

# Executive Summary

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## UPPER TURTLE CREEK BASIN – A STORMWATER MASTER PLAN

November 15, 2018

### **INTRODUCTION**

Huitt-Zollars, Inc. (HZ) was authorized, under a professional services agreement with the City of University Park, Texas, to develop a stormwater master plan (SWMP) for Upper Turtle Creek Basin-A (UTCB-A). The UTCB-A study area encompasses the northeast portion of the city and consists of approximately 336 acres within University Park and approximately 171 acres within the City of Dallas. Runoff from the drainage basin drains in a general south-southwest direction and outfalls via an 84 – inch reinforced concrete pipe (RCP) into Turtle Creek located just south of the Lovers Lane – Thackery Street intersection. The basin boundary is depicted in **Exhibit 1**.

In general, the storm drain system underperforms during small storm events consequently causing streets to function as stormwater conveyance facilities, and areas adjacent to the street to function as detention storage. The study area is subject to frequent flooding primarily in areas adjacent to street sags where conveyance is limited to storm drain capacity. The intent of the SWMP is to provide the City of University Park a high-level assessment of existing stormwater system performance deficiencies and provide recommendations to improve inundation frequency and minimize adverse impacts to private property. Recommended improvements will target resolution of inundation issues associated with the 10% AEP (10-yr) storm event; however, such improvements will also result in a reduction of inundation extents for larger, less frequent storm events. It should be noted that recommendations and construction cost estimates within this SWMP are planning-level only and therefore should be further analyzed and refined during future project design phases.

### **STORMWATER MODEL**

An existing conditions dynamic hydrologic and hydraulic model of the basin developed by Raymond L. Goodson Jr., Inc. (RLG) on November 2017 using XPSTORM version 2017.1 was used as the baseline for this SWMP. HZ completed several adjustments to the model in order to improve definition of drainage patterns within the basin. Some of the more significant revisions to the model included the addition of roughness values based on surface type, inclusion of existing structures by assigning depth varying roughness values to each, addition of an existing wall bounding Coffee Park to the north and incorporating an inlet located on the eastbound side of Northwest Highway. Additional adjustments to model parameters such as reduction in grid size and time step were completed to improve overall model health and continuity. Model simulation and analysis conducted by HZ was completed using XPSWMM Version 2018.1. XPSWMM and XPSTORM are compatible programs, both developed by Innovyze, Inc.

## EXISTING STORMWATER SYSTEM ASSESSMENT

The existing UTCB-A stormwater collection system is primarily comprised of curb inlets and underground storm drains with three major trunk lines servicing areas northwest, northeast and south of Caruth Park. Discharges from the northwest and the northeast are combined with the southern trunk line at a junction point located at the Turtle Creek Blvd – Southwestern Blvd intersection. To aid discussion and assessment of inundation issues, the basin has been divided into three major areas of interest (AOI) based on trunk line and contributing areas shown in **Exhibit 2**. Trunk line limits are described in **Table 1**.

**Table 1 – Trunk Line Description**

<b>AOI</b>	<b>Trunk Line Limits</b>	<b>General Contributing Area</b>
1	Airline Rd – Wentwood St to Colgate Ave Colgate Ave – Airline Rd to Hillcrest Ave Hillcrest Ave – Colgate Ave to Southwestern Blvd Southwestern Blvd – Hillcrest Ave to Turtle Creek Blvd	East of Hillcrest Ave & North of Southwestern Blvd
2	Turtle Creek Blvd – Northwest Hwy to Caruth Park	North of Caruth Park & west of Hillcrest Ave
3	Turtle Creek Blvd – Greenbrier Dr to Thackery St Thackery St – Turtle Creek Blvd to Lovers Lane	South & West of Caruth Park

### AOI - 1

AOI-1 consists primarily of the basin area located east of Hillcrest Ave and north of Southwestern Blvd. The most upstream storm drain located along Airline Rd is a 21-inch RCP with a 60-inch RCP downstream along Southwestern Blvd. Water is conveyed on streets and storm drains from northeast to southwest with observed runoff accumulation at Airline Rd between Marquette St and Colgate Ave, at street sags between Airline Rd and Hillcrest Ave. and at the Hillcrest Ave. – Greenbrier Dr. intersection. The lack of capacity within the storm drain line in this area allows water to build up at these roadway low points until conveyance capacity is available within the storm drain. For most rain events, water depths exceed the 6-inch curb height allowing runoff to spread into adjacent properties.

### AOI – 2 & Caruth Park

Stormwater infrastructure in AOI-2 is limited to inlets and storm drain present within the Turtle Creek Blvd. right-of-way with the exception of a 48-inch lateral extending east of the trunk line at Northwest Hwy and a 24-inch lateral extending east at Centenary Dr. The storm drain trunk line located within the Turtle Creek right-of-way consists of a single-barrel, 48-inch RCP at the upstream end and outfalls through an 8 ft x 3 ft reinforced concrete box (RCB) into the amenity pond located at Caruth Park. Most cross-streets function as surface conveyance facilities draining runoff to Turtle Creek Blvd where it is collected by inlets if pipe capacity is available or continues to flow on the street down to the Turtle Creek Blvd intersection with Caruth Blvd. Water collects in this area fairly quickly due to the Turtle Creek Blvd alignment grade and sag characteristics in the Caruth Blvd street alignment. Inundation depths in this area exceed curb height allowing inundation to spread to properties north and south of Caruth Blvd. Water remains in this area until capacity becomes available at the Caruth Park amenity pond.

The Caruth Park amenity pond provides minimal detention functionality to the drainage system. The pond maintains a normal pool and drains through a riser connected to the Turtle Creek Blvd. trunk line located in

AOI-3. During the 10% AEP storm event, discharges flowing into the pond from the trunk line in AOI- 2 cause overtopping of the pond and allow flows to spread throughout the park and properties north and south of the park. Curb overtopping at the Hillcrest Ave – Greenbrier Dr intersection also contributes to shallow flooding conditions at the park.

### **AOI-3**

The drainage system in this area collects stormwater runoff from areas primarily located south of Southwestern Blvd as well as storm drain flows from AOI-1 & 2. Drainage flow patterns in this area are similar to AOI-2, with cross-streets conveying stormwater from the east and west to Turtle Creek Blvd where curb inlets area located. A total of three laterals branch out from the 84-inch Turtle Creek Blvd trunk line. A 48-in RCP extends east on Purdue St and Stanford St and a 24-in RCP extends north on Thackery St. Storm drains from AOI-1 and AOI-2 discharge into the AOI-3 at the Turtle Creek Blvd – Southwestern Blvd intersection. The 84-inch trunk line appears to be significantly undersized resulting in the aboveground accumulation of runoff at Turtle Creek Blvd. The street conveyance capacity is exceed for the entire extent of the trunk line in this area. Downstream of the Dickens Ave intersection, flows overtopping the Thackery St curb are observed to flow into lower elevated areas to the east creating extensive shallow surface ponding between Purdue St and Stanford St.

### **UTCB-A Summary**

The existing storm drain system within the UTCB-A basin exhibits a lack of underground conveyance capacity. Existing basin infrastructure is shown in **Exhibit 2**. Many areas experience shallow flooding, primarily from overtopped curbs on street sags where water will pond until it can drain into the storm drain system. Significant curb overtopping and shallow inundation is observed in the following areas:

- AOI-1: Area east of Hillcrest Ave between Marquette St and Caruth Ave
- Caruth Park
- AOI-3: Area east of Thackery St between Purdue St and Stanford St

Existing inundation extents resulting from the 10% AEP storm event are depicted in **Exhibit 3**.

### **PROPOSED IMPROVEMENTS**

Given the study area’s urban setting, close to fully-developed conditions and lack of open space, recommended improvements were limited to increasing system conveyance capacity and incorporating underground detention facilities. The following improvement options were developed to improve system deficiencies and reduce inundation frequency throughout UTCB-A.

#### **Storm Drain**

The storm drain system outfall discharges into Turtle Creek where two additional storm drain systems from adjacent basins also outfall. Until analysis of all contributing drainage areas is completed, the size of the UTCB-A system outfall cannot be increased as it could potentially adversely impact downstream properties; therefore, proposed improvements are restricted to the existing 84” RCP at the downstream end. It is important to note that the normal depth at the UTCB-A outfall is higher than the 1% AEP (100-yr) water surface elevation reported in the FEMA FIS report for Turtle Creek; therefore, water surface elevation within the storm drain system is not governed by the water surface elevation at Turtle Creek.

The existing conditions 1D/2D hydrodynamic model was used to develop a proposed conditions model. An iterative process approach was taken to advance the proposed conditions model and develop a drainage system that provides adequate conveyance capacity and visibly minimizes inundation extents. In order to independently assess the existing storm drain, all inlet capacity restrictions were removed. Pipe capacity increases were first completed at existing facilities and were typically replaced by reinforced concrete boxes with heights matching the pipe diameter in order to minimize conflicts with existing water and wastewater utility lines. In general, improvements to the storm drain system were completed to improve system conveyance as well as increase system volume capacity. Conveyance capacity was significantly increased along existing storm drain alignments, however, additional segments of RCBs were added along cross-streets to provide additional storage volume. The intent of these “lateral” lines at cross-streets is to provide additional underground volume capacity and reduce stormwater runoff depth on the surface. **Table 2** provides a summary of storm drain improvements targeted to address inundation issues for the 10% AEP storm event.

**Table 2 – UTCB-A Proposed Improvements**

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>
24"	1200	LF
36" RCP	760	LF
42" RCP	750	LF
54"	180	LF
66"	180	LF
3x2	360	LF
4x2	160	LF
6'x3'	1790	LF
8'x6'	970	LF
10'x4'	5250	LF
10'x5'	3780	LF
10'x6'	12850	LF
10'x7'	4510	LF
<i>Caruth Park Underground Det</i>	17.5	AC-FT
<i>Coffee Park Det</i>	4.2	AC-FT
<i>School/Curtis Det</i>	13.8	AC-FT
<i>Turtle Creek/Purdue Det</i>	5.4	AC-FT

### **Detention Facilities**

As storm drain improvements were completed to the system in AOI-1 and AOI-2, an increase in the magnitude of inundation and peak discharge at the surface was observed downstream in the area where the two upstream trunk lines merge with the main Turtle Creek Blvd trunk line at AOI-3. As conveyance capacity is added to the storm drain system, stormwater is removed from the street and adjacent properties and conveyed downstream faster than existing conditions. This condition can simply move the flooding issue from one location to another unless detention is added to the system to offset the existing storage that occurs within the street and adjacent properties. Caruth Park, being one of the few open space areas within the study area, was selected as the most feasible location for a detention facility. HZ initially determined the total aboveground storage capacity that would be achievable within the limited open space at the park. The vision for the aboveground storage detention was to create a depressed area that could continue to be used by residents as



an athletic field. While the aboveground storage potential at this site provided some reduction in peak discharge, it did not provide what would be necessary to completely eliminate negative downstream impacts created by the storm drain improvements. In addition, the City expressed their concern of creating a limited use scenario at a heavily used park during and after storm events. For these reasons, options for underground detention were explored.

Underground storage at Caruth Park was maximized based on available space and depth. Timing of the storm drain systems within AOI-1 and AOI-2 were assessed to determine which configuration would provide the best beneficial use of the detention facility. The system servicing AOI-1 was allowed to flow downstream undetained and the trunk line servicing AOI-2 was routed through the underground detention facility. This configuration reduced the peak at the junction point at the Southwestern Blvd – Turtle Creek Blvd intersection and maintained existing inundation extents downstream. The underground detention facility at Caruth Park stores approximately 17.5 ac-ft (5.7 million gallons).

A second underground detention facility was incorporated at Coffee Park, located at the northernmost portion of AOI-2. This facility was included to address depth and overall volume of runoff flowing down Turtle Creek Blvd. A sag at Northwest Hwy is located to the north of Coffee Park. A 48-inch RCP is the only storm drain conveyance available in this area, therefore, a measureable amount of runoff remains in the street. Flows from areas located within the City of Dallas accumulate in this area allowing discharge that is not immediately captured by inlets along Northwest Hwy to make its way south via Turtle Creek Blvd. The detention facility at Coffee Park was placed to intercept flows at the corner of Turtle Creek and Northwest Hwy. While storm drain improvements were proposed in this area, increase in underground conveyance capacity was limited due to conflicts with surface grade and target flowline elevation at the Caruth Park pond outfall. The underground detention facility at Coffee Park stores approximately 4.2 ac-ft (1.3 million gallons).

Although the two underground detention facilities provided storm drain relief at the north portion of the study area, additional detention is necessary downstream within AOI-3 in order to offset proposed storm drain improvements within AOI-3. As discussed above in the *Existing Stormwater System Assessment* section, runoff conveyed on the street at the southern portion of Turtle Creek Blvd consistently exceeds the curb height along the street alignment. The area east of Thackery St, between Purdue St and Stanford St, exhibits the greatest impacts of flooding, with water depths exceeding 4 feet at a sag in Stanford St. Stormwater remains in the area until after a storm and conveyance capacity becomes available within the Turtle Creek Blvd trunk line. To address this issue, storm drain collecting runoff from this area was disconnected from the trunk line and connected back to the main trunk line at a location downstream with a lower hydraulic grade line. The underground detention facility is proposed at the open space located west of University Park Elementary School and at the open existing field space within Curtis Park. This detention area will provide temporary volume storage and significantly improve existing inundation conditions at Stanford St. This underground detention facility stores approximately 13.8 ac-ft (4.5 million gallons). This solution also requires a change in grade to Stanford Street to prevent runoff within Turtle Creek Blvd from entering Stanford Street.

Proposed storm drain improvements and underground detention facility locations are shown in **Exhibit 4**. Inundation extents expected after implementation of proposed improvements are shown in **Exhibit 5a**. A comparison of existing and improved inundation boundaries for the 10% AEP storm is depicted in **Exhibits 5b**.

### SWMP Implementation & Project Phasing

Recommended improvements have been modeled to function as a joint network that provide property impact protection from the 10% AEP storm event for the entire study area. Interim project phase models have been prepared in accordance to the project phasing discussed below. These models will need to be revised to reflect final design conditions with each phase to verify that there are no significant adverse impacts expected as a result of these improvements.

HZ recommends that project phasing be established based on AOI with improvements within AOI-1, including the underground detention at Caruth Park, be constructed first. Proposed improvements within AOI-2 should follow, with improvements within AOI-3 completed last. As previously mentioned, the downstream outfall within AOI-3 is currently restricted by the existing 84-inch RCP due to unknown discharges from adjacent basins. Once SWMPs for the two adjacent basins are developed, it is suggested that a downstream assessment that includes discharges from all three basins be completed to evaluate and verify no significant adverse impacts to the water surface elevation at Turtle Creek and downstream properties.

Proposed improvements described herein increase the discharge at the outfall by approximately 70 cfs. This increase is not anticipated to cause a significant impact to the water surface elevation within the creek or adversely impact downstream properties. The current FEMA floodplain downstream of the outfall is based upon more simplistic hydrologic analysis than that contained in this study. The traditional unit hydrograph modeling approach yields higher peak discharges than reflected in a more refined XP-SWMM model analysis. For this reason, the regulated FEMA floodplain appears to be based on higher discharges than the proposed conditions model. This assumption will need to be verified when the adjacent basins are modeled as a part of the ongoing SWMP efforts.

### ADVANCED PROJECT ALTERNATIVE

HZ has advanced improvements for a portion of AOI-1 and developed concept plans as part of this SWMP. The advanced project area is depicted in **Exhibit 6**. This area was identified by the City of University Park as a high priority due to the extent and frequency of inundation residents in the area are experiencing during small storm events. Proposed improvements for the advanced project area have been modeled independent to the overall SWMP in order to verify that proposed improvements will not impact others. Based on independent assessment of the storm drain improvements proposed in this area, HZ determined that the underground detention facility at Caruth Park along with the connection line from the AOI-2 trunk line should be incorporated as part of this advanced project alternative. **Table 3** summarizes overall improvements proposed for this advance project area.

**Table 3 – Advanced Project Alternative Improvements**

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>
10x6 RCB	4,946	LF
10x5 RCB	166	LF
10x4 RCB	187	LF
4x2 RCB	153	LF
3x2 RCB	355	LF
36" RCP	984	LF
48" RCP	181	LF
Caruth Park Detention	17.5	AC-FT

### Utility Conflicts

Potential conflicts with existing water and wastewater lines have been reviewed and assessed for the advanced project alternative improvements. Proposed pipe replacement sections are anticipated to cross major utility lines at six locations and run parallel to utility lines along 4 segments. In general, improvements consist of adding additional barrels of the same diameter or replacing circular conduits with boxes. In most cases, box heights match the pipe diameter of the existing line that is to be replaced. This was done primarily to avoid conflicts when crossing existing utility lines. Potential utility conflicts are summarized in **Table 4** and shown in **Exhibit 7**.

**Table 4 – Potential Utility Conflicts**

Potential Conflict No.	Utility Line	Conflict Type	Existing SD	Proposed SD	Street	ROW Width
1	12" & 6" Water	Cross	54" RCP	10'x6' RCB	Colgate Ave.	50 ft
2	8" Water 12" Wastewater	Cross	30" RCP	48" RCP	Hillcrest Ave.	60 ft
3	12" Water 8" Wastewater	Cross	60" RCP	2-10'x6' RCB	Hillcrest Ave.	60 ft
4	6" Water 6" Wastewater	Cross	60" RCP	2-10'x6' RCB	Hillcrest Ave.	60 ft
5	6" Water 8" Wastewater	Cross	60" RCP	2-10'x6' RCB	Hillcrest Ave.	60 ft
6	6" Water 12" Water	Cross	60" RCP	2-10'x6' RCB	Hillcrest Ave./ Southwestern Blvd Intersection	Hillcrest - 60 ft Southwestern - 55 ft
7	12" Water 8"-12" Wastewater	Parallel	12"- 54" RCP	3'x2' RCB 10'x5' RCB	Airline Rd	City of Dallas - Appx roadway width = 35ft
8	6" Water	Parallel	54" RCP	10'x6' RCB	Colgate Ave.	50 ft
9	12" Water 6" Wastewater	Parallel	60" RCP	2-10'x6' RCB	Hillcrest Ave.	60 ft
10	6" Wastewater	Parallel	60" RCP	2-10'x6' RCB	Southwestern Blvd.	55 ft

A preliminary assessment of potential utility conflicts was completed based on available data. Most utility crossings appear to not intersect with proposed storm drain improvements with the exception of the 8-inch wastewater line listed in Table 4 as Potential Conflict No. 3. Additional survey will be needed during the preliminary design in order to verify if the conflict exists. In addition, potential parallel line conflicts are not considered to be of significant concern based on available street ROW widths.

### Opinion of Probable Construction Costs

In conjunction with this SWMP, HZ has developed cost estimates of construction costs of improvements recommended to address deficiencies in UTCB-A drainage system. **Table 5** includes a summary of cost estimates for all improvements within the basin. **Tables 6-8** included conceptual-level construction costs separated by AOI. All cost estimates include a 30% contingency to account for items that would be determined during concept or preliminary design phases. The following construction cost estimates are considered planning-level only. Proposed improvements and construction costs should be analyzed further during preliminary design.

**Table 5 – Construction Cost Estimate UTCB-A**

Item	Cost
AOI – 1	\$11,933,000
AOI – 2	\$8,746,000
AOI - 3	\$23,839,000
TOTAL COST=	\$44,518,000

**Table 6 – Construction Cost Estimate AOI – 1 (Advanced Project Alternative)**

Item	Quantity	Unit	Unit Cost	Item Total
3x2 RCB	355	LF	\$170	\$60,000
4x2 RCB	153	LF	\$170	\$26,000
10x4 RCB	187	LF	\$600	\$112,000
10x5 RCB	166	LF	\$600	\$100,000
10x6 RCB	4946	LF	\$700	\$3,462,000
Pipe Removal/Disposal	4894	LF	\$20	\$98,000
Pavement Repair	9347	Sq-Yd	\$75	\$701,000
Caruth Park Underground Det	17.5	Ac-Ft	\$264,000	\$4,620,000
			TOTAL COST=	\$9,179,000
			+30% Contingency=	\$11,933,000

**Table 7 – Construction Cost Estimate AOI - 2**

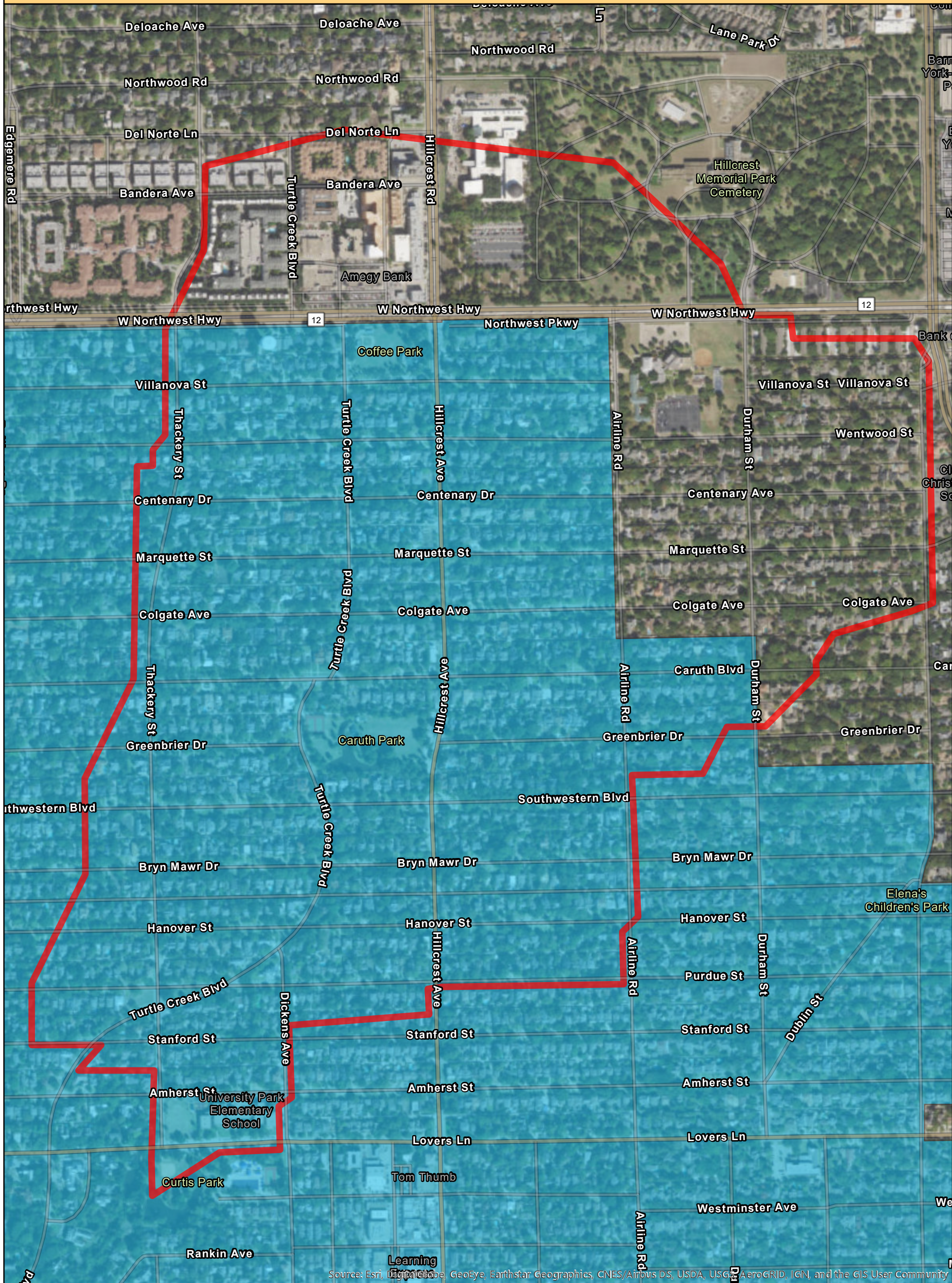
Item	Quantity	Unit	Unit Cost	Item Total
42" RCP	746	LF	\$130	\$97,000
36" RCP	751	LF	\$120	\$90,000
10'x3' RCB	471	LF	\$650	\$306,000
10'x4' RCB	4670	LF	\$600	\$2,802,000
10'x5' RCB	1280	LF	\$600	\$768,000
Pavement Repair	20750	SQ-YD	\$75	\$1,556,000
Coffee Park Det	4.2	AC-FT	\$264,000	\$1,109,000
			TOTAL COST=	\$ 6,728,000
			+30% Contingency=	\$8,746,000

**Table 8 – Construction Cost Estimate AOI - 3**

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>	<i>Unit Cost</i>	<i>Item Total</i>
24" RCP	1197	LF	\$60	\$72,000
54" RCP	170	LF	\$230	\$39,000
66" RCP	173	LF	\$400	\$69,000
6'x3' RBC	1785	LF	\$350	\$625,000
10'x4' RBC	390	LF	\$600	\$234,000
10'x5' RBC	2331	LF	\$600	\$1,399,000
8'x6' RBC	970	LF	\$500	\$485,000
10'x6' RBC	7900	LF	\$650	\$5,135,000
10'x7' RBC	4507	LF	\$700	\$3,155,000
Pipe Removal/Disposal	4894	LF	\$20	\$63,000
Pavement Repair	26567	SQ-YD	\$75	\$1,993,000
School/Curtis Park Det	13.8	AC-FT	\$264,000	\$3,643,000
Turtle Creek/Purdue Det	5.4	AC-FT	\$264,000	\$1,426,000
			TOTAL COST=	\$18,337,600
			+30% Contingency=	\$23,839,000



# Exhibit 1 - Upper Turtle Creek Basin - A



## Legend

-  City of University Park
-  UTCB-A Boundary

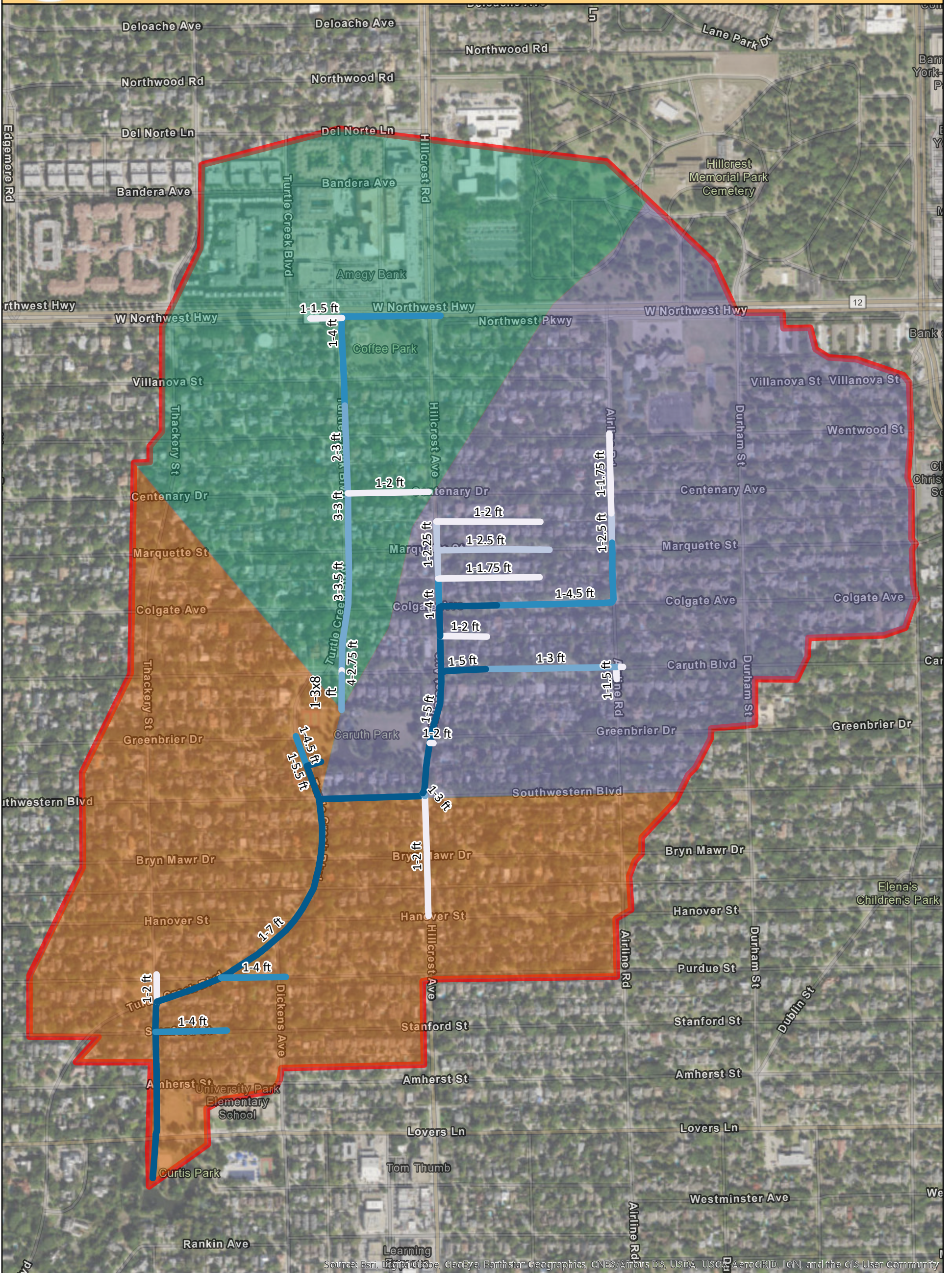
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# Exhibit 2 - Area of Interest Map



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

## Legend

- |                 |       |                      |       |       |       |       |
|-----------------|-------|----------------------|-------|-------|-------|-------|
| UTCB-A Boundary | AOI-1 | Existing Storm Drain | 1.750 | 2.500 | 3.500 | 5.000 |
| AOI-2           | AOI-3 | Diameter (ft)        | 2.000 | 2.750 | 4.000 | 5.500 |
|                 |       | 1.500                | 2.250 | 3.000 | 4.500 | 7.000 |

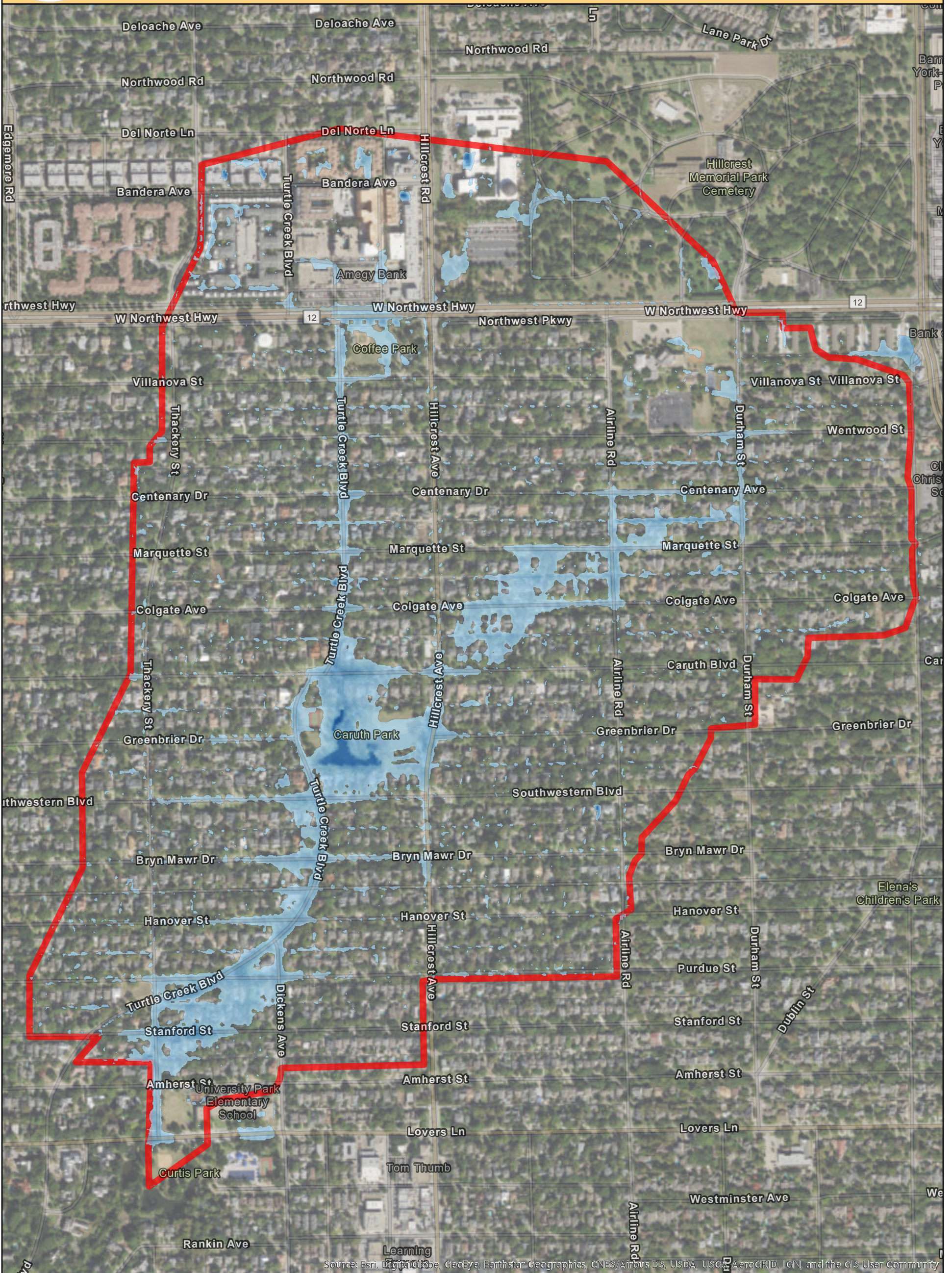
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# Exhibit 3 - Existing 10% AEP



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

## Legend

UTCB-A Boundary	Existing 10% AEP	≤ 1.5	≤ 3.5	≤ 5.5	≤ 7.8
	Depth (ft)	≤ 2	≤ 4	≤ 6	
		≤ 2.5	≤ 4.5	≤ 6.5	
		≤ 1	≤ 3	≤ 5	≤ 7

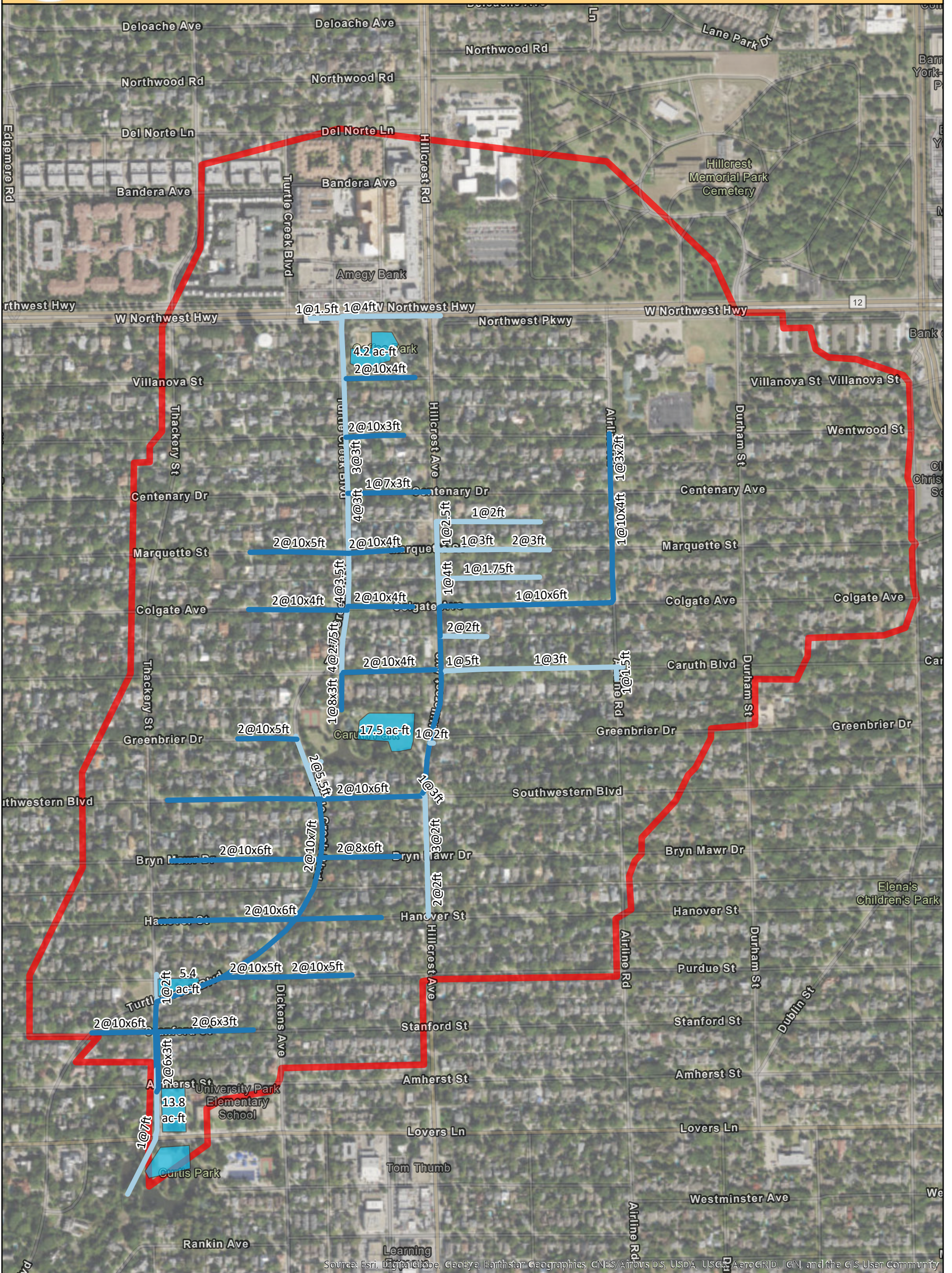
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# Exhibit 4 - Proposed Improvements



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

## Legend

- ▬ UTCB-A Boundary
- ▭ Detention
- ▬ Proposed Improvements
- ▬ RCP
- ▬ RCB

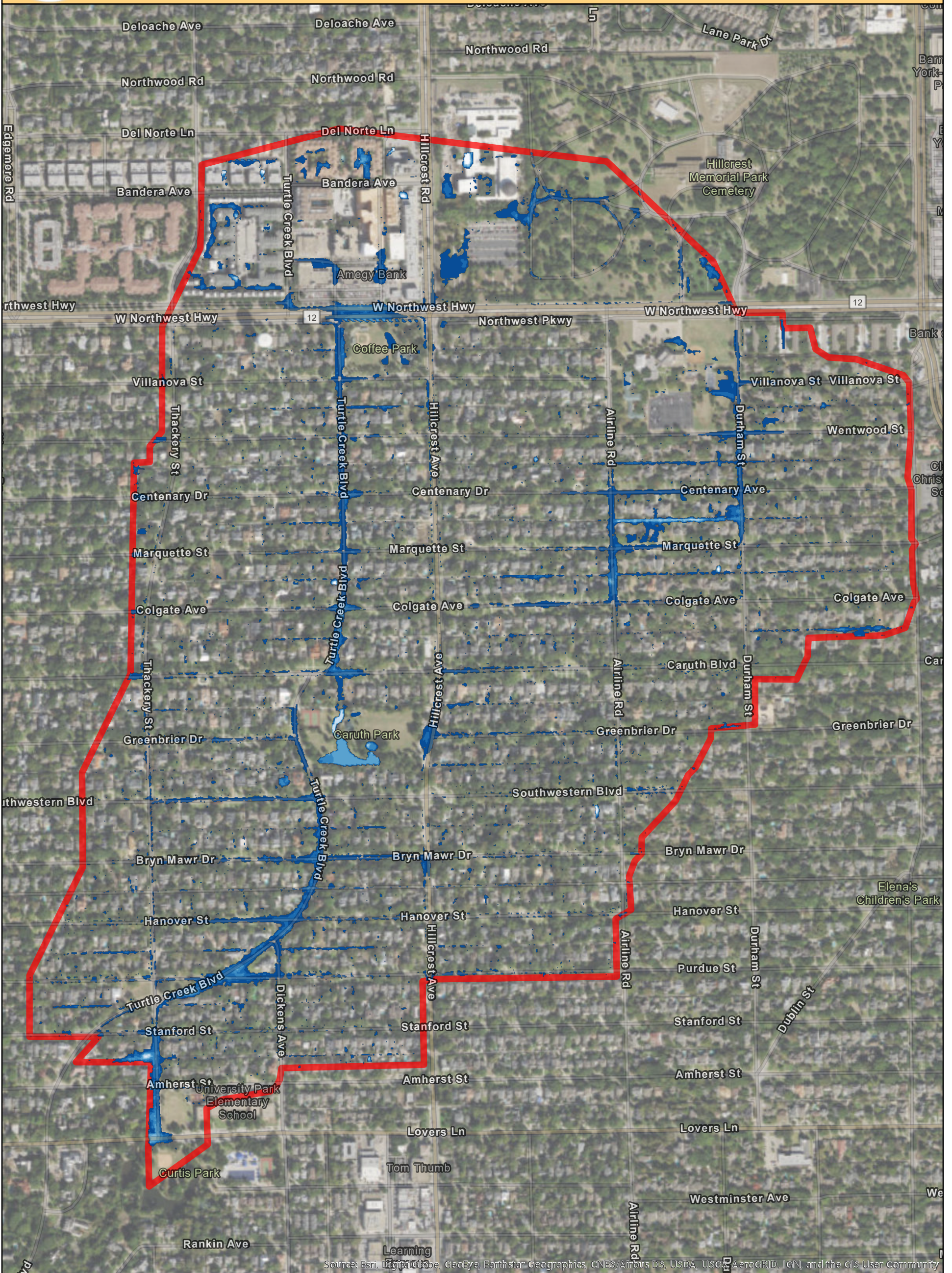
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# Exhibit 5a - Proposed 10% AEP



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

## Legend

 UTCB-A Boundary	Proposed 10% AEP	 ≤ 1	 ≤ 2.5	 ≤ 4
	Value	 ≤ 1.5	 ≤ 3	 ≤ 4.5
		 ≤ 2	 ≤ 3.5	 ≤ 5

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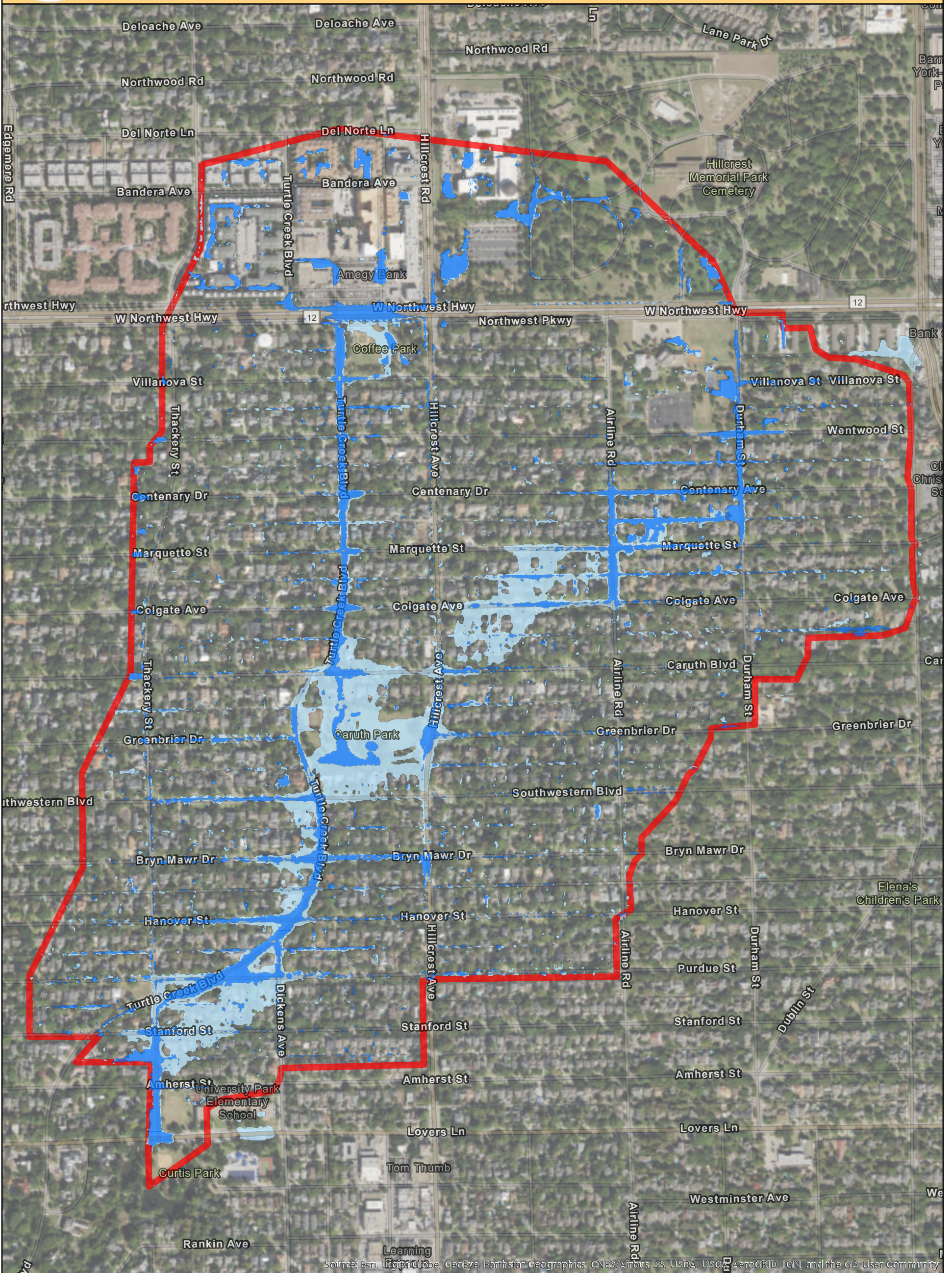


\*Flood extents for depths exceeding 0.5 ft.





# Exhibit 5b - Existing vs Proposed 10% AEP



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

### Legend

- UTCB-A Boundary
- Existing 10% AEP
- Proposed 10% AEP

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Feet

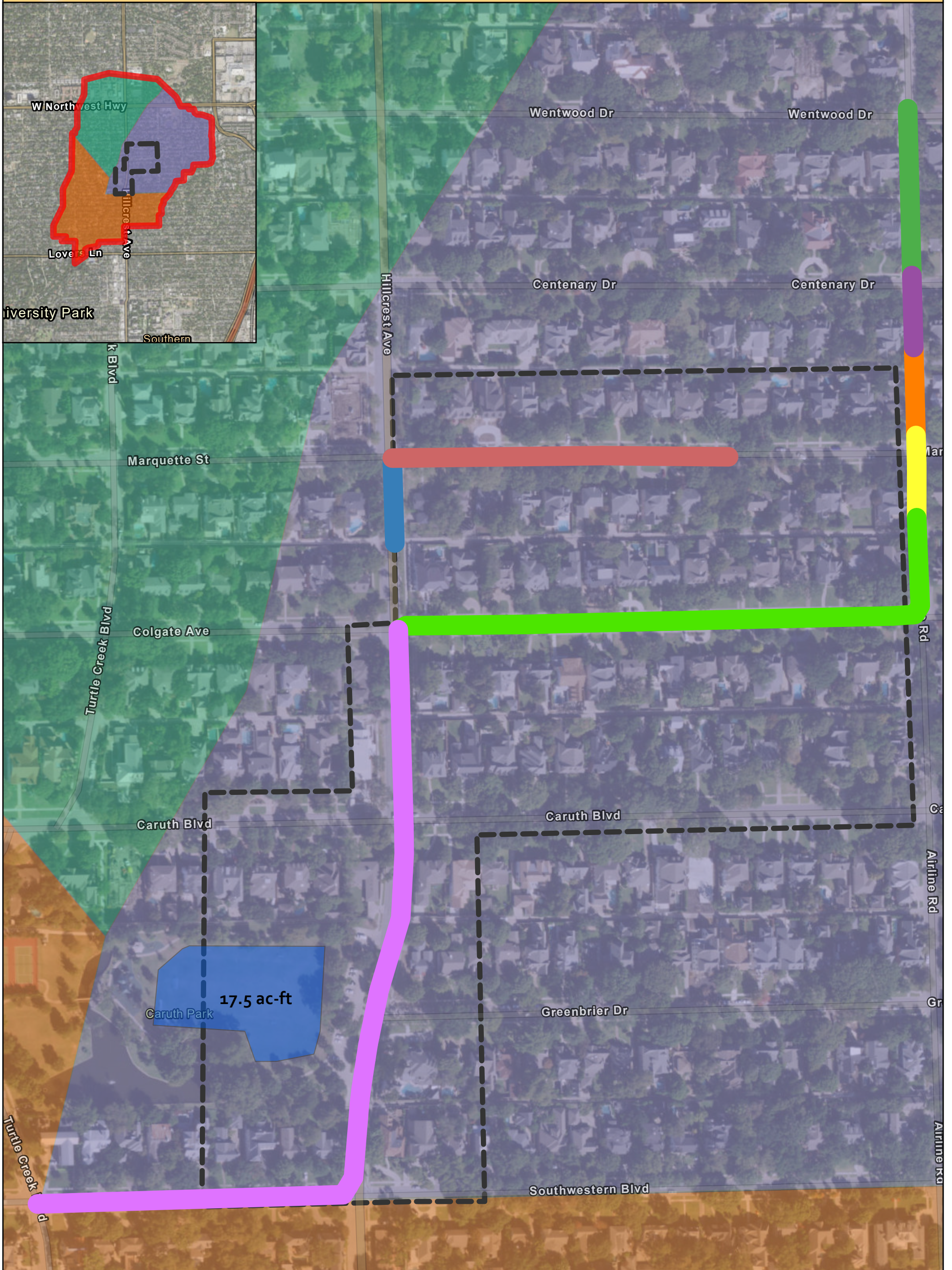


\*Flood extents for depths exceeding 0.5 ft.





# Exhibit 6 - Advanced Project Area



### Legend

- |                       |       |                               |            |          |          |           |
|-----------------------|-------|-------------------------------|------------|----------|----------|-----------|
| UTCB-A Boundary       | AOI-1 | Advanced Project Improvements | 1- 48" RCP | 1- 4'x2' | 1-10'x5' | 2-10'x6'  |
| Advanced Project Area | AOI-2 | 1- 36" RCP                    | 1- 3'x2'   | 1-10'x4' | 1-10'x6' | Detention |
|                       | AOI-3 |                               |            |          |          |           |

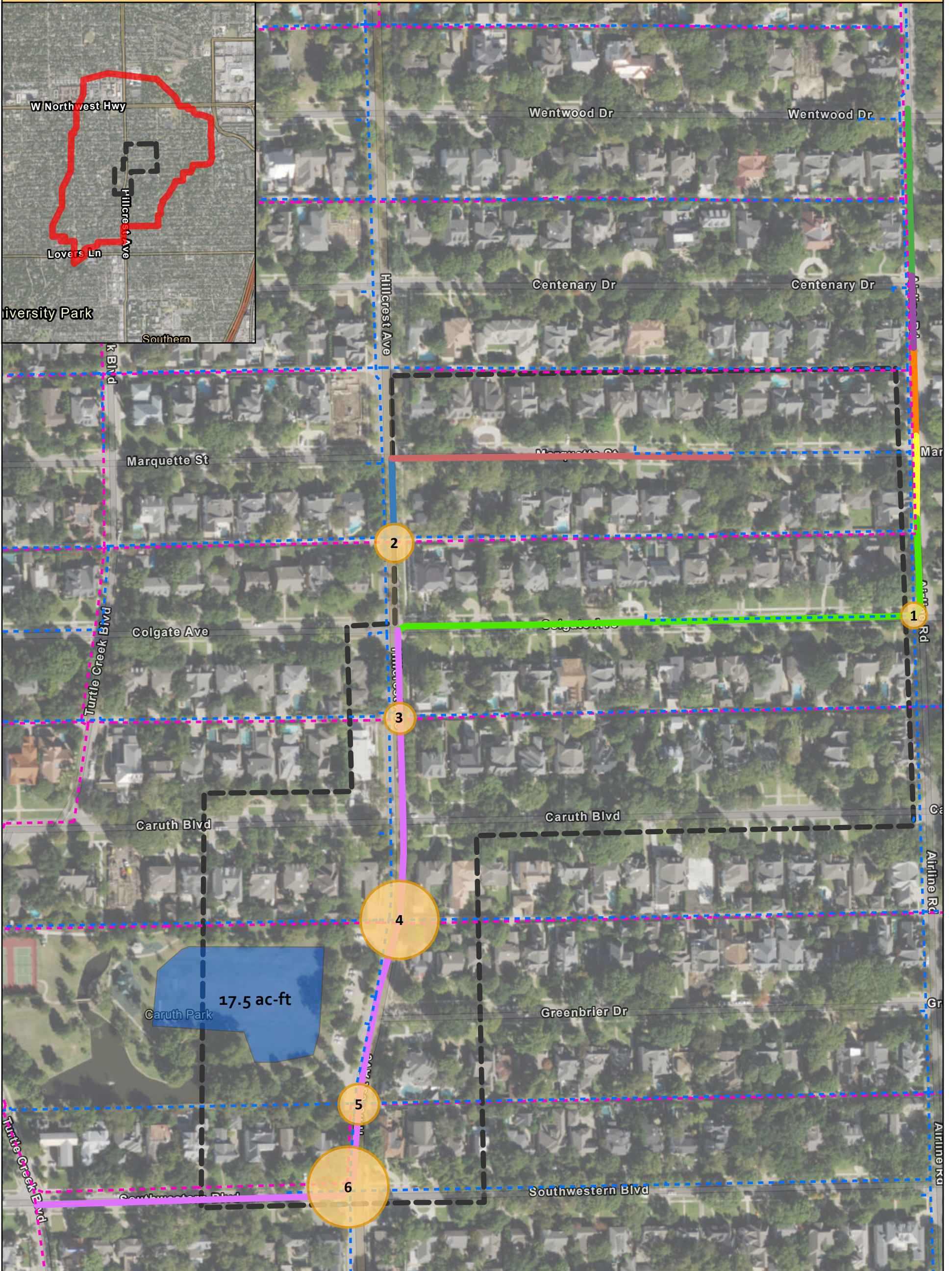
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# Exhibit 7 - Potential Utility Conflicts



**Legend**

- |                             |            |                 |                 |                       |  |          |           |
|-----------------------------|------------|-----------------|-----------------|-----------------------|--|----------|-----------|
| Potential Utility Conflicts | Water Pipe | Wastewater Pipe | UTCB-A Boundary | Advanced Project Area | Advanced Project Improvements 1- 3'x2' | 1-10'x5' | Detention |
|                             |            |                 |                 |                       | 1- 4'x2'                               | 1-10'x6' |           |
|                             |            |                 |                 |                       | 1-10'x4'                               | 2-10'x6' |           |
|                             |            |                 |                 |                       | 1- 36" RCP                             |          |           |
|                             |            |                 |                 |                       | 1- 48" RCP                             |          |           |

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