Huitt-Zollars, Inc.

Downstream Assessment Report For The Molodow And Collinwood Sites

Town of Fairview

Prepared for:

Town of Fairview
372 Town Place
Fairview, TX 75069

Prepared by:

Huitt-Zollars, Inc.
1717 McKinney Avenue, Suite 1400
Dallas, TX 75202
Firm Registration No. F-761

T (214) 871-3311
F (214) 871-0757

www.huitt-zollars.com

April 24, 2020

Table of Contents

Appendices

Overview

Huitt-Zollars has prepared a downstream assessment to determine the potential impacts to downstream properties from developing the Molodow site and the Collinwood site, located near the intersection of Stacy Road and Country Club Road, within the Town of Fairview jurisdictional limits.

The Molodow site is a 28-acre tract of land generally located on the north side of Stacy Road, between Kentucky Lane and Country Club Road. The site is surrounded by low-density residential developments to the west, east, and north sides and by Stacy Road on the south side. A school is adjacent to the site's northwest portion. There is a request for approval of a change in zoning from Agriculture District (AG) to a (PC) Planned Center District with the (RE-2) Two-Acre Ranch Estate District design standards. The proposed development includes a street with a cul-de-sac and 13 residential lots. A site location map and conceptual land plan exhibit can be found in Appendix A.

The Collinwood site is an 11.8-acre tract of land generally located on the west side of Country Club Drive and on the north side of Old Stacy Road. The site is surrounded mostly by low-density residential developments on the south, west and north sides and by Country Club Road and an educational facility on the east side. The site is zoned (PC) Planned Center District. This future development entails the creation of a cul-de-sac street and three additional 1.5-acre residential lots. A site location map and conceptual land plan exhibit is included in Appendix A.

Interviews with residents downstream of the Molodow site have been conducted concurrently with this study. Some of the properties may be directly impacted by this development due to their location in the downstream portion of the watershed draining to Sloan Creek. Residents in these potentially impacted properties have expressed their concerns with the potential drainage impacts related to the new development. A discussion on the drainage concerns is included on Appendix D.

Drainage Design Criteria

According to the Town of Fairview Stormwater Ordinance, the drainage design for areas less than 160 acres must be developed using the Rational Method. The intent of this downstream assessment is to determine the impacts to downstream properties by comparing pre and post development discharges at various locations downstream of the development, accounting for the effects of hydrograph timing of peak at different sub-basins. Since the Rational Method does not account for timing of peak it was not suitable for the intended purposes and goals of this assessment. Therefore, the unit hydrograph method was used to develop a hydrologic model with multiple watersheds and estimate runoff.

Approach

The design approach consisted of developing an existing conditions hydrologic model to establish baseline conditions, calculating peak discharges at various locations downstream of both sites. Then, the existing conditions model was used to create a proposed conditions model reflecting the new developments. In addition to the 1% Annual Chance Flood (100-year flood), lower frequency storms needed to be considered to ensure increase in channel velocities and conveyance were kept in check, to prevent potential channel erosion. Therefore, the 1-year and 5-year storm frequencies were also analyzed. The limits of the analysis extended to the Zone of Influence point, which is the downstream location where the impact due to the development no longer has a potential impact on the watershed. The Zone of Influence (ZOI) point was determined based on the 10% rule, which is the point at which the proposed site area consists of 10% or less of the total watershed area.

Post-project drainage sub-basins within the Molodow site were revised based on the conceptual land plan provided by the developer to the Town of Fairview and based on conversations between Huitt-Zollars engineering staff and the developer on how the proposed site would drain. Proposed conditions hydrologic parameters such as curve number and lag time were adjusted based on the proposed 2-acre residential land use and the revised configuration of drainage boundaries within the site.

Proposed conditions curve numbers were developed for the Collinwood site based on the future 1.5-acre residential land use. Drainage boundaries and lag time were left the same as existing conditions. Due to the location of the site within a larger upstream watershed and the small percentage increase in impervious area, an on-site detention option was not evaluated due its potential adverse impact downstream caused by holding the peak discharge from the site to where it would coincide the peak discharge from the upstream watershed. The downstream analysis extend to the Zone of Influence point based on the 10% rule.

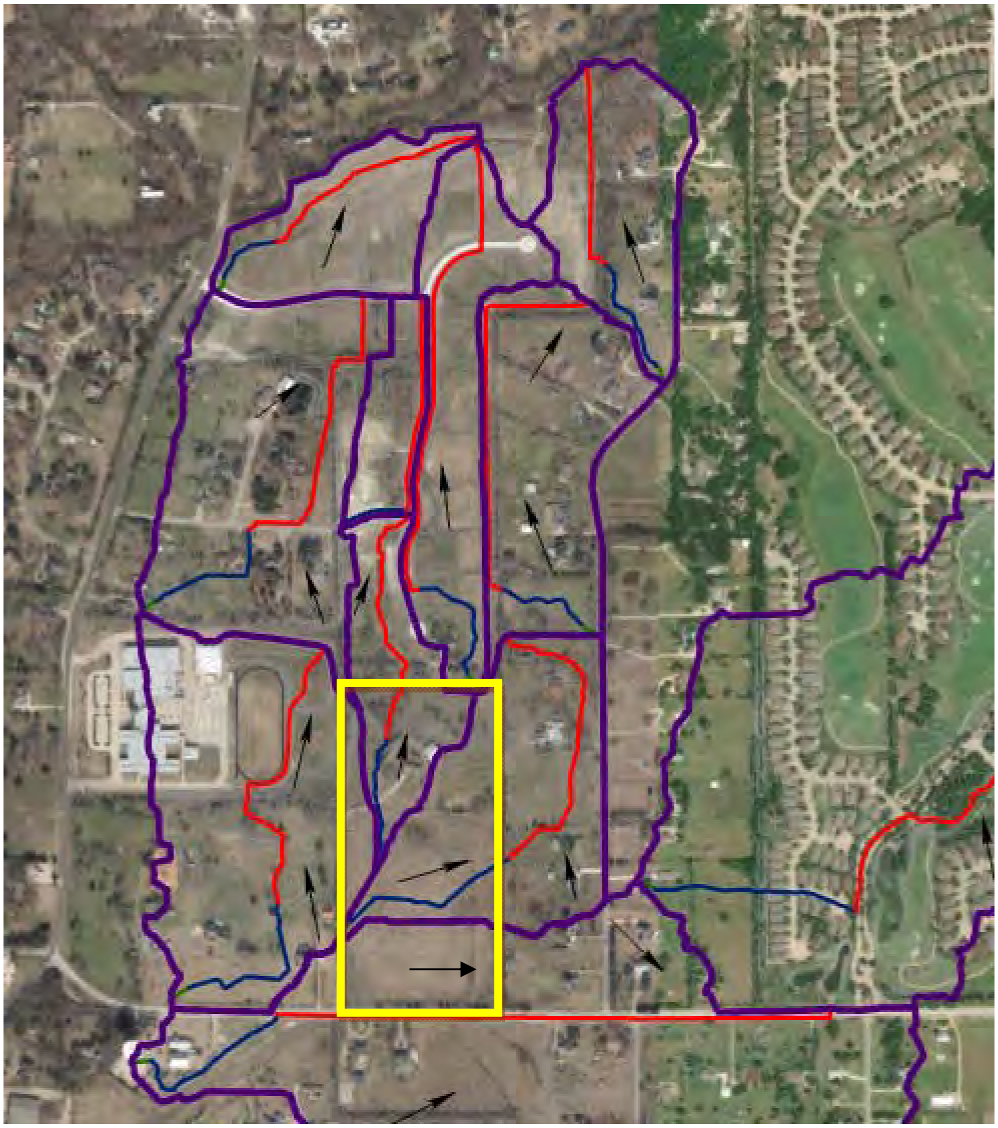
Methodology

The SCS unit hydrograph method was used to generate peak discharges for the 1-yr, 5-yr and 100-yr frequency events. The HEC-HMS model used for the site analysis was extended downstream to the ZOI point for the different watersheds. The downstream analysis used TR-55 methodology to estimate Curve Numbers and Time of Concentration. Soils data was obtained from Natural Resource Conservation Service (NRCS) Web Soil Survey. Land use data was obtained from USGS's National Land Cover Database (NLCD) and corrected at specific locations according to the Town of Fairview Land Use Map. ARC GIS pro was used to generate curve numbers based on the different land uses and soil types. Contour data used to delineate drainage boundaries consisted of one-foot LIDAR generated contours provided to Huitt-Zollars by the Town of Fairview. A field evaluation was performed by Huitt-Zollars at the Molodow site and Harper Landing site to confirm and make adjustments to drainage boundaries delineated based on contours.

Existing and Proposed Conditions Drainage Area Maps can be found in Appendix A. Soils Maps, and Land Use Maps used to derive curve numbers, along with back up calculations for Time of Concentration can be found in Appendix B.

Hydrologic Analysis –Existing Conditions

<u>Molodow Site</u>
The Molodow site is located on "high ground" and the drainage from the site flows into four different directions. The map below shows how the drainage from the site splits into the four different downstream watersheds and the drainage paths downstream of the site.



A small portion along the western property line drains to the school pond. The outfall of the pond drains along a ditch along the back of vacant lots in Harper Landing subdivision. The flowpath along the ditch extends downstream crossing under Harper Landing Street via a culvert and then being carried to a large swale between two vacant lots to Sloan Creek. This is watershed “A”, as shown in the Existing Conditions Drainage Area Map, consisting of three sub-basins.

Sub-basin A1 drains to the school detention facility. As-built drawings indicated the pond was sized using the Modified Rational method, utilizing peak discharges calculated by the Rational Method. The peak discharges calculated using the Unit Hydrograph method for basin A1 were larger than the peak discharges calculated by the Rational Method. In order for the model to run, the curve number for basin A1 was calibrated to generate the same peak discharge calculated by the Rational Method.

A portion of the northern part of the site drains mostly north through Harper Landing until it reaches a roadside ditch along the west side of Michelle Way. A berm along a portion of the northern property line of the site directs the flows to the west side, and then north across vacant lots. From there it flows along the ditch in the west side of Michelle Way, crosses under a culvert on Harper Landing Street, continues along the same ditch until it turns north along a swale between two vacant lots and outfalls into a larger overflow channel which outfalls into Sloan Creek. This is watershed “B”, as shown in the Existing Conditions Drainage Area Map, consisting of three sub-basins.

From Harper Landing looking south to Molodow site

The northeastern portion of the site sheet flows east to the residential properties along Kentucky Lane. The flow path turns northwest and flows along a ditch in the back of the lots along Michelle way until the ditch outfalls into Sloan Creek. This is watershed “C”, as shown in the Existing Conditions Drainage Area Map, consisting of three sub-basins.

The southern portion of the site drains east to the residential properties facing Kentucky Lane. The drainage from this area is collected by a drop inlet at the northwest corner of Kentucky Lane and Stacy Road, and then conveyed via a storm drain main line along Stacy Road which outfalls at a detention pond at the northwest corner of Stacy Road and Heritage Ranch Drive.

Surface cover on the site is pastureland in good condition. A residential dwelling and adjacent sheds are the only structures within the site. Flows through watersheds A, B and C were routed using the Muskingum Cunge method in HEC-HMS, which utilizes an eight-point cross-section representative of the drainage ditches. Peak discharges for existing conditions were calculated for each sub-basin within each of the four watersheds, and can be found on Table 1.

<u>Collinwood Site</u>

Surface cover in the Collinwood site is mostly pastureland in good condition with trees in the western side of the property. There are currently two residential dwellings each with one adjacent building. A small stream runs along the western side of the property. The site drains north to adjacent large residential lots and to the small stream running through the property. All drainage eventually outfalls into an existing retention pond within a residential property east of Hackberry Drive.

Hydrologic Analysis –Proposed Conditions

Molodow Site

Proposed land use for the Molodow site consists of 2-acre residential lots. A total of 13 residential lots and a cul-de-sac street are proposed as depicted in the conceptual land plan provided by the developer to the Town of Fairview shown in Figure 1 below. The proposed conditions drainage boundaries were delineated by generally maintaining existing drainage patterns and based on assumptions on how the site drainage will be handled based on input from the developer and the provided land plan. The southern portion of the site is expected to drain east, similar to pre-development conditions, and the flows to be conveyed via a 42-inch diameter RCP along Stacy Road, which outfalls into a retention pond at Heritage Ranch. As built-drawings for Stacy Road indicate the storm drain system was sized using a runoff coefficient of 0.5 for the Molodow site. The coefficient is adequate considering the type of development being proposed. The storm drain line along Stacy Road was therefore sized to accommodate developed flows from the site. Engineering plans for the receiving pond on Heritage Ranch account for the site being developed with a higher runoff coefficient of 0.6. Therefore, both the storm drain along Stacy Road and the retention pond and outlet structure at Heritage Ranch have been sized to accommodate the developed flows from the Molodow site.

The northeastern portion of the site will continue to drain east as in the pre-developed conditions. It is assumed that the lots on the east side of the proposed street will drain partially to the street (approximately 40 feet, where the setback line is located) and the remaining of the lot to the east. Although impervious cover will be added, by diverting some of the lot drainage to the street there will be less area draining to the east, resulting in no increase in flows to the residential lots to the east of the site.

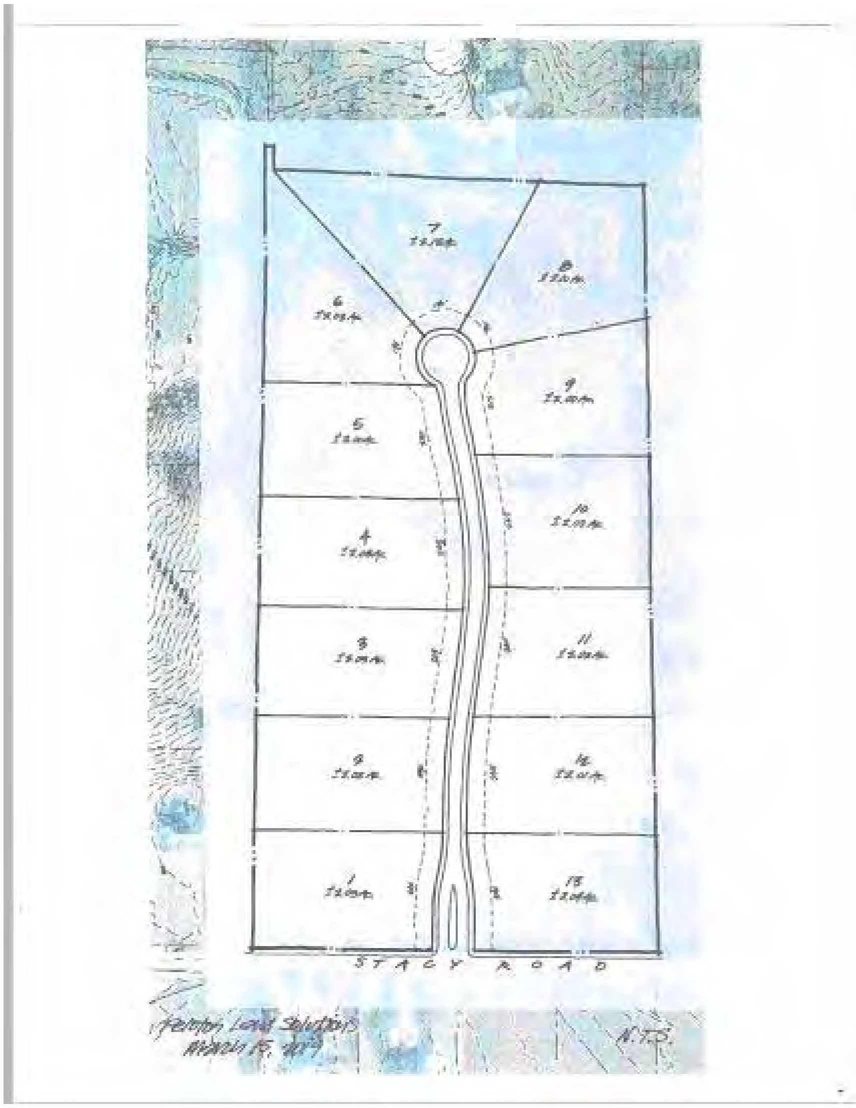


Figure 1 – Conceptual Land Plan for the Molodow site

This analysis assumes – based on the understanding of how the site drainage will be handled - that most of the drainage from the north and west portions of the site will be collected by a new storm drain on the proposed street and routed to the northwest corner of the site, where it will outfall just south of an existing drainage ditch running along the back of the lots on Harper Landing. The existing ditch does not currently extend all the way south to the property line. There is a drainage easement within the private lot at Harper Landing that will allow the ditch to be extended to the southern property line of the Molodow site. The ditch extension should be done to ensure concentrated flow from the site enters the ditch. Routing the runoff to the ditch will cause a slight modification to the existing drainage pattern. This modification will increase the area draining to the drainage ditch and decrease the area that currently drains north through the residential lots on Harper Landing.

Please refer to Table 1 below for a comparison between existing and developed flows.

HMS Junction	Table 1 - Peak Discharges Comparison - Molodow Site						
	Existing (cfs)			Proposed (cfs)			Exis-Prop (cfs)
	1-yr	5-yr	100-yr	1-yr	5-yr	100-yr	100-yr
School Pond	5.8	16.9	65.3	8.3	17.9	69.4	-4.1
JA1B0	5.8	16.9	65.3	11.3	30.0	102.4	-37.1
JA1A2	44.9	91.1	220.7	47.6	99.2	248.2	-27.5
JA2A3	61.9	123.5	295.5	64.0	130.2	319.0	-23.5
JA3B3*	102.7	205.4	490.4	102.4	206.9	499.2	-8.8
Subbasin B1	13.4	26.5	61.2	6.6	13.4	31.6	29.6
JB1B2	17.7	35.1	81.7	14.0	28.6	68.6	13.1
JB2B3	41.0	82.2	194.9	39.2	78.3	183.4	11.5
JA3B3*	102.7	205.4	490.4	101.6	203.5	484.4	6.0
Subbasin C1	28.8	57.7	134.7	25.0	49.8	115.8	18.9
JC1C2	49.8	101.7	246.3	47.8	97.7	235.3	11.0
JC2C3*	67.4	137.6	332.7	66.4	135.0	323.3	9.4
Subbasin D1*	132.8	252.6	563.2	133.4	253.4	564.0	-0.8
JD1D2	274.7	513.9	1125.9	275.3	514.6	1126.7	-0.8

*Zone of Influence point for the watershed

Results from the HEC-HMS hydrologic model show that the post-development discharges are expected to be higher than pre-development discharges through the downstream zone of influence for watershed A, which extends from the ditch just downstream of the existing school pond outfall down to the overflow channel adjacent to Sloan Creek. As an alternative, the runoff from the site can be directed to the school pond in lieu of discharging into the ditch. A proposed condition HEC-HMS model using calibrated curve numbers for the developed site indicated the school pond was not sized to accommodate additional flows. The existing pond has concrete pilot channels, a relatively flat bottom and steep side slopes. This geometry will limit the amount of additional storage that can be obtained by grading the interior of the pond. However, the pond could be expanded to the south to provide additional storage and meet the storage requirements to accommodate additional developed flows from the Molodow site. Assuming an agreement between the developer and the school district can be reached to expand the school pond, a detention pond analysis will be needed to verify the expanded pond will adequately accommodate the additional flows and not significantly increase runoff into the downstream ditch. In addition to the expansion, the outfall structure (currently a V-notch weir) may need to be modified. A HEC-HMS model generated to estimate storage requirements indicated approximately 1 acre-ft of storage capacity would be needed to reduce the post-development discharges back to pre-development discharges. Therefore, it is expected that by expanding the school pond by 1 acre-ft and making a small modification to the existing outfall structure would result in developed discharges and velocities in the downstream ditch that are similar to existing conditions. This approach can be used as an alternative to discharging the site runoff into the ditch and armoring a section of it to prevent erosion.

Post-development discharges for the other three watersheds are expected to be the same or less than pre-development discharges.

<u>Collinwood Site</u>

Future development for the Collinwood site will consist of four residential lots ranging in area from 1.5 acres to 4.1 acres. An additional 2-acre area will remain pastureland. The larger 4.1 acre lot includes the current dwelling, which is to remain. Approximately 5.7 acres of the 11.8 acres will be developed with the proposed zoning change. Figure 2 below illustrates the conceptual land plan provided by the developer to the Town of Fairview.

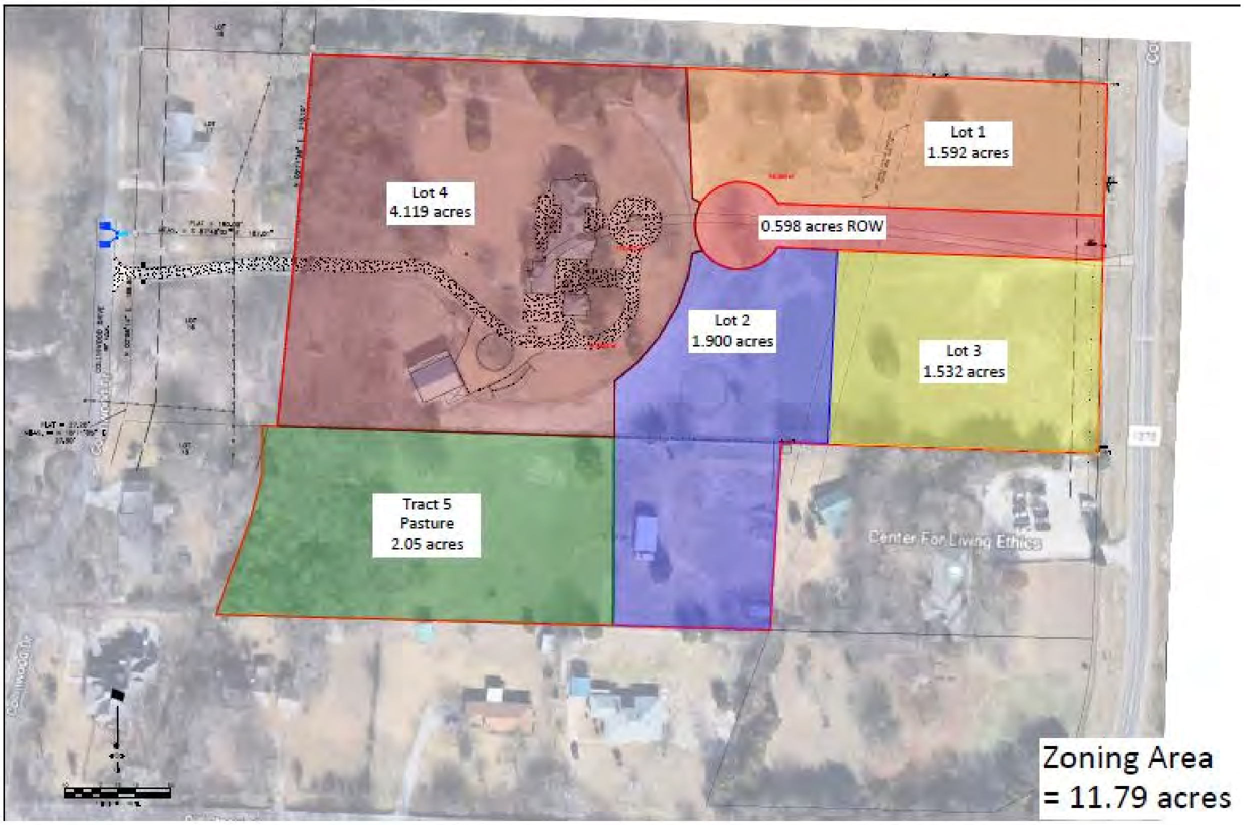


Figure 2 – Conceptual Land Plan for the Collinwood site

This site has a relatively large upstream watershed. Considering the location of the site within the watershed, the limited portion of the site that is expected to be developed in the future, and the low density development being proposed, the increase in runoff is expected to be small. The proposed conditions hydrologic model accounts for developed curve numbers. Table 2 below shows pre-development and post-development discharges at the Zone of Influence point, which is the upstream end of an existing detention pond north of the site and east of Hackberry Drive.

HMS Junction	Table 2 - Peak Discharges-Collinwood					
	Existing (cfs)			Proposed (cfs)		
	1-yr	5-yr	100-yr	1-yr	5-yr	100-yr
F1	271.5	523.8	1182.5	274.2	527	1185.9

Results from the HEC-HMS hydrologic model show a minor/insignificant increase in runoff due to the development at the downstream Zone of Influence point.

Hydraulic Analysis

A hydraulic analysis has been performed in HEC-RAS v.5.07 to determine the impacts due to the increased 1-yr, 5-yr and 100-yr peak discharges in the ditch along the back of the Harper Landing lots facing Farmstead Street and Michelle Way. It is worth noting that existing conditions runoff from the Molodow site draining directly downstream through the Harper Landing lots west of Farmstead Street has been re-routed to the ditch. Although the ditch will carry a larger discharge than under existing conditions, the drainage from the Molodow site which was draining directly to the Harper Landing lots has been essentially eliminated. Table 3 displays the existing conditions peak discharges, water surface elevations, and channel velocities along the ditch for the 1-yr, 5-yr, and 100-yr frequency storms calculated in HEC-RAS.

Table 3 - Existing Conditions Channel Velocities And Water Surface Elevations

	1-Year			5-Year			100-Year		
River Sta.	Q (cfs)	W.S. El. (ft)	Vel. (fps)	Q (cfs)	W.S. El. (ft)	Vel. (fps)	Q (cfs)	W.S. El. (ft)	Vel. (fps)
2869	5.8	557.62	2.22	16.9	558.04	3.17	65.3	558.81	5.39
2129	5.8	547.32	2.66	16.9	547.56	3.38	65.3	548.06	4.65
1655	45.0	541.57	2.38	91.0	541.97	3.19	221.0	542.43	4.34
1375	45.0	539.86	3.27	91.0	540.01	3.95	221.0	540.35	4.55
1277	45.0	539.12	0.43	91.0	539.58	0.57	221.0	540.46	0.81
1207	45.0	539.1	0.72	91.0	539.56	0.88	221.0	540.44	1.2
1116	62.0	538.86	3.3	124.0	539.22	4.35	296.0	539.89	6.07
952	62.0	536.75	4.69	124.0	537.12	5.76	296.0	537.82	7.41
898	62.0	535.14	4.62	124.0	535.55	5.22	296.0	536.24	6.23
202	62.0	525.17	1.52	124.0	525.58	1.91	296.0	526.22	2.58
88	62.0	524.86	2.02	124.0	525.21	2.53	296.0	525.81	3.34

Table 4 displays the proposed conditions peak discharges, water surface elevations, and channel velocities along the ditch for the 1-yr, 5-yr, and 100-yr frequency storms calculated in HEC-RAS.

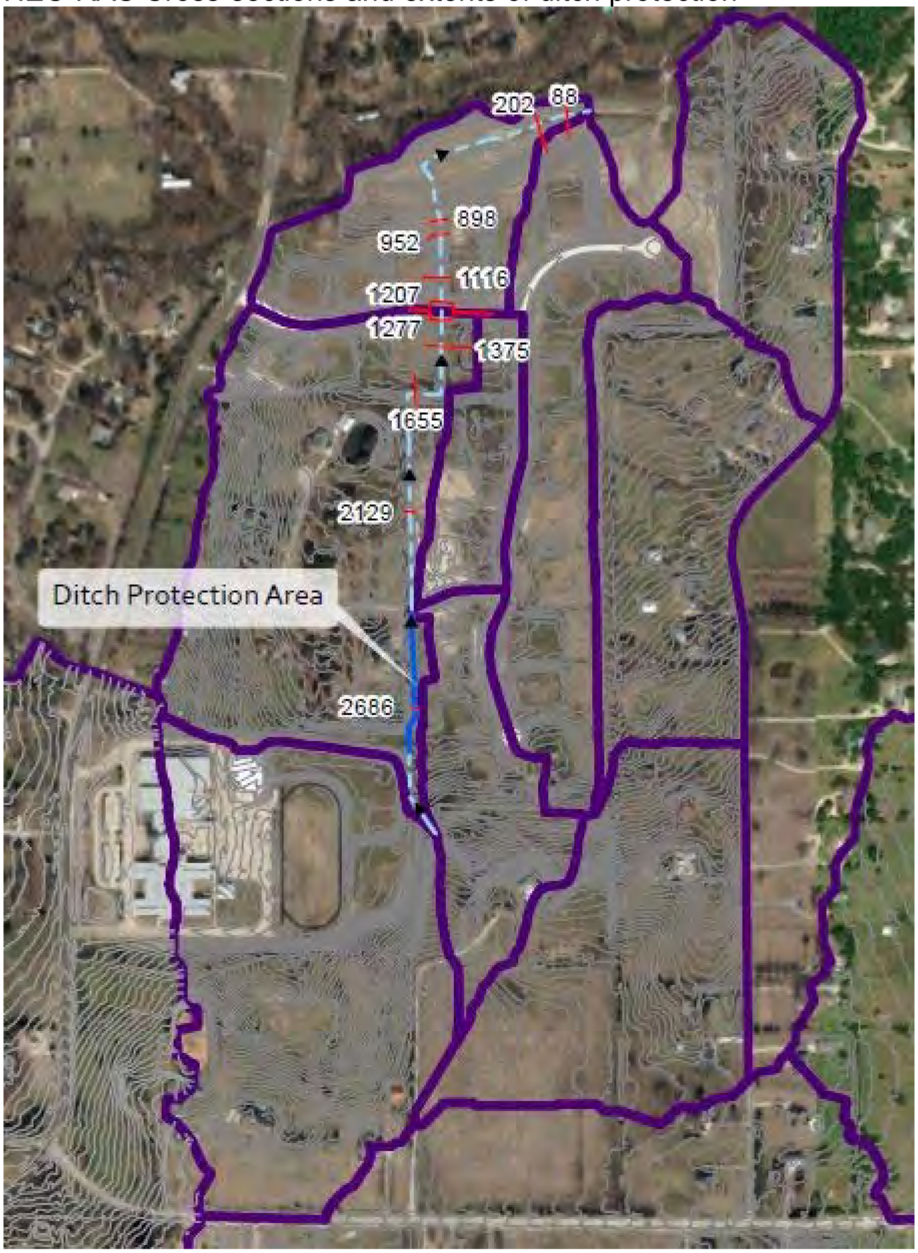
Table 4 - Proposed Conditions Channel Velocities And Water Surface Elevations

	1-Year			5-Year			100-Year		
River Sta.	Q (cfs)	W.S. El. (ft)	Vel. (fps)	Q (cfs)	W.S. El. (ft)	Vel. (fps)	Q (cfs)	W.S. El. (ft)	Vel. (fps)
2869	11.0	557.86	2.71	30.0	558.35	3.86	102.0	559.12	6.69
2129	11.0	547.45	3.08	30.0	547.73	3.83	102.0	548.30	5.24
1655	48.0	541.60	2.45	99.0	542.04	3.36	248.0	542.44	4.76
1375	48.0	539.88	3.32	99.0	540.03	4.05	248.0	540.47	4.22
1277	48.0	539.14	0.45	99.0	539.62	0.6	248.0	540.56	0.87
1207	48.0	539.12	0.75	99.0	539.6	0.93	248.0	540.54	1.29
1116	64.0	538.88	3.33	130.0	539.25	4.43	319.0	539.96	6.23
952	64.0	536.76	4.76	130.0	537.15	5.84	319.0	537.89	7.56
898	64.0	535.15	4.65	130.0	535.59	5.27	319.0	536.31	6.34
202	64.0	525.19	1.54	130.0	525.61	1.95	319.0	526.28	2.66
88	64.0	524.87	2.04	130.0	525.24	2.58	319.0	525.87	3.42

As a general rule, increases in channel velocities by up to 5% of existing velocity values are acceptable and considered to be minor. Velocity increases greater than 5% are acceptable as long as the velocity remains below 6 feet-per-second, which is considered an erosive velocity for most types of soils in the Dallas area. Increases in the 100-yr water surface elevations up to one tenth of foot are acceptable and considered to be minor. Water surface elevation increases greater than one tenth of a foot are acceptable as long as the channel conveying the flow has enough conveyance capacity.

Results of the hydraulic model generally show small increases in water surface elevations and channel velocities. More significant increases in channel velocities take place at cross-sections 2869 and 2129 along the ditch immediately downstream of the school pond. This was expected since part of the site drainage has been redirected to go to the northwest corner of the site and to outfall into the ditch. The only apparent concern is the proposed conditions channel velocity of 6.7 feet-per-second between cross-sections 2869 and 2129, which has a potential for erosion. This section of the ditch should be armored with small size riprap or another suitable armoring or channel lining measure to prevent potential erosion. A Map showing the location of the cross-sections and the ditch section to be protected is included in Appendix C and in the map in the next page. The existing ditch does not currently extend all the way south to the property line. There is a drainage easement within the private lot at Harper Landing that will allow for the ditch to be extended to the southern property line of the Molodow site. The ditch extension should be done to ensure concentrated flow from the site enters the ditch.

HEC-RAS Cross-sections and extents of ditch protection



Increases in 100-yr water surface elevations between 0.1-ft and 0.3-ft are expected at cross-sections 2869, 2129, and 1375.The existing ditch has the capacity to convey the proposed conditions 100-yr flow while providing a minimum of 0.7-ft of freeboard. Discharges are expected to be the same or smaller in the other drainage flowpaths within Harper Landing and the Collinwood site and therefore a hydraulic analysis was not necessary for those ditches and swales.

Conclusion

The increase in impervious area due to the Molodow site development, although relatively small, will increase runoff off-site as expected. The storm drain system along Stacy Road and the detention pond at Heritage Ranch were both sized to accommodate developed discharges from the site. No on-site mitigation or downstream improvements are required for the portion of the site draining to the east and eventually being collected by the Stacy Road drainage system.

The northern portion of the site drains directly to Harper Landing, with a small portion going into the existing school pond. Downstream runoff leaving the site's northeast portion is expected to decrease. Downstream runoff leaving the site's northwest corner is expected to increase when compared to existing conditions, causing potentially erosive channel velocities to occur in the receiving ditch section between the site's northwest corner and the stream running along the back of the lots facing Harper Landing Street. The ditch has the capacity to convey the additional runoff due to the development of the Molodow site, but a section of the channel will need to be armored or appropriately lined to prevent channel erosion. Alternatively, the runoff from the Molodow site could be discharged into the existing school pond. If this approach is chosen in lieu of discharging into the ditch, the pond will need to be expanded to provide approximately 1 acre-ft of additional storage capacity, the outfall structure will possibly need to be modified, and results verified through a detention analysis.

Development of the Collinwood tract is anticipated to result in a small increase in runoff through the downstream zone of influence, but not enough to cause adverse impacts to velocities and water surface elevations. The proposed conditions peak discharges at the downstream Zone of Influence point are expected to be essentially the same as the existing conditions peak discharges.

APPENDIX A

SITE LOCATION MAPS

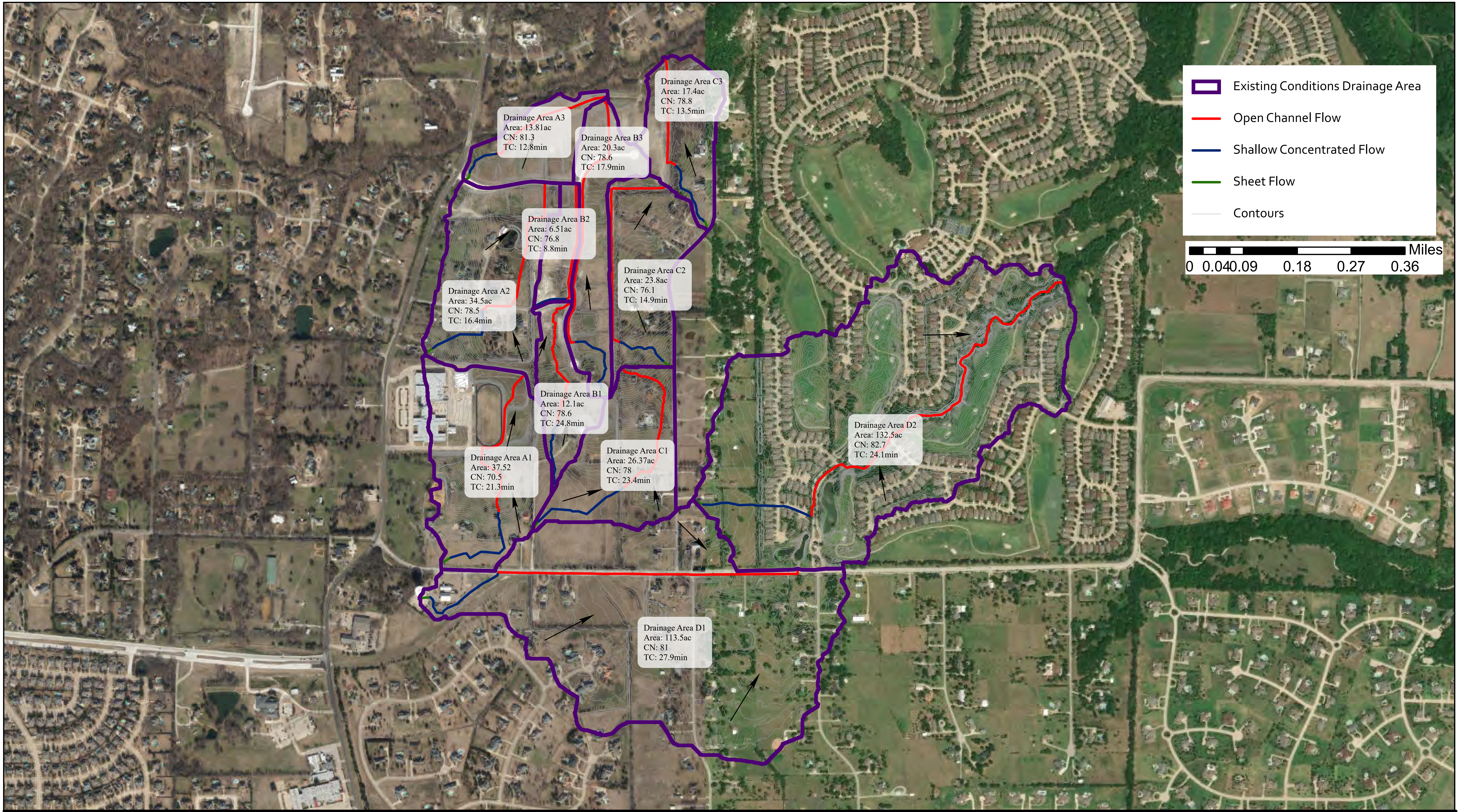
Molodow Tract
ZA2019-04

Collinwood Dr
Subject
FM 1378 (Country Club Rd)
Young Trl
Old Stacy Rd
Stacy Rd

ZA2019-06

APPENDIX B

DRIANGE AREA MAPS



PREPARED BY:

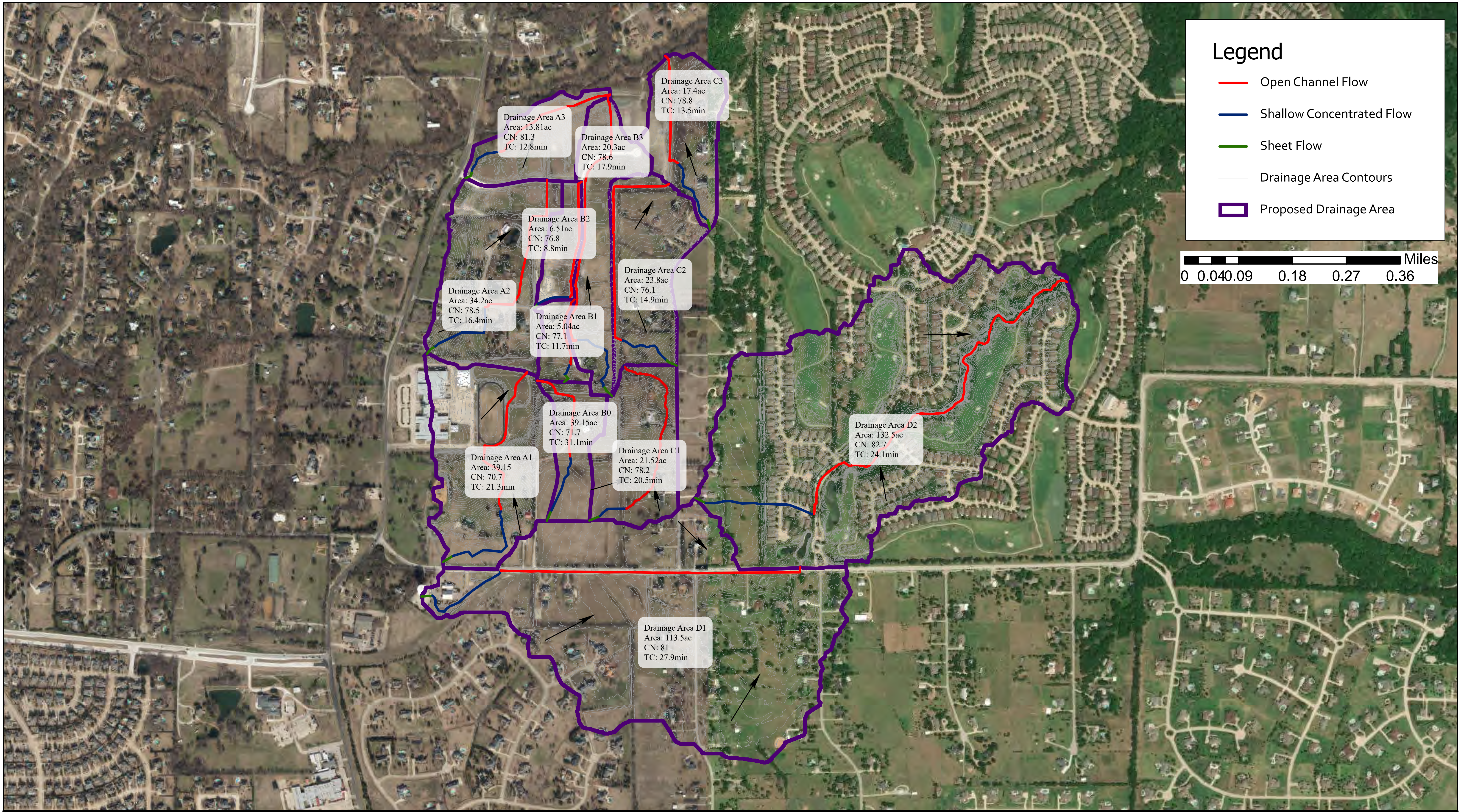
HUITT-ZOLLARS

Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

N

Exhibit 1-Existing Conditions
Drainage Areas

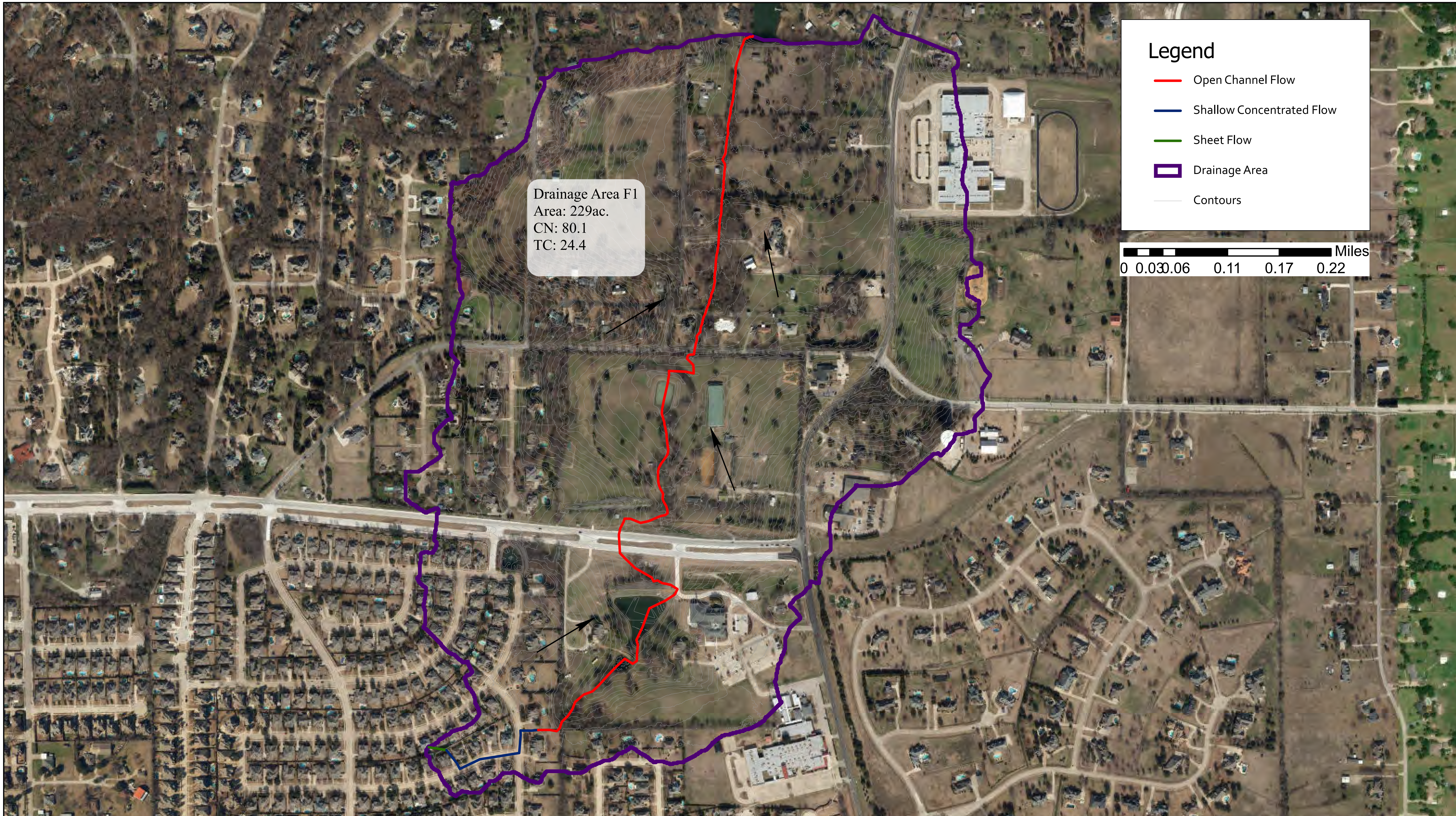


PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

N

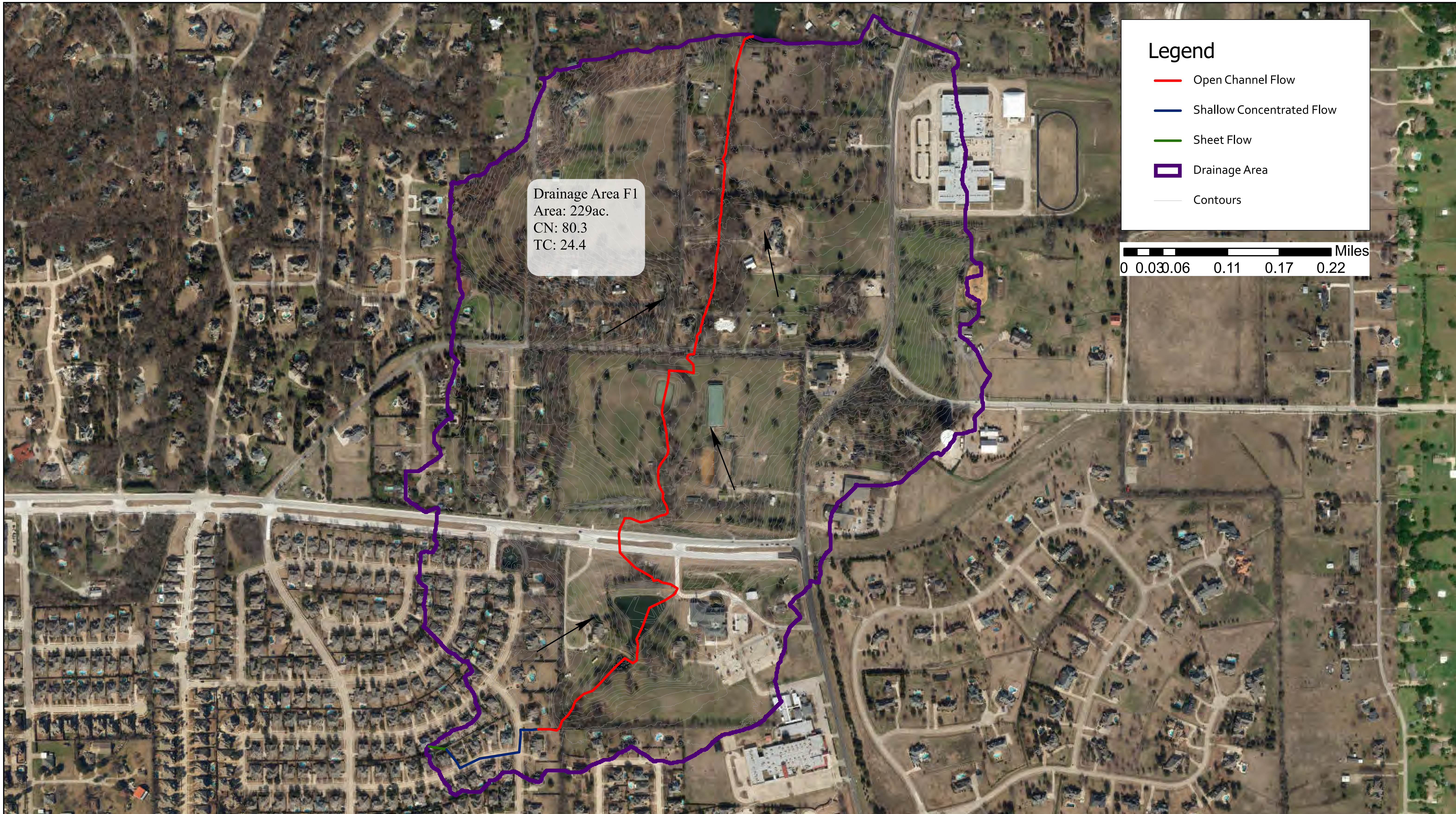
Exhibit 5-Proposed Condition Drainage Area



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Collinwood Property

Exhibit 8- Existing Condition Drainage Areas



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Collinwood Property

N

Exhibit 11- Proposed Condition
Drainage Areas

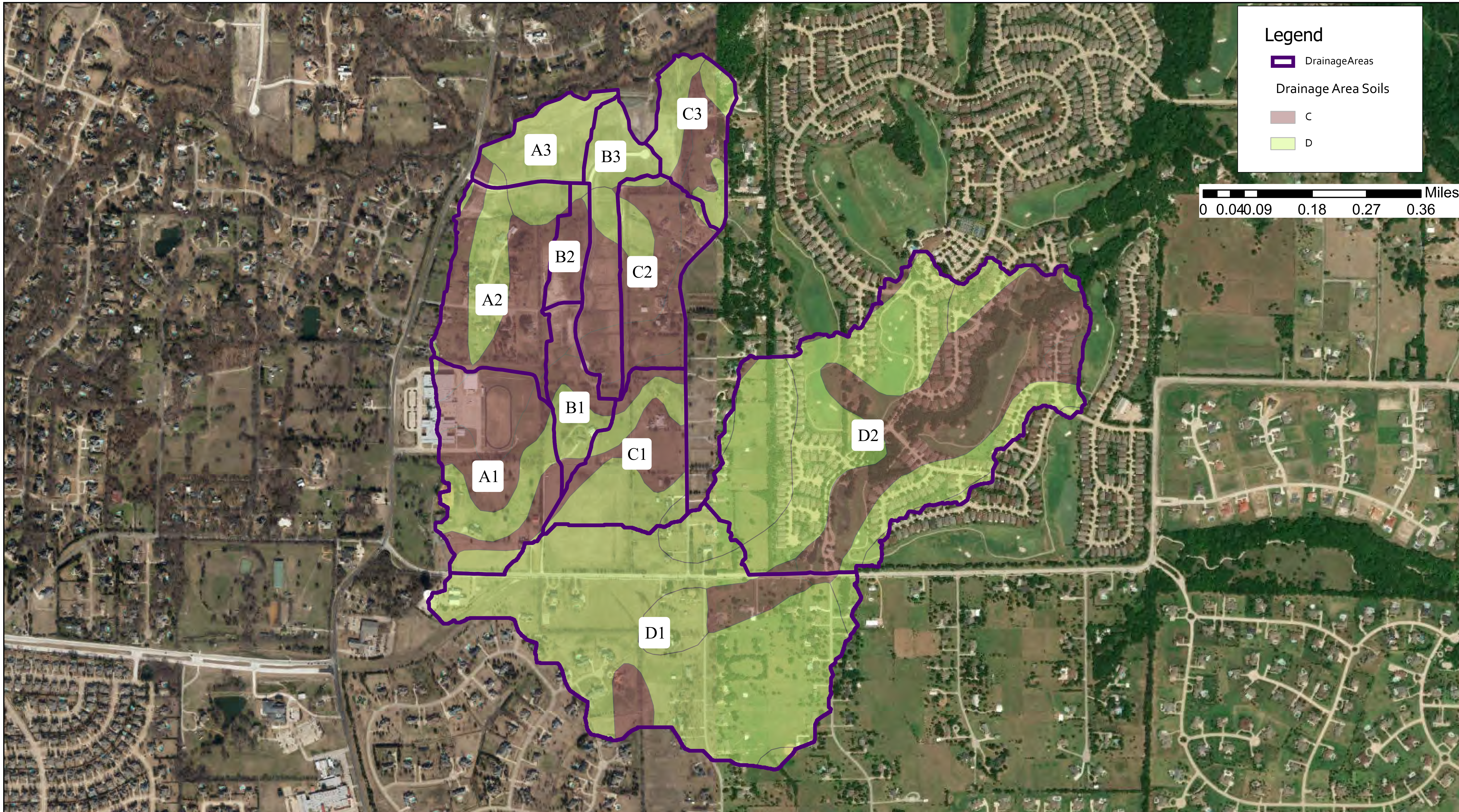
APPENDIX C

SOILS MAP

LAND USE MAP

LAG TIME CALCULATIONS

HEC-RAS CROSS-SECTIONS MAP



PREPARED BY:

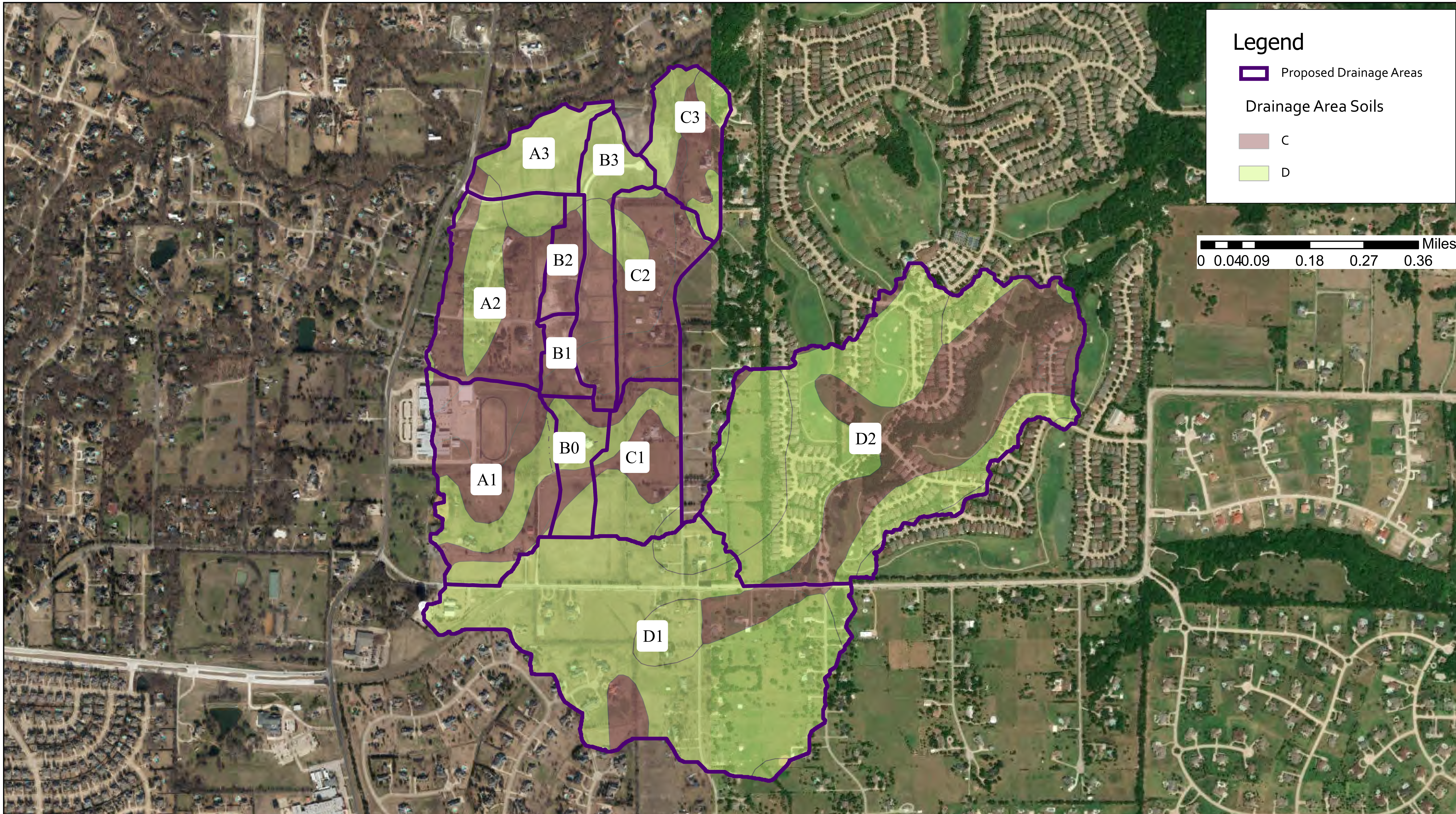
HUITT-ZOLLARS

Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

N

Exhibit 2-Existing Conditions
Soil Map

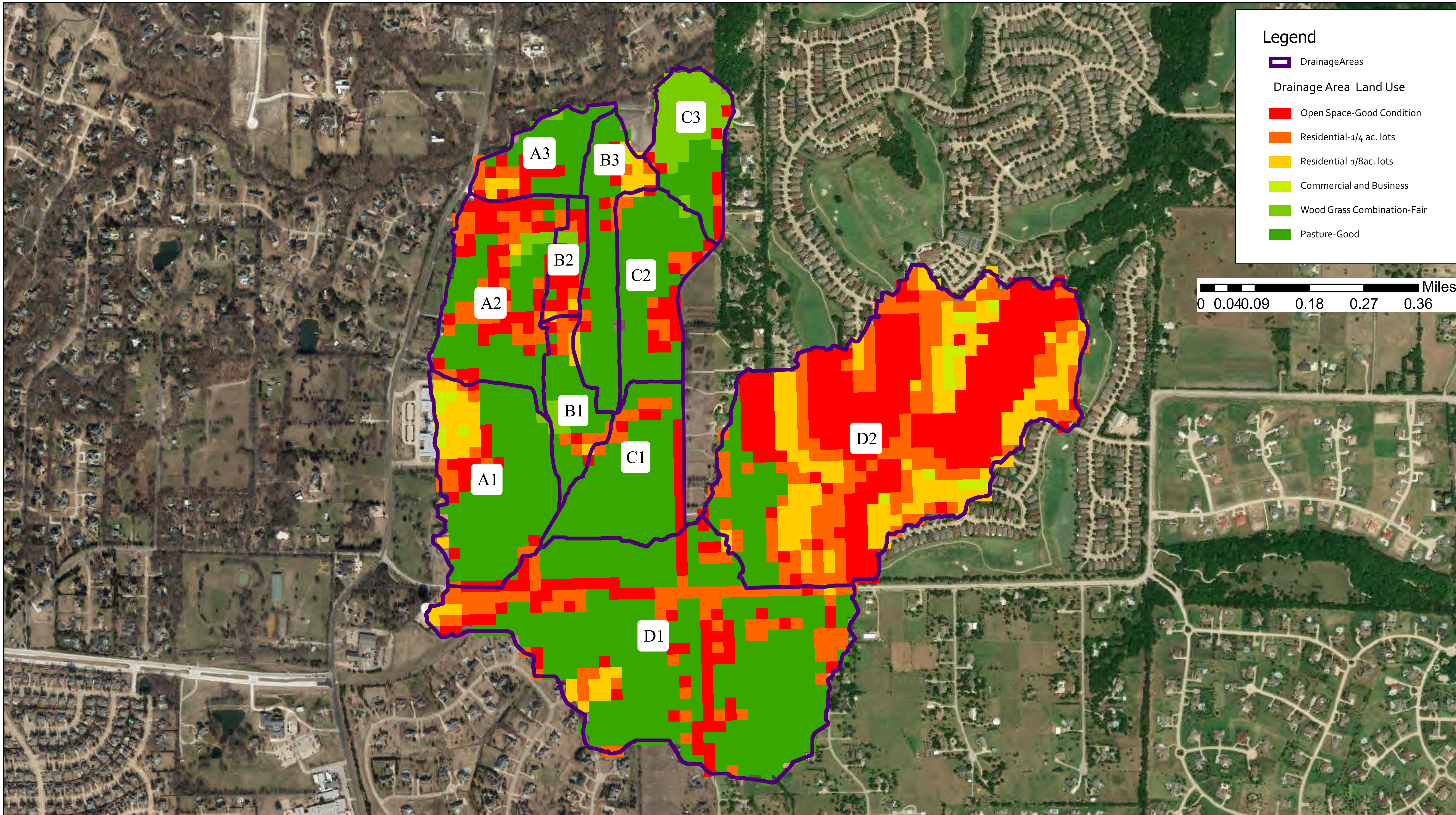


PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

N

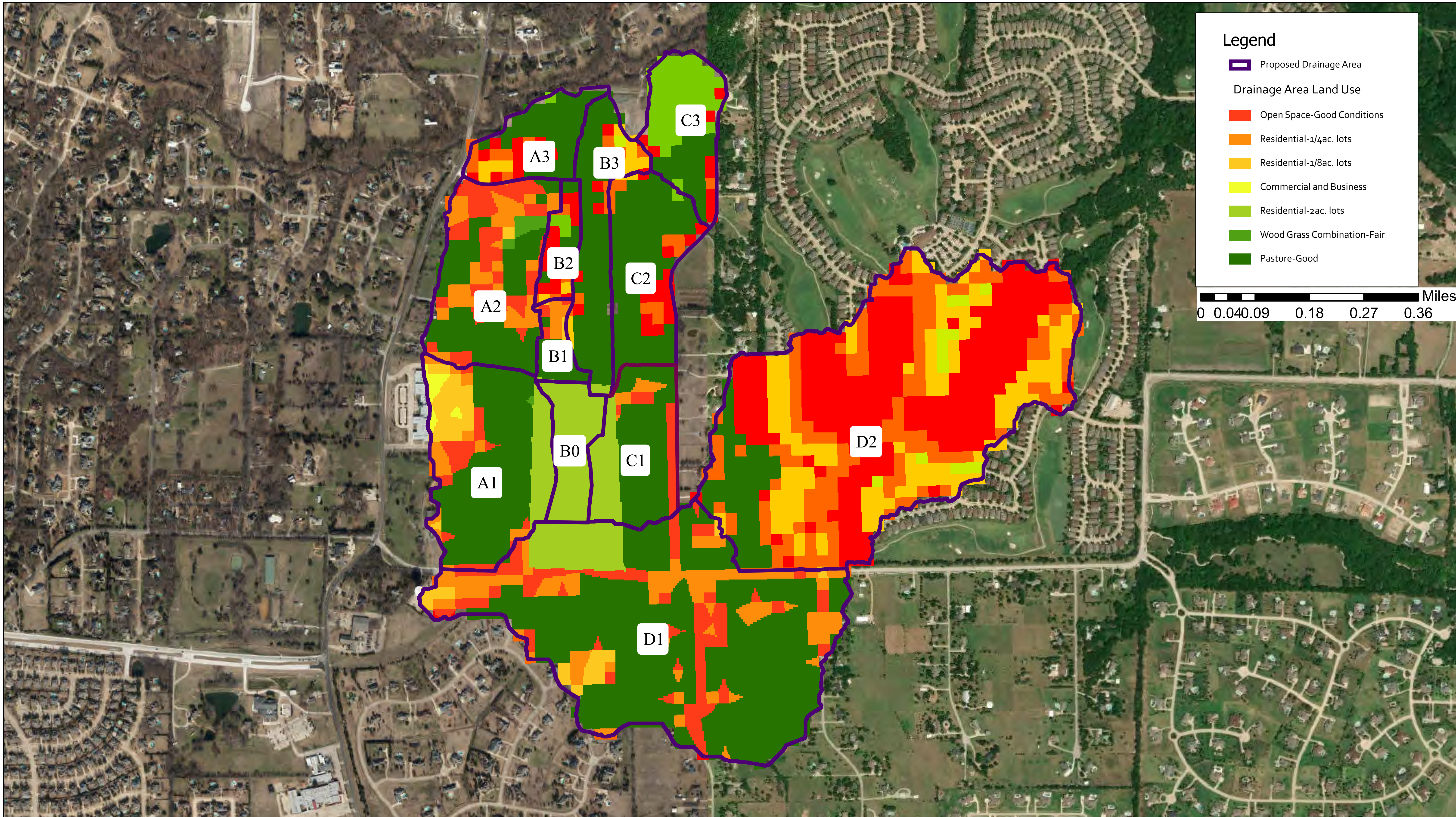
Exhibit 6-Proposed Conditions Soil Map



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

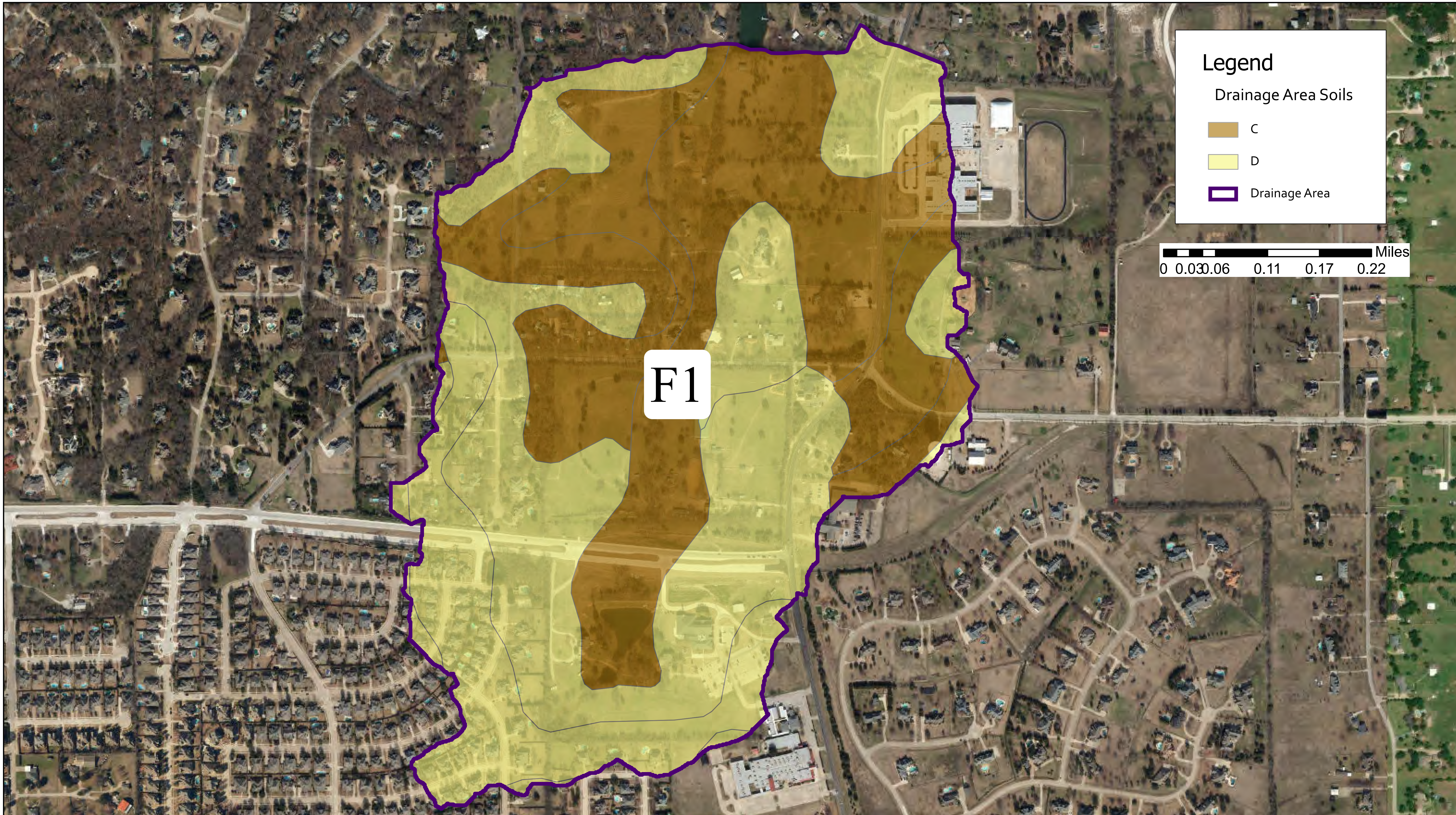
Exhibit 3-Existing Conditions Land Use



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow Property

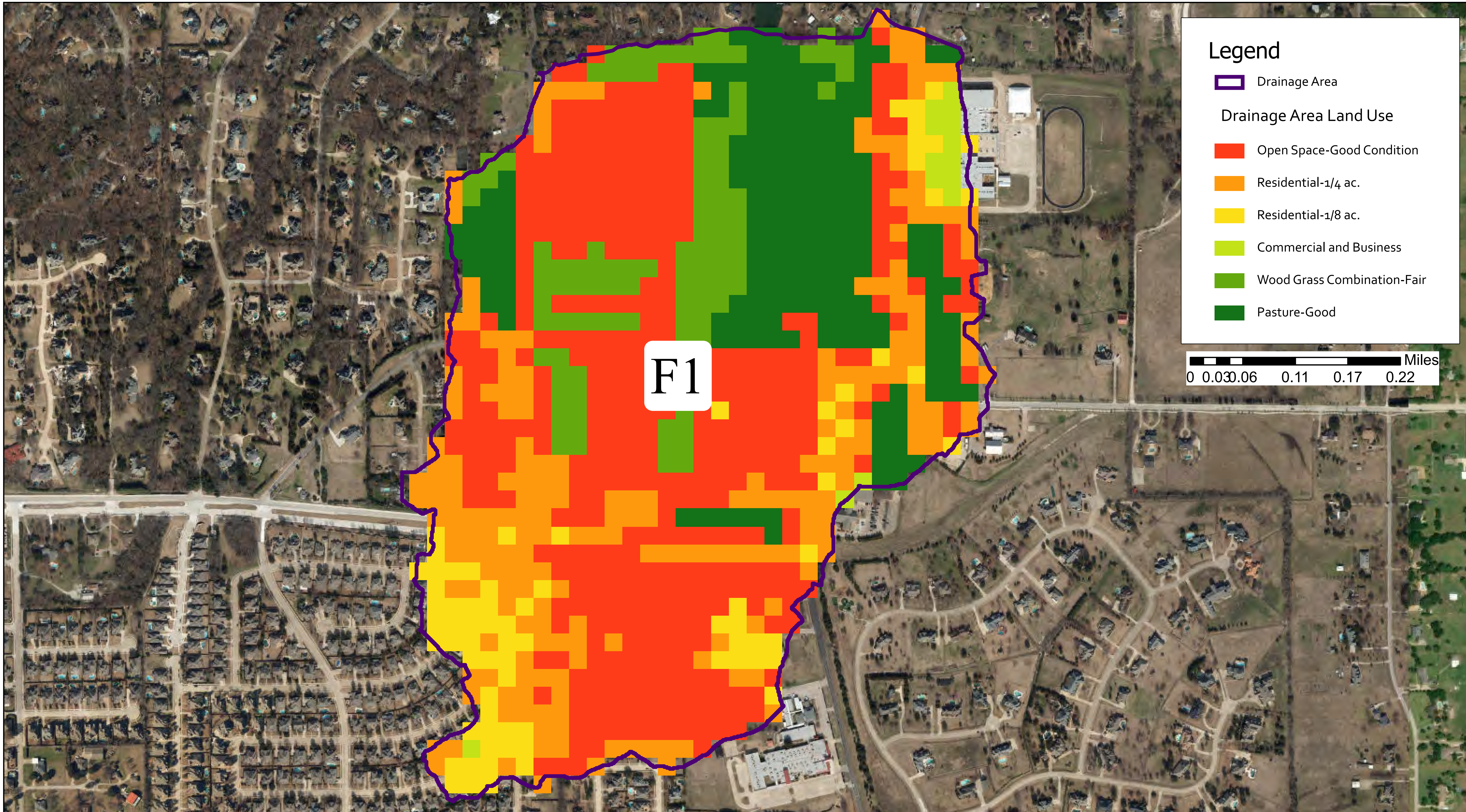
Exhibit 5 -Proposed Conditions Land Use



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Collinwood Property

Exhibit 10- Proposed Condition Soils

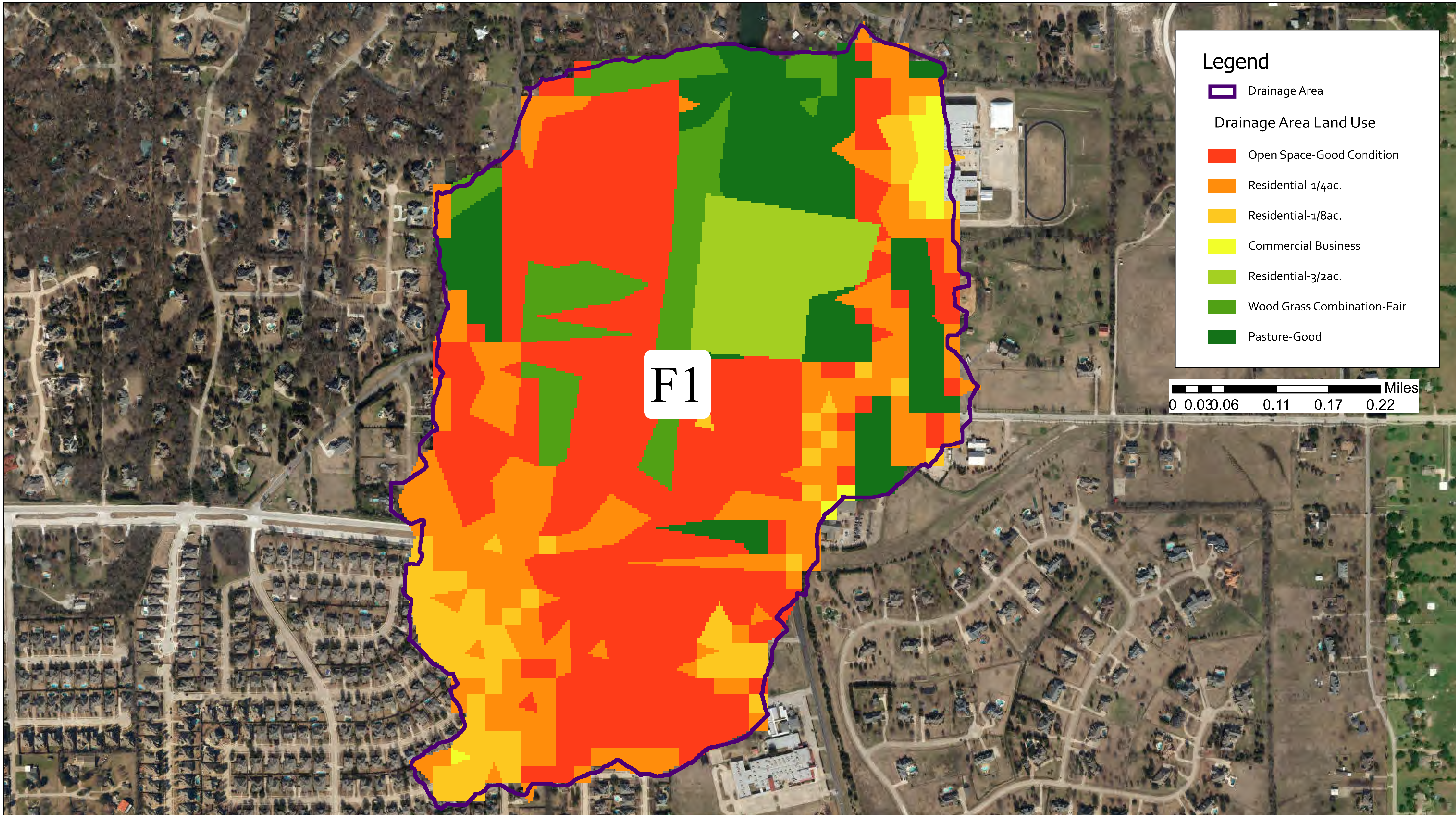


PREPARED BY:
HUITT-ZOLLARS

Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Collinwood Property

Exhibit 9- Existing Condition Land Use



PREPARED BY:
HUITT-ZOLLARS
Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Collinwood Property

Exhibit 12- Proposed Condition Land Use

2yr - 24hr rainfall depth (in)
3.6

DRAINAGE AREA A1
PRE-DEVELOPMENT

PRE-DEVELOPMENT	Type:		Sheet Flow
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	634.3	
	Bottom Ele.	632.9	
	Slope:	0.014	ft/ft
	Computed 'T'		10.70 Minutes

PRE-DEVELOPMENT	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	870	ft
	Top Ele.	632.9	
	Bot. Ele.	610	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.62	ft/sec
Computed 'T':	0.092 hr, or		5.52 Minutes

PRE-DEVELOPMENT	Type:		Open Channel Flow
Flow Phase Three	Length:	1523.3	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.085 hr, or		5.1 Minutes

PRE-DEVELOPMENT	Time of Concentration		
Total Flow	Total $T_{c=}$	21.3	Minutes
Summary	Lag Time		
	$T_{LAG}=$	12.8	Minutes
$T_{LAG}=0.6 \times T_c$	$T_{LAG}=$	0.21	Hours

DRAINAGE AREA C1
PRE-DEVELOPMENT

PRE-DEVELOPMENT	Type:		Sheet Flow
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	625.7	
	Bottom El	624.9	
	Slope:	0.008	ft/ft
	Computed 'T'		13.30 Minutes

PRE-DEVELOPMENT	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	577	ft
	Top Ele.	624.9	
	Bot. Ele.	617	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.89	ft/sec
Computed 'T':	0.085 hr, or		5.1 Minutes

PRE-DEVELOPMENT	Type:		Open Channel Flow
Flow Phase Three	Length:	1489.3	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.083 hr, or		5.0 Minutes

PRE-DEVELOPMENT	Time of Concentration		
Total Flow	Total $T_{c=}$	23.4	Minutes
Summary	Lag Time		
	$T_{LAG}=$	14.0	Minutes
$T_{LAG}=0.6 \times T_c$	$T_{LAG}=$	0.23	Hours

DRAINAGE AREA B1

PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	624.3	
	Bottom El	623.9	
	Slope:	0.004	ft/ft
	Computed 'T'	17.60	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	576.2	ft
	Top Ele.	623.9	
	Bot. Ele.	601	
u=unpaved	Slope:	0.04	ft/ft
p=paved	Velocity:	3.22	ft/sec
Computed 'T':	0.05 hr, or	3 Minutes	

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1264.8	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.07 hr, or	4.2 Minutes	

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total T_{c} =	24.8	Minutes
	Lag Time		
	T_{LAG} =	14.9	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.25	Hours

DRAINAGE AREA A2

PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	588	
	Bottom El	585	
	Slope:	0.03	ft/ft
	Computed 'T'	7.90	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	684.7	ft
	Top Ele.	585	
	Bot. Ele.	555	
u=unpaved	Slope:	0.04	ft/ft
p=paved	Velocity:	3.38	ft/sec
Computed 'T':	0.056 hr, or	3.36 Minutes	

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1524.9	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.085 hr, or	5.1 Minutes	

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total T_{c} =	16.4	Minutes
	Lag Time		
	T_{LAG} =	9.8	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.16	Hours

DRAINAGE AREA B2
PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	44.7	ft
	"N" Value:	0.15	from tables
	Top Ele.	555	
	Bottom El.	553	
	Slope:	0.044743	ft/ft
	Computed 'T'	3.50	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	297.4	ft
	Top Ele.	553	
	Bot. Ele.	545	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.65	ft/sec
Computed 'T':	0.031 hr, or	1.86	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1044	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.058 hr, or	3.5	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total $T_{c=}$	8.8	Minutes
	Lag Time		
	T_{LAG} =	5.3	Minutes
T_{LAG} =0.6 x T_c	T_{LAG} =	0.09	Hours

DRAINAGE AREA B3
PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	583.1	
	Bottom El.	577.5	
	Slope:	0.056	ft/ft
	Computed 'T'	6.10	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	658.5	ft
	Top Ele.	577.5	
	Bot. Ele.	558	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.78	ft/sec
Computed 'T':	0.066 hr, or	3.96	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	2366.8	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.131 hr, or	7.9	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total $T_{c=}$	17.9	Minutes
	Lag Time		
	T_{LAG} =	10.8	Minutes
T_{LAG} =0.6 x T_c	T_{LAG} =	0.18	Hours

DRAINAGE AREA C2
PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	583.5	
	Bottom El	577	
	Slope:	0.065	ft/ft
	Computed 'T'	5.80	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	494.7	ft
	Top Ele.	577	
	Bot. Ele.	561	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.9	ft/sec
Computed 'T':	0.047 hr, or	2.82	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1875.5	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.104 hr, or	6.2	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow	Total $T_{c=}$	14.9	Minutes
Summary	Lag Time		
	T_{LAG} =	8.9	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.15	Hours

DRAINAGE AREA A3
PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	549	
	Bottom El	544	
	Slope:	0.05	ft/ft
	Computed 'T'	6.40	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	331.2	ft
	Top Ele.	544	
	Bot. Ele.	538	
u=unpaved	Slope:	0.02	ft/ft
p=paved	Velocity:	2.17	ft/sec
Computed 'T':	0.042 hr, or	2.52	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1143.2	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.064 hr, or	3.8	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow	Total $T_{c=}$	12.8	Minutes
Summary	Lag Time		
	T_{LAG} =	7.7	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.13	Hours

DRAINAGE AREA D2

PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	614.2	
	Bottom El	613.9	
	Slope:	0.003	ft/ft
	Computed 'T'	19.70	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	978.6	ft
	Top Ele.	613.9	
	Bot. Ele.	598.9	
u=unpaved	Slope:	0.02	ft/ft
p=paved	Velocity:	2	ft/sec
Computed 'T':	0.136 hr, or	8.16	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	3675.1	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.204 hr, or	12.2	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow	Total T_{c} =	40.1	Minutes
Summary	Lag Time		
	T_{LAG} =	24.1	Minutes
$T_{LAG}=0.6 \times T_{c}$	T_{LAG} =	0.40	Hours

DRAINAGE AREA C3

PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	560.5	
	Bottom El	555.5	
	Slope:	0.05	ft/ft
	Computed 'T'	6.40	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	603.7	ft
	Top Ele.	555.5	
	Bot. Ele.	538	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.75	ft/sec
Computed 'T':	0.061 hr, or	3.66	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	1019.8	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.057 hr, or	3.4	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow	Total T_{c} =	13.5	Minutes
Summary	Lag Time		
	T_{LAG} =	8.1	Minutes
$T_{LAG}=0.6 \times T_{c}$	T_{LAG} =	0.14	Hours

DRAINAGE AREA D1

PRE-DEVELOPMENT

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	636	
	Bottom El	634	
	Slope:	0.02	ft/ft
	Computed 'T'	9.20	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	827.7	ft
	Top Ele.	634	
	Bot. Ele.	627.6	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.42	ft/sec
Computed 'T':	0.162 hr, or	9.72	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	2681.4	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.149 hr, or	8.9	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total T_{c} =	27.9	Minutes
	Lag Time		
	T_{LAG} =	16.7	Minutes
$T_{LAG} = 0.6 \times T_c$	T_{LAG} =	0.28	Hours

2yr - 24hr rainfall depth (in)
3.6

DRAINAGE AREA A1
Proposed

PRE-DEVELOPMENT Flow Phase One	Type:		Sheet Flow
	Length:	100	ft
	"N" Value	0.15	from tables
	Top Ele.	634.3	
	Bottom El	632.9	
	Slope:	0.014	ft/ft
	Computed 'T'		10.70 Minutes

PRE-DEVELOPMENT Flow Phase Two	Type:	Shallow Concentrated Flow	
	Surface:	u	
	Length:	870	ft
	Top Ele.	632.9	
	Bot. Ele.	610	
u=unpaved	Slope:	0.03	ft/ft
p=paved	Velocity:	2.62	ft/sec
Computed 'T':	0.092 hr, or		5.52 Minutes

PRE-DEVELOPMENT Flow Phase Three	Type:		Open Channel Flow
	Length:	1523.3	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.085 hr, or		5.1 Minutes

PRE-DEVELOPMENT Total Flow Summary	Time of Concentration		
	Total $T_{c\,=}$	21.3	Minutes
	Lag Time		
	T_{LAG} =	12.8	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.21	Hours

DRAINAGE AREA C1
Proposed

PRE-DEVELOPMENT Flow Phase One	Type:		Sheet Flow
	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	620.5	
	Bottom El	619.5	
	Slope:	0.01	ft/ft
	Computed 'T'		12.20 Minutes

PRE-DEVELOPMENT Flow Phase Two	Type:	Shallow Concentrated Flow	
	Surface:	u	
	Length:	259.8	ft
	Top Ele.	619.5	
	Bot. Ele.	617	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.58	ft/sec
Computed 'T':	0.046 hr, or		2.76 Minutes

PRE-DEVELOPMENT Flow Phase Three	Type:		Open Channel Flow
	Length:	1657.5	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.092 hr, or		5.5 Minutes

PRE-DEVELOPMENT Total Flow Summary	Time of Concentration		
	Total $T_{c\,=}$	20.5	Minutes
	Lag Time		
	T_{LAG} =	12.3	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.21	Hours

DRAINAGE AREA D1
Proposed

PRE-DEVELOPMEN	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	636	
	Bottom El	634	
	Slope:	0.02	ft/ft
	Computed 'T'	9.20	Minutes

PRE-DEVELOPMEN	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	827.7	ft
	Top Ele.	634	
	Bot. Ele.	627.6	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.42	ft/sec
Computed 'T':	0.162 hr, or	9.72	Minutes

PRE-DEVELOPMEN	Type:	Open Channel Flow	
Flow Phase Three	Length:	2681.5	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.149 hr, or	8.9	Minutes

PRE-DEVELOPMEN	Time of Concentration		
Total Flow Summary	Total $T_{c=}$	27.9	Minutes
	Lag Time		
	T_{LAG} =	16.7	Minutes
T_{LAG} =0.6 x T_c	T_{LAG} =	0.28	Hours

DRAINAGE AREA B1
Proposed

PRE-DEVELOPMENT	Type:	Sheet Flow	
Flow Phase One	Length:	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	573	
	Bottom El	571	
	Slope:	0.02	ft/ft
	Computed 'T'	9.20	Minutes

PRE-DEVELOPMENT	Type:	Shallow Concentrated Flow	
Flow Phase Two	Surface:	u	
	Length:	107.9	ft
	Top Ele.	571	
	Bot. Ele.	564	
u=unpaved	Slope:	0.06	ft/ft
p=paved	Velocity:	4.11	ft/sec
Computed 'T':	0.007 hr, or	0.42	Minutes

PRE-DEVELOPMENT	Type:	Open Channel Flow	
Flow Phase Three	Length:	605.7	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.034 hr, or	2.0	Minutes

PRE-DEVELOPMENT	Time of Concentration		
Total Flow Summary	Total $T_{c=}$	11.7	Minutes
	Lag Time		
	T_{LAG} =	7.0	Minutes
T_{LAG} =0.6 x T_c	T_{LAG} =	0.12	Hours

DRAINAGE AREA A2
Proposed

PRE-DEVELOPMENT	**Type:**	**Sheet Flow**	
Flow Phase One	**Length:**	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	588	
	Bottom El	585	
	Slope:	0.03	ft/ft
	Computed 'T'	7.90	Minutes

PRE-DEVELOPMENT	**Type:**	**Shallow Concentrated Flow**	
Flow Phase Two	Surface:	u	
	Length:	684.7	ft
	Top Ele.	585	
	Bot. Ele.	555	
u=unpaved	Slope:	0.04	ft/ft
p=paved	Velocity:	3.38	ft/sec
Computed 'T':	0.056 hr, or	3.36	Minutes

PRE-DEVELOPMENT	**Type:**	**Open Channel Flow**	
Flow Phase Three	Length:	1524.9	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.085 hr, or	5.1	Minutes

PRE-DEVELOPMENT	**Time of Concentration**		
Total Flow	Total $T_{c=}$	16.4	Minutes
Summary	**Lag Time**		
	T_{LAG} =	9.8	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.16	Hours

DRAINAGE AREA B0
Proposed

PRE-DEVELOPMENT	**Type:**	**Sheet Flow**	
Flow Phase One	**Length:**	100	ft
	"N" Value:	0.15	from tables
	Top Ele.	624.8	
	Bottom El	624.6	
	Slope:	0.002	ft/ft
	Computed 'T'	23.20	Minutes

PRE-DEVELOPMENT	**Type:**	**Shallow Concentrated Flow**	
Flow Phase Two	Surface:	u	
	Length:	523.84	ft
	Top Ele.	624.6	
	Bot. Ele.	618	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.81	ft/sec
Computed 'T':	0.08 hr, or	4.8	Minutes

PRE-DEVELOPMENT	**Type:**	**Open Channel Flow**	
Flow Phase Three	Length:	909.6	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.051 hr, or	3.1	Minutes

PRE-DEVELOPMENT	**Time of Concentration**		
Total Flow	Total $T_{c=}$	31.1	Minutes
Summary	**Lag Time**		
	T_{LAG} =	18.6	Minutes
$T_{LAG}=0.6 \times T_c$	T_{LAG} =	0.31	Hours

2yr - 24hr rainfall depth (in)
3.6

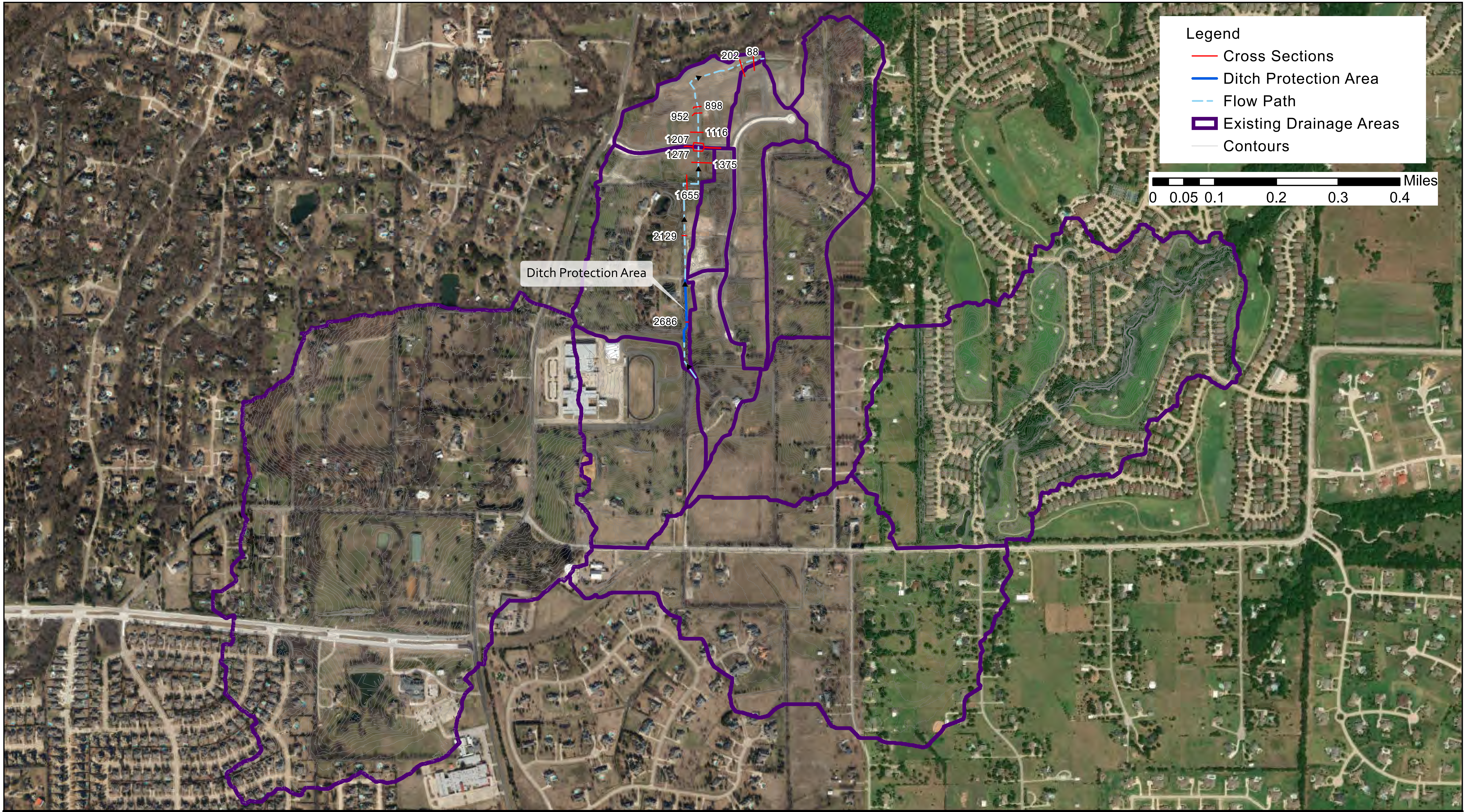
DRAINAGE AREA F1
Existing/Proposed

PRE-DEVELOPMENT Flow Phase One	Type:		Sheet Flow
	Length:	100	ft
	"N" Value	0.011	from tables
	Top Ele.	634	
	Bottom El	631.9	
	Slope:	0.021	ft/ft
	Computed 'T'		1.10 Minutes

PRE-DEVELOPMENT Flow Phase Two	Type:	Shallow Concentrated Flow	
	Surface:	p	
	Length:	703.6	ft
	Top Ele.	631.9	
	Bot. Ele.	626	
u=unpaved	Slope:	0.01	ft/ft
p=paved	Velocity:	1.86	ft/sec
Computed 'T':	0.105 hr, or		6.3 Minutes

PRE-DEVELOPMENT Flow Phase Three	Type:		Open Channel Flow
	Length:	5110.5	ft
	Velocity:	5	ft/sec (assumed)
Computed 'T':	0.284 hr, or		17.0 Minutes

PRE-DEVELOPMENT Total Flow Summary	Time of Concentration		
	Total $T_{c=}$	24.4	Minutes
	Lag Time		
	T_{LAG} =	14.7	Minutes
$T_{LAG} = 0.6 \times T_c$	T_{LAG} =	0.25	Hours



PREPARED BY:

HUITT-ZOLLARS

Huitt-Zollars, Inc. Dallas
1717 McKinney Avenue, Suite 1400
Dallas, Texas 75202-1236
Phone (214) 871-3311 Fax (214) 871-0757

Molodow-Collinwood Properties

N

Exhibit 7-Cross Sections

APPENDIX D

INTERVIEWS WITH RESIDENTS

Interviews with residents

Huitt-Zollars conducted a series of individual interviews with multiple Fairview residents to hear their drainage concerns, discuss the process for development within FEMA regulated floodplains and the overall development process within the Town. The interviews also served the purpose of gaining a deeper understanding of the drainage related issues affecting residents in order to gain insight to make suggestions to the Town on how some of these issues could potentially be addressed. The interviews were conducted between February 28th and April 23th of 2020. Below is a list of the residents interviewed, along with their property addresses and date of the interview.

Name	Address	Date
Ken Hardison	1280 Camino Real	02-28-2020
Holly Parsons	480 Home Place	03-03-2020
Cory Zuerker	540 Hackberry Drive	03-11-2020
James Coates	922 Shoal Creek Drive	03-11-2020
Cheryl Sinacola	1061 Country Trail	03-20-2020
Justin Jinright	571 Kentucky Lane	03-20-2020
Benjamin White	531 Michelle Way	03-25-2020
Rachelle Farkas	1041 Pecan Drive	04-21 & 04-23 2020

Below is a summary of the drainage concerns expressed by each resident, followed by suggestions to the Town on addressing these issues, when applicable.

1280 Camino Real

Concerns:

- Homeowner has been residing in the property for 30 years. He noticed an increase in the frequency of flooding in his backyard in recent years, coinciding with the Harper Landing development. Backyard would normally flood every 5 to 7 years, now it floods 1 to 2 times per year.
- Backyard floods with less rain than it did prior to Harper Landing.
- Overflow channel and ditch created to discharge Harper Landing runoff into Sloan Creek are undergoing erosion. Channel and ditch have a constant flow of water (likely due to groundwater), not present prior to Harper Landing.
- Homeowner believes the removal of the natural ponds on Harper Landing and creation of the channel and ditch caused the increase in frequency of flooding.

Comments and Suggestions:

o The perceived increase in the frequency of flooding in the backyards north of Sloan Creek is likely due to the increase in rainfall amounts seen in the past few years, when compared to historical rainfall data. The table below from the National Weather Service, a division of the National Oceanic and Atmospheric Administration, shows monthly and annual historical precipitation records recorded at DFW Airport between 1975 and the present time. Recording stations near Fairview did not have a long range of recorded data to make a good comparison. Therefore, the data recorded at DFW Airport was used. As seen from the table, 2015 was the wettest year on record since 1975, and June of 2015 was the wettest month in the past 45 years. June of 2017 had the fourth highest precipitation for the month of June since 1975. The year of 2018 was the second wettest year, and the months of September and October of that year had the highest monthly precipitation since 1975. This confirms a pattern of increased rainfall amounts during the past 5 years, which has contributed to the more frequent flooding along the Sloan Creek floodplain.

Monthly and Annual Precipitation Records

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2020	5.00	3.88	6.75										
2019	1.58	1.29	2.01	6.75	8.15	4.13	0.78	2.44	T	4.42	1.80	1.17	34.52
2018	0.85	11.31	2.90	0.77	1.87	1.27	0.25	2.99	12.69	15.66	0.86	4.55	55.97
2017	4.39	2.33	1.06	3.38	0.70	8.44	4.12	4.24	0.47	2.12	0.81	4.56	36.62
2016	1.04	2.20	2.67	4.60	6.25	3.60	3.89	4.42	0.98	2.01	3.22	0.60	35.48
2015	3.62	2.96	2.53	5.56	16.96	3.95	0.92	0.46	2.14	9.82	9.86	3.83	62.61
2014	0.33	0.41	1.45	1.74	3.40	3.26	0.98	4.34	0.06	2.09	2.13	1.13	21.32
2013	4.06	1.68	2.27	1.98	3.17	2.14	2.05	1.32	2.72	3.13	2.12	2.76	29.40
2012	6.18	1.88	5.74	4.24	1.66	2.82	0.78	3.19	1.75	1.02	0.05	1.95	31.26
2011	1.60	0.92	0.07	2.46	7.95	2.84	0.09	0.96	0.66	3.12	0.86	4.35	25.88
2010	2.76	2.83	3.57	2.03	1.09	2.08	3.13	0.41	9.09	1.16	1.50	2.05	31.70
2009	0.82	0.72	5.56	3.54	4.36	3.98	2.09	1.64	6.52	8.05	1.76	1.85	40.89
2008	0.27	2.30	6.07	3.85	2.21	0.84	0.81	2.82	0.84	2.29	4.53	0.27	27.10
2007	5.58	0.43	3.81	2.82	8.34	11.10	5.54	0.35	4.99	3.53	1.22	2.34	50.05
2006	2.25	3.85	4.40	1.86	1.90	0.34	1.78	0.52	2.60	4.34	2.58	3.33	29.75
2005	4.33	1.62	2.17	0.56	3.35	1.14	0.74	2.46	1.36	0.89	0.02	0.33	18.97
2004	3.04	3.84	1.71	2.96	4.73	10.49	4.16	4.24	1.02	5.72	5.01	0.65	47.57
2003	0.22	3.07	0.85	1.90	2.53	5.17	0.08	1.85	3.99	0.78	3.15	0.96	24.55
2002	4.90	0.94	7.39	5.68	5.40	3.10	3.07	1.47	1.38	6.44	0.52	4.13	44.42
2001	2.44	6.17	5.27	0.89	5.58	1.28	3.85	2.72	3.72	1.87	1.11	3.24	38.14
2000	1.59	3.30	2.91	4.28	3.17	5.93	T	0.00	0.17	4.38	6.95	3.57	36.26
1999	1.44	0.48	2.84	2.74	6.91	0.99	0.77	T	2.30	2.26	0.31	2.55	23.59
1998	5.07	3.22	4.45	1.25	2.38	1.75	0.11	0.35	0.68	5.64	4.91	4.43	34.24
1997	0.33	7.40	2.21	6.73	3.92	3.99	1.68	3.13	2.01	5.66	1.01	6.93	45.00
1996	0.97	0.35	2.36	2.14	0.95	3.42	3.85	5.02	1.51	6.56	5.54	0.47	33.14
1995	2.11	0.44	6.69	6.83	7.50	2.41	3.45	0.86	1.54	0.75	0.74	2.07	35.39
1994	1.43	2.01	1.69	3.62	5.80	2.05	4.58	4.89	1.39	8.19	6.03	2.42	44.10
1993	1.74	5.78	3.03	3.49	1.75	3.75	0.00	0.75	3.28	5.10	1.62	2.54	32.83
1992	3.25	2.40	3.24	2.46	6.93	5.23	2.48	2.08	3.25	3.05	3.56	4.26	42.19
1991	2.72	2.60	1.35	3.63	6.97	4.26	3.99	4.30	4.61	9.32	1.04	8.75	53.54
1990	4.54	4.72	5.89	6.90	7.16	1.89	2.60	2.37	1.12	2.81	3.81	1.46	45.27
1989	2.56	3.70	3.72	1.86	9.62	8.75	2.61	1.89	2.40	2.02	0.49	0.33	39.95
1988	0.88	1.23	2.03	2.21	2.11	3.23	2.47	0.44	4.04	1.64	2.28	2.48	25.04
1987	1.22	3.67	1.70	0.11	5.95	3.45	1.77	0.81	1.38	0.12	4.17	2.90	27.25
1986	T	2.49	1.08	5.30	5.52	3.92	0.41	1.63	4.60	1.81	3.25	2.44	32.45

1985	0.81	2.62	3.70	3.75	2.13	3.78	2.40	0.53	3.35	3.91	3.11	0.61	30.70
1984	1.07	3.11	4.92	1.41	3.04	2.79	0.43	1.47	0.09	6.50	2.97	6.09	33.89
1983	2.55	1.25	4.36	0.59	5.83	2.07	1.56	5.55	0.22	4.04	2.22	0.83	31.07
1982	2.33	1.89	1.71	2.71	13.66	4.28	2.73	0.52	0.58	3.36	4.22	2.76	40.75
1981	0.58	1.44	3.39	2.69	6.24	7.85	1.81	2.32	2.40	14.18	1.53	0.17	44.60
1980	2.52	0.84	1.24	2.23	3.01	1.25	0.71	T	6.54	1.08	1.23	1.43	22.08
1979	3.35	1.52	6.33	2.03	5.90	1.36	1.94	2.47	0.99	3.38	0.43	2.72	32.42
1978	1.41	3.33	2.66	1.34	8.01	0.77	0.33	1.53	0.93	0.55	2.73	0.78	24.37
1977	2.39	1.68	5.88	4.31	0.99	0.69	2.20	2.33	1.72	2.96	1.79	0.25	27.19
1976	0.13	0.52	2.29	5.71	6.03	1.40	3.83	4.75	5.02	3.46	0.50	1.99	35.63
1975	3.34	3.72	1.67	3.40	6.88	1.95	5.06	0.30	0.87	T	0.42	1.49	29.10

- Harper Landing’s approach to handle site drainage was to not provide detention due to the location of the site in the downstream portion of the Sloan Creek watershed. Releasing site runoff faster into Sloan Creek allowed for the peak discharges from the upstream watershed not to coincide with the peak discharges from the site. An overflow channel was created to mitigate for flow conveyance lost due to reclaiming a portion of the 100-yr floodplain for development. This approach is adequate, follows industry standards, complies with the Town’s drainage ordinance and meets all FEMA regulations. It is expected that the area in the vicinity of Harper Landing, including the north side of the creek, will flood according to the way it was designed to flood during the 100-yr storm event.
- An analysis of Town provided videos during a significant rain event recorded in March of 2020 revealed the overflow channel in Harper Landing was effectively conveying flow without overtopping the channel banks. Observed velocities in the overflow channel were slow, in the range of 1 to 2 feet-per-second. Sloan creek was near bank full capacity, but not overtopping. The overflow channel seems to be functioning as designed for low and moderate flows. During high intensity, low frequency storms, it is expected that water will be out of the banks of Sloan Creek and the overflow channel, since this area is within the floodplain and subject to frequent flooding.

480 Home Place

Concerns:

- Homeowner is concerned about flooding in her backyard. Large upstream watershed runs through her yard via a culvert under Homestead Drive, causing the yard to flood and become saturated for a long time. Resident has shared with Huitt-Zollars several photos of the flooded backyard during recent rain events. In addition to the large watershed draining through the property, the yard grades are very flat diminishing the ability for runoff to be conveyed.
- Homeowner has concerns about the lack of ability for the City to control what residents do within their lots that could adversely impact other residents. For instance, if one of the downstream lot owners decides to modify the natural

stream along the back of their lots that could cause drainage to back up into her property.

- Homeowner would like to receive answers from the City within a reasonable timeframe.

<u>Comments and Suggestions:</u>

- o Flooding in the resident's backyard is mainly due to the large upstream watershed draining through the property in combination with a shallow water table due to groundwater conditions, flat grades and the lack of a defined swale to convey flows. The nature of this flooding has to do mostly with the way this and many other low-density communities within the Town have been developed over the years, allowing for lot-to-lot drainage, including multiple lots draining through one or more lots. Grading a grassed swale within the yard would provide more conveyance and allow for more effective drainage. However, this would also require the two properties downstream to have the same type of swale graded so that the runoff can outfall into a natural stream running from west to east along the back of the residential lots facing Harper Landing Street.
- o The Town currently has an informal process – by means of phone calls and emails - for receiving complaints or questions from residents related to drainage and other issues. The Town may wish to consider the implementation of a more structured process for receiving and responding to questions and complaints from residents. Such a process could establish a timeframe for Town staff to review and respond to all inquiries.
- o The Town may wish to evaluate the need for additional resources (staff and equipment) if necessary to meet resident's needs, if the Town determines that it is the Town's responsibility to address certain types of issues that have not been addressed.
- o Huitt-Zollars suggests for any new developments that convey drainage from an upstream watershed larger than 10 acres that the channel, ditch, or stream conveying flows be defined within a public drainage easement to be regulated by the Town. This would impose restrictions on what property owners could do that could cause adverse impacts to adjacent properties.

540 Hackberry Drive

<u>Concerns:</u>

- Homeowner understands his lot is partially within the 100-year floodplain and expects flooding and regular maintenance associated with it.

- He has not noticed an increase in the frequency of flooding, except for the year of 2015. He mentioned some of his neighbors have drainage issues.
- Erosion taking place along Sloan Creek streambank. He also noticed tree trunks and sediment movement down Sloan Creek.
- Sediment transport to Lake Lavon could be a concern if it starts to block flow from Wilson Creek creating a backwater effect.
- Resident is not concerned about potential impacts from future upstream developments.

922 Shoal Creek Drive

Concerns:

- Mr. Coates is a member of the Heritage Ranch Infrastructure Committee and is familiar with drainage concerns from residents in the subdivision. He indicated the subdivision was constructed per plans and they have no issues with resident's homes flooding.
- The more common drainage complaint from residents is that swales between homes are not providing positive drainage to the street. However, this is a maintenance issue that each resident is responsible for addressing.
- Some residents have expressed concern about the additional drainage coming from the Molodow site development. Mr. Coates explained to the residents that Heritage Ranch was designed to accept fully developed flows from the upstream watershed, which includes the Molodow site.
- Golf course floods often, but this is expected to happen since it is within the floodplain.
- Happy with the work the City Engineer is doing in helping with maintenance at Heritage Ranch.

1061 Country Trail

Concerns:

- Drainage from adjacent residential property to the north and from the upstream subdivision off Hart Road causing excessive amount of runoff into the backyard and groundwater under the house. New development to the east is also contributing to additional runoff.
- Homeowner thinks there should be regulations on what each resident can do within their properties in order to prevent adverse impacts related to drainage to neighbors.

- Homeowner would like to see a ditch intercepting the upstream drainage and routing the flow to the stream east of the property, to reduce surface runoff in the backyard.

Comments and Suggestions:

- o Town may consider requiring in the permitting process that homebuilder or contractor should demonstrate that drainage will not be diverted due to new construction or expansion within a single lot. This could help in preventing the change in drainage patterns and routing of additional runoff to adjacent properties.
- o An intercepting ditch to route the upstream flows to the stream east of the property is a viable solution to eliminate the diverted runoff from one of the adjacent properties located immediately to the north.
- o Town may consider incorporating into the drainage ordinance the requirement for a downstream assessment to be performed for new developments to verify no adverse impacts downstream, in addition to reducing peak discharges to pre-development values by means of detention or retention facilities.

571 Kentucky Lane

Concerns:

- After development of Harper Landing, part of his property started to experience surface erosion at three different locations near Sloan Creek. During strong storm events, the flows from the overflow channel at Harper Landing can't properly enter Sloan Creek due to the high water level in the main stream. These flows are diverted into his property causing the erosion.
- Homeowner is concerned about adjacent resident's ability to adversely impact his and his neighbors' properties.
- Homeowner believes the removal of natural ponds when Harper Landing was developed increased the volume of water discharging into Sloan Creek. The ponds were providing some amount of detention storage, which is no longer available.

Comments and Suggestions:

- o Homeowner has valid concerns related to the apparent more frequent flooding and erosion taking place within his property. An analysis of the aforementioned recordings during a significant storm event in March of 2020 show the drainage ditch running along Harper Landing northeastern boundary effectively carrying flows at a slow velocity and without being overtopped. The ditch seems to be functioning properly during low and moderate storm events. During high intensity, low frequency storm events, it is expected that water will be out of the banks of Sloan Creek and the ditch, spilling over the homeowner's property, since this area is within the floodplain.

571 Michelle Way

<u>Concerns:</u>

- This property is adjacent (west) of the property on 571 Kentucky Lane. The homeowner has similar concerns as the adjacent homeowner. He is concerned about the impact of the drainage overflowing from the large overflow channel into his property and into his neighbor's property, and would like to work with the City and developer to find a solution.
- Homeowner has concerns about the lack of ability by the City to enforce changes within private properties that can adversely impact neighbors when it relates to drainage.

<u>Comments and Suggestions:</u>

- o As previously stated the overflow channel and the ditch along the west side of the property appear to be functioning adequately. Overtopping of the banks and flooding is expected during high frequency, long duration storm events since this area is within the floodplain. Homeowner suggested widening the overflow channel and creating a detention facility as a solution to the apparent more frequent flooding. Due to the location of this neighborhood near the downstream end of the Sloan Creek watershed, a detention facility would likely increase flooding in the area. The reason for this is that by holding the rainfall volume in a detention pond and releasing it slowly will allow more time for the peak of the storm from the upstream watershed to arrive in this area. The time of peak for the upstream watershed will match more closely with the time of peak released from the detention pond, causing additional flooding.

1041 Pecan Drive and neighboring properties

<u>Concerns:</u>

- Huitt-Zollars staff met with and visited the properties of Mrs. Farkas and six other residents in the Fox Glen neighborhood. The property at 1041 Pecan Drive and adjacent properties are in a low laying area where drainage conveyed through barrow ditches along the street accumulates creating large puddles that remain for several days, allowing for the growth of algae. There is not a positive surface drainage path to drain the accumulated water out. Mrs. Farkas provided several photos and one video of the flooded street and yard.
- 1041 Pecan Drive backs up to Sloan Creek. Severe streambank erosion has occurred over the years, taking away as many as 15 feet of yard land in one area. A couple of trees have fallen due to erosion and currently sit within the main channel along with accumulated organic debris. At least three more large trees in the bank are struggling to stay alive as the bank gest more eroded.
- The front of the property at 1060 Pecan Drive has experienced more frequent flooding recently. Homeowner believes the increased frequency of the flooding coincides with the neighbor's driveway that was recently raised and had small culverts installed underneath it.
- The property at 475 Cottonwood Place has a pond that has overflown a few times in the past 5 years, but the water level has not reached any structures in the property. The property at 490 Hackberry Street is across from this pond and the property owner reported similar concerns. Resident reported seeing an increase in water levels in the past 5 years when pond and swale running along the side of the pond overflow.
- Resident at 520 Cottonwood Place stated water backs up on ditches along the street after rain events, and it takes several days to dry out.
- The property at 561 Cottonwood Place receives the upstream flow from the street ditches and conveys these flows via a swale to Sloan Creek. No issues with flooding in front of the lot, but severe erosion at the streambank has caused loss of backyard land. Dead tree and large amount of organic debris present within the main channel.
- Resident at 491 Hackberry Drive has seen significant increase in runoff at his and his neighbors' properties after the owner of the property at Lakewood Drive that backs to his property has diverted the drainage by creating a berm to protect his house from flooding. The runoff increase has frequently flooded his shed, which did not get flooded prior to the neighbor diverting the drainage into his property. This has adversely affected two other properties downstream along Hackberry Drive.
- The property at 580 Maple Lane backs up to Sloan Creek. Severe streambank has occurred at the three different spots – two along Sloan Creek and one along a very incised tributary of Sloan Creek. Loss of yard as much as 20 feet has occurred along with large trees falling into the creek.

Comments and Suggestions:

- Positive drainage should be provided from the low laying area at 1041 Pecan Drive to Sloan Creek to allow the ponded water to drain out of the. This can be accomplished by grading a swale between lots from the street to Sloan Creek. Grading the yards to drain toward the swale may be necessary to prevent flooding in low spots.
- Streambank protection is highly recommended to prevent further erosion, loss of land, and impact to large trees and secondary structures within the property located at 1041 Pecan Drive.
- The front of the property at 1060 Pecan Drive is in a low spot with limited positive drainage path through the adjacent neighbor newly placed culvert. This set up is expected to work adequately for small rainstorms, but it appears inadequate for more significant rainfall events. Photos provided by the resident during a significant rainstorm show the driveway creating a type of dam constricting flows through the small culverts, which may be undersized. The previous condition allowed the runoff to flow over the low driveway, preventing the excessive amount of temporary flooding in the front yard. Increasing the culvert opening under the driveway can help to alleviate the temporary flooding issue.
- Overflow of the pond at 475 Cottonwood Place and at 490 Hackberry Street can be attributed mostly to the increase in rainfall amounts seen since 2015.
- Ponding along Cottonwood Place is due primarily due to the flat grades of the ditches and lack of positive drainage. Sediment transport and accumulation over the years likely flattened the ditch grades creating flat areas that cannot drain. This seems to be primarily a maintenance issue that can be addressed by re-grading the ditches to provide positive drainage to Sloan Creek.
- Sloan Creek streambank running along the back of the property at 561 Cottonwood Place is severely eroded. Armoring of the streambank along this section of Sloan Creek is necessary to prevent further erosion.
- Drainage diversion due to improvements at the property west of 491 Hackberry Drive appears to be the cause of additional runoff and yard flooding on three properties along Hackberry Drive. Town may consider previous suggestion of incorporating into the permitting process for building or expanding a home a requirement for the builder/owner/developer to demonstrate how drainage patterns will not change, so that adjacent properties are not adversely impacted.
- Streambank erosion at 580 Maple Lane is the most severe based on observations at various properties with similar erosion issues. Streambank protection is highly recommended to prevent further erosion, loss of land, and impact to large trees and secondary structures within this property.