Size	10.851	OK	0.642	Method 2 - OK
Raven South Drive		R	**Q**	**137.00**	137.00	136.50	**137.50**	0.9	27.2	8.18	17.80	3.63	Vel-OK	0.188	0.13	146.84	146.71	10.654	Increase Pipe Size	9.844	OK	0.642	Method 2 - OK
Raven South Drive		Q	**P**	**137.00**	137.00	136.50	**137.50**	0.3	27.6	8.13	30.48	6.21	Vel-OK	0.552	2.36	146.71	144.35	10.702	Increase Pipe Size	9.712	OK	0.871	Method 2 - OK
Raven South Drive		P	**O**	**136.19**	136.19	135.69	**136.69**	1.1	28.7	7.97	30.48	6.21	Vel-OK	0.552	0.47	144.35	143.87	7.919	Increase Pipe Size	8.159	OK	0.871	Method 2 - OK
Raven South Drive		O	**N**	**136.19**	136.19	135.69	**136.69**	0.2	28.9	7.94	30.48	6.21	Vel-OK	0.552	0.91	143.87	142.96	7.694	Increase Pipe Size	7.684	OK	0.871	Method 2 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**136.19**	136.19	135.69	**136.69**	**28.4**	29.4	7.88	61.33	4.88	Vel-OK	0.182	0.52	142.96	142.44	7.123	Increase Pipe Size	6.773	Check Lo Spot	1.328	Increase Pipe Size
Raven South Drive	**Shaft Dr**	M	L	**136.19**	136.19	135.69	**136.69**	**38.6**	38.6	6.85	140.03	2.41	Vel-OK	0.018	0.05	142.44	142.39	6.923	Increase Pipe Size	6.253	Check Lo Spot	2.303	Increase Pipe Size
Raven South Drive	**Nevermore Dr**	L	K	**136.00**	136.00	135.50	**136.50**	**28.4**	40.6	6.67	161.27	2.78	Vel-OK	0.024	0.07	142.39	142.32	6.751	Increase Pipe Size	6.391	Check Lo Spot	2.547	Increase Pipe Size
Raven South Drive	**Birdcall Dr**	K	J	**136.00**	136.00	135.50	**136.50**	**32.9**	42.3	6.53	225.62	3.89	Vel-OK	0.047	0.13	142.32	142.19	6.682	Increase Pipe Size	6.322	Check Lo Spot	3.182	Increase Pipe Size
Raven South Drive	**Ravens Caw**	J	H	**135.51**	135.51	135.01	**136.01**	**29.0**	43.5	6.43	248.19	4.28	Vel-OK	0.057	0.11	142.19	142.07	7.047	Increase Pipe Size	6.677	Check Lo Spot	3.404	Increase Pipe Size
Raven South Drive		H	G	**135.47**	135.47	134.97	**135.97**	0.8	44.3	6.38	248.19	4.28	Vel-OK	0.057	0.05	142.07	142.02	6.773	Increase Pipe Size	6.603	Check Lo Spot	3.404	Increase Pipe Size
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**135.47**	135.47	134.97	**135.97**	**28.4**	44.7	6.35	266.95	4.60	Vel-OK	0.066	0.05	142.02	141.97	7.358	Increase Pipe Size	6.548	Check Lo Spot	3.587	Increase Pipe Size
Raven South Drive		F.2	**F**	**135.47**	135.47	134.97	**135.97**	0.2	44.9	6.33	266.95	4.60	Vel-OK	0.066	0.14	141.97	141.84	6.573	Increase Pipe Size	6.503	Check Lo Spot	3.587	Increase Pipe Size
Raven South Drive		F	E	**135.18**	135.18	134.68	**135.68**	0.8	45.7	6.27	267.77	4.62	Vel-OK	0.067	0.02	141.84	141.82	7.035	Increase Pipe Size	6.655	Check Lo Spot	3.598	Increase Pipe Size
Raven South Drive	**Ravens Flight Dr**	E	D	**135.18**	135.18	134.68	**135.68**	**31.7**	45.7	6.27	293.90	5.07	Vel-OK	0.080	0.22	141.82	141.60	7.018	Increase Pipe Size	6.638	Check Lo Spot	3.836	Increase Pipe Size
Raven South Drive		D	C	**134.50**	134.50	134.00	**135.00**	0.9	46.6	6.20	295.58	5.10	Vel-OK	0.081	0.01	141.60	141.59	7.430	Increase Pipe Size	7.100	Check Lo Spot	3.856	Increase Pipe Size
Raven South Drive	**Blackbird Dr**	C	B	**134.50**	134.50	134.00	**135.00**	**29.0**	46.7	6.20	315.58	5.44	Vel-OK	0.093	0.25	141.59	141.33	7.418	Increase Pipe Size	7.088	Check Lo Spot	4.033	Increase Pipe Size
Raven South Drive		B	A	**135.24**	135.24	134.74	**135.74**	0.8	47.5	6.14	316.69	5.46	Vel-OK	0.093	0.01	141.33	141.32	7.193	Increase Pipe Size	6.093	Check Lo Spot	4.046	Increase Pipe Size
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**135.24**	135.24	134.74	**135.74**	**30.3**	47.6	6.14	339.76	14.30	rease Pipe S	1.024	2.05	141.32	139.27	7.179	Increase Pipe Size	6.079	Check Lo Spot	4.246	Increase Pipe Size
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**136.50**	136.50	136.00	**135.50**	**2.4**	47.8	6.12	**436.64**	18.38	rease Pipe S	1.691	9.38	139.27	129.89	2.772	Increase Pipe Size	2.772	Check Lo Spot	4.787	Increase Pipe Size
Cypress North Houston		CNH 2	**CNH-3**	**136.50**	136.50	136.00	**135.50**	0.5	48.3	6.09	436.64	18.38	rease Pipe S	1.691	1.10	129.89	128.79	-6.612	Method 1 - OK	-6.612	OK		Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**136.50**	136.50	136.00	**135.50**	**144.2**	144.2	3.34	**436.64**	8.05	ease Outfall	0.341	0.29	128.79	**128.50**	-7.711	Method 1 - OK	-7.711	OK		Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**136.03**	136.03	135.53	**136.53**	**27.5**	27.5	8.15	15.63	4.97	Vel-OK	0.477	1.23	144.48	143.25	8.977	Increase Pipe Size	8.447	OK	0.599	Method 2 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**135.94**	135.94	135.44	**136.44**	0.9	28.3	8.02	24.09	7.67	Vel-OK	1.134	0.28	143.25	**142.96**	7.706	Increase Pipe Size	7.306	OK	0.759	Method 2 - OK
Shaft Drive		**M.9**	**M.8**	**136.45**	136.45	135.95	**136.95**	**28.7**	28.7	7.97	14.13	1.47	Vel-OK	0.020	0.06	147.45	147.40	11.712	Increase Pipe Size	11.002	OK	0.569	Method 2 - OK
Shaft Drive		M.8	**M.7**	**136.52**	136.52	136.02	**137.02**	3.2	31.9	7.56	14.13	1.47	Vel-OK	0.020	0.06	147.40	147.34	11.357	Increase Pipe Size	10.877	OK	0.569	Method 2 - OK
Shaft Drive		M.7	**M.5**	**136.52**	136.52	136.02	**137.02**	3.5	35.4	7.17	52.06	5.41	Vel-OK	0.268	1.29	147.34	146.04	11.297	Increase Pipe Size	10.817	Check Lo Spot	1.231	Increase Pipe Size
Shaft Drive		M.5	**M.4**	**136.52**	136.52	136.02	**137.02**	1.5	36.9	7.02	52.06	5.41	Vel-OK	0.268	0.32	146.04	145.72	10.004	Increase Pipe Size	9.524	Check Lo Spot	1.231	Increase Pipe Size
Shaft Drive		M.4	**M.3**	**136.52**	136.52	136.02	**137.02**	0.4	37.2	6.98	58.47	6.08	Vel-OK	0.338	0.08	145.72	145.64	10.203	Increase Pipe Size	9.203	Check Lo Spot	1.336	Increase Pipe Size
Shaft Drive		M.3	**M.2**	**136.52**	136.52	136.02	**137.02**	0.1	37.3	6.97	73.46	7.64	Vel-OK	0.533	3.15	145.64	142.49	10.388	Increase Pipe Size	9.118	Check Lo Spot	1.533	Increase Pipe Size
Shaft Drive		M.2	M	**135.92**	135.92	135.42	**136.42**	1.3	38.6	6.85	82.70	6.58	Vel-OK	0.331	0.05	142.49	**142.44**	6.973	Increase Pipe Size	6.573	Check Lo Spot	1.662	Increase Pipe Size
Nevermore Drive		**L.3.A**	**L.2.A**	**135.90**	135.90	135.40	**136.40**	**26.5**	26.5	8.30	9.96	3.17	Vel-OK	0.194	0.38	145.58	145.21	9.675	Increase Pipe Size	9.685	OK	0.479	Method 2 - OK
Nevermore Drive		L.2.A	**L.1.A**	**135.90**	135.90	135.40	**136.40**	1.0	27.5	8.14	20.26	6.45	Vel-OK	0.802	2.50	145.21	142.71	9.807	Increase Pipe Size	9.307	OK	0.692	Method 2 - OK
Nevermore Drive		L.1.A	L	**135.74**	135.74	135.24	**136.24**	0.8	28.3	8.03	25.61	8.15	Vel-OK	1.282	0.32	142.71	**142.39**	7.371	Increase Pipe Size	6.971	OK	0.792	Method 2 - OK
Birdcall Lane		K.7	**K.6**	**136.50**	136.50	136.00	**137.00**	**29.4**	29.4	7.88	43.46	6.15	Vel-OK	0.425	0.10	145.30	145.19	9.437	Increase Pipe Size	8.797	Check Lo Spot	1.061	Increase Pipe Size
Birdcall Lane		K.6	**K.5**	**136.50**	136.50	136.00	**137.00**	0.1	29.4	7.87	50.04	5.20	Vel-OK	0.247	0.78	145.19	144.42	9.345	Increase Pipe Size	8.695	Check Lo Spot	1.153	Increase Pipe Size
Birdcall Lane		K.5	**K.4**	**135.86**	135.86	135.36	**136.36**	1.0	30.4	7.74	50.04	5.20	Vel-OK	0.247	0.33	144.42	144.08	8.276	Increase Pipe Size	8.556	Check Lo Spot	1.153	Increase Pipe Size
Birdcall Lane		K.4	**K.3**	**135.86**	135.86	135.36	**136.36**	0.4	30.9	7.68	56.42	5.86	Vel-OK	0.314	0.77	144.08	143.31	8.222	Increase Pipe Size	8.222	Check Lo Spot	1.255	Increase Pipe Size
Birdcall Lane		K.3	**K.1**	**135.86**	135.86	135.36	**136.36**	0.7	31.6	7.60	67.79	5.39	Vel-OK	0.223	0.92	143.31	142.39	8.061	Increase Pipe Size	7.451	Check Lo Spot	1.410	Increase Pipe Size
Birdcall Lane		K.1	K	**135.74**	135.74	135.24	**136.24**	1.3	32.9	7.44	73.19	5.82	Vel-OK	0.260	0.06	142.39	**142.32**	7.047	Increase Pipe Size	6.647	Check Lo Spot	1.493	Increase Pipe Size
Ravens Mate Drive		**K.7.1**	**K.7**	**136.50**	136.50	136.00	**137.00**	**27.0**	27.0	8.22	12.67	4.03	Vel-OK	0.314	0.90	146.20	**145.30**	10.560	Increase Pipe Size	9.700	OK	0.539	Method 2 - OK
Ravens Mate Drive		**K.7.2**	**K.7**	**136.25**	136.25	135.75	**136.75**	**28.2**	28.2	8.05	21.06	2.98	Vel-OK	0.100	0.22	145.51	**145.30**	10.012	Increase Pipe Size	9.262	OK	0.700	Method 2 - OK
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**136.50**	136.50	136.00	**137.00**	**26.3**	26.3	8.33	9.17	2.92	Vel-OK	0.164	0.08	145.59	**145.51**	9.791	Increase Pipe Size	9.091	OK	0.461	Method 2 - OK
Ravens Caw Drive		**J.3.A**	**J.2.A**	**135.25**	135.25	134.75	**135.75**	**26.5**	26.5	8.30	9.86	3.14	Vel-OK	0.190	0.50	143.84	143.33	8.428	Increase Pipe Size	8.588	OK	0.477	Method 2 - OK
Ravens Caw Drive		J.2.A	**J.1.A**	**135.25**	135.25	134.75	**135.75**	1.4	27.9	8.09	23.65	4.82	Vel-OK	0.332	1.03	143.33	142.30	8.584	Increase Pipe Size	8.084	OK	0.755	Method 2 - OK
Ravens Caw Drive		J.1.A	J	**135.24**	135.24	134.74	**135.74**	1.1	28.9	7.94	27.60	5.62	Vel-OK	0.453	0.11	142.30	**142.19**	7.460	Increase Pipe Size	7.060	OK	0.831	Method 2 - OK
Raven Roost Drive		**G.3.A**	**G.2.A**	**135.33**	135.33	134.83	**135.83**	**26.0**	26.0	8.38	7.81	2.49	Vel-OK	0.119	0.20	144.55	144.34	9.407	Increase Pipe Size	9.217	OK	0.429	Method 2 - OK
Raven Roost Drive		G.2.A	**G.1.A**	**135.33**	135.33	134.83	**135.83**	1.1	27.1	8.20	17.43	5.55	Vel-OK	0.594	2.10	144.34	142.25	9.634	Increase Pipe Size	9.014	OK	0.640	Method 2 - OK
Raven Roost Drive		G.1.A	G	**135.22**	135.22	134.72	**135.72**	1.1	28.2	8.05	23.54	4.80	Vel-OK	0.329	0.23	142.25	**142.02**	7.429	Increase Pipe Size	7.029	OK	0.759	Method 2 - OK
Raven Rook Drive		**E.4**	**E.3**	**135.11**	135.11	134.61	**135.61**	**27.7**	27.7	8.11	17.38	3.54	Vel-OK	0.180	0.71	143.07	142.36	8.357	Increase Pipe Size	7.957	OK	0.632	Method 2 - OK
Raven Flight Drive		E.3	**E.2**	**134.90**	134.90	134.40	**135.40**	1.9	29.6	7.85	17.38	2.46	Vel-OK	0.068	0.10	142.36	142.26	7.016	Increase Pipe Size	7.456	OK	0.632	Method 2 - OK
Raven Flight Drive		E.2	**E.1**	**134.90**	134.90	134.40	**135.40**	1.0	30.5	7.73	25.64	3.63	Vel-OK	0.148	0.30	142.26	141.96	7.269	Increase Pipe Size	7.359	OK	0.799	Method 2 - OK
Raven Flight Drive		E.1	E	**134.90**	134.90	134.40	**135.40**	0.9	31.5	7.61	32.06	4.54	Vel-OK	0.231	0.14	141.96	**141.82**	7.479	Increase Pipe Size	7.059	OK	0.913	Method 2 - OK
Raven Flight Drive		**E.4.C**	**E.4**	**135.75**	135.75	135.25	**136.25**	**25.8**	25.8	8.41	7.02	2.24	Vel-OK	0.096	0.01	143.08	**143.07**	8.071	Increase Pipe Size	7.331	OK	0.409	Method 2 - OK
Blackbird Drive		**C.3.A**	**C.2.A**	**135.16**	135.16	134.66	**135.66**	**25.8**	25.8	8.40	7.32	2.33	Vel-OK	0.105	0.17	143.38	143.21	8.010	Increase Pipe Size	8.220	OK	0.416	Method 2 - OK
Blackbird Drive		C.2.A	**C.1.A**	**135.16**	135.16	134.66	**135.66**	1.1	27.0	8.22	13.41	4.27	Vel-OK	0.352	1.53	143.21	141.68	8.243	Increase Pipe Size	8.053	OK	0.560	Method 2 - OK
Blackbird Drive		C.1.A	C	**134.44**	134.44	133.94	**134.94**	1.7	28.7	7.97	25.93	3.67	Vel-OK	0.151	0.09	141.68	**141.59**	7.840	Increase Pipe Size	7.240	OK	0.805	Method 2 - OK
Raven Wing Drive		**A.3.A**	**A.2.A**	**134.49**	134.49	133.99	**134.99**	**26.2**	26.2	8.35	8.53	2.71	Vel-OK	0.142	0.38	142.33	141.95	7.680	Increase Pipe Size	7.840	OK	0.446	Method 2 - OK
Raven Wing Drive		A.2.A	**A.1.A**	**134.49**	134.49	133.99	**134.99**	1.7	27.8	8.10	22.77	3.22	Vel-OK	0.117	0.51	141.95	141.44	7.986	Increase Pipe Size	7.456	OK	0.741	Method 2 - OK
Raven Wing Drive		A.1.A	A	**134.24**	134.24	133.74	**134.74**	2.3	30.1	7.79	29.47	4.17	Vel-OK	0.195	0.12	141.44	**141.32**	7.598	Increase Pipe Size	7.198	OK	0.872	Method 2 - OK
				Stage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.5163**				0.461	-0.811							
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**136.50**	**135.50**	**135.50**	**135.50**				127.26	13.23	rease Pipe S	1.600	6.69	**157.32**	150.64	22.225	Increase Pipe Size	21.825	Check Lo Spot	1.568	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**136.50**	**135.50**	**135.50**	**135.50**				127.26	10.13	Vel-OK	0.785	11.37	150.64	**139.27**	14.137	Increase Pipe Size	15.137	Check Lo Spot	1.568	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**133.00**	**132.80**	**132.80**	**132.80**	**139.1**	139.1	3.41	74.56	7.75	Vel-OK	0.549	9.81	141.34	131.53	7.839	Increase Pipe Size	8.539	Check Lo Spot	1.179	Increase Pipe Size
Raven Roost (Lake)		RR7	**RR8**	**136.50**	**135.50**	**135.50**	**135.50**	3.8	143.0	3.36	74.56	7.75	Vel-OK	0.549	2.52	131.53	129.00	-1.474	Method 1 - OK	-3.974	OK		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	1.0	144.0	3.34	74.56	5.27	Vel-OK	0.312	0.22	129.00	**128.79**	-7.495	Method 1 - OK	-6.495	OK		Method 1 - OK
				Stage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**												
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**137.00**	**136.50**	**136.50**	**136.50**	**31.9**	31.9	7.55	**120.42**	8.53	Vel-OK	0.575	2.87	162.58	159.71	25.582	Increase Pipe Size	26.082	Check Lo Spot	1.450	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**135.10**	**134.80**	**134.80**	**134.80**	1.0	32.9	7.44	139.77	9.90	Vel-OK	0.774	1.11	159.71	158.60	22.715	Increase Pipe Size	24.915	Check Lo Spot	1.589	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**135.10**	**134.80**	**134.80**	**134.80**	0.2	33.2	7.41	**49.63**	3.52	Vel-OK	0.098	0.02	158.60	158.58	23.500	Increase Pipe Size	23.800	Check Lo Spot	0.929	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**135.10**	**134.80**	**134.80**	**134.80**	0.1	33.3	7.40	**241.82**	10.46	Vel-OK	0.711	0.53	158.58	158.04	23.476	Increase Pipe Size	23.776	Check Lo Spot	2.183	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	**32.0**	33.4	7.38	**313.32**	13.56	rease Pipe S	1.194	29.25	158.04	**128.79**	22.942	Increase Pipe Size	22.542	Check Lo Spot	2.517	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**136.50**	**135.50**	**135.50**	**135.50**	**31.9**	31.9	7.55	**120.59**	7.58	Vel-OK	0.376	0.09	**158.14**	**158.04**	23.036	Increase Pipe Size	22.636	Check Lo Spot	1.451	Increase Pipe Size
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**135.10**	**134.80**	**134.80**	**134.80**				**125.89**	13.08	rease Pipe S	1.566	0.81	158.14	**157.32**	23.039	Increase Pipe Size	23.339	Check Lo Spot	1.503	Increase Pipe Size

APPENDIX C-4
PROPOSED ALTERNATIVE 2
1% AEP SHEET FLOW COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147001)
Date : 2/14/2022
By : GPF
Reviewed By:

Under HGL Conditions Which Exceed NG Elevations @ ROW Inlet Capacities Are Computed Using
Minimum Head = Difference in Gutter Elevations between High Point and Inlet OR Maximum Allowable Ponding Depth

Maximum Allowable HGL above T/C Elev @ Inlets = 1.50
Maximum Allowable HGL above T/C Elev @ D/S High = 0.50

Assume Overflows at High Points is Weir Flow
$Q_{over} = C_{over} * L_{over} * H^{3/2}$
$C_{over} = 1.50$
$H_{over} = (Q_i/(C*L))^{2/3}$

100-Year SHEET FLOW COMPUTATIONS

INDIVIDUAL INLET CAPACITY COMPUTATIONS

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Inlet Type	Sag or On-Grade	Number of Inlets @ Location	INLET LEADS Inlet 1 (Far) to Inlet 2 (Near) Length (ft)	Size (in)	Pipe Type	Inlet 2 (Near) to MH Length (ft)	Size (in)	Pipe Type	Gutter Elev @ Inlets	Gutter Elev @ D/S High Point	Minimum NG Elev @ D/S High or Inlet	100-year HGL @ MH (ft)	100-year Headloss through Inlet Leads (ft) Inlet 1 (Far)	Inlet 2 (Near)	Available Head for Inlet Flow Only (ft)	Inlet Capacity@ Available Head (cfs)	100-yr Local Runoff To Inlets (cfs)	Carry-Over from U/S High Point (cfs)	Total Flow @ Inlets (cfs)	Available Capacity or Overflow Contained
Raven Song Drive		S.1.C	S	B-B Grate	Sag	1							135.26	135.87	136.26	147.29	-	-	0.61	20.40	7.70	-	7.70	Cap-OK
Raven South Drive		S	R	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.96	135.87	135.96	147.22	0.02	0.01	0.91	49.84	10.60	-	10.60	Cap-OK
Raven South Drive		R	Q														-	-				-		
Raven South Drive		Q	P	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	135.51	136.50	136.51	146.71	0.03	0.02	0.99	51.98	13.63	-	13.63	Cap-OK
Raven South Drive		P	O														-	-				-		
Raven South Drive		O	N														-	-				-		
Raven South Drive	Raven Park (Scamp)	N	M	B-B Grate	Sag	1				36	24	RCP	135.34	135.69	136.34	142.96	-	0.05	0.35	15.45	8.74	-	8.74	Cap-OK
Raven South Drive	Shaft Dr	M	L	B-B Grate	Sag	2	28	24	RCP	50	24	RCP	135.02	135.69	136.02	142.44	0.00	0.03	0.67	42.77	5.22	-	5.22	Cap-OK
Raven South Drive	Nevermore Dr	L	K	B-B Grate	Sag	1				36	24	RCP	135.14	135.50	136.14	142.39	-	0.02	0.36	15.67	4.62	-	4.62	Cap-OK
Raven South Drive	Birdcall Dr	K	J	B-B Grate	Sag	1				36	24	RCP	135.14	135.50	136.14	142.32	-	0.02	0.36	15.67	4.78	-	4.78	Cap-OK
Raven South Drive	Ravens Caw	J	H	B-B Grate	Sag	1				36	24	RCP	134.64	135.01	135.64	142.19	-	0.02	0.37	15.89	4.81	-	4.81	Cap-OK
Raven South Drive		H	G														-	-				-		
Raven South Drive	Ravens Roost Dr	G	F.2	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	134.16	134.97	135.16	142.02	0.00	0.01	0.81	47.02	4.99	-	4.99	Cap-OK
Raven South Drive		F.2	F														-	-				-		
Raven South Drive		F	E	B-B Grate	Sag	1				6	24	RCP	134.30	134.68	135.30	141.84	-	0.00	0.38	16.10	5.40	-	5.40	Cap-OK
Raven South Drive	Ravens Flight Dr	E	D														-	-				-		
Raven South Drive		D	C	B-B Grate	Sag	1				6	24	RCP	133.67	134.00	134.67	141.60	-	0.00	0.33	15.01	6.50	-	6.50	Cap-OK
Raven South Drive	Blackbird Dr	C	B														-	-				-		
Raven South Drive		B	A	B-B Grate	Sag	1				6	24	RCP	133.64	134.74	134.64	141.33	-	0.00	1.10	27.40	5.75	-	5.75	Cap-OK
Cypress North Houst	Raven Wing Dr	A	CNH-1														-	-				-		
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2														-	-				-		
Cypress North Houston		CNH 2	CNH-3														-	-				-		
Cypress North Houst	(South Trunkline)	CNH-3	E133														-	-				-		
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	C-1	Sag	2	28	24	RCP				135.00	135.53	136.00	144.48	0.04	-	0.53	25.69	16.09	-	16.09	Cap-OK
Raven Park Dr (Scamp Dr)		M.1.A	N	C-1	Sag	2	28	24	RCP	25	24	RCP	135.04	135.44	136.04	143.25	0.01	0.04	0.40	22.32	9.22	-	9.22	Cap-OK
Shaft Drive		M.9	M.8	B-B Grate	Sag	2	41	24	RCP	6	24	RCP	135.24	135.95	136.24	147.45	0.04	0.02	0.71	44.02	14.58	-	14.58	Cap-OK
Shaft Drive		M.8	M.7														-	-				-		
Shaft Drive		M.7	M.5	B-B Grate	Sag	2	41	30	RCP	6	30	RCP	135.54	136.02	136.54	147.34	0.11	0.06	0.48	36.20	42.26	-	42.26	Ovrfl-OK
Shaft Drive		M.5	M.4														-	-			6.06			
Shaft Drive		M.4	M.3	B-B Grate	Sag	1				6	24	RCP	135.02	136.02	136.02	145.72	-	0.03	1.00	26.12	9.45	6.06	15.52	Cap-OK
Shaft Drive		M.3	M.2	B-B Grate	Sag	2	28	24	RCP	75	24	RCP	134.75	136.02	135.75	145.64	0.05	0.49	1.27	58.88	18.22	-	18.22	Cap-OK
Shaft Drive		M.2	M	B-B Grate	Sag	2	28	24	RCP	14	24	RCP	135.02	135.42	136.02	142.49	0.02	0.05	0.40	33.04	13.03	-	13.03	Cap-OK
Nevermore Drive		L.3.A	L.2.A	C-1	On-Grade	2	28	24	RCP				135.41	135.40	136.40	145.58	0.01	-	-	-	10.20	-	10.20	Ovrfl-OK
Nevermore Drive		L.2.A	L.1.A	C-1	Sag	2	28	24	RCP				134.90	135.40	135.90	145.21	0.06	-	0.50	24.96	11.13	10.20	21.34	Cap-OK
Nevermore Drive		L.1.A	L	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	134.84	135.24	135.84	142.71	0.01	0.02	0.40	33.04	6.14	-	6.14	Cap-OK
Birdcall Lane		K-7	K.6	B-B Grate	Sag	2	28	24	RCP	60	24	RCP	135.36	136.00	136.36	145.30	0.02	0.15	0.64	41.80	11.45	-	11.45	Cap-OK
Birdcall Lane		K.6	K.5	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	135.35	136.00	136.35	145.19	0.01	0.01	0.65	42.12	7.32	-	7.32	Cap-OK
Birdcall Lane		K.5	K.4														-	-				-		
Birdcall Lane		K.4	K.3	C-1	On-Grade	2	28	24	RCP	6	24	RCP	135.36	135.36	136.36	144.08	0.01	0.01	-	-	8.44	-	8.44	Ovrfl-OK
Birdcall Lane		K.3	K.1	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.75	135.36	135.75	143.31	0.07	0.06	0.61	40.81	13.62	8.44	22.06	Cap-OK
Birdcall Lane		K.1	K	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	134.84	135.24	135.84	142.39	0.01	0.01	0.40	33.04	7.86	-	7.86	Cap-OK
Ravens Mate Drive		K-7.1	K.7	B-B Grate	Sag	2				75	24	RCP	135.14	136.00	136.14	146.20	-	0.25	0.86	48.45	13.09	-	13.09	Cap-OK
Ravens Mate Drive		K-7.2	K.7	B-B Grate	Sag	2	28	24	RCP	25	24	RCP	135.00	135.75	136.00	145.51	0.02	0.08	0.75	45.25	12.76	-	12.76	Cap-OK
Ravens Mate Drive		K.7.2.A	K.7.2	B-B Grate	Sag	1				40	24	RCP	135.30	136.00	136.30	145.59	-	0.07	0.70	21.86	9.27	-	9.27	Cap-OK
Ravens Caw Drive		J.3.A	J.2.A	C-1	On-Grade	2	28	24	RCP				134.91	134.75	135.75	143.84	0.01	-	-	-	10.11	-	10.11	Ovrfl-OK
Ravens Caw Drive		J.2.A	J.1.A	C-1	Sag	2	28	24	RCP				134.25	134.75	135.25	143.33	0.09	-	0.50	24.96	14.84	10.11	24.95	Cap-OK
Ravens Caw Drive		J.1.A	J	C-1	Sag	2	28	24	RCP				134.34	134.74	135.34	142.30	0.00	-	0.40	22.32	4.92	-	4.92	Cap-OK
Raven Roost Drive		G.3.A	G.2.A	C-1	On-Grade	2	28	24	RCP				134.64	134.83	135.64	144.55	0.01	-	-	-	7.92	-	7.92	Ovrfl-OK
Raven Roost Drive		G.2.A	G.1.A	C-1	Sag	2	28	24	RCP				134.21	134.83	135.21	144.34	0.05	-	0.62	27.79	10.35	7.92	18.27	Cap-OK
Raven Roost Drive		G.1.A	G	C-1	Sag	2	28	24	RCP				134.32	134.72	135.32	142.25	0.01	-	0.40	22.32	7.00	-	7.00	Cap-OK
Raven Rook Drive		E.4	E.3	B-B Grate	Sag	2	28	24	RCP	65	24	RCP	134.21	134.61	135.21	143.07	0.02	0.16	0.40	33.04	11.18	-	11.18	Cap-OK
Raven Flight Drive		E.3	E.2														-	-				-		
Raven Flight Drive		E.2	E.1	C-1	On-Grade	2	28	24	RCP	6	24	RCP	134.49	134.40	135.40	142.26	0.01	0.01	-	-	10.00	-	10.00	Ovrfl-OK
Raven Flight Drive		E.1	E	B-B Grate	Sag	2	28	24	RCP	6	24	RCP	133.98	134.40	134.98	141.96	0.04	0.04	0.42	33.86	7.77	10.00	17.77	Cap-OK
Raven Flight Drive		E.4.C	E.4	B-B Grate	Sag	1				15	24	RCP	134.51	135.25	135.51	143.08	-	0.01	0.74	22.47	7.11	-	7.11	Cap-OK
Blackbird Drive		C.3.A	C.2.A	C-1	On-Grade	2	28	24	RCP				134.87	134.66	135.66	143.38	0.01	-	-	-	7.40	-	7.40	Ovrfl-OK
Blackbird Drive		C.2.A	C.1.A	C-1	Sag	2	28	24	RCP				134.47	134.66	135.47	143.21	0.03	-	0.19	15.38	6.61	7.40	14.02	Cap-OK
Blackbird Drive		C.1.A	C	C-2	Sag	2	28	24	RCP				133.34	133.94	134.34	141.68	0.03	-	0.60	43.49	13.73	-	13.73	Cap-OK
Raven Wing Drive		A.3.A	A.2.A	C-1	On-Grade	2	28	24	RCP				134.15	133.99	134.99	142.33	0.01	-	-	-	8.59	-	8.59	Ovrfl-OK
Raven Wing Drive		A.2.A	A.1.A	C-1	Sag	2	28	24	RCP				133.46	133.99	134.46	141.95	0.08	-	0.53	25.69	15.32	8.59	23.91	Cap-OK
Raven Wing Drive		A.1.A	A	C-2	Sag	2	28	24	RCP				133.34	133.74	134.34	141.44	0.01	-	0.40	35.51	8.41	-	8.41	Cap-OK
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5																					
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1																					
Raven Roost (Lake)		RR	RR7																					
Raven Roost (Lake)		RR7	RR8																					
Raven Roost (Lake)		RR8	CNH-3																					
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2																					
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3																					
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3																					
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4																					
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3																					
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4																					
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4																					

LOWEST INLETS PONDING COMPUTATIONS

Critical Minimum NG Elev	Available Head @ Inlets (ft)	Capacity @ Available Head (cfs)	Cumulative Inlet Capacity	Sheet Flow @ Lowest Inlets (100yr-	Available Capacity Exceeds Sheet Flow
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
	-				
	-				
134.34	-	-			
134.34	-	-			
134.34	-	-			
134.34	-	-			
	-				
134.34	0.81	47.02			
	-				
134.34	0.38	16.10			
	-				
134.34	0.33	15.01			
	-				
134.34	1.10	27.40	352.19	218.80	OK
	-				
	-				
	-				
134.34	-	-			
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
	-				
134.34	-	-			
	-				
134.34	-	-			
134.34	-	-			
	-				
134.34	-	-			
134.34	0.50	24.96			
134.34	-	-			
134.34	-	-			
134.34	0.62	27.79			
134.34	0.40	22.32			
134.34	0.40	33.04			
	-				
134.34	-	-			
134.34	0.42	33.86			
134.34	-	-			
	-				
134.34	-	-			
134.34	0.60	43.49			
134.34	-	-			
134.34	0.53	25.69			
134.34	0.40	35.51			

APPENDIX C-5
PROPOSED ALTERNATIVE 2 - 10% AEP HGL COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravenswany South (UPIN 19103MF147011)
Date : 2/14/2022
By : GPF
Reviewed By:

Alternate C Factor Method: C = 0.6*Ia + 0.2 Where Ia = Impervious Area/Total Area

Select Rainfall Data
Atlas 14 HC Reg 3

COH I-D-F Coefficients	
Return Freq (yr)	10
b :	54.68
d :	6.96
e :	0.6623
Peaking Factor C_p :	1.00

i=b/(d+Tc)^e Q=C_i*C*A*I

Initial T_i = 10A^0.1761 + 15 ; A=Drainage Area

V_{MAX} in Pipe = 12.00

V_{MAX} @ Outfall 8.00

Starting FL from LIDAR

Starting TW (Soffit) = @ Outfall

Fixed Curb Height @ Inlet (ft) 0.50

RUNOFF COEFFICIENTS (C) FOR DRAINAGE AREA DEVELOPMENT TYPES

RESIDENTIAL: 1/2 ac & Larger Lots (0.35) | 1/2 to 1/4 ac Lots (0.45) | 1/4 ac & Smaller Lots (0.55) | Townhouses (0.60)
MULTI-FAMILY: Less than 20 Units/Acre (0.65) | 20 Units/Acre or Greater (0.80)
BUSINESS DISTRICTS (0.80)
INDUSTRIAL DISTRICTS: Light Areas (0.65) | Heavy Areas (0.75) | Railroad Yard Areas (0.30)
PARKS & OPEN AREAS (0.18)
PAVEMENT & R.O.W. (0.90)

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Drainage Area Name	Contributing Drainage Area Delta (ac)	Contributing Drainage Area Total (ac)	Composite Runoff Coefficient "C"	Sum of C*A	Time of Concentration (T_c) Delta or Trib T_c	Time of Concentration (T_c) Total	10-year Computations Intensity " i " (in/hr)	10-year Computations Flow (cfs)
Raven Song Drive		S.1.C	S	A1-C-1&2		1.6349						
Raven South Drive		S	R	A1-A&B-1&2		2.2538						
Raven South Drive		R	Q									
Raven South Drive		Q	P	A3-A&B-1&2		2.9238						
Raven South Drive		P	O									
Raven South Drive		O	N									
Raven South Drive	Raven Park (Scamp)	N	M	A6-A-1&2		1.8846						
Raven South Drive	Shaft Dr	M	L	A7-A&B-1&2		1.0755						
Raven South Drive	Nevermore Dr	L	K	A8-A-1&2		0.9607						
Raven South Drive	Birdcall Dr	K	J	A9-A-1&2		0.9956						
Raven South Drive	Ravens Caw	J	H	A10-A-1&2		1.0017						
Raven South Drive		H	G									
Raven South Drive	Ravens Roost Dr	G	F.2	A12-A&B-1&2		1.0228						
Raven South Drive		F.2	F									
Raven South Drive		F	E	A14-A-1&2		1.1371						
Raven South Drive	Ravens Flight Dr	E	D									
Raven South Drive		D	C	A16-A-1&2		1.3717						
Raven South Drive	Blackbird Dr	C	B									
Raven South Drive		B	A	A18-A-1&2		1.2100						
Cypress North Houst	Raven Wing Dr	A	CNH-1			0.6858						
Cypress North Houst	(North Trunkline)	CNH-1	CNH 2			0.5138		4.0		62.6		259.72
Cypress North Houston		CNH 2	CNH-3			0.4638						
Cypress North Houst	(South Trunkline)	CNH-3	E133			0.5672		121.02		147.7		266.21
Raven Park Dr (Scamp Dr)		M.2.A	M.1.A	B1-A&B-1&2		3.4862						
Raven Park Dr (Scamp Dr)		M.1.A	N	B2-A&B-1&2		1.9712						
Shaft Drive		M.9	M.8	C1-A&B-1&2		1.8431						
Shaft Drive		M.8	M.7									
Shaft Drive		M.7	M.5	C1-A&B-1&2		2.5051						
Shaft Drive		M.5	M.4									
Shaft Drive		M.4	M.3	C4-A-1&2		2.0244						
Shaft Drive		M.3	M.2	C5-A&B-1&2		3.9219						
Shaft Drive		M.2	M	C6-A&B-1&2		2.7910						
Nevermore Drive		L.3.A	L.2.A	D0-A&B-1		2.1818						
Nevermore Drive		L.2.A	L.1.A	D1-A&B-1&2		2.3420						
Nevermore Drive		L.1.A	K	D2-A&B-1&2		1.2770						
Birdcall Lane		K.7	K.6	E1-A&B-1&2		2.4690						
Birdcall Lane		K.6	K.5	E2-A&B-1&2		1.5307						
Birdcall Lane		K.5	K.4									
Birdcall Lane		K.4	K.3	E3a-A&B-1		1.7913						
Birdcall Lane		K.3	K.1	E4-A&B-1&2		2.8743						
Birdcall Lane		K.1	K	E5-A&B-1&2		1.6504						
Ravens Mate Drive		K.7.1	K.7	L1-A&B-1&2		2.8026						
Ravens Mate Drive		K.7.2	K.7	K1-A&B-1&2		2.7541						
Ravens Mate Drive		K.7.2.A	K.7.2	K1-C-1&2		2.0029						
Ravens Caw Drive		J.3.A	J.2.A	F0-A&B-1		2.1602						
Ravens Caw Drive		J.2.A	J.1.A	F1-A&B-1&2		3.1540						
Ravens Caw Drive		J.1.A	J	F2-A&B-1&2		1.0077						
Raven Roost Drive		G.3.A	G.2.A	G0-A&B-1		1.6956						
Raven Roost Drive		G.2.A	G.1.A	G1-A&B-1&2		2.1683						
Raven Roost Drive		G.1.A	G	G2-A&B-1&2		1.4552						
Raven Rook Drive		E.4	E.3	H1-A&B-1&2		2.3772						
Raven Flight Drive		E.3	E.2									
Raven Flight Drive		E.2	E.1	H2a-A&B-1		2.1367						
Raven Flight Drive		E.1	E	H3-A&B-1&2		1.6284						
Raven Flight Drive		E.4.C	E.4	K1-C-1&2		1.5183						
Blackbird Drive		C.3.A	C.2.A	I0-A&B-1		1.5844						
Blackbird Drive		C.2.A	C.1.A	I1-A&B-1&2		1.3823						
Blackbird Drive		C.1.A	C	I2-A&B-1&2		2.9466						
Raven Wing Drive		A.3.A	A.2.A	J0-A&B-1		1.8563						
Raven Wing Drive		A.2.A	A.1.A	J1-A&B-1&2		3.2555						
Raven Wing Drive		A.1.A	A	J2-A&B-1&2		1.7690						
Cypress-N. Houston (North Trunkline)		MH 1-4	MH 1-5									
Cypress-N. Houston (North Trunkline)		MH 1-5	CNH-1									
Raven Roost (Lake)		RR	RR7			39.7800						
Raven Roost (Lake)		RR7	RR8									
Raven Roost (Lake)		RR8	CNH-3									
Cypress-N. Houston (South Trunkline)		MH 2-1	MH 2-2		19.9300							
Cypress-N. Houston (South Trunkline)		MH 2-2	MH 1-3		3.5600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 2-3		6.1200							
Cypress-N. Houston (South Trunkline)		MH 2-3	MH 2-4		2.8700							
Cypress-N. Houston (South Trunkline)		MH 2-4	CNH-3		2.2900							
Cypress-N. Houston (South Trunkline)		MH 1-4	MH 2-4		19.9600							
Cypress-N. Houston (South Trunkline)		MH 1-3	MH 1-4	10								

Percentage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4 = 0.4889

Detained Area - Assumed Initial Tc to produce Undeveloped Flow Rate

Percentage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes = 0.2828

Pipe Size, Length & Type Input Data

Reach (ft)	No. of BBLs	Pipe Diameter (inches) or Span (ft)	X	Height (ft)	Pipe Type
24	RCP				
30	RCP				
30	RCP				
30	RCP				
48	RCP				
285	RCB	10	X	6	RCB
285	RCB	10	X	6	RCB
285	RCB	10	X	6	RCB
200	RCB	10	X	6	RCB
95	RCB	10	X	6	RCB
68	RCB	10	X	6	RCB
208	RCB	10	X	6	RCB
25	RCB	10	X	6	RCB
272	RCB	10	X	6	RCB
15	RCB	10	X	6	RCB
275	RCB	10	X	6	RCB
15	RCB	10	X	6	RCB
200	RCB			66	RCP
555	RCB			66	RCP
65	RCB			66	RCP
85	RCB	2	7	X 4	RCB
258	RCP			24	RCP
25	RCP			24	RCP
279	RCP			42	RCP
305	RCP			42	RCP
483	RCP			48	RCP
120	RCP			48	RCP
25	RCP			48	RCP
590	RCP			48	RCP
15	RCP			48	RCP
195	RCP			24	RCP
311	RCP			24	RCP
25	RCP			24	RCP
24	RCP			36	RCP
315	RCP			42	RCP
135	RCP			42	RCP
245	RCP			48	RCP
415	RCP			48	RCP
25	RCP			48	RCP
288	RCP			30	RCP
216	RCP			36	RCP
48	RCP			24	RCP
265	RCP			24	RCP
311	RCP			30	RCP
25	RCP			30	RCP
170	RCP			24	RCP
353	RCP			24	RCP
70	RCP			30	RCP
396	RCP			30	RCP
142	RCP			36	RCP
203	RCP			36	RCP
61	RCP			36	RCP
14	RCP			24	RCP
160	RCP			24	RCP
416	RCP			24	RCP
61	RCP			36	RCP
270	RCP			24	RCP
436	RCP			36	RCP
61	RCP			36	RCP
418	RCP			42	RCP
1,448	RCP			48	RCP
1,787	RCP			42	RCP
459	RCP			42	RCP
69	RCP	2		36	RCP
499	RCB	5	X	3	RCB
144	RCB	5	X	3	RCB
25	RCB	5	X	3	RCB
75	RCB	8	X	3	RCB
2,450	RCB	8	X	3	RCB
24	RCP			36	RCP
315	RCP			42	RCP
135	RCP			42	RCP
245	RCP			48	RCP
415	RCP			48	RCP
25	RCP			48	RCP
288	RCP			30	RCP
216	RCP			36	RCP
48	RCP			24	RCP
265	RCP			24	RCP
311	RCP			30	RCP
25	RCP			30	RCP
170	RCP			24	RCP
353	RCP			24	RCP
70	RCP			30	RCP
396	RCP			30	RCP
142	RCP			36	RCP
203	RCP			36	RCP
61	RCP			36	RCP
14	RCP			24	RCP
160	RCP			24	RCP
416	RCP			24	RCP
61	RCP			36	RCP
270	RCP			24	RCP
436	RCP			36	RCP
61	RCP			36	RCP
418	RCP			42	RCP
1,448	RCP			48	RCP
1,787	RCP			42	RCP
459	RCP			42	RCP
69	RCP	2		36	RCP
499	RCB	5	X	3	RCB
144	RCB	5	X	3	RCB
25	RCB	5	X	3	RCB
75	RCB	8	X	3	RCB
2,450	RCB	8	X	3	RCB

Pipe Hydraulic Data & Design Capacities

Manning's Coefficient "N"	X-Sect Area of Pipe/Box	Hydraulic Radius (ft)	Flowline Design Slope (%)	Design Velocity (V_{DES}) (fps)	Design Capacity (Q_{DES}) (cfs)
0.013	3.14	0.500	**0.200**	3.2	10.12
0.013	4.91	0.625	**0.130**	3.0	14.79
0.013	4.91	0.625	**0.129**	3.0	14.71
0.013	4.91	0.625	**0.129**	3.0	14.70
0.013	4.91	0.625	**0.128**	3.0	14.67
0.013	12.57	1.000	0.070	3.0	38.00
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	58.00	1.956	0.050	4.0	231.84
0.013	23.76	1.375	**0.315**	7.9	188.47
0.013	23.76	1.375	**0.114**	4.8	113.14
0.013	23.76	1.375	**-1.062**	#NUM!	#NUM!
0.013	54.22	1.327	**-0.071**	#NUM!	#NUM!
0.013	9.62	0.875	**0.129**	3.8	36.16
0.013	12.57	1.000	**0.122**	4.0	50.22
0.013	9.62	0.875	0.090	3.1	30.18
0.013	9.62	0.875	0.090	3.1	30.18
0.013	12.57	1.000	0.070	3.0	38.00
0.013	12.57	1.000	0.070	3.0	38.00
0.013	12.57	1.000	0.070	3.0	38.00
0.013	12.57	1.000	0.070	3.0	38.00
0.013	3.14	0.500	0.180	3.1	9.60
0.013	3.14	0.500	**0.450**	4.8	15.18
0.013	3.14	0.500	**1.520**	8.9	27.89
0.013	7.07	0.750	0.110	3.1	22.12
0.013	3.14	0.500	**0.292**	3.9	12.22
0.013	3.14	0.500	0.180	3.1	9.60
0.013	4.91	0.625	0.130	3.0	14.79
0.013	4.91	0.625	0.130	3.0	14.79
0.013	3.14	0.500	0.180	3.1	9.60
0.013	3.14	0.500	**0.218**	3.4	10.57
0.013	4.91	0.625	0.130	3.0	14.79
0.013	7.07	0.750	0.110	3.1	22.12
0.013	7.07	0.750	0.110	3.1	22.12
0.013	7.07	0.750	0.110	3.1	22.12
0.013	3.14	0.500	**4.286**	14.9	46.83
0.013	3.14	0.500	0.180	3.1	9.60
0.013	3.14	0.500	**0.252**	3.6	11.36
0.013	7.07	0.750	0.110	3.1	22.12
0.013	3.14	0.500	0.180	3.1	9.60
0.013	7.07	0.750	0.110	3.1	22.12
0.013	7.07	0.750	0.110	3.1	22.12
0.013	9.62	0.875	**0.129**	3.8	36.16
0.013	12.57	1.000	**0.122**	4.0	50.22
0.013	9.62	0.875	0.090	3.1	30.18
0.013	9.62	0.875	**0.146**	4.0	38.44
0.013	14.14	0.750	**-0.275**	#NUM!	#NUM!
0.013	14.11	0.977	**0.329**	6.5	91.12
0.013	14.11	0.977	**0.566**	8.5	119.51
0.013	14.11	0.977	**1.640**	14.4	203.44
0.013	23.11	1.131	**1.240**	13.8	319.30
0.013	23.11	1.131	**0.105**	4.0	93.05
0.013	15.90	1.125	**4.680**	26.7	425.42
0.013	9.62	0.875	**0.327**	6.0	57.53

Pipe Elevation Data

Fall in Pipe Reach (ft)	M.H. Drop to D/S FL (ft)	Pipe Flowline Elevation @ U/S M.H.	Pipe Flowline Elevation @ D/S M.H.	Pipe Soffitt Elevation U/S (ft)	Pipe Soffitt Elevation D/S (ft)
0.12	**0.000**	**126.94**	**126.82**	128.94	128.82
0.26	**0.000**	**126.82**	**126.56**	129.32	129.06
0.09	**0.000**	**126.56**	**126.47**	129.06	128.97
0.55	**0.000**	**126.47**	**125.92**	128.97	128.42
0.11	**1.129**	**125.92**	**125.81**	128.42	128.31
0.12	2.000	124.68	124.56	128.68	128.56
0.14	0.000	122.56	122.42	128.56	128.42
0.14	0.000	122.42	122.28	128.42	128.28
0.14	0.000	122.28	122.14	128.28	128.14
0.14	0.000	122.14	122.00	128.14	128.00
0.10	0.000	122.00	121.90	128.00	127.90
0.05	0.000	121.90	121.85	127.90	127.85
0.03	0.000	121.85	121.82	127.85	127.82
0.10	0.000	121.82	121.72	127.82	127.72
0.01	0.000	121.72	121.71	127.72	127.71
0.14	0.000	121.71	121.57	127.71	127.57
0.01	0.000	121.57	121.56	127.57	127.56
0.14	0.000	121.56	121.42	127.56	127.42
0.01	**0.000**	121.42	121.41	127.42	127.41
0.63	**0.000**	**121.41**	**120.78**	126.91	126.28
0.63	**0.000**	**120.78**	**120.15**	126.23	125.65
-0.69	**0.000**	**120.15**	**120.84**	125.65	126.34
-0.06		**120.84**	**120.90**	124.84	124.90
0.57	**0.000**	**127.02**	**126.45**	129.02	128.45
0.70	**3.190**	**126.45**	**125.75**	128.45	127.75
0.54	**0.000**	**124.59**	**124.05**	128.09	127.55
1.10	**1.000**	**126.27**	**125.17**	128.27	127.17
0.07	**1.940**	123.57	**123.50**	126.57	126.50
0.49	1.000	124.54	124.05	126.54	126.05
0.48	0.000	123.05	122.57	126.05	125.57
0.07	**2.500**	122.57	122.50	125.57	125.50
0.53	0.500	126.05	126.02	129.05	129.02
0.28	0.000	125.52	125.24	129.02	128.74
0.12	0.500	125.24	125.12	128.74	128.62
0.17	0.000	124.62	124.45	128.62	128.45
0.00	0.000	124.45	124.16	128.45	128.16
0.02	**2.000**	124.16	**124.14**	128.16	128.14
0.37	**0.500**	126.92	**126.55**	129.42	129.05
0.24	**0.000**	126.29	**126.05**	129.29	129.05
0.77	**0.500**	**125.69**	**124.92**	127.69	126.92
0.09	**2.480**	124.42	**124.33**	126.92	126.83
0.51	0.500	124.71	124.20	127.21	126.70
0.16	0.000	123.70	123.54	126.70	126.54
0.22	0.000	123.54	123.32	126.54	126.32
0.07	**3.000**	123.32	**123.25**	126.32	126.25
0.60	**1.419**	**126.73**	**126.13**	128.73	128.13
0.29	0.000	126.56	126.27	128.56	128.27
0.14	0.000	126.27	126.13	128.27	128.13
0.07	**1.940**	123.57	**123.50**	126.57	126.50
-0.19	**0.000**	**120.65**	**120.84**	123.65	123.84
1.64	**0.000**	**127.22**	**125.58**	130.22	128.58
0.82	**0.000**	**125.58**	**124.76**	128.58	127.76
0.41	**0.000**	**124.76**	**124.35**	127.76	127.35
0.93	**0.000**	**124.35**	**123.42**	127.35	126.42
2.58	**0.000**	**123.42**	**120.84**	126.42	123.84
1.17	**0.000**	**124.59**	**123.42**	129.09	127.92
0.17	**0.000**	**124.76**	**124.59**	128.26	128.09

HYDRAULIC GRADE LINE COMPUTATIONS

10-year Design Computations

Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HGL}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation U/S (ft)	Hydraulic Grade Line Elevation D/S (ft)
1.55	Vel-OK	0.046	0.028	132.39	132.36
2.33	Vel-OK	0.078	0.155	132.36	132.21
2.33	Vel-OK	0.078	0.054	132.21	132.15
3.93	Vel-OK	0.221	0.946	132.15	131.21
3.93	Vel-OK	0.221	0.190	131.21	131.02
1.53	Vel-OK	0.018	0.030	131.02	130.99
0.64	Vel-OK	0.001	0.004	130.99	130.98
1.39	Vel-OK	0.006	0.017	130.98	130.97
1.57	Vel-OK	0.008	0.022	130.97	130.94
2.17	Vel-OK	0.015	0.042	130.94	130.90
2.37	Vel-OK	0.018	0.035	130.90	130.87
2.37	Vel-OK	0.018	0.017	130.87	130.85
2.53	Vel-OK	0.020	0.014	130.85	130.84
2.53	Vel-OK	0.020	0.042	130.84	130.80
2.53	Vel-OK	0.020	0.005	130.80	130.79
2.76	Vel-OK	0.024	0.065	130.79	130.73
2.76	Vel-OK	0.024	0.004	130.73	130.72
2.95	Vel-OK	0.027	0.075	130.72	130.65
2.95	Vel-OK	0.027	0.004	130.65	130.64
7.70	Vel-OK	0.297	0.594	130.64	130.05
10.93	Vel-OK	0.598	3.320	130.05	126.73
10.93	Vel-OK	0.598	0.389	126.73	126.34
4.91	Vel-OK	0.127	0.108	125.01	124.90
3.20	Vel-OK	0.198	0.510	131.61	131.10
4.89	Vel-OK	0.461	0.115	131.10	**130.99**
0.94	Vel-OK	0.008	0.023	131.88	131.86
0.94	Vel-OK	0.008	0.025	131.86	131.83
2.50	Vel-OK	0.048	0.232	131.83	131.60
2.50	Vel-OK	0.048	0.058	131.60	131.54
2.73	Vel-OK	0.057	0.014	131.54	131.53
3.43	Vel-OK	0.090	0.530	131.53	131.00
3.78	Vel-OK	0.110	0.016	131.00	**130.98**
4.58	Vel-OK	0.192	3.430	129.39	125.96
4.58	Vel-OK	0.192	0.881	125.96	125.08
3.12	Vel-OK	0.109	0.075	125.08	**125.01**
5.47	Vel-OK	0.236	1.177	138.84	137.66
6.28	Vel-OK	0.312	0.449	137.66	137.22
2.23	Vel-OK	0.039	0.010	137.22	137.21
6.62	Vel-OK	0.284	0.213	137.21	136.99
8.68	Vel-OK	0.489	11.985	136.99	**125.01**
4.86	Vel-OK	0.154	0.039	**137.03**	**136.99**
8.28	Vel-OK	0.627	0.326	136.94	**136.61**

Elevations @ Inlet Location

Top of Curb (ft)	Gutter	Natural Ground @ R.O.W. (ft)	HGL Above(+) / Below(-) Gutter @ Inlets (ft)	10-year Design Check at Inlet Location
135.76	135.26	**136.26**	-2.869	OK
135.46	134.96	**135.96**	-2.597	OK
136.19	135.69	**136.69**	-3.482	OK
136.01	135.51	**136.51**	-3.357	OK
136.43	135.93	**136.93**	-4.723	OK
136.18	135.68	**136.68**	-4.663	OK
135.84	135.34	**136.34**	-4.353	OK
135.52	135.02	**136.02**	-4.036	OK
135.64	135.14	**136.14**	-4.174	OK
135.64	135.14	**136.14**	-4.196	OK
135.14	134.64	**135.64**	-3.738	OK
135.30	134.80	**135.80**	-3.933	OK
134.66	134.16	**135.16**	-3.310	OK
135.40	134.90	**135.90**	-4.063	OK
134.80	134.30	**135.30**	-3.505	OK
134.80	134.30	**135.30**	-3.510	OK
134.17	133.67	**134.67**	-2.945	OK
134.17	133.67	**134.67**	-2.949	OK
134.14	133.64	**134.64**	-2.993	OK
134.14	133.64	**134.64**	-2.997	OK
136.50	136.00	**135.50**	-5.951	OK
136.50	136.00	**135.50**	-9.271	OK
136.50	136.00	**135.50**	-10.992	OK
135.50	135.00	**136.00**	-3.387	OK
135.54	135.04	**136.04**	-3.937	OK
135.74	135.24	**136.24**	-3.359	OK
136.04	135.54	**136.54**	-3.681	OK
136.04	135.54	**136.54**	-3.706	OK
136.04	135.54	**136.54**	-3.938	OK
135.52	135.02	**136.02**	-3.475	OK
135.25	134.75	**135.75**	-3.220	OK
135.52	135.02	**136.02**	-4.020	OK
135.91	135.41	**136.41**	-3.146	OK
135.40	134.90	**135.90**	-2.793	OK
135.34	134.84	**135.84**	-3.746	OK
135.86	135.36	**136.36**	-3.403	OK
135.85	135.35	**136.35**	-3.434	OK
136.14	135.64	**136.64**	-4.038	OK
135.86	135.36	**136.36**	-3.892	OK
135.25	134.75	**135.75**	-3.430	OK
135.34	134.84	**135.84**	-3.872	OK
135.64	135.14	**136.14**	-3.069	OK
135.50	135.00	**136.00**	-2.954	OK
135.80	135.30	**136.30**	-3.221	OK
135.41	134.91	**135.91**	-3.338	OK
134.75	134.25	**135.25**	-2.887	OK
134.84	134.34	**135.34**	-3.393	OK
135.14	134.64	**135.64**	-2.765	OK
134.71	134.21	**135.21**	-2.420	OK
134.82	134.32	**135.32**	-3.379	OK
134.71	134.21	**135.21**	-2.914	OK
135.34	134.84	**135.84**	-3.839	OK
134.99	134.49	**135.49**	-3.529	OK
134.48	133.98	**134.98**	-3.136	OK
135.01	134.51	**135.51**	-3.209	OK
135.97	134.87	**135.87**	-3.422	OK
134.97	134.47	**135.47**	-3.092	OK
133.84	133.34	**134.34**	-2.583	OK
134.65	134.15	**135.15**	-3.099	OK
133.96	133.46	**134.46**	-2.568	OK
133.84	133.34	**134.34**	-2.652	OK
136.50	136.00	**135.50**	-10.417	OK
137.00	**136.50**	**136.50**	2.341	HGL Too High
137.00	**136.50**	**136.50**	1.164	HGL Too High
135.10	**134.80**	**134.80**	2.415	HGL Too High
135.10	**134.80**	**134.80**	2.406	HGL Too High
135.10	**134.80**	**134.80**	2.192	HGL Too High
135.10	**134.80**	**134.80**	2.231	HGL Too High
135.10	**134.80**	**134.80**	2.136	HGL Too High

APPENDIX C-6
PROPOSED ALTERNATIVE 2 - 10% AEP SPREAD COMPUTATIONS
GUTTER SPREAD & INLET PONDING WIDTHS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 191038MF147011)
Date : 2/14/2022
By : GPF
Reviewed By:

Street Type	Pvmt W (B-B)	X-Slope (S_x) (ft-ft)	Blvd or Crown	Curb Height (ft)	Curb Width (ft)	Allow Spread (ft)	Allow Gutter Depth (ft)
1	**28.0**	**0.0208**	**Crown**	**0.50**	**0.50**	13.50	0.281
2	**28.0**	**0.0208**	**Crown**	**0.33**	**1.00**	13.00	0.271
3	**41.0**	**0.0208**	**Crown**	**0.50**	**0.50**	20.00	0.417
4	**25.0**	**0.0208**	**Blvd**	**0.50**	**0.50**	12.00	0.250
5	**25.0**	**0.0208**	**Blvd**	**0.00**	**0.00**	12.00	0.250

Enter Blvd Pavement Width as B-B dimension of One Side of Travel Lanes

DESIGN STORM PONDING DEPTH & GUTTER SPREAD AT INLET LOCATIONS

GUTTER SPREAD CALCULATIONS

Design Storm Return Frequency: 10 yr — $T_{spread}=1.243(Q_{Gutter}{}^{*}N/S_x{}^{1.67}{}^{*}S_x{}^{0.5})^{0.38}$ — Length of Curb Inlet Opening for Intercepting Total Q_{Str}
Override Inlet Time (Tc) (min) = — $Y_{Gutter}{}^{*}T_{spread}{}^{*}S_x$ — $L_T=0.6{}^{*}Q^{0.42}{}^{*}S_x{}^{0.3}{}^{*}[1/(N{}^{*}S_x)]^{0.6}$
Efficiency = 1-(1-L_t/L_T)^1.8
N-Value (Pavement) = 0.016 — TxDOT Hydraulic Manual Table 4-8 — $Q_{Bypass}=Q_{Total}{}^{*}(1-Eff)$

INLET PONDING CALCULATIONS

$Q_{Weir}=C_{weir}{}^{*}L_{weir}{}^{*}H^{1.5}$ — $Q_{Orif}=C_{orif}{}^{*}A_{Orif}{}^{*}(2gH)^{1/2}$
C_{weir}= **2.60** — C_{orif}= **0.60**
$H_{weir}=(Q/(C{}^{*}L))^{2/3}$ — $H_{orif}=(Q/(C{}^{*}A{}^{*}sqrt(2g))^{2}$
$T_{inlet}=H/S_x$

GUTTER SPREAD CALCULATIONS

INLET PONDING CALCULATIONS

For Inlets On-Grade Q_{Bypass} MUST BE ADDED to Downstream Inlet

PONDING WIDTH & GUTTER DEPTH CHECKS FOR DESIGN STORM

| Street Name | Cross Street | FROM M.H. # | TO M.H. # | Street Type | Pavement Width (B-B) (ft) | Cross-Slope (S_x) (ft/ft) | Street Type | Curb Height (ft) | Curb Width (ft) | Maximum Allowable Ponding Spread @ Inlets (ft) | Maximum Allowable Ponding Depth @ Inlets (ft) | INLET #1 (FAR INLET) Gutter Run 1: Drainage Area (ac) | T/C Grade ($S_{T/C}$) (%) | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Gutter} (cfs) | Gutter Spread (ft) | Gutter Depth (ft) | Q_{Bypass} (cfs) | INLET #1 (FAR INLET) Gutter Run 2: Drainage Area (ac) | T/C Grade ($S_{T/C}$) (%) | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Gutter} (cfs) | Gutter Spread (ft) | Gutter Depth (ft) | Q_{Bypass} (cfs) | Inlet 1 (Far): Inlet Type | Sag or On-Grade | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Inlet} (cfs) | Ponding Width at Inlet (ft) | Ponding Depth in Gutter (H) (ft) | GUTTER SPREAD CALCULATIONS Gutter Run 3: Drainage Area (ac) | T/C Grade ($S_{T/C}$) (%) | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Gutter} (cfs) | Gutter Spread (ft) | Gutter Depth (ft) | Q_{Bypass} (cfs) | INLET #2 (NEAR INLET) Gutter Run 4: Drainage Area (ac) | T/C Grade ($S_{T/C}$) (%) | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Gutter} (cfs) | Gutter Spread (ft) | Gutter Depth (ft) | Q_{Bypass} (cfs) | Inlet 2 (Near): Inlet Type | Sag or On-Grade | Inlet Time Tc (min) | Intensity (in/hr) | Q_{Inlet} (cfs) | Ponding Width at Inlet (ft) | Ponding Depth in Gutter (H) (ft) | Maximum Width of Ponding | Spread or Inlet Ponding | PONDING WIDTH ACROSS LANE CHECK | PONDING DEPTH ABOVE T/C CHECK |
|---|---|---|---|---|---|---|---

APPENDIX C-7
PROPOSED ALTERNATIVE 2 - 10% AEP HGL COMPUTATIONS
HYDRAULIC GRADE LINE COMPUTATIONS

STORM SEWER CALCULATIONS
CITY OF HOUSTON / HARRIS COUNTY CRITERIA
Storm Event : 2 & 100-YEAR
Project : HCED Suddivision Drainage Projects - Ravensway South (UPIN 19103MF147011
Date : 2/14/2022
By : GPF
Reviewed By:

COH I-D-F Coefficients	
Return Freq (yr)	10
b :	54.68
d :	6.96
e :	0.6623
Peaking Factor C_k :	1.00

$Q_{Allow}=C_{Allow}*W_{PAVE}*H_{AVE}^{1.5}$
Where W_{PAVE} = Width of Pavement to F/C; H_{AVE} = Avg Depth @ Allowable HGL above T/C

Assumes 2 feet Below Bank
Starting 10-year TW (@ Outfall) = **128.50**

C_{Allow} = **2.10**

Street Name	Cross Street	FROM M.H. #	TO M.H. #	Elevations at D/S High Point in Street: Design Top of Curb (ft)	Actual Top of Curb (ft)	Gutter (ft)	Natural Ground @ R.O.W. (ft)	10-Year Analysis Calculations: Time of Concentration: Delta or Trib T_c	Time of Concentration: Total	Flow Computations: Intensity "i" (in/hr)	Flow Computations: Runoff Flow (cfs)	Actual Velocity (V_{ACT}) (fps)	Velocity Check	Hydraulic Gradient Slope (S_{HYD}) (%)	Headloss (ft)	Hydraulic Grade Line Elevation: U/S (ft)	Hydraulic Grade Line Elevation: D/S (ft)	Allowable 100-yr HGL Height Above T/C @ Location: 1.50 HGL Above(+) / Below(-) T/C @ Inlets (ft)	100-yr Analysis Check @ Inlet Location	Check HGL or Act Gutter Depth vs. Nat Grd @ ROW Locations: 0.50 HGL Above(+) / Below(-) T/C @ D/S High (ft)	Actual Depth in Gutter to Pass Q100 - Q2 @ D/S High (Method 2 Only)	100-yr Analysis Check @ D/S High Point
Raven Song Drive		**S.1.C**	**S**	**136.37**	136.37	135.87	**136.87**	25.9	25.9	5.41	4.87	1.55	Vel-OK	0.046	0.03	133.96	133.93	-1.803	Method 1 - OK	-2.413	OK	Method 1 - OK
Raven South Drive		S	**R**	**136.37**	136.37	135.87	**136.87**	0.6	26.5	5.34	11.43	2.33	Vel-OK	0.078	0.16	133.93	133.77	-1.531	Method 1 - OK	-2.441	OK	Method 1 - OK
Raven South Drive		R	**Q**	**137.00**	137.00	136.50	**137.50**	1.4	28.0	5.20	11.43	2.33	Vel-OK	0.078	0.05	133.77	133.72	-2.416	Method 1 - OK	-3.226	OK	Method 1 - OK
Raven South Drive		Q	**P**	**137.00**	137.00	136.50	**137.50**	0.5	28.5	5.15	19.29	3.93	Vel-OK	0.221	0.95	133.72	132.77	-2.290	Method 1 - OK	-3.280	OK	Method 1 - OK
Raven South Drive		P	**O**	**136.19**	136.19	135.69	**136.69**	1.8	30.3	4.98	19.29	3.93	Vel-OK	0.221	0.19	132.77	132.58	-3.656	Method 1 - OK	-3.416	OK	Method 1 - OK
Raven South Drive		O	**N**	**136.19**	136.19	135.69	**136.69**	0.4	30.7	4.95	19.29	1.53	Vel-OK	0.018	0.03	132.58	132.55	-3.596	Method 1 - OK	-3.606	OK	Method 1 - OK
Raven South Drive	**Raven Park (Scamp)**	N	**M**	**136.19**	136.19	135.69	**136.69**	**28.9**	32.5	4.80	37.35	0.64	Vel-OK	0.001	0.00	132.55	132.55	-3.286	Method 1 - OK	-3.636	OK	Method 1 - OK
Raven South Drive	**Shaft Dr**	M	L	**136.19**	136.19	135.69	**136.69**	**46.1**	46.1	3.94	80.51	1.39	Vel-OK	0.006	0.02	132.55	132.53	-2.970	Method 1 - OK	-3.640	OK	Method 1 - OK
Raven South Drive	**Nevermore Dr**	L	K	**136.00**	136.00	135.50	**136.50**	**29.4**	49.6	3.78	91.30	1.57	Vel-OK	0.008	0.02	132.53	132.51	-3.107	Method 1 - OK	-3.467	OK	Method 1 - OK
Raven South Drive	**Birdcall Dr**	K	J	**136.00**	136.00	135.50	**136.50**	**36.1**	52.6	3.65	126.10	2.17	Vel-OK	0.015	0.04	132.51	132.47	-3.129	Method 1 - OK	-3.489	OK	Method 1 - OK
Raven South Drive	**Ravens Caw**	J	H	**135.51**	135.51	135.01	**136.01**	**30.4**	54.8	3.56	137.48	2.37	Vel-OK	0.018	0.04	132.47	132.43	-2.671	Method 1 - OK	-3.041	OK	Method 1 - OK
Raven South Drive		H	G	**135.47**	135.47	134.97	**135.97**	1.4	56.2	3.51	137.48	2.37	Vel-OK	0.018	0.02	132.43	132.42	-2.866	Method 1 - OK	-3.036	OK	Method 1 - OK
Raven South Drive	**Ravens Roost Dr**	G	**F.2**	**135.47**	135.47	134.97	**135.97**	**29.8**	56.8	3.49	146.67	2.53	Vel-OK	0.020	0.01	132.42	132.40	-2.243	Method 1 - OK	-3.053	OK	Method 1 - OK
Raven South Drive		F.2	**F**	**135.47**	135.47	134.97	**135.97**	0.4	57.3	3.47	146.67	2.53	Vel-OK	0.020	0.04	132.40	132.36	-2.997	Method 1 - OK	-3.067	OK	Method 1 - OK
Raven South Drive		F	E	**135.18**	135.18	134.68	**135.68**	1.4	58.7	3.42	146.67	2.53	Vel-OK	0.020	0.01	132.36	132.36	-2.438	Method 1 - OK	-2.818	OK	Method 1 - OK
Raven South Drive	**Ravens Flight Dr**	E	D	**135.18**	135.18	134.68	**135.68**	**34.0**	58.8	3.42	160.26	2.76	Vel-OK	0.024	0.06	132.36	132.29	-2.443	Method 1 - OK	-2.823	OK	Method 1 - OK
Raven South Drive		D	C	**134.50**	134.50	134.00	**135.00**	1.6	60.5	3.36	160.26	2.76	Vel-OK	0.024	0.00	132.29	132.29	-1.878	Method 1 - OK	-2.208	OK	Method 1 - OK
Raven South Drive	**Blackbird Dr**	C	B	**134.50**	134.50	134.00	**135.00**	**30.7**	60.6	3.36	170.98	2.95	Vel-OK	0.027	0.07	132.29	132.21	-1.882	Method 1 - OK	-2.212	OK	Method 1 - OK
Raven South Drive		B	A	**135.24**	135.24	134.74	**135.74**	1.6	62.1	3.31	170.98	2.95	Vel-OK	0.027	0.00	132.21	132.21	-1.927	Method 1 - OK	-3.027	OK	Method 1 - OK
Cypress North Houst	**Raven Wing Dr**	A	**CNH-1**	**135.24**	135.24	134.74	**135.74**	**32.7**	62.2	3.31	183.00	7.70	Vel-OK	0.297	0.59	132.21	131.62	-1.931	Method 1 - OK	-3.031	OK	Method 1 - OK
Cypress North Houst	**(North Trunkline)**	CNH-1	**CNH 2**	**136.50**	136.50	136.00	**135.50**	**3.6**	62.6	3.29	**234.82**	9.88	Vel-OK	0.489	2.71	131.62	128.90	-4.885	Method 1 - OK	-4.885	OK	Method 1 - OK
Cypress North Houston		CNH 2	**CNH-3**	**136.50**	136.50	136.00	**135.50**	0.9	63.6	3.26	234.82	9.88	Vel-OK	0.489	0.32	128.90	128.58	-7.598	Method 1 - OK	-7.598	OK	Method 1 - OK
Cypress North Houst	**(South Trunkline)**	CNH-3	**E133**	**136.50**	136.50	136.00	**135.50**	**147.7**	147.7	1.94	**234.82**	4.33	Vel-OK	0.098	0.08	128.58	**128.50**	-7.916	Method 1 - OK	-7.916	OK	Method 1 - OK
Raven Park Dr (Scamp Dr)		**M.2.A**	**M.1.A**	**136.03**	136.03	135.53	**136.53**	**27.5**	27.5	5.25	10.06	3.20	Vel-OK	0.198	0.51	133.18	132.67	-2.320	Method 1 - OK	-2.850	OK	Method 1 - OK
Raven Park Dr (Scamp Dr)		M.1.A	**N**	**135.94**	135.94	135.44	**136.44**	1.3	28.8	5.12	15.36	4.89	Vel-OK	0.461	0.12	132.67	**132.55**	-2.871	Method 1 - OK	-3.271	OK	Method 1 - OK
Shaft Drive		**M.9**	**M.8**	**136.45**	136.45	135.95	**136.95**	**28.7**	28.7	5.12	9.09	0.94	Vel-OK	0.008	0.02	133.45	133.43	-2.292	Method 1 - OK	-3.002	OK	Method 1 - OK
Shaft Drive		M.8	**M.7**	**136.52**	136.52	136.02	**137.02**	4.9	33.7	4.70	9.09	0.94	Vel-OK	0.008	0.02	133.43	133.40	-2.615	Method 1 - OK	-3.095	OK	Method 1 - OK
Shaft Drive		M.7	**M.5**	**136.52**	136.52	136.02	**137.02**	5.4	39.0	4.33	31.45	2.50	Vel-OK	0.048	0.23	133.40	133.17	-2.640	Method 1 - OK	-3.120	OK	Method 1 - OK
Shaft Drive		M.5	**M.4**	**136.52**	136.52	136.02	**137.02**	3.2	42.3	4.14	31.45	2.50	Vel-OK	0.048	0.06	133.17	133.11	-2.871	Method 1 - OK	-3.351	OK	Method 1 - OK
Shaft Drive		M.4	**M.3**	**136.52**	136.52	136.02	**137.02**	0.8	43.1	4.10	34.32	2.73	Vel-OK	0.057	0.01	133.11	133.10	-2.409	Method 1 - OK	-3.409	OK	Method 1 - OK
Shaft Drive		M.3	**M.2**	**136.52**	136.52	136.02	**137.02**	0.2	43.2	4.09	43.07	3.43	Vel-OK	0.090	0.53	133.10	132.57	-2.153	Method 1 - OK	-3.423	OK	Method 1 - OK
Shaft Drive		M.2	**M**	**135.92**	135.92	135.42	**136.42**	2.9	46.1	3.94	47.56	3.78	Vel-OK	0.110	0.02	132.57	**132.55**	-2.953	Method 1 - OK	-3.353	OK	Method 1 - OK
Nevermore Drive		**L.3.A**	**L.2.A**	**135.90**	135.90	135.40	**136.40**	**26.5**	26.5	5.35	6.42	2.04	Vel-OK	0.081	0.16	133.83	133.67	-2.080	Method 1 - OK	-2.070	OK	Method 1 - OK
Nevermore Drive		L.2.A	**L.1.A**	**135.90**	135.90	135.40	**136.40**	1.6	28.1	5.19	12.91	4.11	Vel-OK	0.326	1.01	133.67	132.66	-1.727	Method 1 - OK	-2.227	OK	Method 1 - OK
Nevermore Drive		L.1.A	K	**135.74**	135.74	135.24	**136.24**	1.3	29.3	5.07	16.17	5.15	Vel-OK	0.511	0.13	132.66	**132.53**	-2.679	Method 1 - OK	-3.079	OK	Method 1 - OK
Birdcall Lane		K.7	**K.6**	**136.50**	136.50	136.00	**137.00**	**30.0**	30.0	5.00	27.59	3.90	Vel-OK	0.171	0.04	133.52	133.48	-2.336	Method 1 - OK	-2.976	OK	Method 1 - OK
Birdcall Lane		K.6	**K.5**	**136.50**	136.50	136.00	**137.00**	0.1	30.1	4.99	31.75	3.30	Vel-OK	0.100	0.31	133.48	133.17	-2.368	Method 1 - OK	-3.018	OK	Method 1 - OK
Birdcall Lane		K.5	**K.4**	**135.86**	135.86	135.36	**136.36**	1.6	31.7	4.86	31.75	3.30	Vel-OK	0.100	0.13	133.17	133.03	-2.971	Method 1 - OK	-2.691	OK	Method 1 - OK
Birdcall Lane		K.4	**K.3**	**135.86**	135.86	135.36	**136.36**	0.7	32.4	4.80	35.25	2.81	Vel-OK	0.060	0.15	133.03	132.89	-2.826	Method 1 - OK	-2.826	OK	Method 1 - OK
Birdcall Lane		K.3	**K.1**	**135.86**	135.86	135.36	**136.36**	1.5	33.9	4.69	41.82	3.33	Vel-OK	0.085	0.35	132.89	132.53	-2.363	Method 1 - OK	-2.973	OK	Method 1 - OK
Birdcall Lane		K.1	K	**135.74**	135.74	135.24	**136.24**	2.1	35.9	4.54	44.59	3.55	Vel-OK	0.096	0.02	132.53	**132.51**	-2.805	Method 1 - OK	-3.205	OK	Method 1 - OK
Ravens Mate Drive		**K.7.1**	**K.7**	**136.50**	136.50	136.00	**137.00**	**27.0**	27.0	5.30	8.16	1.66	Vel-OK	0.040	0.11	133.64	**133.52**	-2.002	Method 1 - OK	-2.862	OK	Method 1 - OK
Ravens Mate Drive		**K.7.2**	**K.7**	**136.25**	136.25	135.75	**136.75**	**28.2**	28.2	5.18	13.55	1.92	Vel-OK	0.041	0.09	133.61	**133.52**	-1.887	Method 1 - OK	-2.637	OK	Method 1 - OK
Ravens Mate Drive		**K.7.2.A**	**K.7.2**	**136.50**	136.50	136.00	**137.00**	**26.3**	26.3	5.37	5.91	1.88	Vel-OK	0.068	0.03	133.65	**133.61**	-2.155	Method 1 - OK	-2.855	OK	Method 1 - OK
Ravens Caw Drive		**J.3.A**	**J.2.A**	**135.25**	135.25	134.75	**135.75**	**26.5**	26.5	5.35	6.36	2.02	Vel-OK	0.079	0.21	133.14	132.93	-2.271	Method 1 - OK	-2.111	OK	Method 1 - OK
Ravens Caw Drive		J.2.A	**J.1.A**	**135.25**	135.25	134.75	**135.75**	2.2	28.6	5.13	15.00	3.06	Vel-OK	0.134	0.42	132.93	132.51	-1.821	Method 1 - OK	-2.321	OK	Method 1 - OK
Ravens Caw Drive		J.1.A	J	**135.24**	135.24	134.74	**135.74**	1.7	30.3	4.98	17.30	3.53	Vel-OK	0.178	0.04	132.51	**132.47**	-2.327	Method 1 - OK	-2.727	OK	Method 1 - OK
Raven Roost Drive		**G.3.A**	**G.2.A**	**135.33**	135.33	134.83	**135.83**	**26.0**	26.0	5.40	5.04	1.60	Vel-OK	0.050	0.08	133.44	133.36	-1.699	Method 1 - OK	-1.889	OK	Method 1 - OK
Raven Roost Drive		G.2.A	**G.1.A**	**135.33**	135.33	134.83	**135.83**	1.8	27.7	5.22	11.09	3.53	Vel-OK	0.240	0.85	133.36	132.51	-1.353	Method 1 - OK	-1.973	OK	Method 1 - OK
Raven Roost Drive		G.1.A	G	**135.22**	135.22	134.72	**135.72**	1.7	29.4	5.06	14.80	3.02	Vel-OK	0.130	0.09	132.51	**132.42**	-2.312	Method 1 - OK	-2.712	OK	Method 1 - OK
Raven Rook Drive		**E.4**	**E.3**	**135.11**	135.11	134.61	**135.61**	**27.7**	27.7	5.22	11.19	2.28	Vel-OK	0.074	0.29	132.86	132.57	-1.848	Method 1 - OK	-2.248	OK	Method 1 - OK
Raven Flight Drive		E.3	**E.2**	**134.90**	134.90	134.40	**135.40**	2.9	30.6	4.95	11.19	1.58	Vel-OK	0.028	0.04	132.57	132.53	-2.772	Method 1 - OK	-2.332	OK	Method 1 - OK
Raven Flight Drive		E.2	**E.1**	**134.90**	134.90	134.40	**135.40**	1.5	32.1	4.83	16.01	2.27	Vel-OK	0.058	0.12	132.53	132.41	-2.462	Method 1 - OK	-2.372	OK	Method 1 - OK
Raven Flight Drive		E.1	E	**134.90**	134.90	134.40	**135.40**	1.5	33.6	4.71	19.84	2.81	Vel-OK	0.088	0.05	132.41	**132.36**	-2.069	Method 1 - OK	-2.489	OK	Method 1 - OK
Raven Flight Drive		**E.4.C**	**E.4**	**135.75**	135.75	135.25	**136.25**	**25.8**	25.8	5.43	4.53	1.44	Vel-OK	0.040	0.01	132.87	**132.86**	-2.142	Method 1 - OK	-2.882	OK	Method 1 - OK
Blackbird Drive		**C.3.A**	**C.2.A**	**135.16**	135.16	134.66	**135.66**	**25.8**	25.8	5.42	4.72	1.50	Vel-OK	0.044	0.07	133.01	132.94	-2.355	Method 1 - OK	-2.145	OK	Method 1 - OK
Blackbird Drive		C.2.A	**C.1.A**	**135.16**	135.16	134.66	**135.66**	1.8	27.6	5.23	8.54	2.72	Vel-OK	0.142	0.62	132.94	132.32	-2.025	Method 1 - OK	-2.215	OK	Method 1 - OK
Blackbird Drive		C.1.A	C	**134.44**	134.44	133.94	**134.94**	2.7	30.3	4.98	16.20	2.29	Vel-OK	0.059	0.04	132.32	**132.29**	-1.516	Method 1 - OK	-2.116	OK	Method 1 - OK
Raven Wing Drive		**A.3.A**	**A.2.A**	**134.49**	134.49	133.99	**134.99**	**26.2**	26.2	5.38	5.50	1.75	Vel-OK	0.059	0.16	132.62	132.46	-2.032	Method 1 - OK	-1.872	OK	Method 1 - OK
Raven Wing Drive		A.2.A	**A.1.A**	**134.49**	134.49	133.99	**134.99**	2.6	28.7	5.12	14.41	2.04	Vel-OK	0.047	0.20	132.46	132.25	-1.502	Method 1 - OK	-2.032	OK	Method 1 - OK
Raven Wing Drive		A.1.A	A	**134.24**	134.24	133.74	**134.74**	3.6	32.3	4.81	18.21	2.58	Vel-OK	0.075	0.05	132.25	**132.21**	-1.585	Method 1 - OK	-1.985	OK	Method 1 - OK
				Storage of FLOW from MH 1-4 to MH 1-5; Manually Adjusted to Balance HGLs at MH 1-4							**0.5409**				0.343	-0.485						
Cypress-N. Houston (North Trunkline)		**MH 1-4**	**MH 1-5**	**136.50**	**135.50**	**135.50**	**135.50**				**84.88**	8.82	Vel-OK	0.712	2.98	**139.65**	136.67	4.547	Increase Pipe Size	4.147	Check Lo Spot	0.549	Increase Pipe Size
Cypress-N. Houston (North Trunkline)		MH 1-5	**CNH-1**	**136.50**	**135.50**	**135.50**	**135.50**				84.88	6.75	Vel-OK	0.349	5.06	136.67	**131.62**	0.172	Method 1 - OK	1.172	Check Lo Spot	0.549	Increase Pipe Size
Raven Roost (Lake)		**RR**	**RR7**	**133.00**	**132.80**	**132.80**	**132.80**	**139.1**	139.1	2.01	44.08	4.58	Vel-OK	0.192	3.43	132.97	129.54	-0.530	Method 1 - OK	0.170	Check Hi Spot		Method 1 - OK
Raven Roost (Lake)		RR7	**RR8**	**136.50**	**135.50**	**135.50**	**135.50**	6.5	145.6	1.96	44.08	4.58	Vel-OK	0.192	0.88	129.54	128.66	-3.460	Method 1 - OK	-5.960	OK		Method 1 - OK
Raven Roost (Lake)		RR8	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	1.7	147.3	1.94	44.08	3.12	Vel-OK	0.109	0.08	128.66	**128.58**	-7.841	Method 1 - OK	-6.841	OK		Method 1 - OK
				Storage of FLOW from MH 1-3 to MH 2-3; Based on Ratio of Design Qs of Exiting Pipes							**0.2828**											
Cypress-N. Houston (South Trunkline)		**MH 2-1**	**MH 2-2**	**137.00**	**136.50**	**136.50**	**136.50**	**31.9**	31.9	4.84	**77.17**	5.47	Vel-OK	0.236	1.18	141.94	140.76	4.942	Increase Pipe Size	5.442	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-2	**MH 1-3**	**135.10**	**134.80**	**134.80**	**134.80**	1.5	33.5	4.72	88.67	6.28	Vel-OK	0.312	0.45	140.76	140.32	3.765	Increase Pipe Size	5.965	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 1-3	**MH 2-3**	**135.10**	**134.80**	**134.80**	**134.80**	0.4	33.8	4.69	**31.41**	2.23	Vel-OK	0.039	0.01	140.32	140.31	5.216	Increase Pipe Size	5.516	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-3	**MH 2-4**	**135.10**	**134.80**	**134.80**	**134.80**	0.2	34.0	4.67	**152.88**	6.62	Vel-OK	0.284	0.21	140.31	140.09	5.206	Increase Pipe Size	5.506	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		MH 2-4	**CNH-3**	**136.50**	**135.50**	**135.50**	**135.50**	**32.0**	34.2	4.66	**196.53**	8.50	Vel-OK	0.470	11.51	140.09	**128.58**	4.993	Increase Pipe Size	4.593	OK	-0.424	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-4**	**MH 2-4**	**136.50**	**135.50**	**135.50**	**135.50**	**31.9**	31.9	4.84	**77.28**	4.86	Vel-OK	0.154	0.04	**140.13**	**140.09**	5.032	Increase Pipe Size	4.632	Check Lo Spot	0.000	Method 2 - OK
Cypress-N. Houston (South Trunkline)		**MH 1-3**	**MH 1-4**	**135.10**	**134.80**	**134.80**	**134.80**				**79.67**	8.28	Vel-OK	0.627	0.33	139.97	**139.65**	4.873	Increase Pipe Size	5.173	Check Lo Spot	0.000	Method 2 - OK

VII. ATTACHMENTS

CONSTRUCTION COST ESTIMATE - Alt #1

Project: RAVENSWAY SOUTH SUB. DRAINAGE IMPROVEMENTS
Limit From: CYPRESS NORTH HOUSTON ROAD
Limit To: RAVENSWAY SOUTH SUBD.
Proj Length: 5,100'
Precinct: 3
UPIN: 19103MF14701
Job No: This is the number available when advertising project
Prepared By: Binkley & Barfield, Inc.
Date: 02/17/22

Summary of Estimate		
Stage:		Final
Total Amount for DRAINAGE:		$2,840,022.00
Total Amount for ROADWAY:		$698,985.00
Total Amount for XXX:		$0.00
Total Amount for XXX:		$0.00
Grant Total Amount:		$3,539,007.00
Contingencies:	0%	$0.00
Grand Total Project:		$3,539,007.00

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
A	SITE PREPARATION AND EARTHWORK					
1	Drawing	Project Sign	EA	2	$1,000.00	$2,000.00
2	102	Tree & Bush Removal (0" - 12" Dia.)	EA	12	$1,200.00	$14,400.00
3	501	Tree Protection, Including Pruning, Protection Fencing, Trimming of Roots, and all other appurtenances	LS	1	$10,000.00	$10,000.00
4	104	Remove & Dispose Old Concrete Roadway (All Thicknesses)	SY	1,750	$15.00	$26,250.00
5	104	Remove & Dispose Old Concrete Driveways (All Thicknesses)	SY	1,700	$20.00	$34,000.00
6	104	Remove & Dispose Old Concrete Sidewalks (All Thicknesses)	SY	2,300	$12.00	$27,600.00
7	104	Removing Old Concrete (Curb)	LF	1,600	$3.00	$4,800.00
8	110	Roadway Excavation Including 3" Topsoil	CY	425	$25.00	$10,625.00
9	465	Remove and Dispose of Existing Concrete or Metal Pipe (All Sizes)	LF	5,542	$15.00	$83,130.00
10	495	Removing Old Structures – Inlets & Manholes (All Depths, All Types)	EA	25	$800.00	$20,000.00
11	500	Remove & Relocate Traffic Signs and Roadway Signs	EA	16	$1,000.00	$16,000.00
12	561	Video Recording Construction	LS	1	$1,500.00	$1,500.00
					Subtotal of Item A	**$250,305.00**
B	PAVING					
13	500	Remove & Relocate Mail Boxes	LS	22	$1,200.00	$26,400.00
14	220	Prepare and Compact 6" Lime Stabilized Subgrade	SY	1,995	$7.00	$13,965.00
15	221	Furnish Lime (6% by Dry Weight), Complete-in-Place, In Accordance with the Plans and Specifications	TON	36	$220.00	$7,920.00
16	360	Concrete Pavement (6")	SY	1,750	$70.00	$122,500.00
17	530	Reinforced Concrete Curb (Doweled)	LF	1,600	$4.50	$7,200.00
18	530	Reinforced Concrete Driveways (6") - High Early Strength Concrete	SY	1,900	$140.00	$266,000.00
19	530	Concrete Sidewalks, Including Ramps (5' width, 4" thick)	SY	3,400	$75.00	$255,000.00
					Subtotal of Item B	**$698,985.00**
C	STORM SEWER					
20	429	Trench Safety System (5' to 10') [INCLUDES SHEET PILING AS REQ'D]	LF	6,386	$2.00	$12,772.00
21	429	Trench Safety System (10' to 15') [INCLUDES SHEET PILING AS REQ'D]	LF	388	$5.00	$1,940.00
22	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (24")	LF	1,384	$135.00	$186,840.00
23	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (30")	LF	306	$175.00	$53,550.00
24	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (36")	LF	839	$210.00	$176,190.00
25	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (42")	LF	349	$275.00	$95,975.00
26	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (48")	LF	2,208	$350.00	$772,800.00
27	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (66")	LF	1,718	$500.00	$859,000.00
28	471	Precast Concrete Standard Manhole (All Depths) 4' DIA	EA	8	$4,000.00	$32,000.00
29	471	Precast Concrete Standard Manhole (All Depths) 5' DIA	EA	14	$5,500.00	$77,000.00
30	471	Precast Concrete Standard Manhole (All Depths) 6' DIA	EA	2	$6,500.00	$13,000.00
31	471	Precast Concrete Standard Manhole (All Depths) 7' DIA	EA	1	$7,500.00	$7,500.00
32	471	Precast Concrete Standard Manhole (All Depths) 8' DIA	EA	4	$8,500.00	$34,000.00
33	471	Precast Concrete Standard Manhole (All Depths) 10' DIA	EA	3	$10,500.00	$31,500.00
34	472	Remove and Replace Plates with Grates on Existing Type B-B Inlets	EA	39	$400.00	$15,600.00

CONSTRUCTION COST ESTIMATE - Alt #1

Project: RAVENSWAY SOUTH SUB. DRAINAGE IMPROVEMENTS
Limit From: CYPRESS NORTH HOUSTON ROAD
Limit To: RAVENSWAY SOUTH SUBD.
Proj Length: 5,100'
Precinct: 3
UPIN: 19103MF14701
Job No: This is the number available when advertising project
Prepared By: Binkley & Barfield, Inc.
Date: 02/17/22

Summary of Estimate		
Stage:		Final
Total Amount for DRAINAGE:		$2,840,022.00
Total Amount for ROADWAY:		$698,985.00
Total Amount for XXX:		$0.00
Total Amount for XXX:		$0.00
Grant Total Amount:		$3,539,007.00
Contingencies:	0%	$0.00
Grand Total Project:		$3,539,007.00

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
35	472	Type C Curb Inlet (5')	EA	4	$5,500.00	$22,000.00
36	472	Type C-1 Curb Inlet (10')	EA	10	$7,000.00	$70,000.00
37	472	Type C-2 Curb Inlet (15')	EA	4	$8,500.00	$34,000.00
					Subtotal of Item C	**$2,495,667.00**
D	**TRAFFIC CONTROL PLAN**					
38	671	Traffic Control - Barricades, Barriers, Barrels, Cones, and Signing	MO	4	$8,500.00	$34,000.00
					Subtotal of Item D	**$34,000.00**
E	**SIGNING AND PAVEMENT MARKINGS**					
39	624	Aluminum Signs (Ground Mounted)- Furnish & Install	EA	2	$250.00	$500.00
					Subtotal of Item E	**$500.00**
F	**STORM WATER POLLUTION PREVENTION PLAN**					
40	162	Sodding for Erosion Control (Various Widths)	SY	750	$5.00	$3,750.00
41	719	Inlet Protection Barrier (Stage 1, With Fiber Rolls; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	EA	50	$100.00	$5,000.00
42	730	Concrete Truck Washout Structures (60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LS	1	$800.00	$800.00
43	751	SWPPP Inspection and Maintenance (Min. Bid - $6,000.)	MO	4	$6,000.00	$24,000.00
					Subtotal of Item F	**$33,550.00**
G	**** EXTRA WORK ITEMS**					
44	559	Construction Safety Fence	LF	500	$3.00	$1,500.00
45	672	Off-Duty Uniformed Peace Office - As Directed by Engineer (Min. Bid $45/HR)	HR	100	$45.00	$4,500.00
46	SS8006	Electrical Riser Relocation for Property Owner (Customer Owned) Connection to CenterPoint Energy Electrical Server; Single-Phase, 120 Volt, 3-Wire Electrical Service	LF	200	$50.00	$10,000.00
47	SS8006	Electrical Riser Relocation for Property Owner (Customer Owned) Connection to CenterPoint Energy Electrical Service; Three-Phase, (Commercial Customer) Electrical Service	LF	200	$50.00	$10,000.00
					Subtotal of Item G	**$26,000.00**

CONSTRUCTION COST ESTIMATE - Alt #2

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$5,507,335.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$5,507,335.00**
Contingencies:	**25%**	**$1,376,833.75**
Grand Total Project:		**$6,884,168.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
A	**SITE PREPARATION AND EARTHWORK**					
1	Drawing	Project Sign	EA	4.00	$1,000.00	$4,000.00
2	102	Clearing and Grubbing	AC	10.00	$3,000.00	$30,000.00
3	102	Tree Removal (0" - 12" Dia.)	EA	12.00	$1,200.00	$14,400.00
4	102	Tree Removal (12" - 24" Dia.)	EA	12.00	$1,800.00	$21,600.00
5	102	Tree Removal (24"+ Dia.)	EA	6.00	$2,000.00	$12,000.00
6	104	Removing Old Concrete (Pavement)	SY	4,500.00	$8.00	$36,000.00
7	104	Removing Old Concrete (Driveway)	SY	2,000.00	$20.00	$40,000.00
8	104	Removing Old Concrete (Sidewalk)	SY	2,300.00	$12.00	$27,600.00
9	104	Removing Old Concrete (Curb)	LF	1,600.00	$3.00	$4,800.00
10	110	Roadway Excavation Including 3" Topsoil	CY	675.00	$25.00	$16,875.00
11	465	Remove and Dispose of Existing Concrete or Metal Pipe (All Sizes)	LF	6,441.00	$15.00	$96,615.00
12	495	Removing Old Structures – Inlets (All Depths)	EA	25.00	$800.00	$20,000.00
13	500	Remove & Relocate Mail Boxes	LS	1.00	$4,000.00	$4,000.00
14	500	Remove & Relocate Traffic Signs and Roadway Signs	LS	1.00	$1,000.00	$1,000.00
15	500	Tree Protection	LS	1.00	$30,000.00	$30,000.00
16	561	Video Recording Construction	LS	1.00	$1,500.00	$1,500.00
					Subtotal of Item A	**$360,390.00**
B	**PAVING**					
17	220	Lime Stabilized Subgrade (6" Depth)	SY	3,300.00	$7.00	$23,100.00
18	221	Hydrated Lime (Ty A) (Slurry)	TON	80.00	$220.00	$17,600.00
19	360	Concrete Pavement (6")	SY	3,000.00	$70.00	$210,000.00
20	530	Reinforced Concrete Curb (6")	LF	5,000.00	$4.50	$22,500.00
	530	Reinforced Concrete Driveways (6") - High Early Strength Concrete	SY	2,000.00	$140.00	$280,000.00
1	530	Reinforced Concrete Sidewalks (4-1/2")	SY	3,000.00	$75.00	$225,000.00
2	530	Curb Ramp	SY	75.00	$70.00	$5,250.00
					Subtotal of Item B	**$783,450.00**
C	**STORM SEWER**					
3	429	Trench Safety System (5' to 10') [INCLUDES SHEET PILING AS REQ'D]	LF	5,070.00	$3.00	$15,210.00
4	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (24")	LF	1,060.00	$135.00	$143,100.00
5	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (30")	LF	820.00	$175.00	$143,500.00
6	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (36")	LF	1,314.00	$210.00	$275,940.00
7	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (42")	LF	2,495.00	$275.00	$686,125.00
8	460	Reinforced Concrete Pipe, C76, Class III, Rubber Gasket (48")	LF	625.00	$350.00	$218,750.00
9	471	Precast Concrete Standard Manhole (5 ft ≤ Depth ≤ 10 ft) on BC	EA	24.00	$8,000.00	$192,000.00
10	471	Precast Concrete Standard Manhole (All Depths)	EA	8.00	$5,000.00	$40,000.00
11	472	Remove and Replace with Grates on Existing Type B-B Inlets	EA	42.00	$400.00	$16,800.00
12	472	Type C-1 Inlet	EA	14.00	$7,000.00	$98,000.00
13	472	Type C-2 Inlet	EA	4.00	$8,500.00	$34,000.00
14	480	Precast RCB (10' x 6')	LF	2,300.00	$1,000.00	$2,300,000.00

CONSTRUCTION COST ESTIMATE - Alt #2

Project:	**RAVENSWAY SOUTH SUBDIVISION DRAINAGE IMPROVEMENTS**
Limit From:	**SHAFT ROAD**
Limit To:	**CYPRESS -NORTH HOUSTON ROAD**
Proj Area:	**68.5 ACRES**
Precinct:	**3**
UPIN:	**19103MF14701**
Job No:	**This is the number avaiable when advertising project**
Prepared By:	**Binkley & Barfield, Inc.**
Date:	**07/30/21**

Summary of Estimate		
Stage:		**Proposal**
Total Amount for Roadway:		**$5,507,335.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Total Amount for XXXX:		**$0.00**
Grant Total Amount:		**$5,507,335.00**
Contingencies:	**25%**	**$1,376,833.75**
Grand Total Project:		**$6,884,168.75**

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
					Subtotal of Item C	**$4,163,425.00**
D	**TRAFFIC CONTROL PLAN**					
15	671	Traffic Control - Barricades, Barriers, Barrels, Cones, and Signing	MO	12.00	$8,500.00	$102,000.00
16	673	Temporary Pipe Under Driveway for Installing-Maintaining and Removal	LF	200.00	$20.00	$4,000.00
					Subtotal of Item D	**$106,000.00**
E	**SIGNING AND PAVEMENT MARKINGS**					
17	624	Aluminum Signs (Ground Mounted)- Furnish & Install	EA	10.00	$250.00	$2,500.00
					Subtotal of Item E	**$2,500.00**
F	**STORM WATER POLLUTION PREVENTION PLAN**					
18	162	Sodding for Erosion Control (Various Widths)	SY	2,500.00	$4.00	$10,000.00
19	708	Filter Fabric Fence (60% of unit cost for furnish and installation and 40% of unit cost for removal)	LF	1,000.00	$1.20	$1,200.00
20	719	Inlet Protection Barrier (Stage 1, With Fiber Rolls; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	EA	12.00	$100.00	$1,200.00
21	724	Stabilized Construction Access (Type 1-Rock; 60% of unit cost for furnish and installation, and 40% of unit cost for removal))	SY	8.00	$15.00	$120.00
22	730	Concrete Truck Washout Structures (60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LS	1.00	$1,000.00	$1,000.00
23	750	Rock Filter Dam (Type 1; 60% of unit cost for furnish and installation, and 40% of unit cost for removal)	LF	1.00	$50.00	$50.00
24	751	SWPPP Inspection and Maintenance (Min. Bid - $6,000.)	MO	12.00	$6,000.00	$72,000.00
					Subtotal of Item F	**$85,570.00**
G	**** EXTRA WORK ITEMS**					
25	559	Construction Safety Fence	LF	200.00	$3.00	$600.00
26	672	Off-Duty Uniformed Peace Office - As Directed by Engineer (Min. Bid $45/HR)	HR	120.00	$45.00	$5,400.00
					Subtotal of Item G	**$6,000.00**

APPENDIX 5.2
HCFCD LETTER OF NO OBJECTION

March 7, 2022

Ben Lesa, P.E.
Project Manager
Harris County Engineering Department
Recovery & Resiliency Division
Ben.Lesa@eng.hctx.net

HARRIS COUNTY FLOOD CONTROL DISTRICT
9900 Northwest Freeway
Houston, Texas 77092
346-286-4000
www.hcfcd.org

CC: Gregory Frank, P.E., CFM
Costello, Inc.
2107 Citywest Blvd., 3rd Floor
Houston, Texas 77042
gfrank@costelloinc.com

SENT VIA ELECTRONIC MAIL: NO HARD COPY TO FOLLOW

RE: Project No. 2111020168
Ravensway South Subdivision Drainage Improvements
HCFCD Unit E133-00-00; Pct.3

Mr. Lesa,

The above referenced project is proposing improvements that are not within HCFCD right-of-way, but that ultimately drain to HCFCD right-of-way. A technical review of the report and associated models was provided by HCFCD representatives at the request of Harris County Engineering Recovery & Resiliency Division (HCED RRD). The review addressed general project intent as well as issues regarding hydraulic and hydrologic drainage design criteria pursuant to HCFCD guidelines and requirements.

A review comment letter dated November 23, 2021 was issued and is included as Attachment A for reference. The original review comment letter provides a summary of the project, detention, floodplain information, report findings, additional relevant HCFCD criteria, and environmental coordination considerations for reference, as well as the review comments from the HCFCD review team.

HCFCD received a revised report and letter from the drainage Engineer of Record (copied to this correspondence), dated December 13, 2021, with responses to HCFCD review comments, which is provided as Attachment B for reference. The HCFCD team provided a review of the revised report and responses provided, and participated in a coordination meeting with HCED RRD and the drainage engineer on January 26, 2022. The HCFCD review team subsequently provided a second review comment letter dated January 28, 2022, included as Attachment C for reference.

HCFCD received a second revised report and letter from the drainage Engineer of Record, dated February 16, 2022, with responses to HCFCD review comments, which is provided as Attachment D for reference. Upon review of the responses and revised report provided, the HCFCD review team offers the following:

1. Freese and Nichols, Inc. (FNI) staff performed technical review of Hydrologic & Hydraulic calculations provided and reviewed responses to comments provided. FNI concluded that the modeling provided generally supports the conclusions stated in the report. Please refer to the memorandum provided by FNI as Attachment E.
2. The engineer of record added Table 2 to the report to summarize Hydraulic Grade Line (HGL) reductions between the existing system and the proposed system (Alternative 1) in

response to a previous review comment requesting better explanation of benefits associated with the proposed system (in letter dated January 28, 2022). The results of Table 2 generally support the findings in the report that the proposed improvements will significantly reduce HGL elevations for all storm events and that the proposed system will increase the system capacity such that it can convey the 50% AEP storm event. Additional text was added to the report to summarize the storm sewer calculations in section II.C, which states that the HGL elevations computed for the 1% AEP storm event are "unrealistically high". While understood that the existing and proposed storm system is not sized to convey the 1% AEP storm event, it is unclear why the HGL elevations calculated are considered "unrealistic." The same methods were used to compute the HGL elevations for all storm events analyzed, so is recommended that the HGL calculations minimally be verified to be realistic for the 50% AEP, as the results associated with this storm event are the basis for the storm sewer improvement recommendations.

3. Based on previous discussions, the spreadsheets utilized to calculate the flows are proprietary to the engineer, and therefore are not available for detailed review. However, the engineer of record has indicated analysis has sufficiently been performed to verify no impacts to other local storm sewers upstream of the project outfall, as well as no impacts to the receiving channel. The engineer has also included Table 1 within the report to summarize computed flow decreases between existing and proposed conditions at various manholes along the system to further illustrate no adverse impacts. Further, the project is proposing no changes to over 600 linear feet of storm sewer downstream of the project tie in along Cypress North Houston Road to where the system ultimately discharges to channel E133-00-00 (which would serve to restrict flows to existing conditions). Based on these considerations, it is reasonable to conclude that the project will have no adverse impacts to receiving systems.

As this project is not proposing improvements within HCFCD right-of-way, the HCFCD review process is considered complete as HCFCD representatives have reviewed the report and calculations submitted, along with subsequent responses to HCFCD representative review comments. ***The report is signed, dated, and sealed by a Professional Engineer licensed to practice in the State of Texas, which therefore conveys the licensed engineer's responsibility and accountability for the project and addressing comments as the engineer deems appropriate.*** Thank you for coordinating this project with HCFCD. If you have any questions, you may contact me at *abby.crockett@hcfcd.hctx.net*.

Sincerely,

Abby Crockett

Abby Crockett, P.E.
HCFCD Project Management Consultant (Staff Augmentation)
HCFCD Project Liaison for HCED Recovery & Resiliency Division Projects

November 23, 2021

Ben Lesa, P.E.
Project Manager
Harris County Engineering Department
Recovery & Resiliency Division
Ben.Lesa@eng.hctx.net

HARRIS COUNTY FLOOD CONTROL DISTRICT
9900 Northwest Freeway
Houston, Texas 77092
346-286-4000
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CC: Gregory Frank, P.E., CFM
Costello, Inc.
2107 Citywest Blvd., 3rd Floor
Houston, Texas 77042
gfrank@costelloinc.com

SENT VIA ELECTRONIC MAIL: NO HARD COPY TO FOLLOW

RE: Project No. 2111020168
Ravensway South Subdivision Drainage Improvements
HCFCD Unit E133-00-00; Pct.3

Mr. Lesa,

The referenced memorandum has been reviewed pursuant to the HCFCD Policy, Criteria, and Procedure Manual (PCPM) and Section 3.02 of the *"Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure."* The goals of the review are to provide technical support to Harris County Engineering Recovery & Resiliency Division and to apply HCFCD policy and criteria where appropriate.

This review addresses general project intent as well as issues regarding hydraulic and hydrologic drainage design criteria. Design criteria regarding the site layout of the proposed development and drainage facilities will be reviewed upon submittal of site plans.

Our understanding of the memorandum is described below. Please see the response contained within the *"Hydrologic & Hydraulic Technical Review"* section.

HCFCD Jurisdiction

The project meets at least one of the following conditions; HCFCD criteria apply:

- The project directly affects HCFCD Infrastructure.
- The project proposes infrastructure to be maintained by HCFCD.
- The project is located within a watershed where HCFCD has a regional project adopted by Harris County Commissioners Court.
- A technical review has been requested by Harris County.

Submittal Information

Submitted Report	Consulting Engineer
Ravensway South Subdivision Drainage Improvements October 29, 2021	Project Manager 2107 Citywest Blvd., 3rd Floor Houston, Texas 77042 TBPE Registration No. F-280 Ben Lesa, P.E. TX P.E. 68937

Project Summary

As the report states, the Ravensway South subdivision "encompasses approximately 67 acres of single-family residential properties, located in the White Oak Bayou watershed in Precinct 3 of Harris County, Texas. The subdivision is located on the north side of Cypress-N. Houston Road, just east of its intersection with Huffmeister Road.

The subdivision consists of concrete curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into and existing trunkline storm sewer in Cypress-North Houston Road, which then outfall into E133-00-00. The subdivision is reported to have experienced structural flooding in approximately 16 homes during Hurricane Harvey, with approximately 11 of those experiencing flooding in previous major storm events.

A hydraulic analysis (spreadsheet based) of the existing storm sewers, gutter runs and inlets was performed which indicates that the existing system does not provide a 50% AEP Atlas 14 (2-year) level of service as required in the current HCED criteria. Proposed improvements include replacing trunkline storms sewer pipes along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft and Birdcall. Extensions of the existing tributary runs along Nevermore, Ravens Caw, Raven Roost, Blackbird and Raven Wing are also proposed to reduce gutter ponding along those streets during the 50% AEP design event. Additionally, all Type B-B inlets are proposed to have the plates replaced with inlet grates to increase capacity and help reduce ponding depths.

Review of the spreadsheet analysis results indicates that the proposed 50% AEP storm sewer computations provide decreased hydraulic grade line (HGL) elevations within the pipes, without increasing the computed peak flow rates, when compared to existing conditions. The improved storm sewers and inlets will provide reduced ponding depths throughout the subdivision for the 50% AEP design event."

Detention Summary

Due to the minor scale of the proposed improvements, a proposed detention pond will not be necessary for the currently recommended alternative. According to the report, the proposed improvements for the recommended alternative do not change existing impervious cover, sheet flow patterns, or outfall conditions to HCFCD systems, unless a larger subwatershed analysis is performed for E133-00-00 that would allow larger-scale improvements.

Floodplain Related Information

Based on information provided in the report as Exhibit 3, the subdivision project area is located on Panel Number 48201C0430M, effective October 16, 2013, and is located in unshaded Zone X.

Please also note that Harris County is the Floodplain Administrator for the receiving waterways. All issues regarding local floodplain regulations must be coordinated through Harris County.

Report Findings

The report states, “The proposed improvements will increase the level of service of the pipes and inlets to a 50% AEP (2-year) design level, as required in the Harris County design criteria. However, due to the restricted capacity of the downstream systems in Cypress-N. Houston and the E133-00-00 outfall channel, a 1% AEP (100-year) level of service cannot be achieved without significant downstream improvements, as discussed in Alternatives 2 and 3.

The proposed improvements do not increase the HGL elevations within or adjacent to the project areas, nor do the improvements increase the computed discharge rates into the receiving systems. Based on these results there will be no adverse impacts caused by the implementation of this project for the storm events analyzed.”

The report also provides the following information related to the alternatives analyzed:

“Three alternative storm sewer improvement concepts were investigated:

- Alternative 1: Improve storm sewers only within the Ravensway South subdivision to provide a 50% AEP level of protection, assuming no downstream improvements are made.
- Alternative 2: Improve the storm sewers only within the Ravensway South subdivision to provide an increased level of protection from the storm sewers, assuming future downstream improvements would provide improved tailwater conditions to bring the internal system into compliance.
- Alternative 3: Undertake a subwatershed analysis and improvement plan which would provide adequate downstream conveyance and detention capacity to allow improvements to the internal and Cypress-N. Houston trunklines to bring both systems into compliance with current 1% AEP criteria.”

The report provides the following recommendations:

- “The HCED and HCFCD should consider the possibilities of performing a subwatershed project along E133-00-00 (Alternative 3), considering potential benefits to other tributary areas alongCypress-N. Houston Road and downstream along the channel.
- Should Alternative 3 prove to be infeasible at this time, proceed with the design and construction of Alternative 1 improvements.”

Hydrologic & Hydraulic Technical Review

This project is proposing improvements that are not within HCFCD right-of-way and do not change outfall conditions to HCFCD systems based on the report findings. This review has been provided at the request of Harris County Engineering Recovery & Resiliency Division.

HCFCD offers the following:

1. Please review, address, and provide responses to comments in the attached review memorandum from Freese & Nichols, Inc (FNI). FNI performed technical review of Hydrologic & Hydraulic calculations provided with the report.
2. Please revise no adverse impact statements within the report to specifically state that the proposed project will cause no adverse impact to flood hazard conditions on the receiving waterways, including downstream properties within the City of Houston, for storm events up to and including the Atlas 14 100-year storm event (or the current effective 500-year storm event).
3. On page 2, last sentence mentions that no adjustment factor could be directly established for the Harris County 1973 datum. Please clarify how information in as-built drawings was utilized for analysis without an adjustment.
4. Please clarify if right-of-way acquisition is required for the proposed improvements.
5. Please clarify maintenance responsibility for the proposed improvements.
6. Page 6, Section D: last sentence of first paragraph references runoff from offsite park areas that are picked up by interceptors; please clarify how it was verified that these offsite interceptors are sufficient to prevent gutter ponding as implied in the report.
7. Page 6, Section D: second paragraph references that Cypress N. Houston is not capable of conveying 1% AEP discharges based on the fact that the storm sewer was designed in accordance with pre-1983 criteria, but the report previously references 2009 drawings for Cypress N. Houston; please clarify.
8. Page 6, Section D: first sentence of third paragraph mentions 1% and 10% AEP discharge rates; what about 50% AEP?
9. Page 6, Section D: third paragraph mentions reduction in discharge rates for proposed vs. existing; please clarify how discharges are reduced if storm sewer is increased in size and inlets are improved to enhance conveyance. Please clarify how time of concentration (Tc) is increased based on improvements recommended.
10. Page 7, Section E: please clarify if Alternative 2 is capable of providing 10% AEP level of service without downstream improvements of Alternative 3. Please clarify if Alternatives 2 and 3 would require both to be constructed or if Alternative 2 could be constructed without Alternative 3.
11. Page 9, Conclusions: benefits are not truly quantified; what is ponding reduction for 50%, 10%, 1% AEP events? Please clarify why rain on grid analysis was not performed similar to other HCED RRD projects.
12. Page 10, Recommendations: It is first recommended that HCED and HCFCD consider subwatershed project along E133-00-00; it seems this warrants further coordination/action before proceeding with a recommended alternative; please clarify. Please also clarify why Alternative 1 is recommended over Alternative 2 when Alternative 2 appears to provide 10% AEP level of service even without downstream improvements based on information

in report, and further would allow potential future improvements to E133-00-00 to further enhance level of service.

13. Table 1: Please provide plan exhibits with referenced manholes/junctions clearly identified/labeled.
14. Exhibit 2: Please label E133-00-00 channel on exhibit and depict length along Cypress N. Houston between subdivision outfall and outfall to channel.
15. Exhibits: Please clarify if “gutter” failure mode is height or spread (or both) on exhibits.
16. Please provide profile exhibits of proposed system with existing and proposed HGL information based on calculations provided in Appendix A.

Additional HCFCD Criteria

No additional drainage right-of-way acquisition is required based on our current understanding of the memorandum.

Site plans must be submitted to HCFCD for review and signature.

Any work proposed within existing and future HCFCD right-of-way must be designed and constructed in accordance with the HCFCD Policy, Criteria, and Procedure Manual.

HCFCD will not be responsible for maintenance associated with the proposed storm sewer improvements.

Environmental Review & Permitting

The Harris County Flood Control District’s Regulatory Compliance Department requires that proposed projects impacting regulated waters of the U.S. obtain and document the required U.S. Army Corps of Engineers permit(s) for any portions of the project located within any existing or proposed HCFCD right-of-way. The type of permit required (if any) must be stated on the site plans even if written permit authorization from the Corps of Engineers is not required. If written permit authorization is required, copies of approved Corps of Engineers permits must be submitted with the HCFCD *Notification of Construction in Right-of-Way* and submitted to the HCFCD Development Coordination and Inspection Department at least 48 hours prior to construction along with the *48-hour Pre-Construction Notification*.

Thank you for coordinating this project with the Flood Control District. If you have any questions, you may contact me at *abby.crockett@hcfcd.hctx.net*.

Sincerely,

Abby Crockett, P.E.
HCFCD Project Management Consultant (Staff Augmentation)
HCFCD Project Liaison for HCED Recovery & Resiliency Division Projects

MEMORANDUM

FREESE AND NICHOLS

Innovative approaches
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10497 Town and Country Way, Suite 500 + Houston, Texas 77024 + 713-600-6800 + FAX 817-735-7491 www.freese.com

TO: Abby Crockett, P.E.

CC: Project File

FROM: Rolando Ayala, P.E., CFM;

SUBJECT: Review findings for proposed project: Ravensway South Subdivision

DATE: 11/22/2021

PROJECT: DIA for Ravensway South Subdivision
Drainage Improvements Project

Objective

Freese and Nichols has received a copy of the *DIA for Ravensway South Subdivision Drainage Improvements Project* with a submittal date of October 29, 2021, by Costello, Inc., and we appreciate the opportunity to review the submittal. The goals of the review are to provide technical support to Harris County Engineering's Recovery and Resiliency Division and to apply HCFCD policy and criteria where appropriate. This review addresses issues regarding hydraulic and hydrologic drainage design criteria only and is based on the following published materials: *HCFCD Policy Criteria Procedures Manual* (July 2019), *HCFCD Hydrology and Hydraulics Manual* (June 2019), *Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure* (July 2019).

Project Summary

Based on the submitted materials, Freese and Nichols has developed the following understanding of the project being pursued:

Ravensway South subdivision is located in the White Oak Bayou watershed in Precinct 3. The subdivision is on the north side of Cypress-N. Houston Road, just east of its intersection with Huffmeister Road. Ravensway South is approximately 67 acres and consists of curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into an existing trunkline storm sewer in Cypress-North Houston Road, which then outfalls into E133-00-00. The submitted analysis indicates that the existing system does not provide a 50% AEP Atlas 14 (2-year) level of service.
The proposed drainage improvements will include replacing trunkline storm sewers along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft and Birdcall. Extensions of the existing tributary runs along Nevermore, Ravens Caw, Ravens Roost, Blackbird, and Raven Wing are also proposed to reduce gutter ponding along those streets during the 50% AEP (2-year) design event.
These improvements will increase the level of service to a 2-year design level, but due to the restricted capacity downstream, a 100-year level of service cannot be achieved without significant improvements to E133-00-00.

Report Conclusions

The report states: "The proposed improvements do not increase the HGL elevations within or adjacent to the project areas, nor do the improvements increase the computed discharge rates into the receiving systems. "

FNI Review Findings

We have completed a cursory review of the request to ensure that the request is consistent with modeling standards and supports the analysis conclusions. Based on our limited review, we offer the following comments:

A. General:

1. A brief review of Appendix A indicates that the soffit at the outfall pipe was used as the tailwater for the 2-year and 10-year analysis, while a tailwater of 128.75' was used for the 100-year. Please clarify, within the report, the tailwater assumed for this analysis.
2. Provide an exhibit that clearly identifies the manholes listed in Appendix A.

B. Hydrology:

3. The submitted reports states that Harris County Region 3 Atlas 14 was used for this analysis. However, White Oak Bayou is located within Region 2. Please revise the analysis to use the appropriate rainfall values.
4. The report states, "This project will potentially include additional and improved storm inlets which may cause decreased Times of Concentration (Tc) for the runoff to enter the storm sewer pipes, thus increasing the computed peak runoff flows in the storm sewer system."
   Please clarify how this is being accounted for in the Appendix A calculations. It appears that Time of Concentration is currently being calculated based on drainage areas, which does not account for efficiencies of the improved storm inlets.
5. A review of Appendix A indicates that the Time of Concentration for Shaft Drive is 41.1 minutes in existing conditions and 52.6 in proposed. Please verify this is correct as it contradicts the statement above.

C. Hydraulics:

6. Please submit the accompanying spreadsheets used to create Appendix A.
7. Please verify the appropriate tailwater condition is being applied to the calculations submitted in Appendix A. Appendix A-1 indicates the soffit elevations of the 2-7'x4' RCBs that outfall into E133-00-00 is 128.78'. This elevation is used as the downstream HGL in the 2-year, 10-year, and 100-year existing, proposed alternative 1, and proposed alternative 2 analyses.
8. A review of the results indicates 1.77' of headloss at manhole CNH3; MH 1-7. Please clarify the substantial amount of headloss at this node.

D. Results:

9. It is difficult to understand the benefits associated with this project as there are no graphics illustrating the reducing pond depth achieved by Alternative 1 improvements. Please prepare an exhibit which depicts the benefits associated with this project.

December 13, 2021

Mr. Ben Lesa, P.E.
Project Manager
Recovery and Resiliency Division
Harris County Engineering Department
1001 Preston, 7th Floor
Houston, Texas 77002

Re: HCFCD Project No. 2111020168
Response to Comments for Ravensway South Subdivision Drainage Improvements
(UPIN 19103MF14701)
Harris County Engineering Department
CI Job Nos. 2018287-HCE-40-002

Dear Mr. Varadi:

Costello, Inc. (CI) is in receipt of the Harris County Flood Control District (HCFCD) comments dated November 23, 2021 for the above referenced project. Each comment is repeated in in italics in the numbered items below, with our responses immediately following.

HCFCD COMMENTS

1. ***Please review, address, and provide responses to comments in the attached review memorandum from Freese & Nichols, Inc (FNI). FNI performed technical review of Hydrologic & Hydraulic calculations provided with the report.***
   Our responses to the FNI comments are provided in the section.

2. ***Please revise no adverse impact statements within the report to specifically state that the proposed project will cause no adverse impact to flood hazard conditions on the receiving waterways, including downstream properties within the City of Houston, for storm events up to and including the Atlas 14 100-year storm event (or the current effective 500-year storm event).***
   Revised text included in the report

3. ***On page 2, last sentence mentions that no adjustment factor could be directly established for the Harris County 1973 datum. Please clarify how information in as-built drawings was utilized for analysis without an adjustment.***
   An adjustment to the original design elevations was assumed which correlates the pipe flowlines to several surveyed flowlines. A description of these adjustments is presented in the report.

4. ***Please clarify if right-of-way acquisition is required for the proposed improvements.***
   No right of way is required for this project since all improvements will be located within the existing street right of ways, as shown on the exhibits.

5. ***Please clarify maintenance responsibility for the proposed improvements.***
   Maintenance of the proposed storm sewer improvements will be the responsibility of the same entity, either the local Municipal Utility District (MUD) or Harris County, responsible for the maintenance of the existing facilities.

6. ***Page 6, Section D: last sentence of first paragraph references runoff from offsite park areas that are picked up by interceptors; please clarify how it was verified that these offsite interceptors are sufficient to prevent gutter ponding as implied in the report.***
   No construction plan information on these offsite interceptors was made available from County files, therefore such facilities were not included in the hydraulic computations. The report does not imply any conclusion as to the capacity of the offsite facilities, rather it states, *"These two reaches received runoff from the park areas to the north, which **appear** to be picked up by offsite interceptors, therefore those two reaches computations **do not reflect actual gutter ponding**."*. The computations show the ponding widths exceed the allowable widths, which is due to the fact that the large offsite areas as assumed to enter the gutter by means of sheet flow. The text only points out that, in these locations, the results are likely not representative of actual gutter ponding conditions. Further, there were no public comments or information provided by the HCED indicating that street ponding in these locations has been an historical problem.

7. ***Page 6, Section D: second paragraph references that Cypress N. Houston is not capable of conveying 1% AEP discharges based on the fact that the storm sewer was designed in accordance with pre-1983 criteria, but the report previously references 2009 drawings for Cypress N. Houston; please clarify.***
   The 2009 Cypress-N. Houston project did not include the design of any sub-surface drainage facilities, only pavement/lane and roadside ditch/driveway culvert improvements. The existing storm sewers were designed and constructed well prior to that date. Using the current Atlas 14 storm sewer analysis methodologies the existing system does not meet current design standards.

8. ***Page 6, Section D: first sentence of third paragraph mentions 1% and 10% AEP discharge rates; what about 50% AEP?***
   The previous paragraph addressed the 50% AEP.

9. ***Page 6, Section D: third paragraph mentions reduction in discharge rates for proposed vs. existing; please clarify how discharges are reduced if storm sewer is increased in size and inlets are improved to enhance conveyance. Please clarify how time of concentration (Tc) is increased based on improvements recommended.***
   The inlets are improved to help reduce ponding depth/widths on the streets for the 50% AEP only. This computation is independent of the pipe hydraulics computations. With the increased pipe sizes the velocities are DECREASED, which translates into INCREASED Times of Concentration, which then computes reduced intensities and corresponding flow rates. This is shown clearly by comparing Appendices A-1 and B-1.

10. ***Page 7, Section E: please clarify if Alternative 2 is capable of providing 10% AEP level of service without downstream improvements of Alternative 3. Please clarify if Alternatives 2 and 3 would require both to be constructed or if Alternative 2 could be constructed without Alternative 3.***
    There are no criteria in the Harris County **storm sewer design guidelines** which address 10% AEP conditions, only 50% in relation to gutter elevations and 1% in relation to height above T/C and NG at ROW. Discussion of the 10% in this report was included as a third "data point", and to be consistent with the general drainage impact analysis requirements of the three storms.

    Alternative 2 could be constructed independently of Alternative 3, however the resulting HGL elevations for the 1% AEP would still greatly exceed NG elevations.

    It should be pointed out that ALL of the computations presented in this report are HGL computations and ARE NOT reflective of ponding (water surface) elevations in any way.

11. ***Page 9, Conclusions: benefits are not truly quantified; what is ponding reduction for 50%, 10%, 1% AEP events? Please clarify why rain on grid analysis was not performed similar to other HCED RRD projects.***
    As stated above, ALL of the computations presented in this report are HGL computations and **ARE NOT** reflective of ponding (water surface) elevations in any way.

    A rain on grid analysis was outside of the scope of this project as defined in the scope of work approved by HCED. Early evaluations of this project area indicated that the elevations of Cypress-N. Houston cause ponding just north of the roadway. In order to improve those ponding conditions it was obvious that a more regional project approach would be required, which would also have to include significant storm sewer improvements, and possibly profile grade improvements, in Cypress-N. Houston, which was outside of the scope that HCED desired for this project.

    After the design of Alternative 1, limited to "internal" storm sewer improvements, and in discussions with HCED and Precinct 3 staff, it was decided that the two additional alternatives would be briefly addressed in order to identify the methodologies for identifying more area-wide/sub-watershed approaches to alleviate the ponding in this subdivision.

12. ***Page 10, Recommendations: It is first recommended that HCED and HCFCD consider subwatershed project along E133-00-00; it seems this warrants further coordination/action before proceeding with a recommended alternative; please clarify. Please also clarify why Alternative 1 is recommended over Alternative 2 when Alternative 2 appears to provide 10% AEP level of service even without downstream improvements based on information in report, and further would allow potential future improvements to E133-00-00 to further enhance level of service.***
    These considerations were discussed with the HCED and Precinct 3 staffs and the decision was made to proceed with the local improvements since there are no known initiatives for downstream improvements along E133-00-00.

Alternative 1 is recommended over Alternative 2 due to the fact that the estimated construction costs of Alternative 2 are approximately three times that of Alternative 1 AND Alternative 2 still does not provide a 1% AEP level of service.

13. ***Table 1: Please provide plan exhibits with referenced manholes/junctions clearly identified/labeled.***
    The main junctions/manholes along Cypress-N. Houston are identified on the appropriate exhibits.

14. ***Exhibit 2: Please label E133-00-00 channel on exhibit and depict length along Cypress N. Houston between subdivision outfall and outfall to channel.***
    Callouts added to exhibit.

15. ***Exhibits: Please clarify if "gutter" failure mode is height or spread (or both) on exhibits.***
    The allowable depth at gutter and spread (ponding width) are based on the cross-slope and width of the pavement (crown to face-of-curb) of the street, therefore if one fails, they both fail.

16. ***Please provide profile exhibits of proposed system with existing and proposed HGL information based on calculations provided in Appendix A***.
    HGL elevations are depicted in the Plan & Profile sheets being prepared by Binkley-Barfield, Inc. (BBI). Those sheets can be obtained through BBI.

FNI COMMENTS

A. General:

1. A brief review of Appendix A indicates that the soffit at the outfall pipe was used as the tailwater for the 2-year and 10-year analysis, while a tailwater of 128.75' was used for the 100-year. Please clarify, within the report, the tailwater assumed for this analysis.

The TW elevation for all frequencies starts at top of pipe at the outfall, which is a 7'x 4' (W x H) box culvert. The HGL then defaults to the soffit of the first run of round pipe above that location for all frequencies.

2. Provide an exhibit that clearly identifies the manholes listed in Appendix A.

Manhole names added to exhibits. Please note the manhole names/number have been changed to match the construction plans being prepared by BBI.

B. Hydrology:

3. The submitted reports states that Harris County Region 3 Atlas 14 was used for this analysis. However, White Oak Bayou is located within Region 2. Please revise the analysis to use the appropriate rainfall values.

Harris County design guidelines require the use of Region 3 "b, d & e" values for ALL storm sewer analyses, regardless of watershed location.

4. The report states, "This project will potentially include additional and improved storm inlets which may cause decreased Times of Concentration (Tc) for the runoff to enter the storm sewer pipes, thus increasing the computed peak runoff flows in the storm sewer system." Please clarify how this is being accounted for in the Appendix A calculations. It appears that Time of Concentration is currently being calculated based on drainage areas, which does not account for efficiencies of the improved storm inlets.

Text revised. See response to Comment 9, above.

5. A review of Appendix A indicates that the Time of Concentration for Shaft Drive is 41.1 minutes in existing conditions and 52.6 in proposed. Please verify this is correct as it contradicts the statement above.

See above response. The increased Tc is consistent with the increased pipe size, creating decreased velocities, thus decreased intensities and computed flows.

C. Hydraulics:

6. Please submit the accompanying spreadsheets used to create Appendix A.

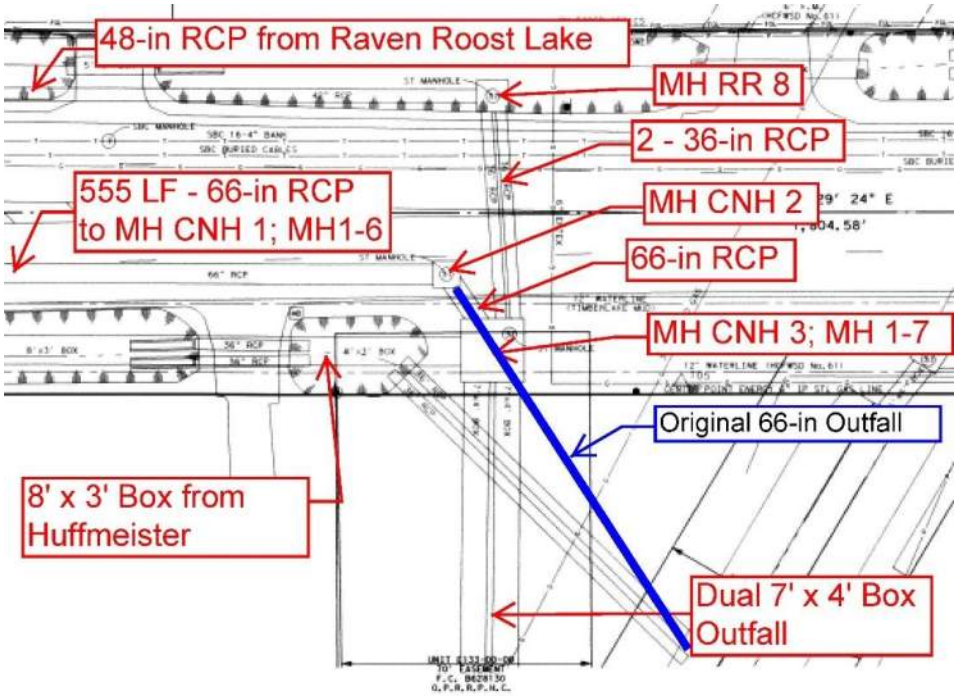
The spreadsheets used are proprietary to Costello use and will not be submitted.

7. Please verify the appropriate tailwater condition is being applied to the calculations submitted in Appendix A. Appendix A-1 indicates the soffit elevations of the 2-7'x4' RCBs that outfall into E133-00-00 is 128.78'. This elevation is used as the downstream HGL in the 2-year, 10-year, and 100-year existing, proposed alternative 1, and proposed alternative 2 analyses.

See response to FNI Comment 1 above.

8. A review of the results indicates 1.77' of headloss at manhole CNH3; MH 1-7. Please clarify the substantial amount of headloss at this node.

The existing system analysis shows 1.74 ft of headloss and the proposed Alternative 1 computations show 1.40 ft of headloss in this reach. That manhole is located at the intersection of Raven South and Cypress-N. Houston and was part of the system originally designed to serve ONLY the Ravensway South subdivision, with a 66-inch outfall into E133-00-00 (see blue line below). Subsequently, several storm sewer projects were tied into the lower part of the system as shown below, adding flows and drainage areas not originally anticipated or accommodated. Those systems were added over time and were designed using older criteria which would likely have produced lower computed flows, so those calculations may have shown available capacity at the time, but using the current criteria the system is severely limited.



D. Results:

9. It is difficult to understand the benefits associated with this project as there are no graphics illustrating the reducing pond depth achieved by Alternative 1 improvements. Please prepare an exhibit which depicts the benefits associated with this project.

The benefits of the project are reduced HGL elevations in the 50% AEP design event, NOT computed ponding depths, so describing benefits as ponding reductions would be misleading. It is NOT advisable to try to represent HGL reductions in an exhibit format.

The revised report, exhibits and tables are attached. If you have any questions or require additional information, please contact me at the numbers above or by e-mail at *gfrank@costelloinc.com*.

Sincerely,
Costello, Inc.
TBPE Firm No. 280

Gregory P. Frank. P.E., CFM
Chief Engineer, Hydrology & Hydraulics

cc: Mr. Tommy Cromer – BBI

January 28, 2022

Ben Lesa, P.E.
Project Manager
Harris County Engineering Department
Recovery & Resiliency Division
Ben.Lesa@eng.hctx.net

HARRIS COUNTY FLOOD CONTROL DISTRICT
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gfrank@costelloinc.com

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RE: Project No. 2111020168
Ravensway South Subdivision Drainage Improvements
HCFCD Unit E133-00-00; Pct.3

Mr. Lesa,

The above referenced project is proposing improvements that are not within HCFCD right-of-way, but that ultimately drain to HCFCD right-of-way. A technical review of the report and associated models was provided by HCFCD representatives at the request of Harris County Engineering Recovery & Resiliency Division (HCED RRD). The review addressed general project intent as well as issues regarding hydraulic and hydrologic drainage design criteria pursuant to HCFCD guidelines and requirements.

A review comment letter dated November 23, 2021 was issued and is included as Attachment A for reference. The original review comment letter provides a summary of the project, detention, floodplain information, report findings, additional relevant HCFCD criteria, and environmental coordination considerations for reference, as well as the review comments from the HCFCD review team.

HCFCD received a revised report and letter from the drainage Engineer of Record (copied to this correspondence), dated December 13, 2021, with responses to HCFCD review comments, which is provided as Attachment B for reference. Upon review of the revised report and responses provided, along with considerations of discussions that took place in a coordination meeting with HCED RRD and the drainage engineer on January 26, 2022, the HCFCD review team offers the following for further clarification and consideration:

1. Freese and Nichols, Inc. (FNI) staff performed technical review of Hydrologic & Hydraulic models provided with the report and reviewed responses to comments provided. Please refer to the memorandum provided by FNI as Attachment C for additional comments.
2. Benefits such as number of structures with reduced flood risk, length of roadway with reduced flood risk, etc. are not quantified in the report for the different storm events analyzed. Based on discussions with HCED RRD staff and the engineer of record, it is understood that budget and scope limited the analysis performed for this project, as it was well anticipated that the project would not be able to provide more than a 2-year level of service without significant improvements to Cypress North Houston Rd, detention

mitigation, and downstream regional improvements to channel E133-00-00. The engineer did not scope or provide rain-on-grid modeling effort as is typically performed for drainage improvements projects, but rather elected a simplified approach to evaluate Hydraulic Grade Line (HGL) reductions. While it is understood that ponding depth reduction data is not available as a result of the approach, is recommended at a minimum that the engineer better quantify the benefits that are provided by the proposed improvements within the report, by providing exhibits or tables better depicting HGL reductions in the project area. It is understood that this project will not provide reduction of structural flooding.

3. Methodology for the flow calculations used to verify no adverse impacts downstream was discussed with FNI, HCED RRD, and the engineer of record in a coordination meeting on January 26, 2021. Uncertainties associated with how the time of concentration influences the calculations were discussed, along with errors depicted in the calculation print outs included as appendices in the report. Based on discussions, it is our understanding that the spreadsheets utilized to calculate the flows are proprietary to the engineer, and therefore are not available for detailed review. However, the engineer of record has indicated analysis has sufficiently been performed to verify no impacts to other local storm sewers upstream of the project outfall, as well as no impacts to the receiving channel. The engineer has also indicated that the errors noted are due to negative storm sewer pipe slopes and are not relevant to the final calculations or conclusions. Further, while storm sewers are increased in size within the limits of the subdivision, the project is proposing no changes to overy 600 linear feet of storm sewer downstream of the project tie in along Cypress North Houston Road, upstream of where the system ultimately discharges to channel E133-00-00. Based on these considerations, it is reasonable to conclude that the project has illustrated no adverse impacts to receiving systems.

It is our understanding that the engineer and HCED RRD plan to address the above comments and resubmit to HCFCD, at which point HCFCD representatives will review resubmittal information and provide a final letter. Thank you for coordinating this project with the Flood Control District. If you have any questions, you may contact me at *abby.crockett@hcfcd.hctx.net*.

Sincerely,

Abby Crockett

Abby Crockett, P.E.
HCFCD Project Management Consultant (Staff Augmentation)
HCFCD Project Liaison for HCED Recovery & Resiliency Division Projects

MEMORANDUM

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TO: Abby Crockett, P.E.

CC: Project File

FROM: Rolando Ayala, P.E., CFM;

SUBJECT: Review findings for proposed project: Ravensway South Subdivision

DATE: 1/15/2022

PROJECT: DIA for Ravensway South Subdivision
Drainage Improvements Project

Objective

Freese and Nichols has received a copy of the *DIA for Ravensway South Subdivision Drainage Improvements Project* with a submittal date of December 23, 2021, by Costello, Inc., and we appreciate the opportunity to review the submittal. The goals of the review are to provide technical support to Harris County Engineering's Recovery and Resiliency Division and to apply HCFCD policy and criteria where appropriate. This review addresses issues regarding hydraulic and hydrologic drainage design criteria only and is based on the following published materials: *HCFCD Policy Criteria Procedures Manual* (July 2019), *HCFCD Hydrology and Hydraulics Manual* (June 2019), *Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure* (July 2019).

Project Summary

Based on the submitted materials, Freese and Nichols has developed the following understanding of the project being pursued:

Ravensway South subdivision is located in the White Oak Bayou watershed in Precinct 3. The subdivision is on the north side of Cypress-N. Houston Road, just east of its intersection with Huffmeister Road. Ravensway South is approximately 67 acres and consists of curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into an existing trunkline storm sewer in Cypress-North Houston Road, which then outfalls into E133-00-00. The submitted analysis indicates that the existing system does not provide a 50% AEP Atlas 14 (2-year) level of service.
The proposed drainage improvements will include replacing trunkline storm sewers along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft and Birdcall. Extensions of the existing tributary runs along Nevermore, Ravens Caw, Ravens Roost, Blackbird, and Raven Wing are also proposed to reduce gutter ponding along those streets during the 50% AEP (2-year) design event.
These improvements will increase the level of service to a 2-year design level, but due to the restricted capacity downstream, a 100-year level of service cannot be achieved without significant improvements to E133-00-00.

Report Conclusions

The report states: "The proposed improvements do not increase the HGL elevations within or adjacent to the project areas, nor do the improvements increase the computed discharge rates into the receiving systems. "

FNI Review Findings

We have completed a cursory review of the request to ensure that the request is consistent with modeling standards and supports the analysis conclusions. Based on our limited review, we offer the following comments:

A. General:

1. It is unclear for the submitted spreadsheets whether this analysis assumes that all the flow from the delineated drainage areas is being conveyed within the storm sewer network. Please clarify if this analysis accounts for any surface flow or assumes all flow is able to enter the existing and proposed system.

B. Hydrology:

2. A review of the calculations presented in Appendix A, B, and C indicated that the flows within the storm sewer system are reduced because of the proposed improvements. This finding does not make sense as there is no change in the service area the storm sewer system is serving.

   The submitted analysis computes flows within the storm sewer system based on a Time of Concentration (Tc) that is dependent upon pipe size. Therefore, the analysis should be revised to assure that the flow being used to size the proposed improvements in unaffected by changes in storm sewer size.

D. Results:

3. As previously commented, it is difficult to understand the benefits associated with this project. Alternative 1, the improvement concept investigated in detail, proposed benefits should be clearly summarized within the report. While it is understood that the HGL elevations in the 50% AEP design event are reduced, there has been no quantification of structures benefited or reduced roadway ponding depths from these improvements. It will be difficult to justify the associated costs with this project if the benefits are not quantified.

February 16, 2022

Mr. Ben Lesa, P.E.
Project Manager
Recovery and Resiliency Division
Harris County Engineering Department
1001 Preston, 7th Floor
Houston, Texas 77002

Re: HCFCD Project No. 2111020168
Response to Comments for Ravensway South Subdivision Drainage Improvements
(UPIN 19103MF14701)
Harris County Engineering Department
CI Job Nos. 2018287-HCE-40-002

Dear Mr. Lesa:

Costello, Inc. (CI) is in receipt of the Harris County Flood Control District (HCFCD) comments dated January 28, 2022, for the above referenced project. Please note that previous comments were provided by the HCFCD and their review consultants Freese and Nichols, Inc. (FNI), dated November 23, 2021, which were addressed in the December 13, 2021 submittal. Additional comments were provided by FNI, dated January 15, 2022. A virtual meeting was held with the project team on January 26, 2022 to discuss the above comments prior to re-submittal of the report and computations. Each of the above comment letters is attached to the re-submittal package. Each comment from the January 15 and 28 letters is repeated in italics in the numbered items below, with our responses immediately following.

1. FNI JANUARY 15 COMMENTS

A. General

1. It is unclear for the submitted spreadsheets whether this analysis assumes that all the flow from the delineated drainage areas is being conveyed within the storm sewer network. Please clarify if this analysis accounts for any surface flow or assumes all flow is able to enter the existing and proposed system.

As discussed during the virtual meeting on January 18, the flows computed as inputs to the storm sewer computations are PEAK flows, computed based on the Time of Concentration (Tc) at each inlet/manhole location along the storm sewer. These computations ARE NOT hydrograph computations and are not intended to compute or route the volume of runoff produced within each drainage area. As discussed, 100-year sheet flow computations, which are used to determine inlet capacities at each inlet and to ensure that adequate inlet capacity is provided at the most downstream inlets, have been added to the information presented in the report.

As stated in the virtual meeting, this Drainage Impact Analysis (DIA) is not a dynamic ponding analysis of the existing and proposed systems, it is a Hydraulic Grade Line (HGL) analysis using the computed peak flows at the outfall point into the existing Cypress-North Houston storm sewer system and into E133-00-00 to demonstrate no adverse impacts to the receiving facilities.

B. Hydrology

2. ***A review of the calculations presented in Appendix A, B, and C indicated that the flows within the storm sewer system are reduced because of the proposed improvements. This finding does not make sense as there is no change in the service area the storm sewer system is serving.***

The submitted analysis computes flows within the storm sewer system based on a Time of Concentration (Tc) that is dependent upon pipe size. Therefore, the analysis should be revised to assure that the flow being used to size the proposed improvements in unaffected by changes in storm sewer size.rm sewer system is serving.

See response above. No additional analysis will be performed.

D. Results

3. ***As previously commented, it is difficult to understand the benefits associated with this project. Alternative 1, the improvement concept investigated in detail, proposed benefits should be clearly summarized within the report. While it is understood that the HGL elevations in the 50% AEP design event are reduced, there has been no quantification of structures benefited or reduced roadway ponding depths from these improvements. It will be difficult to justify the associated costs with this project if the benefits are not quantified.***

See response below.

2. ***Benefits such as number of structures with reduced flood risk, length of roadway with reduced flood risk, etc. are not quantified in the report for the different storm events analyzed. Based on discussions with HCED RRD staff and the engineer of record, it is understood that budget and scope limited the analysis performed for this project, as it was well anticipated that the project would not be able to provide more than a 2-year level of service without significant improvements to Cypress North Houston Rd, detention mitigation, and downstream regional improvements to channel E133-00-00. The engineer did not scope or provide rain-on-grid modeling effort as is typically performed for drainage improvements projects, but rather elected a simplified approach to evaluate Hydraulic Grade Line (HGL) reductions. While it is understood that ponding depth reduction data is not available as a result of the approach, is recommended at a minimum that the engineer better quantify the benefits that are provided by the proposed improvements within the report, by providing exhibits or tables better depicting HGL reductions in the project area. It is understood that this project will not provide reduction of structural flooding.***

Table 2, comparing the HGL elevations along the storm sewer trunklines within the Ravensway subdivision and at key locations along the Cypress-North Houston storm sewers was added to the report to illustrate the reductions in HGL provided by this project.

3. ***Methodology for the flow calculations used to verify no adverse impacts downstream was discussed with FNI, HCED RRD, and the engineer of record in a coordination meeting on January 26, 2021. Uncertainties associated with how the time of concentration influences the calculations were discussed, along with errors depicted in the calculation print outs included as appendices in the report. Based on discussions, it is our understanding that the spreadsheets utilized to calculate the flows are proprietary to the engineer, and therefore are not available for detailed review. However, the engineer of record has indicated analysis has sufficiently been performed to verify no impacts to other local storm sewers upstream of the project outfall, as well as no impacts to the receiving channel. The engineer has also indicated that the errors noted are due to negative storm sewer pipe slopes and are not relevant to the final calculations or conclusions. Further, while storm sewers are increased in size within the limits of the subdivision, the project is proposing no changes to overy 600 linear feet of storm sewer downstream of the project tie in along Cypress North Houston Road, upstream of where the system ultimately discharges to channel E133-00-00. Based on these considerations, it is reasonable to conclude that the project has illustrated no adverse impacts to receiving systems****.***

   Table 1 in the report summarizes computed peak flows at critical storm sewer manholes throughout the system to demonstrate the no adverse impact results of the analysis. Additionally, the error messages caused by the existing "negative" flowline slopes in the pipes are explained in the report text.

The revised report, exhibits and tables are attached. If you have any questions or require additional information, please contact me at the numbers above or by e-mail at *gfrank@costelloinc.com*.

Sincerely,
Costello, Inc.
TBPE Firm No. 280

Gregory P. Frank. P.E., CFM
Chief Engineer, Hydrology & Hydraulics

cc: Mr. Tommy Cromer – BBI

V:\Harris County\Ravensway South\Report\Response to Comments_2-16-2022.docx

MEMORANDUM

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TO: Aby Crockett, P.E.

CC: Project File

FROM: Rolando Ayala, P.E., CFM

SUBJECT: Review Findings for Proposed project: Ravensway South Subdivision

DATE: 3/2/2022

PROJECT: DIA for Ravensway South Subdivision
Drainage Improvements Project

Objective

Freese and Nichols has received a copy of the *DIA for Ravensway South Subdivision Drainage Improvements Project* with a submittal date of February 16, 2022, by Costello, Inc., and we appreciate the opportunity to review the submittal. The goals of the review are to provide technical support to Harris County Engineering's Recovery and Resiliency Division and to apply HCFCD policy and criteria where appropriate. This review addresses issues regarding hydraulic and hydrologic drainage design criteria only and is based on the following published materials: *HCFCD Policy Criteria Procedures Manual* (July 2019), *HCFCD Hydrology and Hydraulics Manual* (June 2019), *Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure* (July 2019).

Project Summary

Based on the submitted materials, Freese and Nichols has developed the following understanding of the project being pursued:

Ravensway South subdivision is located in the White Oak Bayou watershed in Precinct 3. The subdivision is on the north side of Cypress-N. Houston Road, just east of its intersection with Huffmeister Road. Ravensway South is approximately 67 acres and consists of curb-and-gutter streets with existing curb inlets and underground storm sewers, which outfall into an existing trunkline storm sewer in Cypress-North Houston Road, which then outfalls into E133-00-00. The submitted analysis indicates that the existing system does not provide a 50% AEP Atlas 14 (2-year) level of service.
The proposed drainage improvements will include replacing trunkline storm sewers along Raven South Drive from approximately Raven Flight to Scamp, and tributary runs along Shaft and Birdcall. Extensions of the existing tributary runs along Nevermore, Ravens Caw, Ravens Roost, Blackbird, and Raven Wing are also proposed to reduce gutter ponding along those streets during the 50% AEP (2-year) design event.
These improvements will increase the level of service to a 2-year design level, but due to the restricted capacity downstream, a 100-year level of service cannot be achieved without significant improvements to E133-00-00.

Report Conclusions

The report states: “Based on the results of this hydraulic analysis and within the constraints and limitations of this methodology, the proposed improvements described in this report will cause no adverse hydrologic impacts at the outfall point into E133-00-00 for the 50%, 10%, 1% Atlas 14 rainfall events analyzed, thus, it can be reasonably concluded that the downstream flood hazard conditions along E133-00-00, including areas within the City of Houston in this sub-watershed, will not be increased due to the implementation of the project.”

FNI Review

We have completed our review of the initial report and the updated report. Based on our review, Freese and Nichols, Inc. offers the following:

The documentation within the report and modeling provided by the Engineer generally supports the conclusions stated in the report. *Please note that this does not imply that all supporting data and calculations have been completely checked and verified. However, the report is signed, dated, and sealed by a Professional Engineer licensed to practice in the State of Texas, which therefore conveys the engineer’s responsibility and accountability for the content in the report*. Any departure from the proposed concept included within this submittal may affect the findings of the hydrologic and hydraulic assessment which was performed in support of this drainage submittal.