CITY OF DALWORTHINGTON GARDENS

NOTICE OF A MEETING
FEBRUARY 15, 2024

CITY COUNCIL
WORK SESSION AND/OR EXECUTIVE SESSION 6:00 P.M.

CITY COUNCIL REGULAR SESSION AT 7:00 P.M.

CITY HALL COUNCIL CHAMBERS, 2600 ROOSEVELT DRIVE, DALWORTHINGTON GARDENS, TEXAS

WORK SESSION AND/OR EXECUTIVE SESSION – 6:00 p.m.

1. CALL TO ORDER

2. WORK SESSION AND/OR EXECUTIVE SESSION

a. Work session with Douglas Gilliland, Taurus of Texas GP, LLC on Lot 6 of Garden Town Center.

b. Executive Session
   i) Recess into Executive Session:
      (1) Pursuant to Texas Government Code, Section 551.071, Attorney Consultation, and 551.074, Personnel Matters, regarding the City Administrator, City Secretary, Finance Director, Finance Assistant, Public Works Director, and Court Clerk/Administrative Services Clerk.
      (2) Pursuant to Texas Government Code, Section 551.074, Personnel Matters regarding Planning and Zoning Appointment.

   ii) Reconvene into Regular Session for the following
      (1) Discussion and possible action on personnel matters, regarding the City Administrator, City Secretary, Finance Director, Finance Assistant, Public Works Director, and Court Clerk/Administrative Services Clerk.
      (2) Discussion and possible action on personnel matters regarding Planning and Zoning Appointments.

c. Work Session on the above item and other listed agenda items as time permits.

CITY COUNCIL

REGULAR SESSION – 7:00 P.M.

1. CALL TO ORDER

2. INVOCATION AND PLEDGES OF ALLEGIANCE

3. PRESENTATIONS AND PROCLAMATIONS

4. ITEMS OF COMMUNITY INTEREST

DWG's Farmers Market 10-2 p.m. at ACA

a. Great Backyard Bird Count, February 17 from 10:00 a.m. to 1:00 p.m.
b. Pictures with the Easter bunny, March 24 from 3:00 p.m. to 5:00 p.m.

c. Total Eclipse – April 8th
d. Plat Swap and Earth Day Saturday, April 20th
e. National Night Out, Tuesday, October 1, 2024, from 6-8 p.m.

5. CITIZEN COMMENTS

Citizens who wish to speak to the City Council will be heard at this time. In compliance with the Texas Open Meetings Act, unless the subject matter of the presentation is on the agenda, the City staff and City Council members are prevented from discussing the subject and may respond only with statements of factual information or existing policy.

6. MAYOR AND COUNCIL COMMENTS

Pursuant to Texas Government Code § 551.0415, City Council Members and City staff may make a report about items of community interest during a meeting of the governing body without having given notice of the subject of the report. Items of community interest include:

- Expressions of thanks, congratulations, or condolence;
- Information regarding holiday schedules;
- An honorary or salutary recognition of a public official, public employee, or other citizen, except that a discussion regarding a change in the status of a person's public office or public employment is not an honorary or salutary recognition for purposes of this subdivision;
- A reminder about an upcoming event organized or sponsored by the governing body;
- Information regarding a social, ceremonial, or community event organized or sponsored by an entity other than the governing body that was attended or is scheduled to be attended by a member of the governing body or an official or employee of the municipality; and
- Announcements involving an imminent threat to the public health and safety of people in the municipality that has arisen after the posting of the agenda.

7. DEPARTMENTAL REPORTS

Informational reports only; no action to be taken.

a. Director of Public Safety/City Administrator Report **(Tab A)**
b. Financial Reports **(Tab B)**
c.

8. CONSENT AGENDA

a. Approval of Ordinance No. 2024-02, calling for a general election to be held on May 4, 2024 for the offices of Mayor, Alderman Place 1, and Alderman Place 2. **(Tab C)**

b. Ratification of invoices over $5,000.00 for emergency purchase to repair leak at 3621 Wooded Creek Circle in the amount of $12,098.00. **(Tab D)**

c. Approval of Resolution No. 2022-02 authorizing continued participation with the Steering Committee of Cities Served by Oncor; and authorizing the payment of six cents per capita to the Steering Committee to fund regulatory and legal proceedings and activities related to Oncor Electric Delivery Company, LLC. **(Tab E)**

d Discussion and possible action regarding the purchase request from NetGenius for $12,599 for upgrades to the Tyler, Laserfiche, and Commsys Servers. **(Tab F)**

9. REGULAR AGENDA

a. Discussion and action regarding a planned development concept plan application for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas to be known as Roosevelt Estates Lots

1 – 11, 1X, and 11X of Block A an addition to the City of Dalworthington Gardens, Tarrant County, Texas. **(Tab G)**

i. Conduct a public hearing
ii. Discussion and action

b. Discussion and possible action regarding Final Plan for for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11X of Block A an addition to the City of Dalworthington Gardens, Tarrant County, Texas. **(Tab H)**

i. Conduct a public hearing
ii. Discussion and action

c. Discussion and possible action regarding Preliminary Plat application for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11X of Block A, an addition to the City of Dalworthington Gardens, Tarrant County, Texas. **(Tab I)**

i. Conduct a public hearing
ii. Discussion and action

d. Discussion Discussion and possible action request for a concept plan with a Bowen Road planned development overlay for property located at 2500 and 2512 California Lane, Dalworthington Gardens, Tarrant County, Texas **(Tab J)**

i. Conduct a public hearing
ii. Discussion and action

e. Discussion and possible action regarding the Tarrant County 49th Community Development Block Grant program for Ambassador Row, to include but not limited to any change order approval. Resolution 2024-03. **(Tab K)**

f Discussion and possible action to approve Ordinance 2024-03, Amending the code of ordinances Chapter 9 "Personnel," article 9.02 "Officers and Employees," Division 2 "City Administrator" to remove the division in its entirety; amending Chapter 9 "Personnel," article 9.04 "Police," Division 2 "Police Department" in its entirety to update duties of the Director of Public Safety/City Administrator. **(Tab L)**

g. Discussion and possible action on upgrading our outdated SCADA system **(Tab M)**

h. Discussion and possible action regarding amendments to the FY 2023-2024 budget in amounts not to exceed $10,000.00.

10. TABLED ITEMS

a. Discussion and possible action to direct staff regarding correctly indicating when special exceptions are authorized in accordance with Section 14.02.321 of city ordinances, to include but not limited to special exceptions for private stables as allowed in Section 14.02.172 "SF" residential district uses.

11. FUTURE AGENDA ITEMS

In compliance with the Texas Open Meetings Act, Council Members may request that matters of public concern be placed on a future agenda. Council Members may not discuss non-agenda items among themselves. In compliance with the Texas Open Meetings Act, city staff members may respond to questions from Council members only with statements of factual information or existing city policy.

12. ADJOURN

The City Council reserves the right to adjourn into closed session at any time during the course of this meeting to discuss any of the matters listed above, as authorized by Texas Government Code Section 551.071 (Consultation with Attorney), 551.072 (Deliberations about Real Property), 551.073 (Deliberations about Gifts and Donations), 551.074 (Personnel Matters), 551.076 (Deliberations about Security Devices), and 551.087 (Economic Development Negotiations).

Pursuant to Texas Government Code, Section 551.127, on a regular, non-emergency basis, members may attend and participate in the meeting remotely by video conference. Should that occur, a quorum of the members will be physically present at the location noted above on this agenda.

CERTIFICATION

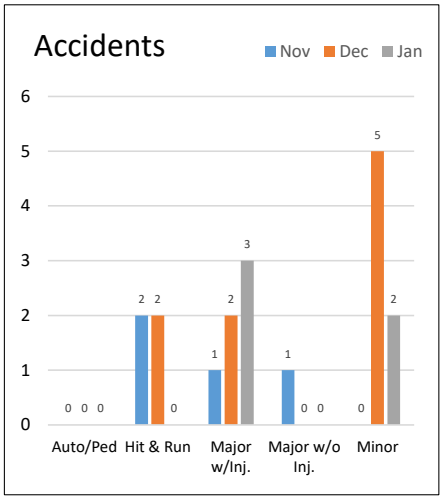
This is to certify that a copy of the **February 15, 2024** City Council Agenda was posted on the City Hall bulletin board, a place convenient and readily accessible to the general public at all times, and to the City's website, www.cityofdwg.net, in compliance with Chapter 551, Texas Government Code.

DATE OF POSTING:_____ TIME OF POSTING:_____ TAKEN DOWN:_____

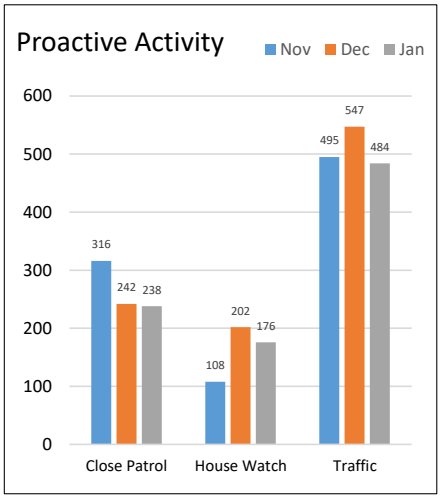
_____
Sandra Ma, City Secretary

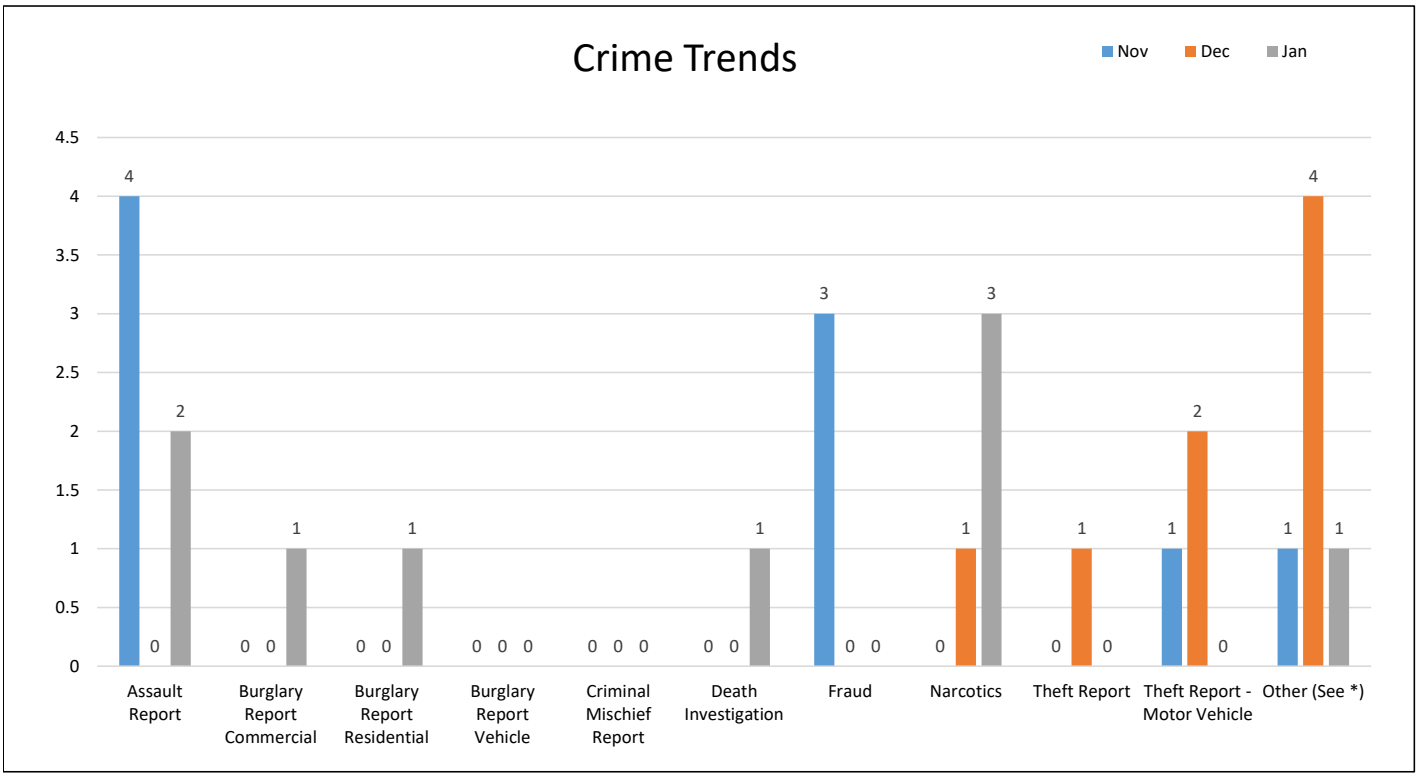
MONTHLY PUBLIC SAFETY REPORT
January 2024

Department News	
Residential Contact	51 Contacts



Activity	Nov	Dec	2023 Total	Jan
DPS Activity	1487	1708	19571	1585
Police CFS	516	663	7050	631
EMS CFS	11	13	147	17
Fire CFS	10	8	109	13
Arrests	21	18	159	16
House Watches, Close Patrols, & Community Contacts	434	459	5323	424
Traffic Enforcement	495	547	6783	484





* Other offenses excluding traffic, warrants and "report only."

VENDOR SET: 01 City of Dalworthington
BANK: * ALL BANKS
DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR	I.D.	NAME		STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000132		COMMERCE BANK - VISA								
	B-CHECK	COMMERCE BANK - VISA	VOIDED	V	1/10/2024			000762		17.77CR
000239		GOODYEAR COMMERCIAL TIRE & SER								
	C-CHECK	GOODYEAR COMMERCIAL TIREUNPOST		V	1/10/2024			065284		24.48CR
000132		COMMERCE BANK - VISA								
	C-CHECK	COMMERCE BANK - VISA	VOIDED	V	1/10/2024			065307		6,604.78CR

* * T O T A L S * *	NO			INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
REGULAR CHECKS:	0			0.00	0.00	0.00
HAND CHECKS:	0			0.00	0.00	0.00
DRAFTS:	0			0.00	0.00	0.00
EFT:	0			0.00	0.00	0.00
NON CHECKS:	0			0.00	0.00	0.00
VOID CHECKS:	3	VOID DEBITS	0.00			
		VOID CREDITS	6,647.03CR	6,647.03CR	0.00	

TOTAL ERRORS: 0

	NO	INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
VENDOR SET: 01 BANK: * TOTALS:	3	6,647.03CR	0.00	0.00
BANK: * TOTALS:	3	6,647.03CR	0.00	0.00

VENDOR SET: 01 City of Dalworthington
BANK: LDEBT LOGIC-DEBT I&S
DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000210	WILMINGTON TRUST							
I-01/25/2024-2014	2014 SERIES BOND INTEREST	D	1/25/2024			000774	O	
150 40.7839	C.O. 2014 Interest Expense	2014 SERIES BOND INT		23,112.50				23,112.50
TRUST ACCT NO: 108612-000								
000210	WILMINGTON TRUST							
I-01/25/2024-2017	2017 SERIES BOND PRINC & INT	D	1/25/2024			000775	O	
150 40.7840	G.O. 2017 Principal	2017 SERIES BOND PRI		85,000.00				
150 40.7841	G.O. 2017 Interest Expense	2017 SERIES BOND PRI		54,531.25				139,531.25
TRUST ACCT NO: 123110-000								
000633	BOK FINANCIAL (BANK OF TEXAS)							
I-01/25/2024-2021	2021 BOND PRINC & INTEREST	D	1/25/2024			000776	O	
150 40.7842	G.O. 2021 Principal	2021 BOND PRINC & IN		35,000.00				
150 40.7843	G.O. 2021 Interest Expense	2021 BOND PRINC & IN		14,303.13				49,303.13
REFERENCE NUMBER : DALW821GO								

* * T O T A L S * *	NO			INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
REGULAR CHECKS:	0			0.00	0.00	0.00
HAND CHECKS:	0			0.00	0.00	0.00
DRAFTS:	3			211,946.88	0.00	211,946.88
EFT:	0			0.00	0.00	0.00
NON CHECKS:	0			0.00	0.00	0.00
VOID CHECKS:	0	VOID DEBITS	0.00			
		VOID CREDITS	0.00	0.00	0.00	

TOTAL ERRORS: 0

** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
150 40.7839	C.O. 2014 Interest Expense	23,112.50
150 40.7840	G.O. 2017 Principal	85,000.00
150 40.7841	G.O. 2017 Interest Expense	54,531.25
150 40.7842	G.O. 2021 Principal	35,000.00
150 40.7843	G.O. 2021 Interest Expense	14,303.13
	*** FUND TOTAL ***	211,946.88

	NO	INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
VENDOR SET: 01 BANK: LDEBTTOTALS:	3	211,946.88	0.00	211,946.88
BANK: LDEBT TOTALS:	3	211,946.88	0.00	211,946.88

VENDOR SET: 01 City of Dalworthington
BANK: POOL POOLED CASH - CHECKING
DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000427		TML MULTISTATE INTERGOVERNMENT							
	C-PDALWOR12401	TML: JAN 2024	N	1/24/2024			000000		
	210 00.2060	Medical Insurance Payable	TML REFUND DUE		833.20CR				
	D-PDALWOR12401	R. KULA DEC PREMIUM CREDIT	N	1/24/2024			000000		
	210 00.2060	Medical Insurance Payable	R. KULA DEC PREMIUM		833.20				
1357		TMRS							
	I-PEN202312041305	TMRS Pension	D	1/01/2024			000755	C	
	110 30.6045	Personnel:TMRS	TMRS Pension		111.36				
	110 50.6045	Personnel:TMRS	TMRS Pension		3,118.29				
	110 55.6045	Personnel:TMRS	TMRS Pension		149.57				
	110 60.6045	Personnel:TMRS	TMRS Pension		111.36				
	120 40.6045	Personnel:TMRS	TMRS Pension		114.73				
	185 50.6045	Personnel:TMRS	TMRS Pension		604.62				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		1,327.44				
	I-PEN202312051306	TMRS Pension	D	1/01/2024			000755	C	
	110 30.6045	Personnel:TMRS	TMRS Pension		527.63				
	110 40.6045	Personnel:TMRS	TMRS Pension		667.05				
	110 50.6045	Personnel:TMRS	TMRS Pension		9,026.31				
	110 55.6045	Personnel:TMRS	TMRS Pension		2,210.90				
	110 60.6045	Personnel:TMRS	TMRS Pension		943.49				
	120 40.6045	Personnel:TMRS	TMRS Pension		1,997.15				
	180 40.6045	Personnel:TMRS	TMRS Pension		233.93				
	185 50.6045	Personnel:TMRS	TMRS Pension		1,709.84				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		5,460.09				
	I-PEN202312191308	TMRS Pension	D	1/01/2024			000755	C	
	110 30.6045	Personnel:TMRS	TMRS Pension		528.04				
	110 40.6045	Personnel:TMRS	TMRS Pension		588.95				
	110 50.6045	Personnel:TMRS	TMRS Pension		8,016.59				
	110 55.6045	Personnel:TMRS	TMRS Pension		1,971.46				
	110 60.6045	Personnel:TMRS	TMRS Pension		951.90				
	120 40.6045	Personnel:TMRS	TMRS Pension		1,819.64				
	180 40.6045	Personnel:TMRS	TMRS Pension		241.93				
	185 50.6045	Personnel:TMRS	TMRS Pension		1,374.31				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		4,885.13				48,691.71
000628		WEX HEALTH INC							
	I-01/02/24	FSA CONTRIBUTION 44189	D	1/02/2024			000756	C	
	210 00.2063	Insurance Payable-FSA	FSA CONTRIBUTION 441		7,199.76				7,199.76
	2024 FSA CONTRIBUTIONS								
000455		TX CHILD SUPPORT SDU							
	I-CS 202401021309	CHILD SUPPORT	D	1/05/2024			000757	C	
	210 00.2055	Child Support Payable	CHILD SUPPORT		461.54				461.54

VENDOR SET: 01 City of Dalworthington
BANK: POOL POOLED CASH - CHECKING
DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000008		EFTPS							
	I-T1 202401021309	Federal Witholding	D	1/05/2024			000758	C	
	210 00.2020	Withholding Payable	Federal Witholding		7,757.13				
	I-T3 202401021309	Social Security	D	1/05/2024			000758	C	
	110 30.6030	Personnel:FICA(SS) & Medicare	Social Security		140.58				
	110 40.6030	Personnel:FICA(SS) & MediCare	Social Security		193.01				
	110 50.6030	Personnel:FICA(SS) & Medicare	Social Security		2,409.44				
	110 55.6030	Personnel:FICA(SS) & Medicare	Social Security		611.76				
	110 60.6030	Personnel:FICA(SS) & Medicare	Social Security		270.17				
	120 40.6030	Personnel:FICA(SS) & MediCare	Social Security		573.77				
	180 40.6030	Personnel:FICA(SS) & MediCare	Social Security		82.40				
	185 50.6030	Personnel:FICA(SS) & Medicare	Social Security		483.97				
	210 00.2010	Social Security Payable	Social Security		4,765.10				
	I-T4 202401021309	Medicare withhold	D	1/05/2024			000758	C	
	110 30.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		32.88				
	110 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		45.14				
	110 50.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		563.51				
	110 55.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		143.08				
	110 60.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		63.17				
	120 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		134.18				
	180 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		19.29				
	185 50.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		113.19				
	210 00.2015	Medicare Payable	Medicare withhold		1,114.44				19,516.21
000425		NATIONWIDE RETIREMENT SOLUTION							
	I-NPR202401021309	457B-Nationwide Pre-Tax	D	1/05/2024			000759	C	
	210 00.2062	Nationwide Payable	457B-Nationwide Pre-		150.00				150.00
000628		WEX HEALTH INC							
	I-HRA202401021309	HRA CONTRIBUTIONS	D	1/05/2024			000760	C	
	110 50.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		758.41				
	110 60.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		82.39				
	120 40.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		164.76				
	180 40.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		82.39				1,087.95
000628		WEX HEALTH INC							
	I-HSA202401021309	HSA CONTRIBUTIONS	D	1/05/2024			000761	C	
	110 30.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		8.20				
	110 50.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		83.88				
	110 60.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		42.05				
	120 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		70.63				
	180 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		28.47				
	185 50.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		147.58				
	210 00.2061	Insurance Payable - HSA	HSA CONTRIBUTIONS		279.45				660.26

VENDOR SET: 01 City of Dalworthington
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DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000132		COMMERCE BANK - VISA							
	I-3988-12/05/2023	PIPE ELBOW, SWING PIPE, PVC, 2701 CLOVER LANE 1" TAP PARTS	V	1/10/2024			000762	V	17.77
000132		COMMERCE BANK - VISA							
	B-CHECK	COMMERCE BANK - VISA VOIDED	V	1/10/2024			000762		17.77CR
0174		STATE COMPTROLLER							
	I-01/11/24	EFT CSUT MONTH: 12/2023	D	1/11/2024			000763	C	
	120 00.2080	State Sales Tax Payable	EFT CSUT MONTH: 12/2		1,428.16				1,428.16
1551		STATE COMPTROLLER							
	I-12/31/2023	STATE CRIMINAL COST FEES 12/23	D	1/12/2024			000764	C	
	205 00.2245	Fees: State Traffic	STATE CRIMINAL COST		16,204.48				
	205 00.2246	Fees:MovingViolation-State/MVF	STATE CRIMINAL COST		0.63				
	205 00.2290	Fees: Consolidated Costs	STATE CRIMINAL COST		37,855.36				
	205 00.2294	Fees: FTA OMNI STATE	STATE CRIMINAL COST		806.67				
	205 00.2296	Fees:Prior Costs-JRF, IDF, JS	STATE CRIMINAL COST		584.73				
	205 00.2299	Fees:Truancy Prevention Fund	STATE CRIMINAL COST		38.41				
	205 00.2310	Time Payment Fee	STATE CRIMINAL COST		157.76				55,648.04
000008		EFTPS							
	I-T1 202401161319	Federal Witholding	D	1/19/2024			000765	C	
	210 00.2020	Withholding Payable	Federal Witholding		7,626.56				
	I-T3 202401161319	Social Security	D	1/19/2024			000765	C	
	110 30.6030	Personnel:FICA(SS) & Medicare	Social Security		139.25				
	110 40.6030	Personnel:FICA(SS) & MediCare	Social Security		190.44				
	110 50.6030	Personnel:FICA(SS) & Medicare	Social Security		2,362.56				
	110 55.6030	Personnel:FICA(SS) & Medicare	Social Security		637.48				
	110 60.6030	Personnel:FICA(SS) & Medicare	Social Security		288.41				
	120 40.6030	Personnel:FICA(SS) & MediCare	Social Security		619.43				
	180 40.6030	Personnel:FICA(SS) & MediCare	Social Security		100.30				
	185 50.6030	Personnel:FICA(SS) & Medicare	Social Security		412.09				
	210 00.2010	Social Security Payable	Social Security		4,749.96				
	I-T4 202401161319	Medicare withhold	D	1/19/2024			000765	C	
	110 30.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		32.58				
	110 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		44.54				
	110 50.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		552.53				
	110 55.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		149.09				
	110 60.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		67.47				
	120 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		144.84				
	180 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		23.45				
	185 50.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		96.37				
	210 00.2015	Medicare Payable	Medicare withhold		1,110.87				19,348.22

VENDOR SET: 01 City of Dalworthington
BANK: POOL POOLED CASH - CHECKING
DATE RANGE: 1/01/2024 THRU 1/31/2024

VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000425		NATIONWIDE RETIREMENT SOLUTION							
	I-NPR202401161319	457B-Nationwide Pre-Tax	D	1/19/2024			000766	C	
	210 00.2062	Nationwide Payable	457B-Nationwide Pre-		150.00				150.00
000455		TX CHILD SUPPORT SDU							
	I-CS 202401161319	CHILD SUPPORT	D	1/19/2024			000767	C	
	210 00.2055	Child Support Payable	CHILD SUPPORT		461.54				461.54
000628		WEX HEALTH INC							
	I-HSA202401161319	HSA CONTRIBUTIONS	D	1/19/2024			000768	C	
	110 30.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		8.20				
	110 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS						
	110 50.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		83.88				
	110 55.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS						
	110 60.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		34.71				
	120 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		61.46				
	180 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		26.64				
	185 50.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		147.58				
	210 00.2061	Insurance Payable - HSA	HSA CONTRIBUTIONS		279.45				641.92
000628		WEX HEALTH INC							
	I-HRA202401161319	HRA CONTRIBUTIONS	D	1/19/2024			000769	C	
	110 50.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		758.41				
	110 55.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS						
	110 60.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		82.39				
	120 40.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		164.76				
	180 40.6048	Personnel:HSA/HRA	HRA CONTRIBUTIONS		82.39				1,087.95
000628		WEX HEALTH INC							
	I-HSA202401201320	HSA CONTRIBUTIONS	D	1/23/2024			000770	C	
	110 60.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		7.34				
	120 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		9.17				
	180 40.6048	Personnel:HSA/HRA	HSA CONTRIBUTIONS		1.83				18.34
000008		EFTPS							
	I-T1 202401201320	Federal Witholding	D	1/23/2024			000771	C	
	210 00.2020	Withholding Payable	Federal Witholding		60.16				
	I-T3 202401201320	Social Security	D	1/23/2024			000771	C	
	110 60.6030	Personnel:FICA(SS) & Medicare	Social Security		45.99				
	120 40.6030	Personnel:FICA(SS) & MediCare	Social Security		57.49				
	180 40.6030	Personnel:FICA(SS) & MediCare	Social Security		11.50				
	210 00.2010	Social Security Payable	Social Security		114.98				
	I-T4 202401201320	Medicare withhold	D	1/23/2024			000771	C	
	110 60.6030	Personnel:FICA(SS) & Medicare	Medicare withhold		10.75				
	120 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		13.45				
	180 40.6030	Personnel:FICA(SS) & MediCare	Medicare withhold		2.69				
	210 00.2015	Medicare Payable	Medicare withhold		26.89				343.90

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
2109		TX WORKFORCE COMMISSION - STAT							
	I-SUI 4TH QTR 23	TWC SUI TAX QTR END 12/31/23	D	1/21/2024			000772	C	
	110 40.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		2.08				
	110 50.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		8.95				
	110 55.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		4.40				
	110 60.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		0.25				
	120 40.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		2.76				
	180 40.6031	Personnel:SUTA Taxes	TWC SUI TAX QTR END		0.31				18.75
1357		TMRS							
	I-PEN202401021309	TMRS Pension	D	1/24/2024			000773	O	
	110 30.6045	Personnel:TMRS	TMRS Pension		564.00				
	110 40.6045	Personnel:TMRS	TMRS Pension		629.54				
	110 50.6045	Personnel:TMRS	TMRS Pension		9,542.54				
	110 55.6045	Personnel:TMRS	TMRS Pension		2,315.57				
	110 60.6045	Personnel:TMRS	TMRS Pension		1,056.13				
	120 40.6045	Personnel:TMRS	TMRS Pension		2,098.96				
	180 40.6045	Personnel:TMRS	TMRS Pension		295.72				
	185 50.6045	Personnel:TMRS	TMRS Pension		1,979.05				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		5,451.77				
	I-PEN202401161319	TMRS Pension	D	1/24/2024			000773	O	
	110 30.6045	Personnel:TMRS	TMRS Pension		564.85				
	110 40.6045	Personnel:TMRS	TMRS Pension		629.54				
	110 50.6045	Personnel:TMRS	TMRS Pension		9,444.27				
	110 55.6045	Personnel:TMRS	TMRS Pension		2,277.64				
	110 60.6045	Personnel:TMRS	TMRS Pension		1,133.75				
	120 40.6045	Personnel:TMRS	TMRS Pension		2,339.73				
	180 40.6045	Personnel:TMRS	TMRS Pension		398.92				
	185 50.6045	Personnel:TMRS	TMRS Pension		1,704.60				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		5,455.29				
	I-PEN202401201320	TMRS Pension	D	1/24/2024			000773	O	
	110 60.6045	Personnel:TMRS	TMRS Pension		176.02				
	120 40.6045	Personnel:TMRS	TMRS Pension		220.03				
	180 40.6045	Personnel:TMRS	TMRS Pension		44.02				
	210 00.2033	Tx Municipal Retirement System	TMRS Pension		129.81				48,451.75
2072		AFLAC							
	I-265526	AFLAC: DEC 2023	R	1/04/2024			065248	C	
	210 00.2059	Aflac Insurance Payable	AFLAC: DEC 2023		508.12				508.12
000478		KTC AUTO CONSULTANT INC							
	I-126596	UNIT: 300 REAR BRAKE SERVICE	R	1/04/2024			065249	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 300 REAR BRAKE		464.94				
	I-126599	UNIT: 300 FRONT BRAKE SERVICE	R	1/04/2024			065249	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 300 FRONT BRAK		374.09				
	I-126643	UNIT: 47 MOUNT/BALANCE 2 TIRES	R	1/04/2024			065249	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 47 MOUNT/BALAN		75.10				914.13

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000357		CITY OF ARLINGTON							
	I-CI-0004711	DEC 2023 ARL AIR TIME	R	1/04/2024			065250	C	
	110 50.7310	Contractual:Arlington Air Time	DEC 2023 ARL AIR TIM		588.00				
	110 55.7310	Contractual:Arlington Air Time	DEC 2023 ARL AIR TIM		588.00				1,176.00
0226		ARLINGTON SEWER UTILITIES							
	I-12/20/2023	SERV: 11/01/23-11/30/23	R	1/04/2024			065251	C	
	120 40.7615	Contractual:Sewer Treatment	SERV: 11/01/23-11/30		27,710.08				27,710.08
000414		ARMSTRONG FORENSIC LABORATORY,							
	I-251468	BLOOD ALCOHOL #2300015428	R	1/04/2024			065252	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #23000		95.00				
	I-251469	BLOOD ALCOHOL #2300015380	R	1/04/2024			065252	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #23000		95.00				
	I-251472	BLOOD ALCOHOL #2300015335	R	1/04/2024			065252	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #23000		95.00				285.00
1275		AT&T MOBILITY DATA CARDS							
	I-X12272023	SERV: 11/20/2023-12/19/2023	R	1/04/2024			065253	C	
	110 40.6510	Utilities:Telephone	SERV: 11/20/2023-12/		21.62				
	110 50.6510	Utilities:Telephone	SERV: 11/20/2023-12/		86.48				
	110 55.6510	Utilities:Telephone	SERV: 11/20/2023-12/		86.48				
	110 60.6510	Utilities:Telephone	SERV: 11/20/2023-12/		10.81				
	120 40.6510	Utilities:Telephone	SERV: 11/20/2023-12/		43.24				
	180 40.6510	Utilities:Telephone	SERV: 11/20/2023-12/		10.81				
	110 40.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		62.49				
	110 50.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		313.65				
	110 55.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		125.00				
	110 60.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		40.98				
	120 40.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		54.54				
	180 40.6520	Utilities:Mobile Data Termin	SERV: 11/20/2023-12/		9.84				865.94
000737		BLUE CROSS BLUE SHIELD OF TX							
	I-1/1/2024	BCBS: JAN 2024	R	1/04/2024			065254	C	
	110 30.6047	Personnel:Employee Insurances	BCBS: JAN 2024		923.32				
	110 40.6047	Personnel:Employee Insurances	BCBS: JAN 2024		469.85				
	110 50.6047	Personnel:Employee Health Ins	BCBS: JAN 2024		11,640.80				
	110 55.6047	Personnel:Employee Health Ins	BCBS: JAN 2024		817.32				
	110 60.6047	Personnel:Employee Health Ins	BCBS: JAN 2024		2,067.52				
	120 40.6047	Personnel:Employee Health Ins	BCBS: JAN 2024		3,297.43				
	180 40.6047	Personnel:Health Insurance	BCBS: JAN 2024		741.50				
	185 50.6047	Personnel:Employee HealthIns	BCBS: JAN 2024		2,946.85				
	210 00.2060	Medical Insurance Payable	BCBS: JAN 2024		5,046.70				
	210 00.2060	Medical Insurance Payable	BCBS: JAN 2024		1,830.54CR				26,120.75

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
1220		COMMERCIAL RECORDER							
	I-CL62296	GRANTING A SPECIAL EXCEPTION	R	1/04/2024			065255	C	
	110 40.6205	Mat/Supplies:Legal Notices	GRANTING A SPECIAL E		20.40				
	PUBLICATION: NOVEMBER 29, 30, 2023								
	I-CL62297	DISTRICT REGULATIONS	R	1/04/2024			065255	C	
	110 40.6205	Mat/Supplies:Legal Notices	DISTRICT REGULATIONS		21.60				
	NOVEMBER 29, 30, 2023								
	I-CL62298	DEFINING & GOVERNING BOWEN RD	R	1/04/2024			065255	C	
	110 40.6205	Mat/Supplies:Legal Notices	DEFINING & GOVERNING		17.60				
	PUBLICATION: NOVEMBER 29, 30, 2023								
	I-CL62299	CHANGE DEFINITION "AT LARGE"	R	1/04/2024			065255	C	
	110 40.6205	Mat/Supplies:Legal Notices	CHANGE DEFINITION "A		18.00				77.60
	PUBLICATION: NOVEMBER 29, 30, 2023								
1380		JOSEPH A. DELPRINCIPE DO PA							
	I-01/01/2024	2024 ANNUAL MEDICAL DIRECTOR	R	1/04/2024			065256	C	
	110 50.7315	Contractual:Medical Director	2024 ANNUAL MEDICAL		2,000.00				
	110 55.7315	Contractual-Medical Director	2024 ANNUAL MEDICAL		2,000.00				4,000.00
000687		EMI HEALTH							
	I-COMM836420240101	EMI HEALTH: JAN 2024	R	1/04/2024			065257	C	
	210 00.2056	Dental Insurance Payable	EMI HEALTH: JAN 2024		694.00				694.00
000526		FIDELITY SECURITY LIFE INSURAN							
	I-166076771	EYEMED: JAN 2024	R	1/04/2024			065258	C	
	210 00.2057	Vision Insurance Payable	EYEMED: JAN 2024		181.13				181.13
0064		FT WORTH WATER DEPARTMENT							
	I-12/19/2023	SERV: NOV 2023	R	1/04/2024			065259	C	
	120 40.7650	Contractual:Water Purchase	SERV: NOV 2023		32,542.70				32,542.70
000734		KIMLEY-HORN AND ASSOCIATES, IN							
	I-068302503-1123	WATER MASTER PLAN UPDATE	R	1/04/2024			065260	C	
	120 40.7030	Consultants:Engineer-Regular	WATER MASTER PLAN UP		20,000.00				
	I-068302505-1123	PLAT REVIEW	R	1/04/2024			065260	C	
	110 40.7045	Consultants-Engineer-Platting	PLAT REVIEW		1,180.00				21,180.00
000174		MOTOROLA SOLUTIONS INC							
	I-8230435790	JAN 2024 RADIO MAINTENANCE	R	1/04/2024			065261	C	
	110 50.7320	Contractual:Comm Radio	JAN 2024 RADIO MAINT		862.54				
	110 55.7320	Contractual:Comm Radio	JAN 2024 RADIO MAINT		862.54				1,725.08
000432		NETGENIUS, INC.							
	I-1974	JAN 2024 NETGENIUS	R	1/04/2024			065262	C	
	110 30.7300	Contractual:Computer System	(46) PCS		165.00				
	110 40.7300	Contractual:Computer System	(46) PCS		385.00				
	110 50.7300	Contractual:Computer System	(46) PCS		797.50				
	110 55.7300	Contractual:Computer System	(46) PCS		632.50				

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000432		NETGENIUS, INC. CONT							
	I-1974	JAN 2024 NETGENIUS	R	1/04/2024			065262	C	
	110 60.7300	Contractual:Computer System	(46) PCS		220.00				
	120 40.7300	Contractual:Computer System	(46) PCS		165.00				
	180 40.7300	Contractual:Computer System	(46) PCS		55.00				
	118 30.7300	Contractual: Computer System	(46) PCS		110.00				
	110 40.7699	Contractual:O/H Cost Recovery	(46) PCS		132.00CR				
	120 40.7699	Contractual:O/H Cost Expense	(46) PCS		132.00				
	110 30.7300	Contractual:Computer System	(11) SERVERS		125.00				
	110 40.7300	Contractual:Computer System	(11) SERVERS		1,687.50				
	110 50.7300	Contractual:Computer System	(11) SERVERS		625.00				
	110 55.7300	Contractual:Computer System	(11) SERVERS		250.00				
	118 30.7300	Contractual: Computer System	(11) SERVERS		62.50				
	110 40.7699	Contractual:O/H Cost Recovery	(11) SERVERS		675.00CR				
	120 40.7699	Contractual:O/H Cost Expense	(11) SERVERS		675.00				
	110 40.6510	Utilities:Telephone	VOIP		725.00				
	110 40.6599	Utilities:O/H Cost Recovery	VOIP		290.00CR				
	120 40.6599	Utilities:O/H Cost Expense	VOIP		290.00				
	110 40.6510	Utilities:Telephone	CITY HALL FAX LINE		25.00				
	110 40.6599	Utilities:O/H Cost Recovery	CITY HALL FAX LINE		10.00CR				
	120 40.6599	Utilities:O/H Cost Expense	CITY HALL FAX LINE		10.00				
	110 40.7300	Contractual:Computer System	(6) SWITHCES		210.00				
	110 40.7699	Contractual:O/H Cost Recovery	(6) SWITHCES		84.00CR				
	120 40.6599	Utilities:O/H Cost Expense	(6) SWITHCES		84.00				
	110 40.7300	Contractual:Computer System	(5) WIRELESS ACCESS		175.00				
	110 40.7699	Contractual:O/H Cost Recovery	(5) WIRELESS ACCESS		70.00CR				
	120 40.6599	Utilities:O/H Cost Expense	(5) WIRELESS ACCESS		70.00				
	110 40.7300	Contractual:Computer System	(2) FIREWALL		500.00				
	110 40.7699	Contractual:O/H Cost Recovery	(2) FIREWALL		200.00CR				
	120 40.6599	Utilities:O/H Cost Expense	(2) FIREWALL		200.00				6,915.00
		(11) SERVERS, (46) PCS, (30) 3CX EXTENSION MANAGEMENT							
		(6) SWITCHES (5) WIRELESS ACCESS POINTS, (2) FIREWALL							
000394		NEW BENEFITS, LTD							
	I-NB4400AY-1193898	NEW BENEFITS: DEC 2023	R	1/04/2024			065263	C	
	110 30.6047	Personnel:Employee Insurances	NEW BENEFITS: DEC 20		8.50				
	110 40.6047	Personnel:Employee Insurances	NEW BENEFITS: DEC 20		4.25				
	110 50.6047	Personnel:Employee Health Ins	NEW BENEFITS: DEC 20		107.95				
	110 55.6047	Personnel:Employee Health Ins	NEW BENEFITS: DEC 20		25.50				
	110 60.6047	Personnel:Employee Health Ins	NEW BENEFITS: DEC 20		13.96				
	120 40.6047	Personnel:Employee Health Ins	NEW BENEFITS: DEC 20		21.31				
	180 40.6047	Personnel:Health Insurance	NEW BENEFITS: DEC 20		2.98				
	185 50.6047	Personnel:Employee HealthIns	NEW BENEFITS: DEC 20		19.55				204.00

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
0218		OFFICE DEPOT							
	I-346937045001	W2 AND 1099 FORMS	R	1/04/2024			065264	C	
	110 40.6240	Mat/Supplies:Printing	W2 AND 1099 FORMS		126.46				
	110 40.6499	Mat/Supplies:O/H Cost Recovery	W2 AND 1099 FORMS		50.59CR				
	120 40.6499	Mat/Supplies:O/H Cost Expense	W2 AND 1099 FORMS		50.59				126.46
1075		OMNIBASE SERVICES OF TEXAS,LP							
	I-423-107220	4TH QTR 2023 (OCT-DEC)	R	1/04/2024			065265	C	
	205 00.2330	OMNI Admin Fees	4TH QTR 2023 (OCT-DE		734.00				734.00
0094		PANTEGO UTILITIES SEWER							
	I-12/22/2023	SERV: 11/01/2023-11/30/2023	R	1/04/2024			065266	C	
	120 40.7615	Contractual:Sewer Treatment	SERV: 11/01/2023-11/		426.31				426.31
000688		RENAISSANCE LIFE & HEALTH INSU							
	I-156043	RENAISSANCE: JAN 2024	R	1/04/2024			065267	C	
	110 30.6049	Personnel:ER-Short Term Disab	RENAISSANCE: JAN 202		10.50				
	110 40.6049	Personnel:ER-ShortTerm Disab	RENAISSANCE: JAN 202		0.49				
	110 50.6049	Personnel:ER ShortTerm Disab	RENAISSANCE: JAN 202		182.75				
	110 55.6049	Personnel:ER ShortTerm Disab	RENAISSANCE: JAN 202		18.52				
	110 60.6049	Personnel:ER-ShortTerm Disab	RENAISSANCE: JAN 202		18.42				
	120 40.6049	Personnel:ER Short Term Disab	RENAISSANCE: JAN 202		23.32				
	180 40.6049	Personnel:ER Short Term Disab	RENAISSANCE: JAN 202		4.15				
	185 50.6049	Personnel:ER ShortTerm Disab	RENAISSANCE: JAN 202		27.18				
	110 30.6046	Personnel:ER-Long Term Disab	RENAISSANCE: JAN 202		10.83				
	110 40.6046	Personnel:ER-LongTerm Disab	RENAISSANCE: JAN 202		3.58				
	110 50.6046	Personnel:ER LongTerm Disab	RENAISSANCE: JAN 202		174.06				
	110 55.6046	Personnel:ER Long Term Disab	RENAISSANCE: JAN 202		16.23				
	110 60.6046	Personnel:ER-LongTerm Disab	RENAISSANCE: JAN 202		19.37				
	120 40.6046	Personnel:ER Long Term Disab	RENAISSANCE: JAN 202		27.17				
	180 40.6046	Personnel:ER-LongTerm Disab	RENAISSANCE: JAN 202		3.98				
	185 50.6046	Personnel:ER LongTerm Disab	RENAISSANCE: JAN 202		27.44				
	110 30.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		3.74				
	110 40.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		0.66CR				
	110 50.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		59.45				
	110 55.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		6.75				
	110 60.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		6.13				
	120 40.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		6.87				
	180 40.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		1.31				
	185 50.6042	Personnel:ER-Life/AD&D Ins	RENAISSANCE: JAN 202		8.60				
	210 00.2058	Vol LIfe/AD&D Ins Payable	RENAISSANCE: JAN 202		146.02				806.20
000736		ROBERT HALF							
	I-63022895	HALF: DELL STAMPLEY 24.50 HRS	R	1/04/2024			065268	C	
	110 40.7415	Contractual:Contract Labor	HALF: DELL STAMPLEY		514.50				
	120 40.7415	Contractual:Contract Labor	HALF: DELL STAMPLEY		514.50				1,029.00

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000582		SOUTHSIDE BANCSHARES INC							
	I-261447-JAN 2024	LOAN #261447 JAN 2024 PMT	R	1/04/2024			065269	C	
	110 55.8087	Other:Capital Lease-Fire Truck	LOAN #261447 JAN 202		47,282.32				
	110 55.8088	Other:Cap Lease Fire Truck Int	LOAN #261447 JAN 202		8,653.37				55,935.69
1107		T C APPRAISAL DISTRICT							
	I-24021	2024 1ST QTR ALLOCATION	R	1/04/2024			065270	C	
	110 40.7210	Contractual:Tarrant Appraisal	2024 1ST QTR ALLOCAT		3,230.28				3,230.28
0253		TX COMMISSION ON ENVIRONMENTAL							
	I-GPS0259926	FY2024 STORMWATER PERMIT	R	1/04/2024			065271	C	
	110 60.7215	Contractual:Filing Fees	FY2024 STORMWATER PE		100.00				100.00
000592		TEXAS POLICE CHIEFS ASSOCIATIO							
	I-PCF202401021309	TX Police Chief Foundation	R	1/04/2024			065272	C	
	210 00.2051	TX Police Chiefs Foundation	TX Police Chief Foun		45.00				45.00
000183		TRANSUNION RISK & ALTERNATIVE							
	I-2661-202312-1	SERV: DEC 2023	R	1/04/2024			065273	C	
	110 30.7300	Contractual:Computer System	SERV: DEC 2023		75.00				75.00
000639		USA BLUEBOOK							
	I-INV00214549	LR/HR DPD CHLORINE	R	1/04/2024			065274	C	
	120 40.6450	Mat/Supplies:Testing Supplies	LR/HR DPD CHLORINE		543.08				543.08
0615		WILDFIRE TRUCK & EQUIPMENT SAL							
	I-47800	UNIT: 49 UPFIT ON TAHOE	R	1/04/2024			065275	C	
	185 50.9100	Capital Outlay:DPS Vehicle	UNIT: 49 UPFIT ON TA		20,992.65				20,992.65
1		CEJKA, XIA							
	I-000202401031310	US REFUND	R	1/04/2024			065276	C	
	120 00.2620	Refundable Deposits	03-000081-02		59.00				59.00
000478		KTC AUTO CONSULTANT INC							
	I-126653	UNIT: 302 REAR/FRONT BREAK SER	R	1/10/2024			065277	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 302 REAR/FRONT		899.20				899.20
0281		ARL MUNICIPAL COURT							
	I-1/8/2024 #100173-1	#100173-1 STUART, ARRIONNA B	R	1/10/2024			065278	C	
	205 00.2300	Outside Entities	#100173-1 STUART, A		700.00				700.00
000067		BIRD'S COPIES LLC							
	I-52535	(828) JAN NEWSLETTER/WTR BILL	R	1/10/2024			065279	C	
	110 40.6240	Mat/Supplies:Printing	11X17 60# WHITE PAPE		211.00				
	120 40.6240	Mat/Supplies:Printing	UTILITY BILL W PERFE		81.00				
	120 40.6240	Mat/Supplies:Printing	MAILING STUFF, SEAL,		225.00				
	120 40.6245	Mat/Supplies:Postage	POSTAGE W OUR PERMIT		457.51				
	120 40.6240	Mat/Supplies:Printing	#10 WINDOW ENVELOPES		80.00				1,054.51

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1484		BOUND TREE MEDICAL, LLC							
	I-85191728	21 GAUGE NEEDLES-BLOOD DRAW	R	1/10/2024			065280	C	
	110 50.6250	Mat/Supplies:PSO Supplies	21 GAUGE NEEDLES-BLO		469.69				469.69
000622		ESO SOLUTIONS INC							
	I-ESO-129818	EMERGENCY RPTG 2/1/24-1/31/25	R	1/10/2024			065281	C	
	110 55.7300	Contractual:Computer System	EMERGENCY RPTG 2/1/2		1,867.50				
	110 60.7300	Contractual:Computer System	EMERGENCY RPTG 2/1/2		1,867.50				3,735.00
000010		CITY OF FT WORTH WHOLESALE WAT							
	I-12/31/2023	1ST QTR2024 OCT-DEC IMPACT FEE	R	1/10/2024			065282	C	
	120 00.2490	Impact Fees - FW Water	1ST QTR FY 2024		344.00				344.00
1922		GEXA ENERGY CORP							
	I-33865297-4	GEXA: 11/29/2023-12/28/2023	R	1/10/2024			065283	C	
	180 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		146.92				
	120 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		1,209.10				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		1,098.72				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		147.17				
	110 60.6500	Utilities:Electricity	GEXA: 11/28/2023-12/		35.97				
	110 50.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		697.71				
	110 55.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		149.51				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		49.84				
	120 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		49.84				
	180 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		49.84				
	110 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		21.72				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		8.08				
	110 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		7.54				
	120 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		22.10				
	120 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		6.92				
	180 40.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		7.22				
	120 40.6500	Utilities:Electricity	GEXA: 11/22/2023-12/		7.18				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		73.68				
	110 60.6500	Utilities:Electricity	GEXA: 11/29/2023-12/		781.17				
	110 40.6500	Utilities:Electricity	GEXA: 11/20/2023-12/		207.66				
	110 40.6599	Utilities:O/H Cost Recovery	GEXA: 11/20/2023-12/		83.06CR				
	120 40.6599	Utilities:O/H Cost Expense	GEXA: 11/20/2023-12/		83.06				4,777.89
000239		GOODYEAR COMMERCIAL TIRE & SER							
	I-INV040222	UNIT: 701 REPAIR FLAT TIRE	V	1/10/2024			065284	O	24.48
0086		HUMANE SOCIETY OF NORTH TX							
	I-132024	1 FOUND STRAY 12/8/23	R	1/10/2024			065285	C	
	110 60.7420	Contractual:Animal Control Vet	1 FOUND STRAY 12/8/2		75.00				75.00

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0847		LANGUAGE LINE SERVICES							
	I-11181643	SPANISH OVER THE PHONE	R	1/10/2024			065286	C	
	110 30.7095	Consultants:Other	SPANISH OVER THE PHO		29.58				29.58
000736		ROBERT HALF							
	I-62990114	RH: DELL STAMPLEY 32.50 HRS	R	1/10/2024			065287	C	
	110 40.7415	Contractual:Contract Labor	RH: DELL STAMPLEY 32		682.50				
	120 40.7415	Contractual:Contract Labor	RH: DELL STAMPLEY 32		682.50				
	I-63043399	RH: DELL STAMPLEY 24.50 HRS	R	1/10/2024			065287	C	
	110 40.7415	Contractual:Contract Labor	RH: DELL STAMPLEY 24		514.50				
	120 40.7415	Contractual:Contract Labor	RH: DELL STAMPLEY 24		514.50				2,394.00
000565		SAFEBUILT TEXAS, LLC							
	I-176663	DEC 2023 INSPECTIONS	R	1/10/2024			065288	C	
	110 60.7515	Contractrua:Inspections	PERMIT INSPECTIONS		3,877.25				
	110 60.7515	Contractrua:Inspections	CODE ENFORCEMENT 8.2		1,020.00				
	110 60.7515	Contractrua:Inspections	CITY PLANNER 5 HRS		525.00				5,422.25
000395		SHRED-IT USA LLC							
	I-8005752850	SHRED-IT: DEC 2023	R	1/10/2024			065289	C	
	110 40.7301	Contractual:Shred Service	SHRED-IT: DEC 2023		106.31				
	110 40.7699	Contractual:O/H Cost Recovery	SHRED-IT: DEC 2023		42.51CR				
	120 40.7699	Contractual:O/H Cost Expense	SHRED-IT: DEC 2023		42.51				106.31
0176		T C PUBLIC HEALTH-N TX REGIONA							
	I-39077	DEC 2023 WATER SAMPLES	R	1/10/2024			065290	C	
	120 40.7655	Contractual:Water Testing	DEC 2023 WATER SAMPL		60.00				60.00
1005		TIMECLOCK PLUS							
	I-INV00320215	ANNUAL HARDWARE SUPPORT & MAIN	R	1/10/2024			065291	C	
	110 40.7300	Contractual:Computer System	ANNUAL HARDWARE SUPP		314.63				
	110 40.7699	Contractual:O/H Cost Recovery	ANNUAL HARDWARE SUPP		125.85CR				
	120 40.7699	Contractual:O/H Cost Expense	ANNUAL HARDWARE SUPP		125.85				314.63
	HARDWARE SUPPORT & MAINTENANCE								
	2/10/2024-2/09/2025								
1243		TML INTERGOVERNMENTAL P/L							
	I-01/01/2024	FY 23/24 2ND QTRLY STATEMENT	R	1/10/2024			065292	C	
	110 40.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		3,455.56				
	110 50.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		9,281.90				
	110 55.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		1,502.43				
	110 60.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		1,153.31				
	120 40.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		1,363.32				
	180 40.7505	Contractual:Liability Insur	FY 23/24 2ND QTRLY S		177.04				
	110 40.7699	Contractual:O/H Cost Recovery	FY 23/24 2ND QTRLY S		1,260.52CR				
	120 40.7699	Contractual:O/H Cost Expense	FY 23/24 2ND QTRLY S		1,260.52				
	110 40.7510	Contractual:Worker's CompensatFY	23/24 2ND QTRLY S		287.00				
	110 50.7510	Contractual:Worker's Compens	FY 23/24 2ND QTRLY S		8,502.20				

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1243		TML INTERGOVERNMENTAL CONT							
	I-01/01/2024	FY 23/24 2ND QTRLY STATEMENT	R	1/10/2024			065292	C	
	110 55.7510	Contractual:Worker's Compens	FY 23/24 2ND QTRLY S		1,438.80				
	110 60.7510	Contractual:Worker's Compens	FY 23/24 2ND QTRLY S		427.45				
	120 40.7510	Contractual:Worker's Compens	FY 23/24 2ND QTRLY S		822.99				
	180 40.7510	Contractual:Worker's Compensat	FY 23/24 2ND QTRLY S		299.31				
	110 40.7699	Contractual:O/H Cost Recovery	FY 23/24 2ND QTRLY S		110.50CR				
	120 40.7699	Contractual:O/H Cost Expense	FY 23/24 2ND QTRLY S		110.50				28,711.31
000276		TAYLOR OLSON ADKINS SRALLA & E							
	I-STMT #19	TOASE: DEC 2023 PIA REQUESTS	R	1/10/2024			065293	C	
	110 40.7015	Consultants:Legal-Regular	TOASE: DEC 2023 PIA		530.00				
	I-STMT #97	TOASE: DEC 2023 15 HRS	R	1/10/2024			065293	C	
	110 40.7015	Consultants:Legal-Regular	TOASE: DEC 2023 15 H		3,213.57				3,743.57
0068		TYLER TECHNOLOGIES - INCODE							
	I-025-450402	INSITE FEES 10/01/23-12/31/23	R	1/10/2024			065294	C	
	120 40.7227	Contractual:CC Online Tran Fee	INSITE FEES-DEC		450.75				
	120 00.2105	Accrued Payables	INSITE FEES OCT		424.40				
	120 00.2105	Accrued Payables	INSITE FEES NOV		433.35				
	I-025-450949	NOTIFY FEES 10/01/23-12/31/23	R	1/10/2024			065294	C	
	118 30.7226	Contractual:Notification Fees	NOTIFY FEES-DEC (COU		28.80				
	118 00.2105	Accrued Payables	NOTIFY FEES NOV (COU		30.20				
	118 00.2105	Accrued Payables	NOTIFY FEES OCT (COU		17.80				
	120 40.7226	Contractual:Call Notification	NOTIFY FEES DEC (SMA		24.90				
	120 00.2105	Accrued Payables	NOTIFY FEES NOV (SMA		20.60				
	120 00.2105	Accrued Payables	NOTIFY FEES OCT (SMA		20.90				
	120 40.7226	Contractual:Call Notification	NOTIFY FEES DEC (UB)		36.10				
	120 00.2105	Accrued Payables	NOTIFY FEES NOV (UB)		29.80				
	120 00.2105	Accrued Payables	NOTIFY FEES OCT (UB)		33.60				1,551.20
000318		VISUAL IMPACT SPECIALTIES							
	I-P-2301622	(2) NAVY SHIRTS K. GARCIA	R	1/10/2024			065295	C	
	110 55.6300	Mat/Supplies:Uniform	(2) NAVY SHIRTS K. G		26.00				26.00
000690		WATER WORKS SUPPLY CO INC							
	I-3021407	(12) NEW METER SETS	R	1/10/2024			065296	C	
	120 40.6910	Maintenance:Water Distribution	(12) NEW METER SETS		3,946.40				3,946.40
000664		WCD ENTERPRISES LLC							
	I-426042	DEC 2023 JANITORIAL SERVICES	R	1/10/2024			065297	C	
	110 40.7440	Contractual:Janitor Services	DEC 2023 JANITORIAL		400.00				
	110 40.7699	Contractual:O/H Cost Recovery	DEC 2023 JANITORIAL		160.00CR				
	120 40.7699	Contractual:O/H Cost Expense	DEC 2023 JANITORIAL		160.00				
	110 50.7440	Contractual:Janitor Services	DEC 2023 JANITORIAL		396.00				
	110 55.7440	Contractual:Janitor Services	DEC 2023 JANITORIAL		99.00				895.00

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000628		WEX HEALTH INC							
	I-0001877598-IN	WEX: DEC 2023 HSA/HRA/FSA FEE	R	1/10/2024			065298	C	
	110 30.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		7.01				
	110 40.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		9.46				
	110 50.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		43.83				
	110 55.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		4.16				
	110 60.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		9.37				
	120 40.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		21.07				
	180 40.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		1.83				
	185 50.6048	Personnel:HSA/HRA	WEX: DEC 2023 HSA/HR		2.92				99.65
1		SOTO, RICARDO							
	I-000202401091318	SOTO, RICARDO:	R	1/10/2024			065299	O	
	110 00.4240	Municipal Ct:Fees-Admin	Cash Refund:G41620		26.10				26.10
1		BEASLEY, LESLIE							
	I-000202401041317	US REFUND	R	1/10/2024			065300	O	
	120 00.2620	Refundable Deposits	11-000117-06		228.25				228.25
1		BROWN, SUSAN							
	I-000202401041315	US REFUND	R	1/10/2024			065301	C	
	120 00.2620	Refundable Deposits	10-000047-09		80.67				80.67
1		CATLETT, ROBERT							
	I-000202401041313	US REFUND	R	1/10/2024			065302	O	
	120 00.2620	Refundable Deposits	02-000227-01		0.39				0.39
1		J&M SQUARED LLC							
	I-000202401041312	US REFUND	R	1/10/2024			065303	C	
	120 00.2620	Refundable Deposits	02-000090-09		87.51				87.51
1		REAL PROPERTY MGMT M							
	I-000202401041314	US REFUND	R	1/10/2024			065304	O	
	120 00.2620	Refundable Deposits	10-000045-10		18.41				18.41
1		TINNEY, TONYA							
	I-000202401041311	US REFUND	R	1/10/2024			065305	C	
	120 00.2620	Refundable Deposits	02-000077-04		8.82				8.82
1		TONG, ANQUY							
	I-000202401041316	US REFUND	R	1/10/2024			065306	C	
	120 00.2620	Refundable Deposits	11-000098-08		54.08				54.08

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000132		COMMERCE BANK - VISA							
	C-1M01M013060739	VISA LIABILITY WAIVER	V	1/10/2024			065307	V	
	C-2675-12/19/2023	PRIME VIDEO TVOD	V	1/10/2024			065307	V	
	C-3905-12/7/23-R	REFUND FOR WALL CALENDAR	V	1/10/2024			065307	V	
	C-3913-12/15/2023	CREDIT ON TAX FEES	V	1/10/2024			065307	V	
	C-3913-12/15/23	BEST BUY CREDIT ON TAXES	V	1/10/2024			065307	V	
	C-3921-09/24/23-2	LARGE TRAUMA BAG CANCELLED	V	1/10/2024			065307	V	
	C-3970-10/27/23	(1) SCADA MONITOR REPLACEMENT	V	1/10/2024			065307	V	
	C-CM 6585-11/30/23	WASHMASTERS DISPUTE-S YANCEY	V	1/10/2024			065307	V	
	I-1M01M013060	VISA LIABILITY REFUND	V	1/10/2024			065307	V	
	I-2616390793	ADOBE DEC23 11/28/23-12/28/23	V	1/10/2024			065307	V	
	I-2675-10/26/23-1	UNIT#E43 DIESEL EXHAUST FLUID	V	1/10/2024			065307	V	
	I-2675-10/26/23-2	HOLIDAY CHRISTMAS CARDS	V	1/10/2024			065307	V	
	I-2675-10/27/23	WALMART CHARGE REIM J. BURKHAR	V	1/10/2024			065307	V	
		Reimbursed by JB ck# 1004							
	I-2675-10/28/2023	EMR BOOK - PITTAWAY	V	1/10/2024			065307	V	
	I-2675-10/29/23	(11)3M MONITORING STETHOSCOPE	V	1/10/2024			065307	V	
	I-2675-10/30/2023	5W-30 GENERATOR MOTOR OIL	V	1/10/2024			065307	V	
	I-2675-10/30/23-1	TCFP FEES	V	1/10/2024			065307	V	
		TCFP FEES/ PETTY, FIKE, BLINN, WITTS, MILLER, WOLF,BASS, CASON							
	I-2675-10/30/23-2	TCFP FEES	V	1/10/2024			065307	V	
		TCFP FEES/ J.FLORES							
	I-2675-10/31/23	HALLOWEEN FIRE TRUCK	V	1/10/2024			065307	V	
	I-2675-11-16/2023	SUPPLIES FOR XMAS BANQUET	V	1/10/2024			065307	V	
	I-2675-11/01/23-1	UNIT: MC3 ANNUAL BMW SOFTWARE	V	1/10/2024			065307	V	
	I-2675-11/01/23-2	UNIT:MC3,48,302 STATE REGISTRA	V	1/10/2024			065307	V	
	I-2675-11/02/23	UNIT: 46 VEHICLE REGISTRATION	V	1/10/2024			065307	V	
	I-2675-11/08/23	UNIT: 300 MCRFST 65W WALL SURF	V	1/10/2024			065307	V	
		MICROSOFT 65W WALL SURFACE							
	I-2675-11/13/23	HERSHEY'S CANDY RING THE BELL	V	1/10/2024			065307	V	
	I-2675-11/14/2023	2024 IACP MEMBERSHIP DUES	V	1/10/2024			065307	V	
		1/1/24-12/31/24							
	I-2675-11/14/23	(200) SALVATION ARMY PR BAGS	V	1/10/2024			065307	V	
	I-2675-11/15/2023	CANDY CANES-XMAS PARADE	V	1/10/2024			065307	V	
	I-2675-11/15/2023-1	SUPPLIES FOR XMAS BANQUET	V	1/10/2024			065307	V	
	I-2675-11/15/2023-2	DOLLAR TREE RECEIPT ADJUSTMENT	V	1/10/2024			065307	V	
	I-2675-11/15/23	BANQUET-GINGERBREAD HOUSE KIT	V	1/10/2024			065307	V	
	I-2675-11/16/2023-1	UNIT: E43 INSPECTION	V	1/10/2024			065307	V	
	I-2675-11/17/2023-1	RIBBON FOR BAGS	V	1/10/2024			065307	V	
		SALVATION ARMY LOST RECEIPT							
	I-2675-11/19/23	UNIT 48: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-11/19/23-1	UNIT 300: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-11/19/23-2	UNIT 46: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-11/19/23-3	COMMERCE BANK - VISA	V	1/10/2024			065307	V	
	I-2675-11/19/23-4	UNIT 51: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-11/19/23-5	UNIT 47: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-11/19/23-6	UNIT 45: WASH MASTERS	V	1/10/2024			065307	V	

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	I-2675-11/20/23	TCFP CERTIFICATION, G. FETZER	V	1/10/2024			065307	V	
	I-2675-11/27/23	IPHONE FAST CHARGER CABLE	V	1/10/2024			065307	V	
	I-2675-11/28/2023	FORKS,MILK,NAPKINS,VELVEETA	V	1/10/2024			065307	V	
	I-2675-11/28/2023-1	WALMART ITEMS FOR XMAS PARTY	V	1/10/2024			065307	V	
	I-2675-11/29/23	7 PAINT PEN MARKERS	V	1/10/2024			065307	V	
	I-2675-11/7/23	TCFP EXAM GRANT FETZER	V	1/10/2024			065307	V	
	I-2675-12/01/2023	SOUR CREAM, REDDI WIP	V	1/10/2024			065307	V	
	I-2675-12/01/2023-1	130 FOOD FOR BANQUET	V	1/10/2024			065307	V	
		MAMA CUCA'S							
	I-2675-12/04/2023	CPSAAA AMAZON	V	1/10/2024			065307	V	
	I-2675-12/13/2023	(3) 4 PACK DURACELL BATTERY	V	1/10/2024			065307	V	
	I-2675-12/13/23-1	SFFMA 2024 MEMBERSHIP	V	1/10/2024			065307	V	
	I-2675-12/13/23-2	EXTERNAL CD DVD DRIVE USB	V	1/10/2024			065307	V	
	I-2675-12/15/2023	FIRST CLASS MAILINGS	V	1/10/2024			065307	V	
	I-2675-12/15/2023-1	20 PACK PENCIL POUCH	V	1/10/2024			065307	V	
	I-2675-12/15/2023-2	(100) MEAD CLASP ENVELOPES	V	1/10/2024			065307	V	
	I-2675-12/19/2023	UNIT 47: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-1	UNIT 51: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-2	UNIT 46: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-3	UNIT 302: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-4	UNIT 300: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-5	UNIT 45: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-6	UNIT 48: WASH MASTERS	V	1/10/2024			065307	V	
	I-2675-12/19/2023-7	TONER CARTRIDGE	V	1/10/2024			065307	V	
	I-2675-12/6/2023	TCFAIA DUES 1/1/24-12/31/2024	V	1/10/2024			065307	V	
	I-3905-10/28/2023	SAMS CLUB MEMBERSHIP FEES	V	1/10/2024			065307	V	
		RENEWED ON 10/28/2023							
	I-3905-10/30/23	OFFICE SUPPLIES	V	1/10/2024			065307	V	
		1PK BLUE PENS (1) STAPLE REMOVER, (1) VOID STAMP (1) MONTHLY PLANNER							
	I-3905-12/07/2023	CD PLAYER AND 2024 CALENDAR	V	1/10/2024			065307	V	
	I-3913-11/22/2023	COMPUTER FROM BEST BUY	V	1/10/2024			065307	V	
	I-3913-12/13/2023	TACO CABANA FOR XMAS LUNCH	V	1/10/2024			065307	V	
	I-3913-12/13/23	MICROSOFT 365 BUSINESS STANDAR	V	1/10/2024			065307	V	
		12/12/2023-12/11/2024							
	I-3913-12/15/2023-1	TO REVERSE CREDIT	V	1/10/2024			065307	V	
	I-3913-12/18/23	TPCA MEMBERSHIP DUES	V	1/10/2024			065307	V	
		12/18/2023-12/17/2024							
	I-3921-09/24/23	LARGE TRAUMA BAG	V	1/10/2024			065307	V	
	I-3921-10/26/23	HOTEL TCOLE CONFERENCE	V	1/10/2024			065307	V	
	I-3921-10/31/23	TRAINING ACADEMY M.BASS	V	1/10/2024			065307	V	
	I-3921-11/09/23-1	UNIT: 46 (2)PK BULBS/LP LIGHTS	V	1/10/2024			065307	V	
	I-3921-11/09/23-2	UNIT:47 (2) PK BULBS/LP LIGHTS	V	1/10/2024			065307	V	
	I-3921-11/09/23-3	UNIT:48 (2) PK BULBS/LP LIGHTS	V	1/10/2024			065307	V	
	I-3921-11/16/23	(4) HOLOSUN HM3X MAGNIFER	V	1/10/2024			065307	V	
	I-3921-11/17/23	UNIT: 302 WIPERBLADES	V	1/10/2024			065307	V	
	I-3921-11/20/23	(4)HOLOSUN RED DOT(4)GREEN DOT	V	1/10/2024			065307	V	
	I-3921-12/01/2023	WATER FOR XMAS PARTY	V	1/10/2024			065307	V	

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
	I-3947-10/26/23	GFOAT CONF PARKING FEE K.DAY	V	1/10/2024			065307	V	
	I-3947-10/27/23	GFOAT CONF PARKING FEE K.DAY	V	1/10/2024			065307	V	
	I-3947-11/03/2023-1	DWG UB 01-000320-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/2023-3	DWG UB 02-000084-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/2023-4	DWG UB 02-000224-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/2023-5	DWG UB 02-028702-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/2023-6	DWG UB 02-028703-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/2023-7	DWG UB 03-003601-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-11/03/23-2	DWG UB 02-000075-00 10/1-10/31	V	1/10/2024			065307	V	
	I-3947-12/05/2023-1	DWG UB 01-000320-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/05/2023-2	DWG UB 02-000075-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/05/2023-4	DWG UB 02-000224-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/05/2023-5	DWG UB 02-028702-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/05/2023-6	DWG UB 02-028703-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/05/2023-7	DWG UB 03-003601-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-12/5/2023-3	DWG UB 02-000084-00 11/1-11/30	V	1/10/2024			065307	V	
	I-3947-2590243512	ADOBE: NOV23 10/29/23-11/27/23	V	1/10/2024			065307	V	
	I-3970-10/25/23	4-PACK DURACELL TYPE D	V	1/10/2024			065307	V	
	I-3970-10/27/23	(1)SCADA MONITOR REPLACEMENT	V	1/10/2024			065307	V	
	I-3970-10/31/23	PARTS TO UPDATE KAYLYNN METER	V	1/10/2024			065307	V	
	I-3970-11/01/23	(1) SCADA MONITOR REPLACEMENT	V	1/10/2024			065307	V	
	I-3970-11/07/23	(1) ORANGE SAFETY BARRIER FENC	V	1/10/2024			065307	V	
	I-3970-11/08/23	SERVICE LINE PULLER TOOLS	V	1/10/2024			065307	V	
	I-3970-11/16/23	HAND PUMP, QKCRETE,BATTERIES	V	1/10/2024			065307	V	
		80 LBS QUICKRETE MIX, HACH COLORIMETER BATTERIES HAND PUMP FOR WATER METER REPAIRS							
	I-3970-11/9/23	MULCH FOR PARK BOARD 11/11/23	V	1/10/2024			065307	V	
	I-3970-12/12/2023	SUPPLIES FROM SAM'S CLUB	V	1/10/2024			065307	V	
	I-3970-12/13/2023	PESTICIDE APP LICENSE-GP	V	1/10/2024			065307	V	
	I-3970-12/21/2023	TX DEPT OF AGRICULTURE FEE	V	1/10/2024			065307	V	
		INVOICE 02025584 G PARKER NONCOMMERCIAL POLITICAL CERTIFICA							
	I-3970-12/21/23	LIGHTS, GARLAND, WREATH	V	1/10/2024			065307	V	
		LIGHTS, GARLAND, AND WREATHS FOR TRAILER SANTA PARADE							
	I-3970-12/22/23	LIGHT BULB REPLACEMENT	V	1/10/2024			065307	V	
		DPS MEN'S BATHROOM LIGHTS WERE OUT							
	I-3988-11/21/23	ZIP TIES,GLOVES,TRASH BAGS	V	1/10/2024			065307	V	6,604.78
000132		COMMERCE BANK - VISA							
	M-CHECK	COMMERCE BANK - VISA VOIDED	V	1/10/2024			065307		6,604.78CR
000132		COMMERCE BANK - VISA							
	C-1M01M013060739	VISA LIABILITY WAIVER	R	1/11/2024	Reissue		065308	C	
	110 40.8110	Other: Theft Charges	VISA LIABILITY WAIVE		34,968.76CR				
	C-2675-12/19/2023	PRIME VIDEO TVOD	R	1/11/2024	Reissue		065308	C	
	110 40.8070	Other:Miscellaneous	PRIME VIDEO TVOD		3.24CR				
	C-3905-12/7/23-R	REFUND FOR WALL CALENDAR	R	1/11/2024	Reissue		065308	C	
	110 40.6215	Mat/Supplies:Office Supplies	REFUND FOR WALL CALE		29.70CR				
	110 40.6499	Mat/Supplies:O/H Cost Recovery	REFUND FOR WALL CALE		11.88				

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000132		COMMERCE BANK - VISA CONT							
	C-3905-12/7/23-R	REFUND FOR WALL CALENDAR	R	1/11/2024	Reissue		065308	C	
	120 40.6499	Mat/Supplies:O/H Cost Expense	REFUND FOR WALL CALE		11.88CR				
	C-3913-12/15/2023	CREDIT ON TAX FEES	R	1/11/2024	Reissue		065308	C	
	110 50.6230	Mat/Supplies:Office Equipment	CREDIT ON TAX FEES		144.37CR				
	C-3913-12/15/23	BEST BUY CREDIT ON TAXES	R	1/11/2024	Reissue		065308	C	
	110 50.6230	Mat/Supplies:Office Equipment	BEST BUY CREDIT ON T		144.37CR				
	C-3921-09/24/23-2	LARGE TRAUMA BAG CANCELLED	R	1/11/2024	Reissue		065308	C	
	110 55.6270	Mat/Supplies:Emergency Equip	LARGE TRAUMA BAG CAN		120.73CR				
	C-3970-10/27/23	(1) SCADA MONITOR REPLACEMENT	R	1/11/2024	Reissue		065308	C	
	120 40.6230	Mat/Supplies:Office Equipment	(1) SCADA MONITOR RE		189.99CR				
	C-CM 6585-11/30/23	WASHMASTERS DISPUTE-S YANCEY	R	1/11/2024	Reissue		065308	C	
	110 50.6805	Maintenance:Vehicles	WASHMASTERS DISPUTE-		16.00CR				
	I-1M01M013060	VISA LIABILITY REFUND	R	1/11/2024	Reissue		065308	C	
	110 00.1295	Accounts Receivable:Other	VISA LIABILITY REFUN		21,019.16				
	I-2616390793	ADOBE DEC23 11/28/23-12/28/23	R	1/11/2024	Reissue		065308	C	
	110 60.7300	Contractual:Computer System	ADOBE DEC23 11/28/23		23.99				
	120 40.7300	Contractual:Computer System	ADOBE DEC23 11/28/23		23.99				
	110 50.7300	Contractual:Computer System	ADOBE DEC23 11/28/23		23.99				
	110 40.7300	Contractual:Computer System	ADOBE DEC23 11/28/23		95.96				
	110 40.7699	Contractual:O/H Cost Recovery	ADOBE DEC23 11/28/23		38.38CR				
	120 40.7699	Contractual:O/H Cost Expense	ADOBE DEC23 11/28/23		38.38				
	I-2675-10/26/23-1	UNIT#E43 DIESEL EXHAUST FLUID	R	1/11/2024	Reissue		065308	C	
	110 55.6805	Maintenance:Vehicles	UNIT#E43 DIESEL EXHA		43.98				
	I-2675-10/26/23-2	HOLIDAY CHRISTMAS CARDS	R	1/11/2024	Reissue		065308	C	
	110 50.8022	Other:Special Events	HOLIDAY CHRISTMAS CA		171.19				
	I-2675-10/27/23	WALMART CHARGE REIM J. BURKHAR	R	1/11/2024	Reissue		065308	C	
	110 00.1295	Accounts Receivable:Other	WALMART CHARGE REIM		191.60				
	Reimbursed by JB ck# 1004								
	I-2675-10/28/2023	EMR BOOK - PITTAWAY	R	1/11/2024	Reissue		065308	C	
	110 55.6100	Training & Travel	EMR BOOK - PITTAWAY		106.14				
	I-2675-10/29/23	(11)3M MONITORING STETHOSCOPE	R	1/11/2024	Reissue		065308	C	
	110 55.6275	Mat/Supplies:Equipment	(11)3M MONITORING ST		1,058.31				
	I-2675-10/30/2023	5W-30 GENERATOR MOTOR OIL	R	1/11/2024	Reissue		065308	C	
	110 50.6810	Maintenance:Blgs/Ground/Park	5W-30 GENERATOR MOTO		30.39				
	110 55.6810	Maintenance:Bldgs/Ground/Park	5W-30 GENERATOR MOTO		7.60				
	I-2675-10/30/23-1	TCFP FEES	R	1/11/2024	Reissue		065308	C	
	110 55.8010	Other:Membership&Dues	TCFP FEES		491.06				
	TCFP FEES/ PETTY, FIKE, BLINN, WITTS, MILLER, WOLF,BASS, CASON								
	I-2675-10/30/23-2	TCFP FEES	R	1/11/2024	Reissue		065308	C	
	110 55.8010	Other:Membership&Dues	TCFP FEES		61.61				
	TCFP FEES/ J.FLORES								
	I-2675-10/31/23	HALLOWEEN FIRE TRUCK	R	1/11/2024	Reissue		065308	C	
	110 50.8022	Other:Special Events	HALLOWEEN FIRE TRUCK		47.57				
	I-2675-11-16/2023	SUPPLIES FOR XMAS BANQUET	R	1/11/2024	Reissue		065308	C	
	110 50.8021	Other:Annual Awards Banquet	SUPPLIES FOR XMAS BA		12.86				
	110 55.8021	Other:Annual Awards Banquet	SUPPLIES FOR XMAS BA		12.85				

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
	I-2675-11/01/23-1	UNIT: MC3 ANNUAL BMW SOFTWARE	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT: MC3 ANNUAL BMW		1,221.94				
	I-2675-11/01/23-2	UNIT:MC3,48,302 STATE REGISTRA	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT:MC3,48,302 STAT		30.00				
	I-2675-11/02/23	UNIT: 46 VEHICLE REGISTRATION	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 46 VEHICLE REG		10.75				
	I-2675-11/08/23	UNIT: 300 MCRFST 65W WALL SURF	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	MICROSOFT 65W WALL S		97.41				
	MICROSOFT 65W WALL SURFACE								
	I-2675-11/13/23	HERSHEY'S CANDY RING THE BELL	R	1/11/2024 Reissue			065308	C	
	110 40.8070	Other:Miscellaneous	HERSHEY'S CANDY RING		75.06				
	I-2675-11/14/2023	2024 IACP MEMBERSHIP DUES	R	1/11/2024 Reissue			065308	C	
	110 50.8010	Other:Membership&Dues	2024 IACP MEMBERSHIP		190.00				
	110 50.8010	Other:Membership&Dues	2024 IACP MEMBERSHIP		47.50CR				
	110 00.1405	Prepaid Expenses	2024 IACP MEMBERSHIP		47.50				
	1/1/24-12/31/24								
	I-2675-11/14/23	(200) SALVATION ARMY PR BAGS	R	1/11/2024 Reissue			065308	C	
	110 40.8070	Other:Miscellaneous	(200) SALVATION ARMY		10.81				
	I-2675-11/15/2023	CANDY CANES-XMAS PARADE	R	1/11/2024 Reissue			065308	C	
	110 50.8022	Other:Special Events	CANDY CANES-XMAS PAR		367.78				
	I-2675-11/15/2023-1	SUPPLIES FOR XMAS BANQUET	R	1/11/2024 Reissue			065308	C	
	110 50.8021	Other:Annual Awards Banquet	SUPPLIES FOR XMAS BA		33.78				
	110 55.8021	Other:Annual Awards Banquet	SUPPLIES FOR XMAS BA		33.78				
	I-2675-11/15/2023-2	DOLLAR TREE RECEIPT ADJUSTMENT	R	1/11/2024 Reissue			065308	C	
	110 50.8021	Other:Annual Awards Banquet	DOLLAR TREE RECEIPT		0.05				
	110 55.8021	Other:Annual Awards Banquet	DOLLAR TREE RECEIPT		0.05				
	I-2675-11/15/23	BANQUET-GINGERBREAD HOUSE KIT	R	1/11/2024 Reissue			065308	C	
	110 50.8021	Other:Annual Awards Banquet	BANQUET-GINGERBREAD		21.58				
	110 55.8021	Other:Annual Awards Banquet	BANQUET-GINGERBREAD		21.57				
	I-2675-11/16/2023-1	UNIT: E43 INSPECTION	R	1/11/2024 Reissue			065308	C	
	110 55.6805	Maintenance:Vehicles	UNIT: E43 INSPECTION		10.00				
	I-2675-11/17/2023-1	RIBBON FOR BAGS	R	1/11/2024 Reissue			065308	C	
	110 40.8070	Other:Miscellaneous	RIBBON FOR BAGS		2.48				
	SALVATION ARMY LOST RECEIPT								
	I-2675-11/19/23	UNIT 48: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 48: WASH MASTER		19.99				
	I-2675-11/19/23-1	UNIT 300: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 300: WASH MASTE		19.99				
	I-2675-11/19/23-2	UNIT 46: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 46: WASH MASTER		19.99				
	I-2675-11/19/23-3	COMMERCE BANK - VISA	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 302: WASH MASTE		19.99				
	I-2675-11/19/23-4	UNIT 51: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 51: WASH MASTER		19.99				
	I-2675-11/19/23-5	UNIT 47: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 47: WASH MASTER		19.99				
	I-2675-11/19/23-6	UNIT 45: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 45: WASH MASTER		19.99				

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I-2675-11/20/23	TCFP CERTIFICATION, G. FETZER	R	1/11/2024 Reissue			065308	C	
110 55.6100	Training & Travel	TCFP CERTIFICATION,		87.17				
I-2675-11/27/23	IPHONE FAST CHARGER CABLE	R	1/11/2024 Reissue			065308	C	
110 50.6230	Mat/Supplies:Office Equipment	IPHONE FAST CHARGER		17.58				
110 55.6230	Mat/Supplies:Office Equipment	IPHONE FAST CHARGER		4.40				
I-2675-11/28/2023	FORKS,MILK,NAPKINS,VELVEETA	R	1/11/2024 Reissue			065308	C	
110 50.8021	Other:Annual Awards Banquet	FORKS,MILK,NAPKINS,V		55.78				
110 55.8021	Other:Annual Awards Banquet	FORKS,MILK,NAPKINS,V		55.79				
I-2675-11/28/2023-1	WALMART ITEMS FOR XMAS PARTY	R	1/11/2024 Reissue			065308	C	
110 50.8021	Other:Annual Awards Banquet	WALMART ITEMS FOR XM		80.15				
110 55.8021	Other:Annual Awards Banquet	WALMART ITEMS FOR XM		80.16				
I-2675-11/29/23	7 PAINT PEN MARKERS	R	1/11/2024 Reissue			065308	C	
110 50.8021	Other:Annual Awards Banquet	7 PAINT PEN MARKERS		52.95				
110 55.8021	Other:Annual Awards Banquet	7 PAINT PEN MARKERS		52.96				
I-2675-11/7/23	TCFP EXAM GRANT FETZER	R	1/11/2024 Reissue			065308	C	
110 55.6100	Training & Travel	TCFP EXAM GRANT FETZ		56.49				
I-2675-12/01/2023	SOUR CREAM, REDDI WIP	R	1/11/2024 Reissue			065308	C	
110 50.8021	Other:Annual Awards Banquet	SOUR CREAM, REDDI WI		13.29				
110 55.8021	Other:Annual Awards Banquet	SOUR CREAM, REDDI WI		13.30				
I-2675-12/01/2023-1	130 FOOD FOR BANQUET	R	1/11/2024 Reissue			065308	C	
110 50.8021	Other:Annual Awards Banquet	130 FOOD FOR BANQUET		1,233.38				
110 55.8021	Other:Annual Awards Banquet	130 FOOD FOR BANQUET		1,233.37				
MAMA CUCA'S								
I-2675-12/04/2023	CPSAAA AMAZON	R	1/11/2024 Reissue			065308	C	
110 00.1295	Accounts Receivable:Other	CPSAAA AMAZON		50.65				
I-2675-12/13/2023	(3) 4 PACK DURACELL BATTERY	R	1/11/2024 Reissue			065308	C	
110 55.6250	Mat/Supplies:FF Supplies	(3) 4 PACK DURACELL		19.41				
I-2675-12/13/23-1	SFFMA 2024 MEMBERSHIP	R	1/11/2024 Reissue			065308	C	
110 55.8010	Other:Membership&Dues	SFFMA 2024 MEMBERSHI		300.00				
I-2675-12/13/23-2	EXTERNAL CD DVD DRIVE USB	R	1/11/2024 Reissue			065308	C	
110 50.6230	Mat/Supplies:Office Equipment	EXTERNAL CD DVD DRIV		28.98				
I-2675-12/15/2023	FIRST CLASS MAILINGS	R	1/11/2024 Reissue			065308	C	
110 50.6245	Mat/Supplies:Postage	FIRST CLASS MAILINGS		34.24				
I-2675-12/15/2023-1	20 PACK PENCIL POUCH	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	20 PACK PENCIL POUCH		31.97				
I-2675-12/15/2023-2	(100) MEAD CLASP ENVELOPES	R	1/11/2024 Reissue			065308	C	
110 50.6215	Mat/Supplies:Office Supplies	(100) MEAD CLASP ENV		24.25				
I-2675-12/19/2023	UNIT 47: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	UNIT 47: WASH MASTER		19.99				
I-2675-12/19/2023-1	UNIT 51: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	UNIT 51: WASH MASTER		19.99				
I-2675-12/19/2023-2	UNIT 46: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	UNIT 46: WASH MASTER		19.99				
I-2675-12/19/2023-3	UNIT 302: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	UNIT 302: WASH MASTE		19.99				
I-2675-12/19/2023-4	UNIT 300: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
110 50.6805	Maintenance:Vehicles	UNIT 300: WASH MASTE		19.99				
I-2675-12/19/2023-5	UNIT 45: WASH MASTERS	R	1/11/2024 Reissue			065308	C	

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000132		COMMERCE BANK - VISA CONT							
	I-2675-12/19/2023-5	UNIT 45: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 45: WASH MASTER		19.99				
	I-2675-12/19/2023-6	UNIT 48: WASH MASTERS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT 48: WASH MASTER		19.99				
	I-2675-12/19/2023-7	TONER CARTRIDGE	R	1/11/2024 Reissue			065308	C	
	110 50.6215	Mat/Supplies:Office Supplies	TONER CARTRIDGE		62.99				
	I-2675-12/6/2023	TCFAIA DUES 1/1/24-12/31/2024	R	1/11/2024 Reissue			065308	C	
	110 55.8010	Other:Membership&Dues	TCFAIA DUES 1/1/24-1		200.00				
	110 55.8010	Other:Membership&Dues	TCFAIA DUES 10/1/24-		50.00CR				
	110 00.1405	Prepaid Expenses	TCFAIA DUES 10/1/24-		50.00				
	I-3905-10/28/2023	SAMS CLUB MEMBERSHIP FEES	R	1/11/2024 Reissue			065308	C	
	110 40.8010	Other:MembershipDues/Subscript	SAMS CLUB MEMBERSHIP		110.00				
	110 40.8199	Other:O/H Cost Recovery	SAMS CLUB MEMBERSHIP		44.00CR				
	120 40.8199	Other:O/H Cost Expense	SAMS CLUB MEMBERSHIP		44.00				
	RENEWED ON 10/28/2023								
	I-3905-10/30/23	OFFICE SUPPLIES	R	1/11/2024 Reissue			065308	C	
	110 40.6215	Mat/Supplies:Office Supplies	OFFICE SUPPLIES		44.71				
	110 40.6499	Mat/Supplies:O/H Cost Recovery	OFFICE SUPPLIES		17.88CR				
	120 40.6499	Mat/Supplies:O/H Cost Expense	OFFICE SUPPLIES		17.88				
	1PK BLUE PENS (1) STAPLE REMOVER, (1) VOID STAMP (1) MONTHLY PLANNER								
	I-3905-12/07/2023	CD PLAYER AND 2024 CALENDAR	R	1/11/2024 Reissue			065308	C	
	110 40.6216	Mat/Supplies:Facility Supplies	CD PLAYER AND 2024 C		29.70				
	110 40.6499	Mat/Supplies:O/H Cost Recovery	CD PLAYER AND 2024 C		11.88CR				
	120 40.6499	Mat/Supplies:O/H Cost Expense	CD PLAYER AND 2024 C		11.88				
	118 30.6230	Mat/Supplies: Office Equipment	CD PLAYER AND 2024 C		26.99				
	I-3913-11/22/2023	COMPUTER FROM BEST BUY	R	1/11/2024 Reissue			065308	C	
	110 50.6230	Mat/Supplies:Office Equipment	COMPUTER FROM BEST B		1,894.36				
	I-3913-12/13/2023	TACO CABANA FOR XMAS LUNCH	R	1/11/2024 Reissue			065308	C	
	110 40.8023	Other:Employee Appreciation	TACO CABANA FOR XMAS		64.92				
	I-3913-12/13/23	MICROSOFT 365 BUSINESS STANDAR	R	1/11/2024 Reissue			065308	C	
	110 50.7300	Contractual:Computer System	MICROSOFT 365 BUSINE		900.00				
	110 50.7300	Contractual:Computer System	MICROSOFT OFFICE 10/		177.54CR				
	110 00.1405	Prepaid Expenses	MICROSOFT OFFICE 10/		177.54				
	12/12/2023-12/11/2024								
	I-3913-12/15/2023-1	TO REVERSE CREDIT	R	1/11/2024 Reissue			065308	C	
	110 50.6230	Mat/Supplies:Office Equipment	TO REVERSE CREDIT		144.37				
	I-3913-12/18/23	TPCA MEMBERSHIP DUES	R	1/11/2024 Reissue			065308	C	
	110 50.8010	Other:Membership&Dues	TPCA MEMBERSHIP DUES		402.00				
	110 50.8010	Other:Membership&Dues	TPCA MEMBERSHIP 10/0		85.91CR				
	110 00.1405	Prepaid Expenses	TPCA MEMBERSHIP 10/0		85.91				
	12/18/2023-12/17/2024								
	I-3921-09/24/23	LARGE TRAUMA BAG	R	1/11/2024 Reissue			065308	C	
	110 55.6270	Mat/Supplies:Emergency Equip	LARGE TRAUMA BAG		120.73				
	I-3921-10/26/23	HOTEL TCOLE CONFERENCE	R	1/11/2024 Reissue			065308	C	
	110 50.6100	Training & Travel	HOTEL TCOLE CONFEREN		1,385.11				
	I-3921-10/31/23	TRAINING ACADEMY M.BASS	R	1/11/2024 Reissue			065308	C	

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000132		COMMERCE BANK - VISA CONT							
	I-3921-10/31/23	TRAINING ACADEMY M.BASS	R	1/11/2024 Reissue			065308	C	
	145 00.6208	GrantLEOSE LawEnforceOffStanEdTRAINING ACADEMY M.B			325.00				
	I-3921-11/09/23-1	UNIT: 46 (2)PK BULBS/LP LIGHTS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 46 (2)PK BULBS		8.11				
	I-3921-11/09/23-2	UNIT:47 (2) PK BULBS/LP LIGHTS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT:47 (2) PK BULBS		7.49				
	I-3921-11/09/23-3	UNIT:48 (2) PK BULBS/LP LIGHTS	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT:48 (2) PK BULBS		7.49				
	I-3921-11/16/23	(4) HOLOSUN HM3X MAGNIFER	R	1/11/2024 Reissue			065308	C	
	110 50.6110	Training:Firearms/Range	(4) HOLOSUN HM3X MAG		799.96				
	I-3921-11/17/23	UNIT: 302 WIPERBLADES	R	1/11/2024 Reissue			065308	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 302 WIPERBLADE		53.98				
	I-3921-11/20/23	(4)HOLOSUN RED DOT(4)GREEN DOT	R	1/11/2024 Reissue			065308	C	
	110 50.6110	Training:Firearms/Range	(4)HOLOSUN RED DOT(4		963.86				
	110 50.6110	Training:Firearms/Range	(4)HOLOSUN RED DOT(4		1,570.81				
	I-3921-12/01/2023	WATER FOR XMAS PARTY	R	1/11/2024 Reissue			065308	C	
	110 50.8021	Other:Annual Awards Banquet	WATER FOR XMAS PARTY		13.40				
	110 55.8021	Other:Annual Awards Banquet	WATER FOR XMAS PARTY		13.40				
	I-3947-10/26/23	GFOAT CONF PARKING FEE K.DAY	R	1/11/2024 Reissue			065308	C	
	110 40.6100	Training & Travel	GFOAT CONF PARKING F		10.82				
	120 40.6100	Training & Travel	GFOAT PARKING FEE K.		10.83				
	I-3947-10/27/23	GFOAT CONF PARKING FEE K.DAY	R	1/11/2024 Reissue			065308	C	
	110 40.6100	Training & Travel	GFOAT CONF PARKING F		10.83				
	120 40.6100	Training & Travel	GFOAT CONF PARKING F		10.82				
	I-3947-11/03/2023-1	DWG UB 01-000320-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	180 40.6515	Utilities:Water & Sewer	DWG UB 01-000320-00		27.08				
	I-3947-11/03/2023-3	DWG UB 02-000084-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	110 50.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		186.89				
	110 55.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		40.05				
	110 60.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		13.35				
	120 40.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		13.35				
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		13.35				
	I-3947-11/03/2023-4	DWG UB 02-000224-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	110 50.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		43.59				
	110 55.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		9.35				
	110 60.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		3.12				
	120 40.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		3.12				
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		3.12				
	I-3947-11/03/2023-5	DWG UB 02-028702-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	110 40.6515	Utilities:Water & Sewer	DWG UB 02-028702-00		108.94				
	110 40.6599	Utilities:O/H Cost Recovery	DWG UB 02-028702-00		43.58CR				
	120 40.6599	Utilities:O/H Cost Expense	DWG UB 02-028702-00		43.58				
	I-3947-11/03/2023-6	DWG UB 02-028703-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	110 40.6515	Utilities:Water & Sewer	DWG UB 02-028703-00		74.08				
	110 40.6599	Utilities:O/H Cost Recovery	DWG UB 02-028703-00		29.63CR				
	120 40.6599	Utilities:O/H Cost Expense	DWG UB 02-028703-00		29.63				
	I-3947-11/03/2023-7	DWG UB 03-003601-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	

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000132		COMMERCE BANK - VISA CONT							
	I-3947-11/03/2023-7	DWG UB 03-003601-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	110 60.6515	Utilities:Water & Sewer	DWG UB 03-003601-00		50.10				
	I-3947-11/03/23-2	DWG UB 02-000075-00 10/1-10/31	R	1/11/2024 Reissue			065308	C	
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000075-00		105.24				
	I-3947-12/05/2023-1	DWG UB 01-000320-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	180 40.6515	Utilities:Water & Sewer	DWG UB 01-000320-00		22.86				
	I-3947-12/05/2023-2	DWG UB 02-000075-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000075-00		50.10				
	I-3947-12/05/2023-4	DWG UB 02-000224-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	110 50.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		35.05				
	110 55.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		7.52				
	110 60.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		2.51				
	120 40.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		2.51				
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000224-00		2.51				
	I-3947-12/05/2023-5	DWG UB 02-028702-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	110 40.6515	Utilities:Water & Sewer	DWG UB 02-028702-00		107.93				
	110 40.6599	Utilities:O/H Cost Recovery	DWG UB 02-028702-00		43.17CR				
	120 40.6599	Utilities:O/H Cost Expense	DWG UB 02-028702-00		43.17				
	I-3947-12/05/2023-6	DWG UB 02-028703-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	110 40.6515	Utilities:Water & Sewer	DWG UB 02-028703-00		50.10				
	110 40.6599	Utilities:O/H Cost Recovery	DWG UB 02-028703-00		20.04CR				
	120 40.6599	Utilities:O/H Cost Expense	DWG UB 02-028703-00		20.04				
	I-3947-12/05/2023-7	DWG UB 03-003601-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	110 60.6515	Utilities:Water & Sewer	DWG UB 03-003601-00		50.10				
	I-3947-12/5/2023-3	DWG UB 02-000084-00 11/1-11/30	R	1/11/2024 Reissue			065308	C	
	110 50.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		156.11				
	110 55.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		33.45				
	110 60.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		11.15				
	120 40.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		11.15				
	180 40.6515	Utilities:Water & Sewer	DWG UB 02-000084-00		11.15				
	I-3947-2590243512	ADOBE: NOV23 10/29/23-11/27/23	R	1/11/2024 Reissue			065308	C	
	110 60.7300	Contractual:Computer System	ADOBE: NOV23 10/29/2		23.99				
	120 40.7300	Contractual:Computer System	ADOBE: NOV23 10/29/2		23.99				
	110 50.7300	Contractual:Computer System	ADOBE: NOV23 10/29/2		23.99				
	110 40.7300	Contractual:Computer System	ADOBE: NOV23 10/29/2		95.96				
	110 40.7699	Contractual:O/H Cost Recovery	ADOBE: NOV23 10/29/2		38.38CR				
	120 40.7699	Contractual:O/H Cost Expense	ADOBE: NOV23 10/29/2		38.38				
	I-3970-10/25/23	4-PACK DURACELL TYPE D	R	1/11/2024 Reissue			065308	C	
	110 60.6400	Mat/Supplies:Tools & Supplies	4-PACK DURACELL TYPE		21.74				
	I-3970-10/27/23	(1)SCADA MONITOR REPLACEMENT	R	1/11/2024 Reissue			065308	C	
	120 40.6230	Mat/Supplies:Office Equipment	(1)SCADA MONITOR REP		189.99				
	I-3970-10/31/23	PARTS TO UPDATE KAYLYNN METER	R	1/11/2024 Reissue			065308	C	
	120 40.6910	Maintenance:Water Distribution	PARTS TO UPDATE KAYL		398.58				
	I-3970-11/01/23	(1) SCADA MONITOR REPLACEMENT	R	1/11/2024 Reissue			065308	C	
	120 40.6230	Mat/Supplies:Office Equipment	(1) SCADA MONITOR RE		129.99				
	I-3970-11/07/23	(1) ORANGE SAFETY BARRIER FENC	R	1/11/2024 Reissue			065308	C	
	110 60.6400	Mat/Supplies:Tools & Supplies	(1) ORANGE SAFETY BA		71.24				

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I-3970-11/08/23		SERVICE LINE PULLER TOOLS	R	1/11/2024 Reissue			065308	C	
120 40.6400		Mat/Supplies:Tools & Supplies	SERVICE LINE PULLER		24.78				
I-3970-11/16/23		HAND PUMP, QKCRETE,BATTERIES	R	1/11/2024 Reissue			065308	C	
120 40.6400		Mat/Supplies:Tools & Supplies	HAND PUMP W/6' HOSE		34.98				
120 40.6400		Mat/Supplies:Tools & Supplies	BATTERIES		15.74				
120 40.6910		Maintenance:Water Distribution	80 LBS QUICKKRETE-EV		14.94				
	80 LBS QUICKRETE MIX, HACH COLORIMETER BATTERIES								
	HAND PUMP FOR WATER METER REPAIRS								
I-3970-11/9/23		MULCH FOR PARK BOARD 11/11/23	R	1/11/2024 Reissue			065308	C	
180 40.6810		Maintenance:Blgs/Ground/Park	MULCH FOR PARK BOARD		34.70				
I-3970-12/12/2023		SUPPLIES FROM SAM'S CLUB	R	1/11/2024 Reissue			065308	C	
110 40.6216		Mat/Supplies:Facility Supplies	FACILITY SUPPLIES		287.32				
110 40.6499		Mat/Supplies:O/H Cost Recovery	FACILITY SUPPLIES		114.93CR				
120 40.6499		Mat/Supplies:O/H Cost Expense	FACILITY SUPPLIES		114.93				
110 40.6215		Mat/Supplies:Office Supplies	COPY PAPER		239.22				
110 40.6499		Mat/Supplies:O/H Cost Recovery	COPY PAPER		95.69CR				
120 40.6499		Mat/Supplies:O/H Cost Expense	COPY PAPER		95.69				
110 50.6215		Mat/Supplies:Office Supplies	DPS OFFICE SUPPLIES		104.45				
110 55.6215		Mat/supplies:Office Supplies	DPS OFFICE SUPPLIES		26.11				
110 50.6216		Mat/Supplies:Facility Supplies	DPS FACILITY SUPPLIE		241.52				
110 55.6216		Mat/Supplies:Facility Supplies	DPS FACILITY SUPPLIE		60.38				
I-3970-12/13/2023		PESTICIDE APP LICENSE-GP	R	1/11/2024 Reissue			065308	C	
110 60.6100		Training & Travel	PESTICIDE APP LICENS		26.00				
120 40.6100		Training & Travel	PESTICIDE APP LICENS		32.50				
180 40.6100		Training & Travel	PESTICIDE APP LICENS		6.50				
I-3970-12/21/2023		TX DEPT OF AGRICULTURE FEE	R	1/11/2024 Reissue			065308	C	
110 60.6100		Training & Travel	TX DEPT OF AGRICULTU		30.78				
120 40.6100		Training & Travel	TX DEPT OF AGRICULTU		38.47				
180 40.6100		Training & Travel	TX DEPT OF AGRICULTU		7.69				
	INVOICE 02025584 G PARKER NONCOMMERCIAL POLITICAL CERTIFICA								
I-3970-12/21/23		LIGHTS, GARLAND, WREATH	R	1/11/2024 Reissue			065308	C	
180 40.8022		Other:Special Events	LIGHTS, GARLAND, WRE		94.82				
	LIGHTS, GARLAND, AND WREATHS FOR TRAILER SANTA PARADE								
I-3970-12/22/23		LIGHT BULB REPLACEMENT	R	1/11/2024 Reissue			065308	C	
110 50.6810		Maintenance:Blgs/Ground/Park	LIGHT BULB REPLACEME		17.57				
110 55.6810		Maintenance:Bldgs/Ground/Park	LIGHT BULB REPLACEME		4.39				
	DPS MEN'S BATHROOM LIGHTS WERE OUT								
I-3988-11/21/23		ZIP TIES,GLOVES,TRASH BAGS	R	1/11/2024 Reissue			065308	C	
180 40.6315		Mat/Supplies:Other	ZIP TIES,GLOVES,TRAS		102.58				
I-3988-12/05/2023		PIPE ELBOW, SWING PIPE, PVC,	R	1/11/2024 Reissue			065308	C	
120 40.6910		Maintenance:Water Distribution	PIPE ELBOW, SWING PI		17.77				6,622.55
	2701 CLOVER LANE 1" TAP PARTS								

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000478		KTC AUTO CONSULTANT INC							
	I-126889	UNIT: 46 (2) USED TIRES	R	1/11/2024			065309	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 46 (2) USED TI		75.10				
	I-126941	UNIT: 701 REPL (2) BATTERIES	R	1/11/2024			065309	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 701 REPL (2) B		454.30				529.40
000650		DANIEL CARBAJAL							
	I-INV0127	DEC 2023 AM/E/B BOWEN & ROOSEV	R	1/11/2024			065310	C	
	110 60.6810	Maintenance:Blgs/Ground/Park	M/E/B ARKANSAS ROW		150.00				
	110 60.6810	Maintenance:Blgs/Ground/Park	M/E/B BOWEN ROW		1,000.00				
	110 60.6810	Maintenance:Blgs/Ground/Park	M/E/B ROOSEVELT/BOWE		100.00				1,250.00
	12/5/23 & 12/21/23								
000738		FLOCK GROUP INC							
	I-INV-29362	FLOCK SAFETY LEASE 2024	R	1/11/2024			065311	C	
	185 50.7335	Contractual: Street Cameras	FLOCK SAFETY LEASE 2		10,950.00				10,950.00
	ANNUAL LEASE $9,000, IMPLEMENTATION FEE $1950								
000357		CITY OF ARLINGTON							
	I-CI-00004711	JAN 2024 ARL AIR TIME	R	1/18/2024			065312	C	
	110 50.7310	Contractual:Arlington Air Time	JAN 2024 ARL AIR TIM		588.00				
	110 55.7310	Contractual:Arlington Air Time	JAN 2024 ARL AIR TIM		588.00				1,176.00
000604		AT&T							
	I-318574804	SERV: 12/07/2023-01/06/2024	R	1/18/2024			065313	C	
	110 50.8072	Other:Radio T1 Line	SERV: 12/07/2023-01/		690.20				
	110 55.8072	Other:Radio T1 Line	SERV: 12/07/2023-01/		690.20				1,380.40
0103		ATMOS ENERGY							
	I-1/16/24-2201	ATMOS: 12/14/2023-1/16/2024	R	1/18/2024			065314	C	
	110 40.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		209.50				
	110 40.6599	Utilities:O/H Cost Recovery	ATMOS: 12/14/2023-1/		83.80CR				
	120 40.6599	Utilities:O/H Cost Expense	ATMOS: 12/14/2023-1/		83.80				
	I-1/16/24-5531	ATMOS: 12/14/2023-1/16/2024	R	1/18/2024			065314	C	
	110 50.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		295.10				
	110 55.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		63.24				
	110 60.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		21.08				
	120 40.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		21.08				
	180 40.6505	Utilities:Gas	ATMOS: 12/14/2023-1/		21.08				631.08
000646		IASHIA BERGAMINI							
	I-12/26/23	CHRISTMAS TREES DECOR	R	1/18/2024			065315	C	
	180 40.8022	Other:Special Events	CHRISTMAS TREES DECO		54.08				54.08

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000038		LOWER COLORADO RIVER AUTHORITY							
	I-LAB-0072024	11/27/23 WATER TESTING-LCRA	R	1/18/2024			065316	C	
	120 40.7655	Contractual:Water Testing	11/27/23 WATER TESTI		257.00				257.00
000692		PAM BOOKOUT							
	I-1/18/24	TRUNK OR TREAT CANDY	R	1/18/2024			065317	C	
	180 40.8022	Other:Special Events	TRUNK OR TREAT CANDY		449.38				449.38
000676		PERDUE,BRANDON,FIELDER,COLLINS							
	I-COLAGY 11/30/23	COLLECTION FEES: NOV 2023	R	1/18/2024			065318	C	
	110 00.2090	Collecton Fee Payable	COLLECTION FEES: NOV		2,584.79				
	I-COLAGY 12/31/23	COLLECTION FEES: DEC 2023	R	1/18/2024			065318	C	
	110 00.2090	Collecton Fee Payable	COLLECTION FEES: DEC		3,923.46				6,508.25
000736		ROBERT HALF							
	I-63071048	HALF:DELL STAMPLEY 24 HRS	R	1/18/2024			065319	C	
	110 40.7415	Contractual:Contract Labor	HALF:DELL STAMPLEY 2		504.00				
	120 40.7415	Contractual:Contract Labor	HALF:DELL STAMPLEY 2		504.00				1,008.00
000592		TEXAS POLICE CHIEFS ASSOCIATIO							
	I-PCF202401161319	TX Police Chief Foundation	R	1/18/2024			065320	C	
	210 00.2051	TX Police Chiefs Foundation	TX Police Chief Foun		45.00				45.00
000488		TOPOGRAPHIC LAND SURVEYORS CO							
	I-W043134	TOPOGRAPHIC: 49TH CDBG	R	1/18/2024			065321	C	
	140 00.6605	CDBG Projects	TOPOGRAPHIC: 49TH CD		5,658.24				5,658.24
000478		KTC AUTO CONSULTANT INC							
	I-127061	UNIT: 300 FRONT BRAKE SRV	R	1/24/2024			065322	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 300 FRONT BRAK		438.34				
	I-127109	UNIT: 48 REPL COOLANT TANK	R	1/24/2024			065322	C	
	110 50.6805	Maintenance:Vehicles	UNIT: 48 REPL COOLAN		215.69				
	I-127173	UNIT 47: (1) BATTERY REPLACE	R	1/24/2024			065322	C	
	110 50.6805	Maintenance:Vehicles	UNIT 47: (1) BATTERY		213.39				867.42
000540		ALLTERRA CENTRAL, INC.							
	I-RI132234	VRS SUBSCRIPT 1/1/24-12/31/24	R	1/24/2024			065323	C	
	110 50.7300	Contractual:Computer System	VRS SUBSCRIPT (JAN -		281.25				
	120 40.7300	Contractual:Computer System	VRS SUBSCRIPT (JAN -		281.25				
	110 00.1405	Prepaid Expenses	VRS SUBSCRIPT (OCT -		93.75				
	120 00.1405	Prepaid Expenses	VRS SUBSCRIPT (OCT -		93.75				750.00
000414		ARMSTRONG FORENSIC LABORATORY,							
	I-253074	BLOOD ALCOHOL #2300015709	R	1/24/2024			065324	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #23000		95.00				
	I-253075	BLOOD ALCOHOL #2400000042	R	1/24/2024			065324	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #24000		95.00				
	I-253076	BLOOD ALCOHOL #2400000667	R	1/24/2024			065324	C	

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000414		ARMSTRONG FORENSIC LABCONT							
	I-253076	BLOOD ALCOHOL #2400000667	R	1/24/2024			065324	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #24000		95.00				
	I-253077	BLOOD ALCOHOL #2300016042	R	1/24/2024			065324	C	
	110 50.7095	Consultants:Other	BLOOD ALCOHOL #23000		95.00				380.00
000323		AT&T LOCAL SERVICES - DPS ALAR							
	I-1/13/2024	SERV: 1/13/2024-2/12/2024	R	1/24/2024			065325	C	
	180 40.6510	Utilities:Telephone	SERV: 1/13/2024-2/12		103.59				
	180 40.6510	Utilities:Telephone	LATE FEE FOR DEC INV		7.76				
	I-12/13/2023	SERV: 12/13/2023-1/12/2024	R	1/24/2024			065325	C	
	180 40.6510	Utilities:Telephone	SERV: 12/13/2023-1/1		103.40				214.75
000331		AT&T-MANAGED INTERNET SERVICE							
	I-4196695808	SERV: 12/11/2023-01/10/2024	R	1/24/2024			065326	C	
	110 40.6510	Utilities:Telephone	SERV: 12/11/2023-01/		953.30				
	110 40.6599	Utilities:O/H Cost Recovery	SERV: 12/11/2023-01/		381.32CR				
	120 40.6599	Utilities:O/H Cost Expense	SERV: 12/11/2023-01/		381.32				953.30
000523		CANON SOLUTIONS AMERICA INC							
	I-31918904	CANON: JAN 2024 & COPIES DEC23	R	1/24/2024			065327	C	
	110 50.7305	Contractual:Copy Machine	CANON: JAN 2024 & CO		23.08				
	110 55.7305	Contractual:Copy Machine	CANON: JAN 2024 & CO		5.77				
	110 50.8090	Other:Leases-Principal	CANON: JAN 2024 & CO		422.40				
	110 55.8090	Other:Leases-Principal	CANON: JAN 2024 & CO		105.60				
	110 50.8091	Other:Leases-Interest	CANON: JAN 2024 & CO		17.60				
	110 55.8091	Other:Leases-Interest	CANON: JAN 2024 & CO		4.40				
	I-31918905	CANON: JAN 2024 & COPIES DEC23	R	1/24/2024			065327	C	
	110 40.7305	Contractual:Copy Machine	CANON: JAN 2024 & CO		209.79				
	110 40.7699	Contractual:O/H Cost Recovery	CANON: JAN 2024 & CO		83.92CR				
	120 40.7699	Contractual:O/H Cost Expense	CANON: JAN 2024 & CO		83.92				
	110 40.8090	Other:Leases-Principal	CANON: JAN 2024 & CO		285.00				
	110 40.8091	Other:Leases-Interest	CANON: JAN 2024 & CO		41.00				
	110 40.8199	Other:O/H Cost Recovery	CANON: JAN 2024 & CO		130.40CR				
	120 40.8199	Other:O/H Cost Expense	CANON: JAN 2024 & CO		130.40				1,114.64
000088		CLEAT							
	I-CLE202401021309	CLEAT DUES	R	1/24/2024			065328	C	
	210 00.2053	CLEAT Payable	CLEAT DUES		152.00				
	I-CLE202401161319	CLEAT DUES	R	1/24/2024			065328	C	
	210 00.2053	CLEAT Payable	CLEAT DUES		152.00				304.00
000721		COMMUNITY WASTE DISPOSAL L.P.							
	I-1496239	RES TRASH/RECYL/HHW-NOV23	R	1/24/2024			065329	C	
	120 40.7600	Contractual:Refuse Collectio	RES TRASH/RECYL-NOV2		14,803.52				
	120 40.7601	Contractual:Hazardous Wst Coll	RES HHW-NOV23		708.48				
	I-1496242	COMM HC/RECYCLE-NOV23	R	1/24/2024			065329	C	
	120 40.7600	Contractual:Refuse Collectio	COMM HC/RECYCLE-NOV2		518.00				

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	I-1506044	RES TRASH/RECYL/HHW-DEC23	R	1/24/2024			065329	C	
	120 40.7600	Contractual:Refuse Collectio	RES TRASH/RECYL-DEC2		14,837.72				
	120 40.7601	Contractual:Hazardous Wst Coll	RES HHW-DEC23		710.12				
	I-1506047	COMM HC/RECYCLE-DEC23	R	1/24/2024			065329	C	
	120 40.7600	Contractual:Refuse Collectio	COMM HC/RECYCLE-DEC2		518.00				32,095.84
0061		FERGUSON ENTERPRISES, INC.							
	C-CMC379081	PARTS FOR CLOVER LN - RETURNED	R	1/24/2024			065330	C	
	120 40.6910	Maintenance:Water Distribution	PARTS FOR CLOVER LN		473.22CR				
	I-1455207	PARTS: CLOVER LN/KATHERINE CT	R	1/24/2024			065330	C	
	120 40.6910	Maintenance:Water Distribution	PARTS FOR 2700 CLOVE		501.36				
	120 40.6910	Maintenance:Water Distribution	PARTS FOR 2808 KATHE		17.25				45.39
0706		GOT YOU COVERED							
	I-INV77919	2 BADGES - BW	R	1/24/2024			065331	C	
	210 00.2068	MISC Employee Payable	2 BADGES - BW		313.66				
	I-INV78117	SUPERSHELL JACKET - BW	R	1/24/2024			065331	C	
	110 50.6300	Mat/Supplies:Uniforms	SUPERSHELL JACKET -		480.68				794.34
1131		GRA-TEX UTILITIES, INC							
	I-46347	EMERG WTR RPR 3621 WOODED CREE	R	1/24/2024			065332	O	
	120 40.6910	Maintenance:Water Distribution	EMERG MOBIL-3621 WOO		6,500.00				
	120 40.6910	Maintenance:Water Distribution	LABOR/SUPP-3621 WOOD		5,598.00				12,098.00
	3621 WOODED CREEK CIR								
000734		KIMLEY-HORN AND ASSOCIATES, IN							
	I-068302501-1223	GIS SERVICES-DEC23	R	1/24/2024			065333	C	
	120 40.7030	Consultants:Engineer-Regular	GIS SERVICES-DEC23		2,062.50				
	I-068302502-1223	BOWEN SWR ASSESSMENT-DEC23	R	1/24/2024			065333	C	
	120 40.7030	Consultants:Engineer-Regular	BOWEN SWR ASSESSMENT		3,025.00				
	I-068302503-1223	WATER SYSTEM-IPO#3-DEC23	R	1/24/2024			065333	C	
	120 40.7030	Consultants:Engineer-Regular	WATER SYSTEM-IPO#3-D		8,000.00				
	I-068302504-1223	2715 PIONEER PKWY-DEC23	R	1/24/2024			065333	C	
	110 40.7045	Consultants-Engineer-Platting	2715 PIONEER PKWY-DE		442.50				
	I-068302505-1223	ROOSEVELT ESTATES-DEC23	R	1/24/2024			065333	C	
	110 40.7045	Consultants-Engineer-Platting	ROOSEVELT ESTATES-DE		1,917.50				15,447.50
000174		MOTOROLA SOLUTIONS INC							
	I-8230439284	FEB 2024 RADIO MAINTENANCE	R	1/24/2024			065334	C	
	110 50.7320	Contractual:Comm Radio	FEB 2024 RADIO MAINT		862.54				
	110 55.7320	Contractual:Comm Radio	FEB 2024 RADIO MAINT		862.54				1,725.08
2039		QUIKTRIP FLEET SERVICES dba							
	I-94501989	QT STMT: JAN 2024	R	1/24/2024			065335	C	
	110 55.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		317.04				
	110 60.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		54.94				
	110 60.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		17.64				
	120 40.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		17.64				

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2039		QUIKTRIP FLEET SERVICECONT							
	I-94501989	QT STMT: JAN 2024	R	1/24/2024			065335	C	
	180 40.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		18.17				
	110 50.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		3,388.61				
	110 60.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		434.91				
	120 40.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		434.91				
	110 50.6350	Mat/Supplies:Fuel	QT STMT: JAN 2024		18.72CR				4,665.14
000522		THE RADAR SHOP INC							
	I-15186	(1) LIDAR AND (7) RADAR RECERT	R	1/24/2024			065336	C	
	110 50.6830	Maintenance:Police Equipment	(1) LIDAR RECERT		110.00				
	110 50.6830	Maintenance:Police Equipment	(7) RADAR RECERT		448.00				558.00
1861		SPECTRUM ENTERPRISE							
	I-18363710101424	CABLE: 1/14/24 - 2/13/24	R	1/24/2024			065337	O	
	110 50.6525	Utilities:Cable	CABLE: 1/14/24 - 2/1		37.64				
	110 55.6525	Utilities:Cable	CABLE: 1/14/24 - 2/1		37.63				75.27
000729		MARK EDWARD STEPHENS							
	I-00001-2	STEPHENS: JAN 2024 6.25 HRS	R	1/24/2024			065338	O	
	110 30.7010	Consultants:City Prosecutor	STEPHENS: JAN 2024 6		781.25				781.25
1241		TEXAS WATER PRODUCTS INC							
	I-175108	WATER MAT/SUPPLIES	R	1/24/2024			065339	C	
	120 40.6250	Mat/Supplies:Water Systems	WATER MAT - (100) TU		275.00				
	120 40.6250	Mat/Supplies:Water Systems	WATER MAT - (4) INSE		11.80				286.80
0615		WILDFIRE TRUCK & EQUIPMENT SAL							
	I-47822	UNIT: 49 - EQUIP REMOVAL	R	1/24/2024			065340	C	
	185 50.9100	Capital Outlay:DPS Vehicle	UNIT: 49 - EQUIP REM		1,320.00				
	I-47826	UNIT: 51- 279154- ACCESSORIES	R	1/24/2024			065340	C	
	185 50.9100	Capital Outlay:DPS Vehicle	UNIT: 51- 279154- AC		11,422.65				
	I-47827	UNIT: 50 - 278974 ACCESSORIES	R	1/24/2024			065340	C	
	185 50.9100	Capital Outlay:DPS Vehicle	UNIT: 50 - 278974 AC		12,192.65				24,935.30
2072		AFLAC							
	I-642745	AFLAC: JAN 2024	R	1/30/2024			065341	O	
	210 00.2059	Aflac Insurance Payable	AFLAC: JAN 2024		508.12				508.12
000478		KTC AUTO CONSULTANT INC							
	I-127216	UNIT: PW2 ST INSPEC/OIL CHNGE	R	1/30/2024			065342	O	
	110 60.6805	Maintenance:Vehicles	UNIT: PW2 ST INSPEC/		51.74				
	120 40.6805	Maintenance:Vehicles	UNIT: PW2 ST INSPEC/		51.75				
	I-127225	UNIT: PW3 OIL CHNG-REPL O2 SEN	R	1/30/2024			065342	O	
	110 60.6805	Maintenance:Vehicles	UNIT: PW3 OIL CHNG-R		517.15				
	120 40.6805	Maintenance:Vehicles	UNIT: PW3 OIL CHNG-R		517.15				
	I-127230	UNIT: SQD 43 STATE INSPECTION	R	1/30/2024			065342	O	
	110 55.6805	Maintenance:Vehicles	UNIT: SQD 43 STATE I		25.50				

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	I-127259	UNIT: 48 OIL AND FILTER CHANGE	R	1/30/2024			065342	O	
	110 50.6300	Mat/Supplies:Uniforms	UNIT: 48 OIL AND FIL		83.29				
	I-127260	UNIT: PW3 ST INSPEC	R	1/30/2024			065342	O	
	110 60.6805	Maintenance:Vehicles	UNIT: PW3 ST INSPEC		12.75				
	120 40.6805	Maintenance:Vehicles	UNIT: PW3 ST INSPEC		12.75				1,272.08
000414		ARMSTRONG FORENSIC LABORATORY,							
	I-253232	THC #2300016042	R	1/30/2024			065343	O	
	110 50.7095	Consultants:Other	THC #2300016042		97.00				
	I-253233	DRUG SCREEN #2400000008	R	1/30/2024			065343	O	
	110 50.7095	Consultants:Other	DRUG SCREEN #2400000		164.00				261.00
000737		BLUE CROSS BLUE SHIELD OF TX							
	I-2/1/2024	BCBS: FEB 2024	R	1/30/2024			065344	O	
	110 30.6047	Personnel:Employee Insurances	INSURANCE EXPENSE		923.32				
	110 40.6047	Personnel:Employee Insurances	INSURANCE EXPENSE		469.85				
	110 50.6047	Personnel:Employee Health Ins	INSURANCE EXPENSE		11,640.80				
	110 55.6047	Personnel:Employee Health Ins	INSURANCE EXPENSE		817.32				
	110 60.6047	Personnel:Employee Health Ins	INSURANCE EXPENSE		1,518.37				
	120 40.6047	Personnel:Employee Health Ins	INSURANCE EXPENSE		2,610.99				
	180 40.6047	Personnel:Health Insurance	INSURANCE EXPENSE		604.21				
	185 50.6047	Personnel:Employee HealthIns	INSURANCE EXPENSE		2,946.85				
	210 00.2060	Medical Insurance Payable	INSURANCE PAYABLE		4,589.08				
	210 00.2060	Medical Insurance Payable	INSURANCE PAYABLE		1,830.54				27,951.33
000644		CARLOS RODRIGUEZ							
	I-JAN2024	JAN 2024 CELL PHONE REIMBURSEM	R	1/30/2024			065345	O	
	110 60.8028	Other:Cell Phone Reimbursement	JAN 2024 CELL PHONE		10.00				
	120 40.8028	Other:Cell Phone Reimbursement	JAN 2024 CELL PHONE		27.50				
	180 40.8028	Other:Cell Phone Reimbursement	JAN 2024 CELL PHONE		12.50				50.00
0156		CASCO INDUSTRIES INC.							
	I-258583	(19) SCBA FLOW TEST & SRV CALL	R	1/30/2024			065346	O	
	110 55.6831	Maintenance:FF Equipment	(19) SCBA FLOW TEST		690.00				690.00
0226		ARLINGTON SEWER UTILITIES							
	I-1/24/2024	SERV: 12/1/23-12/31/23	R	1/30/2024			065347	O	
	120 40.7615	Contractual:Sewer Treatment	SERV: 12/1/23-12/31/		30,410.76				30,410.76
000293		ARLINGTON WATER UTILITIES							
	I-1/19/2024	SERV: 12/9/2023-1/13/2024	R	1/30/2024			065348	O	
	120 40.7650	Contractual:Water Purchase	SERV: 12/9/2023-1/13		13,214.72				13,214.72

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0064		FT WORTH WATER DEPARTMENT							
	I-1/17/2024	SERV: DEC 2023	R	1/30/2024			065349	O	
	120 40.7650	Contractual:Water Purchase	SERV: DEC 2023		29,788.99				29,788.99
0004		GOODYEAR TIRE & AUTO							
	I-INV040587	UNIT: 46 (4) TIRES AND BALANCE	R	1/30/2024			065350	O	
	110 50.6805	Maintenance:Vehicles	(4) TIRES AND BALANC		615.80				615.80
000360		KAY DAY							
	I-JAN 2024	JAN 2024 CELL PHONE REIMBURSEM	R	1/30/2024			065351	O	
	110 40.8028	Other:Cell Phone Reimbursement	JAN 2024 CELL PHONE		25.00				
	120 40.8028	Other:Cell Phone Reimbursement	JAN 2024 CELL PHONE		25.00				50.00
000687		EMI HEALTH							
	I-COMM836420240204	EMI HEALTH: FEB 2024	R	1/30/2024			065352	O	
	210 00.2056	Dental Insurance Payable	EMI HEALTH: FEB 2024		994.80				994.80
0137		SUZANNE HUDSON							
	I-1/31/2024	HUDSON: JAN 2024	R	1/30/2024			065353	O	
	110 30.7000	Consultants:Municipal Judge	HUDSON: JAN 2024		6,875.00				6,875.00
000281		K & B PROMOTIONS							
	I-56034	(3) POLO AND (1) FLEECE EMBRD	R	1/30/2024			065354	O	
	110 50.6300	Mat/Supplies:Uniforms	(3) POLO AND (1) FLE		243.85				243.85
	B. Spurgeon & S	Piazza							
1685		MARK D. HAMILTON (KPC)							
	I-6265555-1/24/24	1/24/24 QTRLY PEST CONTROL	R	1/30/2024			065355	O	
	110 50.6810	Maintenance:Blgs/Ground/Park	1/24/24 QTRLY PEST C		206.50				
	110 55.6810	Maintenance:Bldgs/Ground/Park	1/24/24 QTRLY PEST C		44.25				
	110 60.6810	Maintenance:Blgs/Ground/Park	1/24/24 QTRLY PEST C		14.75				
	120 40.6810	Maintenance:Blgs/Ground/Park	1/24/24 QTRLY PEST C		14.75				
	180 40.6810	Maintenance:Blgs/Ground/Park	1/24/24 QTRLY PEST C		14.75				
	I-6268920-1/24/2024	1/24/24 QRTLY PEST CONTROL	R	1/30/2024			065355	O	
	110 40.6810	Maintenance:Bldg/Grounds/Park	1/24/24 QRTLY PEST C		275.00				
	110 40.6999	Maintenance:O/H Cost Recovery	1/24/24 QRTLY PEST C		110.00CR				
	120 40.6999	Maintenance:O/H Cost Expense	1/24/24 QRTLY PEST C		110.00				570.00
000115		LONESTAR FIRE SPECIALTIES /dba							
	I-2439	PUMP TESTING & TRAVEL EXP	R	1/30/2024			065356	O	
	110 55.6831	Maintenance:FF Equipment	PUMP TESTING & TRAVE		726.00				726.00
000432		NETGENIUS, INC.							
	I-1998	NETGENIUS FEB 2024	R	1/30/2024			065357	O	
	110 30.7300	Contractual:Computer System	(46) PCS		165.00				
	110 40.7300	Contractual:Computer System	(46) PCS		385.00				
	110 50.7300	Contractual:Computer System	(46) PCS		797.50				
	110 55.7300	Contractual:Computer System	(46) PCS		632.50				

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VENDOR	I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000432		NETGENIUS, INC. CONT							
	I-1998	NETGENIUS FEB 2024	R	1/30/2024			065357	O	
	110 60.7300	Contractual:Computer System	(46) PCS		220.00				
	120 40.7300	Contractual:Computer System	(46) PCS		165.00				
	180 40.7300	Contractual:Computer System	(46) PCS		55.00				
	118 30.7300	Contractual: Computer System	(46) PCS		110.00				
	110 40.7699	Contractual:O/H Cost Recovery	(46) PCS		132.00CR				
	120 40.7699	Contractual:O/H Cost Expense	(46) PCS		132.00				
	110 30.7300	Contractual:Computer System	(11) SERVERS		125.00				
	110 40.7300	Contractual:Computer System	(11) SERVERS		1,687.50				
	110 50.7300	Contractual:Computer System	(11) SERVERS		625.00				
	110 55.7300	Contractual:Computer System	(11) SERVERS		250.00				
	118 30.7300	Contractual: Computer System	(11) SERVERS		62.50				
	110 40.7699	Contractual:O/H Cost Recovery	(11) SERVERS		675.00CR				
	120 40.7699	Contractual:O/H Cost Expense	(11) SERVERS		675.00				
	110 40.6510	Utilities:Telephone	VOIP		725.00				
	110 40.6599	Utilities:O/H Cost Recovery	VOIP		290.00CR				
	120 40.6599	Utilities:O/H Cost Expense	VOIP		290.00				
	110 40.6510	Utilities:Telephone	CITY HALL FAX LINE		25.00				
	110 40.6599	Utilities:O/H Cost Recovery	CITY HALL FAX LINE		10.00CR				
	120 40.6599	Utilities:O/H Cost Expense	CITY HALL FAX LINE		10.00				
	110 40.7300	Contractual:Computer System	SWITCHES		210.00				
	110 40.7699	Contractual:O/H Cost Recovery	SWITCHES		84.00CR				
	120 40.6599	Utilities:O/H Cost Expense	SWITCHES		84.00				
	110 40.7300	Contractual:Computer System	ACCESS POINT		175.00				
	110 40.7699	Contractual:O/H Cost Recovery	ACCESS POINT		70.00CR				
	120 40.6599	Utilities:O/H Cost Expense	ACCESS POINT		70.00				
	110 40.7699	Contractual:O/H Cost Recovery	FIREWALL		200.00CR				
	120 40.6599	Utilities:O/H Cost Expense	FIREWALL		200.00				
	110 40.7300	Contractual:Computer System	FIREWALL		500.00				6,915.00
	(46) PCS (11)SRVR VOIP (30) 3CX Extension Mgmt								
	(6) Switches (5) Wireless Access Points (2) Firewall								
000688		RENAISSANCE LIFE & HEALTH INSU							
	I-158398	RENAISSANCE: FEB 2024	R	1/30/2024			065358	O	
	110 30.6049	Personnel:ER-Short Term Disab	STD		10.50				
	110 40.6049	Personnel:ER-ShortTerm Disab	STD		12.82				
	110 50.6049	Personnel:ER ShortTerm Disab	STD		166.35				
	110 55.6049	Personnel:ER ShortTerm Disab	STD		14.42				
	110 60.6049	Personnel:ER-ShortTerm Disab	STD		19.70				
	120 40.6049	Personnel:ER Short Term Disab	STD		42.08				
	180 40.6049	Personnel:ER Short Term Disab	STD		9.29				
	185 50.6049	Personnel:ER ShortTerm Disab	STD		27.18				
	110 30.6046	Personnel:ER-Long Term Disab	LTD		10.83				
	110 40.6046	Personnel:ER-LongTerm Disab	LTD		14.41				
	110 50.6046	Personnel:ER LongTerm Disab	LTD		167.97				
	110 55.6046	Personnel:ER Long Term Disab	LTD		12.76				
	110 60.6046	Personnel:ER-LongTerm Disab	LTD		19.09				

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VENDOR I.D.	NAME	STATUS	CHECK DATE	AMOUNT	DISCOUNT	CHECK NO	CHECK STATUS	CHECK AMOUNT
000688	RENAISSANCE LIFE & HEACONT							
I-158398	RENAISSANCE: FEB 2024	R	1/30/2024			065358	O	
120 40.6046	Personnel:ER Long Term Disab	LTD		42.11				
180 40.6046	Personnel:ER-LongTerm Disab	LTD		8.35				
185 50.6046	Personnel:ER LongTerm Disab	LTD		27.44				
110 30.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		3.74				
110 40.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		3.08				
110 50.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		53.47				
110 55.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		5.25				
110 60.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		6.50				
120 40.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		12.48				
180 40.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		2.81				
185 50.6042	Personnel:ER-Life/AD&D Ins	LIFE/AD&D		8.60				
210 00.2058	Vol LIfe/AD&D Ins Payable	VOL LIFE/AD&D		174.69				875.92
0372	T C TAX ASSESSOR COLLECTOR							
I-1/31/2024	TAX YEAR 2023- TAX COLLECT SRV	R	1/30/2024			065359	O	
110 40.7200	Contractual:Tax Collection	TAX YEAR 2023- TAX C		6,312.18				6,312.18

* * T O T A L S * *	NO			INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
REGULAR CHECKS:	110			532,005.28	0.00	531,998.57
HAND CHECKS:	0			0.00	0.00	0.00
DRAFTS:	18			205,383.77	0.00	205,366.00
EFT:	0			0.00	0.00	0.00
NON CHECKS:	1			0.00	0.00	0.00
VOID CHECKS:	3	VOID DEBITS	6,622.55			
		VOID CREDITS	6,622.55CR	0.00	0.00	

TOTAL ERRORS: 0

** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
110 00.1295	Accounts Receivable:Other	21,261.41
110 00.1405	Prepaid Expenses	454.70
110 00.2090	Collecton Fee Payable	6,508.25
110 00.4240	Municipal Ct:Fees-Admin	26.10
110 30.6030	Personnel:FICA(SS) & Medicare	345.29
110 30.6042	Personnel:ER-Life/AD&D Ins	7.48
110 30.6045	Personnel:TMRS	2,295.88
110 30.6046	Personnel:ER-Long Term Disab	21.66
110 30.6047	Personnel:Employee Insurances	1,855.14
110 30.6048	Personnel:HSA/HRA	23.41

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
110 30.6049	Personnel:ER-Short Term Disab	21.00
110 30.7000	Consultants:Municipal Judge	6,875.00
110 30.7010	Consultants:City Prosecutor	781.25
110 30.7095	Consultants:Other	29.58
110 30.7300	Contractual:Computer System	655.00
110 40.6030	Personnel:FICA(SS) & MediCare	473.13
110 40.6031	Personnel:SUTA Taxes	2.08
110 40.6042	Personnel:ER-Life/AD&D Ins	2.42
110 40.6045	Personnel:TMRS	2,515.08
110 40.6046	Personnel:ER-LongTerm Disab	17.99
110 40.6047	Personnel:Employee Insurances	943.95
110 40.6048	Personnel:HSA/HRA	9.46
110 40.6049	Personnel:ER-ShortTerm Disab	13.31
110 40.6100	Training & Travel	21.65
110 40.6205	Mat/Supplies:Legal Notices	77.60
110 40.6215	Mat/Supplies:Office Supplies	254.23
110 40.6216	Mat/Supplies:Facility Supplies	317.02
110 40.6240	Mat/Supplies:Printing	337.46
110 40.6499	Mat/Supplies:O/H Cost Recovery	279.09CR
110 40.6500	Utilities:Electricity	236.92
110 40.6505	Utilities:Gas	209.50
110 40.6510	Utilities:Telephone	2,474.92
110 40.6515	Utilities:Water & Sewer	341.05
110 40.6520	Utilities:Mobile Data Termin	62.49
110 40.6599	Utilities:O/H Cost Recovery	1,284.60CR
110 40.6810	Maintenance:Bldg/Grounds/Park	275.00
110 40.6999	Maintenance:O/H Cost Recovery	110.00CR
110 40.7015	Consultants:Legal-Regular	3,743.57
110 40.7045	Consultants-Engineer-Platting	3,540.00
110 40.7200	Contractual:Tax Collection	6,312.18
110 40.7210	Contractual:Tarrant Appraisal	3,230.28
110 40.7300	Contractual:Computer System	6,421.55
110 40.7301	Contractual:Shred Service	106.31
110 40.7305	Contractual:Copy Machine	209.79
110 40.7415	Contractual:Contract Labor	2,215.50
110 40.7440	Contractual:Janitor Services	400.00
110 40.7505	Contractual:Liability Insur	3,455.56
110 40.7510	Contractual:Worker's Compensat	287.00
110 40.7699	Contractual:O/H Cost Recovery	4,182.06CR
110 40.8010	Other:MembershipDues/Subscript	110.00
110 40.8023	Other:Employee Appreciation	64.92
110 40.8028	Other:Cell Phone Reimbursement	25.00
110 40.8070	Other:Miscellaneous	85.11
110 40.8090	Other:Leases-Principal	285.00
110 40.8091	Other:Leases-Interest	41.00
110 40.8110	Other: Theft Charges	34,968.76CR

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
110 40.8199	Other:O/H Cost Recovery	174.40CR
110 50.6030	Personnel:FICA(SS) & Medicare	5,888.04
110 50.6031	Personnel:SUTA Taxes	8.95
110 50.6042	Personnel:ER-Life/AD&D Ins	112.92
110 50.6045	Personnel:TMRS	39,148.00
110 50.6046	Personnel:ER LongTerm Disab	342.03
110 50.6047	Personnel:Employee Health Ins	23,389.55
110 50.6048	Personnel:HSA/HRA	1,728.41
110 50.6049	Personnel:ER ShortTerm Disab	349.10
110 50.6100	Training & Travel	1,385.11
110 50.6110	Training:Firearms/Range	3,334.63
110 50.6215	Mat/Supplies:Office Supplies	191.69
110 50.6216	Mat/Supplies:Facility Supplies	241.52
110 50.6230	Mat/Supplies:Office Equipment	1,796.55
110 50.6245	Mat/Supplies:Postage	34.24
110 50.6250	Mat/Supplies:PSO Supplies	469.69
110 50.6300	Mat/Supplies:Uniforms	807.82
110 50.6350	Mat/Supplies:Fuel	3,369.89
110 50.6500	Utilities:Electricity	697.71
110 50.6505	Utilities:Gas	295.10
110 50.6510	Utilities:Telephone	86.48
110 50.6515	Utilities:Water & Sewer	421.64
110 50.6520	Utilities:Mobile Data Termin	313.65
110 50.6525	Utilities:Cable	37.64
110 50.6805	Maintenance:Vehicles	5,558.95
110 50.6810	Maintenance:Blgs/Ground/Park	254.46
110 50.6830	Maintenance:Police Equipment	558.00
110 50.7095	Consultants:Other	926.00
110 50.7300	Contractual:Computer System	3,896.69
110 50.7305	Contractual:Copy Machine	23.08
110 50.7310	Contractual:Arlington Air Time	1,176.00
110 50.7315	Contractual:Medical Director	2,000.00
110 50.7320	Contractual:Comm Radio	1,725.08
110 50.7440	Contractual:Janitor Services	396.00
110 50.7505	Contractual:Liability Insur	9,281.90
110 50.7510	Contractual:Worker's Compens	8,502.20
110 50.8010	Other:Membership&Dues	458.59
110 50.8021	Other:Annual Awards Banquet	1,517.22
110 50.8022	Other:Special Events	586.54
110 50.8072	Other:Radio T1 Line	690.20
110 50.8090	Other:Leases-Principal	422.40
110 50.8091	Other:Leases-Interest	17.60
110 55.6030	Personnel:FICA(SS) & Medicare	1,541.41
110 55.6031	Personnel:SUTA Taxes	4.40
110 55.6042	Personnel:ER-Life/AD&D Ins	12.00
110 55.6045	Personnel:TMRS	8,925.14

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
110 55.6046	Personnel:ER Long Term Disab	28.99
110 55.6047	Personnel:Employee Health Ins	1,660.14
110 55.6048	Personnel:HSA/HRA	4.16
110 55.6049	Personnel:ER ShortTerm Disab	32.94
110 55.6100	Training & Travel	249.80
110 55.6215	Mat/supplies:Office Supplies	26.11
110 55.6216	Mat/Supplies:Facility Supplies	60.38
110 55.6230	Mat/Supplies:Office Equipment	4.40
110 55.6250	Mat/Supplies:FF Supplies	19.41
110 55.6275	Mat/Supplies:Equipment	1,058.31
110 55.6300	Mat/Supplies:Uniform	26.00
110 55.6350	Mat/Supplies:Fuel	317.04
110 55.6500	Utilities:Electricity	149.51
110 55.6505	Utilities:Gas	63.24
110 55.6510	Utilities:Telephone	86.48
110 55.6515	Utilities:Water & Sewer	90.37
110 55.6520	Utilities:Mobile Data Termin	125.00
110 55.6525	Utilities:Cable	37.63
110 55.6805	Maintenance:Vehicles	79.48
110 55.6810	Maintenance:Bldgs/Ground/Park	56.24
110 55.6831	Maintenance:FF Equipment	1,416.00
110 55.7300	Contractual:Computer System	3,632.50
110 55.7305	Contractual:Copy Machine	5.77
110 55.7310	Contractual:Arlington Air Time	1,176.00
110 55.7315	Contractual-Medical Director	2,000.00
110 55.7320	Contractual:Comm Radio	1,725.08
110 55.7440	Contractual:Janitor Services	99.00
110 55.7505	Contractual:Liability Insur	1,502.43
110 55.7510	Contractual:Worker's Compens	1,438.80
110 55.8010	Other:Membership&Dues	1,002.67
110 55.8021	Other:Annual Awards Banquet	1,517.23
110 55.8072	Other:Radio T1 Line	690.20
110 55.8087	Other:Capital Lease-Fire Truck	47,282.32
110 55.8088	Other:Cap Lease Fire Truck Int	8,653.37
110 55.8090	Other:Leases-Principal	105.60
110 55.8091	Other:Leases-Interest	4.40
110 60.6030	Personnel:FICA(SS) & Medicare	745.96
110 60.6031	Personnel:SUTA Taxes	0.25
110 60.6042	Personnel:ER-Life/AD&D Ins	12.63
110 60.6045	Personnel:TMRS	4,372.65
110 60.6046	Personnel:ER-LongTerm Disab	38.46
110 60.6047	Personnel:Employee Health Ins	3,599.85
110 60.6048	Personnel:HSA/HRA	258.25
110 60.6049	Personnel:ER-ShortTerm Disab	38.12
110 60.6100	Training & Travel	56.78
110 60.6350	Mat/Supplies:Fuel	507.49

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
110 60.6400	Mat/Supplies:Tools & Supplies	92.98
110 60.6500	Utilities:Electricity	2,194.63
110 60.6505	Utilities:Gas	21.08
110 60.6510	Utilities:Telephone	10.81
110 60.6515	Utilities:Water & Sewer	130.33
110 60.6520	Utilities:Mobile Data Termin	40.98
110 60.6805	Maintenance:Vehicles	581.64
110 60.6810	Maintenance:Blgs/Ground/Park	1,264.75
110 60.7215	Contractual:Filing Fees	100.00
110 60.7300	Contractual:Computer System	2,355.48
110 60.7420	Contractual:Animal Control Vet	75.00
110 60.7505	Contractual:Liability Insur	1,153.31
110 60.7510	Contractual:Worker's Compens	427.45
110 60.7515	Contractrua:Inspections	5,422.25
110 60.8028	Other:Cell Phone Reimbursement	10.00
	*** FUND TOTAL ***	272,142.62
118 00.2105	Accrued Payables	48.00
118 30.6230	Mat/Supplies: Office Equipment	26.99
118 30.7226	Contractual:Notification Fees	28.80
118 30.7300	Contractual: Computer System	345.00
	*** FUND TOTAL ***	448.79
120 00.1405	Prepaid Expenses	93.75
120 00.2080	State Sales Tax Payable	1,428.16
120 00.2105	Accrued Payables	962.65
120 00.2490	Impact Fees - FW Water	344.00
120 00.2620	Refundable Deposits	537.13
120 40.6030	Personnel:FICA(SS) & MediCare	1,543.16
120 40.6031	Personnel:SUTA Taxes	2.76
120 40.6042	Personnel:ER-Life/AD&D Ins	19.35
120 40.6045	Personnel:TMRS	8,590.24
120 40.6046	Personnel:ER Long Term Disab	69.28
120 40.6047	Personnel:Employee Health Ins	5,929.73
120 40.6048	Personnel:HSA/HRA	491.85
120 40.6049	Personnel:ER Short Term Disab	65.40
120 40.6100	Training & Travel	92.62
120 40.6230	Mat/Supplies:Office Equipment	129.99
120 40.6240	Mat/Supplies:Printing	386.00
120 40.6245	Mat/Supplies:Postage	457.51
120 40.6250	Mat/Supplies:Water Systems	286.80
120 40.6350	Mat/Supplies:Fuel	452.55
120 40.6400	Mat/Supplies:Tools & Supplies	75.50
120 40.6450	Mat/Supplies:Testing Supplies	543.08
120 40.6499	Mat/Supplies:O/H Cost Expense	279.09
120 40.6500	Utilities:Electricity	1,295.14

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
120 40.6505	Utilities:Gas	21.08
120 40.6510	Utilities:Telephone	43.24
120 40.6515	Utilities:Water & Sewer	30.13
120 40.6520	Utilities:Mobile Data Termin	54.54
120 40.6599	Utilities:O/H Cost Expense	1,992.60
120 40.6805	Maintenance:Vehicles	581.65
120 40.6810	Maintenance:Blgs/Ground/Park	14.75
120 40.6910	Maintenance:Water Distribution	16,521.08
120 40.6999	Maintenance:O/H Cost Expense	110.00
120 40.7030	Consultants:Engineer-Regular	33,087.50
120 40.7226	Contractual:Call Notification	61.00
120 40.7227	Contractual:CC Online Tran Fee	450.75
120 40.7300	Contractual:Computer System	659.23
120 40.7415	Contractual:Contract Labor	2,215.50
120 40.7505	Contractual:Liability Insur	1,363.32
120 40.7510	Contractual:Worker's Compens	822.99
120 40.7600	Contractual:Refuse Collectio	30,677.24
120 40.7601	Contractual:Hazardous Wst Coll	1,418.60
120 40.7615	Contractual:Sewer Treatment	58,547.15
120 40.7650	Contractual:Water Purchase	75,546.41
120 40.7655	Contractual:Water Testing	317.00
120 40.7699	Contractual:O/H Cost Expense	3,474.06
120 40.8028	Other:Cell Phone Reimbursement	52.50
120 40.8199	Other:O/H Cost Expense	174.40
	*** FUND TOTAL ***	252,312.46
140 00.6605	CDBG Projects	5,658.24
	*** FUND TOTAL ***	5,658.24
145 00.6208	GrantLEOSE LawEnforceOffStanEd	325.00
	*** FUND TOTAL ***	325.00
180 40.6030	Personnel:FICA(SS) & MediCare	239.63
180 40.6031	Personnel:SUTA Taxes	0.31
180 40.6042	Personnel:ER-Life/AD&D Ins	4.12
180 40.6045	Personnel:TMRS	1,214.52
180 40.6046	Personnel:ER-LongTerm Disab	12.33
180 40.6047	Personnel:Health Insurance	1,348.69
180 40.6048	Personnel:HSA/HRA	223.55
180 40.6049	Personnel:ER Short Term Disab	13.44
180 40.6100	Training & Travel	14.19
180 40.6315	Mat/Supplies:Other	102.58
180 40.6350	Mat/Supplies:Fuel	18.17
180 40.6500	Utilities:Electricity	203.98
180 40.6505	Utilities:Gas	21.08
180 40.6510	Utilities:Telephone	225.56

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** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
180 40.6515	Utilities:Water & Sewer	235.41
180 40.6520	Utilities:Mobile Data Termin	9.84
180 40.6810	Maintenance:Blgs/Ground/Park	49.45
180 40.7300	Contractual:Computer System	110.00
180 40.7505	Contractual:Liability Insur	177.04
180 40.7510	Contractual:Worker's Compensat	299.31
180 40.8022	Other:Special Events	598.28
180 40.8028	Other:Cell Phone Reimbursement	12.50
	*** FUND TOTAL ***	5,133.98
185 50.6030	Personnel:FICA(SS) & Medicare	1,105.62
185 50.6042	Personnel:ER-Life/AD&D Ins	17.20
185 50.6045	Personnel:TMRS	7,372.42
185 50.6046	Personnel:ER LongTerm Disab	54.88
185 50.6047	Personnel:Employee HealthIns	5,913.25
185 50.6048	Personnel:HSA/HRA	298.08
185 50.6049	Personnel:ER ShortTerm Disab	54.36
185 50.7335	Contractual: Street Cameras	10,950.00
185 50.9100	Capital Outlay:DPS Vehicle	45,927.95
	*** FUND TOTAL ***	71,693.76
205 00.2245	Fees: State Traffic	16,204.48
205 00.2246	Fees:MovingViolation-State/MVF	0.63
205 00.2290	Fees: Consolidated Costs	37,855.36
205 00.2294	Fees: FTA OMNI STATE	806.67
205 00.2296	Fees:Prior Costs-JRF, IDF, JS	584.73
205 00.2299	Fees:Truancy Prevention Fund	38.41
205 00.2300	Outside Entities	700.00
205 00.2310	Time Payment Fee	157.76
205 00.2330	OMNI Admin Fees	734.00
	*** FUND TOTAL ***	57,082.04
210 00.2010	Social Security Payable	9,630.04
210 00.2015	Medicare Payable	2,252.20
210 00.2020	Withholding Payable	15,443.85
210 00.2033	Tx Municipal Retirement System	22,709.53
210 00.2051	TX Police Chiefs Foundation	90.00
210 00.2053	CLEAT Payable	304.00
210 00.2055	Child Support Payable	923.08
210 00.2056	Dental Insurance Payable	1,688.80
210 00.2057	Vision Insurance Payable	181.13
210 00.2058	Vol LIfe/AD&D Ins Payable	320.71
210 00.2059	Aflac Insurance Payable	1,016.24
210 00.2060	Medical Insurance Payable	9,635.78
210 00.2061	Insurance Payable - HSA	558.90
210 00.2062	Nationwide Payable	300.00

VENDOR SET: 01 City of Dalworthington
BANK: POOL POOLED CASH - CHECKING
DATE RANGE: 1/01/2024 THRU 1/31/2024

** G/L ACCOUNT TOTALS **

G/L ACCOUNT	NAME	AMOUNT
210 00.2063	Insurance Payable-FSA	7,199.76
210 00.2068	MISC Employee Payable	313.66
	*** FUND TOTAL ***	72,567.68

	NO	INVOICE AMOUNT	DISCOUNTS	CHECK AMOUNT
VENDOR SET: 01 BANK: POOL TOTALS:	132	737,389.05	0.00	737,364.57
BANK: POOL TOTALS:	132	737,389.05	0.00	737,364.57
REPORT TOTALS:	135	949,335.93	0.00	949,311.45

SELECTION CRITERIA

VENDOR SET: 01-Dalworthington Gardens, T
VENDOR: ALL
BANK CODES: All
FUNDS: All

CHECK SELECTION

CHECK RANGE: 000000 THRU 999999
DATE RANGE: 1/01/2024 THRU 1/31/2024
CHECK AMOUNT RANGE: 0.00 THRU 9,999,999.99
INCLUDE ALL VOIDS: YES

PRINT OPTIONS
SEQUENCE: CHECK NUMBER

PRINT TRANSACTIONS: YES
PRINT G/L: YES
UNPOSTED ONLY: NO
EXCLUDE UNPOSTED: NO
MANUAL ONLY: NO
STUB COMMENTS: YES
REPORT FOOTER: NO
CHECK STATUS: YES
PRINT STATUS: * - All

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CITY OF DALWORTHINGTON GARDENS
POOLED CASH
2600 ROOSEVELT DRIVE
DALWORTHINGTON GARDE TX 76016

Date 1/31/24 Page 1
Primary Account XXXXXX0601

XXXXXX0601	Platinum Money Market	311,812.71

Platinum Money Market		Number of Enclosures	147
Account Number	XXXXXX0601	Statement Dates 1/01/24 thru	1/31/24
Previous Balance	201,088.96	Days in the statement period	31
170 Deposits/Credits	1,796,651.56	Average Ledger	232,992.71
148 Checks/Debits	1,686,620.40	Average Collected	230,346.52
Service Charge	.00	Interest Earned	692.59
Interest Paid	692.59	Annual Percentage Yield Earned	3.56%
Current Balance	311,812.71	2024 Interest Paid	692.59

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	122.00
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	604.90
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	670.54
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	812.00
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	817.00
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,091.48
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042	1,215.10

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,823.80
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,907.20
1/02	INVESTMENT 3879 TEXSTAR PG PPD 0003879: 3879 - TEX	2,400.00
1/02	EDI PYMNTS BKV North Texas, PPD EDI	3,298.15
1/02	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	3,444.45
1/02	INVESTMENT 3880 LOGIC FD PPD 0003880: 3880 - LOC	4,700.00
1/02	INVESTMENT 3880 LOGIC FD PPD 0003880: 3880 - LOC	19,178.40
1/02	INVESTMENT 3880 LOGIC FD PPD 0003880: 3880 - LOC	36,788.59
1/03	Transfer fr X1906 to X0601: Me mo: Funds Transfer via Online	200,000.00
1/03	Transfer fr X1906 to X0601: Me mo: Funds Transfer via Online	300,000.00
1/03	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240102*0801*U*00401*	120.00
1/03	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	768.91
1/03	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041	874.00

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/03	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,204.29
1/03	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,215.40
1/03	RLPS SERV COMMERCE BANK CCD 487301000053595 CITY OF DWG	21,019.16
1/04	Transfer fr X1906 to X0601: Me mo: Funds Transfer via Online	250,000.00
1/04	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	593.21
1/04	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	652.50
1/04	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,155.00
1/04	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,278.76
1/05	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	135.06
1/05	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240103*1501*U*00401*	371.33
1/05	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	749.00
1/05	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,749.70

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/05	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	3,440.00
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	145.00
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	324.60
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	828.00
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,267.38
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,341.00
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,751.82
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,521.65
1/08	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	10,343.62
1/08	Deposit/Credit	100.00
1/08	Deposit/Credit	315.24
1/08	Deposit/Credit	574.75
1/08	Deposit/Credit	591.45
1/08	Deposit/Credit	595.00
1/08	Deposit/Credit	719.00
1/08	Deposit/Credit	929.56
1/08	Deposit/Credit	1,895.72
1/08	Deposit/Credit	2,004.37
1/08	Deposit/Credit	4,727.73
1/09	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039	263.49

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/09	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,484.20
1/09	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,815.55
1/09	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,026.00
1/10	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240108*1432*U*00401*	150.00
1/10	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	578.61
1/10	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	613.00
1/10	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	933.20
1/10	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,548.62
1/10	Deposit/Credit	50.00
1/10	Deposit/Credit	1,363.61
1/10	Deposit/Credit	1,648.63
1/10	Deposit/Credit	15,994.93
1/11	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	79.05
1/11	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	739.00
1/11	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041	1,010.60

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/11	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240109*1433*U*00401*	3,041.98
1/11	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	3,814.30
1/12	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	99.16
1/12	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	928.00
1/12	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,451.00
1/12	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,384.67
1/12	INV-PAYMTS CPA STATE FISCAL CTX ISA~00~0000000000~00~000000000 0~ZZ~1746000089 ~ZZ~JPMORG AN CHASE ~240110~2103~U~00304~	67,957.75
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	302.00
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	394.00
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	514.60
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	796.00

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	861.77
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	880.59
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	911.07
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	919.00
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,347.29
1/16	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,723.08
1/17	Transfer fr X1906 to X0601: Me mo: Funds Transfer via Online	150,000.00
1/17	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	572.00
1/17	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	860.79
1/17	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,692.90
1/17	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,020.72
1/18	Transfer fr X1906 to X0601: Me mo: Funds Transfer via Online	146,239.16
1/18	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	293.00

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/18	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	575.92
1/18	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,295.50
1/18	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	3,167.78
1/18	Deposit/Credit	186.10
1/18	Deposit/Credit	346.43
1/18	Deposit/Credit	433.73
1/18	Deposit/Credit	452.57
1/18	Deposit/Credit	579.40
1/18	Deposit/Credit	603.10
1/18	Deposit/Credit	870.39
1/18	Deposit/Credit	3,200.64
1/18	Deposit/Credit	3,531.17
1/18	Deposit/Credit	3,827.41
1/19	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240117*1502*U*00401*	487.16
1/19	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,220.24
1/19	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,231.71
1/19	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,412.70
1/22	EDI/EFTPMT ALLPAID CTX ISA*00* *00* *17*006960416 *ZZ*ALLPAI D *240118*1502*U*00401*	120.00
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	385.70

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/22	EDI/EFTPMT ALLPAID CTX ISA*00^ *00* *17*006960416 *ZZ*ALLPAI D *240119*1433*U*00401*	400.00
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	447.27
1/22	INV-PAYMTS CPA STATE FISCAL CTX ISA~00~0000000000~00~000000000 0~ZZ~1746000089 ~ZZ~JPMORG AN CHASE ~240118~2150~U~00304~	569.62
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	638.66
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	717.00
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	970.20
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,076.00
1/22	ACH Collec City of Dalworth CCD 9756003069 City of Dalworth	4,645.56
1/22	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	19,966.61
1/22	ACH Collec City of Dalworth PPD	23,357.01
1/23	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	319.71
1/23	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	889.00
1/23	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040	1,679.65

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/23	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,261.40
1/23	Deposit/Credit	168.31
1/23	Deposit/Credit	1,909.46
1/23	Deposit/Credit	1,962.07
1/23	Deposit/Credit	2,386.98
1/23	Deposit/Credit	8,350.00
1/23	Deposit/Credit	11,423.72
1/24	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	93.37
1/24	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	548.00
1/24	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,507.37
1/24	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,581.00
1/25	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	232.00
1/25	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	297.76
1/25	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	949.00
1/25	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,307.62
1/29	Transfer fr X1906 to X0601: Memo: Funds Transfer via Online	26,481.19
1/29	Transfer fr X1906 to X0601: Memo: Funds Transfer via Online	200,000.00

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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	145.00
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	515.40
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	521.95
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	566.00
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	606.00
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	879.00
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,102.96
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,322.00
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,849.42
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,099.57
1/29	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	3,224.60
1/29	Deposit/Credit	858.13
1/29	Deposit/Credit	869.62
1/29	Deposit/Credit	971.34
1/29	Deposit/Credit	981.44
1/29	Deposit/Credit	1,794.18

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3030 Matlock Rd, Ste 110
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Platinum Money Market XXXXXX0601 (Continued)

DEPOSITS AND ADDITIONS

Date	Description	Amount
1/29	Deposit/Credit	1,848.76
1/29	Deposit/Credit	2,459.65
1/29	Deposit/Credit	3,094.98
1/30	Transfer fr X9050 to X0601: Memo: Funds Transfer via Online	8,509.08
1/30	Transfer fr X5502 to X0601: Memo: Funds Transfer via Online	87,216.89
1/30	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	584.83
1/30	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	996.00
1/30	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,162.00
1/30	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,625.32
1/31	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	810.00
1/31	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907039 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,088.62
1/31	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,498.00
1/31	GLOBAL DEP GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	2,250.25
1/31	INVESTMENT 3880 LOGIC FD PPD 0003880: 3880 - LOC	5,658.24
1/31	Interest Deposit	692.59

CHECKS AND WITHDRAWALS

Date	Description	Amount
1/02	GLOBAL STL GLOBAL PAYMENTS CCD 8788242907039	151.38-

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Platinum Money Market XXXXXX0601 (Continued)

CHECKS AND WITHDRAWALS

Date	Description	Amount
	CITY OF DALWORTHINGTON BANKCARD PROCESSING	
1/02	GLOBAL STL GLOBAL PAYMENTS CCD 8788242907041 CITY OF DALWORTHINGTON BANKCARD PROCESSING	226.21-
1/02	GLOBAL STL GLOBAL PAYMENTS CCD 8788242907042 CITY OF DALWORTHINGTON BANKCARD PROCESSING	478.30-
1/02	GLOBAL STL GLOBAL PAYMENTS CCD 8788242907040 CITY OF DALWORTHINGTON BANKCARD PROCESSING	1,082.11-
1/02	ACH Paymen City of Dalworth CCD 9756003069 City of Dalworth	7,199.76-
1/02	PAYROLL TMRS CCD 14821 DALWORTHINGTON GARDENS	48,691.71-
1/02	INVESTMENT 3880 - LOCAL GOV PPD 0003880	73,577.18-
1/03	INVESTMENT 3879 - TEXAS SHO PPD 0003879	200,000.00-
1/03	INVESTMENT 3880 - LOCAL GOV PPD 0003880	300,000.00-
1/05	PAYMENTS NATIONWIDE PPD	150.00-
1/05	CHILDSUPP Texas SDU CCD 240040003400253 City of Dalworthington	461.54-
1/05	ACH Paymen City of Dalworth CCD 9756003069 City of Dalworth	1,087.95-
1/05	INVESTMENT 3880 - LOCAL GOV PPD 0003880	1,214.82-
1/05	INVESTMENT 3880 - LOCAL GOV PPD 0003880	2,083.33-

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Platinum Money Market XXXXXX0601 (Continued)

CHECKS AND WITHDRAWALS

Date	Description	Amount
1/05	USATAXPYMT IRS CCD XXXXX0593657666 CITY OF DALWORTHINGTON	19,516.21-
1/05	PAYROLL DD City of Dalworth PPD PAYROLL DEPOSIT	56,792.42-
1/08	PLAN FUND WEX HEALTH INC CCD 24541F2EC72 CITY OF DALWORTHINGTON PRETAX BENEFIT TRANS	279.45-
1/08	PLAN FUND WEX HEALTH INC CCD 2456D62681D CITY OF DALWORTHINGTON PRETAX BENEFIT TRANS	380.81-
1/10	Account Analysis Charge	281.00-
1/12	DD WEBFILE TAX PYMT CCD 902/74491009 33311/12345/EDI/XML - CPA TAX PAYMENTS	1,428.16-
1/12	Transfer fr X0601 to X9050: Me mo: Funds Transfer via Online	11,326.29-
1/16	DD WEBFILE TAX PYMT CCD 902/74497855 33311/12345/EDI/XML - CPA TAX PAYMENTS	55,648.04-
1/18	INVESTMENT 3880 - LOCAL GOV PPD 0003880	11,326.29-
1/18	INVESTMENT 3880 - LOCAL GOV PPD 0003880	146,239.16-
1/19	PAYMENTS NATIONWIDE PPD	150.00-
1/19	CHILDSUPP Texas SDU CCD 240180003418305 City of Dalworthington	461.54-
1/19	ACH Paymen City of Dalworth CCD 9756003069 City of Dalworth	1,087.95-
1/19	USATAXPYMT IRS CCD XXXXX1980165070 CITY OF DALWORTHINGTON	19,348.22-
1/19	PAYROLL DD City of Dalworth PPD	56,689.44-

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Platinum Money Market XXXXXX0601 (Continued)

CHECKS AND WITHDRAWALS

Date	Description	Amount
	PAYROLL DEPOSIT	
1/22	PLAN FUND WEX HEALTH INC CCD 24193C878983 CITY OF DALWORTHINGTON PRETAX BENEFIT TRANS	279.45-
1/22	PLAN FUND WEX HEALTH INC CCD 2419DA323F6F CITY OF DALWORTHINGTON PRETAX BENEFIT TRANS	362.47-
1/23	DEBIT TXWORKFORCECOMM CCD (512)463-2325 TWC-998808561 TWC UI TAX	18.75-
1/23	USATAXPYMT IRS CCD XXXXX2344392301 CITY OF DALWORTHINGTON	343.90-
1/23	PAYROLL DD City of Dalworth PPD PAYROLL DEPOSIT	1,522.63-
1/24	PLAN FUND WEX HEALTH INC CCD 2423D83E13A9 CITY OF DALWORTHINGTON PRETAX BENEFIT TRANS	18.34-
1/25	BUS PRODS DELUXE BUS SYS. CCD 15690974 LAURA BIANCO	226.64-
1/29	INVESTMENT 3880 - LOCAL GOV PPD 0003880	26,481.19-
1/29	INVESTMENT 3880 - LOCAL GOV PPD 0003880	200,000.00-
1/31	INVESTMENT 3880 - LOCAL GOV PPD 0003880	239.25-

--- CHECKS IN NUMBER ORDER ---

Date	Check No	Amount	Date	Check No	Amount
1/23	65026	24.99	1/03	65202*	1,380.40
1/16	65046*	350.00	1/03	65205*	6,550.20
1/03	65188*	45.00	1/02	65210*	600.00
1/04	65197*	89.11	1/02	65212*	178.80
1/29	65199*	93.51	1/03	65213	2,738.20

* Denotes missing check numbers

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SusserBank
3030 Matlock Rd, Ste 110
Arlington, TX 76015

Platinum Money Market XXXXXX0601 (Continued)

--- CHECKS IN NUMBER ORDER ---

Date	Check No	Amount	Date	Check No	Amount
1/02	65222*	614.68	1/18	65278	700.00
1/03	65224*	953.30	1/17	65279	1,054.51
1/02	65225	8,657.60	1/17	65280	469.69
1/02	65226	1,076.11	1/17	65281	3,735.00
1/03	65230*	179.94	1/17	65282	344.00
1/02	65231	33,342.50	1/18	65283	4,777.89
1/03	65232	211.48	1/18	65285*	75.00
1/03	65233	932.13	1/16	65286	29.58
1/02	65236*	628.10	1/18	65287	2,394.00
1/05	65237	3,853.29	1/18	65288	5,422.25
1/03	65238	480.00	1/19	65289	106.31
1/02	65239	1,634.64	1/22	65290	60.00
1/25	65240	75.27	1/18	65291	314.63
1/10	65241	120.00	1/17	65292	28,711.31
1/03	65242	45.00	1/18	65293	3,743.57
1/02	65243	76.16	1/16	65294	1,551.20
1/18	65245*	50.00	1/18	65295	26.00
1/26	65247*	50.00	1/19	65296	3,946.40
1/16	65248	508.12	1/22	65297	895.00
1/09	65249	914.13	1/19	65298	99.65
1/10	65250	1,176.00	1/30	65301*	80.67
1/09	65251	27,710.08	1/18	65303*	87.51
1/09	65252	285.00	1/17	65305*	8.82
1/10	65253	865.94	1/22	65306	54.08
1/09	65254	26,120.75	1/23	65308*	6,622.55
1/17	65255	77.60	1/18	65309	529.40
1/09	65256	4,000.00	1/17	65310	1,250.00
1/17	65257	694.00	1/17	65311	10,950.00
1/10	65258	181.13	1/25	65312	1,176.00
1/09	65259	32,542.70	1/24	65313	1,380.40
1/11	65260	21,180.00	1/24	65314	631.08
1/09	65261	1,725.08	1/24	65315	54.08
1/11	65262	6,915.00	1/23	65316	257.00
1/08	65263	204.00	1/24	65317	449.38
1/09	65264	126.46	1/25	65318	6,508.25
1/10	65265	734.00	1/24	65319	1,008.00
1/11	65266	426.31	1/24	65321*	5,658.24
1/09	65267	806.20	1/31	65322	867.42
1/09	65268	1,029.00	1/31	65323	750.00
1/10	65269	55,935.69	1/30	65324	380.00
1/12	65270	3,230.28	1/31	65326*	953.30
1/11	65271	100.00	1/30	65327	1,114.64
1/24	65272	45.00	1/30	65328	304.00
1/09	65273	75.00	1/30	65329	32,095.84
1/10	65274	543.08	1/29	65330	45.39
1/10	65275	20,992.65	1/31	65331	794.34
1/12	65276	59.00	1/30	65334*	1,725.08
1/18	65277	899.20	1/31	65335	4,665.14

* Denotes missing check numbers

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Platinum Money Market XXXXXX0601 (Continued)

--- CHECKS IN NUMBER ORDER ---

Date	Check No	Amount	Date	Check No	Amount
1/30	65336	558.00	1/31	65340	24,935.30
1/30	65339*	286.80			

* Denotes missing check numbers

DAILY BALANCE INFORMATION

Date	Balance	Date	Balance	Date	Balance
1/01	201,088.96	1/11	152,790.53	1/24	249,149.35
1/02	101,747.33	1/12	209,567.38	1/25	243,949.57
1/03	114,433.44	1/16	160,129.84	1/26	243,899.57
1/04	368,023.80	1/17	267,981.32	1/29	269,470.67
1/05	290,309.33	1/18	256,998.72	1/30	333,019.76
1/08	320,420.96	1/19	180,461.02	1/31	311,812.71
1/09	230,675.80	1/22	232,103.65		
1/10	172,726.91	1/23	254,664.13		

INTEREST RATE SUMMARY

Date	Rate
12/31	3.500000%

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ORDINANCE NO: 2024-02

AN ORDINANCE OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, CALLING FOR A GENERAL ELECTION FOR THE OFFICES OF MAYOR, ALDERMAN PLACE 1, AND ALDERMAN PLACE 2; SUCH GENERAL ELECTION TO BE HELD ON SATURDAY MAY 4, 2024; ESTABLISHING PROCEDURES FOR THE ELECTION; AND PROVIDING AN EFFECTIVE DATE

WHEREAS, the City of Dalworthington Gardens, Texas ("City") is a Type A General Law Municipality located in Tarrant County, created in accordance with the provisions of Chapter 6 of the Local Government Code and operating pursuant to the enabling legislation of the State of Texas; and

WHEREAS, the general election for Mayor and Aldermen of the City of Dalworthington Gardens is required to be held on May 4, 2024, a uniform election date, at which time the voters will elect persons to fill the offices of Mayor, Alderman Place 1 and Alderman Place 2; and

WHEREAS, the City will enter into a Joint Election Agreement and Contract for Election Services with Tarrant County (the "Agreement");

NOW, THEREFORE, BE IT ORDAINED BY THE BOARD OF ALDERMEN OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, THAT:

Section 1.
General Election Called

An election is hereby called to elect the offices of Mayor, Alderman Place 1, and Alderman Place 2 to serve from May 2024 until May 2026 or until their successors are duly elected and qualified. The election shall be held on May 4, 2024 between the hours of 7:00 a.m. and 7:00 p.m. at 2600 Roosevelt, Dalworthington Gardens, Texas 76016 and locations set forth in the Agreement. The City shall constitute a single precinct for said election.

Section 2.
Joint Election Agreement Approved

Prior to the election, the City anticipates that it will enter into a joint election agreement and contract for election services with Tarrant County, conducted under the authority of Chapter 271 of the Election Code (the "Agreement").

Section 3.
Application for Place on Ballot for General Election

Qualified persons may file as candidates for the General Election by filing applications in the office of the City Secretary located at 2600 Roosevelt, Texas 76016 from 8:30 a.m. to 5:00 p.m., on all regular business days from January 12, 2024 through February 16, 2024.

Section 4.
Early Voting

a. Early voting by personal appearance. Early voting by personal appearance shall commence April 22, 2024 and shall continue until April 30, 2024. An early voting site shall be located at Bob Duncan Center, 2800 S. Center Street, Arlington, TX 76014. Specific days, times and locations shall be designated in the Agreement and shall be in compliance with state law. On at least two weekdays during the early voting period, the location for early voting shall be open for at least twelve (12) hours as mandated by state law.

b. Early voting by mail. The Tarrant County Election Administrator ("Elections Administrator") is hereby designated as Early Voting Clerk for the general election, as indicated in the Agreement. Applications for early voting by mail may be delivered to the Elections Administrator at the following address: Early Voting Clerk, 2700 Premier Street, Fort Worth, Texas 76111, FAX: 817-831-6118, email: votebymail@tarrantcounty.com, not later than the close of business on April 23, 2024. Early voting by ballots shall be mailed to the Elections Administrator at the same address. The City Secretary is directed to forward applications and ballots she may receive to the Elections Administrator, as provided in this Agreement.

c. Early voting by Ballot Board. Early voting, both by personal appearance and by mail shall be canvassed by the Early Voting Ballot Board which is hereby created. The election judge, alternate election judge, and ballot board will be appointed by the Elections Administrator, as permitted by law. The presiding judge shall appoint elections clerks as may be necessary for the proper conduct of the election. The election judge, or the alternate election judge in the absence of the election judge, and the election clerks shall constitute the early voting ballot board to process early voting results from the election. The election judge, and alternate election judge, and election clerks shall be qualified voters of the City. To the extent required by law, those persons designated by Tarrant County as election officers and clerks are hereby appointed by the City.

Section 5.
Method of Voting

Early voting and Election Day voting shall be conducted by Tarrant County in accordance with the Agreement. All expenditures necessary for the conduct of the election, the purchase of materials therefore, and the employment of all election officials are hereby authorized, and shall be conducted in accordance with the Agreement, and applicable law. The order in which the names of the candidates are to be printed on the ballot shall be determined by a drawing by the City Secretary pursuant to state law. Notice of the time and place for such drawing shall be given in accordance with the Texas Election Code.

Section 6.
Governing Law and Qualified Voters

The elections shall be held in accordance with the Constitution of the State of Texas and the Texas Elections Code, and all resident qualified voters of the City shall be eligible to vote at the election.

Section 7.
Publication and Posting of Notice of Election

Notice of said elections shall be published in English, Spanish and in Vietnamese, at least once, not earlier than the 30th day and later than the 10th day before Election Day in a newspaper published in the City. A copy of the Notice of Election shall also be posted on the city's board used for posting notices of City meetings not later than the 21st day before Election Day.

Section 8.
Necessary Actions

The Mayor and the City Secretary of the City, in consultation with the City Attorney, are hereby authorized and directed to take any and all actions necessary to comply with the provisions of the Texas Election Code in carrying out and conducting the elections, whether or not expressly authorized herein.

Section 9.
Severability Clause

It is hereby declared to be the intention of the City Council that the sections, paragraphs, sentences, clauses and phrases of this order are severable and if any phrase, clause, sentence, paragraph, or section shall be declared invalid or unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such invalidity or unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs and sections of this order, since the same would have been enacted by the City Council without the incorporation in this order of any such invalid or unconstitutional phrase, clause, sentence, paragraph or section.

Section 10.
Effective Date

This ordinance shall be effective upon its adoption.

PASSED AND APPROVED this 15th day of February, 2024.

CITY OF DALWORTHINGTON GARDENS, TEXAS

_____
Laura Bianco, Mayor

ATTEST:

_____
Sandra Ma, City Secretary

GRA-TEX UTILITIES, INC.
P.O. BOX 1038
Kennedale Texas 76060
PHONE: (817) 781-0234

INVOICE #46347

Date: January 19,2024

To: DWG

Attn. Marcus

RE: 3621 Wooded Creek Cir. -Emerg Repair

Please see attached itemized quote.

1 LS. Repair water service.	$12,098.00

120-40-6910

Greg Petty
Accepted Signature:

01/19/2024
Date:

PLEASE CALL IF YOU HAVE ANY QUESTIONS

Emergency Service Repair
3621 Wooded Creek Cir.

Item			Unit	Total
1	Emergency Mobilization	1 EA	$ 6,500.00	$ 6,500.00
2	Crew cost	5 HR	$ 625.00	$ 3,125.00
3	Mini Excavator	5 HR	$ 195.00	$ 975.00
4	Service Material	1 LS	$ 1,442.00	$ 1,442.00
5	Sand	2 YD	$ 28.00	$ 56.00
				$ 12,098.00

City of Dalworthington Gardens

Purchase Request Form

Vendor ID: Gra-Tex Utilities, INC

Vendor Name:

Address 1: P.O. Box 1038

Address 2:

City, ST ZIP Kennedale, TX 76060

Phone: 817-781-0234

Date: 1/19/2024

ATTN Requestor:

After approval, submit 1 copy to Accounts Payable. Retain original to submit to Accounts Payable when goods and/or

If New Vendor - W9 Form Required - Please Attach

Qty	Description	ACCOUNT NO. Fund	Dept	Acct#	Unit Price	Line Total
1	Emergency Mobilization	120	40	6910	6,500.00	$ 6,500.00
5	Crew Cost(2 crews) (5 Hours)				625.00	$ 3,125.00
5	Mini Excavator (5 Hours)				195.00	$ 975.00
1	Serivce Material (6" Saddle, 1.5" Corporation Stop)				1,442.00	$ 1,442.00
2	2 yards of sand for backfill				28.00	$ 56.00

REASON (Please attach necessary supporting data)

Total $ 12,098.00

3621 Wooded Creek. Homeowner in the area called in the leak.

Water was coming up from multiple locations in the street, as well from peoples yards.

Water was eroding away the dirt below the street. Sand was coming up through the street and eroding to the drainage ditches.

Due to the damage this would cause to the street and peoples property, emergency repairs were needed.

BUDGETED: ○ YES ○ NO

Marcus Day 01/19/2024
Requested By *Date*

Laurie Branco
Authorized By *Date*

Greg Petty 01/19/2024
Director of DPS Approval *Date*

City Administrator Approval *Date*

FOR REQUESTOR USE ONLY:

I CERTIFY THAT ALL GOODS AND/OR SERVICES HAVE BEEN RECEIVED AND/OR COMPLETED

Signature *Date Received*

City Council

Staff Agenda Report **Agenda Item: 8e**

Agenda Subject: Approval of Resolution No. 2024-02 authorizing continued participation with the Steering Committee of Cities Served by Oncor; and authorizing the payment of ten cents per capita to the Steering Committee to fund regulatory and legal proceedings and activities related to Oncor Electric Delivery Company, LLC.		
Meeting Date: February 15, 2024	**Financial Considerations:** **$250.00 Budgeted** **$245.40 Invoiced** **Budgeted:** **☒Yes ☒No ☐N/A**	**Strategic Vision Pillar:** ☐ Financial Stability ☒ Appearance of City ☐ Operations Excellence ☒ Infrastructure Improvements/Upgrade ☐ Building Positive Image ☐ Economic Development ☐ Educational Excellence

Background Information: The City of Dalworthington Gardens is a member of a 169-member city coalition known as the Steering Committee of Cities Served by Oncor (Steering Committee). The resolution approves the assessment of a ten-cent ($0.10) per capita fee to fund the activities of the Steering Committee.

The Steering Committee undertakes activities on behalf of municipalities for which it needs funding support from its members. Municipalities have original jurisdiction over the electric distribution rates and services within the city. The Steering Committee has been in existence since the late 1980s. It took on a formal structure in the early 1990s. Empowered by city resolutions and funded by per capita assessments, the Steering Committee has been the primary public interest advocate before the Public Utility Commission, ERCOT, the courts, and the Legislature on electric utility regulation matters for over three decades.

The Steering Committee is actively involved in rate cases, appeals, rulemakings, and legislative efforts impacting the rates charged by Oncor Electric Delivery Company, LLC within the City. Steering Committee representation is also strong at ERCOT. It is possible that additional efforts will be necessary on new issues that arise during the year, and it is important that the Steering Committee be able to fund its participation on behalf of its member cities. A per capita assessment has historically been used, and is a fair method for the members to bear the burdens associated with the benefits received from that membership.

Recommended Action/Motion: Motion to approve Resolution No. 2024-02 authorizing continued participation with the Steering Committee of Cities Served by Oncor; and authorizing the payment of ten cents per capita to the Steering Committee to fund regulatory and legal proceedings and activities related to Oncor Electric Delivery Company, LLC.

Attachments: Resolution
Invoice

RESOLUTION NO. 2024-02

A RESOLUTION AUTHORIZING CONTINUED PARTICIPATION WITH THE STEERING COMMITTEE OF CITIES SERVED BY ONCOR; AND AUTHORIZING THE PAYMENT OF TEN CENTS PER CAPITA TO THE STEERING COMMITTEE TO FUND REGULATORY AND LEGAL PROCEEDINGS AND ACTIVITIES RELATED TO ONCOR ELECTRIC DELIVERY COMPANY, LLC.

WHEREAS, the City of Dalworthington Gardens is a regulatory authority under the Public Utility Regulatory Act (PURA) and has exclusive original jurisdiction over the rates and services of Oncor Electric Delivery Company, LLC (Oncor) within the municipal boundaries of the city; and

WHEREAS, the Steering Committee of Cities Served By Oncor (Steering Committee) has historically intervened in Oncor rate proceedings and electric utility related rulemakings to protect the interests of municipalities and electric customers residing within municipal boundaries; and

WHEREAS, the Steering Committee is participating in Public Utility Commission dockets and projects, as well as court proceedings, and legislative activity, affecting transmission and distribution utility rates; and

WHEREAS, the City is a member of the Steering Committee; and

WHEREAS, the Steering Committee functions under the direction of an Executive Committee which sets an annual budget and directs interventions before state and federal agencies, courts and legislatures, subject to the right of any member to request and cause its party status to be withdrawn from such activities; and

WHEREAS, the Steering Committee at its December 2023 meeting set a budget for 2024 that compels an assessment of ten cents ($0.10) per capita; and

WHEREAS, in order for the Steering Committee to continue its participation in these activities which affects the provision of electric utility service and the rates to be charged, it must assess its members for such costs.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS:

I.

That the City is authorized to continue its membership with the Steering Committee of Cities Served by Oncor to protect the interests of the City of Dalworthington Gardens and protect the interests of the customers of Oncor Electric Delivery Company, LLC residing and conducting business within the City limits.

II.

The City is further authorized to pay its assessment to the Steering Committee of ten cents ($0.10) per capita based on the population figures for the City shown in the latest TML Directory of City Officials.

III.

A copy of this Resolution and the assessment payment check made payable to *"Steering Committee of Cities Served by Oncor"* shall be sent to Brandi Stigler, Steering Committee of Cities Served by Oncor, c/o City Attorney's Office, Mail Stop 63-0300, 101 S. Mesquite St., Suite 300, Arlington, Texas 76010.

PRESENTED AND PASSED on this the 15th day of February, 2024, by a vote of _____ ayes and _____ nays at a regular meeting of the City Council of the City of Dalworthington Gardens, Texas.

_____
Lauri Bianco
Mayor

ATTEST:

_____
Sandra Ma
City Secretary

APPROVED AS TO FORM:

_____
Signature
City Attorney

City of Arlington, c/o Oncor Cities
Steering Committee
Attn: Brandi Stigler
101 S. Mesquite St., Ste. 300
MS # 63-0300
Arlington, TX 76010

Invoice

Date	Invoice #
1/8/2024	24-39

Bill To
City of Dalworthington Gardens

Item	Population	Per Capita	Amount
2024 Membership Assessment	2,454	0.10	245.40

Please make check payable to: Oncor Cities Steering Committee and mail to Oncor Cities Steering Committee, Attn: Brandi Stigler, Arlington City Attorney's Office, 101 S. Mesquite St., Ste. 300, MS #63-0300, Arlington, Texas 76010

Total $245.40

City Council
Staff Agenda Report

Agenda Subject: Discuss and possible action on the purchase of a new server.		
Meeting Date: February 15, 2024	**Financial Considerations:** **Budgeted:** **☒Yes ☐No ☐N/A**	**Strategic Vision Pillar:** ☐ Financial Stability ☐ Appearance of City ☒ Operations Excellence ☒ Infrastructure Improvements/Upgrade ☐ Building Positive Image ☐ Economic Development ☐ Educational Excellence

Prior Council Action:
None

Background Information:
The Incode, Laserfiche, and Regional Warrant Interface servers are in desperate need of being replaced. They are currently running on "server 2012 and 2008" operating systems that are no longer getting security updates, space is limited, and the hardware is slowing down.

Note: We currently have $12,000 budgeted for this upgrade.

Recommended Action/Motion:
Motion to approve the purchase of a new server Dell server not to exceed $12,599.00

Attachments:
NetGenius Quote

Quote

To: City of Dalworthington Gardens

netGenius

Managed IT and InfoSec Services

(817) 753-1740
1112 E. Copeland Road
Suite 430, Box 6
Arlington, TX 76011
info@netgeniusinc.com
www.netgeniusinc.com

netGenius
Managed IT and InfoSec Services

Pricing

Equipment

Pricing Category	Quantity	Cost	Total
Dell Server	1	$12,599.99	$12,599.99
2x3.5GHz Xeon gold processors, 256 Gb RAM 8TB Raid 10 Storage, Dell Boss card 2x240G, Rails			
Windows Server License	1	Incl.	Incl.
		Total	$12,599.99

**Pricing is based on equipment availability.
***Travel more than 50 miles from netGenius home office not included.

Proposal and cost schedule shall be valid for ninety (90) days. Any applicable monthly recurring charges will become part of the existing managed services agreement.

Accepted and Approved for the Customer:
City of Dalworthington Gardens
2600 Roosevelt

Dalworthington Gardens, TX 76016

_____
Signature

Name (print) _____

Title _____

Date _____

Accepted for:
NETGENIUS, INC.
1112 E. Copeland Road
Suite 430
Arlington, TX 76011

_____
Signature

Name (print) _____

Title _____

Date _____

Staff Agenda Report

Agenda Subject: Discussion and possible action regarding a planned development concept plan application for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas, to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11 X of Block A, an addition to the City of Dalworthington Gardens, Tarrant County, Texas.

Background Information: An application for a change in zoning was submitted by Cannon Clark on December 4, 2024. A Concept Plan was submitted with the application showing the proposed improvements and highlighting the proposed deviations from the base zoning district requirements. The proposed deviations from the requirements of the base zoning district are included in the "Residential Use Criteria" table shown on the Concept Plan.

The Concept Plan was forwarded to the city engineer for review. On January 23, 2024 the city engineer conducted his final review of the Concept Plan and determined that the Concept Plan conforms with the City's ordinance.

Notifications of tonight's public hearing were sent to all property owners within 200' of the subject property as well as being posted in the Commercial Recorder. Of the 24 property owner notifications sent, 1 was returned with comments. 0 were returned in favor of the zoning change and 1 was returned in opposition of the zoning change. All comments included on the notifications returned will be read during the public hearing.

David Pondt, 11 Hemingsford - spoke in concerns with density, police service, drainage, school, and population.

As the application submitted contains all required documents and the concept plan conforms with the City's ordinance, staff recommends approval of the proposed zoning change.

Planning and Zoning Commission met on February 1, 2024 and recommended approval of the concept plan application at 2611 W. Pleasant Ridge Road with a front set back change from 20 to 25 feet for lots 1-4.

Recommended Action/Motion: Motion to approval or deny planned development concept plan application for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas, to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11 X of Block A, an addition to the City of Dalworthington Gardens, Tarrant County, Texas.

Attachments:

Zoning Change Application Concept
Plan Letter of conformance
Notice of Public Hearing Response

PLAT Application

CITY OF DALWORTHINGTON GARDENS

2600 Roosevelt
TEL. 817-274-7368 FAX 817-265-4401
www.cityofdwg.net

☐ Replat ☐ Amending Plat ☐ Preliminary Plat ☐ Final Plat

Applicant's Name: Roosevelt Estates, LLC

Address: 2000 Beach Hop Lane Fort Worth TX 76108

Applicant Contact Number: (682) 902-0850

Applicant Email: Jason.Jo@Hawkeye-Realpartners.com

Surveyor: Steed Engineering

Address: PO Box 470636 Fort Worth TX 76147

I have purchased or have access to the City of Dalworthington Gardens Subdivision Ordinance which specifies requirements for plat submissions.
☐ Yes ☐ No

The attached submission complies with all applicable requirements of the City Subdivision Ordinance.
☐ Yes ☐ No

Signature

12/4/2023
Date

For Office Use Only

Fee: $4500.00 Date Paid: 12/4/2023 Receipt # CK248338

P & Z Scheduled _____ Public Hearing Published: _____

Council Scheduled: _____ Public Hearing Published: _____

Pro-Rata Paid: $_____ Date: _____

12/4/2023 - Sent email to Brandon Amount received to proceed. BS

DEC 04 2023
BY C.Newbell

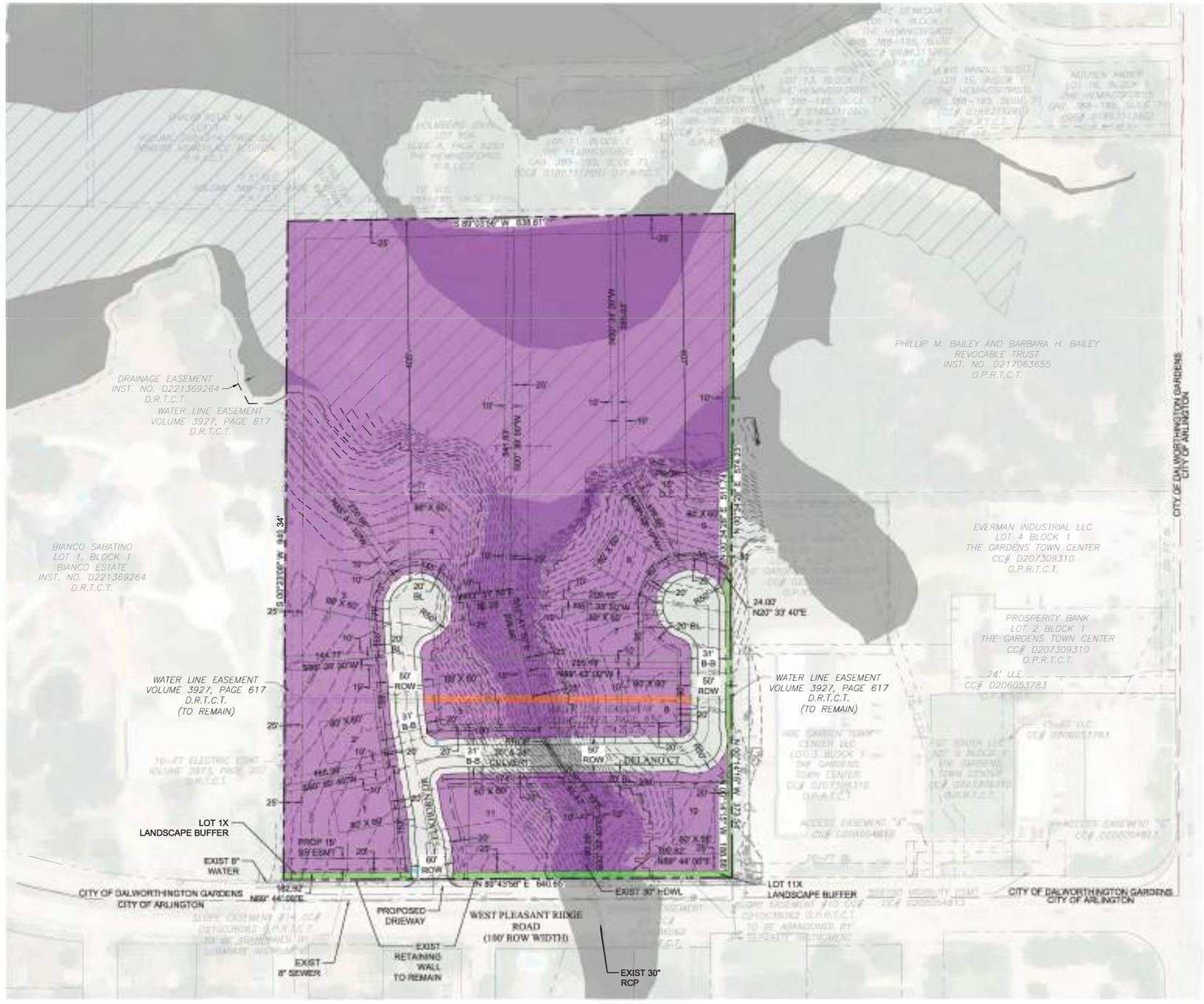
City of DNG
817-274-7368
***** R E P R I N T R E C E I P T *****

REC#: 00246338 12/04/2023 11:36 AM
OPER: CARLA TERM: 002
REF#: WINDOW/CK1038
PAID BY:

TRAN: PLATTING PLATTING CHARGE
ROOSEVLET ESTATES LLC
110-00.4455
Chrg For Service-Pl 4,500.00CR

TENDERED: 4,500.00 CHECK
APPLIED: 4,500.00-

CHANGE: 0.00



LAND USE DATA

TOTAL ACRES = 13.825 ACRES

RESIDENTIAL = 13.584 ACRES

OPEN SPACE = 0.241 ACRES

- 0.5 ACRE MIN = **11 LOTS**
- OPEN SPACE/LANDSCAPE AREA
- EASEMENT & WATER LINE TO BE ABADONED
- FEMA FLOODWAY
- FEMA FLOODPLAIN ZONE A

RESIDENTIAL USE CRITERIA

PROVISION	SF	PROPOSED PD
MINIMUM LOT AREA	21,780 SF	21,780 SF
MINIMUM LIVING AREA	1,250 SF	1,250 SF
MAXIMUM BUILDING COVERAGE	25%	25%
MINIMUM LOT WIDTH	80 FEET	80 FEET
MINIMUM LOT FRONT YARD	50 FEET	20 FEET
MINIMUM LOT SIDE YARD	25 FEET	10 FEET
MINIMUM LOT SIDE YARD FOR CORNER LOT	35 FEET	20 FEET
MINIMUM REAR YARD	25 FEET	25 FEET
MAX STRUCTURE HEIGHT	35 FEET	35 FEET

SHIELD ENGINEERING GROUP

TBPE FIRM #F-11039 · TBPLS FIRM #10193890

0 80 160 240

GRAPHIC SCALE IN FEET

1" = 80'

CITY OF
DALWORTHINGTON GARDENS, TEXAS

ROOSEVELT ESTATES

CONCEPT PLAN

DESIGNED: JGD	SCALE:	DATE:	SHEET:
DRAWN: JGD	1" = 80'	JAN 2024	1OF 1

2024/01/22 JOSE.DWG
COPYRIGHT ©2022 BY SHIELD ENGINEERING GROUP PLLC. TBPE F-11039 & TBPLS 10193890

Kimley»Horn

January 23, 2024

Sandra Ma
Interim City Secretary
City of Dalworthington Gardens
2600 Roosevelt Drive
Dalworthington Gardens, TX 76016

RE: Fourth Concept Plan Submittal Review
Roosevelt Estates
KHA No. 068302505

Dear Sandra:

We have completed our review of the fourth submittal of the Concept Plan for the above referenced project. The Concept Plan was received via email for review on January 22, 2024.

All previous comments have been adequately addressed. The Concept Plan as submitted conforms to the technical requirements listed in the Dalworthington Gardens Code of Ordinances.

Please remember that the adequacy of the design work reflected in the plans reviewed and the responsibility to adhere to all applicable ordinances and codes remains with the design engineer.

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

Brandon Bell, P.E.

Brandon Bell, P.E.

CITY OF DALWORTHINGTON GARDENS

NOTICE OF PUBLIC HEARINGS

Re: Zoning Request for Roosevelt Estates (Cannon Clark)

To Property Owners within 200' of 2611 W. Pleasant Ridge Dalworthington Gardens, Tarrant County, Texas

Notice is hereby given that the Dalworthington Gardens Planning and Zoning Commission will hold a public hearing on February 1, 2024 at 6:00 p.m. and the Dalworthington Gardens City Council will hold a public hearing on February 15, 2024 at 7:00 p.m., both to be held in the City Hall Council Chambers, 2600 Roosevelt Drive, Dalworthington Gardens, Texas to consider the following:

An application from Cannon Clark for a zoning change in accordance with Zoning Ordinance Section 14.02.272(f)(3) Planned development administration to allow for plan revision.

This notice has been sent to all owners of real property within 200 feet of the request as such ownership appears on the last approved city tax roll. All interested persons are encouraged to attend the public hearing and express their opinions on the amendment. If you are unable to attend but wish to have your opinions made part of the public record, please mail your opinions to the address below prior to the public hearing. Please include your name, address, and property description on all correspondence.

COMMENTS: - Density CONCERNS
- Commercial Traffic NOISE

I AM IN FAVOR: _____ I HAVE NO OBJECTIONS: _____ I HAVE OBJECTIONS: X

DAVID PRATT (PRINTED NAME) _____ (SIGNATURE)

11 Hamage Ford Dr (ADDRESS) _____ Arl 76016 (CITY, STATE, ZIP)

MAIL TO:
CITY OF DALWORTHINGTON GARDENS
CITY ADMINISTRATOR
2600 ROOSEVELT DRIVE
DALWORTHINGTON GARDENS, TX 76016

For questions: 817-385-6454 or sandra@cityofdwg.net

Staff Agenda Report

Agenda Subject: Discussion and possible action regarding Final Plan for for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11X of Block A an addition to the City of Dalworthington Gardens, Tarrant County, Texas.

Background Information: A Final Plan was submitted by Jose De Leon, Shield Engineering Group, PLLC on January 22, 2024 showing the proposed improvements and highlighting the proposed deviations from the base zoning district requirements. The proposed deviations from the requirements of the base zoning district are included in the "Residential Use Criteria" table shown on the Final Plan.

Typically the Final Plan for a development within the Planned Development zoning district does not come before the Commission until City Council has approved the zoning change and the Concept Plan. In this case, because the Final Plan is being presented to the Commission prior to Council's decision, if a recommendation of approval is to be provided, it shall be contingent on City Council's approval of the zoning change from Single Family to Planned Development.

The Final Plan was forwarded to the city engineer for review. On January 23, 2024 the city engineer conducted his final review and determined that if City Council approves the proposed zoning change, the Final Plan conforms with the City's ordinance and therefore recommends approval.

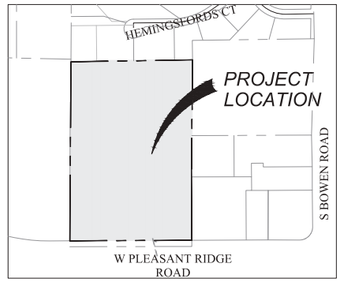
City staff also recommends approval.

Planning and Zoning Commission recommends approval contingent of city council approval of the zoning change with exception of the gate which will require further study.

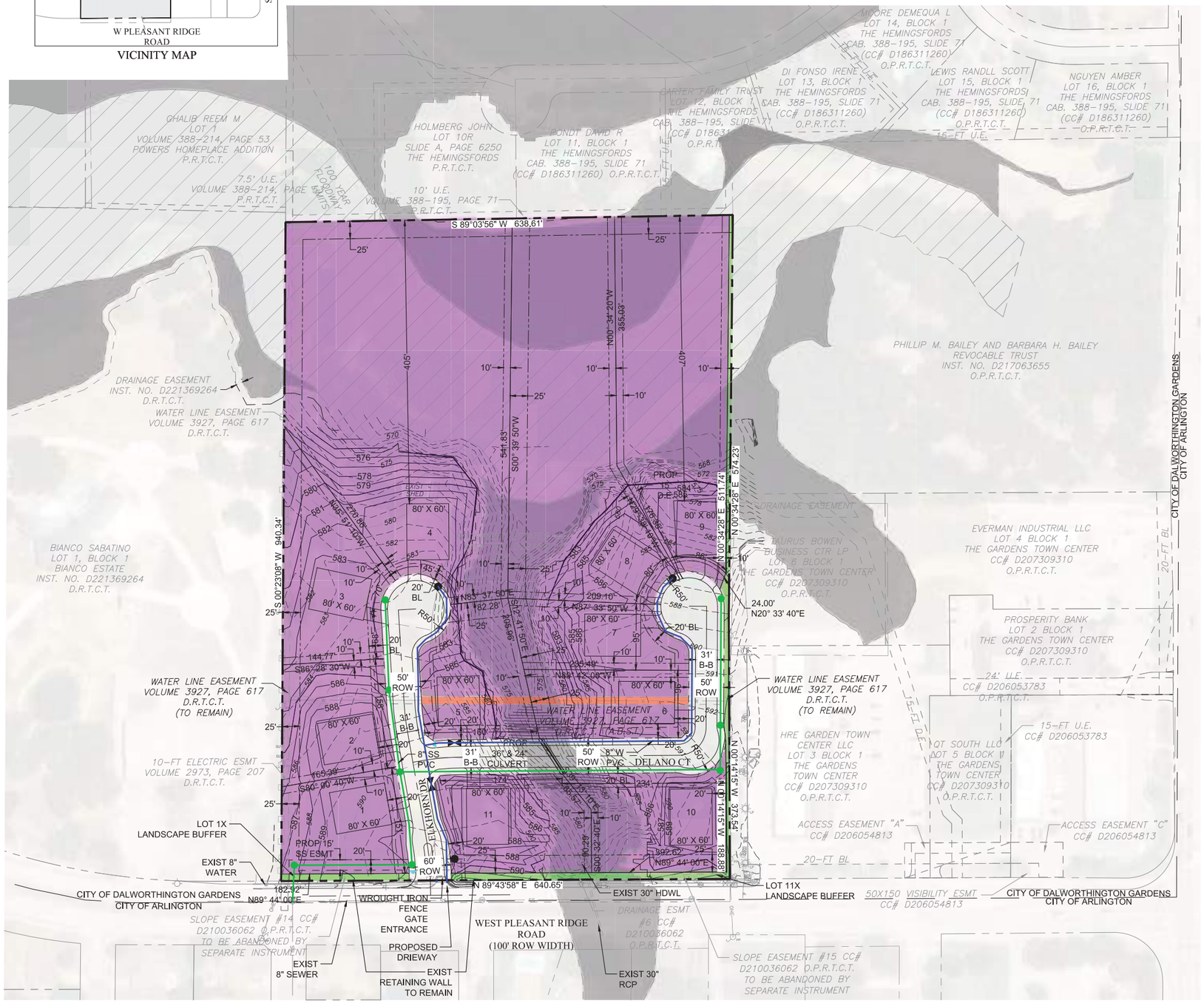
Recommended Action/Motion: Motion to recommend approval of the Final Plan for the property located at 2611 W. Pleasant Ridge Road contingent on City Council's approval of the proposed zoning change of the property from Single Family to Planned Development.

Attachments:

Final Plan Preliminary
Drainage Study Letter of Recommendation



VICINITY MAP



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- FEMA FLOODPLAIN ZONE A

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MINIMUM LOT SIDE YARD FOR CORNER LOT	35 FEET	20 FEET
MINIMUM REAR YARD	25 FEET	25 FEET
MAX STRUCTURE HEIGHT	35 FEET	35 FEET
MAX SITE COVERAGE	25%	25%
LOT DENSITY	---	.80 UNITS PER ACRE

DEVELOPMENT SCHEDULE

GRADING	FEB 1
WET UTILITIES	FEB 15
PAVING	MAR 1
DRY UTILITES	MAR 24
BACKFILL AND LADSCAPE	APR 15
FINAL INSPECTION	MAY 1

SHIELD
ENGINEERING GROUP
TBPE FIRM #F-11039 - TBPLS FIRM #10193890

N

0 80 160 240

GRAPHIC SCALE IN FEET
1" = 80'

CITY OF
DALWORTHINGTON GARDENS, TEXAS

ROOSEVELT ESTATES

FINAL PLAN

DESIGNED: JGD	SCALE:	DATE:	SHEET:
DRAWN: JGD	1" = 80'	JAN 2024	1OF 1

2024/01/22 JOSE.DELEON L:\JOBS\2021\105.01 ROOSEVELT ESTATES\EXHIBITS\20231116 PD CONCEPT PLAN\ROOSEVELT ESTATES FINAL PLAN.DWG
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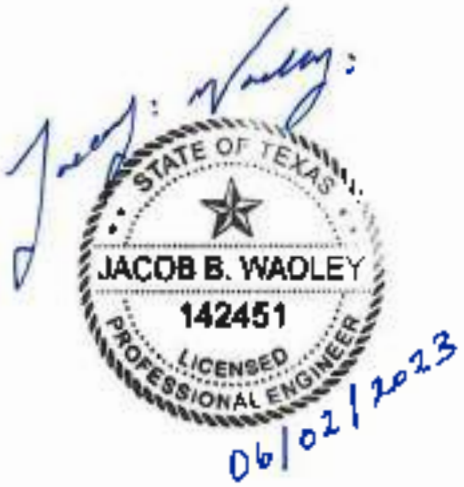
SHIELD
ENGINEERING GROUP

TECHNICAL MEMORANDUM

Roosevelt Estates Preliminary Drainage Study

Dalworthington Gardens, Texas

June 2023



1600 W. 7th Street, Suite 400, Fort Worth, Texas 76102 | P: 817.810.0696
Shield Engineering Group, PLLC
info@shield-engineering.com | www.SHIELDENGINEERINGGROUP.com
TBPE FIRM #F-11009 | TBPLS FIRM #10193890

Table of Contents

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Downstream Assessment 3
Culvert Design 5
Conclusion 5

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Appendix A - Tables and Calculations
Appendix B - Exhibits and Workmaps
Appendix C - Previous Study (2012 Rush Creek Study)
Appendix D – Project Layout Sheets
Appendix E - Digital Data
Appendix F – HEC-RAS Output

Introduction

The purpose of this Preliminary Drainage Study Technical Memorandum is to support the Roosevelt Estates Project. This Preliminary Drainage Study Technical Memorandum includes a downstream assessment and culvert design narrative. The proposed ±14-acre single-family residential development includes 1-acre single family lots with associated improvements (see project layout sheets in Appendix D). The project is located northwest of the West Pleasant Ridge Road and Bowen Road intersection in Dalworthington Gardens, Texas (see Exhibit B-1 in Appendix B). The property is north of West Pleasant Ridge Road and is bound by existing developments on the west, east, and north. Twin Springs Draw, a tributary to Rush Creek, runs through the northern portion of the property. Twin Springs Draw Tributary 2 runs through the center of the property and proposed project layout. The project is located approximately 1600 ft upstream of the Twin Springs Draw and Rush Creek confluence. The following describes the approach, methodology, and results to establish the impacts of the proposed development and provide preliminary sizing of a culvert system.

Previous Study

The Downstream Assessment portion of this study was based on the Rush Creek Watershed Study prepared by Halff Associates, Inc. in 2012 and includes hydrology and hydraulic modeling. This study is categorized as preliminary data and not within FEMA's effective database. The City of Arlington provided the Rush Creek study, as well as associated models and supplemental files to Shield Engineering, PLLC on March 31st, 2023 (see Appendix C for Rush Creek Watershed Study report). See Exhibit B-2 for the Twin Springs Draw watershed delineation.

Downstream Assessment

Hydrology Design Methodology

The modeling approach for the downstream assessment was kept consistent with the Rush Creek Watershed Study. The Rush Creek Watershed Study hydrology was developed using the following methodology and assumptions:

- SCS methodology was used to determine flow rates throughout the watershed.
- Hydrology Analysis was performed using USACE Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS version 3.5)
- The Natural Resource Conservation Services (NRCS) Soil Survey was used to evaluate hydrologic soil groups. Good condition soil was used to determine curve numbers throughout the watershed.
- Percent Impervious values were calculated based on watershed conditions. Percent Impervious values were calculated assuming existing conditions.
- Time of concentration and lag time calculations were performed using NRCS TR-55 methodology.
- Rainfall data was obtained from TP-40 (Hershfield, 1961) for the 24-hour events.

The total watershed square mileage at the project outfall is 1.17 square miles. The project area contributes 2% to the total watershed. Analysis points were defined by junctions along Twin

Springs Draw and all project boundary outfalls. Existing and Proposed conditions analyses were performed for the 10%, 4%, and 1% annual chance events to confirm no adverse impacts (see Tables A1 and A2 for a summary of hydrologic parameters).

Analysis Point Summary	
Junction	Description
C_TWI_000_002	Project outfall at Twin Springs Draw
J_B1	Project outfall along western property boundary
C_TWI_000_003	Confluence along Twin Springs Draw upstream of project
J_B_TWI_000_100_B1	Confluence between Twin Springs Draw and Rush Creek

For existing conditions, drainage area delineations and parameters were updated based on topographic data and 2019 TNRIS LiDAR to basins B_TWI_000_100, B_TWI_000_090, and B_TWI_003_010. Drainage area B_TW_002_010 was split into EX-A1, OS-A1, and EX-B1 to accurately model flow through the project site (see Exhibit B-3 for the existing conditions drainage area map). Hydrologic parameters were updated assuming good condition soil and open space land use (see Tables A3, A4, and A5 for hydrologic parameter calculations). See Exhibits B-5 and B-6 for the soils map and existing land use coverage, respectively.

The proposed development comprises basins PR-A1, PR-A2, and PR-B1 (see Exhibit B-4 for the proposed conditions drainage area map). From existing to proposed conditions, the percent impervious increased from approximately 5% to 25% (see Exhibit B-7 for the proposed conditions land use coverage). The hydrologic study demonstrated an increase in flow at C_TWI_000_002, the confluence with Twin Springs Draw (see Tables A6 and A7 for a summary of discharges and comparison at project outfalls). This comparison was made assuming offsite areas were unchanged between existing and proposed conditions.

Hydraulics Design Methodology

Due to the minimal contribution of the project area to the total watershed and proximity to Twin Springs Draw, a hydraulic comparison was performed to show no increases in water surface elevation along Twin Springs Draw. The Twin Springs Draw Hydraulic Model developed with the Rush Creek Watershed Study was used for the comparison and was developed using the following methodology and assumptions:

1. Hydraulic Analysis was performed using USACE Hydrologic Engineering Center River Analysis System (HEC-RAS version 4.1).
2. The HEC-RAS analysis utilized unsteady flow computations.

The Rush Creek HEC-HMS model did not utilize routing reaches along Twin Springs Draw Mainstem. Uniform Hydrograph and Lateral Inflow Hydrograph flow data was updated in the HEC-RAS model based on hydrology updates for existing and proposed conditions. The hydraulic study comparison demonstrated no rises in water surface elevation from the project outfall to the Tributary Springs Draw to the confluence with Rush Creek (See Table A-8 for a comparison of water surface elevations).

Culvert Design

Hydrology Design Methodology

The proposed project includes a culvert and roadway crossing along Tributary Springs Draw Tributary 2. Design flow rates were determined using rational method in accordance with Chapter 10 Section 10.02.274 of Dalworthington Garden's City Ordinances. See Tables A9 and A10 for rational method and weighted runoff coefficient calculations.

Hydraulics Design Methodology

The USACE HEC-River Analysis System (HEC-RAS version 6.3) was used for hydraulic modeling of the stream and proposed culvert (see Exhibit B-8 for a hydraulic workmap). Rational method discharges for the 1% annual chance event were used as steady flow data in the hydraulic analysis. Topography collected in 2022 by Shield Engineering Group surveying was used in conjunction with Texas Natural Resources Information System (TNRIS) LiDAR 2019 to generate cross section data and map floodplains. A Manning's roughness coefficient of 0.05 was used to represent natural channel areas with light brush. A Manning's roughness coefficient of 0.08 was used to represent natural channel areas with heavy brush and tree growth. Bank stations were set to represent the change in the channel from light brush to heavy tree growth.

The preliminary culvert size was determined to be 36". The preliminary design provides more than 1' of freeboard to the proposed roadway and doesn't impact existing upstream storm drain infrastructure. See Table A11 for a comparison of existing and proposed water surface elevations along Twin Springs Draw Tributary 2. See Table A12 for a comparison between the proposed 100-year water surface elevation and top of bank/roadway.

Conclusion

The goal of this report was to demonstrate no adverse impacts downstream of the project site to adjacent properties and Twin Springs Draw due to the proposed development and provide preliminary sizing of a culvert system. The hydrology study determined that the proposed development increased the percent impervious value of the onsite drainage area from approximately 5% to 25%. This resulted in a discharge increase at the project outfall along Twin Springs Draw and no increase in water surface elevation along Twin Springs Draw to the confluence with Rush Creek. No increases in discharge were observed at project outfalls draining to adjacent properties. Results from the preliminary hydraulic study indicate that a 36" culvert will convey onsite and offsite flow with adequate freeboard and cause no adverse impacts to upstream storm drain infrastructure.

APPENDIX A: TABLES AND CALCULATIONS

Roosevelt Estates Downstream Assessment					
Table A1 - Sumary of Parameters - Existing Conditions					
Basin	Acres	SQ Mile	CN	Percent Impervious	Lag Time
EX-A1	5.075	0.008	77	3	7.0
EX-B1	1.758	0.003	61	8	9.5
OS-A1	6.499	0.010	76	50	5.9
TWI_003_010	27.259	0.043	80	55	Previous Study
TWI_000_090	20.735	0.032	80	35	Previous Study
TWI_000_100	33.076	0.052	68	34	Previous Study

Table A2 - Sumary of Parameters - Proposed Conditions					
Basin	Acres	SQ Mile	CN	Percent Impervious	Lag Time
PR-A1	2.007	0.003	76	25	4.5
PR-A2	4.464	0.007	73	25	5.0
PR-B1	0.683	0.001	61	31	4.1
OS-A1	6.499	0.010	76	50	5.9
TWI_003_010	26.525	0.041	80	57	Previous Study
TWI_000_090	21.147	0.033	81	36	2.0
TWI_000_100	33.076	0.052	68	34	Previous Study

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT

TABLE A3 - TIME OF CONCENTRATION CALCULATIONS

1	2					3				4								5	6
	SHEET FLOW					SHALLOW CONCENTRATED FLOW				CHANNEL / PIPE FLOW									
Drainage Area ID	Sheet Flow Length (ft)	P_2 (in)	Land Slope (ft/ft)	n	t_{sheet} (min)	Shallow Flow Length (ft)	Shallow Flow Slope (ft/ft)	Average Velocity (ft/sec)	$t_{shallow}$ (min)	Channel Length (ft)	Channel Slope (ft/ft)	n	Cross Sectional Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Average Velocity (ft/sec)	$t_{channel}$ (min)	SCS Method T_c (min)	SCS Method t_{lag} (min)
Existing Conditions																			
EX-A1	100	3.95	0.0237	0.15	8.24	-	-	-	-	655.6	-	-	-	-	-	3.20	3.41	11.65	6.99
EX-B1	100	3.95	0.0065	0.15	13.82	333	0.0278	2.69	2.07	-	-	-	-	-	-	-	-	15.89	9.53
OS-A1	100	3.95	0.0589	0.15	5.73	697	0.0359	3.05	3.80	106	0.0040	0.013	-	-	-	6.00	0.29	9.82	5.89
Proposed Conditions																			
PR-A1	100	3.95	0.0465	0.15	6.29	-	-	-	-	230.09	-	-	-	-	-	3.20	1.20	7.49	4.49
PR-A2	69.44	3.95	0.0163	0.15	7.15	527	0.0127	2.29	3.83	210.58	-	-	-	-	-	3.20	1.10	8.25	4.95
PR-B1	100	3.95	0.0437	0.15	6.45	16	0.0019	0.70	0.37	-	-	-	-	-	-	-	-	6.82	4.09
TWI_000_090	50	3.95	0.0050	0.011	1.09	353	0.0374	3.93	1.50	-	-	-	-	-	-	-	-	3.41	2.05
						149	0.0351	3.02	0.82	-	-	-	-	-	-	-	-		

NOTE: CITE SOURCE OF MANNING'S N VALUES USED.

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT				
TABLE A4 - CURVE NUMBER AND PERCENT IMPERVIOUS CALCULATION EXISTING CONDITIONS				
Basin	Total Area (Acres)	Total Area (sq. mi)	[1]Weighted CN	[1]Weighted / Percent Impervious
EX-A1	5.08	0.0079	77	3
EX-B1	1.76	0.0027	61	8
OS-A1	6.50	0.0102	76	50
TWI_000_090	20.74	0.0324	80	35
TWI_000_100	33.08	0.0517	68	34
TWI_003_010	27.26	0.0426	80	55
TWI_000_070	96.93	0.1515	-	57
TWI_000_030	67.34	0.1052	-	51

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT				
TABLE A5 - CURVE NUMBER AND PERCENT IMPERVIOUS CALCULATION PROPOSED CONDITIONS				
Basin	Total Area (Acres)	Total Area (sq. mi)	[1]Weighted CN	[1]Weighted / Percent Impervious
PR-A1	2.01	0.0031	76	25
PR-A2	4.46	0.0070	73	25
PR-B1	0.68	0.0011	61	31
OS-A1	6.50	0.0102	76	50
TWI_000_090	21.15	0.0330	81	36
TWI_000_100	33.08	0.0517	68	34
TWI_003_010	26.53	0.0414	80	57
TWI_000_070	96.93	0.1515	-	57
TWI_000_030	67.34	0.1052	-	51

Notes:

1. Weighted CN and Percent Impervious values calculated using Intersect and Dissolve Geoprocessing Tools in ArcPro

Roosevelt Estates Downstream Assessment						
Table A6 - Summary of Discharges						
Junction	10% ACE		4% ACE		1% ACE	
	Existing Flow	Proposed Flow	Existing Flow	Proposed Flow	Existing Flow	Proposed Flow
Project Site Junction Outfalls						
C_TWI_000_002	60.8	68.7	75.5	85.1	101	114.2
J_B1	5.2	2.8	7.1	3.6	10.6	5
Junctions Downstream through ZOI						
C_TWI_000_003	168.8	161.8	204.4	195.7	265.5	253.9
J_B_TWI_000_100_B1	127.5	123.9	161	156	220.9	213.4

Roosevelt Estates Downstream Assessment			
Table A7 - Discharge Impacts			
Basin	1-yr Comparison	5-yr Comparison	100-yr Comparison
Project Site Junction Outfalls			
C_TWI_000_002	7.9	9.6	13.2
J_B1	-2.4	-3.5	-5.6
Junctions Downstream through ZOI			
C_TWI_000_003	-7	-8.7	-11.6
J_B_TWI_000_100_B1	-3.6	-5	-7.5

Roosevelt Estates Downstream Assessment												
Table A8 - Twin Springs Draw Water Surface Elevation Comparison												
Reach	River	Cross Section	10% ACE Event			4% ACE Event			1% ACE Event			
			Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference	
Twin Springs Draw												
TWI000A	TSD	6594	609.14	609.14	0	609.25	609.25	0	609.43	609.43	0	
TWI000A	TSD	6562	608.23	608.23	0	608.38	608.38	0	608.63	608.63	0	
TWI000A	TSD	6532	607.8	607.8	0	607.9	607.9	0	608.26	608.26	0	
TWI000A	TSD	6498	607.09	607.09	0	607.33	607.33	0	608.08	608.08	0	
TWI000A	TSD	6438	606.49	606.49	0	606.95	606.95	0	607.99	607.99	0	
TWI000A	TSD	6319	606.38	606.38	0	606.85	606.85	0	607.96	607.96	0	
TWI000A	TSD	6249	604.34	604.34	0	605	605	0	605.74	605.74	0	
TWI000A	TSD	6218	604.63	604.63	0	605.18	605.18	0	606.05	606.05	0	
TWI000A	TSD	6179	604.53	604.53	0	605.05	605.05	0	605.86	605.86	0	
TWI000A	TSD	6133	604.29	604.29	0	604.75	604.75	0	605.47	605.47	0	
TWI000A	TSD	6059	603.95	603.95	0	604.34	604.34	0	604.92	604.92	0	
TWI000A	TSD	5935	602.83	602.83	0	603.3	603.3	0	604.04	604.04	0	
TWI000A	TSD	5676	601.16	601.16	0	601.69	601.69	0	602.5	602.5	0	
TWI000A	TSD	5466	599.57	599.57	0	600.05	600.05	0	600.79	600.79	0	
TWI000A	TSD	5296	598.02	598.02	0	598.48	598.48	0	599.18	599.18	0	
TWI000A	TSD	5079	596.18	596.18	0	596.61	596.61	0	597.37	597.37	0	
TWI000A	TSD	4954	595.18	595.18	0	595.71	595.71	0	596.64	596.64	0	
TWI000A	TSD	4851	594.72	594.72	0	595.39	595.39	0	596.45	596.45	0	
TWI000A	TSD	4630	594.32	594.32	0	595.1	595.1	0	596.26	596.26	0	
TWI000A	TSD	4515	593.61	593.61	0	594.4	594.4	0	595.53	595.53	0	
TWI000A	TSD	4315	591.53	591.53	0	592.04	592.04	0	592.87	592.87	0	
TWI000A	TSD	4239	591.04	591.04	0	591.57	591.57	0	592.38	592.38	0	
TWI000A	TSD	4155	590.98	590.98	0	591.55	591.55	0	592.43	592.43	0	
TWI000A	TSD	3981	589.62	589.62	0	590.07	590.07	0	590.75	590.75	0	
TWI000A	TSD	3902	588.54	588.54	0	589.05	589.05	0	589.82	589.82	0	
TWI000A	TSD	3556	584.09	584.09	0	584.68	584.68	0	585.68	585.68	0	
TWI000A	TSD	3490	583.5	583.5	0	584.02	584.02	0	584.86	584.86	0	
TWI000A	TSD	3161	581.24	581.24	0	581.72	581.72	0	582.35	582.35	0	
TWI000A	TSD	3010	580.32	580.32	0	580.72	580.72	0	581.16	581.16	0	
TWI000A	TSD	2970	580.3	580.3	0	580.65	580.65	0	580.97	580.97	0	
TWI000A	TSD	2668	576.75	576.75	0	577.28	577.28	0	578.08	578.08	0	
TWI000A	TSD	2599	576.04	576.04	0	576.54	576.54	0	577.31	577.31	0	
TWI000A	TSD	2389	574.65	574.65	0	575.18	575.18	0	576	576	0	
TWI000A	TSD	2202	573.77	573.77	0	574.31	574.31	0	575.1	575.1	0	
TWI000A	TSD	2201	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	2108	573.28	573.28	0	573.79	573.79	0	574.56	574.56	0	
TWI000A	TSD	1959	572.69	572.69	0	573.22	573.22	0	573.97	573.97	0	
TWI000A	TSD	1815	572.42	572.42	0	572.96	572.96	0	573.7	573.7	0	
TWI000A	TSD	1704	572.36	572.35	-0.01	572.89	572.88	-0.01	573.6	573.6	0	
TWI000A	TSD	1522	572.26	572.26	0	572.78	572.77	-0.01	573.45	573.45	0	
TWI000A	TSD	1354	572.16	572.16	0	572.66	572.66	0	573.3	573.3	0	
TWI000A	TSD	1241	571.58	571.57	-0.01	572.06	572.06	0	572.63	572.63	0	
TWI000A	TSD	1205	571.07	571.07	0	571.46	571.46	0	572	572	0	
TWI000A	TSD	1115	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	1076.5	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	1038	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	1011	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	897	570.81	570.81	0	571.24	571.24	0	571.8	571.8	0	
TWI000A	TSD	736	570.81	570.81	0	571.25	571.24	-0.01	571.81	571.8	-0.01	
TWI000A	TSD	585	570.8	570.8	0	571.24	571.24	0	571.79	571.79	0	
TWI000A	TSD	549	570.66	570.66	0	571.04	571.03	-0.01	571.51	571.51	0	
TWI000A	TSD	544	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	437	554.15	554.15	0	554.85	554.85	0	555.94	555.94	0	
TWI000A	TSD	390	554.25	554.24	-0.01	554.99	554.99	0	555.99	555.99	0	
TWI000A	TSD	329	554.24	554.24	0	554.98	554.98	0	555.97	555.96	-0.01	
TWI000A	TSD	237	554.25	554.25	0	555	554.99	-0.01	555.99	555.99	0	
TWI000A	TSD	179	554.24	554.23	-0.01	554.98	554.98	0	555.97	555.96	-0.01	
TWI000A	TSD	165	554.05	554.05	0	554.78	554.77	-0.01	555.7	555.7	0	
TWI000A	TSD	143	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	106	548.07	548.06	-0.01	548.93	548.93	0	550.79	550.79	0	
TWI000A	TSD	87	548.24	548.24	0	549.44	549.43	-0.01	551.13	551.12	-0.01	

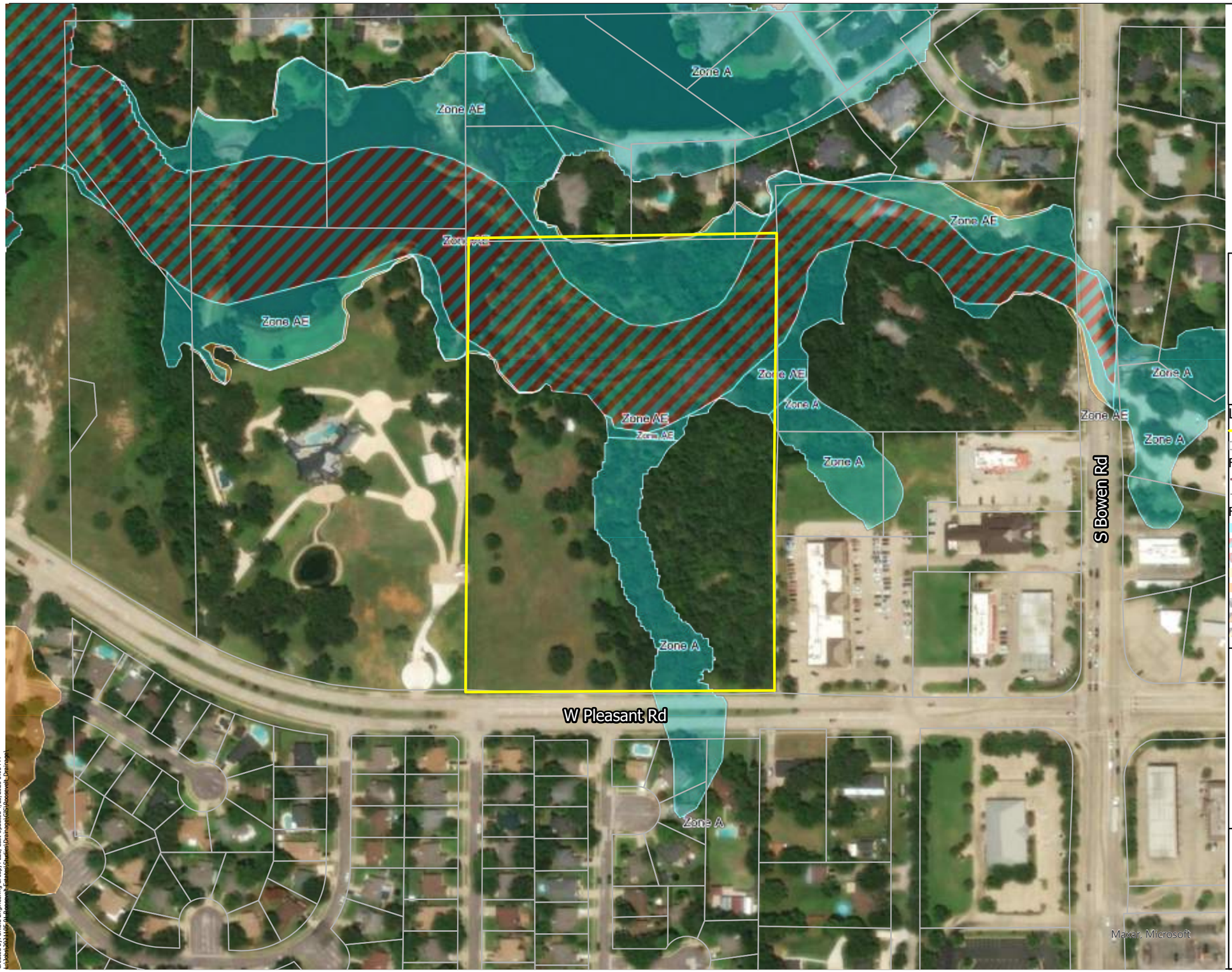
ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT										
Table A9 - Culvert Design Rational Method Calculations										
25 and 100-Year Design Frequency										
1	2	3	4	5	6	7	8	9	10	11
Drainage Area ID	Area (ac)	Land Use Description	Runoff Coefficient C	CA	Total Tc (Min)	I25	Runoff Q25 (cfs)	I100	Runoff Q100 (cfs)	Outfall DesignPoint #
PR-A1	2.007	Residential	0.56	1.13	7.49	8.75	10.84	10.95	15.42	1
PR-A2	4.464	Residential	0.55	2.47	8.25	8.45	22.92	10.58	32.61	1
OS-A1	6.499	Residential	0.56	3.63	9.82	7.91	31.61	9.89	44.94	1
NOTE: TABLE 10.02.274-2. RUNOFF COEFFICIENT - DWG DRAINAGE ORDINANCE										
Q25 AND Q100 INCLUDE ANTECEDENT PRECIPITATION FACTORS OF 1.1 AND 1.25, RESPECTIVELY.										

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT								
TABLE A10 - COMPOSITE RUNOFF COEFFICIENT CALCULATIONS								
Drainage Area ID	Total Area (ac)	Residnetial - Type B Soil		Residnetial - Type C Soil		Residnetial - Type D Soil		Composite C
		C	Area (ac)	C	Area (ac)	C	Area (ac)	
PR-A1	2.007	0.52	0.234	0.55	0.806	0.58	0.968	0.56
PR-A2	4.464	0.52	1.527	0.55	1.046	0.58	1.89	0.55
OS-A1	6.499	0.52	0	0.55	4.445	0.58	2.05	0.56
NOTE: TABLE 10.02.274-2. RUNOFF COEFFICIENT - DWG DRAINAGE ORDINANCE								

Roosevelt Estates Downstream Assessment														
Table A11 - Water Surface Elevation Comparison														
Reach	River	Cross Section	Water Surface Elevation Comparison						Velocity Comparison					
			4% ACE Event			1% ACE Event			4% ACE Event			1% ACE Event		
			Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference
Twin Springs Draw 2														
Reach 1	1	627	585.43	585.43	0	585.57	585.57	0	4.03	4.03	0	4.42	4.42	0
Reach 1	1	590	581.34	581.34	0	581.52	581.52	0	4.46	4.43	-0.03	4.77	4.77	0
Reach 1	1	544	577.67	577.9	0.23	577.84	578.98	1.14	4.38	3.05	-1.33	4.75	1.43	-3.32
Reach 1	1	517	575.9	577.5	1.6	576.07	578.65	2.58	2.37	4.31	1.94	2.66	4.17	1.51
Reach 1	1	407	573.52	573.53	0.01	573.68	573.7	0.02	4.19	4.6	0.41	4.55	5.2	0.65
Reach 1	1	379	572.95	572.96	0.01	573.15	573.16	0.01	2.65	2.61	-0.04	2.96	2.91	-0.05
Reach 1	1	336	571.88	571.88	0	572.03	572.03	0	4.1	4.1	0	4.49	4.49	0
Reach 1	1	273	571.4	571.39	-0.01	571.8	571.79	-0.01	0.84	1.3	0.46	0.89	1.38	0.49
Reach 1	1	208	571.4	571.4	0	571.8	571.8	0	0.24	0.37	0.13	0.3	0.47	0.17
Reach 1	1	150	571.4	571.4	0	571.8	571.8	0	0.16	0.25	0.09	0.21	0.32	0.11
Reach 1	1	89	571.4	571.4	0	571.8	571.8	0	0.09	0.13	0.04	0.11	0.17	0.06
Reach 1	1	57	571.4	571.4	0	571.8	571.8	0	0.06	0.1	0.04	0.08	0.13	0.05

Roosevelt Estates Downstream Assesment					
Table A12 Twin Springs Draw Tributary 2 Freeboard					
Reach	River	Cross Section	Proposed 100-Yr WSEL (ft)	Bank Station Elevation (ft)	Freeboard (ft)
Reach 1	1	627	585.57	589.77	4.2
Reach 1	1	590	581.52	585.39	3.87
Reach 1	1	544	578.98	582.87	3.89
Reach 1	1	517	578.65	582.15	3.5
Reach 1	1	407	573.7	582.15	8.45
Reach 1	1	379	573.16	582.61	9.45
Reach 1	1	336	572.03	581.29	9.26
Reach 1	1	273	571.79	580.89	9.1
Reach 1	1	208	571.8	582.37	10.57
Reach 1	1	150	571.8	582.67	10.87
Reach 1	1	89	571.8	582.59	10.79
Reach 1	1	57	571.8	577.76	5.96

APPENDIX B: EXHIBITS AND WORKMAPS



SHIELD ENGINEERING GROUP

Legend

- Project Location
- Parcels

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

N

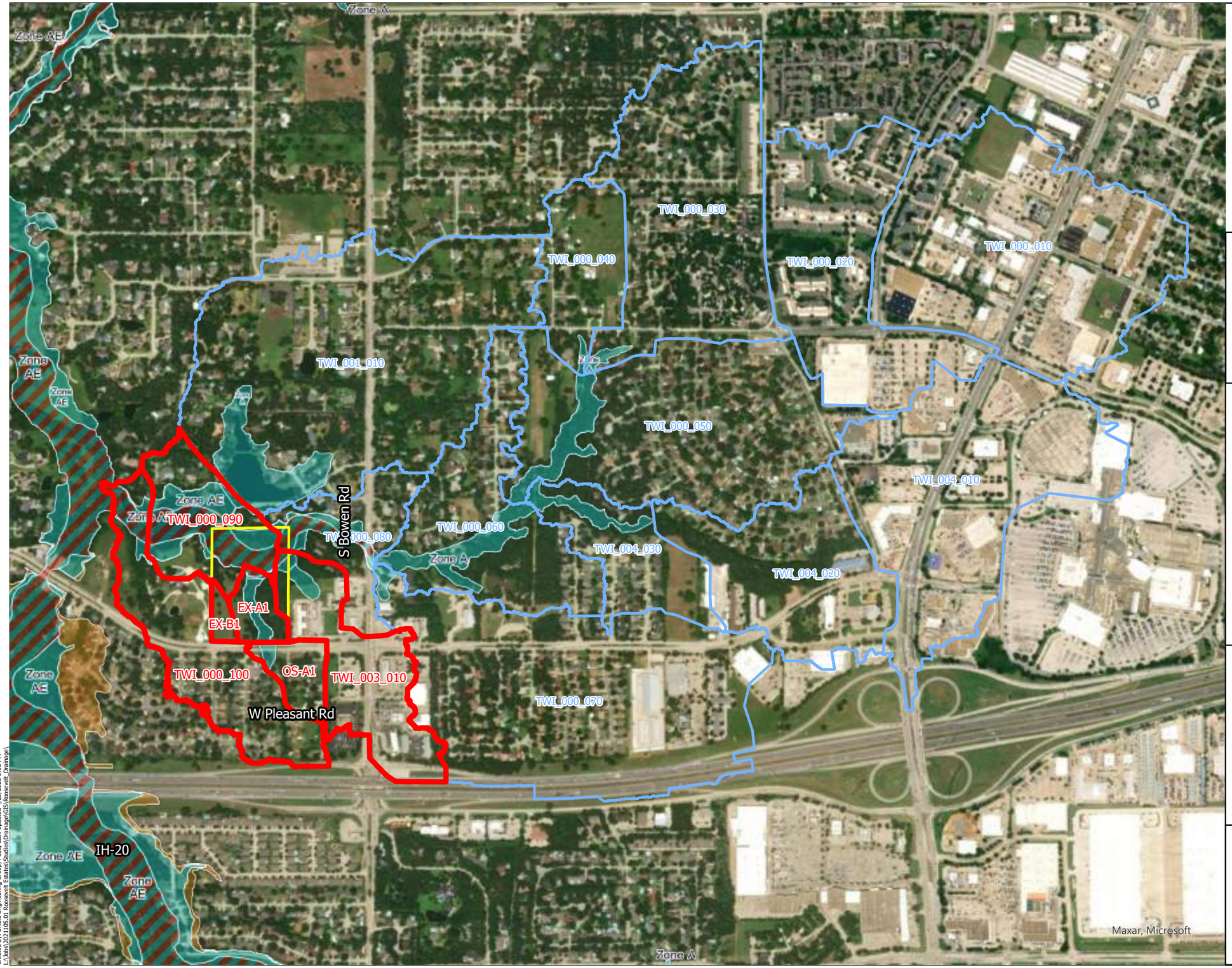
200 100 0 200

US Feet

Scale: 1":200'

Exhibit B-1
Project Location Map

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
K:\Municipal\1456 Roosevelt Estates Studies\Drainage\GIS\Roosevelt_Drainage\



SHIELD ENGINEERING GROUP

Legend

- Project Location
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

N

800 400 0 800

US Feet

Scale: 1":800'

Exhibit B-2
Overall Watershed

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
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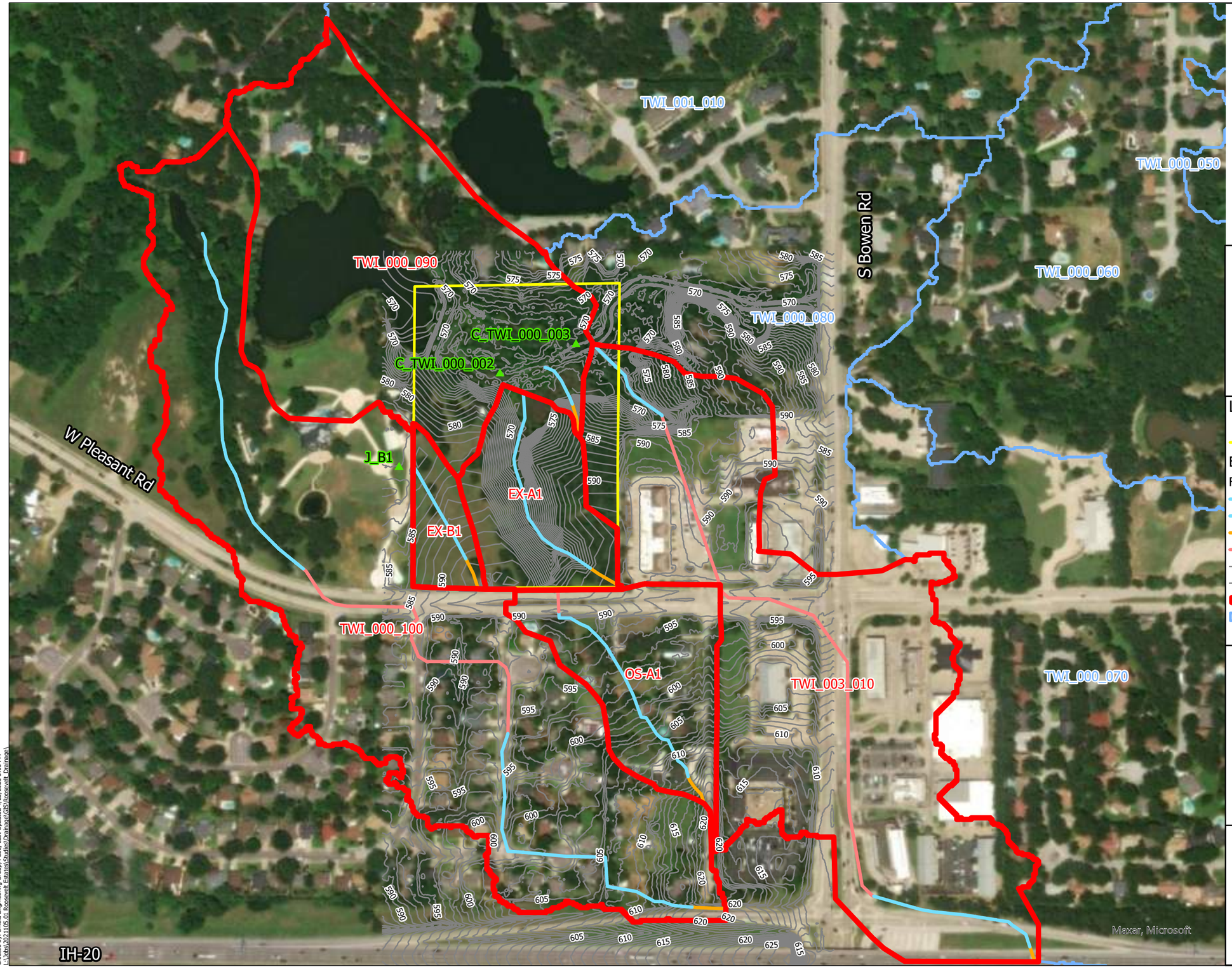

SHIELD ENGINEERING GROUP

Legend

- Junction
- Project Location

Existing Longest Flowpath

FlowType

- Channel Flow
- Shallow Concentrated Flow
- Overland Flow
- Pipe Flow
- LiDAR
- Survey_Contours
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-3
Existing Drainage Area Map

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
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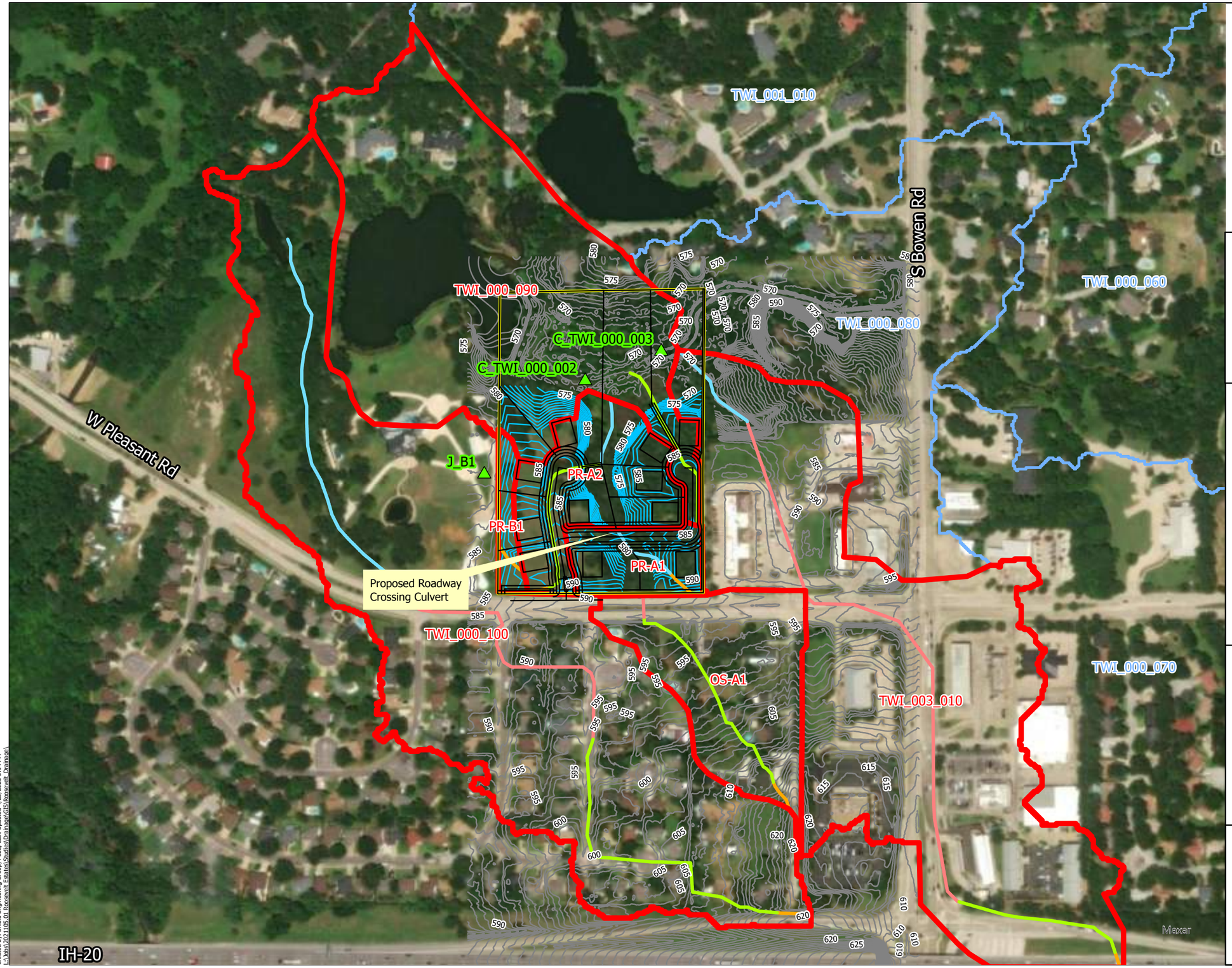

SHIELD ENGINEERING GROUP

Legend

- Layout
- Project Location
- Proposed Drianage Areas
- Twin Springs Draw Drainage Areas

Proposed Longest Flowpath

FlowType

- Channel Flow
- Shallow Concentrated Flow
- Overland Flow
- Pipe Flow
- Preliminary Grading
- LiDAR
- Junction

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-4
Proposed Drainage Area Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:14 PM
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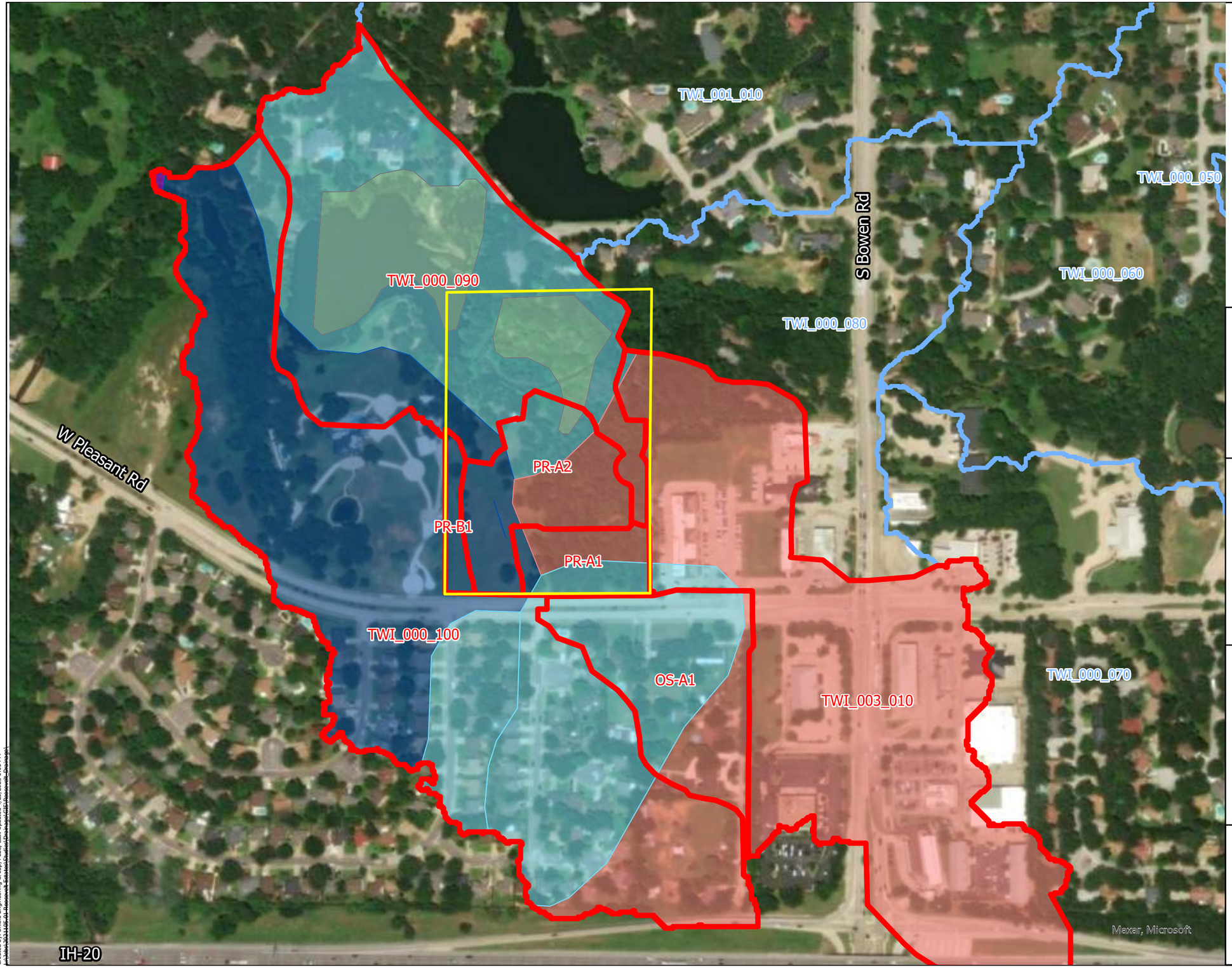


SHIELD ENGINEERING GROUP

Legend

- Project Location

Soil Type

HSG

- A
- B
- C
- D
- Water
- Twin Springs Draw Drainage Areas
- Proposed Drianage Areas

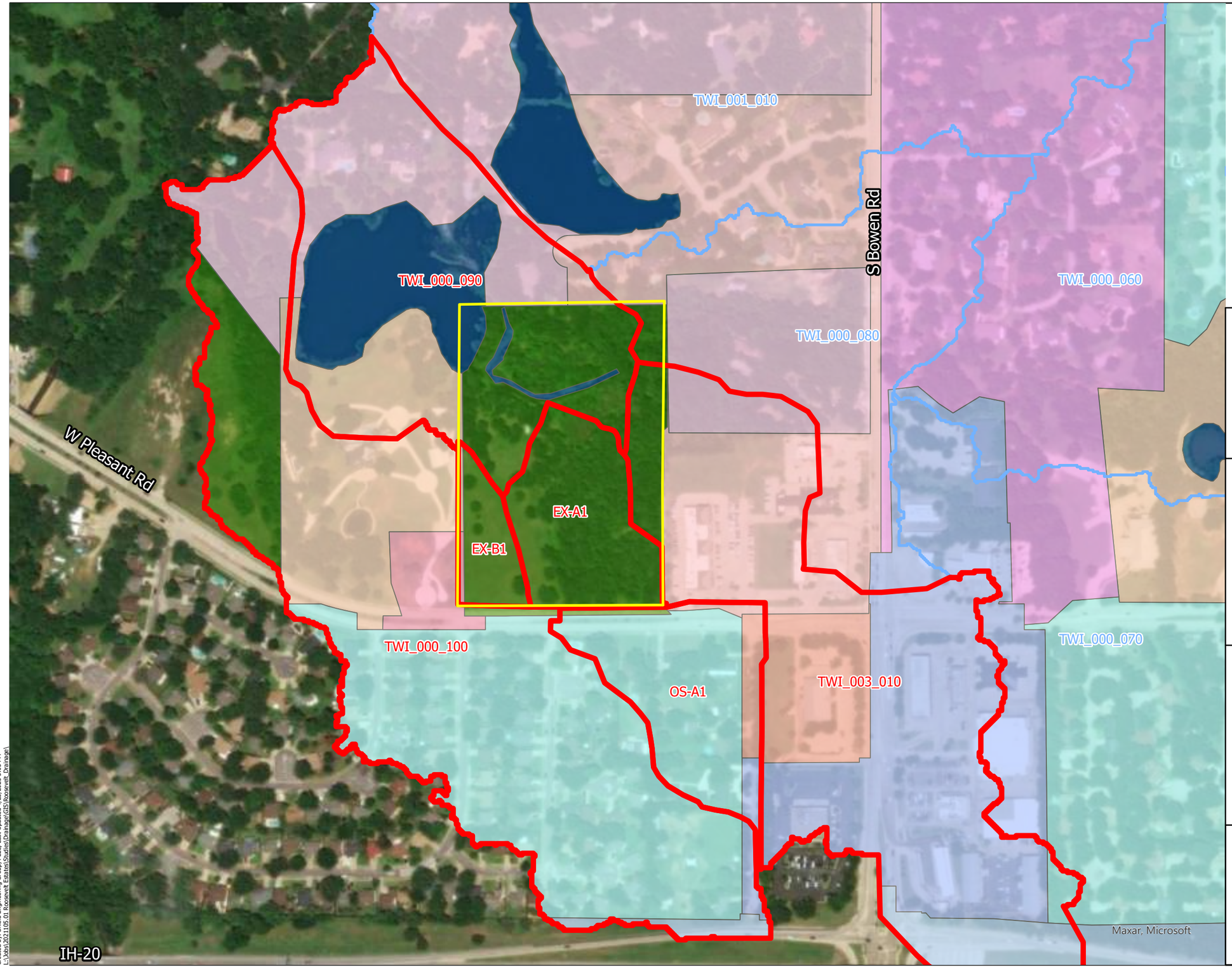
N

300 150 0 300 US Feet

Scale: 1":300'

Exhibit B-5
Soils Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
J:\Projects\2021\05-04 Rockwall Basin\Application Drainage\GIS\Rockwall_Drainage.aprx



SHIELD ENGINEERING GROUP

Legend

Project Location

Existing Land Use Type

- Extremely Low Density
- Group Quarters
- High Density Residential
- Hotel/Motel
- Industrial
- Institutional
- Low Density Residential
- Major Roads
- Medium Density Residential
- Mobile Home
- Multi Family
- Office
- Parks/Recreation
- Retail
- Under Construction
- Utilities
- Vacant
- Very Low Density Residential
- Water
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-6
Existing Land Use Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
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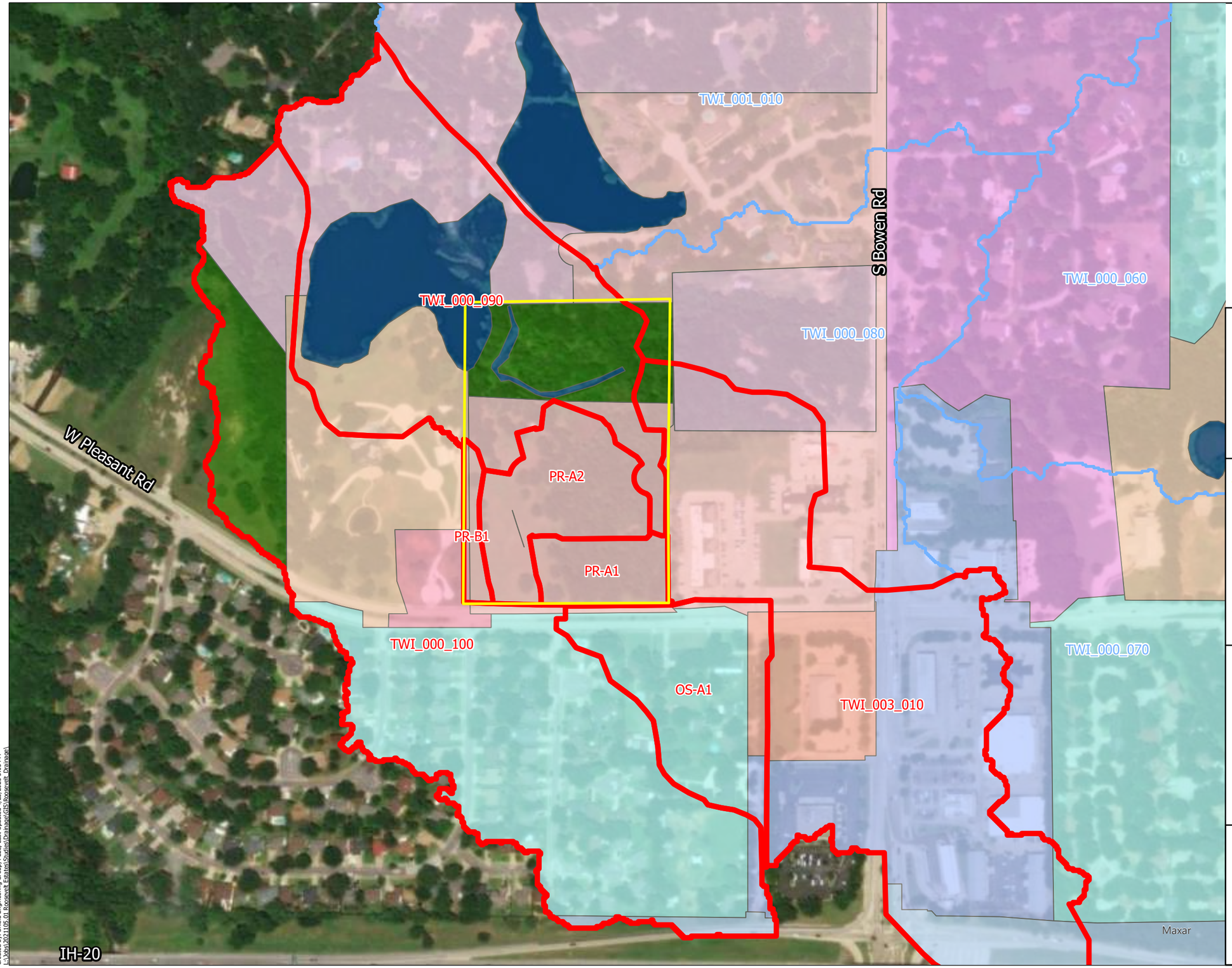

SHIELD ENGINEERING GROUP

Legend

- Project Location

Proposed Land Use Type

- Extremely Low Density
- Group Quarters
- High Density Residential
- Hotel/Motel
- Industrial
- Institutional
- Low Density Residential
- Major Roads
- Medium Density Residential
- Mobile Home
- Multi Family
- Office
- Parks/Recreation
- Retail
- Under Construction
- Utilities
- Vacant
- Very Low Density Residential
- Water
- Proposed Drianage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300 US Feet

Scale: 1":300'

Exhibit B-7
Proposed Land Use Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
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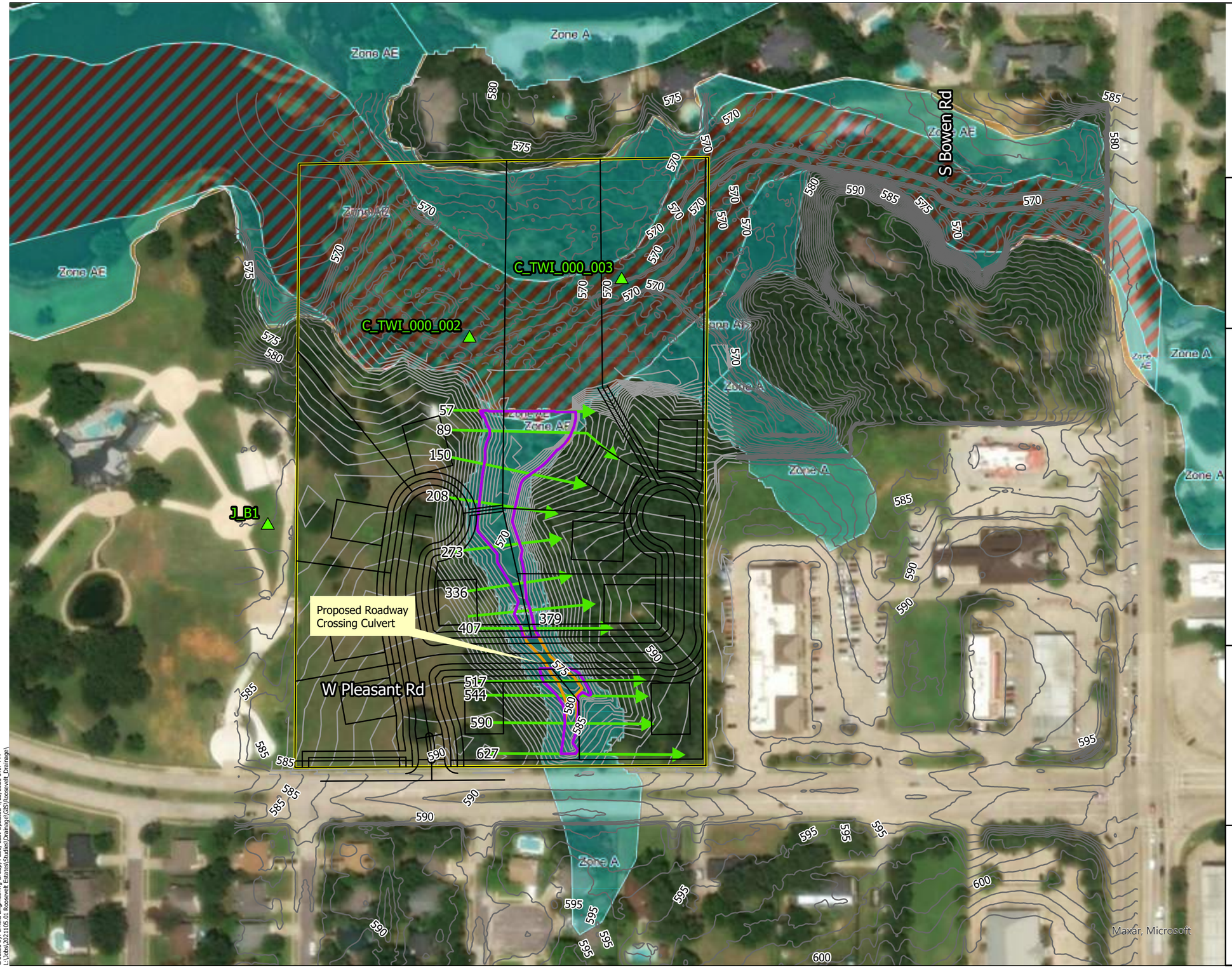

SHIELD ENGINEERING GROUP

Legend

- Layout
- Project Location
- LiDAR
- Survey_Contours
- Existing 100-yr Inundation
- Proposed 100-yr Inundation
- HEC-RAS Cross Sections

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee
- Junction

N

150 75 0 150

US Feet

Scale: 1":150'

Exhibit 8
Hydraulic Workmap

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APPENDIX C: PREVIOUS STUDY (2012 RUSH CREEK STUDY)

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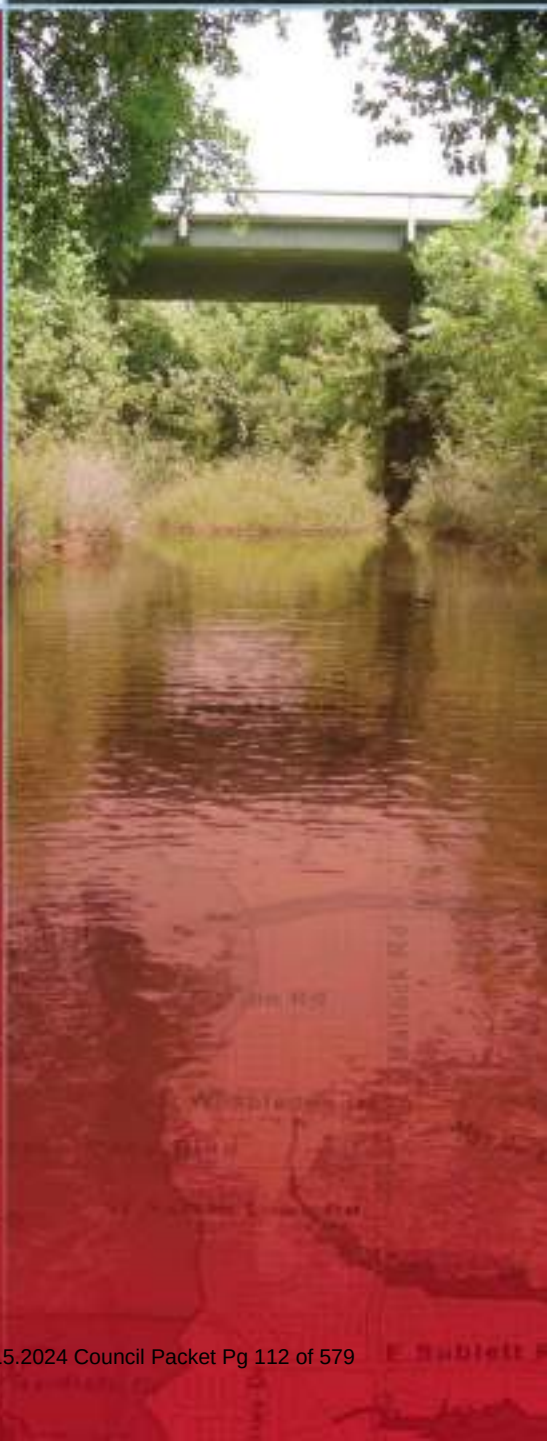
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

RUSH CREEK
City of Arlington
Watershed Study

Rush Creek Watershed Study Hydrology Report

July 2012



TBPE Firm #F-312
5/15/2013
STATE OF TEXAS
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PROFESSIONAL ENGINEER

TBPE Firm #F-312
5/15/2013
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CDM Smith

In Association with

HALFF

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APPENDIX

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Appendix B Hydrologic Data

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1. Executive Summary

1. Executive Summary

The Rush Creek watershed is the largest watershed in Arlington and includes portions of Kennedale, Mansfield, and Fort Worth and the entirety of Pantego and Dalworthington Gardens. The watershed encompasses approximately 35 square miles of contributing drainage area. It has developed significantly over the past 40 years from the time when the original floodplain mapping was produced by the Federal Emergency Management Agency (FEMA) and this development has had a significant impact on floodplains and creeks.

The City of Arlington has undertaken a comprehensive watershed study to update information regarding flooding characteristics and flows in Rush Creek. The purpose of the watershed study is to 1) update the FEMA flood maps so that flooding risk is better defined for Arlington residents; 2) reduce risks by formulating flood management projects; and 3) assess channel erosion risks.

This report summarizes the study methods and results of the hydrologic modeling effort performed by Halff Associates, Inc. As part of this effort, the Rush Creek watershed was divided into the following major sub-watersheds: Kee Branch, Lower Rush Creek, Middle Rush Creek, Stream RC-1, and Upper Rush Creek. HEC-HMS v3.5 was utilized to create hydrologic models for each sub-watershed. The results of this modeling effort will be utilized to develop unsteady hydraulic models to determine flood elevations corresponding to the 50, 20, 10, 4, 2, 1 and 0.2%-annual-chance (2-, 5-, 10-, 25-, 50-, 100- and 500-year) storm events. Figure 1-1 is a map of the Rush Creek study area.

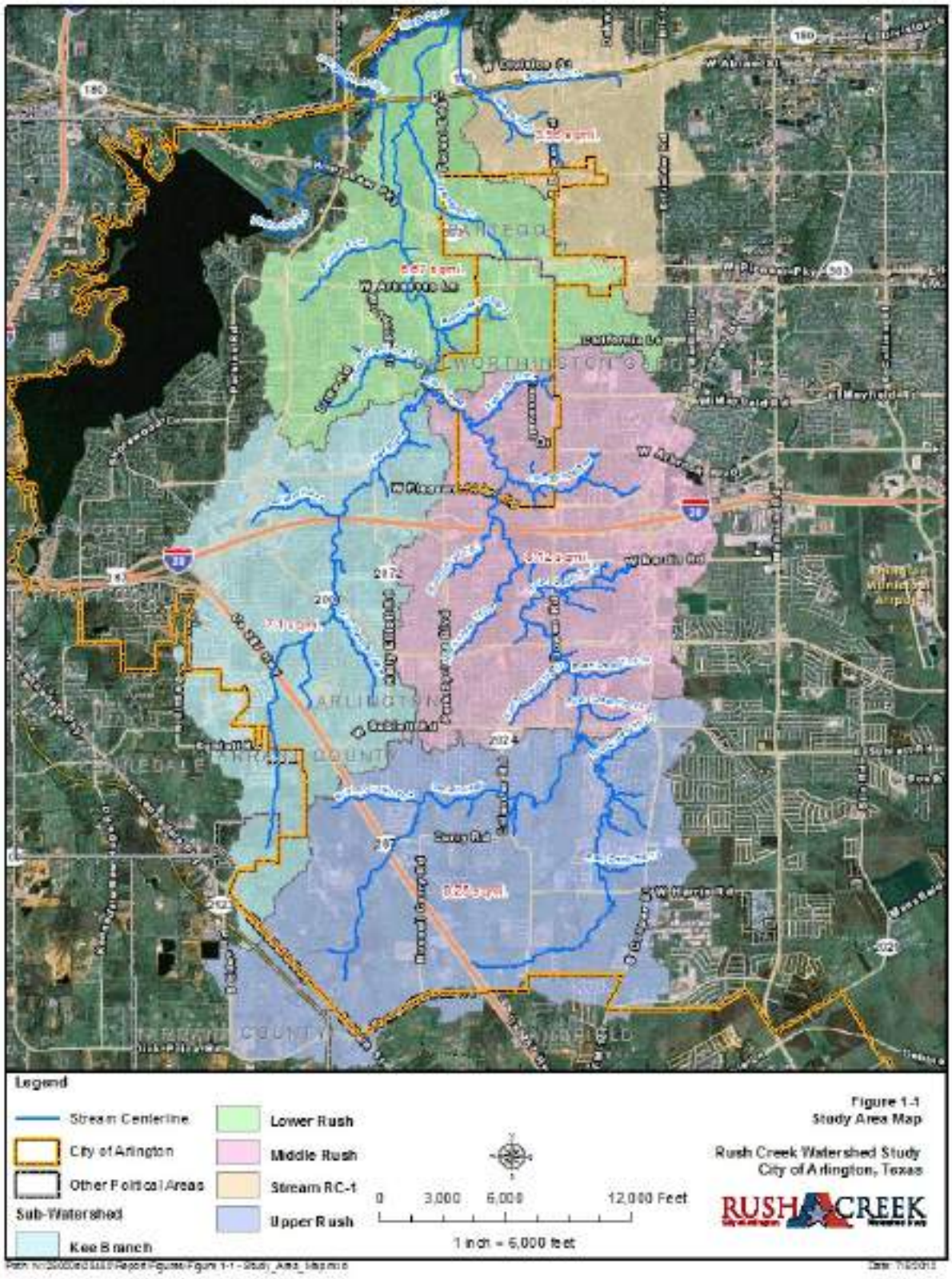


Figure 1-1. Study Area Map

2. Hydrologic Study

2. Hydrologic Study

2.1 Study Area Characteristics

2.1.1 Hydrologic Region

The Rush Creek watershed is located in the Lower West Fork Trinity hydrologic region and is bordered by the Village Creek watershed to the west, the Walnut Creek watershed to the southeast, Fish Creek watershed to the east, Johnson Creek watershed to the northeast. The characteristics of the Lower West Fork Trinity hydrologic region include generally flat terrain and impermeable soils.

2.1.2 Watershed Size

At its outlet, the Rush Creek watershed drainage area measures 34.69 square miles. The Rush Creek watershed was divided into the following five major sub-watersheds:

- *Kee Branch*
- *Lower Rush Creek*
- *Middle Rush Creek*
- *Stream RC-1*
- *Upper Rush Creek*

Figure A-1, Vicinity Map, shows the Rush Creek watershed boundary and the surrounding area.

2.1.3 Soils

The Natural Resource Conservation Service (NRCS) Soil Survey of Tarrant County (2009) was used to evaluate the hydrologic soils in the Rush Creek watershed. The most prevalent soil type in the watershed is Group D which consists of clayey soils with slow infiltration rates and high potential for runoff. The second most prevalent soil type is Group B which consists of soils characterized as having some content of gravelly sand with moderate infiltration rates and low/moderate runoff potential. The third most prevalent soil type in the watershed is Group C which indicates soils having moderately fine to fine texture and slow infiltration rates. A small percentage of soils in the watershed are identified as Group A which indicates soils having high infiltration rates and low runoff potential. Table 2.1 includes a list of the NRCS Soil Survey Geographic Database (SSURGO) Hydrologic Soil Group (HSG) classifications for each Rush Creek sub-watershed.

The hydrologic soils for the Rush Creek watershed are illustrated in Figure A-2, Soils Map.

The antecedent moisture condition (AMC) defines the soil moisture condition prior to a storm. AMC-II, average soil moisture conditions, was used for the watershed study.

Table 2.1 - Watershed Soil Classification				
SSURGO Database Classification	Hydrologic Soil Type Percentage			
	A	B	C	D
Kee Branch	3%	38%	29%	30%
Lower Rush Creek	13%	43%	18%	26%
Middle Rush Creek	4%	25%	18%	53%
Stream RC-1	2%	41%	28%	28%
Upper Rush Creek	3%	29%	17%	50%

2.1.4 Land Use

Land use for the Rush Creek watershed has been determined for both existing and ultimate conditions. Table 2.2 shows the land use categories and corresponding impervious percentages used for this study. Refer to the Technical Standards (May 21, 2012) developed by CDM Smith for sources of these impervious area percentages. Watershed conditions dictated that the recommended percent impervious values provided in the Technical Guidelines be revised to the values shown in Table 2.2 for Extremely Low Density Residential, Very Low Density Residential, Major Transportation, Institutional, and Mobile Home land use categories. A composite percentage of impervious area was computed for each sub-basin for both existing and ultimate land use conditions.

Table 2.2 - Land Use and Percent Impervious	
Land Use Description	Impervious (%) Condition
Extremely Low Density Res (2+ac lots)	15
Very Low Density Res (1 ac lots)	25
Low Density Res (1/2 ac lots)	40
Medium Density Res (1/3 ac lots)	45
High Density Res (1/4 ac lots)	50
Major Transportation	50
Industrial	72
Institutional	50
Group Quarters	40
Hotel/Motel	85
Mobile Home	35
Multi Family	65
Office	85
Parks/Recreation	6
Retail	85
Under Construction	50
Utilities	60
Vacant	3
Water	100

2.1.4.1 *Existing Conditions Land Use*

The existing land use conditions were based on 2005 North Central Texas Council of Governments (NCTCOG) existing land use data provided in shapefile format. The land use shapefile was updated to reflect current development conditions shown on the City of Arlington aerial photography (2011). The existing conditions land use for the Rush Creek watershed is illustrated in Figure A-3, Existing Land Use Map.

2.1.4.2 *Ultimate Conditions Land Use*

Ultimate conditions land use data was not available for the project area. Based on discussion with the project team and the City of Arlington, an impervious area value of 75 percent was applied to all vacant and extremely low density residential land use to estimate the ultimate build out conditions of the watershed. All other land use remained consistent with the existing land use conditions.

2.1.5 Sub-basins

Sub-basin delineations were generated in ESRI's ArcGIS Version 10.0 based on the Texas Natural Resource Information Systems (TNRIS) 2009 Light Detection And Ranging (LiDAR) Terrain Data. Digital storm sewer lines supplied by the City of Arlington, supported by current aerial photography, aided in the sub-basin delineation process. See Figure A-4, Sub-basin Workmap, for sub-basin delineations.

2.1.5.1 *Topographic Data Acquisition and Evaluation*

Topographic data covering the project extent was obtained from the TNRIS 2009 LiDAR acquisition project. This data was available as LiDAR point clouds in the American Society of Photogrammetry and Remote Sensing (ASPRS) common LiDAR Data Exchange Format (LAS 1.1) with 1.0 meter post spacing.

Data was acquired in March 2009 by Fugro Earth Data, Inc. The LiDAR QA Report provided by Dewberry is included in Appendix E of this report. This data was acquired and processed to meet 0.185 meter Root Mean Square Error (RMSEz) vertical accuracy and was tested to have an RMSEz of 0.040 meters using National Standards for Spatial Data Accuracy (NSSDA) and FEMA methodology (see Table 1 of the LiDAR QA Report).

2.1.5.2 *Terrain Processing*

The LiDAR data was processed with Esri's ArcGIS software. The LiDAR data was acquired in Universal Transverse Mercator (UTM), North American Datum of 1983, (NAD83 Meters) with heights in the 1988 North American Vertical Datum (NAVD88 Meters). Each LiDAR tile was projected to Stateplane NAD83, Texas North Central zone with horizontal units of feet and the vertical units were also converted from meters to feet. The projected LiDAR point clouds were then processed in ArcGIS and the ground points were placed into a multipoint feature class within a file geodatabase. The multipoint feature class was then used to generate a seamless terrain dataset within the same file geodatabase. From the terrain dataset, a ground surface Digital Elevation Model (DEM) was generated to support basin delineations and hydrologic modeling.

2.2 Approach and Methodology

2.2.1 Methodology

Hydrologic analyses have been conducted for the Rush Creek watershed as part of the comprehensive watershed study and model updates. The entire watershed has been analyzed for the following hydrologic scenarios:

- *Existing Land Use Conditions*
- *Ultimate Land Use Conditions*

Significant rainfall events considered for the hydrologic models were the 2-, 5-, 10-, 25-, 50-, 100- and 500-year frequency floods. Detailed watershed delineations, existing and ultimate land use determinations, and the hydrologic soil coverage were used to develop HEC-HMS hydrologic computer models for the respective tributaries' watershed. The Rush Creek Watershed Technical Standards (May 21, 2012) along with Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) Second Edition were used as guidelines for the new 2012 hydrologic analyses.

2.2.1.1 *Rainfall*

Rainfall data was obtained from TP-40 (Hershfield, 1961) for the 24-hour storm events corresponding to the 50, 20, 10, 4, 2, 1 and 0.2%-annual-chance (2-, 5-, 10-, 25-, 50-, 100- and 500-year) storm events.

The rainfall data is summarized below in Table 2.3

Table 2.3 - Rainfall Data (inches)

Recurrence Interval (Percent Annual Chance)	Storm Duration							
	5 Min	15 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
50%	0.40	1.02	1.77	2.15	2.37	2.86	3.43	3.95
20%	0.54	1.38	2.39	2.90	3.19	3.86	4.63	5.33
10%	0.64	1.64	2.84	3.44	3.79	4.58	5.49	6.32
4%	0.76	1.94	3.35	4.06	4.48	5.41	6.49	7.47
2%	0.86	2.19	3.79	4.59	5.06	6.12	7.34	8.45
1%	0.96	2.46	4.25	5.15	5.67	6.86	8.23	9.47
0.2%	1.16	2.98	5.15	6.24	6.87	8.31	9.96	11.47

2.2.1.2 *Rainfall Losses*

The loss rate of rainfall, caused by evaporation, interception, depression, storage, and infiltration, is typically evaluated and subtracted from the rainfall to determine rainfall excess for each time increment of a storm. For this study, the SCS Curve Number Method, developed by the Natural Resources Conservation Service (NRCS), was used to develop flood hydrographs based on land use, soil classification, and antecedent moisture conditions. Baseline Curve Numbers were obtained from TR-55, Table 2.2c, for pasture, grassland, or range for AMC-II, average soil moisture conditions. Curve Numbers (CN) were computed

based on a composite percentage of soil types within each sub-basin. Group A soils were defined as having a CN of 39, Group B soils were defined as having CN as 61, Group C soils were defined as having CN as 74, and Group D soils were defined as having CN as 80.

The initial abstraction (I.A.) for all watersheds was computed for AMC-II, average soil conditions using the following equation from TR-55:

$$IA = 0.2\left(\frac{1000}{CN} - 10\right)$$

2.2.1.3 Sub-basin Response

The SCS Dimensionless Unit Hydrograph method was used and SCS lag times were computed for each sub-basin to generate runoff hydrographs. A different time of concentration was computed for existing and ultimate conditions. Both were based on the NRCS TR-55 methodology for overland (sheet) flow, shallow concentrated flow, and channel flow. Overland flow length was limited to a maximum of 100 feet for unpaved surfaces and 50 feet for paved surfaces.

Travel times for channel flow were based on velocities from the HEC-RAS routing models, where available. Channel flows for non-routed reaches were estimated based on Manning's equation, assuming a bankfull depth that was selected based on the channel geometry and the elevation corresponding to the natural channel banks. For improved channels, it was often difficult to estimate the bankfull depth from the channel geometry and some consideration was given to the expected bankfull (2-year) discharges and anticipated velocities associated with bankfull flow. Storm drain velocities were assumed to be 6 feet per second for the purposes of this study.

Based on the recommendation of the project team, the stream channels being modeled using unsteady HEC-RAS were removed from the time of concentration calculations. A memorandum, entitled “Flow paths for estimating Basin Lag Time”, supporting this decision is provided in Appendix D.

The time of concentration is the summation of these phases, where:

$$T_c = t_{sheet} + t_{shallow\ concentrated} + t_{storm\ drain} + t_{channel}$$

Lag times were computed using the following equation:

$$T_p = 0.6 * T_c$$

The Ultimate Conditions times of concentration were estimated by changing overland flow located in vacant land use to be a maximum of 50 feet and paved. All shallow concentrated flow was changed to paved for ultimate conditions. These two changes were intended to estimate the impacts of future development to times of concentration.

Studies have shown that the square root of area can provide a good prediction of time of concentration. Graphs showing the comparison of the estimated times of concentration to the sub-basin area are included in Appendix B of this report.

2.2.1.4 *Routing*

Channel reaches for which there will be no new unsteady hydraulic study were routed in the hydrologic model. The Modified Puls method was used for open channel reaches. HEC-RAS v4.1 was used to develop elevation-storage-discharge relationships for these reaches to route flows in the HEC-HMS model. The HEC-RAS models were generated using cross sections based on the TNRIS LiDAR data. The subreaches (routing step) calculations are provided in Appendix B of this report.

The Muskingum-Cunge method was used to route flows through storm drain reaches outside of the new unsteady hydraulic study reaches. An equivalent pipe diameter size was calculated for most reaches based on a weighted average of the pipe size and length through the reach. The equivalent pipe diameter was input in the HEC-HMS models and a note was added in the description of these routing reaches to specify when this method was applied.

2.2.1.5 *External Input Hydrographs*

There were no external input hydrographs entered into the Rush Creek Hydrology models.

2.2.1.6 *Reservoir Storage*

Two ponds were modeled as reservoirs in HEC-HMS for the Rush Creek watershed. The first is near the intersection of Briarwood Blvd and Winewood Ln in the RC-1 sub-watershed. The second is west of Green Oaks Blvd near the intersection of Fireside Drive in the Lower Rush sub-watershed. The elevation-area-discharge method was used to model these reservoirs in HEC-HMS. Record drawings received from the City of Arlington were utilized to develop elevation-discharge ratings for the outlet structures of these reservoirs. The TNRIS LiDAR data was used to develop the elevation-area tables for each reservoir.

2.2.2 Stream Gages

There are no stream gages in the Rush Creek watershed.

2.2.3 Calibration

Rainfall data was obtained from the National Weather Service (NWS) for the following historical storms:

- *January 24-25, 2012*
- *September 7-9, 2010 (Tropical Storm Hermine)*

Multisensory precipitation estimator (MPE) rainfall data was used to generate the historical rainfall data. This rainfall data is a mosaic of radar, satellite imagery, and rainfall gauge data that is generated on an hourly time-step by the National Weather Service (NWS). The data is available on a 4km x 4km grid (HRAP grid) and provides high-quality temporal and spatial distribution of the rainfall during each storm event. The gridded rainfall product was distributed to the sub-basins by calculating a weighted average for each grid cell and corresponding rainfall depth within each sub-basin. Figure 2.1 below shows the precipitation map of total rainfall from Tropical Storm Hermine courtesy of the NWS.

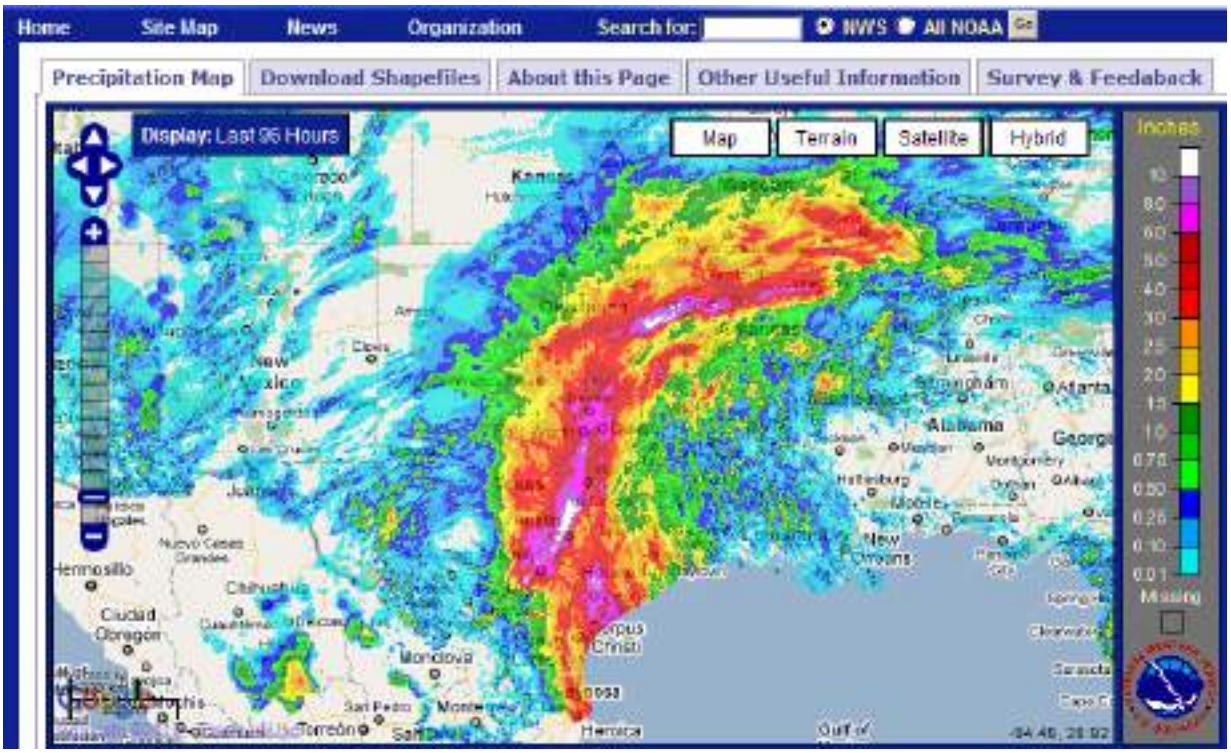


Figure 2-1. Tropical Storm Hermine Total Rainfall

In the absence of stream gage data and watershed wide routing data, the HEC-HMS models have not been calibrated to either storm event at this point. It is anticipated highwater marks documented during these storm events will be used to confirm study results following the completion of the unsteady hydraulic modeling.

2.3 Discharge Comparison

2.3.1 Computed Discharges

Computed discharges will be compared to the effective discharges following the development of the unsteady hydraulic models for the Rush Creek watershed. Previous studies with comparable hydrologic conditions were used to validate the results of the hydrologic models. Discharge comparison graphs are included in Appendix B of this report. The comparison is only conceptually applicable since travel time through unsteady modeled streams was omitted for many of the Rush Creek sub-basins resulting in calculated peak discharges that were higher compared to other sub-basins of similar size. It is anticipated that these discharges will compare favorably after the unsteady routing is utilized to route the hydrographs through the studied reaches. Refer to Appendix D for correspondence documenting technical support for the time of concentration methodology.

2.3.2 Effective Discharges

The current FEMA effective discharges from the September 25, 2009 FEMA Flood Insurance Study (FIS) for Tarrant County are listed in Table 2.4 below.

Table 2.4 - FEMA Effective Discharges

Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
KEE BRANCH					
At confluence with Rush Creek	7.23	6,810	9,490	10,920	13,900
Downstream of confluence of Stream KB-1	6.96	6,210	8,720	9,970	12,470
At Interstate Route 20	4.44	4,360	6,400	7,300	9,070
Downstream of confluence of Tributary K-2	3.55	3,680	4,660	6,420	7,880
Upstream of confluence of Tributary K-2	2.85	2,980	4,400	5,020	6,190
Downstream of confluence of Tributary K-3	1.4	1,340	1,880	2,140	2,650
At U. S. Route 287	1.09	1,030	1,450	1,640	2,020
At Kennenda1e Sublett Road	0.89	1,230	1,650	1,840	2,230
STREAM KB-1					
At confluence with Kee Branch	1.52	2,500	3,310	3,670	4,440
At Oak Springs Road	1.26	2,160	2,890	3,120	3,750
PANTEGO BRANCH					
At confluence with Rush Creek	1.68	2,460	3,320	3,710	4,490
At West Park Row	1.43	2,190	2,940	3,310	4,030
At Smith-Barry Road	0.94	1,550	2,070	2,290	2,840
RUSH CREEK					
At confluence of Pantego Branch	29.01	3,670	4,233	4,704	5,799
At State Route 303	28.77	15,400	23,280	27,060	34,770
At Woodland Park Boulevard	27.59	15,240	22,990	26,670	34,170
At Arkansas Lane	27.17	15,540	23,460	27,180	34,770
Below confluence of Kee Branch	25.24	14,680	21,904	25,280	32,290
At confluence of Kee Branch	18.01	9,920	14,550	16,850	21,650
Below confluence of Tributary R-8	17.83	9,980	14,690	16,950	21,730
Above Kee Branch	17.52	9,600	15,000	17,600	25,000
At confluence of Tributary R-8	16.57	9,710	14,150	16,350	20,900
Below confluence of Tributary R-7	16.3	9,770	14,140	16,340	20,800
At confluence of Tributary R-7	15.16	9,350	13,590	15,700	19,980

Table 2.4 - FEMA Effective Discharges					
Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Downstream of confluence of Tributary R-5 and R-6	14.74	9,400	13,670	15,780	20,010
At Interstate Route 20	13.07	8,860	12,820	14,770	18,680
Downstream of confluence of Tributary R-4	12.78	9,000	13,170	15,190	19,130
At confluence of Tributary R-4	11.51	8,380	12,250	14,010	17,510
At Green Oaks Boulevard	10.82	8,350	12,179	13,890	17,260
Downstream of confluence of Sublett Creek	9.51	8,210	11,620	13,179	16,340
At confluence of Sublett Creek	4.22	4,000	5,560	6,270	7,740
Downstream of confluence of Tributary R-11	3.04	3,520	4,880	5,490	6,820
At confluence of Tributary R-11	2.54	2,990	4,120	4,610	5,690
Below confluence with Tributary R-10	1.9	2,520	3,440	3,850	4,720
At confluence of Tributary R-l	1	1,290	1,770	1,980	2,450
FOREST PARK TRIBUTARY OF RUSH CREEK					
At confluence with Rush Creek	0.18	**	**	610	**
NORTHEAST TRIBUTARY OF RUSH CREEK					
At confluence with Rush Creek	0.11	**	**	361	**
RUSH CREEK RELIEF CHANNEL					
Upstream of convergence with Village Creek	**	15,728	25,147	30,374	40,972
STREAM RC-1					
At confluence with Rush Creek	3.56	4,810	6,220	6,850	8,130
Immediately upstream of Union Pacific Railroad	1.95	2,640	3,310	3,630	4,280
STREAM RC-1(A)					
At confluence with Stream RC-l	1.36	2,210	2,870	3,180	3,810
At headwaters	0.93	1,710	2,240	2,480	3,010
STREAM RC-2					
At confluence with Rush Creek	1.18	1,970	2,520	2,790	3,370
At headwaters	0.64	1,350	1,750	1,930	2,410
RYAN'S BRANCH					

Table 2.4 - FEMA Effective Discharges					
Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
At confluence with Rush Creek	1.29	2,000	2,750	3,100	3,900
At Roosevelt Drive	0.99	1,850	2,500	2,800	3,550
SUBLETT CREEK					
At confluence with Rush Creek	5.29	4,620	6,630	7,500	9,100
At Calendar Road	4.57	4,520	6,310	7,060	8,320
SUBLETT CREEK					
Downstream of U.S. Route 287	3.66	3,790	5,230	5,790	6,620
At U.S. Route 287	2.99	3,520	4,790	5,170	5,790
Downstream of Tributary 1	1.83	2,510	3,400	3,800	4,610
TWIN SPRINGS DRAW					
At confluence with Rush Creek	1.17	1,850	2,550	2,850	3,550

3. Exceptions

3. Exceptions

3.1 Explanation of Deviations from the Standard Procedures

This section documents exceptions to the FEMA study standards, FEMA Guidelines and Specifications, or to the procedures described above.

3.1.1 Data Capture Standards (DCS) Submittal

The data submitted for this study follows the FEMA Appendix M Data Capture Standards dated March 2009. All required spatial files and tables, as listed in the Mapping Information Index in Appendix A, will be submitted with this report with the exception of those listed in Table 3.1 below.

Table 3.1 DCS Omitted Digital Files

DCS Feature or Table	Exception
L_Summary_Elevations	This table was not populated because there are no summary elevations associated with any lakes in this watershed.
L_Summary_Discharges	This table was not populated because the data is not yet available. Data will be available in final submittal when unsteady hydraulic models are complete.
S_Nodes	This layer was not populated because routing for unsteady modeling is still in progress and will be populated when finalized.

Appendix A
Figures

Figure A-1 - Vicinity Map

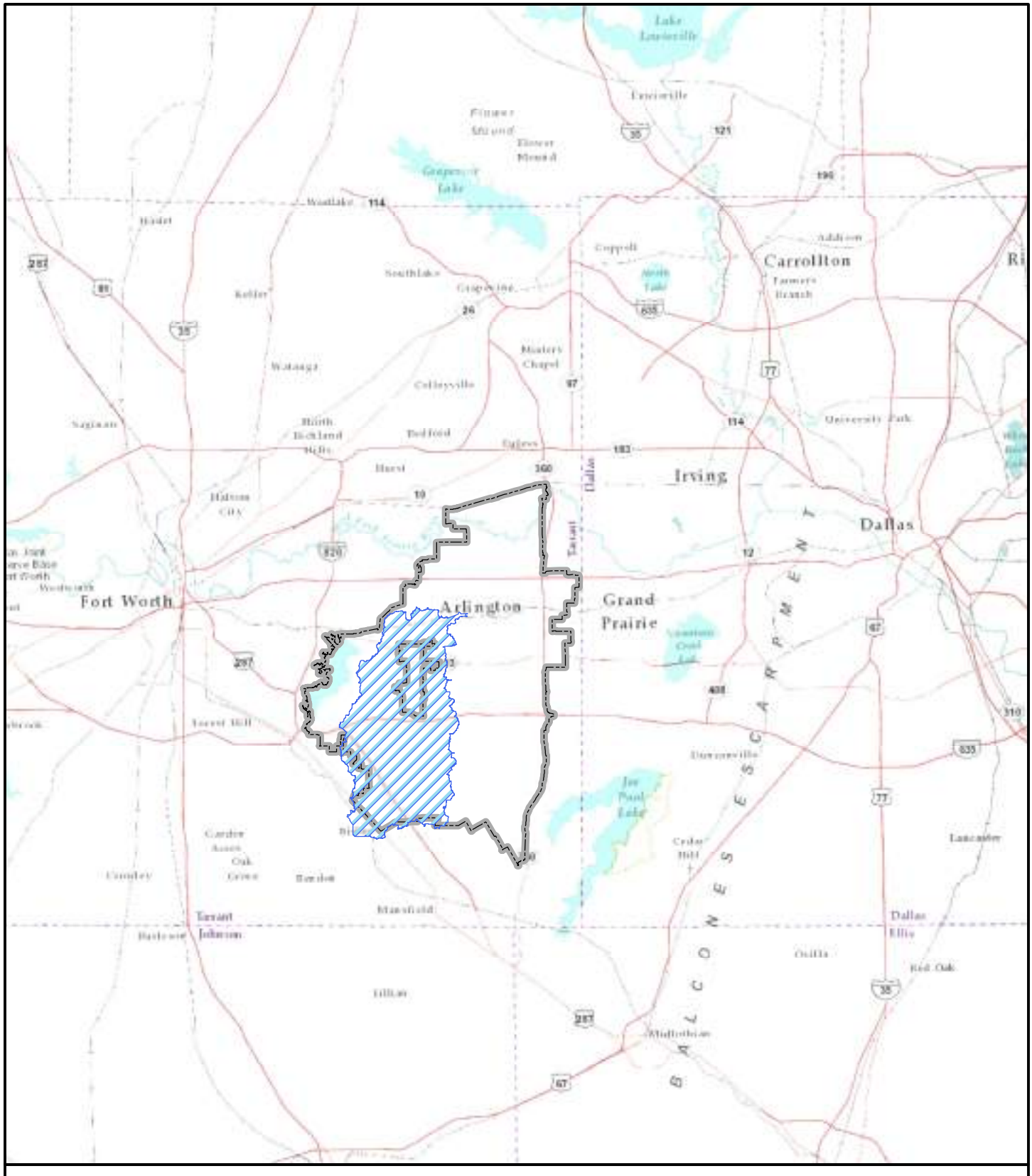


Figure A-1
Vicinity Map

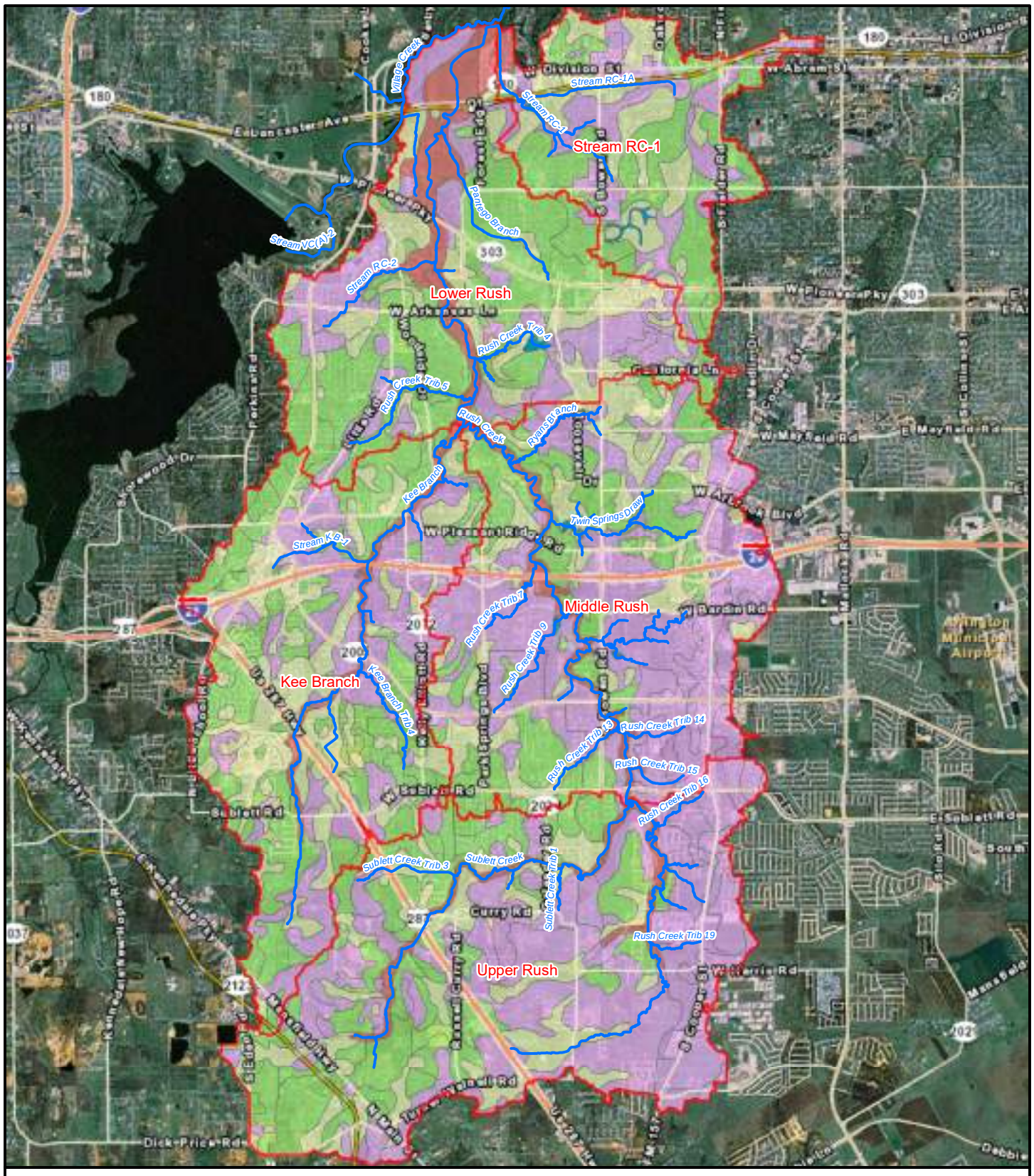
Rush Creek Watershed Study
City of Arlington, Texas

RUSH CREEK

Path: N:\28000s\28480\Report\Figures\Figure A-1 - Vicinity_Map.mxd

Date: 5/31/2012

Figure A-2 - Soils Map



Legend

- Stream Centerline
- Sub-Watershed

HSG

- A
- B
- C
- D
- Water

0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

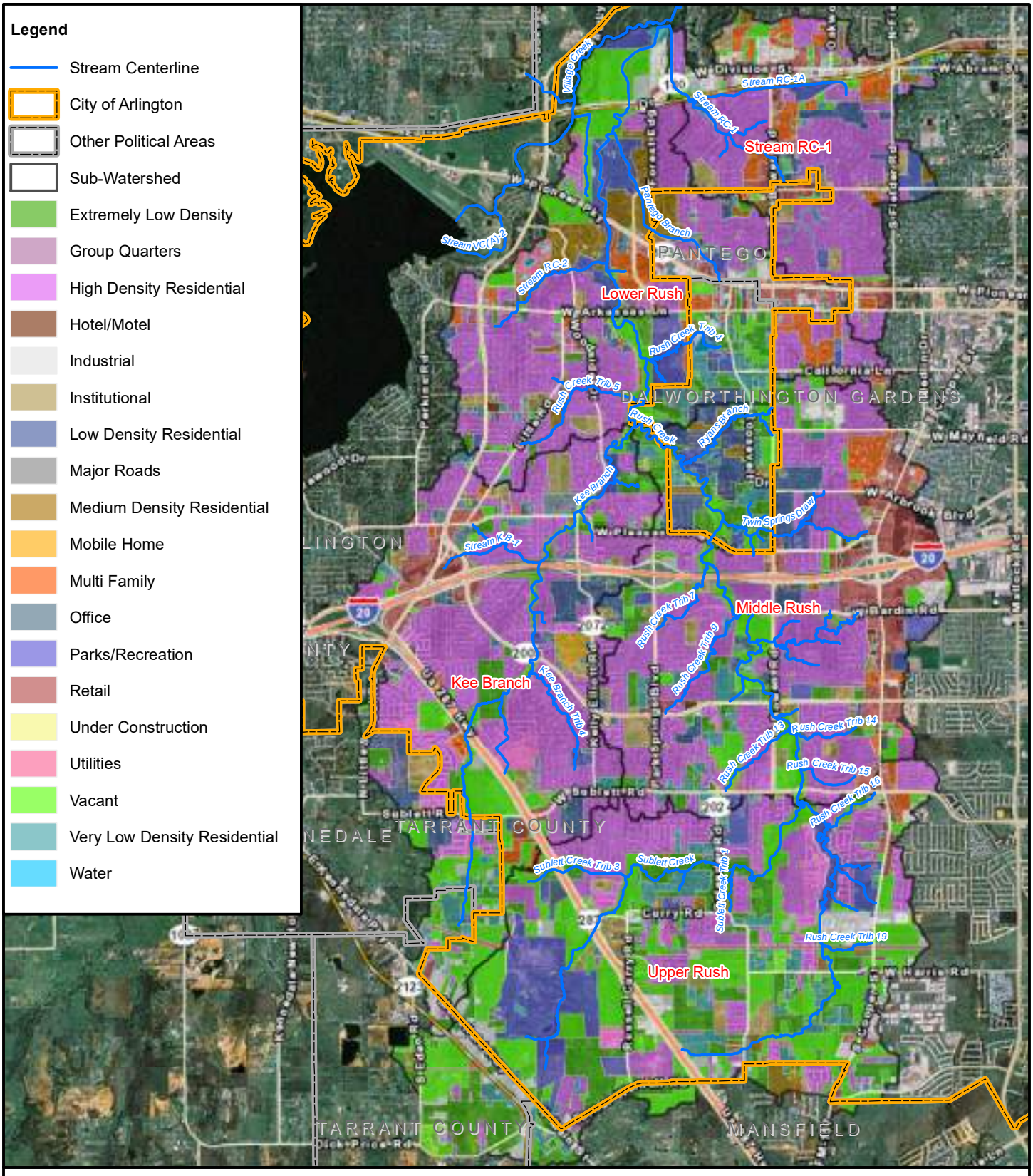
Figure A-2
Soils Map

Rush Creek Watershed Study
City of Arlington, Texas

Path: N:\28000s\28480\Report\Figures\Figure A-2 - Hydrologic_Soils_Map.mxd

Date: 6/1/2012

Figure A-3 - Existing Land Use Map



Notes:

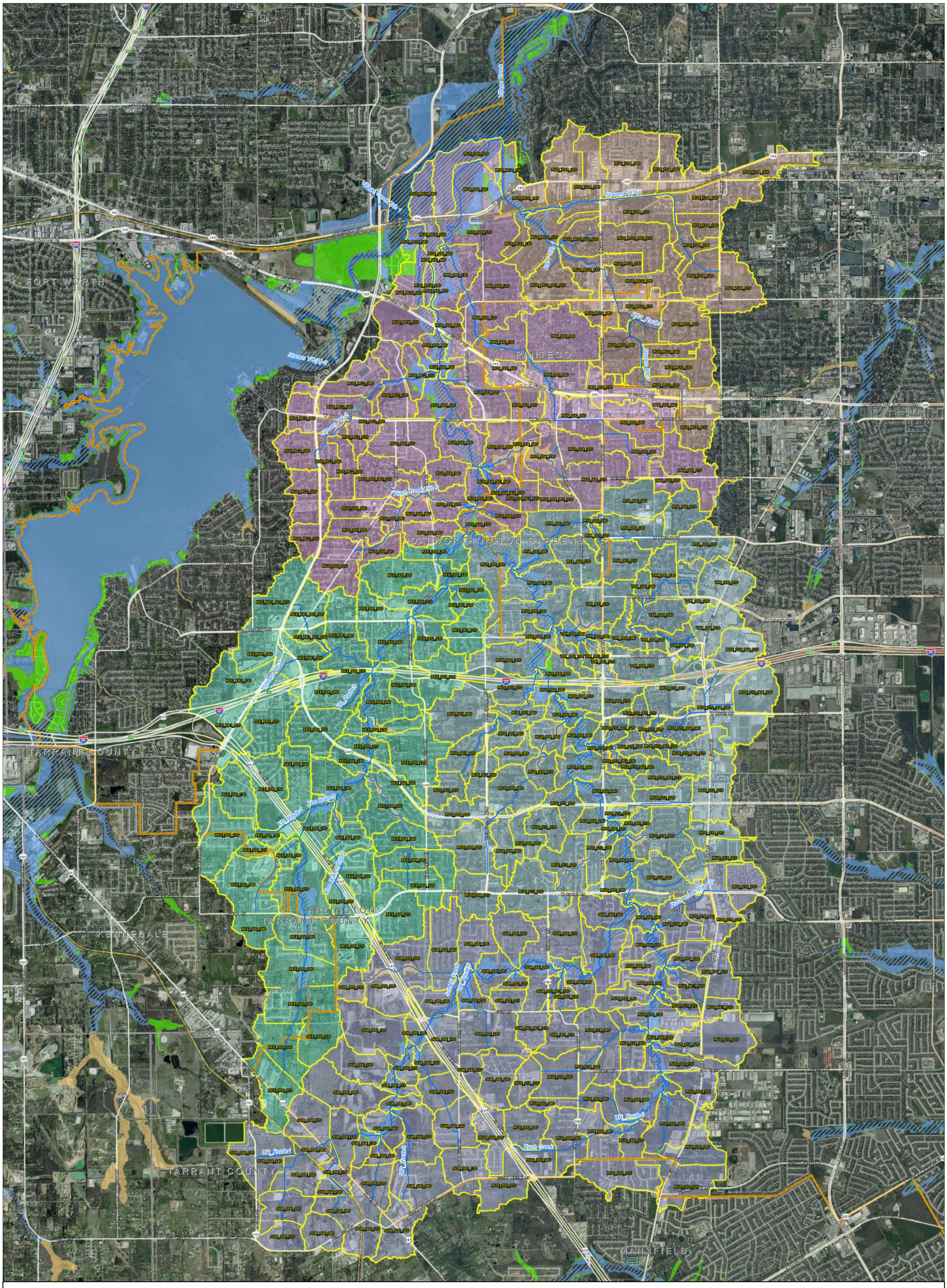
An impervious percentage of 75 was applied to all vacant and extremely low density residential to estimate the ultimate build out conditions of the watershed.

0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

Figure A-3
Existing Land Use Map

Rush Creek Watershed Study
City of Arlington, Texas



Legend

- City of Arlington
- Other Political Areas
- Stream Centerline
- SUBWTRSHD

FLOOD ZONE

- A
- AE
- FLOODWAY
- X500

- KB
- LR
- MR
- RC1
- UR

N W E S

0 2,000 4,000 8,000 Feet

Figure A-4
Sub-basin Workmap

Rush Creek Watershed Study
City of Arlington, Texas

RUSH CREEK
City of Arlington Watershed Study

Appendix B
Hydrologic Data

Appendix B-1
Sub-basin Summary

Appendix B-1

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
KEE_000_010	KB	105.24	0.164	0	0%	59	56%	14	13%	32	30%	0	0%	68	51	68	18	26	25	-1
KEE_000_020	KB	90.75	0.142	0	0%	58	64%	3	4%	30	33%	0	0%	68	26	66	39	21	20	-1
KEE_000_030	KB	83.06	0.130	0	0%	11	14%	17	21%	54	65%	0	0%	76	20	67	47	12	12	0
KEE_000_040	KB	101.65	0.159	0	0%	27	27%	18	18%	56	56%	0	0%	74	18	59	40	8	3	-5
KEE_000_050	KB	114.66	0.179	0	0%	67	58%	30	26%	18	16%	0	0%	67	22	64	42	10	8	-2
KEE_000_060	KB	93.74	0.147	6	6%	51	55%	22	23%	15	16%	0	0%	66	41	51	10	17	15	-2
KEE_000_070	KB	138.70	0.217	23	17%	33	24%	57	41%	24	18%	0	0%	66	19	69	51	17	14	-3
KEE_000_080	KB	52.05	0.081	0	0%	23	44%	15	30%	14	26%	0	0%	70	18	63	46	18	17	-1
KEE_000_090	KB	137.00	0.214	0	0%	49	35%	73	54%	15	11%	0	0%	70	45	45	0	13	13	0
KEE_000_100	KB	22.51	0.035	3	16%	0	0%	19	84%	0	0%	0	0%	69	56	56	0	7	7	0
KEE_000_110	KB	30.05	0.047	1	3%	3	10%	26	85%	0	2%	0	0%	72	51	51	0	13	11	-2
KEE_000_120	KB	141.48	0.221	0	0%	60	43%	41	29%	40	29%	0	0%	70	36	54	18	13	13	0
KEE_000_130	KB	80.53	0.126	0	0%	65	81%	14	18%	1	1%	0	0%	64	47	52	4	11	10	-1
KEE_000_140	KB	24.43	0.038	0	0%	6	25%	18	75%	0	0%	0	0%	71	52	62	9	13	13	0
KEE_000_150	KB	123.70	0.193	0	0%	41	33%	73	59%	10	8%	0	0%	70	39	57	18	10	10	0
KEE_000_160	KB	85.00	0.133	1	1%	14	16%	65	76%	6	7%	0	0%	72	47	51	4	12	12	0
KEE_000_170	KB	71.26	0.111	13	19%	11	15%	41	58%	6	9%	0	0%	66	35	60	26	13	13	0
KEE_000_180	KB	111.92	0.175	12	11%	7	6%	61	54%	33	29%	0	0%	71	33	61	28	17	16	-1
KEE_000_190	KB	35.25	0.055	3	10%	0	0%	6	18%	25	72%	0	0%	75	38	57	19	8	8	0
KEE_000_200	KB	25.48	0.040	0	0%	13	51%	0	0%	12	49%	0	0%	70	52	52	0	7	7	0
KEE_000_210	KB	44.68	0.070	6	13%	0	1%	7	15%	31	70%	0	0%	73	39	43	4	6	6	0
KEE_000_220	KB	139.16	0.218	0	0%	41	29%	11	8%	87	62%	0	0%	74	44	47	3	10	10	0
KEE_000_230	KB	48.42	0.076	3	7%	1	2%	13	28%	31	64%	0	0%	75	46	50	4	10	10	0
KEE_000_240	KB	85.05	0.133	14	17%	0	0%	20	23%	51	60%	0	0%	72	41	51	10	12	12	0
KEE_000_250	KB	103.25	0.161	0	0%	33	32%	29	28%	41	39%	0	0%	72	49	50	0	7	7	0
KEE_000_260	KB	105.08	0.164	4	3%	26	25%	25	24%	50	48%	0	0%	73	51	57	6	10	10	0
KEE_000_270	KB	12.02	0.019	3	21%	0	3%	0	0%	9	76%	0	0%	71	48	51	3	13	13	0
KEE_000_280	KB	56.23	0.088	1	1%	0	0%	13	24%	42	75%	0	0%	78	46	47	1	6	6	0
KEE_000_290	KB	100.62	0.157	16	16%	39	39%	8	8%	37	37%	0	0%	66	40	53	13	14	13	-1
KEE_000_300	KB	52.46	0.082	1	3%	37	70%	14	27%	0	0%	0	0%	64	69	69	1	10	10	0
KEE_000_310	KB	80.84	0.126	16	20%	24	29%	25	31%	16	19%	0	0%	64	47	53	6	9	9	0
KEE_000_320	KB	108.89	0.170	4	3%	83	76%	23	21%	0	0%	0	0%	63	49	50	1	16	15	-1
KEE_000_330	KB	29.28	0.046	10	35%	3	11%	15	51%	1	3%	0	0%	60	22	31	9	9	9	0
KEE_000_340	KB	61.30	0.096	15	24%	34	56%	12	20%	0	0%	0	0%	58	36	54	18	8	8	0
KEE_001_010	KB	80.96	0.127	0	0%	34	42%	39	48%	8	10%	0	0%	69	47	52	5	10	10	0
KEE_001_020	KB	13.08	0.020	0	0%	0	0%	4	28%	9	72%	0	0%	78	43	55	12	8	8	0
KEE_001_030	KB	28.66	0.045	0	0%	11	40%	1	3%	16	57%	0	0%	72	17	73	57	7	7	0
KEE_002_010	KB	87.19	0.136	0	0%	3	3%	10	12%	74	85%	0	0%	79	55	56	1	11	10	-1
KEE_002_020	KB	56.93	0.089	1	2%	7	13%	14	25%	34	60%	0	0%	75	37	58	21	13	13	0
KEE_004_010	KB	116.35	0.182	0	0%	37	32%	41	35%	38	33%	0	0%	72	42	52	10	13	13	0
KEE_004_020	KB	68.25	0.107	0	0%	48	71%	6	9%	14	20%	0	0%	66	48	49	1	7	7	0
KEE_004_030	KB	86.57	0.135	0	0%	42	49%	34	40%	10	12%	0	0%	68	41	44	3	16	15	-1
KEE_004_040	KB	68.46	0.107	0	0%	49	72%	12	17%	8	11%	0	0%	65	50	50	0	7	7	0
KEE_004_050	KB	113.23	0.177	0	0%	63	56%	1	1%	49	44%	0	0%	69	50	50	0	4	4	0
KEE_005_010	KB	87.32	0.136	0	0%	47	54%	11	12%	30	34%	0	0%	69	41	72	31	12	11	-1
KEE_005_020	KB	64.52	0.101	0	0%	1	2%	36	56%	27	42%	0	0%	76	29	63	35	8	8	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
KEE_005_030	KB	85.63	0.134	0	0%	48	55%	28	32%	10	12%	0	0%	68	40	56	16	11	10	-1
KEE_005_040	KB	62.15	0.097	0	1%	23	38%	38	62%	0	0%	0	0%	69	47	52	4	4	4	0
KEE_KB1_001_010	KB	110.82	0.173	0	0%	110	100%	0	0%	0	0%	0	0%	61	48	52	3	6	6	0
KEE_KB1_001_020	KB	71.35	0.112	0	0%	16	22%	9	13%	46	65%	0	0%	75	64	71	7	10	10	0
KEE_KB1_001_030	KB	20.72	0.032	0	0%	4	18%	1	5%	16	77%	0	0%	76	42	73	31	6	6	0
KEE_KB1_010	KB	120.84	0.189	0	0%	50	42%	37	30%	34	28%	0	0%	70	57	58	1	6	6	0
KEE_KB1_020	KB	103.66	0.162	0	0%	42	41%	38	37%	23	23%	0	0%	70	62	63	1	14	10	-4
KEE_KB1_030	KB	115.86	0.181	0	0%	70	60%	46	40%	0	0%	0	0%	66	56	66	10	13	13	0
KEE_KB1_040	KB	98.82	0.154	0	0%	54	54%	32	33%	13	13%	0	0%	68	67	67	0	8	8	0
KEE_KB1_050	KB	57.20	0.089	0	0%	5	9%	3	5%	49	86%	0	0%	78	53	61	8	5	5	0
KEE_KB1_060	KB	128.10	0.200	0	0%	33	26%	25	19%	70	55%	0	0%	74	46	51	5	9	9	0
PAN_000_010	LR	114.57	0.179	0	0%	39	34%	23	20%	52	46%	0	0%	72	50	51	1	15	15	0
PAN_000_020	LR	34.76	0.054	0	0%	15	42%	11	31%	9	27%	0	0%	70	45	55	10	13	12	-1
PAN_000_030	LR	68.21	0.107	0	0%	8	12%	1	2%	59	86%	0	0%	78	59	61	2	12	12	0
PAN_000_040	LR	89.71	0.140	0	0%	0	0%	46	51%	44	49%	0	0%	77	66	69	3	13	13	0
PAN_000_050	LR	94.42	0.148	0	0%	54	58%	35	37%	5	6%	0	0%	67	61	80	19	11	11	0
PAN_000_060	LR	55.37	0.087	0	0%	10	18%	30	54%	16	28%	0	0%	73	72	74	2	14	14	0
PAN_000_070	LR	57.09	0.089	0	0%	42	74%	12	21%	3	5%	0	0%	65	63	67	4	11	11	0
PAN_000_080	LR	80.19	0.125	0	0%	75	94%	5	6%	0	0%	0	0%	62	41	50	9	12	12	0
PAN_000_090	LR	163.11	0.255	0	0%	146	89%	8	5%	9	6%	0	0%	63	46	51	4	14	14	0
PAN_000_100	LR	79.18	0.124	0	0%	74	93%	5	7%	0	0%	0	0%	62	46	50	5	15	15	0
PAN_000_110	LR	81.57	0.127	0	0%	79	97%	0	0%	3	3%	0	0%	62	47	48	1	12	12	0
PAN_000_120	LR	90.84	0.142	1	1%	76	84%	7	7%	7	8%	0	0%	63	47	47	0	11	11	0
PAN_000_130	LR	107.77	0.168	59	55%	5	5%	0	0%	44	41%	0	0%	57	19	20	2	18	18	0
RUS_000_360	LR	51.18	0.080	1	2%	32	62%	6	12%	12	23%	0	0%	67	50	50	0	8	8	0
RUS_000_370	LR	39.84	0.062	15	38%	13	32%	4	11%	8	19%	0	0%	58	11	67	56	9	8	-1
RUS_000_380	LR	36.94	0.058	16	44%	12	33%	2	4%	7	19%	0	0%	55	20	60	40	5	5	0
RUS_000_390	LR	46.87	0.073	0	1%	47	99%	0	0%	0	0%	0	0%	61	49	50	1	11	11	0
RUS_000_400	LR	82.33	0.129	37	45%	27	33%	18	22%	0	0%	0	0%	54	18	65	47	3	3	0
RUS_000_410	LR	131.27	0.205	0	0%	113	86%	10	7%	8	6%	0	0%	63	42	54	12	13	13	0
RUS_000_420	LR	99.02	0.155	41	41%	23	24%	35	35%	0	0%	0	0%	56	30	40	11	9	9	0
RUS_000_430	LR	30.15	0.047	16	52%	2	8%	12	38%	1	2%	0	0%	55	45	49	3	4	4	0
RUS_000_440	LR	27.73	0.043	17	61%	0	0%	11	38%	0	1%	0	0%	53	33	33	0	5	5	0
RUS_000_450	LR	77.92	0.122	6	8%	57	73%	0	0%	15	20%	0	0%	63	70	73	3	21	14	-7
RUS_000_460	LR	36.80	0.058	8	21%	3	9%	0	0%	26	69%	0	0%	70	44	45	1	8	8	0
RUS_000_470	LR	4.34	0.007	4	100%	0	0%	0	0%	0	0%	0	0%	39	48	48	0	6	6	0
RUS_000_480	LR	1.31	0.002	1	100%	0	0%	0	0%	0	0%	0	0%	39	66	66	0	6	6	0
RUS_000_500	LR	2.62	0.004	3	100%	0	0%	0	0%	0	0%	0	0%	39	32	53	22	6	6	0
RUS_000_510	LR	134.12	0.210	38	29%	28	21%	28	21%	39	29%	0	0%	63	42	56	15	11	11	0
RUS_000_520	LR	97.04	0.152	93	96%	2	2%	0	0%	2	2%	0	0%	40	38	73	35	8	8	0
RUS_000_530	LR	110.22	0.172	66	60%	0	0%	0	0%	44	40%	0	0%	55	21	55	34	41	35	-6
RUS_003_010	LR	51.93	0.081	0	0%	45	86%	0	0%	7	14%	0	0%	64	47	65	18	6	6	0
RUS_003_020	LR	98.45	0.154	1	1%	66	67%	24	24%	8	8%	0	0%	65	57	61	3	8	8	0
RUS_004_001_010	LR	42.36	0.066	0	0%	2	5%	8	18%	33	77%	0	0%	78	31	46	15	15	15	0
RUS_004_001_020	LR	25.87	0.040	0	0%	12	48%	4	16%	9	36%	0	0%	70	19	58	38	9	8	-1
RUS_004_001_030	LR	28.87	0.045	0	0%	12	41%	17	59%	0	0%	0	0%	69	17	22	5	5	5	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_004_001_040	LR	14.64	0.023	0	0%	8	53%	7	46%	0	0%	0	0%	67	7	10	4	5	4	-1
RUS_004_010	LR	111.14	0.174	0	0%	4	3%	68	61%	40	36%	0	0%	76	30	55	24	15	15	0
RUS_004_020	LR	56.31	0.088	0	0%	0	0%	9	16%	47	84%	0	0%	79	20	69	49	20	18	-2
RUS_004_030	LR	74.01	0.116	0	0%	17	23%	15	21%	30	40%	11	15%	77	40	54	14	12	7	-5
RUS_004_040	LR	37.24	0.058	0	0%	15	42%	16	43%	6	16%	0	0%	70	35	46	11	14	13	-1
RUS_004_050	LR	82.61	0.129	0	0%	37	45%	23	28%	21	26%	1	1%	70	11	18	7	9	5	-4
RUS_005_002_010	LR	87.86	0.137	0	0%	58	66%	5	5%	26	29%	0	0%	67	49	49	0	9	9	0
RUS_005_010	LR	108.52	0.170	0	0%	74	68%	1	1%	34	32%	0	0%	67	45	53	8	10	10	0
RUS_005_020	LR	41.86	0.065	0	0%	31	74%	4	9%	7	17%	0	0%	65	46	53	7	6	6	0
RUS_005_030	LR	54.13	0.085	0	0%	27	50%	0	0%	27	50%	0	0%	70	44	50	6	13	13	0
RUS_005_040	LR	34.25	0.054	0	0%	19	55%	5	14%	11	31%	0	0%	69	46	47	1	8	8	0
RUS_005_050	LR	49.69	0.078	0	0%	39	78%	1	1%	10	21%	0	0%	65	49	52	3	14	14	0
RUS_005_060	LR	57.28	0.090	0	0%	42	74%	7	13%	8	13%	0	0%	65	50	50	0	12	12	0
RUS_005_070	LR	56.21	0.088	4	6%	53	94%	0	0%	0	0%	0	0%	60	44	53	9	3	3	0
RUS_006_010	LR	39.55	0.062	0	1%	5	14%	8	21%	25	64%	0	0%	76	21	58	37	7	6	-1
RUS_RC2_010	LR	70.41	0.110	0	0%	64	92%	6	8%	0	0%	0	0%	62	44	51	6	14	13	-1
RUS_RC2_020	LR	68.02	0.106	0	0%	61	90%	7	10%	0	0%	0	0%	62	47	49	2	10	10	0
RUS_RC2_030	LR	65.28	0.102	0	0%	46	71%	2	4%	16	25%	0	0%	66	46	50	4	12	12	0
RUS_RC2_040	LR	35.40	0.055	0	0%	8	23%	6	16%	22	61%	0	0%	75	50	51	1	9	9	0
RUS_RC2_050	LR	58.41	0.091	0	0%	40	69%	8	14%	10	18%	0	0%	66	50	50	0	13	13	0
RUS_RC2_060	LR	74.27	0.116	0	0%	4	6%	9	12%	61	82%	0	0%	78	54	59	5	8	8	0
RUS_RC2_070	LR	33.18	0.052	0	0%	0	0%	24	72%	2	7%	0	0%	75	58	59	1	6	6	0
RUS_RC2_080	LR	30.18	0.047	0	0%	2	6%	15	49%	14	45%	0	0%	76	48	54	6	7	6	-1
RUS_RC2_085	LR	35.52	0.056	0	0%	0	0%	0	0%	43	120%	0	0%	80	58	61	3	6	6	0
RUS_RC2_090	LR	97.48	0.152	0	0%	11	11%	7	7%	80	82%	0	0%	77	44	61	17	14	14	0
RUS_RC2_100	LR	97.10	0.152	2	2%	38	39%	28	29%	29	30%	0	0%	70	47	47	0	7	7	0
RUS_RC2_110	LR	45.47	0.071	24	52%	11	23%	11	25%	0	0%	0	0%	53	34	34	0	5	5	0
RUS_RCH_010	LR	93.98	0.147	18	19%	10	11%	49	52%	16	17%	0	0%	67	17	61	44	9	6	-3
RUS_RCH_020	LR	66.07	0.103	24	37%	0	0%	28	43%	14	21%	0	0%	62	29	59	30	12	7	-5
RUS_RCH_030	LR	15.41	0.024	15	100%	0	0%	0	0%	0	0%	0	0%	39	12	18	7	6	6	0
RUS_RCH_040	LR	26.39	0.041	0	0%	0	0%	26	98%	0	2%	0	0%	74	23	70	47	14	13	-1
RUS_RCH_050	LR	29.52	0.046	17	57%	0	0%	9	32%	3	11%	0	0%	55	9	66	56	6	6	0
RUS_RCH_060	LR	50.04	0.078	7	14%	0	0%	0	0%	43	86%	0	0%	74	4	74	71	9	8	-1
RUS_000_190	MR	66.36	0.104	8	12%	19	29%	0	0%	39	59%	0	0%	69	31	61	30	11	11	0
RUS_000_200	MR	44.34	0.069	13	30%	5	12%	0	0%	26	58%	0	0%	65	19	67	48	11	4	-7
RUS_000_210	MR	26.71	0.042	3	12%	4	14%	0	0%	20	74%	0	0%	73	40	54	14	8	8	0
RUS_000_220	MR	8.79	0.014	8	89%	1	10%	0	0%	0	1%	0	0%	42	8	72	64	10	3	-7
RUS_000_230	MR	34.22	0.053	5	14%	0	1%	0	0%	29	85%	0	0%	74	45	52	7	7	7	0
RUS_000_240	MR	75.76	0.118	11	14%	27	35%	16	22%	22	29%	0	0%	66	34	52	18	9	9	0
RUS_000_250	MR	64.17	0.100	16	25%	21	33%	5	7%	23	35%	0	0%	63	34	63	29	5	5	0
RUS_000_260	MR	34.97	0.055	8	22%	15	42%	1	4%	11	32%	0	0%	63	23	77	54	5	3	-2
RUS_000_270	MR	50.28	0.079	0	0%	8	15%	2	3%	41	82%	0	0%	77	48	52	5	18	17	-1
RUS_000_280	MR	33.76	0.053	12	37%	5	14%	3	9%	13	40%	0	0%	62	26	63	36	7	6	-1
RUS_000_290	MR	28.42	0.044	12	41%	5	17%	2	8%	10	34%	0	0%	59	42	54	12	8	8	0
RUS_000_300	MR	45.92	0.072	8	17%	26	58%	5	12%	6	13%	0	0%	61	48	51	3	4	4	0
RUS_000_310	MR	107.92	0.169	11	10%	13	12%	42	39%	42	39%	0	0%	71	40	58	17	18	18	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_000_320	MR	49.32	0.077	5	9%	17	35%	27	54%	1	1%	0	0%	66	27	61	35	11	7	-4
RUS_000_330	MR	102.55	0.160	12	12%	39	38%	43	42%	8	8%	0	0%	65	28	54	25	16	16	0
RUS_000_340	MR	88.59	0.138	17	19%	60	68%	11	13%	0	0%	0	0%	58	30	42	12	12	10	-2
RUS_000_350	MR	128.31	0.201	25	20%	83	65%	20	16%	0	0%	0	0%	59	23	56	33	22	19	-3
RUS_007_010	MR	47.38	0.074	0	0%	16	34%	16	34%	15	32%	0	0%	71	42	50	8	11	11	0
RUS_007_020	MR	68.53	0.107	0	0%	14	21%	12	17%	43	62%	0	0%	75	48	51	3	11	11	0
RUS_007_030	MR	47.96	0.075	0	0%	7	14%	33	68%	9	18%	0	0%	73	41	49	8	21	20	-1
RUS_007_040	MR	129.96	0.203	0	0%	0	0%	3	2%	127	98%	0	0%	80	30	56	26	11	11	0
RUS_007_050	MR	43.72	0.068	0	0%	0	0%	3	6%	41	94%	0	0%	80	50	50	0	7	7	0
RUS_007_060	MR	35.77	0.056	0	0%	0	0%	0	0%	36	100%	0	0%	80	50	50	0	5	5	0
RUS_007_070	MR	68.39	0.107	10	15%	0	0%	14	20%	45	66%	0	0%	73	41	55	14	13	13	0
RUS_008_010	MR	49.96	0.078	4	8%	8	16%	3	7%	34	69%	0	0%	73	50	53	3	17	17	0
RUS_009_010	MR	96.57	0.151	0	0%	90	94%	5	6%	1	1%	0	0%	62	44	50	7	7	7	0
RUS_009_020	MR	104.43	0.163	0	0%	32	31%	65	62%	8	7%	0	0%	70	50	50	0	13	13	0
RUS_009_030	MR	83.53	0.131	0	0%	20	24%	11	14%	52	62%	0	0%	75	53	56	3	9	9	0
RUS_009_040	MR	55.65	0.087	0	0%	10	17%	16	29%	30	54%	0	0%	75	50	50	0	15	15	0
RUS_009_050	MR	45.15	0.071	0	0%	28	62%	11	24%	6	14%	0	0%	67	43	50	7	11	11	0
RUS_009_060	MR	93.54	0.146	0	0%	21	22%	4	4%	69	73%	0	0%	76	48	55	7	4	4	0
RUS_009_070	MR	45.12	0.071	0	0%	0	0%	0	0%	45	100%	0	0%	80	33	56	23	7	7	0
RUS_009_080	MR	38.66	0.060	0	0%	1	3%	2	4%	36	93%	0	0%	79	50	50	1	8	8	0
RUS_009_090	MR	49.83	0.078	0	0%	2	5%	0	0%	43	87%	4	8%	81	54	56	2	2	2	0
RUS_010_001_010	MR	28.33	0.044	0	0%	0	0%	11	37%	18	63%	0	0%	78	50	50	1	7	7	0
RUS_010_001_020	MR	28.06	0.044	0	0%	0	0%	0	0%	28	100%	0	0%	80	48	48	0	10	10	0
RUS_010_002_010	MR	51.39	0.080	0	0%	0	1%	1	1%	50	98%	0	0%	80	49	49	0	8	8	0
RUS_010_002_020	MR	17.95	0.028	0	0%	0	0%	3	14%	15	86%	0	0%	79	50	50	0	3	3	0
RUS_010_002_030	MR	12.72	0.020	0	0%	0	0%	0	0%	10	80%	3	20%	84	59	59	0	4	4	0
RUS_010_003_010	MR	81.10	0.127	0	0%	0	0%	0	0%	81	100%	0	0%	80	66	67	1	8	8	0
RUS_010_003_020	MR	13.03	0.020	0	0%	0	0%	0	0%	13	100%	0	0%	80	50	50	0	2	2	0
RUS_010_004_010	MR	76.27	0.119	0	0%	0	0%	1	1%	76	99%	0	0%	80	79	79	0	13	13	0
RUS_010_004_020	MR	79.94	0.125	0	0%	0	0%	1	1%	79	99%	0	0%	80	59	77	18	11	11	0
RUS_010_004_030	MR	149.77	0.234	0	0%	11	7%	21	14%	118	79%	0	0%	78	57	57	0	23	23	0
RUS_010_004_040	MR	56.79	0.089	0	0%	0	0%	1	2%	56	98%	0	0%	80	55	60	5	6	6	0
RUS_010_010	MR	109.01	0.170	0	0%	34	32%	54	50%	20	19%	0	0%	71	64	64	0	19	19	0
RUS_010_020	MR	13.63	0.021	0	0%	0	0%	0	0%	14	100%	0	0%	80	38	56	18	10	1	-9
RUS_010_030	MR	36.73	0.057	0	0%	0	0%	0	0%	37	100%	0	0%	80	50	50	0	5	5	0
RUS_010_040	MR	29.72	0.046	2	7%	8	26%	0	1%	20	66%	0	0%	72	30	60	30	8	8	0
RUS_011_010	MR	56.26	0.088	0	0%	29	51%	0	0%	28	49%	0	0%	70	27	56	30	11	10	-1
RUS_011_020	MR	51.86	0.081	0	1%	1	1%	7	13%	44	84%	0	0%	79	32	48	16	8	8	0
RUS_012_010	MR	105.30	0.165	0	0%	0	0%	0	0%	105	100%	0	0%	80	68	68	0	11	10	-1
RUS_012_020	MR	60.58	0.095	0	0%	4	6%	0	0%	57	94%	0	0%	79	37	53	16	17	16	-1
RUS_012_030	MR	12.97	0.020	5	36%	8	64%	0	0%	0	0%	0	0%	53	32	60	28	1	1	0
RUS_013_010	MR	122.21	0.191	0	0%	72	59%	42	34%	9	7%	0	0%	67	31	46	15	11	11	0
RUS_013_020	MR	92.60	0.145	0	0%	53	57%	15	16%	25	27%	0	0%	68	28	63	35	16	14	-2
RUS_013_030	MR	55.42	0.087	3	6%	23	41%	0	0%	29	53%	0	0%	70	43	54	11	4	4	0
RUS_014_010	MR	46.82	0.073	0	0%	0	0%	0	0%	47	100%	0	0%	80	51	70	20	13	13	0
RUS_014_020	MR	119.19	0.186	3	3%	0	0%	0	0%	116	97%	0	0%	79	48	50	2	11	11	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_015_010	MR	67.74	0.106	0	0%	0	0%	0	0%	68	100%	0	0%	80	48	63	16	15	15	0
RUS_015_020	MR	80.60	0.126	4	5%	0	0%	0	0%	77	95%	0	0%	78	53	54	1	10	10	0
RYA_000_010	MR	66.67	0.104	0	0%	32	48%	8	12%	27	41%	0	0%	70	53	53	0	10	10	0
RYA_000_020	MR	99.78	0.156	0	0%	46	46%	21	21%	32	32%	0	0%	70	58	60	1	20	19	-1
RYA_000_030	MR	63.29	0.099	0	0%	11	17%	36	57%	16	26%	0	0%	73	41	62	21	16	15	-1
RYA_000_040	MR	92.99	0.145	0	0%	23	25%	68	74%	1	1%	0	0%	71	39	67	29	9	9	0
RYA_000_050	MR	5.45	0.009	0	0%	0	0%	2	34%	4	66%	0	0%	78	3	75	72	6	1	-5
RYA_000_060	MR	81.23	0.127	0	0%	5	6%	21	25%	56	68%	0	0%	77	29	51	22	11	5	-6
RYA_000_070	MR	77.62	0.121	0	0%	36	46%	0	0%	42	54%	0	0%	71	34	47	13	14	7	-7
RYA_000_080	MR	52.02	0.081	3	6%	21	41%	6	12%	21	41%	0	0%	69	30	34	4	8	8	0
RYA_001_010	MR	77.35	0.121	0	0%	4	5%	43	55%	31	40%	0	0%	76	42	53	11	11	11	0
RYA_001_020	MR	12.94	0.020	0	0%	1	5%	7	51%	6	44%	0	0%	76	10	75	65	8	3	-5
TWI_000_010	MR	87.86	0.137	0	0%	0	0%	14	16%	73	84%	0	0%	79	76	76	0	12	12	0
TWI_000_020	MR	55.13	0.086	0	0%	8	15%	26	48%	20	37%	0	0%	74	68	72	4	5	5	0
TWI_000_030	MR	67.34	0.105	0	0%	22	33%	20	29%	25	38%	0	0%	72	48	52	4	14	14	0
TWI_000_040	MR	20.95	0.033	0	0%	1	7%	11	51%	9	42%	0	0%	76	41	41	0	12	10	-2
TWI_000_050	MR	75.53	0.118	0	0%	53	70%	5	7%	18	24%	0	0%	66	47	47	0	9	9	0
TWI_000_060	MR	43.53	0.068	0	0%	18	42%	10	23%	15	35%	0	0%	71	37	37	0	16	15	-1
TWI_000_070	MR	96.93	0.151	0	0%	32	33%	9	9%	56	58%	0	0%	73	51	57	6	21	21	0
TWI_000_080	MR	18.60	0.029	0	0%	6	30%	6	33%	7	37%	0	0%	72	28	52	24	9	9	0
TWI_000_090	MR	20.73	0.032	0	0%	3	15%	11	54%	0	0%	6	30%	80	35	70	35	3	1	-2
TWI_000_100	MR	34.00	0.053	0	0%	20	58%	10	30%	4	12%	0	0%	67	32	50	18	13	13	0
TWI_001_010	MR	111.24	0.174	0	0%	72	65%	29	26%	7	7%	3	2%	67	33	47	15	15	15	0
TWI_002_010	MR	12.24	0.019	0	0%	0	3%	7	59%	4	37%	0	1%	76	30	60	30	8	7	-1
TWI_003_010	MR	27.44	0.043	0	0%	0	0%	0	2%	27	98%	0	0%	80	56	65	9	6	6	0
TWI_004_010	MR	77.75	0.122	0	0%	8	11%	10	13%	60	77%	0	0%	77	80	80	0	10	10	0
TWI_004_020	MR	42.92	0.067	0	0%	34	80%	4	10%	4	10%	0	0%	64	63	69	7	7	7	0
TWI_004_030	MR	21.68	0.034	0	0%	10	48%	2	10%	9	42%	0	0%	70	35	50	15	4	4	0
RUS_RCO_001_010	RC1	101.70	0.159	0	0%	88	87%	0	0%	13	13%	0	0%	63	54	55	1	19	18	-1
RUS_RCO_002_010	RC1	111.56	0.174	0	0%	42	38%	44	39%	26	23%	0	0%	70	52	53	1	19	19	0
RUS_RCO_002_020	RC1	57.70	0.090	0	0%	15	25%	3	6%	40	69%	0	0%	75	50	50	0	12	12	0
RUS_RCO_010	RC1	69.60	0.109	0	0%	45	65%	8	11%	16	23%	0	0%	67	56	57	1	17	17	0
RUS_RCO_020	RC1	90.89	0.142	0	0%	48	53%	23	25%	20	22%	0	0%	68	59	65	5	11	11	0
RUS_RCO_030	RC1	82.01	0.128	0	0%	57	70%	8	10%	17	20%	0	0%	66	44	46	2	14	14	0
RUS_RCO_040	RC1	36.63	0.057	0	0%	16	42%	14	37%	8	21%	0	0%	70	50	50	0	11	11	0
RUS_RCO_050	RC1	84.98	0.133	0	0%	33	39%	21	25%	30	36%	0	0%	71	52	52	0	18	18	0
RUS_RCO_060	RC1	123.32	0.193	0	0%	49	39%	54	43%	7	6%	14	11%	72	53	55	2	20	19	-1
RUS_RCO_070	RC1	55.66	0.087	0	0%	34	61%	11	20%	10	18%	0	0%	67	62	67	6	9	9	0
RUS_RCO_080	RC1	48.51	0.076	0	0%	17	36%	2	5%	29	59%	0	0%	73	59	64	5	11	11	0
RUS_RCO_090	RC1	109.44	0.171	0	0%	55	50%	41	37%	14	13%	0	0%	68	57	59	2	21	21	0
RUS_RCO_100	RC1	34.89	0.055	0	0%	18	53%	16	45%	1	2%	0	0%	67	51	54	3	14	14	0
RUS_RCO_110	RC1	54.88	0.086	0	0%	32	59%	0	0%	23	41%	0	0%	69	63	63	0	12	12	0
RUS_RCO_120	RC1	109.92	0.172	0	0%	32	29%	51	46%	20	18%	7	6%	73	51	51	0	14	14	0
RUS_RCO_130	RC1	24.94	0.039	1	2%	1	3%	10	39%	14	56%	0	0%	76	46	47	1	12	12	0
RUS_RCO_140	RC1	46.75	0.073	8	17%	8	18%	15	31%	16	34%	0	0%	68	52	71	18	12	7	-5
RUS_RCO_150	RC1	39.91	0.062	35	87%	0	0%	0	0%	5	13%	0	0%	44	45	58	12	10	7	-3

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_TOA_010	RC1	105.76	0.165	0	0%	76	72%	2	2%	28	27%	0	0%	66	35	36	1	20	19	-1
RUS_TOA_020	RC1	74.43	0.116	0	0%	21	28%	17	23%	36	49%	0	0%	73	50	50	0	8	8	0
RUS_TOA_030	RC1	45.81	0.072	0	0%	22	49%	13	29%	10	22%	0	0%	69	48	48	0	15	15	0
RUS_TOA_040	RC1	39.09	0.061	0	0%	18	45%	7	18%	14	37%	0	0%	70	46	47	0	13	12	-1
RUS_TOA_050	RC1	107.96	0.169	0	0%	56	52%	0	0%	52	48%	0	0%	70	51	59	7	21	21	0
RUS_TOA_055	RC1	107.75	0.168	0	0%	53	49%	4	4%	51	47%	0	0%	70	65	74	9	31	29	-2
RUS_TOA_060	RC1	52.45	0.082	0	0%	21	41%	24	46%	7	13%	0	0%	69	47	61	14	19	18	-1
RUS_TOA_070	RC1	95.18	0.149	0	0%	5	5%	57	60%	33	35%	0	0%	75	39	46	7	18	18	0
RUS_TOA_080	RC1	156.21	0.244	0	0%	3	2%	76	49%	77	49%	0	0%	77	62	67	5	15	15	0
RUS_TOA_090	RC1	100.69	0.157	0	0%	18	18%	57	57%	25	25%	0	0%	73	51	68	16	14	9	-5
RUS_TOA_100	RC1	109.41	0.171	1	1%	43	40%	61	55%	4	4%	0	0%	69	54	63	9	10	10	0
RUS_000_010	UR	84.84	0.133	0	0%	0	0%	45	53%	40	47%	0	0%	77	12	72	60	29	20	-9
RUS_000_020	UR	78.66	0.123	0	0%	36	45%	2	2%	41	53%	0	0%	71	44	59	15	7	7	0
RUS_000_030	UR	70.31	0.110	0	0%	2	3%	30	42%	38	55%	0	0%	77	22	58	36	27	24	-3
RUS_000_040	UR	51.38	0.080	0	0%	0	0%	32	63%	19	37%	0	0%	76	35	66	30	12	10	-2
RUS_000_050	UR	87.61	0.137	0	0%	0	0%	48	55%	40	45%	0	0%	77	40	52	11	13	13	0
RUS_000_060	UR	76.71	0.120	0	0%	0	0%	19	25%	57	75%	0	0%	78	34	56	21	12	5	-7
RUS_000_070	UR	38.12	0.060	0	0%	0	0%	2	5%	36	95%	0	0%	80	9	67	58	20	18	-2
RUS_000_080	UR	24.57	0.038	0	0%	0	0%	4	17%	20	83%	0	0%	79	39	49	10	17	16	-1
RUS_000_085	UR	52.59	0.082	0	0%	4	7%	1	3%	47	90%	0	0%	79	17	68	51	21	12	-9
RUS_000_090	UR	81.90	0.128	0	0%	2	3%	5	6%	75	92%	0	0%	79	12	66	54	19	17	-2
RUS_000_100	UR	71.48	0.112	0	0%	0	0%	0	0%	71	100%	0	0%	80	36	72	36	16	15	-1
RUS_000_110	UR	90.67	0.142	7	8%	13	14%	8	9%	63	69%	0	0%	74	20	66	46	16	14	-2
RUS_000_120	UR	16.75	0.026	3	17%	1	6%	0	0%	13	77%	0	0%	72	33	72	40	6	5	-1
RUS_000_130	UR	76.02	0.119	9	12%	16	22%	12	16%	39	51%	0	0%	70	54	60	7	12	12	0
RUS_000_140	UR	49.17	0.077	4	8%	29	59%	13	27%	3	7%	0	0%	64	34	53	20	14	13	-1
RUS_000_150	UR	45.29	0.071	10	22%	28	61%	0	0%	8	17%	0	0%	59	38	39	1	11	10	-1
RUS_000_160	UR	40.00	0.063	9	23%	12	29%	0	0%	19	48%	0	0%	65	40	40	0	6	6	0
RUS_000_170	UR	43.90	0.069	10	22%	18	40%	0	0%	16	37%	0	0%	63	38	38	0	11	11	0
RUS_000_180	UR	26.37	0.041	9	33%	0	0%	0	0%	18	67%	0	0%	67	21	44	22	9	9	0
RUS_016_010	UR	64.82	0.101	0	0%	0	0%	0	0%	65	100%	0	0%	80	48	55	7	11	11	0
RUS_016_020	UR	63.32	0.099	0	0%	0	0%	0	0%	63	100%	0	0%	80	73	73	0	12	12	0
RUS_016_030	UR	62.11	0.097	0	0%	0	0%	0	0%	62	100%	0	0%	80	49	68	19	6	6	0
RUS_016_040	UR	66.48	0.104	1	1%	0	0%	0	0%	66	99%	0	0%	79	41	53	12	5	5	0
RUS_017_010	UR	22.61	0.035	0	1%	6	24%	0	0%	17	75%	0	0%	75	27	38	12	9	9	0
RUS_018_010	UR	48.17	0.075	0	0%	0	0%	20	42%	28	58%	0	0%	78	24	61	37	15	14	-1
RUS_018_020	UR	83.21	0.130	0	0%	0	0%	34	41%	49	59%	0	0%	78	10	72	61	21	20	-1
RUS_018_030	UR	34.02	0.053	0	0%	6	18%	8	23%	20	59%	0	0%	75	20	60	39	15	7	-8
RUS_018_040	UR	104.39	0.163	7	6%	18	17%	6	6%	74	71%	0	0%	74	21	64	44	19	10	-9
RUS_018_050	UR	58.72	0.092	9	15%	29	50%	3	6%	17	29%	0	0%	64	38	54	16	15	15	0
RUS_019_010	UR	97.54	0.152	0	0%	0	0%	0	0%	98	100%	0	0%	80	25	74	49	19	17	-2
RUS_019_020	UR	42.19	0.066	1	3%	0	0%	0	0%	41	97%	0	0%	79	39	69	30	7	7	0
RUS_020_010	UR	102.82	0.161	0	0%	0	0%	27	27%	75	73%	0	0%	78	36	56	20	25	23	-2
RUS_020_020	UR	115.59	0.181	0	0%	0	0%	0	0%	116	100%	0	0%	80	29	71	42	29	26	-3
RUS_020_030	UR	71.22	0.111	0	0%	0	0%	0	0%	71	100%	0	0%	80	38	72	35	24	22	-2
RUS_020_040	UR	94.50	0.148	0	0%	0	0%	0	0%	95	100%	0	0%	80	20	69	49	19	18	-1

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_FPT_010	UR	73.59	0.115	0	0%	0	0%	0	0%	74	100%	0	0%	80	41	58	17	8	8	0
RUS_FPT_020	UR	42.95	0.067	0	1%	0	0%	0	0%	43	99%	0	0%	80	37	43	5	8	7	-1
RUS_NET_010	UR	29.41	0.046	0	0%	0	0%	0	0%	29	100%	0	0%	80	42	65	23	6	6	0
RUS_NET_020	UR	46.69	0.073	1	2%	5	10%	0	0%	41	89%	0	0%	78	18	20	2	3	3	0
SUB_000_010	UR	80.66	0.126	0	0%	9	11%	34	43%	37	46%	0	0%	75	39	66	27	21	19	-2
SUB_000_020	UR	57.96	0.091	0	0%	54	92%	3	5%	2	3%	0	0%	62	15	41	26	11	10	-1
SUB_000_030	UR	22.77	0.036	0	1%	23	99%	0	0%	0	0%	0	0%	61	6	12	6	3	2	-1
SUB_000_040	UR	48.35	0.076	9	18%	25	51%	1	2%	14	28%	0	0%	63	6	24	18	12	12	0
SUB_000_050	UR	92.01	0.144	0	0%	7	7%	23	25%	62	67%	0	0%	77	33	66	33	25	22	-3
SUB_000_060	UR	100.61	0.157	0	0%	50	50%	23	22%	28	28%	0	0%	69	28	61	34	18	17	-1
SUB_000_070	UR	90.86	0.142	1	1%	70	77%	6	7%	14	15%	0	0%	64	10	54	44	19	17	-2
SUB_000_080	UR	24.34	0.038	4	16%	6	27%	2	7%	12	49%	0	0%	68	8	8	0	8	7	-1
SUB_000_090	UR	119.82	0.187	2	1%	19	16%	23	20%	76	63%	0	0%	75	8	39	31	26	23	-3
SUB_000_100	UR	81.51	0.127	1	1%	28	35%	0	0%	52	64%	0	0%	73	8	19	11	13	8	-5
SUB_000_110	UR	25.10	0.039	12	46%	6	26%	0	0%	7	29%	0	0%	56	6	6	0	8	8	0
SUB_000_115	UR	33.57	0.052	9	26%	16	47%	0	0%	9	27%	0	0%	60	9	32	23	10	9	-1
SUB_000_120	UR	131.30	0.205	1	1%	41	32%	24	18%	65	49%	0	0%	73	17	44	26	19	17	-2
SUB_000_130	UR	83.72	0.131	0	0%	39	47%	15	18%	29	35%	0	0%	70	26	55	28	17	16	-1
SUB_000_140	UR	84.94	0.133	0	0%	74	88%	8	9%	3	3%	0	0%	63	22	67	45	14	13	-1
SUB_000_150	UR	59.59	0.093	0	0%	20	34%	20	34%	19	32%	0	0%	72	6	57	50	13	6	-7
SUB_000_155	UR	37.43	0.058	1	3%	20	53%	0	1%	16	43%	0	0%	69	23	59	36	12	7	-5
SUB_000_160	UR	21.05	0.033	4	18%	14	64%	2	11%	1	7%	0	0%	60	6	73	67	9	4	-5
SUB_000_170	UR	92.62	0.145	4	4%	28	31%	23	25%	37	40%	0	0%	71	50	50	1	16	16	0
SUB_000_180	UR	54.74	0.086	11	20%	26	47%	18	33%	0	0%	0	0%	61	29	61	33	7	7	0
SUB_000_190	UR	73.49	0.115	5	7%	63	86%	2	3%	3	5%	0	0%	61	41	55	13	10	10	0
SUB_000_200	UR	82.97	0.130	0	0%	4	4%	12	15%	67	81%	0	0%	78	41	62	21	19	17	-2
SUB_000_210	UR	34.11	0.053	0	0%	16	46%	0	0%	18	54%	0	0%	71	14	71	57	9	8	-1
SUB_000_220	UR	118.42	0.185	0	0%	10	8%	23	20%	86	72%	0	0%	77	32	65	32	22	13	-9
SUB_000_230	UR	44.83	0.070	2	5%	0	0%	29	64%	14	31%	0	0%	74	14	65	50	11	11	0
SUB_000_240	UR	55.81	0.087	13	23%	2	3%	22	39%	20	35%	0	0%	68	21	63	42	7	7	0
SUB_000_250	UR	76.62	0.120	1	1%	48	63%	9	11%	19	25%	0	0%	67	44	50	6	13	13	0
SUB_000_260	UR	98.56	0.154	7	7%	19	19%	28	28%	45	46%	0	0%	72	27	55	27	11	11	0
SUB_000_270	UR	83.06	0.130	0	0%	48	57%	35	42%	1	1%	0	0%	66	24	27	3	15	13	-2
SUB_000_280	UR	55.00	0.086	7	13%	5	9%	11	19%	32	59%	0	0%	72	24	68	45	10	9	-1
SUB_000_290	UR	100.99	0.158	15	15%	23	23%	26	25%	38	37%	0	0%	68	25	64	39	8	8	0
SUB_000_300	UR	79.88	0.125	10	12%	56	70%	0	0%	14	18%	0	0%	62	35	57	21	11	11	0
SUB_001_001_010	UR	50.71	0.079	0	0%	0	0%	7	13%	44	87%	0	0%	79	46	53	7	16	8	-8
SUB_001_001_020	UR	13.14	0.021	0	0%	3	26%	9	66%	1	9%	0	0%	71	22	68	46	6	6	0
SUB_001_010	UR	65.94	0.103	0	0%	0	0%	0	0%	66	100%	0	0%	80	33	61	28	13	8	-5
SUB_001_020	UR	25.67	0.040	0	0%	0	0%	6	23%	20	77%	0	0%	79	37	58	21	4	4	0
SUB_002_010	UR	31.92	0.050	0	0%	1	2%	10	31%	21	67%	0	0%	78	23	39	16	6	5	-1
SUB_002_020	UR	18.11	0.028	0	1%	4	24%	5	29%	8	46%	0	0%	73	25	35	10	10	9	-1
SUB_003_010	UR	34.69	0.054	0	0%	23	67%	1	3%	11	30%	0	0%	67	33	60	27	10	10	0
SUB_003_020	UR	101.45	0.159	0	0%	57	56%	16	16%	28	28%	0	0%	68	36	64	29	13	12	-1
SUB_003_030	UR	96.22	0.150	0	0%	55	57%	34	35%	7	7%	0	0%	67	42	55	13	10	10	0
SUB_003_040	UR	107.96	0.169	0	0%	79	73%	11	11%	18	17%	0	0%	66	50	50	0	16	16	0

Appendix B-1

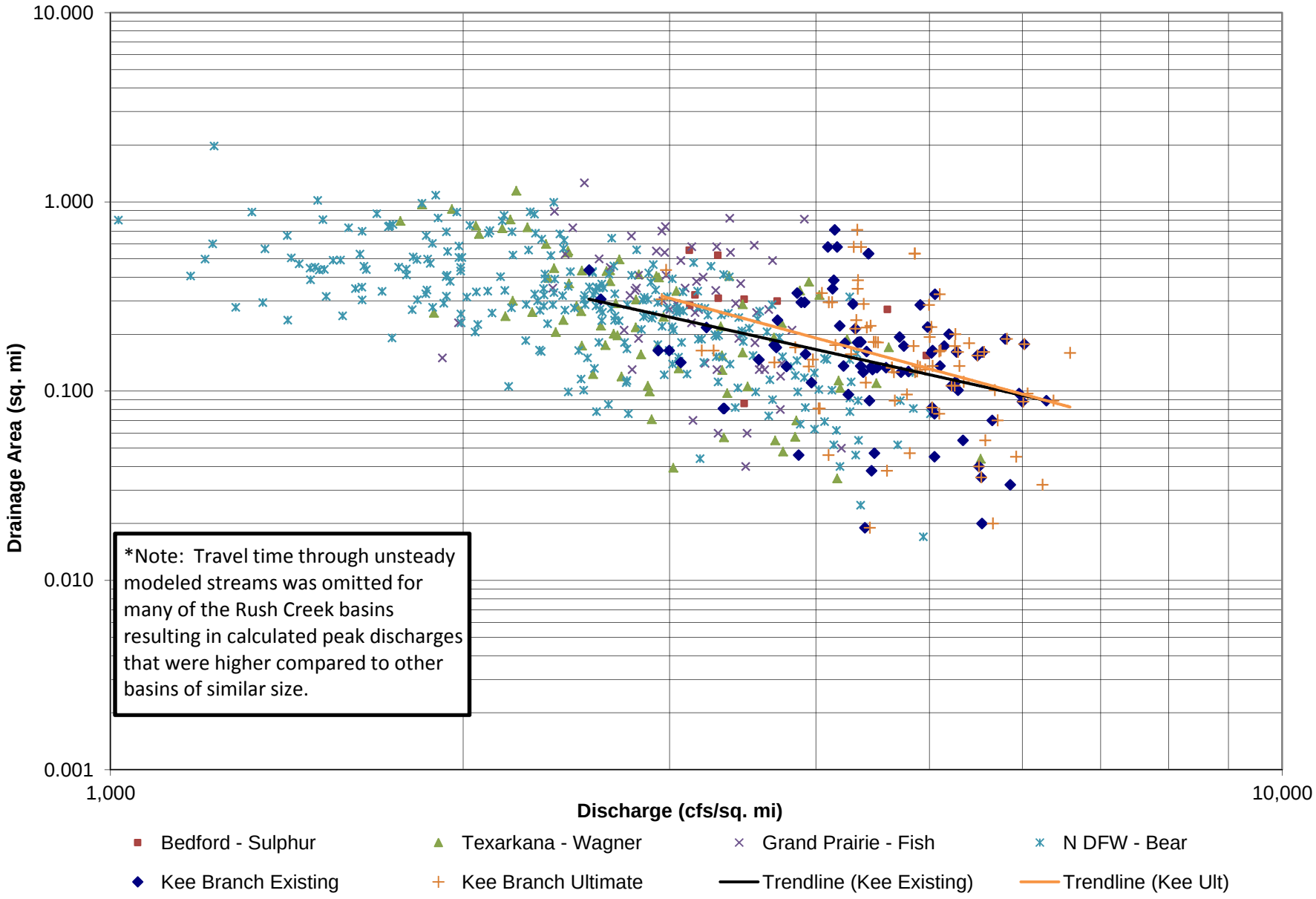
Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
SUB_004_010	UR	50.88	0.080	0	0%	44	87%	6	12%	1	1%	0	0%	63	19	70	51	24	21	-3
SUB_004_020	UR	74.87	0.117	0	0%	68	91%	2	3%	4	5%	0	0%	62	22	74	52	15	14	-1
SUB_004_030	UR	42.07	0.066	0	0%	16	37%	14	34%	12	28%	0	0%	71	18	68	51	13	7	-6
SUB_004_040	UR	90.58	0.142	0	0%	57	63%	33	36%	1	1%	0	0%	66	11	74	64	23	21	-2
SUB_004_050	UR	72.87	0.114	0	0%	54	75%	11	15%	7	10%	0	0%	65	19	71	52	16	11	-5
SUB_004_060	UR	26.26	0.041	0	0%	5	20%	8	30%	13	50%	0	0%	74	68	72	4	13	12	-1
SUB_004_070	UR	83.44	0.130	0	0%	26	32%	3	3%	54	65%	0	0%	74	46	71	25	16	16	0
SUB_004_080	UR	60.12	0.094	0	0%	28	47%	32	52%	1	1%	0	0%	68	23	71	47	8	7	-1
SUB_004_090	UR	51.19	0.080	0	0%	32	63%	16	31%	3	5%	0	0%	66	21	69	48	13	10	-3
SUB_004_100	UR	21.95	0.034	0	0%	19	88%	3	12%	0	0%	0	0%	63	35	46	12	14	7	-7
SUB_004_110	UR	26.34	0.041	0	0%	20	75%	6	22%	1	3%	0	0%	64	49	67	17	24	22	-2
SUB_004_120	UR	62.68	0.098	1	1%	24	39%	27	44%	10	17%	0	0%	70	9	47	38	19	17	-2
SUB_004_130	UR	32.38	0.051	6	19%	22	67%	4	13%	0	0%	0	0%	59	5	48	43	13	8	-5

Appendix B-2
Discharge Comparisons

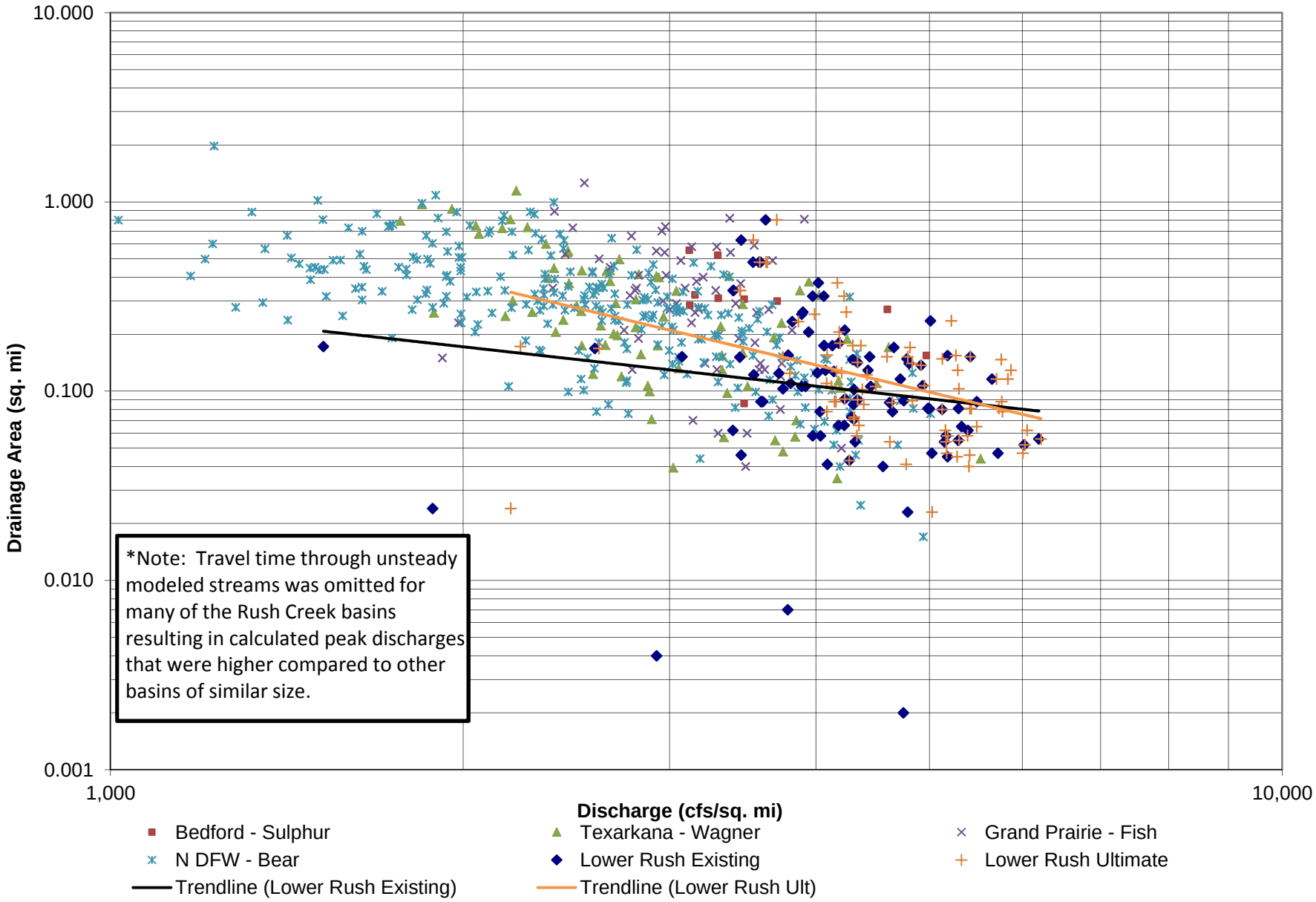
Discharge Comparison

100-Year Flood Peak with Regression Equation for Kee Branch



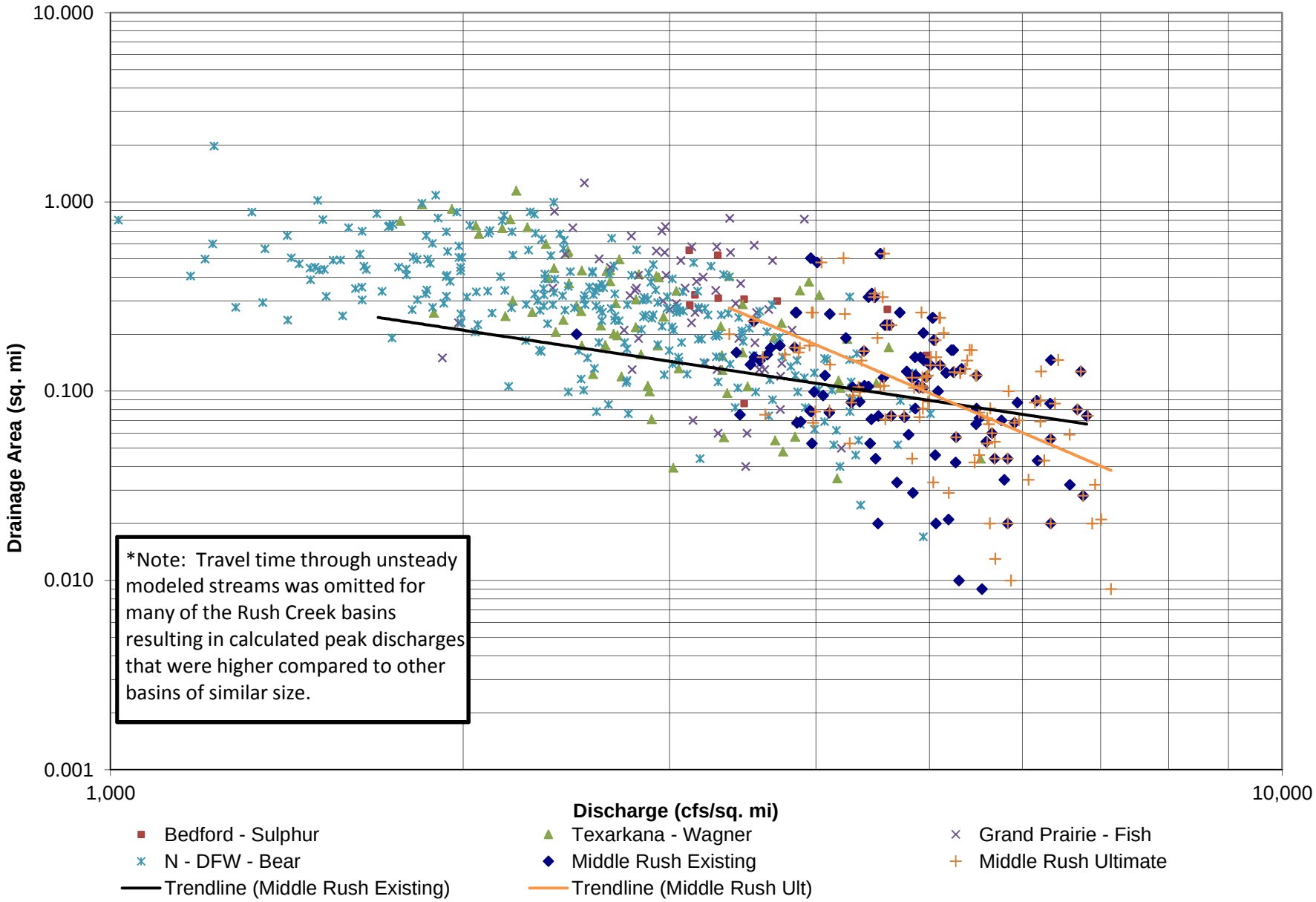
Discharge Comparison

100-Year Flood Peak with Regression Equation for Lower Rush

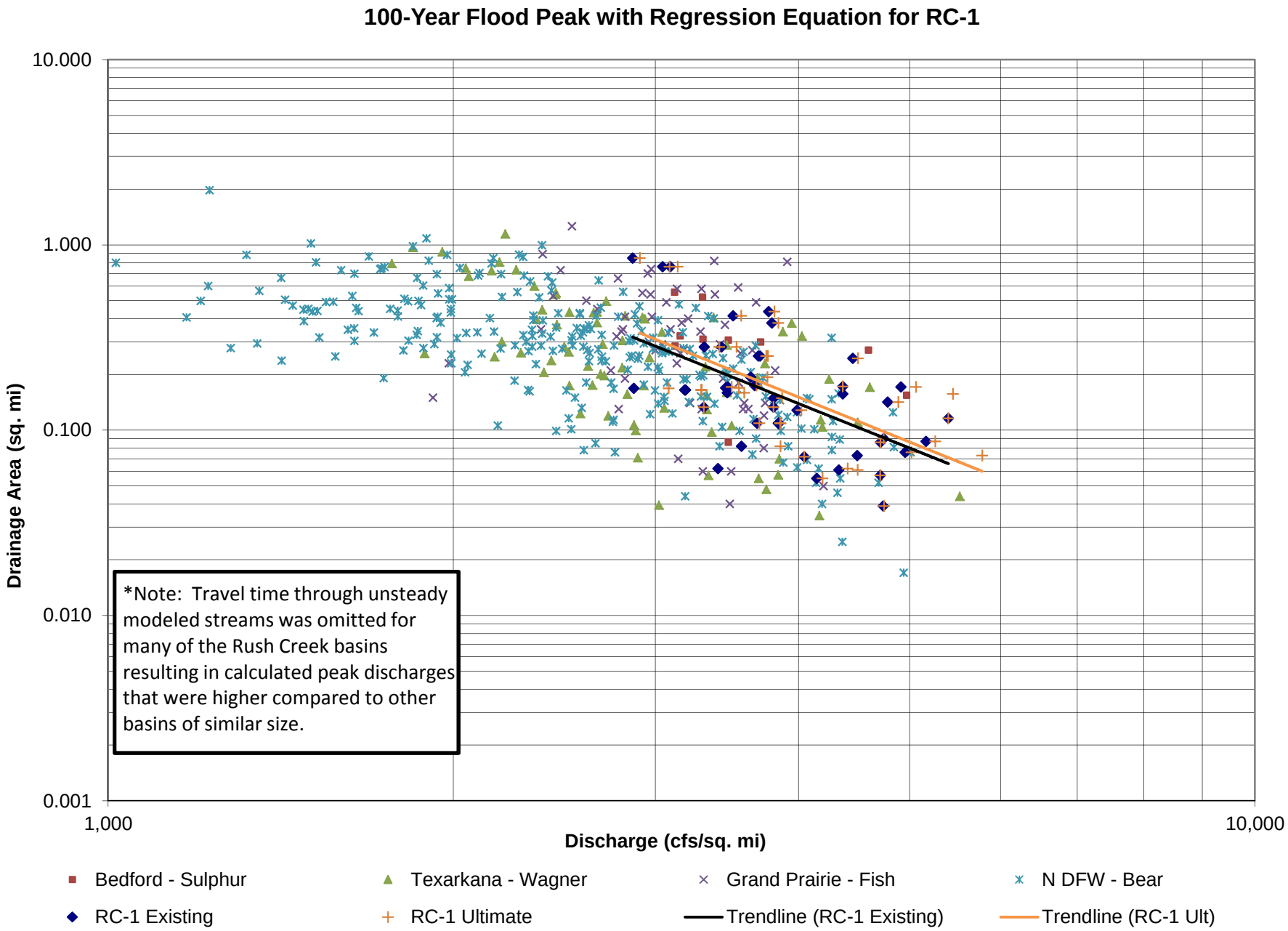


Discharge Comparison

100-Year Flood Peak with Regression Equation for Middle Rush

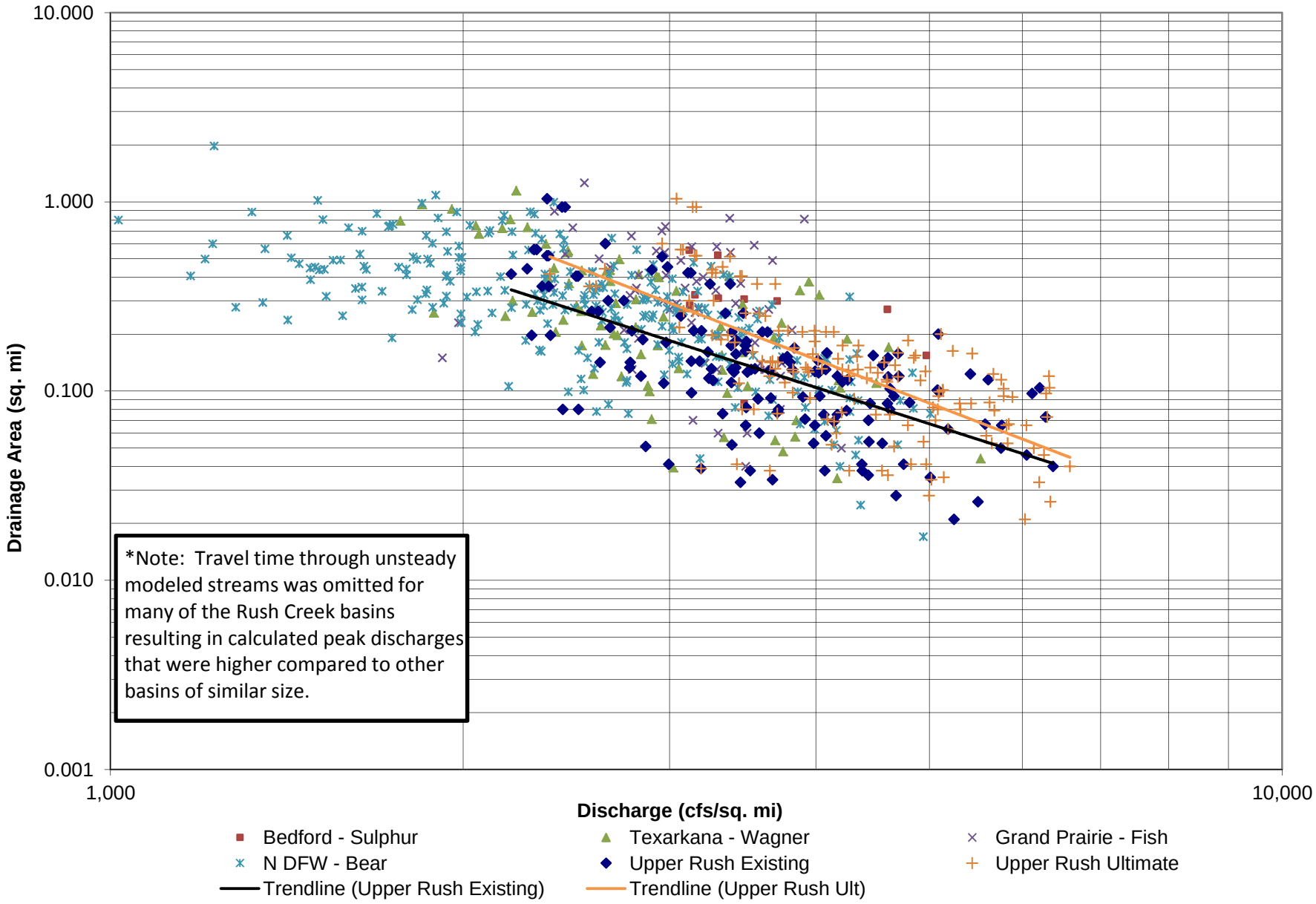


Discharge Comparison

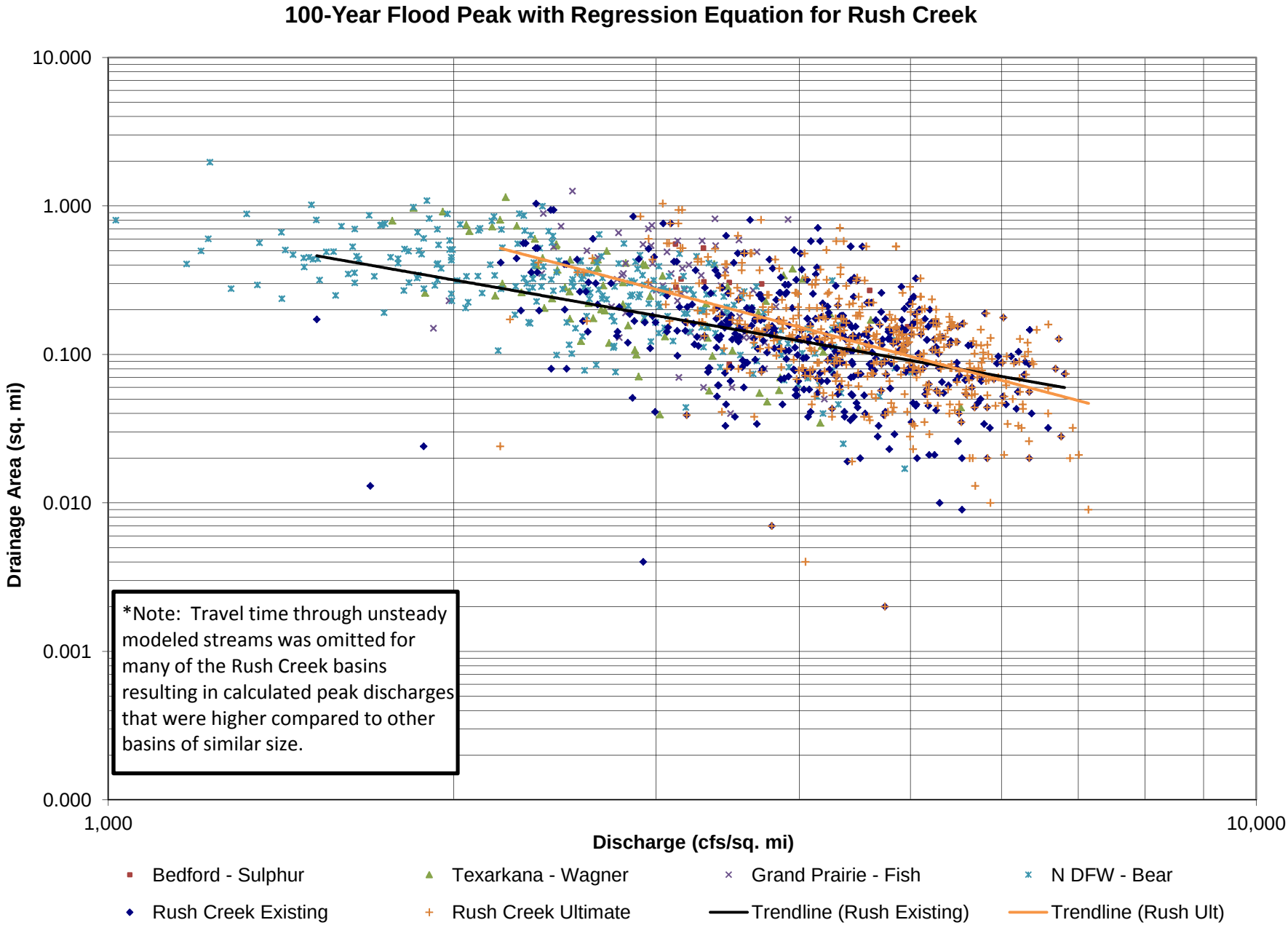


Discharge Comparison

100-Year Flood Peak with Regression Equation for Upper Rush



Discharge Comparison



Appendix B-3
Time of Concentration Calculations

Appendix B-3

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_000_010		3,087	100	0.150	Grass-Short Grass Prairie	4.900	3.95	6.2																		KEE_000_010	6.2	**25.9**	**0.43**
									832	0.921	1.55	Unpaved	8.96														9.0		
														2,155	0.675	4.8	15.0	0.045	1.28		1.28	28.11						28.1		
KEE_000_020		4,034	100	0.150	Grass-Short Grass Prairie	0.690	3.95	13.5																		KEE_000_020	13.5	**21.0**	**0.35**
									663	1.437	1.93	Unpaved	5.71														5.7		
														1,092	2.116	5.9	10.7	0.045	3.24		3.24	5.62						5.6		
														2,179	0.588				3.58	3.58	3.58	10.14						10.1		
KEE_000_030		2,234	54	0.150	Grass-Short Grass Prairie	2.034	3.95	5.4																		KEE_000_030	5.4	**12.3**	**0.21**
									641	0.772	1.79	Paved	5.98														6.0		
														1,538	1.048	5.5	7.4	0.045	2.78		2.78	9.23						9.2		
KEE_000_040		1,299	100	0.150	Grass-Short Grass Prairie	3.510	3.95	7.0																		KEE_000_040	7.0	**7.6**	**0.13**
									572	2.811	2.71	Unpaved	3.52														3.5		
														628	2.524	17.4	19.3	0.045	4.92		4.92	2.13						2.1		
KEE_000_050		1,757	100	0.150	Grass-Short Grass Prairie	2.962	3.95	7.5																		KEE_000_050	7.5	**9.7**	**0.16**
									417	2.557	2.58	Unpaved	2.69														2.7		
														1,241	2.807	5.4	10.7	0.045	3.52		3.52	5.87						5.9		
KEE_000_060		3,065	100	0.150	Grass-Short Grass Prairie	2.965	3.95	7.5																		KEE_000_060	7.5	**16.8**	**0.28**
									487	3.404	2.98	Unpaved	2.73														2.7		
									2,268	1.273	2.29	Paved	16.48														16.5		
														210	1.455	7.7	13.8	0.045	2.70		2.70	1.30						1.3		
KEE_000_070		3,566	100	0.150	Grass-Short Grass Prairie	11.424	3.95	4.4																		KEE_000_070	4.4	**16.9**	**0.28**
									2,853	1.794	2.16	Unpaved	22.00														22.0		
														613	1.330	17.9	5.4	0.065	5.89		5.89	1.73						1.7		
KEE_000_080		2,338	100	0.150	Grass-Short Grass Prairie	2.610	3.95	7.9																		KEE_000_080	7.9	**18.0**	**0.30**
									1,517	2.118	2.35	Unpaved	10.77														10.8		
														721	0.552	13.0	45.9	0.045	1.06		1.06	11.33						11.3		
KEE_000_090		3,947	100	0.150	Grass-Short Grass Prairie	2.650	3.95	7.9																		KEE_000_090	7.9	**13.5**	**0.22**
									60	5.609	3.82	Unpaved	0.26														0.3		
									742	3.436	3.77	Paved	3.28														3.3		
														1,214	1.388	8.5	10.4	0.045	3.42		3.42	5.92						5.9		
																							1,831	6	6.00	5.1		5.1		
KEE_000_100		1,777	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.017	3.95	0.8																		KEE_000_100	0.8	**6.6**	**0.11**
									695	0.674	1.67	Paved	6.94														6.9		
																							862	6	6.00	2.4		2.4		
														170	0.631	33.7	11.6	0.065	3.72		3.72	0.76						0.8		
KEE_000_110		3,519	100	0.150	Grass-Short Grass Prairie	5.080	3.95	6.1																		KEE_000_110	6.1	**12.5**	**0.21**
									1,546	2.758	2.68	Unpaved	9.62														9.6		
																							1,874	6	6.00	5.2		5.2		
KEE_000_120		4,341	100	0.150	Grass-Short Grass Prairie	2.208	3.95	8.5																		KEE_000_120	8.5	**13.0**	**0.22**
									94	3.605	3.06	Unpaved	0.51														0.5		
									818	2.235	3.04	Paved	4.49														4.5		
																							1,289	6	6.00	3.6		3.6		
														2,040	1.426	5.6	11.7	0.015	7.29		7.29	4.66						4.7		
KEE_000_130		3,538	100	0.150	Grass-Short Grass Prairie	6.001	3.95	5.7																		KEE_000_130	5.7	**10.9**	**0.18**
									627	3.096	2.84	Unpaved	3.68														3.7		
									459	2.576	3.26	Paved	2.34														2.3		
																							2,351	6	6.00	6.5		6.5		
KEE_000_140		1,799	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		KEE_000_140	15.4	**12.8**	**0.21**
									344	1.009	2.04	Paved	2.81														2.8		
																							552	6	6.00	1.5		1.5		
														803	0.768				8.33	8.33	8.33	1.61						1.6		
KEE_000_150		4,517	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.139	3.95	0.4																		KEE_000_150	0.4	**10.2**	**0.17**
									1,044	2.939	3.49	Paved	4.99														5.0		
																							1,498	6	6.00	4.2		4.2		
														443	0.875	6.0	10.5	0.015	6.37		6.37	1.16						1.2		
														1,482	1.334	17.1	16.4	0.045	3.93		3.93	6.28						6.3		
KEE_000_160		4,517	60	0.150	Grass-Short Grass Prairie	5.796	3.95	3.8																		KEE_000_160	3.8	**11.6**	**0.19**
									1,732	3.077	3.57	Paved	8.10														8.1		
																							2,518	6	6.00	7.0		7.0		
														208	0.525				7.26	7.26	7.26	0.48						0.5		
KEE_000_170		2,524	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.440	3.95	0.4																		KEE_000_170	0.4	**13.0**	**0.22**
														2,474	0.860	11.8	23.5	0.045	1.94		1.94	21.25						21.3		
KEE_000_180		2,661	100	0.150	Grass-Short Grass Prairie	1.856	3.95	9.1																		KEE_000_180	9.1	**17.5**	**0.29**
									1,466	1.436	1.93	Unpaved	12.64														12.6		
														1,095	1.316	7.7	14.7	0.045	2.47		2.47	7.39						7.4		
KEE_000_190		2,588	100	0.150	Grass-Short Grass Prairie	7.600	3.95	5.2																		KEE_000_190	5.2	**7.9**	**0.13**
									993	4.530	4.33	Paved	3.83														3.8		
																							1,495	6	6.00	4.2		4.2		
KEE_000_200		3,249	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.191	3.95	0.8																		KEE_000_200	0.8	**6.6**	**0.11**
									398	1.732	2.68	Paved	2.48														2.5		
																							2,801	6	6.00	7.8		7.8		
KEE_000_210		1,254	100	0.150	Grass-Short Grass Prairie	4.450	3.95	6.4																		KEE_000_210	6.4	**6.5**	**0.11**
									1,023	4.303	4.22	Paved	4.04														4.0		
																							131	6	6.00	0.4		0.4		
KEE_000_220		5,107	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.505	3.95	1.1																		KEE_000_220	1.1	**9.6**	**0.16**
									325	2.255	3.05	Paved	1.77														1.8		
																							2,301	6	6.00	6.4		6.4		
														530	0.952	22.7	11.2	0.050	4.67		4.67	1.89						1.9		
														310	2.812	2.7	4.6	0.015	11.70		11.70	0.44						0.4		
																							1,592	6	6.00	4.4		4.4		
KEE_000_230		3,201	100	0.150	Grass-Short Grass Prairie	5.898	3.95	5.7																		KEE_000_230	5.7	**10.2**	**0.17**
									279	2.645	3.31	Paved	1.41														1.4		
														1,817	2.361	1.3	7.3	0.015	4.89		4.89	6.20						6.2		

Appendix B-3

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							286	6	6.00	0.8		0.8		
																												2.9		
KEE_000_240		2,832	100	0.150	Grass-Short Grass Prairie	4.426	3.95	6.4						720	1.506	16.8	9.2	0.065	4.19		4.19	2.87					KEE_000_240	6.4	**12.3**	**0.20**
									756	3.744	3.12	Unpaved	4.04														4.0		
									1,590	2.170	2.99	Paved	8.85														8.8		
																							109	6	6.00	0.3		0.3		
														277	2.964	23.3	14.1	0.065	5.52		5.52	0.84						0.8		
KEE_000_250		3,233	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.220	3.95	0.4																			KEE_000_250	0.4	**6.6**	**0.11**
									1,454	4.093	4.11	Paved	5.89														5.9		
																							1,729	6	6.00	4.8		4.8		
KEE_000_260		4,376	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.026	3.95	0.4																			KEE_000_260	0.4	**9.9**	**0.16**
									2,638	3.363	3.73	Paved	11.79														11.8		
																							144	6	6.00	0.4		0.4		
														1,545	1.122				6.71	6.71	6.71	3.84						3.8		
KEE_000_270		3,616	50	0.150	Grass-Short Grass Prairie	0.500	3.95	8.8																			KEE_000_270	8.8	**12.7**	**0.21**
														3,313	2.212	15.0	16.0	0.045	4.71		4.71	11.72						11.7		
																							253	6	6.00	0.7		0.7		
KEE_000_280		3,496	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.999	3.95	0.8																			KEE_000_280	0.8	**6.4**	**0.11**
									69	0.795	1.81	Paved	0.63														0.6		
																							1,688	6	6.00	4.7		4.7		
														452	2.424	1.5	3.5	0.015	8.72		8.72	0.86						0.9		
																							678	6	6.00	1.9		1.9		
														558	2.041	7.7	5.5	0.050	5.33		5.33	1.75						1.7		
KEE_000_290		2,617	100	0.150	Grass-Short Grass Prairie	1.000	3.95	11.6																			KEE_000_290	11.6	**14.1**	**0.24**
									733	1.173	1.75	Unpaved	6.99														7.0		
																							1,784	6	6.00	5.0		5.0		
KEE_000_300		3,375	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.367	3.95	0.6																			KEE_000_300	0.6	**9.7**	**0.16**
									780	1.743	2.68	Paved	4.84														4.8		
																							505	6	6.00	1.4		1.4		
									1,065	1.768	2.70	Paved	6.57														6.6		
																							976	6	6.00	2.7		2.7		
KEE_000_310		2,056	100	0.150	Grass-Short Grass Prairie	10.600	3.95	4.5																			KEE_000_310	4.5	**8.5**	**0.14**
									1,744	2.453	3.18	Paved	9.13														9.1		
																							212	6	6.00	0.6		0.6		
KEE_000_320		5,147	60	0.150	Grass-Short Grass Prairie	7.099	3.95	3.5																			KEE_000_320	3.5	**16.4**	**0.27**
									1,321	1.910	2.81	Paved	7.84														7.8		
									1,642	1.903	2.23	Unpaved	12.30														12.3		
														1,946	2.147	1.0	1.8	0.015	9.78		9.78	3.32						3.3		
														177	2.605	56.7	16.6	0.065	8.38		8.38	0.35						0.4		
KEE_000_330		1,743	100	0.150	Grass-Short Grass Prairie	1.485	3.95	9.9																			KEE_000_330	9.9	**9.4**	**0.16**
														1,643	3.018	8.0	10.5	0.045	4.79		4.79	5.71						5.7		
KEE_000_340		2,174	30	0.150	Grass-Short Grass Prairie	2.694	3.95	3.0																			KEE_000_340	3.0	**7.7**	**0.13**
									738	1.273	2.29	Paved	5.36														5.4		
														1,228	3.625	4.1	6.6	0.045	4.62		4.62	4.43						4.4		
KEE_001_010		3,375	100	0.150	Grass-Short Grass Prairie	6.151	3.95	5.6						178	11.612	16.9	6.3	0.065									KEE_001_010	5.6	**10.4**	**0.17**
									1,063	3.256	3.67	Paved	4.83														4.8		
														218	1.637	1.5	4.7	0.045	1.99		1.99	1.83						1.8		
														526	0.799	7.8	7.9	0.015	8.81		8.81	1.00						1.0		
																							1,468	6	6.00	4.1		4.1		
KEE_001_020		1,554	100	0.150	Grass-Short Grass Prairie	3.210	3.95	7.3																			KEE_001_020	7.3	**7.7**	**0.13**
									867	3.248	3.66	Paved	3.94														3.9		
																							100	6	6.00	0.3		0.3		
														486	2.993	54.2	30.5	0.065	5.82		5.82	1.39						1.4		
KEE_001_030		1,340	100	0.150	Grass-Short Grass Prairie	4.670	3.95	6.3																			KEE_001_030	6.3	**7.4**	**0.12**
									634	2.329	2.46	Unpaved	4.29														4.3		
														606	1.393	15.4	8.3	0.045	5.92		5.92	1.71						1.7		
KEE_002_010		2,469	100	0.150	Grass-Short Grass Prairie	1.870	3.95	9.1																			KEE_002_010	9.1	**10.7**	**0.18**
									626	3.214	2.89	Unpaved	3.61														3.6		
														655	3.682	12.2	9.4	0.065	5.22		5.22	2.09						2.1		
																							1,088	6	6.00	3.0		3.0		
KEE_002_020		1,349	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			KEE_002_020	15.4	**12.9**	**0.22**
									179	1.891	2.22	Unpaved	1.34														1.3		
									465	1.488	2.48	Paved	3.13														3.1		
																							605	6	6.00	1.7		1.7		
KEE_004_010		3,383	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.300	3.95	0.7																			KEE_004_010	0.7	**13.5**	**0.22**
									2,242	1.156	2.19	Paved	17.10														17.1		
														314	1.003	3.9	5.6	0.015	7.88		7.88	0.66						0.7		
									311	0.665	1.66	Paved	3.13														3.1		
														466	1.303	4.5	6.3	0.015	9.02		9.02	0.86						0.9		
KEE_004_020		3,028	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.630	3.95	0.7																			KEE_004_020	0.7	**6.9**	**0.12**
									1,199	2.240	3.04	Paved	6.57														6.6		
																							1,066	6	6.00	3.0		3.0		
														713	0.635				9.01	9.01	9.01	1.32						1.3		
KEE_004_030		3,428	100	0.150	Grass-Short Grass Prairie	1.682	3.95	9.5																			KEE_004_030	9.5	**15.6**	**0.26**
									546	2.474	2.54	Unpaved	3.59														3.6		
									1,024	1.090	2.12	Paved	8.04														8.0		
																							1,757	6	6.00	4.9		4.9		
KEE_004_040		1,473	87	0.150	Grass-Short Grass Prairie	3.045	3.95	6.7																			KEE_004_040	6.7	**7.1**	**0.12**
									138	2.116	2.35	Unpaved	0.98														1.0		
									170	1.563	2.54	Paved	1.11														1.1		
																							1,078	6	6.00	3.0		3.0		
KEE_004_050		1,412	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.520	3.95	0.7																			KEE_004_050	0.7	**3.9**	**0.06**
									894	2.662	3.32	Paved	4.49														4.5		
																							468	6	6.00	1.3		1.3		
KEE_005_010		3,260	100	0.150	Grass-Short Grass Prairie	2.370	3.95	8.2																			KEE_005_010	8.2	**11.7**	**0.20**
									404	1.556	2.01	Unpaved	3.35														3.3		
														483	2.007	58.5	23.7	0.065	5.94		5.94	1.36						1.4		
														463	0.970	84.0	38.7	0.050	4.93		4.93	1.57						1.6		
																							1,811	6	6.00	5.0		5.0		

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_005_020		3,664	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.000	3.95	0.8																		KEE_005_020	0.8	**7.9**	**0.13**
														906	1.467	29.3	31.9	0.045	3.80		3.80	3.98						4.0		
																							867	6	6.00	2.4		2.4		
														1,840	1.124	30.1	17.2	0.045	5.09		5.09	6.03						6.0		
KEE_005_030		3,020	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.980	3.95	0.5																		KEE_005_030	0.5	**10.5**	**0.18**
									305	1.304	2.32	Paved	2.19														2.2		
									774	1.280	1.83	Unpaved	7.07														7.1		
																							589	6	6.00	1.6		1.6		
														802	0.753	10.3	6.1	0.065	2.83		2.83	4.72						4.7		
																							500	6	6.00	1.4		1.4		
KEE_005_040		1,614	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.500	3.95	0.7																		KEE_005_040	0.7	**3.7**	**0.06**
									1,171	4.716	4.41	Paved	4.42														4.4		
																							393	6	6.00	1.1		1.1		
KEE_KB1_001_010		2,967	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.847	3.95	0.6																		KEE_KB1_001_010	0.6	**5.9**	**0.10**
									453	2.351	3.12	Paved	2.42														2.4		
																							2,464	6	6.00	6.8		6.8		
KEE_KB1_001_020		2,885	100	0.150	Grass-Short Grass Prairie	4.280	3.95	6.5																		KEE_KB1_001_020	6.5	**10.1**	**0.17**
									94	4.891	3.57	Unpaved	0.44														0.4		
									629	1.486	2.48	Paved	4.23														4.2		
														97	1.107	5.9	10.5	0.015	7.14		7.14	0.23						0.2		
																							237	6	6.00	0.7		0.7		
														451	0.747	2.9	3.5	0.015	7.46		7.46	1.01						1.0		
														532	1.340				5.50	5.50	5.50	1.61						1.6		
														426	1.319				9.20	9.20	9.20	0.77						0.8		
														318	1.195				3.90	3.90	3.90	1.36						1.4		
KEE_KB1_001_030		696	100	0.150	Grass-Short Grass Prairie	3.406	3.95	7.1																		KEE_KB1_001_030	7.1	**5.9**	**0.10**
									596	5.342	3.73	Unpaved	2.66														2.7		
KEE_KB1_010		3,559	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.067	3.95	0.8																		KEE_KB1_010	0.8	**6.2**	**0.10**
									647	5.107	4.59	Paved	2.35														2.3		
																							703	6	6.00	2.0		2.0		
														1,234	1.280	3.5	6.3	0.015	7.61		7.61	2.70						2.7		
																							925	6	6.00	2.6		2.6		
KEE_KB1_020		4,817	85	0.150	Grass-Short Grass Prairie	2.810	3.95	6.8																		KEE_KB1_020	6.8	**13.6**	**0.23**
									734	1.529	2.51	Paved	4.87														4.9		
																							3,998	6	6.00	11.1		11.1		
KEE_KB1_030		4,936	50	0.150	Grass-Short Grass Prairie	4.172	3.95	3.8																		KEE_KB1_030	3.8	**13.1**	**0.22**
									810	2.627	3.29	Paved	4.10														4.1		
																							129	6	6.00	0.4		0.4		
														2,566	1.746	8.7	9.0	0.045	4.26		4.26	10.03						10.0		
														232	1.415	1.6	2.7	0.015	8.34		8.34	0.46						0.5		
																							1,149	6	6.00	3.2		3.2		
KEE_KB1_040		3,426	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		KEE_KB1_040	0.9	**7.9**	**0.13**
									1,487	3.011	3.53	Paved	7.03														7.0		
																							1,890	6	6.00	5.3		5.3		
KEE_KB1_050		2,596	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.620	3.95	1.0																		KEE_KB1_050	1.0	**5.3**	**0.09**
														872	2.111	17.5	18.4	0.045	4.66		4.66	3.12						3.1		
																							1,674	6	6.00	4.7		4.7		
KEE_KB1_060		3,711	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.080	3.95	0.5																		KEE_KB1_060	0.5	**9.5**	**0.16**
									231	0.917	1.95	Paved	1.98														2.0		
									149	5.852	3.90	Unpaved	0.64														0.6		
														493	0.637	1.8	5.9	0.015	3.57		3.57	2.30						2.3		
														1,246	1.791	4.8	6.5	0.045	3.63		3.63	5.72						5.7		
														371	2.868	4.0	3.4	0.065	4.35		4.35	1.42						1.4		
																							1,171	6	6.00	3.3		3.3		

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
PAN_000_010		4,143	100	0.150	Grass-Short Grass Prairie	3.879	3.95	6.8																		PAN_000_010	6.8	**15.2**	**0.25**
									702	2.327	2.46	Unpaved	4.75														4.8		
									804	0.925	1.96	Paved	6.85														6.9		
																							2,535	6.00	6.00	7.0		7.0		
PAN_000_020		2,536	100	0.150	Grass-Short Grass Prairie	1.424	3.95	10.1																		PAN_000_020	10.1	**13.0**	**0.22**
									962	1.806	2.17	Unpaved	7.39														7.4		
																							1,474	6.00	6.00	4.1		4.1		
PAN_000_030		4,382	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		PAN_000_030	0.9	**11.6**	**0.19**
									1,377	0.938	1.97	Paved	11.66														11.7		
														2,352	0.667			0.015	7.63	7.63	7.63	5.14						5.1		
																							604	6.00	6.00	1.7		1.7		
PAN_000_040		4,196	100	0.150	Grass-Short Grass Prairie	6.914	3.95	5.4																		PAN_000_040	5.4	**12.9**	**0.22**
									113	8.527	4.71	Unpaved	0.40														0.4		
									1,282	1.628	2.59	Paved	8.24														8.2		
																							2,698	6.00	6.00	7.5		7.5		
PAN_000_050		4,121	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.571	3.95	1.0																		PAN_000_050	1.0	**10.5**	**0.18**
									491	0.544	1.50	Paved	5.46														5.5		
																							2,846	6.00	6.00	7.9		7.9		
														734	0.704			0.065	3.86	3.86	3.86	3.17						3.2		
PAN_000_060		6,759	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.284	3.95	0.5																		PAN_000_060	0.5	**14.4**	**0.24**
									1,691	2.112	2.95	Paved	9.54														9.5		
																							5,018	6.00	6.00	13.9		13.9		
PAN_000_070		5,912	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.579	3.95	1.0																		PAN_000_070	1.0	**11.4**	**0.19**
									732	2.560	3.25	Paved	3.75														3.8		
																							5,130	6.00	6.00	14.3		14.3		
PAN_000_080		2,612	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		PAN_000_080	1.1	**11.8**	**0.20**
									2,221	1.112	2.14	Paved	17.27														17.3		
														341	4.360	16.3	17.5	0.065	4.57		4.57	1.24						1.2		
PAN_000_090		5,232	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.011	3.95	0.6																		PAN_000_090	0.6	**13.5**	**0.23**
									854	0.500	1.44	Paved	9.90														9.9		
																							4,328	6.00	6.00	12.0		12.0		
PAN_000_100		2,042	100	0.150	Grass-Short Grass Prairie	0.748	3.95	13.1																		PAN_000_100	13.1	**15.4**	**0.26**
									258	0.786	1.43	Unpaved	3.01														3.0		
									1,685	2.054	2.91	Paved	9.64														9.6		
PAN_000_110		2,848	100	0.150	Grass-Short Grass Prairie	2.376	3.95	8.2																		PAN_000_110	8.2	**12.3**	**0.20**
									958	1.160	2.19	Paved	7.29														7.3		
																							1,790	6.00	6.00	5.0		5.0		
PAN_000_120		2,917	100	0.150	Grass-Short Grass Prairie	2.420	3.95	8.2																		PAN_000_120	8.2	**10.9**	**0.18**
									228	3.247	2.91	Unpaved	1.31														1.3		
									714	2.717	3.35	Paved	3.55														3.6		
																							1,876	6.00	6.00	5.2		5.2		
PAN_000_130		3,301	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.457	3.95	0.7																		PAN_000_130	0.7	**18.4**	**0.31**
									601	3.667	3.89	Paved	2.57														2.6		
														2,650	0.886	10.4	27.8	0.045	1.61		1.61	27.39						27.4		
RUS_000_360		3,176	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_360	1.1	**8.0**	**0.13**
									1,427	2.340	3.11	Paved	7.65														7.6		
																							1,497	6.00	6.00	4.2		4.2		
														202	8.113	17.4	14.8	0.065	7.28		7.28	0.46						0.5		
RUS_000_370		2,146	100	0.150	Grass-Short Grass Prairie	3.750	3.95	6.9																		RUS_000_370	6.9	**9.5**	**0.16**
									121	8.763	4.78	Unpaved	0.42														0.4		
														1,927	3.223	6.1	12.1	0.045	3.77		3.77	8.53						8.5		
RUS_000_380		674	100	0.150	Grass-Short Grass Prairie	4.730	3.95	6.2																		RUS_000_380	6.2	**5.0**	**0.08**
									573	7.984	4.56	Unpaved	2.09														2.1		
RUS_000_390		2,658	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_000_390	1.0	**11.0**	**0.18**
									1,257	0.579	1.55	Paved	13.54														13.5		
																							1,352	6.00	6.00	3.8		3.8		
RUS_000_400		1,435	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.646	3.95	1.0																		RUS_000_400	1.0	**3.1**	**0.05**
									478	5.274	4.67	Paved	1.71														1.7		
																							907	6.00	6.00	2.5		2.5		
RUS_000_410		4,837	100	0.150	Grass-Short Grass Prairie	3.876	3.95	6.8																		RUS_000_410	6.8	**12.9**	**0.22**
									1,216	3.291	3.69	Paved	5.50														5.5		
																							508	6.00	6.00	1.4		1.4		
														2,220	1.962	1.7	5.2	0.015	6.48		6.48	5.71						5.7		
																							791	6.00	6.00	2.2		2.2		
RUS_000_420		2,655	50	0.150	Grass-Short Grass Prairie	1.100	3.95	6.4																		RUS_000_420	6.4	**8.8**	**0.15**
									375	2.429	3.17	Paved	1.97														2.0		
																							2,231	6.00	6.00	6.2		6.2		
RUS_000_430		1,770	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.928	3.95	0.4																		RUS_000_430	0.4	**4.3**	**0.07**
									1,220	3.529	3.82	Paved	5.32														5.3		
																							501	6.00	6.00	1.4		1.4		
RUS_000_440		391	100	0.150	Grass-Short Grass Prairie	3.155	3.95	7.3																		RUS_000_440	7.3	**5.5**	**0.09**
									287	2.680	2.64	Unpaved	1.81														1.8		
RUS_000_450		5,802	100	0.150	Grass-Short Grass Prairie	1.109	3.95	11.2																		RUS_000_450	11.2	**21.1**	**0.35**
									879	0.722	1.37	Unpaved	10.69														10.7		
																							4,822	6.00	6.00	13.4		13.4		
RUS_000_460		2,409	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.526	3.95	1.1																		RUS_000_460	1.1	**7.6**	**0.13**
									653	0.621	1.60	Paved	6.79														6.8		
																							1,707	6.00	6.00	4.7		4.7		

Appendix B-3

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_470														1,965	0.500	100.4	58.2	0.050	3.03		3.03	10.80					RUS_000_470	10.8	**6.5**	**0.11**
RUS_000_480														297	0.500	104.1	60.6	0.065	2.32		2.32	2.13					RUS_000_480	10.0	**6.0**	**0.10**
RUS_000_500		856												856	1.719	140.3	36.4	0.065	7.39		7.39	1.93					RUS_000_500	10.0	**6.0**	**0.10**
RUS_000_510		3,401	50	0.150	Grass-Short Grass Prairie	3.981	3.95	3.8																			RUS_000_510	3.8	**10.5**	**0.18**
									1,647	4.446	4.29	Paved	6.40															6.4		
														1,704	1.624	2.5	2.8	0.045	3.89		3.89	7.30						7.3		
RUS_000_520		689	100	0.150	Grass-Short Grass Prairie	1.650	3.95	9.5																			RUS_000_520	9.5	**8.0**	**0.13**
									589	2.603	2.60	Unpaved	3.77															3.8		
RUS_000_530		5,641	100	0.150	Grass-Short Grass Prairie	7.835	3.95	5.1																			RUS_000_530	5.1	**40.9**	**0.68**
									3,227	0.500	1.14	Unpaved	47.14															47.1		
														2,315	0.500	105.9	58.3	0.065	2.41		2.41	15.99						16.0		
RUS_003_010		2,458	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.628	3.95	1.0																			RUS_003_010	1.0	**5.7**	**0.10**
									731	2.369	3.13	Paved	3.89															3.9		
																							1,676	6.00	6.00	4.7		4.7		
RUS_003_020		3,664	98	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.191	3.95	1.0																			RUS_003_020	1.0	**7.8**	**0.13**
									740	2.179	3.00	Paved	4.11															4.1		
																							2,826	6.00	6.00	7.9		7.9		
RUS_004_001_010		2,717	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.713	3.95	0.9																			RUS_004_001_010	0.9	**14.8**	**0.25**
														2,666	0.585	9.2	14.4	0.045	1.88		1.88	23.68						23.7		
RUS_004_001_020		2,250	100	0.150	Grass-Short Grass Prairie	5.307	3.95	6.0																			RUS_004_001_020	6.0	**8.7**	**0.14**
									560	2.970	2.78	Unpaved	3.36															3.4		
														455	1.358	8.0	10.2	0.045	3.27		3.27	2.32						2.3		
														1,135	0.777			0.065	6.66	6.66	6.66	2.84						2.8		
RUS_004_001_030		2,222	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.375	3.95	0.7																			RUS_004_001_030	0.7	**5.1**	**0.09**
														891	3.344	5.5	13.7	0.045	3.29		3.29	4.52						4.5		
														1,278	2.228			0.065	6.43	6.43	6.43	3.31						3.3		
RUS_004_001_040		592	100	0.150	Grass-Short Grass Prairie	5.366	3.95	5.9																			RUS_004_001_040	5.9	**4.5**	**0.08**
									494	10.075	5.12	Unpaved	1.61															1.6		
RUS_004_010		3,537	77	0.150	Grass-Short Grass Prairie	3.850	3.95	5.5																			RUS_004_010	5.5	**15.3**	**0.26**
									100	2.405	2.50	Unpaved	0.67															0.7		
									614	0.914	1.94	Paved	5.27															5.3		
																							515	6.00	6.00	1.4		1.4		
														2,231	0.537	23.8	17.9	0.045	2.94		2.94	12.65						12.7		
RUS_004_020		2,424	100	0.150	Grass-Short Grass Prairie	1.256	3.95	10.6																			RUS_004_020	10.6	**20.1**	**0.33**
									1,076	0.506	1.15	Unpaved	15.63															15.6		
														1,246	0.850	8.3	9.0	0.045	2.89		2.89	7.19						7.2		
RUS_004_030		1,793	49	0.150	Grass-Short Grass Prairie	1.391	3.95	5.8																			RUS_004_030	5.8	**11.5**	**0.19**
									1,188	1.434	1.93	Unpaved	10.25															10.2		
														556	0.500			0.055	2.87	2.87	2.87	3.23						3.2		
RUS_004_040		1,909	100	0.150	Grass-Short Grass Prairie	2.384	3.95	8.2																			RUS_004_040	8.2	**14.2**	**0.24**
									726	0.500	1.14	Unpaved	10.61															10.6		
														1,084	3.061			0.045	3.73	3.73	3.73	4.84						4.8		
RUS_004_050		2,011	100	0.150	Grass-Short Grass Prairie	3.174	3.95	7.3																			RUS_004_050	7.3	**8.9**	**0.15**
									596	3.614	3.07	Unpaved	3.24															3.2		
									638	1.985	2.86	Paved	3.71															3.7		
														677	2.910	311.4	137.2	0.024	18.29		18.29	0.62						0.6		
RUS_005_002_010		3,287	60	0.150	Grass-Short Grass Prairie	9.203	3.95	3.2																			RUS_005_002_010	3.2	**8.9**	**0.15**
									1,438	3.112	3.59	Paved	6.68															6.7		
																							1,789	6.00	6.00	5.0		5.0		
RUS_005_010		3,228	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.900	3.95	0.6																			RUS_005_010	0.6	**9.7**	**0.16**
									1,760	1.571	2.55	Paved	11.51															11.5		
																							1,417	6.00	6.00	3.9		3.9		
RUS_005_020		1,426	56	0.150	Grass-Short Grass Prairie	8.478	3.95	3.1																			RUS_005_020	3.1	**6.5**	**0.11**
									755	2.282	3.07	Paved	4.10															4.1		
									615	3.197	2.88	Unpaved	3.55															3.6		
RUS_005_030		3,299	81	0.150	Grass-Short Grass Prairie	1.329	3.95	8.8																			RUS_005_030	8.8	**13.4**	**0.22**
									1,672	2.126	2.96	Paved	9.40															9.4		
																							1,257	6.00	6.00	3.5		3.5		
														289	2.204	1.4	3.6	0.015	7.83		7.83	0.62						0.6		
RUS_005_040		1,121	100	0.150	Grass-Short Grass Prairie	4.480	3.95	6.4																			RUS_005_040	6.4	**7.7**	**0.13**
									804	1.240	2.26	Paved	5.92															5.9		
																							217	6.00	6.00	0.6		0.6		
RUS_005_050		4,115	100	0.150	Grass-Short Grass Prairie	5.308	3.95	6.0																			RUS_005_050	6.0	**14.4**	**0.24**
														2,095	1.936	1.9	4.0	0.045	2.76		2.76	12.67						12.7		
																							1,921	6.00	6.00	5.3		5.3		
RUS_005_060		1,894	100	0.150	Grass-Short Grass Prairie	3.446	3.95	7.1																			RUS_005_060	7.1	**12.3**	**0.20**
									1,441	0.916	1.95	Paved	12.34															12.3		
																							354	6.00	6.00	1.0		1.0		
RUS_005_070		671	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.864	3.95	0.9																			RUS_005_070	0.9	**2.6**	**0.04**
									621	2.199	3.01	Paved	3.43															3.4		
RUS_006_010		2,750	38	0.150	Grass-Short Grass Prairie	5.841	3.95	2.6																			RUS_006_010	2.6	**7.3**	**0.12**
									677	3.792	3.96	Paved	2.85															2.9		
														2,035	2.914	45.5	30.9	0.065	5.06		5.06	6.70						6.7		
RUS_RC2_010		4,624	100	0.150	Grass-Short Grass Prairie	5.259	3.95	6.0																			RUS_RC2_010	6.0	**13.6**	**0.23**
									1,085	2.477	2.54	Unpaved	7.12															7.1		
																							3,440	6.00	6.00	9.6		9.6		
RUS_RC2_020		3,281	49	0.150	Grass-Short Grass Prairie	3.496	3.95	4.0																			RUS_RC2_020	4.0	**10.0**	**0.17**
														1,238	2.750	3.3	8.5	0.045	2.90		2.90	7.11						7.1		
																							1,994	6.00	6.00	5.5		5.5		
RUS_RC2_030		2,943	100	0.150	Grass-Short Grass Prairie	3.122	3.95	7.4																			RUS_RC2_030	7.4	**11.5**	**0.19**
														1,631	1.945	4.2	7.2	0.045	3.21		3.21	8.46						8.5		
																							1,212	6.00	6.00	3.4		3.4		

Appendix B-3

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RC2_040		2,905	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_040	1.1	**9.0**	**0.15**
									1,470	1.426	2.43	Paved	10.09														10.1		
																							1,385	6.00	6.00	3.8		3.8		
RUS_RC2_050		3,579	100	0.150	Grass-Short Grass Prairie	4.446	3.95	6.4																		RUS_RC2_050	6.4	**13.2**	**0.22**
									398	2.553	2.58	Unpaved	2.57														2.6		
									963	1.234	2.26	Paved	7.11														7.1		
																							2,117	6.00	6.00	5.9		5.9		
RUS_RC2_060		3,143	65	0.150	Grass-Short Grass Prairie	8.975	3.95	3.4																		RUS_RC2_060	3.4	**8.3**	**0.14**
									860	4.128	4.13	Paved	3.47														3.5		
																							1,110	6.00	6.00	3.1		3.1		
														740	2.606	14.8	11.5	0.065	4.39		4.39	2.81						2.8		
																							369	6.00	6.00	1.0		1.0		
RUS_RC2_070		2,142	42	0.150	Grass-Short Grass Prairie	20.469	3.95	1.7																		RUS_RC2_070	1.7	**6.4**	**0.11**
									1,843	3.404	3.75	Paved	8.19														8.2		
																							257	6.00	6.00	0.7		0.7		
RUS_RC2_080		1,482	100	0.150	Grass-Short Grass Prairie	7.150	3.95	5.3																		RUS_RC2_080	5.3	**6.6**	**0.11**
									418	5.026	3.62	Unpaved	1.93														1.9		
									612	2.960	3.50	Paved	2.92														2.9		
														353	6.538	10.7	7.9	0.065	7.17		7.17	0.82						0.8		
RUS_RC2_085		2,259	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_085	1.1	**6.0**	**0.10**
									762	1.644	2.61	Paved	4.87														4.9		
																							1,448	6.00	6.00	4.0		4.0		
RUS_RC2_090		3,894	83	0.150	Grass-Short Grass Prairie	8.486	3.95	4.3																		RUS_RC2_090	4.3	**13.6**	**0.23**
									1,159	3.169	3.62	Paved	5.34														5.3		
																							238	6.00	6.00	0.7		0.7		
														1,893	1.779	19.5	21.2	0.065	2.90		2.90	10.89						10.9		
																							522	6.00	6.00	1.5		1.5		
RUS_RC2_100		2,889	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.922	3.95	0.6																		RUS_RC2_100	0.6	**6.9**	**0.12**
									1,351	2.673	3.32	Paved	6.77														6.8		
																							1,489	6.00	6.00	4.1		4.1		
RUS_RC2_110		1,928	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_110	1.1	**4.8**	**0.08**
									1,114	3.655	3.89	Paved	4.78														4.8		
																							764	6.00	6.00	2.1		2.1		
RUS_RCH_010		3,584	100	0.150	Grass-Short Grass Prairie	7.263	3.95	5.3																		RUS_RCH_010	5.3	**9.0**	**0.15**
														1,730	4.622	19.8	14.9	0.065	5.95		5.95	4.84						4.8		
																							1,755	6.00	6.00	4.9		4.9		
RUS_RCH_020		1,780	100	0.150	Grass-Short Grass Prairie	2.105	3.95	8.6																		RUS_RCH_020	8.6	**12.0**	**0.20**
									64	4.464	3.41	Unpaved	0.31														0.3		
									759	0.523	1.47	Paved	8.60														8.6		
																							855	6.00	6.00	2.4		2.4		
RUS_RCH_030		0		0.150	Grass-Short Grass Prairie	0.500																				RUS_RCH_030	10.0	**6.0**	**0.10**
RUS_RCH_040		1,724	100	0.150	Grass-Short Grass Prairie	1.610	3.95	9.6																		RUS_RCH_040	9.6	**13.7**	**0.23**
									798	0.721	1.73	Paved	7.71														7.7		
									826	2.342	2.47	Unpaved	5.57														5.6		
RUS_RCH_050		0		0.150	Grass-Short Grass Prairie	0.500																				RUS_RCH_050	10.0	**6.0**	**0.10**
RUS_RCH_060		2,902	100	0.150	Grass-Short Grass Prairie	10.150	3.95	4.6																		RUS_RCH_060	4.6	**8.5**	**0.14**
									471	3.547	3.04	Unpaved	2.58														2.6		
														2,331	0.500	1224.8	249.1	0.055	5.54		5.54	7.01						7.0		

Appendix B-3

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_190		3,167	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.910	3.95	0.6																		RUS_000_190	0.6	**10.7**	**0.18**
									1,512	0.949	1.98	Paved	12.73														12.7		
																						1,605	6.00	6.00	4.5		4.5		
RUS_000_200		1,447	100	0.150	Grass-Short Grass Prairie	1.039	3.95	11.5																		RUS_000_200	11.5	**10.8**	**0.18**
									1,348	4.474	3.41	Unpaved	6.58														6.6		
RUS_000_210		2,148	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.878	3.95	0.9																		RUS_000_210	0.9	**8.4**	**0.14**
									1,259	0.960	1.99	Paved	10.54														10.5		
																						420	6.00	6.00	1.2		1.2		
														417	3.442	31.0	24.1	0.065	5.03		5.03	1.38					1.4		
RUS_000_220		845	100	0.150	Grass-Short Grass Prairie	1.137	3.95	11.1																		RUS_000_220	11.1	**9.8**	**0.16**
									748	2.197	2.39	Unpaved	5.21														5.2		
RUS_000_230		1,908	45	0.150	Grass-Short Grass Prairie	3.872	3.95	3.6																		RUS_000_230	3.6	**6.8**	**0.11**
									1,391	3.055	3.55	Paved	6.52														6.5		
																						471	6.00	6.00	1.3		1.3		
RUS_000_240		1,677	100	0.150	Grass-Short Grass Prairie	1.499	3.95	9.9																		RUS_000_240	9.9	**9.5**	**0.16**
									205	3.455	3.00	Unpaved	1.14														1.1		
									221	1.293	2.31	Paved	1.59														1.6		
																						1,150	6.00	6.00	3.2		3.2		
RUS_000_250		754	100	0.150	Grass-Short Grass Prairie	5.941	3.95	5.7																		RUS_000_250	5.7	**4.9**	**0.08**
									655	7.526	4.43	Unpaved	2.47														2.5		
RUS_000_260		514	100	0.150	Grass-Short Grass Prairie	5.690	3.95	5.8																		RUS_000_260	5.8	**4.6**	**0.08**
									414	5.398	3.75	Unpaved	1.84														1.8		
RUS_000_270		3,893	100	0.150	Grass-Short Grass Prairie	1.409	3.95	10.1																		RUS_000_270	10.1	**18.2**	**0.30**
									752	1.894	2.22	Unpaved	5.64														5.6		
														1,417	2.138	10.5	18.3	0.065	2.31		2.31	10.22					10.2		
																						1,381	6.00	6.00	3.8		3.8		
														243	9.110	11.9	8.3	0.065	8.85		8.85	0.46					0.5		
RUS_000_280		1,435	50	0.150	Grass-Short Grass Prairie	10.595	3.95	2.6																		RUS_000_280	2.6	**6.6**	**0.11**
									1,004	1.550	2.53	Paved	6.61														6.6		
									380	4.793	3.53	Unpaved	1.79														1.8		
RUS_000_290		1,931	100	0.150	Grass-Short Grass Prairie	8.438	3.95	5.0																		RUS_000_290	5.0	**8.4**	**0.14**
									157	1.504	1.98	Unpaved	1.32														1.3		
														1,673	3.209	2.0	4.1	0.045	3.64		3.64	7.65					7.7		
RUS_000_300		2,275	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.076	3.95	0.6																		RUS_000_300	0.6	**4.4**	**0.07**
									37	3.386	3.74	Paved	0.16														0.2		
									118	3.832	3.16	Unpaved	0.62														0.6		
														2,068	3.722	1.3	7.4	0.015	5.86		5.86	5.89					5.9		
RUS_000_310		3,314	100	0.150	Grass-Short Grass Prairie	0.624	3.95	14.1																		RUS_000_310	14.1	**17.6**	**0.29**
														1,362	1.210	19.7	28.6	0.045	2.84		2.84	8.01					8.0		
																						407	6.00	6.00	1.1		1.1		
														1,142	1.393	62.0	39.7	0.065	3.64		3.64	5.23					5.2		
																						301	6.00	6.00	0.8		0.8		
RUS_000_320		3,334	100	0.150	Grass-Short Grass Prairie	4.808	3.95	6.2																		RUS_000_320	6.2	**10.7**	**0.18**
									193	8.064	4.58	Unpaved	0.70														0.7		
									538	1.977	2.86	Paved	3.14														3.1		
														328	1.141	6.8	7.9	0.045	3.23		3.23	1.69					1.7		
																						2,174	6.00	6.00	6.0		6.0		
RUS_000_330		3,501	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.668	3.95	0.6																		RUS_000_330	0.6	**16.2**	**0.27**
									1,910	0.530	1.48	Paved	21.51														21.5		
																						847	6.00	6.00	2.4		2.4		
														694	0.500	152.2	33.1	0.065	4.49		4.49	2.58					2.6		
RUS_000_340		2,466	100	0.150	Grass-Short Grass Prairie	5.297	3.95	6.0																		RUS_000_340	6.0	**11.6**	**0.19**
									861	4.878	3.56	Unpaved	4.03														4.0		
									691	3.183	3.63	Paved	3.18														3.2		
									814	1.818	2.18	Unpaved	6.24														6.2		
RUS_000_350		3,685	100	0.150	Grass-Short Grass Prairie	6.822	3.95	5.4																		RUS_000_350	5.4	**22.3**	**0.37**
									1,104	2.368	2.48	Unpaved	7.41														7.4		
														1,357	0.659	0.7	2.9	0.045	1.03		1.03	21.97					22.0		
																						590	6.00	6.00	1.6		1.6		
														535	4.495	70.0	89.0	0.024	11.21		11.21	0.80					0.8		
RUS_007_010		2,493	100	0.150	Grass-Short Grass Prairie	2.146	3.95	8.6																		RUS_007_010	8.6	**11.3**	**0.19**
									807	2.173	2.38	Unpaved	5.66														5.7		
														138	0.547	4.1	10.1	0.015	4.00		4.00	0.58					0.6		
																						1,448	6.00	6.00	4.0		4.0		
RUS_007_020		3,709	28	0.150	Grass-Short Grass Prairie	1.228	3.95	3.9																		RUS_007_020	3.9	**11.0**	**0.18**
									1,293	1.397	2.40	Paved	8.97														9.0		
																						171	6.00	6.00	0.5		0.5		
														1,837	1.419			0.015	7.83	7.83	7.83	3.91					3.9		
																						380	6.00	6.00	1.1		1.1		

Appendix B-3

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_007_030		3,847	100	0.150	Grass-Short Grass Prairie	1.065	3.95	11.3																		RUS_007_030	11.3	**21.3**	**0.35**
									1,090	0.691	1.34	Unpaved	13.55														13.5		
									791	1.474	2.47	Paved	5.34														5.3		
																						1,867	6.00	6.00	5.2		5.2		
RUS_007_040		3,613	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.497	3.95	0.5																		RUS_007_040	0.5	**10.7**	**0.18**
									273	0.714	1.72	Paved	2.65														2.6		
														1,182	2.760	4.7	11.2	0.045	3.09		3.09	6.38						6.4		
														2,106	1.153	80.2	35.5	0.065	4.24		4.24	8.28						8.3		
RUS_007_050		2,081	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_007_050	1.1	**6.6**	**0.11**
									1,310	1.877	2.79	Paved	7.84														7.8		
																						722	6.00	6.00	2.0		2.0		
RUS_007_060		972	53	0.150	Grass-Short Grass Prairie	3.873	3.95	4.1																		RUS_007_060	4.1	**5.1**	**0.09**
									777	2.448	3.18	Paved	4.07														4.1		
																						142	6.00	6.00	0.4		0.4		
RUS_007_070		3,594	100	0.150	Grass-Short Grass Prairie	5.870	3.95	5.7																		RUS_007_070	5.7	**13.2**	**0.22**
														2,102	1.452	15.5	27.5	0.045	2.73		2.73	12.85						12.9		
																						767	6.00	6.00	2.1		2.1		
														625	3.995	36.3	15.3	0.065	8.17		8.17	1.28						1.3		
RUS_008_010		4,459	100	0.150	Grass-Short Grass Prairie	0.755	3.95	13.0																		RUS_008_010	13.0	**17.4**	**0.29**
														1,283	1.961	2.4	4.6	0.045	3.03		3.03	7.07						7.1		
																						2,450	6.00	6.00	6.8		6.8		
														620	2.319	13.9	8.6	0.065	4.83		4.83	2.14						2.1		
RUS_009_010		3,279	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_010	1.1	**7.1**	**0.12**
									471	1.550	2.53	Paved	3.10														3.1		
																						2,758	6.00	6.00	7.7		7.7		
RUS_009_020		3,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_009_020	1.0	**13.0**	**0.22**
									1,970	1.058	2.09	Paved	15.70														15.7		
																						1,774	6.00	6.00	4.9		4.9		
RUS_009_030		3,660	51	0.150	Grass-Short Grass Prairie	5.576	3.95	3.4																		RUS_009_030	3.4	**9.2**	**0.15**
									223	0.526	1.47	Paved	2.52														2.5		
																						3,387	6.00	6.00	9.4		9.4		
RUS_009_040		3,486	49	0.150	Grass-Short Grass Prairie	2.375	3.95	4.7																		RUS_009_040	4.7	**14.5**	**0.24**
									1,374	0.886	1.91	Paved	11.97														12.0		
														751	2.041	1.3	2.7	0.045	2.89		2.89	4.33						4.3		
																						435	6.00	6.00	1.2		1.2		
														878	1.504	1.4	3.3	0.015	7.01		7.01	2.09						2.1		
RUS_009_050		3,246	32	0.150	Grass-Short Grass Prairie	4.626	3.95	2.5																		RUS_009_050	2.5	**11.1**	**0.19**
									601	0.863	1.89	Paved	5.30														5.3		
																						409	6.00	6.00	1.1		1.1		
														1,290	1.118	38.9	52.1	0.045	2.88		2.88	7.46						7.5		
														914	1.796	1.1	2.8	0.015	7.24		7.24	2.11						2.1		
RUS_009_060		517	50	0.150	Grass-Short Grass Prairie	2.845	3.95	4.4																		RUS_009_060	4.4	**4.1**	**0.07**
									467	2.501	3.21	Paved	2.42														2.4		
RUS_009_070		1,305	100	0.150	Grass-Short Grass Prairie	3.928	3.95	6.7																		RUS_009_070	6.7	**6.5**	**0.11**
														1,205	2.904	11.8	14.8	0.045	4.85		4.85	4.14						4.1		
RUS_009_080		2,650	44	0.150	Grass-Short Grass Prairie	9.012	3.95	2.5																		RUS_009_080	2.5	**8.3**	**0.14**
									1,042	1.494	2.48	Paved	6.99														7.0		
																						1,563	6.00	6.00	4.3		4.3		
RUS_009_090		762	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_090	1.1	**2.3**	**0.04**
									712	4.332	4.23	Paved	2.80														2.8		
RUS_010_001_010		2,007	31	0.150	Grass-Short Grass Prairie	8.518	3.95	1.9																		RUS_010_001_010	1.9	**6.7**	**0.11**
									1,076	1.754	2.69	Paved	6.66														6.7		
																						900	6.00	6.00	2.5		2.5		
RUS_010_001_020		1,631	100	0.150	Grass-Short Grass Prairie	2.568	3.95	8.0																		RUS_010_001_020	8.0	**10.0**	**0.17**
									329	1.345	1.87	Unpaved	2.93														2.9		
									656	1.566	2.54	Paved	4.30														4.3		
																						546	6.00	6.00	1.5		1.5		
RUS_010_002_010		3,151	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.478	3.95	0.7																		RUS_010_002_010	0.7	**7.8**	**0.13**
									1,207	2.020	2.89	Paved	6.96														7.0		
																						1,892	6.00	6.00	5.3		5.3		
RUS_010_002_020		729	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.895	3.95	0.5																		RUS_010_002_020	0.5	**2.7**	**0.05**
									489	1.276	2.30	Paved	3.55														3.5		
																						185	6.00	6.00	0.5		0.5		
RUS_010_002_030		268	100	0.150	Grass-Short Grass Prairie	3.992	3.95	6.7																		RUS_010_002_030	6.7	**4.4**	**0.07**
									169	7.631	4.46	Unpaved	0.63														0.6		
RUS_010_003_010		3,676	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_003_010	1.1	**8.0**	**0.13**
									332	0.979	2.01	Paved	2.75														2.8		
																						2,801	6.00	6.00	7.8		7.8		
														493	2.674	8.4	5.6	0.065	4.95		4.95	1.66						1.7		
RUS_010_003_020		782	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.740	3.95	0.9																		RUS_010_003_020	0.9	**2.3**	**0.04**
									732	4.394	4.26	Paved	2.86														2.9		
RUS_010_004_010		3,696	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.845	3.95	0.6																		RUS_010_004_010	0.6	**13.0**	**0.22**
									2,116	1.071	2.10	Paved	16.76														16.8		
																						1,530	6.00	6.00	4.3		4.3		
RUS_010_004_020		2,840	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_004_020	1.1	**10.7**	**0.18**
									1,248	0.837	1.86	Paved	11.18														11.2		
														695	0.500	87.1	32.9	0.055	3.67		3.67	3.16						3.2		
																						846	6.00	6.00	2.4		2.4		
RUS_010_004_030		5,070	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_010_004_030	15.4	**23.5**	**0.39**
														2,154	0.945	13.7	23.5	0.045	2.25		2.25	15.95						15.9		
																						2,815	6.00	6.00	7.8		7.8		

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_010_004_040		1,541	41	0.150	Grass-Short Grass Prairie	2.765	3.95	3.8																		RUS_010_004_040	3.8	**6.1**	**0.10**
									977	2.681	3.33	Paved	4.89														4.9		
																						523	6.00	6.00	1.5		1.5		
RUS_010_010		4,841	100	0.150	Grass-Short Grass Prairie	4.537	3.95	6.4																		RUS_010_010	6.4	**19.4**	**0.32**
									213	3.976	3.22	Unpaved	1.10														1.1		
														2,090	1.163	3.5	9.2	0.045	1.89		1.89	18.47						18.5		
																						1,312	6.00	6.00	3.6		3.6		
														646	1.756	0.7	1.6	0.015	7.25		7.25	1.49						1.5		
																						480	6.00	6.00	1.3		1.3		
RUS_010_020		343	100	0.150	Grass-Short Grass Prairie	0.525	3.95	15.1																		RUS_010_020	15.1	**9.6**	**0.16**
									241	6.397	4.08	Unpaved	0.98														1.0		
RUS_010_030		1,321	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.663	3.95	0.6																		RUS_010_030	0.6	**4.5**	**0.08**
									1,271	2.209	3.02	Paved	7.01														7.0		
RUS_010_040		1,759	100	0.150	Grass-Short Grass Prairie	4.802	3.95	6.2																		RUS_010_040	6.2	**7.7**	**0.13**
									602	1.730	2.67	Paved	3.75														3.8		
																						1,059	6.00	6.00	2.9		2.9		
RUS_011_010		2,319	100	0.150	Grass-Short Grass Prairie	2.369	3.95	8.2																		RUS_011_010	8.2	**11.0**	**0.18**
									789	2.589	2.60	Unpaved	5.07														5.1		
														1,432	1.614	56.0	26.8	0.065	4.76		4.76	5.02						5.0		
RUS_011_020		1,738	71	0.150	Grass-Short Grass Prairie	3.175	3.95	5.6																		RUS_011_020	5.6	**8.0**	**0.13**
														1,299	3.035	3.9	9.5	0.045	3.18		3.18	6.80						6.8		
																						368	6.00	6.00	1.0		1.0		
RUS_012_010		4,330	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.660	3.95	0.7																		RUS_012_010	0.7	**11.2**	**0.19**
									219	1.260	2.28	Paved	1.60														1.6		
									927	1.540	2.00	Unpaved	7.72														7.7		
																						3,133	6.00	6.00	8.7		8.7		
RUS_012_020		4,124	100	0.150	Grass-Short Grass Prairie	0.813	3.95	12.6																		RUS_012_020	12.6	**16.8**	**0.28**
									540	1.611	2.05	Unpaved	4.39														4.4		
									464	2.235	3.04	Paved	2.54														2.5		
																						3,020	6.00	6.00	8.4		8.4		
RUS_012_030		423	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.381	3.95	0.5																		RUS_012_030	0.5	**1.3**	**0.02**
									375	3.338	3.71	Paved	1.68														1.7		
RUS_013_010		2,469	100	0.150	Grass-Short Grass Prairie	1.827	3.95	9.1																		RUS_013_010	9.1	**11.5**	**0.19**
									743	1.962	2.26	Unpaved	5.48														5.5		
																						1,625	6.00	6.00	4.5		4.5		
RUS_013_020		1,511	100	0.150	Grass-Short Grass Prairie	0.590	3.95	14.4																		RUS_013_020	14.4	**15.5**	**0.26**
									1,410	1.593	2.04	Unpaved	11.54														11.5		
RUS_013_030		1,261	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_013_030	1.1	**4.0**	**0.07**
									1,212	3.168	3.62	Paved	5.58														5.6		
RUS_014_010		3,428	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.947	3.95	0.5																		RUS_014_010	0.5	**12.6**	**0.21**
														1,756	0.732	14.4	21.2	0.045	2.19		2.19	13.37						13.4		
																						528	6.00	6.00	1.5		1.5		
														1,099	1.577	11.1	16.0	0.045	3.26		3.26	5.62						5.6		
RUS_014_020		2,053	100	0.150	Grass-Short Grass Prairie	4.554	3.95	6.3																		RUS_014_020	6.3	**11.4**	**0.19**
									131	5.140	3.66	Unpaved	0.60														0.6		
									475	1.609	2.58	Paved	3.07														3.1		
									467	0.546	1.19	Unpaved	6.53														6.5		
																						882	6.00	6.00	2.5		2.5		
RUS_015_010		3,692	100	0.150	Grass-Short Grass Prairie	2.397	3.95	8.2																		RUS_015_010	8.2	**15.5**	**0.26**
									432	0.582	1.55	Paved	4.64														4.6		
																						638	6.00	6.00	1.8		1.8		
														889	1.588	22.2	56.4	0.045	2.24		2.24	6.61						6.6		
																						1,634	6.00	6.00	4.5		4.5		
RUS_015_020		2,629	100	0.150	Grass-Short Grass Prairie	2.181	3.95	8.5																		RUS_015_020	8.5	**10.2**	**0.17**
									56	2.495	2.55	Unpaved	0.37														0.4		
									388	1.870	2.78	Paved	2.33														2.3		
																						2,085	6.00	6.00	5.8		5.8		
RYA_000_010		2,853	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RYA_000_010	1.1	**10.0**	**0.17**
									1,121	0.714	1.72	Paved	10.88														10.9		
																						1,681	6.00	6.00	4.7		4.7		
RYA_000_020		5,389	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RYA_000_020	15.4	**19.6**	**0.33**
									709	2.571	2.59	Unpaved	4.57														4.6		
																						4,581	6.00	6.00	12.7		12.7		
RYA_000_030		4,581	100	0.150	Grass-Short Grass Prairie	2.566	3.95	8.0																		RYA_000_030	8.0	**16.4**	**0.27**
									1,191	1.453	1.94	Unpaved	10.21														10.2		
																						3,290	6.00	6.00	9.1		9.1		
RYA_000_040		4,283	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.387	3.95	0.7																		RYA_000_040	0.7	**8.7**	**0.14**
									575	1.727	2.67	Paved	3.59														3.6		
																						3,657	6.00	6.00	10.2		10.2		
RYA_000_050		456	100	0.150	Grass-Short Grass Prairie	2.022	3.95	8.8																		RYA_000_050	8.8	**6.5**	**0.11**
									357	3.319	2.94	Unpaved	2.02														2.0		
RYA_000_060		1,480	100	0.150	Grass-Short Grass Prairie	1.520	3.95	9.8																		RYA_000_060	9.8	**11.3**	**0.19**
									1,000	2.134	2.36	Unpaved	7.07														7.1		
									381	4.080	3.26	Unpaved	1.95														1.9		
RYA_000_070		3,198	100	0.150	Grass-Short Grass Prairie	1.235	3.95	10.7																		RYA_000_070	10.7	**14.0**	**0.23**
									937	2.236	2.41	Unpaved	6.47														6.5		
														416	2.751	23.4	15.2	0.065	5.06		5.06	1.37						1.4		
																						1,744	6.00	6.00	4.8		4.8		
RYA_000_080		1,688	100	0.150	Grass-Short Grass Prairie	2.993	3.95	7.5																		RYA_000_080	7.5	**8.3**	**0.14**
									614	3.984	4.06	Paved	2.52														2.5		
														668	1.829	1.1	7.3	0.015	3.85		3.85	2.89						2.9		
																						301	6.00	6.00	0.8		0.8		
RYA_001_010		3,045	47	0.150	Grass-Short Grass Prairie	4.536	3.95	3.5																		RYA_001_010	3.5	**11.1**	**0.18**
									1,943	1.879	2.79	Paved	11.62														11.6		
																						428	6.00	6.00	1.2		1.2		

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
														628	0.866	91.4	26.9	0.065	4.83		4.83	2.17						2.2		
RYA_001_020		1,206	100	0.150	Grass-Short Grass Prairie	1.416	3.95	10.1																			RYA_001_020	10.1	**8.5**	**0.14**
									272	2.860	2.73	Unpaved	1.66															1.7		
																							834	6.00	6.00	2.3		2.3		
TWI_000_010		3,106	35	0.150	Grass-Short Grass Prairie	5.166	3.95	2.6																			TWI_000_010	2.6	**12.0**	**0.20**
									1,530	0.931	1.96	Paved	13.00															13.0		
																							294	6.00	6.00	0.8		0.8		
														334	1.700	28.3	16.5	0.065	4.28		4.28	1.30						1.3		
																							528	6.00	6.00	1.5		1.5		
														385	1.504	6.0	10.7	0.015	8.26		8.26	0.78						0.8		
TWI_000_020		2,662	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.476	3.95	0.6																			TWI_000_020	0.6	**5.3**	**0.09**
									613	3.063	3.56	Paved	2.87															2.9		
																							1,169	6.00	6.00	3.2		3.2		
														831	1.287			0.065	6.27	6.27	6.27	2.21						2.2		
TWI_000_030		3,151	81	0.150	Grass-Short Grass Prairie	3.009	3.95	6.3																			TWI_000_030	6.3	**13.7**	**0.23**
									1,162	0.675	1.67	Paved	11.60															11.6		
																							1,294	6.00	6.00	3.6		3.6		
														613	0.900			0.065	8.10	8.10	8.10	1.26						1.3		
TWI_000_040		1,403	100	0.150	Grass-Short Grass Prairie	2.163	3.95	8.5																			TWI_000_040	8.5	**11.7**	**0.20**
									1,302	1.493	1.97	Unpaved	11.01															11.0		
TWI_000_050		3,239	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.756	3.95	0.7																			TWI_000_050	0.7	**8.7**	**0.15**
									1,619	1.929	2.82	Paved	9.56															9.6		
																							1,570	6.00	6.00	4.4		4.4		
TWI_000_060		1,818	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			TWI_000_060	15.4	**15.6**	**0.26**
									123	1.082	1.68	Unpaved	1.22															1.2		
									1,596	1.899	2.80	Paved	9.50															9.5		
TWI_000_070		4,548	100	0.150	Grass-Short Grass Prairie	0.846	3.95	12.4																			TWI_000_070	12.4	**20.9**	**0.35**
														1,040	0.500	16.7	29.1	0.045	1.61		1.61	10.73						10.7		
														350	3.561	2.7	5.1	0.015	12.41		12.41	0.47						0.5		
									689	1.863	2.77	Paved	4.14															4.1		
																							1,544	6.00	6.00	4.3		4.3		
														825	1.486	87.4	36.7	0.065	4.98		4.98	2.76						2.8		
TWI_000_080		1,292	100	0.150	Grass-Short Grass Prairie	1.766	3.95	9.3																			TWI_000_080	9.3	**9.1**	**0.15**
									348	2.510	2.56	Unpaved	2.27															2.3		
									626	2.994	3.52	Paved	2.97															3.0		
																							219	6.00	6.00	0.6		0.6		
TWI_000_090		248	100	0.150	Grass-Short Grass Prairie	12.420	3.95	4.2																			TWI_000_090	4.2	**3.0**	**0.05**
									149	3.507	3.02	Unpaved	0.82															0.8		
TWI_000_100		3,353	100	0.150	Grass-Short Grass Prairie	2.027	3.95	8.8																			TWI_000_100	8.8	**12.9**	**0.22**
									371	3.046	2.82	Unpaved	2.20															2.2		
									675	1.958	2.84	Paved	3.96															4.0		
																							1,054	6.00	6.00	2.9		2.9		
														1,154	2.465	88.5	50.1	0.065	5.25		5.25	3.66						3.7		
TWI_001_010		3,147	100	0.150	Grass-Short Grass Prairie	2.091	3.95	8.7																			TWI_001_010	8.7	**14.7**	**0.25**
														1,404	0.664	16.2	21.9	0.045	2.21		2.21	10.58						10.6		
																							1,266	6.00	6.00	3.5		3.5		
														378	0.703	50.4	25.4	0.055	3.59		3.59	1.76						1.8		
TWI_002_010		1,046	100	0.150	Grass-Short Grass Prairie	3.380	3.95	7.1																			TWI_002_010	7.1	**7.6**	**0.13**
									491	4.489	3.42	Unpaved	2.39															2.4		
									456	1.497	2.49	Paved	3.06															3.1		
TWI_003_010		2,713	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.596	3.95	0.5																			TWI_003_010	0.5	**6.2**	**0.10**
									536	4.721	4.42	Paved	2.02															2.0		
																							1,811	6.00	6.00	5.0		5.0		
														318	0.500	15.5	12.2	0.065	1.90		1.90	2.79						2.8		
TWI_004_010		3,365	26	0.150	Grass-Short Grass Prairie	6.863	3.95	1.8																			TWI_004_010	1.8	**9.6**	**0.16**
									1,111	1.285	2.30	Paved	8.04															8.0		
																							2,228	6.00	6.00	6.2		6.2		
TWI_004_020		1,374	100	0.150	Grass-Short Grass Prairie	3.757	3.95	6.9																			TWI_004_020	6.9	**7.3**	**0.12**
									678	2.389	3.14	Paved	3.60															3.6		
																							597	6.00	6.00	1.7		1.7		
TWI_004_030		1,291	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.534	3.95	0.5																			TWI_004_030	0.5	**4.2**	**0.07**
									70	4.908	4.50	Paved	0.26															0.3		
									779	2.512	2.56	Unpaved	5.08															5.1		
																							394	6.00	6.00	1.1		1.1		

Appendix B-3

Stream RC-1 Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RCO_001_010		2,640	100	0.150	Grass-Short Grass Prairie	0.880	3.95	12.2																		RUS_RCO_001_010	12.2	**18.7**	**0.31**
									1,101	1.360	1.88	Unpaved	9.75														9.8		
									1,270	1.419	2.42	Paved	8.74														8.7		
																						169	6	6.00	0.5		0.5		
RUS_RCO_002_010		4,461	76	0.150	Grass-Short Grass Prairie	2.473	3.95	6.5																		RUS_RCO_002_010	6.5	**18.8**	**0.31**
									1,586	0.597	1.57	Paved	16.83														16.8		
														633	0.500	9.7	14.5	0.015	5.40		5.40	1.95						2.0		
																						2,166	6	6.00	6.0		6.0		
RUS_RCO_002_020		938	100	0.150	Grass-Short Grass Prairie	1.260	3.95	10.6																		RUS_RCO_002_020	10.6	**11.8**	**0.20**
									37	8.935	4.82	Unpaved	0.13														0.1		
									761	0.500	1.44	Paved	8.82														8.8		
																						40	6	6.00	0.1		0.1		
RUS_RCO_010		3,067	44	0.150	Grass-Short Grass Prairie	0.500	3.95	8.0																		RUS_RCO_010	8.0	**17.0**	**0.28**
									1,226	0.500	1.44	Paved	14.22														14.2		
																						1,267	6	6.00	3.5		3.5		
														530	0.604	111.4	42.6	0.065	3.38		3.38	2.61						2.6		
RUS_RCO_020		5,143	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.260	3.95	0.6																		RUS_RCO_020	0.6	**10.8**	**0.18**
									623	0.894	1.92	Paved	5.40														5.4		
																						3,093	6	6.00	8.6		8.6		
														1,377	0.566					6.81	6.81	3.37						3.4		
RUS_RCO_030		4,440	43	0.150	Grass-Short Grass Prairie	2.596	3.95	4.0																		RUS_RCO_030	4.0	**14.0**	**0.23**
									2,084	1.737	2.68	Paved	12.96														13.0		
																						2,239	6	6.00	6.2		6.2		
														74	0.701	15.0	17.0	0.015	7.65		7.65	0.16						0.2		
RUS_RCO_040		2,647	100	0.150	Grass-Short Grass Prairie	2.280	3.95	8.4																		RUS_RCO_040	8.4	**11.1**	**0.18**
									159	8.315	4.65	Unpaved	0.57														0.6		
									993	2.107	2.95	Paved	5.61														5.6		
																						1,396	6	6.00	3.9		3.9		
RUS_RCO_050		3,439	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_RCO_050	14.9	**18.5**	**0.31**
									82	2.425	2.51	Unpaved	0.54														0.5		
									2,551	2.552	3.25	Paved	13.09														13.1		
																						280	6	6.00	0.8		0.8		
RUS_RCO_060		2,387	100	0.150	Grass-Short Grass Prairie	1.550	3.95	9.8						426	0.501	5.0	9.1	0.015	4.71		4.71	1.51						1.5		
									526	0.547	1.19	Unpaved	7.35														7.3		
									1,273	0.510	1.45	Paved	14.61														14.6		
																						488	6	6.00	1.4		1.4		
RUS_RCO_070		4,161	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.740	3.95	0.4																		RUS_RCO_070	0.4	**9.1**	**0.15**
									2,074	3.498	3.80	Paved	9.09														9.1		
																						2,037	6	6.00	5.7		5.7		
RUS_RCO_080		2,228	100	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		RUS_RCO_080	8.5	**10.5**	**0.18**
									1,001	1.922	2.82	Paved	5.92														5.9		
																						1,128	6	6.00	3.1		3.1		
RUS_RCO_090		4,509	87	0.150	Grass-Short Grass Prairie	2.008	3.95	7.9																		RUS_RCO_090	7.9	**20.7**	**0.35**
									3,099	1.224	2.25	Paved	22.97														23.0		
																						1,324	6	6.00	3.7		3.7		
RUS_RCO_100		2,499	49	0.150	Grass-Short Grass Prairie	0.500	3.95	8.7																		RUS_RCO_100	8.7	**13.7**	**0.23**
									1,120	0.782	1.80	Paved	10.38														10.4		
																						1,330	6	6.00	3.7		3.7		
RUS_RCO_110		2,443	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_RCO_110	1.0	**11.7**	**0.20**
									1,940	0.845	1.87	Paved	17.30														17.3		
																						453	6	6.00	1.3		1.3		
RUS_RCO_120		2,934	100	0.150	Grass-Short Grass Prairie	2.150	3.95	8.6																		RUS_RCO_120	8.6	**14.3**	**0.24**
									25	9.370	4.94	Unpaved	0.08														0.1		
									2,810	2.300	3.08	Paved	15.19														15.2		
RUS_RCO_130		2,380	100	0.150	Grass-Short Grass Prairie	2.210	3.95	8.5																		RUS_RCO_130	8.5	**11.7**	**0.19**
									41	7.259	4.35	Unpaved	0.16														0.2		
									2,128	2.748	3.37	Paved	10.52														10.5		
																						111	6	6.00	0.3		0.3		
RUS_RCO_140		2,218	100	0.150	Grass-Short Grass Prairie	2.020	3.95	8.8																		RUS_RCO_140	8.8	**12.1**	**0.20**
									83	2.624	2.61	Unpaved	0.53														0.5		
									844	0.807	1.83	Paved	7.70														7.7		
									109	10.417	5.21	Unpaved	0.35														0.3		
														1,082	4.248	87.8	54.3	0.065	6.51		6.51	2.77						2.8		
RUS_RCO_150		1,740	100	0.150	Grass-Short Grass Prairie	5.250	3.95	6.0																		RUS_RCO_150	6.0	**10.2**	**0.17**
									696	5.939	3.93	Unpaved	2.95														3.0		
									812	0.761	1.77	Paved	7.63														7.6		
																						132	6	6.00	0.4		0.4		
RUS_TOA_010		3,284	100	0.150	Grass-Short Grass Prairie	0.990	3.95	11.7																		RUS_TOA_010	11.7	**19.5**	**0.33**
									101	1.302	1.84	Unpaved	0.91														0.9		
									1,287	0.500	1.44	Paved	14.92														14.9		
																						1,795	6	6.00	5.0		5.0		
RUS_TOA_020		2,315	100	0.150	Grass-Short Grass Prairie	4.880	3.95	6.2																		RUS_TOA_020	6.2	**7.6**	**0.13**
									131	3.939	3.20	Unpaved	0.68														0.7		
														346	4.051	37.2	51.7	0.045	5.35		5.35	1.08						1.1		
														114	2.516	12.4	36.3	0.015	7.70		7.70	0.25						0.2		
																						1,624	6	6.00	4.5		4.5		
RUS_TOA_030		3,613	100	0.150	Grass-Short Grass Prairie	0.830	3.95	12.5																		RUS_TOA_030	12.5	**14.9**	**0.25**

Appendix B-3

Stream RC-1 Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
									46	8.211	4.62	Unpaved	0.17														0.2		
									1,353	3.017	3.53	Paved	6.39														6.4		
																							240	6	6.00	0.7		0.7		
														1,874	0.970	0.6	2.1	0.015	4.25	6.09	6.09	5.13						5.1		
RUS_TOA_040		2,776	100	0.150	Grass-Short Grass Prairie	1.170	3.95	10.9																			RUS_TOA_040	10.9	**12.5**	**0.21**
									192	3.440	2.99	Unpaved	1.07														1.1		
									785	2.437	3.17	Paved	4.12														4.1		
																							1,698	6	6.00	4.7		4.7		
RUS_TOA_050		4,900	100	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																			RUS_TOA_050	12.4	**21.3**	**0.36**
									34	7.690	4.47	Unpaved	0.13														0.1		
									1,787	0.985	2.02	Paved	14.76														14.8		
																							2,979	6	6.00	8.3		8.3		
RUS_TOA_055		7,994	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																			RUS_TOA_055	0.9	**30.8**	**0.51**
									1,191	0.825	1.47	Unpaved	13.54														13.5		
														6,753	0.908	27.9	21.8	0.055	3.05		3.05	36.92						36.9		
RUS_TOA_060		2,926	100	0.150	Grass-Short Grass Prairie	3.350	3.95	7.2																			RUS_TOA_060	7.2	**19.4**	**0.32**
									651	0.500	1.14	Unpaved	9.51														9.5		
									2,175	1.286	2.30	Paved	15.73														15.7		
RUS_TOA_070		2,587	100	0.150	Grass-Short Grass Prairie	1.070	3.95	11.3																			RUS_TOA_070	11.3	**18.1**	**0.30**
									1,500	0.584	1.55	Paved	16.09														16.1		
																							987	6	6.00	2.7		2.7		
RUS_TOA_080		5,019	100	0.150	Grass-Short Grass Prairie	3.001	3.95	7.5																			RUS_TOA_080	7.5	**14.8**	**0.25**
									1,098	1.873	2.78	Paved	6.58														6.6		
																							3,623	6	6.00	10.1		10.1		
														204	3.945	24.7	13.3	0.065	6.88		6.88	0.49						0.5		
RUS_TOA_090		3,864	100	0.150	Grass-Short Grass Prairie	1.660	3.95	9.5																			RUS_TOA_090	9.5	**14.2**	**0.24**
									608	4.924	3.58	Unpaved	2.83														2.8		
									41	0.879	1.91	Paved	0.36														0.4		
														398	2.856	4.6	6.4	0.045	4.49		4.49	1.48						1.5		
																							303	6	6.00	0.8		0.8		
														504	1.092	6.2	12.1	0.045	2.21		2.21	3.80						3.8		
																							1,202	6	6.00	3.3		3.3		
														709	2.154	134.2	35.6	0.065	8.15		8.15	1.45						1.4		
RUS_TOA_100		4,958	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.980	3.95	0.6																			RUS_TOA_100	0.6	**9.8**	**0.16**
									713	2.022	2.89	Paved	4.11														4.1		
																							2,960	6	6.00	8.2		8.2		
														542	1.081	17.8	8.5	0.045	5.63		5.63	1.60						1.6		
														693	3.696	42.8	24.6	0.065	6.38		6.38	1.81						1.8		

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_010		3,581	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_010	49	**29.5**	**0.49**
									1,480	0.697	1.35	Unpaved	18.31																
														2,001	0.981	55.2	88.3	0.050	2.16		2.16	15.45							
RUS_000_020		2,722	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.320	3.95	0.7																		RUS_000_020	12	**7.4**	**0.12**
														2,672	0.964	27.0	21.0	0.045	3.84		3.84	11.58							
RUS_000_030		3,258	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_030	45	**27.0**	**0.45**
									2,660	1.091	1.69	Unpaved	26.30																
														498	0.500	121.5	110.5	0.045	2.49		2.49	3.33							
RUS_000_040		1,419	100	0.150	Grass-Short Grass Prairie	1.970	3.95	8.9																		RUS_000_040	19	**11.5**	**0.19**
									1,031	1.437	1.93	Unpaved	8.88																
														288	0.625	53.4	22.5	0.065	3.22		3.22	1.49							
RUS_000_050		2,882	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.276	3.95	0.7																		RUS_000_050	21	**12.5**	**0.21**
									1,679	0.864	1.89	Paved	14.81																
																							375	6	6.00	1.0				
														778	0.966	52.9	59.3	0.045	3.02		3.02	4.30							
RUS_000_060		2,425	100	0.150	Grass-Short Grass Prairie	1.115	3.95	11.1																		RUS_000_060	19	**11.6**	**0.19**
									594	2.216	2.40	Unpaved	4.12																
																							1,053	6	6.00	2.9				
														678	1.563	115.4	87.2	0.024	9.36		9.36	1.21							
RUS_000_070		2,113	100	0.150	Grass-Short Grass Prairie	0.505	3.95	15.3																		RUS_000_070	33	**20.1**	**0.33**
									2,013	1.313	1.85	Unpaved	18.15																
RUS_000_080		2,523	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_000_080	28	**16.8**	**0.28**
									673	1.797	2.16	Unpaved	5.19																
														1,749	0.692	5.7	3.7	0.045	3.70		3.70	7.89							
RUS_000_085		3,636	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_085	35	**20.7**	**0.35**
									574	2.162	2.37	Unpaved	4.03																
														2,962	0.935					3.26	3.26	15.14								
RUS_000_090		2,192	100	0.150	Grass-Short Grass Prairie	0.564	3.95	14.6																		RUS_000_090	32	**19.5**	**0.32**
									2,092	1.468	1.96	Unpaved	17.83																
RUS_000_100		4,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																		RUS_000_100	26	**15.8**	**0.26**
									831	1.203	1.77	Unpaved	7.83																
																							1,845	6	6.00	5.1				
														2,037	1.009	131.6	131.6	0.055	2.72		2.72	12.48							
RUS_000_110		3,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.540	3.95	1.1																		RUS_000_110	26	**15.7**	**0.26**
									1,699	1.018	1.63	Unpaved	17.39																
																							262	6	6.00	0.7				
														1,753	1.778	40.8	44.7	0.045	4.15		4.15	7.03							
RUS_000_120		1,360	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.060	3.95	0.6																		RUS_000_120	10	**5.9**	**0.10**
									1,310	2.172	2.38	Unpaved	9.18																
RUS_000_130		2,066	100.0	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																		RUS_000_130	20	**12.0**	**0.20**
														1,966	2.272	6.7	7.4	0.045	4.65		4.65	7.04							
RUS_000_140		2,863	100.0	0.150	Grass-Short Grass Prairie	1.270	3.95	10.6																		RUS_000_140	23	**14.0**	**0.23**
									928	1.585	2.03	Unpaved	7.61																
																							1,835	6	6.00	5.1				
RUS_000_150		2,761	100.0	0.150	Grass-Short Grass Prairie	2.107	3.95	8.6																		RUS_000_150	18	**10.5**	**0.18**
									446	1.850	2.77	Paved	2.69																
																							2,001	6	6.00	5.6				
														214	5.486	31.9	29.5	0.065	5.66		5.66	0.63							
RUS_000_160		1,865	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.940	3.95	0.8																		RUS_000_160	11	**6.4**	**0.11**
									1,089	1.328	2.34	Paved	7.75																
																							726	6	6.00	2.0				
RUS_000_170		1,952	100.0	0.150	Grass-Short Grass Prairie	0.810	3.95	12.7																		RUS_000_170	19	**11.4**	**0.19**
									383	2.035	2.90	Paved	2.20																
																							1,469	6	6.00	4.1				
RUS_000_180		747	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_000_180	16	**9.4**	**0.16**
									647	3.321	2.94	Unpaved	3.67																
RUS_016_010		2,662	100.0	0.150	Grass-Short Grass Prairie	2.835	3.95	7.7																		RUS_016_010	18	**11.0**	**0.18**
									693	1.080	2.11	Paved	5.47																
																							1,869	6	6.00	5.2				
RUS_016_020		3,161	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.705	3.95	1.0																		RUS_016_020	20	**12.2**	**0.20**
									2,082	1.064	2.10	Paved	16.55																
																							1,030	6	6.00	2.9				
RUS_016_030		2,587	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.680	3.95	1.0																		RUS_016_030	9	**5.6**	**0.09**
									504	2.282	3.07	Paved	2.74																
																							2,033	6	6.00	5.6				
RUS_016_040		2,434	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.328	3.95	0.4																		RUS_016_040	9	**5.2**	**0.09**
									707	3.158	3.61	Paved	3.26																
																							1,199	6	6.00	3.3				
														477	2.307	57.3	35.8	0.065	4.77		4.77	1.67							
RUS_017_010		677	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_017_010	15	**8.8**	**0.15**
									145	2.091	2.33	Unpaved	1.04																
														432	1.238	115.9	65.0	0.055	4.43		4.43	1.62							
RUS_018_010		2,702	100.0	0.150	Grass-Short Grass Prairie	1.611	3.95	9.6																		RUS_018_010	25	**15.2**	**0.25**
									1,064	1.266	1.82	Unpaved	9.77																
														884	0.500	70.0	37.8	0.045	3.53		3.53	4.17							
RUS_018_020		2,891	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																		RUS_018_020	35	**21.2**	**0.35**
									1,383	1.595	2.04	Unpaved	11.31																
														1,408	0.795	49.3	81.0	0.050	1.91		1.91	12.29							
RUS_018_030		2,585	100.0	0.150	Grass-Short Grass Prairie	0.742	3.95	13.1																		RUS_018_030	25	**14.7**	**0.25**
									851	2.307	2.45	Unpaved	5.79																
														1,634	1.004					4.86	4.86	5.60								
RUS_018_040		2,976	100.0	0.150	Grass-Short Grass Prairie	0.730	3.95	13.2																		RUS_018_040	31	**18.8**	**0.31**
									1,774	1.860	2.20	Unpaved	13.44																
														1,102	0.645					3.96	3.96	4.64								

Appendix B-3

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_018_050		3,423	100.0	0.150	Grass-Short Grass Prairie	2.870	3.95	7.6																		RUS_018_050	25	**14.7**	**0.25**
									1,647	1.569	2.55	Paved	10.78																
																						585	6	6.00	1.6				
														1,091	0.806					4.07	4.07	4.47							
RUS_019_010		2,630	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_019_010	31	**18.7**	**0.31**
									1,333	1.403	1.91	Unpaved	11.63																
														1,197	1.247	208.7	106.6	0.055	4.73		4.73	4.21							
RUS_019_020		1,706	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.399	3.95	0.6																		RUS_019_020	11	**6.9**	**0.11**
									1,313	1.153	2.18	Paved	10.03																
														343	3.086	46.1	28.9	0.055	6.49		6.49	0.88							
RUS_020_010		4,272	100.0	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_020_010	42	**25.0**	**0.42**
									1,285	0.500	1.14	Unpaved	18.77																
																						2,887	6	6.00	8.0				
RUS_020_020		4,387	100.0	0.150	Grass-Short Grass Prairie	0.671	3.95	13.7																		RUS_020_020	49	**29.4**	**0.49**
									2,493	0.784	1.43	Unpaved	29.08																
																						692	6	6.00	1.9				
														535	0.778	29.9	18.9	0.045	3.96		3.96	2.25							
														350	0.500	30.1	23.2	0.015	8.34		8.34	0.70							
														217	0.500	52.3	45.4	0.045	2.57		2.57	1.41							
RUS_020_030		3,118	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_020_030	40	**23.8**	**0.40**
									1,974	1.221	1.78	Unpaved	18.46																
																						175	6	6.00	0.5				
														870	0.500	81.3	67.1	0.045	2.66		2.66	5.45							
RUS_020_040		4,060	100.0	0.150	Grass-Short Grass Prairie	1.630	3.95	9.6																		RUS_020_040	31	**18.8**	**0.31**
									545	2.494	2.55	Unpaved	3.56																
														3,415	0.621					3.13	3.13	18.18							
RUS_FPT_010		3,184	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.720	3.95	0.9																		RUS_FPT_010	13	**7.9**	**0.13**
									990	1.628	2.59	Paved	6.36																
																						1,560	6	6.00	4.3				
														585	0.500	141.8	78.1	0.024	6.54		6.54	1.49							
RUS_FPT_020		2,432	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_FPT_020	13	**7.7**	**0.13**
									1,403	2.614	2.61	Unpaved	8.96																
																						979	6	6.00	2.7				
RUS_NET_010		2,119	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_NET_010	10	**6.2**	**0.10**
									396	0.500	1.44	Paved	4.59																
																						1,673	6	6.00	4.6				
RUS_NET_020		710	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.380	3.95	0.4																		RUS_NET_020	5	**3.3**	**0.05**
									660	1.809	2.17	Unpaved	5.07																
SUB_000_010		2,952	100.0	0.150	Grass-Short Grass Prairie	0.624	3.95	14.1																		SUB_000_010	36	**21.3**	**0.36**
									1,990	1.658	2.08	Unpaved	15.96																
														862	0.500	54.1	34.2	0.055	2.60		2.60	5.53							
SUB_000_020		2,349	100.0	0.150	Grass-Short Grass Prairie	2.216	3.95	8.5																		SUB_000_020	18	**10.6**	**0.18**
									669	3.707	3.11	Unpaved	3.59																
														1,579	0.699					4.71	4.71	5.59							
SUB_000_030		751	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.084	3.95	0.5																		SUB_000_030	5	**2.8**	**0.05**
									701	3.020	2.80	Unpaved	4.17																
SUB_000_040		1,108	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		SUB_000_040	21	**12.4**	**0.21**
									1,008	3.731	3.12	Unpaved	5.39																
SUB_000_050		3,726	100.0	0.150	Grass-Short Grass Prairie	0.861	3.95	12.4																		SUB_000_050	42	**25.2**	**0.42**
									2,717	1.114	1.70	Unpaved	26.59																
														909	1.239	27.8	17.5	0.045	5.02		5.02	3.02							
SUB_000_060		3,046	100.0	0.150	Grass-Short Grass Prairie	0.725	3.95	13.2																		SUB_000_060	30	**18.1**	**0.30**
									388	1.749	2.13	Unpaved	3.03																
														1,609	1.009	30.0	30.0	0.055	2.72		2.72	9.85							
																						371	6	6.00	1.0				
														577	0.500					3.13	3.13	3.07							
SUB_000_070		4,044	100.0	0.150	Grass-Short Grass Prairie	2.269	3.95	8.4																		SUB_000_070	31	**18.8**	**0.31**
									1,623	2.069	2.32	Unpaved	11.66																
														2,321	0.688					3.45	3.45	11.21							
SUB_000_080		1,251	100.0	0.150	Grass-Short Grass Prairie	4.950	3.95	6.1																		SUB_000_080	13	**7.9**	**0.13**
									1,151	2.888	2.74	Unpaved	7.00																
SUB_000_090		4,935	100.0	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		SUB_000_090	44	**26.3**	**0.44**
									2,607	1.188	1.76	Unpaved	24.70																
														2,228	1.010	117.4	81.9	0.055	3.46		3.46	10.72							
SUB_000_100		3,603	100.0	0.150	Grass-Short Grass Prairie	1.862	3.95	9.1																		SUB_000_100	22	**13.4**	**0.22**
									853	2.248	2.42	Unpaved	5.88																
																						2,650	6	6.00	7.4				
SUB_000_110		1,188	100.0	0.150	Grass-Short Grass Prairie	5.241	3.95	6.0																		SUB_000_110	13	**7.7**	**0.13**
									1,088	2.712	2.66	Unpaved	6.82																
SUB_000_115		1,627	100.0	0.150	Grass-Short Grass Prairie	4.390	3.95	6.4																		SUB_000_115	17	**10.2**	**0.17**
									1,527	2.211	2.40	Unpaved	10.61																
SUB_000_120		4,452	100.0	0.150	Grass-Short Grass Prairie	1.910	3.95	9.0																		SUB_000_120	31	**18.7**	**0.31**
									1,388	1.701	2.10	Unpaved	10.99																
														2,964	1.129	52.1	27.2	0.055	4.44		4.44	11.12							
SUB_000_130		2,603	100.0	0.150	Grass-Short Grass Prairie	0.558	3.95	14.7																		SUB_000_130	28	**17.0**	**0.28**
									1,125	1.420	1.92	Unpaved	9.75																
																						1,378	6	6.00	3.8				
SUB_000_140		2,769	100.0	0.150	Grass-Short Grass Prairie	1.720	3.95	9.4																		SUB_000_140	23	**13.8**	**0.23**
									795	2.961	2.78	Unpaved	4.77																
														1,873	0.500					3.52	3.52	8.87							
SUB_000_150		2,065	100.0	0.150	Grass-Short Grass Prairie	1.166	3.95	10.9																		SUB_000_150	22	**13.1**	**0.22**
									858	2.360	2.48	Unpaved	5.77																
														1,107	0.961					3.65	3.65	5.05							
SUB_000_155		2,374	100.0	0.150	Grass-Short Grass Prairie	1.673	3.95	9.5																		SUB_000_155	21	**12.4**	**0.21**
									979	2.472	2.54	Unpaved	6.43																
														1,296	1.214					4.50	4.50	4.80							

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
SUB_000_160		1,428	100.0	0.150	Grass-Short Grass Prairie	5.050	3.95	6.1																			SUB_000_160	14	**8.6**	**0.14**
									1,328	2.789	2.69	Unpaved	8.21																
SUB_000_170		4,539	100.0	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																			SUB_000_170	27	**16.5**	**0.27**
														4,057	1.095	60.1	34.1	0.045	5.05		5.05	13.38							
																							382	6	6.00	1.1				
SUB_000_180		2,240	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.639	3.95	1.0																			SUB_000_180	12	**7.3**	**0.12**
									768	0.976	2.01	Paved	6.38																
																							713	6	6.00	2.0				
														709	3.297	40.2	39.5	0.065	4.21		4.21	2.80							
SUB_000_190		3,147	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.975	3.95	0.8																			SUB_000_190	16	**9.8**	**0.16**
									2,056	1.796	2.72	Paved	12.58																
																							1,041	6	6.00	2.9				
SUB_000_200		3,651	100.0	0.150	Grass-Short Grass Prairie	1.627	3.95	9.6																			SUB_000_200	32	**19.0**	**0.32**
									1,716	1.266	1.82	Unpaved	15.75																
																							719	6	6.00	2.0				
														798	0.717	14.7	9.3	0.015	11.40		11.40	1.17							
														318	0.500	32.8	39.8	0.055	1.68		1.68	3.15							
SUB_000_210		2,926	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.600	3.95	0.7																			SUB_000_210	15	**8.7**	**0.15**
									1,139	2.044	2.31	Unpaved	8.23																
														1,737	1.113	23.7	9.7	0.055	5.17		5.17	5.60							
SUB_000_220		3,608	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																			SUB_000_220	37	**22.0**	**0.37**
									2,227	1.681	2.09	Unpaved	17.74																
														1,281	0.500			0.055		3.01	3.01	7.09								
SUB_000_230		3,351	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.382	3.95	0.5																			SUB_000_230	18	**11.0**	**0.18**
									499	1.903	2.80	Paved	2.97																
														1,659	0.930			0.055		3.15	3.15	8.78								
														1,143	0.764			0.024		3.15	3.15	6.05								
SUB_000_240		808	100.0	0.150	Grass-Short Grass Prairie	2.188	3.95	8.5																			SUB_000_240	12	**7.3**	**0.12**
									199	2.898	2.75	Unpaved	1.21																
									510	2.798	3.40	Paved	2.50																
SUB_000_250		4,052	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.954	3.95	0.8																			SUB_000_250	22	**13.3**	**0.22**
									1,369	0.907	1.94	Paved	11.79																
																							1,947	6	6.00	5.4				
														686	0.500	25.1	19.5	0.045	2.77		2.77	4.13							
SUB_000_260		3,034	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			SUB_000_260	18	**11.0**	**0.18**
									1,007	0.500	1.44	Paved	11.68																
																							1,977	6	6.00	5.5				
SUB_000_270		3,885	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.059	3.95	0.5																			SUB_000_270	25	**14.8**	**0.25**
									427	0.668	1.66	Paved	4.28																
									1,399	0.940	1.56	Unpaved	14.90																
														585	0.500	32.1	19.5	0.015	9.80		9.80	0.99							
																							1,423	6	6.00	4.0				
SUB_000_280		904	100.0	0.150	Grass-Short Grass Prairie	1.560	3.95	9.7																			SUB_000_280	16	**9.8**	**0.16**
									804	1.604	2.04	Unpaved	6.56																
SUB_000_290		2,946	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			SUB_000_290	14	**8.4**	**0.14**
									1,206	1.448	2.45	Paved	8.22																
																							1,690	6	6.00	4.7				
SUB_000_300		2,628	100.0	0.150	Grass-Short Grass Prairie	2.520	3.95	8.0																			SUB_000_300	18	**10.8**	**0.18**
									775	1.557	2.54	Paved	5.09																
																							1,752	6	6.00	4.9				
SUB_001_001_010		3,113	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			SUB_001_001_010	27	**16.5**	**0.27**
									1,389	2.257	3.05	Paved	7.58																
																							1,624	6	6.00	4.5				
SUB_001_001_020		651	100.0	0.150	Grass-Short Grass Prairie	4.907	3.95	6.2																			SUB_001_001_020	10	**6.0**	**0.10**
									551	2.216	2.40	Unpaved	3.82																
SUB_001_010		3,004	100.0	0.150	Grass-Short Grass Prairie	2.600	3.95	7.9																			SUB_001_010	21	**12.6**	**0.21**
									1,073	2.633	2.62	Unpaved	6.83																
																							826	6	6.00	2.3				
														1,005	0.701	155.8	61.4	0.055	4.22		4.22	3.97							
SUB_001_020		1,504	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.060	3.95	0.8																			SUB_001_020	6	**3.8**	**0.06**
									656	2.658	3.31	Paved	3.30																
																							798	6	6.00	2.2				
SUB_002_010		1,878	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.000	3.95	0.5																			SUB_002_010	10	**5.9**	**0.10**
									1,004	3.108	2.84	Unpaved	5.88																
														824	1.055	36.3	21.2	0.055	3.98		3.98	3.45							
SUB_002_020		876	100.0	0.150	Grass-Short Grass Prairie	1.160	3.95	11.0																			SUB_002_020	16	**9.8**	**0.16**
									776	2.300	2.45	Unpaved	5.29																
SUB_003_010		1,857	100.0	0.150	Grass-Short Grass Prairie	1.299	3.95	10.5																			SUB_003_010	17	**10.0**	**0.17**
									326	1.666	2.62	Paved	2.07																
																							503	6	6.00	1.4				
														928	1.088	15.3	5.4	0.055	5.66		5.66	2.73							
SUB_003_020		3,531	100.0	0.150	Grass-Short Grass Prairie	2.835	3.95	7.7																			SUB_003_020	22	**13.1**	**0.22**
									756	1.938	2.25	Unpaved	5.61																
																							1,941	6	6.00	5.4				
														735	0.872	17.7	12.7	0.045	3.86		3.86	3.17							
SUB_003_030		2,118	54.0	0.150	Grass-Short Grass Prairie	1.130	3.95	6.8																			SUB_003_030	17	**10.1**	**0.17**
														2,064	1.087	25.7	26.0	0.045	3.43		3.43	10.03							
SUB_003_040		3,148	100.0	0.150	Grass-Short Grass Prairie	1.235	3.95	10.7																			SUB_003_040	26	**15.6**	**0.26**
									1,344	1.078	2.11	Paved	10.61																
																							1,704	6	6.00	4.7				
SUB_004_010		2,840	100.0	0.150	Grass-Short Grass Prairie	2.056	3.95	8.7																			SUB_004_010	40	**24.2**	**0.40**
									1,389	1.503	1.98	Unpaved	11.70																
														1,351	0.500	17.7	38.9	0.055	1.13		1.13	19.89							
SUB_004_020		2,607	100.0	0.150	Grass-Short Grass Prairie	1.223	3.95	10.7																			SUB_004_020	25	**15.1**	**0.25**
									1,471	2.471	2.54	Unpaved	9.67																

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
														1,037	0.692					3.63	3.63	4.76								
SUB_004_030		1,858	100.0	0.150	Grass-Short Grass Prairie	1.710	3.95	9.4																			SUB_004_030	21	**12.9**	**0.21**
									1,247	1.819	2.18	Unpaved	9.55																
														511	0.535	17.2	10.6	0.045	3.34		3.34	2.55								
SUB_004_040		3,401	100.0	0.150	Grass-Short Grass Prairie	0.770	3.95	12.9																			SUB_004_040	39	**23.4**	**0.39**
									2,165	1.524	1.99	Unpaved	18.11																
														1,136	0.500					2.36	2.36	8.02								
SUB_004_050		2,930	100.0	0.150	Grass-Short Grass Prairie	3.040	3.95	7.5																			SUB_004_050	27	**16.4**	**0.27**
									1,202	0.887	1.52	Unpaved	13.19																
														1,628	1.014					4.03	4.03	6.73								
SUB_004_060		1,854	100.0	0.150	Grass-Short Grass Prairie	5.133	3.95	6.0																			SUB_004_060	21	**12.8**	**0.21**
									1,023	1.224	1.79	Unpaved	9.55																
														730	0.594					2.15	2.15	5.66								
SUB_004_070		2,708	100.0	0.150	Grass-Short Grass Prairie	2.518	3.95	8.0																			SUB_004_070	26	**15.7**	**0.26**
									2,111	1.351	2.36	Paved	14.89																
														497	1.657					2.54	2.54	3.26								
SUB_004_080		2,193	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.160	3.95	0.8																			SUB_004_080	14	**8.3**	**0.14**
									980	1.330	1.86	Unpaved	8.78																
														1,163	1.518	38.9	24.6	0.055	4.53		4.53	4.28								
SUB_004_090		2,238	100.0	0.150	Grass-Short Grass Prairie	1.645	3.95	9.5																			SUB_004_090	22	**13.2**	**0.22**
									1,034	3.480	3.01	Unpaved	5.73																
														1,104	0.500					2.71	2.71	6.79								
SUB_004_100		1,932	100.0	0.150	Grass-Short Grass Prairie	1.507	3.95	9.9																			SUB_004_100	23	**13.9**	**0.23**
									1,832	2.006	2.29	Unpaved	13.36																
SUB_004_110		3,333	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			SUB_004_110	40	**24.3**	**0.40**
									1,518	0.807	1.45	Unpaved	17.45																
														1,716	0.734					3.72	3.72	7.69								
SUB_004_120		3,147	100.0	0.150	Grass-Short Grass Prairie	3.897	3.95	6.8																			SUB_004_120	31	**18.8**	**0.31**
									2,122	1.617	2.05	Unpaved	17.24																
														925	0.500					2.09	2.09	7.38								
SUB_004_130		1,986	100.0	0.150	Grass-Short Grass Prairie	2.640	3.95	7.9																			SUB_004_130	21	**12.7**	**0.21**
									1,140	2.854	2.73	Unpaved	6.97																
														746	1.432	24.8	52.8	0.055	1.96		1.96	6.34								

Appendix B-3

Kee Branch Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_000_010		3,087	100	0.150	Grass-Short Grass Prairie	4.900	3.95	6.2																		KEE_000_010	6.2	**24.8**	**0.41**
									832	0.921	1.95	Paved	7.11														7.1		
														2,155	0.675	4.8	15.0	0.045	1.28		1.28	28.11					28.1		
KEE_000_020		4,034	100	0.150	Grass-Short Grass Prairie	0.690	3.95	13.5																		KEE_000_020	13.5	**20.3**	**0.34**
									663	1.437	2.44	Paved	4.54														4.5		
														1,092	2.116	5.9	10.7	0.045	3.24		3.24	5.62					5.6		
														2,179	0.588				3.58	3.58	3.58	10.14					10.1		
KEE_000_030		2,234	54	0.150	Grass-Short Grass Prairie	2.034	3.95	5.4																		KEE_000_030	5.4	**12.3**	**0.21**
									641	0.772	1.79	Paved	5.98														6.0		
														1,538	1.048	5.5	7.4	0.045	2.78		2.78	9.23					9.2		
KEE_000_040		1,299	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.510	3.95	0.5																		KEE_000_040	0.5	**3.4**	**0.06**
									622	2.811	3.41	Paved	3.04														3.0		
														628	2.524	17.4	19.3	0.045	4.92		4.92	2.13					2.1		
KEE_000_050		1,757	50	0.150	Grass-Short Grass Prairie	2.962	3.95	4.3																		KEE_000_050	4.3	**7.6**	**0.13**
									467	2.557	3.25	Paved	2.39														2.4		
														1,241	2.807	5.4	10.7	0.045	3.52		3.52	5.87					5.9		
KEE_000_060		3,065	50	0.150	Grass-Short Grass Prairie	2.965	3.95	4.3																		KEE_000_060	4.3	**14.7**	**0.24**
									537	3.404	3.75	Paved	2.39														2.4		
									2,268	1.273	2.29	Paved	16.48														16.5		
														210	1.455	7.7	13.8	0.045	2.70		2.70	1.30					1.3		
KEE_000_070		3,566	100	0.150	Grass-Short Grass Prairie	11.424	3.95	4.4																		KEE_000_070	4.4	**14.2**	**0.24**
									2,853	1.794	2.72	Paved	17.46														17.5		
														613	1.330	17.9	5.4	0.065	5.89		5.89	1.73					1.7		
KEE_000_080		2,338	100	0.150	Grass-Short Grass Prairie	2.610	3.95	7.9																		KEE_000_080	7.9	**16.7**	**0.28**
									1,517	2.118	2.96	Paved	8.55														8.5		
														721	0.552	13.0	45.9	0.045	1.06		1.06	11.33					11.3		
KEE_000_090		3,947	100	0.150	Grass-Short Grass Prairie	2.650	3.95	7.9																		KEE_000_090	7.9	**13.4**	**0.22**
									60	5.609	4.81	Paved	0.21														0.2		
									742	3.436	3.77	Paved	3.28														3.3		
														1,214	1.388	8.5	10.4	0.045	3.42		3.42	5.92					5.9		
																							1,831	6	6.00	5.1		5.1		
KEE_000_100		1,777	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.017	3.95	0.8																		KEE_000_100	0.8	**6.6**	**0.11**
									695	0.674	1.67	Paved	6.94														6.9		
																							862	6	6.00	2.4		2.4		
														170	0.631	33.7	11.6	0.065	3.72		3.72	0.76					0.8		
KEE_000_110		3,519	100	0.150	Grass-Short Grass Prairie	5.080	3.95	6.1																		KEE_000_110	6.1	**11.3**	**0.19**
									1,546	2.758	3.38	Paved	7.63														7.6		
																							1,874	6	6.00	5.2		5.2		
KEE_000_120		4,341	100	0.150	Grass-Short Grass Prairie	2.208	3.95	8.5																		KEE_000_120	8.5	**13.0**	**0.22**
									94	3.605	3.86	Paved	0.41														0.4		
									818	2.235	3.04	Paved	4.49														4.5		
																							1,289	6	6.00	3.6		3.6		
														2,040	1.426	5.6	11.7	0.015	7.29		7.29	4.66					4.7		
KEE_000_130		3,538	100	0.150	Grass-Short Grass Prairie	6.001	3.95	5.7																		KEE_000_130	5.7	**10.5**	**0.17**
									627	3.096	3.58	Paved	2.92														2.9		
									459	2.576	3.26	Paved	2.34														2.3		
																							2,351	6	6.00	6.5		6.5		
KEE_000_140		1,799	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		KEE_000_140	15.4	**12.8**	**0.21**
									344	1.009	2.04	Paved	2.81														2.8		
																							552	6	6.00	1.5		1.5		
														803	0.768				8.33	8.33	8.33	1.61					1.6		
KEE_000_150		4,517	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.139	3.95	0.4																		KEE_000_150	0.4	**10.2**	**0.17**
									1,044	2.939	3.49	Paved	4.99														5.0		
																							1,498	6	6.00	4.2		4.2		
														443	0.875	6.0	10.5	0.015	6.37		6.37	1.16					1.2		
														1,482	1.334	17.1	16.4	0.045	3.93		3.93	6.28					6.3		
KEE_000_160		4,517	60	0.150	Grass-Short Grass Prairie	5.796	3.95	3.8																		KEE_000_160	3.8	**11.6**	**0.19**
									1,732	3.077	3.57	Paved	8.10														8.1		
																							2,518	6	6.00	7.0		7.0		
														208	0.525				7.26	7.26	7.26	0.48					0.5		
KEE_000_170		2,524	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.440	3.95	0.4																		KEE_000_170	0.4	**13.0**	**0.22**
														2,474	0.860	11.8	23.5	0.045	1.94		1.94	21.25					21.3		
KEE_000_180		2,661	100	0.150	Grass-Short Grass Prairie	1.856	3.95	9.1																		KEE_000_180	9.1	**15.9**	**0.27**
									1,466	1.436	2.44	Paved	10.03														10.0		
														1,095	1.316	7.7	14.7	0.045	2.47		2.47	7.39					7.4		
KEE_000_190		2,588	100	0.150	Grass-Short Grass Prairie	7.600	3.95	5.2																		KEE_000_190	5.2	**7.9**	**0.13**
									993	4.530	4.33	Paved	3.83														3.8		
																							1,495	6	6.00	4.2		4.2		
KEE_000_200		3,249	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.191	3.95	0.8																		KEE_000_200	0.8	**6.6**	**0.11**
									398	1.732	2.68	Paved	2.48														2.5		
																							2,801	6	6.00	7.8		7.8		
KEE_000_210		1,254	100	0.150	Grass-Short Grass Prairie	4.450	3.95	6.4																		KEE_000_210	6.4	**6.5**	**0.11**
									1,023	4.303	4.22	Paved	4.04														4.0		
																							131	6	6.00	0.4		0.4		
KEE_000_220		5,107	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.505	3.95	1.1																		KEE_000_220	1.1	**9.6**	**0.16**
									325	2.255	3.05	Paved	1.77														1.8		
																							2,301	6	6.00	6.4		6.4		
														530	0.952	22.7	11.2	0.050	4.67		4.67	1.89					1.9		
														310	2.812	2.7	4.6	0.015	11.70		11.70	0.44					0.4		
																							1,592	6	6.00	4.4		4.4		
KEE_000_230		3,201	100	0.150	Grass-Short Grass Prairie	5.898	3.95	5.7																		KEE_000_230	5.7	**10.2**	**0.17**
									279	2.645	3.31	Paved	1.41														1.4		
														1,817	2.361	1.3	7.3	0.015	4.89		4.89	6.20					6.2		

Appendix B-3

Kee Branch Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							286	6	6.00	0.8		0.8		
																												2.9		
KEE_000_240		2,832	100	0.150	Grass-Short Grass Prairie	4.426	3.95	6.4						720	1.506	16.8	9.2	0.065	4.19		4.19	2.87					KEE_000_240	6.4	**11.8**	**0.20**
									756	3.744	3.93	Paved	3.20														3.2		
									1,590	2.170	2.99	Paved	8.85														8.8		
																							109	6	6.00	0.3		0.3		
														277	2.964	23.3	14.1	0.065	5.52		5.52	0.84						0.8		
KEE_000_250		3,233	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.220	3.95	0.4																			KEE_000_250	0.4	**6.6**	**0.11**
									1,454	4.093	4.11	Paved	5.89														5.9		
																							1,729	6	6.00	4.8		4.8		
KEE_000_260		4,376	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.026	3.95	0.4																			KEE_000_260	0.4	**9.9**	**0.16**
									2,638	3.363	3.73	Paved	11.79														11.8		
																							144	6	6.00	0.4		0.4		
														1,545	1.122				6.71	6.71	6.71	3.84						3.8		
KEE_000_270		3,616	50	0.150	Grass-Short Grass Prairie	0.500	3.95	8.8																			KEE_000_270	8.8	**12.7**	**0.21**
														3,313	2.212	15.0	16.0	0.045	4.71		4.71	11.72						11.7		
																							253	6	6.00	0.7		0.7		
KEE_000_280		3,496	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.999	3.95	0.8																			KEE_000_280	0.8	**6.4**	**0.11**
									69	0.795	1.81	Paved	0.63														0.6		
																							1,688	6	6.00	4.7		4.7		
														452	2.424	1.5	3.5	0.015	8.72		8.72	0.86						0.9		
																							678	6	6.00	1.9		1.9		
														558	2.041	7.7	5.5	0.050	5.33		5.33	1.75						1.7		
KEE_000_290		2,617	100	0.150	Grass-Short Grass Prairie	1.000	3.95	11.6																			KEE_000_290	11.6	**13.3**	**0.22**
									733	1.173	2.20	Paved	5.55														5.5		
																							1,784	6	6.00	5.0		5.0		
KEE_000_300		3,375	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.367	3.95	0.6																			KEE_000_300	0.6	**9.7**	**0.16**
									780	1.743	2.68	Paved	4.84														4.8		
																							505	6	6.00	1.4		1.4		
									1,065	1.768	2.70	Paved	6.57														6.6		
																							976	6	6.00	2.7		2.7		
KEE_000_310		2,056	100	0.150	Grass-Short Grass Prairie	10.600	3.95	4.5																			KEE_000_310	4.5	**8.5**	**0.14**
									1,744	2.453	3.18	Paved	9.13														9.1		
																							212	6	6.00	0.6		0.6		
KEE_000_320		5,147	60	0.150	Grass-Short Grass Prairie	7.099	3.95	3.5																			KEE_000_320	3.5	**14.9**	**0.25**
									1,321	1.910	2.81	Paved	7.84														7.8		
									1,642	1.903	2.80	Paved	9.76														9.8		
														1,946	2.147	1.0	1.8	0.015	9.78		9.78	3.32						3.3		
														177	2.605	56.7	16.6	0.065	8.38		8.38	0.35						0.4		
KEE_000_330		1,743	100	0.150	Grass-Short Grass Prairie	1.485	3.95	9.9																			KEE_000_330	9.9	**9.4**	**0.16**
														1,643	3.018	8.0	10.5	0.045	4.79		4.79	5.71						5.7		
KEE_000_340		2,174	30	0.150	Grass-Short Grass Prairie	2.694	3.95	3.0																			KEE_000_340	3.0	**7.8**	**0.13**
									738	1.273	2.29	Paved	5.36														5.4		
														1,228	3.625	4.1	6.6	0.045	4.62		4.62	4.43						4.4		
														178	11.612	16.9	6.3	0.065	15.05		15.05	0.20						0.2		
KEE_001_010		3,375	100	0.150	Grass-Short Grass Prairie	6.151	3.95	5.6																			KEE_001_010	5.6	**10.4**	**0.17**
									1,063	3.256	3.67	Paved	4.83														4.8		
														218	1.637	1.5	4.7	0.045	1.99		1.99	1.83						1.8		
														526	0.799	7.8	7.9	0.015	8.81		8.81	1.00						1.0		
																							1,468	6	6.00	4.1		4.1		
KEE_001_020		1,554	100	0.150	Grass-Short Grass Prairie	3.210	3.95	7.3																			KEE_001_020	7.3	**7.7**	**0.13**
									867	3.248	3.66	Paved	3.94														3.9		
																							100	6	6.00	0.3		0.3		
														486	2.993	54.2	30.5	0.065	5.82		5.82	1.39						1.4		
KEE_001_030		1,340	100	0.150	Grass-Short Grass Prairie	4.670	3.95	6.3																			KEE_001_030	6.3	**6.8**	**0.11**
									634	2.329	3.10	Paved	3.41														3.4		
														606	1.393	15.4	8.3	0.045	5.92		5.92	1.71						1.7		
KEE_002_010		2,469	100	0.150	Grass-Short Grass Prairie	1.870	3.95	9.1																			KEE_002_010	9.1	**10.2**	**0.17**
									626	3.214	3.64	Paved	2.86														2.9		
														655	3.682	12.2	9.4	0.065	5.22		5.22	2.09						2.1		
																							1,088	6	6.00	3.0		3.0		
KEE_002_020		1,349	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			KEE_002_020	15.4	**12.7**	**0.21**
									179	1.891	2.80	Paved	1.07														1.1		
									465	1.488	2.48	Paved	3.13														3.1		
																							605	6	6.00	1.7		1.7		
KEE_004_010		3,383	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.300	3.95	0.7																			KEE_004_010	0.7	**13.5**	**0.22**
									2,242	1.156	2.19	Paved	17.10														17.1		
														314	1.003	3.9	5.6	0.015	7.88		7.88	0.66						0.7		
									311	0.665	1.66	Paved	3.13														3.1		
														466	1.303	4.5	6.3	0.015	9.02		9.02	0.86						0.9		
KEE_004_020		3,028	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.630	3.95	0.7																			KEE_004_020	0.7	**6.9**	**0.12**
									1,199	2.240	3.04	Paved	6.57														6.6		
																							1,066	6	6.00	3.0		3.0		
														713	0.635				9.01	9.01	9.01	1.32						1.3		
KEE_004_030		3,428	100	0.150	Grass-Short Grass Prairie	1.682	3.95	9.5																			KEE_004_030	9.5	**15.1**	**0.25**
									546	2.474	3.20	Paved	2.85														2.8		
									1,024	1.090	2.12	Paved	8.04														8.0		
																							1,757	6	6.00	4.9		4.9		
KEE_004_040		1,473	87	0.150	Grass-Short Grass Prairie	3.045	3.95	6.7																			KEE_004_040	6.7	**6.9**	**0.12**
									138	2.116	2.96	Paved	0.78														0.8		
									170	1.563	2.54	Paved	1.11														1.1		
																							1,078	6	6.00	3.0		3.0		
KEE_004_050		1,412	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.520	3.95	0.7																			KEE_004_050	0.7	**3.9**	**0.06**
									894	2.662	3.32	Paved	4.49														4.5		
																							468	6	6.00	1.3		1.3		
KEE_005_010		3,260	100	0.150	Grass-Short Grass Prairie	2.370	3.95	8.2																			KEE_005_010	8.2	**11.3**	**0.19**
									404	1.556	2.54	Paved	2.66														2.7		
														483	2.007	58.5	23.7	0.065	5.94		5.94	1.36						1.4		
														463	0.970	84.0	38.7	0.050	4.93		4.93	1.57						1.6		
																							1,811	6	6.00	5.0		5.0		

Kee Branch Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_005_020		3,664	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.000	3.95	0.8																			KEE_005_020	0.8	**7.9**	**0.13**
														906	1.467	29.3	31.9	0.045	3.80		3.80	3.98						4.0		
																							867	6	6.00	2.4		2.4		
														1,840	1.124	30.1	17.2	0.045	5.09		5.09	6.03						6.0		
KEE_005_030		3,020	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.980	3.95	0.5																			KEE_005_030	0.5	**9.6**	**0.16**
									305	1.304	2.32	Paved	2.19														2.2		
									774	1.280	2.30	Paved	5.61														5.6		
																							589	6	6.00	1.6		1.6		
														802	0.753	10.3	6.1	0.065	2.83		2.83	4.72						4.7		
																							500	6	6.00	1.4		1.4		
KEE_005_040		1,614	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.500	3.95	0.7																			KEE_005_040	0.7	**3.7**	**0.06**
									1,171	4.716	4.41	Paved	4.42														4.4		
																							393	6	6.00	1.1		1.1		
KEE_KB1_001_010		2,967	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.847	3.95	0.6																			KEE_KB1_001_010	0.6	**5.9**	**0.10**
									453	2.351	3.12	Paved	2.42														2.4		
																							2,464	6	6.00	6.8		6.8		
KEE_KB1_001_020		2,885	100	0.150	Grass-Short Grass Prairie	4.280	3.95	6.5																			KEE_KB1_001_020	6.5	**10.0**	**0.17**
									94	4.891	4.50	Paved	0.35														0.3		
									629	1.486	2.48	Paved	4.23														4.2		
														97	1.107	5.9	10.5	0.015	7.14		7.14	0.23						0.2		
																							237	6	6.00	0.7		0.7		
														451	0.747	2.9	3.5	0.015	7.46		7.46	1.01						1.0		
														532	1.340				5.50	5.50	5.50	1.61						1.6		
														426	1.319				9.20	9.20	9.20	0.77						0.8		
														318	1.195				3.90	3.90	3.90	1.36						1.4		
KEE_KB1_001_030		696	100	0.150	Grass-Short Grass Prairie	3.406	3.95	7.1																			KEE_KB1_001_030	7.1	**5.5**	**0.09**
									596	5.342	4.70	Paved	2.11														2.1		
KEE_KB1_010		3,559	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.067	3.95	0.8																			KEE_KB1_010	0.8	**6.2**	**0.10**
									647	5.107	4.59	Paved	2.35														2.3		
																							703	6	6.00	2.0		2.0		
														1,234	1.280	3.5	6.3	0.015	7.61		7.61	2.70						2.7		
																							925	6	6.00	2.6		2.6		
KEE_KB1_020		4,817	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.810	3.95	0.5																			KEE_KB1_020	0.5	**10.1**	**0.17**
									770	1.529	2.51	Paved	5.11														5.1		
																							3,998	6	6.00	11.1		11.1		
KEE_KB1_030		4,936	50	0.150	Grass-Short Grass Prairie	4.172	3.95	3.8																			KEE_KB1_030	3.8	**13.1**	**0.22**
									810	2.627	3.29	Paved	4.10														4.1		
																							129	6	6.00	0.4		0.4		
														2,566	1.746	8.7	9.0	0.045	4.26		4.26	10.03						10.0		
														232	1.415	1.6	2.7	0.015	8.34		8.34	0.46						0.5		
																							1,149	6	6.00	3.2		3.2		
KEE_KB1_040		3,426	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																			KEE_KB1_040	0.9	**7.9**	**0.13**
									1,487	3.011	3.53	Paved	7.03														7.0		
																							1,890	6	6.00	5.3		5.3		
KEE_KB1_050		2,596	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.620	3.95	1.0																			KEE_KB1_050	1.0	**5.3**	**0.09**
														872	2.111	17.5	18.4	0.045	4.66		4.66	3.12						3.1		
																							1,674	6	6.00	4.7		4.7		
KEE_KB1_060		3,711	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.080	3.95	0.5																			KEE_KB1_060	0.5	**9.4**	**0.16**
									231	0.917	1.95	Paved	1.98														2.0		
									149	5.852	4.92	Paved	0.51														0.5		
														493	0.637	1.8	5.9	0.015	3.57		3.57	2.30						2.3		
														1,246	1.791	4.8	6.5	0.045	3.63		3.63	5.72						5.7		
														371	2.868	4.0	3.4	0.065	4.35		4.35	1.42						1.4		
																							1,171	6	6.00	3.3		3.3		

Appendix B-3

Lower Rush Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
PAN_000_010		4,143	100	0.150	Grass-Short Grass Prairie	3.879	3.95	6.8																		PAN_000_010	6.8	**14.7**	**0.24**
									702	2.327	3.10	Paved	3.77														3.8		
									804	0.925	1.96	Paved	6.85														6.9		
																						2,535	6.00	6.00	7.0		7.0		
PAN_000_020		2,536	100	0.150	Grass-Short Grass Prairie	1.424	3.95	10.1																		PAN_000_020	10.1	**12.0**	**0.20**
									962	1.806	2.73	Paved	5.87														5.9		
																						1,474	6.00	6.00	4.1		4.1		
PAN_000_030		4,382	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		PAN_000_030	0.9	**11.6**	**0.19**
									1,377	0.938	1.97	Paved	11.66														11.7		
														2,352	0.667			0.015	7.63	7.63	7.63	5.14						5.1		
																						604	6.00	6.00	1.7		1.7		
PAN_000_040		4,196	100	0.150	Grass-Short Grass Prairie	6.914	3.95	5.4																		PAN_000_040	5.4	**12.9**	**0.21**
									113	8.527	5.94	Paved	0.32														0.3		
									1,282	1.628	2.59	Paved	8.24														8.2		
																						2,698	6.00	6.00	7.5		7.5		
PAN_000_050		4,121	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.571	3.95	1.0																		PAN_000_050	1.0	**10.5**	**0.18**
									491	0.544	1.50	Paved	5.46														5.5		
																						2,846	6.00	6.00	7.9		7.9		
														734	0.704			0.065	3.86	3.86	3.86	3.17						3.2		
PAN_000_060		6,759	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.284	3.95	0.5																		PAN_000_060	0.5	**14.4**	**0.24**
									1,691	2.112	2.95	Paved	9.54														9.5		
																						5,018	6.00	6.00	13.9		13.9		
PAN_000_070		5,912	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.579	3.95	1.0																		PAN_000_070	1.0	**11.4**	**0.19**
									732	2.560	3.25	Paved	3.75														3.8		
																						5,130	6.00	6.00	14.3		14.3		
PAN_000_080		2,612	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		PAN_000_080	1.1	**11.8**	**0.20**
									2,221	1.112	2.14	Paved	17.27														17.3		
														341	4.360	16.3	17.5	0.065	4.57		4.57	1.24						1.2		
PAN_000_090		5,232	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.011	3.95	0.6																		PAN_000_090	0.6	**13.5**	**0.23**
									854	0.500	1.44	Paved	9.90														9.9		
																						4,328	6.00	6.00	12.0		12.0		
PAN_000_100		2,042	100	0.150	Grass-Short Grass Prairie	0.748	3.95	13.1																		PAN_000_100	13.1	**15.1**	**0.25**
									258	0.786	1.80	Paved	2.39														2.4		
									1,685	2.054	2.91	Paved	9.64														9.6		
PAN_000_110		2,848	100	0.150	Grass-Short Grass Prairie	2.376	3.95	8.2																		PAN_000_110	8.2	**12.3**	**0.20**
									958	1.160	2.19	Paved	7.29														7.3		
																						1,790	6.00	6.00	5.0		5.0		
PAN_000_120		2,917	100	0.150	Grass-Short Grass Prairie	2.420	3.95	8.2																		PAN_000_120	8.2	**10.8**	**0.18**
									228	3.247	3.66	Paved	1.04														1.0		
									714	2.717	3.35	Paved	3.55														3.6		
																						1,876	6.00	6.00	5.2		5.2		
PAN_000_130		3,301	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.457	3.95	0.7																		PAN_000_130	0.7	**18.4**	**0.31**
									601	3.667	3.89	Paved	2.57														2.6		
														2,650	0.886	10.4	27.8	0.045	1.61		1.61	27.39						27.4		
RUS_000_360		3,176	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_360	1.1	**8.0**	**0.13**
									1,427	2.340	3.11	Paved	7.65														7.6		
																						1,497	6.00	6.00	4.2		4.2		
														202	8.113	17.4	14.8	0.065	7.28		7.28	0.46						0.5		
RUS_000_370		2,146	50	0.150	Grass-Short Grass Prairie	3.750	3.95	3.9																		RUS_000_370	3.9	**7.8**	**0.13**
									171	8.763	6.02	Paved	0.47														0.5		
														1,927	3.223	6.1	12.1	0.045	3.77		3.77	8.53						8.5		
RUS_000_380		674	100	0.150	Grass-Short Grass Prairie	4.730	3.95	6.2																		RUS_000_380	6.2	**4.7**	**0.08**
									573	7.984	5.74	Paved	1.66														1.7		
RUS_000_390		2,658	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_000_390	1.0	**11.0**	**0.18**
									1,257	0.579	1.55	Paved	13.54														13.5		
																						1,352	6.00	6.00	3.8		3.8		
RUS_000_400		1,435	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.646	3.95	1.0																		RUS_000_400	1.0	**3.1**	**0.05**
									478	5.274	4.67	Paved	1.71														1.7		
																						907	6.00	6.00	2.5		2.5		
RUS_000_410		4,837	100	0.150	Grass-Short Grass Prairie	3.876	3.95	6.8																		RUS_000_410	6.8	**12.9**	**0.22**
									1,216	3.291	3.69	Paved	5.50														5.5		
																						508	6.00	6.00	1.4		1.4		
														2,220	1.962	1.7	5.2	0.015	6.48		6.48	5.71						5.7		
																						791	6.00	6.00	2.2		2.2		
RUS_000_420		2,655	50	0.150	Grass-Short Grass Prairie	1.100	3.95	6.4																		RUS_000_420	6.4	**8.8**	**0.15**
									375	2.429	3.17	Paved	1.97														2.0		
																						2,231	6.00	6.00	6.2		6.2		
RUS_000_430		1,770	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.928	3.95	0.4																		RUS_000_430	0.4	**4.3**	**0.07**
									1,220	3.529	3.82	Paved	5.32														5.3		
																						501	6.00	6.00	1.4		1.4		
RUS_000_440		391	100	0.150	Grass-Short Grass Prairie	3.155	3.95	7.3																		RUS_000_440	7.3	**5.5**	**0.09**
									287	2.680	2.64	Unpaved	1.81														1.8		
RUS_000_450		5,802	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.109	3.95	0.8																		RUS_000_450	0.8	**13.9**	**0.23**
									929	0.722	1.73	Paved	8.96														9.0		
																						4,822	6.00	6.00	13.4		13.4		
RUS_000_460		2,409	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.526	3.95	1.1																		RUS_000_460	1.1	**7.6**	**0.13**
									653	0.621	1.60	Paved	6.79														6.8		
																						1,707	6.00	6.00	4.7		4.7		

Lower Rush Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_470														1,965	0.500	100.4	58.2	0.050	3.03		3.03	10.80					RUS_000_470	10.8	**6.5**	**0.11**
RUS_000_480														297	0.500	104.1	60.6	0.065	2.32		2.32	2.13					RUS_000_480	10.0	**6.0**	**0.10**
RUS_000_500		856												856	1.719	140.3	36.4	0.065	7.39		7.39	1.93					RUS_000_500	10.0	**6.0**	**0.10**
RUS_000_510		3,401	50	0.150	Grass-Short Grass Prairie	3.981	3.95	3.8																			RUS_000_510	3.8	**10.5**	**0.18**
									1,647	4.446	4.29	Paved	6.40															6.4		
														1,704	1.624	2.5	2.8	0.045	3.89		3.89	7.30						7.3		
RUS_000_520		689	100	0.150	Grass-Short Grass Prairie	1.650	3.95	9.5																			RUS_000_520	9.5	**7.5**	**0.13**
									589	2.603	3.28	Paved	2.99															3.0		
RUS_000_530		5,641	100	0.150	Grass-Short Grass Prairie	7.835	3.95	5.1																			RUS_000_530	5.1	**35.1**	**0.59**
									3,227	0.500	1.44	Paved	37.42															37.4		
														2,315	0.500	105.9	58.3	0.065	2.41		2.41	15.99						16.0		
RUS_003_010		2,458	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.628	3.95	1.0																			RUS_003_010	1.0	**5.7**	**0.10**
									731	2.369	3.13	Paved	3.89															3.9		
																							1,676	6.00	6.00	4.7		4.7		
RUS_003_020		3,664	98	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.191	3.95	1.0																			RUS_003_020	1.0	**7.8**	**0.13**
									740	2.179	3.00	Paved	4.11															4.1		
																							2,826	6.00	6.00	7.9		7.9		
RUS_004_001_010		2,717	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.713	3.95	0.9																			RUS_004_001_010	0.9	**14.8**	**0.25**
														2,666	0.585	9.2	14.4	0.045	1.88		1.88	23.68						23.7		
RUS_004_001_020		2,250	100	0.150	Grass-Short Grass Prairie	5.307	3.95	6.0																			RUS_004_001_020	6.0	**8.3**	**0.14**
									560	2.970	3.50	Paved	2.66															2.7		
														455	1.358	8.0	10.2	0.045	3.27		3.27	2.32						2.3		
														1,135	0.777			0.065	6.66	6.66	6.66	2.84						2.8		
RUS_004_001_030		2,222	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.375	3.95	0.7																			RUS_004_001_030	0.7	**5.1**	**0.09**
														891	3.344	5.5	13.7	0.045	3.29		3.29	4.52						4.5		
														1,278	2.228			0.065	6.43	6.43	6.43	3.31						3.3		
RUS_004_001_040		592	100	0.150	Grass-Short Grass Prairie	5.366	3.95	5.9																			RUS_004_001_040	5.9	**4.3**	**0.07**
									494	10.075	6.45	Paved	1.28															1.3		
RUS_004_010		3,537	77	0.150	Grass-Short Grass Prairie	3.850	3.95	5.5																			RUS_004_010	5.5	**15.2**	**0.25**
									100	2.405	3.15	Paved	0.53															0.5		
									614	0.914	1.94	Paved	5.27															5.3		
																							515	6.00	6.00	1.4		1.4		
														2,231	0.537	23.8	17.9	0.045	2.94		2.94	12.65						12.7		
RUS_004_020		2,424	100	0.150	Grass-Short Grass Prairie	1.256	3.95	10.6																			RUS_004_020	10.6	**18.1**	**0.30**
									1,076	0.506	1.45	Paved	12.40															12.4		
														1,246	0.850	8.3	9.0	0.045	2.89		2.89	7.19						7.2		
RUS_004_030		1,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.391	3.95	0.7																			RUS_004_030	0.7	**7.3**	**0.12**
									1,188	1.434	2.43	Paved	8.13															8.1		
														556	0.500			0.055	2.87	2.87	2.87	3.23						3.2		
RUS_004_040		1,909	100	0.150	Grass-Short Grass Prairie	2.384	3.95	8.2																			RUS_004_040	8.2	**12.9**	**0.21**
									726	0.500	1.44	Paved	8.42															8.4		
														1,084	3.061			0.045	3.73	3.73	3.73	4.84						4.8		
RUS_004_050		2,011	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.174	3.95	0.5																			RUS_004_050	0.5	**4.6**	**0.08**
									646	3.614	3.86	Paved	2.79															2.8		
									638	1.985	2.86	Paved	3.71															3.7		
														677	2.910	311.4	137.2	0.024	18.29		18.29	0.62						0.6		
RUS_005_002_010		3,287	60	0.150	Grass-Short Grass Prairie	9.203	3.95	3.2																			RUS_005_002_010	3.2	**8.9**	**0.15**
									1,438	3.112	3.59	Paved	6.68															6.7		
																							1,789	6.00	6.00	5.0		5.0		
RUS_005_010		3,228	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.900	3.95	0.6																			RUS_005_010	0.6	**9.7**	**0.16**
									1,760	1.571	2.55	Paved	11.51															11.5		
																							1,417	6.00	6.00	3.9		3.9		
RUS_005_020		1,426	56	0.150	Grass-Short Grass Prairie	8.478	3.95	3.1																			RUS_005_020	3.1	**6.0**	**0.10**
									755	2.282	3.07	Paved	4.10															4.1		
									615	3.197	3.63	Paved	2.82															2.8		
RUS_005_030		3,299	81	0.150	Grass-Short Grass Prairie	1.329	3.95	8.8																			RUS_005_030	8.8	**13.4**	**0.22**
									1,672	2.126	2.96	Paved	9.40															9.4		
																							1,257	6.00	6.00	3.5		3.5		
														289	2.204	1.4	3.6	0.015	7.83		7.83	0.62						0.6		
RUS_005_040		1,121	100	0.150	Grass-Short Grass Prairie	4.480	3.95	6.4																			RUS_005_040	6.4	**7.7**	**0.13**
									804	1.240	2.26	Paved	5.92															5.9		
																							217	6.00	6.00	0.6		0.6		
RUS_005_050		4,115	100	0.150	Grass-Short Grass Prairie	5.308	3.95	6.0																			RUS_005_050	6.0	**14.4**	**0.24**
														2,095	1.936	1.9	4.0	0.045	2.76		2.76	12.67						12.7		
																							1,921	6.00	6.00	5.3		5.3		
RUS_005_060		1,894	100	0.150	Grass-Short Grass Prairie	3.446	3.95	7.1																			RUS_005_060	7.1	**12.3**	**0.20**
									1,441	0.916	1.95	Paved	12.34															12.3		
																							354	6.00	6.00	1.0		1.0		
RUS_005_070		671	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.864	3.95	0.9																			RUS_005_070	0.9	**2.6**	**0.04**
									621	2.199	3.01	Paved	3.43															3.4		
RUS_006_010		2,750	38	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.841	3.95	0.3																			RUS_006_010	0.3	**5.9**	**0.10**
									677	3.792	3.96	Paved	2.85															2.9		
														2,035	2.914	45.5	30.9	0.065	5.06		5.06	6.70						6.7		
RUS_RC2_010		4,624	100	0.150	Grass-Short Grass Prairie	5.259	3.95	6.0																			RUS_RC2_010	6.0	**12.7**	**0.21**
									1,085	2.477	3.20	Paved	5.65															5.7		
																							3,440	6.00	6.00	9.6		9.6		
RUS_RC2_020		3,281	49	0.150	Grass-Short Grass Prairie	3.496	3.95	4.0																			RUS_RC2_020	4.0	**10.0**	**0.17**
														1,238	2.750	3.3	8.5	0.045	2.90		2.90	7.11						7.1		
																							1,994	6.00	6.00	5.5		5.5		
RUS_RC2_030		2,943	100	0.150	Grass-Short Grass Prairie	3.122	3.95	7.4																			RUS_RC2_030	7.4	**11.5**	**0.19**
														1,631	1.945	4.2	7.2	0.045	3.21		3.21	8.46						8.5		

Lower Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							1,212	6.00	6.00	3.4		3.4		
RUS_RC2_040		2,905	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_040	1.1	**9.0**	**0.15**
									1,470	1.426	2.43	Paved	10.09														10.1		
																							1,385	6.00	6.00	3.8		3.8		
RUS_RC2_050		3,579	100	0.150	Grass-Short Grass Prairie	4.446	3.95	6.4																			RUS_RC2_050	6.4	**12.9**	**0.21**
									398	2.553	3.25	Paved	2.04														2.0		
									963	1.234	2.26	Paved	7.11														7.1		
																							2,117	6.00	6.00	5.9		5.9		
RUS_RC2_060		3,143	65	0.150	Grass-Short Grass Prairie	8.975	3.95	3.4																			RUS_RC2_060	3.4	**8.3**	**0.14**
									860	4.128	4.13	Paved	3.47														3.5		
																							1,110	6.00	6.00	3.1		3.1		
														740	2.606	14.8	11.5	0.065	4.39		4.39	2.81						2.8		
																							369	6.00	6.00	1.0		1.0		
RUS_RC2_070		2,142	42	0.150	Grass-Short Grass Prairie	20.469	3.95	1.7																			RUS_RC2_070	1.7	**6.4**	**0.11**
									1,843	3.404	3.75	Paved	8.19														8.2		
																							257	6.00	6.00	0.7		0.7		
RUS_RC2_080		1,482	100	0.150	Grass-Short Grass Prairie	7.150	3.95	5.3																			RUS_RC2_080	5.3	**6.3**	**0.11**
									418	5.026	4.56	Paved	1.53														1.5		
									612	2.960	3.50	Paved	2.92														2.9		
														353	6.538	10.7	7.9	0.065	7.17		7.17	0.82						0.8		
RUS_RC2_085		2,259	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_085	1.1	**6.0**	**0.10**
									762	1.644	2.61	Paved	4.87														4.9		
																							1,448	6.00	6.00	4.0		4.0		
RUS_RC2_090		3,894	83	0.150	Grass-Short Grass Prairie	8.486	3.95	4.3																			RUS_RC2_090	4.3	**13.6**	**0.23**
									1,159	3.169	3.62	Paved	5.34														5.3		
																							238	6.00	6.00	0.7		0.7		
														1,893	1.779	19.5	21.2	0.065	2.90		2.90	10.89						10.9		
																							522	6.00	6.00	1.5		1.5		
RUS_RC2_100		2,889	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.922	3.95	0.6																			RUS_RC2_100	0.6	**6.9**	**0.12**
									1,351	2.673	3.32	Paved	6.77														6.8		
																							1,489	6.00	6.00	4.1		4.1		
RUS_RC2_110		1,928	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_110	1.1	**4.8**	**0.08**
									1,114	3.655	3.89	Paved	4.78														4.8		
																							764	6.00	6.00	2.1		2.1		
RUS_RCH_010		3,584	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.263	3.95	0.4																			RUS_RCH_010	0.4	**6.1**	**0.10**
														1,780	4.622	19.8	14.9	0.065	5.95		5.95	4.98						5.0		
																							1,755	6.00	6.00	4.9		4.9		
RUS_RCH_020		1,780	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.105	3.95	0.6																			RUS_RCH_020	0.6	**7.2**	**0.12**
									114	4.464	4.29	Paved	0.44														0.4		
									759	0.523	1.47	Paved	8.60														8.6		

Appendix B-3

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_190		3,167	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.916	3.95	0.6																		RUS_000_190	0.6	**10.7**	**0.18**
									1,512	0.949	1.98	Paved	12.73														12.7		
																						1,605	6.00	6.00	4.5		4.5		
RUS_000_200		1,447	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.039	3.95	0.8																		RUS_000_200	0.8	**3.7**	**0.06**
									1,398	4.474	4.30	Paved	5.42														5.4		
RUS_000_210		2,148	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.882	3.95	0.9																		RUS_000_210	0.9	**8.4**	**0.14**
									1,259	0.960	1.99	Paved	10.54														10.5		
																						420	6.00	6.00	1.2		1.2		
														417	3.444	31.0	24.1	0.065	5.03		5.03	1.38					1.4		
RUS_000_220		845	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.145	3.95	0.8																		RUS_000_220	0.8	**3.1**	**0.05**
									798	2.196	3.01	Paved	4.42														4.4		
RUS_000_230		1,908	45	0.150	Grass-Short Grass Prairie	3.872	3.95	3.6																		RUS_000_230	3.6	**6.8**	**0.11**
									1,391	3.055	3.55	Paved	6.52														6.5		
																						471	6.00	6.00	1.3		1.3		
RUS_000_240		1,677	100	0.150	Grass-Short Grass Prairie	1.500	3.95	9.9																		RUS_000_240	9.9	**9.4**	**0.16**
									205	3.455	3.78	Paved	0.90														0.9		
									221	1.290	2.31	Paved	1.60														1.6		
																						1,150	6.00	6.00	3.2		3.2		
RUS_000_250		754	100	0.150	Grass-Short Grass Prairie	5.942	3.95	5.7																		RUS_000_250	5.7	**4.6**	**0.08**
									655	7.526	5.58	Paved	1.96														2.0		
RUS_000_260		514	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.690	3.95	0.4																		RUS_000_260	0.4	**3.2**	**0.05**
									1,414	5.398	4.72	Paved	4.99														5.0		
RUS_000_270		3,893	100	0.150	Grass-Short Grass Prairie	1.409	3.95	10.1																		RUS_000_270	10.1	**17.4**	**0.29**
									752	1.895	2.80	Paved	4.48														4.5		
														1,417	2.138	10.5	18.3	0.065	2.31		2.31	10.22						10.2		
																						1,381	6.00	6.00	3.8		3.8		
														243	13.051	11.9	8.3	0.065	10.59		10.59	0.38					0.4		
RUS_000_280		1,435	50	0.150	Grass-Short Grass Prairie	10.597	3.95	2.6																		RUS_000_280	2.6	**6.4**	**0.11**
									1,004	1.551	2.53	Paved	6.61														6.6		
									380	4.792	4.45	Paved	1.42														1.4		
RUS_000_290		1,931	100	0.150	Grass-Short Grass Prairie	8.440	3.95	5.0																		RUS_000_290	5.0	**8.2**	**0.14**
									157	1.502	2.49	Paved	1.05														1.1		
														1,673	3.209	2.0	4.1	0.045	3.64		3.64	7.65						7.7		
RUS_000_300		2,275	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.074	3.95	0.6																		RUS_000_300	0.6	**4.3**	**0.07**
									37	3.377	3.74	Paved	0.17														0.2		
									118	3.837	3.98	Paved	0.49														0.5		
														2,068	3.722	1.3	7.4	0.015	5.86		5.86	5.89						5.9		
RUS_000_310		3,314	100	0.150	Grass-Short Grass Prairie	0.621	3.95	14.1																		RUS_000_310	14.1	**17.6**	**0.29**
														1,362	1.210	19.7	28.6	0.045	2.84		2.84	8.01						8.0		
																						407	6.00	6.00	1.1		1.1		
														1,142	1.393	62.0	39.7	0.065	3.64		3.64	5.23						5.2		
																						301	6.00	6.00	0.8		0.8		
RUS_000_320		3,334	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.801	3.95	0.4																		RUS_000_320	0.4	**7.2**	**0.12**
									243	8.064	5.77	Paved	0.70														0.7		
									538	1.979	2.86	Paved	3.14														3.1		
														328	1.140	6.8	7.9	0.045	3.23		3.23	1.70						1.7		
																						2,174	6.00	6.00	6.0		6.0		
RUS_000_330		3,501	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.676	3.95	0.6																		RUS_000_330	0.6	**16.2**	**0.27**
									1,910	0.530	1.48	Paved	21.51														21.5		
																						847	6.00	6.00	2.4		2.4		
														694	0.500	152.2	33.1	0.065	4.49		4.49	2.58						2.6		
RUS_000_340		2,466	100	0.150	Grass-Short Grass Prairie	5.295	3.95	6.0																		RUS_000_340	6.0	**10.4**	**0.17**
									861	4.877	4.49	Paved	3.20														3.2		
									691	3.183	3.63	Paved	3.18														3.2		
									814	1.818	2.74	Paved	4.95														4.9		
RUS_000_350		3,685	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.820	3.95	0.4																		RUS_000_350	0.4	**18.6**	**0.31**
									1,154	2.369	3.13	Paved	6.15														6.1		
														1,357	0.659	0.7	2.9	0.045	1.03		1.03	21.97						22.0		
																						590	6.00	6.00	1.6		1.6		
														535	4.495	70.0	89.0	0.024	11.21		11.21	0.80						0.8		
RUS_007_010		2,493	100	0.150	Grass-Short Grass Prairie	2.155	3.95	8.6																		RUS_007_010	8.6	**10.6**	**0.18**
									807	2.173	3.00	Paved	4.49														4.5		
														138	0.543	4.1	10.1	0.015	3.98		3.98	0.58						0.6		
																						1,448	6.00	6.00	4.0		4.0		
RUS_007_020		3,709	28	0.150	Grass-Short Grass Prairie	1.232	3.95	3.9																		RUS_007_020	3.9	**11.0**	**0.18**
									1,293	1.397	2.40	Paved	8.97														9.0		
																						171	6.00	6.00	0.5		0.5		
														1,837	1.419			0.015	7.83	7.83	7.83	3.91						3.9		
																						380	6.00	6.00	1.1		1.1		

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_007_030		3,847	100	0.150	Grass-Short Grass Prairie	1.067	3.95	11.3																		RUS_007_030	11.3	**19.6**	**0.33**
									1,090	0.691	1.69	Paved	10.75														10.8		
									791	1.475	2.47	Paved	5.34														5.3		
																						1,867	6.00	6.00	5.2		5.2		
RUS_007_040		3,613	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.499	3.95	0.5																		RUS_007_040	0.5	**10.7**	**0.18**
									273	0.712	1.72	Paved	2.65														2.7		
														1,182	2.761	4.7	11.2	0.045	3.09		3.09	6.38						6.4		
														2,106	1.153	80.2	35.5	0.065	4.24		4.24	8.28						8.3		
RUS_007_050		2,081	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_007_050	1.1	**6.6**	**0.11**
									1,310	1.878	2.79	Paved	7.84														7.8		
																						722	6.00	6.00	2.0		2.0		
RUS_007_060		972	53	0.150	Grass-Short Grass Prairie	3.872	3.95	4.1																		RUS_007_060	4.1	**5.1**	**0.09**
									777	2.448	3.18	Paved	4.07														4.1		
																						142	6.00	6.00	0.4		0.4		
RUS_007_070		3,594	100	0.150	Grass-Short Grass Prairie	5.870	3.95	5.7																		RUS_007_070	5.7	**13.2**	**0.22**
														2,102	1.452	15.5	27.5	0.045	2.73		2.73	12.85						12.9		
																						767	6.00	6.00	2.1		2.1		
														625	3.995	36.3	15.3	0.065	8.17		8.17	1.28						1.3		
RUS_008_010		4,459	100	0.150	Grass-Short Grass Prairie	0.750	3.95	13.1																		RUS_008_010	13.1	**17.4**	**0.29**
														1,283	1.961	2.4	4.6	0.045	3.03		3.03	7.07						7.1		
																						2,450	6.00	6.00	6.8		6.8		
														620	2.319	13.9	8.6	0.065	4.83		4.83	2.14						2.1		
RUS_009_010		3,279	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_010	1.1	**7.1**	**0.12**
									471	1.549	2.53	Paved	3.10														3.1		
																						2,758	6.00	6.00	7.7		7.7		
RUS_009_020		3,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.675	3.95	1.0																		RUS_009_020	1.0	**13.0**	**0.22**
									1,970	1.058	2.09	Paved	15.70														15.7		
																						1,774	6.00	6.00	4.9		4.9		
RUS_009_030		3,660	51	0.150	Grass-Short Grass Prairie	5.583	3.95	3.4																		RUS_009_030	3.4	**9.2**	**0.15**
									223	0.525	1.47	Paved	2.52														2.5		
																						3,387	6.00	6.00	9.4		9.4		
RUS_009_040		3,486	49	0.150	Grass-Short Grass Prairie	2.355	3.95	4.7																		RUS_009_040	4.7	**14.6**	**0.24**
									1,374	0.886	1.91	Paved	11.97														12.0		
														751	2.041	1.3	2.7	0.045	2.89		2.89	4.33						4.3		
																						435	6.00	6.00	1.2		1.2		
														878	1.504	1.4	3.3	0.015	7.01		7.01	2.09						2.1		
RUS_009_050		3,246	32	0.150	Grass-Short Grass Prairie	4.626	3.95	2.5																		RUS_009_050	2.5	**11.1**	**0.19**
									601	0.863	1.89	Paved	5.30														5.3		
																						409	6.00	6.00	1.1		1.1		
														1,290	1.118	38.9	52.1	0.045	2.88		2.88	7.46						7.5		
														914	1.797	1.1	2.8	0.015	7.24		7.24	2.10						2.1		
RUS_009_060		517	50	0.150	Grass-Short Grass Prairie	2.840	3.95	4.4																		RUS_009_060	4.4	**4.1**	**0.07**
									467	2.501	3.21	Paved	2.42														2.4		
RUS_009_070		1,305	100	0.150	Grass-Short Grass Prairie	3.928	3.95	6.7																		RUS_009_070	6.7	**6.5**	**0.11**
														1,205	2.903	11.8	14.8	0.045	4.85		4.85	4.14						4.1		
RUS_009_080		2,650	44	0.150	Grass-Short Grass Prairie	9.014	3.95	2.5																		RUS_009_080	2.5	**8.3**	**0.14**
									1,042	1.494	2.48	Paved	6.99														7.0		
																						1,563	6.00	6.00	4.3		4.3		
RUS_009_090		762	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_090	1.1	**2.3**	**0.04**
									712	4.333	4.23	Paved	2.80														2.8		
RUS_010_001_010		2,007	31	0.150	Grass-Short Grass Prairie	8.520	3.95	1.9																		RUS_010_001_010	1.9	**6.7**	**0.11**
									1,076	1.754	2.69	Paved	6.66														6.7		
																						900	6.00	6.00	2.5		2.5		
RUS_010_001_020		1,631	100	0.150	Grass-Short Grass Prairie	2.562	3.95	8.0																		RUS_010_001_020	8.0	**9.7**	**0.16**
									329	1.347	2.36	Paved	2.32														2.3		
									656	1.565	2.54	Paved	4.30														4.3		
																						546	6.00	6.00	1.5		1.5		
RUS_010_002_010		3,151	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.465	3.95	0.7																		RUS_010_002_010	0.7	**7.8**	**0.13**
									1,207	2.020	2.89	Paved	6.96														7.0		
																						1,892	6.00	6.00	5.3		5.3		
RUS_010_002_020		729	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.894	3.95	0.5																		RUS_010_002_020	0.5	**2.7**	**0.05**
									489	1.275	2.30	Paved	3.55														3.6		
																						185	6.00	6.00	0.5		0.5		
RUS_010_002_030		268	100	0.150	Grass-Short Grass Prairie	3.989	3.95	6.7																		RUS_010_002_030	6.7	**4.3**	**0.07**
									169	7.628	5.61	Paved	0.50														0.5		
RUS_010_003_010		3,676	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_003_010	1.1	**8.0**	**0.13**
									332	0.978	2.01	Paved	2.75														2.8		
																						2,801	6.00	6.00	7.8		7.8		
														493	2.675	8.4	5.6	0.065	4.95		4.95	1.66						1.7		
RUS_010_003_020		782	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.729	3.95	0.9																		RUS_010_003_020	0.9	**2.3**	**0.04**
									732	4.395	4.26	Paved	2.86														2.9		
RUS_010_004_010		3,696	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.845	3.95	0.6																		RUS_010_004_010	0.6	**13.0**	**0.22**
									2,116	1.071	2.10	Paved	16.76														16.8		
																						1,530	6.00	6.00	4.3		4.3		
RUS_010_004_020		2,840	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_004_020	1.1	**10.7**	**0.18**
									1,248	0.837	1.86	Paved	11.18														11.2		
														695	0.500	87.1	32.9	0.055	3.67		3.67	3.16						3.2		
																						846	6.00	6.00	2.4		2.4		
RUS_010_004_030		5,070	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_010_004_030	15.4	**23.5**	**0.39**
														2,154	0.945	13.7	23.5	0.045	2.25		2.25	15.95						15.9		
																						2,815	6.00	6.00	7.8		7.8		

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_010_004_040		1,541	41	0.150	Grass-Short Grass Prairie	2.760	3.95	3.8																		RUS_010_004_040	3.8	**6.1**	**0.10**
									977	2.681	3.33	Paved	4.89														4.9		
																						523	6.00	6.00	1.5		1.5		
RUS_010_010		4,841	100	0.150	Grass-Short Grass Prairie	4.538	3.95	6.4																		RUS_010_010	6.4	**19.3**	**0.32**
									213	3.979	4.05	Paved	0.88														0.9		
														2,090	1.163	3.5	9.2	0.045	1.89		1.89	18.47						18.5		
																						1,312	6.00	6.00	3.6		3.6		
														646	1.756	0.7	1.6	0.015	7.25		7.25	1.49						1.5		
																						480	6.00	6.00	1.3		1.3		
RUS_010_020		343	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.520	3.95	1.1																		RUS_010_020	1.1	**1.2**	**0.02**
									291	6.399	5.14	Paved	0.94														0.9		
RUS_010_030		1,321	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.650	3.95	0.6																		RUS_010_030	0.6	**4.5**	**0.08**
									1,271	2.210	3.02	Paved	7.01														7.0		
RUS_010_040		1,759	100	0.150	Grass-Short Grass Prairie	4.801	3.95	6.2																		RUS_010_040	6.2	**7.7**	**0.13**
									602	1.729	2.67	Paved	3.75														3.8		
																						1,059	6.00	6.00	2.9		2.9		
RUS_011_010		2,319	100	0.150	Grass-Short Grass Prairie	2.375	3.95	8.2																		RUS_011_010	8.2	**10.4**	**0.17**
									789	2.588	3.27	Paved	4.02														4.0		
														1,432	1.614	56.0	26.8	0.065	4.76		4.76	5.02						5.0		
RUS_011_020		1,738	71	0.150	Grass-Short Grass Prairie	3.174	3.95	5.6																		RUS_011_020	5.6	**8.0**	**0.13**
														1,299	3.035	3.9	9.5	0.045	3.18		3.18	6.80						6.8		
																						368	6.00	6.00	1.0		1.0		
RUS_012_010		4,330	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.659	3.95	0.7																		RUS_012_010	0.7	**10.3**	**0.17**
									219	1.259	2.28	Paved	1.60														1.6		
									927	1.540	2.52	Paved	6.12														6.1		
																						3,133	6.00	6.00	8.7		8.7		
RUS_012_020		4,124	100	0.150	Grass-Short Grass Prairie	0.808	3.95	12.7																		RUS_012_020	12.7	**16.3**	**0.27**
									540	1.612	2.58	Paved	3.49														3.5		
									464	2.235	3.04	Paved	2.54														2.5		
																						3,020	6.00	6.00	8.4		8.4		
RUS_012_030		423	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.373	3.95	0.5																		RUS_012_030	0.5	**1.3**	**0.02**
									375	3.337	3.71	Paved	1.68														1.7		
RUS_013_010		2,469	100	0.150	Grass-Short Grass Prairie	1.822	3.95	9.2																		RUS_013_010	9.2	**10.8**	**0.18**
									743	1.961	2.85	Paved	4.35														4.4		
																						1,625	6.00	6.00	4.5		4.5		
RUS_013_020		1,511	100	0.150	Grass-Short Grass Prairie	0.587	3.95	14.4																		RUS_013_020	14.4	**14.1**	**0.24**
									1,410	1.594	2.57	Paved	9.16														9.2		
RUS_013_030		1,261	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_013_030	1.1	**4.0**	**0.07**
									1,212	3.168	3.62	Paved	5.58														5.6		
RUS_014_010		3,428	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.951	3.95	0.5																		RUS_014_010	0.5	**12.6**	**0.21**
														1,756	0.731	14.4	21.2	0.045	2.19		2.19	13.38						13.4		
																						528	6.00	6.00	1.5		1.5		
														1,099	1.577	11.1	16.0	0.045	3.26		3.26	5.62						5.6		
RUS_014_020		2,053	100	0.150	Grass-Short Grass Prairie	4.552	3.95	6.3																		RUS_014_020	6.3	**10.5**	**0.18**
									131	5.141	4.61	Paved	0.47														0.5		
									475	1.609	2.58	Paved	3.07														3.1		
									467	0.546	1.50	Paved	5.18														5.2		
																						882	6.00	6.00	2.5		2.5		
RUS_015_010		3,692	100	0.150	Grass-Short Grass Prairie	2.398	3.95	8.2																		RUS_015_010	8.2	**15.5**	**0.26**
									432	0.584	1.55	Paved	4.63														4.6		
																						638	6.00	6.00	1.8		1.8		
														889	1.588	22.2	56.4	0.045	2.24		2.24	6.61						6.6		
																						1,634	6.00	6.00	4.5		4.5		
RUS_015_020		2,629	100	0.150	Grass-Short Grass Prairie	2.179	3.95	8.5																		RUS_015_020	8.5	**10.2**	**0.17**
									56	2.488	3.21	Paved	0.29														0.3		
									388	1.870	2.78	Paved	2.33														2.3		
																						2,085	6.00	6.00	5.8		5.8		
RYA_000_010		2,853	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RYA_000_010	1.1	**10.0**	**0.17**
									1,121	0.715	1.72	Paved	10.87														10.9		
																						1,681	6.00	6.00	4.7		4.7		
RYA_000_020		5,389	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RYA_000_020	15.4	**19.0**	**0.32**
									709	2.572	3.26	Paved	3.62														3.6		
																						4,581	6.00	6.00	12.7		12.7		
RYA_000_030		4,581	100	0.150	Grass-Short Grass Prairie	2.571	3.95	8.0																		RYA_000_030	8.0	**15.1**	**0.25**
									1,191	1.453	2.45	Paved	8.10														8.1		
																						3,290	6.00	6.00	9.1		9.1		
RYA_000_040		4,283	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.398	3.95	0.7																		RYA_000_040	0.7	**8.7**	**0.14**
									575	1.726	2.67	Paved	3.59														3.6		
																						3,657	6.00	6.00	10.2		10.2		
RYA_000_050		456	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.020	3.95	0.6																		RYA_000_050	0.6	**1.5**	**0.02**
									407	3.320	3.70	Paved	1.83														1.8		
RYA_000_060		1,480	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.517	3.95	0.7																		RYA_000_060	0.7	**4.9**	**0.08**
									1,050	2.133	2.97	Paved	5.89														5.9		
									381	4.081	4.11	Paved	1.55														1.5		
RYA_000_070		3,198	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.228	3.95	0.8																		RYA_000_070	0.8	**7.4**	**0.12**
									987	2.236	3.04	Paved	5.41														5.4		
														416	2.752	23.4	15.2	0.065	5.06		5.06	1.37						1.4		
																						1,744	6.00	6.00	4.8		4.8		
RYA_000_080		1,688	100	0.150	Grass-Short Grass Prairie	2.998	3.95	7.5																		RYA_000_080	7.5	**8.2**	**0.14**
									614	3.984	4.06	Paved	2.52														2.5		
														668	1.829	1.1	7.3	0.015	3.85		3.85	2.89						2.9		
																						301	6.00	6.00	0.8		0.8		
RYA_001_010		3,045	47	0.150	Grass-Short Grass Prairie	4.536	3.95	3.5																		RYA_001_010	3.5	**11.1**	**0.18**
									1,943	1.879	2.79	Paved	11.62														11.6		

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							428	6.00	6.00	1.2		1.2		
														628	0.867	91.4	26.9	0.065	4.83		4.83	2.17						2.2		
RYA_001_020		1,206	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.413	3.95	0.7																			RYA_001_020	0.7	**2.8**	**0.05**
									322	2.861	3.44	Paved	1.56															1.6		
																							834	6.00	6.00	2.3		2.3		
TWI_000_010		3,106	35	0.150	Grass-Short Grass Prairie	5.162	3.95	2.6																			TWI_000_010	2.6	**12.0**	**0.20**
									1,530	0.931	1.96	Paved	13.00															13.0		
																							294	6.00	6.00	0.8		0.8		
														334	1.700	28.3	16.5	0.065	4.28		4.28	1.30						1.3		
																							528	6.00	6.00	1.5		1.5		
														385	1.506	6.0	10.7	0.015	8.26		8.26	0.78						0.8		
TWI_000_020		2,662	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.470	3.95	0.6																			TWI_000_020	0.6	**5.3**	**0.09**
									613	3.063	3.56	Paved	2.87															2.9		
																							1,169	6.00	6.00	3.2		3.2		
														831	1.287			0.065	6.27	6.27	6.27	2.21						2.2		
TWI_000_030		3,151	81	0.150	Grass-Short Grass Prairie	3.007	3.95	6.3																			TWI_000_030	6.3	**13.7**	**0.23**
									1,162	0.675	1.67	Paved	11.60															11.6		
																							1,294	6.00	6.00	3.6		3.6		
														613	0.900			0.065	8.10	8.10	8.10	1.26						1.3		
TWI_000_040		1,403	100	0.150	Grass-Short Grass Prairie	2.161	3.95	8.5																			TWI_000_040	8.5	**10.4**	**0.17**
									1,302	1.493	2.48	Paved	8.74															8.7		
TWI_000_050		3,239	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.753	3.95	0.7																			TWI_000_050	0.7	**8.7**	**0.15**
									1,619	1.929	2.82	Paved	9.56															9.6		
																							1,570	6.00	6.00	4.4		4.4		
TWI_000_060		1,818	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			TWI_000_060	15.4	**15.5**	**0.26**
									123	1.085	2.12	Paved	0.97															1.0		
									1,596	1.899	2.80	Paved	9.50															9.5		
TWI_000_070		4,548	100	0.150	Grass-Short Grass Prairie	0.854	3.95	12.4																			TWI_000_070	12.4	**20.9**	**0.35**
														1,040	0.500	16.7	29.1	0.045	1.61		1.61	10.73						10.7		
														350	3.562	2.7	5.1	0.015	12.41		12.41	0.47						0.5		
									689	1.862	2.77	Paved	4.14															4.1		
																							1,544	6.00	6.00	4.3		4.3		
														825	1.487	87.4	36.7	0.065	4.98		4.98	2.76						2.8		
TWI_000_080		1,292	100	0.150	Grass-Short Grass Prairie	1.770	3.95	9.3																			TWI_000_080	9.3	**8.8**	**0.15**
									348	2.511	3.22	Paved	1.80															1.8		
									626	2.993	3.52	Paved	2.97															3.0		
																							219	6.00	6.00	0.6		0.6		
TWI_000_090		248	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	12.423	3.95	0.3																			TWI_000_090	0.3	**0.7**	**0.01**
									199	3.506	3.81	Paved	0.87															0.9		
TWI_000_100		3,353	100	0.150	Grass-Short Grass Prairie	2.026	3.95	8.8																			TWI_000_100	8.8	**12.6**	**0.21**
									371	3.047	3.55	Paved	1.74															1.7		
									675	1.959	2.85	Paved	3.95															4.0		
																							1,054	6.00	6.00	2.9		2.9		
														1,154	2.465	88.5	50.1	0.065	5.25		5.25	3.66						3.7		
TWI_001_010		3,147	100	0.150	Grass-Short Grass Prairie	2.089	3.95	8.7																			TWI_001_010	8.7	**14.7**	**0.25**
														1,404	0.664	16.2	21.9	0.045	2.21		2.21	10.58						10.6		
																							1,266	6.00	6.00	3.5		3.5		
														378	0.703	50.4	25.4	0.055	3.59		3.59	1.76						1.8		
TWI_002_010		1,046	100	0.150	Grass-Short Grass Prairie	3.373	3.95	7.2																			TWI_002_010	7.2	**7.3**	**0.12**
									491	4.489	4.31	Paved	1.90															1.9		
									456	1.497	2.49	Paved	3.06															3.1		
TWI_003_010		2,713	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.591	3.95	0.5																			TWI_003_010	0.5	**6.2**	**0.10**
									536	4.720	4.42	Paved	2.02															2.0		
																							1,811	6.00	6.00	5.0		5.0		
														318	0.500	15.5	12.2	0.065	1.90		1.90	2.79						2.8		
TWI_004_010		3,365	26	0.150	Grass-Short Grass Prairie	6.863	3.95	1.8																			TWI_004_010	1.8	**9.6**	**0.16**
									1,111	1.285	2.30	Paved	8.04															8.0		
																							2,228	6.00	6.00	6.2		6.2		
TWI_004_020		1,374	100	0.150	Grass-Short Grass Prairie	3.762	3.95	6.8																			TWI_004_020	6.8	**7.3**	**0.12**
									678	2.388	3.14	Paved	3.60															3.6		
																							597	6.00	6.00	1.7		1.7		
TWI_004_030		1,291	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.544	3.95	0.5																			TWI_004_030	0.5	**3.5**	**0.06**
									70	4.900	4.50	Paved	0.26															0.3		
									779	2.512	3.22	Paved	4.03															4.0		
																							394	6.00	6.00	1.1		1.1		

Appendix B-3

Stream RC-1 Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow									Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RCO_001_010		2,640	100	0.150	Grass-Short Grass Prairie	0.880	3.95	12.2																		RUS_RCO_001_010	12.2	**17.5**	**0.29**
									1,101	1.360	2.37	Paved	7.74														7.7		
									1,270	1.419	2.42	Paved	8.74														8.7		
																						169	6	6.00	0.5		0.5		
RUS_RCO_002_010		4,461	76	0.150	Grass-Short Grass Prairie	2.473	3.95	6.5																		RUS_RCO_002_010	6.5	**18.8**	**0.31**
									1,586	0.597	1.57	Paved	16.83														16.8		
														633	0.500	9.7	14.5	0.015	5.40		5.40	1.95						2.0		
																						2,166	6	6.00	6.0		6.0		
RUS_RCO_002_020		938	100	0.150	Grass-Short Grass Prairie	1.260	3.95	10.6																		RUS_RCO_002_020	10.6	**11.8**	**0.20**
									37	8.935	6.08	Paved	0.10														0.1		
									761	0.500	1.44	Paved	8.82														8.8		
																						40	6	6.00	0.1		0.1		
RUS_RCO_010		3,067	44	0.150	Grass-Short Grass Prairie	0.500	3.95	8.0																		RUS_RCO_010	8.0	**17.0**	**0.28**
									1,226	0.500	1.44	Paved	14.22														14.2		
																						1,267	6	6.00	3.5		3.5		
														530	0.604	111.4	42.6	0.065	3.38		3.38	2.61						2.6		
RUS_RCO_020		5,143	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.260	3.95	0.6																		RUS_RCO_020	0.6	**10.8**	**0.18**
									623	0.894	1.92	Paved	5.40														5.4		
																						3,093	6	6.00	8.6		8.6		
														1,377	0.566					6.81	6.81	3.37						3.4		
RUS_RCO_030		4,440	43	0.150	Grass-Short Grass Prairie	2.596	3.95	4.0																		RUS_RCO_030	4.0	**14.0**	**0.23**
									2,084	1.737	2.68	Paved	12.96														13.0		
																						2,239	6	6.00	6.2		6.2		
														74	0.701	15.0	17.0	0.015	7.65		7.65	0.16						0.2		
RUS_RCO_040		2,647	100	0.150	Grass-Short Grass Prairie	2.280	3.95	8.4																		RUS_RCO_040	8.4	**11.0**	**0.18**
									159	8.315	5.86	Paved	0.45														0.5		
									993	2.107	2.95	Paved	5.61														5.6		
																						1,396	6	6.00	3.9		3.9		
RUS_RCO_050		3,439	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_RCO_050	14.9	**18.4**	**0.31**
									82	2.425	3.17	Paved	0.43														0.4		
									2,551	2.552	3.25	Paved	13.09														13.1		
																						280	6	6.00	0.8		0.8		
														426	0.501	5.0	9.1	0.015	4.71		4.71	1.51						1.5		
RUS_RCO_060		2,387	100	0.150	Grass-Short Grass Prairie	1.550	3.95	9.8																		RUS_RCO_060	9.8	**18.9**	**0.32**
									526	0.547	1.50	Paved	5.83														5.8		
									1,273	0.510	1.45	Paved	14.61														14.6		
																						488	6	6.00	1.4		1.4		
RUS_RCO_070		4,161	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.740	3.95	0.4																		RUS_RCO_070	0.4	**9.1**	**0.15**
									2,074	3.498	3.80	Paved	9.09														9.1		
																						2,037	6	6.00	5.7		5.7		
RUS_RCO_080		2,228	100	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		RUS_RCO_080	8.5	**10.5**	**0.18**
									1,001	1.922	2.82	Paved	5.92														5.9		
																						1,128	6	6.00	3.1		3.1		
RUS_RCO_090		4,509	87	0.150	Grass-Short Grass Prairie	2.008	3.95	7.9																		RUS_RCO_090	7.9	**20.7**	**0.35**
									3,099	1.224	2.25	Paved	22.97														23.0		
																						1,324	6	6.00	3.7		3.7		
RUS_RCO_100		2,499	49	0.150	Grass-Short Grass Prairie	0.500	3.95	8.7																		RUS_RCO_100	8.7	**13.7**	**0.23**
									1,120	0.782	1.80	Paved	10.38														10.4		
																						1,330	6	6.00	3.7		3.7		
RUS_RCO_110		2,443	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_RCO_110	1.0	**11.7**	**0.20**
									1,940	0.845	1.87	Paved	17.30														17.3		
																						453	6	6.00	1.3		1.3		
RUS_RCO_120		2,934	100	0.150	Grass-Short Grass Prairie	2.150	3.95	8.6																		RUS_RCO_120	8.6	**14.3**	**0.24**
									25	9.370	6.22	Paved	0.07														0.1		
									2,810	2.300	3.08	Paved	15.19														15.2		
RUS_RCO_130		2,380	100	0.150	Grass-Short Grass Prairie	2.210	3.95	8.5																		RUS_RCO_130	8.5	**11.7**	**0.19**
									41	7.259	5.48	Paved	0.12														0.1		
									2,128	2.748	3.37	Paved	10.52														10.5		
																						111	6	6.00	0.3		0.3		
RUS_RCO_140		2,218	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.020	3.95	0.6																		RUS_RCO_140	0.6	**7.2**	**0.12**
									133	2.624	3.29	Paved	0.67														0.7		
									844	0.807	1.83	Paved	7.70														7.7		
									109	10.417	6.56	Paved	0.28														0.3		
														1,082	4.248	87.8	54.3	0.065	6.51		6.51	2.77						2.8		
RUS_RCO_150		1,740	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.250	3.95	0.4																		RUS_RCO_150	0.4	**6.6**	**0.11**
									746	5.939	4.95	Paved	2.51														2.5		
									812	0.761	1.77	Paved	7.63														7.6		
																						132	6	6.00	0.4		0.4		
RUS_TOA_010		3,284	100	0.150	Grass-Short Grass Prairie	0.990	3.95	11.7																		RUS_TOA_010	11.7	**19.4**	**0.32**
									101	1.302	2.32	Paved	0.73														0.7		
									1,287	0.500	1.44	Paved	14.92														14.9		
																						1,795	6	6.00	5.0		5.0		
RUS_TOA_020		2,315	100	0.150	Grass-Short Grass Prairie	4.880	3.95	6.2																		RUS_TOA_020	6.2	**7.5**	**0.13**
									131	3.939	4.03	Paved	0.54														0.5		
														346	4.051	37.2	51.7	0.045	5.35		5.35	1.08						1.1		
														114	2.516	12.4	36.3	0.015	7.70		7.70	0.25						0.2		
																						1,624	6	6.00	4.5		4.5		
RUS_TOA_030		3,613	100	0.150	Grass-Short Grass Prairie	0.830	3.95	12.5																		RUS_TOA_030	12.5	**14.9**	**0.25**

Stream RC-1 Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
									46	8.211	5.83	Paved	0.13														0.1		
									1,353	3.017	3.53	Paved	6.39														6.4		
																						240	6	6.00	0.7		0.7		
														1,874	0.970	0.6	2.1	0.015	4.25	6.09	6.09	5.13						5.1		
RUS_TOA_040		2,776	100	0.150	Grass-Short Grass Prairie	1.170	3.95	10.9																			RUS_TOA_040	10.9	**12.4**	**0.21**
									192	3.440	3.77	Paved	0.85														0.8		
									785	2.437	3.17	Paved	4.12														4.1		
																						1,698	6	6.00	4.7		4.7		
RUS_TOA_050		4,900	100	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																			RUS_TOA_050	12.4	**21.3**	**0.35**
									34	7.690	5.64	Paved	0.10														0.1		
									1,787	0.985	2.02	Paved	14.76														14.8		
																						2,979	6	6.00	8.3		8.3		
RUS_TOA_055		7,994	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																			RUS_TOA_055	0.9	**29.1**	**0.49**
									1,191	0.825	1.85	Paved	10.75														10.8		
														6,753	0.908	27.9	21.8	0.055	3.05		3.05	36.92						36.9		
RUS_TOA_060		2,926	100	0.150	Grass-Short Grass Prairie	3.350	3.95	7.2																			RUS_TOA_060	7.2	**18.3**	**0.30**
									651	0.500	1.44	Paved	7.55														7.5		
									2,175	1.286	2.30	Paved	15.73														15.7		
RUS_TOA_070		2,587	100	0.150	Grass-Short Grass Prairie	1.070	3.95	11.3																			RUS_TOA_070	11.3	**18.1**	**0.30**
									1,500	0.584	1.55	Paved	16.09														16.1		
																						987	6	6.00	2.7		2.7		
RUS_TOA_080		5,019	100	0.150	Grass-Short Grass Prairie	3.001	3.95	7.5																			RUS_TOA_080	7.5	**14.8**	**0.25**
									1,098	1.873	2.78	Paved	6.58														6.6		
																						3,623	6	6.00	10.1		10.1		
														204	3.945	24.7	13.3	0.065	6.88		6.88	0.49						0.5		
RUS_TOA_090		3,864	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.660	3.95	0.7																			RUS_TOA_090	0.7	**8.6**	**0.14**
									658	4.924	4.51	Paved	2.43														2.4		
									41	0.879	1.91	Paved	0.36														0.4		
														398	2.856	4.6	6.4	0.045	4.49		4.49	1.48						1.5		
																						303	6	6.00	0.8		0.8		
														504	1.092	6.2	12.1	0.045	2.21		2.21	3.80						3.8		
																						1,202	6	6.00	3.3		3.3		
														709	2.154	134.2	35.6	0.065	8.15		8.15	1.45						1.4		
RUS_TOA_100		4,958	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.980	3.95	0.6																			RUS_TOA_100	0.6	**9.8**	**0.16**
									713	2.022	2.89	Paved	4.11														4.1		
																						2,960	6	6.00	8.2		8.2		
														542	1.081	17.8	8.5	0.045	5.63		5.63	1.60						1.6		
														693	3.696	42.8	24.6	0.065	6.38		6.38	1.81						1.8		

Upper Rush Ultimate Time of Concentration Calculations

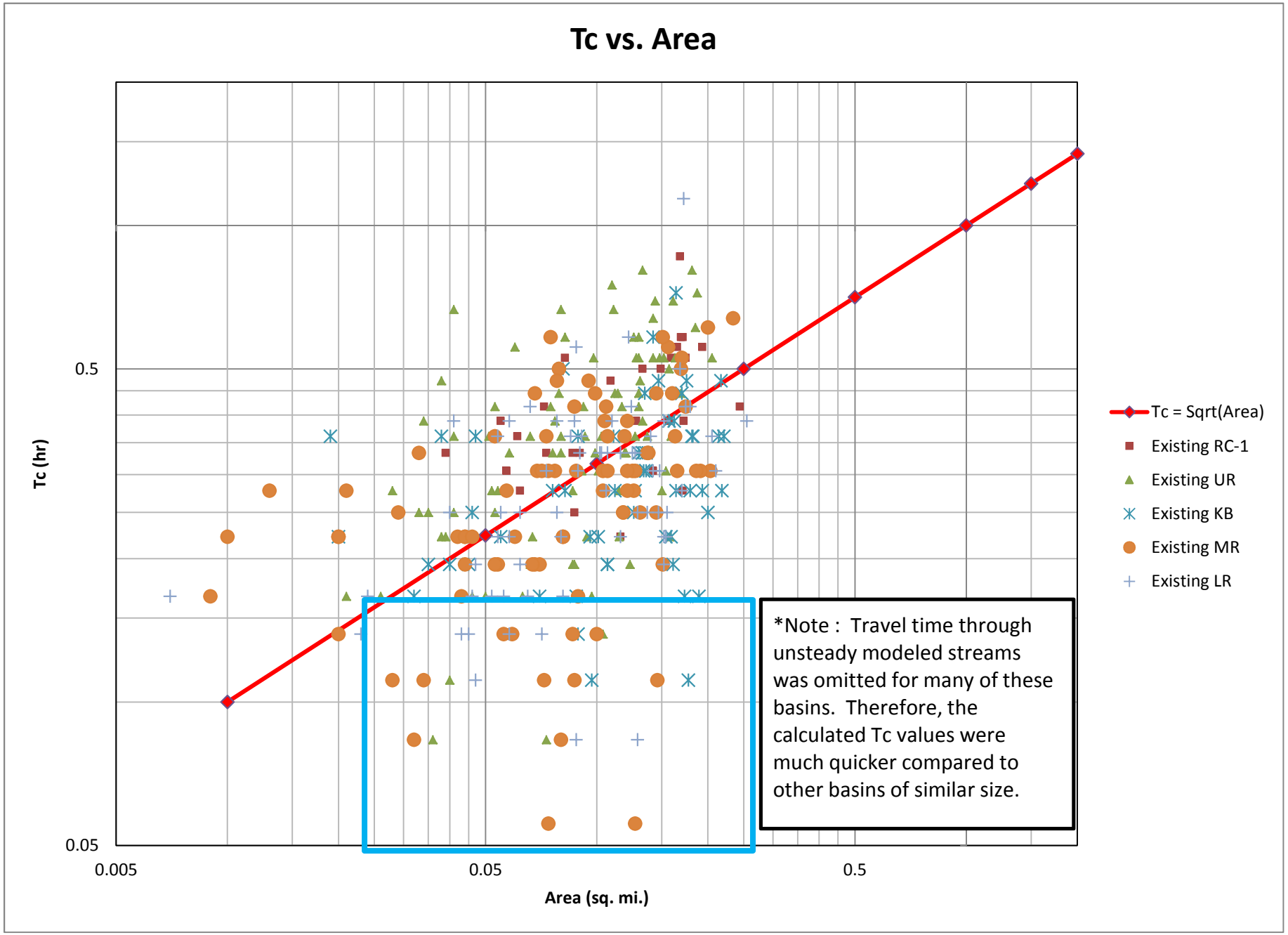
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_010		3,581	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_010	33	**19.9**	**0.33**
									1,530	0.700	1.70	Paved	14.99																
														2,001	0.980	55.2	88.3	0.055	1.96		1.96	17.01							
RUS_000_020		2,722	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.320	3.95	0.7																		RUS_000_020	12	**7.4**	**0.12**
														2,672	0.960	27.0	21.0	0.045	3.84		3.84	11.61							
RUS_000_030		3,258	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_030	40	**24.2**	**0.40**
									2,660	1.090	2.12	Paved	20.89																
														498	0.500	121.5	110.5	0.055	2.04		2.04	4.07							
RUS_000_040		1,419	100	0.150	Grass-Short Grass Prairie	1.970	3.95	8.9																		RUS_000_040	17	**10.4**	**0.17**
									1,031	1.440	2.44	Paved	7.04																
														288	0.630	53.4	22.5	0.065	3.23		3.23	1.48							
RUS_000_050		2,882	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.280	3.95	0.7																		RUS_000_050	21	**12.6**	**0.21**
									1,679	0.860	1.89	Paved	14.84																
																							375	6	6.00	1.0				
														778	0.970	52.9	59.3	0.045	3.02		3.02	4.29							
RUS_000_060		2,425	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.120	3.95	0.8																		RUS_000_060	8	**5.1**	**0.08**
									644	2.210	3.02	Paved	3.55																
																							1,053	6	6.00	2.9				
														678	1.563	115.4	87.2	0.024	9.36		9.36	1.21							
RUS_000_070		2,113	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_070	30	**17.9**	**0.30**
									2,013	1.310	2.33	Paved	14.42																
RUS_000_080		2,523	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_000_080	27	**16.1**	**0.27**
									673	1.800	2.73	Paved	4.11																
														1,750	0.690	5.7	3.7	0.045	3.69		3.69	7.90							
RUS_000_085		3,636	100	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.9																		RUS_000_085	20	**12.1**	**0.20**
									574	2.162	2.99	Paved	3.20																
														2,962	0.935					3.26	3.26	15.14								
RUS_000_090		2,192	100	0.150	Grass-Short Grass Prairie	0.570	3.95	14.6																		RUS_000_090	29	**17.2**	**0.29**
									2,092	1.470	2.46	Paved	14.15																
RUS_000_100		4,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																		RUS_000_100	25	**14.8**	**0.25**
									831	1.200	2.23	Paved	6.22																
																							1,845	6	6.00	5.1				
														2,037	1.010	131.6	131.6	0.055	2.72		2.72	12.47							
RUS_000_110		3,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.540	3.95	1.1																		RUS_000_110	23	**13.6**	**0.23**
									1,699	1.020	2.05	Paved	13.79																
																							262	6	6.00	0.7				
														1,753	1.780	40.8	44.7	0.045	4.16		4.16	7.03							
RUS_000_120		1,360	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.060	3.95	0.6																		RUS_000_120	8	**4.7**	**0.08**
									1,310	2.170	2.99	Paved	7.29																
RUS_000_130		2,066	100.1	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																		RUS_000_130	20	**12.0**	**0.20**
														1,966	2.270	6.7	7.4	0.045	4.65		4.65	7.05							
RUS_000_140		2,863	100.0	0.150	Grass-Short Grass Prairie	1.270	3.95	10.6																		RUS_000_140	22	**13.0**	**0.22**
									928	1.580	2.56	Paved	6.05																
																							1,835	6	6.00	5.1				
RUS_000_150		2,761	100.0	0.150	Grass-Short Grass Prairie	2.100	3.95	8.6																		RUS_000_150	17	**10.5**	**0.17**
									446	1.850	2.76	Paved	2.69																
																							2,001	6	6.00	5.6				
														214	5.486	31.9	29.5	0.055	6.69		6.69	0.53							
RUS_000_160		1,865	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.940	3.95	0.8																		RUS_000_160	11	**6.4**	**0.11**
									1,089	1.330	2.34	Paved	7.74																
																							726	6	6.00	2.0				
RUS_000_170		1,952	100.0	0.150	Grass-Short Grass Prairie	0.810	3.95	12.7																		RUS_000_170	19	**11.4**	**0.19**
									383	2.040	2.90	Paved	2.20																
																							1,469	6	6.00	4.1				
RUS_000_180		747	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_000_180	15	**8.9**	**0.15**
									647	3.320	3.70	Paved	2.91																
RUS_016_010		2,662	100.0	0.150	Grass-Short Grass Prairie	2.830	3.95	7.7																		RUS_016_010	18	**11.0**	**0.18**
									693	1.080	2.11	Paved	5.47																
																							1,869	6	6.00	5.2				
RUS_016_020		3,161	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_016_020	20	**12.2**	**0.20**
									2,082	1.060	2.09	Paved	16.58																
																							1,030	6	6.00	2.9				
RUS_016_030		2,587	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.680	3.95	1.0																		RUS_016_030	9	**5.6**	**0.09**
									504	2.280	3.07	Paved	2.74																
																							2,033	6	6.00	5.6				
RUS_016_040		2,434	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.320	3.95	0.4																		RUS_016_040	9	**5.2**	**0.09**
									707	3.160	3.61	Paved	3.26																
																							1,199	6	6.00	3.3				
														477	2.310	57.3	35.8	0.065	4.77		4.77	1.67							
RUS_017_010		678	100.8	0.150	Grass-Short Grass Prairie	0.900	3.95	12.2																		RUS_017_010	15	**8.8**	**0.15**
									145	2.090	2.94	Paved	0.82																
														432	1.240	115.9	65.0	0.055	4.44		4.44	1.62							
RUS_018_010		2,702	100.0	0.150	Grass-Short Grass Prairie	1.610	3.95	9.6																		RUS_018_010	23	**14.0**	**0.23**
									1,064	1.270	2.29	Paved	7.74																
														884	0.500	70.0	37.8	0.045	3.53		3.53	4.17							
RUS_018_020		2,891	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																		RUS_018_020	33	**19.8**	**0.33**
									1,383	1.600	2.57	Paved	8.96																
														1,408	0.800	49.3	81.0	0.050	1.91		1.91	12.26							
RUS_018_030		2,585	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.740	3.95	0.9																		RUS_018_030	11	**6.8**	**0.11**
									901	2.310	3.09	Paved	4.86																
														1,634	1.000					4.86	4.86	5.60								
RUS_018_040		2,976	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.730	3.95	0.9																		RUS_018_040	17	**9.9**	**0.17**
									1,824	1.860	2.77	Paved	10.97																
														1,102	0.640					3.96	3.96	4.64								

Appendix B-3

Upper Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_018_050		3,423	100.0	0.150	Grass-Short Grass Prairie	2.870	3.95	7.6																		RUS_018_050	25	**14.7**	**0.25**
									1,647	1.570	2.55	Paved	10.78																
																						585	6	6.00	1.6				
														1,091	0.810				4.07	4.07	4.47								
RUS_019_010		2,630	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_019_010	29	**17.3**	**0.29**
									1,333	1.400	2.41	Paved	9.24																
														1,197	1.250	208.7	106.6	0.055	4.74		4.74	4.21							
RUS_019_020		1,706	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.400	3.95	0.6																		RUS_019_020	12	**6.9**	**0.12**
									1,313	1.150	2.18	Paved	10.04																
														343	3.086	46.1	28.9	0.055	6.49		6.49	0.88							
RUS_020_010		4,272	100.0	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_020_010	38	**22.7**	**0.38**
									1,285	0.500	1.44	Paved	14.90																
																						2,887	6	6.00	8.0				
RUS_020_020		4,387	100.0	0.150	Grass-Short Grass Prairie	0.670	3.95	13.7																		RUS_020_020	43	**25.8**	**0.43**
									2,493	0.780	1.80	Paved	23.14																
																						692	6	6.00	1.9				
														535	0.780	29.9	18.9	0.045	3.97		3.97	2.25							
														350	0.500	30.1	23.2	0.015	8.34		8.34	0.70							
														217	0.500	52.3	45.4	0.045	2.57		2.57	1.41							
RUS_020_030		3,118	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_020_030	36	**21.6**	**0.36**
									1,974	1.220	2.25	Paved	14.65																
																						175	6	6.00	0.5				
														870	0.500	81.3	67.1	0.045	2.66		2.66	5.45							
RUS_020_040		4,060	100.0	0.150	Grass-Short Grass Prairie	1.630	3.95	9.6																		RUS_020_040	31	**18.4**	**0.31**
									545	2.490	3.21	Paved	2.83																
														3,415	0.620					3.13	3.13	18.18								
RUS_FPT_010		3,184	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.720	3.95	0.9																		RUS_FPT_010	13	**7.9**	**0.13**
									990	1.630	2.60	Paved	6.36																
																						1,560	6	6.00	4.3				
														585	0.500	141.8	78.1	0.024	6.54		6.54	1.49							
RUS_FPT_020		2,432	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_FPT_020	11	**6.6**	**0.11**
									1,403	2.610	3.28	Paved	7.12																
																						979	6	6.00	2.7				
RUS_NET_010		2,119	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_NET_010	10	**6.2**	**0.10**
									396	0.500	1.44	Paved	4.59																
																						1,673	6	6.00	4.6				
RUS_NET_020		710	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.380	3.95	0.4																		RUS_NET_020	4	**2.6**	**0.04**
									660	1.810	2.73	Paved	4.02																
SUB_000_010		2,952	100.0	0.150	Grass-Short Grass Prairie	0.620	3.95	14.1																		SUB_000_010	31	**18.8**	**0.31**
									1,990	1.660	2.62	Paved	12.66																
														862	0.500	54.1	34.2	0.045	3.18		3.18	4.52							
SUB_000_020		2,349	100.0	0.150	Grass-Short Grass Prairie	2.220	3.95	8.5																		SUB_000_020	17	**10.1**	**0.17**
									669	3.710	3.92	Paved	2.85																
														1,579	0.700					4.71	4.71	5.59								
SUB_000_030		751	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.100	3.95	0.5																		SUB_000_030	4	**2.3**	**0.04**
									701	3.020	3.53	Paved	3.31																
SUB_000_040		1,108	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		SUB_000_040	20	**11.8**	**0.20**
									1,008	3.730	3.93	Paved	4.28																
SUB_000_050		3,726	100.0	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																		SUB_000_050	37	**22.3**	**0.37**
									2,717	1.110	2.14	Paved	21.14																
														909	1.240	27.8	17.5	0.055	4.11		4.11	3.69							
SUB_000_060		3,046	100.0	0.150	Grass-Short Grass Prairie	0.720	3.95	13.3																		SUB_000_060	28	**16.7**	**0.28**
									388	1.750	2.69	Paved	2.40																
														1,609	1.010	30.0	30.0	0.045	3.33		3.33	8.06							
																						371	6	6.00	1.0				
SUB_000_070		4,044	100.0	0.150	Grass-Short Grass Prairie	2.260	3.95	8.4						577	0.500					3.13	3.13	3.07								
									1,623	2.070	2.92	Paved	9.25																
														2,321	0.690					3.45	3.45	11.21								
SUB_000_080		1,251	100.0	0.150	Grass-Short Grass Prairie	4.950	3.95	6.1																		SUB_000_080	12	**7.0**	**0.12**
									1,151	2.890	3.46	Paved	5.55																

Appendix B-4
Time of Concentration Graphs


Tc vs. Area
Tc (hr)
0.5
0.05
0.005
0.05
0.5
Area (sq. mi.)
Tc = Sqrt(Area)
Existing RC-1
Existing UR
Existing KB
Existing MR
Existing LR
*Note : Travel time through unsteady modeled streams was omitted for many of these basins. Therefore, the calculated Tc values were much quicker compared to other basins of similar size.

Appendix B-5
Modified Puls Subreach Calculations

Appendix B-5

Modified Puls Subreach Calculations
Kee Branch

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Kee Branch	R_KEE_000_020	2161	3.58	10.06	10.0
KB_Route1	R_KEE_000_140	1958	8.33	3.92	4.0
	R_KEE_000_160	361	7.26	0.83	1.0
KB_Route2	R_KEE_000_260	2290	6.71	5.69	6.0
Kee Branch Trib 4	R_KEE_004_020	741	9.01	1.37	2.0
Kee Branch Trib 5	R_KEE_005_020	1589	2.81	9.44	10.0
Stream KB-1.1	R_KEE_KB1_001_020	1428	6.99	3.40	4.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Lower Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Pantego	R_PAN_000_030b	2870	7.63	6.27	7.0
	R_PAN_000_050a	687	3.86	2.97	3.0
Rush Creek Trib 3	R_RUS_003_020b	908	5.28	2.87	3.0
Rush Creek Trib 4.1	R_RUS_004_001_020	1140	6.66	2.85	3.0
	R_RUS_004_001_030	1161	6.43	3.01	4.0
LR_Route1	R_RUS_004_030a	1041	2.87	6.05	7.0
Rush Creek Trib 4	R_RUS_004_030b	382	3.73	1.71	2.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Middle Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Rush Creek Trib 7	R_RUS_007_020	1857	7.83	3.95	4.0
Rush Creek Trib 9	R_RUS_009_030	332	10.29	0.54	1.0
Twin Springs Draw	R_TWI_000_020	1012	6.27	2.69	3.0
	R_TWI_000_030	1572	8.10	3.24	4.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Stream RC-1

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Stream RC-1	R_RUS_RCO_020a	1381	6.81	3.38	4.0
	R_RUS_RCO_030	279	8.14	0.57	1.0
	R_RUS_RCO_070	1230	7.43	2.76	3.0
Stream RC-1A	R_RUS_TOA_030	2177	6.09	5.96	6.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Upper Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
UR_Route6	R_RUS_000_085	3143	3.26	16.07	10.0
Rush Creek Trib 18	R_RUS_018_020	2026	4.90	6.89	7.0
	R_RUS_018_030	1252	4.86	4.29	5.0
	R_RUS_018_040	1183	3.96	4.98	5.0
	R_RUS_018_050	1126	4.07	4.61	5.0
Rush Creek Trib 20	R_RUS_020_040	3245	3.13	17.28	10.0
Sublett Creek	R_SUB_000_020	1566	4.71	5.54	6.0
UR_Route 3	R_SUB_000_060	1715	3.13	9.13	10.0
	R_SUB_000_070	2505	3.45	12.10	10.0
UR_Route 4	R_SUB_000_140	1644	3.52	7.78	8.0
	R_SUB_000_150	1859	3.65	8.49	9.0
	R_SUB_000_155	1269	4.50	4.70	5.0
UR_Route 5	R_SUB_000_220	2003	3.01	11.09	10.0
	R_SUB_000_230	2137	3.15	11.31	10.0
Sublett Creek Trib 4	R_SUB_004_020	1219	3.63	5.60	6.0
UR_Route 1	R_SUB_004_040	1634	2.36	11.54	10.0
	R_SUB_004_050a	301	4.03	1.24	2.0
	R_SUB_004_050b	2233	4.03	9.23	10.0
	R_SUB_004_060	794	2.15	6.16	7.0
	R_SUB_004_070	504	2.54	3.31	4.0
UR_Route 2	R_SUB_004_090	1654	2.71	10.17	10.0
	R_SUB_004_100	1194	2.91	6.84	7.0
	R_SUB_004_110	1384	3.72	6.20	7.0
	R_SUB_004_120	1149	2.09	9.16	10.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix C
QAQC Documentation

RUSH CREEK
City of Arlington Watershed Study

QA/QC Review Certification

Product Name: Final Hydrologic Models

Level: ☐ Internal/Subproduct ☑ Deliverable ☐ Audit

Type: ☐ Checklist ☐ Monthly Model Review ☑ Engineer Deliverables

Checklist Category: ☐ Survey ☑ Hydrology ☐ Hydraulic ☐ Mapping

WBS Code: 4.3

Date: 6/22/2012 Status: ☐ Draft ☐ Revision ☑ Final

Originator/Firm: Ben Plyant/Halff Associates, Inc.

QC Reviewer/Firm: Tom Nye/CDM Smith, Inc.

General Comments: Based on comparisons to the aerial photographs in several areas, the percent impervious based on land use may be high, especially for the very low density land use type. The PMC contends that the aerial photography does not always support the argument that large amounts of impervious area is not included in the GIS impervious cover shapefiles. As discussed in the weekly Rush Creek Watershed Study team meeting of 6/11/2012, the PMC accepts these results pending hydraulic model calibration, at which time the percent impervious values may need to be revisited.

Subbasin delineations may also need to be revisited after hydraulic model calibration. As documented in the PMC review of draft subbasin delineations, it was recommened That some subbasin delineations be modified to account for differences between the topography and the anticipated actual flow path (accounting for momentum in the 100-year stormwater flow and depth of funoff from relatively large areas that will be unlikely to funnel into narrow openings without a buildup of depth).

In most cases though, the long "fingers" have been removed from the Tc Calculations. The PMC accepts the subbasin delineations pending hydraulic model calibration.

Additional Review Comments Attached: ☐ Yes ☑ No

Recommendation:

☑ Approved as is ☐ Approved with Minor Corrections ☐ Resubmittal Required

Review Completed By:

Tom Nye/CDM Smith, Inc. *Date:* 6/22/2012

Resubmittal Date (if required):

Approved as Final by: *Date:* 6/27/12

RUSH CREEK
City of Arlington Watershed Study

QA/QC Review Certification

Product Name: Draft Hydrology Report

Level: ☐ Internal/Subproduct ☑ Deliverable ☐ Audit

Type: ☐ Checklist ☐ Monthly Model Review ☑ Engineer Deliverables

Checklist Category: ☐ Survey ☑ Hydrology ☐ Hydraulic ☐ Mapping

WBS Code: 4.4.1

Date: 6/22/2012 *Status:* ☑ Draft ☐ Revision ☐ Final

Originator/Firm: Ben Plyant/Halff Associates, Inc.

QC Reviewer/Firm: Tom Nye/CDM Smith, Inc.

General Comments: Remove Appendix C, or at least remove all but the signed QC Page. Internal review notes, comments and responses are Internal work products that should not be published as part of the final document.
Most of Appendix B should be submitted in electronic form only. We could submit this appendix in electronic form or print just the figures and move the tables to a CD/DVD in order to keep the appendices as labeled.
Other minor edits/comments as noted in the attached scan.

Additional Review Comments Attached: ☑ Yes ☐ No

Recommendation:

☐ Approved as is ☑ Approved with Minor Corrections ☐ Resubmittal Required

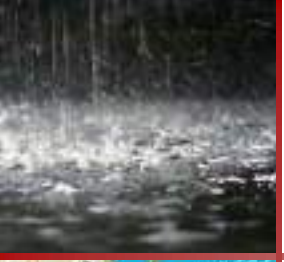
Review Completed By:

Tom Nye, CDM Smith, Inc. *Date:* 6/22/2012

Resubmittal Date (if required): N/A

Approved as Final by: *Date:* 6/22/2012

Appendix D
Correspondence



RUSH CREEK
City of Arlington Watershed Study

Draft Memorandum

To: *Hydrology File*

From: *Eric Loucks, P.E., Ph.D.*

Date: *May 31, 2012*

Subject: *Flow paths for estimating Basin Lag Time*

1. Purpose

This memo clarifies the procedure for defining the subbasin flow path to be used for estimating basin lag time in the Rush Creek hydrologic model. For the Rush Creek hydrology we have selected the SCS unit hydrograph method to convert the subbasin runoff volumes into a runoff hydrograph. The SCS unit hydrograph method uses a single input parameter: the basin lag time, T_L.

Runoff hydrographs are either routed downstream in HEC-HMS or directly loaded into HEC-RAS. There are three different applications for each hydrograph generated in HEC-HMS.

1. It is used in a downstream routing or junction in the HEC-HMS model.
2. It is loaded to the HEC-RAS model as a point flow
3. It is loaded to the HEC-RAS model as a distributed flow

The primary purpose of this memo is to describe the need for using different flow paths when defining basin lag time in cases 2 & 3 above. Generally case 1 is the same application as case 2, but that can depend on how routings through basins are handled in HEC-HMS.

2. Discussion

For the Rush Creek hydrology we have selected the SCS unit hydrograph method to convert the subbasin runoff volumes into a runoff hydrograph. The SCS unit hydrograph method uses a single input parameter: the basin lag time, T_L.

Basin lag time for a storm event is defined as the time from the centroid of the effective rainfall to the peak of the outflow hydrograph. There are several empirical methods for estimating T_L (McCuen, 1989) and one of the most popular uses the time of concentration, T_c even though there is no physical connection between the two. Time of concentration is the time it takes for a drainage area to become 100 percent effective in contributing runoff from the start of a runoff producing rainfall. There are also many empirical methods for estimating T_c (Xing, et al., 2005). One of the most popular, the SCS velocity method, involves selecting the longest flow path within the drainage basin and using estimates of flow velocity to determine the travel time to traverse the entire flow path. In a basin with no internal sinks, topology dictates that the longest flow path end at the basin outlet.

Virtually all methods for estimating either T_L or T_c use a flow path that is extended to the basin outlet. The implication is that the flow path ends where the hydrograph is being determined. The technical literature does not say this explicitly, possibly because the point is obvious. The recommendation for the Rush Creek study is to terminate the flow path at the location where the flow path meets a channel that is being modeled in HEC-RAS, or at the basin outlet if the flow path never meets a HEC-RAS channel.

In a HEC-RAS model, there are two types of hydrograph input, point inflow or distributed inflow along a reach. It is worth noting that, on a computational level, all input is the same. As illustrated in *Figure 2-1*, each computational element receives up to three inflows; one lateral inflow along with inflows each adjacent computational elements. In HEC-RAS, each computational element corresponds to a model cross-section. In reaches with distributed inflows, the inflow hydrograph is allocated proportionally among the elements. Distributed inflow to a reach that has just one cross-section, behaves identically to a point inflow.

The inflow hydrographs are computed in HEC-HMS. The locations of HEC-HMS basin outlets must be carefully defined to correspond to the input points in the HEC-RAS model. An example is illustrated in schematic form in *Figure 2-2*. As indicated, the subbasin KEE_000_040 is being loaded as a headwaters point inflow at cross-section 30699.74; therefore it follows that the calculation of basin lag time should terminate where the flow path intersects this cross-section, which is also the basin outlet. Therefore the flowpath for KEE_000_040 does include the main channel segment.

Subbasin KEE_000_050 is loaded as a distributed inflow between 30699.74 and 28906. In HEC-RAS, the inflow will be represented as seven inflow hydrographs, one for each of the seven cross-sections in the reach. In the actual Kee Branch channel, inflows will occur at various points on each side of the channel through small tributaries and storm sewer outfalls. Of course, it is beyond the scale of this modeling effort to individually account for each one of these sources. The longest flow path for subbasin KEE_000_050 is shown in *Figure 2-3*. The flow path used to estimate T_L for this hydrograph should not include the portion of the channel that is modeled in unsteady HEC-RAS. The east-west flow path segment shown in the figure will be used to approximate the travel time for all of the lateral inflow hydrographs in the subbasin.

Discharge from subbasin KEE_000_060 has characteristics of both a distributed and point inflow to the Kee Branch main channel. As shown in *Figure 2-4*, the longest flow path drains a large area that discharges through an outfall.

It is up to the hydraulic modeler to decide how a given subbasin should be represented. While the choice of approach has some local effect, the impact on overall results will be minor. This is especially true in the Rush Creek Watershed Study because we have elected to use small subbasins, minimizing the effect of the modeling approach on each particular subbasin. Subbasin KEE_000_070 will be loaded as a distributed inflow. The longest flow path for this subbasin is also shown in *Figure 2-4*. Again the portion that overlaps the main channel should be excluded from the basin lag time calculation. This is because routing through the main channel is modeled in HEC-RAS so including it would duplicate this travel time and storage and because the truncated flow path is more representative of all the flow paths leading to the main channel from Subbasin KEE_000_070.

3. Conclusion

The primary conclusion of this memo is a procedural guideline to exclude any portion of the channel modeled in unsteady HEC-RAS from the flow path used to determine basin lag time. This essentially defines a clear boundary between HEC-RAS and HEC-HMS at the point where the HEC-HMS hydrograph enters the HEC-RAS channel model. This is a situation that arises when unsteady HEC-RAS is used because channel routing can occur in both models and it seems appropriate to ensure that not only is no portion of any modeled channel double-counted, but also that the entire channel is used. In other words, HMS-routing should end right where HEC-RAS routing begins. In the examples presented, it has been demonstrated that there is no clean break in subbasins with distributed lateral inflow to the channel due to the fact that there are multiple inflows from these basins. However the recommended approach of excluding the main channel for calculating basin lag will, on average, provide an appropriate path length.

References

Franz, D. D. and C. S. Melching. Full Equations Model for the Solution of the Full, Dynamic Equations of Motion for One-Dimensional Unsteady Flow in Open Channels and Through Control Structures, USGS WRI Report 96-4240, 1997.

McCuen, Richard H., Hydrologic Analysis and Design, Prentice Hall, 1989.

Xing, Fang, Pradhan, P., Malla, R., Cleveland, Theodore, and David Thompson, “Estimating Time of Concentration for Texas Watersheds,” 2005.

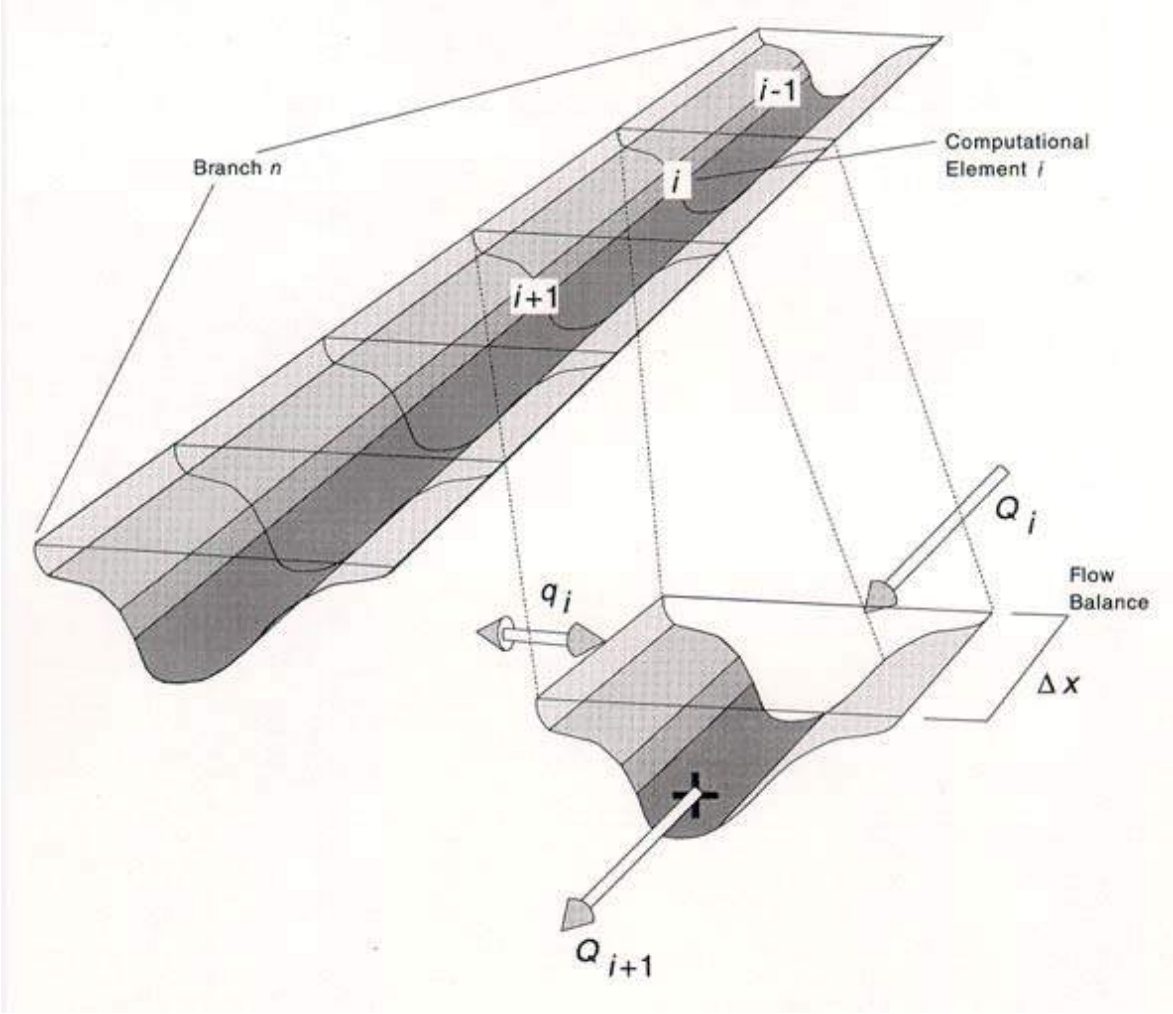


Figure 2-1. Computational elements in an unsteady Flow Model (Franz and Melching, 1996)

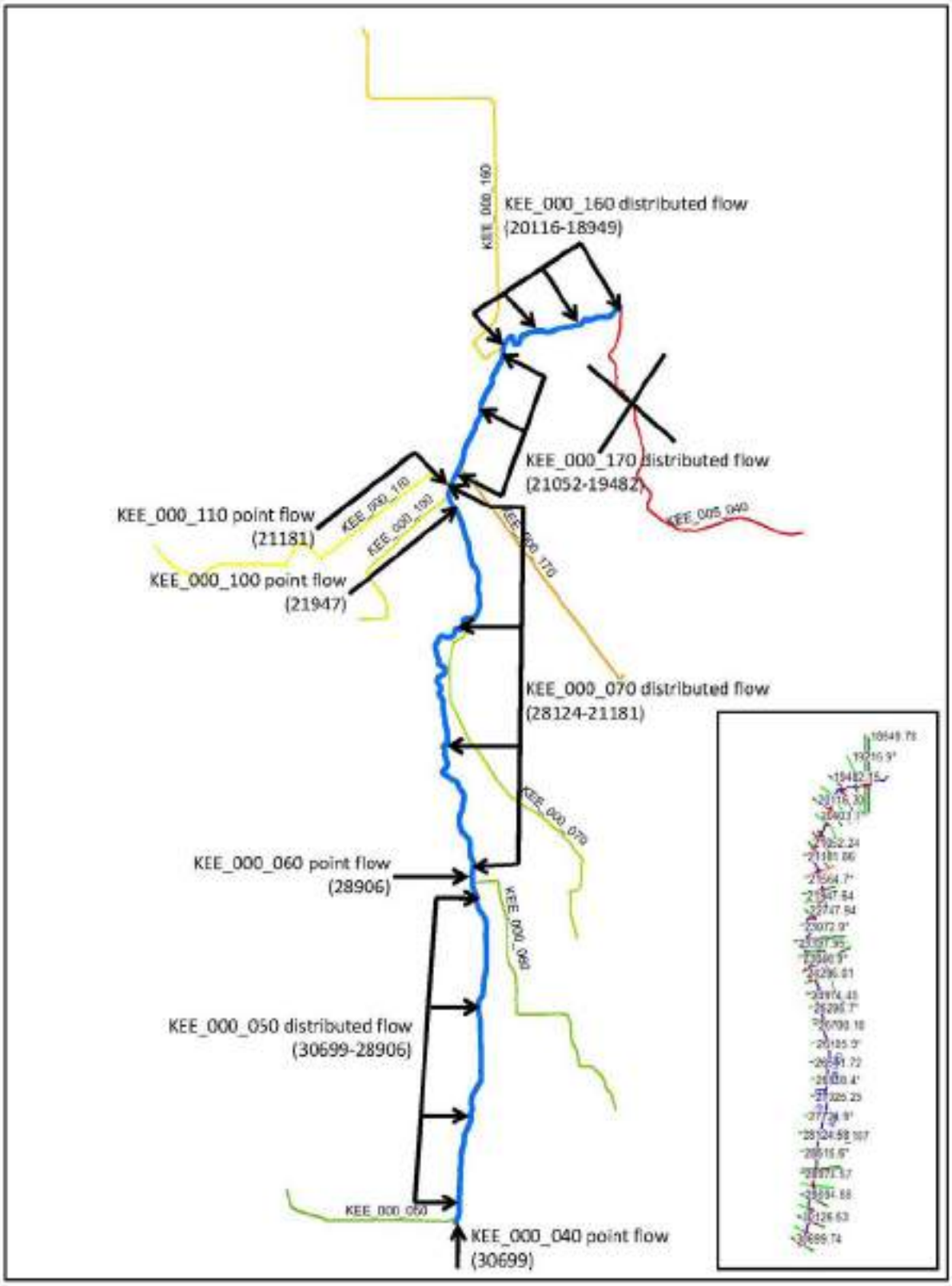


Figure 2-2. Point flow and distributed flow schematics.

Figure 2-3. Longest flow paths for subbasins at the Kee branch Headwaters.

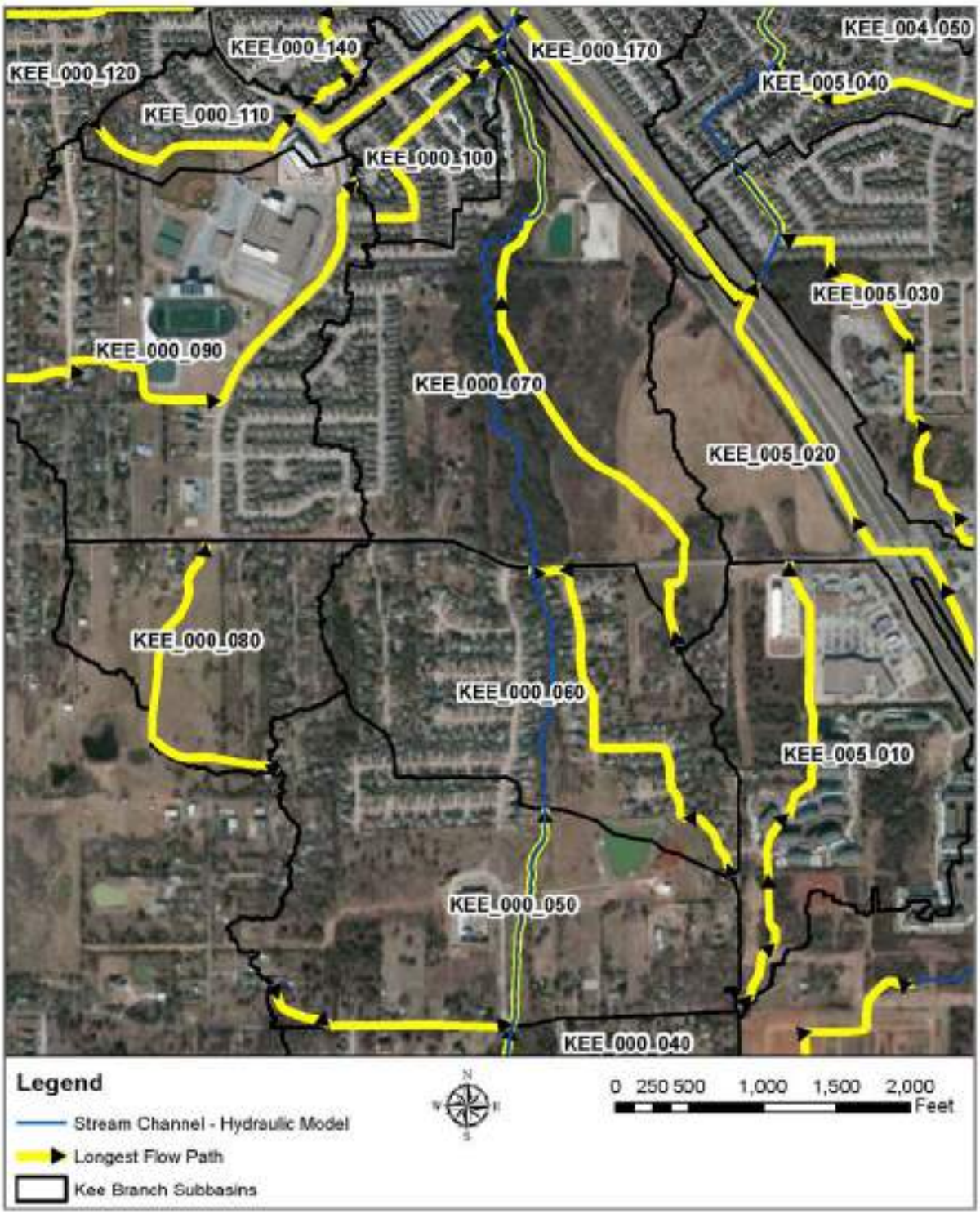


Figure 2-4. Additional KEE_000 Subbasins

Appendix E
LiDAR QA Report

LiDAR Quality Assurance (QA) Report
Fort Worth, Texas
Texas Water Development Board
May 10, 2010

Submitted to:
Texas Water Development Board

Prepared by:
Dewberry
Fairfax, VA

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Executive Summary

Reference: Texas Water Development Board Contract 580-09-0824

This report documents Dewberry's assessment of the quality of the LiDAR deliverables for Fort Worth, Texas, developed under contract to the Texas Water Development Board (TWDB). The LiDAR data and supplemental deliverables were acquired and processed by Fugro Earth Data, Inc. (FEDI) beginning in March 2009. The area consists of 322 tiles of LiDAR data in LAS format 1.1, classified into eight classes as follows.

- Class 1 – Unclassified
- Class 2 – Ground
- Class 3 – Low Vegetation
- Class 4 – Medium Vegetation
- Class 5 – High Vegetation
- Class 6 – Building
- Class 7 – Noise
- Class 9 – Water

The data were reviewed quantitatively for statistical errors and vertical accuracy, and qualitatively for completeness and visual anomalies.

The LiDAR data are of good quality; however, some issues exist in the supplemental products including the breakline dataset, hydro-enforced Digital Elevation Models (DEMs), and metadata products.

- Breakline Dataset - There are topology and completeness issues, albeit minimal, in the breakline dataset. The end user should make note of these errors; however, they do not render the data unusable.
- Hydro-enforced DEMs - The hydro-enforced DEMs contain data voids and incomplete tile edges due to processing errors. The specific tiles containing data voids are documented in this report and must be corrected before use.
- Metadata - Errors exist in the metadata for all products: LAS, breakline, intensity, and DEM. Dewberry has provided suggestions for improvement later in this report.

Completeness: The LiDAR data were required to contain multiple returns per pulse with an intensity value recorded for each point. Dewberry verified that the LAS files adhere to these specifications. Furthermore, the spatial extent of each tile was required to conform to a $1/16^{th}$ 7.5-minute quadrangle, otherwise known as the USGS Quarter-Quarter-Quad. The internal tiles contain a 50-meter overlap between tiles, while those that line the project boundary contain a 300-meter buffer on all sides. The LAS data were projected to NAD83 UTM Zone 14N and NAVD 88, Geoid 03, meters.

Quantitative Assessment: One of the first steps in assessing the quality of the LAS dataset is a vertical accuracy assessment of the ground models in comparison to the survey checkpoints. Using the checkpoints provided by Dewberry's surveyor, Dewberry tested the $RMSE_Z$ per FEMA/NSSDA and NDEP/ASPRS specifications. The checkpoints were collected in a total of four land cover types (Open Terrain, Urban Terrain, Weeds/Crop, and Forest). The LAS dataset conforms to the vertical accuracy requirements using 100% of the

original 72 checkpoints. Table 1 provides the accuracy results in open terrain based on the FEMA/NSSDA methodology ($RMSE_z$ x 1.960).
Table 2 contains the results measured at the 95% confidence level in the Fundamental Vertical Accuracy (FVA) and the 95th percentile for the Consolidated and Supplemental Vertical Accuracies (CVA and SVA).

Table 1 – Vertical accuracy assessment summary (FEMA/NSSDA)

Criterion	Number of Checkpoints	Accuracy Specification(m)	Results(m)
$RMSE_Z$	24	0.185	0.040
FVA	24	0.363	0.078

Table 2 – Vertical accuracy assessment summary (NDEP/ASPRS)

Criterion	Number of Checkpoints	Accuracy Specification(m)	Results(m)
Consolidated	72	0.363	0.084
FVA – Open Terrain	24	0.363	0.078
SVA – Open Terrain	24	0.363	0.076
SVA – Weeds/Crop	11	0.363	0.075
SVA – Forest	12	0.363	0.480
SVA – Urban	25	0.363	0.072

- Tested 0.084 m consolidated vertical accuracy at 95% confidence level in all land cover categories (NDEP/ASPRS methodology)
- Tested 0.078 m fundamental vertical accuracy at 95% confidence level in Open Terrain using $RMSE_Z$ x 1.9600 (FEMA/NSSDA and NDEP/ASPRS methodologies)
- Tested 0.076 m supplemental vertical accuracy at 95th percentile in Open Terrain category (NDEP/ASPRS methodology)
- Tested 0.075 m supplemental vertical accuracy at 95th percentile in Weeds/Crop category (NDEP/ASPRS methodology)
- Tested 0.480 m supplemental vertical accuracy at 95th percentile in Forest category (NDEP/ASPRS methodology)
- Tested 0.072 m supplemental vertical accuracy at 95th percentile in Urban category (NDEP/ASPRS methodology)

Qualitative Assessment: Dewberry conducted a visual inspection of 100% of the data on a tile-by-tile basis. The data do not contain any major anomalies or data voids. The bare earth model is very clean, but contains some minor anomalies. It is 98% free of artifacts, which exceeds expectations (the acceptable limit is 95%). Very few divots and flight line ridges were identified in the ground models. There are misclassification errors in the dataset, specifically within classes 3, 4, 5, and 6; however, these types of errors are to be expected. Overall, Dewberry can confirm that the LiDAR data is of good quality.

QA Report

1 Introduction

The goal of the TWDB LiDAR Task Order is to provide high accuracy elevation datasets of multiple deliverable products including LAS, intensity imagery, hydro-enforced DEMs, and 3D breaklines for the State of Texas. The project area spans 322 tiles covering 1,061 square miles and will support the National Flood Insurance Program in the development of accurate flood zone maps as well as the USGS's efforts in maintaining its National Elevation Data.

Dewberry had previously reviewed data provided by FEDI with both satisfactory and unsatisfactory results. In summary, the LiDAR data passed the quantitative assessment, however the Quality Assurance (QA) review recommended minor corrections. The original breakline dataset did not pass completeness and qualitative checks, and the data contained topology and other quantitative errors. Dewberry identified that the intensity imagery did not contain a defined projection. Lastly, Dewberry identified errors in the LAS metadata and proposed a set of recommendations to improve the overall quality.

The first review of the Fort Worth data did not consist of all deliverables. The following deliverables were not initially included:

- Hydro-enforced DEMs
- Intensity Metadata
- DEM Metadata
- Breakline Metadata

Dewberry performed a final review of all data products, which included completeness checks, vertical accuracy testing, and qualitative reviews. This report documents the results and defines whether or not each deliverable meets specifications. Special notes have been documented where improvements were made.

The sensor used to acquire the data was the Leica ALS-50. Refer to Figure 1 for the flight line trajectories. The trajectories were provided in shapefile format and include the required information: the aircraft position, attitude and GPS time.

Figure 1 – Map of Fort Worth project area displaying complete coverage by trajectories

2 LAS

2.1 Completeness

The LAS datasets were provided in format 1.1, in 322 tiles as defined by USGS 1/16th 7.5 minute quadrangles. The tiles that fall on the project boundary have a 300-meter buffer while those that fall within the boundary contain a 50-meter overlap between tiles.

2.1.1 Methodology

Dewberry conducted a statistical analysis of the LiDAR data to ensure its completeness. The tool used to perform the analysis reports the relevant information specific to LAS data in format 1.1. This information includes the following:

- Number of points per tile;
- ASPRS classes used throughout the dataset;
- Projection and datum;
- Scan angle of the sensor;
- Elevation values per tile;
- Swath overlap; and
- Other criteria.

2.1.2 Assessment Results

Dewberry verified that the LAS contained the appropriate information in each of the aforementioned categories. One point to note is the amount of swath overlap. The scope of work requires a nominal sidelap of 50% on adjoining swaths, meaning that all of the data should have 100% double coverage. The tile in Figure 2 colored by individual flight lines amounts to 34% of overlap on either side. This same characteristic is present throughout the dataset.

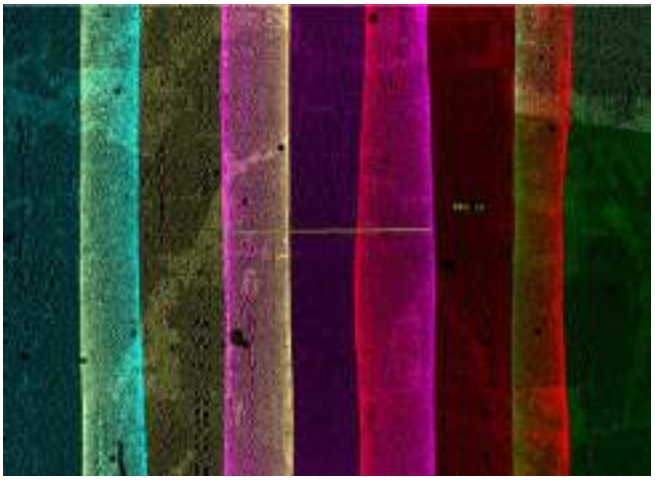


Figure 2 - Tile u339760_2_a; LAS Source data showing flight line overlap. The yellow line defines the width of one flight line.

The LAS data follow the USGS tile naming system and are classified by the following ASPRS classes:

- Class 1 – Unclassified

- Class 2 – Ground
- Class 3 – Low Vegetation
- Class 4 – Medium Vegetation
- Class 5 – High Vegetation
- Class 6 – Building
- Class 7 – Low Point/Noise
- Class 9 – Water

Figure 3 illustrates the total number of LiDAR points collected per tile. The tiles along the project boundary with the highest number of points reflect the 300-meter buffer. This is to be expected.

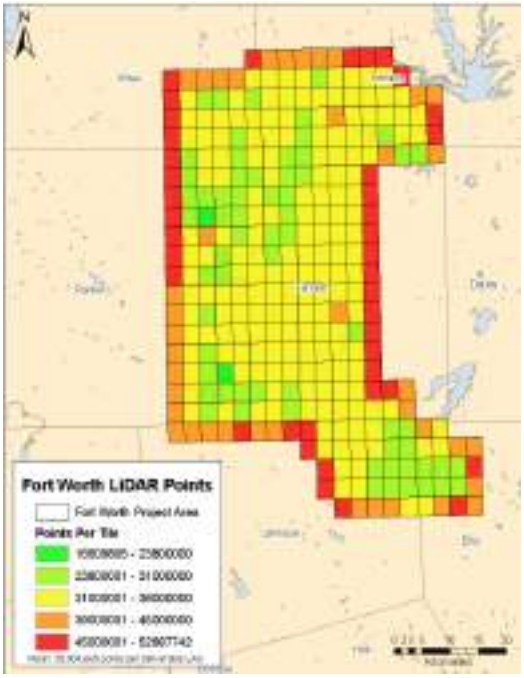


Figure 3 – Map illustrating the total number of LiDAR points per tile

The figures provided below illustrate the minimum and maximum elevation values of the ground class. The lowest z-minimum values depicted by Figure 4 exist in the eastern portion of the project area and elevate toward the west. The same pattern is recognized in Figure 5 as the lowest of the z-maximum values originate in the east and gradually heighten toward the west. The maps also verify that null or extraneous z-values in the ground class do not exist.

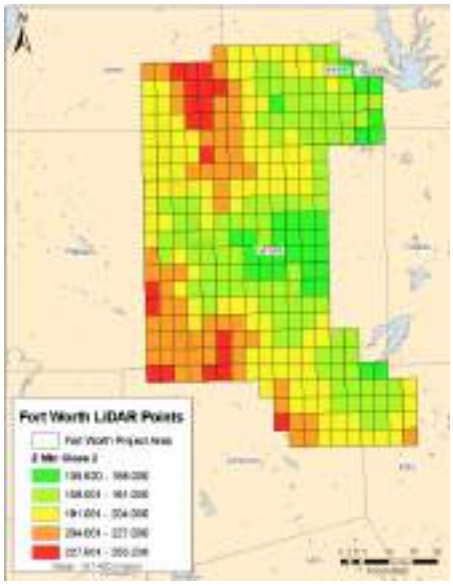


Figure 4 – Map of Z-minimum values in the ground class

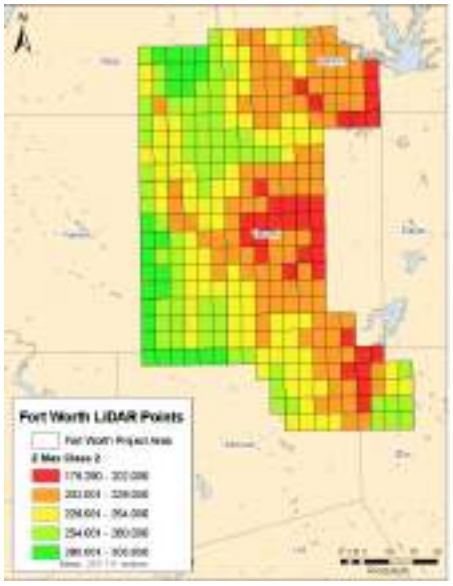


Figure 5 – Map of Z-maximum values in the ground class

2.2 Quantitative Assessment

Dewberry performed an analysis that compared the elevation values of ground survey checkpoints against the LiDAR data to ensure the vertical accuracy of the LiDAR data.

2.2.1 Methodology

Dewberry used 72 surveyed checkpoints, chosen to fall into the following land cover categories:

- Urban Terrain – 25 points
- Open Terrain – 24 points
- Forest – 12 points
- Weeds/Crops – 11 points

The checkpoints were spread across the 1,061 square mile project area in an effort to survey as many flight lines as possible. To verify accuracy of the survey, 50% of the checkpoints were re-surveyed. The re-surveyed values match the initial surveyed positions within the 95% confidence level. Figure 6 illustrates the locations of the checkpoints throughout the project area colored by their respective land cover types.

Figure 6 – Map displaying spatial location of 72 survey checkpoints

The GPS technique used to survey the data was connected to Real Time Kinematic (RTK) network. This network is composed of highly accurate GPS reference stations that compare the survey checkpoints against published coordinates. It is linked to create a Virtual Reference Station (VRS) system. The VRS functions as a network of points that send corrections to the survey checkpoints, solving for ionospheric and tropospheric conditions. Additionally, six National Geodetic Survey monuments were used to validate the accuracy of the VRS network. These monuments also acted as the primary project control monuments.

Dewberry's methodology for testing vertical accuracy used the orthometric heights of the survey checkpoints compared against the bare-earth LiDAR elevations at the same horizontal locations. The survey checkpoints were overlaid on the Triangulated Irregular Network (TIN) created by the LiDAR ground points and the interpolated Z value from the TIN at that point was subtracted from the survey checkpoint elevation. The differences in Z values were recorded, and represent the amount of error between the two measurements.

2.2.2 Assessment Results

The LAS data passed the quantitative assessment using 100% of the survey checkpoints with a consolidated RMSE of 0.112m as shown in Table 3.

Table 3 – RMSE method for testing vertical accuracy

100% of Totals	RMSE (m) Spec=0.185m	Mean (m)	Median (m)	Skew	Std Dev	# of Points	Min (m)	Max (m)
Consolidated	0.112	-0.008	0.009	-6.635	0.113	72	-0.875	0.089
Open Terrain	0.040	0.006	0.003	-0.506	0.040	24	-0.092	0.077
Weeds/Crop	0.041	0.028	0.023	0.344	0.032	11	-0.022	0.089
Forest	0.259	-0.091	0.005	-3.172	0.254	12	-0.875	0.033
Urban	0.041	0.004	0.009	-0.294	0.041	25	-0.080	0.075

The result of the FVA assessment shown in Table 4 provides the best summary of the data, as it describes how well the sensor worked in open terrain - the land cover type with the least amount of induced error. With an FVA value of 7.8 cm and a threshold of 36.3 cm, it can be concluded that the LAS data were collected with accuracy. As a result, we expect that the sensor functioned appropriately in all other land cover types. The CVA and SVA assessments report the RMSE value that 95 percent of the errors fall on or below, known as the 95th percentile. The remaining 5 percent of the errors lie above the stated CVA and SVA values.

Table 4 – Fundamental, Consolidated, and Supplemental Vertical Accuracies

Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy	CVA — Consolidated Vertical Accuracy	SVA — Supplemental Vertical Accuracy
Consolidated	72		0.084	
Open Terrain	24	0.078		0.076
Weeds/Crop	11			0.075
Forest	12			0.480
Urban	25			0.072

The following graph illustrates the RMSE results of the survey checkpoints separated by land cover type. The majority of errors are distributed just above and below zero with one outlier in the forest category.

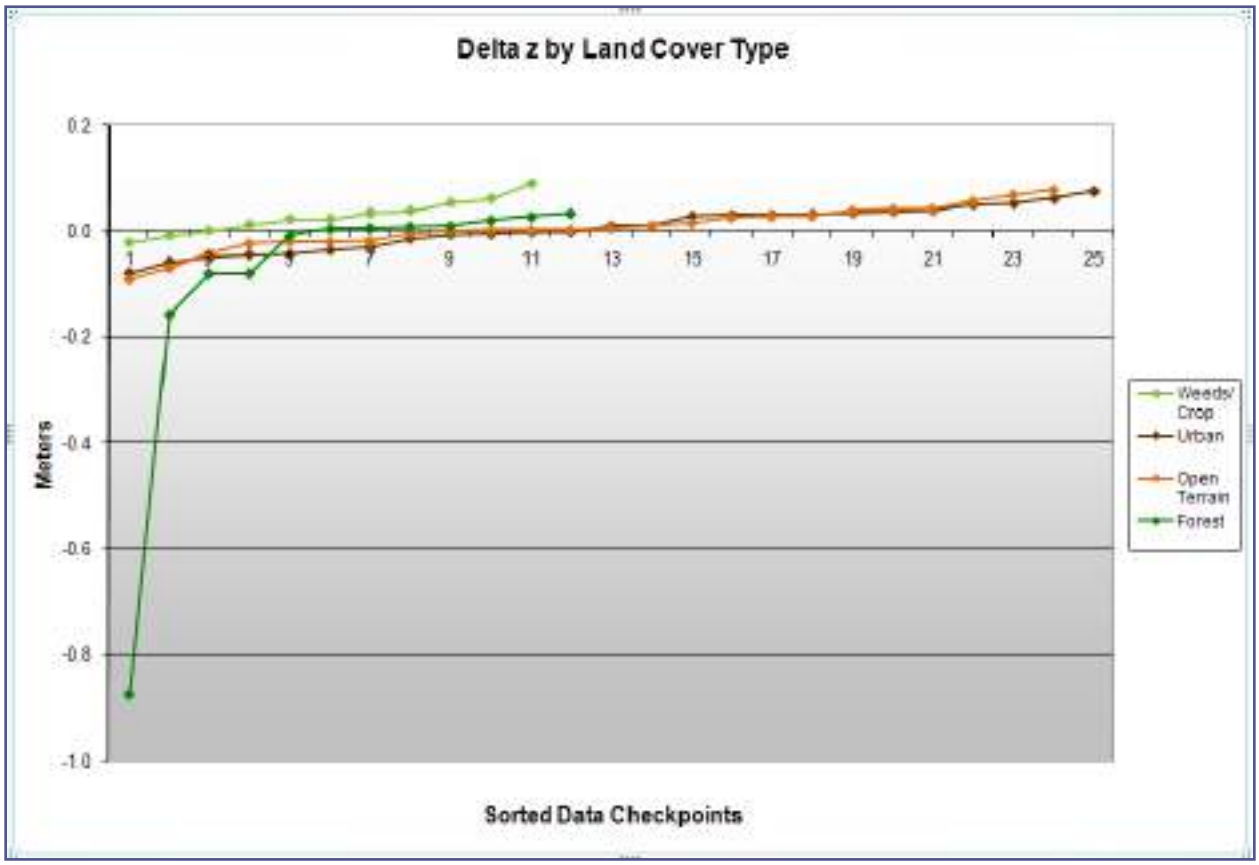


Figure 7 – Display of RMSE value of 72 checkpoints based on land cover type

The RMSE value using the 95% best checkpoints was computed. Table 5 identifies the four points that were removed.

Table 5 – The least accurate 5% of checkpoints

Point	Easting	Northing	Elevation	Z LiDAR	Land Cover Type	DeltaZ
W-612-F	685304.402	3592474.073	218.637	217.762	Forest	-0.875
W-506-VTF	662641.773	3654876.960	175.717	175.560	Forest	-0.157
OT-628	652252.904	3600719.460	245.930	245.838	Open Terrain	-0.092
B-19-VTV	679674.813	3658657.342	178.733	178.822	Weeds/Crop	0.089

The RMSE using the 95% of the best checkpoints is **0.037m,** as shown in Table 6. The most notable improvements exist in the Forest and Weeds/Crop categories.

Table 6 – RMSE method for testing vertical accuracy at 95%

100 % of Totals	RMSE (m) Spec=0.185m	Mean (m)	Median (m)	Skew	Std Dev	# of Points	Min (m)	Max (m)
Consolidated	0.037	0.007	0.007	-0.485	0.036	68	-0.080	0.077
Open Terrain	0.035	0.009	0.003	-0.096	0.034	23	-0.070	0.077
Weeds/Crop	0.031	0.019	0.022	0.076	0.026	10	-0.022	0.061
Forest	0.036	-0.005	0.005	-1.568	0.037	10	-0.079	0.033
Urban	0.041	0.004	0.009	-0.294	0.041	25	-0.080	0.075

Improvements are made in the FVA, CVA, and SVA values using the best 95% of the checkpoints.

Table 7 - Fundamental, Consolidated, and Supplemental Vertical Accuracies

Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy (RMSEz x 1.9600)	CVA — Consolidated Vertical Accuracy (95th Percentile)	SVA — Supplemental Vertical Accuracy (95th Percentile)
Consolidated	68		0.076	
Open Terrain	23	0.069		0.069
Weeds/Crop	10			0.057
Forest	10			0.079
Urban	25			0.072

2.3 Qualitative Assessment

Dewberry performed a micro-level qualitative analysis on 100% of the LAS data by performing a visual analysis of ground models, full point cloud models, and raw LiDAR points. Below is a discussion of the discrepancies identified in the dataset. Appendix A contains a complete list of LiDAR calls. While corrective actions could have been made, the LiDAR data pass the qualitative assessment.

Artifacts

In any dataset it is not uncommon to find artifacts left in the ground models. Typically, artifacts are caused by misclassification of points. As an example, points that should have been classified as a building (class 6) may be left in the ground class (class 2). Dewberry identified a total of four artifacts in the bare-earth LiDAR models throughout the entire Ft. Worth project area. In the Acceptance Criterion, Dewberry requires 95% removal of artifacts. This dataset meets the accuracy specifications, as 98% of the ground models are free of artifacts.

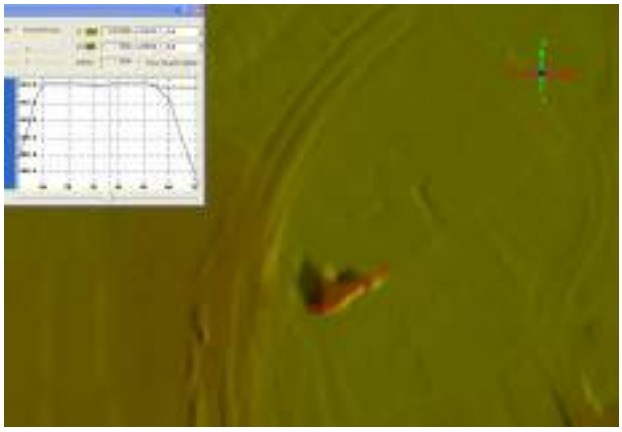


Figure 8 - Tile u329764_1_d; Partial building left in the ground model

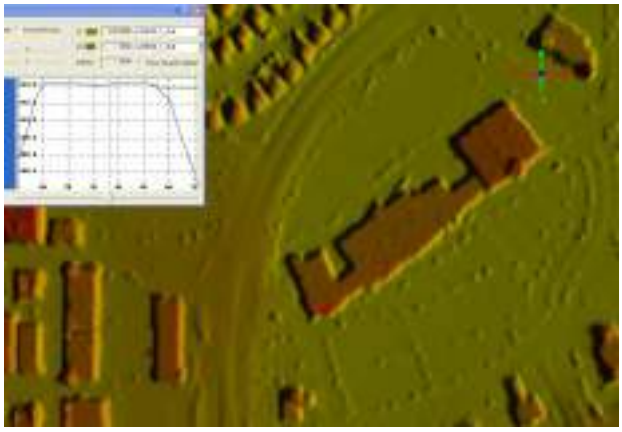


Figure 9 – Full point cloud model showing entire building

Inconsistent Editing

Dewberry identified a few cases in the dataset where inconsistent editing occurred. This type of error may be visible in the removal of buildings, bridges, highway ramps or vegetation. The example below shows a highway ramp that was incorrectly removed from the ground. It is evident when analyzing the full point cloud model that both ramps on either side of the overpass are similar, thus the ground points should have been edited in the same manner. Placing ground points back in the ground class would have improved data quality; however, due to the minimal number of inconsistent edits in the ground models (1.8%), the data meets the requirements.

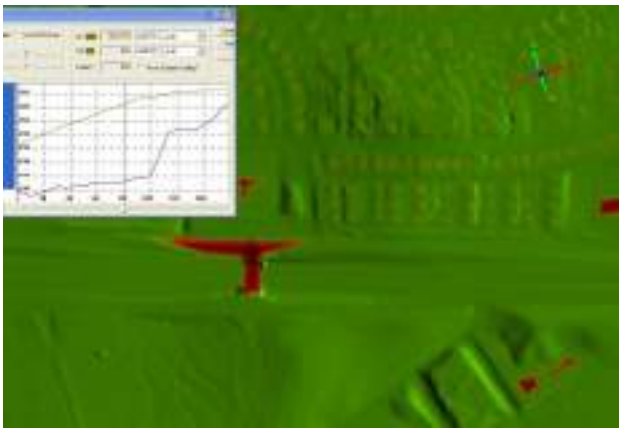


Figure 10 – Tile u329707_2_a; Inconsistent editing of the ground class

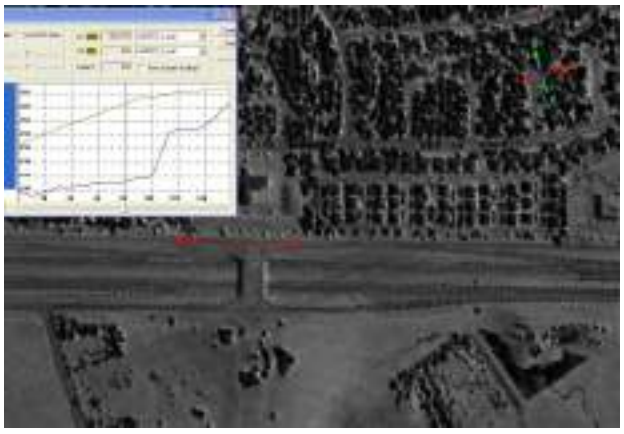


Figure 11 – Full point cloud intensity model showing that the highway ramp and overpass features

Divots

Divots in the dataset are caused by the misclassification of points. As an example, points that should exist in class 7 (noise) may instead be classified as class 2 (ground points). These points lie well below the true ground and may be overlooked during the classification

process. Five examples of divots were identified in the ground models. Since the data are largely free of such outliers, Dewberry did not ask for correction.

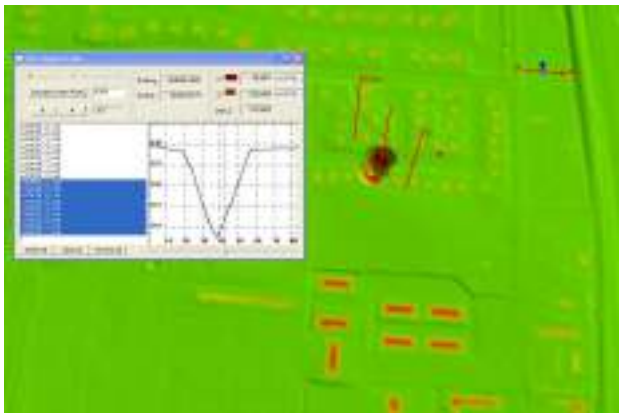


Figure 12 – Tile u329706_2_d; Ground density model of divot

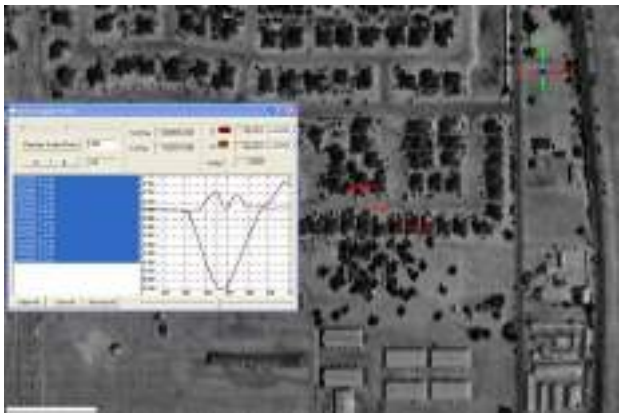


Figure 13 – Full point cloud intensity model

Misclassification

Throughout the dataset there are many examples of the misclassification of LiDAR points in classes 3, 4, 5, and 6. The image below displays an area populated by trailers. Although the trailers should be classified as buildings, they are classified as high vegetation (Figure 14, shown in purple). However, the ground is not affected by this type of misclassification as illustrated by Figure 15. Dewberry is not concerned with this anomaly, as it does not affect the usability of the bare-earth data; it is simply an observation.

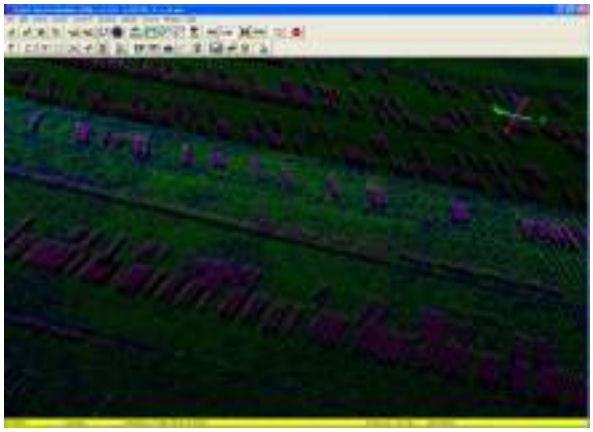


Figure 14 - Tile u329706_1_a; LAS showing trailers classified as high vegetation points

Figure 15 – Tile u329706_1_a; model showing correct classification of ground despite misclassification of trailers

Flight Line Ridges

Minimal flight line ridges, amounting to mismatches of 20-centimeters, were identified in the dataset. The Acceptance Criterion specifies the correction of seam line mismatches that are greater than 20-centimeters. These do not require corrective measures.

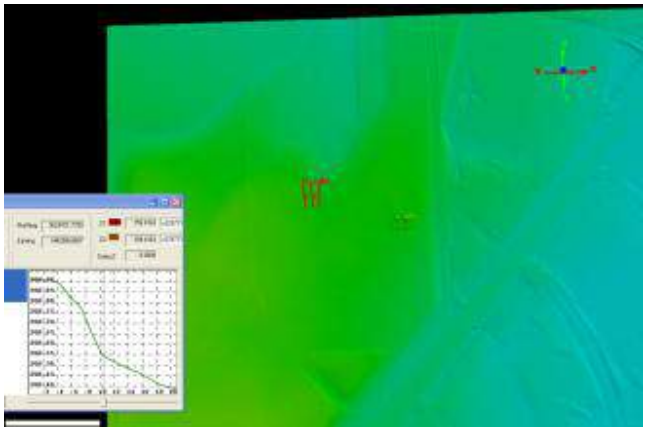


Figure 16 – Tile u329721_2_a; Ground model of flight line ridge

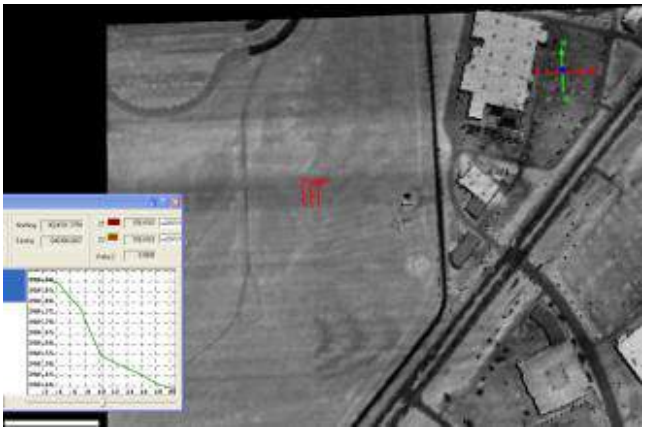


Figure 17 – Intensity image illustrates the boundary between flight lines

3 Breaklines

Dewberry conducted a thorough quantitative and qualitative analysis of the breakline dataset. The breaklines were examined a second time to determine if they met project requirements for completeness, topology (including monotonicity – ensuring that each stream flows downhill), and vertical accuracy. Dewberry assessed the dataset for hydro-enforcement of the hydrolines, the topology of the dataset, and the completeness of the watershed.

In a previous memo, Dewberry provided a list of edit calls and common issues found in the breakline dataset and recommended their correction. After reviewing the most recent geodatabase, it is evident that FEDI has made many improvements to the data. Some outstanding issues still remain that are detailed in the qualitative analysis section below.

3.1 Inventory

Dewberry received an ESRI Geodatabase that included the following feature classes:

- Culvert
- Single Stream
- Stream Polygon
- Stream Connector
- Stream Island Polygon
- Waterbody Polygon
- Waterbody Connector
- Waterbody Island Polygon

3.2 Topology

An important requirement of hydro breaklines intended for modeling is valid topology. Dewberry tested the topology using ESRI's PLTS to ensure that breakline vertices snapped together, that hydro lines were monotonic within a tolerance, that all waterbodies were flat, and that all breaklines had defined elevations. The issues identified during the review are listed below.

- Duplicate geometry:
    - 9 waterbody to waterbody islands
    - 5 stream to stream islands
- Dangles:
    - 1 stream dangle

3.3 Vertical Accuracy Assessment

In order to test the relative accuracy of the breaklines compared to the LiDAR, Dewberry compared a sample of the breakline vertices to the LiDAR masspoints. This is not a definitive test; it is used as an internal guideline to determine how well the breaklines fit the LiDAR. We expect in some cases that the data will not fit, which may be due to the distribution of points or the difficulty in collecting a bankline on a steep slope, for example. Therefore, we use this check as an indication of the vertical consistency between the two products.

3.3.1 Methodology

Dewberry tests the vertical accuracy of the breaklines by comparing the elevation of a sample of the breakline vertices to the surrounding LiDAR points. The vertices of polyline breaklines are converted to points while a GeoTerrain is created from the LiDAR masspoints using only the ground classification. The elevation of the LiDAR is derived by extracting the Z-value of the terrain at the same X/Y-values of the "checkpoints". Finally, an analysis of the elevation comparison between the checkpoints and the terrain is conducted to determine the accuracy of the breakline collection. Due to the enforced montonicity of the breaklines, Dewberry set a criterion of twice the RMSE to allow room for acceptable errors.

A slightly modified version of the process described above was implemented for the analysis of the waterbody features. Since the waterbody breakline vertices are all equal, the purpose of the vertical accuracy assessment is to determine if LiDAR masspoints surrounding the breakline are lower in elevation than the breakline. If there are masspoints with lower elevations, then the horizontal placement of the breakline may need to be adjusted. Dewberry set a criterion that if 20% of the vertices are higher in elevation or "float above" the surrounding masspoints, then the feature is marked as an error.

3.3.2 Assessment Results

The breakline vertex samples were tested for the individual feature classes against the masspoints. Table 1 shows the raw $RMSE_Z$ values, the vertical accuracy value at the 95th percentile, and the vertical accuracy value and percentile level at which the breaklines reach the accuracy of less than twice the $RMSE_Z$ or 0.363 m.

Table 8 – Vertical Accuracy Results

Breakline Feature Class	Vertical Accuracy at 95th Percentile	Percentile at which the vertical accuracy is less than twice the $RMSE_Z$, Spec= 0.363 m
Single Line Stream	0.351	95th
Dual Line Stream	0.852	79th

Table 2 illustrates the results of the vertical accuracy assessment performed on the waterbody feature vertices. Dewberry tested 1,319 breaklines and found that 14 features have at least 20% of their vertices with higher elevations than the surrounding masspoints.

Table 9 – Vertical Accuracy Results of the Water body Feature Class

Total Waterbodies floating (based on 20% criterion)	14
Total Waterbodies	1319
Percent of Water bodies floating	1%

The waterbody feature class achieved the poorest vertical accuracy rating using this method. Of the total feature count, 1% of the waterbody features float above the masspoints. Please note that this analysis does not take into account the distance of the vertices above the terrain, only that a certain percentage of the vertices are in error. However, after the visual review, Dewberry only identified waterbodies floating by 0.35m or less. Dewberry did not identify any major anomalies that would cause concern. Based on the very small percentage of waterbodies floating, and the small degree by which they float, Dewberry is confident in the level of vertical consistency between the waterbodies and the LiDAR masspoints.

3.4 Qualitative Assessment

Dewberry performed a second visual qualitative analysis of the breaklines against intensity imagery as well as a terrain created using LiDAR masspoints. The purpose of this check is to verify the completeness of each feature class. The analysts check for feature coding errors and missing features. They also verify that breaklines are compiled to the correct project boundary, and that features are captured without overlap.

In the previous dataset, a general call was placed to snap all breaklines to the project boundary. It appears that issues still remain, as several breaklines extend past the boundary while others stop short of the boundary. Figure 18 illustrates this issue. All breaklines should be snapped to the project boundary.

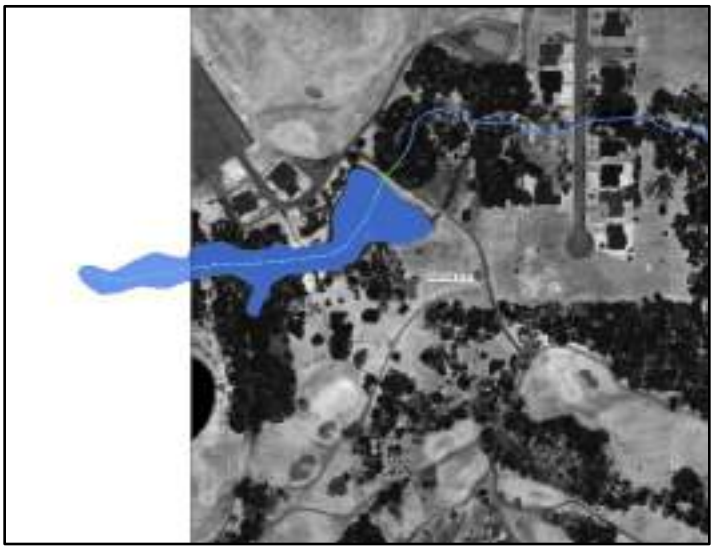


Figure 18 – Tile u329704_4_c; waterbody extends past project boundary

Waterbody Feature Class

As defined by the breakline specifications, any waterbody greater than or equal to 1 acre is to be captured. Previously, Dewberry identified 100+ missing waterbodies in the dataset. FEDI made many improvements to the waterbody feature class; however, there are waterbodies that meet the criteria that have not been collected. Figure 19 and Figure 20 identify a waterbody in the intensity and terrain that is 1.4 acres.

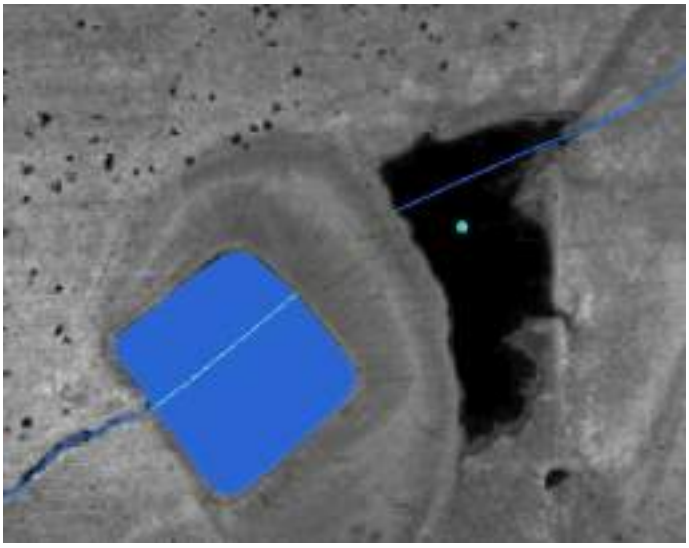


Figure 19 – Tile u339754_4_d; Intensity supports initial claim that a waterbody is missing

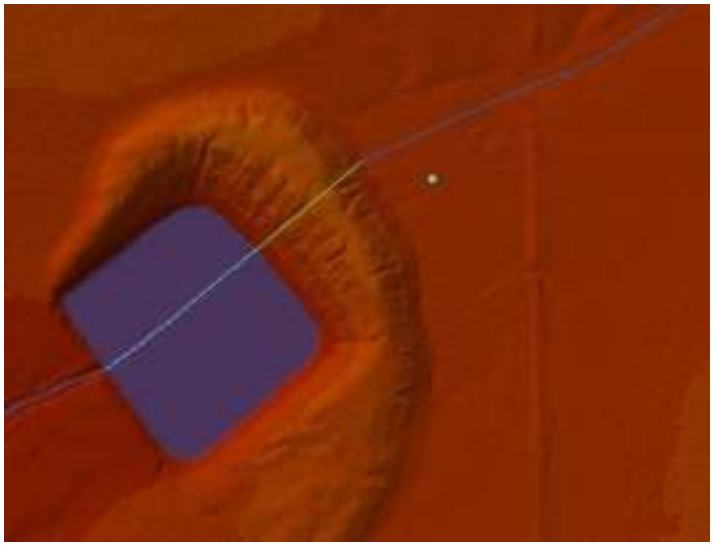


Figure 20 – Flatness of terrain due to absence of masspoints supports the collection of the waterbody

There are very minimal feature coding errors that affect the waterbody feature class. In Figure 21, a single line stream runs through a waterbody. Instead, this feature should have been coded as a waterbody connector.

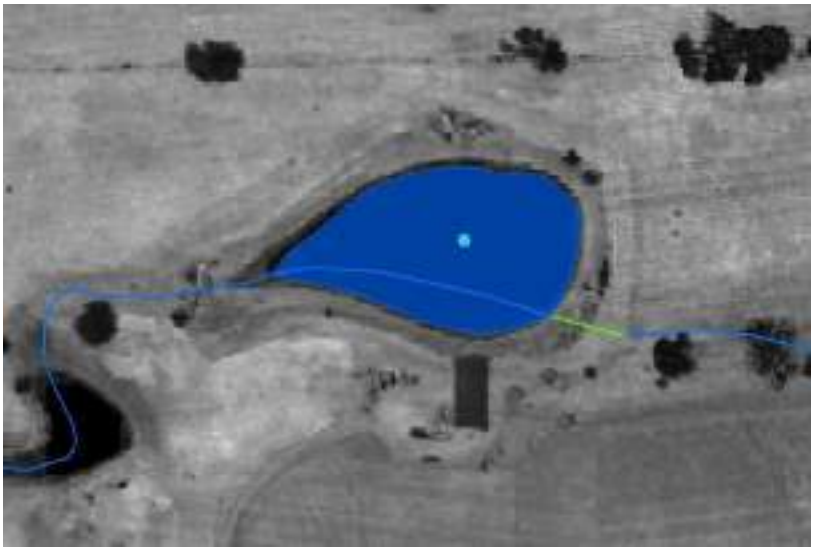


Figure 21 – Tile u339762_2_c; Stream passing through waterbody should be coded as a waterbody connector

Hydrographic Features

Many inconsistencies in the collection of hydrographic features existed in the previous dataset. However, FEDI heeded many of Dewberry's recommendations and as a result the hydrographic features have significantly improved. Some discrepancies may exist - it can be debatable if a feature should be a waterbody or a stream, for example. However, overall the hydrographic

feature class is of good quality in terms of both capture methods and horizontal placement of the breaklines.

Below is an example of one error that was also called in the previous dataset. The major waterbody in blue should have two dual line streams (purple) that feed into the waterbody from the west. The single line stream to the north, highlighted by the yellow arrow, should be captured and coded as a dual line stream for two reasons: it is greater than 40ft wide, and the feature to the south that has the same characteristics was treated as a dual line stream.

Figure 22 – Stream denoted by yellow arrow should be coded as a dual line instead

Waterbody Island Feature Class

Dewberry placed calls that requested the delineation of water body islands in the previously submitted dataset. In their response, FEDI stated that island feature classes less than one acre did not require collection. However, there are island features greater than 1 acre that were not compiled. Figure 23 shows three islands that are between 1 and 2 acres in size that were not collected.

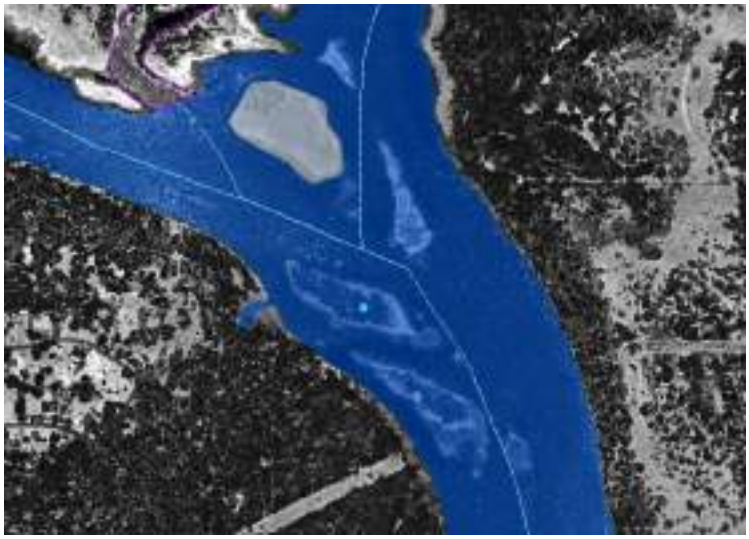


Figure 23 – Tile u329713_1_d; waterbody islands up to 2 acres not collected

Culverts

The purpose of culverts is to connect hydrographic features when they are interrupted by a road. The difficulty in using culverts consistently throughout the dataset is in determining the type of feature underneath which they pass. If the stream is running under a bridge, it should remain a stream. However, if the stream passes under a road as a culvert, then it should be coded as such. It is not always easy to judge if the feature is a road or bridge based on intensity imagery. Therefore, it is possible that one reviewer may interpret the feature as a bridge while the other sees a road. Dewberry took this into account when placing calls that asked for streams to be coded as culverts, and Fugro either made the appropriate changes or provided justifications.

After completing the review of culverts, Dewberry did not identify any major discrepancies that require resolution.

4 Intensity

Dewberry received a complete delivery of LiDAR intensity images. The data were required to meet the following specifications:

- Raster images in GeoTIFF format of 1st-return
- 1-meter pixel size
- 1/4th USGS 7.5-minute quadrangle

Figure 24 - Complete delivery of Fort Worth Intensity

With the exception of the tile grid, all 322 files were delivered in accordance with the requirements. The intensity are tiled based on the 1/16th USGS 7.5-minute quadrangle. They follow the same tiling scheme as the LAS data; that is, the internal tiles have a 50-meter overlap between tiles and those that line the project boundary have a 300-meter buffer.

Dewberry verified that the pixel values in the areas of overlap are the same. However, Dewberry could not verify that the intensity data are projected. FEDI stated that the projection has been defined using a different set of definitions that ArcGIS cannot read as shown in Figure 25. It appears that the projection may be defined by the number 3721, as opposed to a text format definition. Dewberry recommends that the projection be defined so that it may be validated in ArcGIS.

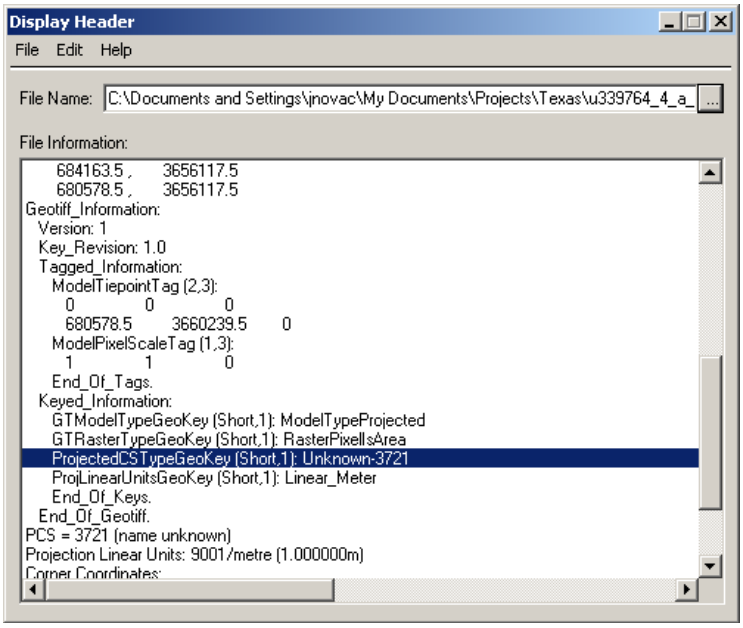


Figure 25 - Intensity header example

5 Hydro-Enforced DEMs

To verify the accuracy and completeness of the hydro-enforced DEMs, Dewberry performed a series of checks on the data, beginning with a visual analysis. This analysis was performed on each DEM, on a tile-by-tile basis in an effort to identify any major anomalies in the data, specifically data voids. Furthermore, each DEM was processed to create a hillshade as a second visual check. Hillshades provide an illuminated view of the ground surface created from a hypothetical light source, which gives analysts an image in which data voids are easier to see during the assessment process.

The DEMs are required to be free of artifacts, gaps, or smoothing at tile boundaries. Upon completion of the visual analysis, Dewberry identified the following discrepancies:

Table 10 – Complete list of errors identified in the hydro-enforced DEMs

DEM Tile	Error Type
u329704_4_b_be	data void
u329704_4_d_be	data void
u329707_4_c_be	data void
u339762_2_b_be	data void
u329633_1_a_be	incomplete tile edge
u329705_3_c_be	incomplete tile edge
u329708_1_b_be	incomplete tile edge
u329712_4_c_be	incomplete tile edge
u329728_2_a_be	incomplete tile edge
u329729_4_b_be	incomplete tile edge
u329732_1_a_be	incomplete tile edge
u339753_4_d_be	incomplete tile edge
u339764_2_c_be	incomplete tile edge

Figure 26 and Figure 27 illustrate the data void identified in tile u329707_4_a. Since the DEMs are composed of LiDAR ground points and hydro-enforced breaklines, a data void of this magnitude would cause suspicion of the quality of the ground points. However, Dewberry verified that the ground points are complete in this particular tile, as illustrated in Figure 28. As a result, Dewberry attributes this error to DEM processing. This is true for all tiles that contain errors, as listed in Table 10. Dewberry verified the integrity of the ground points from the LAS source, and concluded that all errors resulted from the processing steps. Dewberry strongly encourages that these errors be corrected before the data is used.

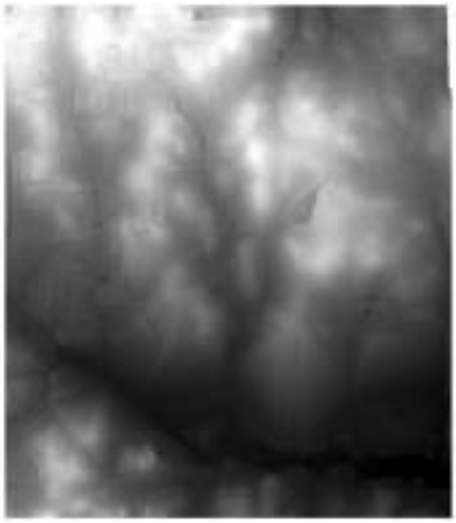


Figure 26 – Tile u329707_4_a; data void in bottom half of DEM

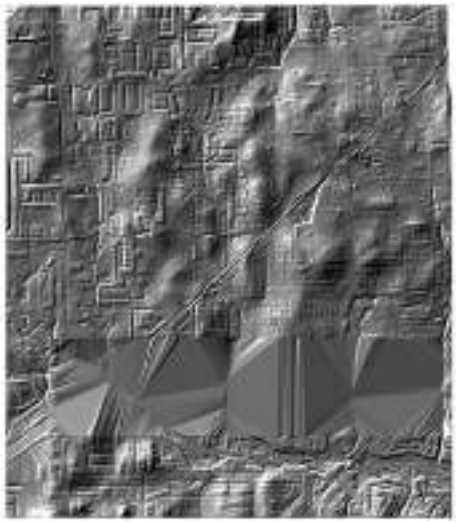


Figure 27 – Data void illustrated by hillshade model

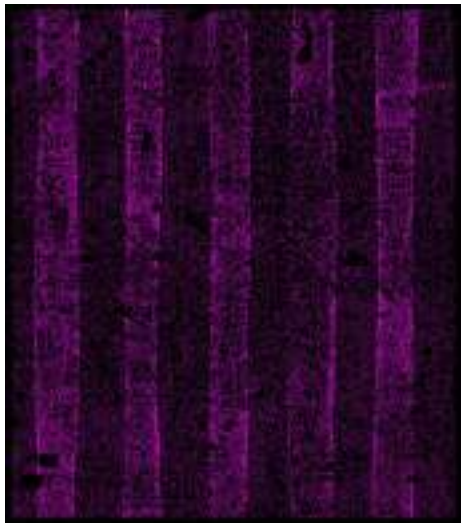


Figure 28 – Ground LiDAR points from source LAS are complete throughout the tile

6 Metadata

Dewberry received tile-based LAS, DEM, and intensity metadata, as well as breakline metadata provided in the geodatabase. Dewberry reviewed the metadata, checking for accuracy and completeness based on Federal Geographic Data Committee (FGDC) requirements.

6.1 LAS Metadata

In the previous delivery, Dewberry received LAS metadata and proposed a set of corrections. Many improvements have been made to the LAS metadata. There are three recommendations remaining:

1. The *Theme* states *intensity image.* This should be removed.
2. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N

6.2 Intensity Metadata

This is the first review that Dewberry has performed on the intensity metadata. Below are recommendations to improve the metadata quality:

1. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
2. *Type of data* reads LAS. This is incorrect and it should be Intensity.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N
4. The *FGDC lineage process steps* should only contain step 3. Steps 1 and 2 are not needed. The *source* information should reference the LAS ground files.
5. The *Attributes* tab lists LAS 1.1 format. This should be removed.

6.3 DEM Metadata

This is the first review that Dewberry has performed on the DEM metadata. Below are recommendations to improve the metadata quality:

1. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
2. *Type of data* reads LAS. This is incorrect. It is DEM data delivered in ESRI grid format.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N
4. The *FGDC lineage process steps* 1 and 2 are not needed.
5. The *Vertical positional accuracy* states the LiDAR accuracy, which is different from the accuracy of the DEMs.
6. The *Attributes* tab lists LAS 1.1 format and GeoTiff. This should be removed as it is DEM data in ESRI grid format.

6.4 Breakline *Meta*data

The breakline metadata was delivered per feature class. Dewberry reviewed each of the eight feature class metadata files for accuracy and completeness. The following issues were identified:

1. The *Theme* specifies *waterbody* for each feature class. This is incorrect for every feature classes with the exception of the waterbody feature class
2. The *FGDC lineage process step* 1 defines the criteria for capturing a single line stream as any hydro feature less than 50 feet, when in fact the breakline specification states 40 feet.

7 Optional Deliverables

7.1 ASCII Ground Point List

Dewberry received 322 ASCII text files that list the x, y, and z coordinates of all ground points, class 2. The models follow the 1/16th USGS 7.5-minute quadrangle tiling scheme. To ensure the correct number of ground points in each file, Dewberry compared the count of the ground class from the LAS to the count from the ASCII text files. In each comparison, Dewberry found consistency between the two types of models. Secondly, Dewberry created ground models of all 322 ASCII files as a second check to verify that data is present in each tile. Dewberry then conducted a macro level assessment of the ground models and did not find any major anomalies.

7.2 First-Return Surface Model

Dewberry performed a qualitative analysis on 322 models in ESRI Grid format. The models are to be created from the first-return of the LiDAR pulse, using either a 1-meter or 2-meter cell size, and following the 1/4th USGS 7.5-minute quadrangle tiling scheme. Dewberry used a random sample of LAS data to create 1-meter gridded models using only the first-return LiDAR pulses. Dewberry queried the pixel values to ensure consistency between the deliverable and the sample model created by Dewberry. This process is used to verify that the raster models conform to the specifications. Figure 29 is an example of a first-return model.

Figure 29 - Tile u329705_2_b; an example of first-return model showing NoData areas in bright blue

8 Conclusion

The LiDAR data for Fort Worth, Texas was thoroughly examined by Dewberry for accuracy, completeness, and conformity to project specifications. Because the data meet the vertical accuracy requirements and are free of major anomalies, Dewberry is confident in the quality and integrity of the LiDAR data for general geographic use and for hydrographic modeling.

The hydrographic breaklines are also of good quality with some minor issues. The breaklines pass the completeness and topology requirements; however, there are vertical accuracy errors in the dataset that should be noted. A specific tolerance (twice the RMSE) was utilized as a baseline to allow for small amounts of vertical accuracy error due to compiler error and monotonicity enforcement, but in this dataset some errors are outside this threshold. As previously stated, this is not a definitive check; however it is important for the end user to be aware of minor discrepancies in vertical accuracy.

The hydro-enforced DEMs require corrective actions before the data can be used. This is due to processing errors that resulted in data voids. Secondly, the DEMs do not have a defined projection. This should be corrected. This deliverable did not meet project specifications.

Although FEDI stated that the intensity are projected, Dewberry strongly encourages that the data have their projection defined in such a way that is readable by ArcGIS.

Lastly, Dewberry identified that the metadata for the LAS, intensity, and DEMs are not FGDC compliant, as they lack a defined projection. Additional recommendations have been provided for improvements to the overall metadata quality.

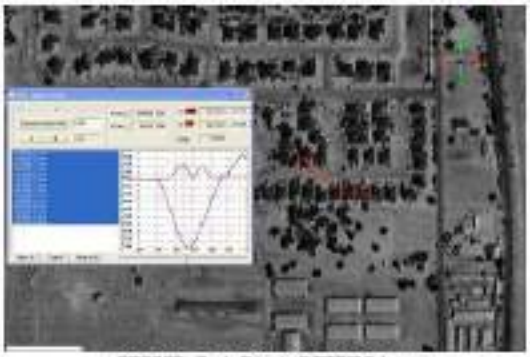
In summary, the following list illustrates the deliverables that meet project specifications:

- ✓ All-Return LAS Point Cloud Data
- ✓ Hydrographic Breaklines
- ✓ Intensity Imagery
- ✓ First-Return Surface Model
- ✓ ASCII Ground Point List
- ✓ Breakline Metadata

The data that require correction include:

- ➢ Hydro-Enforced DEMs
- ➢ LAS Metadata
- ➢ Intensity Metdata
- ➢ DEM Metadata

Appendix A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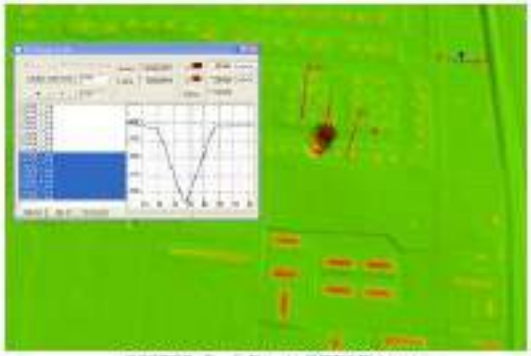
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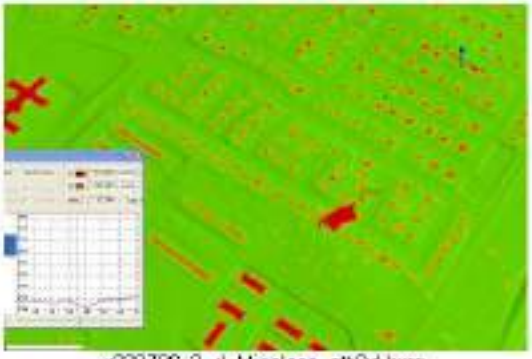
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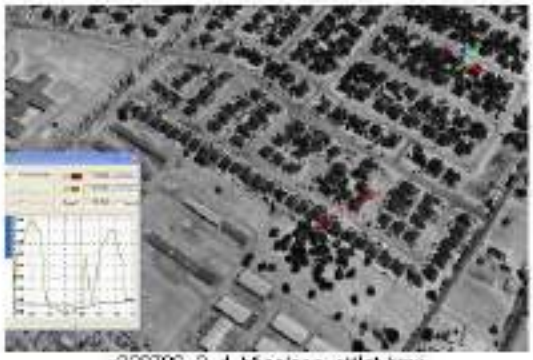
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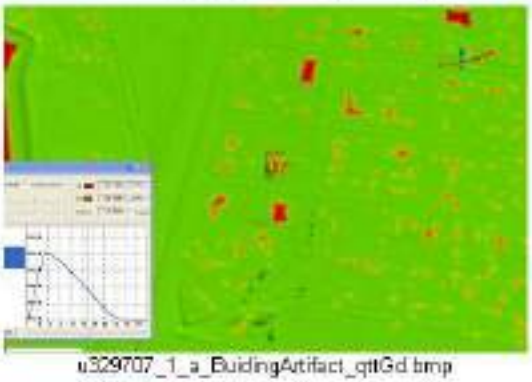
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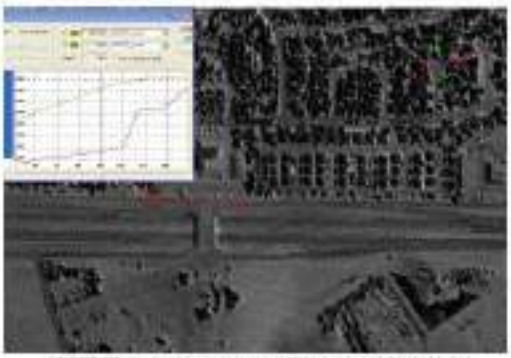
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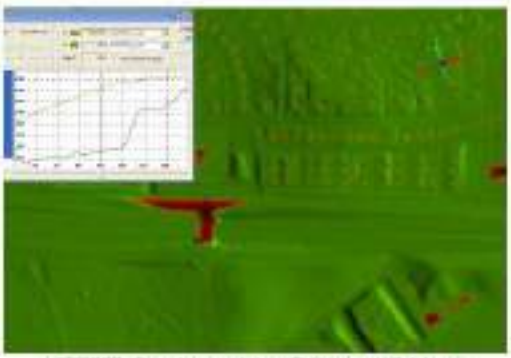
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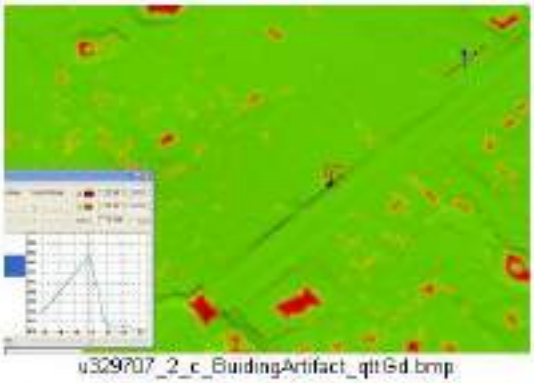
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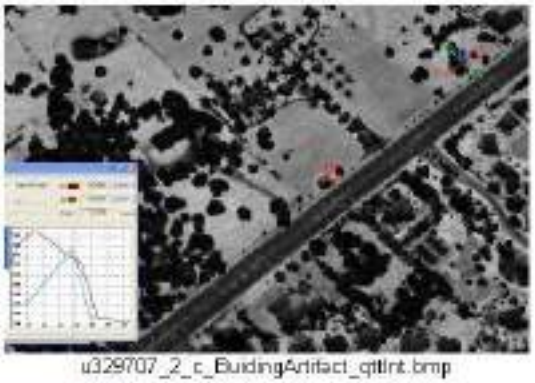
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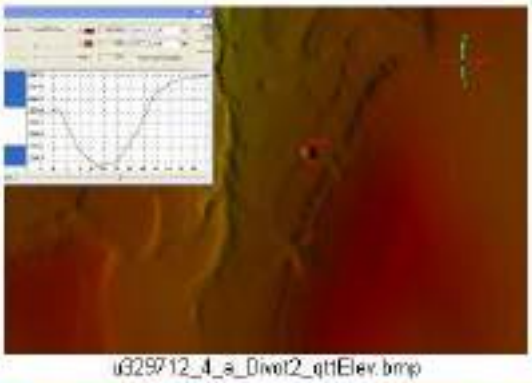
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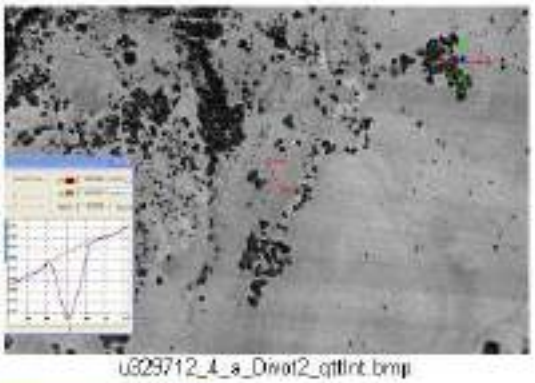
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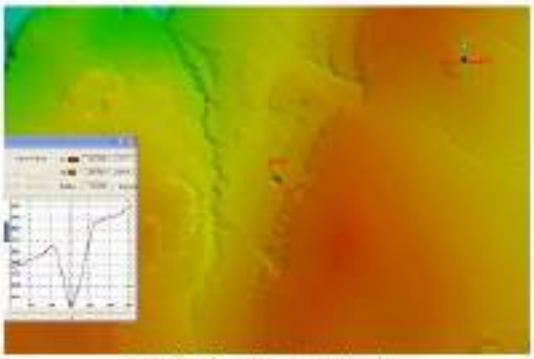
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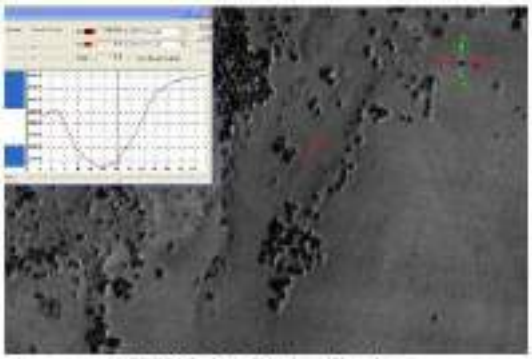
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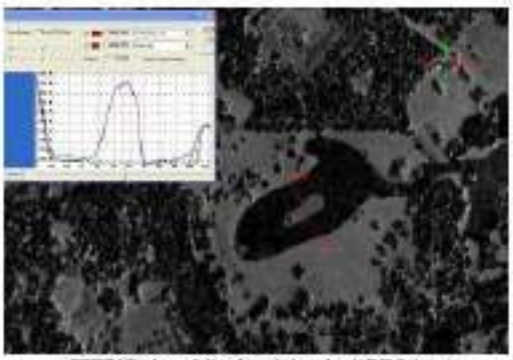
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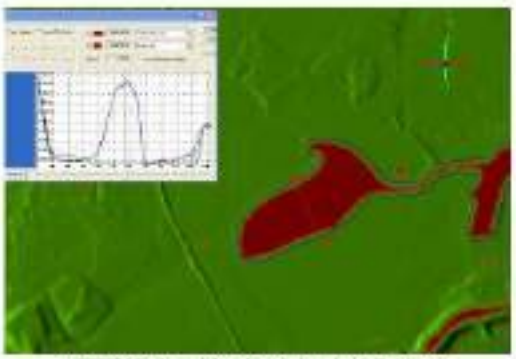
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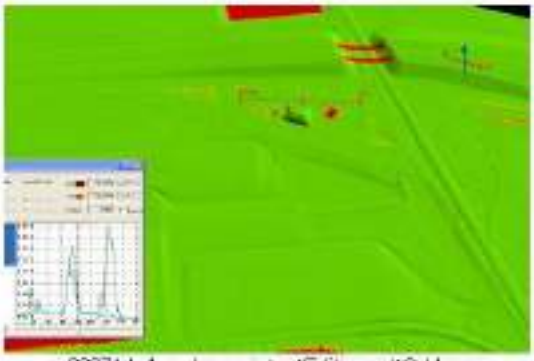
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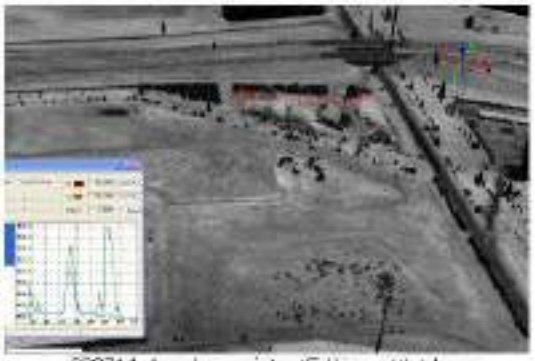
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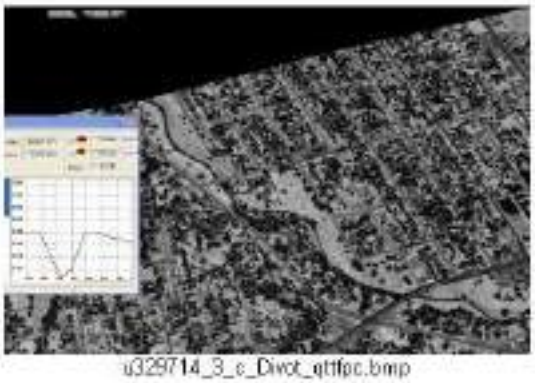
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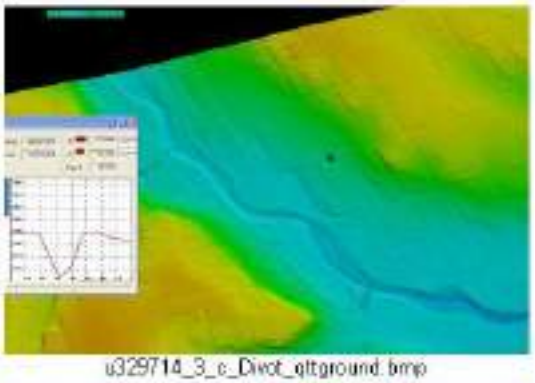
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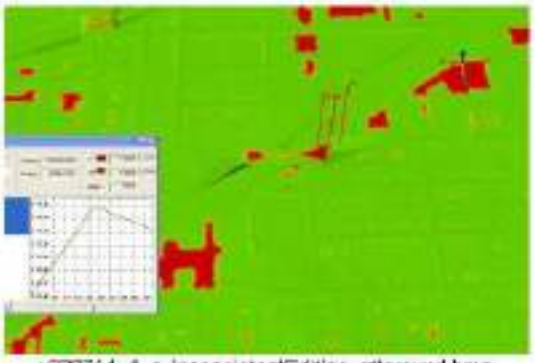
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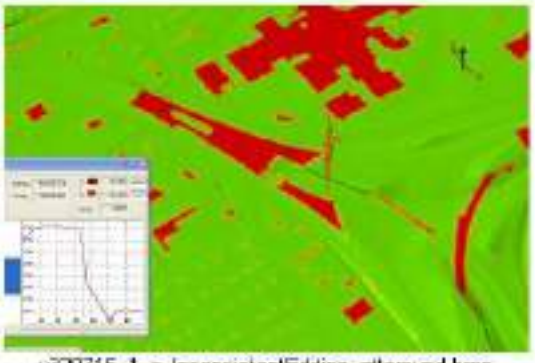
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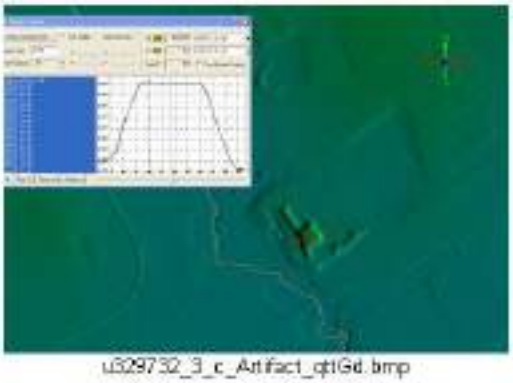
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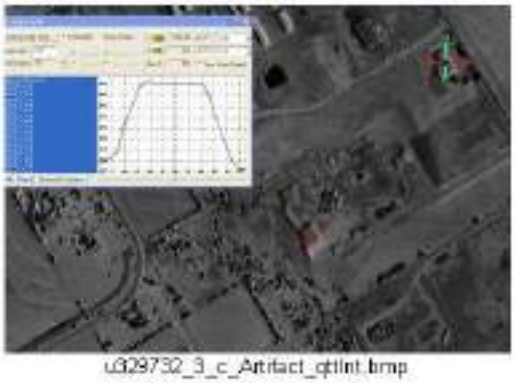
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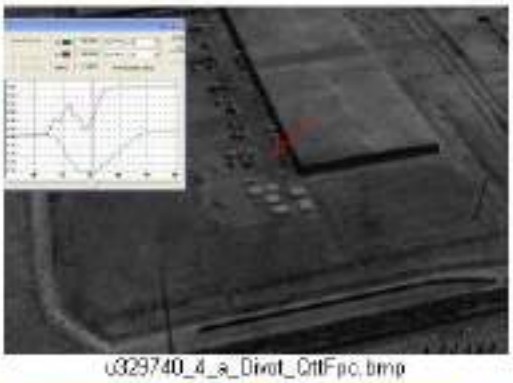
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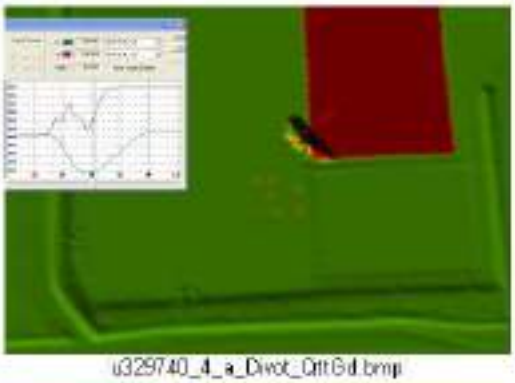
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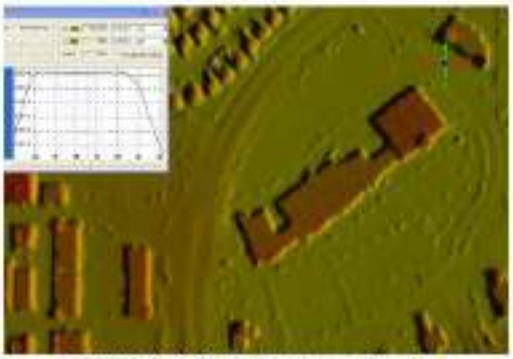
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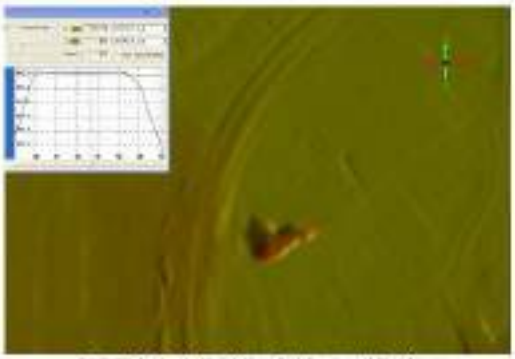
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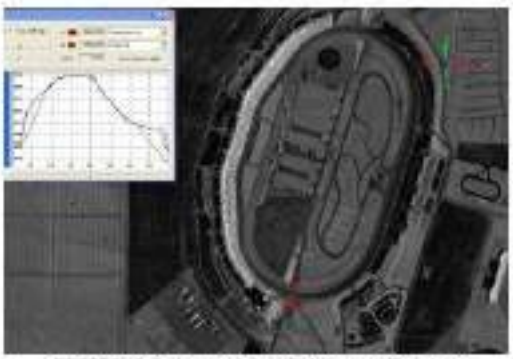
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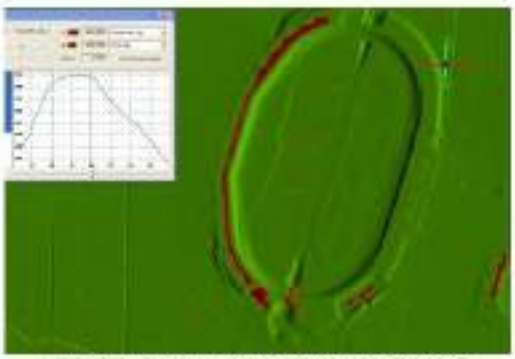
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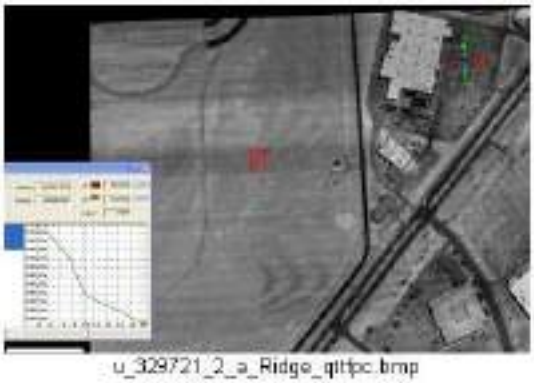
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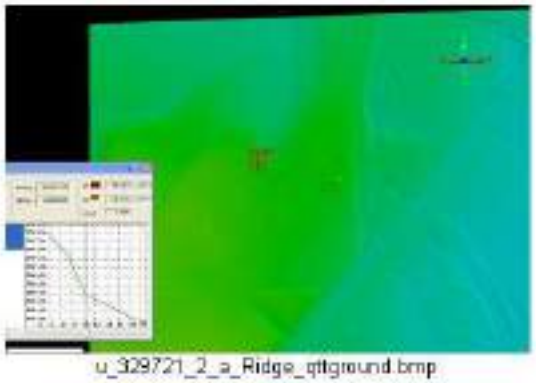
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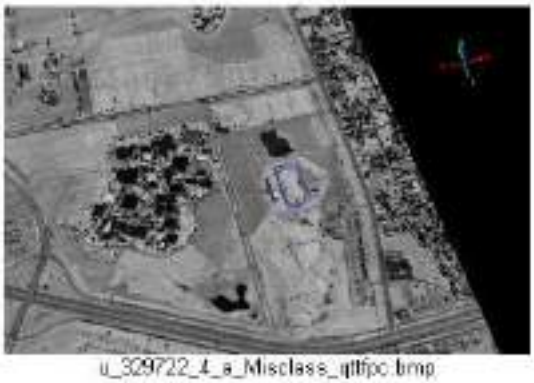
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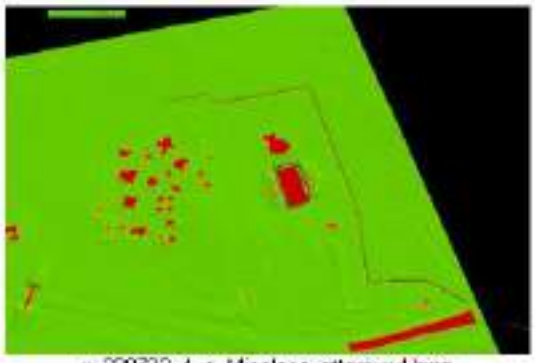
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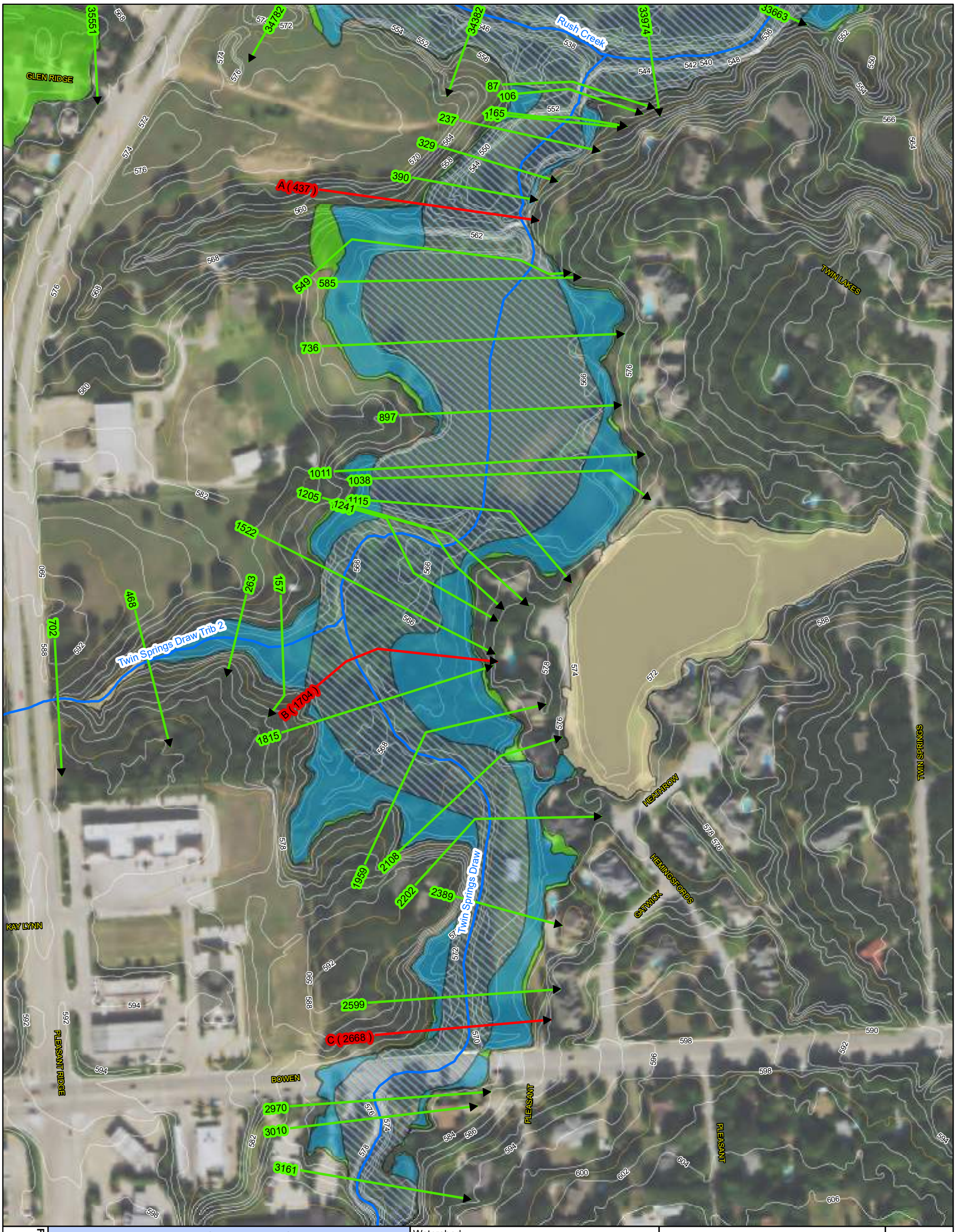
Appendix F
CD-ROM



Figure

Map 96

KEY TO FEATURES

- Cross Section
- Cross Section - Lettered
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw

Title

Hydraulic Work Maps

Panel

1 of 2

0 200 400

Scale in Feet

FEMA

HALFF

ARLINGTON

THE AMERICAN DREAM CITY

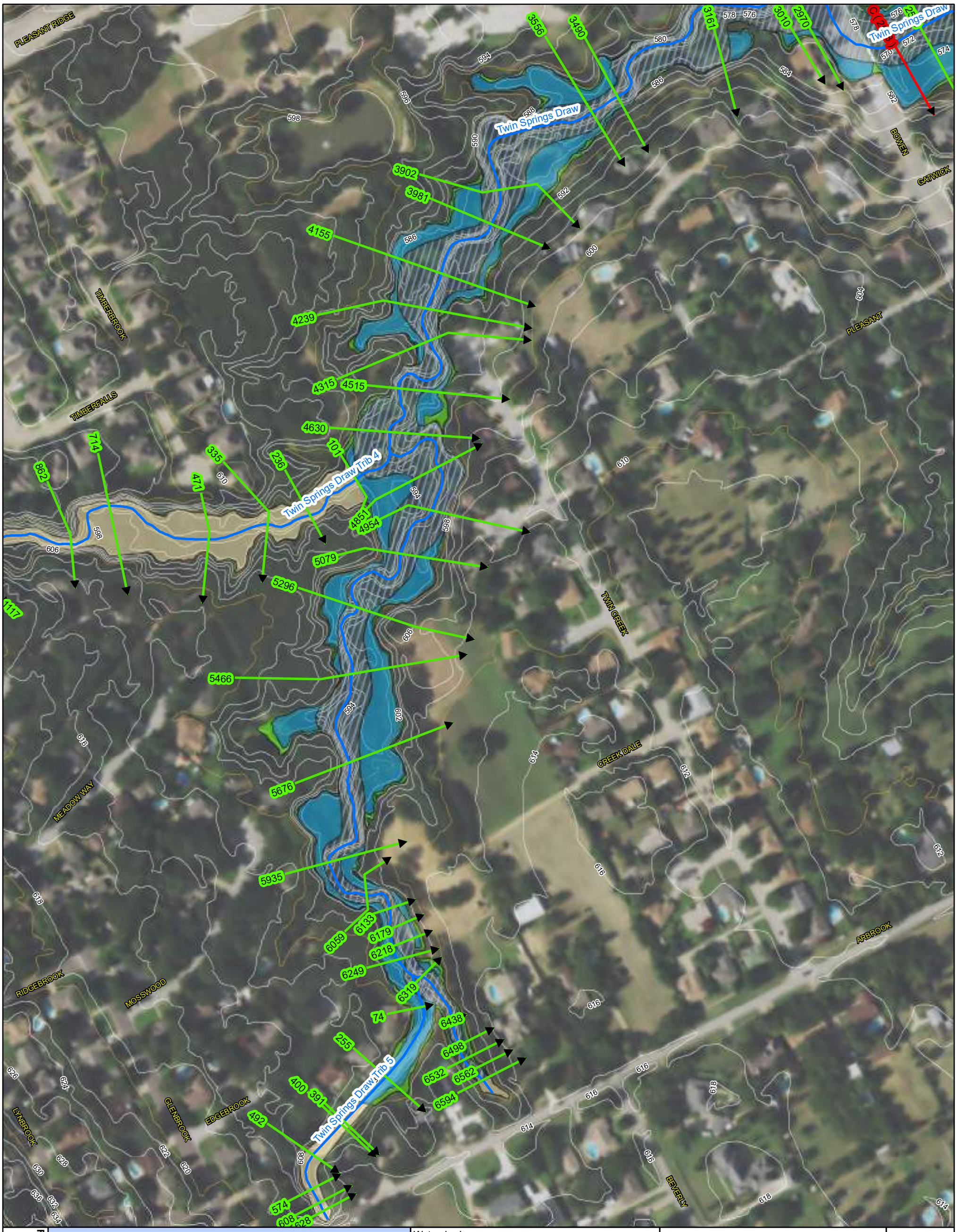
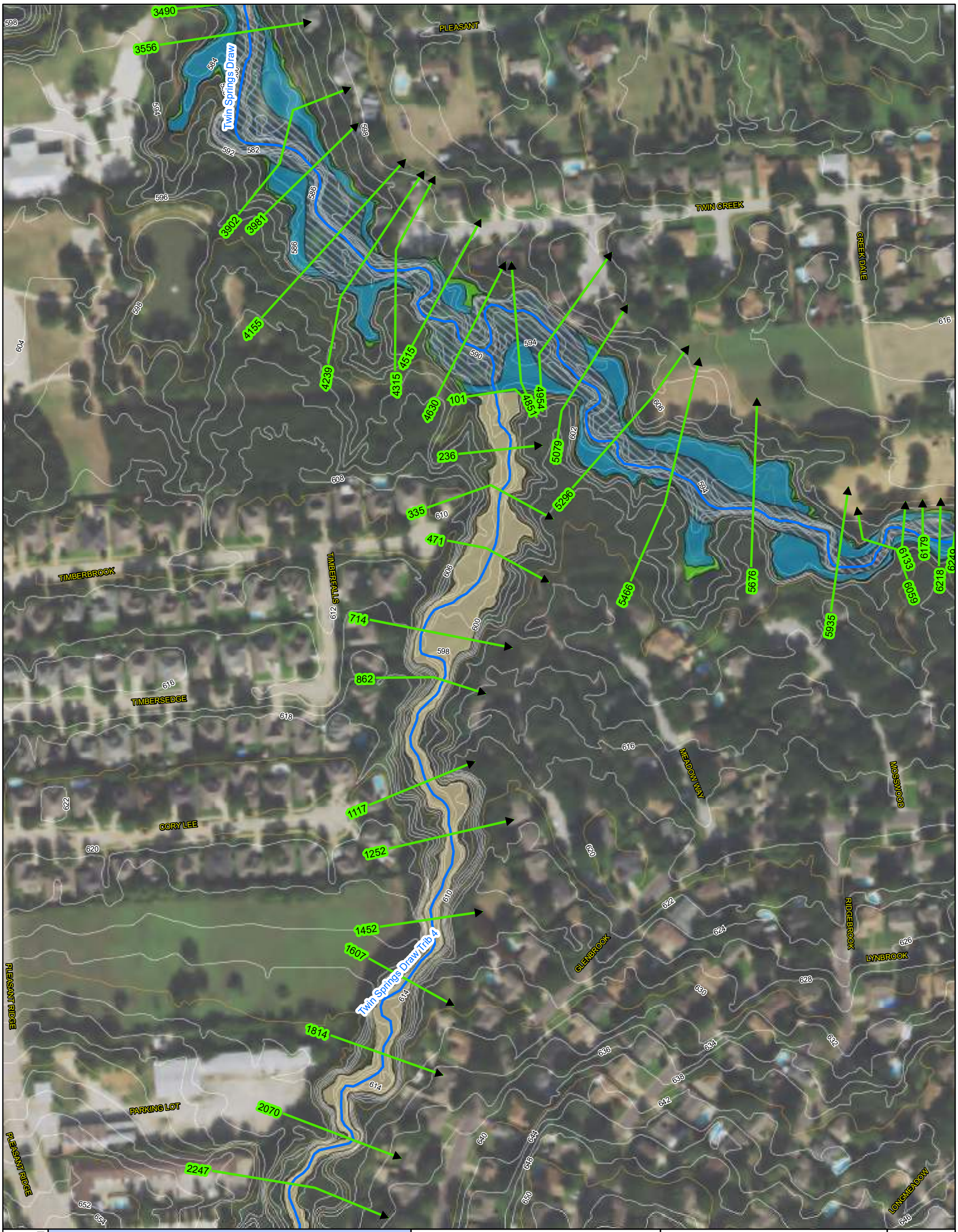


Figure Map 97	KEY TO FEATURES	Watershed: Twin Springs Draw	0 200 400 Scale in Feet
	Cross Section Cross Section - Lettered Stream Centerline **Proposed Mapping** Floodway 1% Annual Chance Floodplain (Zone AE) 1% Annual Chance Floodplain (Zone A) 0.2% Annual Chance Floodplain Contour - 2' Index Contour - 10'	Title: **Hydraulic Work Maps** Panel: **2 of 2**	FEMA HALFF ARLINGTON



Figure

Map 98

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 4

Title

Hydraulic Work Maps

Panel

1 of 2

0 200 400

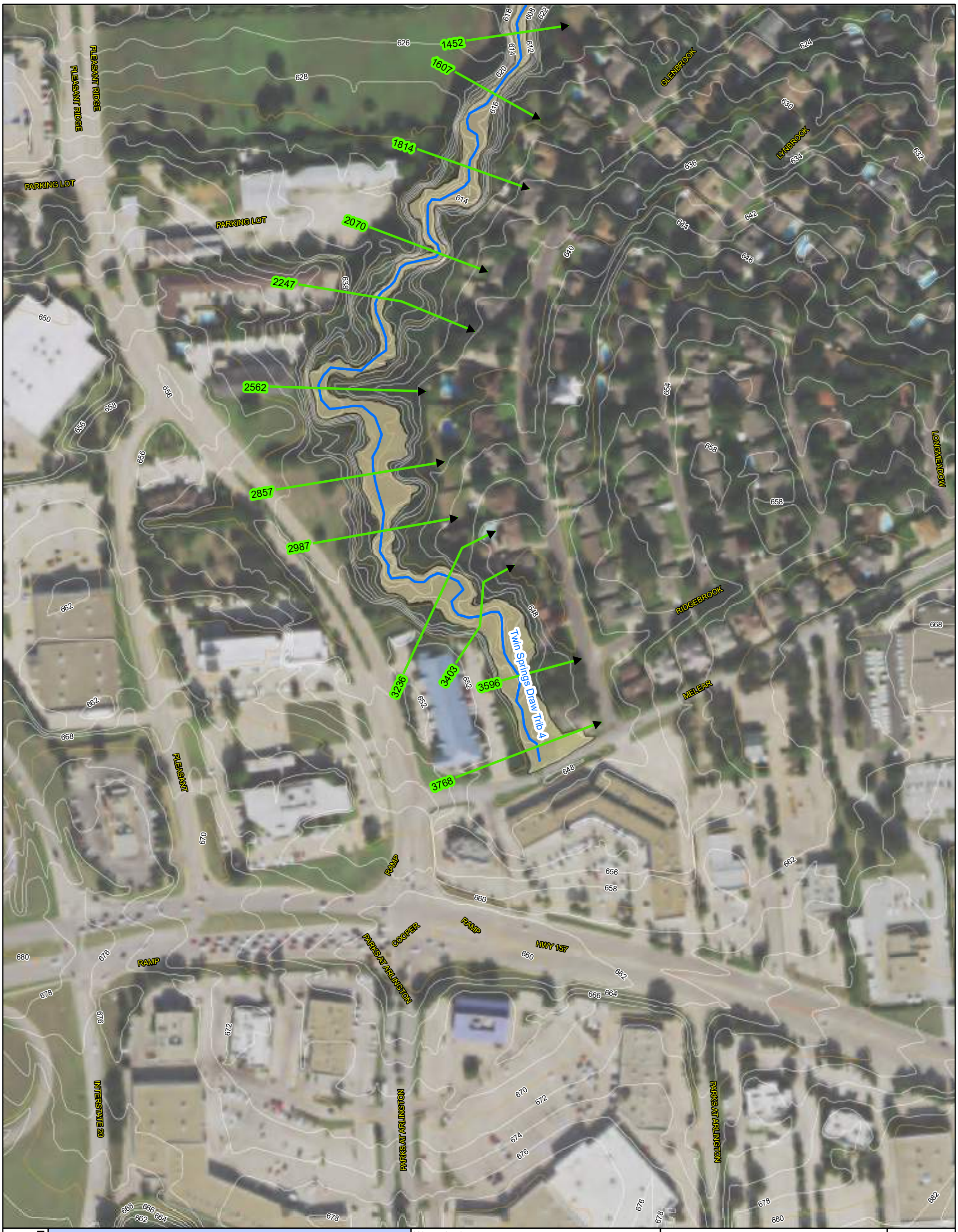
Scale in Feet

FEMA

HALFF

ARLINGTON

THE AMERICAN DREAM CITY



Figure

Map 99

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- 1% Annual Chance Floodplain (Zone A)
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 4

Title

Hydraulic Work Maps

Panel

2 of 2

0 200 400

Scale in Feet

FEMA

HALFF

ARLINGTON

THE AMERICAN DREAM CITY

Figure

Map 100

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 5

Title

Hydraulic Work Maps

Panel

1 of 1

0 200 400

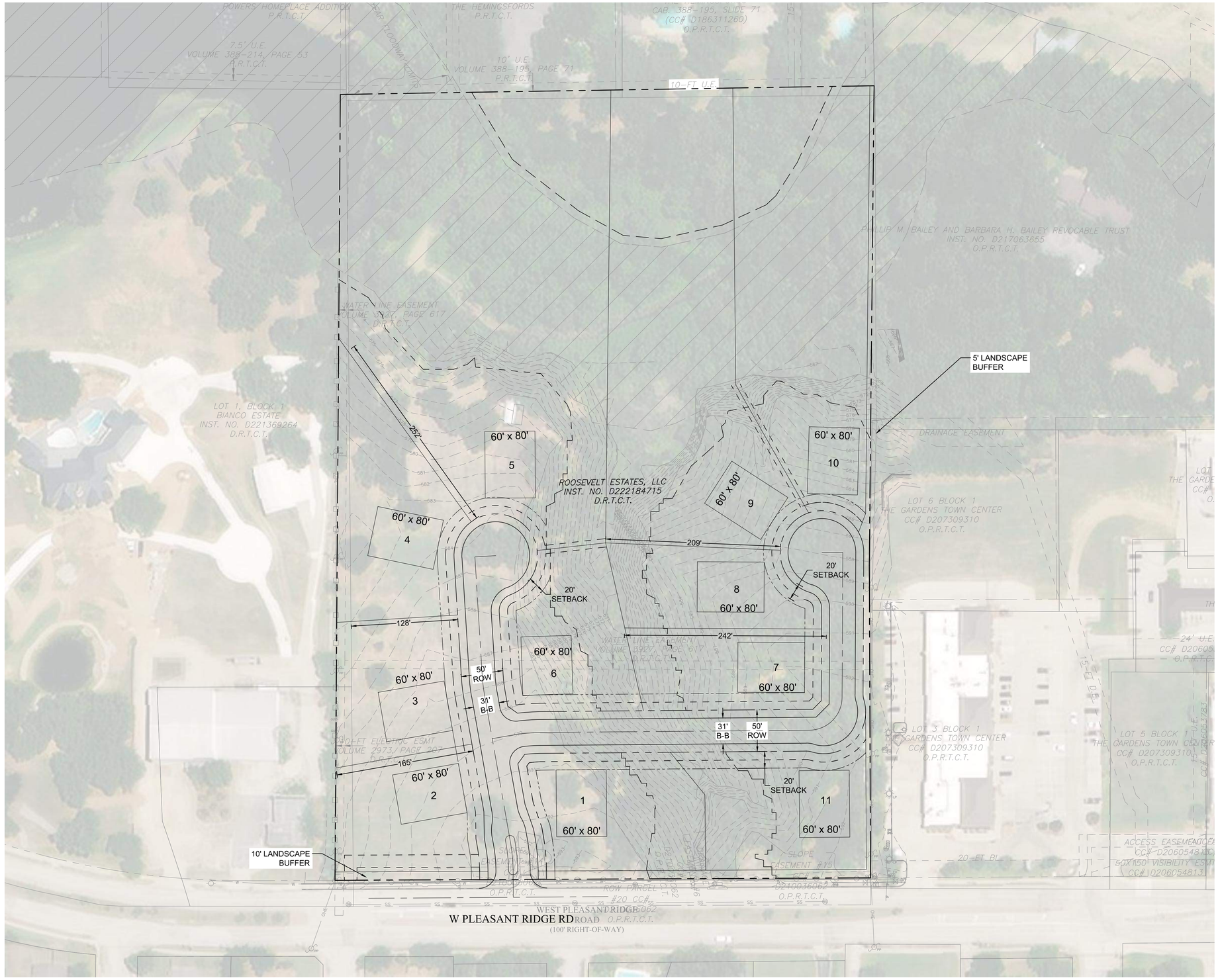
Scale in Feet

FEMA

HALFF

ARLINGTON

APPENDIX D: PROJECT LAYOUT SHEETS



LEGEND

- FLOODPLAIN
- OPEN SPACE
- PROJECT LOCATION

SHIELD ENGINEERING GROUP

TBPE FIRM #F-11039 · TBPLS FIRM #10193890

N

0 60 120 180

GRAPHIC SCALE IN FEET

CITY OF
DALWORTHINGTON GARDENS, TEXAS

ROOSEVELT ESTATES

LAND PLAN
June 2, 2023

DESIGNED: JGD	SCALE:	DATE:	SHEET:
DRAWN: JGD	1" = 60'	JUN 2023	1 OF 1

2023\06\02 JOSE.DELEON L:\JOBS\2021\05.01 ROOSEVELT ESTATES\EXHIBITS\2023\06\02 DRAINAGE STUDY EXHIBIT\LAND PLAN.DWG

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APPENDIX E: DIGITAL DATA

APPENDIX F: HEC-RAS OUTPUT

TWIN SPRINGS DRAW

(HEC-RAS VERSION 4.1)

1600 W. 7th Street, Suite 400, Fort Worth, Texas 76102 | 817.810.0696
Shield Engineering Group, PLLC

info@shield-engineering.com | www.SHIELDENGINEERINGGROUP.com
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6594	Max WS	154.68	607.99	609.43	609.43	609.93	0.036313	5.73	27.87	31.12	1.00
TWI000A	6594	31DEC2011 2400	10.00	607.99	608.41	608.42	608.55	0.071014	3.01	3.32	14.13	1.09
TWI000A	6594	01JAN2012 0100	10.00	607.99	608.41	608.42	608.55	0.068809	2.98	3.36	14.20	1.08
TWI000A	6594	01JAN2012 0200	10.00	607.99	608.41	608.42	608.55	0.068570	2.97	3.36	14.21	1.08
TWI000A	6594	01JAN2012 0300	10.00	607.99	608.41	608.42	608.55	0.068331	2.97	3.37	14.22	1.07
TWI000A	6594	01JAN2012 0400	10.00	607.99	608.41	608.42	608.55	0.068093	2.96	3.37	14.23	1.07
TWI000A	6594	01JAN2012 0500	10.00	607.99	608.41	608.42	608.55	0.067856	2.96	3.38	14.24	1.07
TWI000A	6594	01JAN2012 0600	10.00	607.99	608.41	608.42	608.55	0.067526	2.96	3.38	14.25	1.07
TWI000A	6594	01JAN2012 0700	10.00	607.99	608.41	608.42	608.55	0.066225	2.93	3.41	14.30	1.06
TWI000A	6594	01JAN2012 0800	10.00	607.99	608.42	608.42	608.55	0.065586	2.92	3.42	14.32	1.05
TWI000A	6594	01JAN2012 0900	10.00	607.99	608.42	608.42	608.55	0.064820	2.91	3.43	14.35	1.05
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TWI000A	6594	01JAN2012 1100	10.00	607.99	608.41	608.42	608.55	0.066042	2.93	3.41	14.30	1.06
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TWI000A	6594	01JAN2012 1300	19.16	607.99	608.56	608.57	608.73	0.056993	3.33	5.75	17.77	1.03
TWI000A	6594	01JAN2012 1400	10.00	607.99	608.41	608.42	608.55	0.066686	2.94	3.40	14.28	1.06
TWI000A	6594	01JAN2012 1500	10.00	607.99	608.42	608.42	608.55	0.065496	2.92	3.42	14.33	1.05
TWI000A	6594	01JAN2012 1600	10.00	607.99	608.42	608.42	608.55	0.064686	2.91	3.44	14.36	1.05
TWI000A	6594	01JAN2012 1700	10.00	607.99	608.42	608.42	608.55	0.064776	2.91	3.44	14.35	1.05
TWI000A	6594	01JAN2012 1800	10.00	607.99	608.42	608.42	608.55	0.065000	2.91	3.43	14.34	1.05
TWI000A	6594	01JAN2012 1900	10.00	607.99	608.41	608.42	608.55	0.066317	2.94	3.41	14.29	1.06
TWI000A	6594	01JAN2012 2000	10.00	607.99	608.41	608.42	608.55	0.066686	2.94	3.40	14.28	1.06
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TWI000A	6594	01JAN2012 2200	10.00	607.99	608.41	608.42	608.55	0.067245	2.95	3.39	14.26	1.07
TWI000A	6594	01JAN2012 2300	10.00	607.99	608.41	608.42	608.55	0.067479	2.95	3.38	14.25	1.07
TWI000A	6594	01JAN2012 2400	10.00	607.99	608.41	608.42	608.55	0.067620	2.96	3.38	14.25	1.07
TWI000A	6562	Max WS	154.62	606.81	608.63		608.92	0.014204	4.31	37.48	32.94	0.65
TWI000A	6562	31DEC2011 2400	10.00	606.81	607.38		607.42	0.011509	1.64	6.11	16.59	0.47
TWI000A	6562	01JAN2012 0100	10.00	606.81	607.34		607.39	0.015620	1.82	5.49	15.93	0.55
TWI000A	6562	01JAN2012 0200	10.00	606.81	607.34		607.39	0.015888	1.83	5.46	15.90	0.55
TWI000A	6562	01JAN2012 0300	10.00	606.81	607.34		607.39	0.016136	1.84	5.43	15.87	0.56
TWI000A	6562	01JAN2012 0400	10.00	606.81	607.33		607.39	0.016423	1.85	5.39	15.83	0.56
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TWI000A	6562	01JAN2012 0900	10.00	606.81	607.31		607.37	0.019562	1.97	5.07	15.48	0.61
TWI000A	6562	01JAN2012 1000	10.00	606.81	607.31		607.37	0.019541	1.97	5.07	15.48	0.61
TWI000A	6562	01JAN2012 1100	10.00	606.81	607.32		607.38	0.018534	1.93	5.17	15.59	0.59
TWI000A	6562	01JAN2012 1200	57.33	606.81	607.94		608.11	0.018095	3.22	17.81	24.50	0.67
TWI000A	6562	01JAN2012 1300	19.23	606.81	607.53		607.60	0.015210	2.20	8.75	18.79	0.57
TWI000A	6562	01JAN2012 1400	10.00	606.81	607.32		607.38	0.017884	1.91	5.23	15.66	0.58
TWI000A	6562	01JAN2012 1500	10.00	606.81	607.32		607.37	0.019024	1.95	5.12	15.53	0.60
TWI000A	6562	01JAN2012 1600	10.00	606.81	607.31		607.37	0.019657	1.98	5.06	15.47	0.61
TWI000A	6562	01JAN2012 1700	10.00	606.81	607.31		607.37	0.019621	1.97	5.07	15.47	0.61
TWI000A	6562	01JAN2012 1800	10.00	606.81	607.31		607.37	0.019427	1.97	5.08	15.49	0.61
TWI000A	6562	01JAN2012 1900	10.00	606.81	607.32		607.38	0.018285	1.93	5.19	15.61	0.59
TWI000A	6562	01JAN2012 2000	10.00	606.81	607.32		607.38	0.017871	1.91	5.24	15.66	0.58
TWI000A	6562	01JAN2012 2100	10.00	606.81	607.32		607.38	0.017615	1.90	5.26	15.69	0.58
TWI000A	6562	01JAN2012 2200	10.00	606.81	607.33		607.38	0.017403	1.89	5.28	15.71	0.58
TWI000A	6562	01JAN2012 2300	10.00	606.81	607.33		607.38	0.017187	1.88	5.31	15.74	0.57
TWI000A	6562	01JAN2012 2400	10.00	606.81	607.33		607.38	0.016979	1.88	5.33	15.76	0.57
TWI000A	6532	Max WS	152.46	605.86	608.26		608.53	0.011083	4.14	37.37	27.73	0.59
TWI000A	6532	31DEC2011 2400	10.00	605.86	607.24		607.25	0.000749	0.70	14.37	17.90	0.14
TWI000A	6532	01JAN2012 0100	10.00	605.86	607.14		607.15	0.001072	0.79	12.61	16.91	0.16
TWI000A	6532	01JAN2012 0200	10.00	605.86	607.13		607.14	0.001097	0.80	12.50	16.85	0.16
TWI000A	6532	01JAN2012 0300	10.00	605.86	607.13		607.14	0.001123	0.81	12.40	16.79	0.17
TWI000A	6532	01JAN2012 0400	10.00	605.86	607.12		607.13	0.001151	0.81	12.28	16.72	0.17
TWI000A	6532	01JAN2012 0500	10.00	605.86	607.11		607.12	0.001186	0.82	12.15	16.64	0.17
TWI000A	6532	01JAN2012 0600	10.00	605.86	607.10		607.11	0.001226	0.83	12.01	16.56	0.17
TWI000A	6532	01JAN2012 0700	10.00	605.86	607.07		607.08	0.001376	0.87	11.52	16.26	0.18
TWI000A	6532	01JAN2012 0800	10.00	605.86	607.05		607.07	0.001477	0.89	11.22	16.09	0.19
TWI000A	6532	01JAN2012 0900	10.00	605.86	607.04		607.05	0.001566	0.91	10.99	15.94	0.19
TWI000A	6532	01JAN2012 1000	10.00	605.86	607.04		607.05	0.001563	0.91	10.99	15.94	0.19
TWI000A	6532	01JAN2012 1100	10.00	605.86	607.07		607.08	0.001408	0.88	11.42	16.20	0.18
TWI000A	6532	01JAN2012 1200	56.98	605.86	607.63		607.73	0.007474	2.58	22.10	21.65	0.45
TWI000A	6532	01JAN2012 1300	19.30	605.86	607.32		607.35	0.002110	1.21	15.91	18.74	0.23
TWI000A	6532	01JAN2012 1400	10.00	605.86	607.08		607.09	0.001324	0.86	11.68	16.36	0.18
TWI000A	6532	01JAN2012 1500	10.00	605.86	607.05		607.07	0.001482	0.89	11.21	16.08	0.19
TWI000A	6532	01JAN2012 1600	10.00	605.86	607.04		607.05	0.001584	0.91	10.94	15.91	0.19
TWI000A	6532	01JAN2012 1700	10.00	605.86	607.04		607.05	0.001578	0.91	10.96	15.92	0.19
TWI000A	6532	01JAN2012 1800	10.00	605.86	607.04		607.06	0.001542	0.90	11.05	15.98	0.19
TWI000A	6532	01JAN2012 1900	10.00	605.86	607.07		607.08	0.001374	0.87	11.52	16.27	0.18
TWI000A	6532	01JAN2012 2000	10.00	605.86	607.08		607.09	0.001319	0.86	11.69	16.37	0.18
TWI000A	6532	01JAN2012 2100	10.00	605.86	607.09		607.10	0.001288	0.85	11.79	16.43	0.18
TWI000A	6532	01JAN2012 2200	10.00	605.86	607.09		607.11	0.001261	0.84	11.89	16.48	0.17
TWI000A	6532	01JAN2012 2300	10.00	605.86	607.10		607.11	0.001236	0.84	11.97	16.54	0.17
TWI000A	6532	01JAN2012 2400	10.00	605.86	607.10		607.12	0.001213	0.83	12.05	16.58	0.17
TWI000A	6498	Max WS	152.02	605.51	608.08		608.25	0.005177	3.27	52.29	36.18	0.42
TWI000A	6498	31DEC2011 2400	10.00	605.51	605.97	606.01	606.17	0.083179	3.64	2.75	9.88	1.22
TWI000A	6498	01JAN2012 0100	10.00	605.51	605.98	606.01	606.17	0.072589	3.47	2.88	10.07	1.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6498	01JAN2012 0200	10.00	605.51	605.98	606.01	606.17	0.071986	3.46	2.89	10.08	1.14
TWI000A	6498	01JAN2012 0300	10.00	605.51	605.98	606.01	606.17	0.071263	3.45	2.90	10.09	1.13
TWI000A	6498	01JAN2012 0400	10.00	605.51	605.98	606.01	606.17	0.070580	3.43	2.91	10.10	1.13
TWI000A	6498	01JAN2012 0500	10.00	605.51	605.98	606.01	606.17	0.069707	3.42	2.93	10.12	1.12
TWI000A	6498	01JAN2012 0600	10.00	605.51	605.99	606.01	606.17	0.068780	3.40	2.94	10.14	1.11
TWI000A	6498	01JAN2012 0700	10.00	605.51	605.99	606.01	606.16	0.065559	3.34	2.99	10.21	1.09
TWI000A	6498	01JAN2012 0800	10.00	605.51	605.99	606.01	606.16	0.063570	3.31	3.02	10.26	1.07
TWI000A	6498	01JAN2012 0900	10.00	605.51	606.00	606.01	606.16	0.062022	3.28	3.05	10.29	1.06
TWI000A	6498	01JAN2012 1000	10.00	605.51	606.00	606.01	606.16	0.062074	3.28	3.05	10.29	1.06
TWI000A	6498	01JAN2012 1100	10.00	605.51	605.99	606.01	606.16	0.065004	3.33	3.00	10.22	1.08
TWI000A	6498	01JAN2012 1200	56.58	605.51	606.57	606.63	606.98	0.056873	5.16	10.96	17.48	1.15
TWI000A	6498	01JAN2012 1300	19.36	605.51	606.13	606.19	606.41	0.076250	4.27	4.53	11.98	1.22
TWI000A	6498	01JAN2012 1400	10.01	605.51	605.99	606.01	606.17	0.066626	3.36	2.97	10.19	1.10
TWI000A	6498	01JAN2012 1500	10.00	605.51	605.99	606.01	606.16	0.063543	3.31	3.02	10.26	1.07
TWI000A	6498	01JAN2012 1600	10.00	605.51	606.00	606.01	606.16	0.061732	3.27	3.06	10.30	1.06
TWI000A	6498	01JAN2012 1700	10.00	605.51	606.00	606.01	606.16	0.061823	3.27	3.05	10.30	1.06
TWI000A	6498	01JAN2012 1800	10.00	605.51	606.00	606.01	606.16	0.062455	3.29	3.04	10.28	1.06
TWI000A	6498	01JAN2012 1900	10.00	605.51	605.99	606.01	606.16	0.065675	3.35	2.99	10.21	1.09
TWI000A	6498	01JAN2012 2000	10.00	605.51	605.99	606.01	606.17	0.066774	3.37	2.97	10.18	1.10
TWI000A	6498	01JAN2012 2100	10.00	605.51	605.99	606.01	606.17	0.067423	3.38	2.96	10.17	1.10
TWI000A	6498	01JAN2012 2200	10.00	605.51	605.99	606.01	606.17	0.068012	3.39	2.95	10.16	1.11
TWI000A	6498	01JAN2012 2300	10.00	605.51	605.99	606.01	606.17	0.068594	3.40	2.94	10.15	1.11
TWI000A	6498	01JAN2012 2400	10.00	605.51	605.99	606.01	606.17	0.069146	3.41	2.93	10.13	1.12
TWI000A	6438	Max WS	151.98	602.48	607.99		608.05	0.001016	1.82	86.57	36.15	0.19
TWI000A	6438	31DEC2011 2400	10.00	602.48	602.87	603.06	603.52	0.296380	6.46	1.55	5.99	2.24
TWI000A	6438	01JAN2012 0100	10.00	602.48	602.82	603.06	603.82	0.587827	8.02	1.25	5.88	3.07
TWI000A	6438	01JAN2012 0200	10.00	602.48	602.82	603.06	603.84	0.610553	8.11	1.23	5.88	3.12
TWI000A	6438	01JAN2012 0300	10.00	602.48	602.82	603.06	603.86	0.633750	8.21	1.22	5.87	3.18
TWI000A	6438	01JAN2012 0400	10.00	602.48	602.82	603.06	603.89	0.658254	8.31	1.20	5.87	3.23
TWI000A	6438	01JAN2012 0500	10.00	602.48	602.81	603.06	603.92	0.690472	8.43	1.19	5.86	3.30
TWI000A	6438	01JAN2012 0600	10.00	602.48	602.81	603.06	603.95	0.725084	8.56	1.17	5.85	3.38
TWI000A	6438	01JAN2012 0700	10.00	602.48	602.80	603.06	604.06	0.859460	9.03	1.11	5.83	3.65
TWI000A	6438	01JAN2012 0800	10.00	602.48	602.79	603.06	604.14	0.948194	9.31	1.07	5.82	3.82
TWI000A	6438	01JAN2012 0900	10.00	602.48	602.79	603.06	604.20	1.027305	9.54	1.05	5.81	3.96
TWI000A	6438	01JAN2012 1000	10.00	602.48	602.79	603.06	604.20	1.026504	9.54	1.05	5.81	3.96
TWI000A	6438	01JAN2012 1100	10.00	602.48	602.80	603.06	604.09	0.889926	9.12	1.10	5.83	3.71
TWI000A	6438	01JAN2012 1200	54.99	602.48	604.61		604.82	0.009968	3.63	15.14	9.65	0.51
TWI000A	6438	01JAN2012 1300	19.48	602.48	603.27	603.30	603.62	0.054435	4.74	4.11	6.83	1.08
TWI000A	6438	01JAN2012 1400	10.01	602.48	602.80	603.06	604.02	0.811544	8.87	1.13	5.84	3.56
TWI000A	6438	01JAN2012 1500	10.00	602.48	602.79	603.06	604.14	0.952329	9.32	1.07	5.82	3.82
TWI000A	6438	01JAN2012 1600	10.00	602.48	602.79	603.06	604.22	1.044279	9.59	1.04	5.81	3.99
TWI000A	6438	01JAN2012 1700	10.00	602.48	602.79	603.06	604.21	1.038303	9.57	1.04	5.81	3.98
TWI000A	6438	01JAN2012 1800	10.00	602.48	602.79	603.06	604.18	1.004769	9.48	1.06	5.81	3.92
TWI000A	6438	01JAN2012 1900	10.00	602.48	602.80	603.06	604.06	0.858432	9.02	1.11	5.83	3.65
TWI000A	6438	01JAN2012 2000	10.00	602.48	602.80	603.06	604.02	0.808430	8.86	1.13	5.84	3.55
TWI000A	6438	01JAN2012 2100	10.00	602.48	602.80	603.06	604.00	0.781924	8.76	1.14	5.84	3.50
TWI000A	6438	01JAN2012 2200	10.00	602.48	602.81	603.06	603.98	0.757514	8.68	1.15	5.85	3.44
TWI000A	6438	01JAN2012 2300	10.00	602.48	602.81	603.06	603.96	0.735410	8.60	1.16	5.85	3.40
TWI000A	6438	01JAN2012 2400	10.00	602.48	602.81	603.06	603.94	0.714693	8.52	1.17	5.86	3.35
TWI000A	6319	Max WS	151.73	598.58	607.96		607.96	0.000028	0.49	341.45	85.74	0.04
TWI000A	6319	31DEC2011 2400	10.00	598.58	599.01	599.36	600.94	1.043292	11.16	0.90	3.89	4.10
TWI000A	6319	01JAN2012 0100	10.00	598.58	599.08	599.36	600.14	0.453688	8.26	1.21	4.42	2.78
TWI000A	6319	01JAN2012 0200	10.00	598.58	599.09	599.36	600.09	0.420232	8.03	1.25	4.47	2.68
TWI000A	6319	01JAN2012 0300	10.00	598.58	599.10	599.36	600.04	0.386957	7.79	1.28	4.53	2.58
TWI000A	6319	01JAN2012 0400	10.00	598.58	599.11	599.36	599.99	0.350496	7.52	1.33	4.60	2.46
TWI000A	6319	01JAN2012 0500	10.00	598.58	599.12	599.36	599.92	0.309761	7.19	1.39	4.70	2.33
TWI000A	6319	01JAN2012 0600	10.00	598.58	599.14	599.36	599.85	0.263454	6.77	1.48	4.82	2.16
TWI000A	6319	01JAN2012 0700	10.00	598.58	599.22	599.36	599.65	0.133615	5.28	1.89	5.39	1.57
TWI000A	6319	01JAN2012 0800	10.00	598.58	599.29	599.36	599.59	0.082283	4.42	2.26	5.85	1.25
TWI000A	6319	01JAN2012 0900	9.99	598.58	599.39		599.57	0.041078	3.42	2.92	6.59	0.90
TWI000A	6319	01JAN2012 1000	9.97	598.58	599.64		599.71	0.011349	2.08	4.79	8.67	0.49
TWI000A	6319	01JAN2012 1100	9.91	598.58	599.99		600.01	0.002661	1.19	8.35	11.87	0.25
TWI000A	6319	01JAN2012 1200	40.08	598.58	604.10		604.11	0.000045	0.37	108.50	41.17	0.04
TWI000A	6319	01JAN2012 1300	21.25	598.58	601.74		601.75	0.000177	0.55	38.95	22.90	0.07
TWI000A	6319	01JAN2012 1400	10.08	598.58	600.14		600.15	0.001576	0.99	10.20	12.85	0.20
TWI000A	6319	01JAN2012 1500	10.03	598.58	599.80		599.84	0.005705	1.60	6.28	10.14	0.36
TWI000A	6319	01JAN2012 1600	10.02	598.58	599.55		599.64	0.017570	2.47	4.05	7.84	0.61
TWI000A	6319	01JAN2012 1700	10.01	598.58	599.43		599.58	0.033169	3.16	3.17	6.84	0.82
TWI000A	6319	01JAN2012 1800	10.00	598.58	599.36	599.36	599.57	0.052162	3.73	2.68	6.32	1.01
TWI000A	6319	01JAN2012 1900	10.00	598.58	599.22	599.36	599.66	0.134620	5.30	1.89	5.38	1.58
TWI000A	6319	01JAN2012 2000	10.00	598.58	599.19	599.36	599.70	0.167547	5.74	1.74	5.19	1.75
TWI000A	6319	01JAN2012 2100	10.00	598.58	599.17	599.36	599.75	0.197986	6.10	1.64	5.05	1.89
TWI000A	6319	01JAN2012 2200	10.00	598.58	599.16	599.36	599.79	0.226330	6.41	1.56	4.94	2.01
TWI000A	6319	01JAN2012 2300	10.00	598.58	599.14	599.36	599.83	0.252657	6.67	1.50	4.85	2.12
TWI000A	6319	01JAN2012 2400	10.00	598.58	599.13	599.36	599.87	0.278052	6.91	1.45	4.78	2.21
TWI000A	6249	Max WS	1760.53	597.08	605.74	604.13	607.43	0.018074	10.66	210.56	66.08	0.68
TWI000A	6249	31DEC2011 2400	10.00	597.08	597.78		597.80	0.002601	0.99	10.08	15.60	0.22
TWI000A	6249	01JAN2012 0100	22.06	597.08	598.07		598.10	0.003922	1.52	14.54	15.82	0.28
TWI000A	6249	01JAN2012 0200	23.08	597.08	598.09		598.12	0.003987	1.55	14.88	15.83	0.28
TWI000A	6249	01JAN2012 0300	24.17	597.08	598.11		598.15	0.004060	1.59	15.23	15.85	0.29
TWI000A	6249	01JAN2012 0400	25.50	597.08	598.13		598.18	0.004154	1.63	15.64	15.87	0.29

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6249	01JAN2012 0500	27.15	597.08	598.17		598.21	0.004269	1.68	16.13	15.89	0.29
TWI000A	6249	01JAN2012 0600	29.31	597.08	598.20		598.25	0.004416	1.75	16.75	15.92	0.30
TWI000A	6249	01JAN2012 0700	39.19	597.08	598.37		598.43	0.005039	2.03	19.32	16.05	0.33
TWI000A	6249	01JAN2012 0800	45.99	597.08	598.48		598.55	0.005261	2.18	21.10	16.13	0.34
TWI000A	6249	01JAN2012 0900	56.16	597.08	598.59		598.69	0.006016	2.44	22.98	16.22	0.36
TWI000A	6249	01JAN2012 1000	75.92	597.08	598.84		598.96	0.006695	2.81	26.97	16.40	0.39
TWI000A	6249	01JAN2012 1100	104.08	597.08	599.17		599.33	0.007155	3.21	32.42	16.65	0.41
TWI000A	6249	01JAN2012 1200	598.46	597.08	602.54		603.19	0.010760	6.44	92.97	19.21	0.52
TWI000A	6249	01JAN2012 1300	263.27	597.08	600.78		601.08	0.007186	4.36	60.33	17.88	0.42
TWI000A	6249	01JAN2012 1400	116.51	597.08	599.32		599.49	0.007124	3.33	34.97	16.77	0.41
TWI000A	6249	01JAN2012 1500	88.02	597.08	598.99		599.13	0.006790	2.98	29.56	16.52	0.39
TWI000A	6249	01JAN2012 1600	69.00	597.08	598.75		598.86	0.006540	2.70	25.54	16.34	0.38
TWI000A	6249	01JAN2012 1700	59.29	597.08	598.63		598.73	0.006188	2.51	23.58	16.25	0.37
TWI000A	6249	01JAN2012 1800	52.68	597.08	598.55		598.64	0.005784	2.36	22.34	16.19	0.35
TWI000A	6249	01JAN2012 1900	39.09	597.08	598.36		598.43	0.005030	2.03	19.30	16.04	0.33
TWI000A	6249	01JAN2012 2000	35.96	597.08	598.31		598.37	0.004871	1.94	18.49	16.01	0.32
TWI000A	6249	01JAN2012 2100	33.53	597.08	598.27		598.33	0.004723	1.88	17.86	15.98	0.31
TWI000A	6249	01JAN2012 2200	31.57	597.08	598.24		598.29	0.004585	1.82	17.35	15.95	0.31
TWI000A	6249	01JAN2012 2300	29.94	597.08	598.22		598.26	0.004463	1.77	16.92	15.93	0.30
TWI000A	6249	01JAN2012 2400	28.57	597.08	598.19		598.24	0.004362	1.73	16.55	15.91	0.30
TWI000A	6218	Max WS	1759.68	597.00	606.05		606.59	0.004965	6.03	359.51	90.92	0.43
TWI000A	6218	31DEC2011 2400	10.00	597.00	597.56		597.60	0.012780	1.59	6.27	16.40	0.45
TWI000A	6218	01JAN2012 0100	22.06	597.00	597.72		597.81	0.019616	2.45	9.01	17.01	0.59
TWI000A	6218	01JAN2012 0200	23.08	597.00	597.73		597.83	0.019997	2.50	9.21	17.05	0.60
TWI000A	6218	01JAN2012 0300	24.17	597.00	597.75		597.85	0.020246	2.56	9.45	17.11	0.61
TWI000A	6218	01JAN2012 0400	25.50	597.00	597.77		597.87	0.020312	2.61	9.77	17.17	0.61
TWI000A	6218	01JAN2012 0500	27.14	597.00	597.79		597.90	0.020250	2.67	10.17	17.26	0.61
TWI000A	6218	01JAN2012 0600	29.30	597.00	597.82		597.94	0.019923	2.73	10.74	17.38	0.61
TWI000A	6218	01JAN2012 0700	39.18	597.00	597.99		598.12	0.016604	2.86	13.71	18.01	0.58
TWI000A	6218	01JAN2012 0800	45.98	597.00	598.11		598.24	0.014389	2.89	15.93	18.46	0.55
TWI000A	6218	01JAN2012 0900	56.14	597.00	598.24		598.38	0.014090	3.07	18.27	18.93	0.55
TWI000A	6218	01JAN2012 1000	75.86	597.00	598.53		598.68	0.011388	3.17	23.91	20.00	0.51
TWI000A	6218	01JAN2012 1100	104.00	597.00	598.91		599.08	0.009102	3.27	31.85	21.43	0.47
TWI000A	6218	01JAN2012 1200	594.47	597.00	602.63		602.92	0.004635	4.33	137.38	35.27	0.39
TWI000A	6218	01JAN2012 1300	264.08	597.00	600.70		600.89	0.004723	3.46	76.23	28.09	0.37
TWI000A	6218	01JAN2012 1400	116.57	597.00	599.09		599.25	0.008116	3.26	35.77	22.10	0.45
TWI000A	6218	01JAN2012 1500	88.06	597.00	598.71		598.87	0.009966	3.19	27.62	20.68	0.49
TWI000A	6218	01JAN2012 1600	69.03	597.00	598.43		598.58	0.012199	3.14	21.95	19.64	0.52
TWI000A	6218	01JAN2012 1700	59.31	597.00	598.28		598.43	0.013641	3.10	19.15	19.10	0.55
TWI000A	6218	01JAN2012 1800	52.70	597.00	598.19		598.34	0.014282	3.02	17.45	18.77	0.55
TWI000A	6218	01JAN2012 1900	39.10	597.00	597.99		598.12	0.016565	2.85	13.71	18.01	0.58
TWI000A	6218	01JAN2012 2000	35.96	597.00	597.93		598.06	0.017836	2.84	12.68	17.79	0.59
TWI000A	6218	01JAN2012 2100	33.54	597.00	597.89		598.01	0.018740	2.81	11.94	17.64	0.60
TWI000A	6218	01JAN2012 2200	31.57	597.00	597.86		597.98	0.019377	2.78	11.36	17.52	0.61
TWI000A	6218	01JAN2012 2300	29.94	597.00	597.83		597.95	0.019801	2.75	10.91	17.42	0.61
TWI000A	6218	01JAN2012 2400	28.58	597.00	597.81		597.92	0.020072	2.71	10.54	17.34	0.61
TWI000A	6179	Max WS	1759.58	596.45	605.86		606.39	0.004426	5.91	317.56	61.43	0.41
TWI000A	6179	31DEC2011 2400	10.00	596.45	596.80		596.91	0.054201	2.65	3.78	13.72	0.89
TWI000A	6179	01JAN2012 0100	22.06	596.45	597.11		597.22	0.021671	2.65	8.33	15.06	0.63
TWI000A	6179	01JAN2012 0200	23.07	596.45	597.14		597.25	0.020768	2.65	8.69	15.16	0.62
TWI000A	6179	01JAN2012 0300	24.17	596.45	597.16		597.27	0.019864	2.66	9.09	15.27	0.61
TWI000A	6179	01JAN2012 0400	25.49	596.45	597.19		597.30	0.019026	2.67	9.54	15.40	0.60
TWI000A	6179	01JAN2012 0500	27.14	596.45	597.23		597.34	0.017961	2.68	10.12	15.56	0.59
TWI000A	6179	01JAN2012 0600	29.29	596.45	597.28		597.39	0.016639	2.69	10.91	15.77	0.57
TWI000A	6179	01JAN2012 0700	39.16	596.45	597.52		597.63	0.011642	2.64	14.85	16.80	0.49
TWI000A	6179	01JAN2012 0800	45.95	596.45	597.68		597.79	0.009709	2.62	17.55	17.47	0.46
TWI000A	6179	01JAN2012 0900	56.10	596.45	597.87		597.98	0.008554	2.68	20.95	18.28	0.44
TWI000A	6179	01JAN2012 1000	75.78	596.45	598.24		598.35	0.006685	2.71	27.99	19.85	0.40
TWI000A	6179	01JAN2012 1100	103.87	596.45	598.69		598.81	0.005494	2.79	37.28	21.75	0.37
TWI000A	6179	01JAN2012 1200	587.94	596.45	602.54		602.77	0.003516	3.86	152.42	38.10	0.34
TWI000A	6179	01JAN2012 1300	265.37	596.45	600.59		600.74	0.003399	3.07	86.32	29.83	0.32
TWI000A	6179	01JAN2012 1400	116.66	596.45	598.89		599.01	0.004998	2.79	41.81	22.61	0.36
TWI000A	6179	01JAN2012 1500	88.11	596.45	598.45		598.57	0.005980	2.73	32.28	20.74	0.39
TWI000A	6179	01JAN2012 1600	69.07	596.45	598.13		598.24	0.007066	2.68	25.76	19.36	0.41
TWI000A	6179	01JAN2012 1700	59.33	596.45	597.94		598.05	0.008069	2.67	22.20	18.57	0.43
TWI000A	6179	01JAN2012 1800	52.71	596.45	597.81		597.92	0.008839	2.65	19.87	18.02	0.45
TWI000A	6179	01JAN2012 1900	39.12	596.45	597.53		597.63	0.011514	2.63	14.89	16.81	0.49
TWI000A	6179	01JAN2012 2000	35.97	596.45	597.45		597.56	0.012813	2.65	13.60	16.48	0.51
TWI000A	6179	01JAN2012 2100	33.55	596.45	597.39		597.50	0.014019	2.66	12.61	16.22	0.53
TWI000A	6179	01JAN2012 2200	31.58	596.45	597.34		597.45	0.015139	2.67	11.81	16.01	0.55
TWI000A	6179	01JAN2012 2300	29.95	596.45	597.30		597.41	0.016113	2.68	11.18	15.84	0.56
TWI000A	6179	01JAN2012 2400	28.58	596.45	597.27		597.38	0.016961	2.68	10.67	15.71	0.57
TWI000A	6133	Max WS	1758.85	595.31	605.47		606.21	0.004881	7.04	295.54	57.44	0.44
TWI000A	6133	31DEC2011 2400	10.01	595.31	596.18		596.20	0.002758	1.09	9.17	13.12	0.23
TWI000A	6133	01JAN2012 0100	22.04	595.31	596.75		596.78	0.001986	1.28	17.22	14.91	0.21
TWI000A	6133	01JAN2012 0200	23.07	595.31	596.79		596.82	0.001949	1.29	17.86	15.05	0.21
TWI000A	6133	01JAN2012 0300	24.16	595.31	596.84		596.86	0.001921	1.30	18.52	15.18	0.21
TWI000A	6133	01JAN2012 0400	25.48	595.31	596.88		596.91	0.001925	1.33	19.19	15.32	0.21
TWI000A	6133	01JAN2012 0500	27.13	595.31	596.94		596.96	0.001929	1.36	20.01	15.48	0.21
TWI000A	6133	01JAN2012 0600	29.28	595.31	597.00		597.03	0.001934	1.39	21.06	15.69	0.21
TWI000A	6133	01JAN2012 0700	39.13	595.31	597.30		597.33	0.001914	1.52	25.78	16.60	0.21

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6133	01JAN2012 0800	45.90	595.31	597.48		597.52	0.001900	1.59	28.87	17.17	0.22
TWI000A	6133	01JAN2012 0900	56.04	595.31	597.70		597.75	0.001961	1.71	32.80	17.87	0.22
TWI000A	6133	01JAN2012 1000	75.67	595.31	598.10		598.15	0.002017	1.89	40.11	19.10	0.23
TWI000A	6133	01JAN2012 1100	103.71	595.31	598.56		598.63	0.002110	2.10	49.37	20.56	0.24
TWI000A	6133	01JAN2012 1200	579.70	595.31	602.38		602.62	0.002811	3.87	152.19	35.72	0.31
TWI000A	6133	01JAN2012 1300	266.93	595.31	600.48		600.60	0.002322	2.83	94.43	26.52	0.26
TWI000A	6133	01JAN2012 1400	116.77	595.31	598.77		598.85	0.002110	2.17	53.74	21.21	0.24
TWI000A	6133	01JAN2012 1500	88.19	595.31	598.32		598.38	0.002049	1.98	44.45	19.80	0.23
TWI000A	6133	01JAN2012 1600	69.13	595.31	597.98		598.03	0.001979	1.82	37.89	18.74	0.23
TWI000A	6133	01JAN2012 1700	59.37	595.31	597.78		597.83	0.001957	1.74	34.18	18.11	0.22
TWI000A	6133	01JAN2012 1800	52.74	595.31	597.64		597.68	0.001929	1.67	31.62	17.67	0.22
TWI000A	6133	01JAN2012 1900	39.14	595.31	597.30		597.34	0.001897	1.51	25.86	16.62	0.21
TWI000A	6133	01JAN2012 2000	35.99	595.31	597.21		597.24	0.001903	1.48	24.38	16.34	0.21
TWI000A	6133	01JAN2012 2100	33.56	595.31	597.14		597.17	0.001909	1.45	23.22	16.12	0.21
TWI000A	6133	01JAN2012 2200	31.59	595.31	597.08		597.11	0.001917	1.42	22.24	15.93	0.21
TWI000A	6133	01JAN2012 2300	29.96	595.31	597.03		597.06	0.001921	1.40	21.44	15.77	0.21
TWI000A	6133	01JAN2012 2400	28.59	595.31	596.98		597.01	0.001922	1.38	20.76	15.63	0.21
TWI000A	6059	Max WS	1758.08	594.03	604.92		605.81	0.006873	7.72	269.50	56.43	0.49
TWI000A	6059	31DEC2011 2400	10.04	594.03	596.10		596.10	0.000277	0.55	18.39	12.41	0.08
TWI000A	6059	01JAN2012 0100	22.02	594.03	596.68		596.69	0.000500	0.85	26.04	13.98	0.11
TWI000A	6059	01JAN2012 0200	23.05	594.03	596.72		596.73	0.000514	0.86	26.66	14.10	0.11
TWI000A	6059	01JAN2012 0300	24.15	594.03	596.77		596.78	0.000529	0.89	27.28	14.22	0.11
TWI000A	6059	01JAN2012 0400	25.47	594.03	596.81		596.82	0.000553	0.91	27.88	14.33	0.12
TWI000A	6059	01JAN2012 0500	27.11	594.03	596.86		596.87	0.000582	0.95	28.63	14.47	0.12
TWI000A	6059	01JAN2012 0600	29.25	594.03	596.93		596.94	0.000618	0.99	29.58	14.65	0.12
TWI000A	6059	01JAN2012 0700	39.08	594.03	597.21		597.23	0.000758	1.15	33.89	15.42	0.14
TWI000A	6059	01JAN2012 0800	45.83	594.03	597.39		597.42	0.000834	1.25	36.73	15.91	0.14
TWI000A	6059	01JAN2012 0900	55.94	594.03	597.61		597.64	0.000967	1.39	40.24	16.50	0.16
TWI000A	6059	01JAN2012 1000	75.49	594.03	598.00		598.04	0.001164	1.61	46.81	17.54	0.17
TWI000A	6059	01JAN2012 1100	103.47	594.03	598.45		598.50	0.001407	1.88	55.01	18.76	0.19
TWI000A	6059	01JAN2012 1200	567.71	594.03	602.15		602.40	0.003014	3.99	145.80	34.12	0.31
TWI000A	6059	01JAN2012 1300	269.06	594.03	600.31		600.44	0.002189	2.84	94.71	23.81	0.25
TWI000A	6059	01JAN2012 1400	116.93	594.03	598.65		598.72	0.001490	1.98	58.93	19.32	0.20
TWI000A	6059	01JAN2012 1500	88.30	594.03	598.21		598.26	0.001281	1.74	50.68	18.13	0.18
TWI000A	6059	01JAN2012 1600	69.22	594.03	597.88		597.92	0.001102	1.54	44.81	17.23	0.17
TWI000A	6059	01JAN2012 1700	59.43	594.03	597.69		597.72	0.001003	1.43	41.49	16.70	0.16
TWI000A	6059	01JAN2012 1800	52.78	594.03	597.55		597.58	0.000925	1.35	39.21	16.33	0.15
TWI000A	6059	01JAN2012 1900	39.18	594.03	597.22		597.24	0.000756	1.15	33.97	15.44	0.14
TWI000A	6059	01JAN2012 2000	36.01	594.03	597.13		597.15	0.000716	1.10	32.61	15.20	0.13
TWI000A	6059	01JAN2012 2100	33.58	594.03	597.06		597.08	0.000681	1.06	31.56	15.01	0.13
TWI000A	6059	01JAN2012 2200	31.60	594.03	597.00		597.02	0.000653	1.03	30.67	14.85	0.13
TWI000A	6059	01JAN2012 2300	29.97	594.03	596.95		596.97	0.000628	1.00	29.94	14.71	0.12
TWI000A	6059	01JAN2012 2400	28.60	594.03	596.91		596.92	0.000606	0.98	29.32	14.60	0.12
TWI000A	5935	Max WS	1758.16	594.37	604.04		604.82	0.009381	7.47	290.63	95.85	0.57
TWI000A	5935	31DEC2011 2400	10.11	594.37	595.79		595.82	0.004541	1.53	6.60	7.99	0.30
TWI000A	5935	01JAN2012 0100	21.99	594.37	596.30		596.36	0.004970	1.96	11.25	9.99	0.32
TWI000A	5935	01JAN2012 0200	23.04	594.37	596.34		596.40	0.005010	1.99	11.60	10.12	0.33
TWI000A	5935	01JAN2012 0300	24.13	594.37	596.38		596.44	0.005062	2.02	11.96	10.26	0.33
TWI000A	5935	01JAN2012 0400	25.45	594.37	596.41		596.48	0.005191	2.07	12.32	10.39	0.33
TWI000A	5935	01JAN2012 0500	27.08	594.37	596.45		596.52	0.005336	2.12	12.77	10.56	0.34
TWI000A	5935	01JAN2012 0600	29.21	594.37	596.51		596.58	0.005510	2.19	13.34	10.77	0.35
TWI000A	5935	01JAN2012 0700	39.01	594.37	596.73		596.83	0.006135	2.46	15.87	11.64	0.37
TWI000A	5935	01JAN2012 0800	45.74	594.37	596.87		596.97	0.006460	2.62	17.48	12.10	0.38
TWI000A	5935	01JAN2012 0900	55.82	594.37	597.04		597.17	0.006948	2.84	19.66	12.67	0.40
TWI000A	5935	01JAN2012 1000	75.27	594.37	597.36		597.51	0.007457	3.16	23.79	13.66	0.42
TWI000A	5935	01JAN2012 1100	103.13	594.37	597.77		597.96	0.007621	3.47	29.69	14.96	0.43
TWI000A	5935	01JAN2012 1200	551.10	594.37	601.11		601.61	0.009652	5.67	97.12	27.57	0.53
TWI000A	5935	01JAN2012 1300	272.09	594.37	599.54		599.85	0.007464	4.47	60.88	20.24	0.45
TWI000A	5935	01JAN2012 1400	117.17	594.37	597.98		598.17	0.007449	3.57	32.86	15.61	0.43
TWI000A	5935	01JAN2012 1500	88.46	594.37	597.56		597.73	0.007597	3.33	26.57	14.29	0.43
TWI000A	5935	01JAN2012 1600	69.34	594.37	597.27		597.41	0.007337	3.08	22.55	13.37	0.42
TWI000A	5935	01JAN2012 1700	59.51	594.37	597.11		597.24	0.007053	2.91	20.48	12.87	0.41
TWI000A	5935	01JAN2012 1800	52.84	594.37	597.00		597.11	0.006797	2.77	19.05	12.52	0.40
TWI000A	5935	01JAN2012 1900	39.23	594.37	596.74		596.83	0.006155	2.46	15.92	11.65	0.37
TWI000A	5935	01JAN2012 2000	36.05	594.37	596.67		596.76	0.005913	2.37	15.18	11.41	0.36
TWI000A	5935	01JAN2012 2100	33.61	594.37	596.62		596.70	0.005709	2.30	14.60	11.21	0.36
TWI000A	5935	01JAN2012 2200	31.63	594.37	596.57		596.65	0.005624	2.25	14.04	11.01	0.35
TWI000A	5935	01JAN2012 2300	29.99	594.37	596.53		596.60	0.005532	2.21	13.58	10.85	0.35
TWI000A	5935	01JAN2012 2400	28.62	594.37	596.49		596.57	0.005438	2.17	13.20	10.72	0.34
TWI000A	5676	Max WS	1885.86	592.61	602.50		602.96	0.004499	6.11	507.99	111.14	0.42
TWI000A	5676	31DEC2011 2400	10.55	592.61	595.24		595.24	0.000122	0.40	26.34	15.87	0.05
TWI000A	5676	01JAN2012 0100	22.76	592.61	595.68		595.69	0.000287	0.67	33.73	17.60	0.09
TWI000A	5676	01JAN2012 0200	23.90	592.61	595.70		595.71	0.000307	0.70	34.12	17.68	0.09
TWI000A	5676	01JAN2012 0300	25.07	592.61	595.72		595.73	0.000328	0.73	34.50	17.77	0.09
TWI000A	5676	01JAN2012 0400	26.47	592.61	595.75		595.76	0.000353	0.76	34.95	17.87	0.10
TWI000A	5676	01JAN2012 0500	28.21	592.61	595.78		595.79	0.000384	0.79	35.49	17.99	0.10
TWI000A	5676	01JAN2012 0600	30.47	592.61	595.81		595.83	0.000426	0.84	36.15	18.13	0.11
TWI000A	5676	01JAN2012 0700	40.89	592.61	595.94		595.96	0.000647	1.06	38.50	18.64	0.13
TWI000A	5676	01JAN2012 0800	47.90	592.61	596.00		596.02	0.000827	1.21	39.51	18.85	0.15
TWI000A	5676	01JAN2012 0900	58.66	592.61	596.11		596.14	0.001079	1.41	41.59	19.29	0.17
TWI000A	5676	01JAN2012 1000	79.53	592.61	596.28		596.33	0.001600	1.77	45.03	19.98	0.21

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	5676	01JAN2012 1100	109.41	592.61	596.63		596.70	0.002019	2.09	52.31	21.40	0.24
TWI000A	5676	01JAN2012 1200	573.98	592.61	599.56		599.78	0.003801	3.87	207.06	94.79	0.35
TWI000A	5676	01JAN2012 1300	297.95	592.61	598.35		598.49	0.002913	3.04	113.02	57.10	0.30
TWI000A	5676	01JAN2012 1400	126.11	592.61	596.85		596.93	0.002124	2.21	57.12	22.36	0.24
TWI000A	5676	01JAN2012 1500	94.99	592.61	596.44		596.50	0.001884	1.97	48.33	20.64	0.23
TWI000A	5676	01JAN2012 1600	74.29	592.61	596.22		596.27	0.001493	1.69	43.92	19.76	0.20
TWI000A	5676	01JAN2012 1700	63.62	592.61	596.14		596.18	0.001214	1.50	42.28	19.43	0.18
TWI000A	5676	01JAN2012 1800	56.43	592.61	596.07		596.10	0.001038	1.38	41.00	19.17	0.17
TWI000A	5676	01JAN2012 1900	41.67	592.61	595.94		595.96	0.000674	1.08	38.45	18.63	0.13
TWI000A	5676	01JAN2012 2000	38.22	592.61	595.92		595.93	0.000583	1.00	38.07	18.55	0.12
TWI000A	5676	01JAN2012 2100	35.61	592.61	595.90		595.91	0.000519	0.94	37.72	18.47	0.12
TWI000A	5676	01JAN2012 2200	33.46	592.61	595.86		595.88	0.000481	0.90	37.04	18.33	0.11
TWI000A	5676	01JAN2012 2300	31.68	592.61	595.83		595.84	0.000449	0.87	36.49	18.21	0.11
TWI000A	5676	01JAN2012 2400	30.19	592.61	595.81		595.82	0.000422	0.84	36.04	18.11	0.10
TWI000A	5466	Max WS	1992.81	592.59	600.79		601.61	0.009668	8.32	422.74	110.10	0.60
TWI000A	5466	31DEC2011 2400	10.91	592.59	593.44		593.53	0.021662	2.38	4.58	9.70	0.61
TWI000A	5466	01JAN2012 0100	23.41	592.59	593.76		593.90	0.019245	2.93	7.98	11.20	0.61
TWI000A	5466	01JAN2012 0200	24.62	592.59	593.79		593.93	0.019156	2.98	8.27	11.32	0.61
TWI000A	5466	01JAN2012 0300	25.85	592.59	593.82		593.96	0.019014	3.01	8.58	11.44	0.61
TWI000A	5466	01JAN2012 0400	27.33	592.59	593.85		593.99	0.018768	3.05	8.95	11.59	0.61
TWI000A	5466	01JAN2012 0500	29.16	592.59	593.89		594.04	0.018383	3.09	9.43	11.78	0.61
TWI000A	5466	01JAN2012 0600	31.53	592.59	593.94		594.09	0.017757	3.13	10.07	12.03	0.60
TWI000A	5466	01JAN2012 0700	42.47	592.59	594.17		594.34	0.015719	3.28	12.94	13.08	0.58
TWI000A	5466	01JAN2012 0800	49.72	592.59	594.30		594.48	0.014957	3.38	14.72	13.69	0.57
TWI000A	5466	01JAN2012 0900	61.01	592.59	594.53		594.71	0.012969	3.41	17.87	14.64	0.54
TWI000A	5466	01JAN2012 1000	83.05	592.59	594.93		595.11	0.010312	3.45	24.08	16.25	0.50
TWI000A	5466	01JAN2012 1100	114.70	592.59	595.42		595.61	0.008471	3.53	32.48	18.11	0.46
TWI000A	5466	01JAN2012 1200	584.06	592.59	598.02		598.42	0.009640	5.45	156.28	78.94	0.54
TWI000A	5466	01JAN2012 1300	321.29	592.59	596.99		597.31	0.008731	4.65	86.27	53.16	0.50
TWI000A	5466	01JAN2012 1400	133.72	592.59	595.65		595.85	0.008162	3.64	36.86	21.39	0.46
TWI000A	5466	01JAN2012 1500	100.50	592.59	595.25		595.43	0.008476	3.40	29.55	17.48	0.46
TWI000A	5466	01JAN2012 1600	78.49	592.59	594.85		595.04	0.010680	3.43	22.86	15.96	0.51
TWI000A	5466	01JAN2012 1700	67.10	592.59	594.65		594.83	0.011946	3.41	19.67	15.13	0.53
TWI000A	5466	01JAN2012 1800	59.47	592.59	594.50		594.68	0.013055	3.40	17.52	14.54	0.55
TWI000A	5466	01JAN2012 1900	43.73	592.59	594.20		594.37	0.015507	3.29	13.28	13.20	0.58
TWI000A	5466	01JAN2012 2000	40.06	592.59	594.13		594.29	0.015747	3.23	12.42	12.89	0.58
TWI000A	5466	01JAN2012 2100	37.29	592.59	594.08		594.24	0.015915	3.17	11.76	12.66	0.58
TWI000A	5466	01JAN2012 2200	35.00	592.59	594.03		594.18	0.016631	3.16	11.08	12.41	0.59
TWI000A	5466	01JAN2012 2300	33.11	592.59	593.98		594.13	0.017207	3.14	10.54	12.20	0.60
TWI000A	5466	01JAN2012 2400	31.52	592.59	593.94		594.10	0.017671	3.12	10.09	12.03	0.60
TWI000A	5296	Max WS	2071.95	590.93	599.18		600.05	0.009483	8.36	425.59	125.88	0.60
TWI000A	5296	31DEC2011 2400	11.03	590.93	591.25	591.68	596.79	5.725938	18.88	0.58	3.64	8.30
TWI000A	5296	01JAN2012 0100	23.89	590.93	591.68	591.95	592.60	0.296603	7.69	3.11	8.06	2.18
TWI000A	5296	01JAN2012 0200	25.17	590.93	591.72	591.97	592.54	0.244421	7.28	3.46	8.43	2.00
TWI000A	5296	01JAN2012 0300	26.44	590.93	591.76	591.99	592.51	0.202024	6.92	3.82	8.69	1.84
TWI000A	5296	01JAN2012 0400	27.98	590.93	591.81	592.02	592.48	0.164120	6.56	4.27	9.00	1.68
TWI000A	5296	01JAN2012 0500	29.88	590.93	591.87	592.05	592.47	0.130646	6.18	4.83	9.38	1.52
TWI000A	5296	01JAN2012 0600	32.32	590.93	591.95	592.08	592.48	0.104439	5.86	5.52	9.81	1.38
TWI000A	5296	01JAN2012 0700	43.62	590.93	592.27	592.24	592.64	0.046249	4.87	8.96	11.31	0.96
TWI000A	5296	01JAN2012 0800	51.05	590.93	592.47		592.79	0.032095	4.51	11.33	12.14	0.82
TWI000A	5296	01JAN2012 0900	62.76	590.93	592.76		593.03	0.021878	4.19	14.96	13.32	0.70
TWI000A	5296	01JAN2012 1000	85.66	590.93	593.27		593.50	0.013065	3.83	22.37	15.36	0.56
TWI000A	5296	01JAN2012 1100	118.68	590.93	593.82		594.04	0.009943	3.78	31.42	17.82	0.50
TWI000A	5296	01JAN2012 1200	597.62	590.93	596.57		596.96	0.007682	5.12	149.06	68.36	0.49
TWI000A	5296	01JAN2012 1300	338.10	590.93	595.63		595.90	0.008008	4.20	92.19	53.81	0.48
TWI000A	5296	01JAN2012 1400	139.48	590.93	594.08		594.31	0.009904	3.84	36.34	20.12	0.50
TWI000A	5296	01JAN2012 1500	104.65	590.93	593.65		593.86	0.010002	3.68	28.42	16.83	0.50
TWI000A	5296	01JAN2012 1600	81.68	590.93	593.20		593.43	0.013727	3.84	21.25	15.07	0.57
TWI000A	5296	01JAN2012 1700	69.76	590.93	592.93		593.18	0.017753	4.02	17.35	14.02	0.64
TWI000A	5296	01JAN2012 1800	61.78	590.93	592.74		593.01	0.022016	4.18	14.77	13.26	0.70
TWI000A	5296	01JAN2012 1900	45.30	590.93	592.32		592.67	0.041195	4.73	9.57	11.53	0.92
TWI000A	5296	01JAN2012 2000	41.46	590.93	592.21	592.21	592.60	0.051399	4.97	8.35	11.09	1.01
TWI000A	5296	01JAN2012 2100	38.56	590.93	592.13	592.18	592.55	0.062723	5.19	7.43	10.74	1.10
TWI000A	5296	01JAN2012 2200	36.17	590.93	592.06	592.14	592.51	0.075050	5.40	6.70	10.46	1.19
TWI000A	5296	01JAN2012 2300	34.18	590.93	592.00	592.11	592.49	0.087925	5.60	6.10	10.17	1.28
TWI000A	5296	01JAN2012 2400	32.52	590.93	591.95	592.09	592.48	0.101001	5.80	5.61	9.87	1.36
TWI000A	5079	Max WS	2149.10	588.81	597.37		598.20	0.008699	8.39	401.57	115.90	0.62
TWI000A	5079	31DEC2011 2400	11.34	588.81	590.16		590.19	0.003367	1.41	8.03	10.43	0.28
TWI000A	5079	01JAN2012 0100	24.44	588.81	590.64		590.69	0.003562	1.82	13.40	12.22	0.31
TWI000A	5079	01JAN2012 0200	25.80	588.81	590.68		590.73	0.003534	1.85	13.96	12.39	0.31
TWI000A	5079	01JAN2012 0300	27.13	588.81	590.72		590.77	0.003559	1.88	14.43	12.53	0.31
TWI000A	5079	01JAN2012 0400	28.73	588.81	590.76		590.82	0.003589	1.92	14.98	12.69	0.31
TWI000A	5079	01JAN2012 0500	30.70	588.81	590.81		590.87	0.003626	1.96	15.64	12.89	0.31
TWI000A	5079	01JAN2012 0600	33.24	588.81	590.87		590.94	0.003706	2.02	16.42	13.12	0.32
TWI000A	5079	01JAN2012 0700	44.97	588.81	591.15		591.23	0.003807	2.23	20.17	14.14	0.33
TWI000A	5079	01JAN2012 0800	52.60	588.81	591.29		591.38	0.003988	2.37	22.20	14.66	0.34
TWI000A	5079	01JAN2012 0900	64.80	588.81	591.49		591.59	0.004280	2.58	25.14	15.39	0.36
TWI000A	5079	01JAN2012 1000	88.75	588.81	591.85		591.97	0.004518	2.87	30.95	16.73	0.37
TWI000A	5079	01JAN2012 1100	123.32	588.81	592.26		592.42	0.004908	3.23	38.21	18.33	0.39
TWI000A	5079	01JAN2012 1200	613.15	588.81	594.86		595.30	0.008086	5.47	142.17	89.70	0.54
TWI000A	5079	01JAN2012 1300	359.23	588.81	594.04		594.36	0.006542	4.56	84.48	46.58	0.48

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	5079	01JAN2012 1400	146.22	588.81	592.51		592.69	0.005082	3.42	42.80	19.32	0.40
TWI000A	5079	01JAN2012 1500	109.57	588.81	592.11		592.26	0.004728	3.08	35.52	17.75	0.38
TWI000A	5079	01JAN2012 1600	85.42	588.81	591.81		591.94	0.004406	2.81	30.38	16.60	0.37
TWI000A	5079	01JAN2012 1700	72.89	588.81	591.64		591.75	0.004192	2.64	27.57	15.96	0.35
TWI000A	5079	01JAN2012 1800	64.49	588.81	591.49		591.59	0.004218	2.56	25.18	15.40	0.35
TWI000A	5079	01JAN2012 1900	47.17	588.81	591.20		591.28	0.003817	2.26	20.85	14.32	0.33
TWI000A	5079	01JAN2012 2000	43.11	588.81	591.12		591.19	0.003696	2.18	19.78	14.04	0.32
TWI000A	5079	01JAN2012 2100	40.06	588.81	591.04		591.11	0.003798	2.15	18.59	13.72	0.33
TWI000A	5079	01JAN2012 2200	37.54	588.81	590.98		591.05	0.003755	2.11	17.82	13.51	0.32
TWI000A	5079	01JAN2012 2300	35.45	588.81	590.93		591.00	0.003718	2.06	17.17	13.33	0.32
TWI000A	5079	01JAN2012 2400	33.70	588.81	590.89		590.95	0.003678	2.03	16.63	13.17	0.32
TWI000A	4954	Max WS	2184.96	588.24	596.64		597.24	0.005837	7.13	495.75	146.84	0.52
TWI000A	4954	31DEC2011 2400	11.65	588.24	589.95		589.96	0.000571	0.74	15.79	14.40	0.12
TWI000A	4954	01JAN2012 0100	24.76	588.24	590.39		590.41	0.000956	1.09	22.61	16.70	0.17
TWI000A	4954	01JAN2012 0200	26.19	588.24	590.43		590.45	0.000980	1.12	23.36	16.94	0.17
TWI000A	4954	01JAN2012 0300	27.55	588.24	590.47		590.49	0.001017	1.15	23.91	17.11	0.17
TWI000A	4954	01JAN2012 0400	29.19	588.24	590.50		590.53	0.001063	1.19	24.54	17.31	0.18
TWI000A	4954	01JAN2012 0500	31.21	588.24	590.55		590.57	0.001116	1.23	25.33	17.56	0.18
TWI000A	4954	01JAN2012 0600	33.81	588.24	590.61		590.63	0.001179	1.28	26.32	17.86	0.19
TWI000A	4954	01JAN2012 0700	45.80	588.24	590.87		590.90	0.001352	1.47	31.24	19.23	0.20
TWI000A	4954	01JAN2012 0800	53.56	588.24	590.99		591.03	0.001521	1.60	33.51	19.77	0.22
TWI000A	4954	01JAN2012 0900	66.06	588.24	591.16		591.21	0.001757	1.79	37.00	20.57	0.23
TWI000A	4954	01JAN2012 1000	90.65	588.24	591.49		591.56	0.002042	2.06	44.06	22.10	0.26
TWI000A	4954	01JAN2012 1100	126.19	588.24	591.87		591.95	0.002439	2.40	52.68	23.99	0.28
TWI000A	4954	01JAN2012 1200	618.77	588.24	594.08		594.41	0.005618	4.74	162.25	110.51	0.46
TWI000A	4954	01JAN2012 1300	372.18	588.24	593.43		593.65	0.004515	3.72	102.43	59.57	0.40
TWI000A	4954	01JAN2012 1400	150.39	588.24	592.09		592.19	0.002657	2.58	58.22	25.23	0.30
TWI000A	4954	01JAN2012 1500	112.60	588.24	591.74		591.82	0.002280	2.27	49.61	23.30	0.27
TWI000A	4954	01JAN2012 1600	87.73	588.24	591.46		591.53	0.001983	2.02	43.48	21.98	0.25
TWI000A	4954	01JAN2012 1700	74.83	588.24	591.32		591.37	0.001774	1.85	40.34	21.31	0.24
TWI000A	4954	01JAN2012 1800	66.16	588.24	591.17		591.21	0.001746	1.78	37.12	20.60	0.23
TWI000A	4954	01JAN2012 1900	48.32	588.24	590.91		590.95	0.001398	1.51	32.07	19.43	0.21
TWI000A	4954	01JAN2012 2000	44.13	588.24	590.85		590.88	0.001296	1.43	30.88	19.15	0.20
TWI000A	4954	01JAN2012 2100	40.99	588.24	590.76		590.79	0.001315	1.41	29.13	18.69	0.20
TWI000A	4954	01JAN2012 2200	38.39	588.24	590.71		590.74	0.001265	1.36	28.15	18.41	0.19
TWI000A	4954	01JAN2012 2300	36.24	588.24	590.66		590.69	0.001223	1.33	27.33	18.16	0.19
TWI000A	4954	01JAN2012 2400	34.44	588.24	590.62		590.65	0.001184	1.29	26.63	17.96	0.19
TWI000A	4851	Max WS	2183.75	588.32	596.45		596.72	0.003233	5.14	717.98	207.64	0.39
TWI000A	4851	31DEC2011 2400	11.86	588.32	589.44		589.50	0.009085	1.94	6.11	10.51	0.45
TWI000A	4851	01JAN2012 0100	24.72	588.32	589.79		589.88	0.009728	2.41	10.25	13.40	0.49
TWI000A	4851	01JAN2012 0200	26.18	588.32	589.82		589.91	0.009792	2.45	10.67	13.66	0.49
TWI000A	4851	01JAN2012 0300	27.54	588.32	589.84		589.94	0.009969	2.50	11.00	13.86	0.50
TWI000A	4851	01JAN2012 0400	29.17	588.32	589.87		589.97	0.010106	2.56	11.40	14.04	0.50
TWI000A	4851	01JAN2012 0500	31.19	588.32	589.91		590.01	0.010224	2.62	11.90	14.26	0.51
TWI000A	4851	01JAN2012 0600	33.78	588.32	589.95		590.06	0.010302	2.69	12.56	14.54	0.51
TWI000A	4851	01JAN2012 0700	45.75	588.32	590.11		590.25	0.011666	3.07	14.90	15.50	0.55
TWI000A	4851	01JAN2012 0800	53.49	588.32	590.23		590.39	0.011335	3.18	16.84	16.25	0.55
TWI000A	4851	01JAN2012 0900	65.95	588.32	590.42		590.58	0.010714	3.30	19.97	17.40	0.54
TWI000A	4851	01JAN2012 1000	90.46	588.32	590.66		590.87	0.011569	3.71	24.41	18.90	0.57
TWI000A	4851	01JAN2012 1100	125.92	588.32	591.00		591.26	0.011429	4.02	31.29	21.17	0.58
TWI000A	4851	01JAN2012 1200	593.86	588.32	593.08		593.53	0.013383	5.68	141.54	128.91	0.68
TWI000A	4851	01JAN2012 1300	376.32	588.32	592.39		592.84	0.012995	5.45	74.32	62.51	0.66
TWI000A	4851	01JAN2012 1400	150.59	588.32	591.21		591.48	0.011465	4.22	35.70	22.55	0.59
TWI000A	4851	01JAN2012 1500	112.75	588.32	590.88		591.12	0.011580	3.93	28.68	20.31	0.58
TWI000A	4851	01JAN2012 1600	87.84	588.32	590.62		590.84	0.011778	3.70	23.74	18.68	0.58
TWI000A	4851	01JAN2012 1700	74.90	588.32	590.46		590.66	0.012569	3.62	20.66	17.64	0.59
TWI000A	4851	01JAN2012 1800	66.21	588.32	590.41		590.58	0.010855	3.32	19.93	17.38	0.55
TWI000A	4851	01JAN2012 1900	48.36	588.32	590.14		590.30	0.011757	3.13	15.46	15.72	0.56
TWI000A	4851	01JAN2012 2000	44.15	588.32	590.08		590.22	0.011868	3.06	14.44	15.32	0.55
TWI000A	4851	01JAN2012 2100	41.01	588.32	590.07		590.20	0.010365	2.85	14.38	15.29	0.52
TWI000A	4851	01JAN2012 2200	38.41	588.32	590.03		590.15	0.010442	2.81	13.69	15.01	0.52
TWI000A	4851	01JAN2012 2300	36.26	588.32	589.99		590.11	0.010465	2.76	13.13	14.78	0.52
TWI000A	4851	01JAN2012 2400	34.45	588.32	589.96		590.07	0.010456	2.72	12.67	14.58	0.51
TWI000A	4630	Max WS	2181.47	585.93	596.26		596.37	0.001015	2.99	897.87	190.87	0.20
TWI000A	4630	31DEC2011 2400	11.85	585.93	588.68		588.68	0.000106	0.33	39.63	35.67	0.05
TWI000A	4630	01JAN2012 0100	24.68	585.93	588.95		588.95	0.000250	0.55	49.90	39.97	0.08
TWI000A	4630	01JAN2012 0200	26.15	585.93	588.96		588.97	0.000272	0.58	50.51	40.12	0.08
TWI000A	4630	01JAN2012 0300	27.51	585.93	588.98		588.99	0.000288	0.60	51.29	40.30	0.08
TWI000A	4630	01JAN2012 0400	29.13	585.93	589.01		589.01	0.000306	0.62	52.27	40.53	0.09
TWI000A	4630	01JAN2012 0500	31.14	585.93	589.04		589.04	0.000327	0.65	53.53	40.83	0.09
TWI000A	4630	01JAN2012 0600	33.71	585.93	589.08		589.08	0.000351	0.68	55.23	41.22	0.09
TWI000A	4630	01JAN2012 0700	45.53	585.93	589.10		589.11	0.000617	0.90	55.95	41.39	0.12
TWI000A	4630	01JAN2012 0800	53.24	585.93	589.27		589.28	0.000601	0.93	63.09	43.00	0.12
TWI000A	4630	01JAN2012 0900	65.48	585.93	589.52		589.54	0.000591	0.97	75.12	48.55	0.12
TWI000A	4630	01JAN2012 1000	89.64	585.93	589.70		589.72	0.000808	1.18	84.01	50.22	0.15
TWI000A	4630	01JAN2012 1100	125.17	585.93	590.08		590.11	0.000890	1.33	103.87	55.35	0.16
TWI000A	4630	01JAN2012 1200	554.40	585.93	592.12		592.19	0.001631	2.02	264.94	110.13	0.22
TWI000A	4630	01JAN2012 1300	384.30	585.93	591.33		591.40	0.001784	2.08	188.50	82.59	0.23
TWI000A	4630	01JAN2012 1400	151.14	585.93	590.30		590.32	0.001023	1.48	116.37	62.58	0.17
TWI000A	4630	01JAN2012 1500	113.28	585.93	589.93		589.95	0.000891	1.29	95.75	52.34	0.15
TWI000A	4630	01JAN2012 1600	88.30	585.93	589.64		589.66	0.000875	1.21	80.79	49.62	0.15

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	4630	01JAN2012 1700	75.05	585.93	589.37		589.39	0.001025	1.24	68.01	47.03	0.16
TWI000A	4630	01JAN2012 1800	66.43	585.93	589.51		589.52	0.000628	1.00	74.28	48.39	0.13
TWI000A	4630	01JAN2012 1900	48.54	585.93	589.13		589.14	0.000653	0.93	57.36	41.71	0.13
TWI000A	4630	01JAN2012 2000	44.26	585.93	589.03		589.04	0.000668	0.92	53.33	40.78	0.13
TWI000A	4630	01JAN2012 2100	41.08	585.93	589.18		589.19	0.000423	0.76	59.46	42.19	0.10
TWI000A	4630	01JAN2012 2200	38.47	585.93	589.14		589.14	0.000406	0.74	57.58	41.76	0.10
TWI000A	4630	01JAN2012 2300	36.30	585.93	589.10		589.11	0.000389	0.72	56.11	41.42	0.10
TWI000A	4630	01JAN2012 2400	34.49	585.93	589.07		589.08	0.000373	0.70	54.92	41.15	0.10
TWI000A	4515	Max WS	3183.51	585.61	595.53		595.98	0.003687	5.76	605.03	102.41	0.37
TWI000A	4515	31DEC2011 2400	11.78	585.61	586.50		586.68	0.047664	3.36	3.51	7.87	0.89
TWI000A	4515	01JAN2012 0100	32.34	585.61	586.97		587.23	0.034321	4.08	7.93	10.20	0.81
TWI000A	4515	01JAN2012 0200	34.77	585.61	587.01		587.28	0.034355	4.18	8.32	10.30	0.82
TWI000A	4515	01JAN2012 0300	36.83	585.61	587.04		587.32	0.034335	4.26	8.65	10.39	0.82
TWI000A	4515	01JAN2012 0400	39.36	585.61	587.08		587.37	0.034152	4.34	9.06	10.50	0.82
TWI000A	4515	01JAN2012 0500	42.44	585.61	587.13		587.43	0.033721	4.43	9.57	10.63	0.82
TWI000A	4515	01JAN2012 0600	46.37	585.61	587.19		587.51	0.032917	4.53	10.24	10.81	0.82
TWI000A	4515	01JAN2012 0700	64.36	585.61	587.49		587.84	0.027936	4.73	13.62	11.78	0.77
TWI000A	4515	01JAN2012 0800	75.87	585.61	587.63		588.01	0.027808	4.93	15.47	14.26	0.78
TWI000A	4515	01JAN2012 0900	93.88	585.61	587.84		588.25	0.026798	5.14	18.89	17.99	0.78
TWI000A	4515	01JAN2012 1000	129.78	585.61	588.17		588.61	0.025613	5.45	25.58	23.50	0.77
TWI000A	4515	01JAN2012 1100	182.00	585.61	588.54		588.99	0.023603	5.66	36.70	33.27	0.76
TWI000A	4515	01JAN2012 1200	856.41	585.61	591.07		591.42	0.010337	5.38	186.35	86.13	0.54
TWI000A	4515	01JAN2012 1300	537.43	585.61	590.23		590.58	0.012568	5.41	119.59	69.07	0.59
TWI000A	4515	01JAN2012 1400	216.58	585.61	588.74		589.19	0.022667	5.76	43.43	36.35	0.75
TWI000A	4515	01JAN2012 1500	161.06	585.61	588.43		588.87	0.023216	5.49	33.17	31.64	0.75
TWI000A	4515	01JAN2012 1600	124.59	585.61	588.13		588.57	0.025485	5.39	24.73	22.22	0.77
TWI000A	4515	01JAN2012 1700	105.24	585.61	587.99		588.39	0.024644	5.11	21.65	20.06	0.75
TWI000A	4515	01JAN2012 1800	92.70	585.61	587.83		588.23	0.026847	5.12	18.66	17.82	0.78
TWI000A	4515	01JAN2012 1900	66.50	585.61	587.52		587.87	0.027939	4.77	13.94	11.90	0.78
TWI000A	4515	01JAN2012 2000	60.25	585.61	587.44		587.77	0.027571	4.62	13.04	11.57	0.77
TWI000A	4515	01JAN2012 2100	55.57	585.61	587.34		587.68	0.030319	4.67	11.91	11.22	0.80
TWI000A	4515	01JAN2012 2200	51.74	585.61	587.28		587.61	0.031434	4.62	11.21	11.05	0.81
TWI000A	4515	01JAN2012 2300	48.56	585.61	587.23		587.55	0.032301	4.57	10.64	10.91	0.81
TWI000A	4515	01JAN2012 2400	45.90	585.61	587.18		587.50	0.032951	4.51	10.17	10.79	0.82
TWI000A	4315	Max WS	3181.45	581.62	592.87		594.94	0.013915	11.64	292.48	54.85	0.72
TWI000A	4315	31DEC2011 2400	12.05	581.62	582.62		582.79	0.036508	3.25	3.71	7.12	0.79
TWI000A	4315	01JAN2012 0100	32.21	581.62	583.53		583.64	0.009666	2.63	12.26	11.69	0.45
TWI000A	4315	01JAN2012 0200	34.74	581.62	583.62		583.72	0.009067	2.62	13.27	12.12	0.44
TWI000A	4315	01JAN2012 0300	36.80	581.62	583.67		583.78	0.008891	2.64	13.95	12.40	0.44
TWI000A	4315	01JAN2012 0400	39.33	581.62	583.74		583.85	0.008657	2.66	14.80	12.74	0.43
TWI000A	4315	01JAN2012 0500	42.40	581.62	583.82		583.93	0.008351	2.67	15.86	13.15	0.43
TWI000A	4315	01JAN2012 0600	46.32	581.62	583.92		584.04	0.007976	2.69	17.22	13.66	0.42
TWI000A	4315	01JAN2012 0700	64.26	581.62	584.34		584.46	0.006783	2.75	23.40	15.87	0.40
TWI000A	4315	01JAN2012 0800	75.73	581.62	584.58		584.70	0.006279	2.78	27.28	17.18	0.39
TWI000A	4315	01JAN2012 0900	93.60	581.62	584.87		585.00	0.005817	2.88	32.50	18.18	0.38
TWI000A	4315	01JAN2012 1000	129.24	581.62	585.36		585.51	0.005561	3.07	42.04	20.54	0.38
TWI000A	4315	01JAN2012 1100	181.36	581.62	585.97		586.13	0.005259	3.28	55.34	23.52	0.38
TWI000A	4315	01JAN2012 1200	828.67	581.62	589.48		589.92	0.005774	5.34	155.31	32.39	0.43
TWI000A	4315	01JAN2012 1300	546.73	581.62	588.78		589.04	0.003888	4.11	133.15	30.85	0.35
TWI000A	4315	01JAN2012 1400	217.14	581.62	586.34		586.52	0.005035	3.37	64.39	25.34	0.37
TWI000A	4315	01JAN2012 1500	161.54	581.62	585.77		585.93	0.005255	3.18	50.75	22.53	0.37
TWI000A	4315	01JAN2012 1600	124.90	581.62	585.32		585.46	0.005487	3.03	41.18	20.34	0.38
TWI000A	4315	01JAN2012 1700	105.43	581.62	585.06		585.19	0.005625	2.93	35.93	19.03	0.38
TWI000A	4315	01JAN2012 1800	92.84	581.62	584.87		585.00	0.005731	2.86	32.49	18.18	0.38
TWI000A	4315	01JAN2012 1900	66.60	581.62	584.40		584.52	0.006558	2.74	24.35	16.20	0.39
TWI000A	4315	01JAN2012 2000	60.30	581.62	584.27		584.38	0.006858	2.72	22.20	15.45	0.40
TWI000A	4315	01JAN2012 2100	55.62	581.62	584.16		584.27	0.007075	2.70	20.63	14.87	0.40
TWI000A	4315	01JAN2012 2200	51.78	581.62	584.07		584.18	0.007359	2.69	19.28	14.40	0.41
TWI000A	4315	01JAN2012 2300	48.60	581.62	583.99		584.10	0.007658	2.68	18.12	13.98	0.42
TWI000A	4315	01JAN2012 2400	45.93	581.62	583.92		584.03	0.007909	2.68	17.17	13.64	0.42
TWI000A	4239	Max WS	3191.92	581.19	592.38		593.86	0.010851	10.59	480.26	105.24	0.65
TWI000A	4239	31DEC2011 2400	12.19	581.19	582.40		582.46	0.008551	1.94	6.30	8.84	0.40
TWI000A	4239	01JAN2012 0100	32.22	581.19	583.21		583.28	0.005511	2.17	14.87	12.46	0.35
TWI000A	4239	01JAN2012 0200	34.83	581.19	583.29		583.36	0.005361	2.19	15.90	12.82	0.35
TWI000A	4239	01JAN2012 0300	36.90	581.19	583.34		583.42	0.005341	2.22	16.61	13.07	0.35
TWI000A	4239	01JAN2012 0400	39.43	581.19	583.41		583.49	0.005308	2.26	17.46	13.33	0.35
TWI000A	4239	01JAN2012 0500	42.51	581.19	583.49		583.57	0.005243	2.30	18.51	13.63	0.35
TWI000A	4239	01JAN2012 0600	46.45	581.19	583.58		583.67	0.005185	2.34	19.81	14.00	0.35
TWI000A	4239	01JAN2012 0700	64.42	581.19	583.97		584.07	0.004979	2.52	25.53	15.60	0.35
TWI000A	4239	01JAN2012 0800	75.95	581.19	584.18		584.28	0.004933	2.63	28.91	16.47	0.35
TWI000A	4239	01JAN2012 0900	93.86	581.19	584.48		584.60	0.004750	2.75	34.09	17.50	0.35
TWI000A	4239	01JAN2012 1000	129.62	581.19	584.99		585.12	0.004694	2.99	43.42	19.48	0.35
TWI000A	4239	01JAN2012 1100	182.04	581.19	585.60		585.76	0.004637	3.25	56.02	21.82	0.36
TWI000A	4239	01JAN2012 1200	825.20	581.19	589.02		589.48	0.005842	5.47	170.73	71.60	0.44
TWI000A	4239	01JAN2012 1300	553.45	581.19	588.48		588.75	0.003918	4.18	135.19	57.34	0.35
TWI000A	4239	01JAN2012 1400	218.71	581.19	585.98		586.15	0.004559	3.39	64.56	23.27	0.36
TWI000A	4239	01JAN2012 1500	162.72	581.19	585.40		585.55	0.004575	3.14	51.82	21.07	0.35
TWI000A	4239	01JAN2012 1600	125.77	581.19	584.95		585.08	0.004627	2.95	42.70	19.34	0.35
TWI000A	4239	01JAN2012 1700	106.13	581.19	584.67		584.80	0.004679	2.83	37.53	18.27	0.35
TWI000A	4239	01JAN2012 1800	93.44	581.19	584.49		584.60	0.004677	2.73	34.17	17.52	0.35
TWI000A	4239	01JAN2012 1900	67.01	581.19	584.03		584.13	0.004881	2.53	26.47	15.85	0.35

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	4239	01JAN2012 2000	60.66	581.19	583.90		584.00	0.004931	2.47	24.52	15.33	0.34
TWI000A	4239	01JAN2012 2100	55.94	581.19	583.80		583.89	0.004974	2.43	23.03	14.92	0.34
TWI000A	4239	01JAN2012 2200	52.07	581.19	583.72		583.81	0.005026	2.39	21.78	14.57	0.34
TWI000A	4239	01JAN2012 2300	48.87	581.19	583.64		583.73	0.005088	2.36	20.70	14.26	0.35
TWI000A	4239	01JAN2012 2400	46.18	581.19	583.58		583.66	0.005127	2.33	19.81	14.00	0.35
TWI000A	4155	Max WS	3214.31	580.71	592.43		592.75	0.003311	5.52	1059.63	217.96	0.36
TWI000A	4155	31DEC2011 2400	12.35	580.71	582.14		582.16	0.002685	1.29	9.59	10.37	0.24
TWI000A	4155	01JAN2012 0100	32.20	580.71	582.89		582.94	0.002895	1.74	18.54	13.32	0.26
TWI000A	4155	01JAN2012 0200	34.93	580.71	582.97		583.02	0.002882	1.77	19.68	13.61	0.26
TWI000A	4155	01JAN2012 0300	37.00	580.71	583.03		583.08	0.002895	1.81	20.47	13.81	0.26
TWI000A	4155	01JAN2012 0400	39.55	580.71	583.10		583.15	0.002926	1.85	21.39	14.04	0.26
TWI000A	4155	01JAN2012 0500	42.64	580.71	583.17		583.23	0.002952	1.89	22.50	14.31	0.27
TWI000A	4155	01JAN2012 0600	46.58	580.71	583.27		583.33	0.002990	1.95	23.87	14.64	0.27
TWI000A	4155	01JAN2012 0700	64.60	580.71	583.66		583.73	0.003109	2.17	29.81	15.98	0.28
TWI000A	4155	01JAN2012 0800	76.18	580.71	583.86		583.95	0.003215	2.29	33.20	16.70	0.29
TWI000A	4155	01JAN2012 0900	94.17	580.71	584.17		584.26	0.003280	2.45	38.47	17.76	0.29
TWI000A	4155	01JAN2012 1000	130.07	580.71	584.67		584.78	0.003465	2.73	47.72	19.42	0.31
TWI000A	4155	01JAN2012 1100	182.77	580.71	585.27		585.41	0.003658	3.05	60.74	28.32	0.32
TWI000A	4155	01JAN2012 1200	811.39	580.71	588.83		589.01	0.003700	3.71	332.30	129.47	0.34
TWI000A	4155	01JAN2012 1300	566.71	580.71	588.29		588.42	0.003237	3.17	263.03	126.67	0.31
TWI000A	4155	01JAN2012 1400	220.53	580.71	585.65		585.81	0.003687	3.20	73.28	36.73	0.33
TWI000A	4155	01JAN2012 1500	164.06	580.71	585.08		585.21	0.003560	2.93	56.00	20.77	0.31
TWI000A	4155	01JAN2012 1600	126.76	580.71	584.64		584.75	0.003414	2.69	47.08	19.32	0.30
TWI000A	4155	01JAN2012 1700	106.93	580.71	584.36		584.46	0.003337	2.55	41.95	18.42	0.30
TWI000A	4155	01JAN2012 1800	94.12	580.71	584.18		584.27	0.003244	2.44	38.61	17.79	0.29
TWI000A	4155	01JAN2012 1900	67.49	580.71	583.72		583.79	0.003098	2.19	30.81	16.20	0.28
TWI000A	4155	01JAN2012 2000	61.07	580.71	583.60		583.67	0.003044	2.12	28.84	15.77	0.28
TWI000A	4155	01JAN2012 2100	56.31	580.71	583.50		583.56	0.003020	2.06	27.27	15.42	0.27
TWI000A	4155	01JAN2012 2200	52.41	580.71	583.41		583.47	0.002993	2.02	25.98	15.13	0.27
TWI000A	4155	01JAN2012 2300	49.18	580.71	583.34		583.40	0.002980	1.98	24.85	14.87	0.27
TWI000A	4155	01JAN2012 2400	46.46	580.71	583.27		583.33	0.002961	1.94	23.91	14.65	0.27
TWI000A	3981	Max WS	3248.08	579.93	590.75		591.85	0.010748	9.01	532.10	134.29	0.64
TWI000A	3981	31DEC2011 2400	12.72	579.93	581.77		581.79	0.001743	1.14	11.19	10.36	0.19
TWI000A	3981	01JAN2012 0100	32.15	579.93	582.40		582.45	0.002822	1.74	18.50	12.88	0.26
TWI000A	3981	01JAN2012 0200	35.12	579.93	582.47		582.52	0.002955	1.81	19.39	13.13	0.26
TWI000A	3981	01JAN2012 0300	37.21	579.93	582.52		582.57	0.003046	1.86	20.00	13.29	0.27
TWI000A	3981	01JAN2012 0400	39.77	579.93	582.57		582.63	0.003155	1.92	20.72	13.49	0.27
TWI000A	3981	01JAN2012 0500	42.87	579.93	582.64		582.70	0.003271	1.98	21.60	13.72	0.28
TWI000A	3981	01JAN2012 0600	46.84	579.93	582.72		582.78	0.003387	2.06	22.74	13.99	0.28
TWI000A	3981	01JAN2012 0700	64.94	579.93	583.04		583.12	0.003895	2.37	27.35	15.01	0.31
TWI000A	3981	01JAN2012 0800	76.62	579.93	583.21		583.31	0.004201	2.55	29.99	15.57	0.32
TWI000A	3981	01JAN2012 0900	94.77	579.93	583.47		583.59	0.004503	2.78	34.12	16.40	0.34
TWI000A	3981	01JAN2012 1000	130.95	579.93	583.87		584.03	0.005201	3.19	41.09	17.82	0.37
TWI000A	3981	01JAN2012 1100	184.16	579.93	584.38		584.58	0.005896	3.65	50.51	19.59	0.40
TWI000A	3981	01JAN2012 1200	773.55	579.93	587.60		587.99	0.008800	5.04	167.37	87.88	0.51
TWI000A	3981	01JAN2012 1300	594.06	579.93	586.97		587.35	0.009948	4.90	122.41	58.10	0.53
TWI000A	3981	01JAN2012 1400	223.96	579.93	584.71		584.95	0.006262	3.92	57.17	20.79	0.42
TWI000A	3981	01JAN2012 1500	166.58	579.93	584.22		584.41	0.005690	3.51	47.51	19.05	0.39
TWI000A	3981	01JAN2012 1600	128.62	579.93	583.85		584.01	0.005158	3.16	40.67	17.74	0.37
TWI000A	3981	01JAN2012 1700	108.44	579.93	583.62		583.76	0.004825	2.95	36.73	16.94	0.35
TWI000A	3981	01JAN2012 1800	95.40	579.93	583.47		583.60	0.004515	2.79	34.25	16.42	0.34
TWI000A	3981	01JAN2012 1900	68.41	579.93	583.09		583.18	0.003991	2.43	28.15	15.18	0.31
TWI000A	3981	01JAN2012 2000	61.85	579.93	582.99		583.07	0.003791	2.32	26.66	14.87	0.31
TWI000A	3981	01JAN2012 2100	57.00	579.93	582.91		582.99	0.003629	2.23	25.54	14.62	0.30
TWI000A	3981	01JAN2012 2200	53.05	579.93	582.85		582.92	0.003500	2.16	24.57	14.41	0.29
TWI000A	3981	01JAN2012 2300	49.77	579.93	582.78		582.85	0.003445	2.11	23.60	14.19	0.29
TWI000A	3981	01JAN2012 2400	47.01	579.93	582.72		582.79	0.003386	2.06	22.80	14.01	0.28
TWI000A	3902	Max WS	3265.49	579.57	589.82		591.04	0.011771	10.36	584.25	188.04	0.73
TWI000A	3902	31DEC2011 2400	12.86	579.57	580.66		580.83	0.026369	3.30	3.89	6.48	0.75
TWI000A	3902	01JAN2012 0100	32.17	579.57	581.16		581.43	0.025344	4.17	7.72	8.72	0.78
TWI000A	3902	01JAN2012 0200	35.22	579.57	581.22		581.50	0.025691	4.29	8.21	8.96	0.79
TWI000A	3902	01JAN2012 0300	37.31	579.57	581.26		581.55	0.025791	4.36	8.55	9.13	0.79
TWI000A	3902	01JAN2012 0400	39.88	579.57	581.30		581.61	0.025759	4.44	8.98	9.33	0.80
TWI000A	3902	01JAN2012 0500	43.00	579.57	581.36		581.68	0.025553	4.52	9.52	9.58	0.80
TWI000A	3902	01JAN2012 0600	46.97	579.57	581.43		581.76	0.025106	4.59	10.23	9.90	0.80
TWI000A	3902	01JAN2012 0700	65.14	579.57	581.71		582.09	0.024395	4.98	13.09	10.92	0.80
TWI000A	3902	01JAN2012 0800	76.88	579.57	581.86		582.28	0.024277	5.20	14.78	11.48	0.81
TWI000A	3902	01JAN2012 0900	95.13	579.57	582.09		582.55	0.023295	5.43	17.52	12.32	0.80
TWI000A	3902	01JAN2012 1000	131.47	579.57	582.45		582.99	0.023143	5.91	22.23	13.60	0.82
TWI000A	3902	01JAN2012 1100	185.02	579.57	582.91		583.55	0.022455	6.44	28.74	15.02	0.82
TWI000A	3902	01JAN2012 1200	764.80	579.57	585.89		587.05	0.019435	8.62	88.71	26.49	0.83
TWI000A	3902	01JAN2012 1300	601.86	579.57	585.24		586.31	0.019740	8.30	72.55	23.11	0.82
TWI000A	3902	01JAN2012 1400	225.55	579.57	583.21		583.92	0.021918	6.74	33.48	15.97	0.82
TWI000A	3902	01JAN2012 1500	167.77	579.57	582.77		583.38	0.022579	6.28	26.73	14.59	0.82
TWI000A	3902	01JAN2012 1600	129.51	579.57	582.43		582.97	0.023106	5.89	22.00	13.55	0.81
TWI000A	3902	01JAN2012 1700	109.17	579.57	582.23		582.73	0.023486	5.65	19.32	12.84	0.81
TWI000A	3902	01JAN2012 1800	96.03	579.57	582.10		582.56	0.023238	5.44	17.66	12.36	0.80
TWI000A	3902	01JAN2012 1900	68.85	579.57	581.76		582.15	0.024338	5.05	13.64	11.10	0.80
TWI000A	3902	01JAN2012 2000	62.22	579.57	581.67		582.04	0.024204	4.90	12.70	10.79	0.80
TWI000A	3902	01JAN2012 2100	57.34	579.57	581.61		581.96	0.023907	4.77	12.02	10.56	0.79
TWI000A	3902	01JAN2012 2200	53.37	579.57	581.55		581.89	0.023870	4.67	11.43	10.35	0.78

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	3902	01JAN2012 2300	50.05	579.57	581.49		581.82	0.024518	4.63	10.81	10.13	0.79
TWI000A	3902	01JAN2012 2400	47.28	579.57	581.44		581.77	0.024966	4.59	10.30	9.93	0.79
TWI000A	3556	Max WS	3333.62	574.86	585.68		587.21	0.011314	10.51	418.98	113.63	0.72
TWI000A	3556	31DEC2011 2400	13.70	574.86	576.60		576.61	0.000530	0.78	17.67	13.91	0.12
TWI000A	3556	01JAN2012 0100	32.23	574.86	576.94		576.97	0.001424	1.42	22.67	14.93	0.20
TWI000A	3556	01JAN2012 0200	35.61	574.86	576.99		577.02	0.001601	1.53	23.32	15.06	0.22
TWI000A	3556	01JAN2012 0300	37.73	574.86	577.02		577.06	0.001697	1.59	23.79	15.15	0.22
TWI000A	3556	01JAN2012 0400	40.33	574.86	577.06		577.11	0.001784	1.65	24.49	15.28	0.23
TWI000A	3556	01JAN2012 0500	43.48	574.86	577.12		577.17	0.001867	1.71	25.41	15.46	0.24
TWI000A	3556	01JAN2012 0600	47.52	574.86	577.19		577.24	0.001978	1.79	26.50	15.66	0.24
TWI000A	3556	01JAN2012 0700	65.88	574.86	577.44		577.51	0.002556	2.16	30.46	16.39	0.28
TWI000A	3556	01JAN2012 0800	77.84	574.86	577.58		577.67	0.002883	2.37	32.82	16.77	0.30
TWI000A	3556	01JAN2012 0900	96.44	574.86	577.79		577.90	0.003330	2.66	36.26	17.30	0.32
TWI000A	3556	01JAN2012 1000	133.45	574.86	578.16		578.31	0.003935	3.10	43.01	18.29	0.36
TWI000A	3556	01JAN2012 1100	188.28	574.86	578.63		578.83	0.004651	3.63	51.80	19.52	0.39
TWI000A	3556	01JAN2012 1200	759.30	574.86	581.47		582.11	0.008021	6.41	118.45	27.87	0.55
TWI000A	3556	01JAN2012 1300	628.65	574.86	581.06		581.59	0.007129	5.86	107.25	26.44	0.51
TWI000A	3556	01JAN2012 1400	231.78	574.86	578.98		579.22	0.004975	3.95	58.73	20.46	0.41
TWI000A	3556	01JAN2012 1500	172.43	574.86	578.51		578.70	0.004416	3.48	49.55	19.21	0.38
TWI000A	3556	01JAN2012 1600	132.97	574.86	578.17		578.32	0.003886	3.09	43.10	18.31	0.35
TWI000A	3556	01JAN2012 1700	112.01	574.86	577.97		578.09	0.003534	2.84	39.47	17.78	0.34
TWI000A	3556	01JAN2012 1800	98.45	574.86	577.82		577.93	0.003322	2.67	36.83	17.38	0.32
TWI000A	3556	01JAN2012 1900	70.55	574.86	577.51		577.58	0.002657	2.24	31.53	16.56	0.29
TWI000A	3556	01JAN2012 2000	63.68	574.86	577.42		577.49	0.002450	2.11	30.19	16.34	0.27
TWI000A	3556	01JAN2012 2100	58.66	574.86	577.36		577.42	0.002300	2.01	29.13	16.15	0.26
TWI000A	3556	01JAN2012 2200	54.57	574.86	577.30		577.36	0.002182	1.93	28.21	15.98	0.26
TWI000A	3556	01JAN2012 2300	51.16	574.86	577.25		577.31	0.002074	1.86	27.44	15.84	0.25
TWI000A	3556	01JAN2012 2400	48.31	574.86	577.21		577.26	0.001976	1.80	26.81	15.72	0.24
TWI000A	3490	Max WS	3347.91	574.69	584.86		586.47	0.010429	10.43	378.99	100.66	0.71
TWI000A	3490	31DEC2011 2400	13.94	574.69	576.55		576.56	0.000793	0.84	16.64	16.13	0.15
TWI000A	3490	01JAN2012 0100	32.25	574.69	576.82		576.86	0.002161	1.52	21.21	17.83	0.25
TWI000A	3490	01JAN2012 0200	35.69	574.69	576.85		576.89	0.002485	1.64	21.70	18.00	0.26
TWI000A	3490	01JAN2012 0300	37.82	574.69	576.87		576.92	0.002652	1.71	22.11	18.14	0.27
TWI000A	3490	01JAN2012 0400	40.42	574.69	576.91		576.96	0.002773	1.77	22.83	18.39	0.28
TWI000A	3490	01JAN2012 0500	43.58	574.69	576.97		577.02	0.002866	1.83	23.82	18.73	0.29
TWI000A	3490	01JAN2012 0600	47.64	574.69	577.03		577.08	0.003006	1.91	24.98	19.11	0.29
TWI000A	3490	01JAN2012 0700	66.03	574.69	577.22		577.30	0.003914	2.29	28.79	20.33	0.34
TWI000A	3490	01JAN2012 0800	78.04	574.69	577.34		577.44	0.004325	2.49	31.30	21.01	0.36
TWI000A	3490	01JAN2012 0900	96.70	574.69	577.51		577.63	0.004864	2.77	34.91	21.81	0.39
TWI000A	3490	01JAN2012 1000	133.84	574.69	577.87		578.02	0.005170	3.11	42.97	23.49	0.41
TWI000A	3490	01JAN2012 1100	188.94	574.69	578.31		578.50	0.005447	3.50	53.93	25.60	0.43
TWI000A	3490	01JAN2012 1200	758.36	574.69	581.23		581.65	0.005405	5.19	146.12	37.43	0.46
TWI000A	3490	01JAN2012 1300	634.86	574.69	580.82		581.18	0.005108	4.84	131.07	35.77	0.45
TWI000A	3490	01JAN2012 1400	233.13	574.69	578.67		578.88	0.005283	3.68	63.32	27.19	0.43
TWI000A	3490	01JAN2012 1500	173.45	574.69	578.20		578.38	0.005350	3.40	51.06	25.07	0.42
TWI000A	3490	01JAN2012 1600	133.72	574.69	577.88		578.02	0.005087	3.10	43.19	23.54	0.40
TWI000A	3490	01JAN2012 1700	112.62	574.69	577.68		577.81	0.004899	2.91	38.76	22.63	0.39
TWI000A	3490	01JAN2012 1800	98.96	574.69	577.55		577.66	0.004788	2.77	35.68	21.98	0.38
TWI000A	3490	01JAN2012 1900	70.91	574.69	577.28		577.37	0.004020	2.36	30.03	20.71	0.35
TWI000A	3490	01JAN2012 2000	63.99	574.69	577.21		577.29	0.003725	2.23	28.65	20.29	0.33
TWI000A	3490	01JAN2012 2100	58.94	574.69	577.16		577.23	0.003504	2.14	27.58	19.95	0.32
TWI000A	3490	01JAN2012 2200	54.83	574.69	577.11		577.18	0.003321	2.05	26.68	19.67	0.31
TWI000A	3490	01JAN2012 2300	51.40	574.69	577.08		577.14	0.003148	1.98	25.96	19.44	0.30
TWI000A	3490	01JAN2012 2400	48.52	574.69	577.05		577.10	0.002988	1.91	25.37	19.24	0.29
TWI000A	3161	Max WS	3415.00	572.39	582.35		583.48	0.007306	9.52	531.85	153.01	0.65
TWI000A	3161	31DEC2011 2400	14.88	572.39	573.31		573.44	0.023169	2.88	5.17	11.71	0.76
TWI000A	3161	01JAN2012 0100	32.19	572.39	573.64		573.82	0.019021	3.47	9.29	13.63	0.74
TWI000A	3161	01JAN2012 0200	36.05	572.39	573.71		573.90	0.017894	3.52	10.24	14.03	0.73
TWI000A	3161	01JAN2012 0300	38.20	572.39	573.74		573.94	0.017262	3.54	10.79	14.25	0.72
TWI000A	3161	01JAN2012 0400	40.82	572.39	573.79		573.99	0.016666	3.57	11.43	14.50	0.71
TWI000A	3161	01JAN2012 0500	44.01	572.39	573.84		574.04	0.016002	3.61	12.21	14.81	0.70
TWI000A	3161	01JAN2012 0600	48.14	572.39	573.90		574.11	0.015479	3.66	13.14	15.16	0.69
TWI000A	3161	01JAN2012 0700	66.68	572.39	574.12		574.37	0.015143	4.02	16.58	16.33	0.70
TWI000A	3161	01JAN2012 0800	78.88	572.39	574.27		574.54	0.014140	4.15	19.00	16.87	0.69
TWI000A	3161	01JAN2012 0900	97.83	572.39	574.48		574.77	0.013023	4.33	22.60	17.65	0.67
TWI000A	3161	01JAN2012 1000	135.49	572.39	574.80		575.15	0.012600	4.74	28.58	18.87	0.68
TWI000A	3161	01JAN2012 1100	191.79	572.39	575.22		575.64	0.012310	5.23	36.69	20.44	0.69
TWI000A	3161	01JAN2012 1200	751.44	572.39	577.51		578.50	0.014065	8.02	93.73	29.75	0.80
TWI000A	3161	01JAN2012 1300	663.28	572.39	577.24		578.16	0.013730	7.71	86.02	28.45	0.78
TWI000A	3161	01JAN2012 1400	239.02	572.39	575.50		575.99	0.012549	5.62	42.55	21.50	0.70
TWI000A	3161	01JAN2012 1500	177.93	572.39	575.12		575.53	0.012310	5.11	34.81	20.09	0.68
TWI000A	3161	01JAN2012 1600	137.04	572.39	574.81		575.17	0.012627	4.76	28.78	18.91	0.68
TWI000A	3161	01JAN2012 1700	115.30	572.39	574.63		574.95	0.013038	4.56	25.28	18.21	0.68
TWI000A	3161	01JAN2012 1800	101.24	572.39	574.50		574.80	0.013141	4.39	23.06	17.75	0.68
TWI000A	3161	01JAN2012 1900	72.53	572.39	574.19		574.45	0.014844	4.11	17.66	16.57	0.70
TWI000A	3161	01JAN2012 2000	65.36	572.39	574.10		574.35	0.015430	4.02	16.26	16.25	0.71
TWI000A	3161	01JAN2012 2100	60.16	572.39	574.04		574.28	0.015692	3.94	15.27	15.95	0.71
TWI000A	3161	01JAN2012 2200	55.95	572.39	573.99		574.22	0.015763	3.86	14.50	15.67	0.71
TWI000A	3161	01JAN2012 2300	52.43	572.39	573.95		574.17	0.015736	3.78	13.86	15.43	0.70
TWI000A	3161	01JAN2012 2400	49.48	572.39	573.92		574.13	0.015647	3.71	13.34	15.24	0.70

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	3010	Max WS	3394.40	570.55	581.16	581.11	582.41	0.007648	9.50	487.75	240.05	0.66
TWI000A	3010	31DEC2011 2400	15.15	570.55	571.68		571.73	0.004371	1.68	9.00	13.03	0.36
TWI000A	3010	01JAN2012 0100	31.97	570.55	571.97		572.06	0.006828	2.46	13.00	14.83	0.46
TWI000A	3010	01JAN2012 0200	36.03	570.55	572.02		572.12	0.007473	2.63	13.71	15.12	0.49
TWI000A	3010	01JAN2012 0300	38.18	570.55	572.04		572.16	0.007771	2.71	14.08	15.28	0.50
TWI000A	3010	01JAN2012 0400	40.79	570.55	572.07		572.19	0.008174	2.81	14.50	15.45	0.51
TWI000A	3010	01JAN2012 0500	43.98	570.55	572.10		572.23	0.008659	2.93	14.99	15.64	0.53
TWI000A	3010	01JAN2012 0600	48.10	570.55	572.14		572.29	0.009226	3.08	15.62	15.89	0.55
TWI000A	3010	01JAN2012 0700	66.60	570.55	572.31		572.51	0.011118	3.61	18.44	16.96	0.61
TWI000A	3010	01JAN2012 0800	78.77	570.55	572.43		572.66	0.011704	3.86	20.42	17.67	0.63
TWI000A	3010	01JAN2012 0900	97.67	570.55	572.58		572.85	0.012727	4.22	23.14	18.60	0.67
TWI000A	3010	01JAN2012 1000	135.21	570.55	572.83		573.19	0.014223	4.81	28.14	20.19	0.72
TWI000A	3010	01JAN2012 1100	191.52	570.55	573.17		573.63	0.014798	5.43	35.26	21.57	0.75
TWI000A	3010	01JAN2012 1200	739.56	570.55	575.57		576.51	0.012241	7.76	95.34	28.45	0.75
TWI000A	3010	01JAN2012 1300	669.42	570.55	575.39		576.25	0.011733	7.42	90.21	27.94	0.73
TWI000A	3010	01JAN2012 1400	239.29	570.55	573.45		573.97	0.014520	5.80	41.23	22.39	0.75
TWI000A	3010	01JAN2012 1500	178.18	570.55	573.11		573.54	0.014476	5.27	33.83	21.35	0.74
TWI000A	3010	01JAN2012 1600	137.21	570.55	572.85		573.21	0.014080	4.81	28.54	20.32	0.71
TWI000A	3010	01JAN2012 1700	115.41	570.55	572.71		573.02	0.013451	4.51	25.59	19.40	0.69
TWI000A	3010	01JAN2012 1800	101.32	570.55	572.61		572.89	0.012753	4.27	23.74	18.80	0.67
TWI000A	3010	01JAN2012 1900	72.62	570.55	572.38		572.59	0.011104	3.70	19.63	17.39	0.61
TWI000A	3010	01JAN2012 2000	65.40	570.55	572.31		572.51	0.010664	3.54	18.47	16.97	0.60
TWI000A	3010	01JAN2012 2100	60.19	570.55	572.27		572.45	0.010259	3.41	17.65	16.67	0.58
TWI000A	3010	01JAN2012 2200	55.98	570.55	572.23		572.39	0.009875	3.30	16.99	16.42	0.57
TWI000A	3010	01JAN2012 2300	52.45	570.55	572.19		572.35	0.009510	3.19	16.43	16.21	0.56
TWI000A	3010	01JAN2012 2400	49.50	570.55	572.16		572.31	0.009175	3.10	15.97	16.03	0.55
TWI000A	2970	Max WS	3887.54	571.22	580.97		581.86	0.001601	7.71	663.51	220.61	0.47
TWI000A	2970	31DEC2011 2400	15.26	571.22	571.57		571.60	0.004628	1.43	10.68	38.52	0.48
TWI000A	2970	01JAN2012 0100	35.87	571.22	571.79		571.84	0.003850	1.89	18.99	39.10	0.48
TWI000A	2970	01JAN2012 0200	40.46	571.22	571.83		571.89	0.003649	1.95	20.78	39.23	0.47
TWI000A	2970	01JAN2012 0300	42.98	571.22	571.85		571.91	0.003642	1.99	21.57	39.28	0.47
TWI000A	2970	01JAN2012 0400	46.03	571.22	571.87		571.94	0.003659	2.05	22.47	39.34	0.48
TWI000A	2970	01JAN2012 0500	49.78	571.22	571.90		571.97	0.003660	2.11	23.57	39.42	0.48
TWI000A	2970	01JAN2012 0600	54.61	571.22	571.94		572.01	0.003640	2.19	24.99	39.52	0.48
TWI000A	2970	01JAN2012 0700	76.15	571.22	572.10		572.19	0.003381	2.43	31.35	39.96	0.48
TWI000A	2970	01JAN2012 0800	90.93	571.22	572.21		572.31	0.003146	2.54	35.77	40.26	0.48
TWI000A	2970	01JAN2012 0900	113.68	571.22	572.36		572.47	0.002983	2.72	41.76	40.66	0.47
TWI000A	2970	01JAN2012 1000	158.62	571.22	572.63		572.77	0.002723	3.00	52.87	41.40	0.47
TWI000A	2970	01JAN2012 1100	225.59	571.22	572.99		573.16	0.002448	3.31	68.22	42.41	0.46
TWI000A	2970	01JAN2012 1200	886.34	571.22	575.61		575.95	0.001637	4.70	188.39	49.56	0.43
TWI000A	2970	01JAN2012 1300	821.10	571.22	575.38		575.71	0.001688	4.63	177.25	48.94	0.43
TWI000A	2970	01JAN2012 1400	285.05	571.22	573.29		573.48	0.002286	3.53	80.86	43.21	0.45
TWI000A	2970	01JAN2012 1500	211.10	571.22	572.91		573.08	0.002511	3.25	64.90	42.19	0.46
TWI000A	2970	01JAN2012 1600	161.93	571.22	572.65		572.79	0.002700	3.02	53.70	41.46	0.47
TWI000A	2970	01JAN2012 1700	135.96	571.22	572.49		572.62	0.002870	2.88	47.24	41.03	0.47
TWI000A	2970	01JAN2012 1800	119.08	571.22	572.39		572.51	0.002960	2.76	43.08	40.75	0.47
TWI000A	2970	01JAN2012 1900	84.83	571.22	572.16		572.26	0.003244	2.50	33.94	40.13	0.48
TWI000A	2970	01JAN2012 2000	76.18	571.22	572.10		572.19	0.003379	2.43	31.37	39.96	0.48
TWI000A	2970	01JAN2012 2100	69.95	571.22	572.05		572.14	0.003472	2.37	29.52	39.83	0.49
TWI000A	2970	01JAN2012 2200	64.92	571.22	572.01		572.10	0.003540	2.32	28.02	39.73	0.49
TWI000A	2970	01JAN2012 2300	60.71	571.22	571.98		572.06	0.003588	2.27	26.78	39.64	0.49
TWI000A	2970	01JAN2012 2400	57.19	571.22	571.96		572.03	0.003619	2.22	25.75	39.57	0.49
TWI000A	2820 Bowen Rd		Culvert									
TWI000A	2668	Max WS	3942.57	566.85	578.08		578.64	0.005953	7.71	859.35	224.81	0.48
TWI000A	2668	31DEC2011 2400	15.26	566.85	569.35		569.35	0.000251	0.60	25.50	13.81	0.08
TWI000A	2668	01JAN2012 0100	35.87	566.85	569.91		569.93	0.000635	1.07	33.63	15.08	0.13
TWI000A	2668	01JAN2012 0200	40.46	566.85	569.99		570.02	0.000725	1.16	34.94	15.27	0.13
TWI000A	2668	01JAN2012 0300	42.98	566.85	570.04		570.07	0.000771	1.20	35.68	15.38	0.14
TWI000A	2668	01JAN2012 0400	46.03	566.85	570.10		570.13	0.000825	1.26	36.59	15.51	0.14
TWI000A	2668	01JAN2012 0500	49.78	566.85	570.17		570.20	0.000887	1.32	37.71	15.69	0.15
TWI000A	2668	01JAN2012 0600	54.61	566.85	570.27		570.30	0.000982	1.39	39.19	16.26	0.16
TWI000A	2668	01JAN2012 0700	76.15	566.85	570.59		570.64	0.001412	1.70	44.87	18.29	0.19
TWI000A	2668	01JAN2012 0800	90.93	566.85	570.81		570.86	0.001651	1.86	48.88	19.60	0.21
TWI000A	2668	01JAN2012 0900	113.68	566.85	571.07		571.14	0.002012	2.09	54.33	21.24	0.23
TWI000A	2668	01JAN2012 1000	158.62	566.85	571.54		571.64	0.002390	2.46	64.57	22.42	0.26
TWI000A	2668	01JAN2012 1100	225.59	566.85	572.13		572.26	0.002857	2.89	78.14	24.24	0.28
TWI000A	2668	01JAN2012 1200	886.34	566.85	574.55		574.96	0.006410	5.42	214.36	120.52	0.45
TWI000A	2668	01JAN2012 1300	821.10	566.85	574.49		574.86	0.005853	5.13	207.27	116.72	0.43
TWI000A	2668	01JAN2012 1400	285.05	566.85	572.54		572.70	0.003314	3.22	88.54	26.12	0.31
TWI000A	2668	01JAN2012 1500	211.10	566.85	572.03		572.15	0.002713	2.79	75.69	23.77	0.28
TWI000A	2668	01JAN2012 1600	161.93	566.85	571.58		571.68	0.002395	2.47	65.46	22.52	0.26
TWI000A	2668	01JAN2012 1700	135.96	566.85	571.33		571.41	0.002175	2.27	59.92	21.91	0.24
TWI000A	2668	01JAN2012 1800	119.08	566.85	571.14		571.21	0.002043	2.13	55.83	21.44	0.23
TWI000A	2668	01JAN2012 1900	84.83	566.85	570.72		570.77	0.001555	1.80	47.25	19.08	0.20
TWI000A	2668	01JAN2012 2000	76.18	566.85	570.60		570.64	0.001411	1.70	44.90	18.30	0.19
TWI000A	2668	01JAN2012 2100	69.95	566.85	570.51		570.55	0.001294	1.62	43.26	17.74	0.18
TWI000A	2668	01JAN2012 2200	64.92	566.85	570.43		570.47	0.001193	1.55	41.97	17.28	0.17
TWI000A	2668	01JAN2012 2300	60.71	566.85	570.37		570.40	0.001104	1.48	40.92	16.90	0.17
TWI000A	2668	01JAN2012 2400	57.19	566.85	570.32		570.35	0.001027	1.43	40.06	16.58	0.16
TWI000A	2599	Max WS	3936.53	567.91	577.31		578.21	0.008932	8.90	671.64	189.45	0.61

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	2599	31DEC2011 2400	15.54	567.91	569.03		569.09	0.008675	1.94	7.99	11.49	0.41
TWI000A	2599	01JAN2012 0100	35.69	567.91	569.48		569.58	0.010215	2.59	13.80	14.55	0.47
TWI000A	2599	01JAN2012 0200	40.44	567.91	569.59		569.69	0.009638	2.62	15.43	15.27	0.46
TWI000A	2599	01JAN2012 0300	42.96	567.91	569.63		569.74	0.009626	2.66	16.14	15.57	0.46
TWI000A	2599	01JAN2012 0400	46.01	567.91	569.69		569.80	0.009511	2.70	17.04	15.95	0.46
TWI000A	2599	01JAN2012 0500	49.75	567.91	569.76		569.87	0.009308	2.74	18.19	16.41	0.46
TWI000A	2599	01JAN2012 0600	54.57	567.91	569.85		569.97	0.008987	2.77	19.71	17.01	0.45
TWI000A	2599	01JAN2012 0700	76.09	567.91	570.19		570.32	0.008342	2.95	25.83	19.16	0.45
TWI000A	2599	01JAN2012 0800	90.83	567.91	570.39		570.54	0.007956	3.04	29.87	20.36	0.44
TWI000A	2599	01JAN2012 0900	113.54	567.91	570.66		570.82	0.007661	3.19	35.61	21.96	0.44
TWI000A	2599	01JAN2012 1000	158.37	567.91	571.13		571.31	0.007190	3.40	46.61	24.85	0.44
TWI000A	2599	01JAN2012 1100	225.34	567.91	571.73		571.93	0.006646	3.60	62.67	28.93	0.43
TWI000A	2599	01JAN2012 1200	872.56	567.91	574.02		574.46	0.008301	5.46	186.19	98.85	0.52
TWI000A	2599	01JAN2012 1300	828.95	567.91	573.99		574.40	0.007722	5.24	183.51	97.45	0.50
TWI000A	2599	01JAN2012 1400	285.32	567.91	572.13		572.35	0.006927	3.81	74.82	32.67	0.44
TWI000A	2599	01JAN2012 1500	211.35	567.91	571.64		571.83	0.006565	3.52	59.99	28.29	0.43
TWI000A	2599	01JAN2012 1600	162.08	567.91	571.18		571.36	0.007058	3.39	47.76	25.17	0.43
TWI000A	2599	01JAN2012 1700	136.05	567.91	570.93		571.09	0.007193	3.27	41.59	23.51	0.43
TWI000A	2599	01JAN2012 1800	119.15	567.91	570.74		570.90	0.007394	3.19	37.37	22.43	0.44
TWI000A	2599	01JAN2012 1900	84.90	567.91	570.31		570.45	0.008090	3.00	28.27	19.90	0.44
TWI000A	2599	01JAN2012 2000	76.22	567.91	570.19		570.33	0.008323	2.95	25.88	19.18	0.45
TWI000A	2599	01JAN2012 2100	69.98	567.91	570.10		570.23	0.008445	2.89	24.20	18.64	0.45
TWI000A	2599	01JAN2012 2200	64.95	567.91	570.03		570.15	0.008510	2.84	22.84	18.17	0.45
TWI000A	2599	01JAN2012 2300	60.73	567.91	569.96		570.08	0.008593	2.80	21.67	17.74	0.45
TWI000A	2599	01JAN2012 2400	57.21	567.91	569.91		570.03	0.008629	2.76	20.71	17.39	0.45
TWI000A	2389	Max WS	3939.07	565.02	576.00		576.55	0.005881	7.67	758.73	172.22	0.47
TWI000A	2389	31DEC2011 2400	17.84	565.02	568.22		568.23	0.000178	0.55	32.57	14.73	0.06
TWI000A	2389	01JAN2012 0100	34.96	565.02	568.46		568.47	0.000515	0.97	36.07	15.37	0.11
TWI000A	2389	01JAN2012 0200	40.57	565.02	568.64		568.66	0.000565	1.04	39.04	16.09	0.12
TWI000A	2389	01JAN2012 0300	43.08	565.02	568.69		568.71	0.000607	1.08	39.78	16.27	0.12
TWI000A	2389	01JAN2012 0400	46.14	565.02	568.75		568.77	0.000652	1.13	40.81	16.50	0.13
TWI000A	2389	01JAN2012 0500	49.88	565.02	568.83		568.85	0.000703	1.19	42.08	16.79	0.13
TWI000A	2389	01JAN2012 0600	54.70	565.02	568.93		568.95	0.000766	1.25	43.72	17.16	0.14
TWI000A	2389	01JAN2012 0700	76.33	565.02	569.33		569.36	0.001000	1.50	50.94	18.70	0.16
TWI000A	2389	01JAN2012 0800	91.07	565.02	569.53		569.57	0.001180	1.66	54.74	19.45	0.17
TWI000A	2389	01JAN2012 0900	113.82	565.02	569.83		569.88	0.001403	1.87	60.73	20.59	0.19
TWI000A	2389	01JAN2012 1000	158.88	565.02	570.29		570.37	0.001827	2.24	70.79	22.38	0.22
TWI000A	2389	01JAN2012 1100	226.54	565.02	570.88		570.99	0.002328	2.68	84.52	24.60	0.25
TWI000A	2389	01JAN2012 1200	854.74	565.02	572.59		572.97	0.005905	5.41	225.68	125.83	0.43
TWI000A	2389	01JAN2012 1300	858.45	565.02	572.74		573.07	0.005082	5.12	244.38	131.18	0.40
TWI000A	2389	01JAN2012 1400	288.88	565.02	571.17		571.32	0.002978	3.14	93.37	41.32	0.29
TWI000A	2389	01JAN2012 1500	214.00	565.02	570.81		570.91	0.002189	2.58	82.86	24.34	0.25
TWI000A	2389	01JAN2012 1600	163.96	565.02	570.35		570.43	0.001860	2.28	72.02	22.58	0.22
TWI000A	2389	01JAN2012 1700	137.55	565.02	570.10		570.16	0.001619	2.07	66.43	21.62	0.21
TWI000A	2389	01JAN2012 1800	120.39	565.02	569.92		569.98	0.001440	1.92	62.76	20.97	0.20
TWI000A	2389	01JAN2012 1900	85.85	565.02	569.45		569.49	0.001125	1.61	53.29	19.17	0.17
TWI000A	2389	01JAN2012 2000	76.97	565.02	569.33		569.37	0.001015	1.51	50.99	18.70	0.16
TWI000A	2389	01JAN2012 2100	70.65	565.02	569.24		569.27	0.000935	1.43	49.28	18.35	0.15
TWI000A	2389	01JAN2012 2200	65.57	565.02	569.16		569.18	0.000874	1.37	47.77	18.04	0.15
TWI000A	2389	01JAN2012 2300	61.31	565.02	569.07		569.10	0.000830	1.33	46.26	17.72	0.14
TWI000A	2389	01JAN2012 2400	57.74	565.02	569.00		569.02	0.000792	1.28	44.99	17.44	0.14
TWI000A	2202	Max WS	3928.78	565.73	575.10		575.57	0.004659	6.78	958.90	204.60	0.44
TWI000A	2202	31DEC2011 2400	21.93	565.73	568.19		568.19	0.000222	0.54	40.95	26.07	0.08
TWI000A	2202	01JAN2012 0100	33.65	565.73	568.38		568.39	0.000374	0.73	46.06	27.19	0.10
TWI000A	2202	01JAN2012 0200	40.67	565.73	568.56		568.57	0.000407	0.80	51.12	28.25	0.10
TWI000A	2202	01JAN2012 0300	43.17	565.73	568.60		568.61	0.000431	0.83	52.27	28.48	0.11
TWI000A	2202	01JAN2012 0400	46.24	565.73	568.66		568.67	0.000453	0.86	53.90	28.81	0.11
TWI000A	2202	01JAN2012 0500	49.97	565.73	568.73		568.74	0.000477	0.89	55.93	29.22	0.11
TWI000A	2202	01JAN2012 0600	54.79	565.73	568.82		568.83	0.000504	0.94	58.58	29.74	0.12
TWI000A	2202	01JAN2012 0700	76.57	565.73	569.20		569.21	0.000595	1.09	70.24	32.06	0.13
TWI000A	2202	01JAN2012 0800	91.21	565.73	569.37		569.40	0.000679	1.20	76.05	33.19	0.14
TWI000A	2202	01JAN2012 0900	113.96	565.73	569.65		569.68	0.000773	1.33	85.46	35.02	0.15
TWI000A	2202	01JAN2012 1000	159.19	565.73	570.07		570.11	0.000968	1.58	102.03	45.13	0.17
TWI000A	2202	01JAN2012 1100	227.20	565.73	570.61		570.66	0.001222	1.82	132.82	95.27	0.19
TWI000A	2202	01JAN2012 1200	838.65	565.73	571.89		572.07	0.003038	3.71	342.52	181.31	0.32
TWI000A	2202	01JAN2012 1300	892.44	565.73	572.15		572.30	0.002574	3.55	388.51	183.02	0.30
TWI000A	2202	01JAN2012 1400	293.45	565.73	570.83		570.90	0.001532	2.15	159.10	141.22	0.22
TWI000A	2202	01JAN2012 1500	216.95	565.73	570.55		570.60	0.001193	1.78	127.93	83.96	0.19
TWI000A	2202	01JAN2012 1600	165.75	565.73	570.12		570.16	0.001003	1.61	104.29	46.26	0.17
TWI000A	2202	01JAN2012 1700	138.99	565.73	569.89		569.93	0.000886	1.47	94.46	40.11	0.16
TWI000A	2202	01JAN2012 1800	121.56	565.73	569.74		569.77	0.000796	1.37	88.74	35.68	0.15
TWI000A	2202	01JAN2012 1900	86.78	565.73	569.30		569.33	0.000669	1.18	73.73	32.74	0.14
TWI000A	2202	01JAN2012 2000	77.66	565.73	569.20		569.21	0.000613	1.11	70.22	32.05	0.13
TWI000A	2202	01JAN2012 2100	71.28	565.73	569.11		569.13	0.000573	1.05	67.61	31.53	0.13
TWI000A	2202	01JAN2012 2200	66.17	565.73	569.04		569.05	0.000545	1.01	65.23	31.05	0.12
TWI000A	2202	01JAN2012 2300	61.86	565.73	568.96		568.97	0.000529	0.99	62.76	30.54	0.12
TWI000A	2202	01JAN2012 2400	58.23	565.73	568.89		568.90	0.000515	0.96	60.69	30.15	0.12
TWI000A	2201		Lat Struct									
TWI000A	2108	Max WS	3910.41	566.08	574.56		575.06	0.006241	7.31	1208.96	298.88	0.51
TWI000A	2108	31DEC2011 2400	24.60	566.08	568.15		568.16	0.000503	0.73	33.92	25.46	0.11

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	2108	01JAN2012 0100	32.78	566.08	568.33		568.34	0.000623	0.85	38.62	26.84	0.12
TWI000A	2108	01JAN2012 0200	40.73	566.08	568.51		568.52	0.000693	0.94	43.47	28.20	0.13
TWI000A	2108	01JAN2012 0300	43.22	566.08	568.54		568.56	0.000730	0.97	44.53	28.49	0.14
TWI000A	2108	01JAN2012 0400	46.28	566.08	568.60		568.61	0.000762	1.00	46.08	28.90	0.14
TWI000A	2108	01JAN2012 0500	50.01	566.08	568.66		568.68	0.000792	1.04	48.05	29.42	0.14
TWI000A	2108	01JAN2012 0600	54.82	566.08	568.75		568.77	0.000824	1.08	50.65	30.10	0.15
TWI000A	2108	01JAN2012 0700	76.70	566.08	569.12		569.14	0.000914	1.23	62.22	32.83	0.16
TWI000A	2108	01JAN2012 0800	91.25	566.08	569.29		569.32	0.001018	1.34	67.88	34.08	0.17
TWI000A	2108	01JAN2012 0900	113.94	566.08	569.55		569.59	0.001123	1.48	77.19	71.50	0.18
TWI000A	2108	01JAN2012 1000	158.91	566.08	569.96		570.00	0.001321	1.68	106.80	115.97	0.20
TWI000A	2108	01JAN2012 1100	226.79	566.08	570.49		570.54	0.001400	1.88	147.27	174.48	0.21
TWI000A	2108	01JAN2012 1200	833.29	566.08	571.56		571.74	0.003872	3.80	423.52	229.63	0.36
TWI000A	2108	01JAN2012 1300	914.58	566.08	571.87		572.03	0.003209	3.66	495.40	233.76	0.33
TWI000A	2108	01JAN2012 1400	296.92	566.08	570.67		570.74	0.002016	2.26	162.55	195.93	0.25
TWI000A	2108	01JAN2012 1500	219.35	566.08	570.43		570.48	0.001391	1.86	142.95	167.83	0.20
TWI000A	2108	01JAN2012 1600	166.95	566.08	570.01		570.05	0.001372	1.73	110.07	121.91	0.20
TWI000A	2108	01JAN2012 1700	139.92	566.08	569.79		569.83	0.001291	1.63	86.01	91.06	0.19
TWI000A	2108	01JAN2012 1800	122.28	566.08	569.65		569.68	0.001159	1.52	80.53	78.85	0.18
TWI000A	2108	01JAN2012 1900	87.28	566.08	569.22		569.25	0.001027	1.33	65.49	33.56	0.17
TWI000A	2108	01JAN2012 2000	78.04	566.08	569.12		569.14	0.000951	1.26	62.10	32.80	0.16
TWI000A	2108	01JAN2012 2100	71.60	566.08	569.04		569.06	0.000897	1.20	59.60	32.23	0.16
TWI000A	2108	01JAN2012 2200	66.49	566.08	568.97		568.99	0.000863	1.16	57.28	31.70	0.15
TWI000A	2108	01JAN2012 2300	62.14	566.08	568.89		568.91	0.000851	1.13	54.81	31.12	0.15
TWI000A	2108	01JAN2012 2400	58.50	566.08	568.82		568.84	0.000839	1.11	52.74	30.63	0.15
TWI000A	1959	Max WS	3883.78	565.50	573.97		574.22	0.003874	5.78	1464.31	347.20	0.43
TWI000A	1959	31DEC2011 2400	27.52	565.50	567.35		567.46	0.010342	2.57	10.73	13.07	0.50
TWI000A	1959	01JAN2012 0100	31.93	565.50	567.43		567.54	0.011145	2.73	11.69	13.73	0.52
TWI000A	1959	01JAN2012 0200	40.80	565.50	567.60		567.73	0.010963	2.87	14.21	15.33	0.53
TWI000A	1959	01JAN2012 0300	43.29	565.50	567.64		567.77	0.010919	2.91	14.90	15.74	0.53
TWI000A	1959	01JAN2012 0400	46.34	565.50	567.69		567.83	0.010996	2.96	15.65	16.18	0.53
TWI000A	1959	01JAN2012 0500	50.08	565.50	567.75		567.89	0.011094	3.03	16.55	16.88	0.54
TWI000A	1959	01JAN2012 0600	54.88	565.50	567.81		567.96	0.011155	3.10	17.71	19.84	0.54
TWI000A	1959	01JAN2012 0700	76.87	565.50	568.06		568.25	0.011899	3.44	22.32	28.85	0.57
TWI000A	1959	01JAN2012 0800	91.34	565.50	568.20		568.41	0.012315	3.63	25.13	33.43	0.58
TWI000A	1959	01JAN2012 0900	113.97	565.50	568.40		568.64	0.012541	3.86	29.53	38.53	0.60
TWI000A	1959	01JAN2012 1000	158.53	565.50	568.70		568.99	0.013663	4.32	36.68	46.89	0.63
TWI000A	1959	01JAN2012 1100	226.19	565.50	569.12		569.46	0.013787	4.70	48.13	68.21	0.65
TWI000A	1959	01JAN2012 1200	809.87	565.50	570.55		570.82	0.009771	4.94	339.50	311.10	0.58
TWI000A	1959	01JAN2012 1300	959.21	565.50	571.48		571.58	0.002714	3.28	633.62	321.13	0.33
TWI000A	1959	01JAN2012 1400	301.63	565.50	569.66		569.96	0.012385	4.33	70.23	126.84	0.62
TWI000A	1959	01JAN2012 1500	222.85	565.50	569.17		569.48	0.012352	4.49	49.65	71.86	0.62
TWI000A	1959	01JAN2012 1600	168.71	565.50	568.81		569.09	0.012689	4.26	39.61	51.34	0.62
TWI000A	1959	01JAN2012 1700	141.27	565.50	568.62		568.88	0.012524	4.07	34.75	44.34	0.61
TWI000A	1959	01JAN2012 1800	123.34	565.50	568.50		568.73	0.012120	3.88	31.76	41.05	0.59
TWI000A	1959	01JAN2012 1900	88.04	565.50	568.20		568.39	0.011430	3.50	25.14	33.44	0.56
TWI000A	1959	01JAN2012 2000	78.58	565.50	568.10		568.28	0.011456	3.41	23.03	30.08	0.56
TWI000A	1959	01JAN2012 2100	72.08	565.50	568.03		568.20	0.011208	3.32	21.74	27.83	0.55
TWI000A	1959	01JAN2012 2200	66.93	565.50	567.98		568.14	0.011054	3.24	20.66	25.90	0.54
TWI000A	1959	01JAN2012 2300	62.54	565.50	567.92		568.08	0.011086	3.19	19.60	24.03	0.54
TWI000A	1959	01JAN2012 2400	58.87	565.50	567.87		568.03	0.011071	3.14	18.73	22.36	0.54
TWI000A	1815	Max WS	3868.34	564.98	573.70		573.78	0.001340	3.99	2044.31	381.82	0.25
TWI000A	1815	31DEC2011 2400	29.40	564.98	566.69		566.71	0.000931	1.07	28.54	26.47	0.16
TWI000A	1815	01JAN2012 0100	31.35	564.98	566.67		566.69	0.001107	1.16	28.05	26.23	0.18
TWI000A	1815	01JAN2012 0200	40.74	564.98	566.85		566.88	0.001235	1.31	33.58	42.48	0.19
TWI000A	1815	01JAN2012 0300	43.25	564.98	566.91		566.93	0.001232	1.34	36.19	51.52	0.19
TWI000A	1815	01JAN2012 0400	46.30	564.98	566.95		566.98	0.001280	1.38	38.54	55.37	0.19
TWI000A	1815	01JAN2012 0500	49.92	564.98	567.00		567.03	0.001342	1.44	41.31	65.93	0.20
TWI000A	1815	01JAN2012 0600	54.68	564.98	567.05		567.09	0.001419	1.51	45.41	78.87	0.20
TWI000A	1815	01JAN2012 0700	76.55	564.98	567.21		567.26	0.001953	1.85	60.39	123.68	0.24
TWI000A	1815	01JAN2012 0800	90.87	564.98	567.33		567.38	0.002014	1.95	78.93	163.88	0.25
TWI000A	1815	01JAN2012 0900	113.11	564.98	567.50		567.55	0.001995	2.03	107.69	182.32	0.25
TWI000A	1815	01JAN2012 1000	157.00	564.98	567.75		567.80	0.001957	2.13	155.77	194.42	0.25
TWI000A	1815	01JAN2012 1100	224.04	564.98	568.12		568.16	0.001701	2.14	229.64	217.99	0.23
TWI000A	1815	01JAN2012 1200	737.01	564.98	569.91		569.94	0.000967	2.24	741.52	310.44	0.19
TWI000A	1815	01JAN2012 1300	1012.76	564.98	571.30		571.31	0.000456	1.85	1187.10	333.38	0.14
TWI000A	1815	01JAN2012 1400	307.18	564.98	568.77		568.79	0.000947	1.82	398.14	290.07	0.18
TWI000A	1815	01JAN2012 1500	225.15	564.98	568.26		568.30	0.001259	1.90	263.48	236.82	0.20
TWI000A	1815	01JAN2012 1600	170.00	564.98	567.95		567.99	0.001416	1.89	195.38	202.02	0.21
TWI000A	1815	01JAN2012 1700	142.03	564.98	567.76		567.80	0.001573	1.92	157.15	194.69	0.22
TWI000A	1815	01JAN2012 1800	123.82	564.98	567.63		567.67	0.001667	1.91	132.44	188.94	0.23
TWI000A	1815	01JAN2012 1900	88.70	564.98	567.41		567.45	0.001575	1.76	91.43	175.69	0.22
TWI000A	1815	01JAN2012 2000	78.82	564.98	567.29		567.33	0.001688	1.77	72.20	154.64	0.22
TWI000A	1815	01JAN2012 2100	72.25	564.98	567.23		567.27	0.001655	1.72	63.06	132.40	0.22
TWI000A	1815	01JAN2012 2200	67.06	564.98	567.18		567.22	0.001602	1.67	57.13	113.19	0.22
TWI000A	1815	01JAN2012 2300	62.66	564.98	567.14		567.18	0.001539	1.61	52.87	98.28	0.21
TWI000A	1815	01JAN2012 2400	58.96	564.98	567.10		567.14	0.001472	1.56	49.78	89.20	0.21
TWI000A	1704	Max WS	3923.64	565.00	573.60		573.66	0.000885	3.43	2453.17	412.00	0.22
TWI000A	1704	31DEC2011 2400	34.01	565.00	566.55		566.57	0.002511	1.35	40.91	101.91	0.25
TWI000A	1704	01JAN2012 0100	31.29	565.00	566.53		566.55	0.002297	1.29	38.81	98.78	0.24
TWI000A	1704	01JAN2012 0200	41.92	565.00	566.73		566.75	0.001882	1.22	65.58	188.67	0.22
TWI000A	1704	01JAN2012 0300	44.62	565.00	566.79		566.81	0.001534	1.15	77.50	208.80	0.20

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1704	01JAN2012 0400	47.79	565.00	566.84		566.85	0.001420	1.14	86.41	222.96	0.20
TWI000A	1704	01JAN2012 0500	51.55	565.00	566.88		566.89	0.001333	1.13	96.01	231.79	0.19
TWI000A	1704	01JAN2012 0600	56.62	565.00	566.93		566.94	0.001244	1.13	108.51	242.89	0.19
TWI000A	1704	01JAN2012 0700	79.28	565.00	567.08		567.09	0.001241	1.22	146.31	266.46	0.19
TWI000A	1704	01JAN2012 0800	94.50	565.00	567.21		567.22	0.001024	1.19	182.01	275.69	0.18
TWI000A	1704	01JAN2012 0900	117.70	565.00	567.37		567.38	0.000890	1.19	226.63	282.77	0.17
TWI000A	1704	01JAN2012 1000	163.35	565.00	567.64		567.65	0.000766	1.22	303.81	295.70	0.16
TWI000A	1704	01JAN2012 1100	233.70	565.00	568.02		568.03	0.000628	1.25	417.56	304.90	0.15
TWI000A	1704	01JAN2012 1200	821.80	565.00	569.84		569.85	0.000548	1.74	1019.70	349.50	0.15
TWI000A	1704	01JAN2012 1300	1075.02	565.00	571.26		571.28	0.000271	1.50	1536.37	374.51	0.11
TWI000A	1704	01JAN2012 1400	325.61	565.00	568.71		568.72	0.000355	1.13	637.86	327.71	0.12
TWI000A	1704	01JAN2012 1500	236.26	565.00	568.19		568.20	0.000449	1.11	471.64	309.54	0.13
TWI000A	1704	01JAN2012 1600	178.27	565.00	567.87		567.87	0.000509	1.08	372.37	300.98	0.13
TWI000A	1704	01JAN2012 1700	148.52	565.00	567.67		567.68	0.000581	1.08	313.13	296.36	0.14
TWI000A	1704	01JAN2012 1800	129.23	565.00	567.53		567.54	0.000643	1.08	273.18	290.23	0.14
TWI000A	1704	01JAN2012 1900	93.13	565.00	567.31		567.32	0.000681	1.01	210.22	280.23	0.14
TWI000A	1704	01JAN2012 2000	82.14	565.00	567.19		567.20	0.000837	1.06	176.50	274.55	0.16
TWI000A	1704	01JAN2012 2100	75.15	565.00	567.13		567.14	0.000911	1.07	158.96	270.09	0.16
TWI000A	1704	01JAN2012 2200	69.72	565.00	567.08		567.09	0.000971	1.08	145.61	266.26	0.17
TWI000A	1704	01JAN2012 2300	65.09	565.00	567.03		567.04	0.001018	1.08	134.61	260.56	0.17
TWI000A	1704	01JAN2012 2400	61.23	565.00	567.00		567.01	0.001056	1.08	125.60	252.31	0.17
TWI000A	1522	Max WS	3917.53	564.01	573.45		573.51	0.000714	3.07	2157.35	367.42	0.19
TWI000A	1522	31DEC2011 2400	43.43	564.01	566.33		566.34	0.000806	1.11	57.45	103.01	0.15
TWI000A	1522	01JAN2012 0100	28.43	564.01	566.36		566.36	0.000315	0.70	60.83	106.16	0.10
TWI000A	1522	01JAN2012 0200	41.18	564.01	566.60		566.61	0.000335	0.77	89.18	131.01	0.10
TWI000A	1522	01JAN2012 0300	44.28	564.01	566.67		566.67	0.000322	0.77	98.59	139.24	0.10
TWI000A	1522	01JAN2012 0400	47.50	564.01	566.71		566.71	0.000335	0.79	104.21	148.68	0.10
TWI000A	1522	01JAN2012 0500	51.24	564.01	566.74		566.75	0.000354	0.82	109.97	158.04	0.10
TWI000A	1522	01JAN2012 0600	56.16	564.01	566.79		566.80	0.000387	0.86	117.45	167.51	0.11
TWI000A	1522	01JAN2012 0700	77.50	564.01	566.94		566.95	0.000487	1.00	144.07	184.37	0.12
TWI000A	1522	01JAN2012 0800	92.79	564.01	567.09		567.10	0.000479	1.02	172.51	202.47	0.12
TWI000A	1522	01JAN2012 0900	115.42	564.01	567.25		567.26	0.000493	1.07	207.17	219.87	0.13
TWI000A	1522	01JAN2012 1000	158.96	564.01	567.53		567.54	0.000491	1.12	271.17	242.76	0.13
TWI000A	1522	01JAN2012 1100	228.60	564.01	567.92		567.93	0.000436	1.16	370.66	259.20	0.12
TWI000A	1522	01JAN2012 1200	703.92	564.01	569.76		569.77	0.000316	1.38	898.52	307.03	0.11
TWI000A	1522	01JAN2012 1300	1148.64	564.01	571.22		571.23	0.000243	1.45	1369.87	338.20	0.10
TWI000A	1522	01JAN2012 1400	338.39	564.01	568.66		568.66	0.000282	1.09	570.62	285.14	0.10
TWI000A	1522	01JAN2012 1500	241.43	564.01	568.12		568.13	0.000334	1.06	423.13	265.12	0.11
TWI000A	1522	01JAN2012 1600	182.00	564.01	567.79		567.80	0.000362	1.02	336.72	255.32	0.11
TWI000A	1522	01JAN2012 1700	150.73	564.01	567.58		567.59	0.000388	1.01	285.06	246.14	0.11
TWI000A	1522	01JAN2012 1800	130.60	564.01	567.44		567.45	0.000404	1.00	250.50	237.20	0.11
TWI000A	1522	01JAN2012 1900	95.82	564.01	567.22		567.23	0.000364	0.91	201.10	217.18	0.11
TWI000A	1522	01JAN2012 2000	83.10	564.01	567.09		567.10	0.000381	0.91	173.22	202.93	0.11
TWI000A	1522	01JAN2012 2100	75.81	564.01	567.02		567.03	0.000378	0.90	159.29	194.07	0.11
TWI000A	1522	01JAN2012 2200	70.23	564.01	566.97		566.98	0.000372	0.88	149.15	187.67	0.11
TWI000A	1522	01JAN2012 2300	65.51	564.01	566.92		566.93	0.000365	0.86	140.92	182.51	0.11
TWI000A	1522	01JAN2012 2400	61.58	564.01	566.89		566.89	0.000358	0.85	133.90	178.33	0.11
TWI000A	1354	Max WS	3947.86	563.89	573.30		573.39	0.000991	3.69	1830.60	382.98	0.23
TWI000A	1354	31DEC2011 2400	47.53	563.89	566.22		566.24	0.000655	1.07	66.92	107.53	0.14
TWI000A	1354	01JAN2012 0100	27.18	563.89	566.32		566.33	0.000162	0.55	78.27	113.36	0.07
TWI000A	1354	01JAN2012 0200	40.86	563.89	566.56		566.56	0.000237	0.61	106.76	132.08	0.08
TWI000A	1354	01JAN2012 0300	44.49	563.89	566.63		566.63	0.000244	0.60	116.56	139.24	0.09
TWI000A	1354	01JAN2012 0400	47.78	563.89	566.67		566.67	0.000258	0.62	121.91	142.44	0.09
TWI000A	1354	01JAN2012 0500	51.58	563.89	566.70		566.71	0.000269	0.64	126.98	143.25	0.09
TWI000A	1354	01JAN2012 0600	56.52	563.89	566.75		566.75	0.000283	0.67	133.15	144.22	0.09
TWI000A	1354	01JAN2012 0700	77.33	563.89	566.88		566.89	0.000362	0.80	152.84	147.45	0.11
TWI000A	1354	01JAN2012 0800	93.13	563.89	567.03		567.03	0.000362	0.84	174.61	151.60	0.11
TWI000A	1354	01JAN2012 0900	115.92	563.89	567.19		567.20	0.000386	0.92	199.42	156.18	0.11
TWI000A	1354	01JAN2012 1000	159.21	563.89	567.46		567.47	0.000421	1.04	242.44	169.58	0.12
TWI000A	1354	01JAN2012 1100	229.90	563.89	567.85		567.87	0.000443	1.18	312.74	180.34	0.13
TWI000A	1354	01JAN2012 1200	676.53	563.89	569.70		569.72	0.000410	1.61	684.54	225.66	0.13
TWI000A	1354	01JAN2012 1300	1216.66	563.89	571.16		571.19	0.000391	1.89	1071.08	321.05	0.14
TWI000A	1354	01JAN2012 1400	352.71	563.89	568.60		568.62	0.000355	1.25	452.73	194.83	0.12
TWI000A	1354	01JAN2012 1500	248.97	563.89	568.07		568.08	0.000369	1.14	351.46	183.76	0.12
TWI000A	1354	01JAN2012 1600	187.58	563.89	567.73		567.74	0.000362	1.04	291.41	178.43	0.11
TWI000A	1354	01JAN2012 1700	154.78	563.89	567.53		567.54	0.000365	0.99	254.65	175.09	0.11
TWI000A	1354	01JAN2012 1800	133.69	563.89	567.38		567.39	0.000341	0.92	230.70	161.42	0.11
TWI000A	1354	01JAN2012 1900	99.16	563.89	567.18		567.18	0.000290	0.79	197.68	155.87	0.10
TWI000A	1354	01JAN2012 2000	85.17	563.89	567.04		567.05	0.000292	0.76	177.00	152.04	0.10
TWI000A	1354	01JAN2012 2100	77.56	563.89	566.97		566.98	0.000287	0.73	166.46	150.06	0.10
TWI000A	1354	01JAN2012 2200	71.67	563.89	566.92		566.93	0.000279	0.71	158.84	148.61	0.09
TWI000A	1354	01JAN2012 2300	66.88	563.89	566.88		566.88	0.000272	0.69	152.58	147.40	0.09
TWI000A	1354	01JAN2012 2400	62.80	563.89	566.84		566.85	0.000265	0.67	147.15	146.40	0.09
TWI000A	1241	Max WS	3956.10	563.81	572.63		573.26	0.006068	8.84	874.51	324.46	0.55
TWI000A	1241	31DEC2011 2400	52.95	563.81	566.12		566.14	0.001042	1.35	39.21	21.92	0.18
TWI000A	1241	01JAN2012 0100	30.98	563.81	566.29		566.30	0.000269	0.72	43.16	22.47	0.09
TWI000A	1241	01JAN2012 0200	45.02	563.81	566.51		566.53	0.000420	0.93	48.21	23.59	0.12
TWI000A	1241	01JAN2012 0300	48.80	563.81	566.58		566.60	0.000450	0.98	49.89	23.95	0.12
TWI000A	1241	01JAN2012 0400	52.13	563.81	566.62		566.63	0.000490	1.03	50.72	24.13	0.12
TWI000A	1241	01JAN2012 0500	55.93	563.81	566.65		566.67	0.000542	1.09	51.47	24.29	0.13
TWI000A	1241	01JAN2012 0600	60.83	563.81	566.69		566.71	0.000612	1.16	52.37	24.48	0.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1241	01JAN2012 0700	81.30	563.81	566.79		566.83	0.000944	1.48	54.96	25.11	0.17
TWI000A	1241	01JAN2012 0800	97.21	563.81	566.92		566.96	0.001124	1.67	58.27	26.06	0.19
TWI000A	1241	01JAN2012 0900	119.88	563.81	567.06		567.12	0.001415	1.95	61.89	27.27	0.22
TWI000A	1241	01JAN2012 1000	162.75	563.81	567.28		567.37	0.001955	2.42	68.12	29.23	0.26
TWI000A	1241	01JAN2012 1100	233.22	563.81	567.61		567.75	0.002699	3.07	78.27	32.17	0.31
TWI000A	1241	01JAN2012 1200	738.71	563.81	569.08		569.63	0.006329	6.13	143.81	62.78	0.51
TWI000A	1241	01JAN2012 1300	1253.51	563.81	570.69		571.18	0.004521	6.35	294.14	205.79	0.45
TWI000A	1241	01JAN2012 1400	360.15	563.81	568.31		568.53	0.003054	3.76	103.64	42.78	0.34
TWI000A	1241	01JAN2012 1500	254.54	563.81	567.84		567.98	0.002496	3.10	85.82	34.32	0.30
TWI000A	1241	01JAN2012 1600	192.83	563.81	567.55		567.66	0.001965	2.59	76.54	31.68	0.26
TWI000A	1241	01JAN2012 1700	159.67	563.81	567.37		567.45	0.001673	2.29	70.93	30.07	0.24
TWI000A	1241	01JAN2012 1800	138.42	563.81	567.25		567.32	0.001465	2.08	67.31	28.98	0.22
TWI000A	1241	01JAN2012 1900	104.20	563.81	567.08		567.12	0.001036	1.68	62.52	27.47	0.19
TWI000A	1241	01JAN2012 2000	89.82	563.81	566.96		566.99	0.000913	1.52	59.19	26.37	0.17
TWI000A	1241	01JAN2012 2100	82.13	563.81	566.89		566.93	0.000834	1.43	57.57	25.82	0.17
TWI000A	1241	01JAN2012 2200	76.23	563.81	566.85		566.88	0.000766	1.35	56.42	25.48	0.16
TWI000A	1241	01JAN2012 2300	71.41	563.81	566.81		566.84	0.000708	1.29	55.47	25.24	0.15
TWI000A	1241	01JAN2012 2400	67.32	563.81	566.78		566.80	0.000658	1.23	54.66	25.03	0.15
TWI000A	1205	Max WS	3898.20	563.78	572.00	572.21	573.23	0.012260	11.79	656.99	310.23	0.76
TWI000A	1205	31DEC2011 2400	54.14	563.78	566.07		566.10	0.001217	1.45	37.36	20.63	0.19
TWI000A	1205	01JAN2012 0100	32.16	563.78	566.28		566.29	0.000308	0.77	41.76	21.14	0.10
TWI000A	1205	01JAN2012 0200	46.24	563.78	566.49		566.51	0.000469	1.00	46.33	21.71	0.12
TWI000A	1205	01JAN2012 0300	50.04	563.78	566.56		566.58	0.000500	1.05	47.84	21.90	0.12
TWI000A	1205	01JAN2012 0400	53.37	563.78	566.60		566.62	0.000545	1.10	48.55	21.99	0.13
TWI000A	1205	01JAN2012 0500	57.17	563.78	566.63		566.65	0.000602	1.16	49.19	22.07	0.14
TWI000A	1205	01JAN2012 0600	62.06	563.78	566.66		566.68	0.000679	1.24	49.94	22.16	0.15
TWI000A	1205	01JAN2012 0700	82.51	563.78	566.75		566.79	0.001068	1.59	51.93	22.52	0.18
TWI000A	1205	01JAN2012 0800	98.42	563.78	566.87		566.92	0.001297	1.80	54.69	23.38	0.20
TWI000A	1205	01JAN2012 0900	121.08	563.78	566.99		567.06	0.001684	2.11	57.56	24.68	0.23
TWI000A	1205	01JAN2012 1000	163.92	563.78	567.18		567.29	0.002416	2.65	62.80	30.48	0.28
TWI000A	1205	01JAN2012 1100	234.35	563.78	567.47		567.64	0.003456	3.39	72.87	39.12	0.34
TWI000A	1205	01JAN2012 1200	761.55	563.78	568.58		569.34	0.010567	7.32	122.34	49.80	0.64
TWI000A	1205	01JAN2012 1300	1260.78	563.78	570.41		571.06	0.006127	7.12	237.31	123.20	0.51
TWI000A	1205	01JAN2012 1400	361.73	563.78	568.18		568.42	0.003594	3.99	103.34	45.99	0.36
TWI000A	1205	01JAN2012 1500	255.89	563.78	567.72		567.89	0.003055	3.36	82.85	41.49	0.33
TWI000A	1205	01JAN2012 1600	194.15	563.78	567.46		567.58	0.002404	2.82	72.45	38.95	0.29
TWI000A	1205	01JAN2012 1700	160.95	563.78	567.29		567.39	0.002028	2.50	66.36	33.85	0.26
TWI000A	1205	01JAN2012 1800	139.69	563.78	567.18		567.26	0.001757	2.26	62.77	30.44	0.24
TWI000A	1205	01JAN2012 1900	105.49	563.78	567.03		567.08	0.001210	1.81	58.62	25.96	0.20
TWI000A	1205	01JAN2012 2000	91.08	563.78	566.91		566.96	0.001049	1.64	55.75	23.69	0.18
TWI000A	1205	01JAN2012 2100	83.38	563.78	566.86		566.89	0.000947	1.53	54.38	23.28	0.17
TWI000A	1205	01JAN2012 2200	77.48	563.78	566.81		566.85	0.000863	1.45	53.42	22.99	0.17
TWI000A	1205	01JAN2012 2300	72.66	563.78	566.78		566.81	0.000795	1.38	52.63	22.74	0.16
TWI000A	1205	01JAN2012 2400	68.57	563.78	566.75		566.78	0.000737	1.32	51.95	22.53	0.15
TWI000A	1115	Max WS	3884.53	564.00	571.83		571.86	0.000109	1.33	3243.89	521.43	0.09
TWI000A	1115	31DEC2011 2400	54.52	564.00	566.03		566.03	0.000015	0.20	278.77	359.76	0.03
TWI000A	1115	01JAN2012 0100	35.26	564.00	566.27		566.27	0.000004	0.11	316.13	378.04	0.01
TWI000A	1115	01JAN2012 0200	49.96	564.00	566.48		566.48	0.000006	0.14	348.70	381.53	0.02
TWI000A	1115	01JAN2012 0300	54.15	564.00	566.55		566.55	0.000007	0.15	359.45	382.68	0.02
TWI000A	1115	01JAN2012 0400	57.55	564.00	566.58		566.58	0.000007	0.16	364.41	383.21	0.02
TWI000A	1115	01JAN2012 0500	61.35	564.00	566.61		566.61	0.000008	0.17	368.66	383.66	0.02
TWI000A	1115	01JAN2012 0600	66.21	564.00	566.64		566.64	0.000009	0.18	373.63	384.19	0.02
TWI000A	1115	01JAN2012 0700	86.04	564.00	566.72		566.72	0.000014	0.22	385.95	385.49	0.02
TWI000A	1115	01JAN2012 0800	102.22	564.00	566.83		566.83	0.000017	0.25	404.04	387.41	0.03
TWI000A	1115	01JAN2012 0900	124.73	564.00	566.94		566.94	0.000021	0.30	421.69	389.27	0.03
TWI000A	1115	01JAN2012 1000	167.02	564.00	567.11		567.12	0.000031	0.38	449.34	392.55	0.04
TWI000A	1115	01JAN2012 1100	236.98	564.00	567.38		567.39	0.000047	0.49	493.71	401.70	0.05
TWI000A	1115	01JAN2012 1200	824.82	564.00	568.40		568.42	0.000222	1.27	679.25	439.08	0.11
TWI000A	1115	01JAN2012 1300	1296.82	564.00	570.27		570.28	0.000027	0.57	2455.25	478.00	0.04
TWI000A	1115	01JAN2012 1400	371.40	564.00	568.12		568.12	0.000057	0.62	625.08	432.17	0.06
TWI000A	1115	01JAN2012 1500	261.94	564.00	567.65		567.65	0.000044	0.50	538.81	411.99	0.05
TWI000A	1115	01JAN2012 1600	199.70	564.00	567.40		567.40	0.000033	0.41	496.16	402.19	0.04
TWI000A	1115	01JAN2012 1700	165.91	564.00	567.24		567.24	0.000027	0.36	469.42	396.73	0.04
TWI000A	1115	01JAN2012 1800	144.51	564.00	567.13		567.13	0.000023	0.32	452.06	393.12	0.03
TWI000A	1115	01JAN2012 1900	110.77	564.00	567.00		567.00	0.000016	0.26	430.63	390.14	0.03
TWI000A	1115	01JAN2012 2000	95.77	564.00	566.88		566.88	0.000014	0.23	412.49	388.30	0.03
TWI000A	1115	01JAN2012 2100	87.92	564.00	566.83		566.83	0.000012	0.22	403.59	387.36	0.02
TWI000A	1115	01JAN2012 2200	82.01	564.00	566.79		566.79	0.000011	0.21	397.38	386.70	0.02
TWI000A	1115	01JAN2012 2300	77.14	564.00	566.76		566.76	0.000010	0.20	392.21	386.16	0.02
TWI000A	1115	01JAN2012 2400	72.99	564.00	566.73		566.73	0.000010	0.19	387.72	385.68	0.02
TWI000A	1076.5		Lat Struct									
TWI000A	1038	Max WS	4334.44	564.00	571.83		571.85	0.000049	1.16	4085.73	636.63	0.07
TWI000A	1038	31DEC2011 2400	49.23	564.00	566.03		566.03	0.000002	0.09	528.91	464.71	0.01
TWI000A	1038	01JAN2012 0100	35.19	564.00	566.27		566.27	0.000001	0.06	592.92	470.72	0.01
TWI000A	1038	01JAN2012 0200	51.54	564.00	566.48		566.48	0.000001	0.08	648.51	478.46	0.01
TWI000A	1038	01JAN2012 0300	56.97	564.00	566.55		566.55	0.000001	0.09	666.87	480.95	0.01
TWI000A	1038	01JAN2012 0400	60.82	564.00	566.58		566.58	0.000001	0.09	675.35	482.10	0.01
TWI000A	1038	01JAN2012 0500	65.01	564.00	566.61		566.61	0.000001	0.10	682.64	483.09	0.01
TWI000A	1038	01JAN2012 0600	70.52	564.00	566.64		566.64	0.000002	0.10	691.14	484.24	0.01
TWI000A	1038	01JAN2012 0700	90.30	564.00	566.72		566.72	0.000002	0.13	712.18	485.71	0.01

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1038	01JAN2012 0800	108.55	564.00	566.83		566.83	0.000003	0.15	743.15	487.48	0.02
TWI000A	1038	01JAN2012 0900	133.07	564.00	566.94		566.94	0.000004	0.17	773.41	489.21	0.02
TWI000A	1038	01JAN2012 1000	179.58	564.00	567.11		567.11	0.000006	0.22	820.79	491.89	0.02
TWI000A	1038	01JAN2012 1100	257.93	564.00	567.38		567.38	0.000009	0.29	895.49	496.09	0.03
TWI000A	1038	01JAN2012 1200	865.22	564.00	568.40		568.41	0.000043	0.75	1192.04	526.79	0.06
TWI000A	1038	01JAN2012 1300	1560.36	564.00	570.27		570.27	0.000014	0.53	3124.38	576.20	0.04
TWI000A	1038	01JAN2012 1400	449.10	564.00	568.11		568.12	0.000015	0.41	1106.84	519.08	0.04
TWI000A	1038	01JAN2012 1500	306.39	564.00	567.65		567.65	0.000010	0.32	969.33	502.77	0.03
TWI000A	1038	01JAN2012 1600	232.13	564.00	567.40		567.40	0.000007	0.26	899.51	496.31	0.02
TWI000A	1038	01JAN2012 1700	191.66	564.00	567.24		567.24	0.000006	0.23	854.80	493.81	0.02
TWI000A	1038	01JAN2012 1800	166.13	564.00	567.13		567.13	0.000005	0.20	825.37	492.15	0.02
TWI000A	1038	01JAN2012 1900	128.35	564.00	567.00		567.00	0.000003	0.16	788.71	490.08	0.02
TWI000A	1038	01JAN2012 2000	109.39	564.00	566.88		566.88	0.000003	0.14	757.61	488.31	0.02
TWI000A	1038	01JAN2012 2100	99.80	564.00	566.83		566.83	0.000003	0.13	742.37	487.44	0.01
TWI000A	1038	01JAN2012 2200	92.77	564.00	566.79		566.79	0.000002	0.13	731.76	486.83	0.01
TWI000A	1038	01JAN2012 2300	87.01	564.00	566.75		566.76	0.000002	0.12	722.91	486.32	0.01
TWI000A	1038	01JAN2012 2400	82.12	564.00	566.73		566.73	0.000002	0.12	715.22	485.88	0.01
TWI000A	1011	Max WS	4334.02	564.00	571.83		571.85	0.000052	1.17	4072.91	643.67	0.08
TWI000A	1011	31DEC2011 2400	46.47	564.00	566.03		566.03	0.000003	0.10	443.56	466.30	0.01
TWI000A	1011	01JAN2012 0100	34.34	564.00	566.27		566.27	0.000001	0.07	513.60	483.87	0.01
TWI000A	1011	01JAN2012 0200	51.13	564.00	566.48		566.48	0.000002	0.09	575.67	490.26	0.01
TWI000A	1011	01JAN2012 0300	56.82	564.00	566.55		566.55	0.000002	0.10	596.20	492.36	0.01
TWI000A	1011	01JAN2012 0400	60.72	564.00	566.58		566.58	0.000002	0.10	605.69	493.32	0.01
TWI000A	1011	01JAN2012 0500	64.92	564.00	566.61		566.61	0.000002	0.11	613.84	494.15	0.01
TWI000A	1011	01JAN2012 0600	70.39	564.00	566.64		566.64	0.000003	0.11	623.37	495.12	0.01
TWI000A	1011	01JAN2012 0700	89.73	564.00	566.72		566.72	0.000004	0.14	646.97	497.50	0.02
TWI000A	1011	01JAN2012 0800	108.18	564.00	566.83		566.83	0.000005	0.16	681.81	500.96	0.02
TWI000A	1011	01JAN2012 0900	132.59	564.00	566.94		566.94	0.000006	0.19	715.86	503.95	0.02
TWI000A	1011	01JAN2012 1000	178.75	564.00	567.11		567.11	0.000009	0.24	769.35	509.72	0.03
TWI000A	1011	01JAN2012 1100	256.80	564.00	567.38		567.38	0.000013	0.31	853.75	522.48	0.03
TWI000A	1011	01JAN2012 1200	849.55	564.00	568.40		568.40	0.000050	0.75	1181.81	550.48	0.07
TWI000A	1011	01JAN2012 1300	1576.20	564.00	570.27		570.27	0.000015	0.55	3106.52	600.02	0.04
TWI000A	1011	01JAN2012 1400	452.47	564.00	568.11		568.12	0.000018	0.43	1089.26	544.46	0.04
TWI000A	1011	01JAN2012 1500	307.49	564.00	567.64		567.65	0.000014	0.34	937.37	533.56	0.03
TWI000A	1011	01JAN2012 1600	232.93	564.00	567.40		567.40	0.000010	0.28	858.36	524.68	0.03
TWI000A	1011	01JAN2012 1700	192.14	564.00	567.24		567.24	0.000008	0.24	807.77	514.52	0.03
TWI000A	1011	01JAN2012 1800	166.42	564.00	567.13		567.13	0.000007	0.22	774.54	510.37	0.02
TWI000A	1011	01JAN2012 1900	129.01	564.00	567.00		567.00	0.000005	0.18	733.16	505.46	0.02
TWI000A	1011	01JAN2012 2000	109.67	564.00	566.88		566.88	0.000004	0.16	698.08	502.39	0.02
TWI000A	1011	01JAN2012 2100	99.96	564.00	566.83		566.83	0.000004	0.15	680.95	500.89	0.02
TWI000A	1011	01JAN2012 2200	92.89	564.00	566.79		566.79	0.000004	0.14	668.97	499.71	0.02
TWI000A	1011	01JAN2012 2300	87.11	564.00	566.75		566.75	0.000003	0.13	659.01	498.71	0.02
TWI000A	1011	01JAN2012 2400	82.22	564.00	566.73		566.73	0.000003	0.13	650.41	497.85	0.02
TWI000A	897	Max WS	4332.24	564.00	571.80		571.84	0.000105	1.67	2721.65	408.45	0.11
TWI000A	897	31DEC2011 2400	36.27	564.00	566.03		566.03	0.000001	0.06	594.41	340.31	0.01
TWI000A	897	01JAN2012 0100	31.26	564.00	566.27		566.27	0.000000	0.05	676.80	341.62	0.01
TWI000A	897	01JAN2012 0200	49.65	564.00	566.48		566.48	0.000001	0.07	748.11	342.75	0.01
TWI000A	897	01JAN2012 0300	56.24	564.00	566.55		566.55	0.000001	0.07	771.57	343.12	0.01
TWI000A	897	01JAN2012 0400	60.37	564.00	566.58		566.58	0.000001	0.08	782.38	343.29	0.01
TWI000A	897	01JAN2012 0500	64.56	564.00	566.61		566.61	0.000001	0.08	791.64	343.44	0.01
TWI000A	897	01JAN2012 0600	69.92	564.00	566.64		566.64	0.000001	0.09	802.48	343.61	0.01
TWI000A	897	01JAN2012 0700	87.68	564.00	566.71		566.72	0.000002	0.11	829.15	344.05	0.01
TWI000A	897	01JAN2012 0800	106.82	564.00	566.83		566.83	0.000002	0.12	868.42	344.75	0.01
TWI000A	897	01JAN2012 0900	130.92	564.00	566.94		566.94	0.000003	0.14	906.59	345.42	0.02
TWI000A	897	01JAN2012 1000	175.77	564.00	567.11		567.11	0.000005	0.18	966.21	346.47	0.02
TWI000A	897	01JAN2012 1100	252.75	564.00	567.38		567.38	0.000007	0.24	1060.29	352.18	0.02
TWI000A	897	01JAN2012 1200	792.59	564.00	568.39		568.40	0.000027	0.57	1421.72	361.38	0.05
TWI000A	897	01JAN2012 1300	1633.70	564.00	570.26		570.27	0.000032	0.80	2116.42	383.37	0.06
TWI000A	897	01JAN2012 1400	464.76	564.00	568.11		568.12	0.000012	0.36	1320.99	358.92	0.03
TWI000A	897	01JAN2012 1500	311.65	564.00	567.64		567.65	0.000008	0.27	1153.39	355.22	0.03
TWI000A	897	01JAN2012 1600	235.88	564.00	567.40		567.40	0.000006	0.22	1065.52	352.33	0.02
TWI000A	897	01JAN2012 1700	193.87	564.00	567.24		567.24	0.000005	0.19	1009.07	349.44	0.02
TWI000A	897	01JAN2012 1800	167.66	564.00	567.13		567.13	0.000004	0.17	972.05	346.58	0.02
TWI000A	897	01JAN2012 1900	131.39	564.00	567.00		567.00	0.000003	0.14	925.93	345.76	0.02
TWI000A	897	01JAN2012 2000	110.67	564.00	566.88		566.88	0.000002	0.13	886.69	345.07	0.01
TWI000A	897	01JAN2012 2100	100.53	564.00	566.83		566.83	0.000002	0.12	867.41	344.73	0.01
TWI000A	897	01JAN2012 2200	93.29	564.00	566.79		566.79	0.000002	0.11	853.97	344.49	0.01
TWI000A	897	01JAN2012 2300	87.49	564.00	566.75		566.75	0.000002	0.10	842.79	344.29	0.01
TWI000A	897	01JAN2012 2400	82.54	564.00	566.73		566.73	0.000002	0.10	833.04	344.12	0.01
TWI000A	736	Max WS	4325.60	564.00	571.80		571.83	0.000053	1.21	3888.84	601.31	0.08
TWI000A	736	31DEC2011 2400	22.80	564.00	566.03		566.03	0.000000	0.03	886.58	445.40	0.00
TWI000A	736	01JAN2012 0100	27.18	564.00	566.27		566.27	0.000000	0.03	994.48	447.93	0.00
TWI000A	736	01JAN2012 0200	47.63	564.00	566.48		566.48	0.000000	0.04	1088.10	450.12	0.00
TWI000A	736	01JAN2012 0300	55.55	564.00	566.55		566.55	0.000000	0.05	1118.87	450.84	0.01
TWI000A	736	01JAN2012 0400	59.94	564.00	566.58		566.58	0.000000	0.05	1133.07	451.17	0.01
TWI000A	736	01JAN2012 0500	64.02	564.00	566.61		566.61	0.000000	0.06	1145.28	451.45	0.01
TWI000A	736	01JAN2012 0600	69.30	564.00	566.64		566.64	0.000001	0.06	1159.44	451.81	0.01
TWI000A	736	01JAN2012 0700	84.99	564.00	566.71		566.71	0.000001	0.07	1194.56	452.88	0.01
TWI000A	736	01JAN2012 0800	105.01	564.00	566.83		566.83	0.000001	0.08	1246.26	454.43	0.01
TWI000A	736	01JAN2012 0900	128.71	564.00	566.94		566.94	0.000001	0.10	1296.60	455.94	0.01
TWI000A	736	01JAN2012 1000	171.81	564.00	567.11		567.11	0.000002	0.13	1375.36	458.29	0.01

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	736	01JAN2012 1100	247.30	564.00	567.38		567.38	0.000003	0.17	1501.00	473.22	0.02
TWI000A	736	01JAN2012 1200	717.89	564.00	568.39		568.39	0.000011	0.37	1991.64	497.15	0.03
TWI000A	736	01JAN2012 1300	1711.40	564.00	570.26		570.27	0.000018	0.61	2989.09	568.42	0.04
TWI000A	736	01JAN2012 1400	480.87	564.00	568.11		568.11	0.000006	0.26	1853.99	490.69	0.02
TWI000A	736	01JAN2012 1500	316.96	564.00	567.64		567.64	0.000004	0.20	1626.40	479.50	0.02
TWI000A	736	01JAN2012 1600	239.79	564.00	567.40		567.40	0.000003	0.16	1507.96	473.57	0.02
TWI000A	736	01JAN2012 1700	196.12	564.00	567.23		567.24	0.000002	0.14	1432.49	466.70	0.01
TWI000A	736	01JAN2012 1800	169.10	564.00	567.13		567.13	0.000002	0.12	1383.11	458.52	0.01
TWI000A	736	01JAN2012 1900	134.55	564.00	567.00		567.00	0.000001	0.10	1322.22	456.71	0.01
TWI000A	736	01JAN2012 2000	111.87	564.00	566.88		566.88	0.000001	0.09	1270.41	455.16	0.01
TWI000A	736	01JAN2012 2100	101.23	564.00	566.83		566.83	0.000001	0.08	1245.01	454.40	0.01
TWI000A	736	01JAN2012 2200	93.93	564.00	566.79		566.79	0.000001	0.08	1227.30	453.86	0.01
TWI000A	736	01JAN2012 2300	88.04	564.00	566.75		566.75	0.000001	0.07	1212.49	453.42	0.01
TWI000A	736	01JAN2012 2400	83.04	564.00	566.73		566.73	0.000001	0.07	1199.71	453.03	0.01
TWI000A	585	Max WS	4324.58	564.00	571.79		571.82	0.000060	1.29	3515.73	515.79	0.08
TWI000A	585	31DEC2011 2400	8.80	564.00	566.03		566.03	0.000000	0.01	846.75	425.53	0.00
TWI000A	585	01JAN2012 0100	22.92	564.00	566.27		566.27	0.000000	0.02	949.89	428.27	0.00
TWI000A	585	01JAN2012 0200	45.52	564.00	566.48		566.48	0.000000	0.04	1039.38	430.35	0.00
TWI000A	585	01JAN2012 0300	54.76	564.00	566.55		566.55	0.000000	0.05	1068.82	431.04	0.01
TWI000A	585	01JAN2012 0400	59.43	564.00	566.58		566.58	0.000000	0.05	1082.40	431.35	0.01
TWI000A	585	01JAN2012 0500	63.56	564.00	566.61		566.61	0.000001	0.06	1094.01	431.62	0.01
TWI000A	585	01JAN2012 0600	68.64	564.00	566.64		566.64	0.000001	0.06	1107.61	431.93	0.01
TWI000A	585	01JAN2012 0700	82.14	564.00	566.71		566.71	0.000001	0.07	1141.12	432.71	0.01
TWI000A	585	01JAN2012 0800	103.14	564.00	566.83		566.83	0.000001	0.09	1190.47	433.84	0.01
TWI000A	585	01JAN2012 0900	126.32	564.00	566.94		566.94	0.000001	0.10	1238.48	434.95	0.01
TWI000A	585	01JAN2012 1000	167.63	564.00	567.11		567.11	0.000002	0.13	1313.52	436.66	0.01
TWI000A	585	01JAN2012 1100	241.64	564.00	567.38		567.38	0.000003	0.17	1431.22	438.33	0.02
TWI000A	585	01JAN2012 1200	640.52	564.00	568.39		568.39	0.000009	0.34	1876.20	444.16	0.03
TWI000A	585	01JAN2012 1300	1792.78	564.00	570.26		570.27	0.000022	0.67	2744.35	489.08	0.05
TWI000A	585	01JAN2012 1400	497.69	564.00	568.11		568.11	0.000007	0.29	1753.34	442.01	0.03
TWI000A	585	01JAN2012 1500	322.51	564.00	567.64		567.64	0.000004	0.21	1546.68	439.54	0.02
TWI000A	585	01JAN2012 1600	243.84	564.00	567.40		567.40	0.000003	0.17	1437.75	438.39	0.02
TWI000A	585	01JAN2012 1700	198.50	564.00	567.23		567.23	0.000003	0.15	1367.43	437.75	0.01
TWI000A	585	01JAN2012 1800	170.65	564.00	567.13		567.13	0.000002	0.13	1320.93	436.83	0.01
TWI000A	585	01JAN2012 1900	137.88	564.00	567.00		567.00	0.000002	0.11	1262.92	435.51	0.01
TWI000A	585	01JAN2012 2000	113.19	564.00	566.88		566.88	0.000001	0.09	1213.52	434.37	0.01
TWI000A	585	01JAN2012 2100	102.06	564.00	566.83		566.83	0.000001	0.09	1189.25	433.81	0.01
TWI000A	585	01JAN2012 2200	94.59	564.00	566.79		566.79	0.000001	0.08	1172.34	433.43	0.01
TWI000A	585	01JAN2012 2300	88.55	564.00	566.75		566.75	0.000001	0.08	1158.27	433.10	0.01
TWI000A	585	01JAN2012 2400	83.50	564.00	566.73		566.73	0.000001	0.07	1146.06	432.82	0.01
TWI000A	549	Max WS	4324.16	564.00	571.51	568.32	571.94	0.002724	5.47	977.38	492.93	0.49
TWI000A	549	31DEC2011 2400	6.39	564.00	566.03	564.06	566.03	0.000000	0.04	169.94	205.55	0.00
TWI000A	549	01JAN2012 0100	22.18	564.00	566.27	564.15	566.27	0.000003	0.12	191.29	220.64	0.01
TWI000A	549	01JAN2012 0200	45.13	564.00	566.48	564.22	566.48	0.000008	0.22	209.98	224.75	0.02
TWI000A	549	01JAN2012 0300	54.64	564.00	566.55	564.24	566.55	0.000011	0.25	216.17	226.09	0.03
TWI000A	549	01JAN2012 0400	59.33	564.00	566.58	564.26	566.58	0.000012	0.27	219.03	226.64	0.03
TWI000A	549	01JAN2012 0500	63.48	564.00	566.60	564.27	566.61	0.000014	0.29	221.48	227.06	0.03
TWI000A	549	01JAN2012 0600	68.50	564.00	566.64	564.28	566.64	0.000015	0.31	224.35	227.56	0.03
TWI000A	549	01JAN2012 0700	81.66	564.00	566.71	564.32	566.72	0.000019	0.35	231.41	228.77	0.04
TWI000A	549	01JAN2012 0800	102.83	564.00	566.83	564.37	566.83	0.000027	0.43	241.83	230.55	0.05
TWI000A	549	01JAN2012 0900	125.91	564.00	566.94	564.43	566.94	0.000035	0.50	251.96	232.28	0.05
TWI000A	549	01JAN2012 1000	166.91	564.00	567.11	564.51	567.11	0.000051	0.63	267.80	234.96	0.06
TWI000A	549	01JAN2012 1100	240.65	564.00	567.37	564.65	567.38	0.000080	0.83	292.65	242.40	0.08
TWI000A	549	01JAN2012 1200	626.77	564.00	568.36	565.23	568.40	0.000222	1.66	388.04	276.04	0.14
TWI000A	549	01JAN2012 1300	1807.76	564.00	570.16	566.45	570.33	0.000562	3.34	570.10	355.32	0.24
TWI000A	549	01JAN2012 1400	500.63	564.00	568.09	565.06	568.12	0.000177	1.41	361.50	259.74	0.12
TWI000A	549	01JAN2012 1500	323.49	564.00	567.63	564.79	567.65	0.000111	1.03	317.12	248.08	0.10
TWI000A	549	01JAN2012 1600	244.56	564.00	567.39	564.66	567.40	0.000081	0.84	294.03	242.72	0.08
TWI000A	549	01JAN2012 1700	198.91	564.00	567.23	564.57	567.24	0.000063	0.72	279.17	237.98	0.07
TWI000A	549	01JAN2012 1800	170.95	564.00	567.12	564.52	567.13	0.000052	0.64	269.36	235.22	0.06
TWI000A	549	01JAN2012 1900	138.48	564.00	566.99	564.45	567.00	0.000040	0.54	257.11	233.15	0.06
TWI000A	549	01JAN2012 2000	113.40	564.00	566.88	564.40	566.88	0.000031	0.46	246.70	231.38	0.05
TWI000A	549	01JAN2012 2100	102.22	564.00	566.82	564.37	566.83	0.000027	0.43	241.58	230.51	0.05
TWI000A	549	01JAN2012 2200	94.71	564.00	566.79	564.35	566.79	0.000024	0.40	238.01	229.90	0.04
TWI000A	549	01JAN2012 2300	88.66	564.00	566.75	564.34	566.75	0.000022	0.38	235.04	229.39	0.04
TWI000A	549	01JAN2012 2400	83.58	564.00	566.72	564.32	566.73	0.000020	0.36	232.46	228.95	0.04
TWI000A	544		Inl Struct									
TWI000A	437	Max WS	4321.40	543.21	555.94		556.10	0.000344	3.77	1910.85	233.77	0.20
TWI000A	437	31DEC2011 2400	6.39	543.21	544.22		544.22	0.000275	0.42	15.28	32.80	0.11
TWI000A	437	01JAN2012 0100	22.18	543.21	545.00		545.00	0.000126	0.47	47.06	46.54	0.08
TWI000A	437	01JAN2012 0200	45.13	543.21	545.45		545.45	0.000164	0.65	68.91	50.26	0.10
TWI000A	437	01JAN2012 0300	54.64	543.21	545.63		545.64	0.000162	0.70	78.30	51.48	0.10
TWI000A	437	01JAN2012 0400	59.33	543.21	545.71		545.72	0.000165	0.72	82.18	51.98	0.10
TWI000A	437	01JAN2012 0500	63.48	543.21	545.77		545.78	0.000169	0.74	85.26	52.36	0.10
TWI000A	437	01JAN2012 0600	68.50	543.21	545.83		545.84	0.000174	0.77	88.76	52.80	0.10
TWI000A	437	01JAN2012 0700	81.66	543.21	545.97		545.99	0.000193	0.85	96.28	53.73	0.11
TWI000A	437	01JAN2012 0800	102.83	543.21	546.22		546.24	0.000208	0.94	109.94	64.66	0.12
TWI000A	437	01JAN2012 0900	125.91	543.21	546.46		546.48	0.000243	1.02	123.93	76.26	0.13
TWI000A	437	01JAN2012 1000	166.91	543.21	546.83		546.85	0.000263	1.12	148.51	89.57	0.13
TWI000A	437	01JAN2012 1100	240.65	543.21	547.42		547.45	0.000253	1.27	189.66	103.66	0.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

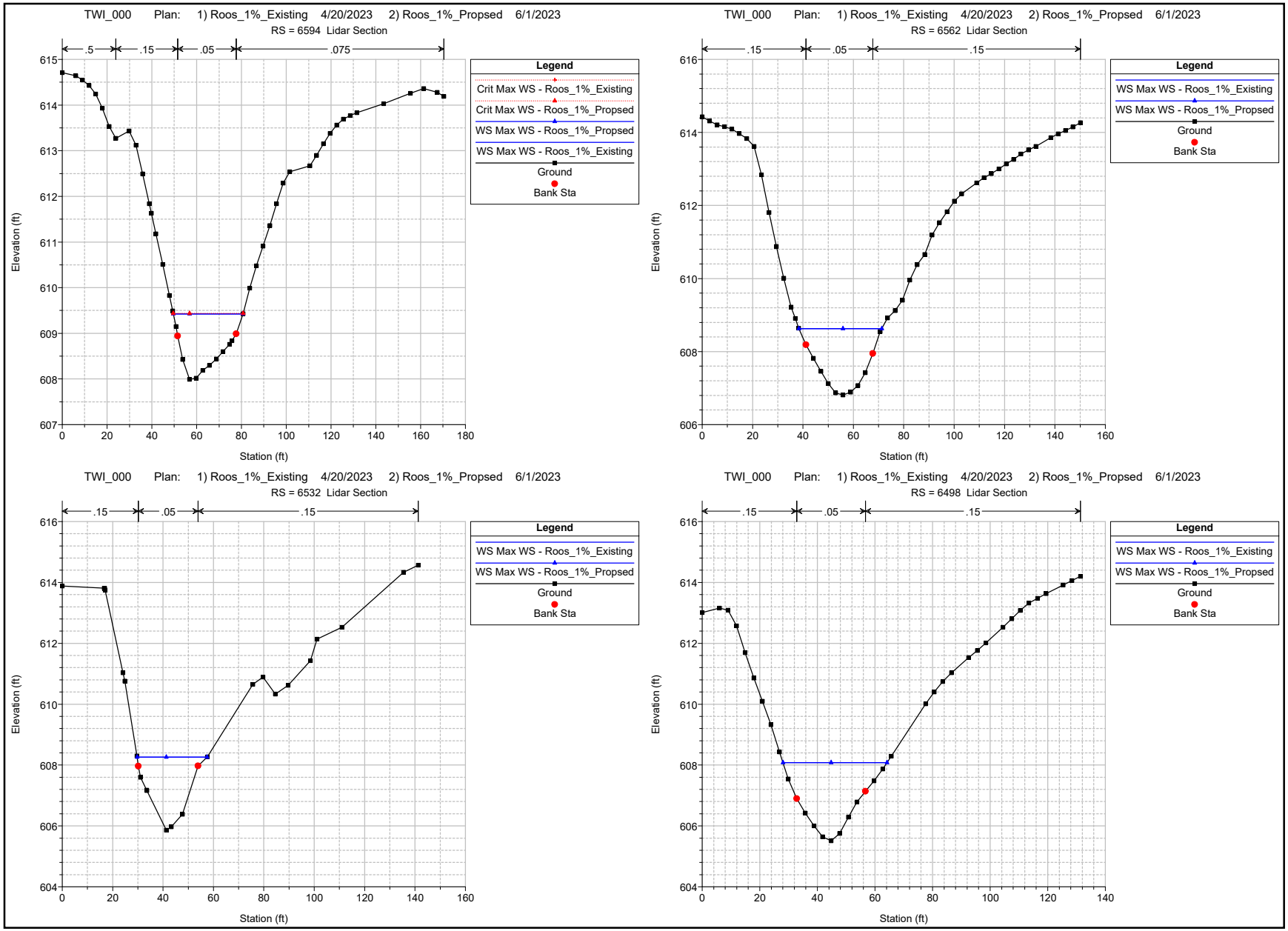
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	437	01JAN2012 1200	626.77	543.21	549.57		549.63	0.000247	1.81	351.72	186.44	0.15
TWI000A	437	01JAN2012 1300	1807.76	543.21	553.50		553.62	0.000267	2.81	675.72	219.12	0.17
TWI000A	437	01JAN2012 1400	500.63	543.21	549.30		549.34	0.000193	1.54	329.62	179.47	0.13
TWI000A	437	01JAN2012 1500	323.49	543.21	548.13		548.15	0.000221	1.35	239.67	132.38	0.13
TWI000A	437	01JAN2012 1600	244.56	543.21	547.56		547.58	0.000225	1.23	198.94	106.70	0.13
TWI000A	437	01JAN2012 1700	198.91	543.21	547.18		547.20	0.000232	1.15	172.75	97.92	0.13
TWI000A	437	01JAN2012 1800	170.95	543.21	546.93		546.95	0.000237	1.10	155.71	92.00	0.13
TWI000A	437	01JAN2012 1900	138.48	543.21	546.66		546.67	0.000236	1.01	136.81	85.72	0.13
TWI000A	437	01JAN2012 2000	113.40	543.21	546.38		546.40	0.000216	0.95	119.07	72.69	0.12
TWI000A	437	01JAN2012 2100	102.22	543.21	546.25		546.27	0.000200	0.92	111.61	66.26	0.12
TWI000A	437	01JAN2012 2200	94.71	543.21	546.17		546.18	0.000190	0.89	106.89	62.78	0.11
TWI000A	437	01JAN2012 2300	88.66	543.21	546.10		546.11	0.000186	0.86	103.07	60.89	0.11
TWI000A	437	01JAN2012 2400	83.58	543.21	546.04		546.05	0.000182	0.84	99.81	56.99	0.11
TWI000A	390	Max WS	4342.35	540.00	555.99		556.05	0.000076	2.13	2482.46	226.77	0.10
TWI000A	390	31DEC2011 2400	6.79	540.00	544.21		544.21	0.000000	0.02	288.92	127.66	0.00
TWI000A	390	01JAN2012 0100	23.54	540.00	545.00		545.00	0.000000	0.06	399.42	144.97	0.01
TWI000A	390	01JAN2012 0200	46.59	540.00	545.45		545.45	0.000001	0.10	465.18	148.00	0.01
TWI000A	390	01JAN2012 0300	56.38	540.00	545.63		545.63	0.000001	0.12	492.70	149.43	0.01
TWI000A	390	01JAN2012 0400	61.11	540.00	545.71		545.71	0.000002	0.12	503.99	150.41	0.01
TWI000A	390	01JAN2012 0500	65.27	540.00	545.77		545.77	0.000002	0.13	512.90	151.18	0.01
TWI000A	390	01JAN2012 0600	70.28	540.00	545.83		545.83	0.000002	0.14	523.04	152.05	0.01
TWI000A	390	01JAN2012 0700	83.16	540.00	545.98		545.98	0.000002	0.16	544.73	153.90	0.01
TWI000A	390	01JAN2012 0800	104.40	540.00	546.23		546.23	0.000003	0.18	583.81	157.04	0.02
TWI000A	390	01JAN2012 0900	127.37	540.00	546.46		546.46	0.000004	0.21	621.21	159.31	0.02
TWI000A	390	01JAN2012 1000	167.98	540.00	546.83		546.83	0.000005	0.26	680.93	162.86	0.02
TWI000A	390	01JAN2012 1100	241.31	540.00	547.43		547.43	0.000006	0.33	780.10	168.07	0.03
TWI000A	390	01JAN2012 1200	620.76	540.00	549.60		549.60	0.000013	0.59	1168.50	187.41	0.04
TWI000A	390	01JAN2012 1300	1827.11	540.00	553.57		553.59	0.000026	1.10	1953.75	207.49	0.06
TWI000A	390	01JAN2012 1400	508.50	540.00	549.32		549.32	0.000010	0.50	1115.89	185.54	0.03
TWI000A	390	01JAN2012 1500	326.82	540.00	548.14		548.14	0.000008	0.39	901.44	176.89	0.03
TWI000A	390	01JAN2012 1600	247.33	540.00	547.56		547.57	0.000006	0.33	802.34	169.38	0.02
TWI000A	390	01JAN2012 1700	201.28	540.00	547.19		547.19	0.000005	0.29	739.23	166.04	0.02
TWI000A	390	01JAN2012 1800	173.15	540.00	546.94		546.94	0.000005	0.26	698.18	163.87	0.02
TWI000A	390	01JAN2012 1900	141.01	540.00	546.66		546.66	0.000004	0.22	652.85	161.20	0.02
TWI000A	390	01JAN2012 2000	115.51	540.00	546.38		546.38	0.000003	0.20	608.57	158.55	0.02
TWI000A	390	01JAN2012 2100	104.23	540.00	546.26		546.26	0.000003	0.18	588.46	157.33	0.02
TWI000A	390	01JAN2012 2200	96.68	540.00	546.17		546.17	0.000003	0.17	575.13	156.45	0.02
TWI000A	390	01JAN2012 2300	90.62	540.00	546.10		546.10	0.000002	0.17	564.21	155.54	0.01
TWI000A	390	01JAN2012 2400	85.52	540.00	546.04		546.04	0.000002	0.16	554.86	154.75	0.01
TWI000A	329	Max WS	4368.50	540.00	555.96		556.05	0.000080	2.34	2085.01	180.15	0.10
TWI000A	329	31DEC2011 2400	6.22	540.00	544.21		544.21	0.000000	0.01	436.88	118.30	0.00
TWI000A	329	01JAN2012 0100	24.95	540.00	545.00		545.00	0.000000	0.05	531.26	121.25	0.00
TWI000A	329	01JAN2012 0200	48.18	540.00	545.45		545.45	0.000000	0.08	586.09	122.93	0.01
TWI000A	329	01JAN2012 0300	58.49	540.00	545.63		545.63	0.000001	0.10	608.94	123.62	0.01
TWI000A	329	01JAN2012 0400	63.31	540.00	545.71		545.71	0.000001	0.10	618.26	123.83	0.01
TWI000A	329	01JAN2012 0500	67.46	540.00	545.77		545.77	0.000001	0.11	625.58	124.00	0.01
TWI000A	329	01JAN2012 0600	72.43	540.00	545.83		545.83	0.000001	0.12	633.87	124.18	0.01
TWI000A	329	01JAN2012 0700	84.83	540.00	545.98		545.98	0.000001	0.13	651.51	124.58	0.01
TWI000A	329	01JAN2012 0800	106.23	540.00	546.23		546.23	0.000001	0.16	682.90	125.28	0.01
TWI000A	329	01JAN2012 0900	129.04	540.00	546.46		546.46	0.000002	0.18	712.60	125.94	0.01
TWI000A	329	01JAN2012 1000	169.13	540.00	546.83		546.83	0.000002	0.23	759.48	126.97	0.02
TWI000A	329	01JAN2012 1100	241.92	540.00	547.43		547.43	0.000004	0.30	836.26	129.59	0.02
TWI000A	329	01JAN2012 1200	615.87	540.00	549.60		549.60	0.000010	0.57	1123.12	135.01	0.03
TWI000A	329	01JAN2012 1300	1849.17	540.00	553.56		553.59	0.000025	1.18	1686.87	150.88	0.06
TWI000A	329	01JAN2012 1400	517.71	540.00	549.32		549.32	0.000008	0.50	1085.22	134.35	0.03
TWI000A	329	01JAN2012 1500	331.02	540.00	548.14		548.14	0.000005	0.37	928.32	131.58	0.02
TWI000A	329	01JAN2012 1600	250.91	540.00	547.56		547.57	0.000004	0.30	853.38	130.18	0.02
TWI000A	329	01JAN2012 1700	204.33	540.00	547.19		547.19	0.000003	0.26	804.71	128.44	0.02
TWI000A	329	01JAN2012 1800	175.99	540.00	546.94		546.94	0.000003	0.23	772.91	127.28	0.02
TWI000A	329	01JAN2012 1900	144.33	540.00	546.66		546.66	0.000002	0.20	737.52	126.49	0.01
TWI000A	329	01JAN2012 2000	118.24	540.00	546.38		546.38	0.000002	0.17	702.59	125.72	0.01
TWI000A	329	01JAN2012 2100	106.78	540.00	546.26		546.26	0.000001	0.16	686.61	125.36	0.01
TWI000A	329	01JAN2012 2200	99.19	540.00	546.17		546.17	0.000001	0.15	675.97	125.12	0.01
TWI000A	329	01JAN2012 2300	93.12	540.00	546.10		546.10	0.000001	0.14	667.20	124.93	0.01
TWI000A	329	01JAN2012 2400	87.98	540.00	546.04		546.04	0.000001	0.13	659.69	124.76	0.01
TWI000A	237	Max WS	4408.75	540.00	555.99		556.04	0.000044	1.76	2783.48	219.82	0.08
TWI000A	237	31DEC2011 2400	4.81	540.00	544.21		544.21	0.000000	0.01	596.92	156.15	0.00
TWI000A	237	01JAN2012 0100	27.13	540.00	545.00		545.00	0.000000	0.04	721.28	159.88	0.00
TWI000A	237	01JAN2012 0200	50.62	540.00	545.45		545.45	0.000000	0.06	793.77	163.19	0.01
TWI000A	237	01JAN2012 0300	61.69	540.00	545.63		545.63	0.000000	0.08	824.14	164.48	0.01
TWI000A	237	01JAN2012 0400	66.69	540.00	545.71		545.71	0.000000	0.08	836.52	164.82	0.01
TWI000A	237	01JAN2012 0500	70.85	540.00	545.77		545.77	0.000000	0.08	846.29	165.10	0.01
TWI000A	237	01JAN2012 0600	75.76	540.00	545.83		545.83	0.000000	0.09	857.33	165.29	0.01
TWI000A	237	01JAN2012 0700	87.36	540.00	545.98		545.98	0.000001	0.10	880.79	165.67	0.01
TWI000A	237	01JAN2012 0800	109.04	540.00	546.23		546.23	0.000001	0.12	922.51	166.36	0.01
TWI000A	237	01JAN2012 0900	131.63	540.00	546.46		546.46	0.000001	0.14	961.92	167.00	0.01
TWI000A	237	01JAN2012 1000	170.91	540.00	546.83		546.83	0.000001	0.17	1024.05	168.17	0.01
TWI000A	237	01JAN2012 1100	242.94	540.00	547.43		547.43	0.000002	0.22	1125.52	170.61	0.01
TWI000A	237	01JAN2012 1200	609.54	540.00	549.60		549.60	0.000005	0.42	1505.93	181.37	0.02
TWI000A	237	01JAN2012 1300	1882.77	540.00	553.57		553.58	0.000014	0.90	2267.98	205.22	0.04
TWI000A	237	01JAN2012 1400	531.63	540.00	549.32		549.32	0.000004	0.38	1455.28	179.37	0.02

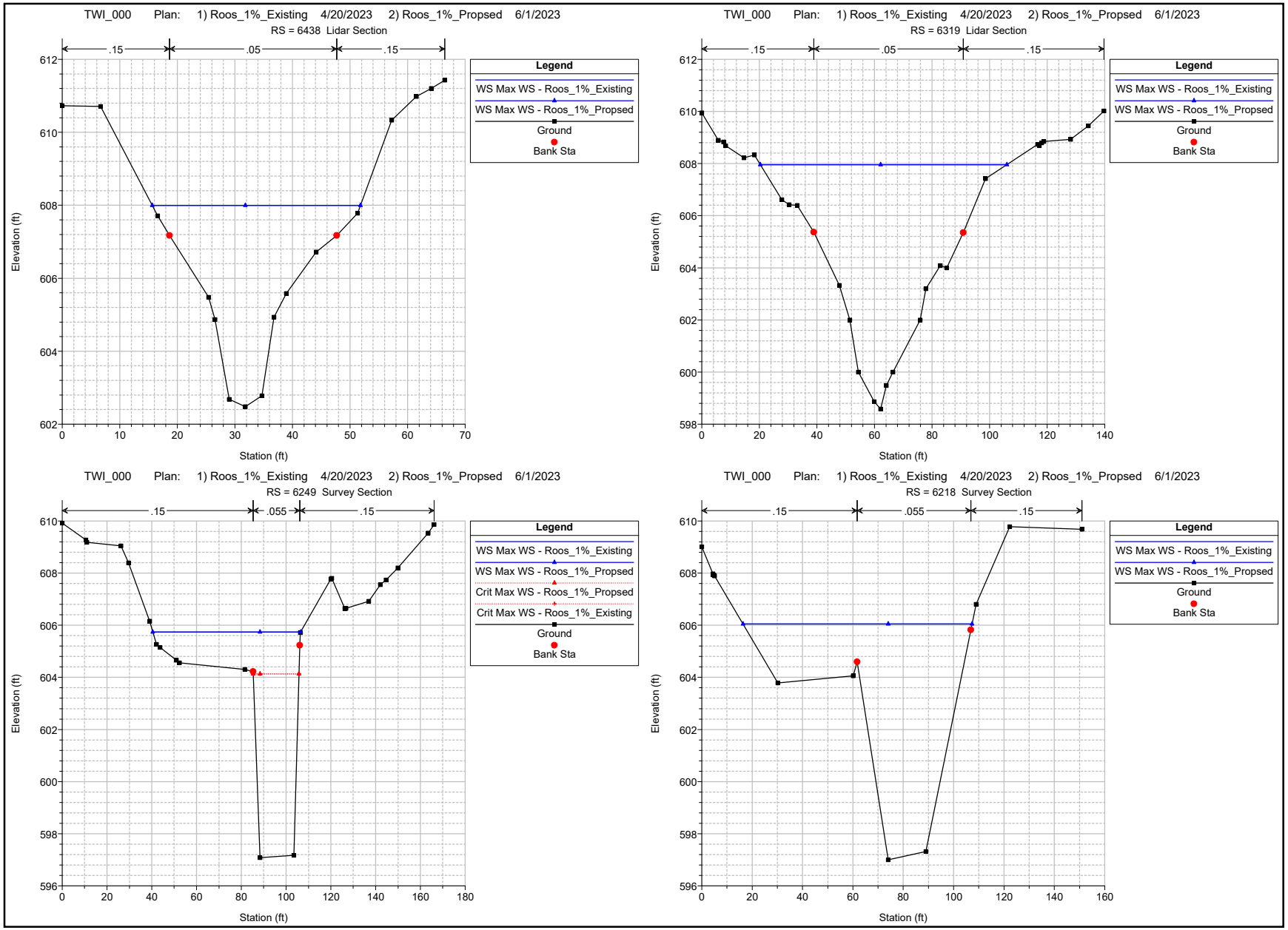
HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

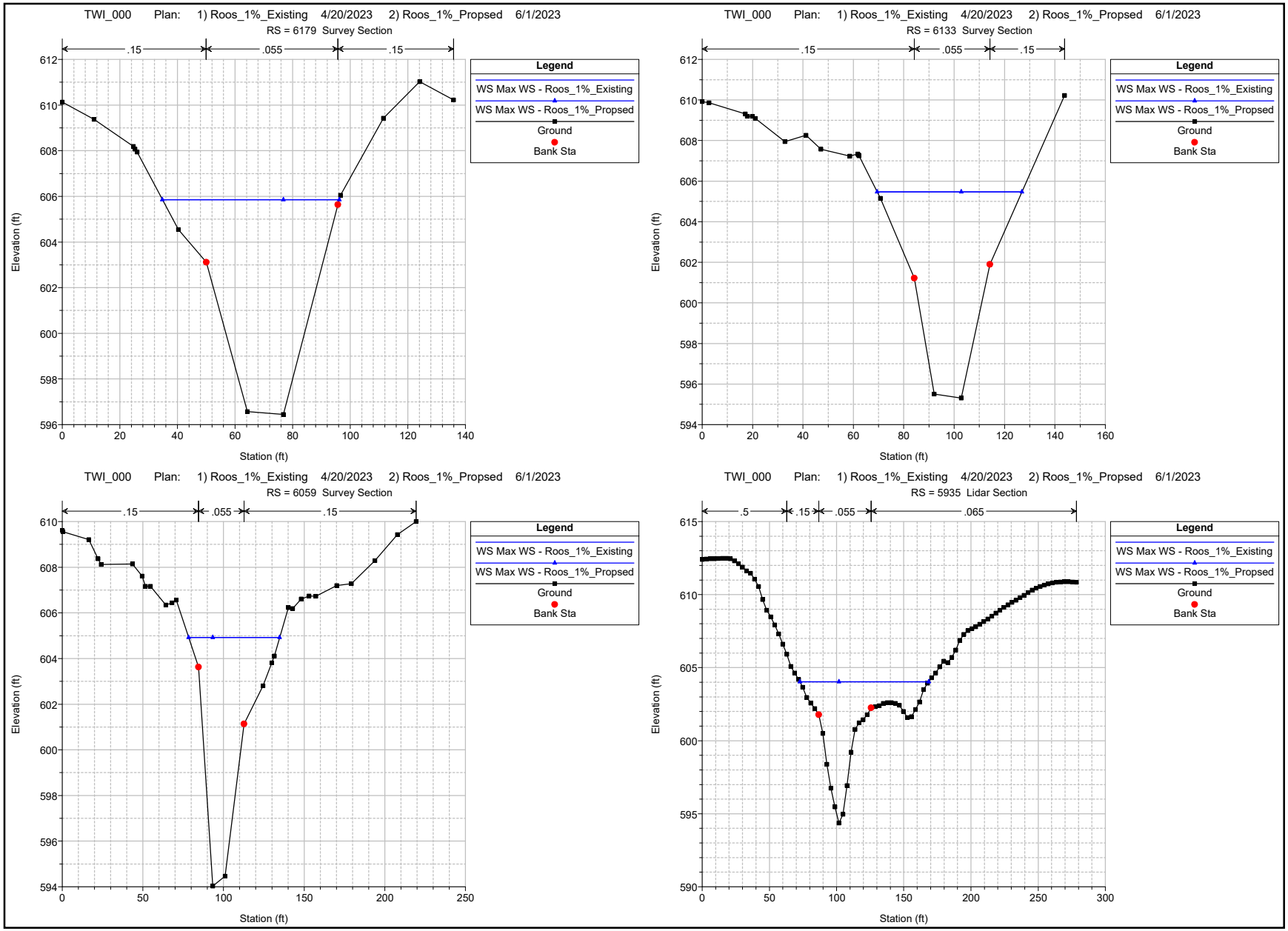
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	237	01JAN2012 1500	337.45	540.00	548.14		548.14	0.000003	0.28	1246.80	173.78	0.02
TWI000A	237	01JAN2012 1600	256.40	540.00	547.56		547.57	0.000002	0.23	1148.08	171.15	0.02
TWI000A	237	01JAN2012 1700	209.05	540.00	547.19		547.19	0.000002	0.20	1083.91	169.61	0.01
TWI000A	237	01JAN2012 1800	180.39	540.00	546.94		546.94	0.000001	0.18	1041.83	168.60	0.01
TWI000A	237	01JAN2012 1900	149.44	540.00	546.66		546.66	0.000001	0.15	994.99	167.54	0.01
TWI000A	237	01JAN2012 2000	122.46	540.00	546.38		546.38	0.000001	0.13	948.67	166.79	0.01
TWI000A	237	01JAN2012 2100	110.75	540.00	546.26		546.26	0.000001	0.12	927.44	166.44	0.01
TWI000A	237	01JAN2012 2200	103.09	540.00	546.17		546.17	0.000001	0.11	913.30	166.21	0.01
TWI000A	237	01JAN2012 2300	96.97	540.00	546.10		546.10	0.000001	0.11	901.68	166.02	0.01
TWI000A	237	01JAN2012 2400	91.81	540.00	546.04		546.04	0.000001	0.10	891.68	165.85	0.01
TWI000A	179	Max WS	4432.28	540.00	555.96		556.04	0.000074	2.24	2376.57	215.10	0.10
TWI000A	179	31DEC2011 2400	3.79	540.00	544.21		544.21	0.000000	0.01	425.23	122.71	0.00
TWI000A	179	01JAN2012 0100	28.37	540.00	545.00		545.00	0.000000	0.05	526.61	133.08	0.00
TWI000A	179	01JAN2012 0200	52.02	540.00	545.45		545.45	0.000001	0.09	587.39	137.53	0.01
TWI000A	179	01JAN2012 0300	63.63	540.00	545.63		545.63	0.000001	0.11	613.03	139.11	0.01
TWI000A	179	01JAN2012 0400	68.73	540.00	545.71		545.71	0.000001	0.11	623.52	139.74	0.01
TWI000A	179	01JAN2012 0500	72.88	540.00	545.77		545.77	0.000001	0.12	631.80	140.33	0.01
TWI000A	179	01JAN2012 0600	77.74	540.00	545.83		545.83	0.000001	0.12	641.20	140.99	0.01
TWI000A	179	01JAN2012 0700	88.84	540.00	545.97		545.98	0.000001	0.14	661.28	142.41	0.01
TWI000A	179	01JAN2012 0800	110.68	540.00	546.23		546.23	0.000002	0.16	697.36	144.76	0.01
TWI000A	179	01JAN2012 0900	133.11	540.00	546.46		546.46	0.000002	0.19	731.83	146.96	0.01
TWI000A	179	01JAN2012 1000	171.86	540.00	546.83		546.83	0.000003	0.23	786.82	149.04	0.02
TWI000A	179	01JAN2012 1100	243.36	540.00	547.43		547.43	0.000004	0.29	876.50	150.48	0.02
TWI000A	179	01JAN2012 1200	603.55	540.00	549.60		549.60	0.000009	0.54	1208.93	156.98	0.03
TWI000A	179	01JAN2012 1300	1905.10	540.00	553.56		553.58	0.000025	1.16	1884.06	193.09	0.06
TWI000A	179	01JAN2012 1400	540.60	540.00	549.32		549.32	0.000008	0.50	1165.09	156.09	0.03
TWI000A	179	01JAN2012 1500	341.53	540.00	548.14		548.14	0.000005	0.37	983.06	152.17	0.02
TWI000A	179	01JAN2012 1600	259.82	540.00	547.56		547.57	0.000004	0.31	896.37	150.80	0.02
TWI000A	179	01JAN2012 1700	211.98	540.00	547.19		547.19	0.000003	0.27	839.79	149.89	0.02
TWI000A	179	01JAN2012 1800	183.07	540.00	546.94		546.94	0.000003	0.24	802.57	149.30	0.02
TWI000A	179	01JAN2012 1900	152.62	540.00	546.66		546.66	0.000002	0.21	761.06	148.59	0.02
TWI000A	179	01JAN2012 2000	125.05	540.00	546.38		546.38	0.000002	0.18	720.19	146.22	0.01
TWI000A	179	01JAN2012 2100	113.15	540.00	546.26		546.26	0.000002	0.17	701.65	145.04	0.01
TWI000A	179	01JAN2012 2200	105.46	540.00	546.17		546.17	0.000001	0.16	689.35	144.25	0.01
TWI000A	179	01JAN2012 2300	99.30	540.00	546.10		546.10	0.000001	0.15	679.29	143.60	0.01
TWI000A	179	01JAN2012 2400	94.13	540.00	546.04		546.04	0.000001	0.14	670.65	143.04	0.01
TWI000A	165	Max WS	4432.25	540.00	555.70	551.20	556.16	0.002470	6.25	1003.13	217.24	0.49
TWI000A	165	31DEC2011 2400	3.24	540.00	544.21	540.19	544.21	0.000000	0.05	62.98	97.25	0.01
TWI000A	165	01JAN2012 0100	28.20	540.00	545.00	540.77	545.00	0.000014	0.34	84.35	107.90	0.03
TWI000A	165	01JAN2012 0200	51.88	540.00	545.44	541.11	545.45	0.000030	0.55	98.62	113.29	0.05
TWI000A	165	01JAN2012 0300	63.60	540.00	545.63	541.26	545.64	0.000038	0.64	104.94	115.18	0.06
TWI000A	165	01JAN2012 0400	68.71	540.00	545.70	541.31	545.71	0.000041	0.68	107.59	116.06	0.06
TWI000A	165	01JAN2012 0500	72.86	540.00	545.76	541.36	545.77	0.000044	0.71	109.86	122.16	0.06
TWI000A	165	01JAN2012 0600	77.70	540.00	545.83	541.41	545.84	0.000048	0.74	112.64	122.68	0.06
TWI000A	165	01JAN2012 0700	88.72	540.00	545.97	541.52	545.98	0.000055	0.82	118.55	123.77	0.07
TWI000A	165	01JAN2012 0800	110.58	540.00	546.22	541.73	546.23	0.000070	0.95	129.03	125.70	0.08
TWI000A	165	01JAN2012 0900	132.99	540.00	546.45	541.92	546.47	0.000084	1.08	138.87	127.50	0.09
TWI000A	165	01JAN2012 1000	171.64	540.00	546.82	542.21	546.85	0.000107	1.28	154.30	130.29	0.10
TWI000A	165	01JAN2012 1100	243.04	540.00	547.41	542.67	547.45	0.000144	1.60	179.17	134.79	0.12
TWI000A	165	01JAN2012 1200	599.42	540.00	549.54	544.29	549.65	0.000335	2.69	278.66	148.33	0.19
TWI000A	165	01JAN2012 1300	1907.98	540.00	553.41	547.40	553.71	0.000584	4.84	586.74	190.80	0.26
TWI000A	165	01JAN2012 1400	541.68	540.00	549.27	544.08	549.36	0.000320	2.55	260.86	146.14	0.18
TWI000A	165	01JAN2012 1500	341.86	540.00	548.11	543.19	548.16	0.000188	1.98	208.35	139.44	0.14
TWI000A	165	01JAN2012 1600	260.05	540.00	547.54	542.76	547.58	0.000152	1.67	184.64	135.79	0.12
TWI000A	165	01JAN2012 1700	212.12	540.00	547.17	542.48	547.20	0.000129	1.47	169.03	132.95	0.11
TWI000A	165	01JAN2012 1800	183.16	540.00	546.93	542.29	546.95	0.000113	1.34	158.69	131.08	0.10
TWI000A	165	01JAN2012 1900	152.80	540.00	546.65	542.07	546.67	0.000096	1.19	147.10	128.98	0.09
TWI000A	165	01JAN2012 2000	125.12	540.00	546.37	541.85	546.39	0.000079	1.04	135.57	126.90	0.08
TWI000A	165	01JAN2012 2100	113.19	540.00	546.25	541.75	546.26	0.000071	0.97	130.26	125.93	0.08
TWI000A	165	01JAN2012 2200	105.50	540.00	546.16	541.68	546.18	0.000066	0.92	126.72	125.27	0.08
TWI000A	165	01JAN2012 2300	99.33	540.00	546.09	541.63	546.11	0.000062	0.88	123.80	124.74	0.07
TWI000A	165	01JAN2012 2400	94.16	540.00	546.04	541.58	546.05	0.000059	0.85	121.29	124.27	0.07
TWI000A	143		Inl Struct									
TWI000A	106	Max WS	4432.25	537.10	550.79	548.90	553.07	0.008250	13.03	479.64	143.92	0.66
TWI000A	106	31DEC2011 2400	3.24	537.10	537.76		537.82	0.020018	1.97	1.64	4.95	0.60
TWI000A	106	01JAN2012 0100	28.20	537.10	538.69		538.81	0.014543	2.86	9.85	13.20	0.58
TWI000A	106	01JAN2012 0200	51.88	537.10	539.17		539.31	0.011071	3.01	17.24	17.43	0.53
TWI000A	106	01JAN2012 0300	63.60	537.10	539.36		539.51	0.009608	3.08	20.67	18.06	0.51
TWI000A	106	01JAN2012 0400	68.71	537.10	539.44		539.59	0.009139	3.11	22.09	18.24	0.50
TWI000A	106	01JAN2012 0500	72.86	537.10	539.50		539.65	0.008833	3.14	23.20	18.38	0.49
TWI000A	106	01JAN2012 0600	77.70	537.10	539.57		539.73	0.008475	3.17	24.53	18.55	0.49
TWI000A	106	01JAN2012 0700	88.72	537.10	539.72		539.88	0.007950	3.25	27.32	18.89	0.48
TWI000A	106	01JAN2012 0800	110.58	537.10	539.99		540.17	0.007252	3.39	32.58	19.52	0.46
TWI000A	106	01JAN2012 0900	132.99	537.10	540.23		540.43	0.006994	3.56	37.32	20.09	0.46
TWI000A	106	01JAN2012 1000	171.64	537.10	540.60		540.83	0.006777	3.83	44.84	20.97	0.46
TWI000A	106	01JAN2012 1100	243.04	537.10	541.19		541.46	0.006560	4.22	57.58	22.39	0.46
TWI000A	106	01JAN2012 1200	599.42	537.10	543.12		543.63	0.006321	5.75	105.52	27.24	0.49
TWI000A	106	01JAN2012 1300	1907.98	537.10	547.21		548.36	0.006093	8.83	233.26	34.66	0.54
TWI000A	106	01JAN2012 1400	541.68	537.10	542.88		543.35	0.006304	5.52	98.94	26.61	0.48
TWI000A	106	01JAN2012 1500	341.86	537.10	541.88		542.21	0.006405	4.64	73.64	24.05	0.47

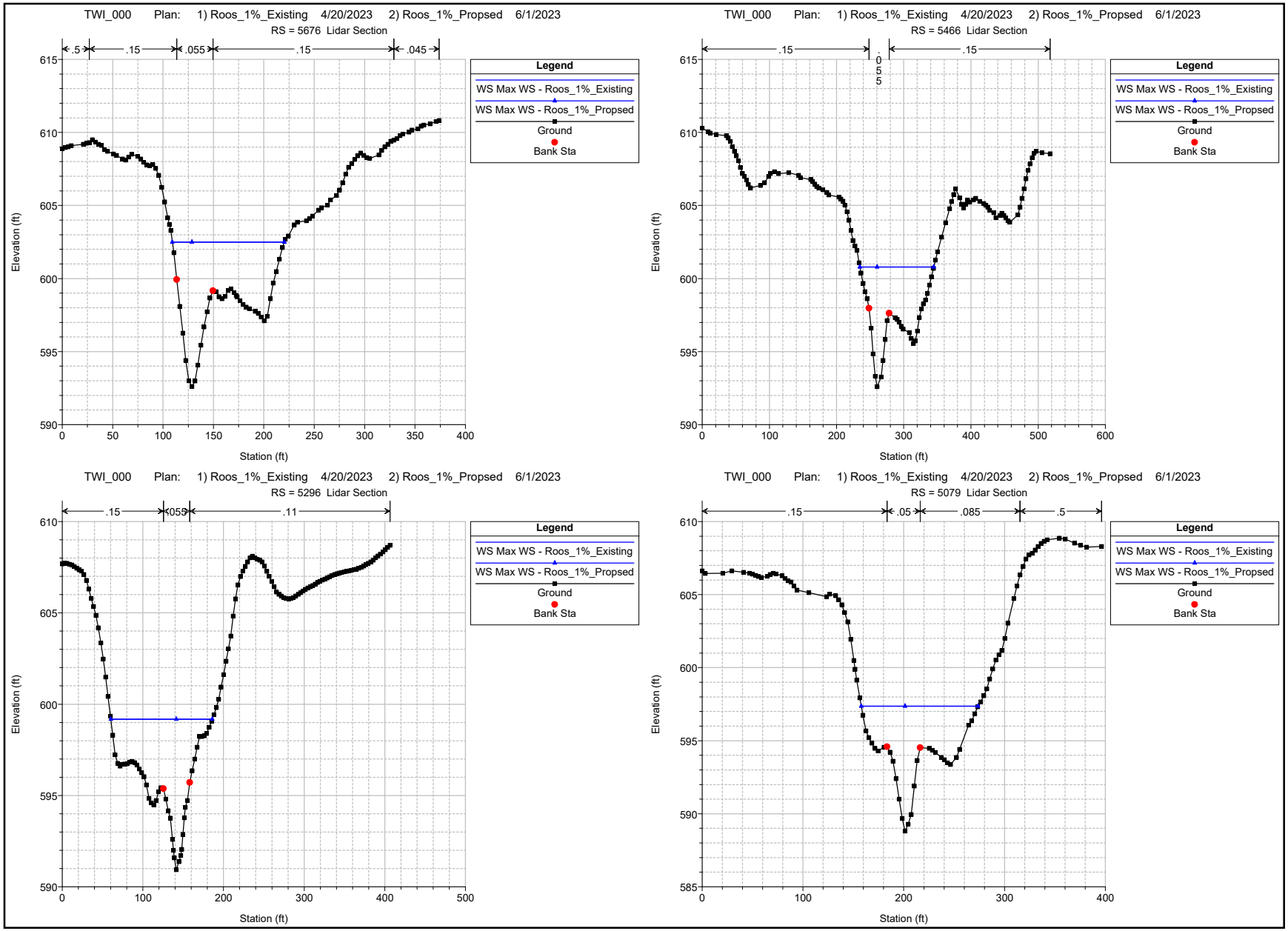
HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

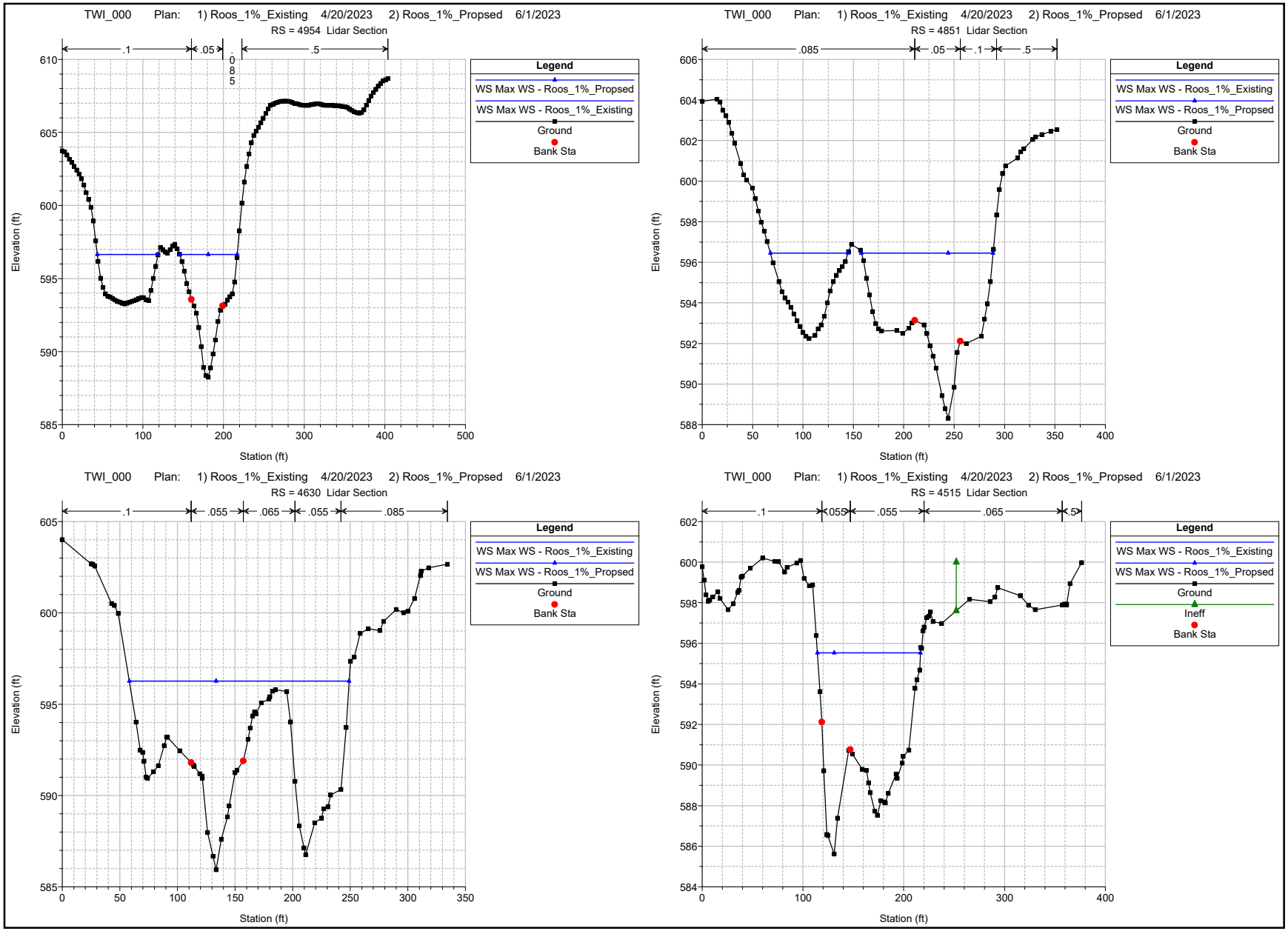
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	106	01JAN2012 1600	260.05	537.10	541.31		541.60	0.006518	4.30	60.47	22.70	0.46
TWI000A	106	01JAN2012 1700	212.12	537.10	540.94		541.20	0.006627	4.06	52.23	21.81	0.46
TWI000A	106	01JAN2012 1800	183.16	537.10	540.70		540.94	0.006729	3.90	46.99	21.22	0.46
TWI000A	106	01JAN2012 1900	152.80	537.10	540.43		540.64	0.006863	3.70	41.26	20.56	0.46
TWI000A	106	01JAN2012 2000	125.12	537.10	540.15		540.34	0.007044	3.50	35.74	19.90	0.46
TWI000A	106	01JAN2012 2100	113.19	537.10	540.02		540.20	0.007217	3.41	33.15	19.59	0.46
TWI000A	106	01JAN2012 2200	105.50	537.10	539.93		540.11	0.007375	3.36	31.40	19.38	0.47
TWI000A	106	01JAN2012 2300	99.33	537.10	539.86		540.03	0.007559	3.32	29.93	19.20	0.47
TWI000A	106	01JAN2012 2400	94.16	537.10	539.79		539.96	0.007705	3.28	28.71	19.06	0.47
TWI000A	87	Max WS	4432.39	536.80	551.12	549.27	552.45	0.004988	10.47	735.89	189.58	0.52
TWI000A	87	31DEC2011 2400	3.17	536.80	537.57	537.29	537.59	0.005357	1.14	2.79	7.21	0.32
TWI000A	87	01JAN2012 0100	28.17	536.80	538.56	537.98	538.63	0.005046	2.04	13.78	13.88	0.36
TWI000A	87	01JAN2012 0200	51.85	536.80	539.06	538.28	539.15	0.005018	2.43	21.31	16.25	0.37
TWI000A	87	01JAN2012 0300	63.59	536.80	539.26	538.41	539.37	0.005016	2.58	24.68	17.21	0.38
TWI000A	87	01JAN2012 0400	68.70	536.80	539.35	538.46	539.45	0.005018	2.63	26.10	17.59	0.38
TWI000A	87	01JAN2012 0500	72.85	536.80	539.41	538.51	539.52	0.005023	2.68	27.22	17.89	0.38
TWI000A	87	01JAN2012 0600	77.70	536.80	539.48	538.55	539.60	0.005008	2.72	28.55	18.24	0.38
TWI000A	87	01JAN2012 0700	88.69	536.80	539.64	538.65	539.76	0.005018	2.82	31.41	18.97	0.39
TWI000A	87	01JAN2012 0800	110.56	536.80	539.92	538.84	540.06	0.005011	3.00	36.91	20.30	0.39
TWI000A	87	01JAN2012 0900	132.96	536.80	540.16	539.01	540.32	0.005012	3.17	41.97	21.13	0.40
TWI000A	87	01JAN2012 1000	171.59	536.80	540.53	539.28	540.71	0.005006	3.43	50.00	22.14	0.40
TWI000A	87	01JAN2012 1100	242.96	536.80	541.13	539.70	541.35	0.005005	3.82	63.66	23.74	0.41
TWI000A	87	01JAN2012 1200	598.36	536.80	543.10	541.13	543.52	0.005001	5.23	115.15	28.01	0.44
TWI000A	87	01JAN2012 1300	1909.71	536.80	547.25	544.26	548.24	0.005003	8.17	269.10	67.35	0.49
TWI000A	87	01JAN2012 1400	541.95	536.80	542.85	540.95	543.24	0.005004	5.03	108.18	27.57	0.44
TWI000A	87	01JAN2012 1500	341.95	536.80	541.83	540.17	542.10	0.005006	4.22	80.95	25.64	0.42
TWI000A	87	01JAN2012 1600	260.11	536.80	541.26	539.79	541.49	0.005006	3.90	66.77	24.09	0.41
TWI000A	87	01JAN2012 1700	212.15	536.80	540.88	539.53	541.09	0.005004	3.66	57.92	23.08	0.41
TWI000A	87	01JAN2012 1800	183.18	536.80	540.63	539.35	540.83	0.005009	3.50	52.30	22.42	0.40
TWI000A	87	01JAN2012 1900	152.85	536.80	540.36	539.15	540.53	0.005010	3.31	46.17	21.66	0.40
TWI000A	87	01JAN2012 2000	125.14	536.80	540.08	538.96	540.23	0.005011	3.11	40.28	20.92	0.39
TWI000A	87	01JAN2012 2100	113.21	536.80	539.95	538.86	540.09	0.005026	3.02	37.51	20.44	0.39
TWI000A	87	01JAN2012 2200	105.51	536.80	539.85	538.80	539.99	0.005012	2.96	35.66	20.01	0.39
TWI000A	87	01JAN2012 2300	99.33	536.80	539.78	538.75	539.91	0.005017	2.91	34.12	19.64	0.39
TWI000A	87	01JAN2012 2400	94.16	536.80	539.71	538.70	539.84	0.005005	2.87	32.84	19.33	0.39

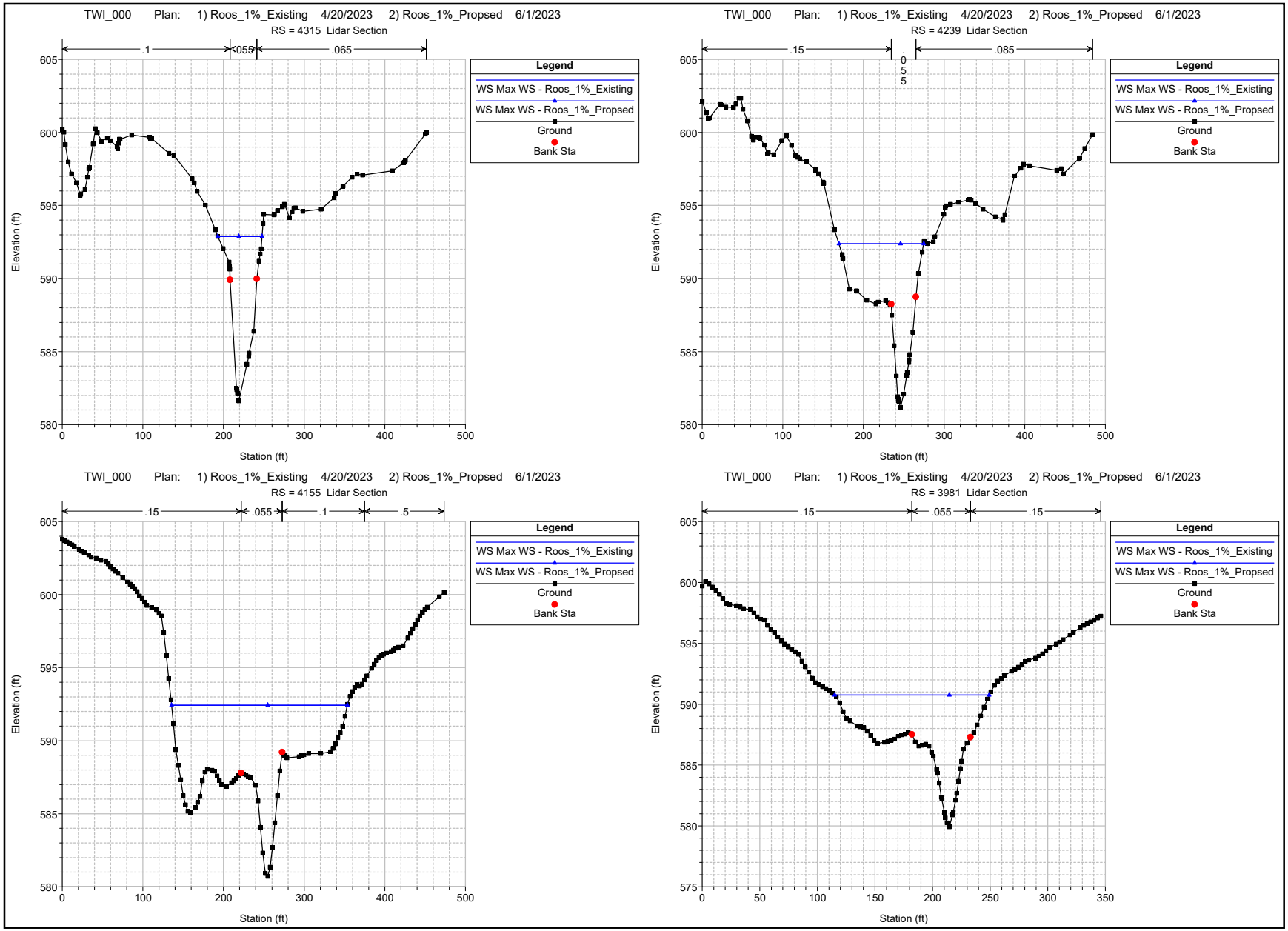

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6594 Lidar Section
.5
.15
.05
.075
Legend
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6562 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6532 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6498 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

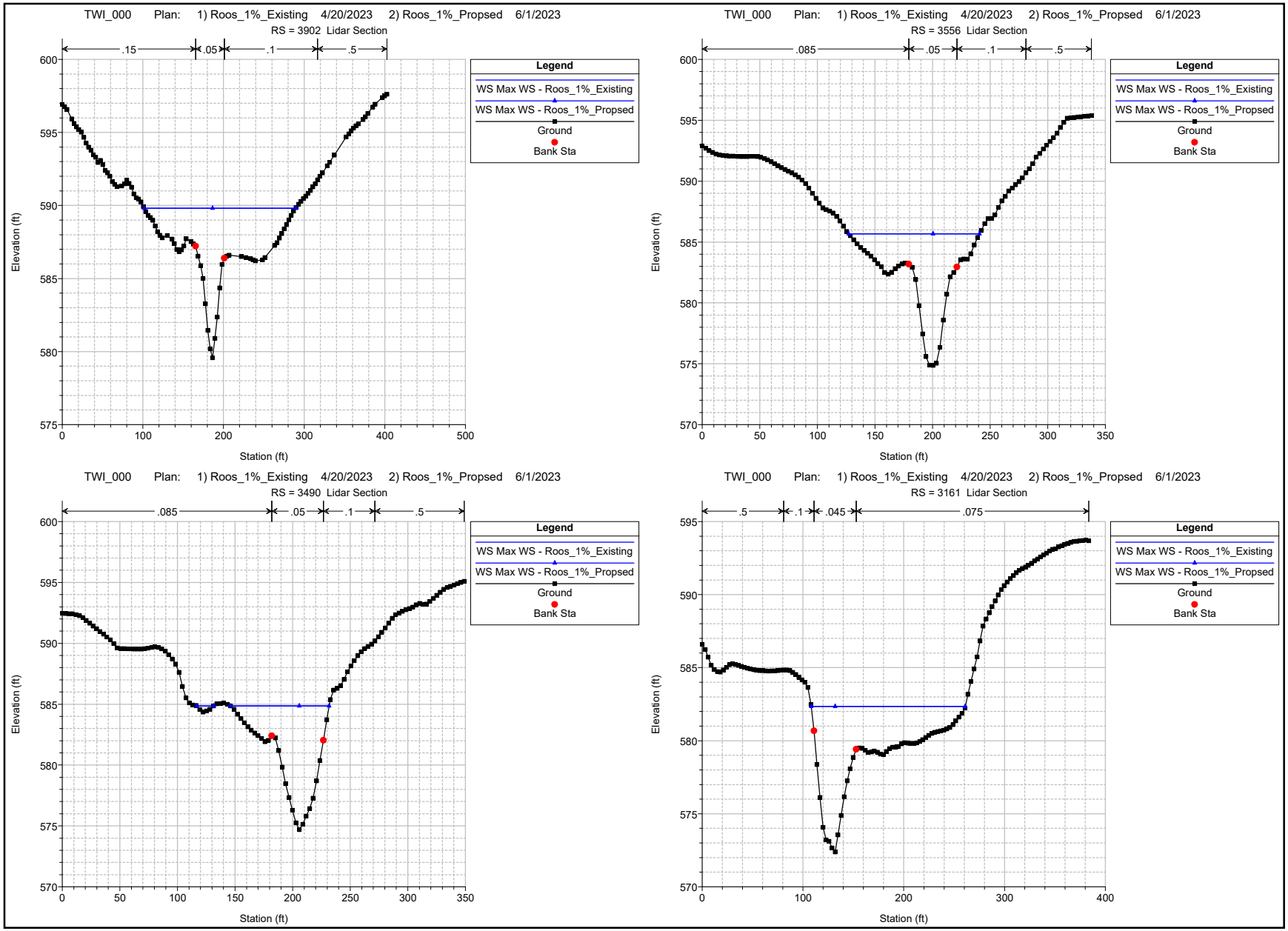

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6438 Lidar Section
.15
.05
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6319 Lidar Section
.15
.05
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6249 Survey Section
.15
.055
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6218 Survey Section
.15
.055
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta

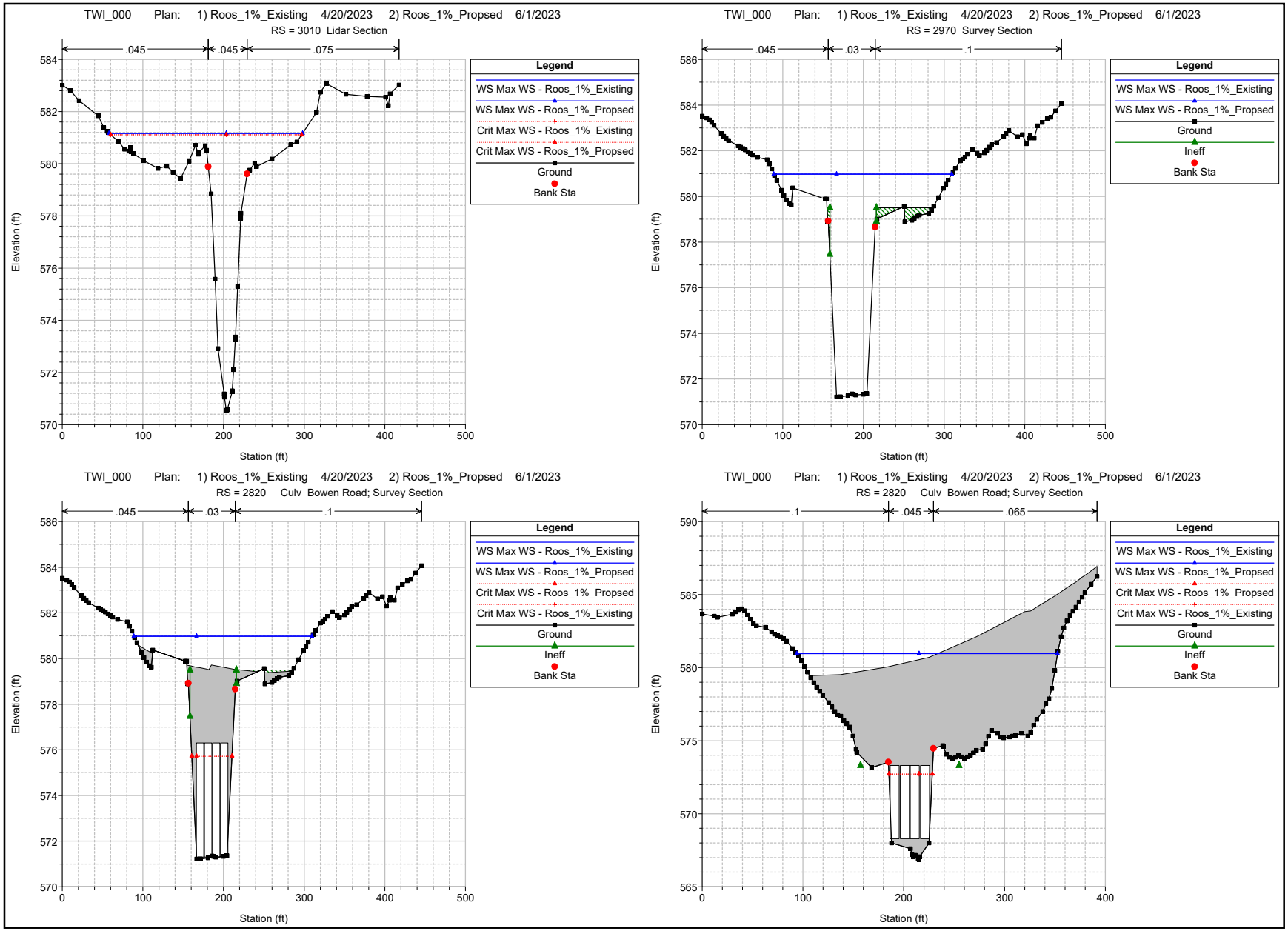

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6179 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6133 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6059 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5935 Lidar Section
.5
.15
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

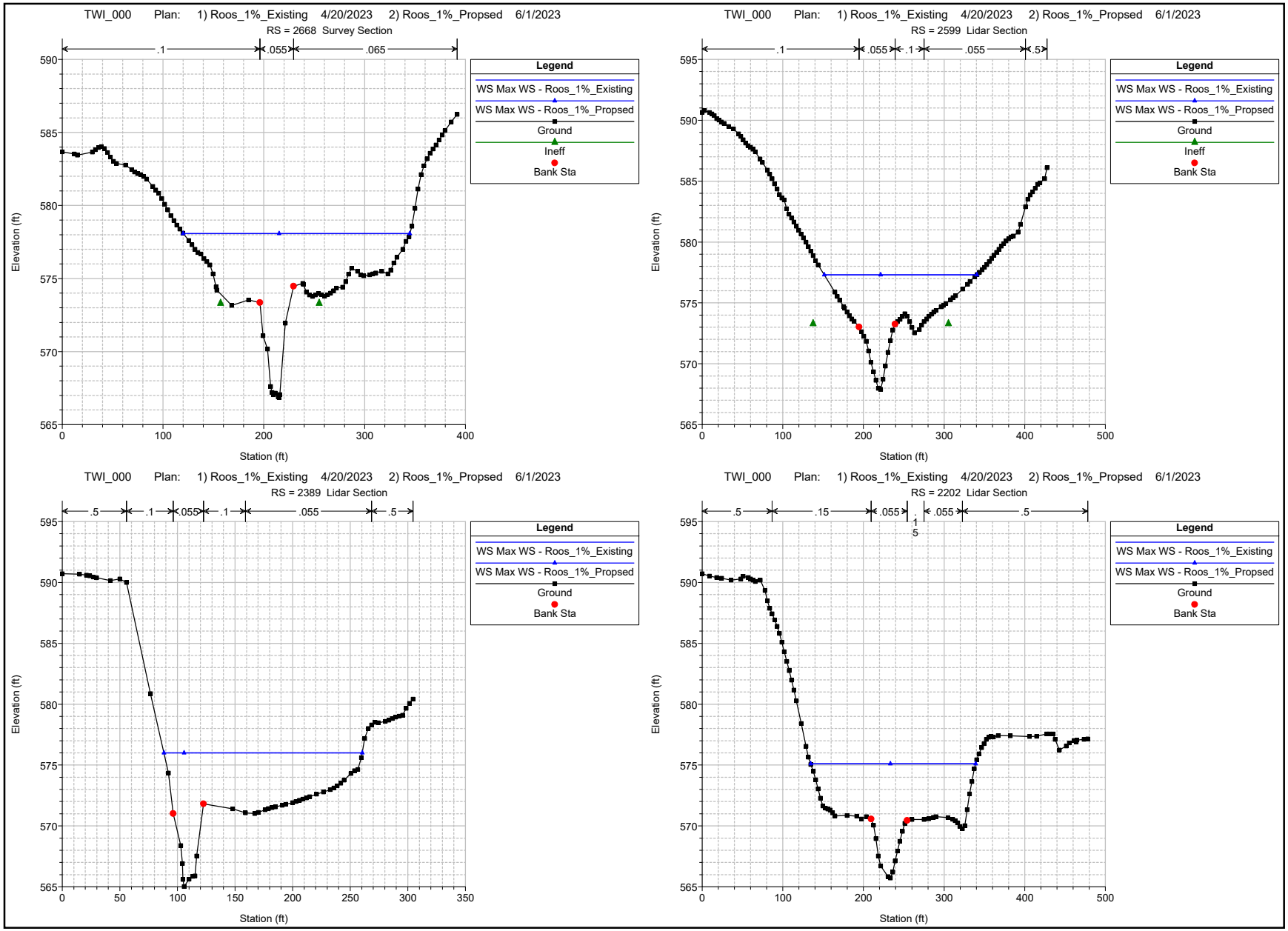

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5676 Lidar Section
.5
.15
.055
.15
.045
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5466 Lidar Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5296 Lidar Section
.15
.055
.11
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5079 Lidar Section
.15
.05
.085
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

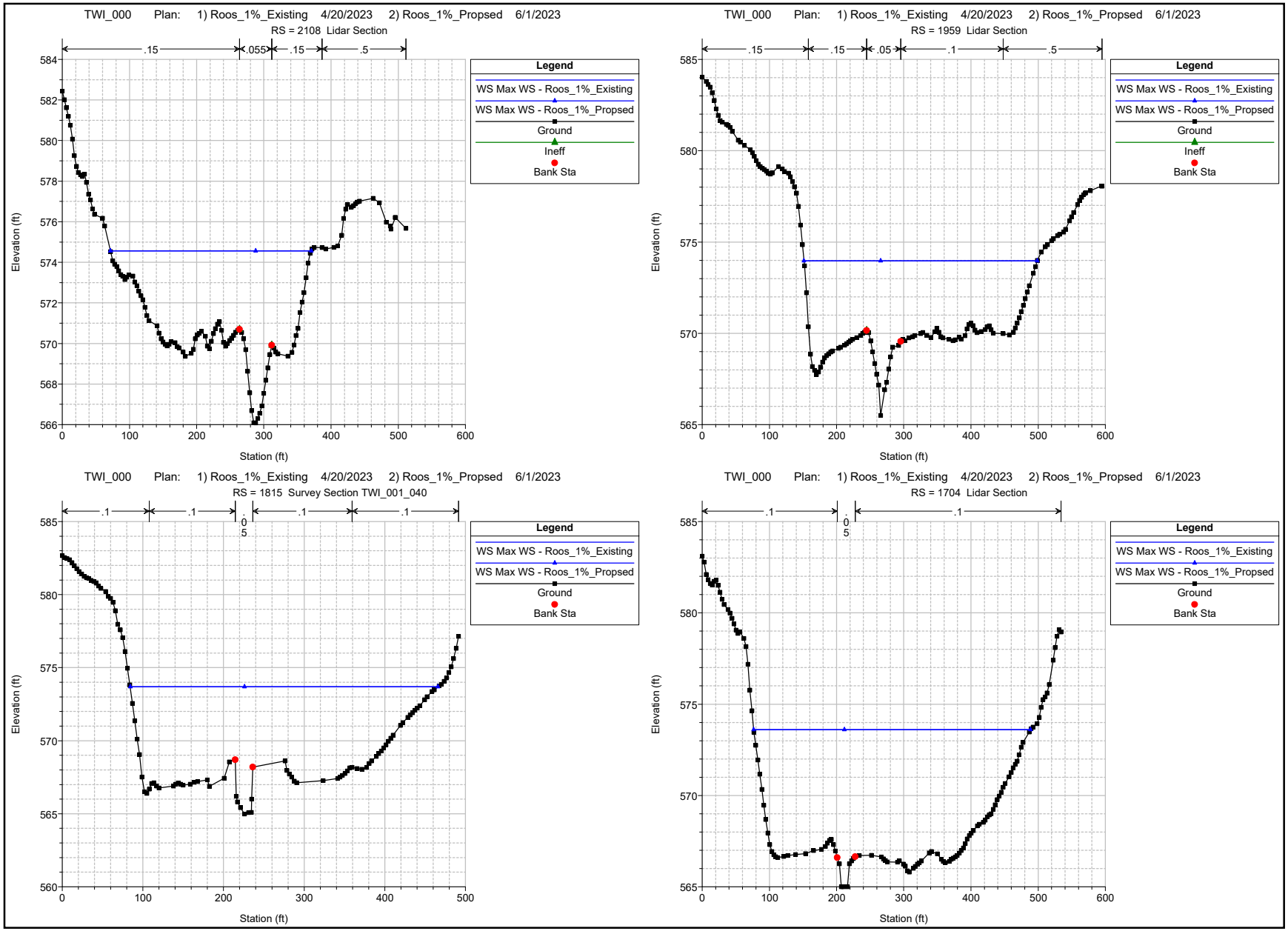

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4954 Lidar Section
.1
.05
.085
.5
Legend
WS Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4851 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4630 Lidar Section
.1
.055
.065
.055
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4515 Lidar Section
.1
.055
.055
.065
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

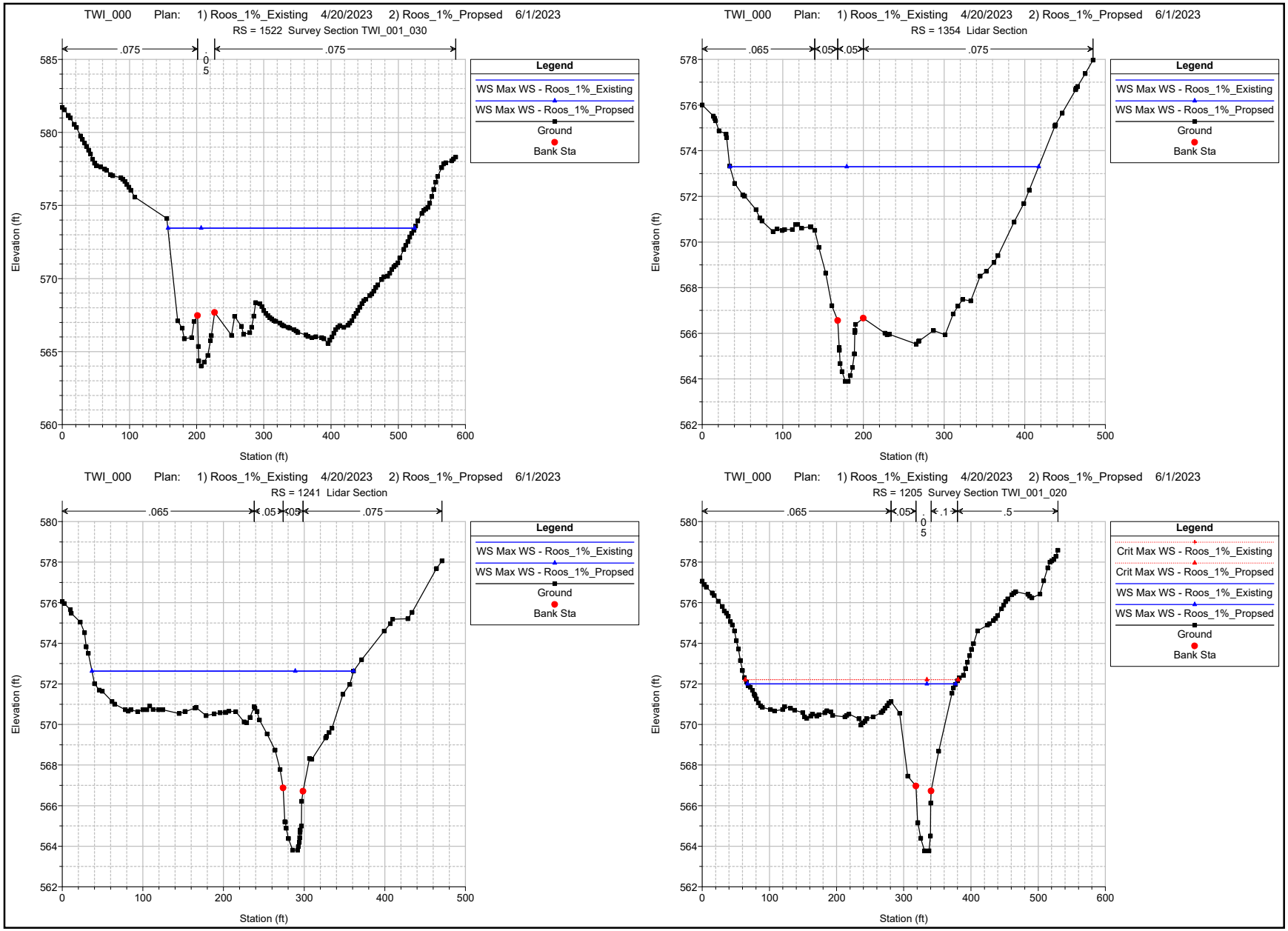

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4315 Lidar Section
.1
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4239 Lidar Section
.15
.055
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4155 Lidar Section
.15
.055
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3981 Lidar Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

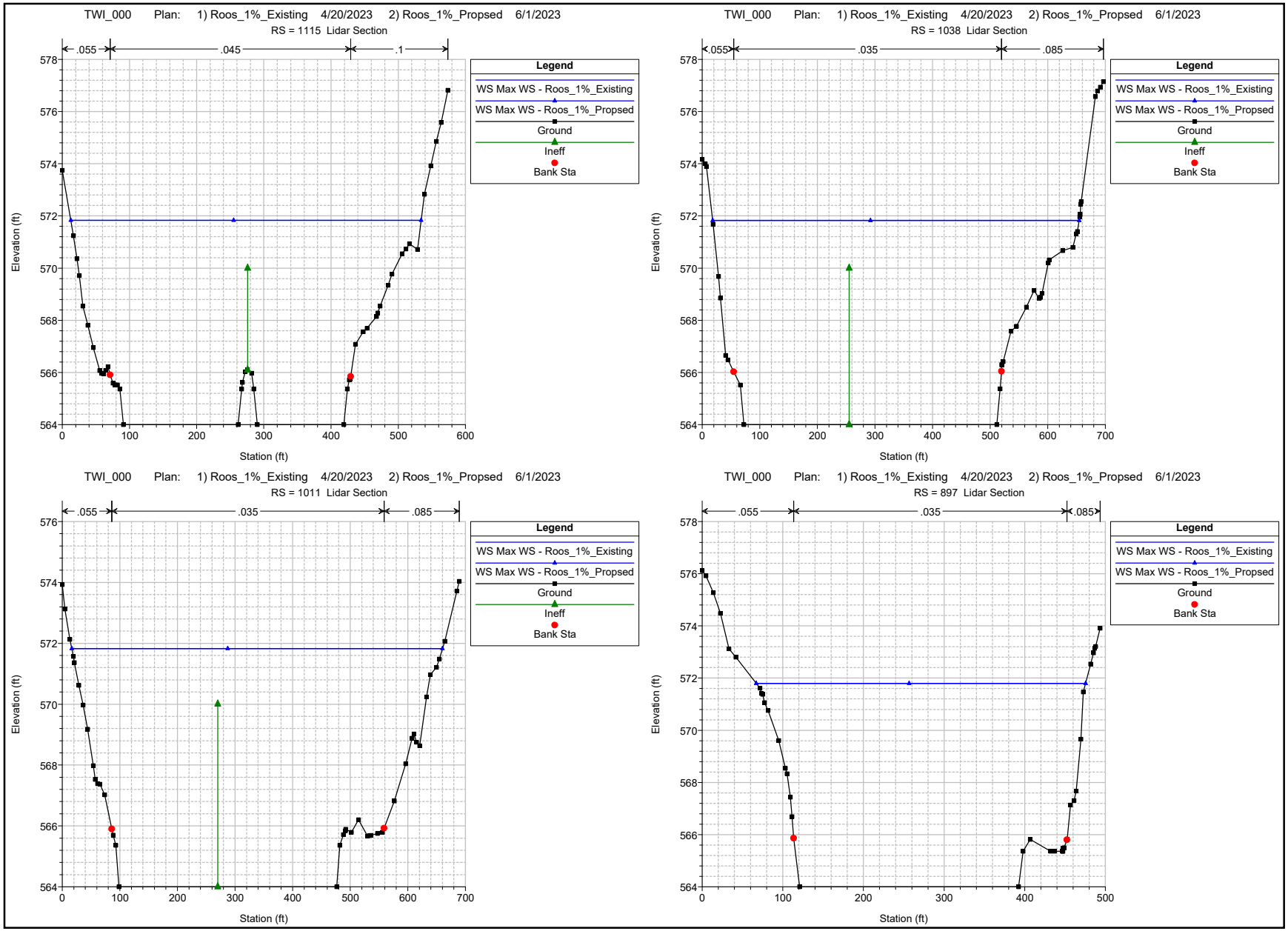

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3902 Lidar Section
.15
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3556 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3490 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3161 Lidar Section
.5
.1
.045
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

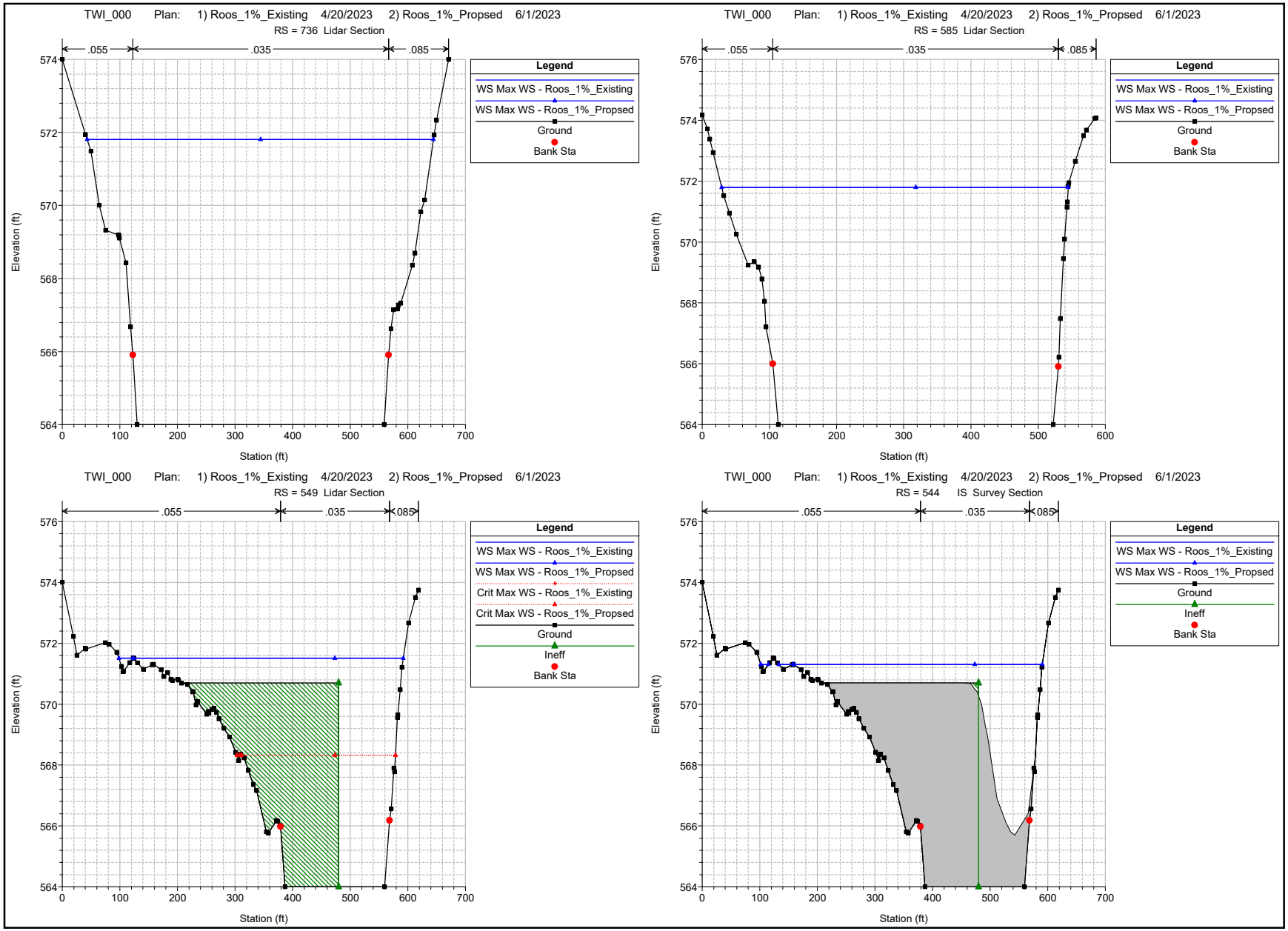

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3010 Lidar Section
.045
.045
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2970 Survey Section
.045
.03
.1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2820 Culv Bowen Road; Survey Section
.045
.03
.1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2820 Culv Bowen Road; Survey Section
.1
.045
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

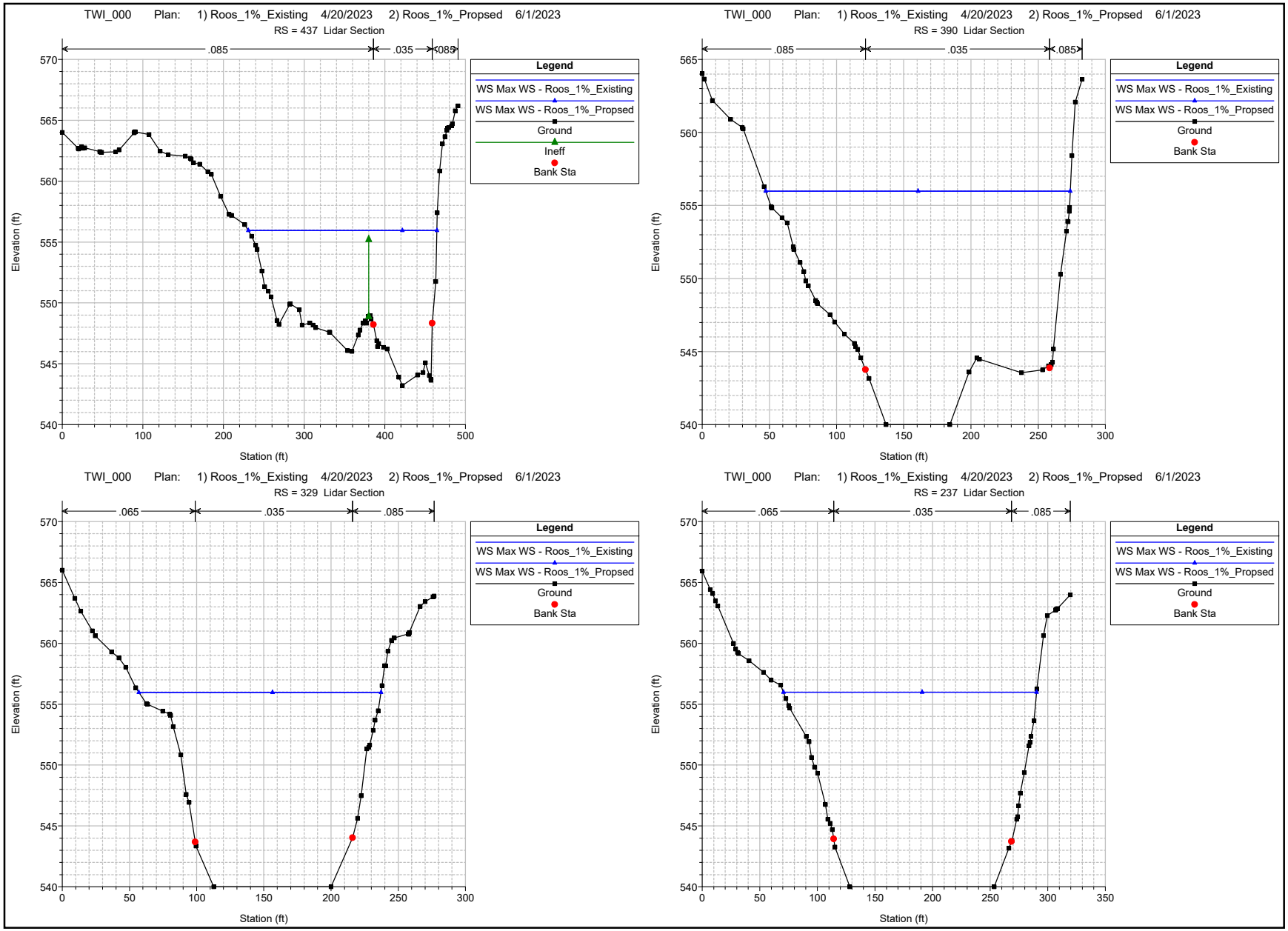

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2668 Survey Section
.1
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2599 Lidar Section
.1
.055
.1
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2389 Lidar Section
.5
.1
.055
.1
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2202 Lidar Section
.5
.15
.055
.1
.5
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

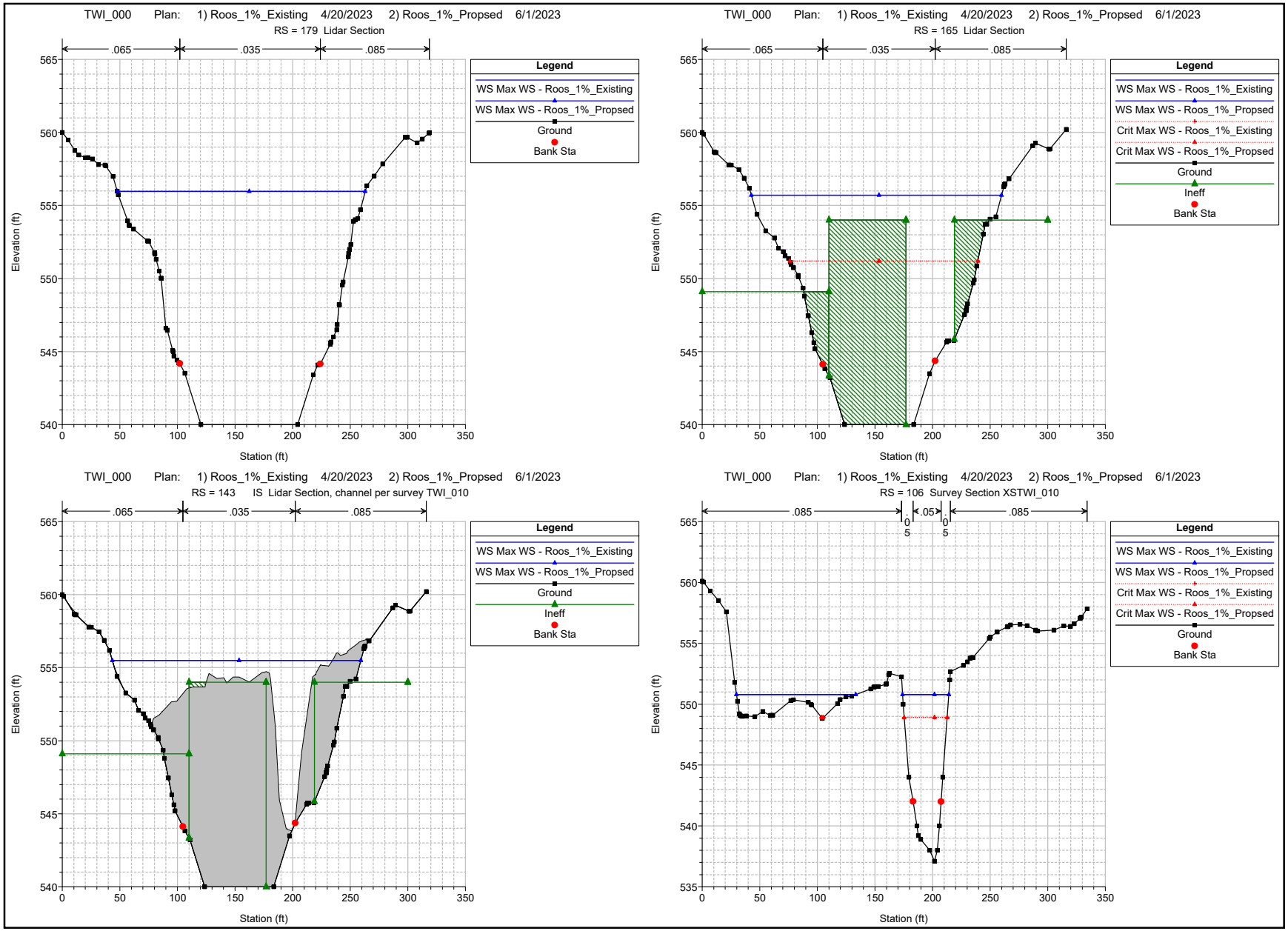

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2108 Lidar Section
.15 .055 .15 .5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1959 Lidar Section
.15 .15 .05 .1 .5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1815 Survey Section TWI_001_040
.1 .1 .05 .1 .1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1704 Lidar Section
.1 .05 .1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

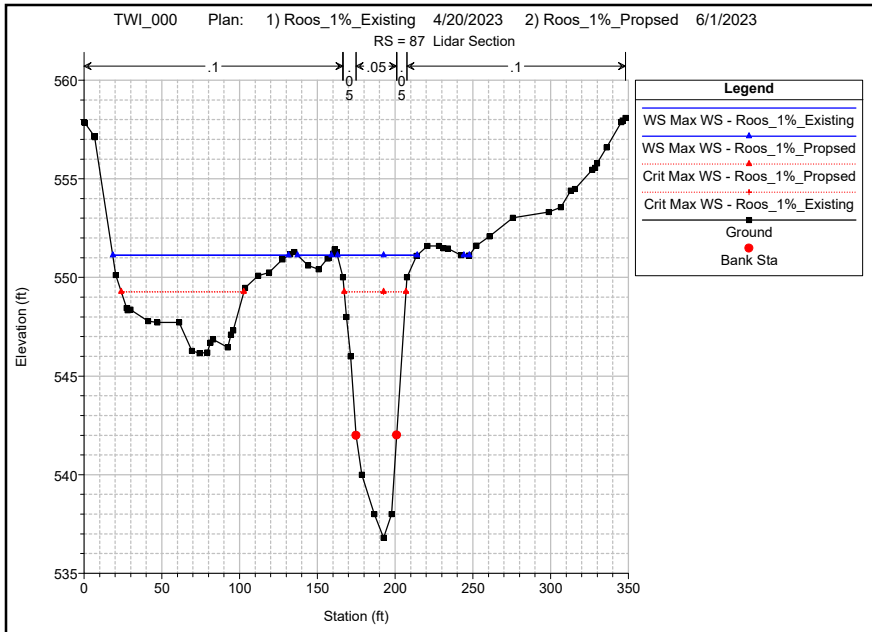

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1522 Survey Section TWI_001_030
.075
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1354 Lidar Section
.065
.05
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1241 Lidar Section
.065
.05
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1205 Survey Section TWI_001_020
.065
.05
.05
.1
.5
Legend
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

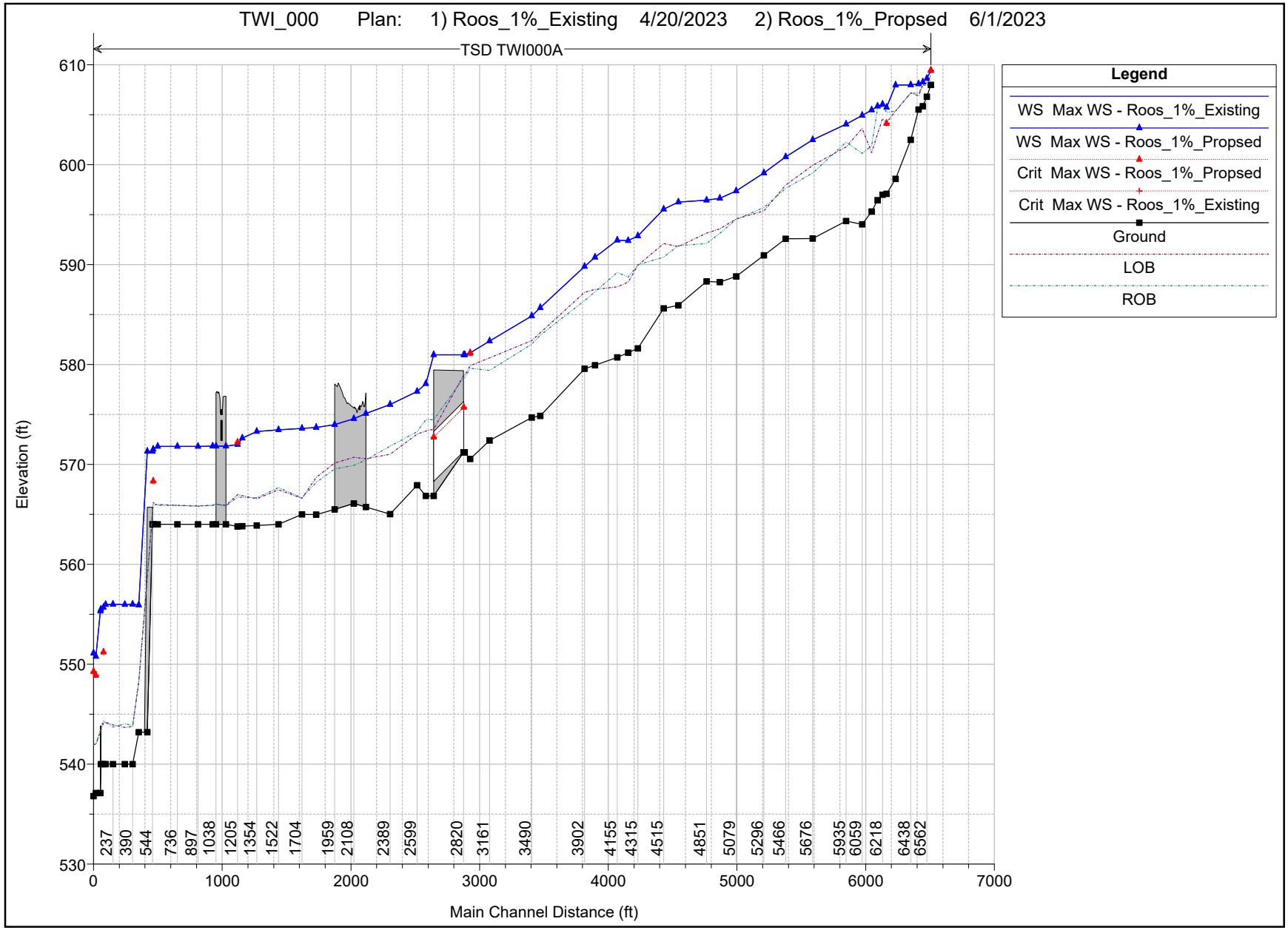

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1115 Lidar Section
.055
.045
.1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1038 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1011 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 897 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 736 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 585 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 549 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 544 IS Survey Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 437 Lidar Section
.085
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 390 Lidar Section
.085
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 329 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 237 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 179 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 165 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 143 IS Lidar Section, channel per survey TWI_010
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 106 Survey Section XSTWI_010
.085
.05
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 87 Lidar Section
.1
.05
.1
0.5
0.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
560
555
550
545
540
535
0
50
100
150
200
250
300
350
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
TSD TWI000A
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
LOB
ROB
Elevation (ft)
610
600
590
580
570
560
550
540
530
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)
237
390
544
736
897
1038
1205
1354
1522
1704
1959
2108
2389
2599
2820
3161
3490
3902
4155
4315
4515
4851
5079
5296
5466
5676
5935
6059
6218
6438
6562

TWIN SPRINGS DRAW TRIBUTARY 2

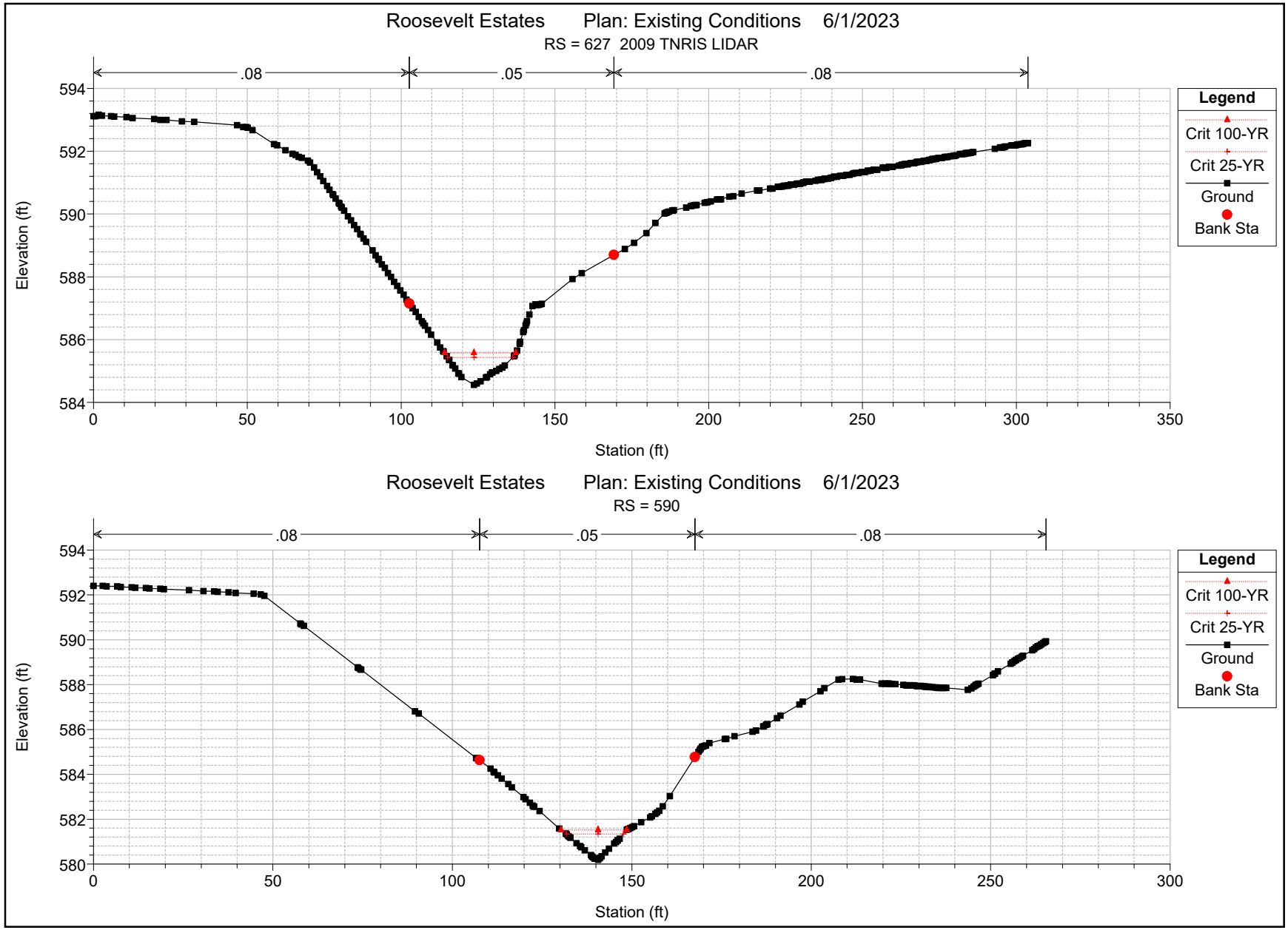
(HEC-RAS VERSION 6.3)

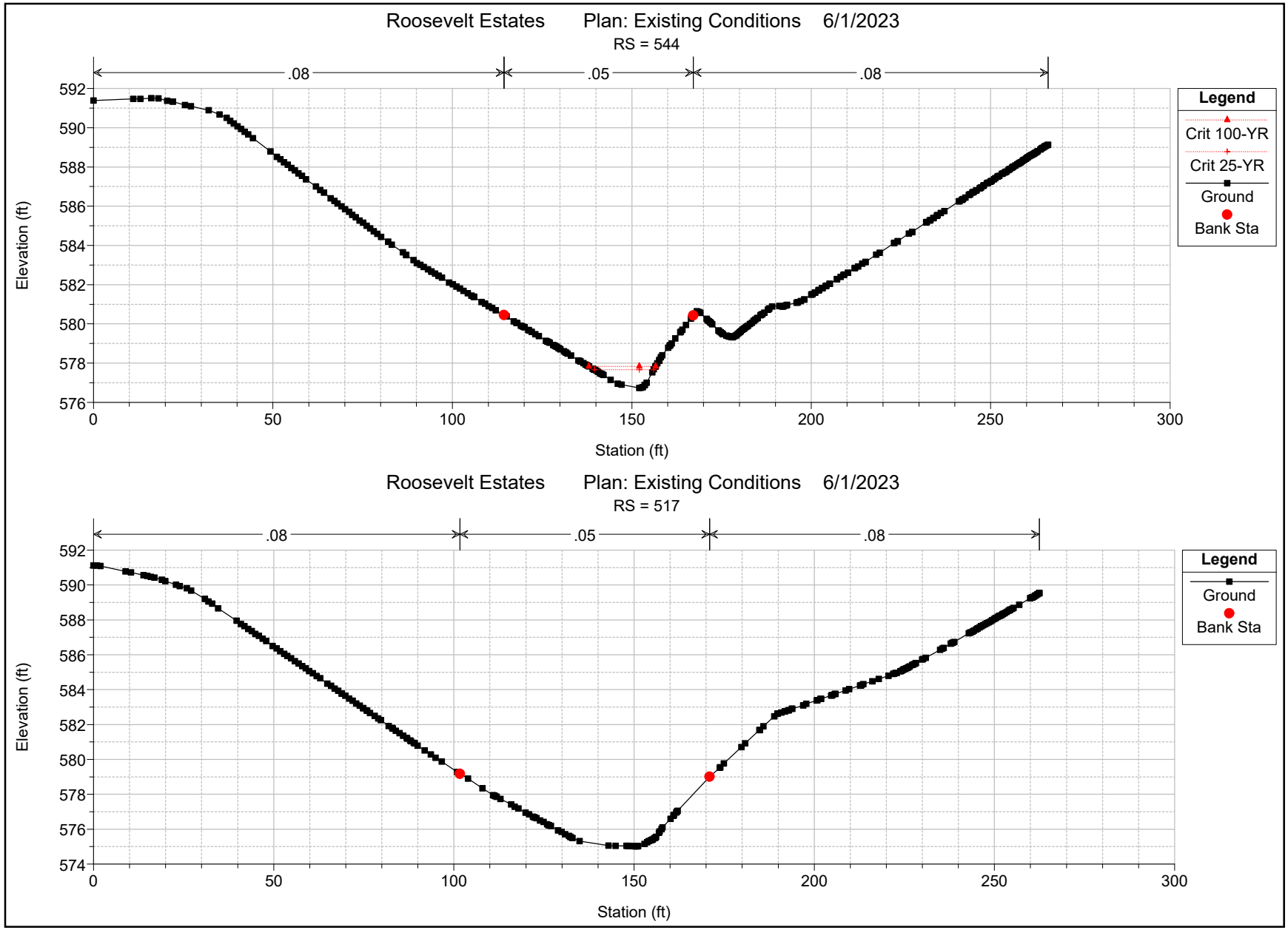
1600 W. 7th Street, Suite 400, Fort Worth, Texas 76102 | 817.810.0696
Shield Engineering Group, PLLC

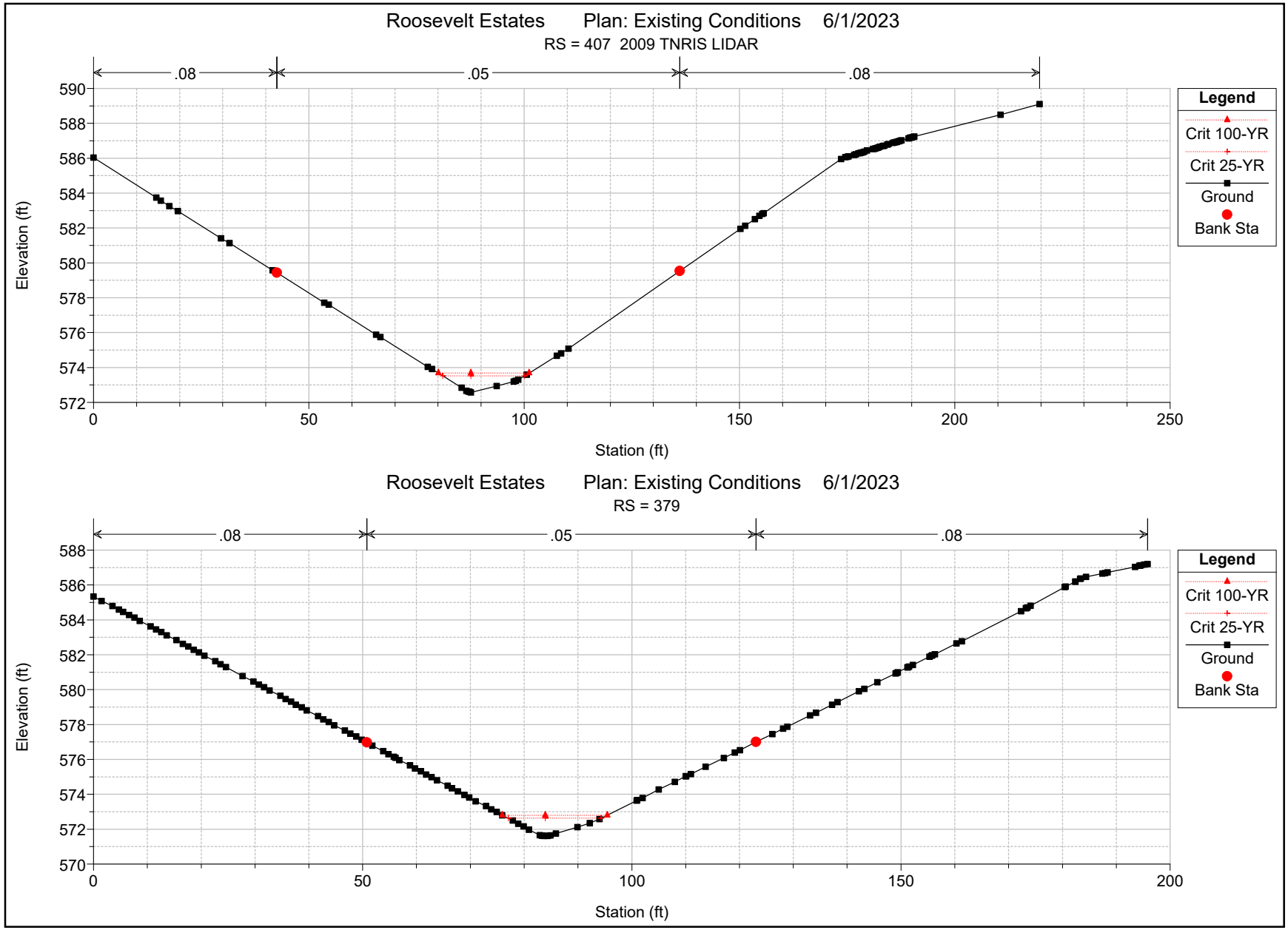
info@shield-engineering.com | www.SHIELDENGINEERINGGROUP.com
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

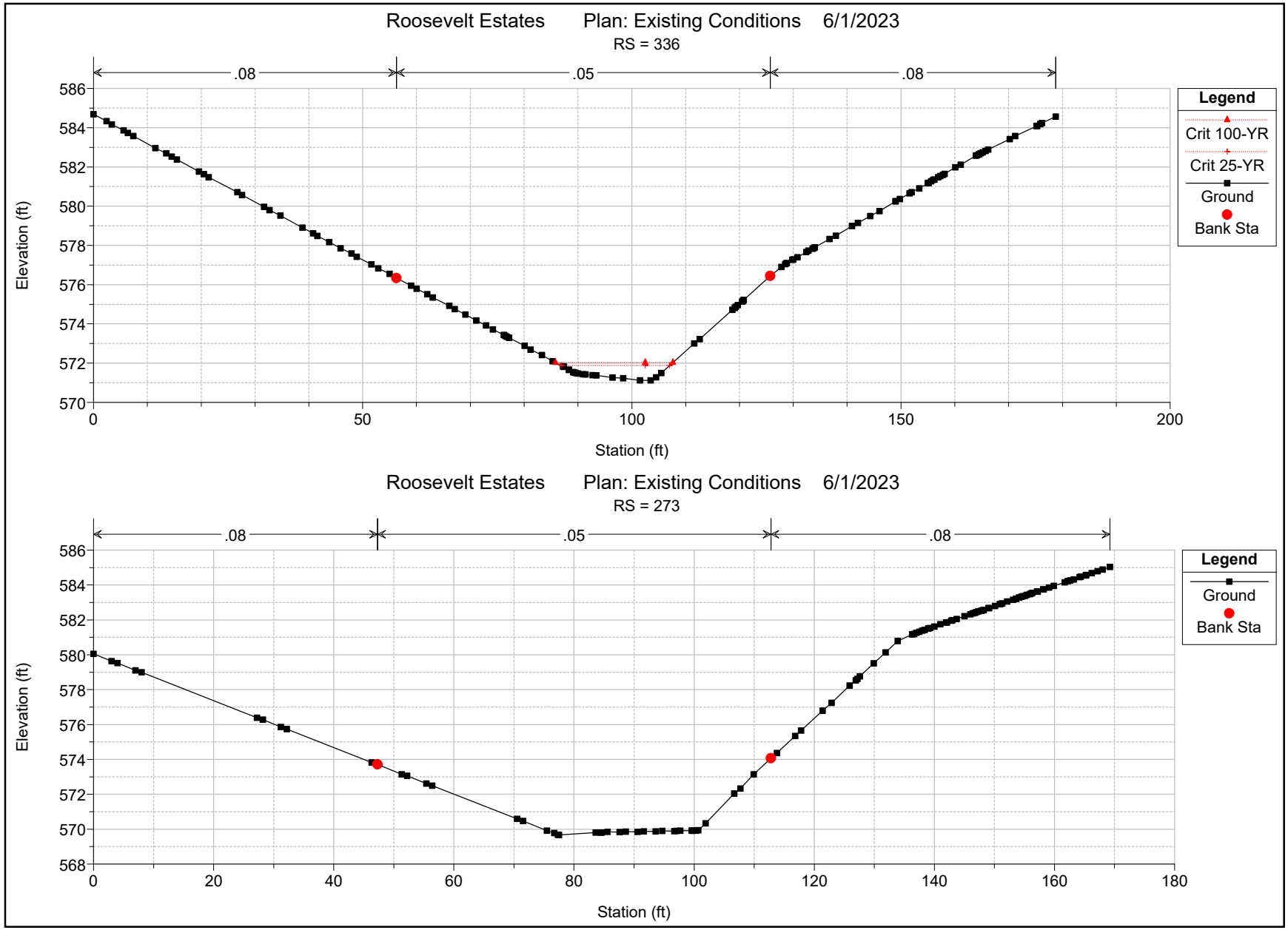
HEC-RAS Plan: Exist River: River 1 Reach: Reach 1

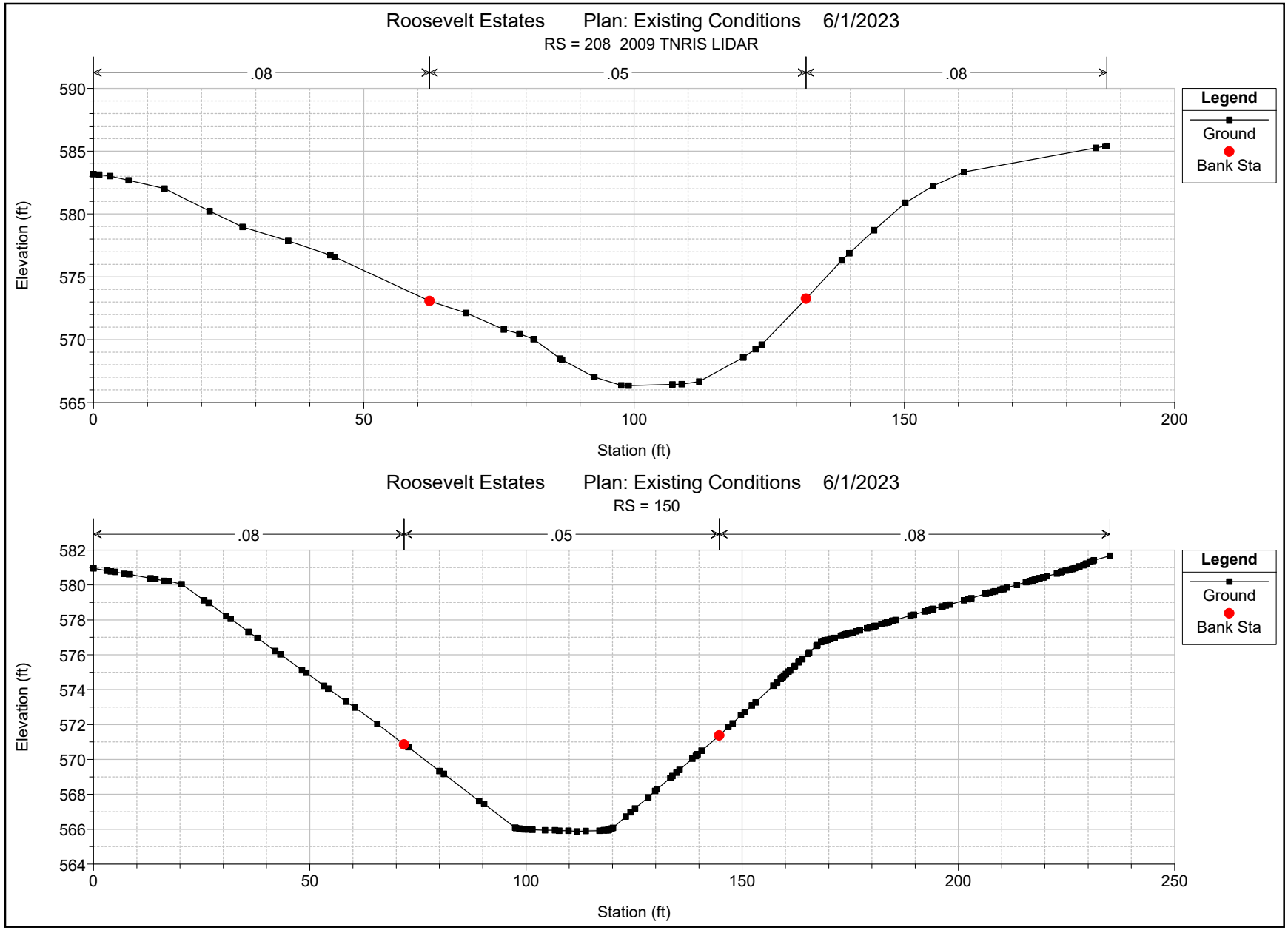
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	627	25-YR	42.44	584.56	585.43	585.43	585.69	0.047281	4.03	10.52	21.24	1.01
Reach 1	627	100-YR	60.37	584.56	585.57	585.57	585.88	0.044966	4.42	13.67	23.19	1.01
Reach 1	590	25-YR	42.44	580.19	581.34	581.34	581.65	0.045034	4.46	9.53	15.87	1.01
Reach 1	590	100-YR	60.37	580.19	581.52	581.52	581.87	0.042768	4.77	12.64	18.26	1.01
Reach 1	544	25-YR	42.44	576.74	577.67	577.67	577.97	0.044905	4.38	9.69	16.51	1.01
Reach 1	544	100-YR	60.37	576.74	577.84	577.84	578.19	0.043284	4.75	12.71	18.65	1.01
Reach 1	517	25-YR	42.44	575.02	575.90		575.99	0.011576	2.37	17.92	27.99	0.52
Reach 1	517	100-YR	60.37	575.02	576.07		576.18	0.011699	2.66	22.68	29.95	0.54
Reach 1	407	25-YR	42.44	572.57	573.52	573.52	573.79	0.046624	4.19	10.12	19.03	1.01
Reach 1	407	100-YR	60.37	572.57	573.68	573.68	574.00	0.043963	4.55	13.25	21.07	1.01
Reach 1	379	25-YR	42.44	571.61	572.90		573.03	0.014118	2.83	15.00	20.73	0.59
Reach 1	379	100-YR	60.37	571.61	573.53		573.59	0.004152	1.98	30.48	28.70	0.34
Reach 1	336	25-YR	42.44	571.12	572.82		572.85	0.001497	1.24	34.32	30.46	0.21
Reach 1	336	100-YR	60.37	571.12	573.50		573.51	0.000735	1.05	57.33	37.93	0.15
Reach 1	273	25-YR	42.44	569.67	572.83		572.83	0.000053	0.36	118.99	55.18	0.04
Reach 1	273	100-YR	60.37	569.67	573.50		573.50	0.000048	0.38	158.32	62.22	0.04
Reach 1	208	25-YR	42.44	566.34	572.83		572.83	0.000005	0.16	264.01	67.02	0.01
Reach 1	208	100-YR	60.37	566.34	573.50		573.50	0.000006	0.19	310.81	72.35	0.02
Reach 1	150	25-YR	42.44	565.88	572.83		572.83	0.000002	0.11	383.25	89.83	0.01
Reach 1	150	100-YR	60.37	565.88	573.50		573.50	0.000002	0.14	445.73	96.72	0.01
Reach 1	89	25-YR	42.44	566.08	572.83		572.83	0.000000	0.06	659.92	122.63	0.00
Reach 1	89	100-YR	60.37	566.08	573.50		573.50	0.000001	0.08	743.85	127.93	0.01
Reach 1	57	25-YR	42.44	565.97	572.83	566.27	572.83	0.000000	0.05	896.35	159.58	0.00
Reach 1	57	100-YR	60.37	565.97	573.50	566.31	573.50	0.000000	0.06	1005.18	165.22	0.00

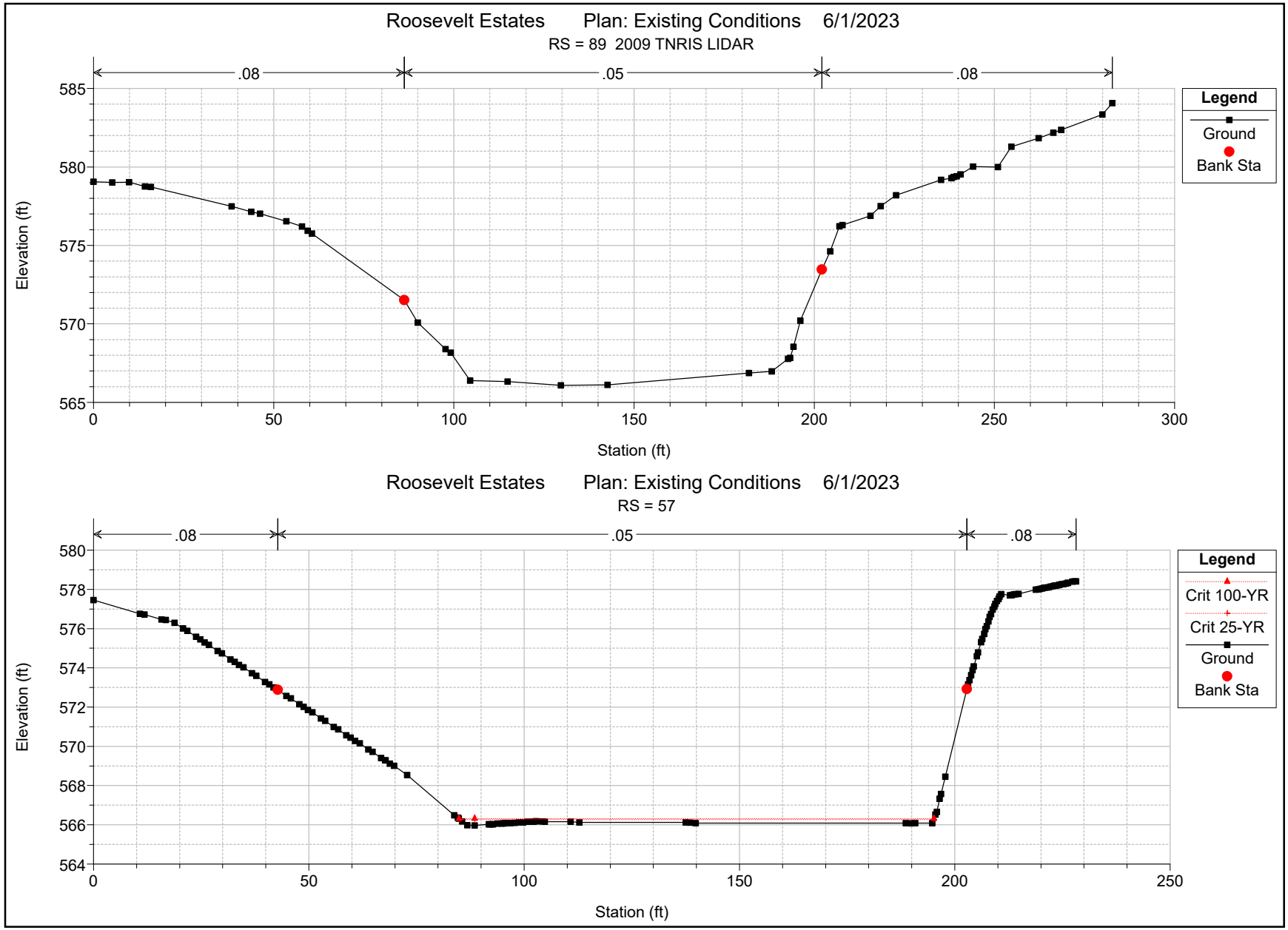

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 627 2009 TNRIS LIDAR
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 590
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta

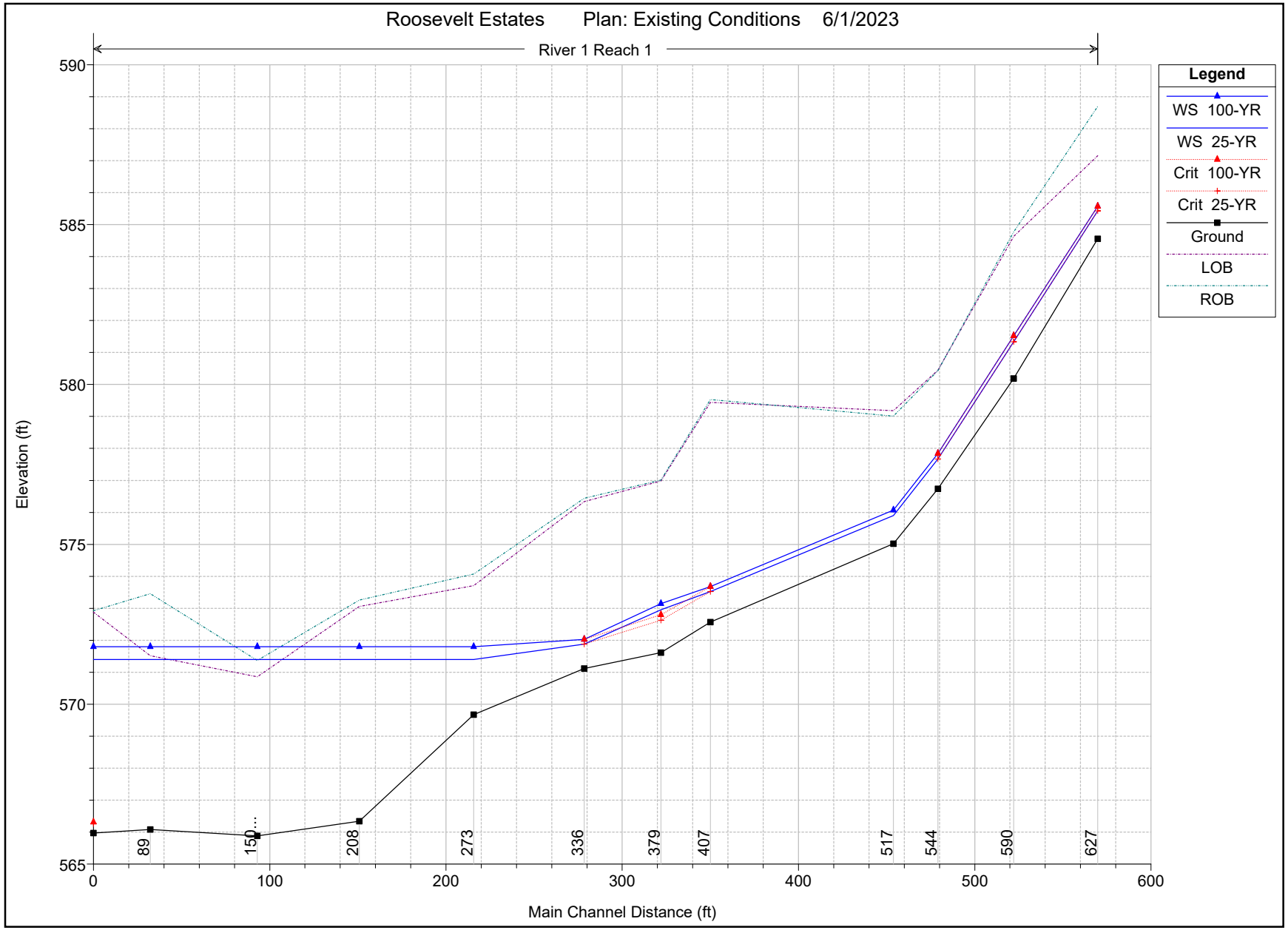

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 544
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 517
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 407 2009 TNRIS LIDAR
.08
.05
.08
590
588
586
584
582
580
578
576
574
572
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 379
.08
.05
.08
588
586
584
582
580
578
576
574
572
570
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 336
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 273
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta

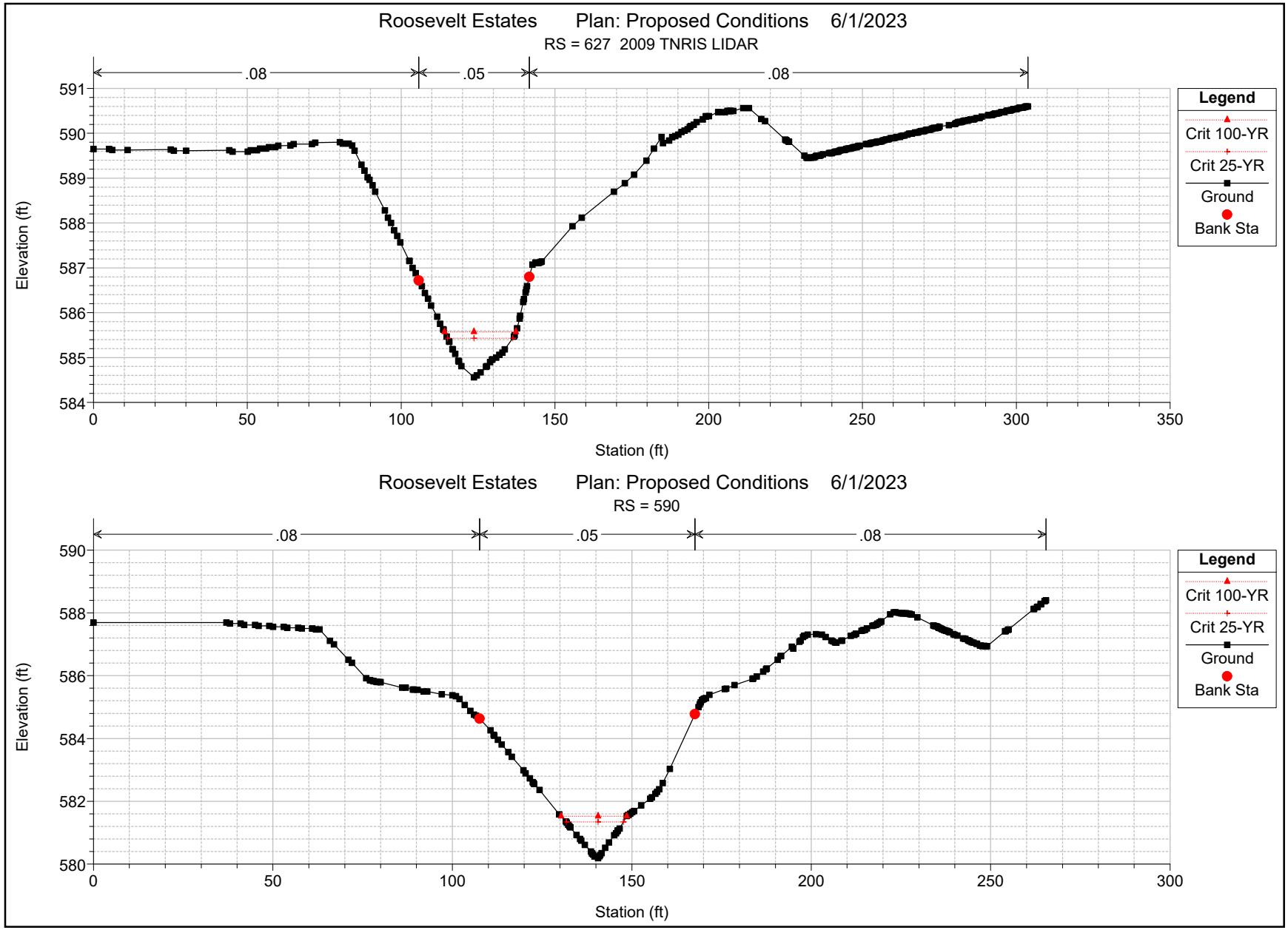

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 208 2009 TNRIS LIDAR
.08
.05
.08
590
585
580
575
570
565
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 150
.08
.05
.08
582
580
578
576
574
572
570
568
566
564
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
Ground
Bank Sta

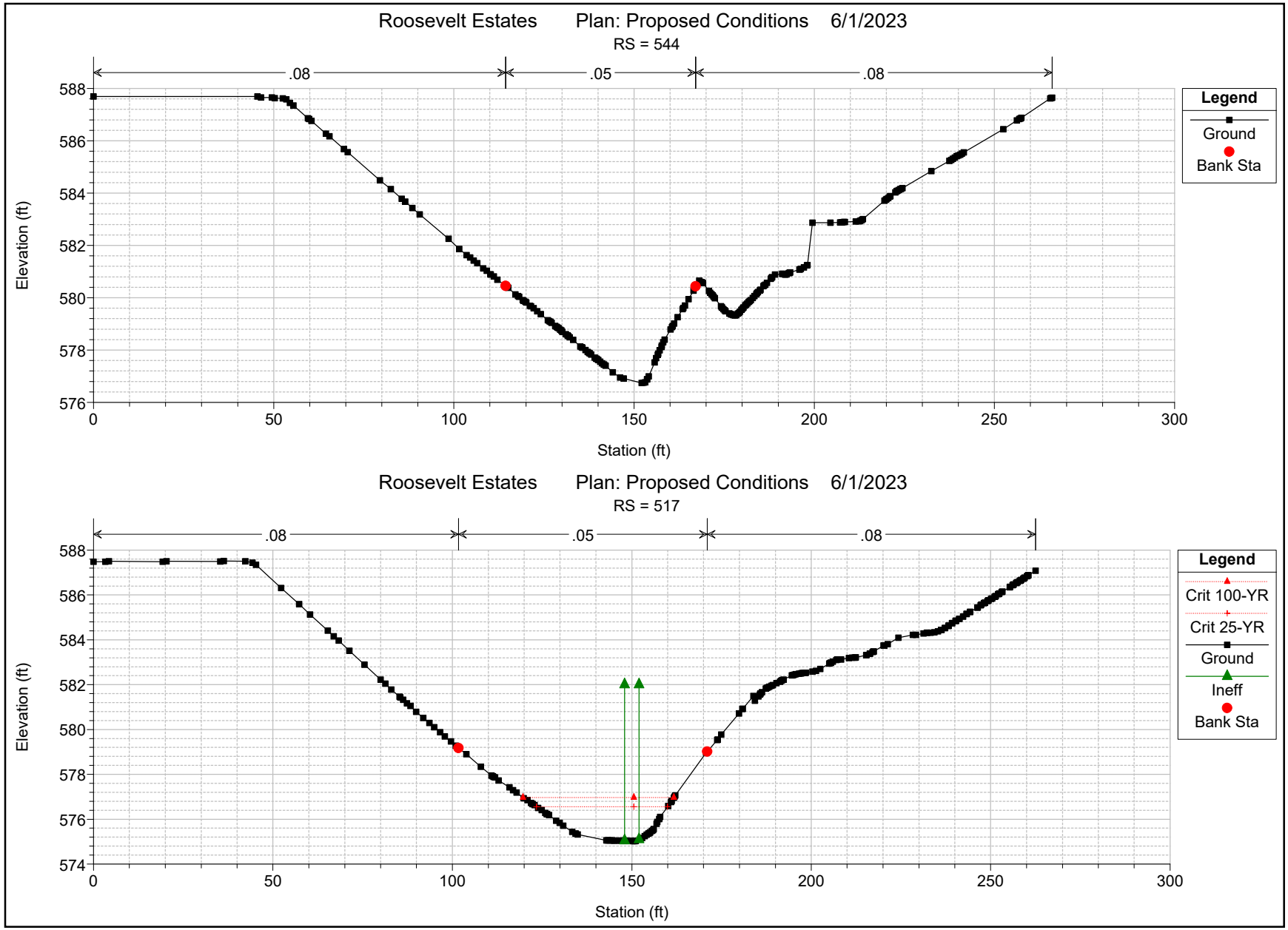

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 89 2009 TNRIS LIDAR
.08
.05
.08
585
580
575
570
565
0
50
100
150
200
250
300
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 57
.08
.05
.08
580
578
576
574
572
570
568
566
564
0
50
100
150
200
250
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
River 1 Reach 1
Legend
WS 100-YR
WS 25-YR
Crit 100-YR
Crit 25-YR
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
590
585
580
575
570
565
0
100
200
300
400
500
600
89
150
208
273
336
379
407
517
544
590
627

HEC-RAS Plan: Prop River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	627	25-YR	42.44	584.56	585.43	585.43	585.69	0.047265	4.03	10.52	21.24	1.01
Reach 1	627	100-YR	60.37	584.56	585.57	585.57	585.88	0.044993	4.42	13.66	23.18	1.01
Reach 1	590	25-YR	42.44	580.19	581.34	581.34	581.65	0.044336	4.43	9.58	15.91	1.01
Reach 1	590	100-YR	60.37	580.19	581.52	581.52	581.87	0.042607	4.77	12.66	18.28	1.01
Reach 1	544	25-YR	42.44	576.74	577.90		578.05	0.016735	3.05	13.92	19.47	0.64
Reach 1	544	100-YR	60.37	576.74	578.98		579.01	0.001739	1.43	42.07	33.33	0.23
Reach 1	517	25-YR	42.44	575.02	577.50	576.56	577.79	0.006338	4.31	9.85	48.94	0.48
Reach 1	517	100-YR	60.37	575.02	578.65	576.97	578.92	0.003554	4.17	14.47	63.66	0.39
Reach 1	454 Culvert Crossing		Culvert									
Reach 1	407	25-YR	42.44	572.57	573.53	573.53	573.86	0.041888	4.60	9.23	19.13	1.00
Reach 1	407	100-YR	60.37	572.57	573.70	573.70	574.12	0.039525	5.20	11.61	21.34	1.01
Reach 1	379	25-YR	42.44	571.61	572.96	572.63	573.07	0.011269	2.61	16.28	21.48	0.53
Reach 1	379	100-YR	60.37	571.61	573.16	572.81	573.29	0.011769	2.91	20.77	24.04	0.55
Reach 1	336	25-YR	42.44	571.12	571.88	571.88	572.14	0.046726	4.10	10.35	20.18	1.01
Reach 1	336	100-YR	60.37	571.12	572.03	572.03	572.34	0.043965	4.49	13.44	21.81	1.01
Reach 1	273	25-YR	65.36	569.67	571.39		571.42	0.001437	1.30	50.31	40.27	0.20
Reach 1	273	100-YR	92.98	569.67	571.79		571.82	0.001259	1.38	67.26	44.36	0.20
Reach 1	208	25-YR	65.36	566.34	571.40		571.40	0.000033	0.37	177.32	54.92	0.04
Reach 1	208	100-YR	92.98	566.34	571.80		571.80	0.000049	0.47	199.88	57.93	0.04
Reach 1	150	25-YR	65.36	565.88	571.40		571.40	0.000013	0.25	264.82	75.89	0.02
Reach 1	150	100-YR	92.98	565.88	571.80		571.80	0.000018	0.32	295.92	79.72	0.03
Reach 1	89	25-YR	65.36	566.08	571.40		571.40	0.000003	0.13	492.48	111.49	0.01
Reach 1	89	100-YR	92.98	566.08	571.80		571.80	0.000004	0.17	537.81	116.09	0.01
Reach 1	57	25-YR	65.36	565.97	571.40	566.32	571.40	0.000001	0.10	676.47	147.74	0.01
Reach 1	57	100-YR	92.98	565.97	571.80	566.38	571.80	0.000002	0.13	736.01	150.02	0.01


Roosevelt Estates Plan: Proposed Conditions 6/1/2023
RS = 627 2009 TNRIS LIDAR
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Proposed Conditions 6/1/2023
RS = 590
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta


Roosevelt Estates Plan: Proposed Conditions 6/1/2023
RS = 544
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.08
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Station (ft)
Legend
Ground
Bank Sta
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Station (ft)
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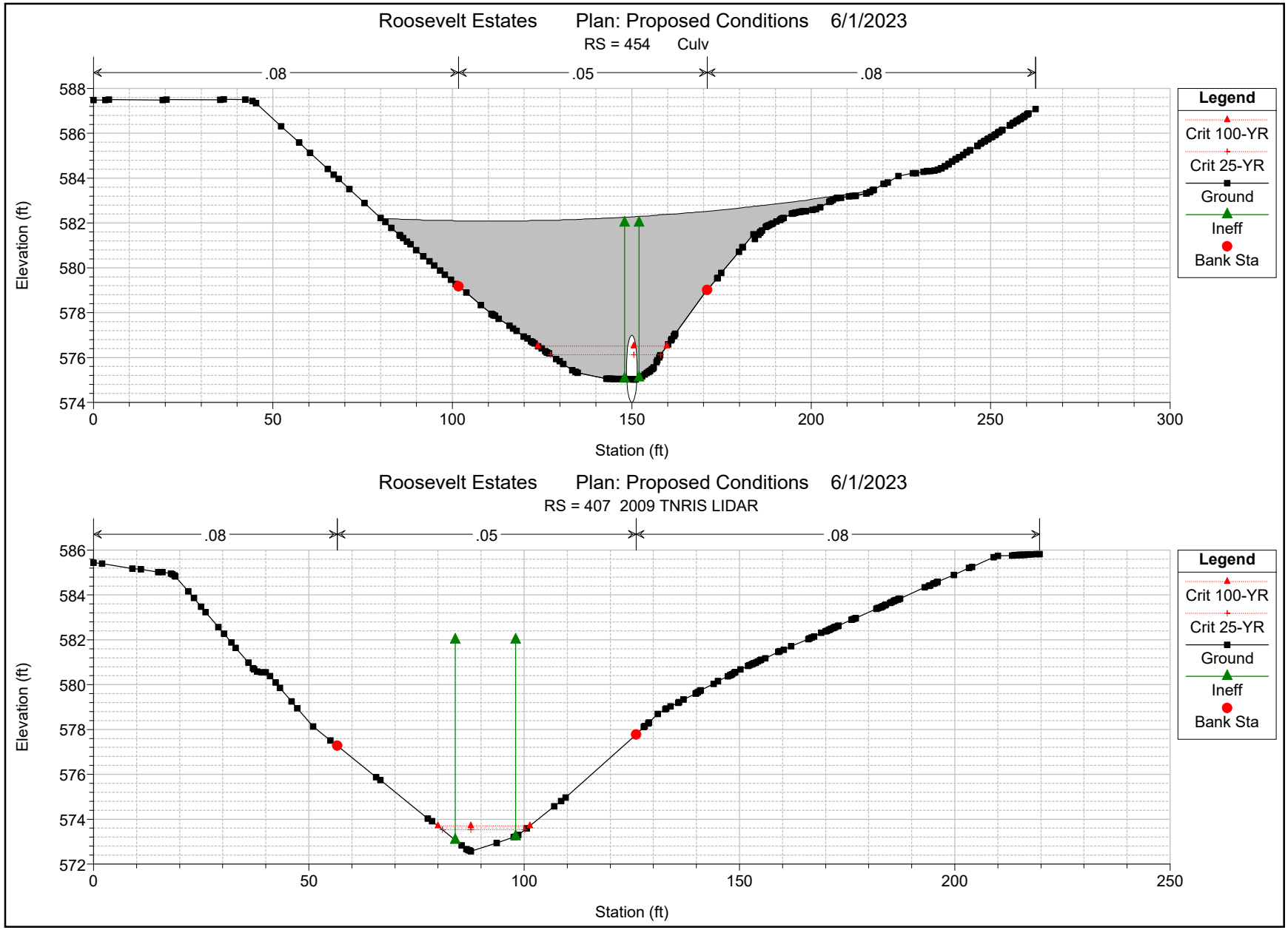
Ground
Ineff
Bank Sta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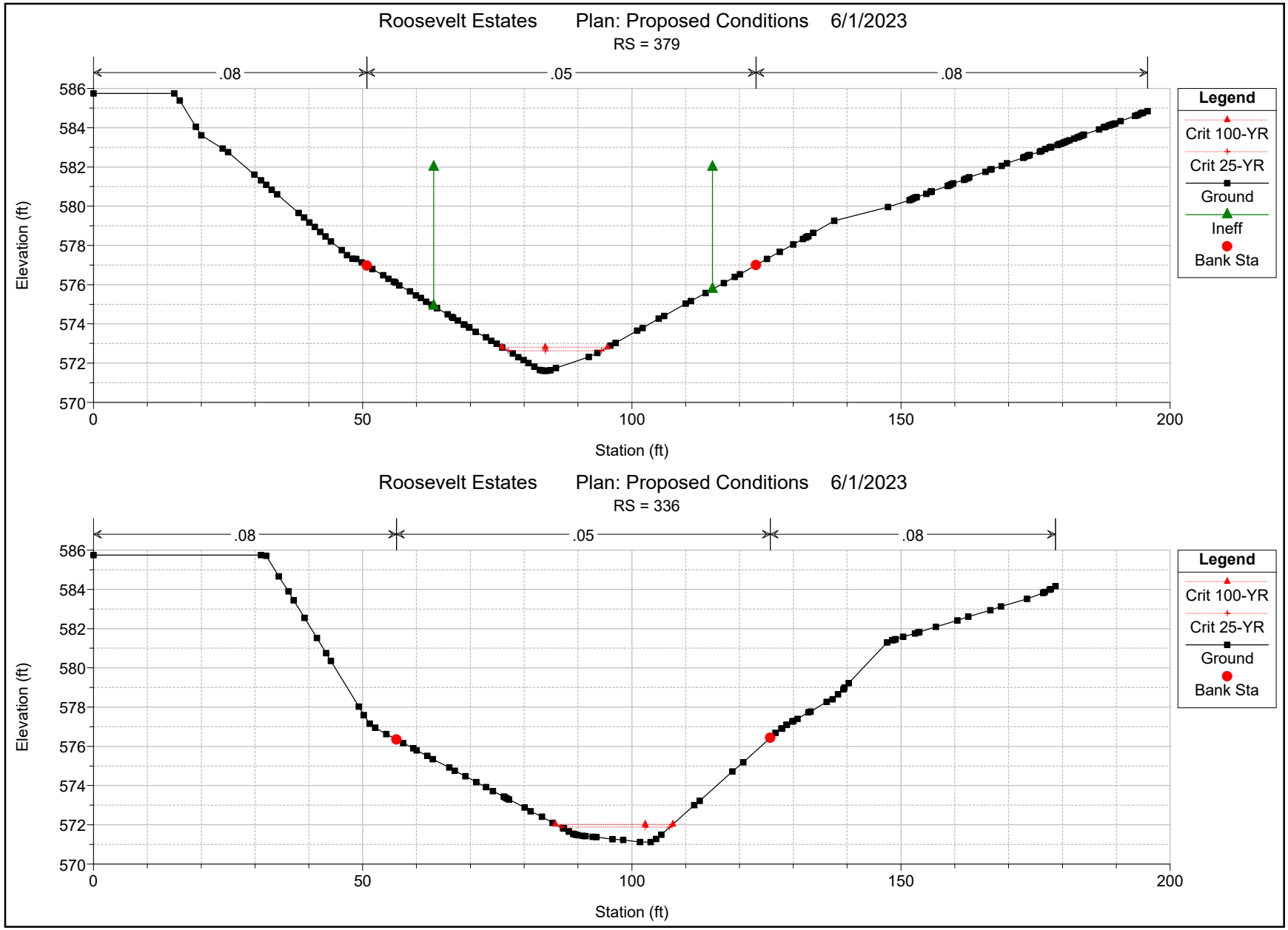
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.08
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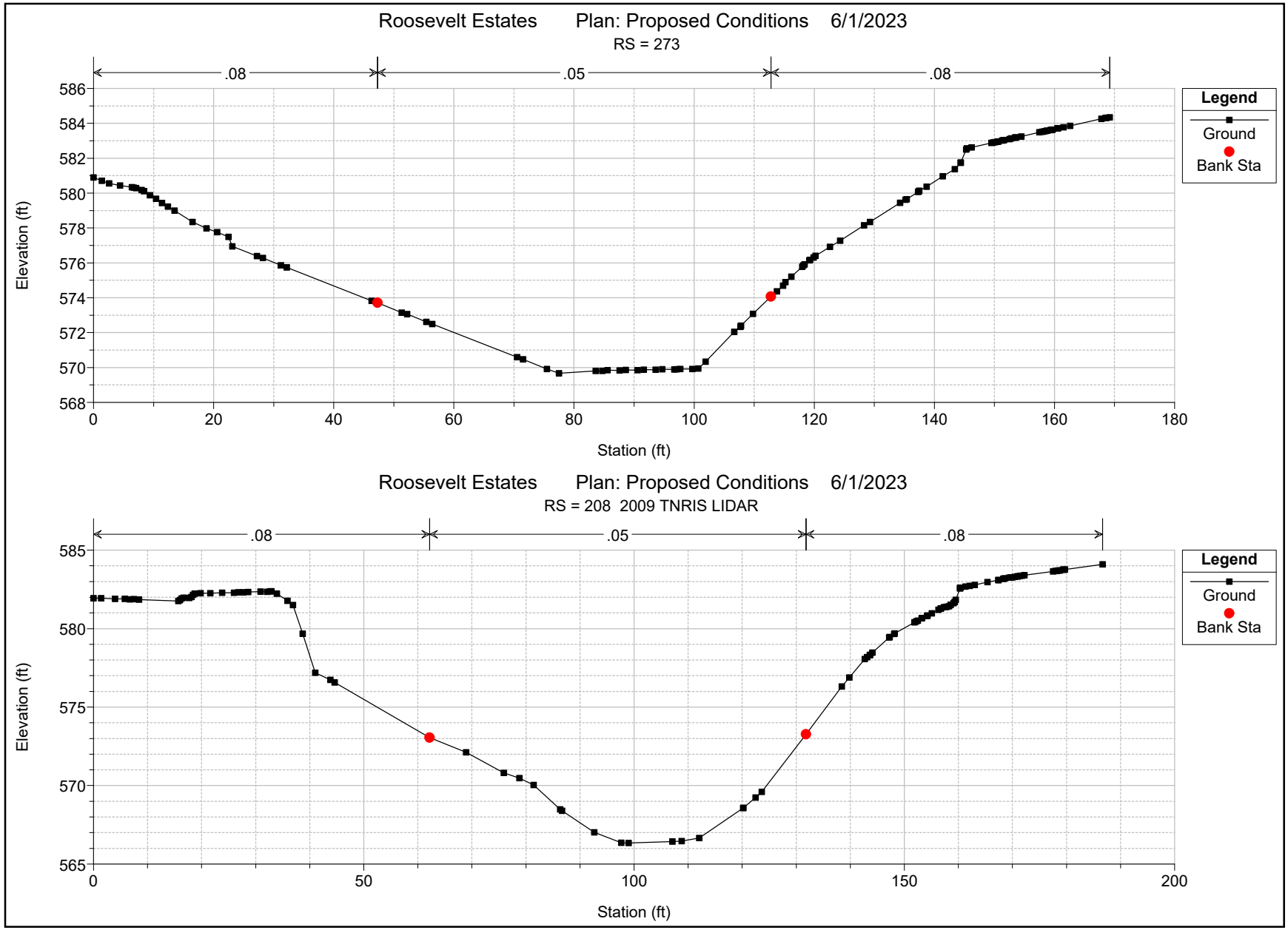
Bank Sta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Station (ft)
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Ground
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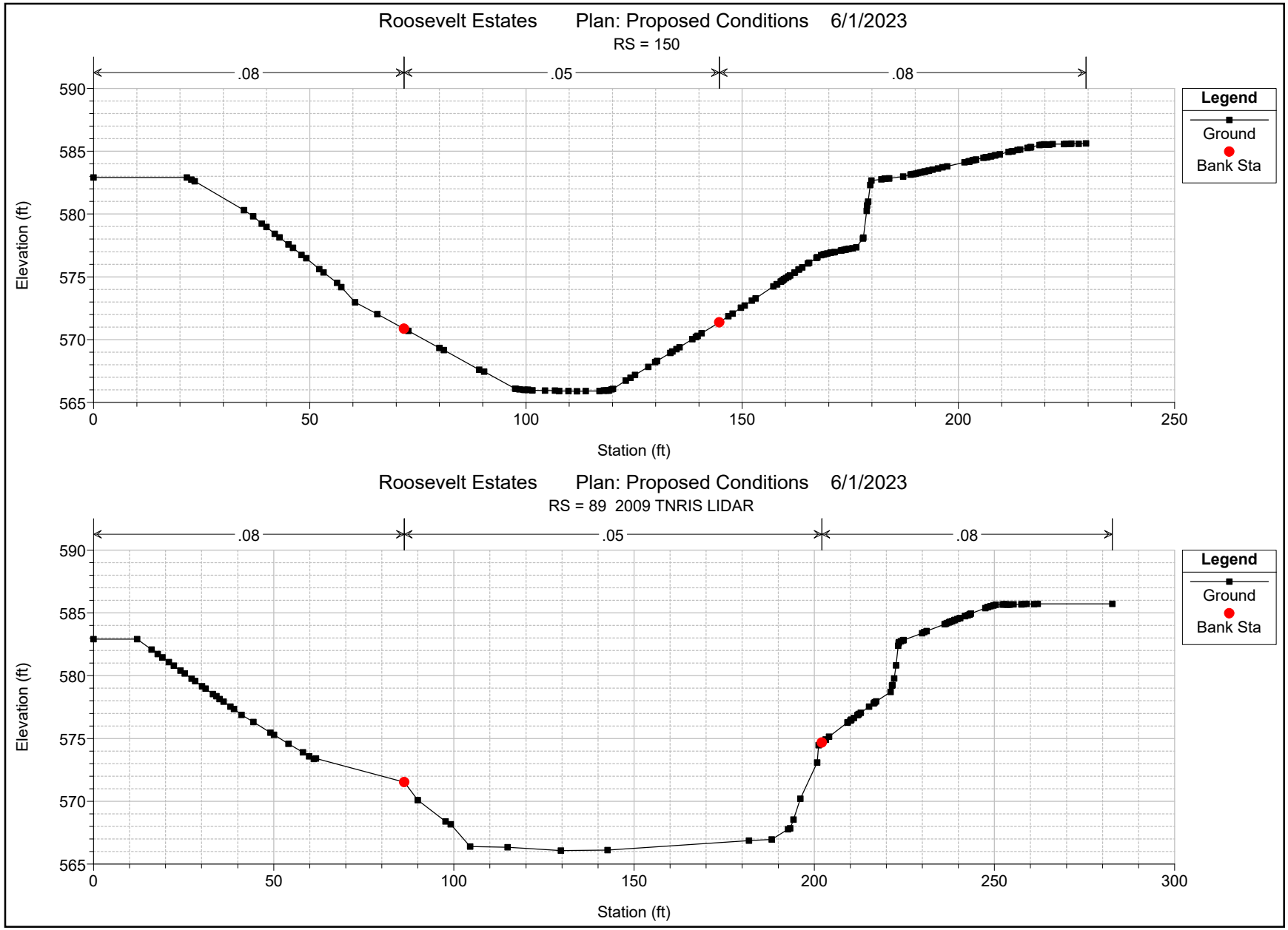
Bank Sta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150
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Station (ft)
Legend
Ground
Bank Sta
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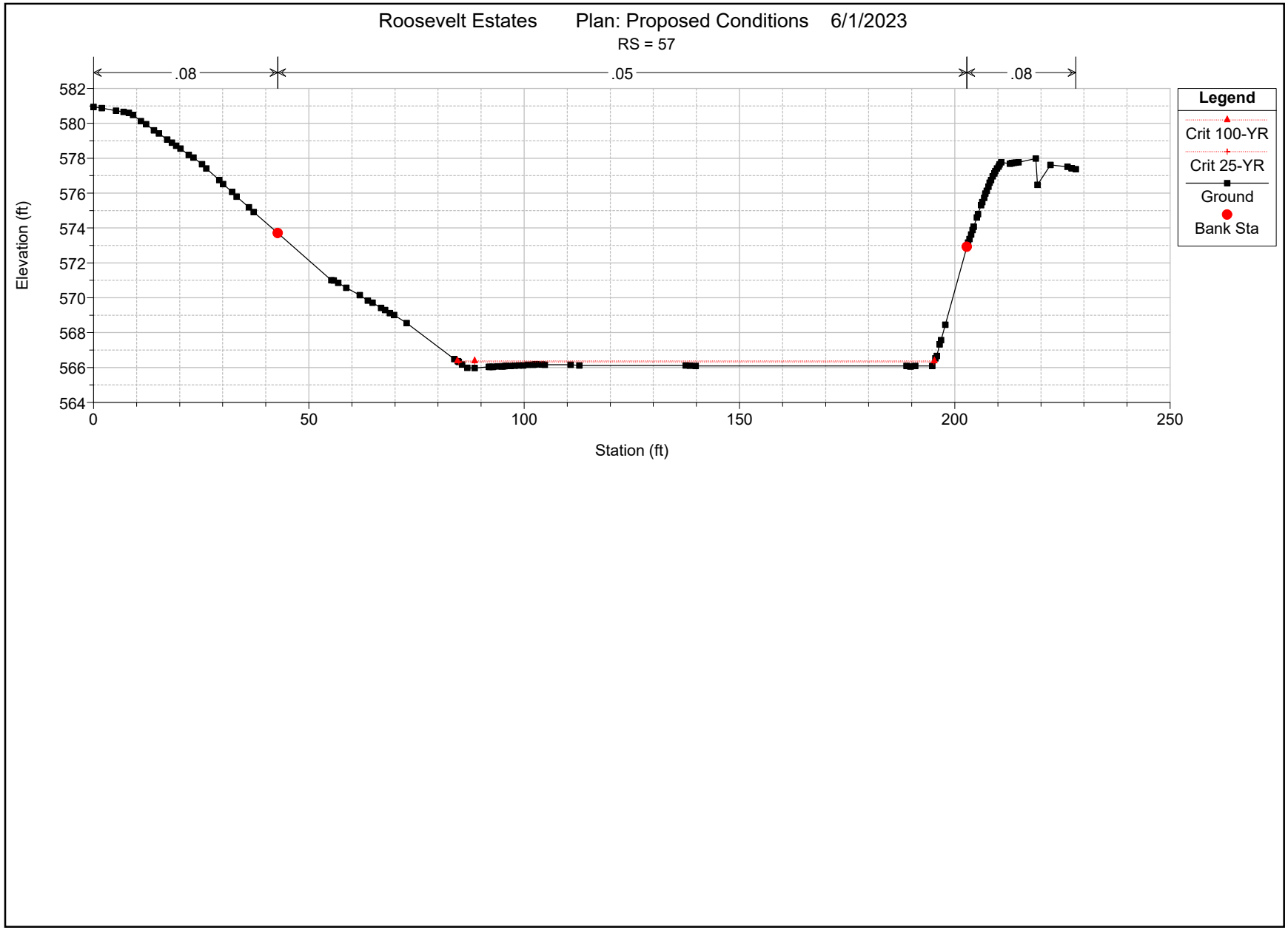
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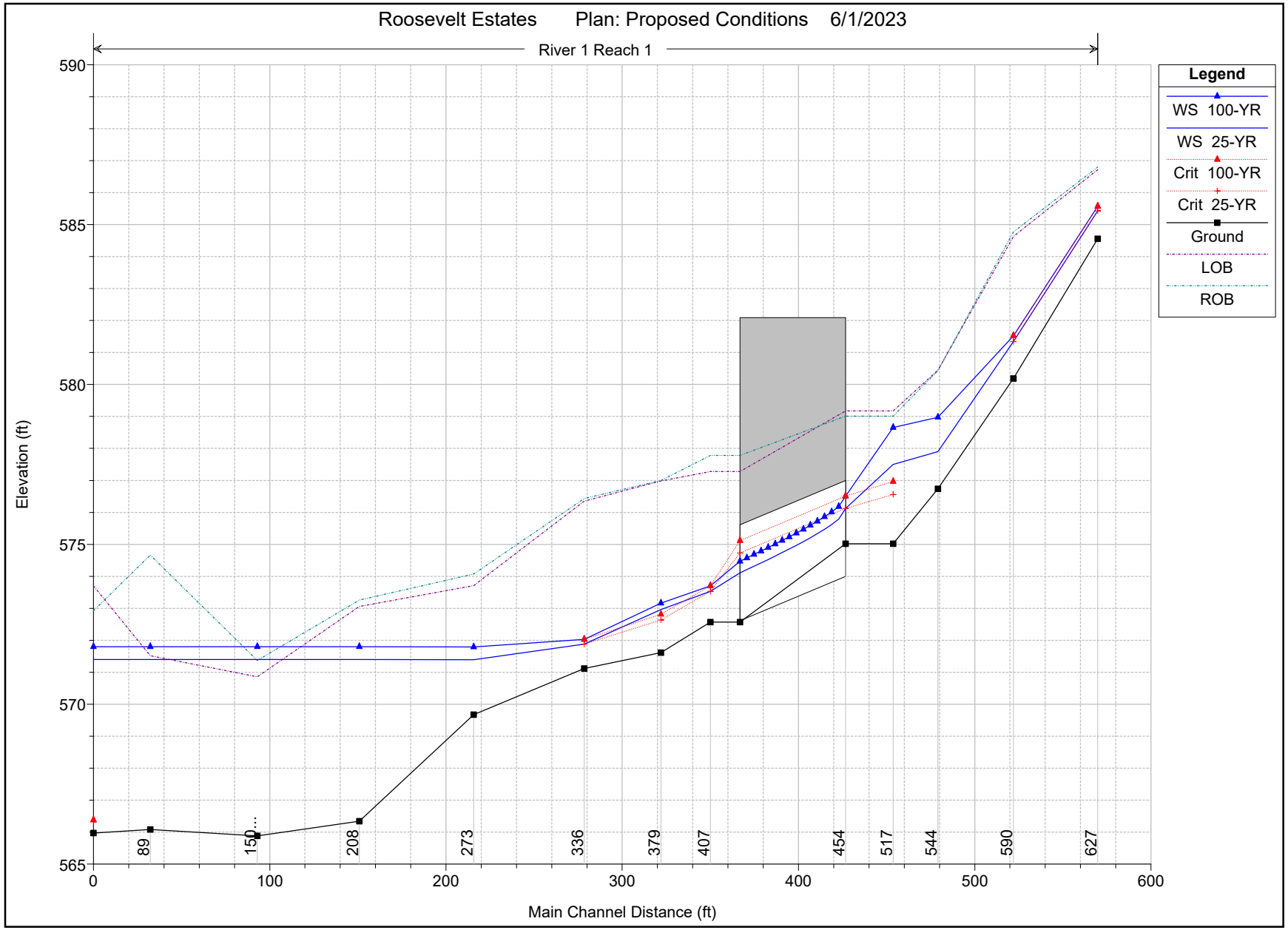
Crit 25-YR
Ground
Bank Sta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ROB
Elevation (ft)
Main Channel Distance (ft)
590
585
580
575
570
565
0
100
200
300
400
500
600
89
150
208
273
336
379
407
454
517
544
590
627

Kimley»Horn

January 23, 2024

Sandra Ma
Interim City Secretary
City of Dalworthington Gardens
2600 Roosevelt Drive
Dalworthington Gardens, TX 76016

RE: Fourth Final Plan Submittal Review
Roosevelt Estates
KHA No. 068302505

Dear Sandra:

We have completed our review of the fourth submittal of the Final Plan for the above referenced project. The Final Plan was received via email for review on January 22, 2024.

All previous comments have been adequately addressed. Conformity of the Final Plan submitted is contingent on Dalworthington Gardens City Council's approval of the zoning change application for the subject property.

If council approves the zoning change application, the Final Plan as submitted conforms to the technical requirements listed in the Dalworthington Gardens Code of Ordinances and we recommend approval.

If council denies the zoning change application, the Final Plan as submitted would not comply with an approved concept plan and we therefore recommend denial.

Please remember that the adequacy of the design work reflected in the plans reviewed and the responsibility to adhere to all applicable ordinances and codes remains with the design engineer.

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

Brandon Bell, P.E.

Brandon Bell, P.E.

Staff Agenda Report

Agenda Subject: Discussion and possible recommendation regarding Preliminary Plat application for property located at 2611 W. Pleasant Ridge Road, Dalworthington Gardens, Texas to be known as Roosevelt Estates Lots 1 – 11, 1X, and 11X of Block A an addition to the City of Dalworthington Gardens, Tarrant County, Texas.

Background Information: A Preliminary Plat was submitted by Jose De Leon with Shield Engineering on January 22, 2024.

Typically the Preliminary Plat for a development within the Planned Development zoning district does not come before the Commission until City Council has approved the zoning change and the Concept Plan. In this case, because the Preliminary Plat is being presented to the Commission prior to Council's decision, if a recommendation of approval is to be provided, it shall be contingent on City Council's approval of the zoning change from Single Family to Planned Development.

The Preliminary Plat was forwarded to the city engineer for review. On January 23, 2024 the city engineer conducted his final review and determined that if City Council approves the proposed zoning change, the Preliminary Plat conforms with the City's ordinance and therefore recommends approval.

City staff also recommends approval.

Planning and Zoning recommends approval contingent on city council approval of zoning change single family to planned development, change of lots 1-4 setback increased to 25 feet from the roadway, and with further study of the gate at the front entrance.

Recommended Action/Motion: Motion to recommend approval of the Preliminary Plat for the property located at 2611 W. Pleasant Ridge Road contingent on City Council's approval of the proposed zoning change of the property from Single Family to Planned Development.

Attachments:

Preliminary Plat
Preliminary Drainage Study Proposed Water & Sewer Layout Letter of Recommendation

ABBREVIATION LEGEND:
DE = INDICATES A DRAINAGE EASEMENT

SSE = INDICATES A SANITARY SEWER EASEMENT

UE = INDICATES A UTILITY EASEMENT

BL = INDICATES A BUILDING LINE

XCF = INDICATES "X" CUT IN CONCRETE; FOUND

XCS = INDICATES "X" CUT IN CONCRETE SET

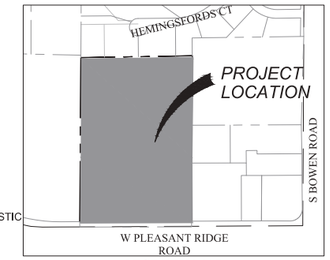
IRF = INDICATES 5/8-INCH IRON ROD FOUND WITH PLASTIC CAP STAMPED "SHIELD ENGINEERING"

IRS = INDICATES 5/8-INCH IRON ROD SET WITH PLASTIC CAP STAMPED "SHIELD ENGINEERING"

CM = INDICATES A CONTROLLING MONUMENT

O.P.R.T.C.T. = OFFICIAL PUBLIC RECORDS, TARRANT COUNTY, TEXAS

P.R.T.C.T.= PLAT RECORDS, TARRANT COUNTY, TEXAS



VICINITY MAP
NOT TO SCALE

0 50 100 150
GRAPHIC SCALE IN FEET
1" = 50'

NOTES:
1. NOTICE: SELLING A PORTION OF THIS ADDITION BY METES AND BOUNDS IS A VIOLATION OF CITY SUBDIVISION ORDINANCE AND STATE PLATTING STATUTES AND IS SUBJECT TO FINES AND WITHHOLDING OF UTILITIES AND BUILDING PERMITS.
2. ALL OPEN SPACE WILL BE PRIVATE HOA/DEVELOPER OWNED AND MAINTAINED OPEN SPACE.
3. COORDINATES REFERENCED TO TEXAS PLANE COORDINATE SYSTEM, NORTH CENTRAL ZONE, NAD-83. (VERTICAL DATUM: NAVD88).

LINE TABLE		
LINE #	BEARING	LENGTH
L1	N00°29'13"W	19.62'
L2	N86°28'27"E	25.00'
L3	S80°00'37"W	12.29'
L4	S89°42'02"E	25.00'

CURVE TABLE					
CURVE #	LENGTH	RADIUS	DELTA	CHORD BEARING	CHORD LENGTH
C1	58.05'	350.00'	9°30'10"	N05°14'18"W	57.98'
C2	39.49'	350.00'	6°27'51"	N06°45'28"W	39.47'
C3	58.04'	350.00'	9°30'07"	S84°45'40"W	57.98'
C4	61.50'	39.50'	89°12'50"	S44°54'22"W	55.48'

BLOCK LENGTH TABLE			
BLOCK	STREET(S)	LOTS	LENGTH
A	ELKHOM DR	1-4, 1X	765.38
A	DELANO CT	5-11, 11X	724.9

LOT AREA TABLE			
BLOCK	LOTS	AREA (SF)	AREA (AC)
A	1	24,393.60	0.56
A	2	25,264.80	0.58
A	3	34,412.40	0.79
A	4	150,282.00	3.45
A	5	27,007.20	0.62
A	6	21,780.00	0.5
A	7	21,780.00	0.5
A	8	92,347.20	2.12
A	9	74,923.20	1.72
A	10	28,749.60	0.66
A	11	28,749.60	0.66
A	1X	1,742.40	0.04
A	11X	9,147.60	0.21

DEVELOPMENT YIELD

GROSS SITE AREA (ACRES): 13.825		TOTAL NUMBER LOTS: 13	
RESIDENTIAL LOTS: 11		TOTAL NUMBER OF DWELLING UNITS: 11	
ACREAGE: SINGLE FAMILY DETACHED 12.142	SINGLE FAMILY ATTACHED 0	TWO FAMILY 0	MULTIFAMILY 0
COMMERCIAL LOTS: 0		OPEN SPACE LOTS: 2	PARKS LOTS: 0
ACREAGE: COMMERCIAL LOTS 0 • INDUSTRIAL LOTS 0	OPEN SPACE LOTS 0.241	RIGHT-OF-WAY 1.442	PARK 0.000

PRELIMINARY PLAT OF ROOSEVELT ESTATES

LOTS 1-11, 1X, 11X BLOCK A
AN ADDITION TO
THE CITY OF DALWORTHINGTON GARDENS,
TARRANT COUNTY, TEXAS
BEING 13.825 ACRES OF LAND
SITUATED IN THE HALE, J W SURVEY,
ABSTRACT NO. 802, TRACT 1E & 1E1.
CITY OF DALWORTHINGTON GARDENS, TARRANT

SHIELD ENGINEERING GROUP
TBPE FIRM #F-11039 • TBLS FIRM #10193890
1600 West 7th Street, Suite 400, Fort Worth, TX 76102 • 817.810.0696

BENCHMARK DESCRIPTION
CONTROL PT. #50
"X" CUT SET IN A SIDEWALK IN THE NORTH RIGHT-OFWAY OF PLESANT RIDGE ROAD ±7 FEET SOUTHEAST OF THE SOUTHEAST FENCE CORNER AND BEING ±1 FOOT NORTH OF AN ELECTRIC BOX.
CONTROL PT. #51
"X" CUT SET IN A SIDEWALK IN THE NORTH RIGHT-OFWAY OF PLESANT RIDGE ROAD ±5 FEET EAST OF A DRIVEWAY AND BEING ±23 FEET SOUTHWEST OF A WATER VALVE .
CONTROL PT #53
"X" CUT SET IN A SIDEWALK IN THE NORTH RIGHT-OFWAY OF PLESANT RIDGE ROAD ±22 FEET NORTHEASTOF A SANITARY SEWER MANHOLE AND BEING ±13 FEET SOUTHEAST OF A TELEPHONE POLE FOUND IN THE SOUTHWEST CORNER OF THE SUBJECT TRACT.

ENGINEER/SURVEYOR
SHIELD ENGINEERING GROUP, PLLC
1600 WEST 7TH STREET, SUITE 400
FORT WORTH, TEXAS 76102
(817) 810-0696

DEVELOPER
ROOSEVELT ESTATES LLC
2000 PRAIRIE HOLLY LN
ALEDO, TEXAS 76008
682-719-5263

OWNER
ROOSEVELT ESTATES LLC
2000 PRAIRIE HOLLY LN
ALEDO, TEXAS 76008
682-719-5263

PREPARED Jan. 2024

DRAWING: ROOSEVELT ESTATES PPLAT.DWG SAVED: 01/22/2024
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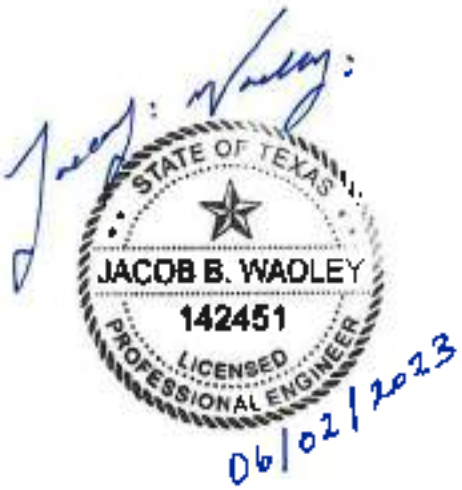
SHIELD
ENGINEERING GROUP

TECHNICAL MEMORANDUM

Roosevelt Estates Preliminary Drainage Study

Dalworthington Gardens, Texas

June 2023



1600 W. 7th Street, Suite 400, Fort Worth, Texas 76102 | (817.810.0696
Shield Engineering Group, PLLC

info@shield-engineering.com | www.SHIELDENGINEERINGGROUP.com
TBPE FIRM #F-11009 | TBPLS FIRM #10193890

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Introduction 3
Previous Study 3
Downstream Assessment 3
Culvert Design 5
Conclusion 5

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Appendix A - Tables and Calculations
Appendix B - Exhibits and Workmaps
Appendix C - Previous Study (2012 Rush Creek Study)
Appendix D – Project Layout Sheets
Appendix E - Digital Data
Appendix F – HEC-RAS Output

Introduction

The purpose of this Preliminary Drainage Study Technical Memorandum is to support the Roosevelt Estates Project. This Preliminary Drainage Study Technical Memorandum includes a downstream assessment and culvert design narrative. The proposed ±14-acre single-family residential development includes 1-acre single family lots with associated improvements (see project layout sheets in Appendix D). The project is located northwest of the West Pleasant Ridge Road and Bowen Road intersection in Dalworthington Gardens, Texas (see Exhibit B-1 in Appendix B). The property is north of West Pleasant Ridge Road and is bound by existing developments on the west, east, and north. Twin Springs Draw, a tributary to Rush Creek, runs through the northern portion of the property. Twin Springs Draw Tributary 2 runs through the center of the property and proposed project layout. The project is located approximately 1600 ft upstream of the Twin Springs Draw and Rush Creek confluence. The following describes the approach, methodology, and results to establish the impacts of the proposed development and provide preliminary sizing of a culvert system.

Previous Study

The Downstream Assessment portion of this study was based on the Rush Creek Watershed Study prepared by Halff Associates, Inc. in 2012 and includes hydrology and hydraulic modeling. This study is categorized as preliminary data and not within FEMA's effective database. The City of Arlington provided the Rush Creek study, as well as associated models and supplemental files to Shield Engineering, PLLC on March 31st, 2023 (see Appendix C for Rush Creek Watershed Study report). See Exhibit B-2 for the Twin Springs Draw watershed delineation.

Downstream Assessment

Hydrology Design Methodology

The modeling approach for the downstream assessment was kept consistent with the Rush Creek Watershed Study. The Rush Creek Watershed Study hydrology was developed using the following methodology and assumptions:

- SCS methodology was used to determine flow rates throughout the watershed.
- Hydrology Analysis was performed using USACE Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS version 3.5)
- The Natural Resource Conservation Services (NRCS) Soil Survey was used to evaluate hydrologic soil groups. Good condition soil was used to determine curve numbers throughout the watershed.
- Percent Impervious values were calculated based on watershed conditions. Percent Impervious values were calculated assuming existing conditions.
- Time of concentration and lag time calculations were performed using NRCS TR-55 methodology.
- Rainfall data was obtained from TP-40 (Hershfield, 1961) for the 24-hour events.

The total watershed square mileage at the project outfall is 1.17 square miles. The project area contributes 2% to the total watershed. Analysis points were defined by junctions along Twin

Springs Draw and all project boundary outfalls. Existing and Proposed conditions analyses were performed for the 10%, 4%, and 1% annual chance events to confirm no adverse impacts (see Tables A1 and A2 for a summary of hydrologic parameters).

Analysis Point Summary	
Junction	Description
C_TWI_000_002	Project outfall at Twin Springs Draw
J_B1	Project outfall along western property boundary
C_TWI_000_003	Confluence along Twin Springs Draw upstream of project
J_B_TWI_000_100_B1	Confluence between Twin Springs Draw and Rush Creek

For existing conditions, drainage area delineations and parameters were updated based on topographic data and 2019 TNRIS LiDAR to basins B_TWI_000_100, B_TWI_000_090, and B_TWI_003_010. Drainage area B_TW_002_010 was split into EX-A1, OS-A1, and EX-B1 to accurately model flow through the project site (see Exhibit B-3 for the existing conditions drainage area map). Hydrologic parameters were updated assuming good condition soil and open space land use (see Tables A3, A4, and A5 for hydrologic parameter calculations). See Exhibits B-5 and B-6 for the soils map and existing land use coverage, respectively.

The proposed development comprises basins PR-A1, PR-A2, and PR-B1 (see Exhibit B-4 for the proposed conditions drainage area map). From existing to proposed conditions, the percent impervious increased from approximately 5% to 25% (see Exhibit B-7 for the proposed conditions land use coverage). The hydrologic study demonstrated an increase in flow at C_TWI_000_002, the confluence with Twin Springs Draw (see Tables A6 and A7 for a summary of discharges and comparison at project outfalls). This comparison was made assuming offsite areas were unchanged between existing and proposed conditions.

Hydraulics Design Methodology

Due to the minimal contribution of the project area to the total watershed and proximity to Twin Springs Draw, a hydraulic comparison was performed to show no increases in water surface elevation along Twin Springs Draw. The Twin Springs Draw Hydraulic Model developed with the Rush Creek Watershed Study was used for the comparison and was developed using the following methodology and assumptions:

1. Hydraulic Analysis was performed using USACE Hydrologic Engineering Center River Analysis System (HEC-RAS version 4.1).
2. The HEC-RAS analysis utilized unsteady flow computations.

The Rush Creek HEC-HMS model did not utilize routing reaches along Twin Springs Draw Mainstem. Uniform Hydrograph and Lateral Inflow Hydrograph flow data was updated in the HEC-RAS model based on hydrology updates for existing and proposed conditions. The hydraulic study comparison demonstrated no rises in water surface elevation from the project outfall to the Tributary Springs Draw to the confluence with Rush Creek (See Table A-8 for a comparison of water surface elevations).

Culvert Design

Hydrology Design Methodology

The proposed project includes a culvert and roadway crossing along Tributary Springs Draw Tributary 2. Design flow rates were determined using rational method in accordance with Chapter 10 Section 10.02.274 of Dalworthington Garden's City Ordinances. See Tables A9 and A10 for rational method and weighted runoff coefficient calculations.

Hydraulics Design Methodology

The USACE HEC-River Analysis System (HEC-RAS version 6.3) was used for hydraulic modeling of the stream and proposed culvert (see Exhibit B-8 for a hydraulic workmap). Rational method discharges for the 1% annual chance event were used as steady flow data in the hydraulic analysis. Topography collected in 2022 by Shield Engineering Group surveying was used in conjunction with Texas Natural Resources Information System (TNRIS) LiDAR 2019 to generate cross section data and map floodplains. A Manning's roughness coefficient of 0.05 was used to represent natural channel areas with light brush. A Manning's roughness coefficient of 0.08 was used to represent natural channel areas with heavy brush and tree growth. Bank stations were set to represent the change in the channel from light brush to heavy tree growth.

The preliminary culvert size was determined to be 36". The preliminary design provides more than 1' of freeboard to the proposed roadway and doesn't impact existing upstream storm drain infrastructure. See Table A11 for a comparison of existing and proposed water surface elevations along Twin Springs Draw Tributary 2. See Table A12 for a comparison between the proposed 100-year water surface elevation and top of bank/roadway.

Conclusion

The goal of this report was to demonstrate no adverse impacts downstream of the project site to adjacent properties and Twin Springs Draw due to the proposed development and provide preliminary sizing of a culvert system. The hydrology study determined that the proposed development increased the percent impervious value of the onsite drainage area from approximately 5% to 25%. This resulted in a discharge increase at the project outfall along Twin Springs Draw and no increase in water surface elevation along Twin Springs Draw to the confluence with Rush Creek. No increases in discharge were observed at project outfalls draining to adjacent properties. Results from the preliminary hydraulic study indicate that a 36" culvert will convey onsite and offsite flow with adequate freeboard and cause no adverse impacts to upstream storm drain infrastructure.

APPENDIX A: TABLES AND CALCULATIONS

Roosevelt Estates Downstream Assessment					
Table A1 - Sumary of Parameters - Existing Conditions					
Basin	Acres	SQ Mile	CN	Percent Impervious	Lag Time
EX-A1	5.075	0.008	77	3	7.0
EX-B1	1.758	0.003	61	8	9.5
OS-A1	6.499	0.010	76	50	5.9
TWI_003_010	27.259	0.043	80	55	Previous Study
TWI_000_090	20.735	0.032	80	35	Previous Study
TWI_000_100	33.076	0.052	68	34	Previous Study

Table A2 - Sumary of Parameters - Proposed Conditions					
Basin	Acres	SQ Mile	CN	Percent Impervious	Lag Time
PR-A1	2.007	0.003	76	25	4.5
PR-A2	4.464	0.007	73	25	5.0
PR-B1	0.683	0.001	61	31	4.1
OS-A1	6.499	0.010	76	50	5.9
TWI_003_010	26.525	0.041	80	57	Previous Study
TWI_000_090	21.147	0.033	81	36	2.0
TWI_000_100	33.076	0.052	68	34	Previous Study

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT

TABLE A3 - TIME OF CONCENTRATION CALCULATIONS

1	2					3				4								5	6
	SHEET FLOW					SHALLOW CONCENTRATED FLOW				CHANNEL / PIPE FLOW									
Drainage Area ID	Sheet Flow Length (ft)	P_2 (in)	Land Slope (ft/ft)	n	t_{sheet} (min)	Shallow Flow Length (ft)	Shallow Flow Slope (ft/ft)	Average Velocity (ft/sec)	$t_{shallow}$ (min)	Channel Length (ft)	Channel Slope (ft/ft)	n	Cross Sectional Area (sf)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Average Velocity (ft/sec)	$t_{channel}$ (min)	SCS Method T_c (min)	SCS Method t_{lag} (min)
Existing Conditions																			
EX-A1	100	3.95	0.0237	0.15	8.24	-	-	-	-	655.6	-	-	-	-	-	3.20	3.41	11.65	6.99
EX-B1	100	3.95	0.0065	0.15	13.82	333	0.0278	2.69	2.07	-	-	-	-	-	-	-	-	15.89	9.53
OS-A1	100	3.95	0.0589	0.15	5.73	697	0.0359	3.05	3.80	106	0.0040	0.013	-	-	-	6.00	0.29	9.82	5.89
Proposed Conditions																			
PR-A1	100	3.95	0.0465	0.15	6.29	-	-	-	-	230.09	-	-	-	-	-	3.20	1.20	7.49	4.49
PR-A2	69.44	3.95	0.0163	0.15	7.15	527	0.0127	2.29	3.83	210.58	-	-	-	-	-	3.20	1.10	8.25	4.95
PR-B1	100	3.95	0.0437	0.15	6.45	16	0.0019	0.70	0.37	-	-	-	-	-	-	-	-	6.82	4.09
TWI_000_090	50	3.95	0.0050	0.011	1.09	353	0.0374	3.93	1.50	-	-	-	-	-	-	-	-	3.41	2.05
						149	0.0351	3.02	0.82	-	-	-	-	-	-	-	-		

NOTE: CITE SOURCE OF MANNING'S N VALUES USED.

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT				
TABLE A4 - CURVE NUMBER AND PERCENT IMPERVIOUS CALCULATION EXISTING CONDITIONS				
Basin	Total Area (Acres)	Total Area (sq. mi)	[1]Weighted CN	[1]Weighted / Percent Impervious
EX-A1	5.08	0.0079	77	3
EX-B1	1.76	0.0027	61	8
OS-A1	6.50	0.0102	76	50
TWI_000_090	20.74	0.0324	80	35
TWI_000_100	33.08	0.0517	68	34
TWI_003_010	27.26	0.0426	80	55
TWI_000_070	96.93	0.1515	-	57
TWI_000_030	67.34	0.1052	-	51

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT				
TABLE A5 - CURVE NUMBER AND PERCENT IMPERVIOUS CALCULATION PROPOSED CONDITIONS				
Basin	Total Area (Acres)	Total Area (sq. mi)	[1]Weighted CN	[1]Weighted / Percent Impervious
PR-A1	2.01	0.0031	76	25
PR-A2	4.46	0.0070	73	25
PR-B1	0.68	0.0011	61	31
OS-A1	6.50	0.0102	76	50
TWI_000_090	21.15	0.0330	81	36
TWI_000_100	33.08	0.0517	68	34
TWI_003_010	26.53	0.0414	80	57
TWI_000_070	96.93	0.1515	-	57
TWI_000_030	67.34	0.1052	-	51

Notes:

1. Weighted CN and Percent Impervious values calculated using Intersect and Dissolve Geoprocessing Tools in ArcPro

Roosevelt Estates Downstream Assessment						
Table A6 - Summary of Discharges						
Junction	10% ACE		4% ACE		1% ACE	
	Existing Flow	Proposed Flow	Existing Flow	Proposed Flow	Existing Flow	Proposed Flow
Project Site Junction Outfalls						
C_TWI_000_002	60.8	68.7	75.5	85.1	101	114.2
J_B1	5.2	2.8	7.1	3.6	10.6	5
Junctions Downstream through ZOI						
C_TWI_000_003	168.8	161.8	204.4	195.7	265.5	253.9
J_B_TWI_000_100_B1	127.5	123.9	161	156	220.9	213.4

Roosevelt Estates Downstream Assessment			
Table A7 - Discharge Impacts			
Basin	1-yr Comparison	5-yr Comparison	100-yr Comparison
Project Site Junction Outfalls			
C_TWI_000_002	7.9	9.6	13.2
J_B1	-2.4	-3.5	-5.6
Junctions Downstream through ZOI			
C_TWI_000_003	-7	-8.7	-11.6
J_B_TWI_000_100_B1	-3.6	-5	-7.5

Roosevelt Estates Downstream Assessment												
Table A8 - Twin Springs Draw Water Surface Elevation Comparison												
Reach	River	Cross Section	10% ACE Event			4% ACE Event			1% ACE Event			
			Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference	
Twin Springs Draw												
TWI000A	TSD	6594	609.14	609.14	0	609.25	609.25	0	609.43	609.43	0	
TWI000A	TSD	6562	608.23	608.23	0	608.38	608.38	0	608.63	608.63	0	
TWI000A	TSD	6532	607.8	607.8	0	607.9	607.9	0	608.26	608.26	0	
TWI000A	TSD	6498	607.09	607.09	0	607.33	607.33	0	608.08	608.08	0	
TWI000A	TSD	6438	606.49	606.49	0	606.95	606.95	0	607.99	607.99	0	
TWI000A	TSD	6319	606.38	606.38	0	606.85	606.85	0	607.96	607.96	0	
TWI000A	TSD	6249	604.34	604.34	0	605	605	0	605.74	605.74	0	
TWI000A	TSD	6218	604.63	604.63	0	605.18	605.18	0	606.05	606.05	0	
TWI000A	TSD	6179	604.53	604.53	0	605.05	605.05	0	605.86	605.86	0	
TWI000A	TSD	6133	604.29	604.29	0	604.75	604.75	0	605.47	605.47	0	
TWI000A	TSD	6059	603.95	603.95	0	604.34	604.34	0	604.92	604.92	0	
TWI000A	TSD	5935	602.83	602.83	0	603.3	603.3	0	604.04	604.04	0	
TWI000A	TSD	5676	601.16	601.16	0	601.69	601.69	0	602.5	602.5	0	
TWI000A	TSD	5466	599.57	599.57	0	600.05	600.05	0	600.79	600.79	0	
TWI000A	TSD	5296	598.02	598.02	0	598.48	598.48	0	599.18	599.18	0	
TWI000A	TSD	5079	596.18	596.18	0	596.61	596.61	0	597.37	597.37	0	
TWI000A	TSD	4954	595.18	595.18	0	595.71	595.71	0	596.64	596.64	0	
TWI000A	TSD	4851	594.72	594.72	0	595.39	595.39	0	596.45	596.45	0	
TWI000A	TSD	4630	594.32	594.32	0	595.1	595.1	0	596.26	596.26	0	
TWI000A	TSD	4515	593.61	593.61	0	594.4	594.4	0	595.53	595.53	0	
TWI000A	TSD	4315	591.53	591.53	0	592.04	592.04	0	592.87	592.87	0	
TWI000A	TSD	4239	591.04	591.04	0	591.57	591.57	0	592.38	592.38	0	
TWI000A	TSD	4155	590.98	590.98	0	591.55	591.55	0	592.43	592.43	0	
TWI000A	TSD	3981	589.62	589.62	0	590.07	590.07	0	590.75	590.75	0	
TWI000A	TSD	3902	588.54	588.54	0	589.05	589.05	0	589.82	589.82	0	
TWI000A	TSD	3556	584.09	584.09	0	584.68	584.68	0	585.68	585.68	0	
TWI000A	TSD	3490	583.5	583.5	0	584.02	584.02	0	584.86	584.86	0	
TWI000A	TSD	3161	581.24	581.24	0	581.72	581.72	0	582.35	582.35	0	
TWI000A	TSD	3010	580.32	580.32	0	580.72	580.72	0	581.16	581.16	0	
TWI000A	TSD	2970	580.3	580.3	0	580.65	580.65	0	580.97	580.97	0	
TWI000A	TSD	2668	576.75	576.75	0	577.28	577.28	0	578.08	578.08	0	
TWI000A	TSD	2599	576.04	576.04	0	576.54	576.54	0	577.31	577.31	0	
TWI000A	TSD	2389	574.65	574.65	0	575.18	575.18	0	576	576	0	
TWI000A	TSD	2202	573.77	573.77	0	574.31	574.31	0	575.1	575.1	0	
TWI000A	TSD	2201	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	2108	573.28	573.28	0	573.79	573.79	0	574.56	574.56	0	
TWI000A	TSD	1959	572.69	572.69	0	573.22	573.22	0	573.97	573.97	0	
TWI000A	TSD	1815	572.42	572.42	0	572.96	572.96	0	573.7	573.7	0	
TWI000A	TSD	1704	572.36	572.35	-0.01	572.89	572.88	-0.01	573.6	573.6	0	
TWI000A	TSD	1522	572.26	572.26	0	572.78	572.77	-0.01	573.45	573.45	0	
TWI000A	TSD	1354	572.16	572.16	0	572.66	572.66	0	573.3	573.3	0	
TWI000A	TSD	1241	571.58	571.57	-0.01	572.06	572.06	0	572.63	572.63	0	
TWI000A	TSD	1205	571.07	571.07	0	571.46	571.46	0	572	572	0	
TWI000A	TSD	1115	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	1076.5	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	1038	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	1011	570.82	570.82	0	571.26	571.26	0	571.83	571.83	0	
TWI000A	TSD	897	570.81	570.81	0	571.24	571.24	0	571.8	571.8	0	
TWI000A	TSD	736	570.81	570.81	0	571.25	571.24	-0.01	571.81	571.8	-0.01	
TWI000A	TSD	585	570.8	570.8	0	571.24	571.24	0	571.79	571.79	0	
TWI000A	TSD	549	570.66	570.66	0	571.04	571.03	-0.01	571.51	571.51	0	
TWI000A	TSD	544	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	437	554.15	554.15	0	554.85	554.85	0	555.94	555.94	0	
TWI000A	TSD	390	554.25	554.24	-0.01	554.99	554.99	0	555.99	555.99	0	
TWI000A	TSD	329	554.24	554.24	0	554.98	554.98	0	555.97	555.96	-0.01	
TWI000A	TSD	237	554.25	554.25	0	555	554.99	-0.01	555.99	555.99	0	
TWI000A	TSD	179	554.24	554.23	-0.01	554.98	554.98	0	555.97	555.96	-0.01	
TWI000A	TSD	165	554.05	554.05	0	554.78	554.77	-0.01	555.7	555.7	0	
TWI000A	TSD	143	0	0	0	0	0	0	0	0	0	
TWI000A	TSD	106	548.07	548.06	-0.01	548.93	548.93	0	550.79	550.79	0	
TWI000A	TSD	87	548.24	548.24	0	549.44	549.43	-0.01	551.13	551.12	-0.01	

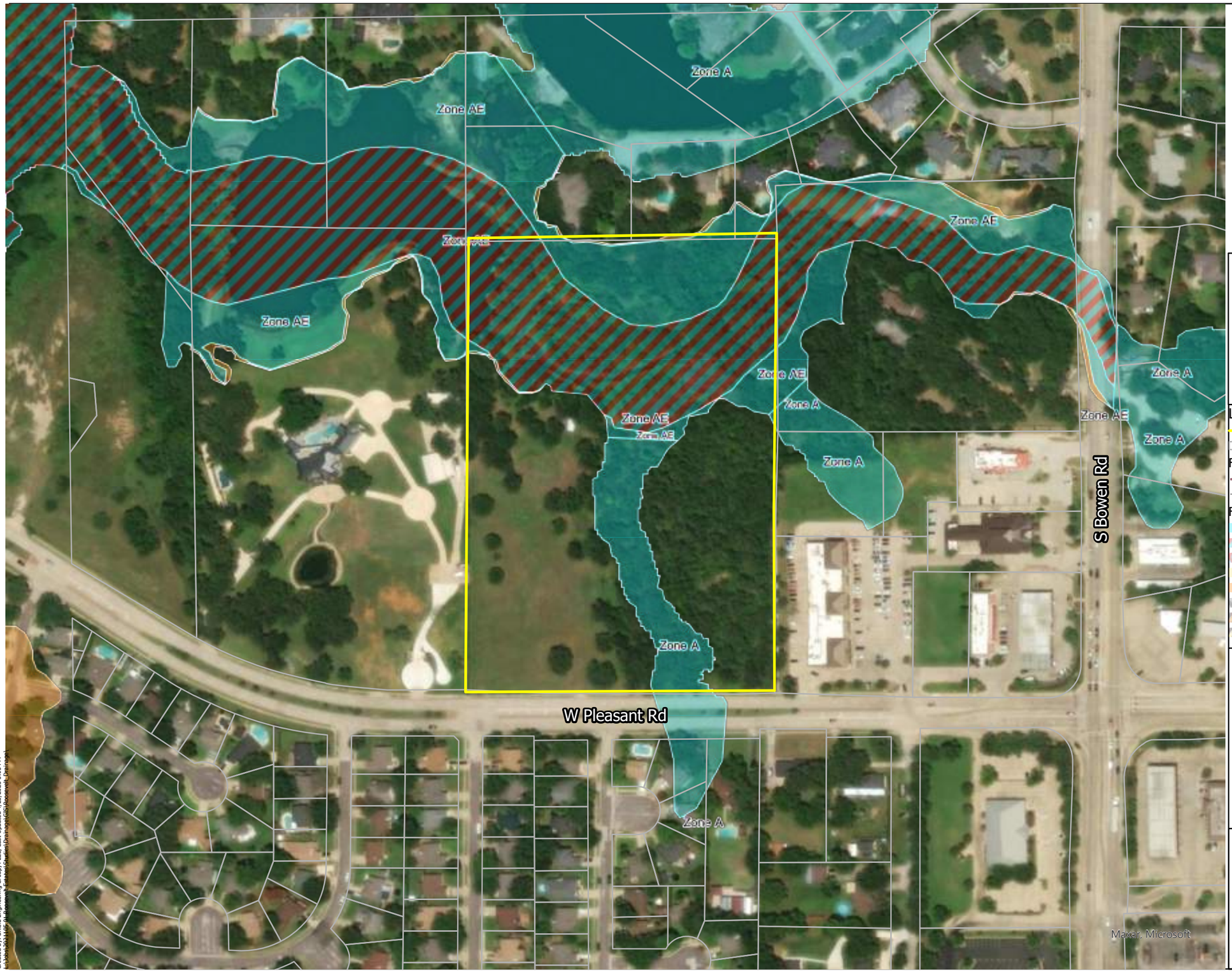
ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT										
Table A9 - Culvert Design Rational Method Calculations										
25 and 100-Year Design Frequency										
1	2	3	4	5	6	7	8	9	10	11
Drainage Area ID	Area (ac)	Land Use Description	Runoff Coefficient C	CA	Total Tc (Min)	I25	Runoff Q25 (cfs)	I100	Runoff Q100 (cfs)	Outfall DesignPoint #
PR-A1	2.007	Residential	0.56	1.13	7.49	8.75	10.84	10.95	15.42	1
PR-A2	4.464	Residential	0.55	2.47	8.25	8.45	22.92	10.58	32.61	1
OS-A1	6.499	Residential	0.56	3.63	9.82	7.91	31.61	9.89	44.94	1
NOTE: TABLE 10.02.274-2. RUNOFF COEFFICIENT - DWG DRAINAGE ORDINANCE										
Q25 AND Q100 INCLUDE ANTECEDENT PRECIPITATION FACTORS OF 1.1 AND 1.25, RESPECTIVELY.										

ROOSEVELT ESTATES DOWNSTREAM ASSESSMENT								
TABLE A10 - COMPOSITE RUNOFF COEFFICIENT CALCULATIONS								
Drainage Area ID	Total Area (ac)	Residnetial - Type B Soil		Residnetial - Type C Soil		Residnetial - Type D Soil		Composite C
		C	Area (ac)	C	Area (ac)	C	Area (ac)	
PR-A1	2.007	0.52	0.234	0.55	0.806	0.58	0.968	0.56
PR-A2	4.464	0.52	1.527	0.55	1.046	0.58	1.89	0.55
OS-A1	6.499	0.52	0	0.55	4.445	0.58	2.05	0.56
NOTE: TABLE 10.02.274-2. RUNOFF COEFFICIENT - DWG DRAINAGE ORDINANCE								

Roosevelt Estates Downstream Assessment														
Table A11 - Water Surface Elevation Comparison														
Reach	River	Cross Section	Water Surface Elevation Comparison						Velocity Comparison					
			4% ACE Event			1% ACE Event			4% ACE Event			1% ACE Event		
			Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed	Difference
Twin Springs Draw 2														
Reach 1	1	627	585.43	585.43	0	585.57	585.57	0	4.03	4.03	0	4.42	4.42	0
Reach 1	1	590	581.34	581.34	0	581.52	581.52	0	4.46	4.43	-0.03	4.77	4.77	0
Reach 1	1	544	577.67	577.9	0.23	577.84	578.98	1.14	4.38	3.05	-1.33	4.75	1.43	-3.32
Reach 1	1	517	575.9	577.5	1.6	576.07	578.65	2.58	2.37	4.31	1.94	2.66	4.17	1.51
Reach 1	1	407	573.52	573.53	0.01	573.68	573.7	0.02	4.19	4.6	0.41	4.55	5.2	0.65
Reach 1	1	379	572.95	572.96	0.01	573.15	573.16	0.01	2.65	2.61	-0.04	2.96	2.91	-0.05
Reach 1	1	336	571.88	571.88	0	572.03	572.03	0	4.1	4.1	0	4.49	4.49	0
Reach 1	1	273	571.4	571.39	-0.01	571.8	571.79	-0.01	0.84	1.3	0.46	0.89	1.38	0.49
Reach 1	1	208	571.4	571.4	0	571.8	571.8	0	0.24	0.37	0.13	0.3	0.47	0.17
Reach 1	1	150	571.4	571.4	0	571.8	571.8	0	0.16	0.25	0.09	0.21	0.32	0.11
Reach 1	1	89	571.4	571.4	0	571.8	571.8	0	0.09	0.13	0.04	0.11	0.17	0.06
Reach 1	1	57	571.4	571.4	0	571.8	571.8	0	0.06	0.1	0.04	0.08	0.13	0.05

Roosevelt Estates Downstream Assesment					
Table A12 Twin Springs Draw Tributary 2 Freeboard					
Reach	River	Cross Section	Proposed 100-Yr WSEL (ft)	Bank Station Elevation (ft)	Freeboard (ft)
Reach 1	1	627	585.57	589.77	4.2
Reach 1	1	590	581.52	585.39	3.87
Reach 1	1	544	578.98	582.87	3.89
Reach 1	1	517	578.65	582.15	3.5
Reach 1	1	407	573.7	582.15	8.45
Reach 1	1	379	573.16	582.61	9.45
Reach 1	1	336	572.03	581.29	9.26
Reach 1	1	273	571.79	580.89	9.1
Reach 1	1	208	571.8	582.37	10.57
Reach 1	1	150	571.8	582.67	10.87
Reach 1	1	89	571.8	582.59	10.79
Reach 1	1	57	571.8	577.76	5.96

APPENDIX B: EXHIBITS AND WORKMAPS



SHIELD ENGINEERING GROUP

Legend

- Project Location
- Parcels

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

N

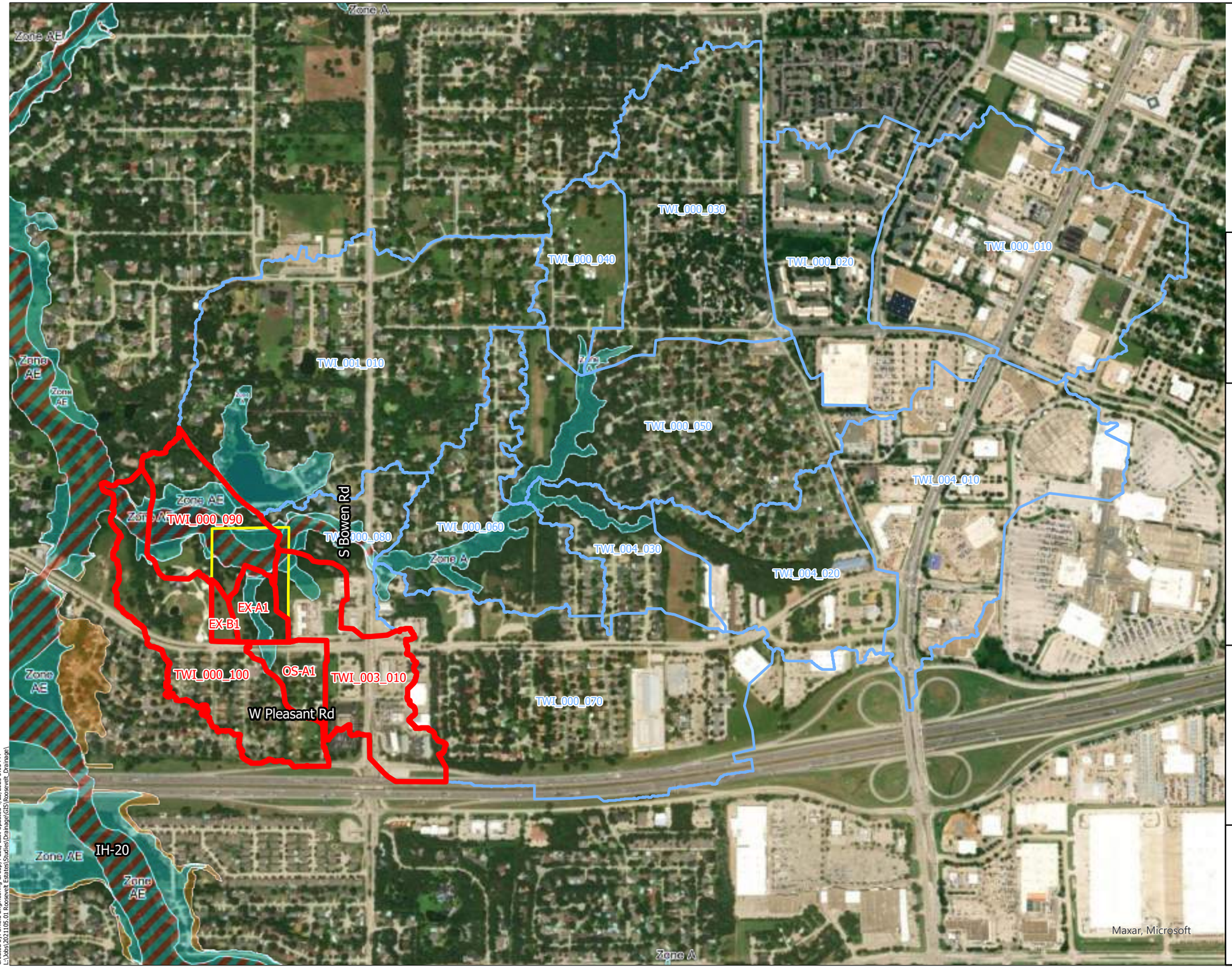
200 100 0 200

US Feet

Scale: 1":200'

Exhibit B-1
Project Location Map

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
K:\Roosevelt Estates Studies\Drainage\GIS\Roosevelt_Drainage\



SHIELD ENGINEERING GROUP

Legend

- Project Location
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

N

800 400 0 800

US Feet

Scale: 1":800'

Exhibit B-2
Overall Watershed

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
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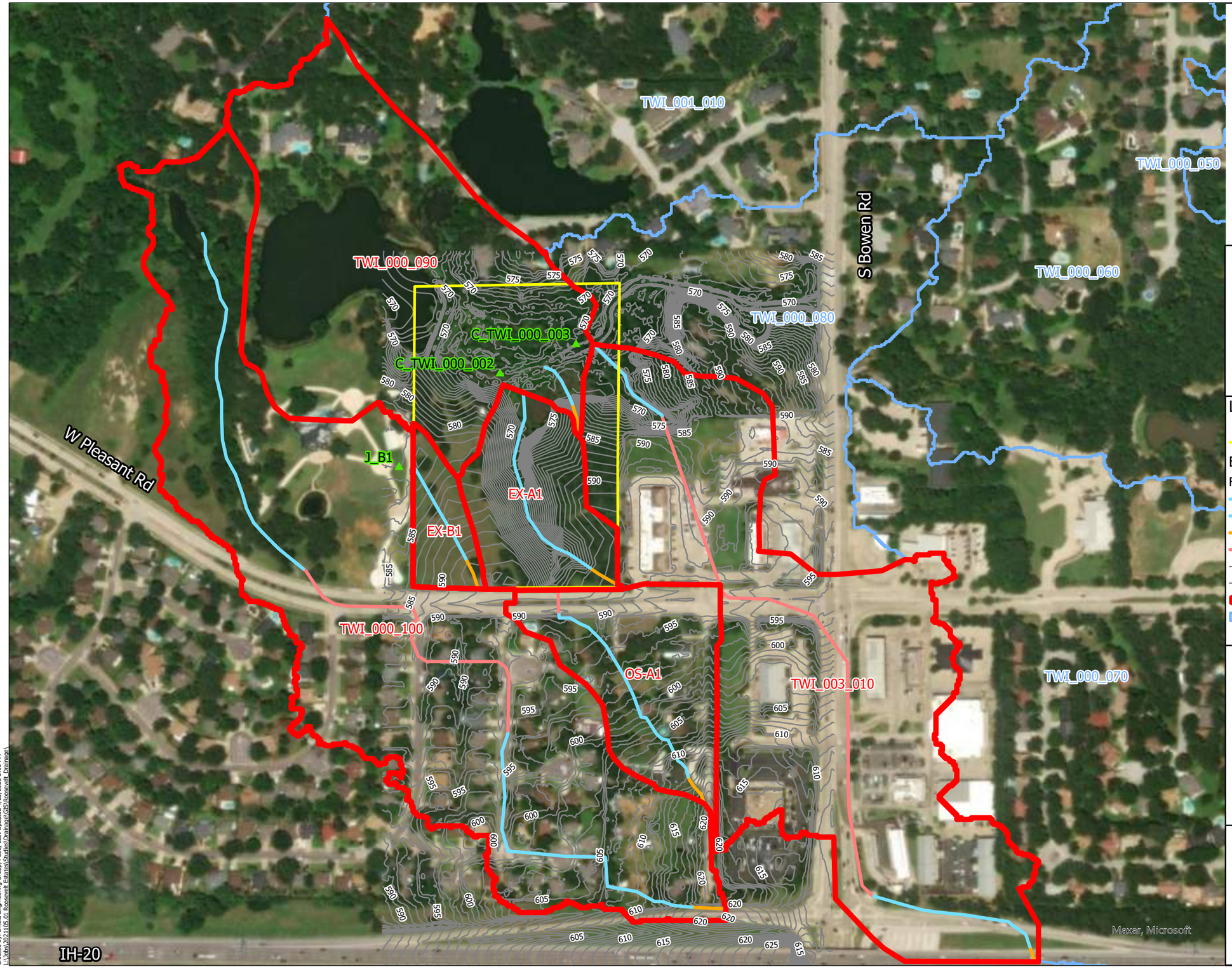

SHIELD ENGINEERING GROUP

Legend

- Junction
- Project Location

Existing Longest Flowpath

FlowType

- Channel Flow
- Shallow Concentrated Flow
- Overland Flow
- Pipe Flow
- LiDAR
- Survey_Contours
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-3
Existing Drainage Area Map

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:05 PM
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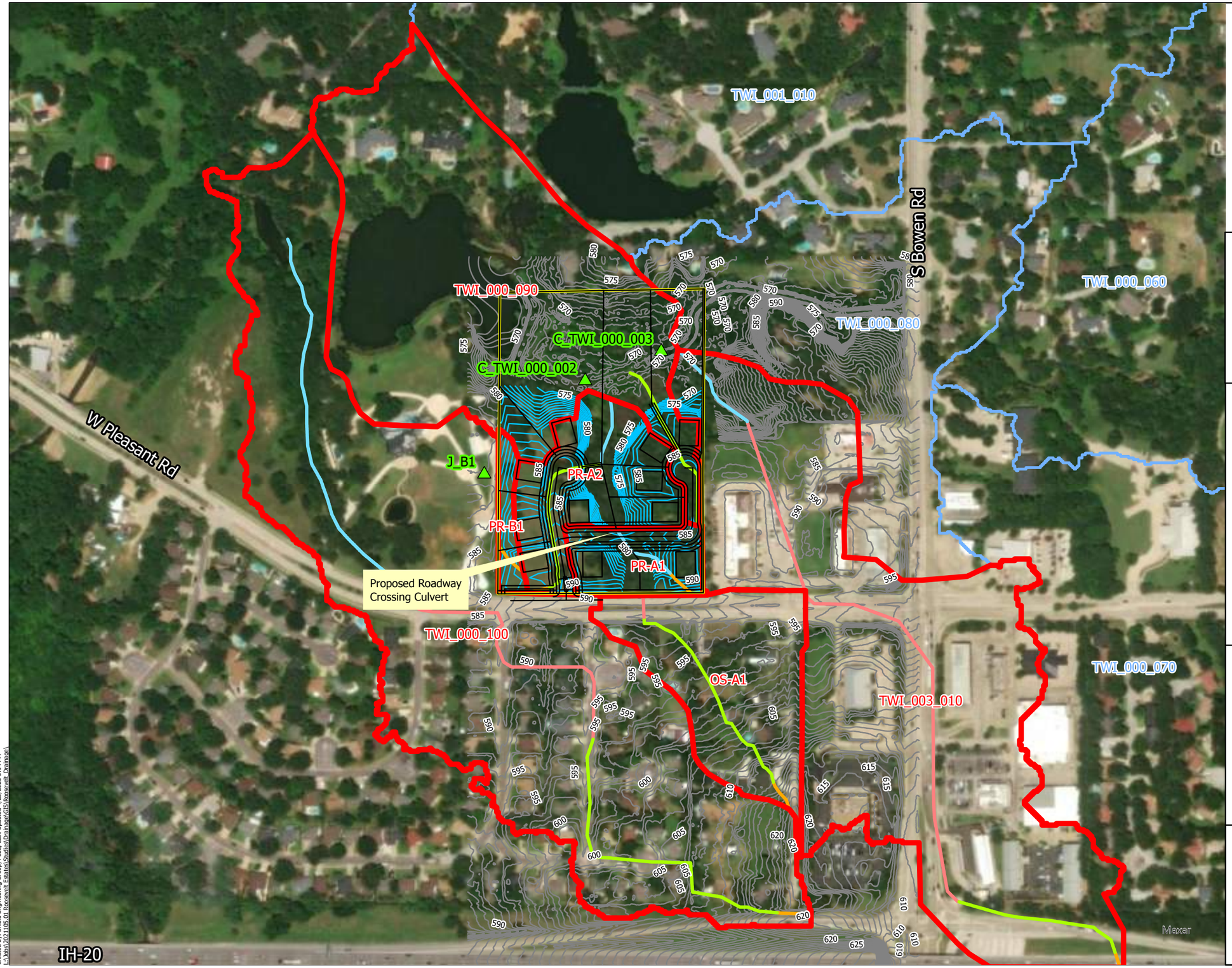

SHIELD ENGINEERING GROUP

Legend

- Layout
- Project Location
- Proposed Drianage Areas
- Twin Springs Draw Drainage Areas

Proposed Longest Flowpath

FlowType

- Channel Flow
- Shallow Concentrated Flow
- Overland Flow
- Pipe Flow
- Preliminary Grading
- LiDAR
- Junction

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-4
Proposed Drainage Area Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:14 PM
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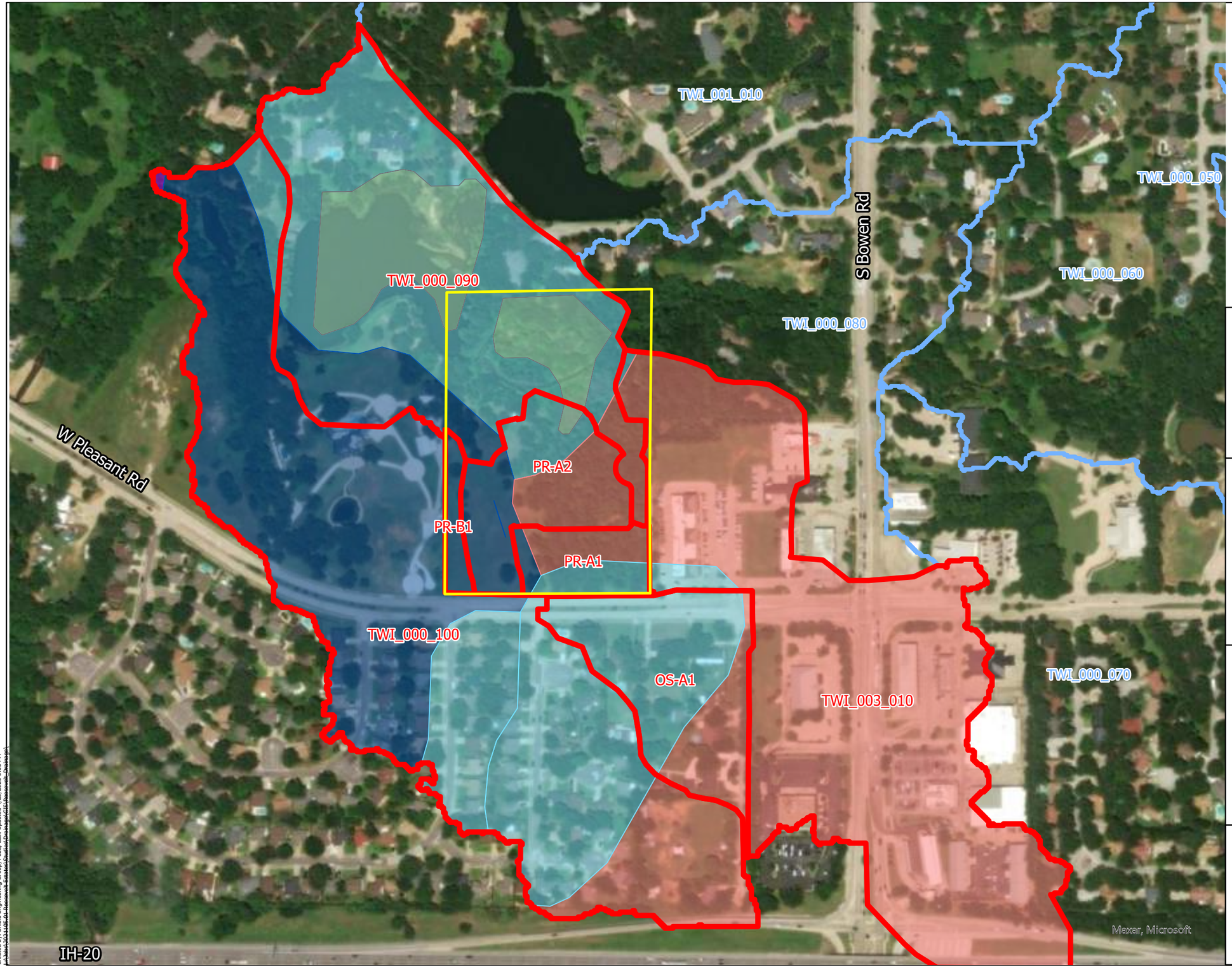


SHIELD ENGINEERING GROUP

Legend

- Project Location

Soil Type

HSG

- A
- B
- C
- D
- Water
- Twin Springs Draw Drainage Areas
- Proposed Drianage Areas

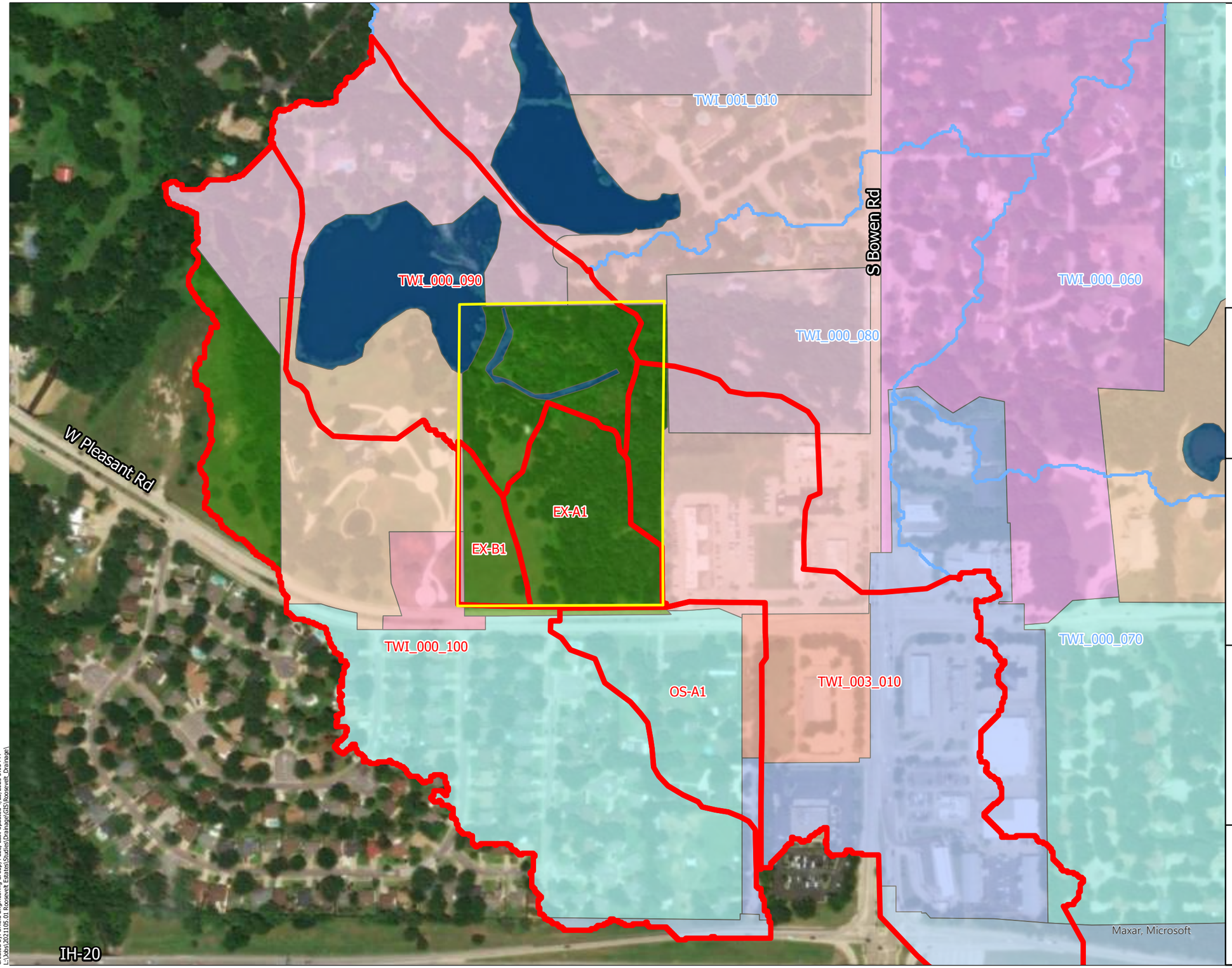
N

300 150 0 300 US Feet

Scale: 1":300'

Exhibit B-5
Soils Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
J:\Projects\2021\05-04 Rockwall Basic\Application Drawings\Exhibit B\Rockwall_Drainage.aprx



SHIELD ENGINEERING GROUP

Legend

Project Location

Existing Land Use Type

- Extremely Low Density
- Group Quarters
- High Density Residential
- Hotel/Motel
- Industrial
- Institutional
- Low Density Residential
- Major Roads
- Medium Density Residential
- Mobile Home
- Multi Family
- Office
- Parks/Recreation
- Retail
- Under Construction
- Utilities
- Vacant
- Very Low Density Residential
- Water
- Existing Drainage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300

US Feet

Scale: 1":300'

Exhibit B-6
Existing Land Use Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
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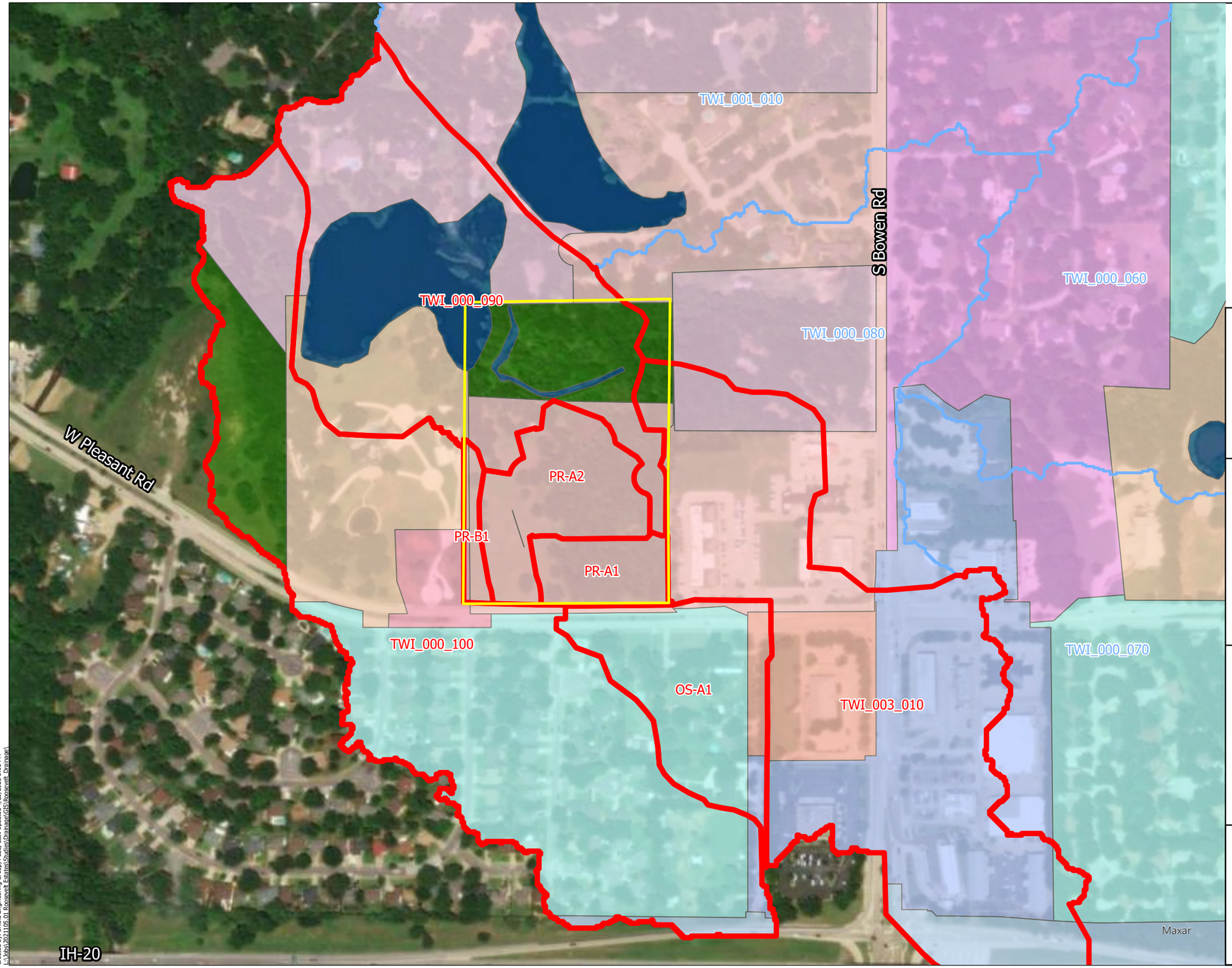

SHIELD ENGINEERING GROUP

Legend

- Project Location

Proposed Land Use Type

- Extremely Low Density
- Group Quarters
- High Density Residential
- Hotel/Motel
- Industrial
- Institutional
- Low Density Residential
- Major Roads
- Medium Density Residential
- Mobile Home
- Multi Family
- Office
- Parks/Recreation
- Retail
- Under Construction
- Utilities
- Vacant
- Very Low Density Residential
- Water
- Proposed Drianage Areas
- Twin Springs Draw Drainage Areas

N

300 150 0 300 US Feet

Scale: 1":300'

Exhibit B-7
Proposed Land Use Map

Created by: Shield Engineering Group, PLLC. Last Updated 4/25/2023 5:05 PM
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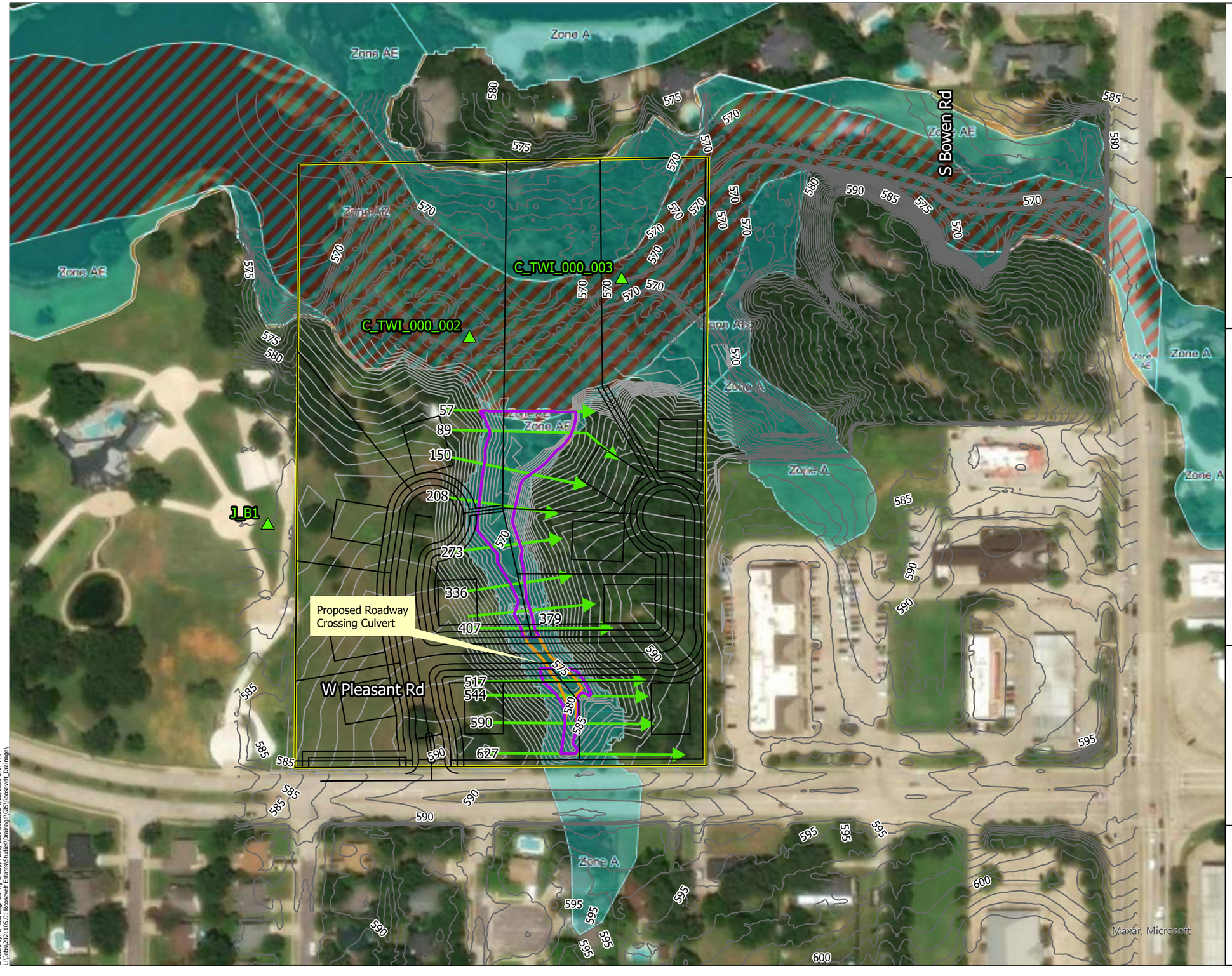

SHIELD ENGINEERING GROUP

Legend

- Layout
- Project Location
- LiDAR
- Survey_Contours
- Existing 100-yr Inundation
- Proposed 100-yr Inundation
- HEC-RAS Cross Sections

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee
- Junction

N

150 75 0 150

US Feet

Scale: 1":150'

Exhibit 8
Hydraulic Workmap

Created by: Shield Engineering Group, PLLC, Last Updated 4/25/2023 5:17 PM
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APPENDIX C: PREVIOUS STUDY (2012 RUSH CREEK STUDY)

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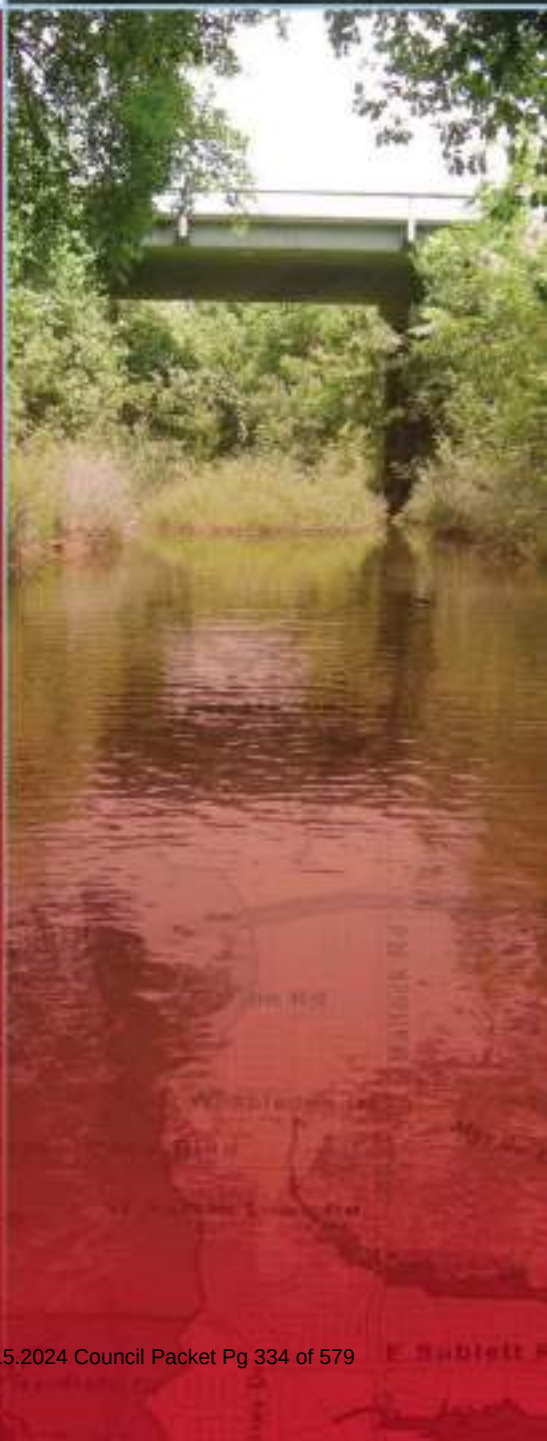
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

RUSH CREEK
City of Arlington
Watershed Study

Rush Creek Watershed Study Hydrology Report

July 2012



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1. Executive Summary

1. Executive Summary

The Rush Creek watershed is the largest watershed in Arlington and includes portions of Kennedale, Mansfield, and Fort Worth and the entirety of Pantego and Dalworthington Gardens. The watershed encompasses approximately 35 square miles of contributing drainage area. It has developed significantly over the past 40 years from the time when the original floodplain mapping was produced by the Federal Emergency Management Agency (FEMA) and this development has had a significant impact on floodplains and creeks.

The City of Arlington has undertaken a comprehensive watershed study to update information regarding flooding characteristics and flows in Rush Creek. The purpose of the watershed study is to 1) update the FEMA flood maps so that flooding risk is better defined for Arlington residents; 2) reduce risks by formulating flood management projects; and 3) assess channel erosion risks.

This report summarizes the study methods and results of the hydrologic modeling effort performed by Halff Associates, Inc. As part of this effort, the Rush Creek watershed was divided into the following major sub-watersheds: Kee Branch, Lower Rush Creek, Middle Rush Creek, Stream RC-1, and Upper Rush Creek. HEC-HMS v3.5 was utilized to create hydrologic models for each sub-watershed. The results of this modeling effort will be utilized to develop unsteady hydraulic models to determine flood elevations corresponding to the 50, 20, 10, 4, 2, 1 and 0.2%-annual-chance (2-, 5-, 10-, 25-, 50-, 100- and 500-year) storm events. Figure 1-1 is a map of the Rush Creek study area.

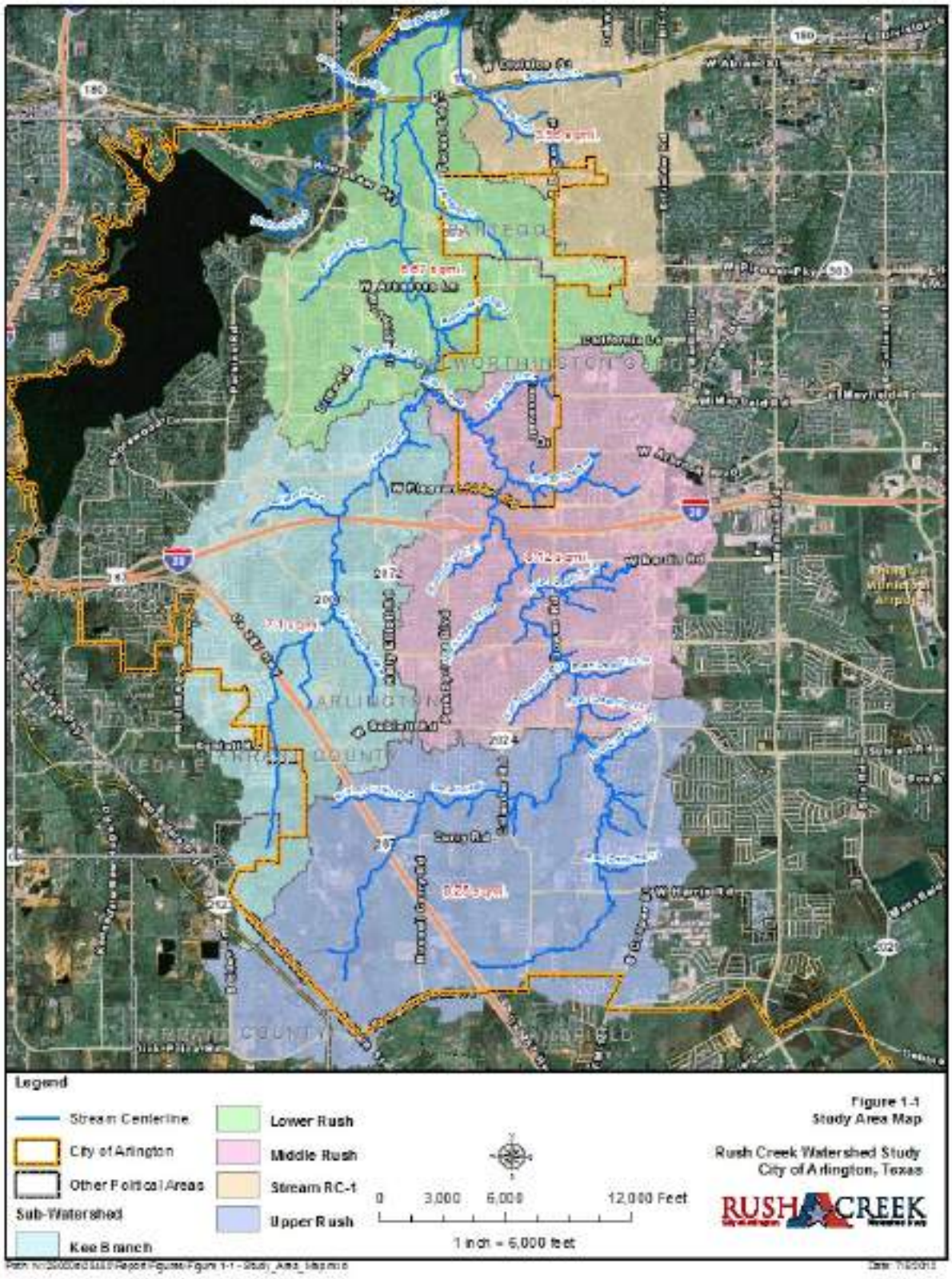


Figure 1-1. Study Area Map

2. Hydrologic Study

2. Hydrologic Study

2.1 Study Area Characteristics

2.1.1 Hydrologic Region

The Rush Creek watershed is located in the Lower West Fork Trinity hydrologic region and is bordered by the Village Creek watershed to the west, the Walnut Creek watershed to the southeast, Fish Creek watershed to the east, Johnson Creek watershed to the northeast. The characteristics of the Lower West Fork Trinity hydrologic region include generally flat terrain and impermeable soils.

2.1.2 Watershed Size

At its outlet, the Rush Creek watershed drainage area measures 34.69 square miles. The Rush Creek watershed was divided into the following five major sub-watersheds:

- *Kee Branch*
- *Lower Rush Creek*
- *Middle Rush Creek*
- *Stream RC-1*
- *Upper Rush Creek*

Figure A-1, Vicinity Map, shows the Rush Creek watershed boundary and the surrounding area.

2.1.3 Soils

The Natural Resource Conservation Service (NRCS) Soil Survey of Tarrant County (2009) was used to evaluate the hydrologic soils in the Rush Creek watershed. The most prevalent soil type in the watershed is Group D which consists of clayey soils with slow infiltration rates and high potential for runoff. The second most prevalent soil type is Group B which consists of soils characterized as having some content of gravelly sand with moderate infiltration rates and low/moderate runoff potential. The third most prevalent soil type in the watershed is Group C which indicates soils having moderately fine to fine texture and slow infiltration rates. A small percentage of soils in the watershed are identified as Group A which indicates soils having high infiltration rates and low runoff potential. Table 2.1 includes a list of the NRCS Soil Survey Geographic Database (SSURGO) Hydrologic Soil Group (HSG) classifications for each Rush Creek sub-watershed.

The hydrologic soils for the Rush Creek watershed are illustrated in Figure A-2, Soils Map.

The antecedent moisture condition (AMC) defines the soil moisture condition prior to a storm. AMC-II, average soil moisture conditions, was used for the watershed study.

Table 2.1 - Watershed Soil Classification				
SSURGO Database Classification	Hydrologic Soil Type Percentage			
	A	B	C	D
Kee Branch	3%	38%	29%	30%
Lower Rush Creek	13%	43%	18%	26%
Middle Rush Creek	4%	25%	18%	53%
Stream RC-1	2%	41%	28%	28%
Upper Rush Creek	3%	29%	17%	50%

2.1.4 Land Use

Land use for the Rush Creek watershed has been determined for both existing and ultimate conditions. Table 2.2 shows the land use categories and corresponding impervious percentages used for this study. Refer to the Technical Standards (May 21, 2012) developed by CDM Smith for sources of these impervious area percentages. Watershed conditions dictated that the recommended percent impervious values provided in the Technical Guidelines be revised to the values shown in Table 2.2 for Extremely Low Density Residential, Very Low Density Residential, Major Transportation, Institutional, and Mobile Home land use categories. A composite percentage of impervious area was computed for each sub-basin for both existing and ultimate land use conditions.

Table 2.2 - Land Use and Percent Impervious	
Land Use Description	Impervious (%) Condition
Extremely Low Density Res (2+ac lots)	15
Very Low Density Res (1 ac lots)	25
Low Density Res (1/2 ac lots)	40
Medium Density Res (1/3 ac lots)	45
High Density Res (1/4 ac lots)	50
Major Transportation	50
Industrial	72
Institutional	50
Group Quarters	40
Hotel/Motel	85
Mobile Home	35
Multi Family	65
Office	85
Parks/Recreation	6
Retail	85
Under Construction	50
Utilities	60
Vacant	3
Water	100

2.1.4.1 *Existing Conditions Land Use*

The existing land use conditions were based on 2005 North Central Texas Council of Governments (NCTCOG) existing land use data provided in shapefile format. The land use shapefile was updated to reflect current development conditions shown on the City of Arlington aerial photography (2011). The existing conditions land use for the Rush Creek watershed is illustrated in Figure A-3, Existing Land Use Map.

2.1.4.2 *Ultimate Conditions Land Use*

Ultimate conditions land use data was not available for the project area. Based on discussion with the project team and the City of Arlington, an impervious area value of 75 percent was applied to all vacant and extremely low density residential land use to estimate the ultimate build out conditions of the watershed. All other land use remained consistent with the existing land use conditions.

2.1.5 Sub-basins

Sub-basin delineations were generated in ESRI's ArcGIS Version 10.0 based on the Texas Natural Resource Information Systems (TNRIS) 2009 Light Detection And Ranging (LiDAR) Terrain Data. Digital storm sewer lines supplied by the City of Arlington, supported by current aerial photography, aided in the sub-basin delineation process. See Figure A-4, Sub-basin Workmap, for sub-basin delineations.

2.1.5.1 *Topographic Data Acquisition and Evaluation*

Topographic data covering the project extent was obtained from the TNRIS 2009 LiDAR acquisition project. This data was available as LiDAR point clouds in the American Society of Photogrammetry and Remote Sensing (ASPRS) common LiDAR Data Exchange Format (LAS 1.1) with 1.0 meter post spacing.

Data was acquired in March 2009 by Fugro Earth Data, Inc. The LiDAR QA Report provided by Dewberry is included in Appendix E of this report. This data was acquired and processed to meet 0.185 meter Root Mean Square Error (RMSEz) vertical accuracy and was tested to have an RMSEz of 0.040 meters using National Standards for Spatial Data Accuracy (NSSDA) and FEMA methodology (see Table 1 of the LiDAR QA Report).

2.1.5.2 *Terrain Processing*

The LiDAR data was processed with Esri's ArcGIS software. The LiDAR data was acquired in Universal Transverse Mercator (UTM), North American Datum of 1983, (NAD83 Meters) with heights in the 1988 North American Vertical Datum (NAVD88 Meters). Each LiDAR tile was projected to Stateplane NAD83, Texas North Central zone with horizontal units of feet and the vertical units were also converted from meters to feet. The projected LiDAR point clouds were then processed in ArcGIS and the ground points were placed into a multipoint feature class within a file geodatabase. The multipoint feature class was then used to generate a seamless terrain dataset within the same file geodatabase. From the terrain dataset, a ground surface Digital Elevation Model (DEM) was generated to support basin delineations and hydrologic modeling.

2.2 Approach and Methodology

2.2.1 Methodology

Hydrologic analyses have been conducted for the Rush Creek watershed as part of the comprehensive watershed study and model updates. The entire watershed has been analyzed for the following hydrologic scenarios:

- *Existing Land Use Conditions*
- *Ultimate Land Use Conditions*

Significant rainfall events considered for the hydrologic models were the 2-, 5-, 10-, 25-, 50-, 100- and 500-year frequency floods. Detailed watershed delineations, existing and ultimate land use determinations, and the hydrologic soil coverage were used to develop HEC-HMS hydrologic computer models for the respective tributaries' watershed. The Rush Creek Watershed Technical Standards (May 21, 2012) along with Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) Second Edition were used as guidelines for the new 2012 hydrologic analyses.

2.2.1.1 *Rainfall*

Rainfall data was obtained from TP-40 (Hershfield, 1961) for the 24-hour storm events corresponding to the 50, 20, 10, 4, 2, 1 and 0.2%-annual-chance (2-, 5-, 10-, 25-, 50-, 100- and 500-year) storm events.

The rainfall data is summarized below in Table 2.3

Table 2.3 - Rainfall Data (inches)

Recurrence Interval (Percent Annual Chance)	Storm Duration							
	5 Min	15 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
50%	0.40	1.02	1.77	2.15	2.37	2.86	3.43	3.95
20%	0.54	1.38	2.39	2.90	3.19	3.86	4.63	5.33
10%	0.64	1.64	2.84	3.44	3.79	4.58	5.49	6.32
4%	0.76	1.94	3.35	4.06	4.48	5.41	6.49	7.47
2%	0.86	2.19	3.79	4.59	5.06	6.12	7.34	8.45
1%	0.96	2.46	4.25	5.15	5.67	6.86	8.23	9.47
0.2%	1.16	2.98	5.15	6.24	6.87	8.31	9.96	11.47

2.2.1.2 *Rainfall Losses*

The loss rate of rainfall, caused by evaporation, interception, depression, storage, and infiltration, is typically evaluated and subtracted from the rainfall to determine rainfall excess for each time increment of a storm. For this study, the SCS Curve Number Method, developed by the Natural Resources Conservation Service (NRCS), was used to develop flood hydrographs based on land use, soil classification, and antecedent moisture conditions. Baseline Curve Numbers were obtained from TR-55, Table 2.2c, for pasture, grassland, or range for AMC-II, average soil moisture conditions. Curve Numbers (CN) were computed

based on a composite percentage of soil types within each sub-basin. Group A soils were defined as having a CN of 39, Group B soils were defined as having CN as 61, Group C soils were defined as having CN as 74, and Group D soils were defined as having CN as 80.

The initial abstraction (I.A.) for all watersheds was computed for AMC-II, average soil conditions using the following equation from TR-55:

$$IA = 0.2\left(\frac{1000}{CN} - 10\right)$$

2.2.1.3 Sub-basin Response

The SCS Dimensionless Unit Hydrograph method was used and SCS lag times were computed for each sub-basin to generate runoff hydrographs. A different time of concentration was computed for existing and ultimate conditions. Both were based on the NRCS TR-55 methodology for overland (sheet) flow, shallow concentrated flow, and channel flow. Overland flow length was limited to a maximum of 100 feet for unpaved surfaces and 50 feet for paved surfaces.

Travel times for channel flow were based on velocities from the HEC-RAS routing models, where available. Channel flows for non-routed reaches were estimated based on Manning's equation, assuming a bankfull depth that was selected based on the channel geometry and the elevation corresponding to the natural channel banks. For improved channels, it was often difficult to estimate the bankfull depth from the channel geometry and some consideration was given to the expected bankfull (2-year) discharges and anticipated velocities associated with bankfull flow. Storm drain velocities were assumed to be 6 feet per second for the purposes of this study.

Based on the recommendation of the project team, the stream channels being modeled using unsteady HEC-RAS were removed from the time of concentration calculations. A memorandum, entitled “Flow paths for estimating Basin Lag Time”, supporting this decision is provided in Appendix D.

The time of concentration is the summation of these phases, where:

$$T_c = t_{sheet} + t_{shallow\ concentrated} + t_{storm\ drain} + t_{channel}$$

Lag times were computed using the following equation:

$$T_p = 0.6 * T_c$$

The Ultimate Conditions times of concentration were estimated by changing overland flow located in vacant land use to be a maximum of 50 feet and paved. All shallow concentrated flow was changed to paved for ultimate conditions. These two changes were intended to estimate the impacts of future development to times of concentration.

Studies have shown that the square root of area can provide a good prediction of time of concentration. Graphs showing the comparison of the estimated times of concentration to the sub-basin area are included in Appendix B of this report.

2.2.1.4 *Routing*

Channel reaches for which there will be no new unsteady hydraulic study were routed in the hydrologic model. The Modified Puls method was used for open channel reaches. HEC-RAS v4.1 was used to develop elevation-storage-discharge relationships for these reaches to route flows in the HEC-HMS model. The HEC-RAS models were generated using cross sections based on the TNRIS LiDAR data. The subreaches (routing step) calculations are provided in Appendix B of this report.

The Muskingum-Cunge method was used to route flows through storm drain reaches outside of the new unsteady hydraulic study reaches. An equivalent pipe diameter size was calculated for most reaches based on a weighted average of the pipe size and length through the reach. The equivalent pipe diameter was input in the HEC-HMS models and a note was added in the description of these routing reaches to specify when this method was applied.

2.2.1.5 *External Input Hydrographs*

There were no external input hydrographs entered into the Rush Creek Hydrology models.

2.2.1.6 *Reservoir Storage*

Two ponds were modeled as reservoirs in HEC-HMS for the Rush Creek watershed. The first is near the intersection of Briarwood Blvd and Winewood Ln in the RC-1 sub-watershed. The second is west of Green Oaks Blvd near the intersection of Fireside Drive in the Lower Rush sub-watershed. The elevation-area-discharge method was used to model these reservoirs in HEC-HMS. Record drawings received from the City of Arlington were utilized to develop elevation-discharge ratings for the outlet structures of these reservoirs. The TNRIS LiDAR data was used to develop the elevation-area tables for each reservoir.

2.2.2 Stream Gages

There are no stream gages in the Rush Creek watershed.

2.2.3 Calibration

Rainfall data was obtained from the National Weather Service (NWS) for the following historical storms:

- *January 24-25, 2012*
- *September 7-9, 2010 (Tropical Storm Hermine)*

Multisensory precipitation estimator (MPE) rainfall data was used to generate the historical rainfall data. This rainfall data is a mosaic of radar, satellite imagery, and rainfall gauge data that is generated on an hourly time-step by the National Weather Service (NWS). The data is available on a 4km x 4km grid (HRAP grid) and provides high-quality temporal and spatial distribution of the rainfall during each storm event. The gridded rainfall product was distributed to the sub-basins by calculating a weighted average for each grid cell and corresponding rainfall depth within each sub-basin. Figure 2.1 below shows the precipitation map of total rainfall from Tropical Storm Hermine courtesy of the NWS.

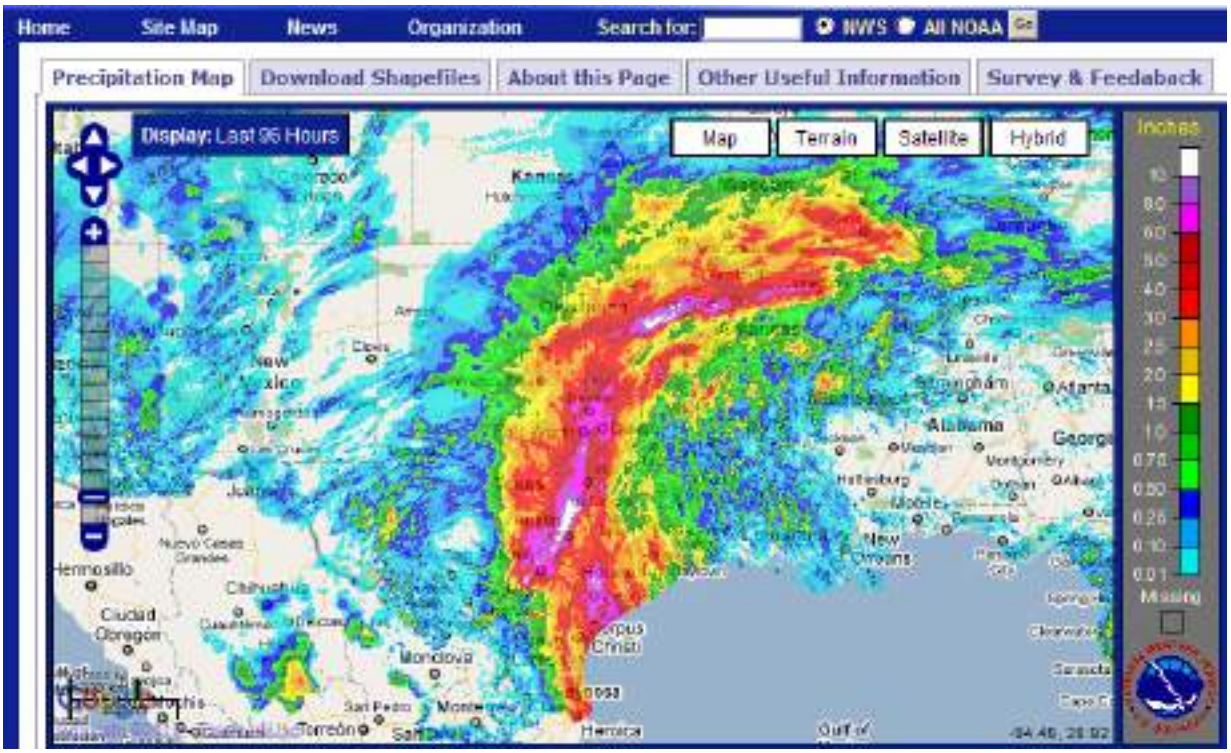


Figure 2-1. Tropical Storm Hermine Total Rainfall

In the absence of stream gage data and watershed wide routing data, the HEC-HMS models have not been calibrated to either storm event at this point. It is anticipated highwater marks documented during these storm events will be used to confirm study results following the completion of the unsteady hydraulic modeling.

2.3 Discharge Comparison

2.3.1 Computed Discharges

Computed discharges will be compared to the effective discharges following the development of the unsteady hydraulic models for the Rush Creek watershed. Previous studies with comparable hydrologic conditions were used to validate the results of the hydrologic models. Discharge comparison graphs are included in Appendix B of this report. The comparison is only conceptually applicable since travel time through unsteady modeled streams was omitted for many of the Rush Creek sub-basins resulting in calculated peak discharges that were higher compared to other sub-basins of similar size. It is anticipated that these discharges will compare favorably after the unsteady routing is utilized to route the hydrographs through the studied reaches. Refer to Appendix D for correspondence documenting technical support for the time of concentration methodology.

2.3.2 Effective Discharges

The current FEMA effective discharges from the September 25, 2009 FEMA Flood Insurance Study (FIS) for Tarrant County are listed in Table 2.4 below.

Table 2.4 - FEMA Effective Discharges

Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
KEE BRANCH					
At confluence with Rush Creek	7.23	6,810	9,490	10,920	13,900
Downstream of confluence of Stream KB-1	6.96	6,210	8,720	9,970	12,470
At Interstate Route 20	4.44	4,360	6,400	7,300	9,070
Downstream of confluence of Tributary K-2	3.55	3,680	4,660	6,420	7,880
Upstream of confluence of Tributary K-2	2.85	2,980	4,400	5,020	6,190
Downstream of confluence of Tributary K-3	1.4	1,340	1,880	2,140	2,650
At U. S. Route 287	1.09	1,030	1,450	1,640	2,020
At Kennenda1e Sublett Road	0.89	1,230	1,650	1,840	2,230
STREAM KB-1					
At confluence with Kee Branch	1.52	2,500	3,310	3,670	4,440
At Oak Springs Road	1.26	2,160	2,890	3,120	3,750
PANTEGO BRANCH					
At confluence with Rush Creek	1.68	2,460	3,320	3,710	4,490
At West Park Row	1.43	2,190	2,940	3,310	4,030
At Smith-Barry Road	0.94	1,550	2,070	2,290	2,840
RUSH CREEK					
At confluence of Pantego Branch	29.01	3,670	4,233	4,704	5,799
At State Route 303	28.77	15,400	23,280	27,060	34,770
At Woodland Park Boulevard	27.59	15,240	22,990	26,670	34,170
At Arkansas Lane	27.17	15,540	23,460	27,180	34,770
Below confluence of Kee Branch	25.24	14,680	21,904	25,280	32,290
At confluence of Kee Branch	18.01	9,920	14,550	16,850	21,650
Below confluence of Tributary R-8	17.83	9,980	14,690	16,950	21,730
Above Kee Branch	17.52	9,600	15,000	17,600	25,000
At confluence of Tributary R-8	16.57	9,710	14,150	16,350	20,900
Below confluence of Tributary R-7	16.3	9,770	14,140	16,340	20,800
At confluence of Tributary R-7	15.16	9,350	13,590	15,700	19,980

Table 2.4 - FEMA Effective Discharges					
Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Downstream of confluence of Tributary R-5 and R-6	14.74	9,400	13,670	15,780	20,010
At Interstate Route 20	13.07	8,860	12,820	14,770	18,680
Downstream of confluence of Tributary R-4	12.78	9,000	13,170	15,190	19,130
At confluence of Tributary R-4	11.51	8,380	12,250	14,010	17,510
At Green Oaks Boulevard	10.82	8,350	12,179	13,890	17,260
Downstream of confluence of Sublett Creek	9.51	8,210	11,620	13,179	16,340
At confluence of Sublett Creek	4.22	4,000	5,560	6,270	7,740
Downstream of confluence of Tributary R-11	3.04	3,520	4,880	5,490	6,820
At confluence of Tributary R-11	2.54	2,990	4,120	4,610	5,690
Below confluence with Tributary R-10	1.9	2,520	3,440	3,850	4,720
At confluence of Tributary R-l	1	1,290	1,770	1,980	2,450
FOREST PARK TRIBUTARY OF RUSH CREEK					
At confluence with Rush Creek	0.18	**	**	610	**
NORTHEAST TRIBUTARY OF RUSH CREEK					
At confluence with Rush Creek	0.11	**	**	361	**
RUSH CREEK RELIEF CHANNEL					
Upstream of convergence with Village Creek	**	15,728	25,147	30,374	40,972
STREAM RC-1					
At confluence with Rush Creek	3.56	4,810	6,220	6,850	8,130
Immediately upstream of Union Pacific Railroad	1.95	2,640	3,310	3,630	4,280
STREAM RC-1(A)					
At confluence with Stream RC-l	1.36	2,210	2,870	3,180	3,810
At headwaters	0.93	1,710	2,240	2,480	3,010
STREAM RC-2					
At confluence with Rush Creek	1.18	1,970	2,520	2,790	3,370
At headwaters	0.64	1,350	1,750	1,930	2,410
RYAN'S BRANCH					

Table 2.4 - FEMA Effective Discharges					
Flooding Source and Approximate Location	Basin Area (sq. mi.)	Peak Discharge (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
At confluence with Rush Creek	1.29	2,000	2,750	3,100	3,900
At Roosevelt Drive	0.99	1,850	2,500	2,800	3,550
SUBLETT CREEK					
At confluence with Rush Creek	5.29	4,620	6,630	7,500	9,100
At Calendar Road	4.57	4,520	6,310	7,060	8,320
SUBLETT CREEK					
Downstream of U.S. Route 287	3.66	3,790	5,230	5,790	6,620
At U.S. Route 287	2.99	3,520	4,790	5,170	5,790
Downstream of Tributary 1	1.83	2,510	3,400	3,800	4,610
TWIN SPRINGS DRAW					
At confluence with Rush Creek	1.17	1,850	2,550	2,850	3,550

3. Exceptions

3. Exceptions

3.1 Explanation of Deviations from the Standard Procedures

This section documents exceptions to the FEMA study standards, FEMA Guidelines and Specifications, or to the procedures described above.

3.1.1 Data Capture Standards (DCS) Submittal

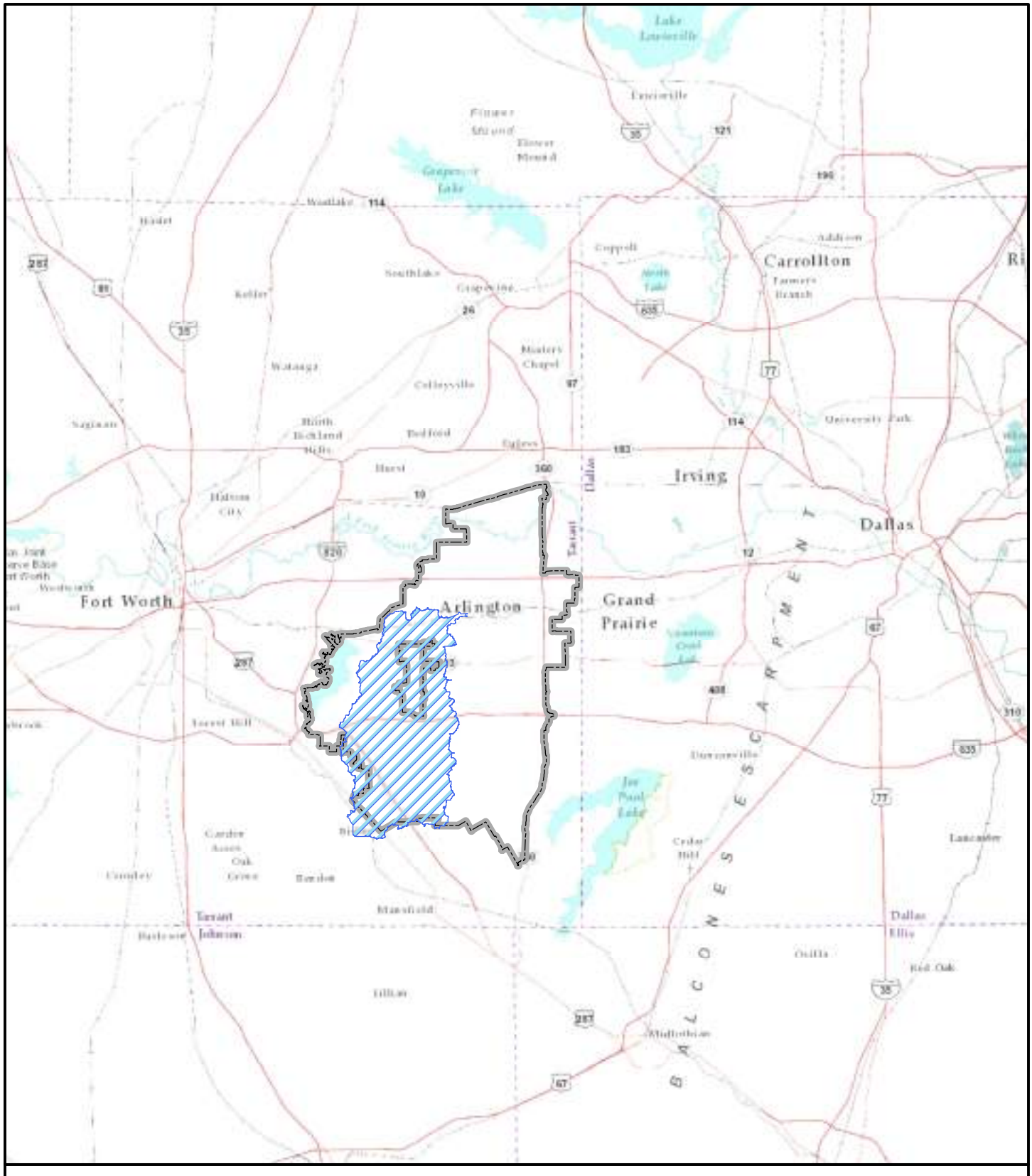
The data submitted for this study follows the FEMA Appendix M Data Capture Standards dated March 2009. All required spatial files and tables, as listed in the Mapping Information Index in Appendix A, will be submitted with this report with the exception of those listed in Table 3.1 below.

Table 3.1 DCS Omitted Digital Files

DCS Feature or Table	Exception
L_Summary_Elevations	This table was not populated because there are no summary elevations associated with any lakes in this watershed.
L_Summary_Discharges	This table was not populated because the data is not yet available. Data will be available in final submittal when unsteady hydraulic models are complete.
S_Nodes	This layer was not populated because routing for unsteady modeling is still in progress and will be populated when finalized.

Appendix A
Figures

Figure A-1 - Vicinity Map



Legend

Rush Creek Watershed

City of Arlington

Figure A-1
Vicinity Map

Rush Creek Watershed Study
City of Arlington, Texas

0 15,000 30,000 60,000 Feet

1 inch = 30,000 feet

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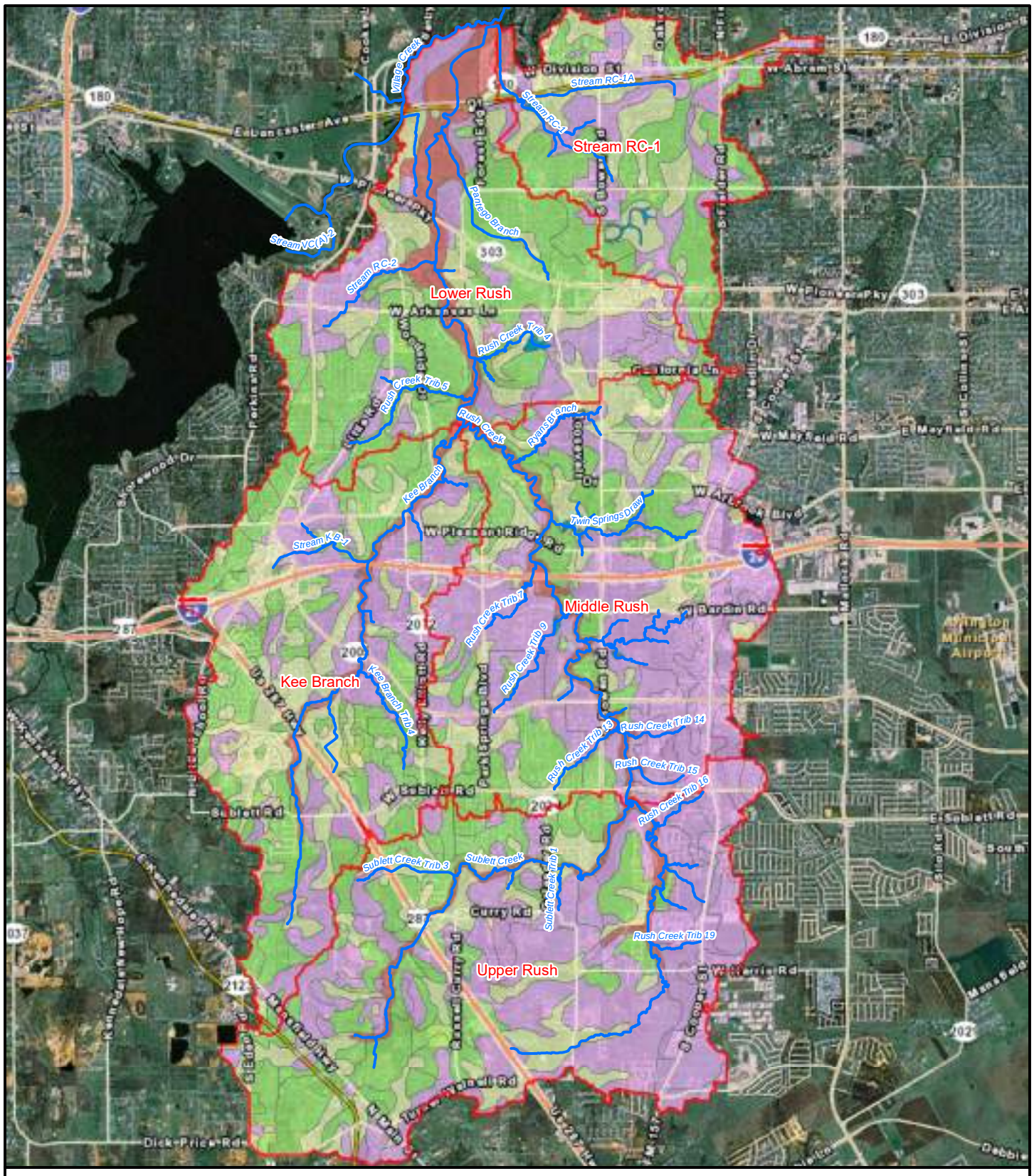
Date: 5/31/2012

Figure A-2 - Soils Map



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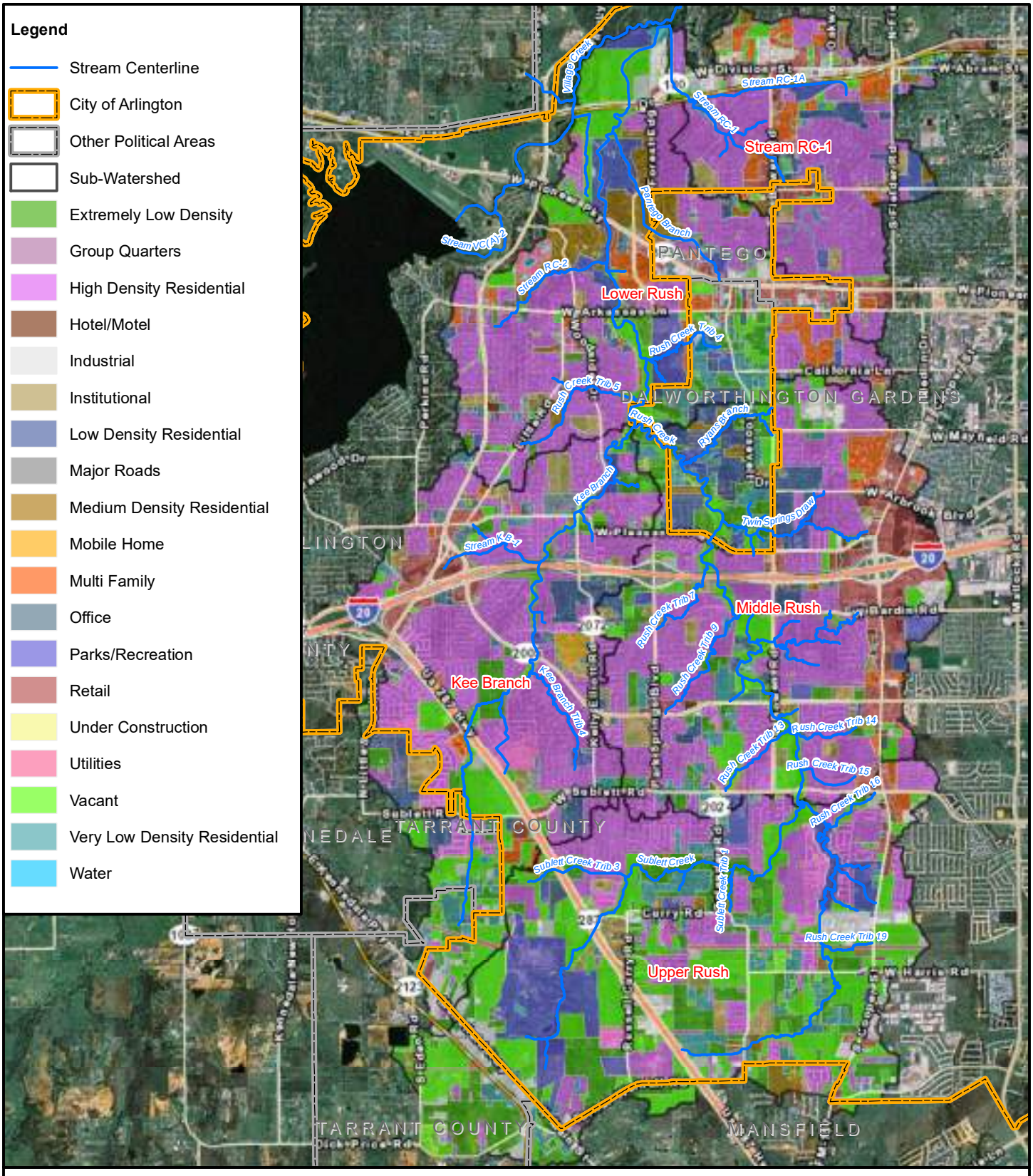
Date: 6/1/2012

Figure A-3 - Existing Land Use Map



Notes:

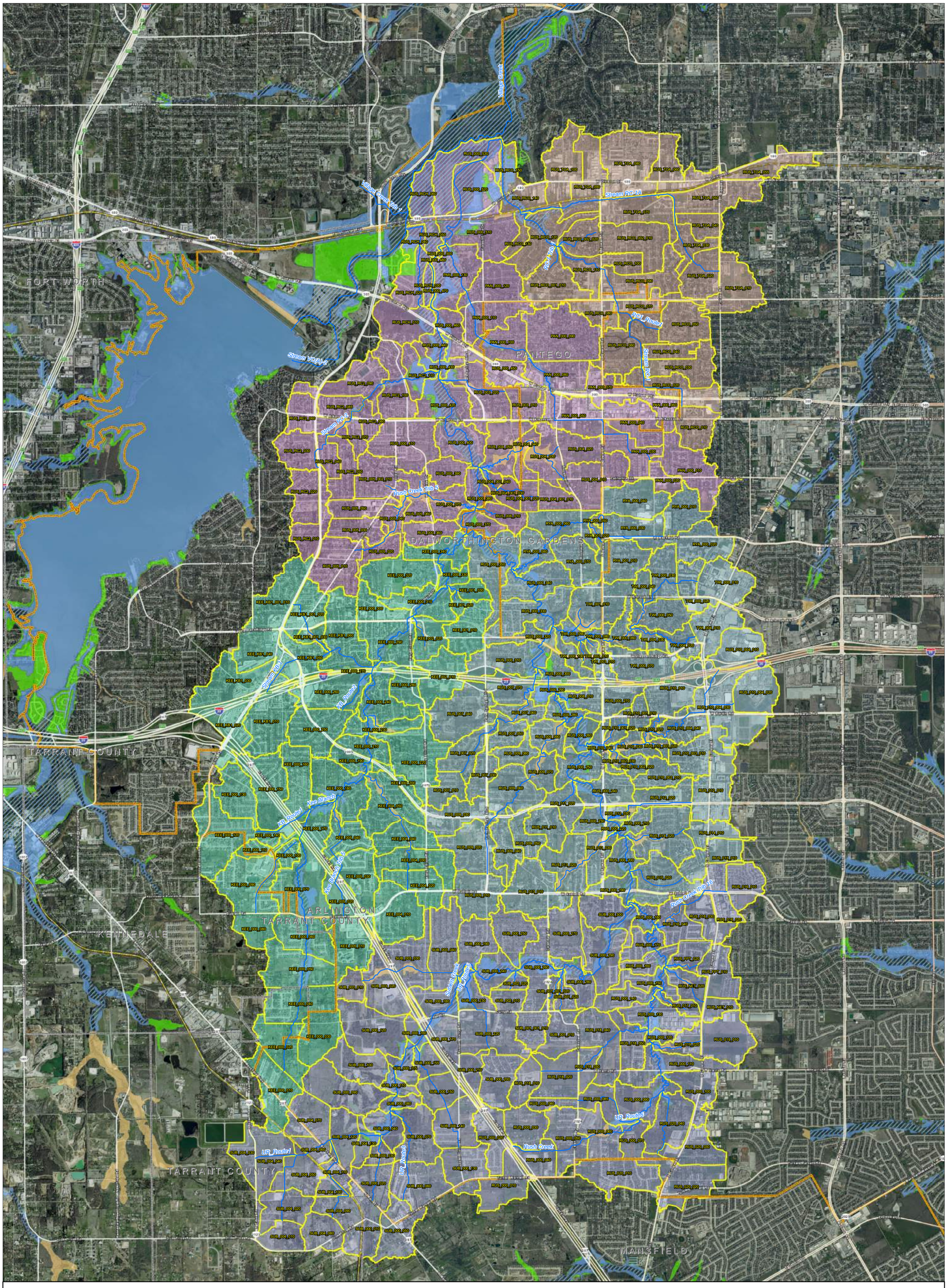
An impervious percentage of 75 was applied to all vacant and extremely low density residential to estimate the ultimate build out conditions of the watershed.

0 3,000 6,000 12,000 Feet

1 inch = 6,000 feet

Figure A-3
Existing Land Use Map

Rush Creek Watershed Study
City of Arlington, Texas



Legend

- City of Arlington
- Other Political Areas
- Stream Centerline
- SUBWTRSHD

FLOOD ZONE

- A
- AE
- FLOODWAY
- X500

SUBWTRSHD

- KB
- LR
- MR
- RC1
- UR

N W E S

0 2,000 4,000 8,000 Feet

Figure A-4
Sub-basin Workmap

Rush Creek Watershed Study
City of Arlington, Texas

RUSH CREEK
City of Arlington Watershed Study

Appendix B
Hydrologic Data

Appendix B-1
Sub-basin Summary

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
KEE_000_010	KB	105.24	0.164	0	0%	59	56%	14	13%	32	30%	0	0%	68	51	68	18	26	25	-1
KEE_000_020	KB	90.75	0.142	0	0%	58	64%	3	4%	30	33%	0	0%	68	26	66	39	21	20	-1
KEE_000_030	KB	83.06	0.130	0	0%	11	14%	17	21%	54	65%	0	0%	76	20	67	47	12	12	0
KEE_000_040	KB	101.65	0.159	0	0%	27	27%	18	18%	56	56%	0	0%	74	18	59	40	8	3	-5
KEE_000_050	KB	114.66	0.179	0	0%	67	58%	30	26%	18	16%	0	0%	67	22	64	42	10	8	-2
KEE_000_060	KB	93.74	0.147	6	6%	51	55%	22	23%	15	16%	0	0%	66	41	51	10	17	15	-2
KEE_000_070	KB	138.70	0.217	23	17%	33	24%	57	41%	24	18%	0	0%	66	19	69	51	17	14	-3
KEE_000_080	KB	52.05	0.081	0	0%	23	44%	15	30%	14	26%	0	0%	70	18	63	46	18	17	-1
KEE_000_090	KB	137.00	0.214	0	0%	49	35%	73	54%	15	11%	0	0%	70	45	45	0	13	13	0
KEE_000_100	KB	22.51	0.035	3	16%	0	0%	19	84%	0	0%	0	0%	69	56	56	0	7	7	0
KEE_000_110	KB	30.05	0.047	1	3%	3	10%	26	85%	0	2%	0	0%	72	51	51	0	13	11	-2
KEE_000_120	KB	141.48	0.221	0	0%	60	43%	41	29%	40	29%	0	0%	70	36	54	18	13	13	0
KEE_000_130	KB	80.53	0.126	0	0%	65	81%	14	18%	1	1%	0	0%	64	47	52	4	11	10	-1
KEE_000_140	KB	24.43	0.038	0	0%	6	25%	18	75%	0	0%	0	0%	71	52	62	9	13	13	0
KEE_000_150	KB	123.70	0.193	0	0%	41	33%	73	59%	10	8%	0	0%	70	39	57	18	10	10	0
KEE_000_160	KB	85.00	0.133	1	1%	14	16%	65	76%	6	7%	0	0%	72	47	51	4	12	12	0
KEE_000_170	KB	71.26	0.111	13	19%	11	15%	41	58%	6	9%	0	0%	66	35	60	26	13	13	0
KEE_000_180	KB	111.92	0.175	12	11%	7	6%	61	54%	33	29%	0	0%	71	33	61	28	17	16	-1
KEE_000_190	KB	35.25	0.055	3	10%	0	0%	6	18%	25	72%	0	0%	75	38	57	19	8	8	0
KEE_000_200	KB	25.48	0.040	0	0%	13	51%	0	0%	12	49%	0	0%	70	52	52	0	7	7	0
KEE_000_210	KB	44.68	0.070	6	13%	0	1%	7	15%	31	70%	0	0%	73	39	43	4	6	6	0
KEE_000_220	KB	139.16	0.218	0	0%	41	29%	11	8%	87	62%	0	0%	74	44	47	3	10	10	0
KEE_000_230	KB	48.42	0.076	3	7%	1	2%	13	28%	31	64%	0	0%	75	46	50	4	10	10	0
KEE_000_240	KB	85.05	0.133	14	17%	0	0%	20	23%	51	60%	0	0%	72	41	51	10	12	12	0
KEE_000_250	KB	103.25	0.161	0	0%	33	32%	29	28%	41	39%	0	0%	72	49	50	0	7	7	0
KEE_000_260	KB	105.08	0.164	4	3%	26	25%	25	24%	50	48%	0	0%	73	51	57	6	10	10	0
KEE_000_270	KB	12.02	0.019	3	21%	0	3%	0	0%	9	76%	0	0%	71	48	51	3	13	13	0
KEE_000_280	KB	56.23	0.088	1	1%	0	0%	13	24%	42	75%	0	0%	78	46	47	1	6	6	0
KEE_000_290	KB	100.62	0.157	16	16%	39	39%	8	8%	37	37%	0	0%	66	40	53	13	14	13	-1
KEE_000_300	KB	52.46	0.082	1	3%	37	70%	14	27%	0	0%	0	0%	64	69	69	1	10	10	0
KEE_000_310	KB	80.84	0.126	16	20%	24	29%	25	31%	16	19%	0	0%	64	47	53	6	9	9	0
KEE_000_320	KB	108.89	0.170	4	3%	83	76%	23	21%	0	0%	0	0%	63	49	50	1	16	15	-1
KEE_000_330	KB	29.28	0.046	10	35%	3	11%	15	51%	1	3%	0	0%	60	22	31	9	9	9	0
KEE_000_340	KB	61.30	0.096	15	24%	34	56%	12	20%	0	0%	0	0%	58	36	54	18	8	8	0
KEE_001_010	KB	80.96	0.127	0	0%	34	42%	39	48%	8	10%	0	0%	69	47	52	5	10	10	0
KEE_001_020	KB	13.08	0.020	0	0%	0	0%	4	28%	9	72%	0	0%	78	43	55	12	8	8	0
KEE_001_030	KB	28.66	0.045	0	0%	11	40%	1	3%	16	57%	0	0%	72	17	73	57	7	7	0
KEE_002_010	KB	87.19	0.136	0	0%	3	3%	10	12%	74	85%	0	0%	79	55	56	1	11	10	-1
KEE_002_020	KB	56.93	0.089	1	2%	7	13%	14	25%	34	60%	0	0%	75	37	58	21	13	13	0
KEE_004_010	KB	116.35	0.182	0	0%	37	32%	41	35%	38	33%	0	0%	72	42	52	10	13	13	0
KEE_004_020	KB	68.25	0.107	0	0%	48	71%	6	9%	14	20%	0	0%	66	48	49	1	7	7	0
KEE_004_030	KB	86.57	0.135	0	0%	42	49%	34	40%	10	12%	0	0%	68	41	44	3	16	15	-1
KEE_004_040	KB	68.46	0.107	0	0%	49	72%	12	17%	8	11%	0	0%	65	50	50	0	7	7	0
KEE_004_050	KB	113.23	0.177	0	0%	63	56%	1	1%	49	44%	0	0%	69	50	50	0	4	4	0
KEE_005_010	KB	87.32	0.136	0	0%	47	54%	11	12%	30	34%	0	0%	69	41	72	31	12	11	-1
KEE_005_020	KB	64.52	0.101	0	0%	1	2%	36	56%	27	42%	0	0%	76	29	63	35	8	8	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
KEE_005_030	KB	85.63	0.134	0	0%	48	55%	28	32%	10	12%	0	0%	68	40	56	16	11	10	-1
KEE_005_040	KB	62.15	0.097	0	1%	23	38%	38	62%	0	0%	0	0%	69	47	52	4	4	4	0
KEE_KB1_001_010	KB	110.82	0.173	0	0%	110	100%	0	0%	0	0%	0	0%	61	48	52	3	6	6	0
KEE_KB1_001_020	KB	71.35	0.112	0	0%	16	22%	9	13%	46	65%	0	0%	75	64	71	7	10	10	0
KEE_KB1_001_030	KB	20.72	0.032	0	0%	4	18%	1	5%	16	77%	0	0%	76	42	73	31	6	6	0
KEE_KB1_010	KB	120.84	0.189	0	0%	50	42%	37	30%	34	28%	0	0%	70	57	58	1	6	6	0
KEE_KB1_020	KB	103.66	0.162	0	0%	42	41%	38	37%	23	23%	0	0%	70	62	63	1	14	10	-4
KEE_KB1_030	KB	115.86	0.181	0	0%	70	60%	46	40%	0	0%	0	0%	66	56	66	10	13	13	0
KEE_KB1_040	KB	98.82	0.154	0	0%	54	54%	32	33%	13	13%	0	0%	68	67	67	0	8	8	0
KEE_KB1_050	KB	57.20	0.089	0	0%	5	9%	3	5%	49	86%	0	0%	78	53	61	8	5	5	0
KEE_KB1_060	KB	128.10	0.200	0	0%	33	26%	25	19%	70	55%	0	0%	74	46	51	5	9	9	0
PAN_000_010	LR	114.57	0.179	0	0%	39	34%	23	20%	52	46%	0	0%	72	50	51	1	15	15	0
PAN_000_020	LR	34.76	0.054	0	0%	15	42%	11	31%	9	27%	0	0%	70	45	55	10	13	12	-1
PAN_000_030	LR	68.21	0.107	0	0%	8	12%	1	2%	59	86%	0	0%	78	59	61	2	12	12	0
PAN_000_040	LR	89.71	0.140	0	0%	0	0%	46	51%	44	49%	0	0%	77	66	69	3	13	13	0
PAN_000_050	LR	94.42	0.148	0	0%	54	58%	35	37%	5	6%	0	0%	67	61	80	19	11	11	0
PAN_000_060	LR	55.37	0.087	0	0%	10	18%	30	54%	16	28%	0	0%	73	72	74	2	14	14	0
PAN_000_070	LR	57.09	0.089	0	0%	42	74%	12	21%	3	5%	0	0%	65	63	67	4	11	11	0
PAN_000_080	LR	80.19	0.125	0	0%	75	94%	5	6%	0	0%	0	0%	62	41	50	9	12	12	0
PAN_000_090	LR	163.11	0.255	0	0%	146	89%	8	5%	9	6%	0	0%	63	46	51	4	14	14	0
PAN_000_100	LR	79.18	0.124	0	0%	74	93%	5	7%	0	0%	0	0%	62	46	50	5	15	15	0
PAN_000_110	LR	81.57	0.127	0	0%	79	97%	0	0%	3	3%	0	0%	62	47	48	1	12	12	0
PAN_000_120	LR	90.84	0.142	1	1%	76	84%	7	7%	7	8%	0	0%	63	47	47	0	11	11	0
PAN_000_130	LR	107.77	0.168	59	55%	5	5%	0	0%	44	41%	0	0%	57	19	20	2	18	18	0
RUS_000_360	LR	51.18	0.080	1	2%	32	62%	6	12%	12	23%	0	0%	67	50	50	0	8	8	0
RUS_000_370	LR	39.84	0.062	15	38%	13	32%	4	11%	8	19%	0	0%	58	11	67	56	9	8	-1
RUS_000_380	LR	36.94	0.058	16	44%	12	33%	2	4%	7	19%	0	0%	55	20	60	40	5	5	0
RUS_000_390	LR	46.87	0.073	0	1%	47	99%	0	0%	0	0%	0	0%	61	49	50	1	11	11	0
RUS_000_400	LR	82.33	0.129	37	45%	27	33%	18	22%	0	0%	0	0%	54	18	65	47	3	3	0
RUS_000_410	LR	131.27	0.205	0	0%	113	86%	10	7%	8	6%	0	0%	63	42	54	12	13	13	0
RUS_000_420	LR	99.02	0.155	41	41%	23	24%	35	35%	0	0%	0	0%	56	30	40	11	9	9	0
RUS_000_430	LR	30.15	0.047	16	52%	2	8%	12	38%	1	2%	0	0%	55	45	49	3	4	4	0
RUS_000_440	LR	27.73	0.043	17	61%	0	0%	11	38%	0	1%	0	0%	53	33	33	0	5	5	0
RUS_000_450	LR	77.92	0.122	6	8%	57	73%	0	0%	15	20%	0	0%	63	70	73	3	21	14	-7
RUS_000_460	LR	36.80	0.058	8	21%	3	9%	0	0%	26	69%	0	0%	70	44	45	1	8	8	0
RUS_000_470	LR	4.34	0.007	4	100%	0	0%	0	0%	0	0%	0	0%	39	48	48	0	6	6	0
RUS_000_480	LR	1.31	0.002	1	100%	0	0%	0	0%	0	0%	0	0%	39	66	66	0	6	6	0
RUS_000_500	LR	2.62	0.004	3	100%	0	0%	0	0%	0	0%	0	0%	39	32	53	22	6	6	0
RUS_000_510	LR	134.12	0.210	38	29%	28	21%	28	21%	39	29%	0	0%	63	42	56	15	11	11	0
RUS_000_520	LR	97.04	0.152	93	96%	2	2%	0	0%	2	2%	0	0%	40	38	73	35	8	8	0
RUS_000_530	LR	110.22	0.172	66	60%	0	0%	0	0%	44	40%	0	0%	55	21	55	34	41	35	-6
RUS_003_010	LR	51.93	0.081	0	0%	45	86%	0	0%	7	14%	0	0%	64	47	65	18	6	6	0
RUS_003_020	LR	98.45	0.154	1	1%	66	67%	24	24%	8	8%	0	0%	65	57	61	3	8	8	0
RUS_004_001_010	LR	42.36	0.066	0	0%	2	5%	8	18%	33	77%	0	0%	78	31	46	15	15	15	0
RUS_004_001_020	LR	25.87	0.040	0	0%	12	48%	4	16%	9	36%	0	0%	70	19	58	38	9	8	-1
RUS_004_001_030	LR	28.87	0.045	0	0%	12	41%	17	59%	0	0%	0	0%	69	17	22	5	5	5	0

Appendix B-1

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_004_001_040	LR	14.64	0.023	0	0%	8	53%	7	46%	0	0%	0	0%	67	7	10	4	5	4	-1
RUS_004_010	LR	111.14	0.174	0	0%	4	3%	68	61%	40	36%	0	0%	76	30	55	24	15	15	0
RUS_004_020	LR	56.31	0.088	0	0%	0	0%	9	16%	47	84%	0	0%	79	20	69	49	20	18	-2
RUS_004_030	LR	74.01	0.116	0	0%	17	23%	15	21%	30	40%	11	15%	77	40	54	14	12	7	-5
RUS_004_040	LR	37.24	0.058	0	0%	15	42%	16	43%	6	16%	0	0%	70	35	46	11	14	13	-1
RUS_004_050	LR	82.61	0.129	0	0%	37	45%	23	28%	21	26%	1	1%	70	11	18	7	9	5	-4
RUS_005_002_010	LR	87.86	0.137	0	0%	58	66%	5	5%	26	29%	0	0%	67	49	49	0	9	9	0
RUS_005_010	LR	108.52	0.170	0	0%	74	68%	1	1%	34	32%	0	0%	67	45	53	8	10	10	0
RUS_005_020	LR	41.86	0.065	0	0%	31	74%	4	9%	7	17%	0	0%	65	46	53	7	6	6	0
RUS_005_030	LR	54.13	0.085	0	0%	27	50%	0	0%	27	50%	0	0%	70	44	50	6	13	13	0
RUS_005_040	LR	34.25	0.054	0	0%	19	55%	5	14%	11	31%	0	0%	69	46	47	1	8	8	0
RUS_005_050	LR	49.69	0.078	0	0%	39	78%	1	1%	10	21%	0	0%	65	49	52	3	14	14	0
RUS_005_060	LR	57.28	0.090	0	0%	42	74%	7	13%	8	13%	0	0%	65	50	50	0	12	12	0
RUS_005_070	LR	56.21	0.088	4	6%	53	94%	0	0%	0	0%	0	0%	60	44	53	9	3	3	0
RUS_006_010	LR	39.55	0.062	0	1%	5	14%	8	21%	25	64%	0	0%	76	21	58	37	7	6	-1
RUS_RC2_010	LR	70.41	0.110	0	0%	64	92%	6	8%	0	0%	0	0%	62	44	51	6	14	13	-1
RUS_RC2_020	LR	68.02	0.106	0	0%	61	90%	7	10%	0	0%	0	0%	62	47	49	2	10	10	0
RUS_RC2_030	LR	65.28	0.102	0	0%	46	71%	2	4%	16	25%	0	0%	66	46	50	4	12	12	0
RUS_RC2_040	LR	35.40	0.055	0	0%	8	23%	6	16%	22	61%	0	0%	75	50	51	1	9	9	0
RUS_RC2_050	LR	58.41	0.091	0	0%	40	69%	8	14%	10	18%	0	0%	66	50	50	0	13	13	0
RUS_RC2_060	LR	74.27	0.116	0	0%	4	6%	9	12%	61	82%	0	0%	78	54	59	5	8	8	0
RUS_RC2_070	LR	33.18	0.052	0	0%	0	0%	24	72%	2	7%	0	0%	75	58	59	1	6	6	0
RUS_RC2_080	LR	30.18	0.047	0	0%	2	6%	15	49%	14	45%	0	0%	76	48	54	6	7	6	-1
RUS_RC2_085	LR	35.52	0.056	0	0%	0	0%	0	0%	43	120%	0	0%	80	58	61	3	6	6	0
RUS_RC2_090	LR	97.48	0.152	0	0%	11	11%	7	7%	80	82%	0	0%	77	44	61	17	14	14	0
RUS_RC2_100	LR	97.10	0.152	2	2%	38	39%	28	29%	29	30%	0	0%	70	47	47	0	7	7	0
RUS_RC2_110	LR	45.47	0.071	24	52%	11	23%	11	25%	0	0%	0	0%	53	34	34	0	5	5	0
RUS_RCH_010	LR	93.98	0.147	18	19%	10	11%	49	52%	16	17%	0	0%	67	17	61	44	9	6	-3
RUS_RCH_020	LR	66.07	0.103	24	37%	0	0%	28	43%	14	21%	0	0%	62	29	59	30	12	7	-5
RUS_RCH_030	LR	15.41	0.024	15	100%	0	0%	0	0%	0	0%	0	0%	39	12	18	7	6	6	0
RUS_RCH_040	LR	26.39	0.041	0	0%	0	0%	26	98%	0	2%	0	0%	74	23	70	47	14	13	-1
RUS_RCH_050	LR	29.52	0.046	17	57%	0	0%	9	32%	3	11%	0	0%	55	9	66	56	6	6	0
RUS_RCH_060	LR	50.04	0.078	7	14%	0	0%	0	0%	43	86%	0	0%	74	4	74	71	9	8	-1
RUS_000_190	MR	66.36	0.104	8	12%	19	29%	0	0%	39	59%	0	0%	69	31	61	30	11	11	0
RUS_000_200	MR	44.34	0.069	13	30%	5	12%	0	0%	26	58%	0	0%	65	19	67	48	11	4	-7
RUS_000_210	MR	26.71	0.042	3	12%	4	14%	0	0%	20	74%	0	0%	73	40	54	14	8	8	0
RUS_000_220	MR	8.79	0.014	8	89%	1	10%	0	0%	0	1%	0	0%	42	8	72	64	10	3	-7
RUS_000_230	MR	34.22	0.053	5	14%	0	1%	0	0%	29	85%	0	0%	74	45	52	7	7	7	0
RUS_000_240	MR	75.76	0.118	11	14%	27	35%	16	22%	22	29%	0	0%	66	34	52	18	9	9	0
RUS_000_250	MR	64.17	0.100	16	25%	21	33%	5	7%	23	35%	0	0%	63	34	63	29	5	5	0
RUS_000_260	MR	34.97	0.055	8	22%	15	42%	1	4%	11	32%	0	0%	63	23	77	54	5	3	-2
RUS_000_270	MR	50.28	0.079	0	0%	8	15%	2	3%	41	82%	0	0%	77	48	52	5	18	17	-1
RUS_000_280	MR	33.76	0.053	12	37%	5	14%	3	9%	13	40%	0	0%	62	26	63	36	7	6	-1
RUS_000_290	MR	28.42	0.044	12	41%	5	17%	2	8%	10	34%	0	0%	59	42	54	12	8	8	0
RUS_000_300	MR	45.92	0.072	8	17%	26	58%	5	12%	6	13%	0	0%	61	48	51	3	4	4	0
RUS_000_310	MR	107.92	0.169	11	10%	13	12%	42	39%	42	39%	0	0%	71	40	58	17	18	18	0

Appendix B-1

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_000_320	MR	49.32	0.077	5	9%	17	35%	27	54%	1	1%	0	0%	66	27	61	35	11	7	-4
RUS_000_330	MR	102.55	0.160	12	12%	39	38%	43	42%	8	8%	0	0%	65	28	54	25	16	16	0
RUS_000_340	MR	88.59	0.138	17	19%	60	68%	11	13%	0	0%	0	0%	58	30	42	12	12	10	-2
RUS_000_350	MR	128.31	0.201	25	20%	83	65%	20	16%	0	0%	0	0%	59	23	56	33	22	19	-3
RUS_007_010	MR	47.38	0.074	0	0%	16	34%	16	34%	15	32%	0	0%	71	42	50	8	11	11	0
RUS_007_020	MR	68.53	0.107	0	0%	14	21%	12	17%	43	62%	0	0%	75	48	51	3	11	11	0
RUS_007_030	MR	47.96	0.075	0	0%	7	14%	33	68%	9	18%	0	0%	73	41	49	8	21	20	-1
RUS_007_040	MR	129.96	0.203	0	0%	0	0%	3	2%	127	98%	0	0%	80	30	56	26	11	11	0
RUS_007_050	MR	43.72	0.068	0	0%	0	0%	3	6%	41	94%	0	0%	80	50	50	0	7	7	0
RUS_007_060	MR	35.77	0.056	0	0%	0	0%	0	0%	36	100%	0	0%	80	50	50	0	5	5	0
RUS_007_070	MR	68.39	0.107	10	15%	0	0%	14	20%	45	66%	0	0%	73	41	55	14	13	13	0
RUS_008_010	MR	49.96	0.078	4	8%	8	16%	3	7%	34	69%	0	0%	73	50	53	3	17	17	0
RUS_009_010	MR	96.57	0.151	0	0%	90	94%	5	6%	1	1%	0	0%	62	44	50	7	7	7	0
RUS_009_020	MR	104.43	0.163	0	0%	32	31%	65	62%	8	7%	0	0%	70	50	50	0	13	13	0
RUS_009_030	MR	83.53	0.131	0	0%	20	24%	11	14%	52	62%	0	0%	75	53	56	3	9	9	0
RUS_009_040	MR	55.65	0.087	0	0%	10	17%	16	29%	30	54%	0	0%	75	50	50	0	15	15	0
RUS_009_050	MR	45.15	0.071	0	0%	28	62%	11	24%	6	14%	0	0%	67	43	50	7	11	11	0
RUS_009_060	MR	93.54	0.146	0	0%	21	22%	4	4%	69	73%	0	0%	76	48	55	7	4	4	0
RUS_009_070	MR	45.12	0.071	0	0%	0	0%	0	0%	45	100%	0	0%	80	33	56	23	7	7	0
RUS_009_080	MR	38.66	0.060	0	0%	1	3%	2	4%	36	93%	0	0%	79	50	50	1	8	8	0
RUS_009_090	MR	49.83	0.078	0	0%	2	5%	0	0%	43	87%	4	8%	81	54	56	2	2	2	0
RUS_010_001_010	MR	28.33	0.044	0	0%	0	0%	11	37%	18	63%	0	0%	78	50	50	1	7	7	0
RUS_010_001_020	MR	28.06	0.044	0	0%	0	0%	0	0%	28	100%	0	0%	80	48	48	0	10	10	0
RUS_010_002_010	MR	51.39	0.080	0	0%	0	1%	1	1%	50	98%	0	0%	80	49	49	0	8	8	0
RUS_010_002_020	MR	17.95	0.028	0	0%	0	0%	3	14%	15	86%	0	0%	79	50	50	0	3	3	0
RUS_010_002_030	MR	12.72	0.020	0	0%	0	0%	0	0%	10	80%	3	20%	84	59	59	0	4	4	0
RUS_010_003_010	MR	81.10	0.127	0	0%	0	0%	0	0%	81	100%	0	0%	80	66	67	1	8	8	0
RUS_010_003_020	MR	13.03	0.020	0	0%	0	0%	0	0%	13	100%	0	0%	80	50	50	0	2	2	0
RUS_010_004_010	MR	76.27	0.119	0	0%	0	0%	1	1%	76	99%	0	0%	80	79	79	0	13	13	0
RUS_010_004_020	MR	79.94	0.125	0	0%	0	0%	1	1%	79	99%	0	0%	80	59	77	18	11	11	0
RUS_010_004_030	MR	149.77	0.234	0	0%	11	7%	21	14%	118	79%	0	0%	78	57	57	0	23	23	0
RUS_010_004_040	MR	56.79	0.089	0	0%	0	0%	1	2%	56	98%	0	0%	80	55	60	5	6	6	0
RUS_010_010	MR	109.01	0.170	0	0%	34	32%	54	50%	20	19%	0	0%	71	64	64	0	19	19	0
RUS_010_020	MR	13.63	0.021	0	0%	0	0%	0	0%	14	100%	0	0%	80	38	56	18	10	1	-9
RUS_010_030	MR	36.73	0.057	0	0%	0	0%	0	0%	37	100%	0	0%	80	50	50	0	5	5	0
RUS_010_040	MR	29.72	0.046	2	7%	8	26%	0	1%	20	66%	0	0%	72	30	60	30	8	8	0
RUS_011_010	MR	56.26	0.088	0	0%	29	51%	0	0%	28	49%	0	0%	70	27	56	30	11	10	-1
RUS_011_020	MR	51.86	0.081	0	1%	1	1%	7	13%	44	84%	0	0%	79	32	48	16	8	8	0
RUS_012_010	MR	105.30	0.165	0	0%	0	0%	0	0%	105	100%	0	0%	80	68	68	0	11	10	-1
RUS_012_020	MR	60.58	0.095	0	0%	4	6%	0	0%	57	94%	0	0%	79	37	53	16	17	16	-1
RUS_012_030	MR	12.97	0.020	5	36%	8	64%	0	0%	0	0%	0	0%	53	32	60	28	1	1	0
RUS_013_010	MR	122.21	0.191	0	0%	72	59%	42	34%	9	7%	0	0%	67	31	46	15	11	11	0
RUS_013_020	MR	92.60	0.145	0	0%	53	57%	15	16%	25	27%	0	0%	68	28	63	35	16	14	-2
RUS_013_030	MR	55.42	0.087	3	6%	23	41%	0	0%	29	53%	0	0%	70	43	54	11	4	4	0
RUS_014_010	MR	46.82	0.073	0	0%	0	0%	0	0%	47	100%	0	0%	80	51	70	20	13	13	0
RUS_014_020	MR	119.19	0.186	3	3%	0	0%	0	0%	116	97%	0	0%	79	48	50	2	11	11	0

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_015_010	MR	67.74	0.106	0	0%	0	0%	0	0%	68	100%	0	0%	80	48	63	16	15	15	0
RUS_015_020	MR	80.60	0.126	4	5%	0	0%	0	0%	77	95%	0	0%	78	53	54	1	10	10	0
RYA_000_010	MR	66.67	0.104	0	0%	32	48%	8	12%	27	41%	0	0%	70	53	53	0	10	10	0
RYA_000_020	MR	99.78	0.156	0	0%	46	46%	21	21%	32	32%	0	0%	70	58	60	1	20	19	-1
RYA_000_030	MR	63.29	0.099	0	0%	11	17%	36	57%	16	26%	0	0%	73	41	62	21	16	15	-1
RYA_000_040	MR	92.99	0.145	0	0%	23	25%	68	74%	1	1%	0	0%	71	39	67	29	9	9	0
RYA_000_050	MR	5.45	0.009	0	0%	0	0%	2	34%	4	66%	0	0%	78	3	75	72	6	1	-5
RYA_000_060	MR	81.23	0.127	0	0%	5	6%	21	25%	56	68%	0	0%	77	29	51	22	11	5	-6
RYA_000_070	MR	77.62	0.121	0	0%	36	46%	0	0%	42	54%	0	0%	71	34	47	13	14	7	-7
RYA_000_080	MR	52.02	0.081	3	6%	21	41%	6	12%	21	41%	0	0%	69	30	34	4	8	8	0
RYA_001_010	MR	77.35	0.121	0	0%	4	5%	43	55%	31	40%	0	0%	76	42	53	11	11	11	0
RYA_001_020	MR	12.94	0.020	0	0%	1	5%	7	51%	6	44%	0	0%	76	10	75	65	8	3	-5
TWI_000_010	MR	87.86	0.137	0	0%	0	0%	14	16%	73	84%	0	0%	79	76	76	0	12	12	0
TWI_000_020	MR	55.13	0.086	0	0%	8	15%	26	48%	20	37%	0	0%	74	68	72	4	5	5	0
TWI_000_030	MR	67.34	0.105	0	0%	22	33%	20	29%	25	38%	0	0%	72	48	52	4	14	14	0
TWI_000_040	MR	20.95	0.033	0	0%	1	7%	11	51%	9	42%	0	0%	76	41	41	0	12	10	-2
TWI_000_050	MR	75.53	0.118	0	0%	53	70%	5	7%	18	24%	0	0%	66	47	47	0	9	9	0
TWI_000_060	MR	43.53	0.068	0	0%	18	42%	10	23%	15	35%	0	0%	71	37	37	0	16	15	-1
TWI_000_070	MR	96.93	0.151	0	0%	32	33%	9	9%	56	58%	0	0%	73	51	57	6	21	21	0
TWI_000_080	MR	18.60	0.029	0	0%	6	30%	6	33%	7	37%	0	0%	72	28	52	24	9	9	0
TWI_000_090	MR	20.73	0.032	0	0%	3	15%	11	54%	0	0%	6	30%	80	35	70	35	3	1	-2
TWI_000_100	MR	34.00	0.053	0	0%	20	58%	10	30%	4	12%	0	0%	67	32	50	18	13	13	0
TWI_001_010	MR	111.24	0.174	0	0%	72	65%	29	26%	7	7%	3	2%	67	33	47	15	15	15	0
TWI_002_010	MR	12.24	0.019	0	0%	0	3%	7	59%	4	37%	0	1%	76	30	60	30	8	7	-1
TWI_003_010	MR	27.44	0.043	0	0%	0	0%	0	2%	27	98%	0	0%	80	56	65	9	6	6	0
TWI_004_010	MR	77.75	0.122	0	0%	8	11%	10	13%	60	77%	0	0%	77	80	80	0	10	10	0
TWI_004_020	MR	42.92	0.067	0	0%	34	80%	4	10%	4	10%	0	0%	64	63	69	7	7	7	0
TWI_004_030	MR	21.68	0.034	0	0%	10	48%	2	10%	9	42%	0	0%	70	35	50	15	4	4	0
RUS_RCO_001_010	RC1	101.70	0.159	0	0%	88	87%	0	0%	13	13%	0	0%	63	54	55	1	19	18	-1
RUS_RCO_002_010	RC1	111.56	0.174	0	0%	42	38%	44	39%	26	23%	0	0%	70	52	53	1	19	19	0
RUS_RCO_002_020	RC1	57.70	0.090	0	0%	15	25%	3	6%	40	69%	0	0%	75	50	50	0	12	12	0
RUS_RCO_010	RC1	69.60	0.109	0	0%	45	65%	8	11%	16	23%	0	0%	67	56	57	1	17	17	0
RUS_RCO_020	RC1	90.89	0.142	0	0%	48	53%	23	25%	20	22%	0	0%	68	59	65	5	11	11	0
RUS_RCO_030	RC1	82.01	0.128	0	0%	57	70%	8	10%	17	20%	0	0%	66	44	46	2	14	14	0
RUS_RCO_040	RC1	36.63	0.057	0	0%	16	42%	14	37%	8	21%	0	0%	70	50	50	0	11	11	0
RUS_RCO_050	RC1	84.98	0.133	0	0%	33	39%	21	25%	30	36%	0	0%	71	52	52	0	18	18	0
RUS_RCO_060	RC1	123.32	0.193	0	0%	49	39%	54	43%	7	6%	14	11%	72	53	55	2	20	19	-1
RUS_RCO_070	RC1	55.66	0.087	0	0%	34	61%	11	20%	10	18%	0	0%	67	62	67	6	9	9	0
RUS_RCO_080	RC1	48.51	0.076	0	0%	17	36%	2	5%	29	59%	0	0%	73	59	64	5	11	11	0
RUS_RCO_090	RC1	109.44	0.171	0	0%	55	50%	41	37%	14	13%	0	0%	68	57	59	2	21	21	0
RUS_RCO_100	RC1	34.89	0.055	0	0%	18	53%	16	45%	1	2%	0	0%	67	51	54	3	14	14	0
RUS_RCO_110	RC1	54.88	0.086	0	0%	32	59%	0	0%	23	41%	0	0%	69	63	63	0	12	12	0
RUS_RCO_120	RC1	109.92	0.172	0	0%	32	29%	51	46%	20	18%	7	6%	73	51	51	0	14	14	0
RUS_RCO_130	RC1	24.94	0.039	1	2%	1	3%	10	39%	14	56%	0	0%	76	46	47	1	12	12	0
RUS_RCO_140	RC1	46.75	0.073	8	17%	8	18%	15	31%	16	34%	0	0%	68	52	71	18	12	7	-5
RUS_RCO_150	RC1	39.91	0.062	35	87%	0	0%	0	0%	5	13%	0	0%	44	45	58	12	10	7	-3

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_TOA_010	RC1	105.76	0.165	0	0%	76	72%	2	2%	28	27%	0	0%	66	35	36	1	20	19	-1
RUS_TOA_020	RC1	74.43	0.116	0	0%	21	28%	17	23%	36	49%	0	0%	73	50	50	0	8	8	0
RUS_TOA_030	RC1	45.81	0.072	0	0%	22	49%	13	29%	10	22%	0	0%	69	48	48	0	15	15	0
RUS_TOA_040	RC1	39.09	0.061	0	0%	18	45%	7	18%	14	37%	0	0%	70	46	47	0	13	12	-1
RUS_TOA_050	RC1	107.96	0.169	0	0%	56	52%	0	0%	52	48%	0	0%	70	51	59	7	21	21	0
RUS_TOA_055	RC1	107.75	0.168	0	0%	53	49%	4	4%	51	47%	0	0%	70	65	74	9	31	29	-2
RUS_TOA_060	RC1	52.45	0.082	0	0%	21	41%	24	46%	7	13%	0	0%	69	47	61	14	19	18	-1
RUS_TOA_070	RC1	95.18	0.149	0	0%	5	5%	57	60%	33	35%	0	0%	75	39	46	7	18	18	0
RUS_TOA_080	RC1	156.21	0.244	0	0%	3	2%	76	49%	77	49%	0	0%	77	62	67	5	15	15	0
RUS_TOA_090	RC1	100.69	0.157	0	0%	18	18%	57	57%	25	25%	0	0%	73	51	68	16	14	9	-5
RUS_TOA_100	RC1	109.41	0.171	1	1%	43	40%	61	55%	4	4%	0	0%	69	54	63	9	10	10	0
RUS_000_010	UR	84.84	0.133	0	0%	0	0%	45	53%	40	47%	0	0%	77	12	72	60	29	20	-9
RUS_000_020	UR	78.66	0.123	0	0%	36	45%	2	2%	41	53%	0	0%	71	44	59	15	7	7	0
RUS_000_030	UR	70.31	0.110	0	0%	2	3%	30	42%	38	55%	0	0%	77	22	58	36	27	24	-3
RUS_000_040	UR	51.38	0.080	0	0%	0	0%	32	63%	19	37%	0	0%	76	35	66	30	12	10	-2
RUS_000_050	UR	87.61	0.137	0	0%	0	0%	48	55%	40	45%	0	0%	77	40	52	11	13	13	0
RUS_000_060	UR	76.71	0.120	0	0%	0	0%	19	25%	57	75%	0	0%	78	34	56	21	12	5	-7
RUS_000_070	UR	38.12	0.060	0	0%	0	0%	2	5%	36	95%	0	0%	80	9	67	58	20	18	-2
RUS_000_080	UR	24.57	0.038	0	0%	0	0%	4	17%	20	83%	0	0%	79	39	49	10	17	16	-1
RUS_000_085	UR	52.59	0.082	0	0%	4	7%	1	3%	47	90%	0	0%	79	17	68	51	21	12	-9
RUS_000_090	UR	81.90	0.128	0	0%	2	3%	5	6%	75	92%	0	0%	79	12	66	54	19	17	-2
RUS_000_100	UR	71.48	0.112	0	0%	0	0%	0	0%	71	100%	0	0%	80	36	72	36	16	15	-1
RUS_000_110	UR	90.67	0.142	7	8%	13	14%	8	9%	63	69%	0	0%	74	20	66	46	16	14	-2
RUS_000_120	UR	16.75	0.026	3	17%	1	6%	0	0%	13	77%	0	0%	72	33	72	40	6	5	-1
RUS_000_130	UR	76.02	0.119	9	12%	16	22%	12	16%	39	51%	0	0%	70	54	60	7	12	12	0
RUS_000_140	UR	49.17	0.077	4	8%	29	59%	13	27%	3	7%	0	0%	64	34	53	20	14	13	-1
RUS_000_150	UR	45.29	0.071	10	22%	28	61%	0	0%	8	17%	0	0%	59	38	39	1	11	10	-1
RUS_000_160	UR	40.00	0.063	9	23%	12	29%	0	0%	19	48%	0	0%	65	40	40	0	6	6	0
RUS_000_170	UR	43.90	0.069	10	22%	18	40%	0	0%	16	37%	0	0%	63	38	38	0	11	11	0
RUS_000_180	UR	26.37	0.041	9	33%	0	0%	0	0%	18	67%	0	0%	67	21	44	22	9	9	0
RUS_016_010	UR	64.82	0.101	0	0%	0	0%	0	0%	65	100%	0	0%	80	48	55	7	11	11	0
RUS_016_020	UR	63.32	0.099	0	0%	0	0%	0	0%	63	100%	0	0%	80	73	73	0	12	12	0
RUS_016_030	UR	62.11	0.097	0	0%	0	0%	0	0%	62	100%	0	0%	80	49	68	19	6	6	0
RUS_016_040	UR	66.48	0.104	1	1%	0	0%	0	0%	66	99%	0	0%	79	41	53	12	5	5	0
RUS_017_010	UR	22.61	0.035	0	1%	6	24%	0	0%	17	75%	0	0%	75	27	38	12	9	9	0
RUS_018_010	UR	48.17	0.075	0	0%	0	0%	20	42%	28	58%	0	0%	78	24	61	37	15	14	-1
RUS_018_020	UR	83.21	0.130	0	0%	0	0%	34	41%	49	59%	0	0%	78	10	72	61	21	20	-1
RUS_018_030	UR	34.02	0.053	0	0%	6	18%	8	23%	20	59%	0	0%	75	20	60	39	15	7	-8
RUS_018_040	UR	104.39	0.163	7	6%	18	17%	6	6%	74	71%	0	0%	74	21	64	44	19	10	-9
RUS_018_050	UR	58.72	0.092	9	15%	29	50%	3	6%	17	29%	0	0%	64	38	54	16	15	15	0
RUS_019_010	UR	97.54	0.152	0	0%	0	0%	0	0%	98	100%	0	0%	80	25	74	49	19	17	-2
RUS_019_020	UR	42.19	0.066	1	3%	0	0%	0	0%	41	97%	0	0%	79	39	69	30	7	7	0
RUS_020_010	UR	102.82	0.161	0	0%	0	0%	27	27%	75	73%	0	0%	78	36	56	20	25	23	-2
RUS_020_020	UR	115.59	0.181	0	0%	0	0%	0	0%	116	100%	0	0%	80	29	71	42	29	26	-3
RUS_020_030	UR	71.22	0.111	0	0%	0	0%	0	0%	71	100%	0	0%	80	38	72	35	24	22	-2
RUS_020_040	UR	94.50	0.148	0	0%	0	0%	0	0%	95	100%	0	0%	80	20	69	49	19	18	-1

Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
RUS_FPT_010	UR	73.59	0.115	0	0%	0	0%	0	0%	74	100%	0	0%	80	41	58	17	8	8	0
RUS_FPT_020	UR	42.95	0.067	0	1%	0	0%	0	0%	43	99%	0	0%	80	37	43	5	8	7	-1
RUS_NET_010	UR	29.41	0.046	0	0%	0	0%	0	0%	29	100%	0	0%	80	42	65	23	6	6	0
RUS_NET_020	UR	46.69	0.073	1	2%	5	10%	0	0%	41	89%	0	0%	78	18	20	2	3	3	0
SUB_000_010	UR	80.66	0.126	0	0%	9	11%	34	43%	37	46%	0	0%	75	39	66	27	21	19	-2
SUB_000_020	UR	57.96	0.091	0	0%	54	92%	3	5%	2	3%	0	0%	62	15	41	26	11	10	-1
SUB_000_030	UR	22.77	0.036	0	1%	23	99%	0	0%	0	0%	0	0%	61	6	12	6	3	2	-1
SUB_000_040	UR	48.35	0.076	9	18%	25	51%	1	2%	14	28%	0	0%	63	6	24	18	12	12	0
SUB_000_050	UR	92.01	0.144	0	0%	7	7%	23	25%	62	67%	0	0%	77	33	66	33	25	22	-3
SUB_000_060	UR	100.61	0.157	0	0%	50	50%	23	22%	28	28%	0	0%	69	28	61	34	18	17	-1
SUB_000_070	UR	90.86	0.142	1	1%	70	77%	6	7%	14	15%	0	0%	64	10	54	44	19	17	-2
SUB_000_080	UR	24.34	0.038	4	16%	6	27%	2	7%	12	49%	0	0%	68	8	8	0	8	7	-1
SUB_000_090	UR	119.82	0.187	2	1%	19	16%	23	20%	76	63%	0	0%	75	8	39	31	26	23	-3
SUB_000_100	UR	81.51	0.127	1	1%	28	35%	0	0%	52	64%	0	0%	73	8	19	11	13	8	-5
SUB_000_110	UR	25.10	0.039	12	46%	6	26%	0	0%	7	29%	0	0%	56	6	6	0	8	8	0
SUB_000_115	UR	33.57	0.052	9	26%	16	47%	0	0%	9	27%	0	0%	60	9	32	23	10	9	-1
SUB_000_120	UR	131.30	0.205	1	1%	41	32%	24	18%	65	49%	0	0%	73	17	44	26	19	17	-2
SUB_000_130	UR	83.72	0.131	0	0%	39	47%	15	18%	29	35%	0	0%	70	26	55	28	17	16	-1
SUB_000_140	UR	84.94	0.133	0	0%	74	88%	8	9%	3	3%	0	0%	63	22	67	45	14	13	-1
SUB_000_150	UR	59.59	0.093	0	0%	20	34%	20	34%	19	32%	0	0%	72	6	57	50	13	6	-7
SUB_000_155	UR	37.43	0.058	1	3%	20	53%	0	1%	16	43%	0	0%	69	23	59	36	12	7	-5
SUB_000_160	UR	21.05	0.033	4	18%	14	64%	2	11%	1	7%	0	0%	60	6	73	67	9	4	-5
SUB_000_170	UR	92.62	0.145	4	4%	28	31%	23	25%	37	40%	0	0%	71	50	50	1	16	16	0
SUB_000_180	UR	54.74	0.086	11	20%	26	47%	18	33%	0	0%	0	0%	61	29	61	33	7	7	0
SUB_000_190	UR	73.49	0.115	5	7%	63	86%	2	3%	3	5%	0	0%	61	41	55	13	10	10	0
SUB_000_200	UR	82.97	0.130	0	0%	4	4%	12	15%	67	81%	0	0%	78	41	62	21	19	17	-2
SUB_000_210	UR	34.11	0.053	0	0%	16	46%	0	0%	18	54%	0	0%	71	14	71	57	9	8	-1
SUB_000_220	UR	118.42	0.185	0	0%	10	8%	23	20%	86	72%	0	0%	77	32	65	32	22	13	-9
SUB_000_230	UR	44.83	0.070	2	5%	0	0%	29	64%	14	31%	0	0%	74	14	65	50	11	11	0
SUB_000_240	UR	55.81	0.087	13	23%	2	3%	22	39%	20	35%	0	0%	68	21	63	42	7	7	0
SUB_000_250	UR	76.62	0.120	1	1%	48	63%	9	11%	19	25%	0	0%	67	44	50	6	13	13	0
SUB_000_260	UR	98.56	0.154	7	7%	19	19%	28	28%	45	46%	0	0%	72	27	55	27	11	11	0
SUB_000_270	UR	83.06	0.130	0	0%	48	57%	35	42%	1	1%	0	0%	66	24	27	3	15	13	-2
SUB_000_280	UR	55.00	0.086	7	13%	5	9%	11	19%	32	59%	0	0%	72	24	68	45	10	9	-1
SUB_000_290	UR	100.99	0.158	15	15%	23	23%	26	25%	38	37%	0	0%	68	25	64	39	8	8	0
SUB_000_300	UR	79.88	0.125	10	12%	56	70%	0	0%	14	18%	0	0%	62	35	57	21	11	11	0
SUB_001_001_010	UR	50.71	0.079	0	0%	0	0%	7	13%	44	87%	0	0%	79	46	53	7	16	8	-8
SUB_001_001_020	UR	13.14	0.021	0	0%	3	26%	9	66%	1	9%	0	0%	71	22	68	46	6	6	0
SUB_001_010	UR	65.94	0.103	0	0%	0	0%	0	0%	66	100%	0	0%	80	33	61	28	13	8	-5
SUB_001_020	UR	25.67	0.040	0	0%	0	0%	6	23%	20	77%	0	0%	79	37	58	21	4	4	0
SUB_002_010	UR	31.92	0.050	0	0%	1	2%	10	31%	21	67%	0	0%	78	23	39	16	6	5	-1
SUB_002_020	UR	18.11	0.028	0	1%	4	24%	5	29%	8	46%	0	0%	73	25	35	10	10	9	-1
SUB_003_010	UR	34.69	0.054	0	0%	23	67%	1	3%	11	30%	0	0%	67	33	60	27	10	10	0
SUB_003_020	UR	101.45	0.159	0	0%	57	56%	16	16%	28	28%	0	0%	68	36	64	29	13	12	-1
SUB_003_030	UR	96.22	0.150	0	0%	55	57%	34	35%	7	7%	0	0%	67	42	55	13	10	10	0
SUB_003_040	UR	107.96	0.169	0	0%	79	73%	11	11%	18	17%	0	0%	66	50	50	0	16	16	0

Appendix B-1

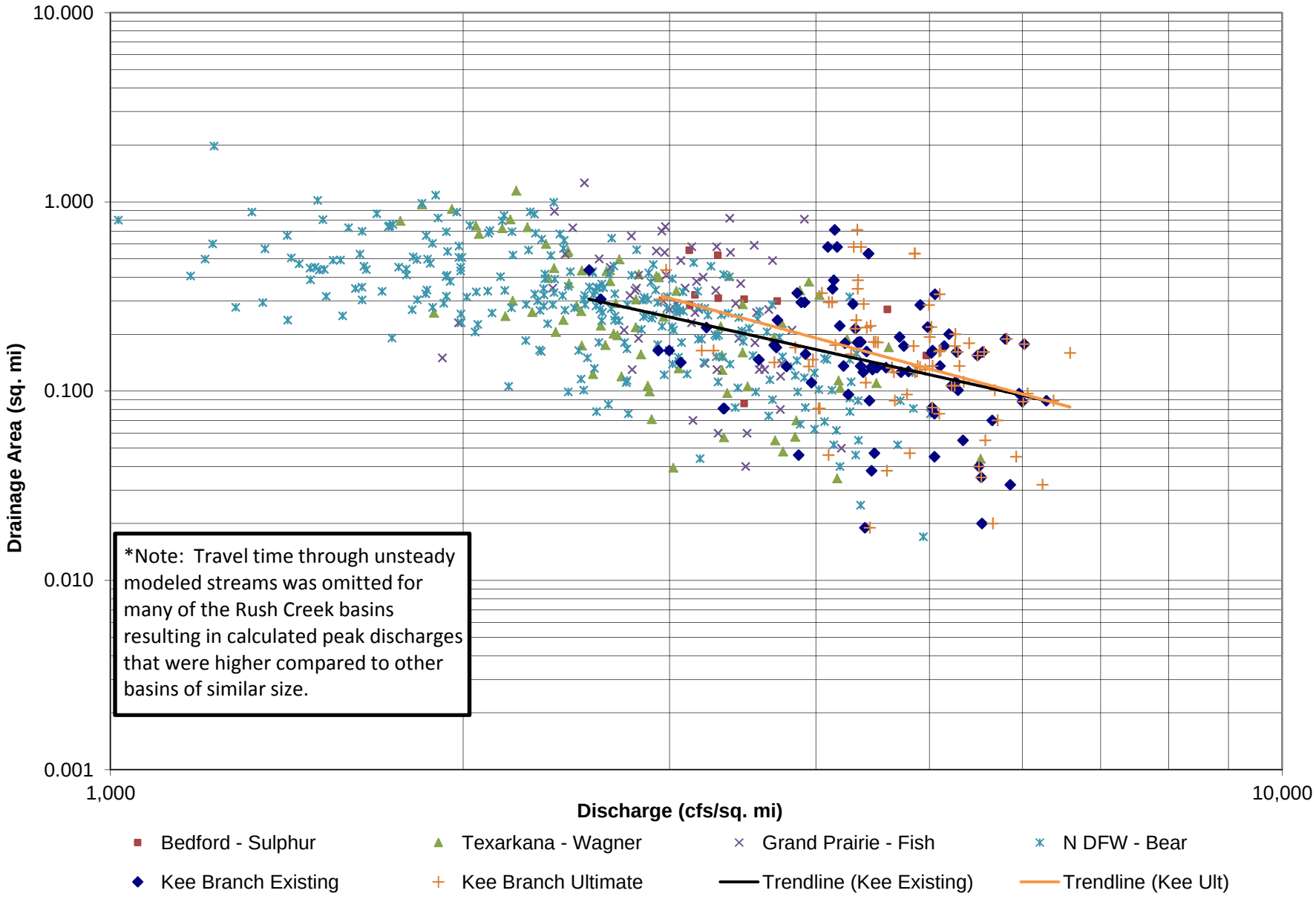
Rush Creek Sub-basin Summary

NAME	SUBWTRSHD	AREA	AREA	Area_A	Percent_A	Area_B	Percent_B	Area_C	Percent_C	Area_D	Percent_D	Area_Water	Percent_Wa	CN	EX_IMP	ULT_IMP	Difference	Existing Lag Time	Ultimate Lag Time	Difference
		Ac	SQ. MI.	Ac		Ac		Ac		Ac		Ac			%	%	%	Min	Min	Min
SUB_004_010	UR	50.88	0.080	0	0%	44	87%	6	12%	1	1%	0	0%	63	19	70	51	24	21	-3
SUB_004_020	UR	74.87	0.117	0	0%	68	91%	2	3%	4	5%	0	0%	62	22	74	52	15	14	-1
SUB_004_030	UR	42.07	0.066	0	0%	16	37%	14	34%	12	28%	0	0%	71	18	68	51	13	7	-6
SUB_004_040	UR	90.58	0.142	0	0%	57	63%	33	36%	1	1%	0	0%	66	11	74	64	23	21	-2
SUB_004_050	UR	72.87	0.114	0	0%	54	75%	11	15%	7	10%	0	0%	65	19	71	52	16	11	-5
SUB_004_060	UR	26.26	0.041	0	0%	5	20%	8	30%	13	50%	0	0%	74	68	72	4	13	12	-1
SUB_004_070	UR	83.44	0.130	0	0%	26	32%	3	3%	54	65%	0	0%	74	46	71	25	16	16	0
SUB_004_080	UR	60.12	0.094	0	0%	28	47%	32	52%	1	1%	0	0%	68	23	71	47	8	7	-1
SUB_004_090	UR	51.19	0.080	0	0%	32	63%	16	31%	3	5%	0	0%	66	21	69	48	13	10	-3
SUB_004_100	UR	21.95	0.034	0	0%	19	88%	3	12%	0	0%	0	0%	63	35	46	12	14	7	-7
SUB_004_110	UR	26.34	0.041	0	0%	20	75%	6	22%	1	3%	0	0%	64	49	67	17	24	22	-2
SUB_004_120	UR	62.68	0.098	1	1%	24	39%	27	44%	10	17%	0	0%	70	9	47	38	19	17	-2
SUB_004_130	UR	32.38	0.051	6	19%	22	67%	4	13%	0	0%	0	0%	59	5	48	43	13	8	-5

Appendix B-2
Discharge Comparisons

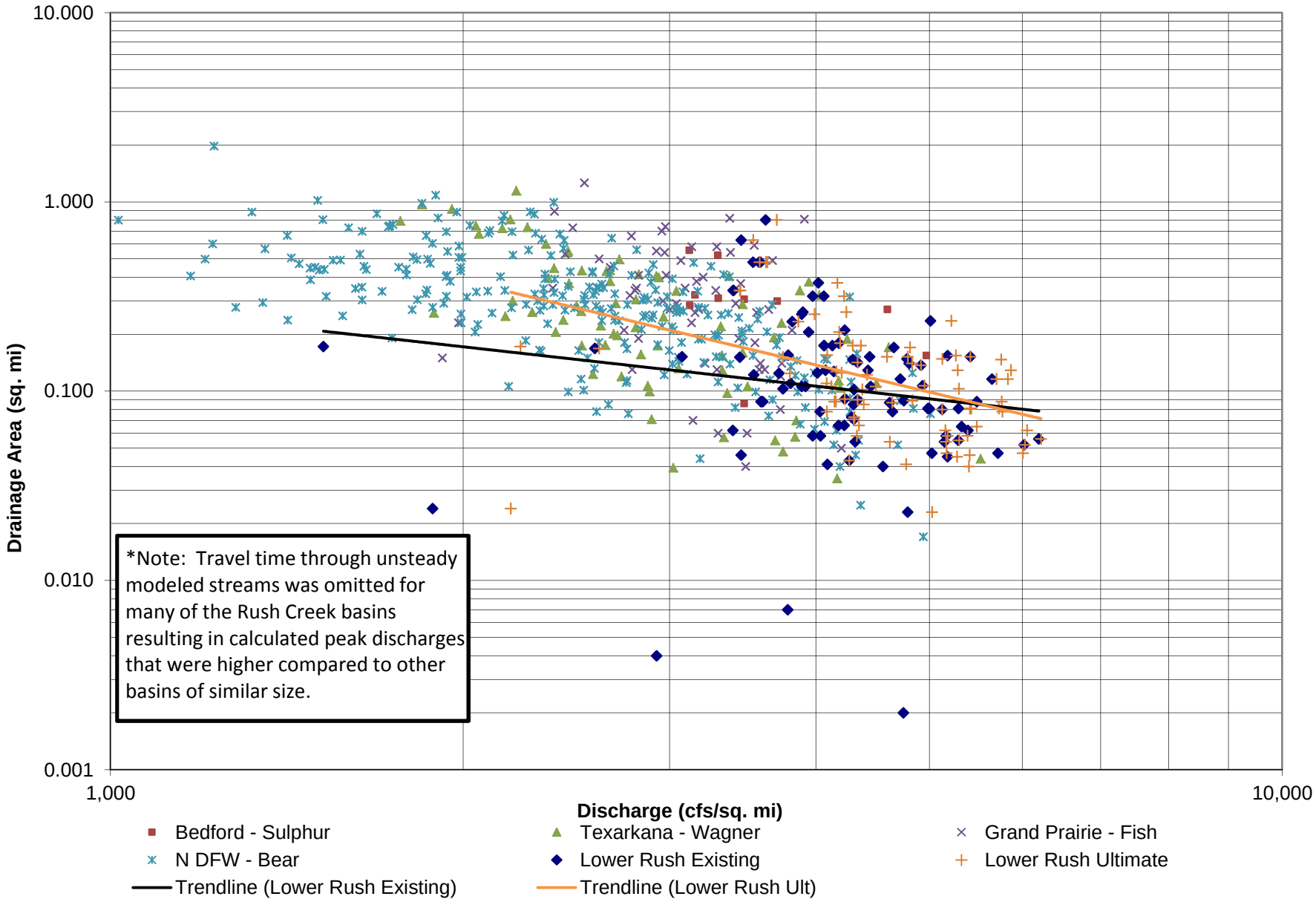
Discharge Comparison

100-Year Flood Peak with Regression Equation for Kee Branch



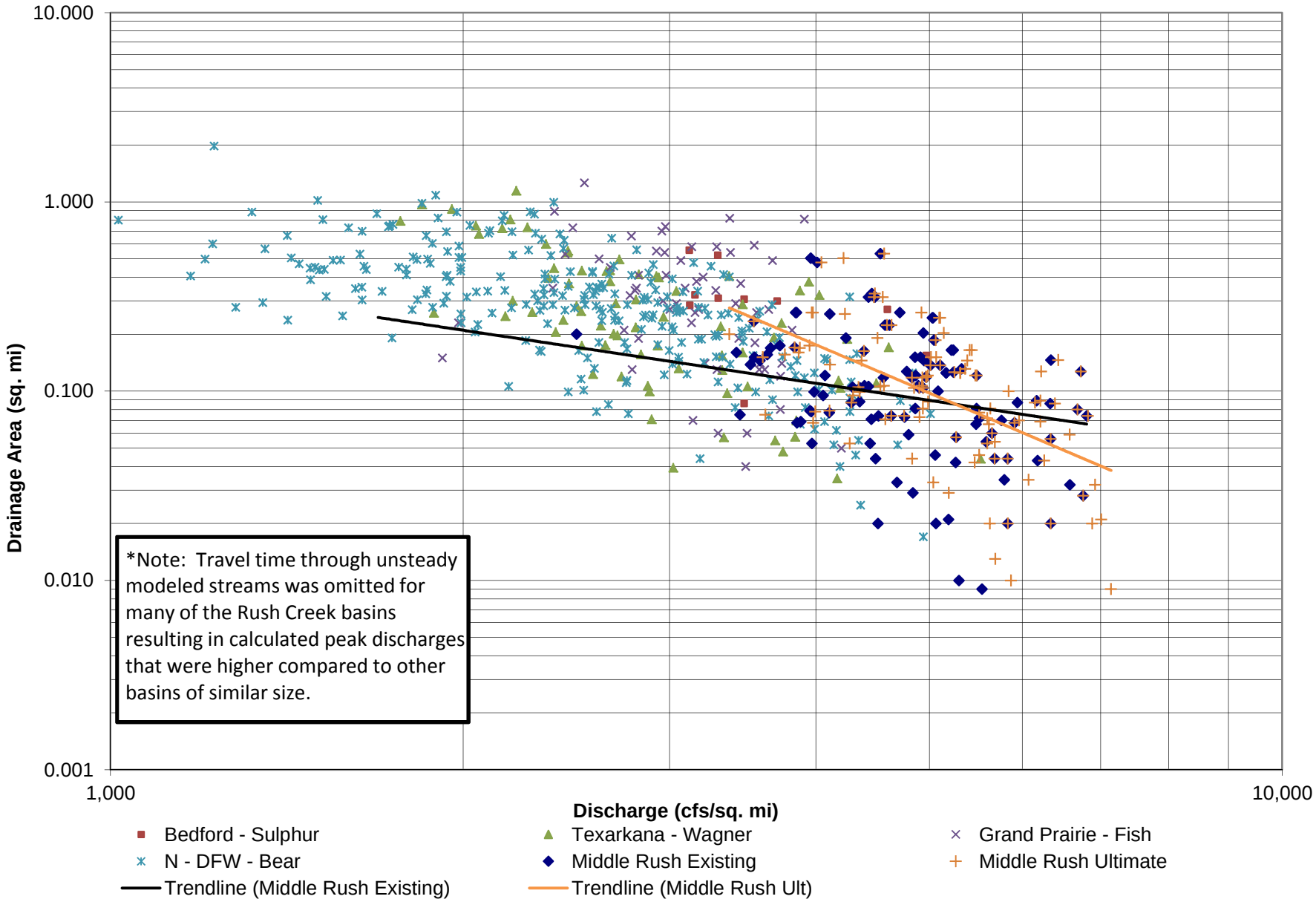
Discharge Comparison

100-Year Flood Peak with Regression Equation for Lower Rush



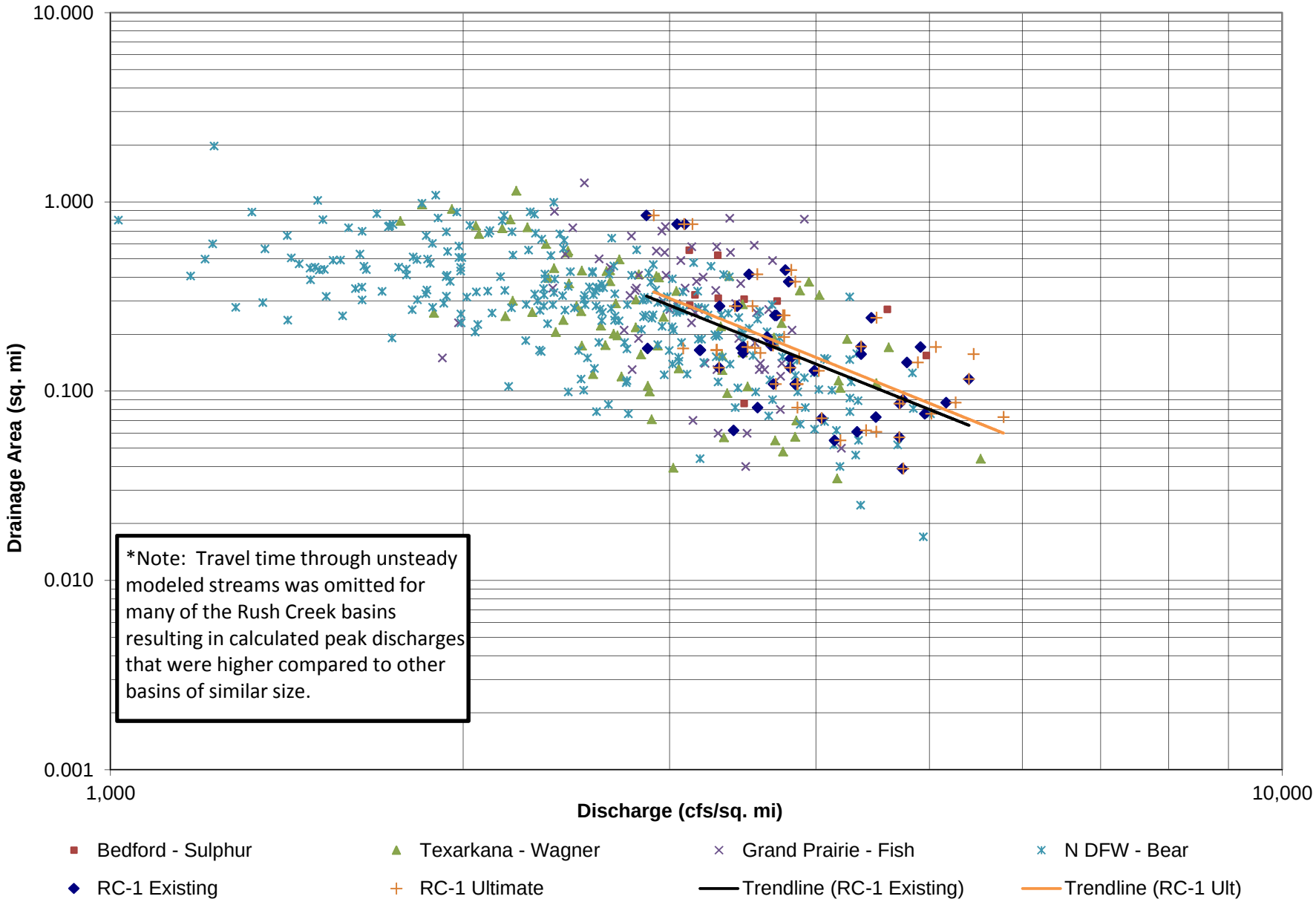
Discharge Comparison

100-Year Flood Peak with Regression Equation for Middle Rush

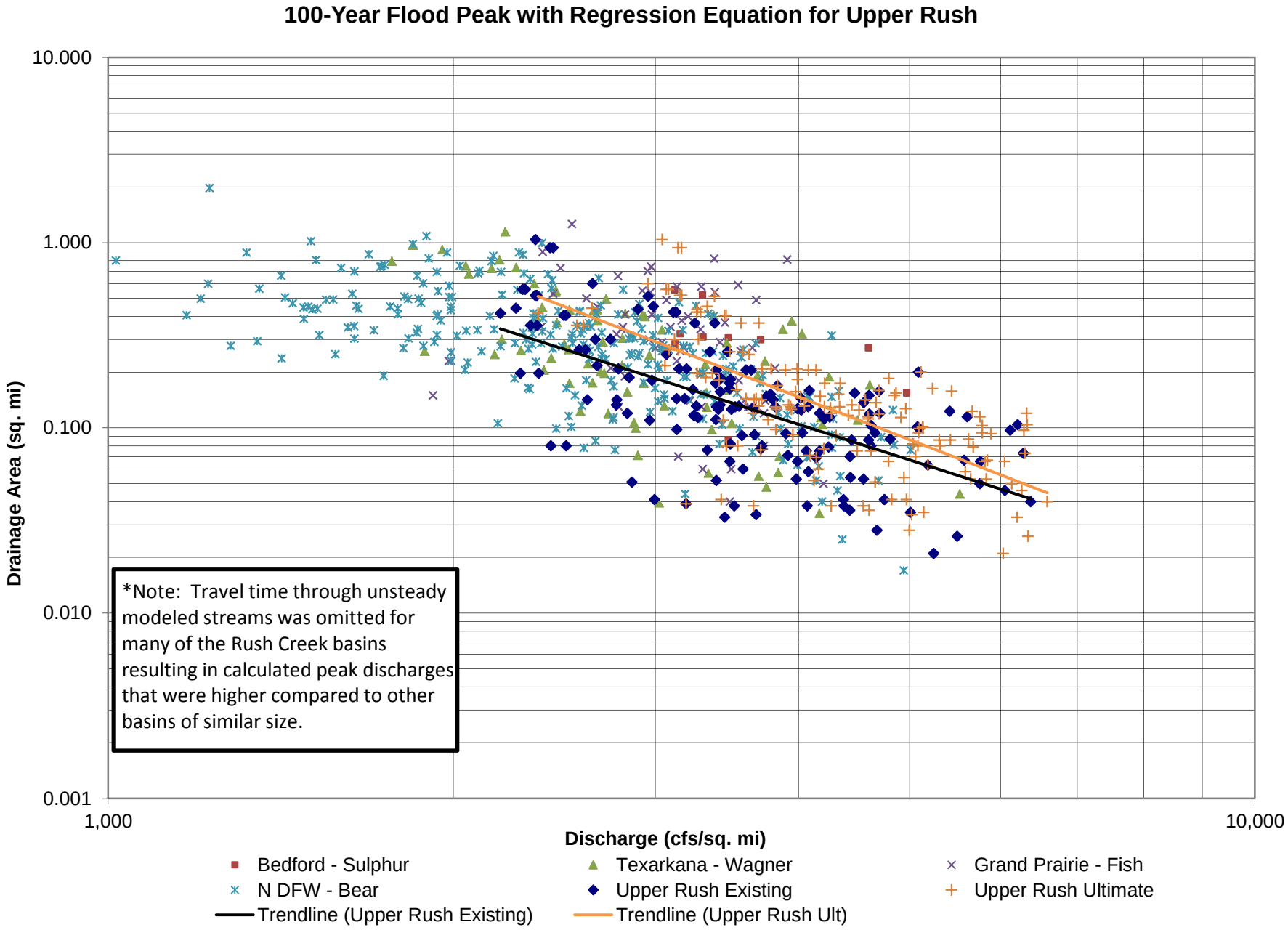


Discharge Comparison

100-Year Flood Peak with Regression Equation for RC-1

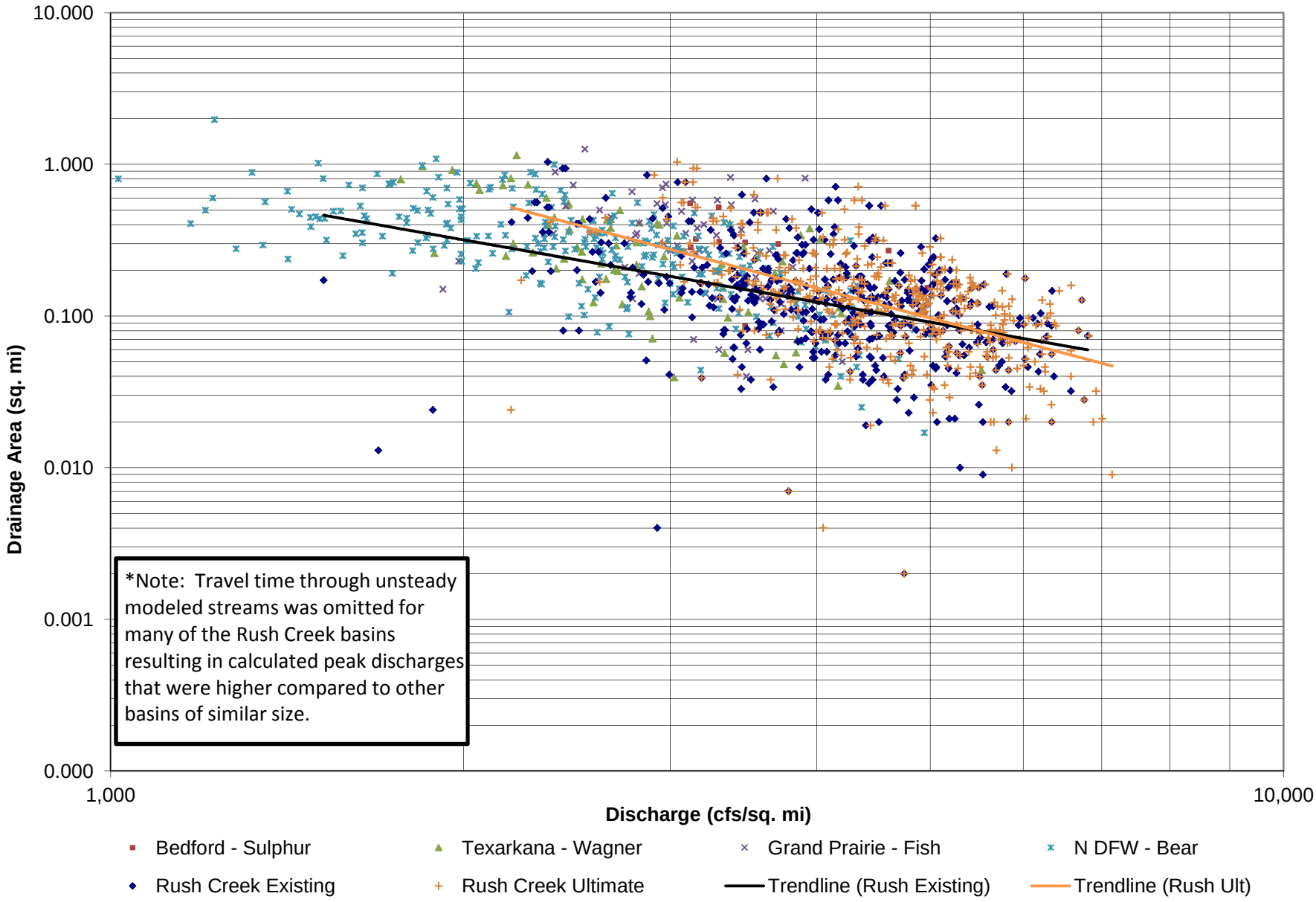


Discharge Comparison



Discharge Comparison

100-Year Flood Peak with Regression Equation for Rush Creek



Appendix B-3
Time of Concentration Calculations

Appendix B-3

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_000_010		3,087	100	0.150	Grass-Short Grass Prairie	4.900	3.95	6.2																		KEE_000_010	6.2	**25.9**	**0.43**
									832	0.921	1.55	Unpaved	8.96														9.0		
														2,155	0.675	4.8	15.0	0.045	1.28		1.28	28.11						28.1		
KEE_000_020		4,034	100	0.150	Grass-Short Grass Prairie	0.690	3.95	13.5																		KEE_000_020	13.5	**21.0**	**0.35**
									663	1.437	1.93	Unpaved	5.71														5.7		
														1,092	2.116	5.9	10.7	0.045	3.24		3.24	5.62						5.6		
														2,179	0.588				3.58	3.58	3.58	10.14						10.1		
KEE_000_030		2,234	54	0.150	Grass-Short Grass Prairie	2.034	3.95	5.4																		KEE_000_030	5.4	**12.3**	**0.21**
									641	0.772	1.79	Paved	5.98														6.0		
														1,538	1.048	5.5	7.4	0.045	2.78		2.78	9.23						9.2		
KEE_000_040		1,299	100	0.150	Grass-Short Grass Prairie	3.510	3.95	7.0																		KEE_000_040	7.0	**7.6**	**0.13**
									572	2.811	2.71	Unpaved	3.52														3.5		
														628	2.524	17.4	19.3	0.045	4.92		4.92	2.13						2.1		
KEE_000_050		1,757	100	0.150	Grass-Short Grass Prairie	2.962	3.95	7.5																		KEE_000_050	7.5	**9.7**	**0.16**
									417	2.557	2.58	Unpaved	2.69														2.7		
														1,241	2.807	5.4	10.7	0.045	3.52		3.52	5.87						5.9		
KEE_000_060		3,065	100	0.150	Grass-Short Grass Prairie	2.965	3.95	7.5																		KEE_000_060	7.5	**16.8**	**0.28**
									487	3.404	2.98	Unpaved	2.73														2.7		
									2,268	1.273	2.29	Paved	16.48														16.5		
														210	1.455	7.7	13.8	0.045	2.70		2.70	1.30						1.3		
KEE_000_070		3,566	100	0.150	Grass-Short Grass Prairie	11.424	3.95	4.4																		KEE_000_070	4.4	**16.9**	**0.28**
									2,853	1.794	2.16	Unpaved	22.00														22.0		
														613	1.330	17.9	5.4	0.065	5.89		5.89	1.73						1.7		
KEE_000_080		2,338	100	0.150	Grass-Short Grass Prairie	2.610	3.95	7.9																		KEE_000_080	7.9	**18.0**	**0.30**
									1,517	2.118	2.35	Unpaved	10.77														10.8		
														721	0.552	13.0	45.9	0.045	1.06		1.06	11.33						11.3		
KEE_000_090		3,947	100	0.150	Grass-Short Grass Prairie	2.650	3.95	7.9																		KEE_000_090	7.9	**13.5**	**0.22**
									60	5.609	3.82	Unpaved	0.26														0.3		
									742	3.436	3.77	Paved	3.28														3.3		
														1,214	1.388	8.5	10.4	0.045	3.42		3.42	5.92						5.9		
																							1,831	6	6.00	5.1		5.1		
KEE_000_100		1,777	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.017	3.95	0.8																		KEE_000_100	0.8	**6.6**	**0.11**
									695	0.674	1.67	Paved	6.94														6.9		
																							862	6	6.00	2.4		2.4		
														170	0.631	33.7	11.6	0.065	3.72		3.72	0.76						0.8		
KEE_000_110		3,519	100	0.150	Grass-Short Grass Prairie	5.080	3.95	6.1																		KEE_000_110	6.1	**12.5**	**0.21**
									1,546	2.758	2.68	Unpaved	9.62														9.6		
																							1,874	6	6.00	5.2		5.2		
KEE_000_120		4,341	100	0.150	Grass-Short Grass Prairie	2.208	3.95	8.5																		KEE_000_120	8.5	**13.0**	**0.22**
									94	3.605	3.06	Unpaved	0.51														0.5		
									818	2.235	3.04	Paved	4.49														4.5		
																							1,289	6	6.00	3.6		3.6		
														2,040	1.426	5.6	11.7	0.015	7.29		7.29	4.66						4.7		
KEE_000_130		3,538	100	0.150	Grass-Short Grass Prairie	6.001	3.95	5.7																		KEE_000_130	5.7	**10.9**	**0.18**
									627	3.096	2.84	Unpaved	3.68														3.7		
									459	2.576	3.26	Paved	2.34														2.3		
																							2,351	6	6.00	6.5		6.5		
KEE_000_140		1,799	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		KEE_000_140	15.4	**12.8**	**0.21**
									344	1.009	2.04	Paved	2.81														2.8		
																							552	6	6.00	1.5		1.5		
														803	0.768				8.33	8.33	8.33	1.61						1.6		
KEE_000_150		4,517	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.139	3.95	0.4																		KEE_000_150	0.4	**10.2**	**0.17**
									1,044	2.939	3.49	Paved	4.99														5.0		
																							1,498	6	6.00	4.2		4.2		
														443	0.875	6.0	10.5	0.015	6.37		6.37	1.16						1.2		
														1,482	1.334	17.1	16.4	0.045	3.93		3.93	6.28						6.3		
KEE_000_160		4,517	60	0.150	Grass-Short Grass Prairie	5.796	3.95	3.8																		KEE_000_160	3.8	**11.6**	**0.19**
									1,732	3.077	3.57	Paved	8.10														8.1		
																							2,518	6	6.00	7.0		7.0		
														208	0.525				7.26	7.26	7.26	0.48						0.5		
KEE_000_170		2,524	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.440	3.95	0.4																		KEE_000_170	0.4	**13.0**	**0.22**
														2,474	0.860	11.8	23.5	0.045	1.94		1.94	21.25						21.3		
KEE_000_180		2,661	100	0.150	Grass-Short Grass Prairie	1.856	3.95	9.1																		KEE_000_180	9.1	**17.5**	**0.29**
									1,466	1.436	1.93	Unpaved	12.64														12.6		
														1,095	1.316	7.7	14.7	0.045	2.47		2.47	7.39						7.4		
KEE_000_190		2,588	100	0.150	Grass-Short Grass Prairie	7.600	3.95	5.2																		KEE_000_190	5.2	**7.9**	**0.13**
									993	4.530	4.33	Paved	3.83														3.8		
																							1,495	6	6.00	4.2		4.2		
KEE_000_200		3,249	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.191	3.95	0.8																		KEE_000_200	0.8	**6.6**	**0.11**
									398	1.732	2.68	Paved	2.48														2.5		
																							2,801	6	6.00	7.8		7.8		
KEE_000_210		1,254	100	0.150	Grass-Short Grass Prairie	4.450	3.95	6.4																		KEE_000_210	6.4	**6.5**	**0.11**
									1,023	4.303	4.22	Paved	4.04														4.0		
																							131	6	6.00	0.4		0.4		
KEE_000_220		5,107	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.505	3.95	1.1																		KEE_000_220	1.1	**9.6**	**0.16**
									325	2.255	3.05	Paved	1.77														1.8		
																							2,301	6	6.00	6.4		6.4		
														530	0.952	22.7	11.2	0.050	4.67		4.67	1.89						1.9		
														310	2.812	2.7	4.6	0.015	11.70		11.70	0.44						0.4		
																							1,592	6	6.00	4.4		4.4		
KEE_000_230		3,201	100	0.150	Grass-Short Grass Prairie	5.898	3.95	5.7																		KEE_000_230	5.7	**10.2**	**0.17**
									279	2.645	3.31	Paved	1.41														1.4		
														1,817	2.361	1.3	7.3	0.015	4.89		4.89	6.20						6.2		

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							286	6	6.00	0.8		0.8		
																												2.9		
KEE_000_240		2,832	100	0.150	Grass-Short Grass Prairie	4.426	3.95	6.4						720	1.506	16.8	9.2	0.065	4.19		4.19	2.87					KEE_000_240	6.4	**12.3**	**0.20**
									756	3.744	3.12	Unpaved	4.04														4.0		
									1,590	2.170	2.99	Paved	8.85														8.8		
																							109	6	6.00	0.3		0.3		
														277	2.964	23.3	14.1	0.065	5.52		5.52	0.84						0.8		
KEE_000_250		3,233	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.220	3.95	0.4																			KEE_000_250	0.4	**6.6**	**0.11**
									1,454	4.093	4.11	Paved	5.89														5.9		
																							1,729	6	6.00	4.8		4.8		
KEE_000_260		4,376	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.026	3.95	0.4																			KEE_000_260	0.4	**9.9**	**0.16**
									2,638	3.363	3.73	Paved	11.79														11.8		
																							144	6	6.00	0.4		0.4		
														1,545	1.122				6.71	6.71	6.71	3.84						3.8		
KEE_000_270		3,616	50	0.150	Grass-Short Grass Prairie	0.500	3.95	8.8																			KEE_000_270	8.8	**12.7**	**0.21**
														3,313	2.212	15.0	16.0	0.045	4.71		4.71	11.72						11.7		
																							253	6	6.00	0.7		0.7		
KEE_000_280		3,496	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.999	3.95	0.8																			KEE_000_280	0.8	**6.4**	**0.11**
									69	0.795	1.81	Paved	0.63														0.6		
																							1,688	6	6.00	4.7		4.7		
														452	2.424	1.5	3.5	0.015	8.72		8.72	0.86						0.9		
																							678	6	6.00	1.9		1.9		
														558	2.041	7.7	5.5	0.050	5.33		5.33	1.75						1.7		
KEE_000_290		2,617	100	0.150	Grass-Short Grass Prairie	1.000	3.95	11.6																			KEE_000_290	11.6	**14.1**	**0.24**
									733	1.173	1.75	Unpaved	6.99														7.0		
																							1,784	6	6.00	5.0		5.0		
KEE_000_300		3,375	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.367	3.95	0.6																			KEE_000_300	0.6	**9.7**	**0.16**
									780	1.743	2.68	Paved	4.84														4.8		
																							505	6	6.00	1.4		1.4		
									1,065	1.768	2.70	Paved	6.57														6.6		
																							976	6	6.00	2.7		2.7		
KEE_000_310		2,056	100	0.150	Grass-Short Grass Prairie	10.600	3.95	4.5																			KEE_000_310	4.5	**8.5**	**0.14**
									1,744	2.453	3.18	Paved	9.13														9.1		
																							212	6	6.00	0.6		0.6		
KEE_000_320		5,147	60	0.150	Grass-Short Grass Prairie	7.099	3.95	3.5																			KEE_000_320	3.5	**16.4**	**0.27**
									1,321	1.910	2.81	Paved	7.84														7.8		
									1,642	1.903	2.23	Unpaved	12.30														12.3		
														1,946	2.147	1.0	1.8	0.015	9.78		9.78	3.32						3.3		
														177	2.605	56.7	16.6	0.065	8.38		8.38	0.35						0.4		
KEE_000_330		1,743	100	0.150	Grass-Short Grass Prairie	1.485	3.95	9.9																			KEE_000_330	9.9	**9.4**	**0.16**
														1,643	3.018	8.0	10.5	0.045	4.79		4.79	5.71						5.7		
KEE_000_340		2,174	30	0.150	Grass-Short Grass Prairie	2.694	3.95	3.0																			KEE_000_340	3.0	**7.7**	**0.13**
									738	1.273	2.29	Paved	5.36														5.4		
														1,228	3.625	4.1	6.6	0.045	4.62		4.62	4.43						4.4		
KEE_001_010		3,375	100	0.150	Grass-Short Grass Prairie	6.151	3.95	5.6						178	11.612	16.9	6.3	0.065									KEE_001_010	5.6	**10.4**	**0.17**
									1,063	3.256	3.67	Paved	4.83														4.8		
														218	1.637	1.5	4.7	0.045	1.99		1.99	1.83						1.8		
														526	0.799	7.8	7.9	0.015	8.81		8.81	1.00						1.0		
																							1,468	6	6.00	4.1		4.1		
KEE_001_020		1,554	100	0.150	Grass-Short Grass Prairie	3.210	3.95	7.3																			KEE_001_020	7.3	**7.7**	**0.13**
									867	3.248	3.66	Paved	3.94														3.9		
																							100	6	6.00	0.3		0.3		
														486	2.993	54.2	30.5	0.065	5.82		5.82	1.39						1.4		
KEE_001_030		1,340	100	0.150	Grass-Short Grass Prairie	4.670	3.95	6.3																			KEE_001_030	6.3	**7.4**	**0.12**
									634	2.329	2.46	Unpaved	4.29														4.3		
														606	1.393	15.4	8.3	0.045	5.92		5.92	1.71						1.7		
KEE_002_010		2,469	100	0.150	Grass-Short Grass Prairie	1.870	3.95	9.1																			KEE_002_010	9.1	**10.7**	**0.18**
									626	3.214	2.89	Unpaved	3.61														3.6		
														655	3.682	12.2	9.4	0.065	5.22		5.22	2.09						2.1		
																							1,088	6	6.00	3.0		3.0		
KEE_002_020		1,349	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			KEE_002_020	15.4	**12.9**	**0.22**
									179	1.891	2.22	Unpaved	1.34														1.3		
									465	1.488	2.48	Paved	3.13														3.1		
																							605	6	6.00	1.7		1.7		
KEE_004_010		3,383	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.300	3.95	0.7																			KEE_004_010	0.7	**13.5**	**0.22**
									2,242	1.156	2.19	Paved	17.10														17.1		
														314	1.003	3.9	5.6	0.015	7.88		7.88	0.66						0.7		
									311	0.665	1.66	Paved	3.13														3.1		
														466	1.303	4.5	6.3	0.015	9.02		9.02	0.86						0.9		
KEE_004_020		3,028	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.630	3.95	0.7																			KEE_004_020	0.7	**6.9**	**0.12**
									1,199	2.240	3.04	Paved	6.57														6.6		
																							1,066	6	6.00	3.0		3.0		
														713	0.635				9.01	9.01	9.01	1.32						1.3		
KEE_004_030		3,428	100	0.150	Grass-Short Grass Prairie	1.682	3.95	9.5																			KEE_004_030	9.5	**15.6**	**0.26**
									546	2.474	2.54	Unpaved	3.59														3.6		
									1,024	1.090	2.12	Paved	8.04														8.0		
																							1,757	6	6.00	4.9		4.9		
KEE_004_040		1,473	87	0.150	Grass-Short Grass Prairie	3.045	3.95	6.7																			KEE_004_040	6.7	**7.1**	**0.12**
									138	2.116	2.35	Unpaved	0.98														1.0		
									170	1.563	2.54	Paved	1.11														1.1		
																							1,078	6	6.00	3.0		3.0		
KEE_004_050		1,412	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.520	3.95	0.7																			KEE_004_050	0.7	**3.9**	**0.06**
									894	2.662	3.32	Paved	4.49														4.5		
																							468	6	6.00	1.3		1.3		
KEE_005_010		3,260	100	0.150	Grass-Short Grass Prairie	2.370	3.95	8.2																			KEE_005_010	8.2	**11.7**	**0.20**
									404	1.556	2.01	Unpaved	3.35														3.3		
														483	2.007	58.5	23.7	0.065	5.94		5.94	1.36						1.4		
														463	0.970	84.0	38.7	0.050	4.93		4.93	1.57						1.6		
																							1,811	6	6.00	5.0		5.0		

Appendix B-3

Kee Branch Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_005_020		3,664	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.000	3.95	0.8																		KEE_005_020	0.8	**7.9**	**0.13**
														906	1.467	29.3	31.9	0.045	3.80		3.80	3.98						4.0		
																							867	6	6.00	2.4		2.4		
														1,840	1.124	30.1	17.2	0.045	5.09		5.09	6.03						6.0		
KEE_005_030		3,020	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.980	3.95	0.5																		KEE_005_030	0.5	**10.5**	**0.18**
									305	1.304	2.32	Paved	2.19														2.2		
									774	1.280	1.83	Unpaved	7.07														7.1		
																							589	6	6.00	1.6		1.6		
														802	0.753	10.3	6.1	0.065	2.83		2.83	4.72						4.7		
																							500	6	6.00	1.4		1.4		
KEE_005_040		1,614	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.500	3.95	0.7																		KEE_005_040	0.7	**3.7**	**0.06**
									1,171	4.716	4.41	Paved	4.42														4.4		
																							393	6	6.00	1.1		1.1		
KEE_KB1_001_010		2,967	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.847	3.95	0.6																		KEE_KB1_001_010	0.6	**5.9**	**0.10**
									453	2.351	3.12	Paved	2.42														2.4		
																							2,464	6	6.00	6.8		6.8		
KEE_KB1_001_020		2,885	100	0.150	Grass-Short Grass Prairie	4.280	3.95	6.5																		KEE_KB1_001_020	6.5	**10.1**	**0.17**
									94	4.891	3.57	Unpaved	0.44														0.4		
									629	1.486	2.48	Paved	4.23														4.2		
														97	1.107	5.9	10.5	0.015	7.14		7.14	0.23						0.2		
																							237	6	6.00	0.7		0.7		
														451	0.747	2.9	3.5	0.015	7.46		7.46	1.01						1.0		
														532	1.340				5.50	5.50	5.50	1.61						1.6		
														426	1.319				9.20	9.20	9.20	0.77						0.8		
														318	1.195				3.90	3.90	3.90	1.36						1.4		
KEE_KB1_001_030		696	100	0.150	Grass-Short Grass Prairie	3.406	3.95	7.1																		KEE_KB1_001_030	7.1	**5.9**	**0.10**
									596	5.342	3.73	Unpaved	2.66														2.7		
KEE_KB1_010		3,559	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.067	3.95	0.8																		KEE_KB1_010	0.8	**6.2**	**0.10**
									647	5.107	4.59	Paved	2.35														2.3		
																							703	6	6.00	2.0		2.0		
														1,234	1.280	3.5	6.3	0.015	7.61		7.61	2.70						2.7		
																							925	6	6.00	2.6		2.6		
KEE_KB1_020		4,817	85	0.150	Grass-Short Grass Prairie	2.810	3.95	6.8																		KEE_KB1_020	6.8	**13.6**	**0.23**
									734	1.529	2.51	Paved	4.87														4.9		
																							3,998	6	6.00	11.1		11.1		
KEE_KB1_030		4,936	50	0.150	Grass-Short Grass Prairie	4.172	3.95	3.8																		KEE_KB1_030	3.8	**13.1**	**0.22**
									810	2.627	3.29	Paved	4.10														4.1		
																							129	6	6.00	0.4		0.4		
														2,566	1.746	8.7	9.0	0.045	4.26		4.26	10.03						10.0		
														232	1.415	1.6	2.7	0.015	8.34		8.34	0.46						0.5		
																							1,149	6	6.00	3.2		3.2		
KEE_KB1_040		3,426	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		KEE_KB1_040	0.9	**7.9**	**0.13**
									1,487	3.011	3.53	Paved	7.03														7.0		
																							1,890	6	6.00	5.3		5.3		
KEE_KB1_050		2,596	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.620	3.95	1.0																		KEE_KB1_050	1.0	**5.3**	**0.09**
														872	2.111	17.5	18.4	0.045	4.66		4.66	3.12						3.1		
																							1,674	6	6.00	4.7		4.7		
KEE_KB1_060		3,711	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.080	3.95	0.5																		KEE_KB1_060	0.5	**9.5**	**0.16**
									231	0.917	1.95	Paved	1.98														2.0		
									149	5.852	3.90	Unpaved	0.64														0.6		
														493	0.637	1.8	5.9	0.015	3.57		3.57	2.30						2.3		
														1,246	1.791	4.8	6.5	0.045	3.63		3.63	5.72						5.7		
														371	2.868	4.0	3.4	0.065	4.35		4.35	1.42						1.4		
																							1,171	6	6.00	3.3		3.3		

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
PAN_000_010		4,143	100	0.150	Grass-Short Grass Prairie	3.879	3.95	6.8																		PAN_000_010	6.8	**15.2**	**0.25**
									702	2.327	2.46	Unpaved	4.75														4.8		
									804	0.925	1.96	Paved	6.85														6.9		
																							2,535	6.00	6.00	7.0		7.0		
PAN_000_020		2,536	100	0.150	Grass-Short Grass Prairie	1.424	3.95	10.1																		PAN_000_020	10.1	**13.0**	**0.22**
									962	1.806	2.17	Unpaved	7.39														7.4		
																							1,474	6.00	6.00	4.1		4.1		
PAN_000_030		4,382	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		PAN_000_030	0.9	**11.6**	**0.19**
									1,377	0.938	1.97	Paved	11.66														11.7		
														2,352	0.667			0.015	7.63	7.63	7.63	5.14						5.1		
																							604	6.00	6.00	1.7		1.7		
PAN_000_040		4,196	100	0.150	Grass-Short Grass Prairie	6.914	3.95	5.4																		PAN_000_040	5.4	**12.9**	**0.22**
									113	8.527	4.71	Unpaved	0.40														0.4		
									1,282	1.628	2.59	Paved	8.24														8.2		
																							2,698	6.00	6.00	7.5		7.5		
PAN_000_050		4,121	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.571	3.95	1.0																		PAN_000_050	1.0	**10.5**	**0.18**
									491	0.544	1.50	Paved	5.46														5.5		
																							2,846	6.00	6.00	7.9		7.9		
														734	0.704			0.065	3.86	3.86	3.86	3.17						3.2		
PAN_000_060		6,759	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.284	3.95	0.5																		PAN_000_060	0.5	**14.4**	**0.24**
									1,691	2.112	2.95	Paved	9.54														9.5		
																							5,018	6.00	6.00	13.9		13.9		
PAN_000_070		5,912	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.579	3.95	1.0																		PAN_000_070	1.0	**11.4**	**0.19**
									732	2.560	3.25	Paved	3.75														3.8		
																							5,130	6.00	6.00	14.3		14.3		
PAN_000_080		2,612	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		PAN_000_080	1.1	**11.8**	**0.20**
									2,221	1.112	2.14	Paved	17.27														17.3		
														341	4.360	16.3	17.5	0.065	4.57		4.57	1.24						1.2		
PAN_000_090		5,232	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.011	3.95	0.6																		PAN_000_090	0.6	**13.5**	**0.23**
									854	0.500	1.44	Paved	9.90														9.9		
																							4,328	6.00	6.00	12.0		12.0		
PAN_000_100		2,042	100	0.150	Grass-Short Grass Prairie	0.748	3.95	13.1																		PAN_000_100	13.1	**15.4**	**0.26**
									258	0.786	1.43	Unpaved	3.01														3.0		
									1,685	2.054	2.91	Paved	9.64														9.6		
PAN_000_110		2,848	100	0.150	Grass-Short Grass Prairie	2.376	3.95	8.2																		PAN_000_110	8.2	**12.3**	**0.20**
									958	1.160	2.19	Paved	7.29														7.3		
																							1,790	6.00	6.00	5.0		5.0		
PAN_000_120		2,917	100	0.150	Grass-Short Grass Prairie	2.420	3.95	8.2																		PAN_000_120	8.2	**10.9**	**0.18**
									228	3.247	2.91	Unpaved	1.31														1.3		
									714	2.717	3.35	Paved	3.55														3.6		
																							1,876	6.00	6.00	5.2		5.2		
PAN_000_130		3,301	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.457	3.95	0.7																		PAN_000_130	0.7	**18.4**	**0.31**
									601	3.667	3.89	Paved	2.57														2.6		
														2,650	0.886	10.4	27.8	0.045	1.61		1.61	27.39						27.4		
RUS_000_360		3,176	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_360	1.1	**8.0**	**0.13**
									1,427	2.340	3.11	Paved	7.65														7.6		
																							1,497	6.00	6.00	4.2		4.2		
														202	8.113	17.4	14.8	0.065	7.28		7.28	0.46						0.5		
RUS_000_370		2,146	100	0.150	Grass-Short Grass Prairie	3.750	3.95	6.9																		RUS_000_370	6.9	**9.5**	**0.16**
									121	8.763	4.78	Unpaved	0.42														0.4		
														1,927	3.223	6.1	12.1	0.045	3.77		3.77	8.53						8.5		
RUS_000_380		674	100	0.150	Grass-Short Grass Prairie	4.730	3.95	6.2																		RUS_000_380	6.2	**5.0**	**0.08**
									573	7.984	4.56	Unpaved	2.09														2.1		
RUS_000_390		2,658	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_000_390	1.0	**11.0**	**0.18**
									1,257	0.579	1.55	Paved	13.54														13.5		
																							1,352	6.00	6.00	3.8		3.8		
RUS_000_400		1,435	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.646	3.95	1.0																		RUS_000_400	1.0	**3.1**	**0.05**
									478	5.274	4.67	Paved	1.71														1.7		
																							907	6.00	6.00	2.5		2.5		
RUS_000_410		4,837	100	0.150	Grass-Short Grass Prairie	3.876	3.95	6.8																		RUS_000_410	6.8	**12.9**	**0.22**
									1,216	3.291	3.69	Paved	5.50														5.5		
																							508	6.00	6.00	1.4		1.4		
														2,220	1.962	1.7	5.2	0.015	6.48		6.48	5.71						5.7		
																							791	6.00	6.00	2.2		2.2		
RUS_000_420		2,655	50	0.150	Grass-Short Grass Prairie	1.100	3.95	6.4																		RUS_000_420	6.4	**8.8**	**0.15**
									375	2.429	3.17	Paved	1.97														2.0		
																							2,231	6.00	6.00	6.2		6.2		
RUS_000_430		1,770	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.928	3.95	0.4																		RUS_000_430	0.4	**4.3**	**0.07**
									1,220	3.529	3.82	Paved	5.32														5.3		
																							501	6.00	6.00	1.4		1.4		
RUS_000_440		391	100	0.150	Grass-Short Grass Prairie	3.155	3.95	7.3																		RUS_000_440	7.3	**5.5**	**0.09**
									287	2.680	2.64	Unpaved	1.81														1.8		
RUS_000_450		5,802	100	0.150	Grass-Short Grass Prairie	1.109	3.95	11.2																		RUS_000_450	11.2	**21.1**	**0.35**
									879	0.722	1.37	Unpaved	10.69														10.7		
																							4,822	6.00	6.00	13.4		13.4		
RUS_000_460		2,409	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.526	3.95	1.1																		RUS_000_460	1.1	**7.6**	**0.13**
									653	0.621	1.60	Paved	6.79														6.8		
																							1,707	6.00	6.00	4.7		4.7		

Appendix B-3

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_470														1,965	0.500	100.4	58.2	0.050	3.03		3.03	10.80					RUS_000_470	10.8	**6.5**	**0.11**
RUS_000_480														297	0.500	104.1	60.6	0.065	2.32		2.32	2.13					RUS_000_480	10.0	**6.0**	**0.10**
RUS_000_500		856												856	1.719	140.3	36.4	0.065	7.39		7.39	1.93					RUS_000_500	10.0	**6.0**	**0.10**
RUS_000_510		3,401	50	0.150	Grass-Short Grass Prairie	3.981	3.95	3.8																			RUS_000_510	3.8	**10.5**	**0.18**
									1,647	4.446	4.29	Paved	6.40															6.4		
														1,704	1.624	2.5	2.8	0.045	3.89		3.89	7.30						7.3		
RUS_000_520		689	100	0.150	Grass-Short Grass Prairie	1.650	3.95	9.5																			RUS_000_520	9.5	**8.0**	**0.13**
									589	2.603	2.60	Unpaved	3.77															3.8		
RUS_000_530		5,641	100	0.150	Grass-Short Grass Prairie	7.835	3.95	5.1																			RUS_000_530	5.1	**40.9**	**0.68**
									3,227	0.500	1.14	Unpaved	47.14															47.1		
														2,315	0.500	105.9	58.3	0.065	2.41		2.41	15.99						16.0		
RUS_003_010		2,458	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.628	3.95	1.0																			RUS_003_010	1.0	**5.7**	**0.10**
									731	2.369	3.13	Paved	3.89															3.9		
																							1,676	6.00	6.00	4.7		4.7		
RUS_003_020		3,664	98	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.191	3.95	1.0																			RUS_003_020	1.0	**7.8**	**0.13**
									740	2.179	3.00	Paved	4.11															4.1		
																							2,826	6.00	6.00	7.9		7.9		
RUS_004_001_010		2,717	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.713	3.95	0.9																			RUS_004_001_010	0.9	**14.8**	**0.25**
														2,666	0.585	9.2	14.4	0.045	1.88		1.88	23.68						23.7		
RUS_004_001_020		2,250	100	0.150	Grass-Short Grass Prairie	5.307	3.95	6.0																			RUS_004_001_020	6.0	**8.7**	**0.14**
									560	2.970	2.78	Unpaved	3.36															3.4		
														455	1.358	8.0	10.2	0.045	3.27		3.27	2.32						2.3		
														1,135	0.777			0.065	6.66	6.66	6.66	2.84						2.8		
RUS_004_001_030		2,222	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.375	3.95	0.7																			RUS_004_001_030	0.7	**5.1**	**0.09**
														891	3.344	5.5	13.7	0.045	3.29		3.29	4.52						4.5		
														1,278	2.228			0.065	6.43	6.43	6.43	3.31						3.3		
RUS_004_001_040		592	100	0.150	Grass-Short Grass Prairie	5.366	3.95	5.9																			RUS_004_001_040	5.9	**4.5**	**0.08**
									494	10.075	5.12	Unpaved	1.61															1.6		
RUS_004_010		3,537	77	0.150	Grass-Short Grass Prairie	3.850	3.95	5.5																			RUS_004_010	5.5	**15.3**	**0.26**
									100	2.405	2.50	Unpaved	0.67															0.7		
									614	0.914	1.94	Paved	5.27															5.3		
																							515	6.00	6.00	1.4		1.4		
														2,231	0.537	23.8	17.9	0.045	2.94		2.94	12.65						12.7		
RUS_004_020		2,424	100	0.150	Grass-Short Grass Prairie	1.256	3.95	10.6																			RUS_004_020	10.6	**20.1**	**0.33**
									1,076	0.506	1.15	Unpaved	15.63															15.6		
														1,246	0.850	8.3	9.0	0.045	2.89		2.89	7.19						7.2		
RUS_004_030		1,793	49	0.150	Grass-Short Grass Prairie	1.391	3.95	5.8																			RUS_004_030	5.8	**11.5**	**0.19**
									1,188	1.434	1.93	Unpaved	10.25															10.2		
														556	0.500			0.055	2.87	2.87	2.87	3.23						3.2		
RUS_004_040		1,909	100	0.150	Grass-Short Grass Prairie	2.384	3.95	8.2																			RUS_004_040	8.2	**14.2**	**0.24**
									726	0.500	1.14	Unpaved	10.61															10.6		
														1,084	3.061			0.045	3.73	3.73	3.73	4.84						4.8		
RUS_004_050		2,011	100	0.150	Grass-Short Grass Prairie	3.174	3.95	7.3																			RUS_004_050	7.3	**8.9**	**0.15**
									596	3.614	3.07	Unpaved	3.24															3.2		
									638	1.985	2.86	Paved	3.71															3.7		
														677	2.910	311.4	137.2	0.024	18.29		18.29	0.62						0.6		
RUS_005_002_010		3,287	60	0.150	Grass-Short Grass Prairie	9.203	3.95	3.2																			RUS_005_002_010	3.2	**8.9**	**0.15**
									1,438	3.112	3.59	Paved	6.68															6.7		
																							1,789	6.00	6.00	5.0		5.0		
RUS_005_010		3,228	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.900	3.95	0.6																			RUS_005_010	0.6	**9.7**	**0.16**
									1,760	1.571	2.55	Paved	11.51															11.5		
																							1,417	6.00	6.00	3.9		3.9		
RUS_005_020		1,426	56	0.150	Grass-Short Grass Prairie	8.478	3.95	3.1																			RUS_005_020	3.1	**6.5**	**0.11**
									755	2.282	3.07	Paved	4.10															4.1		
									615	3.197	2.88	Unpaved	3.55															3.6		
RUS_005_030		3,299	81	0.150	Grass-Short Grass Prairie	1.329	3.95	8.8																			RUS_005_030	8.8	**13.4**	**0.22**
									1,672	2.126	2.96	Paved	9.40															9.4		
																							1,257	6.00	6.00	3.5		3.5		
														289	2.204	1.4	3.6	0.015	7.83		7.83	0.62						0.6		
RUS_005_040		1,121	100	0.150	Grass-Short Grass Prairie	4.480	3.95	6.4																			RUS_005_040	6.4	**7.7**	**0.13**
									804	1.240	2.26	Paved	5.92															5.9		
																							217	6.00	6.00	0.6		0.6		
RUS_005_050		4,115	100	0.150	Grass-Short Grass Prairie	5.308	3.95	6.0																			RUS_005_050	6.0	**14.4**	**0.24**
														2,095	1.936	1.9	4.0	0.045	2.76		2.76	12.67						12.7		
																							1,921	6.00	6.00	5.3		5.3		
RUS_005_060		1,894	100	0.150	Grass-Short Grass Prairie	3.446	3.95	7.1																			RUS_005_060	7.1	**12.3**	**0.20**
									1,441	0.916	1.95	Paved	12.34															12.3		
																							354	6.00	6.00	1.0		1.0		
RUS_005_070		671	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.864	3.95	0.9																			RUS_005_070	0.9	**2.6**	**0.04**
									621	2.199	3.01	Paved	3.43															3.4		
RUS_006_010		2,750	38	0.150	Grass-Short Grass Prairie	5.841	3.95	2.6																			RUS_006_010	2.6	**7.3**	**0.12**
									677	3.792	3.96	Paved	2.85															2.9		
														2,035	2.914	45.5	30.9	0.065	5.06		5.06	6.70						6.7		
RUS_RC2_010		4,624	100	0.150	Grass-Short Grass Prairie	5.259	3.95	6.0																			RUS_RC2_010	6.0	**13.6**	**0.23**
									1,085	2.477	2.54	Unpaved	7.12															7.1		
																							3,440	6.00	6.00	9.6		9.6		
RUS_RC2_020		3,281	49	0.150	Grass-Short Grass Prairie	3.496	3.95	4.0																			RUS_RC2_020	4.0	**10.0**	**0.17**
														1,238	2.750	3.3	8.5	0.045	2.90		2.90	7.11						7.1		
																							1,994	6.00	6.00	5.5		5.5		
RUS_RC2_030		2,943	100	0.150	Grass-Short Grass Prairie	3.122	3.95	7.4																			RUS_RC2_030	7.4	**11.5**	**0.19**
														1,631	1.945	4.2	7.2	0.045	3.21		3.21	8.46						8.5		
																							1,212	6.00	6.00	3.4		3.4		

Appendix B-3

Lower Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RC2_040		2,905	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_040	1.1	**9.0**	**0.15**
									1,470	1.426	2.43	Paved	10.09														10.1		
																							1,385	6.00	6.00	3.8		3.8		
RUS_RC2_050		3,579	100	0.150	Grass-Short Grass Prairie	4.446	3.95	6.4																		RUS_RC2_050	6.4	**13.2**	**0.22**
									398	2.553	2.58	Unpaved	2.57														2.6		
									963	1.234	2.26	Paved	7.11														7.1		
																							2,117	6.00	6.00	5.9		5.9		
RUS_RC2_060		3,143	65	0.150	Grass-Short Grass Prairie	8.975	3.95	3.4																		RUS_RC2_060	3.4	**8.3**	**0.14**
									860	4.128	4.13	Paved	3.47														3.5		
																							1,110	6.00	6.00	3.1		3.1		
														740	2.606	14.8	11.5	0.065	4.39		4.39	2.81						2.8		
																							369	6.00	6.00	1.0		1.0		
RUS_RC2_070		2,142	42	0.150	Grass-Short Grass Prairie	20.469	3.95	1.7																		RUS_RC2_070	1.7	**6.4**	**0.11**
									1,843	3.404	3.75	Paved	8.19														8.2		
																							257	6.00	6.00	0.7		0.7		
RUS_RC2_080		1,482	100	0.150	Grass-Short Grass Prairie	7.150	3.95	5.3																		RUS_RC2_080	5.3	**6.6**	**0.11**
									418	5.026	3.62	Unpaved	1.93														1.9		
									612	2.960	3.50	Paved	2.92														2.9		
														353	6.538	10.7	7.9	0.065	7.17		7.17	0.82						0.8		
RUS_RC2_085		2,259	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_085	1.1	**6.0**	**0.10**
									762	1.644	2.61	Paved	4.87														4.9		
																							1,448	6.00	6.00	4.0		4.0		
RUS_RC2_090		3,894	83	0.150	Grass-Short Grass Prairie	8.486	3.95	4.3																		RUS_RC2_090	4.3	**13.6**	**0.23**
									1,159	3.169	3.62	Paved	5.34														5.3		
																							238	6.00	6.00	0.7		0.7		
														1,893	1.779	19.5	21.2	0.065	2.90		2.90	10.89						10.9		
																							522	6.00	6.00	1.5		1.5		
RUS_RC2_100		2,889	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.922	3.95	0.6																		RUS_RC2_100	0.6	**6.9**	**0.12**
									1,351	2.673	3.32	Paved	6.77														6.8		
																							1,489	6.00	6.00	4.1		4.1		
RUS_RC2_110		1,928	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_RC2_110	1.1	**4.8**	**0.08**
									1,114	3.655	3.89	Paved	4.78														4.8		
																							764	6.00	6.00	2.1		2.1		
RUS_RCH_010		3,584	100	0.150	Grass-Short Grass Prairie	7.263	3.95	5.3																		RUS_RCH_010	5.3	**9.0**	**0.15**
														1,730	4.622	19.8	14.9	0.065	5.95		5.95	4.84						4.8		
																							1,755	6.00	6.00	4.9		4.9		
RUS_RCH_020		1,780	100	0.150	Grass-Short Grass Prairie	2.105	3.95	8.6																		RUS_RCH_020	8.6	**12.0**	**0.20**
									64	4.464	3.41	Unpaved	0.31														0.3		
									759	0.523	1.47	Paved	8.60														8.6		
																							855	6.00	6.00	2.4		2.4		
RUS_RCH_030		0		0.150	Grass-Short Grass Prairie	0.500																				RUS_RCH_030	10.0	**6.0**	**0.10**
RUS_RCH_040		1,724	100	0.150	Grass-Short Grass Prairie	1.610	3.95	9.6																		RUS_RCH_040	9.6	**13.7**	**0.23**
									798	0.721	1.73	Paved	7.71														7.7		
									826	2.342	2.47	Unpaved	5.57														5.6		
RUS_RCH_050		0		0.150	Grass-Short Grass Prairie	0.500																				RUS_RCH_050	10.0	**6.0**	**0.10**
RUS_RCH_060		2,902	100	0.150	Grass-Short Grass Prairie	10.150	3.95	4.6																		RUS_RCH_060	4.6	**8.5**	**0.14**
									471	3.547	3.04	Unpaved	2.58														2.6		
														2,331	0.500	1224.8	249.1	0.055	5.54		5.54	7.01						7.0		

Appendix B-3

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_190		3,167	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.910	3.95	0.6																		RUS_000_190	0.6	**10.7**	**0.18**
									1,512	0.949	1.98	Paved	12.73														12.7		
																						1,605	6.00	6.00	4.5		4.5		
RUS_000_200		1,447	100	0.150	Grass-Short Grass Prairie	1.039	3.95	11.5																		RUS_000_200	11.5	**10.8**	**0.18**
									1,348	4.474	3.41	Unpaved	6.58														6.6		
RUS_000_210		2,148	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.878	3.95	0.9																		RUS_000_210	0.9	**8.4**	**0.14**
									1,259	0.960	1.99	Paved	10.54														10.5		
																						420	6.00	6.00	1.2		1.2		
														417	3.442	31.0	24.1	0.065	5.03		5.03	1.38					1.4		
RUS_000_220		845	100	0.150	Grass-Short Grass Prairie	1.137	3.95	11.1																		RUS_000_220	11.1	**9.8**	**0.16**
									748	2.197	2.39	Unpaved	5.21														5.2		
RUS_000_230		1,908	45	0.150	Grass-Short Grass Prairie	3.872	3.95	3.6																		RUS_000_230	3.6	**6.8**	**0.11**
									1,391	3.055	3.55	Paved	6.52														6.5		
																						471	6.00	6.00	1.3		1.3		
RUS_000_240		1,677	100	0.150	Grass-Short Grass Prairie	1.499	3.95	9.9																		RUS_000_240	9.9	**9.5**	**0.16**
									205	3.455	3.00	Unpaved	1.14														1.1		
									221	1.293	2.31	Paved	1.59														1.6		
																						1,150	6.00	6.00	3.2		3.2		
RUS_000_250		754	100	0.150	Grass-Short Grass Prairie	5.941	3.95	5.7																		RUS_000_250	5.7	**4.9**	**0.08**
									655	7.526	4.43	Unpaved	2.47														2.5		
RUS_000_260		514	100	0.150	Grass-Short Grass Prairie	5.690	3.95	5.8																		RUS_000_260	5.8	**4.6**	**0.08**
									414	5.398	3.75	Unpaved	1.84														1.8		
RUS_000_270		3,893	100	0.150	Grass-Short Grass Prairie	1.409	3.95	10.1																		RUS_000_270	10.1	**18.2**	**0.30**
									752	1.894	2.22	Unpaved	5.64														5.6		
														1,417	2.138	10.5	18.3	0.065	2.31		2.31	10.22					10.2		
																						1,381	6.00	6.00	3.8		3.8		
														243	9.110	11.9	8.3	0.065	8.85		8.85	0.46					0.5		
RUS_000_280		1,435	50	0.150	Grass-Short Grass Prairie	10.595	3.95	2.6																		RUS_000_280	2.6	**6.6**	**0.11**
									1,004	1.550	2.53	Paved	6.61														6.6		
									380	4.793	3.53	Unpaved	1.79														1.8		
RUS_000_290		1,931	100	0.150	Grass-Short Grass Prairie	8.438	3.95	5.0																		RUS_000_290	5.0	**8.4**	**0.14**
									157	1.504	1.98	Unpaved	1.32														1.3		
														1,673	3.209	2.0	4.1	0.045	3.64		3.64	7.65					7.7		
RUS_000_300		2,275	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.076	3.95	0.6																		RUS_000_300	0.6	**4.4**	**0.07**
									37	3.386	3.74	Paved	0.16														0.2		
									118	3.832	3.16	Unpaved	0.62														0.6		
														2,068	3.722	1.3	7.4	0.015	5.86		5.86	5.89					5.9		
RUS_000_310		3,314	100	0.150	Grass-Short Grass Prairie	0.624	3.95	14.1																		RUS_000_310	14.1	**17.6**	**0.29**
														1,362	1.210	19.7	28.6	0.045	2.84		2.84	8.01					8.0		
																						407	6.00	6.00	1.1		1.1		
														1,142	1.393	62.0	39.7	0.065	3.64		3.64	5.23					5.2		
																						301	6.00	6.00	0.8		0.8		
RUS_000_320		3,334	100	0.150	Grass-Short Grass Prairie	4.808	3.95	6.2																		RUS_000_320	6.2	**10.7**	**0.18**
									193	8.064	4.58	Unpaved	0.70														0.7		
									538	1.977	2.86	Paved	3.14														3.1		
														328	1.141	6.8	7.9	0.045	3.23		3.23	1.69					1.7		
																						2,174	6.00	6.00	6.0		6.0		
RUS_000_330		3,501	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.668	3.95	0.6																		RUS_000_330	0.6	**16.2**	**0.27**
									1,910	0.530	1.48	Paved	21.51														21.5		
																						847	6.00	6.00	2.4		2.4		
														694	0.500	152.2	33.1	0.065	4.49		4.49	2.58					2.6		
RUS_000_340		2,466	100	0.150	Grass-Short Grass Prairie	5.297	3.95	6.0																		RUS_000_340	6.0	**11.6**	**0.19**
									861	4.878	3.56	Unpaved	4.03														4.0		
									691	3.183	3.63	Paved	3.18														3.2		
									814	1.818	2.18	Unpaved	6.24														6.2		
RUS_000_350		3,685	100	0.150	Grass-Short Grass Prairie	6.822	3.95	5.4																		RUS_000_350	5.4	**22.3**	**0.37**
									1,104	2.368	2.48	Unpaved	7.41														7.4		
														1,357	0.659	0.7	2.9	0.045	1.03		1.03	21.97					22.0		
																						590	6.00	6.00	1.6		1.6		
														535	4.495	70.0	89.0	0.024	11.21		11.21	0.80					0.8		
RUS_007_010		2,493	100	0.150	Grass-Short Grass Prairie	2.146	3.95	8.6																		RUS_007_010	8.6	**11.3**	**0.19**
									807	2.173	2.38	Unpaved	5.66														5.7		
														138	0.547	4.1	10.1	0.015	4.00		4.00	0.58					0.6		
																						1,448	6.00	6.00	4.0		4.0		
RUS_007_020		3,709	28	0.150	Grass-Short Grass Prairie	1.228	3.95	3.9																		RUS_007_020	3.9	**11.0**	**0.18**
									1,293	1.397	2.40	Paved	8.97														9.0		
																						171	6.00	6.00	0.5		0.5		
														1,837	1.419			0.015	7.83	7.83	7.83	3.91					3.9		
																						380	6.00	6.00	1.1		1.1		

Appendix B-3

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_007_030		3,847	100	0.150	Grass-Short Grass Prairie	1.065	3.95	11.3																		RUS_007_030	11.3	**21.3**	**0.35**
									1,090	0.691	1.34	Unpaved	13.55														13.5		
									791	1.474	2.47	Paved	5.34														5.3		
																						1,867	6.00	6.00	5.2		5.2		
RUS_007_040		3,613	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.497	3.95	0.5																		RUS_007_040	0.5	**10.7**	**0.18**
									273	0.714	1.72	Paved	2.65														2.6		
														1,182	2.760	4.7	11.2	0.045	3.09		3.09	6.38						6.4		
														2,106	1.153	80.2	35.5	0.065	4.24		4.24	8.28						8.3		
RUS_007_050		2,081	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_007_050	1.1	**6.6**	**0.11**
									1,310	1.877	2.79	Paved	7.84														7.8		
																						722	6.00	6.00	2.0		2.0		
RUS_007_060		972	53	0.150	Grass-Short Grass Prairie	3.873	3.95	4.1																		RUS_007_060	4.1	**5.1**	**0.09**
									777	2.448	3.18	Paved	4.07														4.1		
																						142	6.00	6.00	0.4		0.4		
RUS_007_070		3,594	100	0.150	Grass-Short Grass Prairie	5.870	3.95	5.7																		RUS_007_070	5.7	**13.2**	**0.22**
														2,102	1.452	15.5	27.5	0.045	2.73		2.73	12.85						12.9		
																						767	6.00	6.00	2.1		2.1		
														625	3.995	36.3	15.3	0.065	8.17		8.17	1.28						1.3		
RUS_008_010		4,459	100	0.150	Grass-Short Grass Prairie	0.755	3.95	13.0																		RUS_008_010	13.0	**17.4**	**0.29**
														1,283	1.961	2.4	4.6	0.045	3.03		3.03	7.07						7.1		
																						2,450	6.00	6.00	6.8		6.8		
														620	2.319	13.9	8.6	0.065	4.83		4.83	2.14						2.1		
RUS_009_010		3,279	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_010	1.1	**7.1**	**0.12**
									471	1.550	2.53	Paved	3.10														3.1		
																						2,758	6.00	6.00	7.7		7.7		
RUS_009_020		3,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_009_020	1.0	**13.0**	**0.22**
									1,970	1.058	2.09	Paved	15.70														15.7		
																						1,774	6.00	6.00	4.9		4.9		
RUS_009_030		3,660	51	0.150	Grass-Short Grass Prairie	5.576	3.95	3.4																		RUS_009_030	3.4	**9.2**	**0.15**
									223	0.526	1.47	Paved	2.52														2.5		
																						3,387	6.00	6.00	9.4		9.4		
RUS_009_040		3,486	49	0.150	Grass-Short Grass Prairie	2.375	3.95	4.7																		RUS_009_040	4.7	**14.5**	**0.24**
									1,374	0.886	1.91	Paved	11.97														12.0		
														751	2.041	1.3	2.7	0.045	2.89		2.89	4.33						4.3		
																						435	6.00	6.00	1.2		1.2		
														878	1.504	1.4	3.3	0.015	7.01		7.01	2.09						2.1		
RUS_009_050		3,246	32	0.150	Grass-Short Grass Prairie	4.626	3.95	2.5																		RUS_009_050	2.5	**11.1**	**0.19**
									601	0.863	1.89	Paved	5.30														5.3		
																						409	6.00	6.00	1.1		1.1		
														1,290	1.118	38.9	52.1	0.045	2.88		2.88	7.46						7.5		
														914	1.796	1.1	2.8	0.015	7.24		7.24	2.11						2.1		
RUS_009_060		517	50	0.150	Grass-Short Grass Prairie	2.845	3.95	4.4																		RUS_009_060	4.4	**4.1**	**0.07**
									467	2.501	3.21	Paved	2.42														2.4		
RUS_009_070		1,305	100	0.150	Grass-Short Grass Prairie	3.928	3.95	6.7																		RUS_009_070	6.7	**6.5**	**0.11**
														1,205	2.904	11.8	14.8	0.045	4.85		4.85	4.14						4.1		
RUS_009_080		2,650	44	0.150	Grass-Short Grass Prairie	9.012	3.95	2.5																		RUS_009_080	2.5	**8.3**	**0.14**
									1,042	1.494	2.48	Paved	6.99														7.0		
																						1,563	6.00	6.00	4.3		4.3		
RUS_009_090		762	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_090	1.1	**2.3**	**0.04**
									712	4.332	4.23	Paved	2.80														2.8		
RUS_010_001_010		2,007	31	0.150	Grass-Short Grass Prairie	8.518	3.95	1.9																		RUS_010_001_010	1.9	**6.7**	**0.11**
									1,076	1.754	2.69	Paved	6.66														6.7		
																						900	6.00	6.00	2.5		2.5		
RUS_010_001_020		1,631	100	0.150	Grass-Short Grass Prairie	2.568	3.95	8.0																		RUS_010_001_020	8.0	**10.0**	**0.17**
									329	1.345	1.87	Unpaved	2.93														2.9		
									656	1.566	2.54	Paved	4.30														4.3		
																						546	6.00	6.00	1.5		1.5		
RUS_010_002_010		3,151	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.478	3.95	0.7																		RUS_010_002_010	0.7	**7.8**	**0.13**
									1,207	2.020	2.89	Paved	6.96														7.0		
																						1,892	6.00	6.00	5.3		5.3		
RUS_010_002_020		729	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.895	3.95	0.5																		RUS_010_002_020	0.5	**2.7**	**0.05**
									489	1.276	2.30	Paved	3.55														3.5		
																						185	6.00	6.00	0.5		0.5		
RUS_010_002_030		268	100	0.150	Grass-Short Grass Prairie	3.992	3.95	6.7																		RUS_010_002_030	6.7	**4.4**	**0.07**
									169	7.631	4.46	Unpaved	0.63														0.6		
RUS_010_003_010		3,676	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_003_010	1.1	**8.0**	**0.13**
									332	0.979	2.01	Paved	2.75														2.8		
																						2,801	6.00	6.00	7.8		7.8		
														493	2.674	8.4	5.6	0.065	4.95		4.95	1.66						1.7		
RUS_010_003_020		782	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.740	3.95	0.9																		RUS_010_003_020	0.9	**2.3**	**0.04**
									732	4.394	4.26	Paved	2.86														2.9		
RUS_010_004_010		3,696	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.845	3.95	0.6																		RUS_010_004_010	0.6	**13.0**	**0.22**
									2,116	1.071	2.10	Paved	16.76														16.8		
																						1,530	6.00	6.00	4.3		4.3		
RUS_010_004_020		2,840	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_004_020	1.1	**10.7**	**0.18**
									1,248	0.837	1.86	Paved	11.18														11.2		
														695	0.500	87.1	32.9	0.055	3.67		3.67	3.16						3.2		
																						846	6.00	6.00	2.4		2.4		
RUS_010_004_030		5,070	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_010_004_030	15.4	**23.5**	**0.39**
														2,154	0.945	13.7	23.5	0.045	2.25		2.25	15.95						15.9		
																						2,815	6.00	6.00	7.8		7.8		

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_010_004_040		1,541	41	0.150	Grass-Short Grass Prairie	2.765	3.95	3.8																		RUS_010_004_040	3.8	**6.1**	**0.10**
									977	2.681	3.33	Paved	4.89														4.9		
																						523	6.00	6.00	1.5		1.5		
RUS_010_010		4,841	100	0.150	Grass-Short Grass Prairie	4.537	3.95	6.4																		RUS_010_010	6.4	**19.4**	**0.32**
									213	3.976	3.22	Unpaved	1.10														1.1		
														2,090	1.163	3.5	9.2	0.045	1.89		1.89	18.47						18.5		
																						1,312	6.00	6.00	3.6		3.6		
														646	1.756	0.7	1.6	0.015	7.25		7.25	1.49						1.5		
																						480	6.00	6.00	1.3		1.3		
RUS_010_020		343	100	0.150	Grass-Short Grass Prairie	0.525	3.95	15.1																		RUS_010_020	15.1	**9.6**	**0.16**
									241	6.397	4.08	Unpaved	0.98														1.0		
RUS_010_030		1,321	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.663	3.95	0.6																		RUS_010_030	0.6	**4.5**	**0.08**
									1,271	2.209	3.02	Paved	7.01														7.0		
RUS_010_040		1,759	100	0.150	Grass-Short Grass Prairie	4.802	3.95	6.2																		RUS_010_040	6.2	**7.7**	**0.13**
									602	1.730	2.67	Paved	3.75														3.8		
																						1,059	6.00	6.00	2.9		2.9		
RUS_011_010		2,319	100	0.150	Grass-Short Grass Prairie	2.369	3.95	8.2																		RUS_011_010	8.2	**11.0**	**0.18**
									789	2.589	2.60	Unpaved	5.07														5.1		
														1,432	1.614	56.0	26.8	0.065	4.76		4.76	5.02						5.0		
RUS_011_020		1,738	71	0.150	Grass-Short Grass Prairie	3.175	3.95	5.6																		RUS_011_020	5.6	**8.0**	**0.13**
														1,299	3.035	3.9	9.5	0.045	3.18		3.18	6.80						6.8		
																						368	6.00	6.00	1.0		1.0		
RUS_012_010		4,330	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.660	3.95	0.7																		RUS_012_010	0.7	**11.2**	**0.19**
									219	1.260	2.28	Paved	1.60														1.6		
									927	1.540	2.00	Unpaved	7.72														7.7		
																						3,133	6.00	6.00	8.7		8.7		
RUS_012_020		4,124	100	0.150	Grass-Short Grass Prairie	0.813	3.95	12.6																		RUS_012_020	12.6	**16.8**	**0.28**
									540	1.611	2.05	Unpaved	4.39														4.4		
									464	2.235	3.04	Paved	2.54														2.5		
																						3,020	6.00	6.00	8.4		8.4		
RUS_012_030		423	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.381	3.95	0.5																		RUS_012_030	0.5	**1.3**	**0.02**
									375	3.338	3.71	Paved	1.68														1.7		
RUS_013_010		2,469	100	0.150	Grass-Short Grass Prairie	1.827	3.95	9.1																		RUS_013_010	9.1	**11.5**	**0.19**
									743	1.962	2.26	Unpaved	5.48														5.5		
																						1,625	6.00	6.00	4.5		4.5		
RUS_013_020		1,511	100	0.150	Grass-Short Grass Prairie	0.590	3.95	14.4																		RUS_013_020	14.4	**15.5**	**0.26**
									1,410	1.593	2.04	Unpaved	11.54														11.5		
RUS_013_030		1,261	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_013_030	1.1	**4.0**	**0.07**
									1,212	3.168	3.62	Paved	5.58														5.6		
RUS_014_010		3,428	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.947	3.95	0.5																		RUS_014_010	0.5	**12.6**	**0.21**
														1,756	0.732	14.4	21.2	0.045	2.19		2.19	13.37						13.4		
																						528	6.00	6.00	1.5		1.5		
														1,099	1.577	11.1	16.0	0.045	3.26		3.26	5.62						5.6		
RUS_014_020		2,053	100	0.150	Grass-Short Grass Prairie	4.554	3.95	6.3																		RUS_014_020	6.3	**11.4**	**0.19**
									131	5.140	3.66	Unpaved	0.60														0.6		
									475	1.609	2.58	Paved	3.07														3.1		
									467	0.546	1.19	Unpaved	6.53														6.5		
																						882	6.00	6.00	2.5		2.5		
RUS_015_010		3,692	100	0.150	Grass-Short Grass Prairie	2.397	3.95	8.2																		RUS_015_010	8.2	**15.5**	**0.26**
									432	0.582	1.55	Paved	4.64														4.6		
																						638	6.00	6.00	1.8		1.8		
														889	1.588	22.2	56.4	0.045	2.24		2.24	6.61						6.6		
																						1,634	6.00	6.00	4.5		4.5		
RUS_015_020		2,629	100	0.150	Grass-Short Grass Prairie	2.181	3.95	8.5																		RUS_015_020	8.5	**10.2**	**0.17**
									56	2.495	2.55	Unpaved	0.37														0.4		
									388	1.870	2.78	Paved	2.33														2.3		
																						2,085	6.00	6.00	5.8		5.8		
RYA_000_010		2,853	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RYA_000_010	1.1	**10.0**	**0.17**
									1,121	0.714	1.72	Paved	10.88														10.9		
																						1,681	6.00	6.00	4.7		4.7		
RYA_000_020		5,389	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RYA_000_020	15.4	**19.6**	**0.33**
									709	2.571	2.59	Unpaved	4.57														4.6		
																						4,581	6.00	6.00	12.7		12.7		
RYA_000_030		4,581	100	0.150	Grass-Short Grass Prairie	2.566	3.95	8.0																		RYA_000_030	8.0	**16.4**	**0.27**
									1,191	1.453	1.94	Unpaved	10.21														10.2		
																						3,290	6.00	6.00	9.1		9.1		
RYA_000_040		4,283	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.387	3.95	0.7																		RYA_000_040	0.7	**8.7**	**0.14**
									575	1.727	2.67	Paved	3.59														3.6		
																						3,657	6.00	6.00	10.2		10.2		
RYA_000_050		456	100	0.150	Grass-Short Grass Prairie	2.022	3.95	8.8																		RYA_000_050	8.8	**6.5**	**0.11**
									357	3.319	2.94	Unpaved	2.02														2.0		
RYA_000_060		1,480	100	0.150	Grass-Short Grass Prairie	1.520	3.95	9.8																		RYA_000_060	9.8	**11.3**	**0.19**
									1,000	2.134	2.36	Unpaved	7.07														7.1		
									381	4.080	3.26	Unpaved	1.95														1.9		
RYA_000_070		3,198	100	0.150	Grass-Short Grass Prairie	1.235	3.95	10.7																		RYA_000_070	10.7	**14.0**	**0.23**
									937	2.236	2.41	Unpaved	6.47														6.5		
														416	2.751	23.4	15.2	0.065	5.06		5.06	1.37						1.4		
																						1,744	6.00	6.00	4.8		4.8		
RYA_000_080		1,688	100	0.150	Grass-Short Grass Prairie	2.993	3.95	7.5																		RYA_000_080	7.5	**8.3**	**0.14**
									614	3.984	4.06	Paved	2.52														2.5		
														668	1.829	1.1	7.3	0.015	3.85		3.85	2.89						2.9		
																						301	6.00	6.00	0.8		0.8		
RYA_001_010		3,045	47	0.150	Grass-Short Grass Prairie	4.536	3.95	3.5																		RYA_001_010	3.5	**11.1**	**0.18**
									1,943	1.879	2.79	Paved	11.62														11.6		
																						428	6.00	6.00	1.2		1.2		

Appendix B-3

Middle Rush Existing Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
														628	0.866	91.4	26.9	0.065	4.83		4.83	2.17						2.2		
RYA_001_020		1,206	100	0.150	Grass-Short Grass Prairie	1.416	3.95	10.1																			RYA_001_020	10.1	**8.5**	**0.14**
									272	2.860	2.73	Unpaved	1.66															1.7		
																							834	6.00	6.00	2.3		2.3		
TWI_000_010		3,106	35	0.150	Grass-Short Grass Prairie	5.166	3.95	2.6																			TWI_000_010	2.6	**12.0**	**0.20**
									1,530	0.931	1.96	Paved	13.00															13.0		
																							294	6.00	6.00	0.8		0.8		
														334	1.700	28.3	16.5	0.065	4.28		4.28	1.30						1.3		
																							528	6.00	6.00	1.5		1.5		
														385	1.504	6.0	10.7	0.015	8.26		8.26	0.78						0.8		
TWI_000_020		2,662	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.476	3.95	0.6																			TWI_000_020	0.6	**5.3**	**0.09**
									613	3.063	3.56	Paved	2.87															2.9		
																							1,169	6.00	6.00	3.2		3.2		
														831	1.287			0.065	6.27	6.27	6.27	2.21						2.2		
TWI_000_030		3,151	81	0.150	Grass-Short Grass Prairie	3.009	3.95	6.3																			TWI_000_030	6.3	**13.7**	**0.23**
									1,162	0.675	1.67	Paved	11.60															11.6		
																							1,294	6.00	6.00	3.6		3.6		
														613	0.900			0.065	8.10	8.10	8.10	1.26						1.3		
TWI_000_040		1,403	100	0.150	Grass-Short Grass Prairie	2.163	3.95	8.5																			TWI_000_040	8.5	**11.7**	**0.20**
									1,302	1.493	1.97	Unpaved	11.01															11.0		
TWI_000_050		3,239	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.756	3.95	0.7																			TWI_000_050	0.7	**8.7**	**0.15**
									1,619	1.929	2.82	Paved	9.56															9.6		
																							1,570	6.00	6.00	4.4		4.4		
TWI_000_060		1,818	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			TWI_000_060	15.4	**15.6**	**0.26**
									123	1.082	1.68	Unpaved	1.22															1.2		
									1,596	1.899	2.80	Paved	9.50															9.5		
TWI_000_070		4,548	100	0.150	Grass-Short Grass Prairie	0.846	3.95	12.4																			TWI_000_070	12.4	**20.9**	**0.35**
														1,040	0.500	16.7	29.1	0.045	1.61		1.61	10.73						10.7		
														350	3.561	2.7	5.1	0.015	12.41		12.41	0.47						0.5		
									689	1.863	2.77	Paved	4.14															4.1		
																							1,544	6.00	6.00	4.3		4.3		
														825	1.486	87.4	36.7	0.065	4.98		4.98	2.76						2.8		
TWI_000_080		1,292	100	0.150	Grass-Short Grass Prairie	1.766	3.95	9.3																			TWI_000_080	9.3	**9.1**	**0.15**
									348	2.510	2.56	Unpaved	2.27															2.3		
									626	2.994	3.52	Paved	2.97															3.0		
																							219	6.00	6.00	0.6		0.6		
TWI_000_090		248	100	0.150	Grass-Short Grass Prairie	12.420	3.95	4.2																			TWI_000_090	4.2	**3.0**	**0.05**
									149	3.507	3.02	Unpaved	0.82															0.8		
TWI_000_100		3,353	100	0.150	Grass-Short Grass Prairie	2.027	3.95	8.8																			TWI_000_100	8.8	**12.9**	**0.22**
									371	3.046	2.82	Unpaved	2.20															2.2		
									675	1.958	2.84	Paved	3.96															4.0		
																							1,054	6.00	6.00	2.9		2.9		
														1,154	2.465	88.5	50.1	0.065	5.25		5.25	3.66						3.7		
TWI_001_010		3,147	100	0.150	Grass-Short Grass Prairie	2.091	3.95	8.7																			TWI_001_010	8.7	**14.7**	**0.25**
														1,404	0.664	16.2	21.9	0.045	2.21		2.21	10.58						10.6		
																							1,266	6.00	6.00	3.5		3.5		
														378	0.703	50.4	25.4	0.055	3.59		3.59	1.76						1.8		
TWI_002_010		1,046	100	0.150	Grass-Short Grass Prairie	3.380	3.95	7.1																			TWI_002_010	7.1	**7.6**	**0.13**
									491	4.489	3.42	Unpaved	2.39															2.4		
									456	1.497	2.49	Paved	3.06															3.1		
TWI_003_010		2,713	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.596	3.95	0.5																			TWI_003_010	0.5	**6.2**	**0.10**
									536	4.721	4.42	Paved	2.02															2.0		
																							1,811	6.00	6.00	5.0		5.0		
														318	0.500	15.5	12.2	0.065	1.90		1.90	2.79						2.8		
TWI_004_010		3,365	26	0.150	Grass-Short Grass Prairie	6.863	3.95	1.8																			TWI_004_010	1.8	**9.6**	**0.16**
									1,111	1.285	2.30	Paved	8.04															8.0		
																							2,228	6.00	6.00	6.2		6.2		
TWI_004_020		1,374	100	0.150	Grass-Short Grass Prairie	3.757	3.95	6.9																			TWI_004_020	6.9	**7.3**	**0.12**
									678	2.389	3.14	Paved	3.60															3.6		
																							597	6.00	6.00	1.7		1.7		
TWI_004_030		1,291	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.534	3.95	0.5																			TWI_004_030	0.5	**4.2**	**0.07**
									70	4.908	4.50	Paved	0.26															0.3		
									779	2.512	2.56	Unpaved	5.08															5.1		
																							394	6.00	6.00	1.1		1.1		

Appendix B-3

Stream RC-1 Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RCO_001_010		2,640	100	0.150	Grass-Short Grass Prairie	0.880	3.95	12.2																		RUS_RCO_001_010	12.2	**18.7**	**0.31**
									1,101	1.360	1.88	Unpaved	9.75														9.8		
									1,270	1.419	2.42	Paved	8.74														8.7		
																						169	6	6.00	0.5		0.5		
RUS_RCO_002_010		4,461	76	0.150	Grass-Short Grass Prairie	2.473	3.95	6.5																		RUS_RCO_002_010	6.5	**18.8**	**0.31**
									1,586	0.597	1.57	Paved	16.83														16.8		
														633	0.500	9.7	14.5	0.015	5.40		5.40	1.95						2.0		
																							2,166	6	6.00	6.0		6.0		
RUS_RCO_002_020		938	100	0.150	Grass-Short Grass Prairie	1.260	3.95	10.6																		RUS_RCO_002_020	10.6	**11.8**	**0.20**
									37	8.935	4.82	Unpaved	0.13														0.1		
									761	0.500	1.44	Paved	8.82														8.8		
																						40	6	6.00	0.1		0.1		
RUS_RCO_010		3,067	44	0.150	Grass-Short Grass Prairie	0.500	3.95	8.0																		RUS_RCO_010	8.0	**17.0**	**0.28**
									1,226	0.500	1.44	Paved	14.22														14.2		
																						1,267	6	6.00	3.5		3.5		
														530	0.604	111.4	42.6	0.065	3.38		3.38	2.61						2.6		
RUS_RCO_020		5,143	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.260	3.95	0.6																		RUS_RCO_020	0.6	**10.8**	**0.18**
									623	0.894	1.92	Paved	5.40														5.4		
																						3,093	6	6.00	8.6		8.6		
														1,377	0.566					6.81	6.81	3.37						3.4		
RUS_RCO_030		4,440	43	0.150	Grass-Short Grass Prairie	2.596	3.95	4.0																		RUS_RCO_030	4.0	**14.0**	**0.23**
									2,084	1.737	2.68	Paved	12.96														13.0		
																						2,239	6	6.00	6.2		6.2		
														74	0.701	15.0	17.0	0.015	7.65		7.65	0.16						0.2		
RUS_RCO_040		2,647	100	0.150	Grass-Short Grass Prairie	2.280	3.95	8.4																		RUS_RCO_040	8.4	**11.1**	**0.18**
									159	8.315	4.65	Unpaved	0.57														0.6		
									993	2.107	2.95	Paved	5.61														5.6		
																						1,396	6	6.00	3.9		3.9		
RUS_RCO_050		3,439	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_RCO_050	14.9	**18.5**	**0.31**
									82	2.425	2.51	Unpaved	0.54														0.5		
									2,551	2.552	3.25	Paved	13.09														13.1		
																						280	6	6.00	0.8		0.8		
RUS_RCO_060		2,387	100	0.150	Grass-Short Grass Prairie	1.550	3.95	9.8						426	0.501	5.0	9.1	0.015	4.71		4.71	1.51						1.5		
									526	0.547	1.19	Unpaved	7.35														7.3		
									1,273	0.510	1.45	Paved	14.61														14.6		
																						488	6	6.00	1.4		1.4		
RUS_RCO_070		4,161	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.740	3.95	0.4																		RUS_RCO_070	0.4	**9.1**	**0.15**
									2,074	3.498	3.80	Paved	9.09														9.1		
																						2,037	6	6.00	5.7		5.7		
RUS_RCO_080		2,228	100	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		RUS_RCO_080	8.5	**10.5**	**0.18**
									1,001	1.922	2.82	Paved	5.92														5.9		
																						1,128	6	6.00	3.1		3.1		
RUS_RCO_090		4,509	87	0.150	Grass-Short Grass Prairie	2.008	3.95	7.9																		RUS_RCO_090	7.9	**20.7**	**0.35**
									3,099	1.224	2.25	Paved	22.97														23.0		
																						1,324	6	6.00	3.7		3.7		
RUS_RCO_100		2,499	49	0.150	Grass-Short Grass Prairie	0.500	3.95	8.7																		RUS_RCO_100	8.7	**13.7**	**0.23**
									1,120	0.782	1.80	Paved	10.38														10.4		
																						1,330	6	6.00	3.7		3.7		
RUS_RCO_110		2,443	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_RCO_110	1.0	**11.7**	**0.20**
									1,940	0.845	1.87	Paved	17.30														17.3		
																						453	6	6.00	1.3		1.3		
RUS_RCO_120		2,934	100	0.150	Grass-Short Grass Prairie	2.150	3.95	8.6																		RUS_RCO_120	8.6	**14.3**	**0.24**
									25	9.370	4.94	Unpaved	0.08														0.1		
									2,810	2.300	3.08	Paved	15.19														15.2		
RUS_RCO_130		2,380	100	0.150	Grass-Short Grass Prairie	2.210	3.95	8.5																		RUS_RCO_130	8.5	**11.7**	**0.19**
									41	7.259	4.35	Unpaved	0.16														0.2		
									2,128	2.748	3.37	Paved	10.52														10.5		
																						111	6	6.00	0.3		0.3		
RUS_RCO_140		2,218	100	0.150	Grass-Short Grass Prairie	2.020	3.95	8.8																		RUS_RCO_140	8.8	**12.1**	**0.20**
									83	2.624	2.61	Unpaved	0.53														0.5		
									844	0.807	1.83	Paved	7.70														7.7		
									109	10.417	5.21	Unpaved	0.35														0.3		
														1,082	4.248	87.8	54.3	0.065	6.51		6.51	2.77						2.8		
RUS_RCO_150		1,740	100	0.150	Grass-Short Grass Prairie	5.250	3.95	6.0																		RUS_RCO_150	6.0	**10.2**	**0.17**
									696	5.939	3.93	Unpaved	2.95														3.0		
									812	0.761	1.77	Paved	7.63														7.6		
																						132	6	6.00	0.4		0.4		
RUS_TOA_010		3,284	100	0.150	Grass-Short Grass Prairie	0.990	3.95	11.7																		RUS_TOA_010	11.7	**19.5**	**0.33**
									101	1.302	1.84	Unpaved	0.91														0.9		
									1,287	0.500	1.44	Paved	14.92														14.9		
																						1,795	6	6.00	5.0		5.0		
RUS_TOA_020		2,315	100	0.150	Grass-Short Grass Prairie	4.880	3.95	6.2																		RUS_TOA_020	6.2	**7.6**	**0.13**
									131	3.939	3.20	Unpaved	0.68														0.7		
														346	4.051	37.2	51.7	0.045	5.35		5.35	1.08						1.1		
														114	2.516	12.4	36.3	0.015	7.70		7.70	0.25						0.2		
																						1,624	6	6.00	4.5		4.5		
RUS_TOA_030		3,613	100	0.150	Grass-Short Grass Prairie	0.830	3.95	12.5																		RUS_TOA_030	12.5	**14.9**	**0.25**

Appendix B-3

Stream RC-1 Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
									46	8.211	4.62	Unpaved	0.17														0.2		
									1,353	3.017	3.53	Paved	6.39														6.4		
																							240	6	6.00	0.7		0.7		
														1,874	0.970	0.6	2.1	0.015	4.25	6.09	6.09	5.13						5.1		
RUS_TOA_040		2,776	100	0.150	Grass-Short Grass Prairie	1.170	3.95	10.9																			RUS_TOA_040	10.9	**12.5**	**0.21**
									192	3.440	2.99	Unpaved	1.07														1.1		
									785	2.437	3.17	Paved	4.12														4.1		
																							1,698	6	6.00	4.7		4.7		
RUS_TOA_050		4,900	100	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																			RUS_TOA_050	12.4	**21.3**	**0.36**
									34	7.690	4.47	Unpaved	0.13														0.1		
									1,787	0.985	2.02	Paved	14.76														14.8		
																							2,979	6	6.00	8.3		8.3		
RUS_TOA_055		7,994	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																			RUS_TOA_055	0.9	**30.8**	**0.51**
									1,191	0.825	1.47	Unpaved	13.54														13.5		
														6,753	0.908	27.9	21.8	0.055	3.05		3.05	36.92						36.9		
RUS_TOA_060		2,926	100	0.150	Grass-Short Grass Prairie	3.350	3.95	7.2																			RUS_TOA_060	7.2	**19.4**	**0.32**
									651	0.500	1.14	Unpaved	9.51														9.5		
									2,175	1.286	2.30	Paved	15.73														15.7		
RUS_TOA_070		2,587	100	0.150	Grass-Short Grass Prairie	1.070	3.95	11.3																			RUS_TOA_070	11.3	**18.1**	**0.30**
									1,500	0.584	1.55	Paved	16.09														16.1		
																							987	6	6.00	2.7		2.7		
RUS_TOA_080		5,019	100	0.150	Grass-Short Grass Prairie	3.001	3.95	7.5																			RUS_TOA_080	7.5	**14.8**	**0.25**
									1,098	1.873	2.78	Paved	6.58														6.6		
																							3,623	6	6.00	10.1		10.1		
														204	3.945	24.7	13.3	0.065	6.88		6.88	0.49						0.5		
RUS_TOA_090		3,864	100	0.150	Grass-Short Grass Prairie	1.660	3.95	9.5																			RUS_TOA_090	9.5	**14.2**	**0.24**
									608	4.924	3.58	Unpaved	2.83														2.8		
									41	0.879	1.91	Paved	0.36														0.4		
														398	2.856	4.6	6.4	0.045	4.49		4.49	1.48						1.5		
																							303	6	6.00	0.8		0.8		
														504	1.092	6.2	12.1	0.045	2.21		2.21	3.80						3.8		
																							1,202	6	6.00	3.3		3.3		
														709	2.154	134.2	35.6	0.065	8.15		8.15	1.45						1.4		
RUS_TOA_100		4,958	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.980	3.95	0.6																			RUS_TOA_100	0.6	**9.8**	**0.16**
									713	2.022	2.89	Paved	4.11														4.1		
																							2,960	6	6.00	8.2		8.2		
														542	1.081	17.8	8.5	0.045	5.63		5.63	1.60						1.6		
														693	3.696	42.8	24.6	0.065	6.38		6.38	1.81						1.8		

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_010		3,581	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_010	49	**29.5**	**0.49**
									1,480	0.697	1.35	Unpaved	18.31																
														2,001	0.981	55.2	88.3	0.050	2.16		2.16	15.45							
RUS_000_020		2,722	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.320	3.95	0.7																		RUS_000_020	12	**7.4**	**0.12**
														2,672	0.964	27.0	21.0	0.045	3.84		3.84	11.58							
RUS_000_030		3,258	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_030	45	**27.0**	**0.45**
									2,660	1.091	1.69	Unpaved	26.30																
														498	0.500	121.5	110.5	0.045	2.49		2.49	3.33							
RUS_000_040		1,419	100	0.150	Grass-Short Grass Prairie	1.970	3.95	8.9																		RUS_000_040	19	**11.5**	**0.19**
									1,031	1.437	1.93	Unpaved	8.88																
														288	0.625	53.4	22.5	0.065	3.22		3.22	1.49							
RUS_000_050		2,882	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.276	3.95	0.7																		RUS_000_050	21	**12.5**	**0.21**
									1,679	0.864	1.89	Paved	14.81																
																							375	6	6.00	1.0				
														778	0.966	52.9	59.3	0.045	3.02		3.02	4.30							
RUS_000_060		2,425	100	0.150	Grass-Short Grass Prairie	1.115	3.95	11.1																		RUS_000_060	19	**11.6**	**0.19**
									594	2.216	2.40	Unpaved	4.12																
																							1,053	6	6.00	2.9				
														678	1.563	115.4	87.2	0.024	9.36		9.36	1.21							
RUS_000_070		2,113	100	0.150	Grass-Short Grass Prairie	0.505	3.95	15.3																		RUS_000_070	33	**20.1**	**0.33**
									2,013	1.313	1.85	Unpaved	18.15																
RUS_000_080		2,523	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_000_080	28	**16.8**	**0.28**
									673	1.797	2.16	Unpaved	5.19																
														1,749	0.692	5.7	3.7	0.045	3.70		3.70	7.89							
RUS_000_085		3,636	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_085	35	**20.7**	**0.35**
									574	2.162	2.37	Unpaved	4.03																
														2,962	0.935					3.26	3.26	15.14								
RUS_000_090		2,192	100	0.150	Grass-Short Grass Prairie	0.564	3.95	14.6																		RUS_000_090	32	**19.5**	**0.32**
									2,092	1.468	1.96	Unpaved	17.83																
RUS_000_100		4,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																		RUS_000_100	26	**15.8**	**0.26**
									831	1.203	1.77	Unpaved	7.83																
																							1,845	6	6.00	5.1				
														2,037	1.009	131.6	131.6	0.055	2.72		2.72	12.48							
RUS_000_110		3,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.540	3.95	1.1																		RUS_000_110	26	**15.7**	**0.26**
									1,699	1.018	1.63	Unpaved	17.39																
																							262	6	6.00	0.7				
														1,753	1.778	40.8	44.7	0.045	4.15		4.15	7.03							
RUS_000_120		1,360	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.060	3.95	0.6																		RUS_000_120	10	**5.9**	**0.10**
									1,310	2.172	2.38	Unpaved	9.18																
RUS_000_130		2,066	100.0	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																		RUS_000_130	20	**12.0**	**0.20**
														1,966	2.272	6.7	7.4	0.045	4.65		4.65	7.04							
RUS_000_140		2,863	100.0	0.150	Grass-Short Grass Prairie	1.270	3.95	10.6																		RUS_000_140	23	**14.0**	**0.23**
									928	1.585	2.03	Unpaved	7.61																
																							1,835	6	6.00	5.1				
RUS_000_150		2,761	100.0	0.150	Grass-Short Grass Prairie	2.107	3.95	8.6																		RUS_000_150	18	**10.5**	**0.18**
									446	1.850	2.77	Paved	2.69																
																							2,001	6	6.00	5.6				
														214	5.486	31.9	29.5	0.065	5.66		5.66	0.63							
RUS_000_160		1,865	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.940	3.95	0.8																		RUS_000_160	11	**6.4**	**0.11**
									1,089	1.328	2.34	Paved	7.75																
																							726	6	6.00	2.0				
RUS_000_170		1,952	100.0	0.150	Grass-Short Grass Prairie	0.810	3.95	12.7																		RUS_000_170	19	**11.4**	**0.19**
									383	2.035	2.90	Paved	2.20																
																							1,469	6	6.00	4.1				
RUS_000_180		747	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_000_180	16	**9.4**	**0.16**
									647	3.321	2.94	Unpaved	3.67																
RUS_016_010		2,662	100.0	0.150	Grass-Short Grass Prairie	2.835	3.95	7.7																		RUS_016_010	18	**11.0**	**0.18**
									693	1.080	2.11	Paved	5.47																
																							1,869	6	6.00	5.2				
RUS_016_020		3,161	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.705	3.95	1.0																		RUS_016_020	20	**12.2**	**0.20**
									2,082	1.064	2.10	Paved	16.55																
																							1,030	6	6.00	2.9				
RUS_016_030		2,587	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.680	3.95	1.0																		RUS_016_030	9	**5.6**	**0.09**
									504	2.282	3.07	Paved	2.74																
																							2,033	6	6.00	5.6				
RUS_016_040		2,434	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.328	3.95	0.4																		RUS_016_040	9	**5.2**	**0.09**
									707	3.158	3.61	Paved	3.26																
																							1,199	6	6.00	3.3				
														477	2.307	57.3	35.8	0.065	4.77		4.77	1.67							
RUS_017_010		677	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_017_010	15	**8.8**	**0.15**
									145	2.091	2.33	Unpaved	1.04																
														432	1.238	115.9	65.0	0.055	4.43		4.43	1.62							
RUS_018_010		2,702	100.0	0.150	Grass-Short Grass Prairie	1.611	3.95	9.6																		RUS_018_010	25	**15.2**	**0.25**
									1,064	1.266	1.82	Unpaved	9.77																
														884	0.500	70.0	37.8	0.045	3.53		3.53	4.17							
RUS_018_020		2,891	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																		RUS_018_020	35	**21.2**	**0.35**
									1,383	1.595	2.04	Unpaved	11.31																
														1,408	0.795	49.3	81.0	0.050	1.91		1.91	12.29							
RUS_018_030		2,585	100.0	0.150	Grass-Short Grass Prairie	0.742	3.95	13.1																		RUS_018_030	25	**14.7**	**0.25**
									851	2.307	2.45	Unpaved	5.79																
														1,634	1.004					4.86	4.86	5.60								
RUS_018_040		2,976	100.0	0.150	Grass-Short Grass Prairie	0.730	3.95	13.2																		RUS_018_040	31	**18.8**	**0.31**
									1,774	1.860	2.20	Unpaved	13.44																
														1,102	0.645					3.96	3.96	4.64								

Appendix B-3

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_018_050		3,423	100.0	0.150	Grass-Short Grass Prairie	2.870	3.95	7.6																		RUS_018_050	25	**14.7**	**0.25**
									1,647	1.569	2.55	Paved	10.78																
																						585	6	6.00	1.6				
														1,091	0.806					4.07	4.07	4.47							
RUS_019_010		2,630	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_019_010	31	**18.7**	**0.31**
									1,333	1.403	1.91	Unpaved	11.63																
														1,197	1.247	208.7	106.6	0.055	4.73		4.73	4.21							
RUS_019_020		1,706	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.399	3.95	0.6																		RUS_019_020	11	**6.9**	**0.11**
									1,313	1.153	2.18	Paved	10.03																
														343	3.086	46.1	28.9	0.055	6.49		6.49	0.88							
RUS_020_010		4,272	100.0	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_020_010	42	**25.0**	**0.42**
									1,285	0.500	1.14	Unpaved	18.77																
																						2,887	6	6.00	8.0				
RUS_020_020		4,387	100.0	0.150	Grass-Short Grass Prairie	0.671	3.95	13.7																		RUS_020_020	49	**29.4**	**0.49**
									2,493	0.784	1.43	Unpaved	29.08																
																						692	6	6.00	1.9				
														535	0.778	29.9	18.9	0.045	3.96		3.96	2.25							
														350	0.500	30.1	23.2	0.015	8.34		8.34	0.70							
														217	0.500	52.3	45.4	0.045	2.57		2.57	1.41							
RUS_020_030		3,118	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_020_030	40	**23.8**	**0.40**
									1,974	1.221	1.78	Unpaved	18.46																
																						175	6	6.00	0.5				
														870	0.500	81.3	67.1	0.045	2.66		2.66	5.45							
RUS_020_040		4,060	100.0	0.150	Grass-Short Grass Prairie	1.630	3.95	9.6																		RUS_020_040	31	**18.8**	**0.31**
									545	2.494	2.55	Unpaved	3.56																
														3,415	0.621					3.13	3.13	18.18							
RUS_FPT_010		3,184	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.720	3.95	0.9																		RUS_FPT_010	13	**7.9**	**0.13**
									990	1.628	2.59	Paved	6.36																
																						1,560	6	6.00	4.3				
														585	0.500	141.8	78.1	0.024	6.54		6.54	1.49							
RUS_FPT_020		2,432	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_FPT_020	13	**7.7**	**0.13**
									1,403	2.614	2.61	Unpaved	8.96																
																						979	6	6.00	2.7				
RUS_NET_010		2,119	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_NET_010	10	**6.2**	**0.10**
									396	0.500	1.44	Paved	4.59																
																						1,673	6	6.00	4.6				
RUS_NET_020		710	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.380	3.95	0.4																		RUS_NET_020	5	**3.3**	**0.05**
									660	1.809	2.17	Unpaved	5.07																
SUB_000_010		2,952	100.0	0.150	Grass-Short Grass Prairie	0.624	3.95	14.1																		SUB_000_010	36	**21.3**	**0.36**
									1,990	1.658	2.08	Unpaved	15.96																
														862	0.500	54.1	34.2	0.055	2.60		2.60	5.53							
SUB_000_020		2,349	100.0	0.150	Grass-Short Grass Prairie	2.216	3.95	8.5																		SUB_000_020	18	**10.6**	**0.18**
									669	3.707	3.11	Unpaved	3.59																
														1,579	0.699					4.71	4.71	5.59							
SUB_000_030		751	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.084	3.95	0.5																		SUB_000_030	5	**2.8**	**0.05**
									701	3.020	2.80	Unpaved	4.17																
SUB_000_040		1,108	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		SUB_000_040	21	**12.4**	**0.21**
									1,008	3.731	3.12	Unpaved	5.39																
SUB_000_050		3,726	100.0	0.150	Grass-Short Grass Prairie	0.861	3.95	12.4																		SUB_000_050	42	**25.2**	**0.42**
									2,717	1.114	1.70	Unpaved	26.59																
														909	1.239	27.8	17.5	0.045	5.02		5.02	3.02							
SUB_000_060		3,046	100.0	0.150	Grass-Short Grass Prairie	0.725	3.95	13.2																		SUB_000_060	30	**18.1**	**0.30**
									388	1.749	2.13	Unpaved	3.03																
														1,609	1.009	30.0	30.0	0.055	2.72		2.72	9.85							
																						371	6	6.00	1.0				
														577	0.500					3.13	3.13	3.07							
SUB_000_070		4,044	100.0	0.150	Grass-Short Grass Prairie	2.269	3.95	8.4																		SUB_000_070	31	**18.8**	**0.31**
									1,623	2.069	2.32	Unpaved	11.66																
														2,321	0.688					3.45	3.45	11.21							
SUB_000_080		1,251	100.0	0.150	Grass-Short Grass Prairie	4.950	3.95	6.1																		SUB_000_080	13	**7.9**	**0.13**
									1,151	2.888	2.74	Unpaved	7.00																
SUB_000_090		4,935	100.0	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		SUB_000_090	44	**26.3**	**0.44**
									2,607	1.188	1.76	Unpaved	24.70																
														2,228	1.010	117.4	81.9	0.055	3.46		3.46	10.72							
SUB_000_100		3,603	100.0	0.150	Grass-Short Grass Prairie	1.862	3.95	9.1																		SUB_000_100	22	**13.4**	**0.22**
									853	2.248	2.42	Unpaved	5.88																
																						2,650	6	6.00	7.4				
SUB_000_110		1,188	100.0	0.150	Grass-Short Grass Prairie	5.241	3.95	6.0																		SUB_000_110	13	**7.7**	**0.13**
									1,088	2.712	2.66	Unpaved	6.82																
SUB_000_115		1,627	100.0	0.150	Grass-Short Grass Prairie	4.390	3.95	6.4																		SUB_000_115	17	**10.2**	**0.17**
									1,527	2.211	2.40	Unpaved	10.61																
SUB_000_120		4,452	100.0	0.150	Grass-Short Grass Prairie	1.910	3.95	9.0																		SUB_000_120	31	**18.7**	**0.31**
									1,388	1.701	2.10	Unpaved	10.99																
														2,964	1.129	52.1	27.2	0.055	4.44		4.44	11.12							
SUB_000_130		2,603	100.0	0.150	Grass-Short Grass Prairie	0.558	3.95	14.7																		SUB_000_130	28	**17.0**	**0.28**
									1,125	1.420	1.92	Unpaved	9.75																
																						1,378	6	6.00	3.8				
SUB_000_140		2,769	100.0	0.150	Grass-Short Grass Prairie	1.720	3.95	9.4																		SUB_000_140	23	**13.8**	**0.23**
									795	2.961	2.78	Unpaved	4.77																
														1,873	0.500					3.52	3.52	8.87							
SUB_000_150		2,065	100.0	0.150	Grass-Short Grass Prairie	1.166	3.95	10.9																		SUB_000_150	22	**13.1**	**0.22**
									858	2.360	2.48	Unpaved	5.77																
														1,107	0.961					3.65	3.65	5.05							
SUB_000_155		2,374	100.0	0.150	Grass-Short Grass Prairie	1.673	3.95	9.5																		SUB_000_155	21	**12.4**	**0.21**
									979	2.472	2.54	Unpaved	6.43																
														1,296	1.214					4.50	4.50	4.80							

Upper Rush Existing Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
SUB_000_160		1,428	100.0	0.150	Grass-Short Grass Prairie	5.050	3.95	6.1																			SUB_000_160	14	**8.6**	**0.14**
									1,328	2.789	2.69	Unpaved	8.21																
SUB_000_170		4,539	100.0	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																			SUB_000_170	27	**16.5**	**0.27**
														4,057	1.095	60.1	34.1	0.045	5.05		5.05	13.38							
																							382	6	6.00	1.1				
SUB_000_180		2,240	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.639	3.95	1.0																			SUB_000_180	12	**7.3**	**0.12**
									768	0.976	2.01	Paved	6.38																
																							713	6	6.00	2.0				
														709	3.297	40.2	39.5	0.065	4.21		4.21	2.80							
SUB_000_190		3,147	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.975	3.95	0.8																			SUB_000_190	16	**9.8**	**0.16**
									2,056	1.796	2.72	Paved	12.58																
																							1,041	6	6.00	2.9				
SUB_000_200		3,651	100.0	0.150	Grass-Short Grass Prairie	1.627	3.95	9.6																			SUB_000_200	32	**19.0**	**0.32**
									1,716	1.266	1.82	Unpaved	15.75																
																							719	6	6.00	2.0				
														798	0.717	14.7	9.3	0.015	11.40		11.40	1.17							
														318	0.500	32.8	39.8	0.055	1.68		1.68	3.15							
SUB_000_210		2,926	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.600	3.95	0.7																			SUB_000_210	15	**8.7**	**0.15**
									1,139	2.044	2.31	Unpaved	8.23																
														1,737	1.113	23.7	9.7	0.055	5.17		5.17	5.60							
SUB_000_220		3,608	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																			SUB_000_220	37	**22.0**	**0.37**
									2,227	1.681	2.09	Unpaved	17.74																
														1,281	0.500			0.055		3.01	3.01	7.09								
SUB_000_230		3,351	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.382	3.95	0.5																			SUB_000_230	18	**11.0**	**0.18**
									499	1.903	2.80	Paved	2.97																
														1,659	0.930			0.055		3.15	3.15	8.78								
														1,143	0.764			0.024		3.15	3.15	6.05								
SUB_000_240		808	100.0	0.150	Grass-Short Grass Prairie	2.188	3.95	8.5																			SUB_000_240	12	**7.3**	**0.12**
									199	2.898	2.75	Unpaved	1.21																
									510	2.798	3.40	Paved	2.50																
SUB_000_250		4,052	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.954	3.95	0.8																			SUB_000_250	22	**13.3**	**0.22**
									1,369	0.907	1.94	Paved	11.79																
																							1,947	6	6.00	5.4				
														686	0.500	25.1	19.5	0.045	2.77		2.77	4.13							
SUB_000_260		3,034	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			SUB_000_260	18	**11.0**	**0.18**
									1,007	0.500	1.44	Paved	11.68																
																							1,977	6	6.00	5.5				
SUB_000_270		3,885	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.059	3.95	0.5																			SUB_000_270	25	**14.8**	**0.25**
									427	0.668	1.66	Paved	4.28																
									1,399	0.940	1.56	Unpaved	14.90																
														585	0.500	32.1	19.5	0.015	9.80		9.80	0.99							
																							1,423	6	6.00	4.0				
SUB_000_280		904	100.0	0.150	Grass-Short Grass Prairie	1.560	3.95	9.7																			SUB_000_280	16	**9.8**	**0.16**
									804	1.604	2.04	Unpaved	6.56																
SUB_000_290		2,946	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			SUB_000_290	14	**8.4**	**0.14**
									1,206	1.448	2.45	Paved	8.22																
																							1,690	6	6.00	4.7				
SUB_000_300		2,628	100.0	0.150	Grass-Short Grass Prairie	2.520	3.95	8.0																			SUB_000_300	18	**10.8**	**0.18**
									775	1.557	2.54	Paved	5.09																
																							1,752	6	6.00	4.9				
SUB_001_001_010		3,113	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			SUB_001_001_010	27	**16.5**	**0.27**
									1,389	2.257	3.05	Paved	7.58																
																							1,624	6	6.00	4.5				
SUB_001_001_020		651	100.0	0.150	Grass-Short Grass Prairie	4.907	3.95	6.2																			SUB_001_001_020	10	**6.0**	**0.10**
									551	2.216	2.40	Unpaved	3.82																
SUB_001_010		3,004	100.0	0.150	Grass-Short Grass Prairie	2.600	3.95	7.9																			SUB_001_010	21	**12.6**	**0.21**
									1,073	2.633	2.62	Unpaved	6.83																
																							826	6	6.00	2.3				
														1,005	0.701	155.8	61.4	0.055	4.22		4.22	3.97							
SUB_001_020		1,504	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.060	3.95	0.8																			SUB_001_020	6	**3.8**	**0.06**
									656	2.658	3.31	Paved	3.30																
																							798	6	6.00	2.2				
SUB_002_010		1,878	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.000	3.95	0.5																			SUB_002_010	10	**5.9**	**0.10**
									1,004	3.108	2.84	Unpaved	5.88																
														824	1.055	36.3	21.2	0.055	3.98		3.98	3.45							
SUB_002_020		876	100.0	0.150	Grass-Short Grass Prairie	1.160	3.95	11.0																			SUB_002_020	16	**9.8**	**0.16**
									776	2.300	2.45	Unpaved	5.29																
SUB_003_010		1,857	100.0	0.150	Grass-Short Grass Prairie	1.299	3.95	10.5																			SUB_003_010	17	**10.0**	**0.17**
									326	1.666	2.62	Paved	2.07																
																							503	6	6.00	1.4				
														928	1.088	15.3	5.4	0.055	5.66		5.66	2.73							
SUB_003_020		3,531	100.0	0.150	Grass-Short Grass Prairie	2.835	3.95	7.7																			SUB_003_020	22	**13.1**	**0.22**
									756	1.938	2.25	Unpaved	5.61																
																							1,941	6	6.00	5.4				
														735	0.872	17.7	12.7	0.045	3.86		3.86	3.17							
SUB_003_030		2,118	54.0	0.150	Grass-Short Grass Prairie	1.130	3.95	6.8																			SUB_003_030	17	**10.1**	**0.17**
														2,064	1.087	25.7	26.0	0.045	3.43		3.43	10.03							
SUB_003_040		3,148	100.0	0.150	Grass-Short Grass Prairie	1.235	3.95	10.7																			SUB_003_040	26	**15.6**	**0.26**
									1,344	1.078	2.11	Paved	10.61																
																							1,704	6	6.00	4.7				
SUB_004_010		2,840	100.0	0.150	Grass-Short Grass Prairie	2.056	3.95	8.7																			SUB_004_010	40	**24.2**	**0.40**
									1,389	1.503	1.98	Unpaved	11.70																
														1,351	0.500	17.7	38.9	0.055	1.13		1.13	19.89							
SUB_004_020		2,607	100.0	0.150	Grass-Short Grass Prairie	1.223	3.95	10.7																			SUB_004_020	25	**15.1**	**0.25**
									1,471	2.471	2.54	Unpaved	9.67																

Upper Rush Existing Time of Concentration Calculations

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HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
														1,037	0.692					3.63	3.63	4.76								
SUB_004_030		1,858	100.0	0.150	Grass-Short Grass Prairie	1.710	3.95	9.4																			SUB_004_030	21	**12.9**	**0.21**
									1,247	1.819	2.18	Unpaved	9.55																
														511	0.535	17.2	10.6	0.045	3.34		3.34	2.55								
SUB_004_040		3,401	100.0	0.150	Grass-Short Grass Prairie	0.770	3.95	12.9																			SUB_004_040	39	**23.4**	**0.39**
									2,165	1.524	1.99	Unpaved	18.11																
														1,136	0.500					2.36	2.36	8.02								
SUB_004_050		2,930	100.0	0.150	Grass-Short Grass Prairie	3.040	3.95	7.5																			SUB_004_050	27	**16.4**	**0.27**
									1,202	0.887	1.52	Unpaved	13.19																
														1,628	1.014					4.03	4.03	6.73								
SUB_004_060		1,854	100.0	0.150	Grass-Short Grass Prairie	5.133	3.95	6.0																			SUB_004_060	21	**12.8**	**0.21**
									1,023	1.224	1.79	Unpaved	9.55																
														730	0.594					2.15	2.15	5.66								
SUB_004_070		2,708	100.0	0.150	Grass-Short Grass Prairie	2.518	3.95	8.0																			SUB_004_070	26	**15.7**	**0.26**
									2,111	1.351	2.36	Paved	14.89																
														497	1.657					2.54	2.54	3.26								
SUB_004_080		2,193	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.160	3.95	0.8																			SUB_004_080	14	**8.3**	**0.14**
									980	1.330	1.86	Unpaved	8.78																
														1,163	1.518	38.9	24.6	0.055	4.53		4.53	4.28								
SUB_004_090		2,238	100.0	0.150	Grass-Short Grass Prairie	1.645	3.95	9.5																			SUB_004_090	22	**13.2**	**0.22**
									1,034	3.480	3.01	Unpaved	5.73																
														1,104	0.500					2.71	2.71	6.79								
SUB_004_100		1,932	100.0	0.150	Grass-Short Grass Prairie	1.507	3.95	9.9																			SUB_004_100	23	**13.9**	**0.23**
									1,832	2.006	2.29	Unpaved	13.36																
SUB_004_110		3,333	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			SUB_004_110	40	**24.3**	**0.40**
									1,518	0.807	1.45	Unpaved	17.45																
														1,716	0.734					3.72	3.72	7.69								
SUB_004_120		3,147	100.0	0.150	Grass-Short Grass Prairie	3.897	3.95	6.8																			SUB_004_120	31	**18.8**	**0.31**
									2,122	1.617	2.05	Unpaved	17.24																
														925	0.500					2.09	2.09	7.38								
SUB_004_130		1,986	100.0	0.150	Grass-Short Grass Prairie	2.640	3.95	7.9																			SUB_004_130	21	**12.7**	**0.21**
									1,140	2.854	2.73	Unpaved	6.97																
														746	1.432	24.8	52.8	0.055	1.96		1.96	6.34								

Appendix B-3

Kee Branch Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_000_010		3,087	100	0.150	Grass-Short Grass Prairie	4.900	3.95	6.2																		KEE_000_010	6.2	**24.8**	**0.41**
									832	0.921	1.95	Paved	7.11														7.1		
														2,155	0.675	4.8	15.0	0.045	1.28		1.28	28.11					28.1		
KEE_000_020		4,034	100	0.150	Grass-Short Grass Prairie	0.690	3.95	13.5																		KEE_000_020	13.5	**20.3**	**0.34**
									663	1.437	2.44	Paved	4.54														4.5		
														1,092	2.116	5.9	10.7	0.045	3.24		3.24	5.62					5.6		
														2,179	0.588				3.58	3.58	3.58	10.14					10.1		
KEE_000_030		2,234	54	0.150	Grass-Short Grass Prairie	2.034	3.95	5.4																		KEE_000_030	5.4	**12.3**	**0.21**
									641	0.772	1.79	Paved	5.98														6.0		
														1,538	1.048	5.5	7.4	0.045	2.78		2.78	9.23					9.2		
KEE_000_040		1,299	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.510	3.95	0.5																		KEE_000_040	0.5	**3.4**	**0.06**
									622	2.811	3.41	Paved	3.04														3.0		
														628	2.524	17.4	19.3	0.045	4.92		4.92	2.13					2.1		
KEE_000_050		1,757	50	0.150	Grass-Short Grass Prairie	2.962	3.95	4.3																		KEE_000_050	4.3	**7.6**	**0.13**
									467	2.557	3.25	Paved	2.39														2.4		
														1,241	2.807	5.4	10.7	0.045	3.52		3.52	5.87					5.9		
KEE_000_060		3,065	50	0.150	Grass-Short Grass Prairie	2.965	3.95	4.3																		KEE_000_060	4.3	**14.7**	**0.24**
									537	3.404	3.75	Paved	2.39														2.4		
									2,268	1.273	2.29	Paved	16.48														16.5		
														210	1.455	7.7	13.8	0.045	2.70		2.70	1.30					1.3		
KEE_000_070		3,566	100	0.150	Grass-Short Grass Prairie	11.424	3.95	4.4																		KEE_000_070	4.4	**14.2**	**0.24**
									2,853	1.794	2.72	Paved	17.46														17.5		
														613	1.330	17.9	5.4	0.065	5.89		5.89	1.73					1.7		
KEE_000_080		2,338	100	0.150	Grass-Short Grass Prairie	2.610	3.95	7.9																		KEE_000_080	7.9	**16.7**	**0.28**
									1,517	2.118	2.96	Paved	8.55														8.5		
														721	0.552	13.0	45.9	0.045	1.06		1.06	11.33					11.3		
KEE_000_090		3,947	100	0.150	Grass-Short Grass Prairie	2.650	3.95	7.9																		KEE_000_090	7.9	**13.4**	**0.22**
									60	5.609	4.81	Paved	0.21														0.2		
									742	3.436	3.77	Paved	3.28														3.3		
														1,214	1.388	8.5	10.4	0.045	3.42		3.42	5.92					5.9		
																							1,831	6	6.00	5.1		5.1		
KEE_000_100		1,777	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.017	3.95	0.8																		KEE_000_100	0.8	**6.6**	**0.11**
									695	0.674	1.67	Paved	6.94														6.9		
																							862	6	6.00	2.4		2.4		
														170	0.631	33.7	11.6	0.065	3.72		3.72	0.76					0.8		
KEE_000_110		3,519	100	0.150	Grass-Short Grass Prairie	5.080	3.95	6.1																		KEE_000_110	6.1	**11.3**	**0.19**
									1,546	2.758	3.38	Paved	7.63														7.6		
																							1,874	6	6.00	5.2		5.2		
KEE_000_120		4,341	100	0.150	Grass-Short Grass Prairie	2.208	3.95	8.5																		KEE_000_120	8.5	**13.0**	**0.22**
									94	3.605	3.86	Paved	0.41														0.4		
									818	2.235	3.04	Paved	4.49														4.5		
																							1,289	6	6.00	3.6		3.6		
														2,040	1.426	5.6	11.7	0.015	7.29		7.29	4.66					4.7		
KEE_000_130		3,538	100	0.150	Grass-Short Grass Prairie	6.001	3.95	5.7																		KEE_000_130	5.7	**10.5**	**0.17**
									627	3.096	3.58	Paved	2.92														2.9		
									459	2.576	3.26	Paved	2.34														2.3		
																							2,351	6	6.00	6.5		6.5		
KEE_000_140		1,799	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		KEE_000_140	15.4	**12.8**	**0.21**
									344	1.009	2.04	Paved	2.81														2.8		
																							552	6	6.00	1.5		1.5		
														803	0.768				8.33	8.33	8.33	1.61					1.6		
KEE_000_150		4,517	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.139	3.95	0.4																		KEE_000_150	0.4	**10.2**	**0.17**
									1,044	2.939	3.49	Paved	4.99														5.0		
																							1,498	6	6.00	4.2		4.2		
														443	0.875	6.0	10.5	0.015	6.37		6.37	1.16					1.2		
														1,482	1.334	17.1	16.4	0.045	3.93		3.93	6.28					6.3		
KEE_000_160		4,517	60	0.150	Grass-Short Grass Prairie	5.796	3.95	3.8																		KEE_000_160	3.8	**11.6**	**0.19**
									1,732	3.077	3.57	Paved	8.10														8.1		
																							2,518	6	6.00	7.0		7.0		
														208	0.525				7.26	7.26	7.26	0.48					0.5		
KEE_000_170		2,524	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.440	3.95	0.4																		KEE_000_170	0.4	**13.0**	**0.22**
														2,474	0.860	11.8	23.5	0.045	1.94		1.94	21.25					21.3		
KEE_000_180		2,661	100	0.150	Grass-Short Grass Prairie	1.856	3.95	9.1																		KEE_000_180	9.1	**15.9**	**0.27**
									1,466	1.436	2.44	Paved	10.03														10.0		
														1,095	1.316	7.7	14.7	0.045	2.47		2.47	7.39					7.4		
KEE_000_190		2,588	100	0.150	Grass-Short Grass Prairie	7.600	3.95	5.2																		KEE_000_190	5.2	**7.9**	**0.13**
									993	4.530	4.33	Paved	3.83														3.8		
																							1,495	6	6.00	4.2		4.2		
KEE_000_200		3,249	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.191	3.95	0.8																		KEE_000_200	0.8	**6.6**	**0.11**
									398	1.732	2.68	Paved	2.48														2.5		
																							2,801	6	6.00	7.8		7.8		
KEE_000_210		1,254	100	0.150	Grass-Short Grass Prairie	4.450	3.95	6.4																		KEE_000_210	6.4	**6.5**	**0.11**
									1,023	4.303	4.22	Paved	4.04														4.0		
																							131	6	6.00	0.4		0.4		
KEE_000_220		5,107	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.505	3.95	1.1																		KEE_000_220	1.1	**9.6**	**0.16**
									325	2.255	3.05	Paved	1.77														1.8		
																							2,301	6	6.00	6.4		6.4		
														530	0.952	22.7	11.2	0.050	4.67		4.67	1.89					1.9		
														310	2.812	2.7	4.6	0.015	11.70		11.70	0.44					0.4		
																							1,592	6	6.00	4.4		4.4		
KEE_000_230		3,201	100	0.150	Grass-Short Grass Prairie	5.898	3.95	5.7																		KEE_000_230	5.7	**10.2**	**0.17**
									279	2.645	3.31	Paved	1.41														1.4		
														1,817	2.361	1.3	7.3	0.015	4.89		4.89	6.20					6.2		

Appendix B-3

Kee Branch Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							286	6	6.00	0.8		0.8		
																												2.9		
KEE_000_240		2,832	100	0.150	Grass-Short Grass Prairie	4.426	3.95	6.4						720	1.506	16.8	9.2	0.065	4.19		4.19	2.87					KEE_000_240	6.4	**11.8**	**0.20**
									756	3.744	3.93	Paved	3.20														3.2		
									1,590	2.170	2.99	Paved	8.85														8.8		
																							109	6	6.00	0.3		0.3		
														277	2.964	23.3	14.1	0.065	5.52		5.52	0.84						0.8		
KEE_000_250		3,233	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.220	3.95	0.4																			KEE_000_250	0.4	**6.6**	**0.11**
									1,454	4.093	4.11	Paved	5.89														5.9		
																							1,729	6	6.00	4.8		4.8		
KEE_000_260		4,376	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.026	3.95	0.4																			KEE_000_260	0.4	**9.9**	**0.16**
									2,638	3.363	3.73	Paved	11.79														11.8		
																							144	6	6.00	0.4		0.4		
														1,545	1.122				6.71	6.71	6.71	3.84						3.8		
KEE_000_270		3,616	50	0.150	Grass-Short Grass Prairie	0.500	3.95	8.8																			KEE_000_270	8.8	**12.7**	**0.21**
														3,313	2.212	15.0	16.0	0.045	4.71		4.71	11.72						11.7		
																							253	6	6.00	0.7		0.7		
KEE_000_280		3,496	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.999	3.95	0.8																			KEE_000_280	0.8	**6.4**	**0.11**
									69	0.795	1.81	Paved	0.63														0.6		
																							1,688	6	6.00	4.7		4.7		
														452	2.424	1.5	3.5	0.015	8.72		8.72	0.86						0.9		
																							678	6	6.00	1.9		1.9		
														558	2.041	7.7	5.5	0.050	5.33		5.33	1.75						1.7		
KEE_000_290		2,617	100	0.150	Grass-Short Grass Prairie	1.000	3.95	11.6																			KEE_000_290	11.6	**13.3**	**0.22**
									733	1.173	2.20	Paved	5.55														5.5		
																							1,784	6	6.00	5.0		5.0		
KEE_000_300		3,375	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.367	3.95	0.6																			KEE_000_300	0.6	**9.7**	**0.16**
									780	1.743	2.68	Paved	4.84														4.8		
																							505	6	6.00	1.4		1.4		
									1,065	1.768	2.70	Paved	6.57														6.6		
																							976	6	6.00	2.7		2.7		
KEE_000_310		2,056	100	0.150	Grass-Short Grass Prairie	10.600	3.95	4.5																			KEE_000_310	4.5	**8.5**	**0.14**
									1,744	2.453	3.18	Paved	9.13														9.1		
																							212	6	6.00	0.6		0.6		
KEE_000_320		5,147	60	0.150	Grass-Short Grass Prairie	7.099	3.95	3.5																			KEE_000_320	3.5	**14.9**	**0.25**
									1,321	1.910	2.81	Paved	7.84														7.8		
									1,642	1.903	2.80	Paved	9.76														9.8		
														1,946	2.147	1.0	1.8	0.015	9.78		9.78	3.32						3.3		
														177	2.605	56.7	16.6	0.065	8.38		8.38	0.35						0.4		
KEE_000_330		1,743	100	0.150	Grass-Short Grass Prairie	1.485	3.95	9.9																			KEE_000_330	9.9	**9.4**	**0.16**
														1,643	3.018	8.0	10.5	0.045	4.79		4.79	5.71						5.7		
KEE_000_340		2,174	30	0.150	Grass-Short Grass Prairie	2.694	3.95	3.0																			KEE_000_340	3.0	**7.8**	**0.13**
									738	1.273	2.29	Paved	5.36														5.4		
														1,228	3.625	4.1	6.6	0.045	4.62		4.62	4.43						4.4		
														178	11.612	16.9	6.3	0.065	15.05		15.05	0.20						0.2		
KEE_001_010		3,375	100	0.150	Grass-Short Grass Prairie	6.151	3.95	5.6																			KEE_001_010	5.6	**10.4**	**0.17**
									1,063	3.256	3.67	Paved	4.83														4.8		
														218	1.637	1.5	4.7	0.045	1.99		1.99	1.83						1.8		
														526	0.799	7.8	7.9	0.015	8.81		8.81	1.00						1.0		
																							1,468	6	6.00	4.1		4.1		
KEE_001_020		1,554	100	0.150	Grass-Short Grass Prairie	3.210	3.95	7.3																			KEE_001_020	7.3	**7.7**	**0.13**
									867	3.248	3.66	Paved	3.94														3.9		
																							100	6	6.00	0.3		0.3		
														486	2.993	54.2	30.5	0.065	5.82		5.82	1.39						1.4		
KEE_001_030		1,340	100	0.150	Grass-Short Grass Prairie	4.670	3.95	6.3																			KEE_001_030	6.3	**6.8**	**0.11**
									634	2.329	3.10	Paved	3.41														3.4		
														606	1.393	15.4	8.3	0.045	5.92		5.92	1.71						1.7		
KEE_002_010		2,469	100	0.150	Grass-Short Grass Prairie	1.870	3.95	9.1																			KEE_002_010	9.1	**10.2**	**0.17**
									626	3.214	3.64	Paved	2.86														2.9		
														655	3.682	12.2	9.4	0.065	5.22		5.22	2.09						2.1		
																							1,088	6	6.00	3.0		3.0		
KEE_002_020		1,349	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			KEE_002_020	15.4	**12.7**	**0.21**
									179	1.891	2.80	Paved	1.07														1.1		
									465	1.488	2.48	Paved	3.13														3.1		
																							605	6	6.00	1.7		1.7		
KEE_004_010		3,383	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.300	3.95	0.7																			KEE_004_010	0.7	**13.5**	**0.22**
									2,242	1.156	2.19	Paved	17.10														17.1		
														314	1.003	3.9	5.6	0.015	7.88		7.88	0.66						0.7		
									311	0.665	1.66	Paved	3.13														3.1		
														466	1.303	4.5	6.3	0.015	9.02		9.02	0.86						0.9		
KEE_004_020		3,028	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.630	3.95	0.7																			KEE_004_020	0.7	**6.9**	**0.12**
									1,199	2.240	3.04	Paved	6.57														6.6		
																							1,066	6	6.00	3.0		3.0		
														713	0.635				9.01	9.01	9.01	1.32						1.3		
KEE_004_030		3,428	100	0.150	Grass-Short Grass Prairie	1.682	3.95	9.5																			KEE_004_030	9.5	**15.1**	**0.25**
									546	2.474	3.20	Paved	2.85														2.8		
									1,024	1.090	2.12	Paved	8.04														8.0		
																							1,757	6	6.00	4.9		4.9		
KEE_004_040		1,473	87	0.150	Grass-Short Grass Prairie	3.045	3.95	6.7																			KEE_004_040	6.7	**6.9**	**0.12**
									138	2.116	2.96	Paved	0.78														0.8		
									170	1.563	2.54	Paved	1.11														1.1		
																							1,078	6	6.00	3.0		3.0		
KEE_004_050		1,412	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.520	3.95	0.7																			KEE_004_050	0.7	**3.9**	**0.06**
									894	2.662	3.32	Paved	4.49														4.5		
																							468	6	6.00	1.3		1.3		
KEE_005_010		3,260	100	0.150	Grass-Short Grass Prairie	2.370	3.95	8.2																			KEE_005_010	8.2	**11.3**	**0.19**
									404	1.556	2.54	Paved	2.66														2.7		
														483	2.007	58.5	23.7	0.065	5.94		5.94	1.36						1.4		
														463	0.970	84.0	38.7	0.050	4.93		4.93	1.57						1.6		
																							1,811	6	6.00	5.0		5.0		

Kee Branch Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
KEE_005_020		3,664	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.000	3.95	0.8																			KEE_005_020	0.8	**7.9**	**0.13**
														906	1.467	29.3	31.9	0.045	3.80		3.80	3.98						4.0		
																							867	6	6.00	2.4		2.4		
														1,840	1.124	30.1	17.2	0.045	5.09		5.09	6.03						6.0		
KEE_005_030		3,020	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.980	3.95	0.5																			KEE_005_030	0.5	**9.6**	**0.16**
									305	1.304	2.32	Paved	2.19														2.2		
									774	1.280	2.30	Paved	5.61														5.6		
																							589	6	6.00	1.6		1.6		
														802	0.753	10.3	6.1	0.065	2.83		2.83	4.72						4.7		
																							500	6	6.00	1.4		1.4		
KEE_005_040		1,614	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.500	3.95	0.7																			KEE_005_040	0.7	**3.7**	**0.06**
									1,171	4.716	4.41	Paved	4.42														4.4		
																							393	6	6.00	1.1		1.1		
KEE_KB1_001_010		2,967	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.847	3.95	0.6																			KEE_KB1_001_010	0.6	**5.9**	**0.10**
									453	2.351	3.12	Paved	2.42														2.4		
																							2,464	6	6.00	6.8		6.8		
KEE_KB1_001_020		2,885	100	0.150	Grass-Short Grass Prairie	4.280	3.95	6.5																			KEE_KB1_001_020	6.5	**10.0**	**0.17**
									94	4.891	4.50	Paved	0.35														0.3		
									629	1.486	2.48	Paved	4.23														4.2		
														97	1.107	5.9	10.5	0.015	7.14		7.14	0.23						0.2		
																							237	6	6.00	0.7		0.7		
														451	0.747	2.9	3.5	0.015	7.46		7.46	1.01						1.0		
														532	1.340				5.50	5.50	5.50	1.61						1.6		
														426	1.319				9.20	9.20	9.20	0.77						0.8		
														318	1.195				3.90	3.90	3.90	1.36						1.4		
KEE_KB1_001_030		696	100	0.150	Grass-Short Grass Prairie	3.406	3.95	7.1																			KEE_KB1_001_030	7.1	**5.5**	**0.09**
									596	5.342	4.70	Paved	2.11														2.1		
KEE_KB1_010		3,559	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.067	3.95	0.8																			KEE_KB1_010	0.8	**6.2**	**0.10**
									647	5.107	4.59	Paved	2.35														2.3		
																							703	6	6.00	2.0		2.0		
														1,234	1.280	3.5	6.3	0.015	7.61		7.61	2.70						2.7		
																							925	6	6.00	2.6		2.6		
KEE_KB1_020		4,817	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.810	3.95	0.5																			KEE_KB1_020	0.5	**10.1**	**0.17**
									770	1.529	2.51	Paved	5.11														5.1		
																							3,998	6	6.00	11.1		11.1		
KEE_KB1_030		4,936	50	0.150	Grass-Short Grass Prairie	4.172	3.95	3.8																			KEE_KB1_030	3.8	**13.1**	**0.22**
									810	2.627	3.29	Paved	4.10														4.1		
																							129	6	6.00	0.4		0.4		
														2,566	1.746	8.7	9.0	0.045	4.26		4.26	10.03						10.0		
														232	1.415	1.6	2.7	0.015	8.34		8.34	0.46						0.5		
																							1,149	6	6.00	3.2		3.2		
KEE_KB1_040		3,426	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																			KEE_KB1_040	0.9	**7.9**	**0.13**
									1,487	3.011	3.53	Paved	7.03														7.0		
																							1,890	6	6.00	5.3		5.3		
KEE_KB1_050		2,596	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.620	3.95	1.0																			KEE_KB1_050	1.0	**5.3**	**0.09**
														872	2.111	17.5	18.4	0.045	4.66		4.66	3.12						3.1		
																							1,674	6	6.00	4.7		4.7		
KEE_KB1_060		3,711	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.080	3.95	0.5																			KEE_KB1_060	0.5	**9.4**	**0.16**
									231	0.917	1.95	Paved	1.98														2.0		
									149	5.852	4.92	Paved	0.51														0.5		
														493	0.637	1.8	5.9	0.015	3.57		3.57	2.30						2.3		
														1,246	1.791	4.8	6.5	0.045	3.63		3.63	5.72						5.7		
														371	2.868	4.0	3.4	0.065	4.35		4.35	1.42						1.4		
																							1,171	6	6.00	3.3		3.3		

Appendix B-3

Lower Rush Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
PAN_000_010		4,143	100	0.150	Grass-Short Grass Prairie	3.879	3.95	6.8																		PAN_000_010	6.8	**14.7**	**0.24**
									702	2.327	3.10	Paved	3.77														3.8		
									804	0.925	1.96	Paved	6.85														6.9		
																						2,535	6.00	6.00	7.0		7.0		
PAN_000_020		2,536	100	0.150	Grass-Short Grass Prairie	1.424	3.95	10.1																		PAN_000_020	10.1	**12.0**	**0.20**
									962	1.806	2.73	Paved	5.87														5.9		
																						1,474	6.00	6.00	4.1		4.1		
PAN_000_030		4,382	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.843	3.95	0.9																		PAN_000_030	0.9	**11.6**	**0.19**
									1,377	0.938	1.97	Paved	11.66														11.7		
														2,352	0.667			0.015	7.63	7.63	7.63	5.14						5.1		
																						604	6.00	6.00	1.7		1.7		
PAN_000_040		4,196	100	0.150	Grass-Short Grass Prairie	6.914	3.95	5.4																		PAN_000_040	5.4	**12.9**	**0.21**
									113	8.527	5.94	Paved	0.32														0.3		
									1,282	1.628	2.59	Paved	8.24														8.2		
																						2,698	6.00	6.00	7.5		7.5		
PAN_000_050		4,121	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.571	3.95	1.0																		PAN_000_050	1.0	**10.5**	**0.18**
									491	0.544	1.50	Paved	5.46														5.5		
																						2,846	6.00	6.00	7.9		7.9		
														734	0.704			0.065	3.86	3.86	3.86	3.17						3.2		
PAN_000_060		6,759	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.284	3.95	0.5																		PAN_000_060	0.5	**14.4**	**0.24**
									1,691	2.112	2.95	Paved	9.54														9.5		
																						5,018	6.00	6.00	13.9		13.9		
PAN_000_070		5,912	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.579	3.95	1.0																		PAN_000_070	1.0	**11.4**	**0.19**
									732	2.560	3.25	Paved	3.75														3.8		
																						5,130	6.00	6.00	14.3		14.3		
PAN_000_080		2,612	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		PAN_000_080	1.1	**11.8**	**0.20**
									2,221	1.112	2.14	Paved	17.27														17.3		
														341	4.360	16.3	17.5	0.065	4.57		4.57	1.24						1.2		
PAN_000_090		5,232	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.011	3.95	0.6																		PAN_000_090	0.6	**13.5**	**0.23**
									854	0.500	1.44	Paved	9.90														9.9		
																						4,328	6.00	6.00	12.0		12.0		
PAN_000_100		2,042	100	0.150	Grass-Short Grass Prairie	0.748	3.95	13.1																		PAN_000_100	13.1	**15.1**	**0.25**
									258	0.786	1.80	Paved	2.39														2.4		
									1,685	2.054	2.91	Paved	9.64														9.6		
PAN_000_110		2,848	100	0.150	Grass-Short Grass Prairie	2.376	3.95	8.2																		PAN_000_110	8.2	**12.3**	**0.20**
									958	1.160	2.19	Paved	7.29														7.3		
																						1,790	6.00	6.00	5.0		5.0		
PAN_000_120		2,917	100	0.150	Grass-Short Grass Prairie	2.420	3.95	8.2																		PAN_000_120	8.2	**10.8**	**0.18**
									228	3.247	3.66	Paved	1.04														1.0		
									714	2.717	3.35	Paved	3.55														3.6		
																						1,876	6.00	6.00	5.2		5.2		
PAN_000_130		3,301	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.457	3.95	0.7																		PAN_000_130	0.7	**18.4**	**0.31**
									601	3.667	3.89	Paved	2.57														2.6		
														2,650	0.886	10.4	27.8	0.045	1.61		1.61	27.39						27.4		
RUS_000_360		3,176	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_360	1.1	**8.0**	**0.13**
									1,427	2.340	3.11	Paved	7.65														7.6		
																						1,497	6.00	6.00	4.2		4.2		
														202	8.113	17.4	14.8	0.065	7.28		7.28	0.46						0.5		
RUS_000_370		2,146	50	0.150	Grass-Short Grass Prairie	3.750	3.95	3.9																		RUS_000_370	3.9	**7.8**	**0.13**
									171	8.763	6.02	Paved	0.47														0.5		
														1,927	3.223	6.1	12.1	0.045	3.77		3.77	8.53						8.5		
RUS_000_380		674	100	0.150	Grass-Short Grass Prairie	4.730	3.95	6.2																		RUS_000_380	6.2	**4.7**	**0.08**
									573	7.984	5.74	Paved	1.66														1.7		
RUS_000_390		2,658	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.672	3.95	1.0																		RUS_000_390	1.0	**11.0**	**0.18**
									1,257	0.579	1.55	Paved	13.54														13.5		
																						1,352	6.00	6.00	3.8		3.8		
RUS_000_400		1,435	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.646	3.95	1.0																		RUS_000_400	1.0	**3.1**	**0.05**
									478	5.274	4.67	Paved	1.71														1.7		
																						907	6.00	6.00	2.5		2.5		
RUS_000_410		4,837	100	0.150	Grass-Short Grass Prairie	3.876	3.95	6.8																		RUS_000_410	6.8	**12.9**	**0.22**
									1,216	3.291	3.69	Paved	5.50														5.5		
																						508	6.00	6.00	1.4		1.4		
														2,220	1.962	1.7	5.2	0.015	6.48		6.48	5.71						5.7		
																						791	6.00	6.00	2.2		2.2		
RUS_000_420		2,655	50	0.150	Grass-Short Grass Prairie	1.100	3.95	6.4																		RUS_000_420	6.4	**8.8**	**0.15**
									375	2.429	3.17	Paved	1.97														2.0		
																						2,231	6.00	6.00	6.2		6.2		
RUS_000_430		1,770	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.928	3.95	0.4																		RUS_000_430	0.4	**4.3**	**0.07**
									1,220	3.529	3.82	Paved	5.32														5.3		
																						501	6.00	6.00	1.4		1.4		
RUS_000_440		391	100	0.150	Grass-Short Grass Prairie	3.155	3.95	7.3																		RUS_000_440	7.3	**5.5**	**0.09**
									287	2.680	2.64	Unpaved	1.81														1.8		
RUS_000_450		5,802	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.109	3.95	0.8																		RUS_000_450	0.8	**13.9**	**0.23**
									929	0.722	1.73	Paved	8.96														9.0		
																						4,822	6.00	6.00	13.4		13.4		
RUS_000_460		2,409	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.526	3.95	1.1																		RUS_000_460	1.1	**7.6**	**0.13**
									653	0.621	1.60	Paved	6.79														6.8		
																						1,707	6.00	6.00	4.7		4.7		

Lower Rush Ultimate Time of Concentration Calculations

			Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_470														1,965	0.500	100.4	58.2	0.050	3.03		3.03	10.80					RUS_000_470	10.8	**6.5**	**0.11**
RUS_000_480														297	0.500	104.1	60.6	0.065	2.32		2.32	2.13					RUS_000_480	10.0	**6.0**	**0.10**
RUS_000_500		856												856	1.719	140.3	36.4	0.065	7.39		7.39	1.93					RUS_000_500	10.0	**6.0**	**0.10**
RUS_000_510		3,401	50	0.150	Grass-Short Grass Prairie	3.981	3.95	3.8																			RUS_000_510	3.8	**10.5**	**0.18**
									1,647	4.446	4.29	Paved	6.40															6.4		
														1,704	1.624	2.5	2.8	0.045	3.89		3.89	7.30						7.3		
RUS_000_520		689	100	0.150	Grass-Short Grass Prairie	1.650	3.95	9.5																			RUS_000_520	9.5	**7.5**	**0.13**
									589	2.603	3.28	Paved	2.99															3.0		
RUS_000_530		5,641	100	0.150	Grass-Short Grass Prairie	7.835	3.95	5.1																			RUS_000_530	5.1	**35.1**	**0.59**
									3,227	0.500	1.44	Paved	37.42															37.4		
														2,315	0.500	105.9	58.3	0.065	2.41		2.41	15.99						16.0		
RUS_003_010		2,458	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.628	3.95	1.0																			RUS_003_010	1.0	**5.7**	**0.10**
									731	2.369	3.13	Paved	3.89															3.9		
																							1,676	6.00	6.00	4.7		4.7		
RUS_003_020		3,664	98	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.191	3.95	1.0																			RUS_003_020	1.0	**7.8**	**0.13**
									740	2.179	3.00	Paved	4.11															4.1		
																							2,826	6.00	6.00	7.9		7.9		
RUS_004_001_010		2,717	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.713	3.95	0.9																			RUS_004_001_010	0.9	**14.8**	**0.25**
														2,666	0.585	9.2	14.4	0.045	1.88		1.88	23.68						23.7		
RUS_004_001_020		2,250	100	0.150	Grass-Short Grass Prairie	5.307	3.95	6.0																			RUS_004_001_020	6.0	**8.3**	**0.14**
									560	2.970	3.50	Paved	2.66															2.7		
														455	1.358	8.0	10.2	0.045	3.27		3.27	2.32						2.3		
														1,135	0.777			0.065	6.66	6.66	6.66	2.84						2.8		
RUS_004_001_030		2,222	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.375	3.95	0.7																			RUS_004_001_030	0.7	**5.1**	**0.09**
														891	3.344	5.5	13.7	0.045	3.29		3.29	4.52						4.5		
														1,278	2.228			0.065	6.43	6.43	6.43	3.31						3.3		
RUS_004_001_040		592	100	0.150	Grass-Short Grass Prairie	5.366	3.95	5.9																			RUS_004_001_040	5.9	**4.3**	**0.07**
									494	10.075	6.45	Paved	1.28															1.3		
RUS_004_010		3,537	77	0.150	Grass-Short Grass Prairie	3.850	3.95	5.5																			RUS_004_010	5.5	**15.2**	**0.25**
									100	2.405	3.15	Paved	0.53															0.5		
									614	0.914	1.94	Paved	5.27															5.3		
																							515	6.00	6.00	1.4		1.4		
														2,231	0.537	23.8	17.9	0.045	2.94		2.94	12.65						12.7		
RUS_004_020		2,424	100	0.150	Grass-Short Grass Prairie	1.256	3.95	10.6																			RUS_004_020	10.6	**18.1**	**0.30**
									1,076	0.506	1.45	Paved	12.40															12.4		
														1,246	0.850	8.3	9.0	0.045	2.89		2.89	7.19						7.2		
RUS_004_030		1,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.391	3.95	0.7																			RUS_004_030	0.7	**7.3**	**0.12**
									1,188	1.434	2.43	Paved	8.13															8.1		
														556	0.500			0.055	2.87	2.87	2.87	3.23						3.2		
RUS_004_040		1,909	100	0.150	Grass-Short Grass Prairie	2.384	3.95	8.2																			RUS_004_040	8.2	**12.9**	**0.21**
									726	0.500	1.44	Paved	8.42															8.4		
														1,084	3.061			0.045	3.73	3.73	3.73	4.84						4.8		
RUS_004_050		2,011	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.174	3.95	0.5																			RUS_004_050	0.5	**4.6**	**0.08**
									646	3.614	3.86	Paved	2.79															2.8		
									638	1.985	2.86	Paved	3.71															3.7		
														677	2.910	311.4	137.2	0.024	18.29		18.29	0.62						0.6		
RUS_005_002_010		3,287	60	0.150	Grass-Short Grass Prairie	9.203	3.95	3.2																			RUS_005_002_010	3.2	**8.9**	**0.15**
									1,438	3.112	3.59	Paved	6.68															6.7		
																							1,789	6.00	6.00	5.0		5.0		
RUS_005_010		3,228	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.900	3.95	0.6																			RUS_005_010	0.6	**9.7**	**0.16**
									1,760	1.571	2.55	Paved	11.51															11.5		
																							1,417	6.00	6.00	3.9		3.9		
RUS_005_020		1,426	56	0.150	Grass-Short Grass Prairie	8.478	3.95	3.1																			RUS_005_020	3.1	**6.0**	**0.10**
									755	2.282	3.07	Paved	4.10															4.1		
									615	3.197	3.63	Paved	2.82															2.8		
RUS_005_030		3,299	81	0.150	Grass-Short Grass Prairie	1.329	3.95	8.8																			RUS_005_030	8.8	**13.4**	**0.22**
									1,672	2.126	2.96	Paved	9.40															9.4		
																							1,257	6.00	6.00	3.5		3.5		
														289	2.204	1.4	3.6	0.015	7.83		7.83	0.62						0.6		
RUS_005_040		1,121	100	0.150	Grass-Short Grass Prairie	4.480	3.95	6.4																			RUS_005_040	6.4	**7.7**	**0.13**
									804	1.240	2.26	Paved	5.92															5.9		
																							217	6.00	6.00	0.6		0.6		
RUS_005_050		4,115	100	0.150	Grass-Short Grass Prairie	5.308	3.95	6.0																			RUS_005_050	6.0	**14.4**	**0.24**
														2,095	1.936	1.9	4.0	0.045	2.76		2.76	12.67						12.7		
																							1,921	6.00	6.00	5.3		5.3		
RUS_005_060		1,894	100	0.150	Grass-Short Grass Prairie	3.446	3.95	7.1																			RUS_005_060	7.1	**12.3**	**0.20**
									1,441	0.916	1.95	Paved	12.34															12.3		
																							354	6.00	6.00	1.0		1.0		
RUS_005_070		671	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.864	3.95	0.9																			RUS_005_070	0.9	**2.6**	**0.04**
									621	2.199	3.01	Paved	3.43															3.4		
RUS_006_010		2,750	38	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.841	3.95	0.3																			RUS_006_010	0.3	**5.9**	**0.10**
									677	3.792	3.96	Paved	2.85															2.9		
														2,035	2.914	45.5	30.9	0.065	5.06		5.06	6.70						6.7		
RUS_RC2_010		4,624	100	0.150	Grass-Short Grass Prairie	5.259	3.95	6.0																			RUS_RC2_010	6.0	**12.7**	**0.21**
									1,085	2.477	3.20	Paved	5.65															5.7		
																							3,440	6.00	6.00	9.6		9.6		
RUS_RC2_020		3,281	49	0.150	Grass-Short Grass Prairie	3.496	3.95	4.0																			RUS_RC2_020	4.0	**10.0**	**0.17**
														1,238	2.750	3.3	8.5	0.045	2.90		2.90	7.11						7.1		
																							1,994	6.00	6.00	5.5		5.5		
RUS_RC2_030		2,943	100	0.150	Grass-Short Grass Prairie	3.122	3.95	7.4																			RUS_RC2_030	7.4	**11.5**	**0.19**
														1,631	1.945	4.2	7.2	0.045	3.21		3.21	8.46						8.5		

Lower Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							1,212	6.00	6.00	3.4		3.4		
RUS_RC2_040		2,905	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_040	1.1	**9.0**	**0.15**
									1,470	1.426	2.43	Paved	10.09														10.1		
																							1,385	6.00	6.00	3.8		3.8		
RUS_RC2_050		3,579	100	0.150	Grass-Short Grass Prairie	4.446	3.95	6.4																			RUS_RC2_050	6.4	**12.9**	**0.21**
									398	2.553	3.25	Paved	2.04														2.0		
									963	1.234	2.26	Paved	7.11														7.1		
																							2,117	6.00	6.00	5.9		5.9		
RUS_RC2_060		3,143	65	0.150	Grass-Short Grass Prairie	8.975	3.95	3.4																			RUS_RC2_060	3.4	**8.3**	**0.14**
									860	4.128	4.13	Paved	3.47														3.5		
																							1,110	6.00	6.00	3.1		3.1		
														740	2.606	14.8	11.5	0.065	4.39		4.39	2.81						2.8		
																							369	6.00	6.00	1.0		1.0		
RUS_RC2_070		2,142	42	0.150	Grass-Short Grass Prairie	20.469	3.95	1.7																			RUS_RC2_070	1.7	**6.4**	**0.11**
									1,843	3.404	3.75	Paved	8.19														8.2		
																							257	6.00	6.00	0.7		0.7		
RUS_RC2_080		1,482	100	0.150	Grass-Short Grass Prairie	7.150	3.95	5.3																			RUS_RC2_080	5.3	**6.3**	**0.11**
									418	5.026	4.56	Paved	1.53														1.5		
									612	2.960	3.50	Paved	2.92														2.9		
														353	6.538	10.7	7.9	0.065	7.17		7.17	0.82						0.8		
RUS_RC2_085		2,259	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_085	1.1	**6.0**	**0.10**
									762	1.644	2.61	Paved	4.87														4.9		
																							1,448	6.00	6.00	4.0		4.0		
RUS_RC2_090		3,894	83	0.150	Grass-Short Grass Prairie	8.486	3.95	4.3																			RUS_RC2_090	4.3	**13.6**	**0.23**
									1,159	3.169	3.62	Paved	5.34														5.3		
																							238	6.00	6.00	0.7		0.7		
														1,893	1.779	19.5	21.2	0.065	2.90		2.90	10.89						10.9		
																							522	6.00	6.00	1.5		1.5		
RUS_RC2_100		2,889	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.922	3.95	0.6																			RUS_RC2_100	0.6	**6.9**	**0.12**
									1,351	2.673	3.32	Paved	6.77														6.8		
																							1,489	6.00	6.00	4.1		4.1		
RUS_RC2_110		1,928	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																			RUS_RC2_110	1.1	**4.8**	**0.08**
									1,114	3.655	3.89	Paved	4.78														4.8		
																							764	6.00	6.00	2.1		2.1		
RUS_RCH_010		3,584	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	7.263	3.95	0.4																			RUS_RCH_010	0.4	**6.1**	**0.10**
														1,780	4.622	19.8	14.9	0.065	5.95		5.95	4.98						5.0		
																							1,755	6.00	6.00	4.9		4.9		
RUS_RCH_020		1,780	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.105	3.95	0.6																			RUS_RCH_020	0.6	**7.2**	**0.12**
									114	4.464	4.29	Paved	0.44														0.4		
									759	0.523	1.47	Paved	8.60														8.6		

Appendix B-3

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_190		3,167	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.916	3.95	0.6																		RUS_000_190	0.6	**10.7**	**0.18**
									1,512	0.949	1.98	Paved	12.73														12.7		
																						1,605	6.00	6.00	4.5		4.5		
RUS_000_200		1,447	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.039	3.95	0.8																		RUS_000_200	0.8	**3.7**	**0.06**
									1,398	4.474	4.30	Paved	5.42														5.4		
RUS_000_210		2,148	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.882	3.95	0.9																		RUS_000_210	0.9	**8.4**	**0.14**
									1,259	0.960	1.99	Paved	10.54														10.5		
																						420	6.00	6.00	1.2		1.2		
														417	3.444	31.0	24.1	0.065	5.03		5.03	1.38					1.4		
RUS_000_220		845	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.145	3.95	0.8																		RUS_000_220	0.8	**3.1**	**0.05**
									798	2.196	3.01	Paved	4.42														4.4		
RUS_000_230		1,908	45	0.150	Grass-Short Grass Prairie	3.872	3.95	3.6																		RUS_000_230	3.6	**6.8**	**0.11**
									1,391	3.055	3.55	Paved	6.52														6.5		
																						471	6.00	6.00	1.3		1.3		
RUS_000_240		1,677	100	0.150	Grass-Short Grass Prairie	1.500	3.95	9.9																		RUS_000_240	9.9	**9.4**	**0.16**
									205	3.455	3.78	Paved	0.90														0.9		
									221	1.290	2.31	Paved	1.60														1.6		
																						1,150	6.00	6.00	3.2		3.2		
RUS_000_250		754	100	0.150	Grass-Short Grass Prairie	5.942	3.95	5.7																		RUS_000_250	5.7	**4.6**	**0.08**
									655	7.526	5.58	Paved	1.96														2.0		
RUS_000_260		514	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.690	3.95	0.4																		RUS_000_260	0.4	**3.2**	**0.05**
									1,414	5.398	4.72	Paved	4.99														5.0		
RUS_000_270		3,893	100	0.150	Grass-Short Grass Prairie	1.409	3.95	10.1																		RUS_000_270	10.1	**17.4**	**0.29**
									752	1.895	2.80	Paved	4.48														4.5		
														1,417	2.138	10.5	18.3	0.065	2.31		2.31	10.22						10.2		
																						1,381	6.00	6.00	3.8		3.8		
														243	13.051	11.9	8.3	0.065	10.59		10.59	0.38						0.4		
RUS_000_280		1,435	50	0.150	Grass-Short Grass Prairie	10.597	3.95	2.6																		RUS_000_280	2.6	**6.4**	**0.11**
									1,004	1.551	2.53	Paved	6.61														6.6		
									380	4.792	4.45	Paved	1.42														1.4		
RUS_000_290		1,931	100	0.150	Grass-Short Grass Prairie	8.440	3.95	5.0																		RUS_000_290	5.0	**8.2**	**0.14**
									157	1.502	2.49	Paved	1.05														1.1		
														1,673	3.209	2.0	4.1	0.045	3.64		3.64	7.65						7.7		
RUS_000_300		2,275	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.074	3.95	0.6																		RUS_000_300	0.6	**4.3**	**0.07**
									37	3.377	3.74	Paved	0.17														0.2		
									118	3.837	3.98	Paved	0.49														0.5		
														2,068	3.722	1.3	7.4	0.015	5.86		5.86	5.89						5.9		
RUS_000_310		3,314	100	0.150	Grass-Short Grass Prairie	0.621	3.95	14.1																		RUS_000_310	14.1	**17.6**	**0.29**
														1,362	1.210	19.7	28.6	0.045	2.84		2.84	8.01						8.0		
																						407	6.00	6.00	1.1		1.1		
														1,142	1.393	62.0	39.7	0.065	3.64		3.64	5.23						5.2		
																						301	6.00	6.00	0.8		0.8		
RUS_000_320		3,334	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.801	3.95	0.4																		RUS_000_320	0.4	**7.2**	**0.12**
									243	8.064	5.77	Paved	0.70														0.7		
									538	1.979	2.86	Paved	3.14														3.1		
														328	1.140	6.8	7.9	0.045	3.23		3.23	1.70						1.7		
																						2,174	6.00	6.00	6.0		6.0		
RUS_000_330		3,501	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.676	3.95	0.6																		RUS_000_330	0.6	**16.2**	**0.27**
									1,910	0.530	1.48	Paved	21.51														21.5		
																						847	6.00	6.00	2.4		2.4		
														694	0.500	152.2	33.1	0.065	4.49		4.49	2.58						2.6		
RUS_000_340		2,466	100	0.150	Grass-Short Grass Prairie	5.295	3.95	6.0																		RUS_000_340	6.0	**10.4**	**0.17**
									861	4.877	4.49	Paved	3.20														3.2		
									691	3.183	3.63	Paved	3.18														3.2		
									814	1.818	2.74	Paved	4.95														4.9		
RUS_000_350		3,685	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.820	3.95	0.4																		RUS_000_350	0.4	**18.6**	**0.31**
									1,154	2.369	3.13	Paved	6.15														6.1		
														1,357	0.659	0.7	2.9	0.045	1.03		1.03	21.97						22.0		
																						590	6.00	6.00	1.6		1.6		
														535	4.495	70.0	89.0	0.024	11.21		11.21	0.80						0.8		
RUS_007_010		2,493	100	0.150	Grass-Short Grass Prairie	2.155	3.95	8.6																		RUS_007_010	8.6	**10.6**	**0.18**
									807	2.173	3.00	Paved	4.49														4.5		
														138	0.543	4.1	10.1	0.015	3.98		3.98	0.58						0.6		
																						1,448	6.00	6.00	4.0		4.0		
RUS_007_020		3,709	28	0.150	Grass-Short Grass Prairie	1.232	3.95	3.9																		RUS_007_020	3.9	**11.0**	**0.18**
									1,293	1.397	2.40	Paved	8.97														9.0		
																						171	6.00	6.00	0.5		0.5		
														1,837	1.419			0.015	7.83	7.83	7.83	3.91						3.9		
																						380	6.00	6.00	1.1		1.1		

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Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_007_030		3,847	100	0.150	Grass-Short Grass Prairie	1.067	3.95	11.3																		RUS_007_030	11.3	**19.6**	**0.33**
									1,090	0.691	1.69	Paved	10.75														10.8		
									791	1.475	2.47	Paved	5.34														5.3		
																						1,867	6.00	6.00	5.2		5.2		
RUS_007_040		3,613	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.499	3.95	0.5																		RUS_007_040	0.5	**10.7**	**0.18**
									273	0.712	1.72	Paved	2.65														2.7		
														1,182	2.761	4.7	11.2	0.045	3.09		3.09	6.38						6.4		
														2,106	1.153	80.2	35.5	0.065	4.24		4.24	8.28						8.3		
RUS_007_050		2,081	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_007_050	1.1	**6.6**	**0.11**
									1,310	1.878	2.79	Paved	7.84														7.8		
																						722	6.00	6.00	2.0		2.0		
RUS_007_060		972	53	0.150	Grass-Short Grass Prairie	3.872	3.95	4.1																		RUS_007_060	4.1	**5.1**	**0.09**
									777	2.448	3.18	Paved	4.07														4.1		
																						142	6.00	6.00	0.4		0.4		
RUS_007_070		3,594	100	0.150	Grass-Short Grass Prairie	5.870	3.95	5.7																		RUS_007_070	5.7	**13.2**	**0.22**
														2,102	1.452	15.5	27.5	0.045	2.73		2.73	12.85						12.9		
																						767	6.00	6.00	2.1		2.1		
														625	3.995	36.3	15.3	0.065	8.17		8.17	1.28						1.3		
RUS_008_010		4,459	100	0.150	Grass-Short Grass Prairie	0.750	3.95	13.1																		RUS_008_010	13.1	**17.4**	**0.29**
														1,283	1.961	2.4	4.6	0.045	3.03		3.03	7.07						7.1		
																						2,450	6.00	6.00	6.8		6.8		
														620	2.319	13.9	8.6	0.065	4.83		4.83	2.14						2.1		
RUS_009_010		3,279	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_010	1.1	**7.1**	**0.12**
									471	1.549	2.53	Paved	3.10														3.1		
																						2,758	6.00	6.00	7.7		7.7		
RUS_009_020		3,793	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.675	3.95	1.0																		RUS_009_020	1.0	**13.0**	**0.22**
									1,970	1.058	2.09	Paved	15.70														15.7		
																						1,774	6.00	6.00	4.9		4.9		
RUS_009_030		3,660	51	0.150	Grass-Short Grass Prairie	5.583	3.95	3.4																		RUS_009_030	3.4	**9.2**	**0.15**
									223	0.525	1.47	Paved	2.52														2.5		
																						3,387	6.00	6.00	9.4		9.4		
RUS_009_040		3,486	49	0.150	Grass-Short Grass Prairie	2.355	3.95	4.7																		RUS_009_040	4.7	**14.6**	**0.24**
									1,374	0.886	1.91	Paved	11.97														12.0		
														751	2.041	1.3	2.7	0.045	2.89		2.89	4.33						4.3		
																						435	6.00	6.00	1.2		1.2		
														878	1.504	1.4	3.3	0.015	7.01		7.01	2.09						2.1		
RUS_009_050		3,246	32	0.150	Grass-Short Grass Prairie	4.626	3.95	2.5																		RUS_009_050	2.5	**11.1**	**0.19**
									601	0.863	1.89	Paved	5.30														5.3		
																						409	6.00	6.00	1.1		1.1		
														1,290	1.118	38.9	52.1	0.045	2.88		2.88	7.46						7.5		
														914	1.797	1.1	2.8	0.015	7.24		7.24	2.10						2.1		
RUS_009_060		517	50	0.150	Grass-Short Grass Prairie	2.840	3.95	4.4																		RUS_009_060	4.4	**4.1**	**0.07**
									467	2.501	3.21	Paved	2.42														2.4		
RUS_009_070		1,305	100	0.150	Grass-Short Grass Prairie	3.928	3.95	6.7																		RUS_009_070	6.7	**6.5**	**0.11**
														1,205	2.903	11.8	14.8	0.045	4.85		4.85	4.14						4.1		
RUS_009_080		2,650	44	0.150	Grass-Short Grass Prairie	9.014	3.95	2.5																		RUS_009_080	2.5	**8.3**	**0.14**
									1,042	1.494	2.48	Paved	6.99														7.0		
																						1,563	6.00	6.00	4.3		4.3		
RUS_009_090		762	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_009_090	1.1	**2.3**	**0.04**
									712	4.333	4.23	Paved	2.80														2.8		
RUS_010_001_010		2,007	31	0.150	Grass-Short Grass Prairie	8.520	3.95	1.9																		RUS_010_001_010	1.9	**6.7**	**0.11**
									1,076	1.754	2.69	Paved	6.66														6.7		
																						900	6.00	6.00	2.5		2.5		
RUS_010_001_020		1,631	100	0.150	Grass-Short Grass Prairie	2.562	3.95	8.0																		RUS_010_001_020	8.0	**9.7**	**0.16**
									329	1.347	2.36	Paved	2.32														2.3		
									656	1.565	2.54	Paved	4.30														4.3		
																						546	6.00	6.00	1.5		1.5		
RUS_010_002_010		3,151	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.465	3.95	0.7																		RUS_010_002_010	0.7	**7.8**	**0.13**
									1,207	2.020	2.89	Paved	6.96														7.0		
																						1,892	6.00	6.00	5.3		5.3		
RUS_010_002_020		729	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.894	3.95	0.5																		RUS_010_002_020	0.5	**2.7**	**0.05**
									489	1.275	2.30	Paved	3.55														3.6		
																						185	6.00	6.00	0.5		0.5		
RUS_010_002_030		268	100	0.150	Grass-Short Grass Prairie	3.989	3.95	6.7																		RUS_010_002_030	6.7	**4.3**	**0.07**
									169	7.628	5.61	Paved	0.50														0.5		
RUS_010_003_010		3,676	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_003_010	1.1	**8.0**	**0.13**
									332	0.978	2.01	Paved	2.75														2.8		
																						2,801	6.00	6.00	7.8		7.8		
														493	2.675	8.4	5.6	0.065	4.95		4.95	1.66						1.7		
RUS_010_003_020		782	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.729	3.95	0.9																		RUS_010_003_020	0.9	**2.3**	**0.04**
									732	4.395	4.26	Paved	2.86														2.9		
RUS_010_004_010		3,696	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.845	3.95	0.6																		RUS_010_004_010	0.6	**13.0**	**0.22**
									2,116	1.071	2.10	Paved	16.76														16.8		
																						1,530	6.00	6.00	4.3		4.3		
RUS_010_004_020		2,840	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_010_004_020	1.1	**10.7**	**0.18**
									1,248	0.837	1.86	Paved	11.18														11.2		
														695	0.500	87.1	32.9	0.055	3.67		3.67	3.16						3.2		
																						846	6.00	6.00	2.4		2.4		
RUS_010_004_030		5,070	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_010_004_030	15.4	**23.5**	**0.39**
														2,154	0.945	13.7	23.5	0.045	2.25		2.25	15.95						15.9		
																						2,815	6.00	6.00	7.8		7.8		

Appendix B-3

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_010_004_040		1,541	41	0.150	Grass-Short Grass Prairie	2.760	3.95	3.8																		RUS_010_004_040	3.8	**6.1**	**0.10**
									977	2.681	3.33	Paved	4.89														4.9		
																						523	6.00	6.00	1.5		1.5		
RUS_010_010		4,841	100	0.150	Grass-Short Grass Prairie	4.538	3.95	6.4																		RUS_010_010	6.4	**19.3**	**0.32**
									213	3.979	4.05	Paved	0.88														0.9		
														2,090	1.163	3.5	9.2	0.045	1.89		1.89	18.47						18.5		
																						1,312	6.00	6.00	3.6		3.6		
														646	1.756	0.7	1.6	0.015	7.25		7.25	1.49						1.5		
																						480	6.00	6.00	1.3		1.3		
RUS_010_020		343	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.520	3.95	1.1																		RUS_010_020	1.1	**1.2**	**0.02**
									291	6.399	5.14	Paved	0.94														0.9		
RUS_010_030		1,321	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.650	3.95	0.6																		RUS_010_030	0.6	**4.5**	**0.08**
									1,271	2.210	3.02	Paved	7.01														7.0		
RUS_010_040		1,759	100	0.150	Grass-Short Grass Prairie	4.801	3.95	6.2																		RUS_010_040	6.2	**7.7**	**0.13**
									602	1.729	2.67	Paved	3.75														3.8		
																						1,059	6.00	6.00	2.9		2.9		
RUS_011_010		2,319	100	0.150	Grass-Short Grass Prairie	2.375	3.95	8.2																		RUS_011_010	8.2	**10.4**	**0.17**
									789	2.588	3.27	Paved	4.02														4.0		
														1,432	1.614	56.0	26.8	0.065	4.76		4.76	5.02						5.0		
RUS_011_020		1,738	71	0.150	Grass-Short Grass Prairie	3.174	3.95	5.6																		RUS_011_020	5.6	**8.0**	**0.13**
														1,299	3.035	3.9	9.5	0.045	3.18		3.18	6.80						6.8		
																						368	6.00	6.00	1.0		1.0		
RUS_012_010		4,330	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.659	3.95	0.7																		RUS_012_010	0.7	**10.3**	**0.17**
									219	1.259	2.28	Paved	1.60														1.6		
									927	1.540	2.52	Paved	6.12														6.1		
																						3,133	6.00	6.00	8.7		8.7		
RUS_012_020		4,124	100	0.150	Grass-Short Grass Prairie	0.808	3.95	12.7																		RUS_012_020	12.7	**16.3**	**0.27**
									540	1.612	2.58	Paved	3.49														3.5		
									464	2.235	3.04	Paved	2.54														2.5		
																						3,020	6.00	6.00	8.4		8.4		
RUS_012_030		423	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.373	3.95	0.5																		RUS_012_030	0.5	**1.3**	**0.02**
									375	3.337	3.71	Paved	1.68														1.7		
RUS_013_010		2,469	100	0.150	Grass-Short Grass Prairie	1.822	3.95	9.2																		RUS_013_010	9.2	**10.8**	**0.18**
									743	1.961	2.85	Paved	4.35														4.4		
																						1,625	6.00	6.00	4.5		4.5		
RUS_013_020		1,511	100	0.150	Grass-Short Grass Prairie	0.587	3.95	14.4																		RUS_013_020	14.4	**14.1**	**0.24**
									1,410	1.594	2.57	Paved	9.16														9.2		
RUS_013_030		1,261	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_013_030	1.1	**4.0**	**0.07**
									1,212	3.168	3.62	Paved	5.58														5.6		
RUS_014_010		3,428	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.951	3.95	0.5																		RUS_014_010	0.5	**12.6**	**0.21**
														1,756	0.731	14.4	21.2	0.045	2.19		2.19	13.38						13.4		
																						528	6.00	6.00	1.5		1.5		
														1,099	1.577	11.1	16.0	0.045	3.26		3.26	5.62						5.6		
RUS_014_020		2,053	100	0.150	Grass-Short Grass Prairie	4.552	3.95	6.3																		RUS_014_020	6.3	**10.5**	**0.18**
									131	5.141	4.61	Paved	0.47														0.5		
									475	1.609	2.58	Paved	3.07														3.1		
									467	0.546	1.50	Paved	5.18														5.2		
																						882	6.00	6.00	2.5		2.5		
RUS_015_010		3,692	100	0.150	Grass-Short Grass Prairie	2.398	3.95	8.2																		RUS_015_010	8.2	**15.5**	**0.26**
									432	0.584	1.55	Paved	4.63														4.6		
																						638	6.00	6.00	1.8		1.8		
														889	1.588	22.2	56.4	0.045	2.24		2.24	6.61						6.6		
																						1,634	6.00	6.00	4.5		4.5		
RUS_015_020		2,629	100	0.150	Grass-Short Grass Prairie	2.179	3.95	8.5																		RUS_015_020	8.5	**10.2**	**0.17**
									56	2.488	3.21	Paved	0.29														0.3		
									388	1.870	2.78	Paved	2.33														2.3		
																						2,085	6.00	6.00	5.8		5.8		
RYA_000_010		2,853	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RYA_000_010	1.1	**10.0**	**0.17**
									1,121	0.715	1.72	Paved	10.87														10.9		
																						1,681	6.00	6.00	4.7		4.7		
RYA_000_020		5,389	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RYA_000_020	15.4	**19.0**	**0.32**
									709	2.572	3.26	Paved	3.62														3.6		
																						4,581	6.00	6.00	12.7		12.7		
RYA_000_030		4,581	100	0.150	Grass-Short Grass Prairie	2.571	3.95	8.0																		RYA_000_030	8.0	**15.1**	**0.25**
									1,191	1.453	2.45	Paved	8.10														8.1		
																						3,290	6.00	6.00	9.1		9.1		
RYA_000_040		4,283	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.398	3.95	0.7																		RYA_000_040	0.7	**8.7**	**0.14**
									575	1.726	2.67	Paved	3.59														3.6		
																						3,657	6.00	6.00	10.2		10.2		
RYA_000_050		456	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.020	3.95	0.6																		RYA_000_050	0.6	**1.5**	**0.02**
									407	3.320	3.70	Paved	1.83														1.8		
RYA_000_060		1,480	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.517	3.95	0.7																		RYA_000_060	0.7	**4.9**	**0.08**
									1,050	2.133	2.97	Paved	5.89														5.9		
									381	4.081	4.11	Paved	1.55														1.5		
RYA_000_070		3,198	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.228	3.95	0.8																		RYA_000_070	0.8	**7.4**	**0.12**
									987	2.236	3.04	Paved	5.41														5.4		
														416	2.752	23.4	15.2	0.065	5.06		5.06	1.37						1.4		
																						1,744	6.00	6.00	4.8		4.8		
RYA_000_080		1,688	100	0.150	Grass-Short Grass Prairie	2.998	3.95	7.5																		RYA_000_080	7.5	**8.2**	**0.14**
									614	3.984	4.06	Paved	2.52														2.5		
														668	1.829	1.1	7.3	0.015	3.85		3.85	2.89						2.9		
																						301	6.00	6.00	0.8		0.8		
RYA_001_010		3,045	47	0.150	Grass-Short Grass Prairie	4.536	3.95	3.5																		RYA_001_010	3.5	**11.1**	**0.18**
									1,943	1.879	2.79	Paved	11.62														11.6		

Appendix B-3

Middle Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
																							428	6.00	6.00	1.2		1.2		
														628	0.867	91.4	26.9	0.065	4.83		4.83	2.17						2.2		
RYA_001_020		1,206	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.413	3.95	0.7																			RYA_001_020	0.7	**2.8**	**0.05**
									322	2.861	3.44	Paved	1.56															1.6		
																							834	6.00	6.00	2.3		2.3		
TWI_000_010		3,106	35	0.150	Grass-Short Grass Prairie	5.162	3.95	2.6																			TWI_000_010	2.6	**12.0**	**0.20**
									1,530	0.931	1.96	Paved	13.00															13.0		
																							294	6.00	6.00	0.8		0.8		
														334	1.700	28.3	16.5	0.065	4.28		4.28	1.30						1.3		
																							528	6.00	6.00	1.5		1.5		
														385	1.506	6.0	10.7	0.015	8.26		8.26	0.78						0.8		
TWI_000_020		2,662	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.470	3.95	0.6																			TWI_000_020	0.6	**5.3**	**0.09**
									613	3.063	3.56	Paved	2.87															2.9		
																							1,169	6.00	6.00	3.2		3.2		
														831	1.287			0.065	6.27	6.27	6.27	2.21						2.2		
TWI_000_030		3,151	81	0.150	Grass-Short Grass Prairie	3.007	3.95	6.3																			TWI_000_030	6.3	**13.7**	**0.23**
									1,162	0.675	1.67	Paved	11.60															11.6		
																							1,294	6.00	6.00	3.6		3.6		
														613	0.900			0.065	8.10	8.10	8.10	1.26						1.3		
TWI_000_040		1,403	100	0.150	Grass-Short Grass Prairie	2.161	3.95	8.5																			TWI_000_040	8.5	**10.4**	**0.17**
									1,302	1.493	2.48	Paved	8.74															8.7		
TWI_000_050		3,239	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.753	3.95	0.7																			TWI_000_050	0.7	**8.7**	**0.15**
									1,619	1.929	2.82	Paved	9.56															9.6		
																							1,570	6.00	6.00	4.4		4.4		
TWI_000_060		1,818	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																			TWI_000_060	15.4	**15.5**	**0.26**
									123	1.085	2.12	Paved	0.97															1.0		
									1,596	1.899	2.80	Paved	9.50															9.5		
TWI_000_070		4,548	100	0.150	Grass-Short Grass Prairie	0.854	3.95	12.4																			TWI_000_070	12.4	**20.9**	**0.35**
														1,040	0.500	16.7	29.1	0.045	1.61		1.61	10.73						10.7		
														350	3.562	2.7	5.1	0.015	12.41		12.41	0.47						0.5		
									689	1.862	2.77	Paved	4.14															4.1		
																							1,544	6.00	6.00	4.3		4.3		
														825	1.487	87.4	36.7	0.065	4.98		4.98	2.76						2.8		
TWI_000_080		1,292	100	0.150	Grass-Short Grass Prairie	1.770	3.95	9.3																			TWI_000_080	9.3	**8.8**	**0.15**
									348	2.511	3.22	Paved	1.80															1.8		
									626	2.993	3.52	Paved	2.97															3.0		
																							219	6.00	6.00	0.6		0.6		
TWI_000_090		248	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	12.423	3.95	0.3																			TWI_000_090	0.3	**0.7**	**0.01**
									199	3.506	3.81	Paved	0.87															0.9		
TWI_000_100		3,353	100	0.150	Grass-Short Grass Prairie	2.026	3.95	8.8																			TWI_000_100	8.8	**12.6**	**0.21**
									371	3.047	3.55	Paved	1.74															1.7		
									675	1.959	2.85	Paved	3.95															4.0		
																							1,054	6.00	6.00	2.9		2.9		
														1,154	2.465	88.5	50.1	0.065	5.25		5.25	3.66						3.7		
TWI_001_010		3,147	100	0.150	Grass-Short Grass Prairie	2.089	3.95	8.7																			TWI_001_010	8.7	**14.7**	**0.25**
														1,404	0.664	16.2	21.9	0.045	2.21		2.21	10.58						10.6		
																							1,266	6.00	6.00	3.5		3.5		
														378	0.703	50.4	25.4	0.055	3.59		3.59	1.76						1.8		
TWI_002_010		1,046	100	0.150	Grass-Short Grass Prairie	3.373	3.95	7.2																			TWI_002_010	7.2	**7.3**	**0.12**
									491	4.489	4.31	Paved	1.90															1.9		
									456	1.497	2.49	Paved	3.06															3.1		
TWI_003_010		2,713	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.591	3.95	0.5																			TWI_003_010	0.5	**6.2**	**0.10**
									536	4.720	4.42	Paved	2.02															2.0		
																							1,811	6.00	6.00	5.0		5.0		
														318	0.500	15.5	12.2	0.065	1.90		1.90	2.79						2.8		
TWI_004_010		3,365	26	0.150	Grass-Short Grass Prairie	6.863	3.95	1.8																			TWI_004_010	1.8	**9.6**	**0.16**
									1,111	1.285	2.30	Paved	8.04															8.0		
																							2,228	6.00	6.00	6.2		6.2		
TWI_004_020		1,374	100	0.150	Grass-Short Grass Prairie	3.762	3.95	6.8																			TWI_004_020	6.8	**7.3**	**0.12**
									678	2.388	3.14	Paved	3.60															3.6		
																							597	6.00	6.00	1.7		1.7		
TWI_004_030		1,291	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.544	3.95	0.5																			TWI_004_030	0.5	**3.5**	**0.06**
									70	4.900	4.50	Paved	0.26															0.3		
									779	2.512	3.22	Paved	4.03															4.0		
																							394	6.00	6.00	1.1		1.1		

Appendix B-3

Stream RC-1 Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow									Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_RCO_001_010		2,640	100	0.150	Grass-Short Grass Prairie	0.880	3.95	12.2																		RUS_RCO_001_010	12.2	**17.5**	**0.29**
									1,101	1.360	2.37	Paved	7.74														7.7		
									1,270	1.419	2.42	Paved	8.74														8.7		
																						169	6	6.00	0.5		0.5		
RUS_RCO_002_010		4,461	76	0.150	Grass-Short Grass Prairie	2.473	3.95	6.5																		RUS_RCO_002_010	6.5	**18.8**	**0.31**
									1,586	0.597	1.57	Paved	16.83														16.8		
														633	0.500	9.7	14.5	0.015	5.40		5.40	1.95						2.0		
																						2,166	6	6.00	6.0		6.0		
RUS_RCO_002_020		938	100	0.150	Grass-Short Grass Prairie	1.260	3.95	10.6																		RUS_RCO_002_020	10.6	**11.8**	**0.20**
									37	8.935	6.08	Paved	0.10														0.1		
									761	0.500	1.44	Paved	8.82														8.8		
																						40	6	6.00	0.1		0.1		
RUS_RCO_010		3,067	44	0.150	Grass-Short Grass Prairie	0.500	3.95	8.0																		RUS_RCO_010	8.0	**17.0**	**0.28**
									1,226	0.500	1.44	Paved	14.22														14.2		
																						1,267	6	6.00	3.5		3.5		
														530	0.604	111.4	42.6	0.065	3.38		3.38	2.61						2.6		
RUS_RCO_020		5,143	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.260	3.95	0.6																		RUS_RCO_020	0.6	**10.8**	**0.18**
									623	0.894	1.92	Paved	5.40														5.4		
																						3,093	6	6.00	8.6		8.6		
														1,377	0.566					6.81	6.81	3.37						3.4		
RUS_RCO_030		4,440	43	0.150	Grass-Short Grass Prairie	2.596	3.95	4.0																		RUS_RCO_030	4.0	**14.0**	**0.23**
									2,084	1.737	2.68	Paved	12.96														13.0		
																						2,239	6	6.00	6.2		6.2		
														74	0.701	15.0	17.0	0.015	7.65		7.65	0.16						0.2		
RUS_RCO_040		2,647	100	0.150	Grass-Short Grass Prairie	2.280	3.95	8.4																		RUS_RCO_040	8.4	**11.0**	**0.18**
									159	8.315	5.86	Paved	0.45														0.5		
									993	2.107	2.95	Paved	5.61														5.6		
																						1,396	6	6.00	3.9		3.9		
RUS_RCO_050		3,439	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_RCO_050	14.9	**18.4**	**0.31**
									82	2.425	3.17	Paved	0.43														0.4		
									2,551	2.552	3.25	Paved	13.09														13.1		
																						280	6	6.00	0.8		0.8		
														426	0.501	5.0	9.1	0.015	4.71		4.71	1.51						1.5		
RUS_RCO_060		2,387	100	0.150	Grass-Short Grass Prairie	1.550	3.95	9.8																		RUS_RCO_060	9.8	**18.9**	**0.32**
									526	0.547	1.50	Paved	5.83														5.8		
									1,273	0.510	1.45	Paved	14.61														14.6		
																						488	6	6.00	1.4		1.4		
RUS_RCO_070		4,161	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	4.740	3.95	0.4																		RUS_RCO_070	0.4	**9.1**	**0.15**
									2,074	3.498	3.80	Paved	9.09														9.1		
																						2,037	6	6.00	5.7		5.7		
RUS_RCO_080		2,228	100	0.150	Grass-Short Grass Prairie	2.225	3.95	8.5																		RUS_RCO_080	8.5	**10.5**	**0.18**
									1,001	1.922	2.82	Paved	5.92														5.9		
																						1,128	6	6.00	3.1		3.1		
RUS_RCO_090		4,509	87	0.150	Grass-Short Grass Prairie	2.008	3.95	7.9																		RUS_RCO_090	7.9	**20.7**	**0.35**
									3,099	1.224	2.25	Paved	22.97														23.0		
																						1,324	6	6.00	3.7		3.7		
RUS_RCO_100		2,499	49	0.150	Grass-Short Grass Prairie	0.500	3.95	8.7																		RUS_RCO_100	8.7	**13.7**	**0.23**
									1,120	0.782	1.80	Paved	10.38														10.4		
																						1,330	6	6.00	3.7		3.7		
RUS_RCO_110		2,443	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_RCO_110	1.0	**11.7**	**0.20**
									1,940	0.845	1.87	Paved	17.30														17.3		
																						453	6	6.00	1.3		1.3		
RUS_RCO_120		2,934	100	0.150	Grass-Short Grass Prairie	2.150	3.95	8.6																		RUS_RCO_120	8.6	**14.3**	**0.24**
									25	9.370	6.22	Paved	0.07														0.1		
									2,810	2.300	3.08	Paved	15.19														15.2		
RUS_RCO_130		2,380	100	0.150	Grass-Short Grass Prairie	2.210	3.95	8.5																		RUS_RCO_130	8.5	**11.7**	**0.19**
									41	7.259	5.48	Paved	0.12														0.1		
									2,128	2.748	3.37	Paved	10.52														10.5		
																						111	6	6.00	0.3		0.3		
RUS_RCO_140		2,218	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.020	3.95	0.6																		RUS_RCO_140	0.6	**7.2**	**0.12**
									133	2.624	3.29	Paved	0.67														0.7		
									844	0.807	1.83	Paved	7.70														7.7		
									109	10.417	6.56	Paved	0.28														0.3		
														1,082	4.248	87.8	54.3	0.065	6.51		6.51	2.77						2.8		
RUS_RCO_150		1,740	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	5.250	3.95	0.4																		RUS_RCO_150	0.4	**6.6**	**0.11**
									746	5.939	4.95	Paved	2.51														2.5		
									812	0.761	1.77	Paved	7.63														7.6		
																						132	6	6.00	0.4		0.4		
RUS_TOA_010		3,284	100	0.150	Grass-Short Grass Prairie	0.990	3.95	11.7																		RUS_TOA_010	11.7	**19.4**	**0.32**
									101	1.302	2.32	Paved	0.73														0.7		
									1,287	0.500	1.44	Paved	14.92														14.9		
																						1,795	6	6.00	5.0		5.0		
RUS_TOA_020		2,315	100	0.150	Grass-Short Grass Prairie	4.880	3.95	6.2																		RUS_TOA_020	6.2	**7.5**	**0.13**
									131	3.939	4.03	Paved	0.54														0.5		
														346	4.051	37.2	51.7	0.045	5.35		5.35	1.08						1.1		
														114	2.516	12.4	36.3	0.015	7.70		7.70	0.25						0.2		
																						1,624	6	6.00	4.5		4.5		
RUS_TOA_030		3,613	100	0.150	Grass-Short Grass Prairie	0.830	3.95	12.5																		RUS_TOA_030	12.5	**14.9**	**0.25**

Stream RC-1 Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel Flow	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
									46	8.211	5.83	Paved	0.13														0.1		
									1,353	3.017	3.53	Paved	6.39														6.4		
																						240	6	6.00	0.7		0.7		
														1,874	0.970	0.6	2.1	0.015	4.25	6.09	6.09	5.13						5.1		
RUS_TOA_040		2,776	100	0.150	Grass-Short Grass Prairie	1.170	3.95	10.9																			RUS_TOA_040	10.9	**12.4**	**0.21**
									192	3.440	3.77	Paved	0.85														0.8		
									785	2.437	3.17	Paved	4.12														4.1		
																						1,698	6	6.00	4.7		4.7		
RUS_TOA_050		4,900	100	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																			RUS_TOA_050	12.4	**21.3**	**0.35**
									34	7.690	5.64	Paved	0.10														0.1		
									1,787	0.985	2.02	Paved	14.76														14.8		
																						2,979	6	6.00	8.3		8.3		
RUS_TOA_055		7,994	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																			RUS_TOA_055	0.9	**29.1**	**0.49**
									1,191	0.825	1.85	Paved	10.75														10.8		
														6,753	0.908	27.9	21.8	0.055	3.05		3.05	36.92						36.9		
RUS_TOA_060		2,926	100	0.150	Grass-Short Grass Prairie	3.350	3.95	7.2																			RUS_TOA_060	7.2	**18.3**	**0.30**
									651	0.500	1.44	Paved	7.55														7.5		
									2,175	1.286	2.30	Paved	15.73														15.7		
RUS_TOA_070		2,587	100	0.150	Grass-Short Grass Prairie	1.070	3.95	11.3																			RUS_TOA_070	11.3	**18.1**	**0.30**
									1,500	0.584	1.55	Paved	16.09														16.1		
																						987	6	6.00	2.7		2.7		
RUS_TOA_080		5,019	100	0.150	Grass-Short Grass Prairie	3.001	3.95	7.5																			RUS_TOA_080	7.5	**14.8**	**0.25**
									1,098	1.873	2.78	Paved	6.58														6.6		
																						3,623	6	6.00	10.1		10.1		
														204	3.945	24.7	13.3	0.065	6.88		6.88	0.49						0.5		
RUS_TOA_090		3,864	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.660	3.95	0.7																			RUS_TOA_090	0.7	**8.6**	**0.14**
									658	4.924	4.51	Paved	2.43														2.4		
									41	0.879	1.91	Paved	0.36														0.4		
														398	2.856	4.6	6.4	0.045	4.49		4.49	1.48						1.5		
																						303	6	6.00	0.8		0.8		
														504	1.092	6.2	12.1	0.045	2.21		2.21	3.80						3.8		
																						1,202	6	6.00	3.3		3.3		
														709	2.154	134.2	35.6	0.065	8.15		8.15	1.45						1.4		
RUS_TOA_100		4,958	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.980	3.95	0.6																			RUS_TOA_100	0.6	**9.8**	**0.16**
									713	2.022	2.89	Paved	4.11														4.1		
																						2,960	6	6.00	8.2		8.2		
														542	1.081	17.8	8.5	0.045	5.63		5.63	1.60						1.6		
														693	3.696	42.8	24.6	0.065	6.38		6.38	1.81						1.8		

Appendix B-3

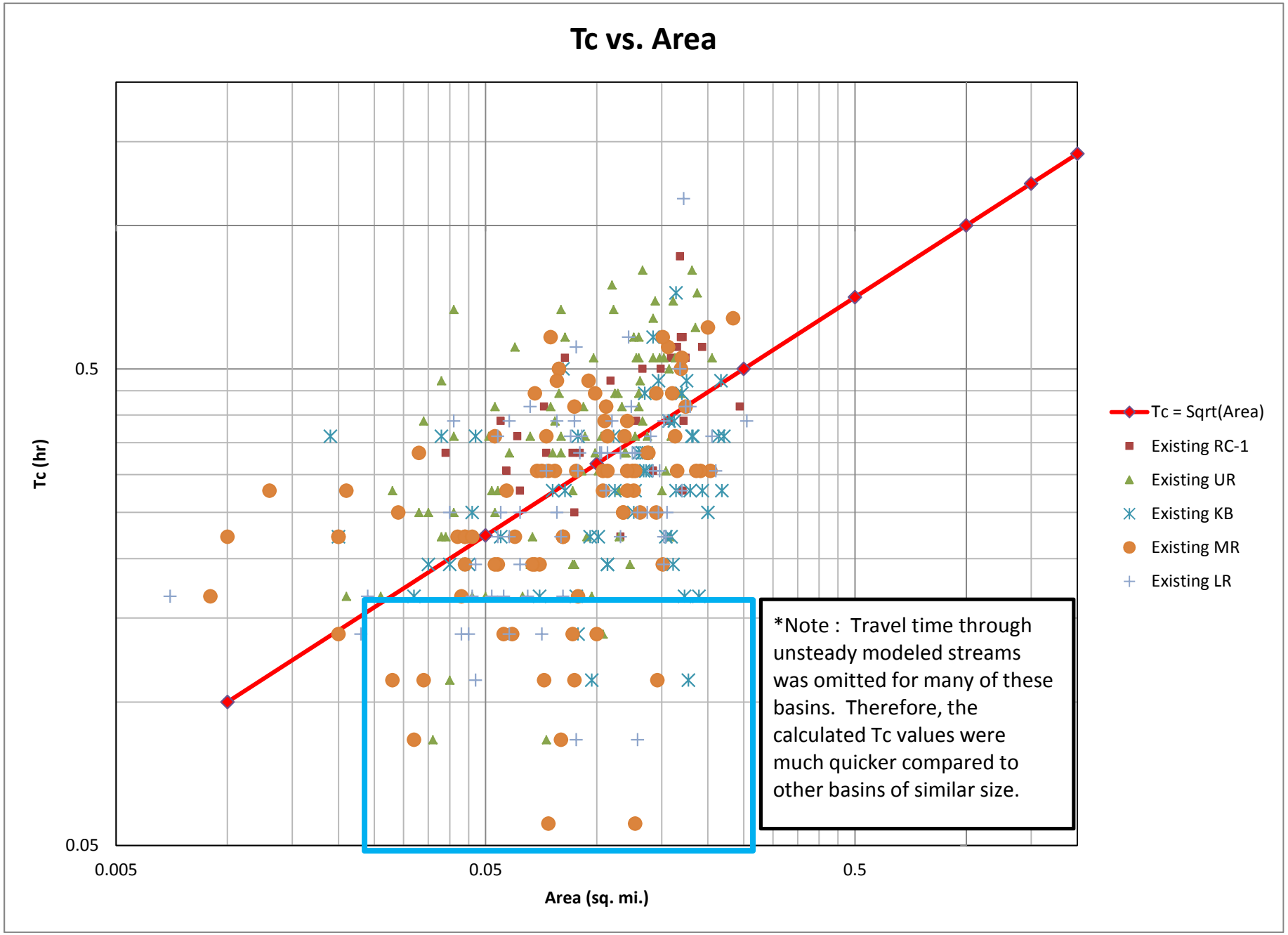
Upper Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_000_010		3,581	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_000_010	33	**19.9**	**0.33**
									1,530	0.700	1.70	Paved	14.99															
														2,001	0.980	55.2	88.3	0.055	1.96		1.96	17.01							
RUS_000_020		2,722	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.320	3.95	0.7																		RUS_000_020	12	**7.4**	**0.12**
														2,672	0.960	27.0	21.0	0.045	3.84		3.84	11.61							
RUS_000_030		3,258	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_030	40	**24.2**	**0.40**
									2,660	1.090	2.12	Paved	20.89															
														498	0.500	121.5	110.5	0.055	2.04		2.04	4.07							
RUS_000_040		1,419	100	0.150	Grass-Short Grass Prairie	1.970	3.95	8.9																		RUS_000_040	17	**10.4**	**0.17**
									1,031	1.440	2.44	Paved	7.04															
														288	0.630	53.4	22.5	0.065	3.23		3.23	1.48							
RUS_000_050		2,882	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.280	3.95	0.7																		RUS_000_050	21	**12.6**	**0.21**
									1,679	0.860	1.89	Paved	14.84															
																							375	6	6.00	1.0				
														778	0.970	52.9	59.3	0.045	3.02		3.02	4.29							
RUS_000_060		2,425	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	1.120	3.95	0.8																		RUS_000_060	8	**5.1**	**0.08**
									644	2.210	3.02	Paved	3.55															
																							1,053	6	6.00	2.9				
														678	1.563	115.4	87.2	0.024	9.36		9.36	1.21							
RUS_000_070		2,113	100	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_000_070	30	**17.9**	**0.30**
									2,013	1.310	2.33	Paved	14.42															
RUS_000_080		2,523	100	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_000_080	27	**16.1**	**0.27**
									673	1.800	2.73	Paved	4.11															
														1,750	0.690	5.7	3.7	0.045	3.69		3.69	7.90							
RUS_000_085		3,636	100	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.9																		RUS_000_085	20	**12.1**	**0.20**
									574	2.162	2.99	Paved	3.20															
														2,962	0.935					3.26	3.26	15.14							
RUS_000_090		2,192	100	0.150	Grass-Short Grass Prairie	0.570	3.95	14.6																		RUS_000_090	29	**17.2**	**0.29**
									2,092	1.470	2.46	Paved	14.15															
RUS_000_100		4,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.820	3.95	0.9																		RUS_000_100	25	**14.8**	**0.25**
									831	1.200	2.23	Paved	6.22															
																							1,845	6	6.00	5.1				
														2,037	1.010	131.6	131.6	0.055	2.72		2.72	12.47							
RUS_000_110		3,764	50	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.540	3.95	1.1																		RUS_000_110	23	**13.6**	**0.23**
									1,699	1.020	2.05	Paved	13.79															
																							262	6	6.00	0.7				
														1,753	1.780	40.8	44.7	0.045	4.16		4.16	7.03							
RUS_000_120		1,360	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.060	3.95	0.6																		RUS_000_120	8	**4.7**	**0.08**
									1,310	2.170	2.99	Paved	7.29															
RUS_000_130		2,066	100.1	0.150	Grass-Short Grass Prairie	0.760	3.95	13.0																		RUS_000_130	20	**12.0**	**0.20**
														1,966	2.270	6.7	7.4	0.045	4.65		4.65	7.05							
RUS_000_140		2,863	100.0	0.150	Grass-Short Grass Prairie	1.270	3.95	10.6																		RUS_000_140	22	**13.0**	**0.22**
									928	1.580	2.56	Paved	6.05															
																							1,835	6	6.00	5.1				
RUS_000_150		2,761	100.0	0.150	Grass-Short Grass Prairie	2.100	3.95	8.6																		RUS_000_150	17	**10.5**	**0.17**
									446	1.850	2.76	Paved	2.69															
																							2,001	6	6.00	5.6				
														214	5.486	31.9	29.5	0.055	6.69		6.69	0.53							
RUS_000_160		1,865	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.940	3.95	0.8																		RUS_000_160	11	**6.4**	**0.11**
									1,089	1.330	2.34	Paved	7.74															
																							726	6	6.00	2.0				
RUS_000_170		1,952	100.0	0.150	Grass-Short Grass Prairie	0.810	3.95	12.7																		RUS_000_170	19	**11.4**	**0.19**
									383	2.040	2.90	Paved	2.20															
																							1,469	6	6.00	4.1				
RUS_000_180		747	100.0	0.150	Grass-Short Grass Prairie	0.940	3.95	11.9																		RUS_000_180	15	**8.9**	**0.15**
									647	3.320	3.70	Paved	2.91															
RUS_016_010		2,662	100.0	0.150	Grass-Short Grass Prairie	2.830	3.95	7.7																		RUS_016_010	18	**11.0**	**0.18**
									693	1.080	2.11	Paved	5.47															
																							1,869	6	6.00	5.2				
RUS_016_020		3,161	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.700	3.95	1.0																		RUS_016_020	20	**12.2**	**0.20**
									2,082	1.060	2.09	Paved	16.58															
																							1,030	6	6.00	2.9				
RUS_016_030		2,587	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.680	3.95	1.0																		RUS_016_030	9	**5.6**	**0.09**
									504	2.280	3.07	Paved	2.74															
																							2,033	6	6.00	5.6				
RUS_016_040		2,434	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.320	3.95	0.4																		RUS_016_040	9	**5.2**	**0.09**
									707	3.160	3.61	Paved	3.26															
																							1,199	6	6.00	3.3				
														477	2.310	57.3	35.8	0.065	4.77		4.77	1.67							
RUS_017_010		678	100.8	0.150	Grass-Short Grass Prairie	0.900	3.95	12.2																		RUS_017_010	15	**8.8**	**0.15**
									145	2.090	2.94	Paved	0.82															
														432	1.240	115.9	65.0	0.055	4.44		4.44	1.62							
RUS_018_010		2,702	100.0	0.150	Grass-Short Grass Prairie	1.610	3.95	9.6																		RUS_018_010	23	**14.0**	**0.23**
									1,064	1.270	2.29	Paved	7.74															
														884	0.500	70.0	37.8	0.045	3.53		3.53	4.17							
RUS_018_020		2,891	100.0	0.150	Grass-Short Grass Prairie	0.970	3.95	11.8																		RUS_018_020	33	**19.8**	**0.33**
									1,383	1.600	2.57	Paved	8.96															
														1,408	0.800	49.3	81.0	0.050	1.91		1.91	12.26							
RUS_018_030		2,585	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.740	3.95	0.9																		RUS_018_030	11	**6.8**	**0.11**
									901	2.310	3.09	Paved	4.86															
														1,634	1.000					4.86	4.86	5.60							
RUS_018_040		2,976	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.730	3.95	0.9																		RUS_018_040	17	**9.9**	**0.17**
									1,824	1.860	2.77	Paved	10.97															
														1,102	0.640					3.96	3.96	4.64							

Upper Rush Ultimate Time of Concentration Calculations

HMS Program Basin Name	Notes	Longest Flowpath (ft) (1)	Overland Flow						Shallow Concentrated Flow					Channel Flow								Pipe Flow				Totals			
			Length (ft) (2)	n-Value (3)	Land Use/Surface Description (4)	Slope (%) (5)	Rainfall (in) (6b)	TcOverland (min) (7)	Length 1 (ft) (8)	Slope 1 (%) (9)	V1 (ft/s) (10)	Assumption for V1 (Paved/Unpaved) (11)	Tc Shallow Concentrated (min) (12)	Length 2 (ft) (13)	Slope 2 (%) (14)	Bankfull Area (ft^2) (15)	Bankfull Wet Peri (ft) (16)	Channel n-Value (17)	V2 (ft/s) Manning's (18)	V2 (ft/s) from RAS Model (19)	Selected Velocity (ft/s) (20)	Tc Channel (min) (21)	Pipe Length (ft) (23)	Pipe Velocity Other Source (ft/s) (26)	Selected Velocity (ft/s) (27)	Tc Pipe (min) (28)	Sub-basin	Final Tc (min) (29)	Tlag (min) (30)	Tlag (hr)
RUS_018_050		3,423	100.0	0.150	Grass-Short Grass Prairie	2.870	3.95	7.6																		RUS_018_050	25	**14.7**	**0.25**
									1,647	1.570	2.55	Paved	10.78																
																						585	6	6.00	1.6				
														1,091	0.810				4.07	4.07	4.47								
RUS_019_010		2,630	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_019_010	29	**17.3**	**0.29**
									1,333	1.400	2.41	Paved	9.24																
														1,197	1.250	208.7	106.6	0.055	4.74		4.74	4.21							
RUS_019_020		1,706	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	2.400	3.95	0.6																		RUS_019_020	12	**6.9**	**0.12**
									1,313	1.150	2.18	Paved	10.04																
														343	3.086	46.1	28.9	0.055	6.49		6.49	0.88							
RUS_020_010		4,272	100.0	0.150	Grass-Short Grass Prairie	0.540	3.95	14.9																		RUS_020_010	38	**22.7**	**0.38**
									1,285	0.500	1.44	Paved	14.90																
																						2,887	6	6.00	8.0				
RUS_020_020		4,387	100.0	0.150	Grass-Short Grass Prairie	0.670	3.95	13.7																		RUS_020_020	43	**25.8**	**0.43**
									2,493	0.780	1.80	Paved	23.14																
																						692	6	6.00	1.9				
														535	0.780	29.9	18.9	0.045	3.97		3.97	2.25							
														350	0.500	30.1	23.2	0.015	8.34		8.34	0.70							
														217	0.500	52.3	45.4	0.045	2.57		2.57	1.41							
RUS_020_030		3,118	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		RUS_020_030	36	**21.6**	**0.36**
									1,974	1.220	2.25	Paved	14.65																
																						175	6	6.00	0.5				
														870	0.500	81.3	67.1	0.045	2.66		2.66	5.45							
RUS_020_040		4,060	100.0	0.150	Grass-Short Grass Prairie	1.630	3.95	9.6																		RUS_020_040	31	**18.4**	**0.31**
									545	2.490	3.21	Paved	2.83																
														3,415	0.620					3.13	3.13	18.18								
RUS_FPT_010		3,184	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.720	3.95	0.9																		RUS_FPT_010	13	**7.9**	**0.13**
									990	1.630	2.60	Paved	6.36																
																						1,560	6	6.00	4.3				
														585	0.500	141.8	78.1	0.024	6.54		6.54	1.49							
RUS_FPT_020		2,432	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_FPT_020	11	**6.6**	**0.11**
									1,403	2.610	3.28	Paved	7.12																
																						979	6	6.00	2.7				
RUS_NET_010		2,119	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	0.500	3.95	1.1																		RUS_NET_010	10	**6.2**	**0.10**
									396	0.500	1.44	Paved	4.59																
																						1,673	6	6.00	4.6				
RUS_NET_020		710	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	6.380	3.95	0.4																		RUS_NET_020	4	**2.6**	**0.04**
									660	1.810	2.73	Paved	4.02																
SUB_000_010		2,952	100.0	0.150	Grass-Short Grass Prairie	0.620	3.95	14.1																		SUB_000_010	31	**18.8**	**0.31**
									1,990	1.660	2.62	Paved	12.66																
														862	0.500	54.1	34.2	0.045	3.18		3.18	4.52							
SUB_000_020		2,349	100.0	0.150	Grass-Short Grass Prairie	2.220	3.95	8.5																		SUB_000_020	17	**10.1**	**0.17**
									669	3.710	3.92	Paved	2.85																
														1,579	0.700					4.71	4.71	5.59								
SUB_000_030		751	50.0	0.011	Smooth Surface (concrete, asphalt, bare earth)	3.100	3.95	0.5																		SUB_000_030	4	**2.3**	**0.04**
									701	3.020	3.53	Paved	3.31																
SUB_000_040		1,108	100.0	0.150	Grass-Short Grass Prairie	0.500	3.95	15.4																		SUB_000_040	20	**11.8**	**0.20**
									1,008	3.730	3.93	Paved	4.28																
SUB_000_050		3,726	100.0	0.150	Grass-Short Grass Prairie	0.860	3.95	12.4																		SUB_000_050	37	**22.3**	**0.37**
									2,717	1.110	2.14	Paved	21.14																
														909	1.240	27.8	17.5	0.055	4.11		4.11	3.69							
SUB_000_060		3,046	100.0	0.150	Grass-Short Grass Prairie	0.720	3.95	13.3																		SUB_000_060	28	**16.7**	**0.28**
									388	1.750	2.69	Paved	2.40																
														1,609	1.010	30.0	30.0	0.045	3.33		3.33	8.06							
																						371	6	6.00	1.0				
														577	0.500					3.13	3.13	3.07								
SUB_000_070		4,044	100.0	0.150	Grass-Short Grass Prairie	2.260	3.95	8.4																		SUB_000_070	29	**17.3**	**0.29**
									1,623	2.070	2.92	Paved	9.25																
														2,321	0.690					3.45	3.45	11.21								
SUB_000_080		1,251	100.0	0.150	Grass-Short Grass Prairie	4.950	3.95	6.1																		SUB_000_080	12	**7.0**	**0.12**
									1,151	2.890	3.46	Paved	5.55																

Appendix B-4
Time of Concentration Graphs


Tc vs. Area
Tc (hr)
0.5
0.05
0.005
0.05
0.5
Area (sq. mi.)
Tc = Sqrt(Area)
Existing RC-1
Existing UR
Existing KB
Existing MR
Existing LR
*Note : Travel time through unsteady modeled streams was omitted for many of these basins. Therefore, the calculated Tc values were much quicker compared to other basins of similar size.

Appendix B-5
Modified Puls Subreach Calculations

Appendix B-5

Modified Puls Subreach Calculations
Kee Branch

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Kee Branch	R_KEE_000_020	2161	3.58	10.06	10.0
KB_Route1	R_KEE_000_140	1958	8.33	3.92	4.0
	R_KEE_000_160	361	7.26	0.83	1.0
KB_Route2	R_KEE_000_260	2290	6.71	5.69	6.0
Kee Branch Trib 4	R_KEE_004_020	741	9.01	1.37	2.0
Kee Branch Trib 5	R_KEE_005_020	1589	2.81	9.44	10.0
Stream KB-1.1	R_KEE_KB1_001_020	1428	6.99	3.40	4.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Lower Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Pantego	R_PAN_000_030b	2870	7.63	6.27	7.0
	R_PAN_000_050a	687	3.86	2.97	3.0
Rush Creek Trib 3	R_RUS_003_020b	908	5.28	2.87	3.0
Rush Creek Trib 4.1	R_RUS_004_001_020	1140	6.66	2.85	3.0
	R_RUS_004_001_030	1161	6.43	3.01	4.0
LR_Route1	R_RUS_004_030a	1041	2.87	6.05	7.0
Rush Creek Trib 4	R_RUS_004_030b	382	3.73	1.71	2.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Middle Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Rush Creek Trib 7	R_RUS_007_020	1857	7.83	3.95	4.0
Rush Creek Trib 9	R_RUS_009_030	332	10.29	0.54	1.0
Twin Springs Draw	R_TWI_000_020	1012	6.27	2.69	3.0
	R_TWI_000_030	1572	8.10	3.24	4.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Stream RC-1

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
Stream RC-1	R_RUS_RCO_020a	1381	6.81	3.38	4.0
	R_RUS_RCO_030	279	8.14	0.57	1.0
	R_RUS_RCO_070	1230	7.43	2.76	3.0
Stream RC-1A	R_RUS_TOA_030	2177	6.09	5.96	6.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix B-5

Modified Puls Subreach Calculations
Upper Rush

Time Step (min) = 1

Creek/River	Reach Name	Length	Average Velocity	Steps	Rounded Steps
UR_Route6	R_RUS_000_085	3143	3.26	16.07	10.0
Rush Creek Trib 18	R_RUS_018_020	2026	4.90	6.89	7.0
	R_RUS_018_030	1252	4.86	4.29	5.0
	R_RUS_018_040	1183	3.96	4.98	5.0
	R_RUS_018_050	1126	4.07	4.61	5.0
Rush Creek Trib 20	R_RUS_020_040	3245	3.13	17.28	10.0
Sublett Creek	R_SUB_000_020	1566	4.71	5.54	6.0
UR_Route 3	R_SUB_000_060	1715	3.13	9.13	10.0
	R_SUB_000_070	2505	3.45	12.10	10.0
UR_Route 4	R_SUB_000_140	1644	3.52	7.78	8.0
	R_SUB_000_150	1859	3.65	8.49	9.0
	R_SUB_000_155	1269	4.50	4.70	5.0
UR_Route 5	R_SUB_000_220	2003	3.01	11.09	10.0
	R_SUB_000_230	2137	3.15	11.31	10.0
Sublett Creek Trib 4	R_SUB_004_020	1219	3.63	5.60	6.0
UR_Route 1	R_SUB_004_040	1634	2.36	11.54	10.0
	R_SUB_004_050a	301	4.03	1.24	2.0
	R_SUB_004_050b	2233	4.03	9.23	10.0
	R_SUB_004_060	794	2.15	6.16	7.0
	R_SUB_004_070	504	2.54	3.31	4.0
UR_Route 2	R_SUB_004_090	1654	2.71	10.17	10.0
	R_SUB_004_100	1194	2.91	6.84	7.0
	R_SUB_004_110	1384	3.72	6.20	7.0
	R_SUB_004_120	1149	2.09	9.16	10.0

Notes:
(1) Length of the main channel
(2) Average channel velocity calculated in the time of concentration spreadsheet (V2)
(3) Number of Routing Steps = (River Length / Channel Velocity) * (1 / 60 min/s) / Time Step
(4) Rounded Steps = the number or routing steps rounded up

Appendix C
QAQC Documentation

RUSH CREEK
City of Arlington Watershed Study

QA/QC Review Certification

Product Name: Final Hydrologic Models

Level: ☐ Internal/Subproduct ☑ Deliverable ☐ Audit

Type: ☐ Checklist ☐ Monthly Model Review ☑ Engineer Deliverables

Checklist Category: ☐ Survey ☑ Hydrology ☐ Hydraulic ☐ Mapping

WBS Code: 4.3

Date: 6/22/2012 Status: ☐ Draft ☐ Revision ☑ Final

Originator/Firm: Ben Plyant/Halff Associates, Inc.

QC Reviewer/Firm: Tom Nye/CDM Smith, Inc.

General Comments: Based on comparisons to the aerial photographs in several areas, the percent impervious based on land use may be high, especially for the very low density land use type. The PMC contends that the aerial photography does not always support the argument that large amounts of impervious area is not included in the GIS impervious cover shapefiles. As discussed in the weekly Rush Creek Watershed Study team meeting of 6/11/2012, the PMC accepts these results pending hydraulic model calibration, at which time the percent impervious values may need to be revisited.

Subbasin delineations may also need to be revisited after hydraulic model calibration. As documented in the PMC review of draft subbasin delineations, it was recommened That some subbasin delineations be modified to account for differences between the topography and the anticipated actual flow path (accounting for momentum in the 100-year stormwater flow and depth of funoff from relatively large areas that will be unlikely to funnel into narrow openings without a buildup of depth).

In most cases though, the long "fingers" have been removed from the Tc Calculations. The PMC accepts the subbasin delineations pending hydraulic model calibration.

Additional Review Comments Attached: ☐ Yes ☑ No

Recommendation:

☑ Approved as is ☐ Approved with Minor Corrections ☐ Resubmittal Required

Review Completed By:

Tom Nye/CDM Smith, Inc. *Date:* 6/22/2012

Resubmittal Date (if required):

Approved as Final by: *Date:* 6/27/12

RUSH CREEK
City of Arlington Watershed Study

QA/QC Review Certification

Product Name: Draft Hydrology Report

Level: ☐ Internal/Subproduct ☑ Deliverable ☐ Audit

Type: ☐ Checklist ☐ Monthly Model Review ☑ Engineer Deliverables

Checklist Category: ☐ Survey ☑ Hydrology ☐ Hydraulic ☐ Mapping

WBS Code: 4.4.1

Date: 6/22/2012 *Status:* ☑ Draft ☐ Revision ☐ Final

Originator/Firm: Ben Plyant/Halff Associates, Inc.

QC Reviewer/Firm: Tom Nye/CDM Smith, Inc.

General Comments: Remove Appendix C, or at least remove all but the signed QC Page. Internal review notes, comments and responses are Internal work products that should not be published as part of the final document.
Most of Appendix B should be submitted in electronic form only. We could submit this appendix in electronic form or print just the figures and move the tables to a CD/DVD in order to keep the appendices as labeled.
Other minor edits/comments as noted in the attached scan.

Additional Review Comments Attached: ☑ Yes ☐ No

Recommendation:

☐ Approved as is ☑ Approved with Minor Corrections ☐ Resubmittal Required

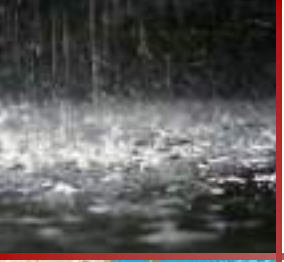
Review Completed By:

Tom Nye, CDM Smith, Inc. *Date:* 6 / 2 2 / 2 0 1 2

Resubmittal Date (if required): N/A

Approved as Final by: *Date:* 6/22/2012

Appendix D
Correspondence



RUSH CREEK
City of Arlington Watershed Study

Draft Memorandum

To: *Hydrology File*

From: *Eric Loucks, P.E., Ph.D.*

Date: *May 31, 2012*

Subject: *Flow paths for estimating Basin Lag Time*

1. Purpose

This memo clarifies the procedure for defining the subbasin flow path to be used for estimating basin lag time in the Rush Creek hydrologic model. For the Rush Creek hydrology we have selected the SCS unit hydrograph method to convert the subbasin runoff volumes into a runoff hydrograph. The SCS unit hydrograph method uses a single input parameter: the basin lag time, T_L.

Runoff hydrographs are either routed downstream in HEC-HMS or directly loaded into HEC-RAS. There are three different applications for each hydrograph generated in HEC-HMS.

1. It is used in a downstream routing or junction in the HEC-HMS model.
2. It is loaded to the HEC-RAS model as a point flow
3. It is loaded to the HEC-RAS model as a distributed flow

The primary purpose of this memo is to describe the need for using different flow paths when defining basin lag time in cases 2 & 3 above. Generally case 1 is the same application as case 2, but that can depend on how routings through basins are handled in HEC-HMS.

2. Discussion

For the Rush Creek hydrology we have selected the SCS unit hydrograph method to convert the subbasin runoff volumes into a runoff hydrograph. The SCS unit hydrograph method uses a single input parameter: the basin lag time, T_L.

Basin lag time for a storm event is defined as the time from the centroid of the effective rainfall to the peak of the outflow hydrograph. There are several empirical methods for estimating T_L (McCuen, 1989) and one of the most popular uses the time of concentration, T_c even though there is no physical connection between the two. Time of concentration is the time it takes for a drainage area to become 100 percent effective in contributing runoff from the start of a runoff producing rainfall. There are also many empirical methods for estimating T_c (Xing, et al., 2005). One of the most popular, the SCS velocity method, involves selecting the longest flow path within the drainage basin and using estimates of flow velocity to determine the travel time to traverse the entire flow path. In a basin with no internal sinks, topology dictates that the longest flow path end at the basin outlet.

Virtually all methods for estimating either T_L or T_c use a flow path that is extended to the basin outlet. The implication is that the flow path ends where the hydrograph is being determined. The technical literature does not say this explicitly, possibly because the point is obvious. The recommendation for the Rush Creek study is to terminate the flow path at the location where the flow path meets a channel that is being modeled in HEC-RAS, or at the basin outlet if the flow path never meets a HEC-RAS channel.

In a HEC-RAS model, there are two types of hydrograph input, point inflow or distributed inflow along a reach. It is worth noting that, on a computational level, all input is the same. As illustrated in *Figure 2-1*, each computational element receives up to three inflows; one lateral inflow along with inflows each adjacent computational elements. In HEC-RAS, each computational element corresponds to a model cross-section. In reaches with distributed inflows, the inflow hydrograph is allocated proportionally among the elements. Distributed inflow to a reach that has just one cross-section, behaves identically to a point inflow.

The inflow hydrographs are computed in HEC-HMS. The locations of HEC-HMS basin outlets must be carefully defined to correspond to the input points in the HEC-RAS model. An example is illustrated in schematic form in *Figure 2-2*. As indicated, the subbasin KEE_000_040 is being loaded as a headwaters point inflow at cross-section 30699.74; therefore it follows that the calculation of basin lag time should terminate where the flow path intersects this cross-section, which is also the basin outlet. Therefore the flowpath for KEE_000_040 does include the main channel segment.

Subbasin KEE_000_050 is loaded as a distributed inflow between 30699.74 and 28906. In HEC-RAS, the inflow will be represented as seven inflow hydrographs, one for each of the seven cross-sections in the reach. In the actual Kee Branch channel, inflows will occur at various points on each side of the channel through small tributaries and storm sewer outfalls. Of course, it is beyond the scale of this modeling effort to individually account for each one of these sources. The longest flow path for subbasin KEE_000_050 is shown in *Figure 2-3*. The flow path used to estimate T_L for this hydrograph should not include the portion of the channel that is modeled in unsteady HEC-RAS. The east-west flow path segment shown in the figure will be used to approximate the travel time for all of the lateral inflow hydrographs in the subbasin.

Discharge from subbasin KEE_000_060 has characteristics of both a distributed and point inflow to the Kee Branch main channel. As shown in *Figure 2-4*, the longest flow path drains a large area that discharges through an outfall.

It is up to the hydraulic modeler to decide how a given subbasin should be represented. While the choice of approach has some local effect, the impact on overall results will be minor. This is especially true in the Rush Creek Watershed Study because we have elected to use small subbasins, minimizing the effect of the modeling approach on each particular subbasin. Subbasin KEE_000_070 will be loaded as a distributed inflow. The longest flow path for this subbasin is also shown in *Figure 2-4*. Again the portion that overlaps the main channel should be excluded from the basin lag time calculation. This is because routing through the main channel is modeled in HEC-RAS so including it would duplicate this travel time and storage and because the truncated flow path is more representative of all the flow paths leading to the main channel from Subbasin KEE_000_070.

3. Conclusion

The primary conclusion of this memo is a procedural guideline to exclude any portion of the channel modeled in unsteady HEC-RAS from the flow path used to determine basin lag time. This essentially defines a clear boundary between HEC-RAS and HEC-HMS at the point where the HEC-HMS hydrograph enters the HEC-RAS channel model. This is a situation that arises when unsteady HEC-RAS is used because channel routing can occur in both models and it seems appropriate to ensure that not only is no portion of any modeled channel double-counted, but also that the entire channel is used. In other words, HMS-routing should end right where HEC-RAS routing begins. In the examples presented, it has been demonstrated that there is no clean break in subbasins with distributed lateral inflow to the channel due to the fact that there are multiple inflows from these basins. However the recommended approach of excluding the main channel for calculating basin lag will, on average, provide an appropriate path length.

References

Franz, D. D. and C. S. Melching. Full Equations Model for the Solution of the Full, Dynamic Equations of Motion for One-Dimensional Unsteady Flow in Open Channels and Through Control Structures, USGS WRI Report 96-4240, 1997.

McCuen, Richard H., Hydrologic Analysis and Design, Prentice Hall, 1989.

Xing, Fang, Pradhan, P., Malla, R., Cleveland, Theodore, and David Thompson, “Estimating Time of Concentration for Texas Watersheds,” 2005.

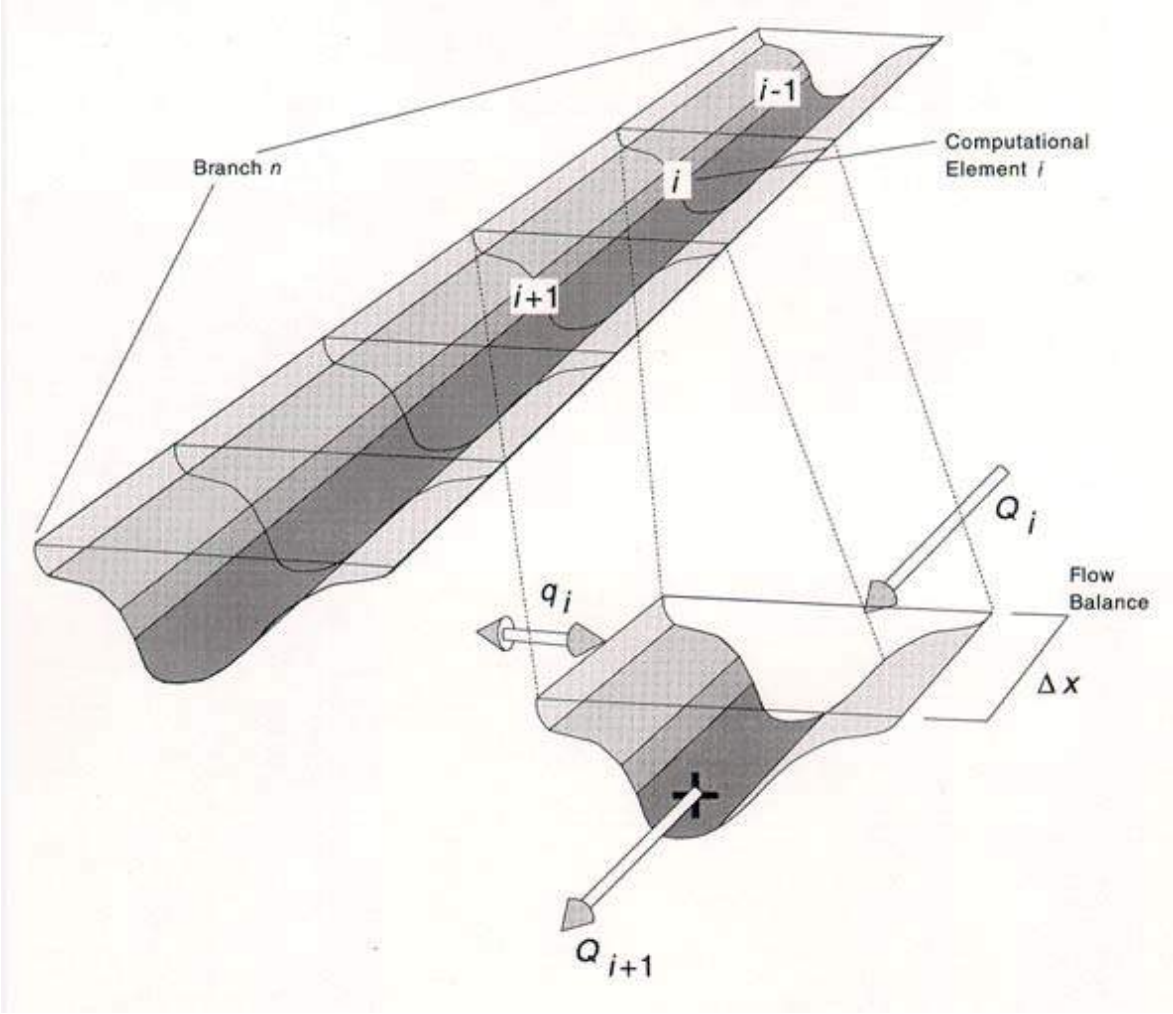


Figure 2-1. Computational elements in an unsteady Flow Model (Franz and Melching, 1996)

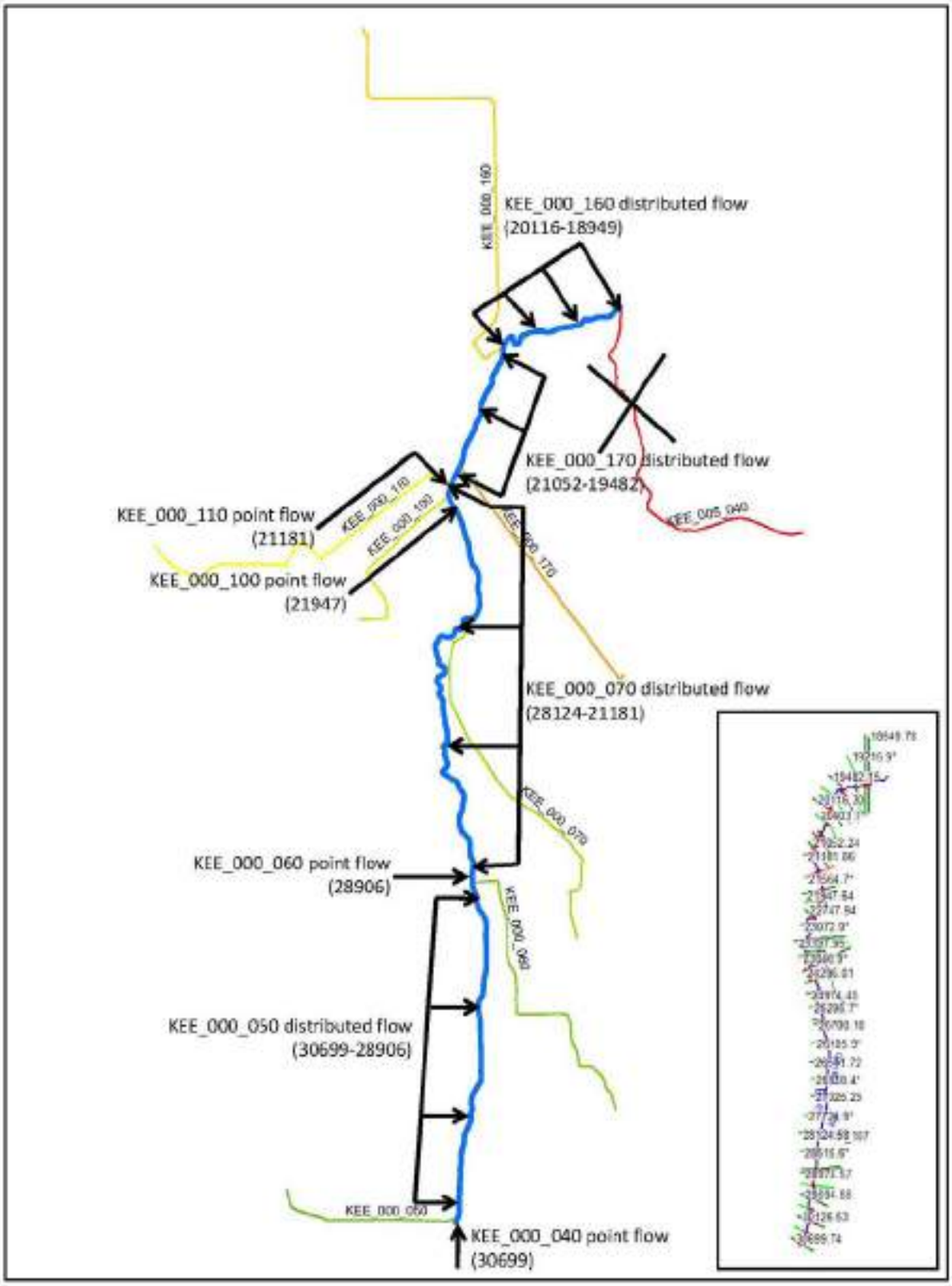


Figure 2-2. Point flow and distributed flow schematics.

Figure 2-3. Longest flow paths for subbasins at the Kee branch Headwaters.

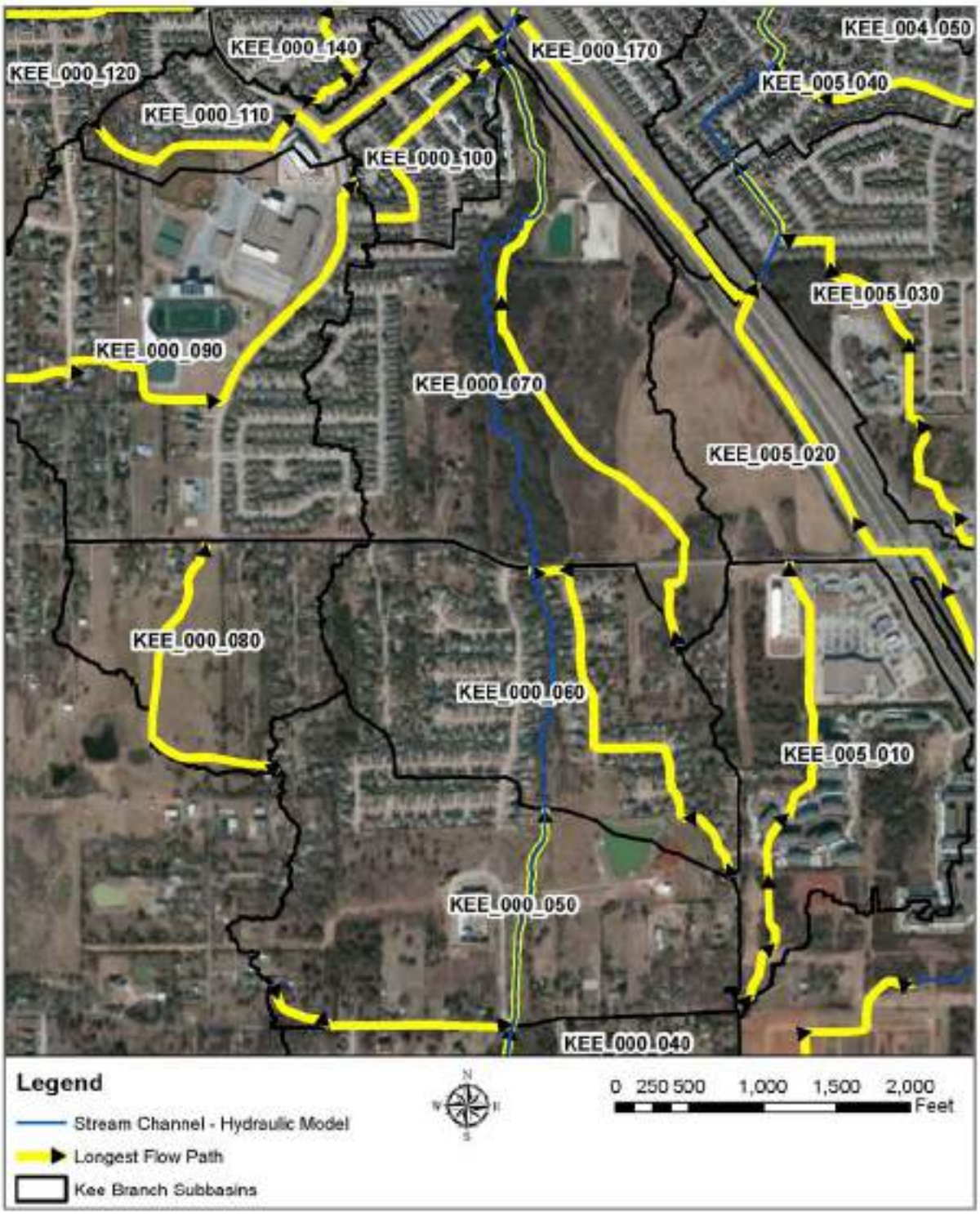


Figure 2-4. Additional KEE_000 Subbasins

Appendix E
LiDAR QA Report

LiDAR Quality Assurance (QA) Report
Fort Worth, Texas
Texas Water Development Board
May 10, 2010

Submitted to:
Texas Water Development Board

Prepared by:
Dewberry
Fairfax, VA

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Executive Summary

Reference: Texas Water Development Board Contract 580-09-0824

This report documents Dewberry's assessment of the quality of the LiDAR deliverables for Fort Worth, Texas, developed under contract to the Texas Water Development Board (TWDB). The LiDAR data and supplemental deliverables were acquired and processed by Fugro Earth Data, Inc. (FEDI) beginning in March 2009. The area consists of 322 tiles of LiDAR data in LAS format 1.1, classified into eight classes as follows.

- Class 1 – Unclassified
- Class 2 – Ground
- Class 3 – Low Vegetation
- Class 4 – Medium Vegetation
- Class 5 – High Vegetation
- Class 6 – Building
- Class 7 – Noise
- Class 9 – Water

The data were reviewed quantitatively for statistical errors and vertical accuracy, and qualitatively for completeness and visual anomalies.

The LiDAR data are of good quality; however, some issues exist in the supplemental products including the breakline dataset, hydro-enforced Digital Elevation Models (DEMs), and metadata products.

- Breakline Dataset - There are topology and completeness issues, albeit minimal, in the breakline dataset. The end user should make note of these errors; however, they do not render the data unusable.
- Hydro-enforced DEMs - The hydro-enforced DEMs contain data voids and incomplete tile edges due to processing errors. The specific tiles containing data voids are documented in this report and must be corrected before use.
- Metadata - Errors exist in the metadata for all products: LAS, breakline, intensity, and DEM. Dewberry has provided suggestions for improvement later in this report.

Completeness: The LiDAR data were required to contain multiple returns per pulse with an intensity value recorded for each point. Dewberry verified that the LAS files adhere to these specifications. Furthermore, the spatial extent of each tile was required to conform to a $1/16^{th}$ 7.5-minute quadrangle, otherwise known as the USGS Quarter-Quarter-Quad. The internal tiles contain a 50-meter overlap between tiles, while those that line the project boundary contain a 300-meter buffer on all sides. The LAS data were projected to NAD83 UTM Zone 14N and NAVD 88, Geoid 03, meters.

Quantitative Assessment: One of the first steps in assessing the quality of the LAS dataset is a vertical accuracy assessment of the ground models in comparison to the survey checkpoints. Using the checkpoints provided by Dewberry's surveyor, Dewberry tested the $RMSE_Z$ per FEMA/NSSDA and NDEP/ASPRS specifications. The checkpoints were collected in a total of four land cover types (Open Terrain, Urban Terrain, Weeds/Crop, and Forest). The LAS dataset conforms to the vertical accuracy requirements using 100% of the

original 72 checkpoints. Table 1 provides the accuracy results in open terrain based on the FEMA/NSSDA methodology ($RMSE_z$ x 1.960).
Table 2 contains the results measured at the 95% confidence level in the Fundamental Vertical Accuracy (FVA) and the 95th percentile for the Consolidated and Supplemental Vertical Accuracies (CVA and SVA).

Table 1 – Vertical accuracy assessment summary (FEMA/NSSDA)

Criterion	Number of Checkpoints	Accuracy Specification(m)	Results(m)
$RMSE_Z$	24	0.185	0.040
FVA	24	0.363	0.078

Table 2 – Vertical accuracy assessment summary (NDEP/ASPRS)

Criterion	Number of Checkpoints	Accuracy Specification(m)	Results(m)
Consolidated	72	0.363	0.084
FVA – Open Terrain	24	0.363	0.078
SVA – Open Terrain	24	0.363	0.076
SVA – Weeds/Crop	11	0.363	0.075
SVA – Forest	12	0.363	0.480
SVA – Urban	25	0.363	0.072

- Tested 0.084 m consolidated vertical accuracy at 95% confidence level in all land cover categories (NDEP/ASPRS methodology)
- Tested 0.078 m fundamental vertical accuracy at 95% confidence level in Open Terrain using $RMSE_Z$ x 1.9600 (FEMA/NSSDA and NDEP/ASPRS methodologies)
- Tested 0.076 m supplemental vertical accuracy at 95th percentile in Open Terrain category (NDEP/ASPRS methodology)
- Tested 0.075 m supplemental vertical accuracy at 95th percentile in Weeds/Crop category (NDEP/ASPRS methodology)
- Tested 0.480 m supplemental vertical accuracy at 95th percentile in Forest category (NDEP/ASPRS methodology)
- Tested 0.072 m supplemental vertical accuracy at 95th percentile in Urban category (NDEP/ASPRS methodology)

Qualitative Assessment: Dewberry conducted a visual inspection of 100% of the data on a tile-by-tile basis. The data do not contain any major anomalies or data voids. The bare earth model is very clean, but contains some minor anomalies. It is 98% free of artifacts, which exceeds expectations (the acceptable limit is 95%). Very few divots and flight line ridges were identified in the ground models. There are misclassification errors in the dataset, specifically within classes 3, 4, 5, and 6; however, these types of errors are to be expected. Overall, Dewberry can confirm that the LiDAR data is of good quality.

QA Report

1 Introduction

The goal of the TWDB LiDAR Task Order is to provide high accuracy elevation datasets of multiple deliverable products including LAS, intensity imagery, hydro-enforced DEMs, and 3D breaklines for the State of Texas. The project area spans 322 tiles covering 1,061 square miles and will support the National Flood Insurance Program in the development of accurate flood zone maps as well as the USGS's efforts in maintaining its National Elevation Data.

Dewberry had previously reviewed data provided by FEDI with both satisfactory and unsatisfactory results. In summary, the LiDAR data passed the quantitative assessment, however the Quality Assurance (QA) review recommended minor corrections. The original breakline dataset did not pass completeness and qualitative checks, and the data contained topology and other quantitative errors. Dewberry identified that the intensity imagery did not contain a defined projection. Lastly, Dewberry identified errors in the LAS metadata and proposed a set of recommendations to improve the overall quality.

The first review of the Fort Worth data did not consist of all deliverables. The following deliverables were not initially included:

- Hydro-enforced DEMs
- Intensity Metadata
- DEM Metadata
- Breakline Metadata

Dewberry performed a final review of all data products, which included completeness checks, vertical accuracy testing, and qualitative reviews. This report documents the results and defines whether or not each deliverable meets specifications. Special notes have been documented where improvements were made.

The sensor used to acquire the data was the Leica ALS-50. Refer to Figure 1 for the flight line trajectories. The trajectories were provided in shapefile format and include the required information: the aircraft position, attitude and GPS time.

Figure 1 – Map of Fort Worth project area displaying complete coverage by trajectories

2 LAS

2.1 Completeness

The LAS datasets were provided in format 1.1, in 322 tiles as defined by USGS 1/16th 7.5 minute quadrangles. The tiles that fall on the project boundary have a 300-meter buffer while those that fall within the boundary contain a 50-meter overlap between tiles.

2.1.1 Methodology

Dewberry conducted a statistical analysis of the LiDAR data to ensure its completeness. The tool used to perform the analysis reports the relevant information specific to LAS data in format 1.1. This information includes the following:

- Number of points per tile;
- ASPRS classes used throughout the dataset;
- Projection and datum;
- Scan angle of the sensor;
- Elevation values per tile;
- Swath overlap; and
- Other criteria.

2.1.2 Assessment Results

Dewberry verified that the LAS contained the appropriate information in each of the aforementioned categories. One point to note is the amount of swath overlap. The scope of work requires a nominal sidelap of 50% on adjoining swaths, meaning that all of the data should have 100% double coverage. The tile in Figure 2 colored by individual flight lines amounts to 34% of overlap on either side. This same characteristic is present throughout the dataset.

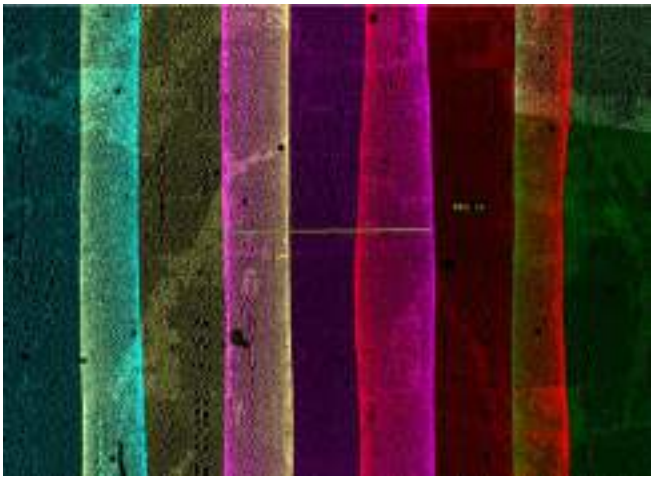


Figure 2 - Tile u339760_2_a; LAS Source data showing flight line overlap. The yellow line defines the width of one flight line.

The LAS data follow the USGS tile naming system and are classified by the following ASPRS classes:

- Class 1 – Unclassified

- Class 2 – Ground
- Class 3 – Low Vegetation
- Class 4 – Medium Vegetation
- Class 5 – High Vegetation
- Class 6 – Building
- Class 7 – Low Point/Noise
- Class 9 – Water

Figure 3 illustrates the total number of LiDAR points collected per tile. The tiles along the project boundary with the highest number of points reflect the 300-meter buffer. This is to be expected.

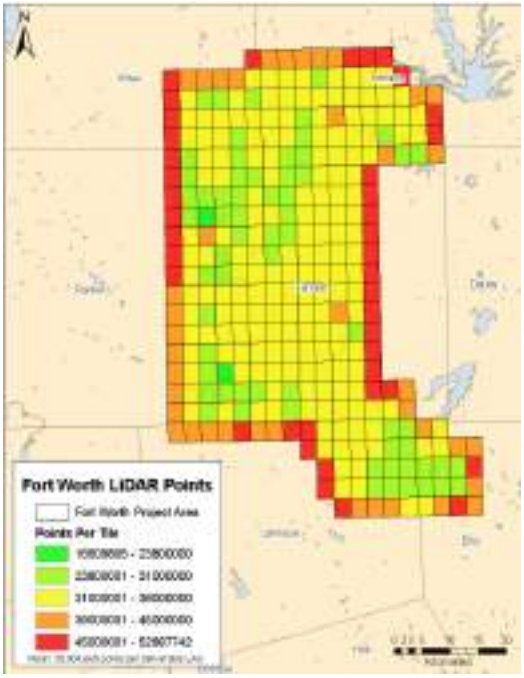


Figure 3 – Map illustrating the total number of LiDAR points per tile

The figures provided below illustrate the minimum and maximum elevation values of the ground class. The lowest z-minimum values depicted by Figure 4 exist in the eastern portion of the project area and elevate toward the west. The same pattern is recognized in Figure 5 as the lowest of the z-maximum values originate in the east and gradually heighten toward the west. The maps also verify that null or extraneous z-values in the ground class do not exist.

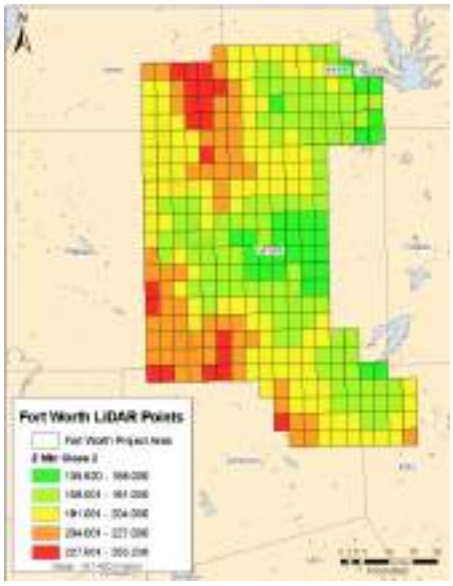


Figure 4 – Map of Z-minimum values in the ground class

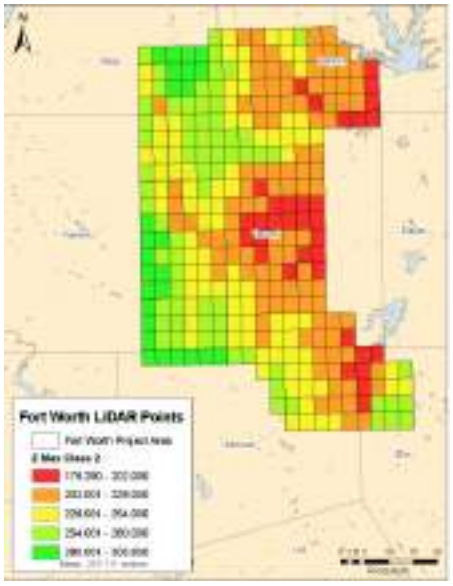


Figure 5 – Map of Z-maximum values in the ground class

2.2 Quantitative Assessment

Dewberry performed an analysis that compared the elevation values of ground survey checkpoints against the LiDAR data to ensure the vertical accuracy of the LiDAR data.

2.2.1 Methodology

Dewberry used 72 surveyed checkpoints, chosen to fall into the following land cover categories:

- Urban Terrain – 25 points
- Open Terrain – 24 points
- Forest – 12 points
- Weeds/Crops – 11 points

The checkpoints were spread across the 1,061 square mile project area in an effort to survey as many flight lines as possible. To verify accuracy of the survey, 50% of the checkpoints were re-surveyed. The re-surveyed values match the initial surveyed positions within the 95% confidence level. Figure 6 illustrates the locations of the checkpoints throughout the project area colored by their respective land cover types.

Figure 6 – Map displaying spatial location of 72 survey checkpoints

The GPS technique used to survey the data was connected to Real Time Kinematic (RTK) network. This network is composed of highly accurate GPS reference stations that compare the survey checkpoints against published coordinates. It is linked to create a Virtual Reference Station (VRS) system. The VRS functions as a network of points that send corrections to the survey checkpoints, solving for ionospheric and tropospheric conditions. Additionally, six National Geodetic Survey monuments were used to validate the accuracy of the VRS network. These monuments also acted as the primary project control monuments.

Dewberry's methodology for testing vertical accuracy used the orthometric heights of the survey checkpoints compared against the bare-earth LiDAR elevations at the same horizontal locations. The survey checkpoints were overlaid on the Triangulated Irregular Network (TIN) created by the LiDAR ground points and the interpolated Z value from the TIN at that point was subtracted from the survey checkpoint elevation. The differences in Z values were recorded, and represent the amount of error between the two measurements.

2.2.2 Assessment Results

The LAS data passed the quantitative assessment using 100% of the survey checkpoints with a consolidated RMSE of 0.112m as shown in Table 3.

Table 3 – RMSE method for testing vertical accuracy

100% of Totals	RMSE (m) Spec=0.185m	Mean (m)	Median (m)	Skew	Std Dev	# of Points	Min (m)	Max (m)
Consolidated	0.112	-0.008	0.009	-6.635	0.113	72	-0.875	0.089
Open Terrain	0.040	0.006	0.003	-0.506	0.040	24	-0.092	0.077
Weeds/Crop	0.041	0.028	0.023	0.344	0.032	11	-0.022	0.089
Forest	0.259	-0.091	0.005	-3.172	0.254	12	-0.875	0.033
Urban	0.041	0.004	0.009	-0.294	0.041	25	-0.080	0.075

The result of the FVA assessment shown in Table 4 provides the best summary of the data, as it describes how well the sensor worked in open terrain - the land cover type with the least amount of induced error. With an FVA value of 7.8 cm and a threshold of 36.3 cm, it can be concluded that the LAS data were collected with accuracy. As a result, we expect that the sensor functioned appropriately in all other land cover types. The CVA and SVA assessments report the RMSE value that 95 percent of the errors fall on or below, known as the 95th percentile. The remaining 5 percent of the errors lie above the stated CVA and SVA values.

Table 4 – Fundamental, Consolidated, and Supplemental Vertical Accuracies

Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy	CVA — Consolidated Vertical Accuracy	SVA — Supplemental Vertical Accuracy
Consolidated	72		0.084	
Open Terrain	24	0.078		0.076
Weeds/Crop	11			0.075
Forest	12			0.480
Urban	25			0.072

The following graph illustrates the RMSE results of the survey checkpoints separated by land cover type. The majority of errors are distributed just above and below zero with one outlier in the forest category.

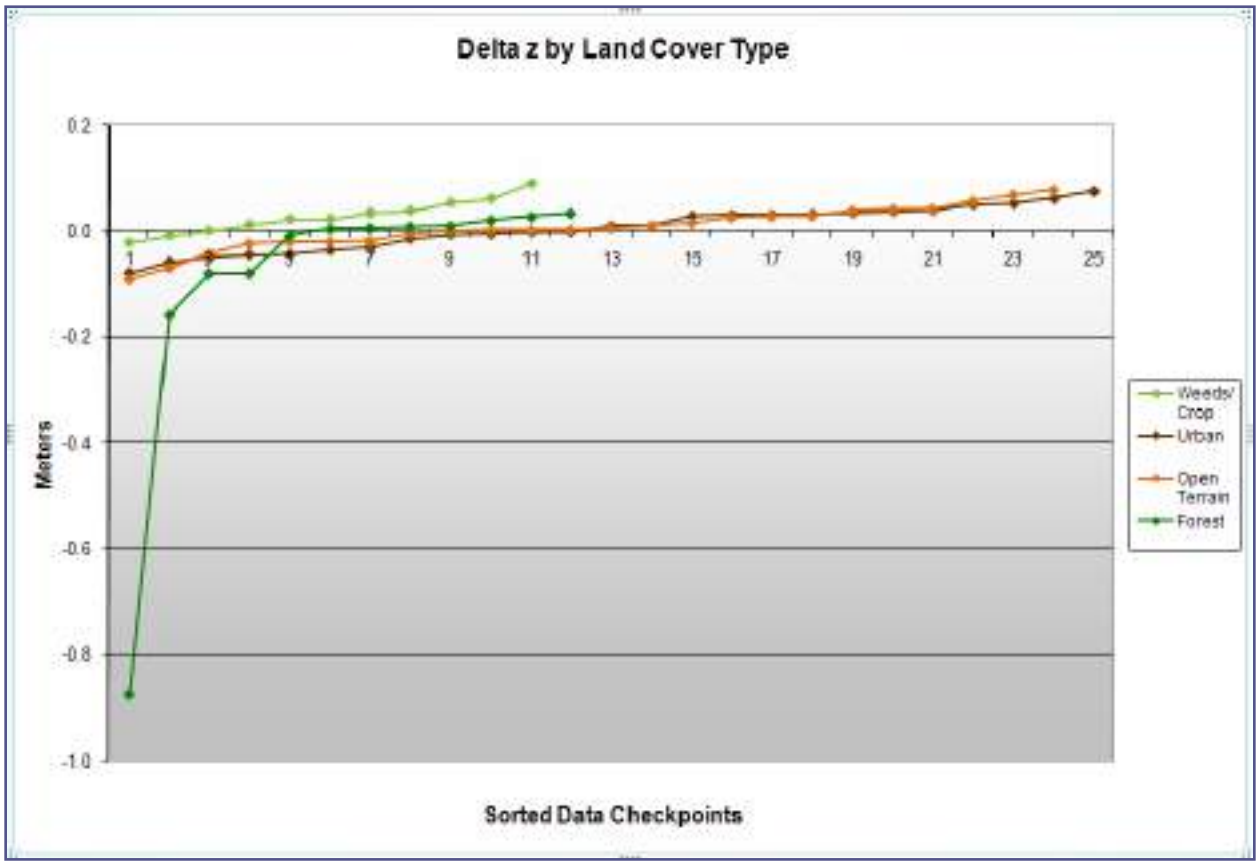


Figure 7 – Display of RMSE value of 72 checkpoints based on land cover type

The RMSE value using the 95% best checkpoints was computed. Table 5 identifies the four points that were removed.

Table 5 – The least accurate 5% of checkpoints

Point	Easting	Northing	Elevation	Z LiDAR	Land Cover Type	DeltaZ
W-612-F	685304.402	3592474.073	218.637	217.762	Forest	-0.875
W-506-VTF	662641.773	3654876.960	175.717	175.560	Forest	-0.157
OT-628	652252.904	3600719.460	245.930	245.838	Open Terrain	-0.092
B-19-VTV	679674.813	3658657.342	178.733	178.822	Weeds/Crop	0.089

The RMSE using the 95% of the best checkpoints is **0.037m,** as shown in Table 6. The most notable improvements exist in the Forest and Weeds/Crop categories.

Table 6 – RMSE method for testing vertical accuracy at 95%

100 % of Totals	RMSE (m) Spec=0.185m	Mean (m)	Median (m)	Skew	Std Dev	# of Points	Min (m)	Max (m)
Consolidated	0.037	0.007	0.007	-0.485	0.036	68	-0.080	0.077
Open Terrain	0.035	0.009	0.003	-0.096	0.034	23	-0.070	0.077
Weeds/Crop	0.031	0.019	0.022	0.076	0.026	10	-0.022	0.061
Forest	0.036	-0.005	0.005	-1.568	0.037	10	-0.079	0.033
Urban	0.041	0.004	0.009	-0.294	0.041	25	-0.080	0.075

Improvements are made in the FVA, CVA, and SVA values using the best 95% of the checkpoints.

Table 7 - Fundamental, Consolidated, and Supplemental Vertical Accuracies

Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy (RMSEz x 1.9600)	CVA — Consolidated Vertical Accuracy (95th Percentile)	SVA — Supplemental Vertical Accuracy (95th Percentile)
Consolidated	68		0.076	
Open Terrain	23	0.069		0.069
Weeds/Crop	10			0.057
Forest	10			0.079
Urban	25			0.072

2.3 Qualitative Assessment

Dewberry performed a micro-level qualitative analysis on 100% of the LAS data by performing a visual analysis of ground models, full point cloud models, and raw LiDAR points. Below is a discussion of the discrepancies identified in the dataset. Appendix A contains a complete list of LiDAR calls. While corrective actions could have been made, the LiDAR data pass the qualitative assessment.

Artifacts

In any dataset it is not uncommon to find artifacts left in the ground models. Typically, artifacts are caused by misclassification of points. As an example, points that should have been classified as a building (class 6) may be left in the ground class (class 2). Dewberry identified a total of four artifacts in the bare-earth LiDAR models throughout the entire Ft. Worth project area. In the Acceptance Criterion, Dewberry requires 95% removal of artifacts. This dataset meets the accuracy specifications, as 98% of the ground models are free of artifacts.

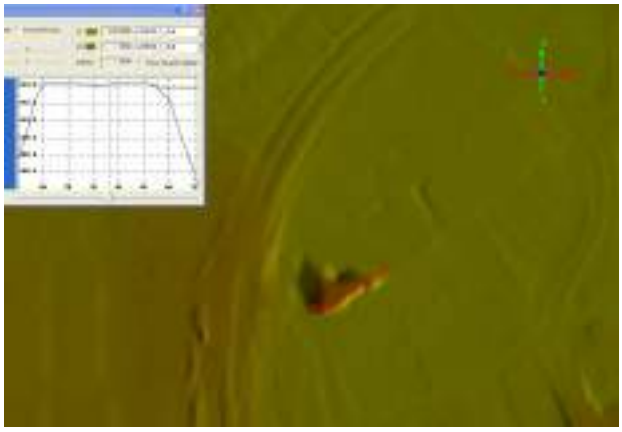


Figure 8 - Tile u329764_1_d; Partial building left in the ground model

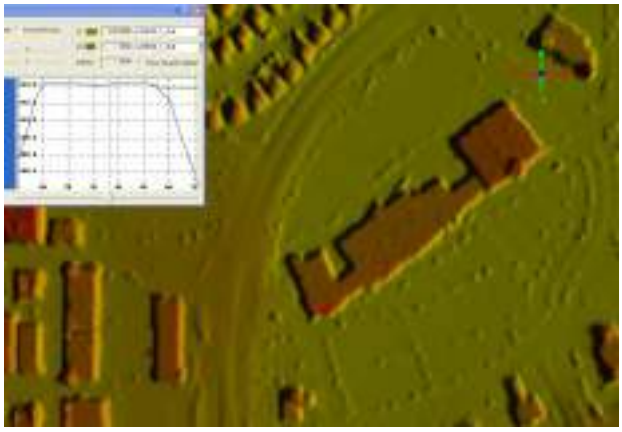


Figure 9 – Full point cloud model showing entire building

Inconsistent Editing

Dewberry identified a few cases in the dataset where inconsistent editing occurred. This type of error may be visible in the removal of buildings, bridges, highway ramps or vegetation. The example below shows a highway ramp that was incorrectly removed from the ground. It is evident when analyzing the full point cloud model that both ramps on either side of the overpass are similar, thus the ground points should have been edited in the same manner. Placing ground points back in the ground class would have improved data quality; however, due to the minimal number of inconsistent edits in the ground models (1.8%), the data meets the requirements.

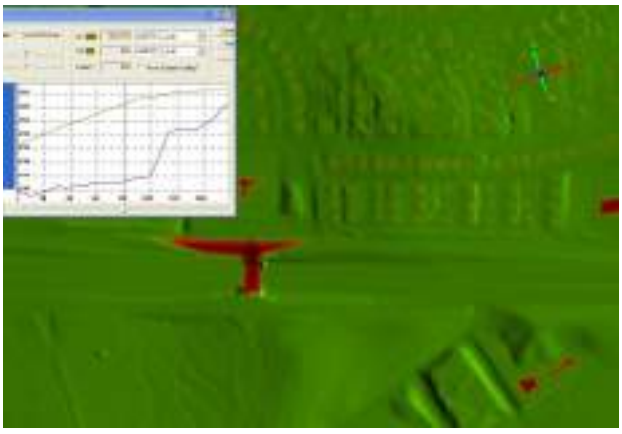


Figure 10 – Tile u329707_2_a; Inconsistent editing of the ground class

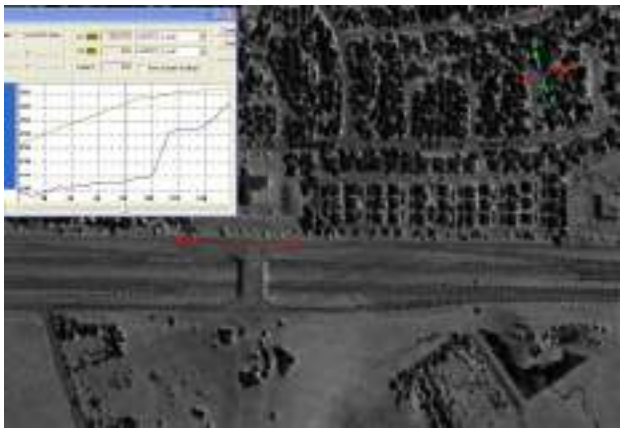


Figure 11 – Full point cloud intensity model showing that the highway ramp and overpass features

Divots

Divots in the dataset are caused by the misclassification of points. As an example, points that should exist in class 7 (noise) may instead be classified as class 2 (ground points). These points lie well below the true ground and may be overlooked during the classification

process. Five examples of divots were identified in the ground models. Since the data are largely free of such outliers, Dewberry did not ask for correction.

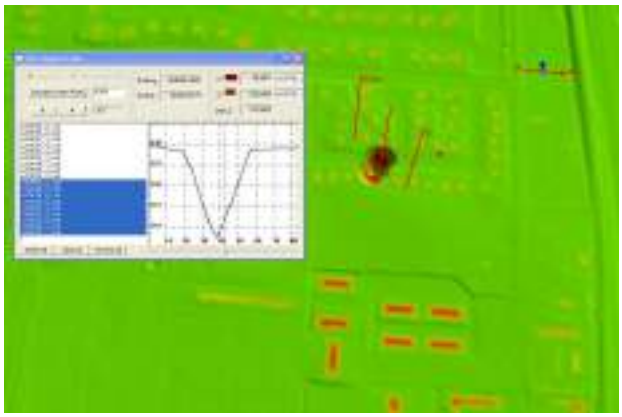


Figure 12 – Tile u329706_2_d; Ground density model of divot

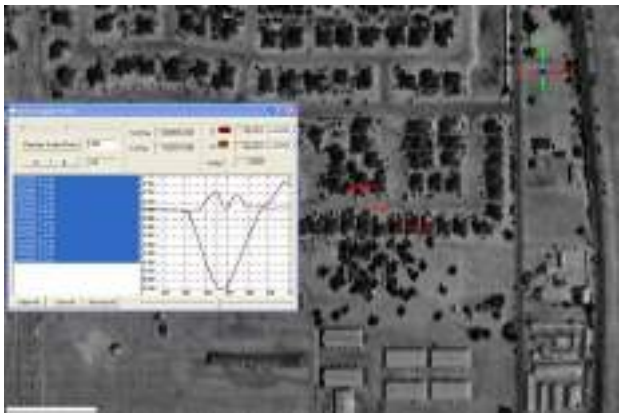


Figure 13 – Full point cloud intensity model

Misclassification

Throughout the dataset there are many examples of the misclassification of LiDAR points in classes 3, 4, 5, and 6. The image below displays an area populated by trailers. Although the trailers should be classified as buildings, they are classified as high vegetation (Figure 14, shown in purple). However, the ground is not affected by this type of misclassification as illustrated by Figure 15. Dewberry is not concerned with this anomaly, as it does not affect the usability of the bare-earth data; it is simply an observation.

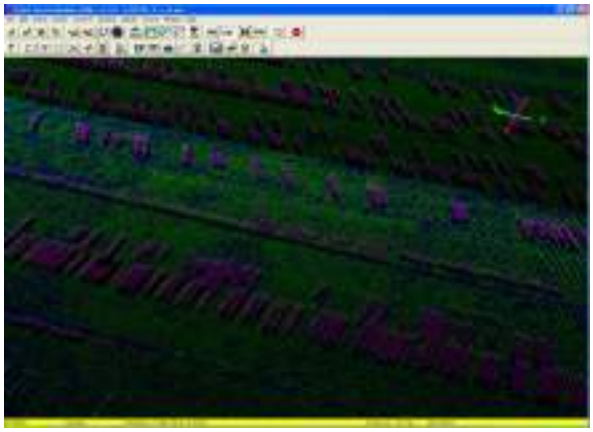


Figure 14 - Tile u329706_1_a; LAS showing trailers classified as high vegetation points

Figure 15 – Tile u329706_1_a; model showing correct classification of ground despite misclassification of trailers

Flight Line Ridges

Minimal flight line ridges, amounting to mismatches of 20-centimeters, were identified in the dataset. The Acceptance Criterion specifies the correction of seam line mismatches that are greater than 20-centimeters. These do not require corrective measures.

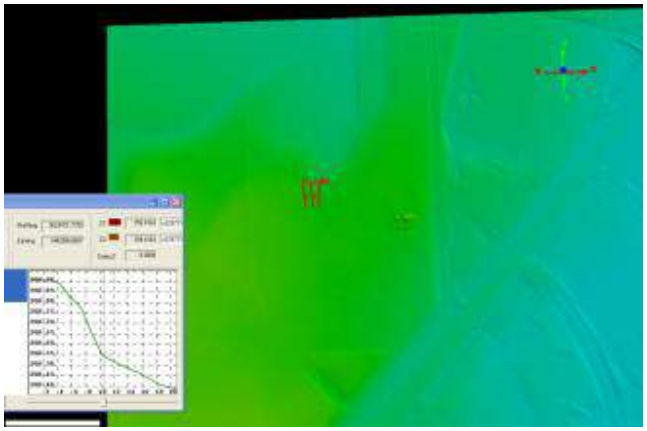


Figure 16 – Tile u329721_2_a; Ground model of flight line ridge

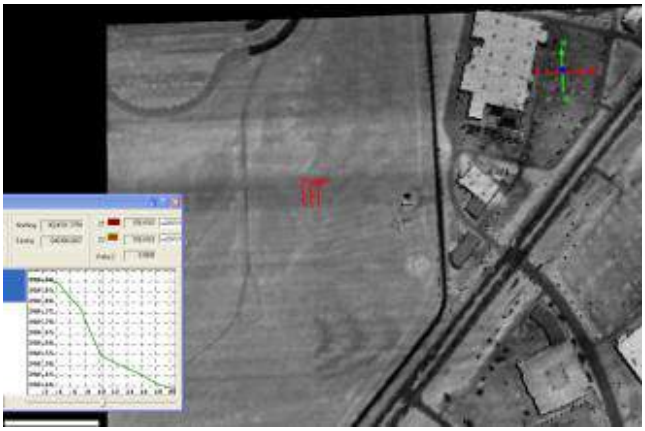


Figure 17 – Intensity image illustrates the boundary between flight lines

3 Breaklines

Dewberry conducted a thorough quantitative and qualitative analysis of the breakline dataset. The breaklines were examined a second time to determine if they met project requirements for completeness, topology (including monotonicity – ensuring that each stream flows downhill), and vertical accuracy. Dewberry assessed the dataset for hydro-enforcement of the hydrolines, the topology of the dataset, and the completeness of the watershed.

In a previous memo, Dewberry provided a list of edit calls and common issues found in the breakline dataset and recommended their correction. After reviewing the most recent geodatabase, it is evident that FEDI has made many improvements to the data. Some outstanding issues still remain that are detailed in the qualitative analysis section below.

3.1 Inventory

Dewberry received an ESRI Geodatabase that included the following feature classes:

- Culvert
- Single Stream
- Stream Polygon
- Stream Connector
- Stream Island Polygon
- Waterbody Polygon
- Waterbody Connector
- Waterbody Island Polygon

3.2 Topology

An important requirement of hydro breaklines intended for modeling is valid topology. Dewberry tested the topology using ESRI's PLTS to ensure that breakline vertices snapped together, that hydro lines were monotonic within a tolerance, that all waterbodies were flat, and that all breaklines had defined elevations. The issues identified during the review are listed below.

- Duplicate geometry:
    - 9 waterbody to waterbody islands
    - 5 stream to stream islands
- Dangles:
    - 1 stream dangle

3.3 Vertical Accuracy Assessment

In order to test the relative accuracy of the breaklines compared to the LiDAR, Dewberry compared a sample of the breakline vertices to the LiDAR masspoints. This is not a definitive test; it is used as an internal guideline to determine how well the breaklines fit the LiDAR. We expect in some cases that the data will not fit, which may be due to the distribution of points or the difficulty in collecting a bankline on a steep slope, for example. Therefore, we use this check as an indication of the vertical consistency between the two products.

3.3.1 Methodology

Dewberry tests the vertical accuracy of the breaklines by comparing the elevation of a sample of the breakline vertices to the surrounding LiDAR points. The vertices of polyline breaklines are converted to points while a GeoTerrain is created from the LiDAR masspoints using only the ground classification. The elevation of the LiDAR is derived by extracting the Z-value of the terrain at the same X/Y-values of the "checkpoints". Finally, an analysis of the elevation comparison between the checkpoints and the terrain is conducted to determine the accuracy of the breakline collection. Due to the enforced montonicity of the breaklines, Dewberry set a criterion of twice the RMSE to allow room for acceptable errors.

A slightly modified version of the process described above was implemented for the analysis of the waterbody features. Since the waterbody breakline vertices are all equal, the purpose of the vertical accuracy assessment is to determine if LiDAR masspoints surrounding the breakline are lower in elevation than the breakline. If there are masspoints with lower elevations, then the horizontal placement of the breakline may need to be adjusted. Dewberry set a criterion that if 20% of the vertices are higher in elevation or "float above" the surrounding masspoints, then the feature is marked as an error.

3.3.2 Assessment Results

The breakline vertex samples were tested for the individual feature classes against the masspoints. Table 1 shows the raw $RMSE_Z$ values, the vertical accuracy value at the 95th percentile, and the vertical accuracy value and percentile level at which the breaklines reach the accuracy of less than twice the $RMSE_Z$ or 0.363 m.

Table 8 – Vertical Accuracy Results

Breakline Feature Class	Vertical Accuracy at 95th Percentile	Percentile at which the vertical accuracy is less than twice the $RMSE_Z$ Spec= 0.363 m
Single Line Stream	0.351	95th
Dual Line Stream	0.852	79th

Table 2 illustrates the results of the vertical accuracy assessment performed on the waterbody feature vertices. Dewberry tested 1,319 breaklines and found that 14 features have at least 20% of their vertices with higher elevations than the surrounding masspoints.

Table 9 – Vertical Accuracy Results of the Water body Feature Class

Total Waterbodies floating (based on 20% criterion)	14
Total Waterbodies	1319
Percent of Water bodies floating	1%

The waterbody feature class achieved the poorest vertical accuracy rating using this method. Of the total feature count, 1% of the waterbody features float above the masspoints. Please note that this analysis does not take into account the distance of the vertices above the terrain, only that a certain percentage of the vertices are in error. However, after the visual review, Dewberry only identified waterbodies floating by 0.35m or less. Dewberry did not identify any major anomalies that would cause concern. Based on the very small percentage of waterbodies floating, and the small degree by which they float, Dewberry is confident in the level of vertical consistency between the waterbodies and the LiDAR masspoints.

3.4 Qualitative Assessment

Dewberry performed a second visual qualitative analysis of the breaklines against intensity imagery as well as a terrain created using LiDAR masspoints. The purpose of this check is to verify the completeness of each feature class. The analysts check for feature coding errors and missing features. They also verify that breaklines are compiled to the correct project boundary, and that features are captured without overlap.

In the previous dataset, a general call was placed to snap all breaklines to the project boundary. It appears that issues still remain, as several breaklines extend past the boundary while others stop short of the boundary. Figure 18 illustrates this issue. All breaklines should be snapped to the project boundary.

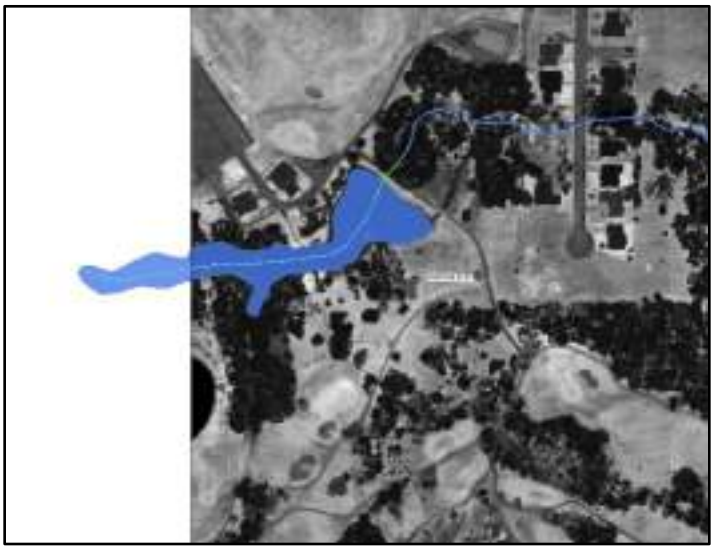


Figure 18 – Tile u329704_4_c; waterbody extends past project boundary

Waterbody Feature Class

As defined by the breakline specifications, any waterbody greater than or equal to 1 acre is to be captured. Previously, Dewberry identified 100+ missing waterbodies in the dataset. FEDI made many improvements to the waterbody feature class; however, there are waterbodies that meet the criteria that have not been collected. Figure 19 and Figure 20 identify a waterbody in the intensity and terrain that is 1.4 acres.

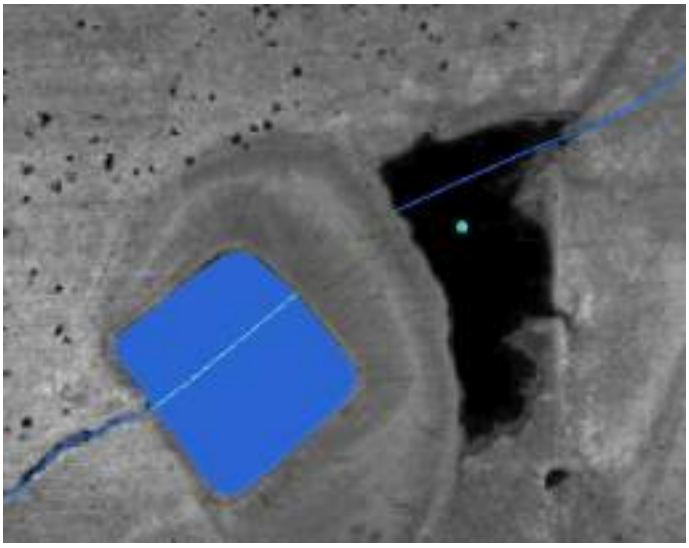


Figure 19 – Tile u339754_4_d; Intensity supports initial claim that a waterbody is missing

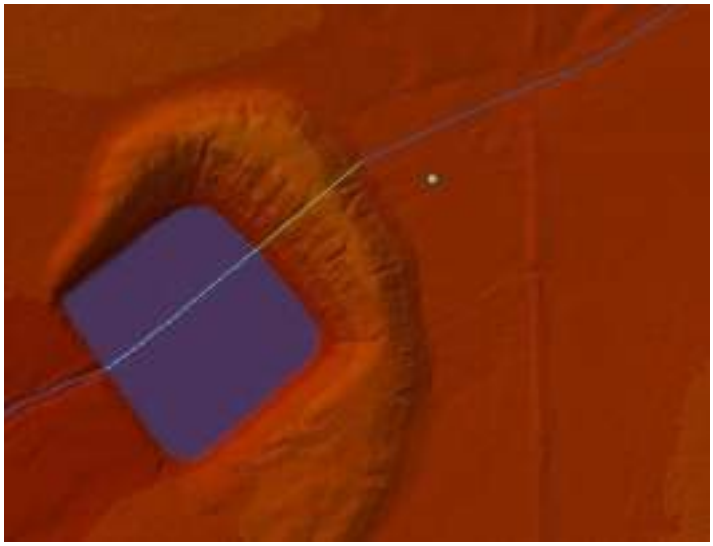


Figure 20 – Flatness of terrain due to absence of masspoints supports the collection of the waterbody

There are very minimal feature coding errors that affect the waterbody feature class. In Figure 21, a single line stream runs through a waterbody. Instead, this feature should have been coded as a waterbody connector.

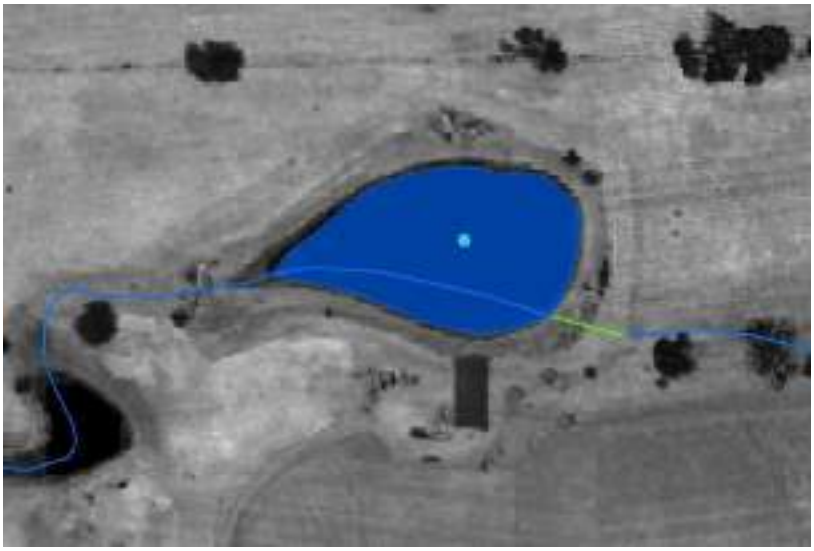


Figure 21 – Tile u339762_2_c; Stream passing through waterbody should be coded as a waterbody connector

Hydrographic Features

Many inconsistencies in the collection of hydrographic features existed in the previous dataset. However, FEDI heeded many of Dewberry's recommendations and as a result the hydrographic features have significantly improved. Some discrepancies may exist - it can be debatable if a feature should be a waterbody or a stream, for example. However, overall the hydrographic

feature class is of good quality in terms of both capture methods and horizontal placement of the breaklines.

Below is an example of one error that was also called in the previous dataset. The major waterbody in blue should have two dual line streams (purple) that feed into the waterbody from the west. The single line stream to the north, highlighted by the yellow arrow, should be captured and coded as a dual line stream for two reasons: it is greater than 40ft wide, and the feature to the south that has the same characteristics was treated as a dual line stream.

Figure 22 – Stream denoted by yellow arrow should be coded as a dual line instead

Waterbody Island Feature Class

Dewberry placed calls that requested the delineation of water body islands in the previously submitted dataset. In their response, FEDI stated that island feature classes less than one acre did not require collection. However, there are island features greater than 1 acre that were not compiled. Figure 23 shows three islands that are between 1 and 2 acres in size that were not collected.

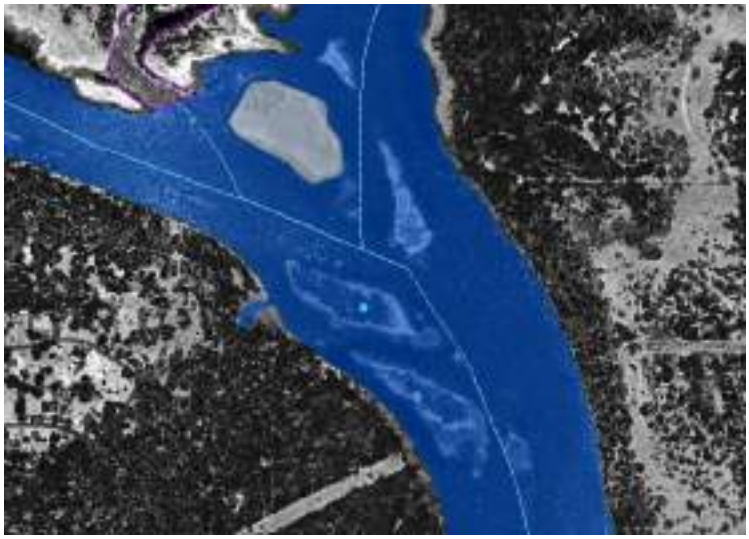


Figure 23 – Tile u329713_1_d; waterbody islands up to 2 acres not collected

Culverts

The purpose of culverts is to connect hydrographic features when they are interrupted by a road. The difficulty in using culverts consistently throughout the dataset is in determining the type of feature underneath which they pass. If the stream is running under a bridge, it should remain a stream. However, if the stream passes under a road as a culvert, then it should be coded as such. It is not always easy to judge if the feature is a road or bridge based on intensity imagery. Therefore, it is possible that one reviewer may interpret the feature as a bridge while the other sees a road. Dewberry took this into account when placing calls that asked for streams to be coded as culverts, and Fugro either made the appropriate changes or provided justifications.

After completing the review of culverts, Dewberry did not identify any major discrepancies that require resolution.

4 Intensity

Dewberry received a complete delivery of LiDAR intensity images. The data were required to meet the following specifications:

- Raster images in GeoTIFF format of 1st-return
- 1-meter pixel size
- 1/4th USGS 7.5-minute quadrangle

Figure 24 - Complete delivery of Fort Worth Intensity

With the exception of the tile grid, all 322 files were delivered in accordance with the requirements. The intensity are tiled based on the 1/16th USGS 7.5-minute quadrangle. They follow the same tiling scheme as the LAS data; that is, the internal tiles have a 50-meter overlap between tiles and those that line the project boundary have a 300-meter buffer.

Dewberry verified that the pixel values in the areas of overlap are the same. However, Dewberry could not verify that the intensity data are projected. FEDI stated that the projection has been defined using a different set of definitions that ArcGIS cannot read as shown in Figure 25. It appears that the projection may be defined by the number 3721, as opposed to a text format definition. Dewberry recommends that the projection be defined so that it may be validated in ArcGIS.

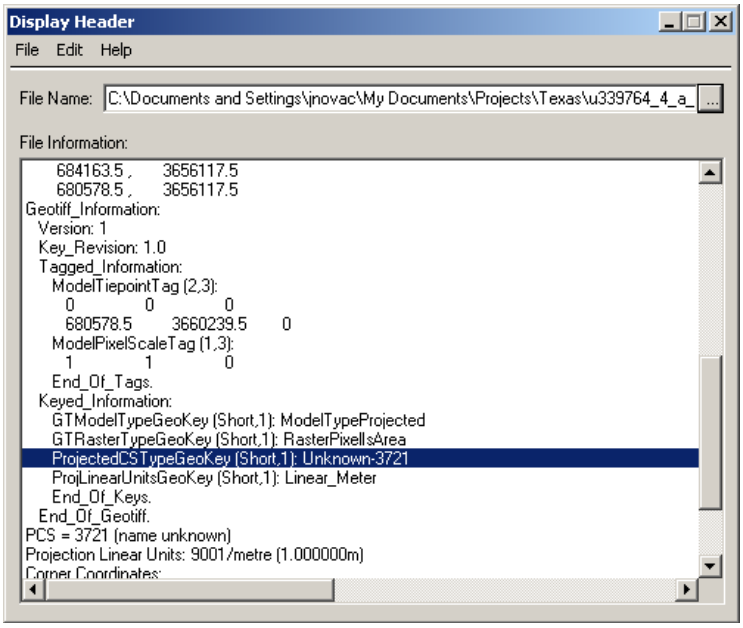


Figure 25 - Intensity header example

5 Hydro-Enforced DEMs

To verify the accuracy and completeness of the hydro-enforced DEMs, Dewberry performed a series of checks on the data, beginning with a visual analysis. This analysis was performed on each DEM, on a tile-by-tile basis in an effort to identify any major anomalies in the data, specifically data voids. Furthermore, each DEM was processed to create a hillshade as a second visual check. Hillshades provide an illuminated view of the ground surface created from a hypothetical light source, which gives analysts an image in which data voids are easier to see during the assessment process.

The DEMs are required to be free of artifacts, gaps, or smoothing at tile boundaries. Upon completion of the visual analysis, Dewberry identified the following discrepancies:

Table 10 – Complete list of errors identified in the hydro-enforced DEMs

DEM Tile	Error Type
u329704_4_b_be	data void
u329704_4_d_be	data void
u329707_4_c_be	data void
u339762_2_b_be	data void
u329633_1_a_be	incomplete tile edge
u329705_3_c_be	incomplete tile edge
u329708_1_b_be	incomplete tile edge
u329712_4_c_be	incomplete tile edge
u329728_2_a_be	incomplete tile edge
u329729_4_b_be	incomplete tile edge
u329732_1_a_be	incomplete tile edge
u339753_4_d_be	incomplete tile edge
u339764_2_c_be	incomplete tile edge

Figure 26 and Figure 27 illustrate the data void identified in tile u329707_4_a. Since the DEMs are composed of LiDAR ground points and hydro-enforced breaklines, a data void of this magnitude would cause suspicion of the quality of the ground points. However, Dewberry verified that the ground points are complete in this particular tile, as illustrated in Figure 28. As a result, Dewberry attributes this error to DEM processing. This is true for all tiles that contain errors, as listed in Table 10. Dewberry verified the integrity of the ground points from the LAS source, and concluded that all errors resulted from the processing steps. Dewberry strongly encourages that these errors be corrected before the data is used.

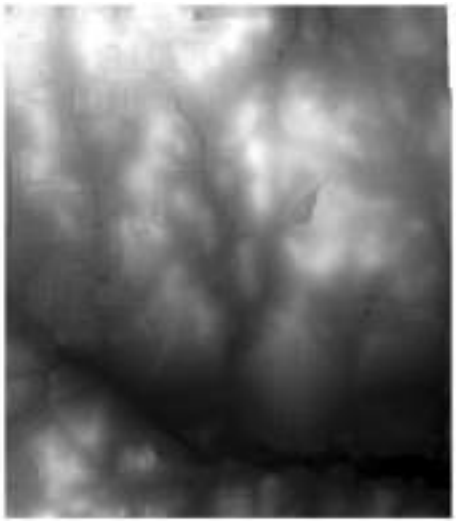


Figure 26 – Tile u329707_4_a; data void in bottom half of DEM

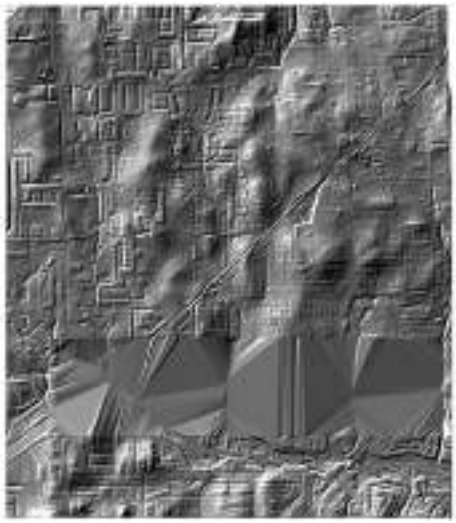


Figure 27 – Data void illustrated by hillshade model

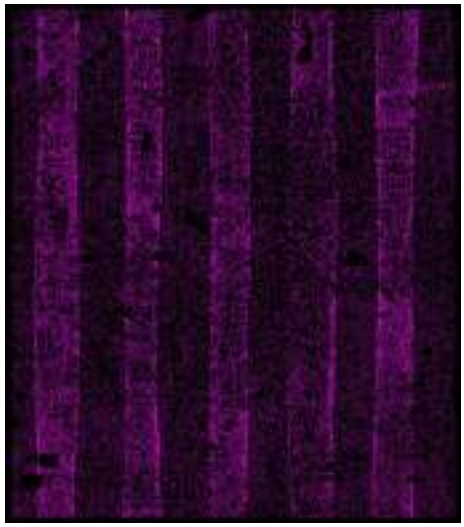


Figure 28 – Ground LiDAR points from source LAS are complete throughout the tile

6 Metadata

Dewberry received tile-based LAS, DEM, and intensity metadata, as well as breakline metadata provided in the geodatabase. Dewberry reviewed the metadata, checking for accuracy and completeness based on Federal Geographic Data Committee (FGDC) requirements.

6.1 LAS Metadata

In the previous delivery, Dewberry received LAS metadata and proposed a set of corrections. Many improvements have been made to the LAS metadata. There are three recommendations remaining:

1. The *Theme* states *intensity image.* This should be removed.
2. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N

6.2 Intensity Metadata

This is the first review that Dewberry has performed on the intensity metadata. Below are recommendations to improve the metadata quality:

1. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
2. *Type of data* reads LAS. This is incorrect and it should be Intensity.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N
4. The *FGDC lineage process steps* should only contain step 3. Steps 1 and 2 are not needed. The *source* information should reference the LAS ground files.
5. The *Attributes* tab lists LAS 1.1 format. This should be removed.

6.3 DEM Metadata

This is the first review that Dewberry has performed on the DEM metadata. Below are recommendations to improve the metadata quality:

1. *Who created the data* and *who completed this document* is FEDI, instead of the TWDB.
2. *Type of data* reads LAS. This is incorrect. It is DEM data delivered in ESRI grid format.
3. The *Horizontal Coordinate System* does not state the projection: UTM Zone 14N
4. The *FGDC lineage process steps* 1 and 2 are not needed.
5. The *Vertical positional accuracy* states the LiDAR accuracy, which is different from the accuracy of the DEMs.
6. The *Attributes* tab lists LAS 1.1 format and GeoTiff. This should be removed as it is DEM data in ESRI grid format.

6.4 Breakline *Meta*data

The breakline metadata was delivered per feature class. Dewberry reviewed each of the eight feature class metadata files for accuracy and completeness. The following issues were identified:

1. The *Theme* specifies *waterbody* for each feature class. This is incorrect for every feature classes with the exception of the waterbody feature class
2. The *FGDC lineage process step* 1 defines the criteria for capturing a single line stream as any hydro feature less than 50 feet, when in fact the breakline specification states 40 feet.

7 Optional Deliverables

7.1 ASCII Ground Point List

Dewberry received 322 ASCII text files that list the x, y, and z coordinates of all ground points, class 2. The models follow the 1/16th USGS 7.5-minute quadrangle tiling scheme. To ensure the correct number of ground points in each file, Dewberry compared the count of the ground class from the LAS to the count from the ASCII text files. In each comparison, Dewberry found consistency between the two types of models. Secondly, Dewberry created ground models of all 322 ASCII files as a second check to verify that data is present in each tile. Dewberry then conducted a macro level assessment of the ground models and did not find any major anomalies.

7.2 First-Return Surface Model

Dewberry performed a qualitative analysis on 322 models in ESRI Grid format. The models are to be created from the first-return of the LiDAR pulse, using either a 1-meter or 2-meter cell size, and following the 1/4th USGS 7.5-minute quadrangle tiling scheme. Dewberry used a random sample of LAS data to create 1-meter gridded models using only the first-return LiDAR pulses. Dewberry queried the pixel values to ensure consistency between the deliverable and the sample model created by Dewberry. This process is used to verify that the raster models conform to the specifications. Figure 29 is an example of a first-return model.

Figure 29 - Tile u329705_2_b; an example of first-return model showing NoData areas in bright blue

8 Conclusion

The LiDAR data for Fort Worth, Texas was thoroughly examined by Dewberry for accuracy, completeness, and conformity to project specifications. Because the data meet the vertical accuracy requirements and are free of major anomalies, Dewberry is confident in the quality and integrity of the LiDAR data for general geographic use and for hydrographic modeling.

The hydrographic breaklines are also of good quality with some minor issues. The breaklines pass the completeness and topology requirements; however, there are vertical accuracy errors in the dataset that should be noted. A specific tolerance (twice the RMSE) was utilized as a baseline to allow for small amounts of vertical accuracy error due to compiler error and monotonicity enforcement, but in this dataset some errors are outside this threshold. As previously stated, this is not a definitive check; however it is important for the end user to be aware of minor discrepancies in vertical accuracy.

The hydro-enforced DEMs require corrective actions before the data can be used. This is due to processing errors that resulted in data voids. Secondly, the DEMs do not have a defined projection. This should be corrected. This deliverable did not meet project specifications.

Although FEDI stated that the intensity are projected, Dewberry strongly encourages that the data have their projection defined in such a way that is readable by ArcGIS.

Lastly, Dewberry identified that the metadata for the LAS, intensity, and DEMs are not FGDC compliant, as they lack a defined projection. Additional recommendations have been provided for improvements to the overall metadata quality.

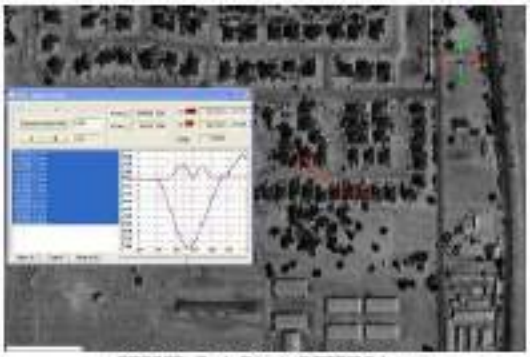
In summary, the following list illustrates the deliverables that meet project specifications:

- ✓ All-Return LAS Point Cloud Data
- ✓ Hydrographic Breaklines
- ✓ Intensity Imagery
- ✓ First-Return Surface Model
- ✓ ASCII Ground Point List
- ✓ Breakline Metadata

The data that require correction include:

- ➢ Hydro-Enforced DEMs
- ➢ LAS Metadata
- ➢ Intensity Metdata
- ➢ DEM Metadata

Appendix A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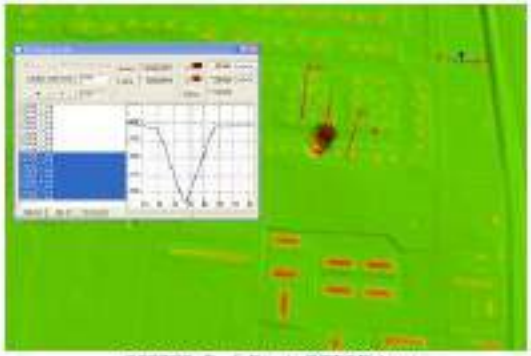
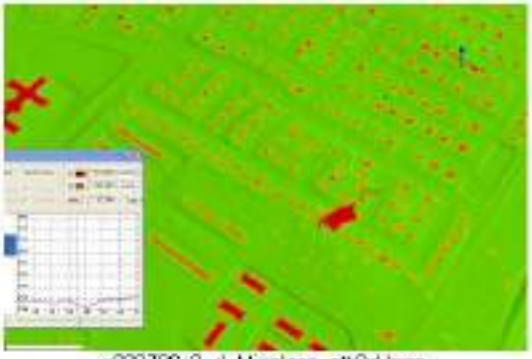

u329706_2_d_Divot_QTTGD.bmp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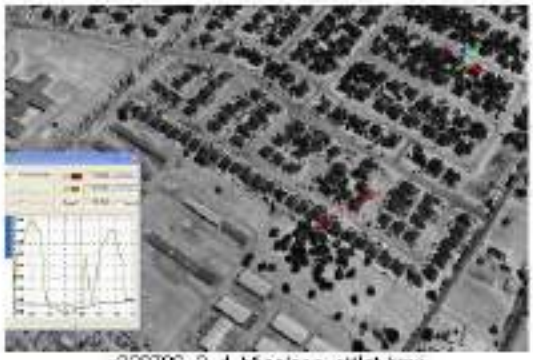
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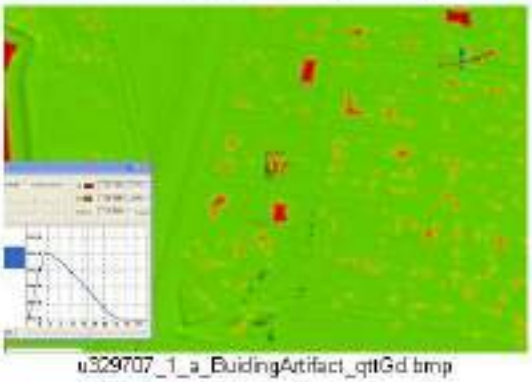
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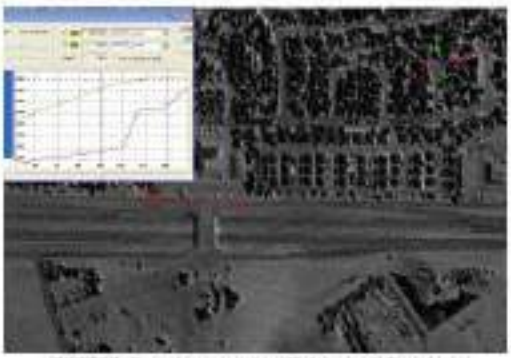
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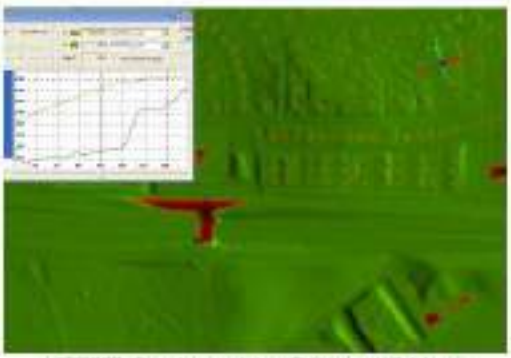
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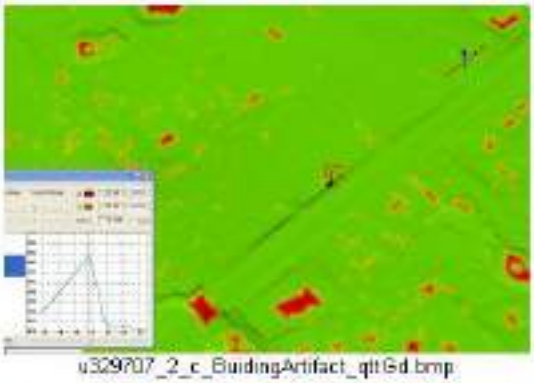
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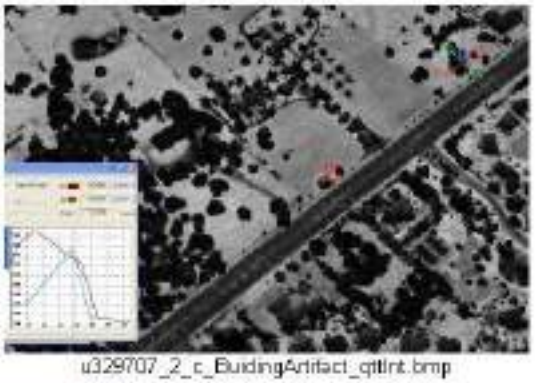
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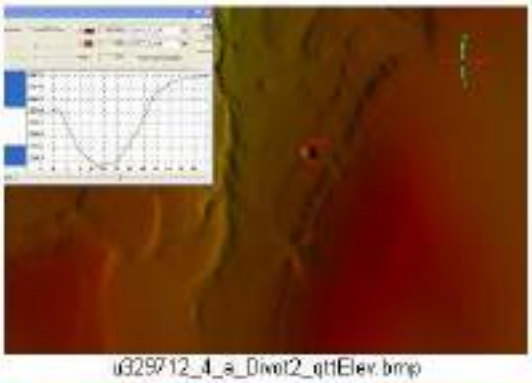
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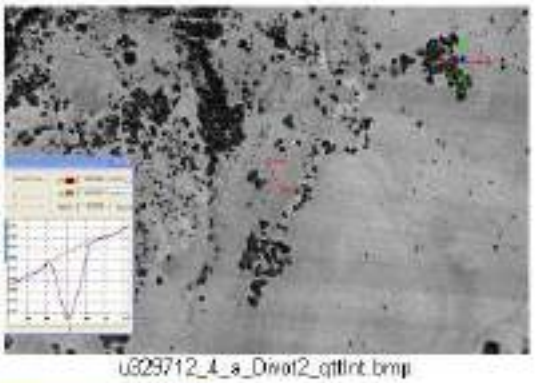
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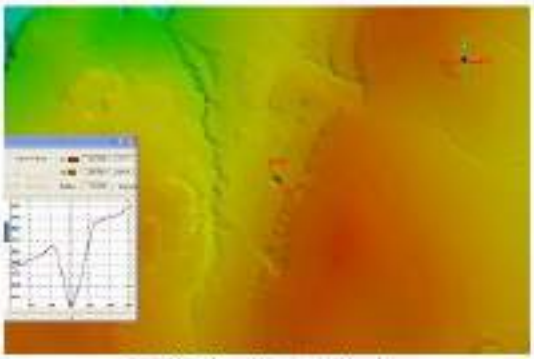
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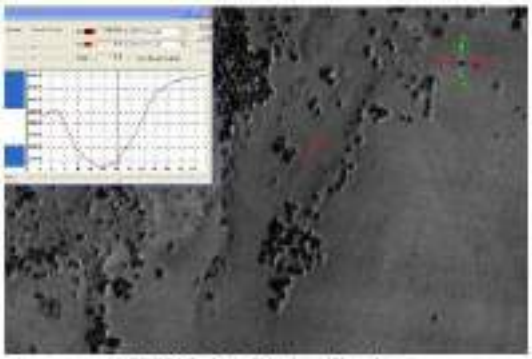
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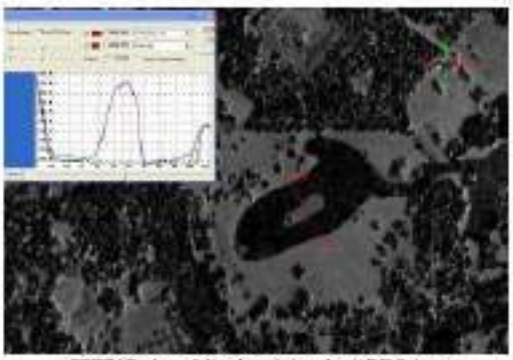
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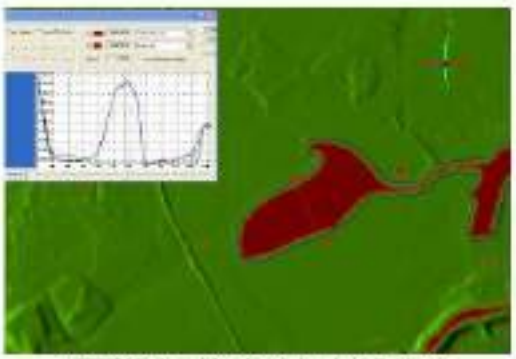
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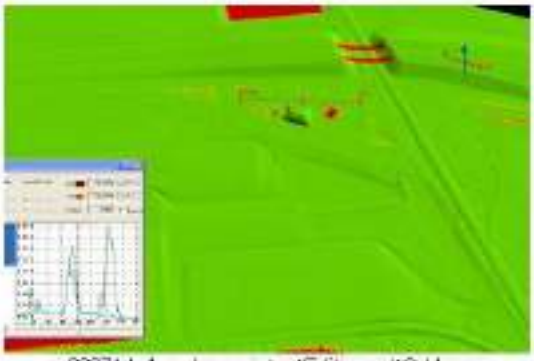
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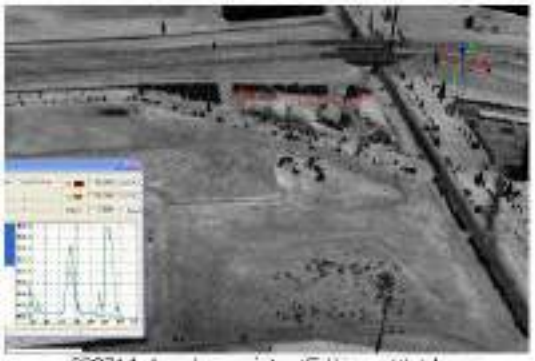
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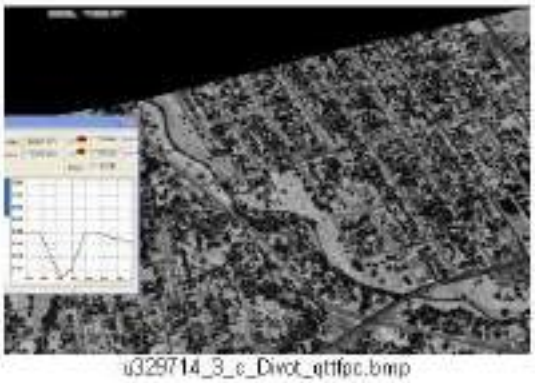
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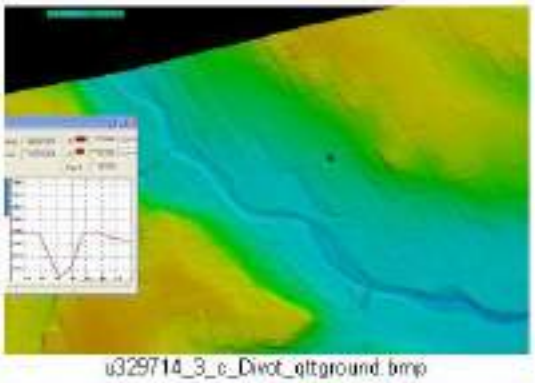
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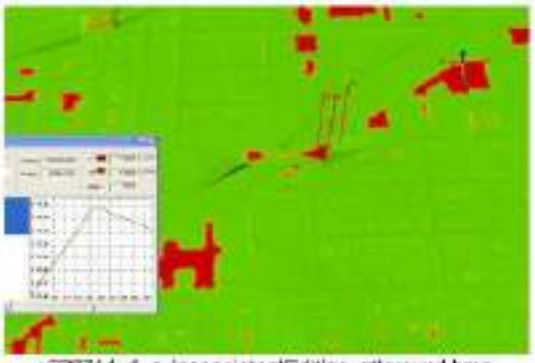
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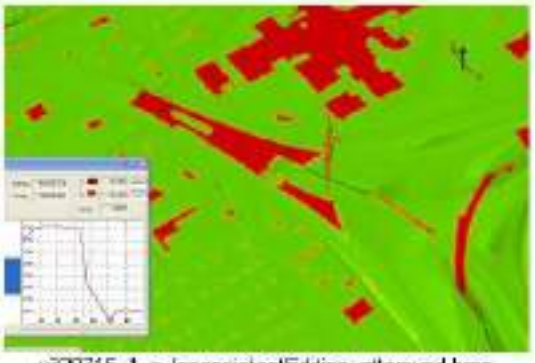
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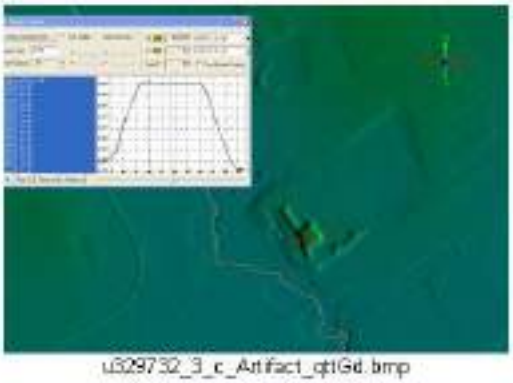
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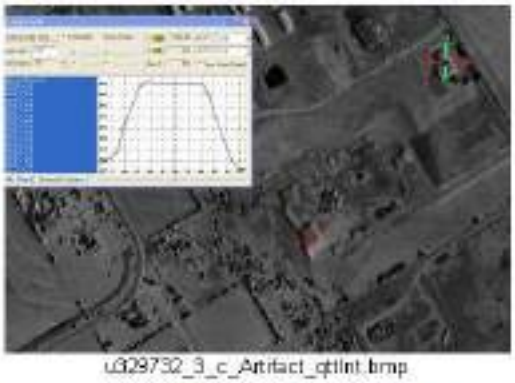
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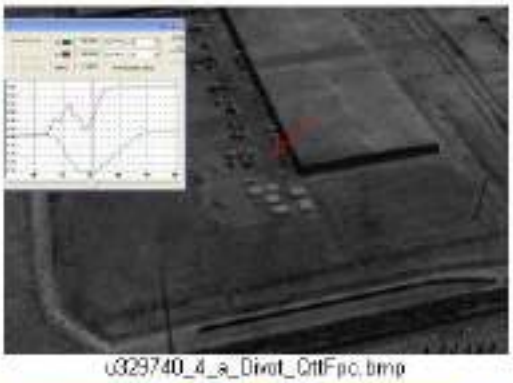
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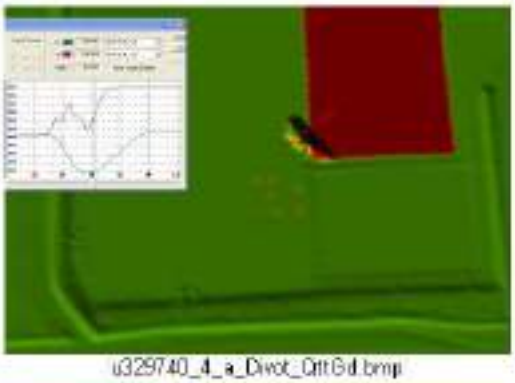
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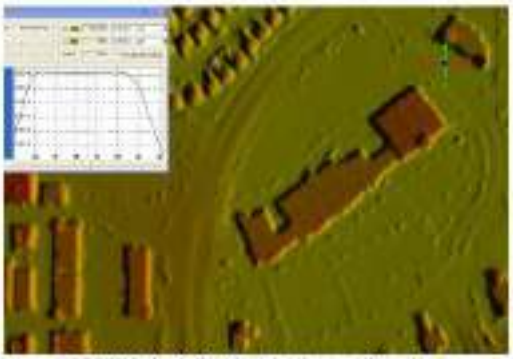
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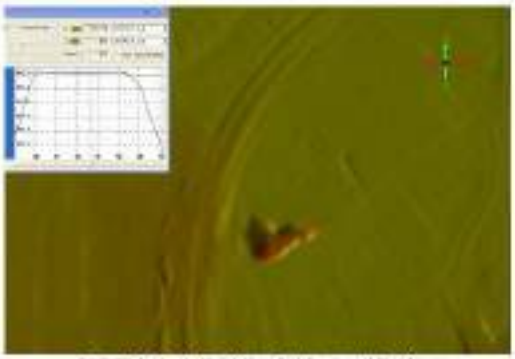
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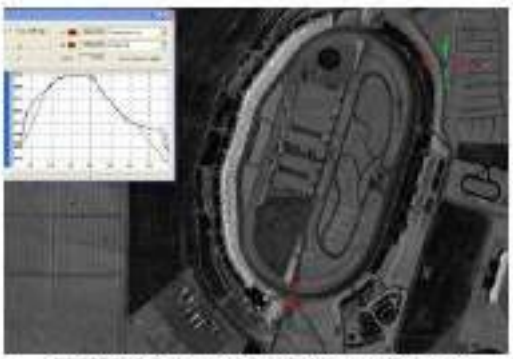
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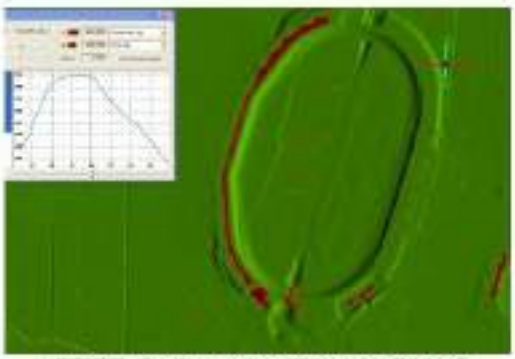
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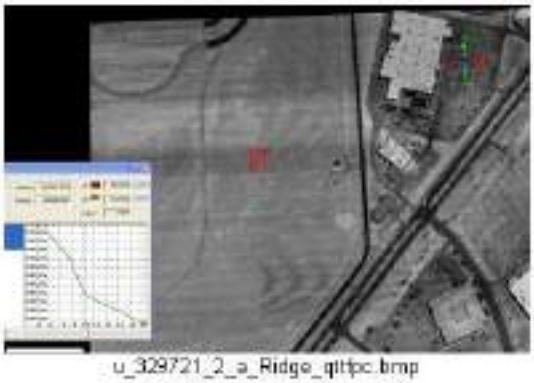
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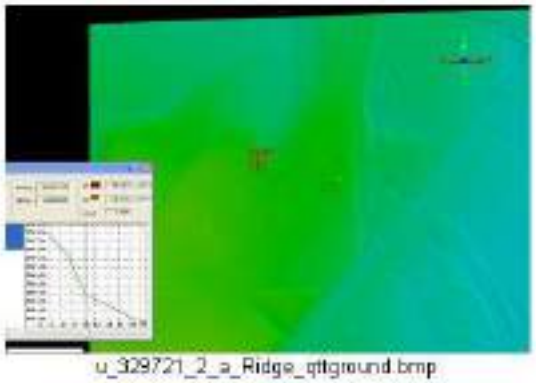
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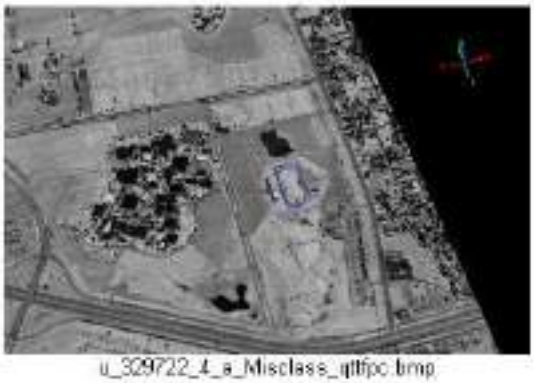
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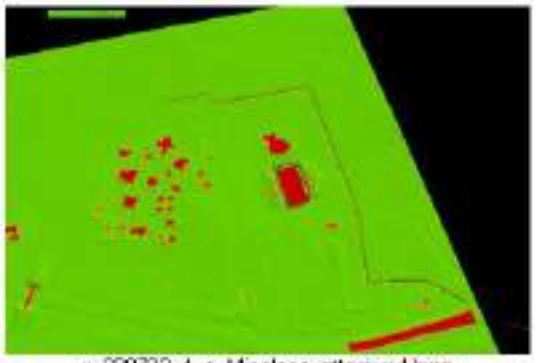
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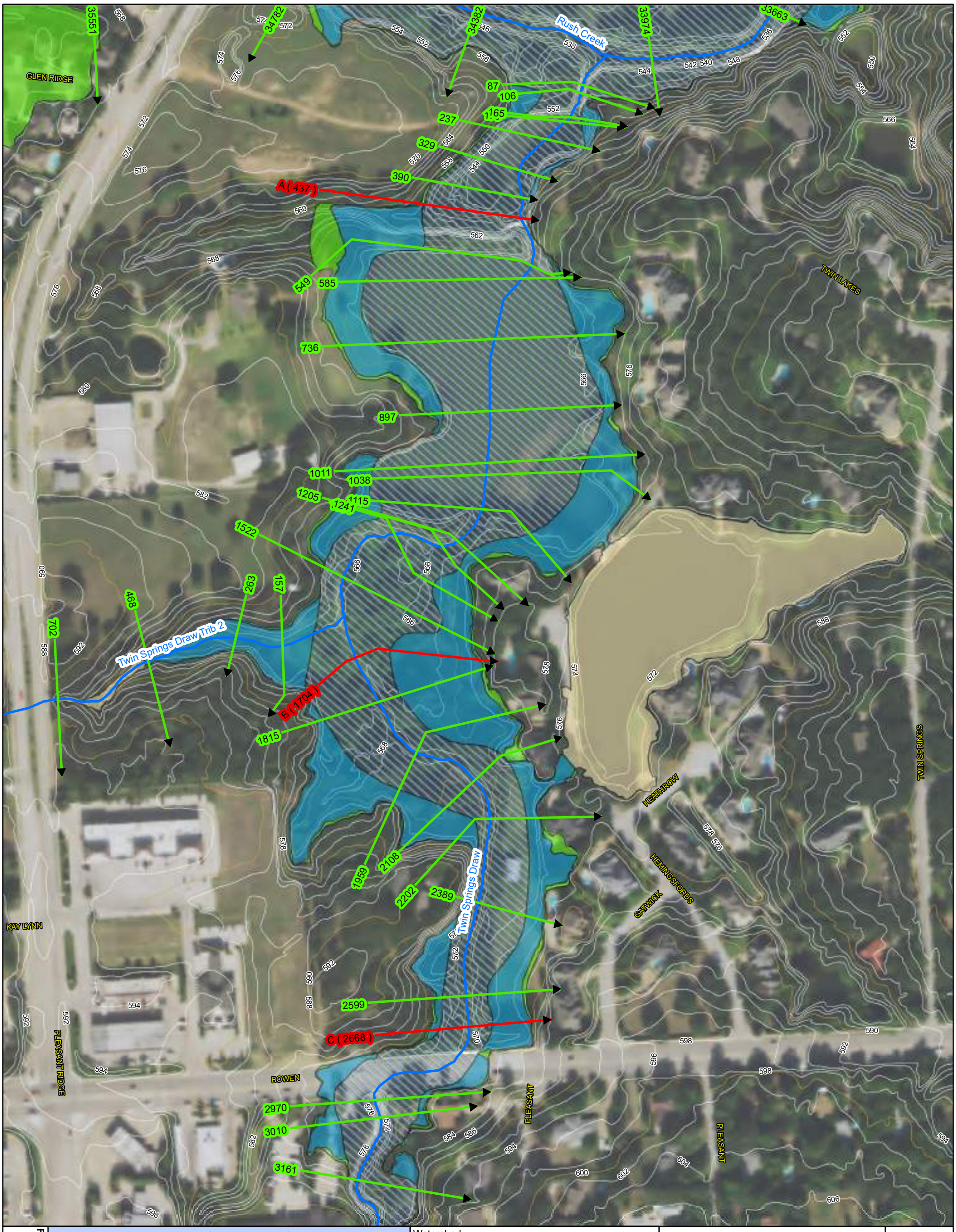
Appendix F
CD-ROM



Figure

Map 96

KEY TO FEATURES

- Cross Section
- Cross Section - Lettered
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw

Title

Hydraulic Work Maps

Panel

1 of 2

0 200 400

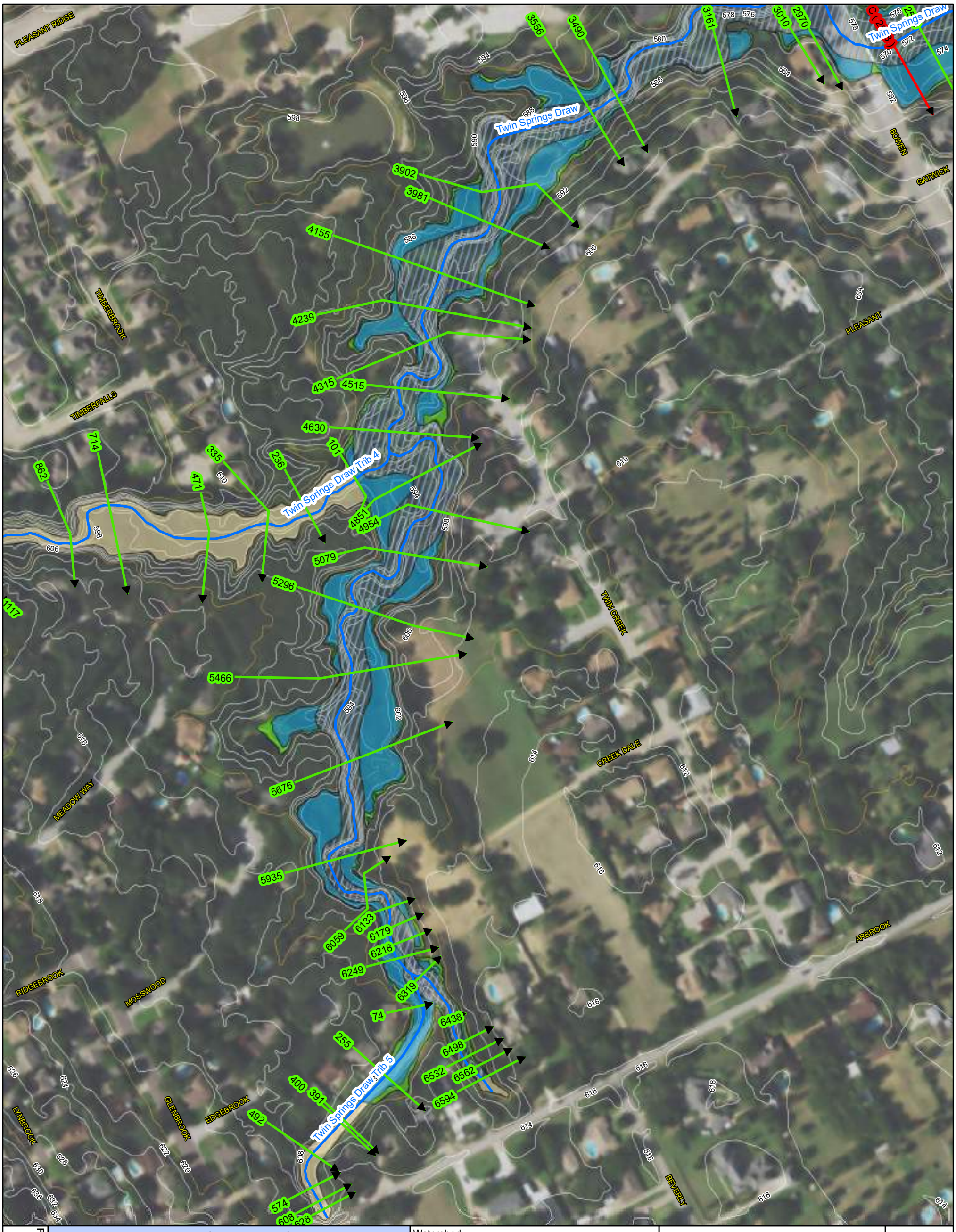
Scale in Feet

FEMA

HALFF

ARLINGTON

THE AMERICAN DREAM CITY



KEY TO FEATURES

- Cross Section
- Cross Section - Lettered
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Figure
Map 97

Watershed
Twin Springs Draw

Title
Hydraulic Work Maps

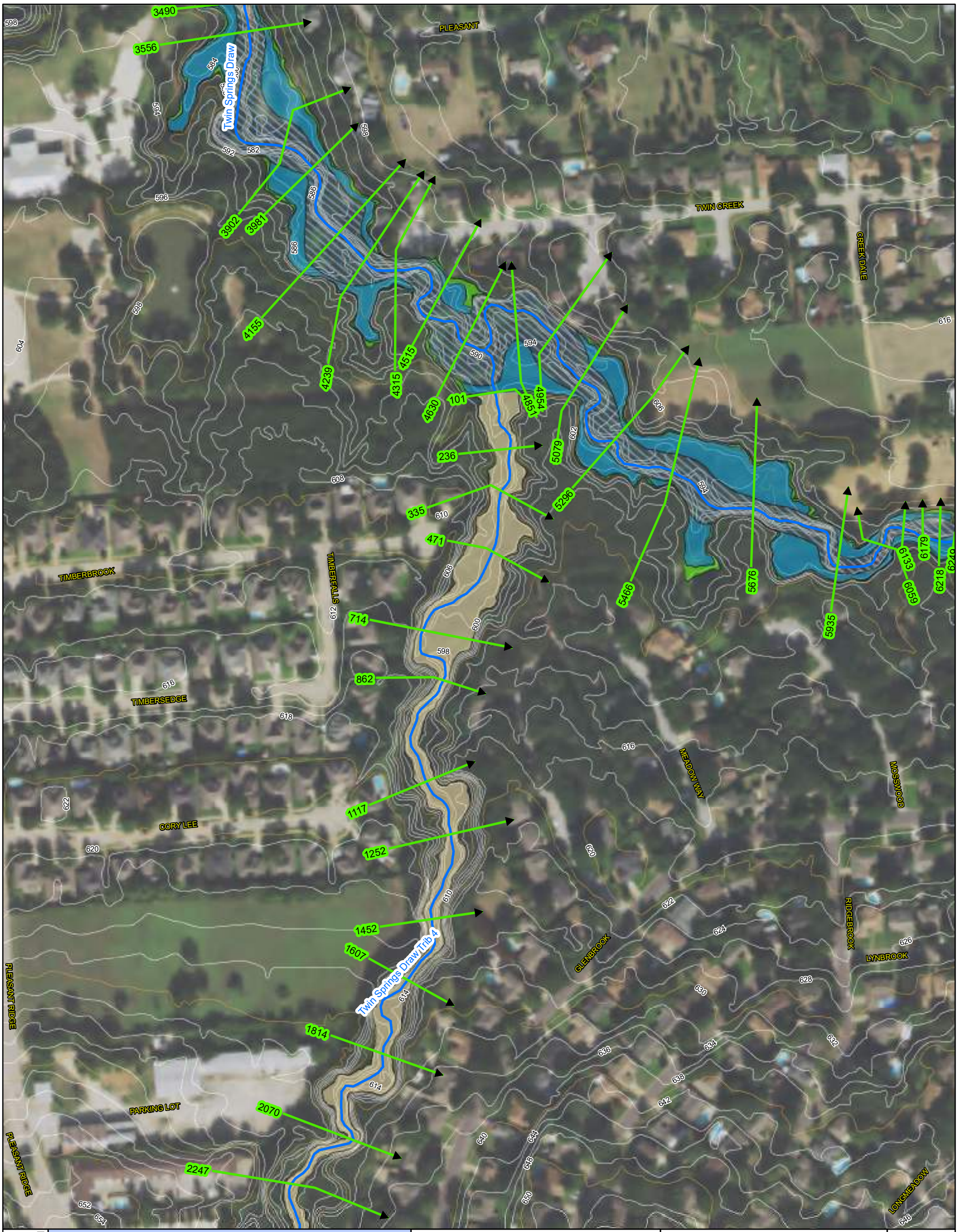
Panel
2 of 2

0 200 400
Scale in Feet

FEMA

HALFF

ARLINGTON
THE AMERICAN DREAM CITY



Figure

Map 98

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 4

Title

Hydraulic Work Maps

Panel

1 of 2

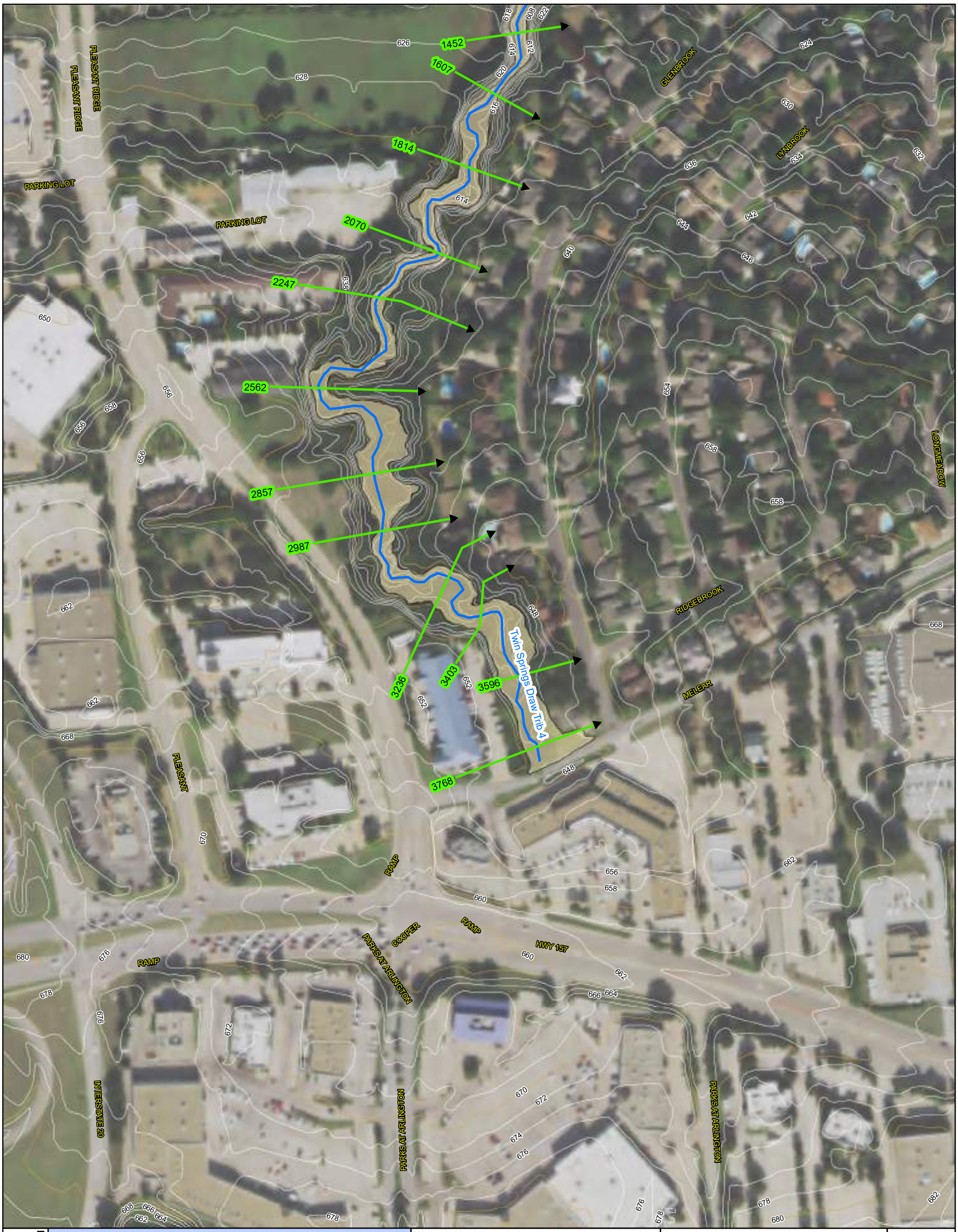
0 200 400

Scale in Feet

FEMA

HALFF

ARLINGTON



Figure

Map 99

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- 1% Annual Chance Floodplain (Zone A)
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 4

Title

Hydraulic Work Maps

Panel

2 of 2

0 200 400

Scale in Feet

FEMA

HALFF

ARLINGTON

THE AMERICAN DREAM CITY

Figure

Map 100

KEY TO FEATURES

- Cross Section
- Stream Centerline

Proposed Mapping

- Floodway
- 1% Annual Chance Floodplain (Zone AE)
- 1% Annual Chance Floodplain (Zone A)
- 0.2% Annual Chance Floodplain
- Contour - 2'
- Index Contour - 10'

Watershed

Twin Springs Draw Trib 5

Title

Hydraulic Work Maps

Panel

1 of 1

0 200 400

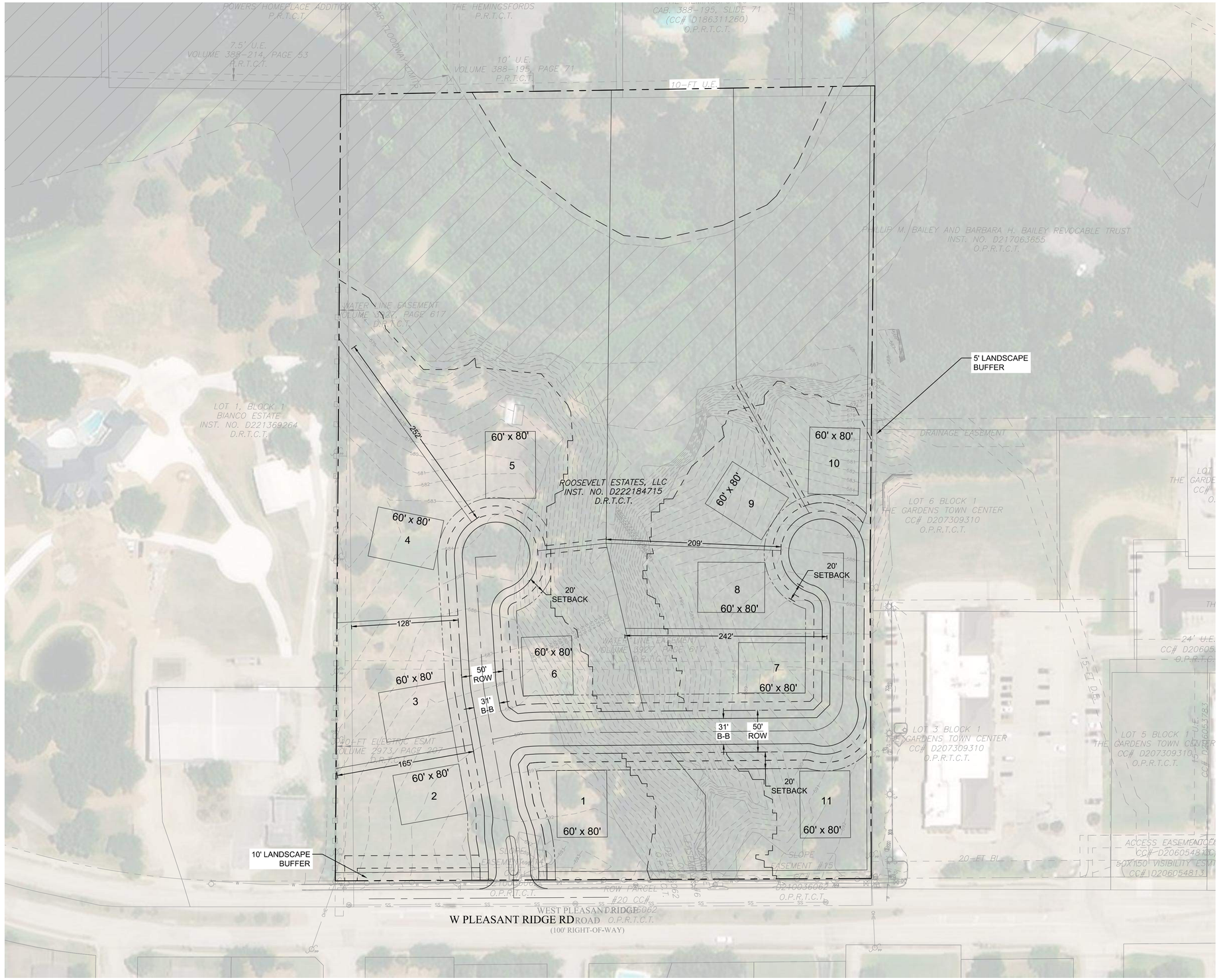
Scale in Feet

FEMA

HALFF

ARLINGTON

APPENDIX D: PROJECT LAYOUT SHEETS



LEGEND

- FLOODPLAIN
- OPEN SPACE
- PROJECT LOCATION

SHIELD ENGINEERING GROUP

TBPE FIRM #F-11039 · TBPLS FIRM #10193890

N

0 60 120 180

GRAPHIC SCALE IN FEET

CITY OF
DALWORTHINGTON GARDENS, TEXAS

ROOSEVELT ESTATES

LAND PLAN
June 2, 2023

DESIGNED: JGD	SCALE:	DATE:	SHEET:
DRAWN: JGD	1" = 60'	JUN 2023	1 OF 1

2023\06\02 JOSE.DELEON L:\JOBS\2021\05.01 ROOSEVELT ESTATES\EXHIBITS\20230602 DRAINAGE STUDY EXHIBIT\LAND PLAN.DWG

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APPENDIX E: DIGITAL DATA

APPENDIX F: HEC-RAS OUTPUT

TWIN SPRINGS DRAW

(HEC-RAS VERSION 4.1)

1600 W. 7th Street, Suite 400, Fort Worth, Texas 76102 | 817.810.0696
Shield Engineering Group, PLLC

info@shield-engineering.com | www.SHIELDENGINEERINGGROUP.com
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6594	Max WS	154.68	607.99	609.43	609.43	609.93	0.036313	5.73	27.87	31.12	1.00
TWI000A	6594	31DEC2011 2400	10.00	607.99	608.41	608.42	608.55	0.071014	3.01	3.32	14.13	1.09
TWI000A	6594	01JAN2012 0100	10.00	607.99	608.41	608.42	608.55	0.068809	2.98	3.36	14.20	1.08
TWI000A	6594	01JAN2012 0200	10.00	607.99	608.41	608.42	608.55	0.068570	2.97	3.36	14.21	1.08
TWI000A	6594	01JAN2012 0300	10.00	607.99	608.41	608.42	608.55	0.068331	2.97	3.37	14.22	1.07
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TWI000A	6594	01JAN2012 0600	10.00	607.99	608.41	608.42	608.55	0.067526	2.96	3.38	14.25	1.07
TWI000A	6594	01JAN2012 0700	10.00	607.99	608.41	608.42	608.55	0.066225	2.93	3.41	14.30	1.06
TWI000A	6594	01JAN2012 0800	10.00	607.99	608.42	608.42	608.55	0.065586	2.92	3.42	14.32	1.05
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TWI000A	6594	01JAN2012 1000	10.00	607.99	608.42	608.42	608.55	0.064820	2.91	3.43	14.35	1.05
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TWI000A	6594	01JAN2012 1300	19.16	607.99	608.56	608.57	608.73	0.056993	3.33	5.75	17.77	1.03
TWI000A	6594	01JAN2012 1400	10.00	607.99	608.41	608.42	608.55	0.066686	2.94	3.40	14.28	1.06
TWI000A	6594	01JAN2012 1500	10.00	607.99	608.42	608.42	608.55	0.065496	2.92	3.42	14.33	1.05
TWI000A	6594	01JAN2012 1600	10.00	607.99	608.42	608.42	608.55	0.064686	2.91	3.44	14.36	1.05
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TWI000A	6594	01JAN2012 1800	10.00	607.99	608.42	608.42	608.55	0.065000	2.91	3.43	14.34	1.05
TWI000A	6594	01JAN2012 1900	10.00	607.99	608.41	608.42	608.55	0.066317	2.94	3.41	14.29	1.06
TWI000A	6594	01JAN2012 2000	10.00	607.99	608.41	608.42	608.55	0.066686	2.94	3.40	14.28	1.06
TWI000A	6594	01JAN2012 2100	10.00	607.99	608.41	608.42	608.55	0.067011	2.95	3.39	14.27	1.07
TWI000A	6594	01JAN2012 2200	10.00	607.99	608.41	608.42	608.55	0.067245	2.95	3.39	14.26	1.07
TWI000A	6594	01JAN2012 2300	10.00	607.99	608.41	608.42	608.55	0.067479	2.95	3.38	14.25	1.07
TWI000A	6594	01JAN2012 2400	10.00	607.99	608.41	608.42	608.55	0.067620	2.96	3.38	14.25	1.07
TWI000A	6562	Max WS	154.62	606.81	608.63		608.92	0.014204	4.31	37.48	32.94	0.65
TWI000A	6562	31DEC2011 2400	10.00	606.81	607.38		607.42	0.011509	1.64	6.11	16.59	0.47
TWI000A	6562	01JAN2012 0100	10.00	606.81	607.34		607.39	0.015620	1.82	5.49	15.93	0.55
TWI000A	6562	01JAN2012 0200	10.00	606.81	607.34		607.39	0.015888	1.83	5.46	15.90	0.55
TWI000A	6562	01JAN2012 0300	10.00	606.81	607.34		607.39	0.016136	1.84	5.43	15.87	0.56
TWI000A	6562	01JAN2012 0400	10.00	606.81	607.33		607.39	0.016423	1.85	5.39	15.83	0.56
TWI000A	6562	01JAN2012 0500	10.00	606.81	607.33		607.38	0.016732	1.87	5.36	15.79	0.56
TWI000A	6562	01JAN2012 0600	10.00	606.81	607.33		607.38	0.017094	1.88	5.32	15.75	0.57
TWI000A	6562	01JAN2012 0700	10.00	606.81	607.32		607.38	0.018297	1.93	5.19	15.61	0.59
TWI000A	6562	01JAN2012 0800	10.00	606.81	607.32		607.37	0.018993	1.95	5.12	15.54	0.60
TWI000A	6562	01JAN2012 0900	10.00	606.81	607.31		607.37	0.019562	1.97	5.07	15.48	0.61
TWI000A	6562	01JAN2012 1000	10.00	606.81	607.31		607.37	0.019541	1.97	5.07	15.48	0.61
TWI000A	6562	01JAN2012 1100	10.00	606.81	607.32		607.38	0.018534	1.93	5.17	15.59	0.59
TWI000A	6562	01JAN2012 1200	57.33	606.81	607.94		608.11	0.018095	3.22	17.81	24.50	0.67
TWI000A	6562	01JAN2012 1300	19.23	606.81	607.53		607.60	0.015210	2.20	8.75	18.79	0.57
TWI000A	6562	01JAN2012 1400	10.00	606.81	607.32		607.38	0.017884	1.91	5.23	15.66	0.58
TWI000A	6562	01JAN2012 1500	10.00	606.81	607.32		607.37	0.019024	1.95	5.12	15.53	0.60
TWI000A	6562	01JAN2012 1600	10.00	606.81	607.31		607.37	0.019657	1.98	5.06	15.47	0.61
TWI000A	6562	01JAN2012 1700	10.00	606.81	607.31		607.37	0.019621	1.97	5.07	15.47	0.61
TWI000A	6562	01JAN2012 1800	10.00	606.81	607.31		607.37	0.019427	1.97	5.08	15.49	0.61
TWI000A	6562	01JAN2012 1900	10.00	606.81	607.32		607.38	0.018285	1.93	5.19	15.61	0.59
TWI000A	6562	01JAN2012 2000	10.00	606.81	607.32		607.38	0.017871	1.91	5.24	15.66	0.58
TWI000A	6562	01JAN2012 2100	10.00	606.81	607.32		607.38	0.017615	1.90	5.26	15.69	0.58
TWI000A	6562	01JAN2012 2200	10.00	606.81	607.33		607.38	0.017403	1.89	5.28	15.71	0.58
TWI000A	6562	01JAN2012 2300	10.00	606.81	607.33		607.38	0.017187	1.88	5.31	15.74	0.57
TWI000A	6562	01JAN2012 2400	10.00	606.81	607.33		607.38	0.016979	1.88	5.33	15.76	0.57
TWI000A	6532	Max WS	152.46	605.86	608.26		608.53	0.011083	4.14	37.37	27.73	0.59
TWI000A	6532	31DEC2011 2400	10.00	605.86	607.24		607.25	0.000749	0.70	14.37	17.90	0.14
TWI000A	6532	01JAN2012 0100	10.00	605.86	607.14		607.15	0.001072	0.79	12.61	16.91	0.16
TWI000A	6532	01JAN2012 0200	10.00	605.86	607.13		607.14	0.001097	0.80	12.50	16.85	0.16
TWI000A	6532	01JAN2012 0300	10.00	605.86	607.13		607.14	0.001123	0.81	12.40	16.79	0.17
TWI000A	6532	01JAN2012 0400	10.00	605.86	607.12		607.13	0.001151	0.81	12.28	16.72	0.17
TWI000A	6532	01JAN2012 0500	10.00	605.86	607.11		607.12	0.001186	0.82	12.15	16.64	0.17
TWI000A	6532	01JAN2012 0600	10.00	605.86	607.10		607.11	0.001226	0.83	12.01	16.56	0.17
TWI000A	6532	01JAN2012 0700	10.00	605.86	607.07		607.08	0.001376	0.87	11.52	16.26	0.18
TWI000A	6532	01JAN2012 0800	10.00	605.86	607.05		607.07	0.001477	0.89	11.22	16.09	0.19
TWI000A	6532	01JAN2012 0900	10.00	605.86	607.04		607.05	0.001566	0.91	10.99	15.94	0.19
TWI000A	6532	01JAN2012 1000	10.00	605.86	607.04		607.05	0.001563	0.91	10.99	15.94	0.19
TWI000A	6532	01JAN2012 1100	10.00	605.86	607.07		607.08	0.001408	0.88	11.42	16.20	0.18
TWI000A	6532	01JAN2012 1200	56.98	605.86	607.63		607.73	0.007474	2.58	22.10	21.65	0.45
TWI000A	6532	01JAN2012 1300	19.30	605.86	607.32		607.35	0.002110	1.21	15.91	18.74	0.23
TWI000A	6532	01JAN2012 1400	10.00	605.86	607.08		607.09	0.001324	0.86	11.68	16.36	0.18
TWI000A	6532	01JAN2012 1500	10.00	605.86	607.05		607.07	0.001482	0.89	11.21	16.08	0.19
TWI000A	6532	01JAN2012 1600	10.00	605.86	607.04		607.05	0.001584	0.91	10.94	15.91	0.19
TWI000A	6532	01JAN2012 1700	10.00	605.86	607.04		607.05	0.001578	0.91	10.96	15.92	0.19
TWI000A	6532	01JAN2012 1800	10.00	605.86	607.04		607.06	0.001542	0.90	11.05	15.98	0.19
TWI000A	6532	01JAN2012 1900	10.00	605.86	607.07		607.08	0.001374	0.87	11.52	16.27	0.18
TWI000A	6532	01JAN2012 2000	10.00	605.86	607.08		607.09	0.001319	0.86	11.69	16.37	0.18
TWI000A	6532	01JAN2012 2100	10.00	605.86	607.09		607.10	0.001288	0.85	11.79	16.43	0.18
TWI000A	6532	01JAN2012 2200	10.00	605.86	607.09		607.11	0.001261	0.84	11.89	16.48	0.17
TWI000A	6532	01JAN2012 2300	10.00	605.86	607.10		607.11	0.001236	0.84	11.97	16.54	0.17
TWI000A	6532	01JAN2012 2400	10.00	605.86	607.10		607.12	0.001213	0.83	12.05	16.58	0.17
TWI000A	6498	Max WS	152.02	605.51	608.08		608.25	0.005177	3.27	52.29	36.18	0.42
TWI000A	6498	31DEC2011 2400	10.00	605.51	605.97	606.01	606.17	0.083179	3.64	2.75	9.88	1.22
TWI000A	6498	01JAN2012 0100	10.00	605.51	605.98	606.01	606.17	0.072589	3.47	2.88	10.07	1.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6498	01JAN2012 0200	10.00	605.51	605.98	606.01	606.17	0.071986	3.46	2.89	10.08	1.14
TWI000A	6498	01JAN2012 0300	10.00	605.51	605.98	606.01	606.17	0.071263	3.45	2.90	10.09	1.13
TWI000A	6498	01JAN2012 0400	10.00	605.51	605.98	606.01	606.17	0.070580	3.43	2.91	10.10	1.13
TWI000A	6498	01JAN2012 0500	10.00	605.51	605.98	606.01	606.17	0.069707	3.42	2.93	10.12	1.12
TWI000A	6498	01JAN2012 0600	10.00	605.51	605.99	606.01	606.17	0.068780	3.40	2.94	10.14	1.11
TWI000A	6498	01JAN2012 0700	10.00	605.51	605.99	606.01	606.16	0.065559	3.34	2.99	10.21	1.09
TWI000A	6498	01JAN2012 0800	10.00	605.51	605.99	606.01	606.16	0.063570	3.31	3.02	10.26	1.07
TWI000A	6498	01JAN2012 0900	10.00	605.51	606.00	606.01	606.16	0.062022	3.28	3.05	10.29	1.06
TWI000A	6498	01JAN2012 1000	10.00	605.51	606.00	606.01	606.16	0.062074	3.28	3.05	10.29	1.06
TWI000A	6498	01JAN2012 1100	10.00	605.51	605.99	606.01	606.16	0.065004	3.33	3.00	10.22	1.08
TWI000A	6498	01JAN2012 1200	56.58	605.51	606.57	606.63	606.98	0.056873	5.16	10.96	17.48	1.15
TWI000A	6498	01JAN2012 1300	19.36	605.51	606.13	606.19	606.41	0.076250	4.27	4.53	11.98	1.22
TWI000A	6498	01JAN2012 1400	10.01	605.51	605.99	606.01	606.17	0.066626	3.36	2.97	10.19	1.10
TWI000A	6498	01JAN2012 1500	10.00	605.51	605.99	606.01	606.16	0.063543	3.31	3.02	10.26	1.07
TWI000A	6498	01JAN2012 1600	10.00	605.51	606.00	606.01	606.16	0.061732	3.27	3.06	10.30	1.06
TWI000A	6498	01JAN2012 1700	10.00	605.51	606.00	606.01	606.16	0.061823	3.27	3.05	10.30	1.06
TWI000A	6498	01JAN2012 1800	10.00	605.51	606.00	606.01	606.16	0.062455	3.29	3.04	10.28	1.06
TWI000A	6498	01JAN2012 1900	10.00	605.51	605.99	606.01	606.16	0.065675	3.35	2.99	10.21	1.09
TWI000A	6498	01JAN2012 2000	10.00	605.51	605.99	606.01	606.17	0.066774	3.37	2.97	10.18	1.10
TWI000A	6498	01JAN2012 2100	10.00	605.51	605.99	606.01	606.17	0.067423	3.38	2.96	10.17	1.10
TWI000A	6498	01JAN2012 2200	10.00	605.51	605.99	606.01	606.17	0.068012	3.39	2.95	10.16	1.11
TWI000A	6498	01JAN2012 2300	10.00	605.51	605.99	606.01	606.17	0.068594	3.40	2.94	10.15	1.11
TWI000A	6498	01JAN2012 2400	10.00	605.51	605.99	606.01	606.17	0.069146	3.41	2.93	10.13	1.12
TWI000A	6438	Max WS	151.98	602.48	607.99		608.05	0.001016	1.82	86.57	36.15	0.19
TWI000A	6438	31DEC2011 2400	10.00	602.48	602.87	603.06	603.52	0.296380	6.46	1.55	5.99	2.24
TWI000A	6438	01JAN2012 0100	10.00	602.48	602.82	603.06	603.82	0.587827	8.02	1.25	5.88	3.07
TWI000A	6438	01JAN2012 0200	10.00	602.48	602.82	603.06	603.84	0.610553	8.11	1.23	5.88	3.12
TWI000A	6438	01JAN2012 0300	10.00	602.48	602.82	603.06	603.86	0.633750	8.21	1.22	5.87	3.18
TWI000A	6438	01JAN2012 0400	10.00	602.48	602.82	603.06	603.89	0.658254	8.31	1.20	5.87	3.23
TWI000A	6438	01JAN2012 0500	10.00	602.48	602.81	603.06	603.92	0.690472	8.43	1.19	5.86	3.30
TWI000A	6438	01JAN2012 0600	10.00	602.48	602.81	603.06	603.95	0.725084	8.56	1.17	5.85	3.38
TWI000A	6438	01JAN2012 0700	10.00	602.48	602.80	603.06	604.06	0.859460	9.03	1.11	5.83	3.65
TWI000A	6438	01JAN2012 0800	10.00	602.48	602.79	603.06	604.14	0.948194	9.31	1.07	5.82	3.82
TWI000A	6438	01JAN2012 0900	10.00	602.48	602.79	603.06	604.20	1.027305	9.54	1.05	5.81	3.96
TWI000A	6438	01JAN2012 1000	10.00	602.48	602.79	603.06	604.20	1.026504	9.54	1.05	5.81	3.96
TWI000A	6438	01JAN2012 1100	10.00	602.48	602.80	603.06	604.09	0.889926	9.12	1.10	5.83	3.71
TWI000A	6438	01JAN2012 1200	54.99	602.48	604.61		604.82	0.009968	3.63	15.14	9.65	0.51
TWI000A	6438	01JAN2012 1300	19.48	602.48	603.27	603.30	603.62	0.054435	4.74	4.11	6.83	1.08
TWI000A	6438	01JAN2012 1400	10.01	602.48	602.80	603.06	604.02	0.811544	8.87	1.13	5.84	3.56
TWI000A	6438	01JAN2012 1500	10.00	602.48	602.79	603.06	604.14	0.952329	9.32	1.07	5.82	3.82
TWI000A	6438	01JAN2012 1600	10.00	602.48	602.79	603.06	604.22	1.044279	9.59	1.04	5.81	3.99
TWI000A	6438	01JAN2012 1700	10.00	602.48	602.79	603.06	604.21	1.038303	9.57	1.04	5.81	3.98
TWI000A	6438	01JAN2012 1800	10.00	602.48	602.79	603.06	604.18	1.004769	9.48	1.06	5.81	3.92
TWI000A	6438	01JAN2012 1900	10.00	602.48	602.80	603.06	604.06	0.858432	9.02	1.11	5.83	3.65
TWI000A	6438	01JAN2012 2000	10.00	602.48	602.80	603.06	604.02	0.808430	8.86	1.13	5.84	3.55
TWI000A	6438	01JAN2012 2100	10.00	602.48	602.80	603.06	604.00	0.781924	8.76	1.14	5.84	3.50
TWI000A	6438	01JAN2012 2200	10.00	602.48	602.81	603.06	603.98	0.757514	8.68	1.15	5.85	3.44
TWI000A	6438	01JAN2012 2300	10.00	602.48	602.81	603.06	603.96	0.735410	8.60	1.16	5.85	3.40
TWI000A	6438	01JAN2012 2400	10.00	602.48	602.81	603.06	603.94	0.714693	8.52	1.17	5.86	3.35
TWI000A	6319	Max WS	151.73	598.58	607.96		607.96	0.000028	0.49	341.45	85.74	0.04
TWI000A	6319	31DEC2011 2400	10.00	598.58	599.01	599.36	600.94	1.043292	11.16	0.90	3.89	4.10
TWI000A	6319	01JAN2012 0100	10.00	598.58	599.08	599.36	600.14	0.453688	8.26	1.21	4.42	2.78
TWI000A	6319	01JAN2012 0200	10.00	598.58	599.09	599.36	600.09	0.420232	8.03	1.25	4.47	2.68
TWI000A	6319	01JAN2012 0300	10.00	598.58	599.10	599.36	600.04	0.386957	7.79	1.28	4.53	2.58
TWI000A	6319	01JAN2012 0400	10.00	598.58	599.11	599.36	599.99	0.350496	7.52	1.33	4.60	2.46
TWI000A	6319	01JAN2012 0500	10.00	598.58	599.12	599.36	599.92	0.309761	7.19	1.39	4.70	2.33
TWI000A	6319	01JAN2012 0600	10.00	598.58	599.14	599.36	599.85	0.263454	6.77	1.48	4.82	2.16
TWI000A	6319	01JAN2012 0700	10.00	598.58	599.22	599.36	599.65	0.133615	5.28	1.89	5.39	1.57
TWI000A	6319	01JAN2012 0800	10.00	598.58	599.29	599.36	599.59	0.082283	4.42	2.26	5.85	1.25
TWI000A	6319	01JAN2012 0900	9.99	598.58	599.39		599.57	0.041078	3.42	2.92	6.59	0.90
TWI000A	6319	01JAN2012 1000	9.97	598.58	599.64		599.71	0.011349	2.08	4.79	8.67	0.49
TWI000A	6319	01JAN2012 1100	9.91	598.58	599.99		600.01	0.002661	1.19	8.35	11.87	0.25
TWI000A	6319	01JAN2012 1200	40.08	598.58	604.10		604.11	0.000045	0.37	108.50	41.17	0.04
TWI000A	6319	01JAN2012 1300	21.25	598.58	601.74		601.75	0.000177	0.55	38.95	22.90	0.07
TWI000A	6319	01JAN2012 1400	10.08	598.58	600.14		600.15	0.001576	0.99	10.20	12.85	0.20
TWI000A	6319	01JAN2012 1500	10.03	598.58	599.80		599.84	0.005705	1.60	6.28	10.14	0.36
TWI000A	6319	01JAN2012 1600	10.02	598.58	599.55		599.64	0.017570	2.47	4.05	7.84	0.61
TWI000A	6319	01JAN2012 1700	10.01	598.58	599.43		599.58	0.033169	3.16	3.17	6.84	0.82
TWI000A	6319	01JAN2012 1800	10.00	598.58	599.36	599.36	599.57	0.052162	3.73	2.68	6.32	1.01
TWI000A	6319	01JAN2012 1900	10.00	598.58	599.22	599.36	599.66	0.134620	5.30	1.89	5.38	1.58
TWI000A	6319	01JAN2012 2000	10.00	598.58	599.19	599.36	599.70	0.167547	5.74	1.74	5.19	1.75
TWI000A	6319	01JAN2012 2100	10.00	598.58	599.17	599.36	599.75	0.197986	6.10	1.64	5.05	1.89
TWI000A	6319	01JAN2012 2200	10.00	598.58	599.16	599.36	599.79	0.226330	6.41	1.56	4.94	2.01
TWI000A	6319	01JAN2012 2300	10.00	598.58	599.14	599.36	599.83	0.252657	6.67	1.50	4.85	2.12
TWI000A	6319	01JAN2012 2400	10.00	598.58	599.13	599.36	599.87	0.278052	6.91	1.45	4.78	2.21
TWI000A	6249	Max WS	1760.53	597.08	605.74	604.13	607.43	0.018074	10.66	210.56	66.08	0.68
TWI000A	6249	31DEC2011 2400	10.00	597.08	597.78		597.80	0.002601	0.99	10.08	15.60	0.22
TWI000A	6249	01JAN2012 0100	22.06	597.08	598.07		598.10	0.003922	1.52	14.54	15.82	0.28
TWI000A	6249	01JAN2012 0200	23.08	597.08	598.09		598.12	0.003987	1.55	14.88	15.83	0.28
TWI000A	6249	01JAN2012 0300	24.17	597.08	598.11		598.15	0.004060	1.59	15.23	15.85	0.29
TWI000A	6249	01JAN2012 0400	25.50	597.08	598.13		598.18	0.004154	1.63	15.64	15.87	0.29

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6249	01JAN2012 0500	27.15	597.08	598.17		598.21	0.004269	1.68	16.13	15.89	0.29
TWI000A	6249	01JAN2012 0600	29.31	597.08	598.20		598.25	0.004416	1.75	16.75	15.92	0.30
TWI000A	6249	01JAN2012 0700	39.19	597.08	598.37		598.43	0.005039	2.03	19.32	16.05	0.33
TWI000A	6249	01JAN2012 0800	45.99	597.08	598.48		598.55	0.005261	2.18	21.10	16.13	0.34
TWI000A	6249	01JAN2012 0900	56.16	597.08	598.59		598.69	0.006016	2.44	22.98	16.22	0.36
TWI000A	6249	01JAN2012 1000	75.92	597.08	598.84		598.96	0.006695	2.81	26.97	16.40	0.39
TWI000A	6249	01JAN2012 1100	104.08	597.08	599.17		599.33	0.007155	3.21	32.42	16.65	0.41
TWI000A	6249	01JAN2012 1200	598.46	597.08	602.54		603.19	0.010760	6.44	92.97	19.21	0.52
TWI000A	6249	01JAN2012 1300	263.27	597.08	600.78		601.08	0.007186	4.36	60.33	17.88	0.42
TWI000A	6249	01JAN2012 1400	116.51	597.08	599.32		599.49	0.007124	3.33	34.97	16.77	0.41
TWI000A	6249	01JAN2012 1500	88.02	597.08	598.99		599.13	0.006790	2.98	29.56	16.52	0.39
TWI000A	6249	01JAN2012 1600	69.00	597.08	598.75		598.86	0.006540	2.70	25.54	16.34	0.38
TWI000A	6249	01JAN2012 1700	59.29	597.08	598.63		598.73	0.006188	2.51	23.58	16.25	0.37
TWI000A	6249	01JAN2012 1800	52.68	597.08	598.55		598.64	0.005784	2.36	22.34	16.19	0.35
TWI000A	6249	01JAN2012 1900	39.09	597.08	598.36		598.43	0.005030	2.03	19.30	16.04	0.33
TWI000A	6249	01JAN2012 2000	35.96	597.08	598.31		598.37	0.004871	1.94	18.49	16.01	0.32
TWI000A	6249	01JAN2012 2100	33.53	597.08	598.27		598.33	0.004723	1.88	17.86	15.98	0.31
TWI000A	6249	01JAN2012 2200	31.57	597.08	598.24		598.29	0.004585	1.82	17.35	15.95	0.31
TWI000A	6249	01JAN2012 2300	29.94	597.08	598.22		598.26	0.004463	1.77	16.92	15.93	0.30
TWI000A	6249	01JAN2012 2400	28.57	597.08	598.19		598.24	0.004362	1.73	16.55	15.91	0.30
TWI000A	6218	Max WS	1759.68	597.00	606.05		606.59	0.004965	6.03	359.51	90.92	0.43
TWI000A	6218	31DEC2011 2400	10.00	597.00	597.56		597.60	0.012780	1.59	6.27	16.40	0.45
TWI000A	6218	01JAN2012 0100	22.06	597.00	597.72		597.81	0.019616	2.45	9.01	17.01	0.59
TWI000A	6218	01JAN2012 0200	23.08	597.00	597.73		597.83	0.019997	2.50	9.21	17.05	0.60
TWI000A	6218	01JAN2012 0300	24.17	597.00	597.75		597.85	0.020246	2.56	9.45	17.11	0.61
TWI000A	6218	01JAN2012 0400	25.50	597.00	597.77		597.87	0.020312	2.61	9.77	17.17	0.61
TWI000A	6218	01JAN2012 0500	27.14	597.00	597.79		597.90	0.020250	2.67	10.17	17.26	0.61
TWI000A	6218	01JAN2012 0600	29.30	597.00	597.82		597.94	0.019923	2.73	10.74	17.38	0.61
TWI000A	6218	01JAN2012 0700	39.18	597.00	597.99		598.12	0.016604	2.86	13.71	18.01	0.58
TWI000A	6218	01JAN2012 0800	45.98	597.00	598.11		598.24	0.014389	2.89	15.93	18.46	0.55
TWI000A	6218	01JAN2012 0900	56.14	597.00	598.24		598.38	0.014090	3.07	18.27	18.93	0.55
TWI000A	6218	01JAN2012 1000	75.86	597.00	598.53		598.68	0.011388	3.17	23.91	20.00	0.51
TWI000A	6218	01JAN2012 1100	104.00	597.00	598.91		599.08	0.009102	3.27	31.85	21.43	0.47
TWI000A	6218	01JAN2012 1200	594.47	597.00	602.63		602.92	0.004635	4.33	137.38	35.27	0.39
TWI000A	6218	01JAN2012 1300	264.08	597.00	600.70		600.89	0.004723	3.46	76.23	28.09	0.37
TWI000A	6218	01JAN2012 1400	116.57	597.00	599.09		599.25	0.008116	3.26	35.77	22.10	0.45
TWI000A	6218	01JAN2012 1500	88.06	597.00	598.71		598.87	0.009966	3.19	27.62	20.68	0.49
TWI000A	6218	01JAN2012 1600	69.03	597.00	598.43		598.58	0.012199	3.14	21.95	19.64	0.52
TWI000A	6218	01JAN2012 1700	59.31	597.00	598.28		598.43	0.013641	3.10	19.15	19.10	0.55
TWI000A	6218	01JAN2012 1800	52.70	597.00	598.19		598.34	0.014282	3.02	17.45	18.77	0.55
TWI000A	6218	01JAN2012 1900	39.10	597.00	597.99		598.12	0.016565	2.85	13.71	18.01	0.58
TWI000A	6218	01JAN2012 2000	35.96	597.00	597.93		598.06	0.017836	2.84	12.68	17.79	0.59
TWI000A	6218	01JAN2012 2100	33.54	597.00	597.89		598.01	0.018740	2.81	11.94	17.64	0.60
TWI000A	6218	01JAN2012 2200	31.57	597.00	597.86		597.98	0.019377	2.78	11.36	17.52	0.61
TWI000A	6218	01JAN2012 2300	29.94	597.00	597.83		597.95	0.019801	2.75	10.91	17.42	0.61
TWI000A	6218	01JAN2012 2400	28.58	597.00	597.81		597.92	0.020072	2.71	10.54	17.34	0.61
TWI000A	6179	Max WS	1759.58	596.45	605.86		606.39	0.004426	5.91	317.56	61.43	0.41
TWI000A	6179	31DEC2011 2400	10.00	596.45	596.80		596.91	0.054201	2.65	3.78	13.72	0.89
TWI000A	6179	01JAN2012 0100	22.06	596.45	597.11		597.22	0.021671	2.65	8.33	15.06	0.63
TWI000A	6179	01JAN2012 0200	23.07	596.45	597.14		597.25	0.020768	2.65	8.69	15.16	0.62
TWI000A	6179	01JAN2012 0300	24.17	596.45	597.16		597.27	0.019864	2.66	9.09	15.27	0.61
TWI000A	6179	01JAN2012 0400	25.49	596.45	597.19		597.30	0.019026	2.67	9.54	15.40	0.60
TWI000A	6179	01JAN2012 0500	27.14	596.45	597.23		597.34	0.017961	2.68	10.12	15.56	0.59
TWI000A	6179	01JAN2012 0600	29.29	596.45	597.28		597.39	0.016639	2.69	10.91	15.77	0.57
TWI000A	6179	01JAN2012 0700	39.16	596.45	597.52		597.63	0.011642	2.64	14.85	16.80	0.49
TWI000A	6179	01JAN2012 0800	45.95	596.45	597.68		597.79	0.009709	2.62	17.55	17.47	0.46
TWI000A	6179	01JAN2012 0900	56.10	596.45	597.87		597.98	0.008554	2.68	20.95	18.28	0.44
TWI000A	6179	01JAN2012 1000	75.78	596.45	598.24		598.35	0.006685	2.71	27.99	19.85	0.40
TWI000A	6179	01JAN2012 1100	103.87	596.45	598.69		598.81	0.005494	2.79	37.28	21.75	0.37
TWI000A	6179	01JAN2012 1200	587.94	596.45	602.54		602.77	0.003516	3.86	152.42	38.10	0.34
TWI000A	6179	01JAN2012 1300	265.37	596.45	600.59		600.74	0.003399	3.07	86.32	29.83	0.32
TWI000A	6179	01JAN2012 1400	116.66	596.45	598.89		599.01	0.004998	2.79	41.81	22.61	0.36
TWI000A	6179	01JAN2012 1500	88.11	596.45	598.45		598.57	0.005980	2.73	32.28	20.74	0.39
TWI000A	6179	01JAN2012 1600	69.07	596.45	598.13		598.24	0.007066	2.68	25.76	19.36	0.41
TWI000A	6179	01JAN2012 1700	59.33	596.45	597.94		598.05	0.008069	2.67	22.20	18.57	0.43
TWI000A	6179	01JAN2012 1800	52.71	596.45	597.81		597.92	0.008839	2.65	19.87	18.02	0.45
TWI000A	6179	01JAN2012 1900	39.12	596.45	597.53		597.63	0.011514	2.63	14.89	16.81	0.49
TWI000A	6179	01JAN2012 2000	35.97	596.45	597.45		597.56	0.012813	2.65	13.60	16.48	0.51
TWI000A	6179	01JAN2012 2100	33.55	596.45	597.39		597.50	0.014019	2.66	12.61	16.22	0.53
TWI000A	6179	01JAN2012 2200	31.58	596.45	597.34		597.45	0.015139	2.67	11.81	16.01	0.55
TWI000A	6179	01JAN2012 2300	29.95	596.45	597.30		597.41	0.016113	2.68	11.18	15.84	0.56
TWI000A	6179	01JAN2012 2400	28.58	596.45	597.27		597.38	0.016961	2.68	10.67	15.71	0.57
TWI000A	6133	Max WS	1758.85	595.31	605.47		606.21	0.004881	7.04	295.54	57.44	0.44
TWI000A	6133	31DEC2011 2400	10.01	595.31	596.18		596.20	0.002758	1.09	9.17	13.12	0.23
TWI000A	6133	01JAN2012 0100	22.04	595.31	596.75		596.78	0.001986	1.28	17.22	14.91	0.21
TWI000A	6133	01JAN2012 0200	23.07	595.31	596.79		596.82	0.001949	1.29	17.86	15.05	0.21
TWI000A	6133	01JAN2012 0300	24.16	595.31	596.84		596.86	0.001921	1.30	18.52	15.18	0.21
TWI000A	6133	01JAN2012 0400	25.48	595.31	596.88		596.91	0.001925	1.33	19.19	15.32	0.21
TWI000A	6133	01JAN2012 0500	27.13	595.31	596.94		596.96	0.001929	1.36	20.01	15.48	0.21
TWI000A	6133	01JAN2012 0600	29.28	595.31	597.00		597.03	0.001934	1.39	21.06	15.69	0.21
TWI000A	6133	01JAN2012 0700	39.13	595.31	597.30		597.33	0.001914	1.52	25.78	16.60	0.21

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	6133	01JAN2012 0800	45.90	595.31	597.48		597.52	0.001900	1.59	28.87	17.17	0.22
TWI000A	6133	01JAN2012 0900	56.04	595.31	597.70		597.75	0.001961	1.71	32.80	17.87	0.22
TWI000A	6133	01JAN2012 1000	75.67	595.31	598.10		598.15	0.002017	1.89	40.11	19.10	0.23
TWI000A	6133	01JAN2012 1100	103.71	595.31	598.56		598.63	0.002110	2.10	49.37	20.56	0.24
TWI000A	6133	01JAN2012 1200	579.70	595.31	602.38		602.62	0.002811	3.87	152.19	35.72	0.31
TWI000A	6133	01JAN2012 1300	266.93	595.31	600.48		600.60	0.002322	2.83	94.43	26.52	0.26
TWI000A	6133	01JAN2012 1400	116.77	595.31	598.77		598.85	0.002110	2.17	53.74	21.21	0.24
TWI000A	6133	01JAN2012 1500	88.19	595.31	598.32		598.38	0.002049	1.98	44.45	19.80	0.23
TWI000A	6133	01JAN2012 1600	69.13	595.31	597.98		598.03	0.001979	1.82	37.89	18.74	0.23
TWI000A	6133	01JAN2012 1700	59.37	595.31	597.78		597.83	0.001957	1.74	34.18	18.11	0.22
TWI000A	6133	01JAN2012 1800	52.74	595.31	597.64		597.68	0.001929	1.67	31.62	17.67	0.22
TWI000A	6133	01JAN2012 1900	39.14	595.31	597.30		597.34	0.001897	1.51	25.86	16.62	0.21
TWI000A	6133	01JAN2012 2000	35.99	595.31	597.21		597.24	0.001903	1.48	24.38	16.34	0.21
TWI000A	6133	01JAN2012 2100	33.56	595.31	597.14		597.17	0.001909	1.45	23.22	16.12	0.21
TWI000A	6133	01JAN2012 2200	31.59	595.31	597.08		597.11	0.001917	1.42	22.24	15.93	0.21
TWI000A	6133	01JAN2012 2300	29.96	595.31	597.03		597.06	0.001921	1.40	21.44	15.77	0.21
TWI000A	6133	01JAN2012 2400	28.59	595.31	596.98		597.01	0.001922	1.38	20.76	15.63	0.21
TWI000A	6059	Max WS	1758.08	594.03	604.92		605.81	0.006873	7.72	269.50	56.43	0.49
TWI000A	6059	31DEC2011 2400	10.04	594.03	596.10		596.10	0.000277	0.55	18.39	12.41	0.08
TWI000A	6059	01JAN2012 0100	22.02	594.03	596.68		596.69	0.000500	0.85	26.04	13.98	0.11
TWI000A	6059	01JAN2012 0200	23.05	594.03	596.72		596.73	0.000514	0.86	26.66	14.10	0.11
TWI000A	6059	01JAN2012 0300	24.15	594.03	596.77		596.78	0.000529	0.89	27.28	14.22	0.11
TWI000A	6059	01JAN2012 0400	25.47	594.03	596.81		596.82	0.000553	0.91	27.88	14.33	0.12
TWI000A	6059	01JAN2012 0500	27.11	594.03	596.86		596.87	0.000582	0.95	28.63	14.47	0.12
TWI000A	6059	01JAN2012 0600	29.25	594.03	596.93		596.94	0.000618	0.99	29.58	14.65	0.12
TWI000A	6059	01JAN2012 0700	39.08	594.03	597.21		597.23	0.000758	1.15	33.89	15.42	0.14
TWI000A	6059	01JAN2012 0800	45.83	594.03	597.39		597.42	0.000834	1.25	36.73	15.91	0.14
TWI000A	6059	01JAN2012 0900	55.94	594.03	597.61		597.64	0.000967	1.39	40.24	16.50	0.16
TWI000A	6059	01JAN2012 1000	75.49	594.03	598.00		598.04	0.001164	1.61	46.81	17.54	0.17
TWI000A	6059	01JAN2012 1100	103.47	594.03	598.45		598.50	0.001407	1.88	55.01	18.76	0.19
TWI000A	6059	01JAN2012 1200	567.71	594.03	602.15		602.40	0.003014	3.99	145.80	34.12	0.31
TWI000A	6059	01JAN2012 1300	269.06	594.03	600.31		600.44	0.002189	2.84	94.71	23.81	0.25
TWI000A	6059	01JAN2012 1400	116.93	594.03	598.65		598.72	0.001490	1.98	58.93	19.32	0.20
TWI000A	6059	01JAN2012 1500	88.30	594.03	598.21		598.26	0.001281	1.74	50.68	18.13	0.18
TWI000A	6059	01JAN2012 1600	69.22	594.03	597.88		597.92	0.001102	1.54	44.81	17.23	0.17
TWI000A	6059	01JAN2012 1700	59.43	594.03	597.69		597.72	0.001003	1.43	41.49	16.70	0.16
TWI000A	6059	01JAN2012 1800	52.78	594.03	597.55		597.58	0.000925	1.35	39.21	16.33	0.15
TWI000A	6059	01JAN2012 1900	39.18	594.03	597.22		597.24	0.000756	1.15	33.97	15.44	0.14
TWI000A	6059	01JAN2012 2000	36.01	594.03	597.13		597.15	0.000716	1.10	32.61	15.20	0.13
TWI000A	6059	01JAN2012 2100	33.58	594.03	597.06		597.08	0.000681	1.06	31.56	15.01	0.13
TWI000A	6059	01JAN2012 2200	31.60	594.03	597.00		597.02	0.000653	1.03	30.67	14.85	0.13
TWI000A	6059	01JAN2012 2300	29.97	594.03	596.95		596.97	0.000628	1.00	29.94	14.71	0.12
TWI000A	6059	01JAN2012 2400	28.60	594.03	596.91		596.92	0.000606	0.98	29.32	14.60	0.12
TWI000A	5935	Max WS	1758.16	594.37	604.04		604.82	0.009381	7.47	290.63	95.85	0.57
TWI000A	5935	31DEC2011 2400	10.11	594.37	595.79		595.82	0.004541	1.53	6.60	7.99	0.30
TWI000A	5935	01JAN2012 0100	21.99	594.37	596.30		596.36	0.004970	1.96	11.25	9.99	0.32
TWI000A	5935	01JAN2012 0200	23.04	594.37	596.34		596.40	0.005010	1.99	11.60	10.12	0.33
TWI000A	5935	01JAN2012 0300	24.13	594.37	596.38		596.44	0.005062	2.02	11.96	10.26	0.33
TWI000A	5935	01JAN2012 0400	25.45	594.37	596.41		596.48	0.005191	2.07	12.32	10.39	0.33
TWI000A	5935	01JAN2012 0500	27.08	594.37	596.45		596.52	0.005336	2.12	12.77	10.56	0.34
TWI000A	5935	01JAN2012 0600	29.21	594.37	596.51		596.58	0.005510	2.19	13.34	10.77	0.35
TWI000A	5935	01JAN2012 0700	39.01	594.37	596.73		596.83	0.006135	2.46	15.87	11.64	0.37
TWI000A	5935	01JAN2012 0800	45.74	594.37	596.87		596.97	0.006460	2.62	17.48	12.10	0.38
TWI000A	5935	01JAN2012 0900	55.82	594.37	597.04		597.17	0.006948	2.84	19.66	12.67	0.40
TWI000A	5935	01JAN2012 1000	75.27	594.37	597.36		597.51	0.007457	3.16	23.79	13.66	0.42
TWI000A	5935	01JAN2012 1100	103.13	594.37	597.77		597.96	0.007621	3.47	29.69	14.96	0.43
TWI000A	5935	01JAN2012 1200	551.10	594.37	601.11		601.61	0.009652	5.67	97.12	27.57	0.53
TWI000A	5935	01JAN2012 1300	272.09	594.37	599.54		599.85	0.007464	4.47	60.88	20.24	0.45
TWI000A	5935	01JAN2012 1400	117.17	594.37	597.98		598.17	0.007449	3.57	32.86	15.61	0.43
TWI000A	5935	01JAN2012 1500	88.46	594.37	597.56		597.73	0.007597	3.33	26.57	14.29	0.43
TWI000A	5935	01JAN2012 1600	69.34	594.37	597.27		597.41	0.007337	3.08	22.55	13.37	0.42
TWI000A	5935	01JAN2012 1700	59.51	594.37	597.11		597.24	0.007053	2.91	20.48	12.87	0.41
TWI000A	5935	01JAN2012 1800	52.84	594.37	597.00		597.11	0.006797	2.77	19.05	12.52	0.40
TWI000A	5935	01JAN2012 1900	39.23	594.37	596.74		596.83	0.006155	2.46	15.92	11.65	0.37
TWI000A	5935	01JAN2012 2000	36.05	594.37	596.67		596.76	0.005913	2.37	15.18	11.41	0.36
TWI000A	5935	01JAN2012 2100	33.61	594.37	596.62		596.70	0.005709	2.30	14.60	11.21	0.36
TWI000A	5935	01JAN2012 2200	31.63	594.37	596.57		596.65	0.005624	2.25	14.04	11.01	0.35
TWI000A	5935	01JAN2012 2300	29.99	594.37	596.53		596.60	0.005532	2.21	13.58	10.85	0.35
TWI000A	5935	01JAN2012 2400	28.62	594.37	596.49		596.57	0.005438	2.17	13.20	10.72	0.34
TWI000A	5676	Max WS	1885.86	592.61	602.50		602.96	0.004499	6.11	507.99	111.14	0.42
TWI000A	5676	31DEC2011 2400	10.55	592.61	595.24		595.24	0.000122	0.40	26.34	15.87	0.05
TWI000A	5676	01JAN2012 0100	22.76	592.61	595.68		595.69	0.000287	0.67	33.73	17.60	0.09
TWI000A	5676	01JAN2012 0200	23.90	592.61	595.70		595.71	0.000307	0.70	34.12	17.68	0.09
TWI000A	5676	01JAN2012 0300	25.07	592.61	595.72		595.73	0.000328	0.73	34.50	17.77	0.09
TWI000A	5676	01JAN2012 0400	26.47	592.61	595.75		595.76	0.000353	0.76	34.95	17.87	0.10
TWI000A	5676	01JAN2012 0500	28.21	592.61	595.78		595.79	0.000384	0.79	35.49	17.99	0.10
TWI000A	5676	01JAN2012 0600	30.47	592.61	595.81		595.83	0.000426	0.84	36.15	18.13	0.11
TWI000A	5676	01JAN2012 0700	40.89	592.61	595.94		595.96	0.000647	1.06	38.50	18.64	0.13
TWI000A	5676	01JAN2012 0800	47.90	592.61	596.00		596.02	0.000827	1.21	39.51	18.85	0.15
TWI000A	5676	01JAN2012 0900	58.66	592.61	596.11		596.14	0.001079	1.41	41.59	19.29	0.17
TWI000A	5676	01JAN2012 1000	79.53	592.61	596.28		596.33	0.001600	1.77	45.03	19.98	0.21

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	5676	01JAN2012 1100	109.41	592.61	596.63		596.70	0.002019	2.09	52.31	21.40	0.24
TWI000A	5676	01JAN2012 1200	573.98	592.61	599.56		599.78	0.003801	3.87	207.06	94.79	0.35
TWI000A	5676	01JAN2012 1300	297.95	592.61	598.35		598.49	0.002913	3.04	113.02	57.10	0.30
TWI000A	5676	01JAN2012 1400	126.11	592.61	596.85		596.93	0.002124	2.21	57.12	22.36	0.24
TWI000A	5676	01JAN2012 1500	94.99	592.61	596.44		596.50	0.001884	1.97	48.33	20.64	0.23
TWI000A	5676	01JAN2012 1600	74.29	592.61	596.22		596.27	0.001493	1.69	43.92	19.76	0.20
TWI000A	5676	01JAN2012 1700	63.62	592.61	596.14		596.18	0.001214	1.50	42.28	19.43	0.18
TWI000A	5676	01JAN2012 1800	56.43	592.61	596.07		596.10	0.001038	1.38	41.00	19.17	0.17
TWI000A	5676	01JAN2012 1900	41.67	592.61	595.94		595.96	0.000674	1.08	38.45	18.63	0.13
TWI000A	5676	01JAN2012 2000	38.22	592.61	595.92		595.93	0.000583	1.00	38.07	18.55	0.12
TWI000A	5676	01JAN2012 2100	35.61	592.61	595.90		595.91	0.000519	0.94	37.72	18.47	0.12
TWI000A	5676	01JAN2012 2200	33.46	592.61	595.86		595.88	0.000481	0.90	37.04	18.33	0.11
TWI000A	5676	01JAN2012 2300	31.68	592.61	595.83		595.84	0.000449	0.87	36.49	18.21	0.11
TWI000A	5676	01JAN2012 2400	30.19	592.61	595.81		595.82	0.000422	0.84	36.04	18.11	0.10
TWI000A	5466	Max WS	1992.81	592.59	600.79		601.61	0.009668	8.32	422.74	110.10	0.60
TWI000A	5466	31DEC2011 2400	10.91	592.59	593.44		593.53	0.021662	2.38	4.58	9.70	0.61
TWI000A	5466	01JAN2012 0100	23.41	592.59	593.76		593.90	0.019245	2.93	7.98	11.20	0.61
TWI000A	5466	01JAN2012 0200	24.62	592.59	593.79		593.93	0.019156	2.98	8.27	11.32	0.61
TWI000A	5466	01JAN2012 0300	25.85	592.59	593.82		593.96	0.019014	3.01	8.58	11.44	0.61
TWI000A	5466	01JAN2012 0400	27.33	592.59	593.85		593.99	0.018768	3.05	8.95	11.59	0.61
TWI000A	5466	01JAN2012 0500	29.16	592.59	593.89		594.04	0.018383	3.09	9.43	11.78	0.61
TWI000A	5466	01JAN2012 0600	31.53	592.59	593.94		594.09	0.017757	3.13	10.07	12.03	0.60
TWI000A	5466	01JAN2012 0700	42.47	592.59	594.17		594.34	0.015719	3.28	12.94	13.08	0.58
TWI000A	5466	01JAN2012 0800	49.72	592.59	594.30		594.48	0.014957	3.38	14.72	13.69	0.57
TWI000A	5466	01JAN2012 0900	61.01	592.59	594.53		594.71	0.012969	3.41	17.87	14.64	0.54
TWI000A	5466	01JAN2012 1000	83.05	592.59	594.93		595.11	0.010312	3.45	24.08	16.25	0.50
TWI000A	5466	01JAN2012 1100	114.70	592.59	595.42		595.61	0.008471	3.53	32.48	18.11	0.46
TWI000A	5466	01JAN2012 1200	584.06	592.59	598.02		598.42	0.009640	5.45	156.28	78.94	0.54
TWI000A	5466	01JAN2012 1300	321.29	592.59	596.99		597.31	0.008731	4.65	86.27	53.16	0.50
TWI000A	5466	01JAN2012 1400	133.72	592.59	595.65		595.85	0.008162	3.64	36.86	21.39	0.46
TWI000A	5466	01JAN2012 1500	100.50	592.59	595.25		595.43	0.008476	3.40	29.55	17.48	0.46
TWI000A	5466	01JAN2012 1600	78.49	592.59	594.85		595.04	0.010680	3.43	22.86	15.96	0.51
TWI000A	5466	01JAN2012 1700	67.10	592.59	594.65		594.83	0.011946	3.41	19.67	15.13	0.53
TWI000A	5466	01JAN2012 1800	59.47	592.59	594.50		594.68	0.013055	3.40	17.52	14.54	0.55
TWI000A	5466	01JAN2012 1900	43.73	592.59	594.20		594.37	0.015507	3.29	13.28	13.20	0.58
TWI000A	5466	01JAN2012 2000	40.06	592.59	594.13		594.29	0.015747	3.23	12.42	12.89	0.58
TWI000A	5466	01JAN2012 2100	37.29	592.59	594.08		594.24	0.015915	3.17	11.76	12.66	0.58
TWI000A	5466	01JAN2012 2200	35.00	592.59	594.03		594.18	0.016631	3.16	11.08	12.41	0.59
TWI000A	5466	01JAN2012 2300	33.11	592.59	593.98		594.13	0.017207	3.14	10.54	12.20	0.60
TWI000A	5466	01JAN2012 2400	31.52	592.59	593.94		594.10	0.017671	3.12	10.09	12.03	0.60
TWI000A	5296	Max WS	2071.95	590.93	599.18		600.05	0.009483	8.36	425.59	125.88	0.60
TWI000A	5296	31DEC2011 2400	11.03	590.93	591.25	591.68	596.79	5.725938	18.88	0.58	3.64	8.30
TWI000A	5296	01JAN2012 0100	23.89	590.93	591.68	591.95	592.60	0.296603	7.69	3.11	8.06	2.18
TWI000A	5296	01JAN2012 0200	25.17	590.93	591.72	591.97	592.54	0.244421	7.28	3.46	8.43	2.00
TWI000A	5296	01JAN2012 0300	26.44	590.93	591.76	591.99	592.51	0.202024	6.92	3.82	8.69	1.84
TWI000A	5296	01JAN2012 0400	27.98	590.93	591.81	592.02	592.48	0.164120	6.56	4.27	9.00	1.68
TWI000A	5296	01JAN2012 0500	29.88	590.93	591.87	592.05	592.47	0.130646	6.18	4.83	9.38	1.52
TWI000A	5296	01JAN2012 0600	32.32	590.93	591.95	592.08	592.48	0.104439	5.86	5.52	9.81	1.38
TWI000A	5296	01JAN2012 0700	43.62	590.93	592.27	592.24	592.64	0.046249	4.87	8.96	11.31	0.96
TWI000A	5296	01JAN2012 0800	51.05	590.93	592.47		592.79	0.032095	4.51	11.33	12.14	0.82
TWI000A	5296	01JAN2012 0900	62.76	590.93	592.76		593.03	0.021878	4.19	14.96	13.32	0.70
TWI000A	5296	01JAN2012 1000	85.66	590.93	593.27		593.50	0.013065	3.83	22.37	15.36	0.56
TWI000A	5296	01JAN2012 1100	118.68	590.93	593.82		594.04	0.009943	3.78	31.42	17.82	0.50
TWI000A	5296	01JAN2012 1200	597.62	590.93	596.57		596.96	0.007682	5.12	149.06	68.36	0.49
TWI000A	5296	01JAN2012 1300	338.10	590.93	595.63		595.90	0.008008	4.20	92.19	53.81	0.48
TWI000A	5296	01JAN2012 1400	139.48	590.93	594.08		594.31	0.009904	3.84	36.34	20.12	0.50
TWI000A	5296	01JAN2012 1500	104.65	590.93	593.65		593.86	0.010002	3.68	28.42	16.83	0.50
TWI000A	5296	01JAN2012 1600	81.68	590.93	593.20		593.43	0.013727	3.84	21.25	15.07	0.57
TWI000A	5296	01JAN2012 1700	69.76	590.93	592.93		593.18	0.017753	4.02	17.35	14.02	0.64
TWI000A	5296	01JAN2012 1800	61.78	590.93	592.74		593.01	0.022016	4.18	14.77	13.26	0.70
TWI000A	5296	01JAN2012 1900	45.30	590.93	592.32		592.67	0.041195	4.73	9.57	11.53	0.92
TWI000A	5296	01JAN2012 2000	41.46	590.93	592.21	592.21	592.60	0.051399	4.97	8.35	11.09	1.01
TWI000A	5296	01JAN2012 2100	38.56	590.93	592.13	592.18	592.55	0.062723	5.19	7.43	10.74	1.10
TWI000A	5296	01JAN2012 2200	36.17	590.93	592.06	592.14	592.51	0.075050	5.40	6.70	10.46	1.19
TWI000A	5296	01JAN2012 2300	34.18	590.93	592.00	592.11	592.49	0.087925	5.60	6.10	10.17	1.28
TWI000A	5296	01JAN2012 2400	32.52	590.93	591.95	592.09	592.48	0.101001	5.80	5.61	9.87	1.36
TWI000A	5079	Max WS	2149.10	588.81	597.37		598.20	0.008699	8.39	401.57	115.90	0.62
TWI000A	5079	31DEC2011 2400	11.34	588.81	590.16		590.19	0.003367	1.41	8.03	10.43	0.28
TWI000A	5079	01JAN2012 0100	24.44	588.81	590.64		590.69	0.003562	1.82	13.40	12.22	0.31
TWI000A	5079	01JAN2012 0200	25.80	588.81	590.68		590.73	0.003534	1.85	13.96	12.39	0.31
TWI000A	5079	01JAN2012 0300	27.13	588.81	590.72		590.77	0.003559	1.88	14.43	12.53	0.31
TWI000A	5079	01JAN2012 0400	28.73	588.81	590.76		590.82	0.003589	1.92	14.98	12.69	0.31
TWI000A	5079	01JAN2012 0500	30.70	588.81	590.81		590.87	0.003626	1.96	15.64	12.89	0.31
TWI000A	5079	01JAN2012 0600	33.24	588.81	590.87		590.94	0.003706	2.02	16.42	13.12	0.32
TWI000A	5079	01JAN2012 0700	44.97	588.81	591.15		591.23	0.003807	2.23	20.17	14.14	0.33
TWI000A	5079	01JAN2012 0800	52.60	588.81	591.29		591.38	0.003988	2.37	22.20	14.66	0.34
TWI000A	5079	01JAN2012 0900	64.80	588.81	591.49		591.59	0.004280	2.58	25.14	15.39	0.36
TWI000A	5079	01JAN2012 1000	88.75	588.81	591.85		591.97	0.004518	2.87	30.95	16.73	0.37
TWI000A	5079	01JAN2012 1100	123.32	588.81	592.26		592.42	0.004908	3.23	38.21	18.33	0.39
TWI000A	5079	01JAN2012 1200	613.15	588.81	594.86		595.30	0.008086	5.47	142.17	89.70	0.54
TWI000A	5079	01JAN2012 1300	359.23	588.81	594.04		594.36	0.006542	4.56	84.48	46.58	0.48

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	5079	01JAN2012 1400	146.22	588.81	592.51		592.69	0.005082	3.42	42.80	19.32	0.40
TWI000A	5079	01JAN2012 1500	109.57	588.81	592.11		592.26	0.004728	3.08	35.52	17.75	0.38
TWI000A	5079	01JAN2012 1600	85.42	588.81	591.81		591.94	0.004406	2.81	30.38	16.60	0.37
TWI000A	5079	01JAN2012 1700	72.89	588.81	591.64		591.75	0.004192	2.64	27.57	15.96	0.35
TWI000A	5079	01JAN2012 1800	64.49	588.81	591.49		591.59	0.004218	2.56	25.18	15.40	0.35
TWI000A	5079	01JAN2012 1900	47.17	588.81	591.20		591.28	0.003817	2.26	20.85	14.32	0.33
TWI000A	5079	01JAN2012 2000	43.11	588.81	591.12		591.19	0.003696	2.18	19.78	14.04	0.32
TWI000A	5079	01JAN2012 2100	40.06	588.81	591.04		591.11	0.003798	2.15	18.59	13.72	0.33
TWI000A	5079	01JAN2012 2200	37.54	588.81	590.98		591.05	0.003755	2.11	17.82	13.51	0.32
TWI000A	5079	01JAN2012 2300	35.45	588.81	590.93		591.00	0.003718	2.06	17.17	13.33	0.32
TWI000A	5079	01JAN2012 2400	33.70	588.81	590.89		590.95	0.003678	2.03	16.63	13.17	0.32
TWI000A	4954	Max WS	2184.96	588.24	596.64		597.24	0.005837	7.13	495.75	146.84	0.52
TWI000A	4954	31DEC2011 2400	11.65	588.24	589.95		589.96	0.000571	0.74	15.79	14.40	0.12
TWI000A	4954	01JAN2012 0100	24.76	588.24	590.39		590.41	0.000956	1.09	22.61	16.70	0.17
TWI000A	4954	01JAN2012 0200	26.19	588.24	590.43		590.45	0.000980	1.12	23.36	16.94	0.17
TWI000A	4954	01JAN2012 0300	27.55	588.24	590.47		590.49	0.001017	1.15	23.91	17.11	0.17
TWI000A	4954	01JAN2012 0400	29.19	588.24	590.50		590.53	0.001063	1.19	24.54	17.31	0.18
TWI000A	4954	01JAN2012 0500	31.21	588.24	590.55		590.57	0.001116	1.23	25.33	17.56	0.18
TWI000A	4954	01JAN2012 0600	33.81	588.24	590.61		590.63	0.001179	1.28	26.32	17.86	0.19
TWI000A	4954	01JAN2012 0700	45.80	588.24	590.87		590.90	0.001352	1.47	31.24	19.23	0.20
TWI000A	4954	01JAN2012 0800	53.56	588.24	590.99		591.03	0.001521	1.60	33.51	19.77	0.22
TWI000A	4954	01JAN2012 0900	66.06	588.24	591.16		591.21	0.001757	1.79	37.00	20.57	0.23
TWI000A	4954	01JAN2012 1000	90.65	588.24	591.49		591.56	0.002042	2.06	44.06	22.10	0.26
TWI000A	4954	01JAN2012 1100	126.19	588.24	591.87		591.95	0.002439	2.40	52.68	23.99	0.28
TWI000A	4954	01JAN2012 1200	618.77	588.24	594.08		594.41	0.005618	4.74	162.25	110.51	0.46
TWI000A	4954	01JAN2012 1300	372.18	588.24	593.43		593.65	0.004515	3.72	102.43	59.57	0.40
TWI000A	4954	01JAN2012 1400	150.39	588.24	592.09		592.19	0.002657	2.58	58.22	25.23	0.30
TWI000A	4954	01JAN2012 1500	112.60	588.24	591.74		591.82	0.002280	2.27	49.61	23.30	0.27
TWI000A	4954	01JAN2012 1600	87.73	588.24	591.46		591.53	0.001983	2.02	43.48	21.98	0.25
TWI000A	4954	01JAN2012 1700	74.83	588.24	591.32		591.37	0.001774	1.85	40.34	21.31	0.24
TWI000A	4954	01JAN2012 1800	66.16	588.24	591.17		591.21	0.001746	1.78	37.12	20.60	0.23
TWI000A	4954	01JAN2012 1900	48.32	588.24	590.91		590.95	0.001398	1.51	32.07	19.43	0.21
TWI000A	4954	01JAN2012 2000	44.13	588.24	590.85		590.88	0.001296	1.43	30.88	19.15	0.20
TWI000A	4954	01JAN2012 2100	40.99	588.24	590.76		590.79	0.001315	1.41	29.13	18.69	0.20
TWI000A	4954	01JAN2012 2200	38.39	588.24	590.71		590.74	0.001265	1.36	28.15	18.41	0.19
TWI000A	4954	01JAN2012 2300	36.24	588.24	590.66		590.69	0.001223	1.33	27.33	18.16	0.19
TWI000A	4954	01JAN2012 2400	34.44	588.24	590.62		590.65	0.001184	1.29	26.63	17.96	0.19
TWI000A	4851	Max WS	2183.75	588.32	596.45		596.72	0.003233	5.14	717.98	207.64	0.39
TWI000A	4851	31DEC2011 2400	11.86	588.32	589.44		589.50	0.009085	1.94	6.11	10.51	0.45
TWI000A	4851	01JAN2012 0100	24.72	588.32	589.79		589.88	0.009728	2.41	10.25	13.40	0.49
TWI000A	4851	01JAN2012 0200	26.18	588.32	589.82		589.91	0.009792	2.45	10.67	13.66	0.49
TWI000A	4851	01JAN2012 0300	27.54	588.32	589.84		589.94	0.009969	2.50	11.00	13.86	0.50
TWI000A	4851	01JAN2012 0400	29.17	588.32	589.87		589.97	0.010106	2.56	11.40	14.04	0.50
TWI000A	4851	01JAN2012 0500	31.19	588.32	589.91		590.01	0.010224	2.62	11.90	14.26	0.51
TWI000A	4851	01JAN2012 0600	33.78	588.32	589.95		590.06	0.010302	2.69	12.56	14.54	0.51
TWI000A	4851	01JAN2012 0700	45.75	588.32	590.11		590.25	0.011666	3.07	14.90	15.50	0.55
TWI000A	4851	01JAN2012 0800	53.49	588.32	590.23		590.39	0.011335	3.18	16.84	16.25	0.55
TWI000A	4851	01JAN2012 0900	65.95	588.32	590.42		590.58	0.010714	3.30	19.97	17.40	0.54
TWI000A	4851	01JAN2012 1000	90.46	588.32	590.66		590.87	0.011569	3.71	24.41	18.90	0.57
TWI000A	4851	01JAN2012 1100	125.92	588.32	591.00		591.26	0.011429	4.02	31.29	21.17	0.58
TWI000A	4851	01JAN2012 1200	593.86	588.32	593.08		593.53	0.013383	5.68	141.54	128.91	0.68
TWI000A	4851	01JAN2012 1300	376.32	588.32	592.39		592.84	0.012995	5.45	74.32	62.51	0.66
TWI000A	4851	01JAN2012 1400	150.59	588.32	591.21		591.48	0.011465	4.22	35.70	22.55	0.59
TWI000A	4851	01JAN2012 1500	112.75	588.32	590.88		591.12	0.011580	3.93	28.68	20.31	0.58
TWI000A	4851	01JAN2012 1600	87.84	588.32	590.62		590.84	0.011778	3.70	23.74	18.68	0.58
TWI000A	4851	01JAN2012 1700	74.90	588.32	590.46		590.66	0.012569	3.62	20.66	17.64	0.59
TWI000A	4851	01JAN2012 1800	66.21	588.32	590.41		590.58	0.010855	3.32	19.93	17.38	0.55
TWI000A	4851	01JAN2012 1900	48.36	588.32	590.14		590.30	0.011757	3.13	15.46	15.72	0.56
TWI000A	4851	01JAN2012 2000	44.15	588.32	590.08		590.22	0.011868	3.06	14.44	15.32	0.55
TWI000A	4851	01JAN2012 2100	41.01	588.32	590.07		590.20	0.010365	2.85	14.38	15.29	0.52
TWI000A	4851	01JAN2012 2200	38.41	588.32	590.03		590.15	0.010442	2.81	13.69	15.01	0.52
TWI000A	4851	01JAN2012 2300	36.26	588.32	589.99		590.11	0.010465	2.76	13.13	14.78	0.52
TWI000A	4851	01JAN2012 2400	34.45	588.32	589.96		590.07	0.010456	2.72	12.67	14.58	0.51
TWI000A	4630	Max WS	2181.47	585.93	596.26		596.37	0.001015	2.99	897.87	190.87	0.20
TWI000A	4630	31DEC2011 2400	11.85	585.93	588.68		588.68	0.000106	0.33	39.63	35.67	0.05
TWI000A	4630	01JAN2012 0100	24.68	585.93	588.95		588.95	0.000250	0.55	49.90	39.97	0.08
TWI000A	4630	01JAN2012 0200	26.15	585.93	588.96		588.97	0.000272	0.58	50.51	40.12	0.08
TWI000A	4630	01JAN2012 0300	27.51	585.93	588.98		588.99	0.000288	0.60	51.29	40.30	0.08
TWI000A	4630	01JAN2012 0400	29.13	585.93	589.01		589.01	0.000306	0.62	52.27	40.53	0.09
TWI000A	4630	01JAN2012 0500	31.14	585.93	589.04		589.04	0.000327	0.65	53.53	40.83	0.09
TWI000A	4630	01JAN2012 0600	33.71	585.93	589.08		589.08	0.000351	0.68	55.23	41.22	0.09
TWI000A	4630	01JAN2012 0700	45.53	585.93	589.10		589.11	0.000617	0.90	55.95	41.39	0.12
TWI000A	4630	01JAN2012 0800	53.24	585.93	589.27		589.28	0.000601	0.93	63.09	43.00	0.12
TWI000A	4630	01JAN2012 0900	65.48	585.93	589.52		589.54	0.000591	0.97	75.12	48.55	0.12
TWI000A	4630	01JAN2012 1000	89.64	585.93	589.70		589.72	0.000808	1.18	84.01	50.22	0.15
TWI000A	4630	01JAN2012 1100	125.17	585.93	590.08		590.11	0.000890	1.33	103.87	55.35	0.16
TWI000A	4630	01JAN2012 1200	554.40	585.93	592.12		592.19	0.001631	2.02	264.94	110.13	0.22
TWI000A	4630	01JAN2012 1300	384.30	585.93	591.33		591.40	0.001784	2.08	188.50	82.59	0.23
TWI000A	4630	01JAN2012 1400	151.14	585.93	590.30		590.32	0.001023	1.48	116.37	62.58	0.17
TWI000A	4630	01JAN2012 1500	113.28	585.93	589.93		589.95	0.000891	1.29	95.75	52.34	0.15
TWI000A	4630	01JAN2012 1600	88.30	585.93	589.64		589.66	0.000875	1.21	80.79	49.62	0.15

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	4630	01JAN2012 1700	75.05	585.93	589.37		589.39	0.001025	1.24	68.01	47.03	0.16
TWI000A	4630	01JAN2012 1800	66.43	585.93	589.51		589.52	0.000628	1.00	74.28	48.39	0.13
TWI000A	4630	01JAN2012 1900	48.54	585.93	589.13		589.14	0.000653	0.93	57.36	41.71	0.13
TWI000A	4630	01JAN2012 2000	44.26	585.93	589.03		589.04	0.000668	0.92	53.33	40.78	0.13
TWI000A	4630	01JAN2012 2100	41.08	585.93	589.18		589.19	0.000423	0.76	59.46	42.19	0.10
TWI000A	4630	01JAN2012 2200	38.47	585.93	589.14		589.14	0.000406	0.74	57.58	41.76	0.10
TWI000A	4630	01JAN2012 2300	36.30	585.93	589.10		589.11	0.000389	0.72	56.11	41.42	0.10
TWI000A	4630	01JAN2012 2400	34.49	585.93	589.07		589.08	0.000373	0.70	54.92	41.15	0.10
TWI000A	4515	Max WS	3183.51	585.61	595.53		595.98	0.003687	5.76	605.03	102.41	0.37
TWI000A	4515	31DEC2011 2400	11.78	585.61	586.50		586.68	0.047664	3.36	3.51	7.87	0.89
TWI000A	4515	01JAN2012 0100	32.34	585.61	586.97		587.23	0.034321	4.08	7.93	10.20	0.81
TWI000A	4515	01JAN2012 0200	34.77	585.61	587.01		587.28	0.034355	4.18	8.32	10.30	0.82
TWI000A	4515	01JAN2012 0300	36.83	585.61	587.04		587.32	0.034335	4.26	8.65	10.39	0.82
TWI000A	4515	01JAN2012 0400	39.36	585.61	587.08		587.37	0.034152	4.34	9.06	10.50	0.82
TWI000A	4515	01JAN2012 0500	42.44	585.61	587.13		587.43	0.033721	4.43	9.57	10.63	0.82
TWI000A	4515	01JAN2012 0600	46.37	585.61	587.19		587.51	0.032917	4.53	10.24	10.81	0.82
TWI000A	4515	01JAN2012 0700	64.36	585.61	587.49		587.84	0.027936	4.73	13.62	11.78	0.77
TWI000A	4515	01JAN2012 0800	75.87	585.61	587.63		588.01	0.027808	4.93	15.47	14.26	0.78
TWI000A	4515	01JAN2012 0900	93.88	585.61	587.84		588.25	0.026798	5.14	18.89	17.99	0.78
TWI000A	4515	01JAN2012 1000	129.78	585.61	588.17		588.61	0.025613	5.45	25.58	23.50	0.77
TWI000A	4515	01JAN2012 1100	182.00	585.61	588.54		588.99	0.023603	5.66	36.70	33.27	0.76
TWI000A	4515	01JAN2012 1200	856.41	585.61	591.07		591.42	0.010337	5.38	186.35	86.13	0.54
TWI000A	4515	01JAN2012 1300	537.43	585.61	590.23		590.58	0.012568	5.41	119.59	69.07	0.59
TWI000A	4515	01JAN2012 1400	216.58	585.61	588.74		589.19	0.022667	5.76	43.43	36.35	0.75
TWI000A	4515	01JAN2012 1500	161.06	585.61	588.43		588.87	0.023216	5.49	33.17	31.64	0.75
TWI000A	4515	01JAN2012 1600	124.59	585.61	588.13		588.57	0.025485	5.39	24.73	22.22	0.77
TWI000A	4515	01JAN2012 1700	105.24	585.61	587.99		588.39	0.024644	5.11	21.65	20.06	0.75
TWI000A	4515	01JAN2012 1800	92.70	585.61	587.83		588.23	0.026847	5.12	18.66	17.82	0.78
TWI000A	4515	01JAN2012 1900	66.50	585.61	587.52		587.87	0.027939	4.77	13.94	11.90	0.78
TWI000A	4515	01JAN2012 2000	60.25	585.61	587.44		587.77	0.027571	4.62	13.04	11.57	0.77
TWI000A	4515	01JAN2012 2100	55.57	585.61	587.34		587.68	0.030319	4.67	11.91	11.22	0.80
TWI000A	4515	01JAN2012 2200	51.74	585.61	587.28		587.61	0.031434	4.62	11.21	11.05	0.81
TWI000A	4515	01JAN2012 2300	48.56	585.61	587.23		587.55	0.032301	4.57	10.64	10.91	0.81
TWI000A	4515	01JAN2012 2400	45.90	585.61	587.18		587.50	0.032951	4.51	10.17	10.79	0.82
TWI000A	4315	Max WS	3181.45	581.62	592.87		594.94	0.013915	11.64	292.48	54.85	0.72
TWI000A	4315	31DEC2011 2400	12.05	581.62	582.62		582.79	0.036508	3.25	3.71	7.12	0.79
TWI000A	4315	01JAN2012 0100	32.21	581.62	583.53		583.64	0.009666	2.63	12.26	11.69	0.45
TWI000A	4315	01JAN2012 0200	34.74	581.62	583.62		583.72	0.009067	2.62	13.27	12.12	0.44
TWI000A	4315	01JAN2012 0300	36.80	581.62	583.67		583.78	0.008891	2.64	13.95	12.40	0.44
TWI000A	4315	01JAN2012 0400	39.33	581.62	583.74		583.85	0.008657	2.66	14.80	12.74	0.43
TWI000A	4315	01JAN2012 0500	42.40	581.62	583.82		583.93	0.008351	2.67	15.86	13.15	0.43
TWI000A	4315	01JAN2012 0600	46.32	581.62	583.92		584.04	0.007976	2.69	17.22	13.66	0.42
TWI000A	4315	01JAN2012 0700	64.26	581.62	584.34		584.46	0.006783	2.75	23.40	15.87	0.40
TWI000A	4315	01JAN2012 0800	75.73	581.62	584.58		584.70	0.006279	2.78	27.28	17.18	0.39
TWI000A	4315	01JAN2012 0900	93.60	581.62	584.87		585.00	0.005817	2.88	32.50	18.18	0.38
TWI000A	4315	01JAN2012 1000	129.24	581.62	585.36		585.51	0.005561	3.07	42.04	20.54	0.38
TWI000A	4315	01JAN2012 1100	181.36	581.62	585.97		586.13	0.005259	3.28	55.34	23.52	0.38
TWI000A	4315	01JAN2012 1200	828.67	581.62	589.48		589.92	0.005774	5.34	155.31	32.39	0.43
TWI000A	4315	01JAN2012 1300	546.73	581.62	588.78		589.04	0.003888	4.11	133.15	30.85	0.35
TWI000A	4315	01JAN2012 1400	217.14	581.62	586.34		586.52	0.005035	3.37	64.39	25.34	0.37
TWI000A	4315	01JAN2012 1500	161.54	581.62	585.77		585.93	0.005255	3.18	50.75	22.53	0.37
TWI000A	4315	01JAN2012 1600	124.90	581.62	585.32		585.46	0.005487	3.03	41.18	20.34	0.38
TWI000A	4315	01JAN2012 1700	105.43	581.62	585.06		585.19	0.005625	2.93	35.93	19.03	0.38
TWI000A	4315	01JAN2012 1800	92.84	581.62	584.87		585.00	0.005731	2.86	32.49	18.18	0.38
TWI000A	4315	01JAN2012 1900	66.60	581.62	584.40		584.52	0.006558	2.74	24.35	16.20	0.39
TWI000A	4315	01JAN2012 2000	60.30	581.62	584.27		584.38	0.006858	2.72	22.20	15.45	0.40
TWI000A	4315	01JAN2012 2100	55.62	581.62	584.16		584.27	0.007075	2.70	20.63	14.87	0.40
TWI000A	4315	01JAN2012 2200	51.78	581.62	584.07		584.18	0.007359	2.69	19.28	14.40	0.41
TWI000A	4315	01JAN2012 2300	48.60	581.62	583.99		584.10	0.007658	2.68	18.12	13.98	0.42
TWI000A	4315	01JAN2012 2400	45.93	581.62	583.92		584.03	0.007909	2.68	17.17	13.64	0.42
TWI000A	4239	Max WS	3191.92	581.19	592.38		593.86	0.010851	10.59	480.26	105.24	0.65
TWI000A	4239	31DEC2011 2400	12.19	581.19	582.40		582.46	0.008551	1.94	6.30	8.84	0.40
TWI000A	4239	01JAN2012 0100	32.22	581.19	583.21		583.28	0.005511	2.17	14.87	12.46	0.35
TWI000A	4239	01JAN2012 0200	34.83	581.19	583.29		583.36	0.005361	2.19	15.90	12.82	0.35
TWI000A	4239	01JAN2012 0300	36.90	581.19	583.34		583.42	0.005341	2.22	16.61	13.07	0.35
TWI000A	4239	01JAN2012 0400	39.43	581.19	583.41		583.49	0.005308	2.26	17.46	13.33	0.35
TWI000A	4239	01JAN2012 0500	42.51	581.19	583.49		583.57	0.005243	2.30	18.51	13.63	0.35
TWI000A	4239	01JAN2012 0600	46.45	581.19	583.58		583.67	0.005185	2.34	19.81	14.00	0.35
TWI000A	4239	01JAN2012 0700	64.42	581.19	583.97		584.07	0.004979	2.52	25.53	15.60	0.35
TWI000A	4239	01JAN2012 0800	75.95	581.19	584.18		584.28	0.004933	2.63	28.91	16.47	0.35
TWI000A	4239	01JAN2012 0900	93.86	581.19	584.48		584.60	0.004750	2.75	34.09	17.50	0.35
TWI000A	4239	01JAN2012 1000	129.62	581.19	584.99		585.12	0.004694	2.99	43.42	19.48	0.35
TWI000A	4239	01JAN2012 1100	182.04	581.19	585.60		585.76	0.004637	3.25	56.02	21.82	0.36
TWI000A	4239	01JAN2012 1200	825.20	581.19	589.02		589.48	0.005842	5.47	170.73	71.60	0.44
TWI000A	4239	01JAN2012 1300	553.45	581.19	588.48		588.75	0.003918	4.18	135.19	57.34	0.35
TWI000A	4239	01JAN2012 1400	218.71	581.19	585.98		586.15	0.004559	3.39	64.56	23.27	0.36
TWI000A	4239	01JAN2012 1500	162.72	581.19	585.40		585.55	0.004575	3.14	51.82	21.07	0.35
TWI000A	4239	01JAN2012 1600	125.77	581.19	584.95		585.08	0.004627	2.95	42.70	19.34	0.35
TWI000A	4239	01JAN2012 1700	106.13	581.19	584.67		584.80	0.004679	2.83	37.53	18.27	0.35
TWI000A	4239	01JAN2012 1800	93.44	581.19	584.49		584.60	0.004677	2.73	34.17	17.52	0.35
TWI000A	4239	01JAN2012 1900	67.01	581.19	584.03		584.13	0.004881	2.53	26.47	15.85	0.35

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	4239	01JAN2012 2000	60.66	581.19	583.90		584.00	0.004931	2.47	24.52	15.33	0.34
TWI000A	4239	01JAN2012 2100	55.94	581.19	583.80		583.89	0.004974	2.43	23.03	14.92	0.34
TWI000A	4239	01JAN2012 2200	52.07	581.19	583.72		583.81	0.005026	2.39	21.78	14.57	0.34
TWI000A	4239	01JAN2012 2300	48.87	581.19	583.64		583.73	0.005088	2.36	20.70	14.26	0.35
TWI000A	4239	01JAN2012 2400	46.18	581.19	583.58		583.66	0.005127	2.33	19.81	14.00	0.35
TWI000A	4155	Max WS	3214.31	580.71	592.43		592.75	0.003311	5.52	1059.63	217.96	0.36
TWI000A	4155	31DEC2011 2400	12.35	580.71	582.14		582.16	0.002685	1.29	9.59	10.37	0.24
TWI000A	4155	01JAN2012 0100	32.20	580.71	582.89		582.94	0.002895	1.74	18.54	13.32	0.26
TWI000A	4155	01JAN2012 0200	34.93	580.71	582.97		583.02	0.002882	1.77	19.68	13.61	0.26
TWI000A	4155	01JAN2012 0300	37.00	580.71	583.03		583.08	0.002895	1.81	20.47	13.81	0.26
TWI000A	4155	01JAN2012 0400	39.55	580.71	583.10		583.15	0.002926	1.85	21.39	14.04	0.26
TWI000A	4155	01JAN2012 0500	42.64	580.71	583.17		583.23	0.002952	1.89	22.50	14.31	0.27
TWI000A	4155	01JAN2012 0600	46.58	580.71	583.27		583.33	0.002990	1.95	23.87	14.64	0.27
TWI000A	4155	01JAN2012 0700	64.60	580.71	583.66		583.73	0.003109	2.17	29.81	15.98	0.28
TWI000A	4155	01JAN2012 0800	76.18	580.71	583.86		583.95	0.003215	2.29	33.20	16.70	0.29
TWI000A	4155	01JAN2012 0900	94.17	580.71	584.17		584.26	0.003280	2.45	38.47	17.76	0.29
TWI000A	4155	01JAN2012 1000	130.07	580.71	584.67		584.78	0.003465	2.73	47.72	19.42	0.31
TWI000A	4155	01JAN2012 1100	182.77	580.71	585.27		585.41	0.003658	3.05	60.74	28.32	0.32
TWI000A	4155	01JAN2012 1200	811.39	580.71	588.83		589.01	0.003700	3.71	332.30	129.47	0.34
TWI000A	4155	01JAN2012 1300	566.71	580.71	588.29		588.42	0.003237	3.17	263.03	126.67	0.31
TWI000A	4155	01JAN2012 1400	220.53	580.71	585.65		585.81	0.003687	3.20	73.28	36.73	0.33
TWI000A	4155	01JAN2012 1500	164.06	580.71	585.08		585.21	0.003560	2.93	56.00	20.77	0.31
TWI000A	4155	01JAN2012 1600	126.76	580.71	584.64		584.75	0.003414	2.69	47.08	19.32	0.30
TWI000A	4155	01JAN2012 1700	106.93	580.71	584.36		584.46	0.003337	2.55	41.95	18.42	0.30
TWI000A	4155	01JAN2012 1800	94.12	580.71	584.18		584.27	0.003244	2.44	38.61	17.79	0.29
TWI000A	4155	01JAN2012 1900	67.49	580.71	583.72		583.79	0.003098	2.19	30.81	16.20	0.28
TWI000A	4155	01JAN2012 2000	61.07	580.71	583.60		583.67	0.003044	2.12	28.84	15.77	0.28
TWI000A	4155	01JAN2012 2100	56.31	580.71	583.50		583.56	0.003020	2.06	27.27	15.42	0.27
TWI000A	4155	01JAN2012 2200	52.41	580.71	583.41		583.47	0.002993	2.02	25.98	15.13	0.27
TWI000A	4155	01JAN2012 2300	49.18	580.71	583.34		583.40	0.002980	1.98	24.85	14.87	0.27
TWI000A	4155	01JAN2012 2400	46.46	580.71	583.27		583.33	0.002961	1.94	23.91	14.65	0.27
TWI000A	3981	Max WS	3248.08	579.93	590.75		591.85	0.010748	9.01	532.10	134.29	0.64
TWI000A	3981	31DEC2011 2400	12.72	579.93	581.77		581.79	0.001743	1.14	11.19	10.36	0.19
TWI000A	3981	01JAN2012 0100	32.15	579.93	582.40		582.45	0.002822	1.74	18.50	12.88	0.26
TWI000A	3981	01JAN2012 0200	35.12	579.93	582.47		582.52	0.002955	1.81	19.39	13.13	0.26
TWI000A	3981	01JAN2012 0300	37.21	579.93	582.52		582.57	0.003046	1.86	20.00	13.29	0.27
TWI000A	3981	01JAN2012 0400	39.77	579.93	582.57		582.63	0.003155	1.92	20.72	13.49	0.27
TWI000A	3981	01JAN2012 0500	42.87	579.93	582.64		582.70	0.003271	1.98	21.60	13.72	0.28
TWI000A	3981	01JAN2012 0600	46.84	579.93	582.72		582.78	0.003387	2.06	22.74	13.99	0.28
TWI000A	3981	01JAN2012 0700	64.94	579.93	583.04		583.12	0.003895	2.37	27.35	15.01	0.31
TWI000A	3981	01JAN2012 0800	76.62	579.93	583.21		583.31	0.004201	2.55	29.99	15.57	0.32
TWI000A	3981	01JAN2012 0900	94.77	579.93	583.47		583.59	0.004503	2.78	34.12	16.40	0.34
TWI000A	3981	01JAN2012 1000	130.95	579.93	583.87		584.03	0.005201	3.19	41.09	17.82	0.37
TWI000A	3981	01JAN2012 1100	184.16	579.93	584.38		584.58	0.005896	3.65	50.51	19.59	0.40
TWI000A	3981	01JAN2012 1200	773.55	579.93	587.60		587.99	0.008800	5.04	167.37	87.88	0.51
TWI000A	3981	01JAN2012 1300	594.06	579.93	586.97		587.35	0.009948	4.90	122.41	58.10	0.53
TWI000A	3981	01JAN2012 1400	223.96	579.93	584.71		584.95	0.006262	3.92	57.17	20.79	0.42
TWI000A	3981	01JAN2012 1500	166.58	579.93	584.22		584.41	0.005690	3.51	47.51	19.05	0.39
TWI000A	3981	01JAN2012 1600	128.62	579.93	583.85		584.01	0.005158	3.16	40.67	17.74	0.37
TWI000A	3981	01JAN2012 1700	108.44	579.93	583.62		583.76	0.004825	2.95	36.73	16.94	0.35
TWI000A	3981	01JAN2012 1800	95.40	579.93	583.47		583.60	0.004515	2.79	34.25	16.42	0.34
TWI000A	3981	01JAN2012 1900	68.41	579.93	583.09		583.18	0.003991	2.43	28.15	15.18	0.31
TWI000A	3981	01JAN2012 2000	61.85	579.93	582.99		583.07	0.003791	2.32	26.66	14.87	0.31
TWI000A	3981	01JAN2012 2100	57.00	579.93	582.91		582.99	0.003629	2.23	25.54	14.62	0.30
TWI000A	3981	01JAN2012 2200	53.05	579.93	582.85		582.92	0.003500	2.16	24.57	14.41	0.29
TWI000A	3981	01JAN2012 2300	49.77	579.93	582.78		582.85	0.003445	2.11	23.60	14.19	0.29
TWI000A	3981	01JAN2012 2400	47.01	579.93	582.72		582.79	0.003386	2.06	22.80	14.01	0.28
TWI000A	3902	Max WS	3265.49	579.57	589.82		591.04	0.011771	10.36	584.25	188.04	0.73
TWI000A	3902	31DEC2011 2400	12.86	579.57	580.66		580.83	0.026369	3.30	3.89	6.48	0.75
TWI000A	3902	01JAN2012 0100	32.17	579.57	581.16		581.43	0.025344	4.17	7.72	8.72	0.78
TWI000A	3902	01JAN2012 0200	35.22	579.57	581.22		581.50	0.025691	4.29	8.21	8.96	0.79
TWI000A	3902	01JAN2012 0300	37.31	579.57	581.26		581.55	0.025791	4.36	8.55	9.13	0.79
TWI000A	3902	01JAN2012 0400	39.88	579.57	581.30		581.61	0.025759	4.44	8.98	9.33	0.80
TWI000A	3902	01JAN2012 0500	43.00	579.57	581.36		581.68	0.025553	4.52	9.52	9.58	0.80
TWI000A	3902	01JAN2012 0600	46.97	579.57	581.43		581.76	0.025106	4.59	10.23	9.90	0.80
TWI000A	3902	01JAN2012 0700	65.14	579.57	581.71		582.09	0.024395	4.98	13.09	10.92	0.80
TWI000A	3902	01JAN2012 0800	76.88	579.57	581.86		582.28	0.024277	5.20	14.78	11.48	0.81
TWI000A	3902	01JAN2012 0900	95.13	579.57	582.09		582.55	0.023295	5.43	17.52	12.32	0.80
TWI000A	3902	01JAN2012 1000	131.47	579.57	582.45		582.99	0.023143	5.91	22.23	13.60	0.82
TWI000A	3902	01JAN2012 1100	185.02	579.57	582.91		583.55	0.022455	6.44	28.74	15.02	0.82
TWI000A	3902	01JAN2012 1200	764.80	579.57	585.89		587.05	0.019435	8.62	88.71	26.49	0.83
TWI000A	3902	01JAN2012 1300	601.86	579.57	585.24		586.31	0.019740	8.30	72.55	23.11	0.82
TWI000A	3902	01JAN2012 1400	225.55	579.57	583.21		583.92	0.021918	6.74	33.48	15.97	0.82
TWI000A	3902	01JAN2012 1500	167.77	579.57	582.77		583.38	0.022579	6.28	26.73	14.59	0.82
TWI000A	3902	01JAN2012 1600	129.51	579.57	582.43		582.97	0.023106	5.89	22.00	13.55	0.81
TWI000A	3902	01JAN2012 1700	109.17	579.57	582.23		582.73	0.023486	5.65	19.32	12.84	0.81
TWI000A	3902	01JAN2012 1800	96.03	579.57	582.10		582.56	0.023238	5.44	17.66	12.36	0.80
TWI000A	3902	01JAN2012 1900	68.85	579.57	581.76		582.15	0.024338	5.05	13.64	11.10	0.80
TWI000A	3902	01JAN2012 2000	62.22	579.57	581.67		582.04	0.024204	4.90	12.70	10.79	0.80
TWI000A	3902	01JAN2012 2100	57.34	579.57	581.61		581.96	0.023907	4.77	12.02	10.56	0.79
TWI000A	3902	01JAN2012 2200	53.37	579.57	581.55		581.89	0.023870	4.67	11.43	10.35	0.78

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	3902	01JAN2012 2300	50.05	579.57	581.49		581.82	0.024518	4.63	10.81	10.13	0.79
TWI000A	3902	01JAN2012 2400	47.28	579.57	581.44		581.77	0.024966	4.59	10.30	9.93	0.79
TWI000A	3556	Max WS	3333.62	574.86	585.68		587.21	0.011314	10.51	418.98	113.63	0.72
TWI000A	3556	31DEC2011 2400	13.70	574.86	576.60		576.61	0.000530	0.78	17.67	13.91	0.12
TWI000A	3556	01JAN2012 0100	32.23	574.86	576.94		576.97	0.001424	1.42	22.67	14.93	0.20
TWI000A	3556	01JAN2012 0200	35.61	574.86	576.99		577.02	0.001601	1.53	23.32	15.06	0.22
TWI000A	3556	01JAN2012 0300	37.73	574.86	577.02		577.06	0.001697	1.59	23.79	15.15	0.22
TWI000A	3556	01JAN2012 0400	40.33	574.86	577.06		577.11	0.001784	1.65	24.49	15.28	0.23
TWI000A	3556	01JAN2012 0500	43.48	574.86	577.12		577.17	0.001867	1.71	25.41	15.46	0.24
TWI000A	3556	01JAN2012 0600	47.52	574.86	577.19		577.24	0.001978	1.79	26.50	15.66	0.24
TWI000A	3556	01JAN2012 0700	65.88	574.86	577.44		577.51	0.002556	2.16	30.46	16.39	0.28
TWI000A	3556	01JAN2012 0800	77.84	574.86	577.58		577.67	0.002883	2.37	32.82	16.77	0.30
TWI000A	3556	01JAN2012 0900	96.44	574.86	577.79		577.90	0.003330	2.66	36.26	17.30	0.32
TWI000A	3556	01JAN2012 1000	133.45	574.86	578.16		578.31	0.003935	3.10	43.01	18.29	0.36
TWI000A	3556	01JAN2012 1100	188.28	574.86	578.63		578.83	0.004651	3.63	51.80	19.52	0.39
TWI000A	3556	01JAN2012 1200	759.30	574.86	581.47		582.11	0.008021	6.41	118.45	27.87	0.55
TWI000A	3556	01JAN2012 1300	628.65	574.86	581.06		581.59	0.007129	5.86	107.25	26.44	0.51
TWI000A	3556	01JAN2012 1400	231.78	574.86	578.98		579.22	0.004975	3.95	58.73	20.46	0.41
TWI000A	3556	01JAN2012 1500	172.43	574.86	578.51		578.70	0.004416	3.48	49.55	19.21	0.38
TWI000A	3556	01JAN2012 1600	132.97	574.86	578.17		578.32	0.003886	3.09	43.10	18.31	0.35
TWI000A	3556	01JAN2012 1700	112.01	574.86	577.97		578.09	0.003534	2.84	39.47	17.78	0.34
TWI000A	3556	01JAN2012 1800	98.45	574.86	577.82		577.93	0.003322	2.67	36.83	17.38	0.32
TWI000A	3556	01JAN2012 1900	70.55	574.86	577.51		577.58	0.002657	2.24	31.53	16.56	0.29
TWI000A	3556	01JAN2012 2000	63.68	574.86	577.42		577.49	0.002450	2.11	30.19	16.34	0.27
TWI000A	3556	01JAN2012 2100	58.66	574.86	577.36		577.42	0.002300	2.01	29.13	16.15	0.26
TWI000A	3556	01JAN2012 2200	54.57	574.86	577.30		577.36	0.002182	1.93	28.21	15.98	0.26
TWI000A	3556	01JAN2012 2300	51.16	574.86	577.25		577.31	0.002074	1.86	27.44	15.84	0.25
TWI000A	3556	01JAN2012 2400	48.31	574.86	577.21		577.26	0.001976	1.80	26.81	15.72	0.24
TWI000A	3490	Max WS	3347.91	574.69	584.86		586.47	0.010429	10.43	378.99	100.66	0.71
TWI000A	3490	31DEC2011 2400	13.94	574.69	576.55		576.56	0.000793	0.84	16.64	16.13	0.15
TWI000A	3490	01JAN2012 0100	32.25	574.69	576.82		576.86	0.002161	1.52	21.21	17.83	0.25
TWI000A	3490	01JAN2012 0200	35.69	574.69	576.85		576.89	0.002485	1.64	21.70	18.00	0.26
TWI000A	3490	01JAN2012 0300	37.82	574.69	576.87		576.92	0.002652	1.71	22.11	18.14	0.27
TWI000A	3490	01JAN2012 0400	40.42	574.69	576.91		576.96	0.002773	1.77	22.83	18.39	0.28
TWI000A	3490	01JAN2012 0500	43.58	574.69	576.97		577.02	0.002866	1.83	23.82	18.73	0.29
TWI000A	3490	01JAN2012 0600	47.64	574.69	577.03		577.08	0.003006	1.91	24.98	19.11	0.29
TWI000A	3490	01JAN2012 0700	66.03	574.69	577.22		577.30	0.003914	2.29	28.79	20.33	0.34
TWI000A	3490	01JAN2012 0800	78.04	574.69	577.34		577.44	0.004325	2.49	31.30	21.01	0.36
TWI000A	3490	01JAN2012 0900	96.70	574.69	577.51		577.63	0.004864	2.77	34.91	21.81	0.39
TWI000A	3490	01JAN2012 1000	133.84	574.69	577.87		578.02	0.005170	3.11	42.97	23.49	0.41
TWI000A	3490	01JAN2012 1100	188.94	574.69	578.31		578.50	0.005447	3.50	53.93	25.60	0.43
TWI000A	3490	01JAN2012 1200	758.36	574.69	581.23		581.65	0.005405	5.19	146.12	37.43	0.46
TWI000A	3490	01JAN2012 1300	634.86	574.69	580.82		581.18	0.005108	4.84	131.07	35.77	0.45
TWI000A	3490	01JAN2012 1400	233.13	574.69	578.67		578.88	0.005283	3.68	63.32	27.19	0.43
TWI000A	3490	01JAN2012 1500	173.45	574.69	578.20		578.38	0.005350	3.40	51.06	25.07	0.42
TWI000A	3490	01JAN2012 1600	133.72	574.69	577.88		578.02	0.005087	3.10	43.19	23.54	0.40
TWI000A	3490	01JAN2012 1700	112.62	574.69	577.68		577.81	0.004899	2.91	38.76	22.63	0.39
TWI000A	3490	01JAN2012 1800	98.96	574.69	577.55		577.66	0.004788	2.77	35.68	21.98	0.38
TWI000A	3490	01JAN2012 1900	70.91	574.69	577.28		577.37	0.004020	2.36	30.03	20.71	0.35
TWI000A	3490	01JAN2012 2000	63.99	574.69	577.21		577.29	0.003725	2.23	28.65	20.29	0.33
TWI000A	3490	01JAN2012 2100	58.94	574.69	577.16		577.23	0.003504	2.14	27.58	19.95	0.32
TWI000A	3490	01JAN2012 2200	54.83	574.69	577.11		577.18	0.003321	2.05	26.68	19.67	0.31
TWI000A	3490	01JAN2012 2300	51.40	574.69	577.08		577.14	0.003148	1.98	25.96	19.44	0.30
TWI000A	3490	01JAN2012 2400	48.52	574.69	577.05		577.10	0.002988	1.91	25.37	19.24	0.29
TWI000A	3161	Max WS	3415.00	572.39	582.35		583.48	0.007306	9.52	531.85	153.01	0.65
TWI000A	3161	31DEC2011 2400	14.88	572.39	573.31		573.44	0.023169	2.88	5.17	11.71	0.76
TWI000A	3161	01JAN2012 0100	32.19	572.39	573.64		573.82	0.019021	3.47	9.29	13.63	0.74
TWI000A	3161	01JAN2012 0200	36.05	572.39	573.71		573.90	0.017894	3.52	10.24	14.03	0.73
TWI000A	3161	01JAN2012 0300	38.20	572.39	573.74		573.94	0.017262	3.54	10.79	14.25	0.72
TWI000A	3161	01JAN2012 0400	40.82	572.39	573.79		573.99	0.016666	3.57	11.43	14.50	0.71
TWI000A	3161	01JAN2012 0500	44.01	572.39	573.84		574.04	0.016002	3.61	12.21	14.81	0.70
TWI000A	3161	01JAN2012 0600	48.14	572.39	573.90		574.11	0.015479	3.66	13.14	15.16	0.69
TWI000A	3161	01JAN2012 0700	66.68	572.39	574.12		574.37	0.015143	4.02	16.58	16.33	0.70
TWI000A	3161	01JAN2012 0800	78.88	572.39	574.27		574.54	0.014140	4.15	19.00	16.87	0.69
TWI000A	3161	01JAN2012 0900	97.83	572.39	574.48		574.77	0.013023	4.33	22.60	17.65	0.67
TWI000A	3161	01JAN2012 1000	135.49	572.39	574.80		575.15	0.012600	4.74	28.58	18.87	0.68
TWI000A	3161	01JAN2012 1100	191.79	572.39	575.22		575.64	0.012310	5.23	36.69	20.44	0.69
TWI000A	3161	01JAN2012 1200	751.44	572.39	577.51		578.50	0.014065	8.02	93.73	29.75	0.80
TWI000A	3161	01JAN2012 1300	663.28	572.39	577.24		578.16	0.013730	7.71	86.02	28.45	0.78
TWI000A	3161	01JAN2012 1400	239.02	572.39	575.50		575.99	0.012549	5.62	42.55	21.50	0.70
TWI000A	3161	01JAN2012 1500	177.93	572.39	575.12		575.53	0.012310	5.11	34.81	20.09	0.68
TWI000A	3161	01JAN2012 1600	137.04	572.39	574.81		575.17	0.012627	4.76	28.78	18.91	0.68
TWI000A	3161	01JAN2012 1700	115.30	572.39	574.63		574.95	0.013038	4.56	25.28	18.21	0.68
TWI000A	3161	01JAN2012 1800	101.24	572.39	574.50		574.80	0.013141	4.39	23.06	17.75	0.68
TWI000A	3161	01JAN2012 1900	72.53	572.39	574.19		574.45	0.014844	4.11	17.66	16.57	0.70
TWI000A	3161	01JAN2012 2000	65.36	572.39	574.10		574.35	0.015430	4.02	16.26	16.25	0.71
TWI000A	3161	01JAN2012 2100	60.16	572.39	574.04		574.28	0.015692	3.94	15.27	15.95	0.71
TWI000A	3161	01JAN2012 2200	55.95	572.39	573.99		574.22	0.015763	3.86	14.50	15.67	0.71
TWI000A	3161	01JAN2012 2300	52.43	572.39	573.95		574.17	0.015736	3.78	13.86	15.43	0.70
TWI000A	3161	01JAN2012 2400	49.48	572.39	573.92		574.13	0.015647	3.71	13.34	15.24	0.70

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	3010	Max WS	3394.40	570.55	581.16	581.11	582.41	0.007648	9.50	487.75	240.05	0.66
TWI000A	3010	31DEC2011 2400	15.15	570.55	571.68		571.73	0.004371	1.68	9.00	13.03	0.36
TWI000A	3010	01JAN2012 0100	31.97	570.55	571.97		572.06	0.006828	2.46	13.00	14.83	0.46
TWI000A	3010	01JAN2012 0200	36.03	570.55	572.02		572.12	0.007473	2.63	13.71	15.12	0.49
TWI000A	3010	01JAN2012 0300	38.18	570.55	572.04		572.16	0.007771	2.71	14.08	15.28	0.50
TWI000A	3010	01JAN2012 0400	40.79	570.55	572.07		572.19	0.008174	2.81	14.50	15.45	0.51
TWI000A	3010	01JAN2012 0500	43.98	570.55	572.10		572.23	0.008659	2.93	14.99	15.64	0.53
TWI000A	3010	01JAN2012 0600	48.10	570.55	572.14		572.29	0.009226	3.08	15.62	15.89	0.55
TWI000A	3010	01JAN2012 0700	66.60	570.55	572.31		572.51	0.011118	3.61	18.44	16.96	0.61
TWI000A	3010	01JAN2012 0800	78.77	570.55	572.43		572.66	0.011704	3.86	20.42	17.67	0.63
TWI000A	3010	01JAN2012 0900	97.67	570.55	572.58		572.85	0.012727	4.22	23.14	18.60	0.67
TWI000A	3010	01JAN2012 1000	135.21	570.55	572.83		573.19	0.014223	4.81	28.14	20.19	0.72
TWI000A	3010	01JAN2012 1100	191.52	570.55	573.17		573.63	0.014798	5.43	35.26	21.57	0.75
TWI000A	3010	01JAN2012 1200	739.56	570.55	575.57		576.51	0.012241	7.76	95.34	28.45	0.75
TWI000A	3010	01JAN2012 1300	669.42	570.55	575.39		576.25	0.011733	7.42	90.21	27.94	0.73
TWI000A	3010	01JAN2012 1400	239.29	570.55	573.45		573.97	0.014520	5.80	41.23	22.39	0.75
TWI000A	3010	01JAN2012 1500	178.18	570.55	573.11		573.54	0.014476	5.27	33.83	21.35	0.74
TWI000A	3010	01JAN2012 1600	137.21	570.55	572.85		573.21	0.014080	4.81	28.54	20.32	0.71
TWI000A	3010	01JAN2012 1700	115.41	570.55	572.71		573.02	0.013451	4.51	25.59	19.40	0.69
TWI000A	3010	01JAN2012 1800	101.32	570.55	572.61		572.89	0.012753	4.27	23.74	18.80	0.67
TWI000A	3010	01JAN2012 1900	72.62	570.55	572.38		572.59	0.011104	3.70	19.63	17.39	0.61
TWI000A	3010	01JAN2012 2000	65.40	570.55	572.31		572.51	0.010664	3.54	18.47	16.97	0.60
TWI000A	3010	01JAN2012 2100	60.19	570.55	572.27		572.45	0.010259	3.41	17.65	16.67	0.58
TWI000A	3010	01JAN2012 2200	55.98	570.55	572.23		572.39	0.009875	3.30	16.99	16.42	0.57
TWI000A	3010	01JAN2012 2300	52.45	570.55	572.19		572.35	0.009510	3.19	16.43	16.21	0.56
TWI000A	3010	01JAN2012 2400	49.50	570.55	572.16		572.31	0.009175	3.10	15.97	16.03	0.55
TWI000A	2970	Max WS	3887.54	571.22	580.97		581.86	0.001601	7.71	663.51	220.61	0.47
TWI000A	2970	31DEC2011 2400	15.26	571.22	571.57		571.60	0.004628	1.43	10.68	38.52	0.48
TWI000A	2970	01JAN2012 0100	35.87	571.22	571.79		571.84	0.003850	1.89	18.99	39.10	0.48
TWI000A	2970	01JAN2012 0200	40.46	571.22	571.83		571.89	0.003649	1.95	20.78	39.23	0.47
TWI000A	2970	01JAN2012 0300	42.98	571.22	571.85		571.91	0.003642	1.99	21.57	39.28	0.47
TWI000A	2970	01JAN2012 0400	46.03	571.22	571.87		571.94	0.003659	2.05	22.47	39.34	0.48
TWI000A	2970	01JAN2012 0500	49.78	571.22	571.90		571.97	0.003660	2.11	23.57	39.42	0.48
TWI000A	2970	01JAN2012 0600	54.61	571.22	571.94		572.01	0.003640	2.19	24.99	39.52	0.48
TWI000A	2970	01JAN2012 0700	76.15	571.22	572.10		572.19	0.003381	2.43	31.35	39.96	0.48
TWI000A	2970	01JAN2012 0800	90.93	571.22	572.21		572.31	0.003146	2.54	35.77	40.26	0.48
TWI000A	2970	01JAN2012 0900	113.68	571.22	572.36		572.47	0.002983	2.72	41.76	40.66	0.47
TWI000A	2970	01JAN2012 1000	158.62	571.22	572.63		572.77	0.002723	3.00	52.87	41.40	0.47
TWI000A	2970	01JAN2012 1100	225.59	571.22	572.99		573.16	0.002448	3.31	68.22	42.41	0.46
TWI000A	2970	01JAN2012 1200	886.34	571.22	575.61		575.95	0.001637	4.70	188.39	49.56	0.43
TWI000A	2970	01JAN2012 1300	821.10	571.22	575.38		575.71	0.001688	4.63	177.25	48.94	0.43
TWI000A	2970	01JAN2012 1400	285.05	571.22	573.29		573.48	0.002286	3.53	80.86	43.21	0.45
TWI000A	2970	01JAN2012 1500	211.10	571.22	572.91		573.08	0.002511	3.25	64.90	42.19	0.46
TWI000A	2970	01JAN2012 1600	161.93	571.22	572.65		572.79	0.002700	3.02	53.70	41.46	0.47
TWI000A	2970	01JAN2012 1700	135.96	571.22	572.49		572.62	0.002870	2.88	47.24	41.03	0.47
TWI000A	2970	01JAN2012 1800	119.08	571.22	572.39		572.51	0.002960	2.76	43.08	40.75	0.47
TWI000A	2970	01JAN2012 1900	84.83	571.22	572.16		572.26	0.003244	2.50	33.94	40.13	0.48
TWI000A	2970	01JAN2012 2000	76.18	571.22	572.10		572.19	0.003379	2.43	31.37	39.96	0.48
TWI000A	2970	01JAN2012 2100	69.95	571.22	572.05		572.14	0.003472	2.37	29.52	39.83	0.49
TWI000A	2970	01JAN2012 2200	64.92	571.22	572.01		572.10	0.003540	2.32	28.02	39.73	0.49
TWI000A	2970	01JAN2012 2300	60.71	571.22	571.98		572.06	0.003588	2.27	26.78	39.64	0.49
TWI000A	2970	01JAN2012 2400	57.19	571.22	571.96		572.03	0.003619	2.22	25.75	39.57	0.49
TWI000A	2820 Bowen Rd		Culvert									
TWI000A	2668	Max WS	3942.57	566.85	578.08		578.64	0.005953	7.71	859.35	224.81	0.48
TWI000A	2668	31DEC2011 2400	15.26	566.85	569.35		569.35	0.000251	0.60	25.50	13.81	0.08
TWI000A	2668	01JAN2012 0100	35.87	566.85	569.91		569.93	0.000635	1.07	33.63	15.08	0.13
TWI000A	2668	01JAN2012 0200	40.46	566.85	569.99		570.02	0.000725	1.16	34.94	15.27	0.13
TWI000A	2668	01JAN2012 0300	42.98	566.85	570.04		570.07	0.000771	1.20	35.68	15.38	0.14
TWI000A	2668	01JAN2012 0400	46.03	566.85	570.10		570.13	0.000825	1.26	36.59	15.51	0.14
TWI000A	2668	01JAN2012 0500	49.78	566.85	570.17		570.20	0.000887	1.32	37.71	15.69	0.15
TWI000A	2668	01JAN2012 0600	54.61	566.85	570.27		570.30	0.000982	1.39	39.19	16.26	0.16
TWI000A	2668	01JAN2012 0700	76.15	566.85	570.59		570.64	0.001412	1.70	44.87	18.29	0.19
TWI000A	2668	01JAN2012 0800	90.93	566.85	570.81		570.86	0.001651	1.86	48.88	19.60	0.21
TWI000A	2668	01JAN2012 0900	113.68	566.85	571.07		571.14	0.002012	2.09	54.33	21.24	0.23
TWI000A	2668	01JAN2012 1000	158.62	566.85	571.54		571.64	0.002390	2.46	64.57	22.42	0.26
TWI000A	2668	01JAN2012 1100	225.59	566.85	572.13		572.26	0.002857	2.89	78.14	24.24	0.28
TWI000A	2668	01JAN2012 1200	886.34	566.85	574.55		574.96	0.006410	5.42	214.36	120.52	0.45
TWI000A	2668	01JAN2012 1300	821.10	566.85	574.49		574.86	0.005853	5.13	207.27	116.72	0.43
TWI000A	2668	01JAN2012 1400	285.05	566.85	572.54		572.70	0.003314	3.22	88.54	26.12	0.31
TWI000A	2668	01JAN2012 1500	211.10	566.85	572.03		572.15	0.002713	2.79	75.69	23.77	0.28
TWI000A	2668	01JAN2012 1600	161.93	566.85	571.58		571.68	0.002395	2.47	65.46	22.52	0.26
TWI000A	2668	01JAN2012 1700	135.96	566.85	571.33		571.41	0.002175	2.27	59.92	21.91	0.24
TWI000A	2668	01JAN2012 1800	119.08	566.85	571.14		571.21	0.002043	2.13	55.83	21.44	0.23
TWI000A	2668	01JAN2012 1900	84.83	566.85	570.72		570.77	0.001555	1.80	47.25	19.08	0.20
TWI000A	2668	01JAN2012 2000	76.18	566.85	570.60		570.64	0.001411	1.70	44.90	18.30	0.19
TWI000A	2668	01JAN2012 2100	69.95	566.85	570.51		570.55	0.001294	1.62	43.26	17.74	0.18
TWI000A	2668	01JAN2012 2200	64.92	566.85	570.43		570.47	0.001193	1.55	41.97	17.28	0.17
TWI000A	2668	01JAN2012 2300	60.71	566.85	570.37		570.40	0.001104	1.48	40.92	16.90	0.17
TWI000A	2668	01JAN2012 2400	57.19	566.85	570.32		570.35	0.001027	1.43	40.06	16.58	0.16
TWI000A	2599	Max WS	3936.53	567.91	577.31		578.21	0.008932	8.90	671.64	189.45	0.61

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	2599	31DEC2011 2400	15.54	567.91	569.03		569.09	0.008675	1.94	7.99	11.49	0.41
TWI000A	2599	01JAN2012 0100	35.69	567.91	569.48		569.58	0.010215	2.59	13.80	14.55	0.47
TWI000A	2599	01JAN2012 0200	40.44	567.91	569.59		569.69	0.009638	2.62	15.43	15.27	0.46
TWI000A	2599	01JAN2012 0300	42.96	567.91	569.63		569.74	0.009626	2.66	16.14	15.57	0.46
TWI000A	2599	01JAN2012 0400	46.01	567.91	569.69		569.80	0.009511	2.70	17.04	15.95	0.46
TWI000A	2599	01JAN2012 0500	49.75	567.91	569.76		569.87	0.009308	2.74	18.19	16.41	0.46
TWI000A	2599	01JAN2012 0600	54.57	567.91	569.85		569.97	0.008987	2.77	19.71	17.01	0.45
TWI000A	2599	01JAN2012 0700	76.09	567.91	570.19		570.32	0.008342	2.95	25.83	19.16	0.45
TWI000A	2599	01JAN2012 0800	90.83	567.91	570.39		570.54	0.007956	3.04	29.87	20.36	0.44
TWI000A	2599	01JAN2012 0900	113.54	567.91	570.66		570.82	0.007661	3.19	35.61	21.96	0.44
TWI000A	2599	01JAN2012 1000	158.37	567.91	571.13		571.31	0.007190	3.40	46.61	24.85	0.44
TWI000A	2599	01JAN2012 1100	225.34	567.91	571.73		571.93	0.006646	3.60	62.67	28.93	0.43
TWI000A	2599	01JAN2012 1200	872.56	567.91	574.02		574.46	0.008301	5.46	186.19	98.85	0.52
TWI000A	2599	01JAN2012 1300	828.95	567.91	573.99		574.40	0.007722	5.24	183.51	97.45	0.50
TWI000A	2599	01JAN2012 1400	285.32	567.91	572.13		572.35	0.006927	3.81	74.82	32.67	0.44
TWI000A	2599	01JAN2012 1500	211.35	567.91	571.64		571.83	0.006565	3.52	59.99	28.29	0.43
TWI000A	2599	01JAN2012 1600	162.08	567.91	571.18		571.36	0.007058	3.39	47.76	25.17	0.43
TWI000A	2599	01JAN2012 1700	136.05	567.91	570.93		571.09	0.007193	3.27	41.59	23.51	0.43
TWI000A	2599	01JAN2012 1800	119.15	567.91	570.74		570.90	0.007394	3.19	37.37	22.43	0.44
TWI000A	2599	01JAN2012 1900	84.90	567.91	570.31		570.45	0.008090	3.00	28.27	19.90	0.44
TWI000A	2599	01JAN2012 2000	76.22	567.91	570.19		570.33	0.008323	2.95	25.88	19.18	0.45
TWI000A	2599	01JAN2012 2100	69.98	567.91	570.10		570.23	0.008445	2.89	24.20	18.64	0.45
TWI000A	2599	01JAN2012 2200	64.95	567.91	570.03		570.15	0.008510	2.84	22.84	18.17	0.45
TWI000A	2599	01JAN2012 2300	60.73	567.91	569.96		570.08	0.008593	2.80	21.67	17.74	0.45
TWI000A	2599	01JAN2012 2400	57.21	567.91	569.91		570.03	0.008629	2.76	20.71	17.39	0.45
TWI000A	2389	Max WS	3939.07	565.02	576.00		576.55	0.005881	7.67	758.73	172.22	0.47
TWI000A	2389	31DEC2011 2400	17.84	565.02	568.22		568.23	0.000178	0.55	32.57	14.73	0.06
TWI000A	2389	01JAN2012 0100	34.96	565.02	568.46		568.47	0.000515	0.97	36.07	15.37	0.11
TWI000A	2389	01JAN2012 0200	40.57	565.02	568.64		568.66	0.000565	1.04	39.04	16.09	0.12
TWI000A	2389	01JAN2012 0300	43.08	565.02	568.69		568.71	0.000607	1.08	39.78	16.27	0.12
TWI000A	2389	01JAN2012 0400	46.14	565.02	568.75		568.77	0.000652	1.13	40.81	16.50	0.13
TWI000A	2389	01JAN2012 0500	49.88	565.02	568.83		568.85	0.000703	1.19	42.08	16.79	0.13
TWI000A	2389	01JAN2012 0600	54.70	565.02	568.93		568.95	0.000766	1.25	43.72	17.16	0.14
TWI000A	2389	01JAN2012 0700	76.33	565.02	569.33		569.36	0.001000	1.50	50.94	18.70	0.16
TWI000A	2389	01JAN2012 0800	91.07	565.02	569.53		569.57	0.001180	1.66	54.74	19.45	0.17
TWI000A	2389	01JAN2012 0900	113.82	565.02	569.83		569.88	0.001403	1.87	60.73	20.59	0.19
TWI000A	2389	01JAN2012 1000	158.88	565.02	570.29		570.37	0.001827	2.24	70.79	22.38	0.22
TWI000A	2389	01JAN2012 1100	226.54	565.02	570.88		570.99	0.002328	2.68	84.52	24.60	0.25
TWI000A	2389	01JAN2012 1200	854.74	565.02	572.59		572.97	0.005905	5.41	225.68	125.83	0.43
TWI000A	2389	01JAN2012 1300	858.45	565.02	572.74		573.07	0.005082	5.12	244.38	131.18	0.40
TWI000A	2389	01JAN2012 1400	288.88	565.02	571.17		571.32	0.002978	3.14	93.37	41.32	0.29
TWI000A	2389	01JAN2012 1500	214.00	565.02	570.81		570.91	0.002189	2.58	82.86	24.34	0.25
TWI000A	2389	01JAN2012 1600	163.96	565.02	570.35		570.43	0.001860	2.28	72.02	22.58	0.22
TWI000A	2389	01JAN2012 1700	137.55	565.02	570.10		570.16	0.001619	2.07	66.43	21.62	0.21
TWI000A	2389	01JAN2012 1800	120.39	565.02	569.92		569.98	0.001440	1.92	62.76	20.97	0.20
TWI000A	2389	01JAN2012 1900	85.85	565.02	569.45		569.49	0.001125	1.61	53.29	19.17	0.17
TWI000A	2389	01JAN2012 2000	76.97	565.02	569.33		569.37	0.001015	1.51	50.99	18.70	0.16
TWI000A	2389	01JAN2012 2100	70.65	565.02	569.24		569.27	0.000935	1.43	49.28	18.35	0.15
TWI000A	2389	01JAN2012 2200	65.57	565.02	569.16		569.18	0.000874	1.37	47.77	18.04	0.15
TWI000A	2389	01JAN2012 2300	61.31	565.02	569.07		569.10	0.000830	1.33	46.26	17.72	0.14
TWI000A	2389	01JAN2012 2400	57.74	565.02	569.00		569.02	0.000792	1.28	44.99	17.44	0.14
TWI000A	2202	Max WS	3928.78	565.73	575.10		575.57	0.004659	6.78	958.90	204.60	0.44
TWI000A	2202	31DEC2011 2400	21.93	565.73	568.19		568.19	0.000222	0.54	40.95	26.07	0.08
TWI000A	2202	01JAN2012 0100	33.65	565.73	568.38		568.39	0.000374	0.73	46.06	27.19	0.10
TWI000A	2202	01JAN2012 0200	40.67	565.73	568.56		568.57	0.000407	0.80	51.12	28.25	0.10
TWI000A	2202	01JAN2012 0300	43.17	565.73	568.60		568.61	0.000431	0.83	52.27	28.48	0.11
TWI000A	2202	01JAN2012 0400	46.24	565.73	568.66		568.67	0.000453	0.86	53.90	28.81	0.11
TWI000A	2202	01JAN2012 0500	49.97	565.73	568.73		568.74	0.000477	0.89	55.93	29.22	0.11
TWI000A	2202	01JAN2012 0600	54.79	565.73	568.82		568.83	0.000504	0.94	58.58	29.74	0.12
TWI000A	2202	01JAN2012 0700	76.57	565.73	569.20		569.21	0.000595	1.09	70.24	32.06	0.13
TWI000A	2202	01JAN2012 0800	91.21	565.73	569.37		569.40	0.000679	1.20	76.05	33.19	0.14
TWI000A	2202	01JAN2012 0900	113.96	565.73	569.65		569.68	0.000773	1.33	85.46	35.02	0.15
TWI000A	2202	01JAN2012 1000	159.19	565.73	570.07		570.11	0.000968	1.58	102.03	45.13	0.17
TWI000A	2202	01JAN2012 1100	227.20	565.73	570.61		570.66	0.001222	1.82	132.82	95.27	0.19
TWI000A	2202	01JAN2012 1200	838.65	565.73	571.89		572.07	0.003038	3.71	342.52	181.31	0.32
TWI000A	2202	01JAN2012 1300	892.44	565.73	572.15		572.30	0.002574	3.55	388.51	183.02	0.30
TWI000A	2202	01JAN2012 1400	293.45	565.73	570.83		570.90	0.001532	2.15	159.10	141.22	0.22
TWI000A	2202	01JAN2012 1500	216.95	565.73	570.55		570.60	0.001193	1.78	127.93	83.96	0.19
TWI000A	2202	01JAN2012 1600	165.75	565.73	570.12		570.16	0.001003	1.61	104.29	46.26	0.17
TWI000A	2202	01JAN2012 1700	138.99	565.73	569.89		569.93	0.000886	1.47	94.46	40.11	0.16
TWI000A	2202	01JAN2012 1800	121.56	565.73	569.74		569.77	0.000796	1.37	88.74	35.68	0.15
TWI000A	2202	01JAN2012 1900	86.78	565.73	569.30		569.33	0.000669	1.18	73.73	32.74	0.14
TWI000A	2202	01JAN2012 2000	77.66	565.73	569.20		569.21	0.000613	1.11	70.22	32.05	0.13
TWI000A	2202	01JAN2012 2100	71.28	565.73	569.11		569.13	0.000573	1.05	67.61	31.53	0.13
TWI000A	2202	01JAN2012 2200	66.17	565.73	569.04		569.05	0.000545	1.01	65.23	31.05	0.12
TWI000A	2202	01JAN2012 2300	61.86	565.73	568.96		568.97	0.000529	0.99	62.76	30.54	0.12
TWI000A	2202	01JAN2012 2400	58.23	565.73	568.89		568.90	0.000515	0.96	60.69	30.15	0.12
TWI000A	2201		Lat Struct									
TWI000A	2108	Max WS	3910.41	566.08	574.56		575.06	0.006241	7.31	1208.96	298.88	0.51
TWI000A	2108	31DEC2011 2400	24.60	566.08	568.15		568.16	0.000503	0.73	33.92	25.46	0.11

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	2108	01JAN2012 0100	32.78	566.08	568.33		568.34	0.000623	0.85	38.62	26.84	0.12
TWI000A	2108	01JAN2012 0200	40.73	566.08	568.51		568.52	0.000693	0.94	43.47	28.20	0.13
TWI000A	2108	01JAN2012 0300	43.22	566.08	568.54		568.56	0.000730	0.97	44.53	28.49	0.14
TWI000A	2108	01JAN2012 0400	46.28	566.08	568.60		568.61	0.000762	1.00	46.08	28.90	0.14
TWI000A	2108	01JAN2012 0500	50.01	566.08	568.66		568.68	0.000792	1.04	48.05	29.42	0.14
TWI000A	2108	01JAN2012 0600	54.82	566.08	568.75		568.77	0.000824	1.08	50.65	30.10	0.15
TWI000A	2108	01JAN2012 0700	76.70	566.08	569.12		569.14	0.000914	1.23	62.22	32.83	0.16
TWI000A	2108	01JAN2012 0800	91.25	566.08	569.29		569.32	0.001018	1.34	67.88	34.08	0.17
TWI000A	2108	01JAN2012 0900	113.94	566.08	569.55		569.59	0.001123	1.48	77.19	71.50	0.18
TWI000A	2108	01JAN2012 1000	158.91	566.08	569.96		570.00	0.001321	1.68	106.80	115.97	0.20
TWI000A	2108	01JAN2012 1100	226.79	566.08	570.49		570.54	0.001400	1.88	147.27	174.48	0.21
TWI000A	2108	01JAN2012 1200	833.29	566.08	571.56		571.74	0.003872	3.80	423.52	229.63	0.36
TWI000A	2108	01JAN2012 1300	914.58	566.08	571.87		572.03	0.003209	3.66	495.40	233.76	0.33
TWI000A	2108	01JAN2012 1400	296.92	566.08	570.67		570.74	0.002016	2.26	162.55	195.93	0.25
TWI000A	2108	01JAN2012 1500	219.35	566.08	570.43		570.48	0.001391	1.86	142.95	167.83	0.20
TWI000A	2108	01JAN2012 1600	166.95	566.08	570.01		570.05	0.001372	1.73	110.07	121.91	0.20
TWI000A	2108	01JAN2012 1700	139.92	566.08	569.79		569.83	0.001291	1.63	86.01	91.06	0.19
TWI000A	2108	01JAN2012 1800	122.28	566.08	569.65		569.68	0.001159	1.52	80.53	78.85	0.18
TWI000A	2108	01JAN2012 1900	87.28	566.08	569.22		569.25	0.001027	1.33	65.49	33.56	0.17
TWI000A	2108	01JAN2012 2000	78.04	566.08	569.12		569.14	0.000951	1.26	62.10	32.80	0.16
TWI000A	2108	01JAN2012 2100	71.60	566.08	569.04		569.06	0.000897	1.20	59.60	32.23	0.16
TWI000A	2108	01JAN2012 2200	66.49	566.08	568.97		568.99	0.000863	1.16	57.28	31.70	0.15
TWI000A	2108	01JAN2012 2300	62.14	566.08	568.89		568.91	0.000851	1.13	54.81	31.12	0.15
TWI000A	2108	01JAN2012 2400	58.50	566.08	568.82		568.84	0.000839	1.11	52.74	30.63	0.15
TWI000A	1959	Max WS	3883.78	565.50	573.97		574.22	0.003874	5.78	1464.31	347.20	0.43
TWI000A	1959	31DEC2011 2400	27.52	565.50	567.35		567.46	0.010342	2.57	10.73	13.07	0.50
TWI000A	1959	01JAN2012 0100	31.93	565.50	567.43		567.54	0.011145	2.73	11.69	13.73	0.52
TWI000A	1959	01JAN2012 0200	40.80	565.50	567.60		567.73	0.010963	2.87	14.21	15.33	0.53
TWI000A	1959	01JAN2012 0300	43.29	565.50	567.64		567.77	0.010919	2.91	14.90	15.74	0.53
TWI000A	1959	01JAN2012 0400	46.34	565.50	567.69		567.83	0.010996	2.96	15.65	16.18	0.53
TWI000A	1959	01JAN2012 0500	50.08	565.50	567.75		567.89	0.011094	3.03	16.55	16.88	0.54
TWI000A	1959	01JAN2012 0600	54.88	565.50	567.81		567.96	0.011155	3.10	17.71	19.84	0.54
TWI000A	1959	01JAN2012 0700	76.87	565.50	568.06		568.25	0.011899	3.44	22.32	28.85	0.57
TWI000A	1959	01JAN2012 0800	91.34	565.50	568.20		568.41	0.012315	3.63	25.13	33.43	0.58
TWI000A	1959	01JAN2012 0900	113.97	565.50	568.40		568.64	0.012541	3.86	29.53	38.53	0.60
TWI000A	1959	01JAN2012 1000	158.53	565.50	568.70		568.99	0.013663	4.32	36.68	46.89	0.63
TWI000A	1959	01JAN2012 1100	226.19	565.50	569.12		569.46	0.013787	4.70	48.13	68.21	0.65
TWI000A	1959	01JAN2012 1200	809.87	565.50	570.55		570.82	0.009771	4.94	339.50	311.10	0.58
TWI000A	1959	01JAN2012 1300	959.21	565.50	571.48		571.58	0.002714	3.28	633.62	321.13	0.33
TWI000A	1959	01JAN2012 1400	301.63	565.50	569.66		569.96	0.012385	4.33	70.23	126.84	0.62
TWI000A	1959	01JAN2012 1500	222.85	565.50	569.17		569.48	0.012352	4.49	49.65	71.86	0.62
TWI000A	1959	01JAN2012 1600	168.71	565.50	568.81		569.09	0.012689	4.26	39.61	51.34	0.62
TWI000A	1959	01JAN2012 1700	141.27	565.50	568.62		568.88	0.012524	4.07	34.75	44.34	0.61
TWI000A	1959	01JAN2012 1800	123.34	565.50	568.50		568.73	0.012120	3.88	31.76	41.05	0.59
TWI000A	1959	01JAN2012 1900	88.04	565.50	568.20		568.39	0.011430	3.50	25.14	33.44	0.56
TWI000A	1959	01JAN2012 2000	78.58	565.50	568.10		568.28	0.011456	3.41	23.03	30.08	0.56
TWI000A	1959	01JAN2012 2100	72.08	565.50	568.03		568.20	0.011208	3.32	21.74	27.83	0.55
TWI000A	1959	01JAN2012 2200	66.93	565.50	567.98		568.14	0.011054	3.24	20.66	25.90	0.54
TWI000A	1959	01JAN2012 2300	62.54	565.50	567.92		568.08	0.011086	3.19	19.60	24.03	0.54
TWI000A	1959	01JAN2012 2400	58.87	565.50	567.87		568.03	0.011071	3.14	18.73	22.36	0.54
TWI000A	1815	Max WS	3868.34	564.98	573.70		573.78	0.001340	3.99	2044.31	381.82	0.25
TWI000A	1815	31DEC2011 2400	29.40	564.98	566.69		566.71	0.000931	1.07	28.54	26.47	0.16
TWI000A	1815	01JAN2012 0100	31.35	564.98	566.67		566.69	0.001107	1.16	28.05	26.23	0.18
TWI000A	1815	01JAN2012 0200	40.74	564.98	566.85		566.88	0.001235	1.31	33.58	42.48	0.19
TWI000A	1815	01JAN2012 0300	43.25	564.98	566.91		566.93	0.001232	1.34	36.19	51.52	0.19
TWI000A	1815	01JAN2012 0400	46.30	564.98	566.95		566.98	0.001280	1.38	38.54	55.37	0.19
TWI000A	1815	01JAN2012 0500	49.92	564.98	567.00		567.03	0.001342	1.44	41.31	65.93	0.20
TWI000A	1815	01JAN2012 0600	54.68	564.98	567.05		567.09	0.001419	1.51	45.41	78.87	0.20
TWI000A	1815	01JAN2012 0700	76.55	564.98	567.21		567.26	0.001953	1.85	60.39	123.68	0.24
TWI000A	1815	01JAN2012 0800	90.87	564.98	567.33		567.38	0.002014	1.95	78.93	163.88	0.25
TWI000A	1815	01JAN2012 0900	113.11	564.98	567.50		567.55	0.001995	2.03	107.69	182.32	0.25
TWI000A	1815	01JAN2012 1000	157.00	564.98	567.75		567.80	0.001957	2.13	155.77	194.42	0.25
TWI000A	1815	01JAN2012 1100	224.04	564.98	568.12		568.16	0.001701	2.14	229.64	217.99	0.23
TWI000A	1815	01JAN2012 1200	737.01	564.98	569.91		569.94	0.000967	2.24	741.52	310.44	0.19
TWI000A	1815	01JAN2012 1300	1012.76	564.98	571.30		571.31	0.000456	1.85	1187.10	333.38	0.14
TWI000A	1815	01JAN2012 1400	307.18	564.98	568.77		568.79	0.000947	1.82	398.14	290.07	0.18
TWI000A	1815	01JAN2012 1500	225.15	564.98	568.26		568.30	0.001259	1.90	263.48	236.82	0.20
TWI000A	1815	01JAN2012 1600	170.00	564.98	567.95		567.99	0.001416	1.89	195.38	202.02	0.21
TWI000A	1815	01JAN2012 1700	142.03	564.98	567.76		567.80	0.001573	1.92	157.15	194.69	0.22
TWI000A	1815	01JAN2012 1800	123.82	564.98	567.63		567.67	0.001667	1.91	132.44	188.94	0.23
TWI000A	1815	01JAN2012 1900	88.70	564.98	567.41		567.45	0.001575	1.76	91.43	175.69	0.22
TWI000A	1815	01JAN2012 2000	78.82	564.98	567.29		567.33	0.001688	1.77	72.20	154.64	0.22
TWI000A	1815	01JAN2012 2100	72.25	564.98	567.23		567.27	0.001655	1.72	63.06	132.40	0.22
TWI000A	1815	01JAN2012 2200	67.06	564.98	567.18		567.22	0.001602	1.67	57.13	113.19	0.22
TWI000A	1815	01JAN2012 2300	62.66	564.98	567.14		567.18	0.001539	1.61	52.87	98.28	0.21
TWI000A	1815	01JAN2012 2400	58.96	564.98	567.10		567.14	0.001472	1.56	49.78	89.20	0.21
TWI000A	1704	Max WS	3923.64	565.00	573.60		573.66	0.000885	3.43	2453.17	412.00	0.22
TWI000A	1704	31DEC2011 2400	34.01	565.00	566.55		566.57	0.002511	1.35	40.91	101.91	0.25
TWI000A	1704	01JAN2012 0100	31.29	565.00	566.53		566.55	0.002297	1.29	38.81	98.78	0.24
TWI000A	1704	01JAN2012 0200	41.92	565.00	566.73		566.75	0.001882	1.22	65.58	188.67	0.22
TWI000A	1704	01JAN2012 0300	44.62	565.00	566.79		566.81	0.001534	1.15	77.50	208.80	0.20

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1704	01JAN2012 0400	47.79	565.00	566.84		566.85	0.001420	1.14	86.41	222.96	0.20
TWI000A	1704	01JAN2012 0500	51.55	565.00	566.88		566.89	0.001333	1.13	96.01	231.79	0.19
TWI000A	1704	01JAN2012 0600	56.62	565.00	566.93		566.94	0.001244	1.13	108.51	242.89	0.19
TWI000A	1704	01JAN2012 0700	79.28	565.00	567.08		567.09	0.001241	1.22	146.31	266.46	0.19
TWI000A	1704	01JAN2012 0800	94.50	565.00	567.21		567.22	0.001024	1.19	182.01	275.69	0.18
TWI000A	1704	01JAN2012 0900	117.70	565.00	567.37		567.38	0.000890	1.19	226.63	282.77	0.17
TWI000A	1704	01JAN2012 1000	163.35	565.00	567.64		567.65	0.000766	1.22	303.81	295.70	0.16
TWI000A	1704	01JAN2012 1100	233.70	565.00	568.02		568.03	0.000628	1.25	417.56	304.90	0.15
TWI000A	1704	01JAN2012 1200	821.80	565.00	569.84		569.85	0.000548	1.74	1019.70	349.50	0.15
TWI000A	1704	01JAN2012 1300	1075.02	565.00	571.26		571.28	0.000271	1.50	1536.37	374.51	0.11
TWI000A	1704	01JAN2012 1400	325.61	565.00	568.71		568.72	0.000355	1.13	637.86	327.71	0.12
TWI000A	1704	01JAN2012 1500	236.26	565.00	568.19		568.20	0.000449	1.11	471.64	309.54	0.13
TWI000A	1704	01JAN2012 1600	178.27	565.00	567.87		567.87	0.000509	1.08	372.37	300.98	0.13
TWI000A	1704	01JAN2012 1700	148.52	565.00	567.67		567.68	0.000581	1.08	313.13	296.36	0.14
TWI000A	1704	01JAN2012 1800	129.23	565.00	567.53		567.54	0.000643	1.08	273.18	290.23	0.14
TWI000A	1704	01JAN2012 1900	93.13	565.00	567.31		567.32	0.000681	1.01	210.22	280.23	0.14
TWI000A	1704	01JAN2012 2000	82.14	565.00	567.19		567.20	0.000837	1.06	176.50	274.55	0.16
TWI000A	1704	01JAN2012 2100	75.15	565.00	567.13		567.14	0.000911	1.07	158.96	270.09	0.16
TWI000A	1704	01JAN2012 2200	69.72	565.00	567.08		567.09	0.000971	1.08	145.61	266.26	0.17
TWI000A	1704	01JAN2012 2300	65.09	565.00	567.03		567.04	0.001018	1.08	134.61	260.56	0.17
TWI000A	1704	01JAN2012 2400	61.23	565.00	567.00		567.01	0.001056	1.08	125.60	252.31	0.17
TWI000A	1522	Max WS	3917.53	564.01	573.45		573.51	0.000714	3.07	2157.35	367.42	0.19
TWI000A	1522	31DEC2011 2400	43.43	564.01	566.33		566.34	0.000806	1.11	57.45	103.01	0.15
TWI000A	1522	01JAN2012 0100	28.43	564.01	566.36		566.36	0.000315	0.70	60.83	106.16	0.10
TWI000A	1522	01JAN2012 0200	41.18	564.01	566.60		566.61	0.000335	0.77	89.18	131.01	0.10
TWI000A	1522	01JAN2012 0300	44.28	564.01	566.67		566.67	0.000322	0.77	98.59	139.24	0.10
TWI000A	1522	01JAN2012 0400	47.50	564.01	566.71		566.71	0.000335	0.79	104.21	148.68	0.10
TWI000A	1522	01JAN2012 0500	51.24	564.01	566.74		566.75	0.000354	0.82	109.97	158.04	0.10
TWI000A	1522	01JAN2012 0600	56.16	564.01	566.79		566.80	0.000387	0.86	117.45	167.51	0.11
TWI000A	1522	01JAN2012 0700	77.50	564.01	566.94		566.95	0.000487	1.00	144.07	184.37	0.12
TWI000A	1522	01JAN2012 0800	92.79	564.01	567.09		567.10	0.000479	1.02	172.51	202.47	0.12
TWI000A	1522	01JAN2012 0900	115.42	564.01	567.25		567.26	0.000493	1.07	207.17	219.87	0.13
TWI000A	1522	01JAN2012 1000	158.96	564.01	567.53		567.54	0.000491	1.12	271.17	242.76	0.13
TWI000A	1522	01JAN2012 1100	228.60	564.01	567.92		567.93	0.000436	1.16	370.66	259.20	0.12
TWI000A	1522	01JAN2012 1200	703.92	564.01	569.76		569.77	0.000316	1.38	898.52	307.03	0.11
TWI000A	1522	01JAN2012 1300	1148.64	564.01	571.22		571.23	0.000243	1.45	1369.87	338.20	0.10
TWI000A	1522	01JAN2012 1400	338.39	564.01	568.66		568.66	0.000282	1.09	570.62	285.14	0.10
TWI000A	1522	01JAN2012 1500	241.43	564.01	568.12		568.13	0.000334	1.06	423.13	265.12	0.11
TWI000A	1522	01JAN2012 1600	182.00	564.01	567.79		567.80	0.000362	1.02	336.72	255.32	0.11
TWI000A	1522	01JAN2012 1700	150.73	564.01	567.58		567.59	0.000388	1.01	285.06	246.14	0.11
TWI000A	1522	01JAN2012 1800	130.60	564.01	567.44		567.45	0.000404	1.00	250.50	237.20	0.11
TWI000A	1522	01JAN2012 1900	95.82	564.01	567.22		567.23	0.000364	0.91	201.10	217.18	0.11
TWI000A	1522	01JAN2012 2000	83.10	564.01	567.09		567.10	0.000381	0.91	173.22	202.93	0.11
TWI000A	1522	01JAN2012 2100	75.81	564.01	567.02		567.03	0.000378	0.90	159.29	194.07	0.11
TWI000A	1522	01JAN2012 2200	70.23	564.01	566.97		566.98	0.000372	0.88	149.15	187.67	0.11
TWI000A	1522	01JAN2012 2300	65.51	564.01	566.92		566.93	0.000365	0.86	140.92	182.51	0.11
TWI000A	1522	01JAN2012 2400	61.58	564.01	566.89		566.89	0.000358	0.85	133.90	178.33	0.11
TWI000A	1354	Max WS	3947.86	563.89	573.30		573.39	0.000991	3.69	1830.60	382.98	0.23
TWI000A	1354	31DEC2011 2400	47.53	563.89	566.22		566.24	0.000655	1.07	66.92	107.53	0.14
TWI000A	1354	01JAN2012 0100	27.18	563.89	566.32		566.33	0.000162	0.55	78.27	113.36	0.07
TWI000A	1354	01JAN2012 0200	40.86	563.89	566.56		566.56	0.000237	0.61	106.76	132.08	0.08
TWI000A	1354	01JAN2012 0300	44.49	563.89	566.63		566.63	0.000244	0.60	116.56	139.24	0.09
TWI000A	1354	01JAN2012 0400	47.78	563.89	566.67		566.67	0.000258	0.62	121.91	142.44	0.09
TWI000A	1354	01JAN2012 0500	51.58	563.89	566.70		566.71	0.000269	0.64	126.98	143.25	0.09
TWI000A	1354	01JAN2012 0600	56.52	563.89	566.75		566.75	0.000283	0.67	133.15	144.22	0.09
TWI000A	1354	01JAN2012 0700	77.33	563.89	566.88		566.89	0.000362	0.80	152.84	147.45	0.11
TWI000A	1354	01JAN2012 0800	93.13	563.89	567.03		567.03	0.000362	0.84	174.61	151.60	0.11
TWI000A	1354	01JAN2012 0900	115.92	563.89	567.19		567.20	0.000386	0.92	199.42	156.18	0.11
TWI000A	1354	01JAN2012 1000	159.21	563.89	567.46		567.47	0.000421	1.04	242.44	169.58	0.12
TWI000A	1354	01JAN2012 1100	229.90	563.89	567.85		567.87	0.000443	1.18	312.74	180.34	0.13
TWI000A	1354	01JAN2012 1200	676.53	563.89	569.70		569.72	0.000410	1.61	684.54	225.66	0.13
TWI000A	1354	01JAN2012 1300	1216.66	563.89	571.16		571.19	0.000391	1.89	1071.08	321.05	0.14
TWI000A	1354	01JAN2012 1400	352.71	563.89	568.60		568.62	0.000355	1.25	452.73	194.83	0.12
TWI000A	1354	01JAN2012 1500	248.97	563.89	568.07		568.08	0.000369	1.14	351.46	183.76	0.12
TWI000A	1354	01JAN2012 1600	187.58	563.89	567.73		567.74	0.000362	1.04	291.41	178.43	0.11
TWI000A	1354	01JAN2012 1700	154.78	563.89	567.53		567.54	0.000365	0.99	254.65	175.09	0.11
TWI000A	1354	01JAN2012 1800	133.69	563.89	567.38		567.39	0.000341	0.92	230.70	161.42	0.11
TWI000A	1354	01JAN2012 1900	99.16	563.89	567.18		567.18	0.000290	0.79	197.68	155.87	0.10
TWI000A	1354	01JAN2012 2000	85.17	563.89	567.04		567.05	0.000292	0.76	177.00	152.04	0.10
TWI000A	1354	01JAN2012 2100	77.56	563.89	566.97		566.98	0.000287	0.73	166.46	150.06	0.10
TWI000A	1354	01JAN2012 2200	71.67	563.89	566.92		566.93	0.000279	0.71	158.84	148.61	0.09
TWI000A	1354	01JAN2012 2300	66.88	563.89	566.88		566.88	0.000272	0.69	152.58	147.40	0.09
TWI000A	1354	01JAN2012 2400	62.80	563.89	566.84		566.85	0.000265	0.67	147.15	146.40	0.09
TWI000A	1241	Max WS	3956.10	563.81	572.63		573.26	0.006068	8.84	874.51	324.46	0.55
TWI000A	1241	31DEC2011 2400	52.95	563.81	566.12		566.14	0.001042	1.35	39.21	21.92	0.18
TWI000A	1241	01JAN2012 0100	30.98	563.81	566.29		566.30	0.000269	0.72	43.16	22.47	0.09
TWI000A	1241	01JAN2012 0200	45.02	563.81	566.51		566.53	0.000420	0.93	48.21	23.59	0.12
TWI000A	1241	01JAN2012 0300	48.80	563.81	566.58		566.60	0.000450	0.98	49.89	23.95	0.12
TWI000A	1241	01JAN2012 0400	52.13	563.81	566.62		566.63	0.000490	1.03	50.72	24.13	0.12
TWI000A	1241	01JAN2012 0500	55.93	563.81	566.65		566.67	0.000542	1.09	51.47	24.29	0.13
TWI000A	1241	01JAN2012 0600	60.83	563.81	566.69		566.71	0.000612	1.16	52.37	24.48	0.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1241	01JAN2012 0700	81.30	563.81	566.79		566.83	0.000944	1.48	54.96	25.11	0.17
TWI000A	1241	01JAN2012 0800	97.21	563.81	566.92		566.96	0.001124	1.67	58.27	26.06	0.19
TWI000A	1241	01JAN2012 0900	119.88	563.81	567.06		567.12	0.001415	1.95	61.89	27.27	0.22
TWI000A	1241	01JAN2012 1000	162.75	563.81	567.28		567.37	0.001955	2.42	68.12	29.23	0.26
TWI000A	1241	01JAN2012 1100	233.22	563.81	567.61		567.75	0.002699	3.07	78.27	32.17	0.31
TWI000A	1241	01JAN2012 1200	738.71	563.81	569.08		569.63	0.006329	6.13	143.81	62.78	0.51
TWI000A	1241	01JAN2012 1300	1253.51	563.81	570.69		571.18	0.004521	6.35	294.14	205.79	0.45
TWI000A	1241	01JAN2012 1400	360.15	563.81	568.31		568.53	0.003054	3.76	103.64	42.78	0.34
TWI000A	1241	01JAN2012 1500	254.54	563.81	567.84		567.98	0.002496	3.10	85.82	34.32	0.30
TWI000A	1241	01JAN2012 1600	192.83	563.81	567.55		567.66	0.001965	2.59	76.54	31.68	0.26
TWI000A	1241	01JAN2012 1700	159.67	563.81	567.37		567.45	0.001673	2.29	70.93	30.07	0.24
TWI000A	1241	01JAN2012 1800	138.42	563.81	567.25		567.32	0.001465	2.08	67.31	28.98	0.22
TWI000A	1241	01JAN2012 1900	104.20	563.81	567.08		567.12	0.001036	1.68	62.52	27.47	0.19
TWI000A	1241	01JAN2012 2000	89.82	563.81	566.96		566.99	0.000913	1.52	59.19	26.37	0.17
TWI000A	1241	01JAN2012 2100	82.13	563.81	566.89		566.93	0.000834	1.43	57.57	25.82	0.17
TWI000A	1241	01JAN2012 2200	76.23	563.81	566.85		566.88	0.000766	1.35	56.42	25.48	0.16
TWI000A	1241	01JAN2012 2300	71.41	563.81	566.81		566.84	0.000708	1.29	55.47	25.24	0.15
TWI000A	1241	01JAN2012 2400	67.32	563.81	566.78		566.80	0.000658	1.23	54.66	25.03	0.15
TWI000A	1205	Max WS	3898.20	563.78	572.00	572.21	573.23	0.012260	11.79	656.99	310.23	0.76
TWI000A	1205	31DEC2011 2400	54.14	563.78	566.07		566.10	0.001217	1.45	37.36	20.63	0.19
TWI000A	1205	01JAN2012 0100	32.16	563.78	566.28		566.29	0.000308	0.77	41.76	21.14	0.10
TWI000A	1205	01JAN2012 0200	46.24	563.78	566.49		566.51	0.000469	1.00	46.33	21.71	0.12
TWI000A	1205	01JAN2012 0300	50.04	563.78	566.56		566.58	0.000500	1.05	47.84	21.90	0.12
TWI000A	1205	01JAN2012 0400	53.37	563.78	566.60		566.62	0.000545	1.10	48.55	21.99	0.13
TWI000A	1205	01JAN2012 0500	57.17	563.78	566.63		566.65	0.000602	1.16	49.19	22.07	0.14
TWI000A	1205	01JAN2012 0600	62.06	563.78	566.66		566.68	0.000679	1.24	49.94	22.16	0.15
TWI000A	1205	01JAN2012 0700	82.51	563.78	566.75		566.79	0.001068	1.59	51.93	22.52	0.18
TWI000A	1205	01JAN2012 0800	98.42	563.78	566.87		566.92	0.001297	1.80	54.69	23.38	0.20
TWI000A	1205	01JAN2012 0900	121.08	563.78	566.99		567.06	0.001684	2.11	57.56	24.68	0.23
TWI000A	1205	01JAN2012 1000	163.92	563.78	567.18		567.29	0.002416	2.65	62.80	30.48	0.28
TWI000A	1205	01JAN2012 1100	234.35	563.78	567.47		567.64	0.003456	3.39	72.87	39.12	0.34
TWI000A	1205	01JAN2012 1200	761.55	563.78	568.58		569.34	0.010567	7.32	122.34	49.80	0.64
TWI000A	1205	01JAN2012 1300	1260.78	563.78	570.41		571.06	0.006127	7.12	237.31	123.20	0.51
TWI000A	1205	01JAN2012 1400	361.73	563.78	568.18		568.42	0.003594	3.99	103.34	45.99	0.36
TWI000A	1205	01JAN2012 1500	255.89	563.78	567.72		567.89	0.003055	3.36	82.85	41.49	0.33
TWI000A	1205	01JAN2012 1600	194.15	563.78	567.46		567.58	0.002404	2.82	72.45	38.95	0.29
TWI000A	1205	01JAN2012 1700	160.95	563.78	567.29		567.39	0.002028	2.50	66.36	33.85	0.26
TWI000A	1205	01JAN2012 1800	139.69	563.78	567.18		567.26	0.001757	2.26	62.77	30.44	0.24
TWI000A	1205	01JAN2012 1900	105.49	563.78	567.03		567.08	0.001210	1.81	58.62	25.96	0.20
TWI000A	1205	01JAN2012 2000	91.08	563.78	566.91		566.96	0.001049	1.64	55.75	23.69	0.18
TWI000A	1205	01JAN2012 2100	83.38	563.78	566.86		566.89	0.000947	1.53	54.38	23.28	0.17
TWI000A	1205	01JAN2012 2200	77.48	563.78	566.81		566.85	0.000863	1.45	53.42	22.99	0.17
TWI000A	1205	01JAN2012 2300	72.66	563.78	566.78		566.81	0.000795	1.38	52.63	22.74	0.16
TWI000A	1205	01JAN2012 2400	68.57	563.78	566.75		566.78	0.000737	1.32	51.95	22.53	0.15
TWI000A	1115	Max WS	3884.53	564.00	571.83		571.86	0.000109	1.33	3243.89	521.43	0.09
TWI000A	1115	31DEC2011 2400	54.52	564.00	566.03		566.03	0.000015	0.20	278.77	359.76	0.03
TWI000A	1115	01JAN2012 0100	35.26	564.00	566.27		566.27	0.000004	0.11	316.13	378.04	0.01
TWI000A	1115	01JAN2012 0200	49.96	564.00	566.48		566.48	0.000006	0.14	348.70	381.53	0.02
TWI000A	1115	01JAN2012 0300	54.15	564.00	566.55		566.55	0.000007	0.15	359.45	382.68	0.02
TWI000A	1115	01JAN2012 0400	57.55	564.00	566.58		566.58	0.000007	0.16	364.41	383.21	0.02
TWI000A	1115	01JAN2012 0500	61.35	564.00	566.61		566.61	0.000008	0.17	368.66	383.66	0.02
TWI000A	1115	01JAN2012 0600	66.21	564.00	566.64		566.64	0.000009	0.18	373.63	384.19	0.02
TWI000A	1115	01JAN2012 0700	86.04	564.00	566.72		566.72	0.000014	0.22	385.95	385.49	0.02
TWI000A	1115	01JAN2012 0800	102.22	564.00	566.83		566.83	0.000017	0.25	404.04	387.41	0.03
TWI000A	1115	01JAN2012 0900	124.73	564.00	566.94		566.94	0.000021	0.30	421.69	389.27	0.03
TWI000A	1115	01JAN2012 1000	167.02	564.00	567.11		567.12	0.000031	0.38	449.34	392.55	0.04
TWI000A	1115	01JAN2012 1100	236.98	564.00	567.38		567.39	0.000047	0.49	493.71	401.70	0.05
TWI000A	1115	01JAN2012 1200	824.82	564.00	568.40		568.42	0.000222	1.27	679.25	439.08	0.11
TWI000A	1115	01JAN2012 1300	1296.82	564.00	570.27		570.28	0.000027	0.57	2455.25	478.00	0.04
TWI000A	1115	01JAN2012 1400	371.40	564.00	568.12		568.12	0.000057	0.62	625.08	432.17	0.06
TWI000A	1115	01JAN2012 1500	261.94	564.00	567.65		567.65	0.000044	0.50	538.81	411.99	0.05
TWI000A	1115	01JAN2012 1600	199.70	564.00	567.40		567.40	0.000033	0.41	496.16	402.19	0.04
TWI000A	1115	01JAN2012 1700	165.91	564.00	567.24		567.24	0.000027	0.36	469.42	396.73	0.04
TWI000A	1115	01JAN2012 1800	144.51	564.00	567.13		567.13	0.000023	0.32	452.06	393.12	0.03
TWI000A	1115	01JAN2012 1900	110.77	564.00	567.00		567.00	0.000016	0.26	430.63	390.14	0.03
TWI000A	1115	01JAN2012 2000	95.77	564.00	566.88		566.88	0.000014	0.23	412.49	388.30	0.03
TWI000A	1115	01JAN2012 2100	87.92	564.00	566.83		566.83	0.000012	0.22	403.59	387.36	0.02
TWI000A	1115	01JAN2012 2200	82.01	564.00	566.79		566.79	0.000011	0.21	397.38	386.70	0.02
TWI000A	1115	01JAN2012 2300	77.14	564.00	566.76		566.76	0.000010	0.20	392.21	386.16	0.02
TWI000A	1115	01JAN2012 2400	72.99	564.00	566.73		566.73	0.000010	0.19	387.72	385.68	0.02
TWI000A	1076.5		Lat Struct									
TWI000A	1038	Max WS	4334.44	564.00	571.83		571.85	0.000049	1.16	4085.73	636.63	0.07
TWI000A	1038	31DEC2011 2400	49.23	564.00	566.03		566.03	0.000002	0.09	528.91	464.71	0.01
TWI000A	1038	01JAN2012 0100	35.19	564.00	566.27		566.27	0.000001	0.06	592.92	470.72	0.01
TWI000A	1038	01JAN2012 0200	51.54	564.00	566.48		566.48	0.000001	0.08	648.51	478.46	0.01
TWI000A	1038	01JAN2012 0300	56.97	564.00	566.55		566.55	0.000001	0.09	666.87	480.95	0.01
TWI000A	1038	01JAN2012 0400	60.82	564.00	566.58		566.58	0.000001	0.09	675.35	482.10	0.01
TWI000A	1038	01JAN2012 0500	65.01	564.00	566.61		566.61	0.000001	0.10	682.64	483.09	0.01
TWI000A	1038	01JAN2012 0600	70.52	564.00	566.64		566.64	0.000002	0.10	691.14	484.24	0.01
TWI000A	1038	01JAN2012 0700	90.30	564.00	566.72		566.72	0.000002	0.13	712.18	485.71	0.01

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	1038	01JAN2012 0800	108.55	564.00	566.83		566.83	0.000003	0.15	743.15	487.48	0.02
TWI000A	1038	01JAN2012 0900	133.07	564.00	566.94		566.94	0.000004	0.17	773.41	489.21	0.02
TWI000A	1038	01JAN2012 1000	179.58	564.00	567.11		567.11	0.000006	0.22	820.79	491.89	0.02
TWI000A	1038	01JAN2012 1100	257.93	564.00	567.38		567.38	0.000009	0.29	895.49	496.09	0.03
TWI000A	1038	01JAN2012 1200	865.22	564.00	568.40		568.41	0.000043	0.75	1192.04	526.79	0.06
TWI000A	1038	01JAN2012 1300	1560.36	564.00	570.27		570.27	0.000014	0.53	3124.38	576.20	0.04
TWI000A	1038	01JAN2012 1400	449.10	564.00	568.11		568.12	0.000015	0.41	1106.84	519.08	0.04
TWI000A	1038	01JAN2012 1500	306.39	564.00	567.65		567.65	0.000010	0.32	969.33	502.77	0.03
TWI000A	1038	01JAN2012 1600	232.13	564.00	567.40		567.40	0.000007	0.26	899.51	496.31	0.02
TWI000A	1038	01JAN2012 1700	191.66	564.00	567.24		567.24	0.000006	0.23	854.80	493.81	0.02
TWI000A	1038	01JAN2012 1800	166.13	564.00	567.13		567.13	0.000005	0.20	825.37	492.15	0.02
TWI000A	1038	01JAN2012 1900	128.35	564.00	567.00		567.00	0.000003	0.16	788.71	490.08	0.02
TWI000A	1038	01JAN2012 2000	109.39	564.00	566.88		566.88	0.000003	0.14	757.61	488.31	0.02
TWI000A	1038	01JAN2012 2100	99.80	564.00	566.83		566.83	0.000003	0.13	742.37	487.44	0.01
TWI000A	1038	01JAN2012 2200	92.77	564.00	566.79		566.79	0.000002	0.13	731.76	486.83	0.01
TWI000A	1038	01JAN2012 2300	87.01	564.00	566.75		566.76	0.000002	0.12	722.91	486.32	0.01
TWI000A	1038	01JAN2012 2400	82.12	564.00	566.73		566.73	0.000002	0.12	715.22	485.88	0.01
TWI000A	1011	Max WS	4334.02	564.00	571.83		571.85	0.000052	1.17	4072.91	643.67	0.08
TWI000A	1011	31DEC2011 2400	46.47	564.00	566.03		566.03	0.000003	0.10	443.56	466.30	0.01
TWI000A	1011	01JAN2012 0100	34.34	564.00	566.27		566.27	0.000001	0.07	513.60	483.87	0.01
TWI000A	1011	01JAN2012 0200	51.13	564.00	566.48		566.48	0.000002	0.09	575.67	490.26	0.01
TWI000A	1011	01JAN2012 0300	56.82	564.00	566.55		566.55	0.000002	0.10	596.20	492.36	0.01
TWI000A	1011	01JAN2012 0400	60.72	564.00	566.58		566.58	0.000002	0.10	605.69	493.32	0.01
TWI000A	1011	01JAN2012 0500	64.92	564.00	566.61		566.61	0.000002	0.11	613.84	494.15	0.01
TWI000A	1011	01JAN2012 0600	70.39	564.00	566.64		566.64	0.000003	0.11	623.37	495.12	0.01
TWI000A	1011	01JAN2012 0700	89.73	564.00	566.72		566.72	0.000004	0.14	646.97	497.50	0.02
TWI000A	1011	01JAN2012 0800	108.18	564.00	566.83		566.83	0.000005	0.16	681.81	500.96	0.02
TWI000A	1011	01JAN2012 0900	132.59	564.00	566.94		566.94	0.000006	0.19	715.86	503.95	0.02
TWI000A	1011	01JAN2012 1000	178.75	564.00	567.11		567.11	0.000009	0.24	769.35	509.72	0.03
TWI000A	1011	01JAN2012 1100	256.80	564.00	567.38		567.38	0.000013	0.31	853.75	522.48	0.03
TWI000A	1011	01JAN2012 1200	849.55	564.00	568.40		568.40	0.000050	0.75	1181.81	550.48	0.07
TWI000A	1011	01JAN2012 1300	1576.20	564.00	570.27		570.27	0.000015	0.55	3106.52	600.02	0.04
TWI000A	1011	01JAN2012 1400	452.47	564.00	568.11		568.12	0.000018	0.43	1089.26	544.46	0.04
TWI000A	1011	01JAN2012 1500	307.49	564.00	567.64		567.65	0.000014	0.34	937.37	533.56	0.03
TWI000A	1011	01JAN2012 1600	232.93	564.00	567.40		567.40	0.000010	0.28	858.36	524.68	0.03
TWI000A	1011	01JAN2012 1700	192.14	564.00	567.24		567.24	0.000008	0.24	807.77	514.52	0.03
TWI000A	1011	01JAN2012 1800	166.42	564.00	567.13		567.13	0.000007	0.22	774.54	510.37	0.02
TWI000A	1011	01JAN2012 1900	129.01	564.00	567.00		567.00	0.000005	0.18	733.16	505.46	0.02
TWI000A	1011	01JAN2012 2000	109.67	564.00	566.88		566.88	0.000004	0.16	698.08	502.39	0.02
TWI000A	1011	01JAN2012 2100	99.96	564.00	566.83		566.83	0.000004	0.15	680.95	500.89	0.02
TWI000A	1011	01JAN2012 2200	92.89	564.00	566.79		566.79	0.000004	0.14	668.97	499.71	0.02
TWI000A	1011	01JAN2012 2300	87.11	564.00	566.75		566.75	0.000003	0.13	659.01	498.71	0.02
TWI000A	1011	01JAN2012 2400	82.22	564.00	566.73		566.73	0.000003	0.13	650.41	497.85	0.02
TWI000A	897	Max WS	4332.24	564.00	571.80		571.84	0.000105	1.67	2721.65	408.45	0.11
TWI000A	897	31DEC2011 2400	36.27	564.00	566.03		566.03	0.000001	0.06	594.41	340.31	0.01
TWI000A	897	01JAN2012 0100	31.26	564.00	566.27		566.27	0.000000	0.05	676.80	341.62	0.01
TWI000A	897	01JAN2012 0200	49.65	564.00	566.48		566.48	0.000001	0.07	748.11	342.75	0.01
TWI000A	897	01JAN2012 0300	56.24	564.00	566.55		566.55	0.000001	0.07	771.57	343.12	0.01
TWI000A	897	01JAN2012 0400	60.37	564.00	566.58		566.58	0.000001	0.08	782.38	343.29	0.01
TWI000A	897	01JAN2012 0500	64.56	564.00	566.61		566.61	0.000001	0.08	791.64	343.44	0.01
TWI000A	897	01JAN2012 0600	69.92	564.00	566.64		566.64	0.000001	0.09	802.48	343.61	0.01
TWI000A	897	01JAN2012 0700	87.68	564.00	566.71		566.72	0.000002	0.11	829.15	344.05	0.01
TWI000A	897	01JAN2012 0800	106.82	564.00	566.83		566.83	0.000002	0.12	868.42	344.75	0.01
TWI000A	897	01JAN2012 0900	130.92	564.00	566.94		566.94	0.000003	0.14	906.59	345.42	0.02
TWI000A	897	01JAN2012 1000	175.77	564.00	567.11		567.11	0.000005	0.18	966.21	346.47	0.02
TWI000A	897	01JAN2012 1100	252.75	564.00	567.38		567.38	0.000007	0.24	1060.29	352.18	0.02
TWI000A	897	01JAN2012 1200	792.59	564.00	568.39		568.40	0.000027	0.57	1421.72	361.38	0.05
TWI000A	897	01JAN2012 1300	1633.70	564.00	570.26		570.27	0.000032	0.80	2116.42	383.37	0.06
TWI000A	897	01JAN2012 1400	464.76	564.00	568.11		568.12	0.000012	0.36	1320.99	358.92	0.03
TWI000A	897	01JAN2012 1500	311.65	564.00	567.64		567.65	0.000008	0.27	1153.39	355.22	0.03
TWI000A	897	01JAN2012 1600	235.88	564.00	567.40		567.40	0.000006	0.22	1065.52	352.33	0.02
TWI000A	897	01JAN2012 1700	193.87	564.00	567.24		567.24	0.000005	0.19	1009.07	349.44	0.02
TWI000A	897	01JAN2012 1800	167.66	564.00	567.13		567.13	0.000004	0.17	972.05	346.58	0.02
TWI000A	897	01JAN2012 1900	131.39	564.00	567.00		567.00	0.000003	0.14	925.93	345.76	0.02
TWI000A	897	01JAN2012 2000	110.67	564.00	566.88		566.88	0.000002	0.13	886.69	345.07	0.01
TWI000A	897	01JAN2012 2100	100.53	564.00	566.83		566.83	0.000002	0.12	867.41	344.73	0.01
TWI000A	897	01JAN2012 2200	93.29	564.00	566.79		566.79	0.000002	0.11	853.97	344.49	0.01
TWI000A	897	01JAN2012 2300	87.49	564.00	566.75		566.75	0.000002	0.10	842.79	344.29	0.01
TWI000A	897	01JAN2012 2400	82.54	564.00	566.73		566.73	0.000002	0.10	833.04	344.12	0.01
TWI000A	736	Max WS	4325.60	564.00	571.80		571.83	0.000053	1.21	3888.84	601.31	0.08
TWI000A	736	31DEC2011 2400	22.80	564.00	566.03		566.03	0.000000	0.03	886.58	445.40	0.00
TWI000A	736	01JAN2012 0100	27.18	564.00	566.27		566.27	0.000000	0.03	994.48	447.93	0.00
TWI000A	736	01JAN2012 0200	47.63	564.00	566.48		566.48	0.000000	0.04	1088.10	450.12	0.00
TWI000A	736	01JAN2012 0300	55.55	564.00	566.55		566.55	0.000000	0.05	1118.87	450.84	0.01
TWI000A	736	01JAN2012 0400	59.94	564.00	566.58		566.58	0.000000	0.05	1133.07	451.17	0.01
TWI000A	736	01JAN2012 0500	64.02	564.00	566.61		566.61	0.000000	0.06	1145.28	451.45	0.01
TWI000A	736	01JAN2012 0600	69.30	564.00	566.64		566.64	0.000001	0.06	1159.44	451.81	0.01
TWI000A	736	01JAN2012 0700	84.99	564.00	566.71		566.71	0.000001	0.07	1194.56	452.88	0.01
TWI000A	736	01JAN2012 0800	105.01	564.00	566.83		566.83	0.000001	0.08	1246.26	454.43	0.01
TWI000A	736	01JAN2012 0900	128.71	564.00	566.94		566.94	0.000001	0.10	1296.60	455.94	0.01
TWI000A	736	01JAN2012 1000	171.81	564.00	567.11		567.11	0.000002	0.13	1375.36	458.29	0.01

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	736	01JAN2012 1100	247.30	564.00	567.38		567.38	0.000003	0.17	1501.00	473.22	0.02
TWI000A	736	01JAN2012 1200	717.89	564.00	568.39		568.39	0.000011	0.37	1991.64	497.15	0.03
TWI000A	736	01JAN2012 1300	1711.40	564.00	570.26		570.27	0.000018	0.61	2989.09	568.42	0.04
TWI000A	736	01JAN2012 1400	480.87	564.00	568.11		568.11	0.000006	0.26	1853.99	490.69	0.02
TWI000A	736	01JAN2012 1500	316.96	564.00	567.64		567.64	0.000004	0.20	1626.40	479.50	0.02
TWI000A	736	01JAN2012 1600	239.79	564.00	567.40		567.40	0.000003	0.16	1507.96	473.57	0.02
TWI000A	736	01JAN2012 1700	196.12	564.00	567.23		567.24	0.000002	0.14	1432.49	466.70	0.01
TWI000A	736	01JAN2012 1800	169.10	564.00	567.13		567.13	0.000002	0.12	1383.11	458.52	0.01
TWI000A	736	01JAN2012 1900	134.55	564.00	567.00		567.00	0.000001	0.10	1322.22	456.71	0.01
TWI000A	736	01JAN2012 2000	111.87	564.00	566.88		566.88	0.000001	0.09	1270.41	455.16	0.01
TWI000A	736	01JAN2012 2100	101.23	564.00	566.83		566.83	0.000001	0.08	1245.01	454.40	0.01
TWI000A	736	01JAN2012 2200	93.93	564.00	566.79		566.79	0.000001	0.08	1227.30	453.86	0.01
TWI000A	736	01JAN2012 2300	88.04	564.00	566.75		566.75	0.000001	0.07	1212.49	453.42	0.01
TWI000A	736	01JAN2012 2400	83.04	564.00	566.73		566.73	0.000001	0.07	1199.71	453.03	0.01
TWI000A	585	Max WS	4324.58	564.00	571.79		571.82	0.000060	1.29	3515.73	515.79	0.08
TWI000A	585	31DEC2011 2400	8.80	564.00	566.03		566.03	0.000000	0.01	846.75	425.53	0.00
TWI000A	585	01JAN2012 0100	22.92	564.00	566.27		566.27	0.000000	0.02	949.89	428.27	0.00
TWI000A	585	01JAN2012 0200	45.52	564.00	566.48		566.48	0.000000	0.04	1039.38	430.35	0.00
TWI000A	585	01JAN2012 0300	54.76	564.00	566.55		566.55	0.000000	0.05	1068.82	431.04	0.01
TWI000A	585	01JAN2012 0400	59.43	564.00	566.58		566.58	0.000000	0.05	1082.40	431.35	0.01
TWI000A	585	01JAN2012 0500	63.56	564.00	566.61		566.61	0.000001	0.06	1094.01	431.62	0.01
TWI000A	585	01JAN2012 0600	68.64	564.00	566.64		566.64	0.000001	0.06	1107.61	431.93	0.01
TWI000A	585	01JAN2012 0700	82.14	564.00	566.71		566.71	0.000001	0.07	1141.12	432.71	0.01
TWI000A	585	01JAN2012 0800	103.14	564.00	566.83		566.83	0.000001	0.09	1190.47	433.84	0.01
TWI000A	585	01JAN2012 0900	126.32	564.00	566.94		566.94	0.000001	0.10	1238.48	434.95	0.01
TWI000A	585	01JAN2012 1000	167.63	564.00	567.11		567.11	0.000002	0.13	1313.52	436.66	0.01
TWI000A	585	01JAN2012 1100	241.64	564.00	567.38		567.38	0.000003	0.17	1431.22	438.33	0.02
TWI000A	585	01JAN2012 1200	640.52	564.00	568.39		568.39	0.000009	0.34	1876.20	444.16	0.03
TWI000A	585	01JAN2012 1300	1792.78	564.00	570.26		570.27	0.000022	0.67	2744.35	489.08	0.05
TWI000A	585	01JAN2012 1400	497.69	564.00	568.11		568.11	0.000007	0.29	1753.34	442.01	0.03
TWI000A	585	01JAN2012 1500	322.51	564.00	567.64		567.64	0.000004	0.21	1546.68	439.54	0.02
TWI000A	585	01JAN2012 1600	243.84	564.00	567.40		567.40	0.000003	0.17	1437.75	438.39	0.02
TWI000A	585	01JAN2012 1700	198.50	564.00	567.23		567.23	0.000003	0.15	1367.43	437.75	0.01
TWI000A	585	01JAN2012 1800	170.65	564.00	567.13		567.13	0.000002	0.13	1320.93	436.83	0.01
TWI000A	585	01JAN2012 1900	137.88	564.00	567.00		567.00	0.000002	0.11	1262.92	435.51	0.01
TWI000A	585	01JAN2012 2000	113.19	564.00	566.88		566.88	0.000001	0.09	1213.52	434.37	0.01
TWI000A	585	01JAN2012 2100	102.06	564.00	566.83		566.83	0.000001	0.09	1189.25	433.81	0.01
TWI000A	585	01JAN2012 2200	94.59	564.00	566.79		566.79	0.000001	0.08	1172.34	433.43	0.01
TWI000A	585	01JAN2012 2300	88.55	564.00	566.75		566.75	0.000001	0.08	1158.27	433.10	0.01
TWI000A	585	01JAN2012 2400	83.50	564.00	566.73		566.73	0.000001	0.07	1146.06	432.82	0.01
TWI000A	549	Max WS	4324.16	564.00	571.51	568.32	571.94	0.002724	5.47	977.38	492.93	0.49
TWI000A	549	31DEC2011 2400	6.39	564.00	566.03	564.06	566.03	0.000000	0.04	169.94	205.55	0.00
TWI000A	549	01JAN2012 0100	22.18	564.00	566.27	564.15	566.27	0.000003	0.12	191.29	220.64	0.01
TWI000A	549	01JAN2012 0200	45.13	564.00	566.48	564.22	566.48	0.000008	0.22	209.98	224.75	0.02
TWI000A	549	01JAN2012 0300	54.64	564.00	566.55	564.24	566.55	0.000011	0.25	216.17	226.09	0.03
TWI000A	549	01JAN2012 0400	59.33	564.00	566.58	564.26	566.58	0.000012	0.27	219.03	226.64	0.03
TWI000A	549	01JAN2012 0500	63.48	564.00	566.60	564.27	566.61	0.000014	0.29	221.48	227.06	0.03
TWI000A	549	01JAN2012 0600	68.50	564.00	566.64	564.28	566.64	0.000015	0.31	224.35	227.56	0.03
TWI000A	549	01JAN2012 0700	81.66	564.00	566.71	564.32	566.72	0.000019	0.35	231.41	228.77	0.04
TWI000A	549	01JAN2012 0800	102.83	564.00	566.83	564.37	566.83	0.000027	0.43	241.83	230.55	0.05
TWI000A	549	01JAN2012 0900	125.91	564.00	566.94	564.43	566.94	0.000035	0.50	251.96	232.28	0.05
TWI000A	549	01JAN2012 1000	166.91	564.00	567.11	564.51	567.11	0.000051	0.63	267.80	234.96	0.06
TWI000A	549	01JAN2012 1100	240.65	564.00	567.37	564.65	567.38	0.000080	0.83	292.65	242.40	0.08
TWI000A	549	01JAN2012 1200	626.77	564.00	568.36	565.23	568.40	0.000222	1.66	388.04	276.04	0.14
TWI000A	549	01JAN2012 1300	1807.76	564.00	570.16	566.45	570.33	0.000562	3.34	570.10	355.32	0.24
TWI000A	549	01JAN2012 1400	500.63	564.00	568.09	565.06	568.12	0.000177	1.41	361.50	259.74	0.12
TWI000A	549	01JAN2012 1500	323.49	564.00	567.63	564.79	567.65	0.000111	1.03	317.12	248.08	0.10
TWI000A	549	01JAN2012 1600	244.56	564.00	567.39	564.66	567.40	0.000081	0.84	294.03	242.72	0.08
TWI000A	549	01JAN2012 1700	198.91	564.00	567.23	564.57	567.24	0.000063	0.72	279.17	237.98	0.07
TWI000A	549	01JAN2012 1800	170.95	564.00	567.12	564.52	567.13	0.000052	0.64	269.36	235.22	0.06
TWI000A	549	01JAN2012 1900	138.48	564.00	566.99	564.45	567.00	0.000040	0.54	257.11	233.15	0.06
TWI000A	549	01JAN2012 2000	113.40	564.00	566.88	564.40	566.88	0.000031	0.46	246.70	231.38	0.05
TWI000A	549	01JAN2012 2100	102.22	564.00	566.82	564.37	566.83	0.000027	0.43	241.58	230.51	0.05
TWI000A	549	01JAN2012 2200	94.71	564.00	566.79	564.35	566.79	0.000024	0.40	238.01	229.90	0.04
TWI000A	549	01JAN2012 2300	88.66	564.00	566.75	564.34	566.75	0.000022	0.38	235.04	229.39	0.04
TWI000A	549	01JAN2012 2400	83.58	564.00	566.72	564.32	566.73	0.000020	0.36	232.46	228.95	0.04
TWI000A	544		Inl Struct									
TWI000A	437	Max WS	4321.40	543.21	555.94		556.10	0.000344	3.77	1910.85	233.77	0.20
TWI000A	437	31DEC2011 2400	6.39	543.21	544.22		544.22	0.000275	0.42	15.28	32.80	0.11
TWI000A	437	01JAN2012 0100	22.18	543.21	545.00		545.00	0.000126	0.47	47.06	46.54	0.08
TWI000A	437	01JAN2012 0200	45.13	543.21	545.45		545.45	0.000164	0.65	68.91	50.26	0.10
TWI000A	437	01JAN2012 0300	54.64	543.21	545.63		545.64	0.000162	0.70	78.30	51.48	0.10
TWI000A	437	01JAN2012 0400	59.33	543.21	545.71		545.72	0.000165	0.72	82.18	51.98	0.10
TWI000A	437	01JAN2012 0500	63.48	543.21	545.77		545.78	0.000169	0.74	85.26	52.36	0.10
TWI000A	437	01JAN2012 0600	68.50	543.21	545.83		545.84	0.000174	0.77	88.76	52.80	0.10
TWI000A	437	01JAN2012 0700	81.66	543.21	545.97		545.99	0.000193	0.85	96.28	53.73	0.11
TWI000A	437	01JAN2012 0800	102.83	543.21	546.22		546.24	0.000208	0.94	109.94	64.66	0.12
TWI000A	437	01JAN2012 0900	125.91	543.21	546.46		546.48	0.000243	1.02	123.93	76.26	0.13
TWI000A	437	01JAN2012 1000	166.91	543.21	546.83		546.85	0.000263	1.12	148.51	89.57	0.13
TWI000A	437	01JAN2012 1100	240.65	543.21	547.42		547.45	0.000253	1.27	189.66	103.66	0.14

HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

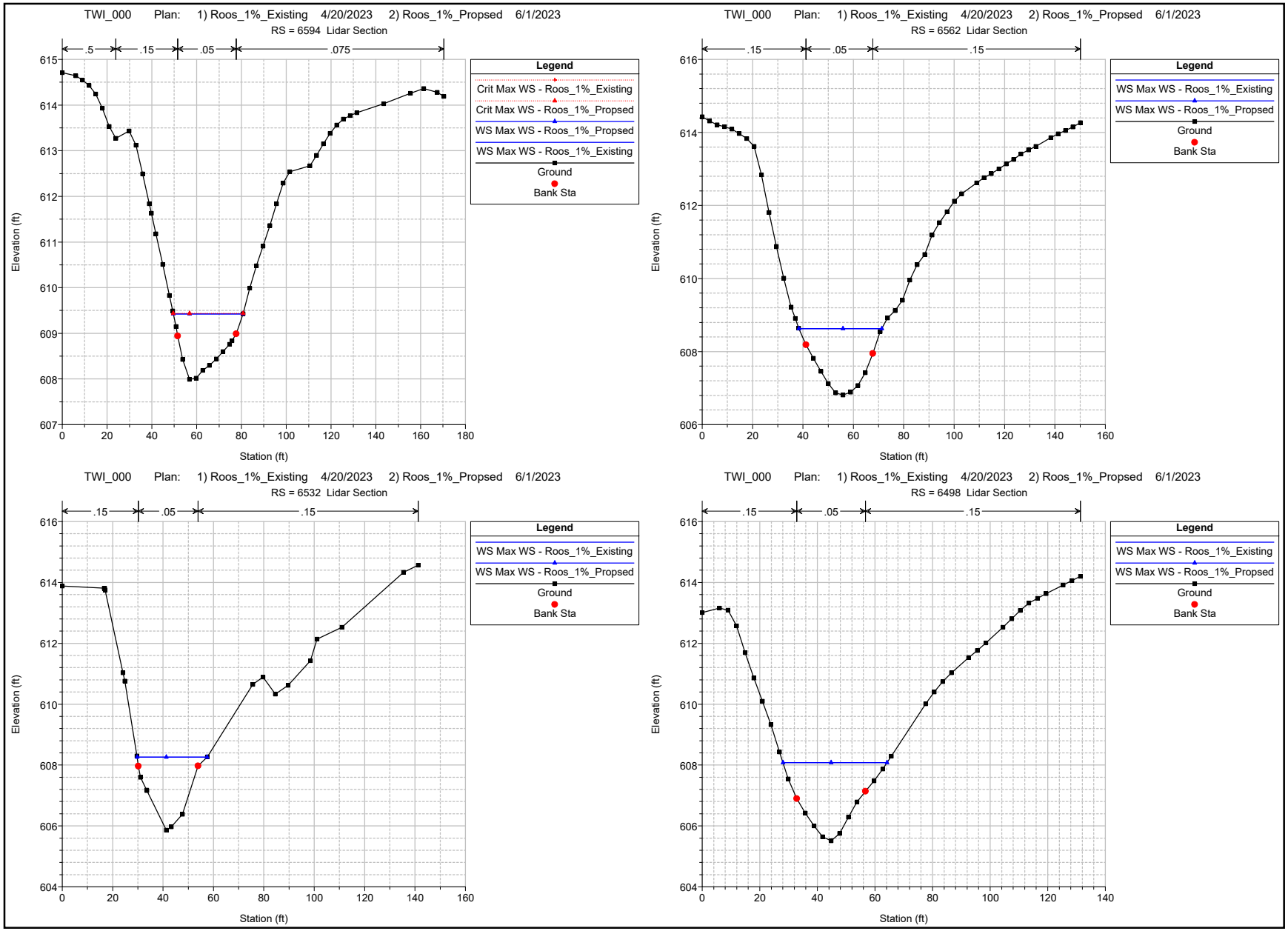
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	437	01JAN2012 1200	626.77	543.21	549.57		549.63	0.000247	1.81	351.72	186.44	0.15
TWI000A	437	01JAN2012 1300	1807.76	543.21	553.50		553.62	0.000267	2.81	675.72	219.12	0.17
TWI000A	437	01JAN2012 1400	500.63	543.21	549.30		549.34	0.000193	1.54	329.62	179.47	0.13
TWI000A	437	01JAN2012 1500	323.49	543.21	548.13		548.15	0.000221	1.35	239.67	132.38	0.13
TWI000A	437	01JAN2012 1600	244.56	543.21	547.56		547.58	0.000225	1.23	198.94	106.70	0.13
TWI000A	437	01JAN2012 1700	198.91	543.21	547.18		547.20	0.000232	1.15	172.75	97.92	0.13
TWI000A	437	01JAN2012 1800	170.95	543.21	546.93		546.95	0.000237	1.10	155.71	92.00	0.13
TWI000A	437	01JAN2012 1900	138.48	543.21	546.66		546.67	0.000236	1.01	136.81	85.72	0.13
TWI000A	437	01JAN2012 2000	113.40	543.21	546.38		546.40	0.000216	0.95	119.07	72.69	0.12
TWI000A	437	01JAN2012 2100	102.22	543.21	546.25		546.27	0.000200	0.92	111.61	66.26	0.12
TWI000A	437	01JAN2012 2200	94.71	543.21	546.17		546.18	0.000190	0.89	106.89	62.78	0.11
TWI000A	437	01JAN2012 2300	88.66	543.21	546.10		546.11	0.000186	0.86	103.07	60.89	0.11
TWI000A	437	01JAN2012 2400	83.58	543.21	546.04		546.05	0.000182	0.84	99.81	56.99	0.11
TWI000A	390	Max WS	4342.35	540.00	555.99		556.05	0.000076	2.13	2482.46	226.77	0.10
TWI000A	390	31DEC2011 2400	6.79	540.00	544.21		544.21	0.000000	0.02	288.92	127.66	0.00
TWI000A	390	01JAN2012 0100	23.54	540.00	545.00		545.00	0.000000	0.06	399.42	144.97	0.01
TWI000A	390	01JAN2012 0200	46.59	540.00	545.45		545.45	0.000001	0.10	465.18	148.00	0.01
TWI000A	390	01JAN2012 0300	56.38	540.00	545.63		545.63	0.000001	0.12	492.70	149.43	0.01
TWI000A	390	01JAN2012 0400	61.11	540.00	545.71		545.71	0.000002	0.12	503.99	150.41	0.01
TWI000A	390	01JAN2012 0500	65.27	540.00	545.77		545.77	0.000002	0.13	512.90	151.18	0.01
TWI000A	390	01JAN2012 0600	70.28	540.00	545.83		545.83	0.000002	0.14	523.04	152.05	0.01
TWI000A	390	01JAN2012 0700	83.16	540.00	545.98		545.98	0.000002	0.16	544.73	153.90	0.01
TWI000A	390	01JAN2012 0800	104.40	540.00	546.23		546.23	0.000003	0.18	583.81	157.04	0.02
TWI000A	390	01JAN2012 0900	127.37	540.00	546.46		546.46	0.000004	0.21	621.21	159.31	0.02
TWI000A	390	01JAN2012 1000	167.98	540.00	546.83		546.83	0.000005	0.26	680.93	162.86	0.02
TWI000A	390	01JAN2012 1100	241.31	540.00	547.43		547.43	0.000006	0.33	780.10	168.07	0.03
TWI000A	390	01JAN2012 1200	620.76	540.00	549.60		549.60	0.000013	0.59	1168.50	187.41	0.04
TWI000A	390	01JAN2012 1300	1827.11	540.00	553.57		553.59	0.000026	1.10	1953.75	207.49	0.06
TWI000A	390	01JAN2012 1400	508.50	540.00	549.32		549.32	0.000010	0.50	1115.89	185.54	0.03
TWI000A	390	01JAN2012 1500	326.82	540.00	548.14		548.14	0.000008	0.39	901.44	176.89	0.03
TWI000A	390	01JAN2012 1600	247.33	540.00	547.56		547.57	0.000006	0.33	802.34	169.38	0.02
TWI000A	390	01JAN2012 1700	201.28	540.00	547.19		547.19	0.000005	0.29	739.23	166.04	0.02
TWI000A	390	01JAN2012 1800	173.15	540.00	546.94		546.94	0.000005	0.26	698.18	163.87	0.02
TWI000A	390	01JAN2012 1900	141.01	540.00	546.66		546.66	0.000004	0.22	652.85	161.20	0.02
TWI000A	390	01JAN2012 2000	115.51	540.00	546.38		546.38	0.000003	0.20	608.57	158.55	0.02
TWI000A	390	01JAN2012 2100	104.23	540.00	546.26		546.26	0.000003	0.18	588.46	157.33	0.02
TWI000A	390	01JAN2012 2200	96.68	540.00	546.17		546.17	0.000003	0.17	575.13	156.45	0.02
TWI000A	390	01JAN2012 2300	90.62	540.00	546.10		546.10	0.000002	0.17	564.21	155.54	0.01
TWI000A	390	01JAN2012 2400	85.52	540.00	546.04		546.04	0.000002	0.16	554.86	154.75	0.01
TWI000A	329	Max WS	4368.50	540.00	555.96		556.05	0.000080	2.34	2085.01	180.15	0.10
TWI000A	329	31DEC2011 2400	6.22	540.00	544.21		544.21	0.000000	0.01	436.88	118.30	0.00
TWI000A	329	01JAN2012 0100	24.95	540.00	545.00		545.00	0.000000	0.05	531.26	121.25	0.00
TWI000A	329	01JAN2012 0200	48.18	540.00	545.45		545.45	0.000000	0.08	586.09	122.93	0.01
TWI000A	329	01JAN2012 0300	58.49	540.00	545.63		545.63	0.000001	0.10	608.94	123.62	0.01
TWI000A	329	01JAN2012 0400	63.31	540.00	545.71		545.71	0.000001	0.10	618.26	123.83	0.01
TWI000A	329	01JAN2012 0500	67.46	540.00	545.77		545.77	0.000001	0.11	625.58	124.00	0.01
TWI000A	329	01JAN2012 0600	72.43	540.00	545.83		545.83	0.000001	0.12	633.87	124.18	0.01
TWI000A	329	01JAN2012 0700	84.83	540.00	545.98		545.98	0.000001	0.13	651.51	124.58	0.01
TWI000A	329	01JAN2012 0800	106.23	540.00	546.23		546.23	0.000001	0.16	682.90	125.28	0.01
TWI000A	329	01JAN2012 0900	129.04	540.00	546.46		546.46	0.000002	0.18	712.60	125.94	0.01
TWI000A	329	01JAN2012 1000	169.13	540.00	546.83		546.83	0.000002	0.23	759.48	126.97	0.02
TWI000A	329	01JAN2012 1100	241.92	540.00	547.43		547.43	0.000004	0.30	836.26	129.59	0.02
TWI000A	329	01JAN2012 1200	615.87	540.00	549.60		549.60	0.000010	0.57	1123.12	135.01	0.03
TWI000A	329	01JAN2012 1300	1849.17	540.00	553.56		553.59	0.000025	1.18	1686.87	150.88	0.06
TWI000A	329	01JAN2012 1400	517.71	540.00	549.32		549.32	0.000008	0.50	1085.22	134.35	0.03
TWI000A	329	01JAN2012 1500	331.02	540.00	548.14		548.14	0.000005	0.37	928.32	131.58	0.02
TWI000A	329	01JAN2012 1600	250.91	540.00	547.56		547.57	0.000004	0.30	853.38	130.18	0.02
TWI000A	329	01JAN2012 1700	204.33	540.00	547.19		547.19	0.000003	0.26	804.71	128.44	0.02
TWI000A	329	01JAN2012 1800	175.99	540.00	546.94		546.94	0.000003	0.23	772.91	127.28	0.02
TWI000A	329	01JAN2012 1900	144.33	540.00	546.66		546.66	0.000002	0.20	737.52	126.49	0.01
TWI000A	329	01JAN2012 2000	118.24	540.00	546.38		546.38	0.000002	0.17	702.59	125.72	0.01
TWI000A	329	01JAN2012 2100	106.78	540.00	546.26		546.26	0.000001	0.16	686.61	125.36	0.01
TWI000A	329	01JAN2012 2200	99.19	540.00	546.17		546.17	0.000001	0.15	675.97	125.12	0.01
TWI000A	329	01JAN2012 2300	93.12	540.00	546.10		546.10	0.000001	0.14	667.20	124.93	0.01
TWI000A	329	01JAN2012 2400	87.98	540.00	546.04		546.04	0.000001	0.13	659.69	124.76	0.01
TWI000A	237	Max WS	4408.75	540.00	555.99		556.04	0.000044	1.76	2783.48	219.82	0.08
TWI000A	237	31DEC2011 2400	4.81	540.00	544.21		544.21	0.000000	0.01	596.92	156.15	0.00
TWI000A	237	01JAN2012 0100	27.13	540.00	545.00		545.00	0.000000	0.04	721.28	159.88	0.00
TWI000A	237	01JAN2012 0200	50.62	540.00	545.45		545.45	0.000000	0.06	793.77	163.19	0.01
TWI000A	237	01JAN2012 0300	61.69	540.00	545.63		545.63	0.000000	0.08	824.14	164.48	0.01
TWI000A	237	01JAN2012 0400	66.69	540.00	545.71		545.71	0.000000	0.08	836.52	164.82	0.01
TWI000A	237	01JAN2012 0500	70.85	540.00	545.77		545.77	0.000000	0.08	846.29	165.10	0.01
TWI000A	237	01JAN2012 0600	75.76	540.00	545.83		545.83	0.000000	0.09	857.33	165.29	0.01
TWI000A	237	01JAN2012 0700	87.36	540.00	545.98		545.98	0.000001	0.10	880.79	165.67	0.01
TWI000A	237	01JAN2012 0800	109.04	540.00	546.23		546.23	0.000001	0.12	922.51	166.36	0.01
TWI000A	237	01JAN2012 0900	131.63	540.00	546.46		546.46	0.000001	0.14	961.92	167.00	0.01
TWI000A	237	01JAN2012 1000	170.91	540.00	546.83		546.83	0.000001	0.17	1024.05	168.17	0.01
TWI000A	237	01JAN2012 1100	242.94	540.00	547.43		547.43	0.000002	0.22	1125.52	170.61	0.01
TWI000A	237	01JAN2012 1200	609.54	540.00	549.60		549.60	0.000005	0.42	1505.93	181.37	0.02
TWI000A	237	01JAN2012 1300	1882.77	540.00	553.57		553.58	0.000014	0.90	2267.98	205.22	0.04
TWI000A	237	01JAN2012 1400	531.63	540.00	549.32		549.32	0.000004	0.38	1455.28	179.37	0.02

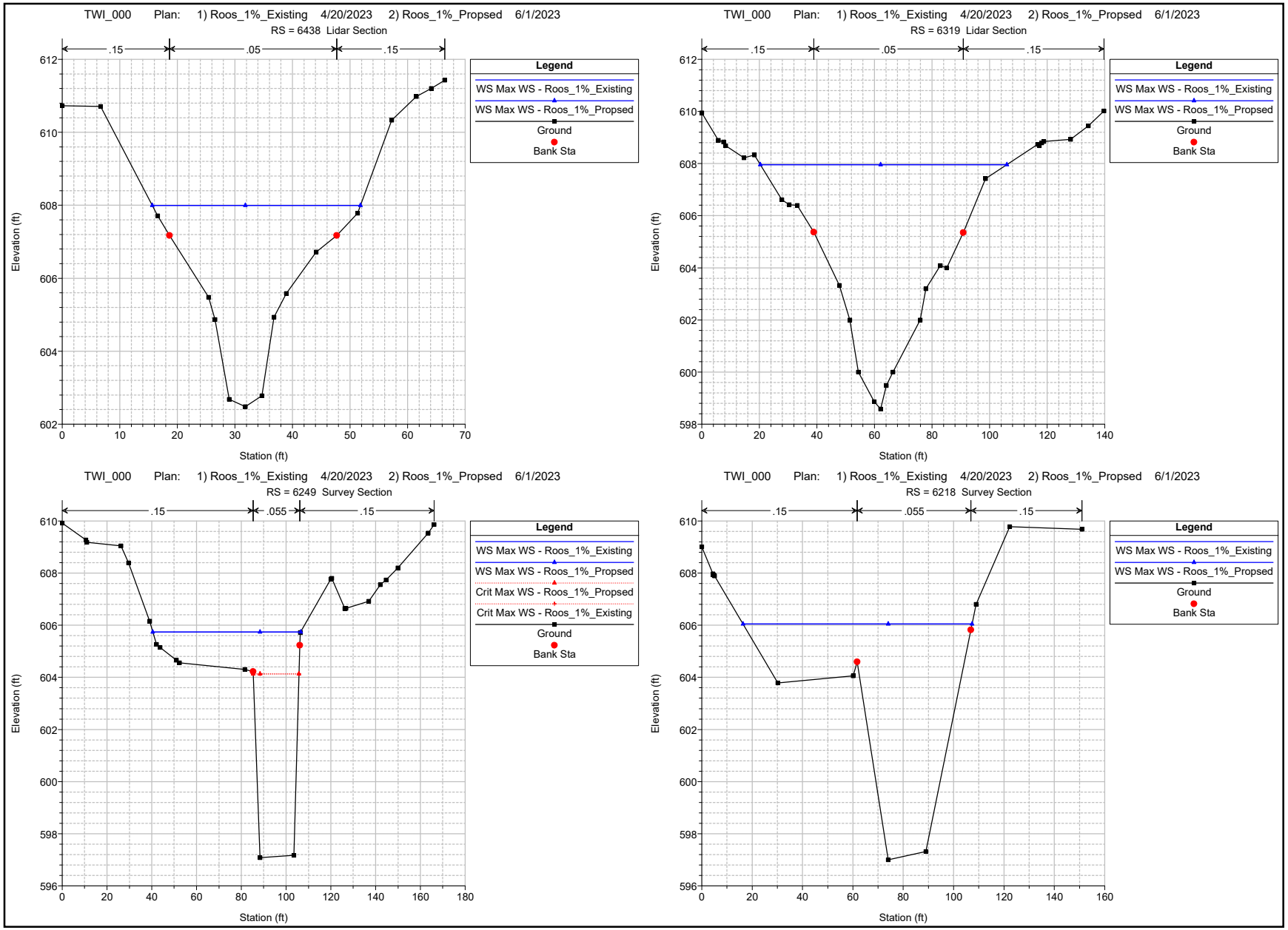
HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

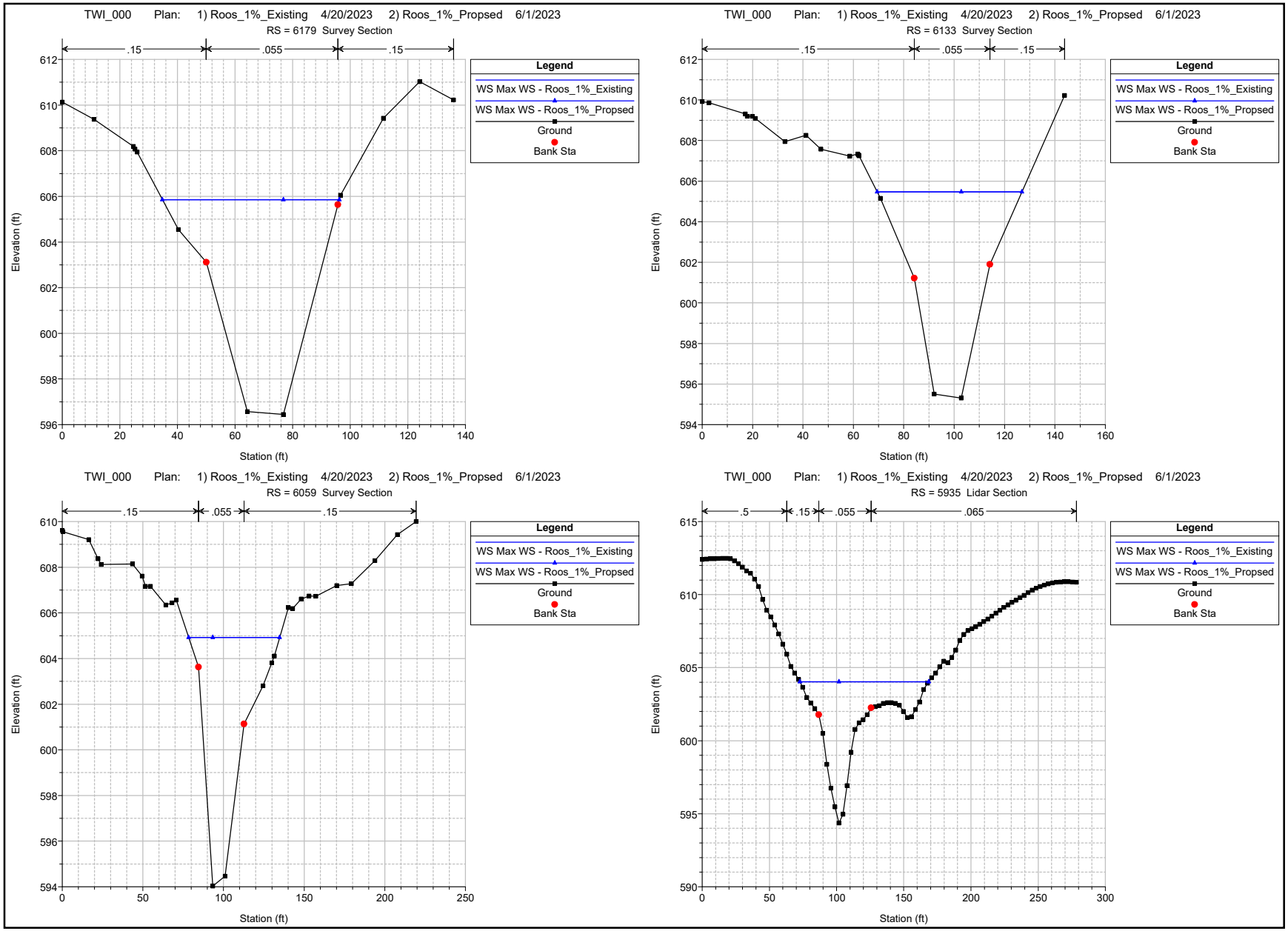
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	237	01JAN2012 1500	337.45	540.00	548.14		548.14	0.000003	0.28	1246.80	173.78	0.02
TWI000A	237	01JAN2012 1600	256.40	540.00	547.56		547.57	0.000002	0.23	1148.08	171.15	0.02
TWI000A	237	01JAN2012 1700	209.05	540.00	547.19		547.19	0.000002	0.20	1083.91	169.61	0.01
TWI000A	237	01JAN2012 1800	180.39	540.00	546.94		546.94	0.000001	0.18	1041.83	168.60	0.01
TWI000A	237	01JAN2012 1900	149.44	540.00	546.66		546.66	0.000001	0.15	994.99	167.54	0.01
TWI000A	237	01JAN2012 2000	122.46	540.00	546.38		546.38	0.000001	0.13	948.67	166.79	0.01
TWI000A	237	01JAN2012 2100	110.75	540.00	546.26		546.26	0.000001	0.12	927.44	166.44	0.01
TWI000A	237	01JAN2012 2200	103.09	540.00	546.17		546.17	0.000001	0.11	913.30	166.21	0.01
TWI000A	237	01JAN2012 2300	96.97	540.00	546.10		546.10	0.000001	0.11	901.68	166.02	0.01
TWI000A	237	01JAN2012 2400	91.81	540.00	546.04		546.04	0.000001	0.10	891.68	165.85	0.01
TWI000A	179	Max WS	4432.28	540.00	555.96		556.04	0.000074	2.24	2376.57	215.10	0.10
TWI000A	179	31DEC2011 2400	3.79	540.00	544.21		544.21	0.000000	0.01	425.23	122.71	0.00
TWI000A	179	01JAN2012 0100	28.37	540.00	545.00		545.00	0.000000	0.05	526.61	133.08	0.00
TWI000A	179	01JAN2012 0200	52.02	540.00	545.45		545.45	0.000001	0.09	587.39	137.53	0.01
TWI000A	179	01JAN2012 0300	63.63	540.00	545.63		545.63	0.000001	0.11	613.03	139.11	0.01
TWI000A	179	01JAN2012 0400	68.73	540.00	545.71		545.71	0.000001	0.11	623.52	139.74	0.01
TWI000A	179	01JAN2012 0500	72.88	540.00	545.77		545.77	0.000001	0.12	631.80	140.33	0.01
TWI000A	179	01JAN2012 0600	77.74	540.00	545.83		545.83	0.000001	0.12	641.20	140.99	0.01
TWI000A	179	01JAN2012 0700	88.84	540.00	545.97		545.98	0.000001	0.14	661.28	142.41	0.01
TWI000A	179	01JAN2012 0800	110.68	540.00	546.23		546.23	0.000002	0.16	697.36	144.76	0.01
TWI000A	179	01JAN2012 0900	133.11	540.00	546.46		546.46	0.000002	0.19	731.83	146.96	0.01
TWI000A	179	01JAN2012 1000	171.86	540.00	546.83		546.83	0.000003	0.23	786.82	149.04	0.02
TWI000A	179	01JAN2012 1100	243.36	540.00	547.43		547.43	0.000004	0.29	876.50	150.48	0.02
TWI000A	179	01JAN2012 1200	603.55	540.00	549.60		549.60	0.000009	0.54	1208.93	156.98	0.03
TWI000A	179	01JAN2012 1300	1905.10	540.00	553.56		553.58	0.000025	1.16	1884.06	193.09	0.06
TWI000A	179	01JAN2012 1400	540.60	540.00	549.32		549.32	0.000008	0.50	1165.09	156.09	0.03
TWI000A	179	01JAN2012 1500	341.53	540.00	548.14		548.14	0.000005	0.37	983.06	152.17	0.02
TWI000A	179	01JAN2012 1600	259.82	540.00	547.56		547.57	0.000004	0.31	896.37	150.80	0.02
TWI000A	179	01JAN2012 1700	211.98	540.00	547.19		547.19	0.000003	0.27	839.79	149.89	0.02
TWI000A	179	01JAN2012 1800	183.07	540.00	546.94		546.94	0.000003	0.24	802.57	149.30	0.02
TWI000A	179	01JAN2012 1900	152.62	540.00	546.66		546.66	0.000002	0.21	761.06	148.59	0.02
TWI000A	179	01JAN2012 2000	125.05	540.00	546.38		546.38	0.000002	0.18	720.19	146.22	0.01
TWI000A	179	01JAN2012 2100	113.15	540.00	546.26		546.26	0.000002	0.17	701.65	145.04	0.01
TWI000A	179	01JAN2012 2200	105.46	540.00	546.17		546.17	0.000001	0.16	689.35	144.25	0.01
TWI000A	179	01JAN2012 2300	99.30	540.00	546.10		546.10	0.000001	0.15	679.29	143.60	0.01
TWI000A	179	01JAN2012 2400	94.13	540.00	546.04		546.04	0.000001	0.14	670.65	143.04	0.01
TWI000A	165	Max WS	4432.25	540.00	555.70	551.20	556.16	0.002470	6.25	1003.13	217.24	0.49
TWI000A	165	31DEC2011 2400	3.24	540.00	544.21	540.19	544.21	0.000000	0.05	62.98	97.25	0.01
TWI000A	165	01JAN2012 0100	28.20	540.00	545.00	540.77	545.00	0.000014	0.34	84.35	107.90	0.03
TWI000A	165	01JAN2012 0200	51.88	540.00	545.44	541.11	545.45	0.000030	0.55	98.62	113.29	0.05
TWI000A	165	01JAN2012 0300	63.60	540.00	545.63	541.26	545.64	0.000038	0.64	104.94	115.18	0.06
TWI000A	165	01JAN2012 0400	68.71	540.00	545.70	541.31	545.71	0.000041	0.68	107.59	116.06	0.06
TWI000A	165	01JAN2012 0500	72.86	540.00	545.76	541.36	545.77	0.000044	0.71	109.86	122.16	0.06
TWI000A	165	01JAN2012 0600	77.70	540.00	545.83	541.41	545.84	0.000048	0.74	112.64	122.68	0.06
TWI000A	165	01JAN2012 0700	88.72	540.00	545.97	541.52	545.98	0.000055	0.82	118.55	123.77	0.07
TWI000A	165	01JAN2012 0800	110.58	540.00	546.22	541.73	546.23	0.000070	0.95	129.03	125.70	0.08
TWI000A	165	01JAN2012 0900	132.99	540.00	546.45	541.92	546.47	0.000084	1.08	138.87	127.50	0.09
TWI000A	165	01JAN2012 1000	171.64	540.00	546.82	542.21	546.85	0.000107	1.28	154.30	130.29	0.10
TWI000A	165	01JAN2012 1100	243.04	540.00	547.41	542.67	547.45	0.000144	1.60	179.17	134.79	0.12
TWI000A	165	01JAN2012 1200	599.42	540.00	549.54	544.29	549.65	0.000335	2.69	278.66	148.33	0.19
TWI000A	165	01JAN2012 1300	1907.98	540.00	553.41	547.40	553.71	0.000584	4.84	586.74	190.80	0.26
TWI000A	165	01JAN2012 1400	541.68	540.00	549.27	544.08	549.36	0.000320	2.55	260.86	146.14	0.18
TWI000A	165	01JAN2012 1500	341.86	540.00	548.11	543.19	548.16	0.000188	1.98	208.35	139.44	0.14
TWI000A	165	01JAN2012 1600	260.05	540.00	547.54	542.76	547.58	0.000152	1.67	184.64	135.79	0.12
TWI000A	165	01JAN2012 1700	212.12	540.00	547.17	542.48	547.20	0.000129	1.47	169.03	132.95	0.11
TWI000A	165	01JAN2012 1800	183.16	540.00	546.93	542.29	546.95	0.000113	1.34	158.69	131.08	0.10
TWI000A	165	01JAN2012 1900	152.80	540.00	546.65	542.07	546.67	0.000096	1.19	147.10	128.98	0.09
TWI000A	165	01JAN2012 2000	125.12	540.00	546.37	541.85	546.39	0.000079	1.04	135.57	126.90	0.08
TWI000A	165	01JAN2012 2100	113.19	540.00	546.25	541.75	546.26	0.000071	0.97	130.26	125.93	0.08
TWI000A	165	01JAN2012 2200	105.50	540.00	546.16	541.68	546.18	0.000066	0.92	126.72	125.27	0.08
TWI000A	165	01JAN2012 2300	99.33	540.00	546.09	541.63	546.11	0.000062	0.88	123.80	124.74	0.07
TWI000A	165	01JAN2012 2400	94.16	540.00	546.04	541.58	546.05	0.000059	0.85	121.29	124.27	0.07
TWI000A	143		Inl Struct									
TWI000A	106	Max WS	4432.25	537.10	550.79	548.90	553.07	0.008250	13.03	479.64	143.92	0.66
TWI000A	106	31DEC2011 2400	3.24	537.10	537.76		537.82	0.020018	1.97	1.64	4.95	0.60
TWI000A	106	01JAN2012 0100	28.20	537.10	538.69		538.81	0.014543	2.86	9.85	13.20	0.58
TWI000A	106	01JAN2012 0200	51.88	537.10	539.17		539.31	0.011071	3.01	17.24	17.43	0.53
TWI000A	106	01JAN2012 0300	63.60	537.10	539.36		539.51	0.009608	3.08	20.67	18.06	0.51
TWI000A	106	01JAN2012 0400	68.71	537.10	539.44		539.59	0.009139	3.11	22.09	18.24	0.50
TWI000A	106	01JAN2012 0500	72.86	537.10	539.50		539.65	0.008833	3.14	23.20	18.38	0.49
TWI000A	106	01JAN2012 0600	77.70	537.10	539.57		539.73	0.008475	3.17	24.53	18.55	0.49
TWI000A	106	01JAN2012 0700	88.72	537.10	539.72		539.88	0.007950	3.25	27.32	18.89	0.48
TWI000A	106	01JAN2012 0800	110.58	537.10	539.99		540.17	0.007252	3.39	32.58	19.52	0.46
TWI000A	106	01JAN2012 0900	132.99	537.10	540.23		540.43	0.006994	3.56	37.32	20.09	0.46
TWI000A	106	01JAN2012 1000	171.64	537.10	540.60		540.83	0.006777	3.83	44.84	20.97	0.46
TWI000A	106	01JAN2012 1100	243.04	537.10	541.19		541.46	0.006560	4.22	57.58	22.39	0.46
TWI000A	106	01JAN2012 1200	599.42	537.10	543.12		543.63	0.006321	5.75	105.52	27.24	0.49
TWI000A	106	01JAN2012 1300	1907.98	537.10	547.21		548.36	0.006093	8.83	233.26	34.66	0.54
TWI000A	106	01JAN2012 1400	541.68	537.10	542.88		543.35	0.006304	5.52	98.94	26.61	0.48
TWI000A	106	01JAN2012 1500	341.86	537.10	541.88		542.21	0.006405	4.64	73.64	24.05	0.47

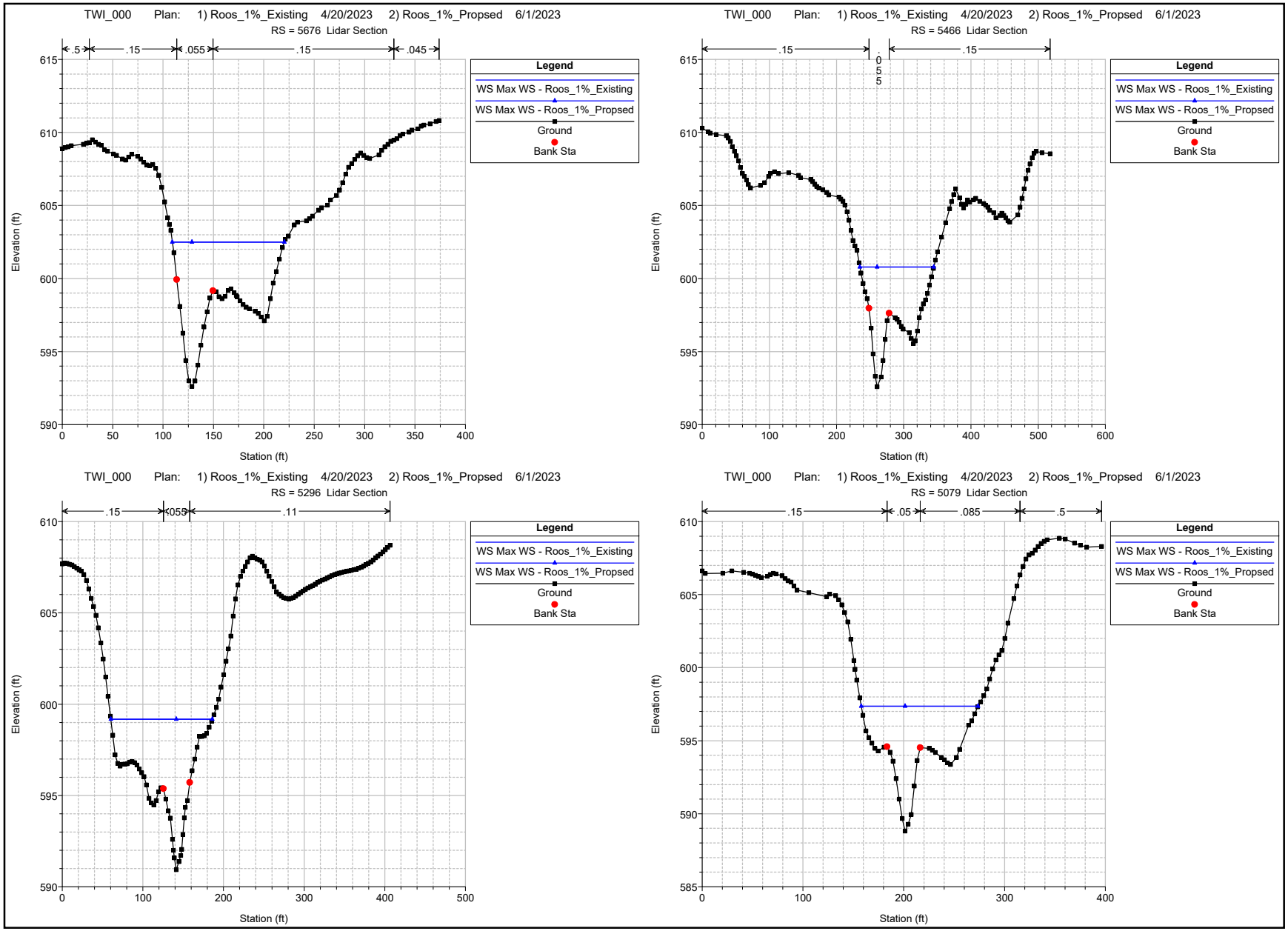
HEC-RAS Plan: Roos_1%_Propsed River: TSD Reach: TWI000A (Continued)

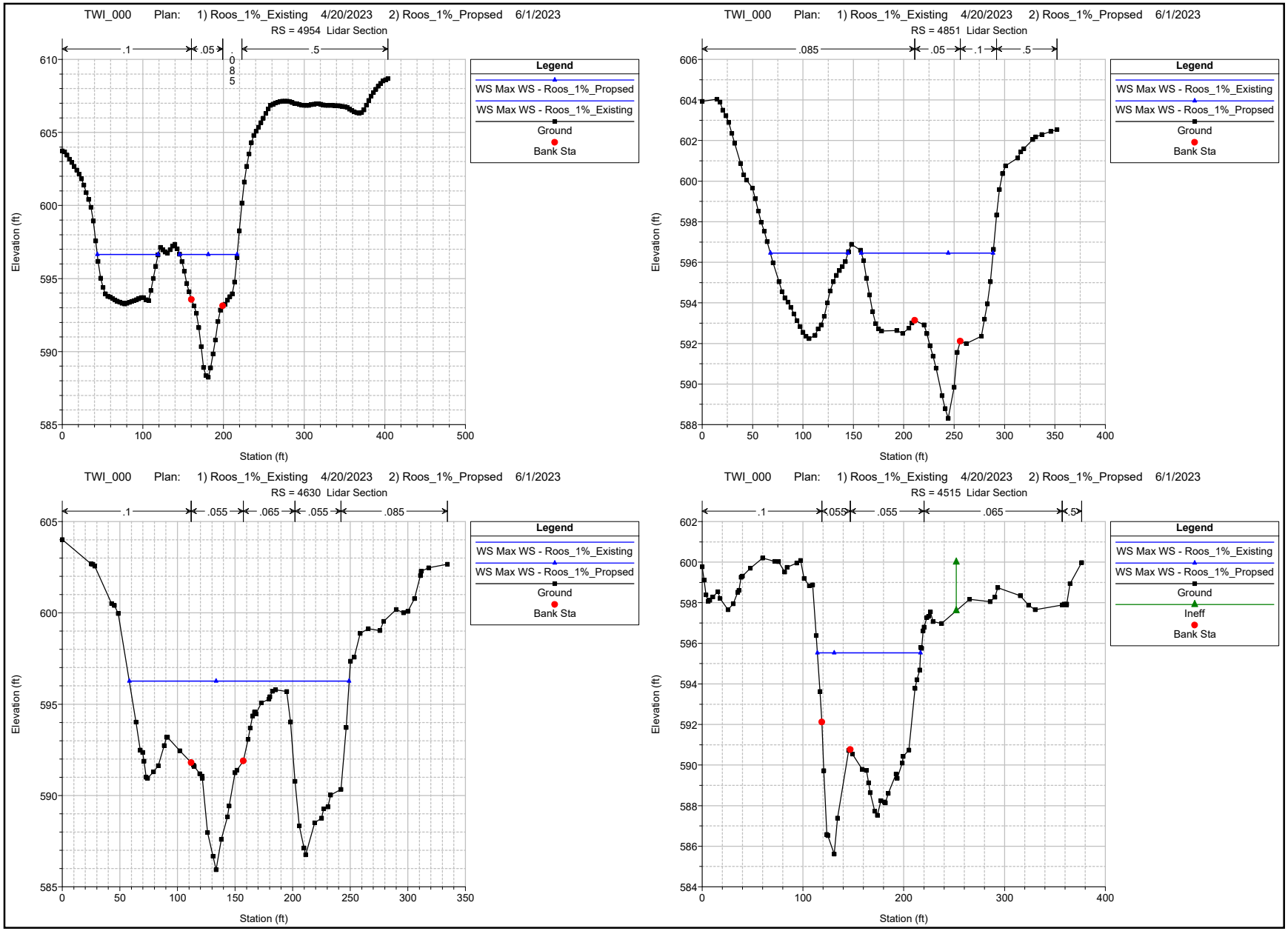
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
TWI000A	106	01JAN2012 1600	260.05	537.10	541.31		541.60	0.006518	4.30	60.47	22.70	0.46
TWI000A	106	01JAN2012 1700	212.12	537.10	540.94		541.20	0.006627	4.06	52.23	21.81	0.46
TWI000A	106	01JAN2012 1800	183.16	537.10	540.70		540.94	0.006729	3.90	46.99	21.22	0.46
TWI000A	106	01JAN2012 1900	152.80	537.10	540.43		540.64	0.006863	3.70	41.26	20.56	0.46
TWI000A	106	01JAN2012 2000	125.12	537.10	540.15		540.34	0.007044	3.50	35.74	19.90	0.46
TWI000A	106	01JAN2012 2100	113.19	537.10	540.02		540.20	0.007217	3.41	33.15	19.59	0.46
TWI000A	106	01JAN2012 2200	105.50	537.10	539.93		540.11	0.007375	3.36	31.40	19.38	0.47
TWI000A	106	01JAN2012 2300	99.33	537.10	539.86		540.03	0.007559	3.32	29.93	19.20	0.47
TWI000A	106	01JAN2012 2400	94.16	537.10	539.79		539.96	0.007705	3.28	28.71	19.06	0.47
TWI000A	87	Max WS	4432.39	536.80	551.12	549.27	552.45	0.004988	10.47	735.89	189.58	0.52
TWI000A	87	31DEC2011 2400	3.17	536.80	537.57	537.29	537.59	0.005357	1.14	2.79	7.21	0.32
TWI000A	87	01JAN2012 0100	28.17	536.80	538.56	537.98	538.63	0.005046	2.04	13.78	13.88	0.36
TWI000A	87	01JAN2012 0200	51.85	536.80	539.06	538.28	539.15	0.005018	2.43	21.31	16.25	0.37
TWI000A	87	01JAN2012 0300	63.59	536.80	539.26	538.41	539.37	0.005016	2.58	24.68	17.21	0.38
TWI000A	87	01JAN2012 0400	68.70	536.80	539.35	538.46	539.45	0.005018	2.63	26.10	17.59	0.38
TWI000A	87	01JAN2012 0500	72.85	536.80	539.41	538.51	539.52	0.005023	2.68	27.22	17.89	0.38
TWI000A	87	01JAN2012 0600	77.70	536.80	539.48	538.55	539.60	0.005008	2.72	28.55	18.24	0.38
TWI000A	87	01JAN2012 0700	88.69	536.80	539.64	538.65	539.76	0.005018	2.82	31.41	18.97	0.39
TWI000A	87	01JAN2012 0800	110.56	536.80	539.92	538.84	540.06	0.005011	3.00	36.91	20.30	0.39
TWI000A	87	01JAN2012 0900	132.96	536.80	540.16	539.01	540.32	0.005012	3.17	41.97	21.13	0.40
TWI000A	87	01JAN2012 1000	171.59	536.80	540.53	539.28	540.71	0.005006	3.43	50.00	22.14	0.40
TWI000A	87	01JAN2012 1100	242.96	536.80	541.13	539.70	541.35	0.005005	3.82	63.66	23.74	0.41
TWI000A	87	01JAN2012 1200	598.36	536.80	543.10	541.13	543.52	0.005001	5.23	115.15	28.01	0.44
TWI000A	87	01JAN2012 1300	1909.71	536.80	547.25	544.26	548.24	0.005003	8.17	269.10	67.35	0.49
TWI000A	87	01JAN2012 1400	541.95	536.80	542.85	540.95	543.24	0.005004	5.03	108.18	27.57	0.44
TWI000A	87	01JAN2012 1500	341.95	536.80	541.83	540.17	542.10	0.005006	4.22	80.95	25.64	0.42
TWI000A	87	01JAN2012 1600	260.11	536.80	541.26	539.79	541.49	0.005006	3.90	66.77	24.09	0.41
TWI000A	87	01JAN2012 1700	212.15	536.80	540.88	539.53	541.09	0.005004	3.66	57.92	23.08	0.41
TWI000A	87	01JAN2012 1800	183.18	536.80	540.63	539.35	540.83	0.005009	3.50	52.30	22.42	0.40
TWI000A	87	01JAN2012 1900	152.85	536.80	540.36	539.15	540.53	0.005010	3.31	46.17	21.66	0.40
TWI000A	87	01JAN2012 2000	125.14	536.80	540.08	538.96	540.23	0.005011	3.11	40.28	20.92	0.39
TWI000A	87	01JAN2012 2100	113.21	536.80	539.95	538.86	540.09	0.005026	3.02	37.51	20.44	0.39
TWI000A	87	01JAN2012 2200	105.51	536.80	539.85	538.80	539.99	0.005012	2.96	35.66	20.01	0.39
TWI000A	87	01JAN2012 2300	99.33	536.80	539.78	538.75	539.91	0.005017	2.91	34.12	19.64	0.39
TWI000A	87	01JAN2012 2400	94.16	536.80	539.71	538.70	539.84	0.005005	2.87	32.84	19.33	0.39

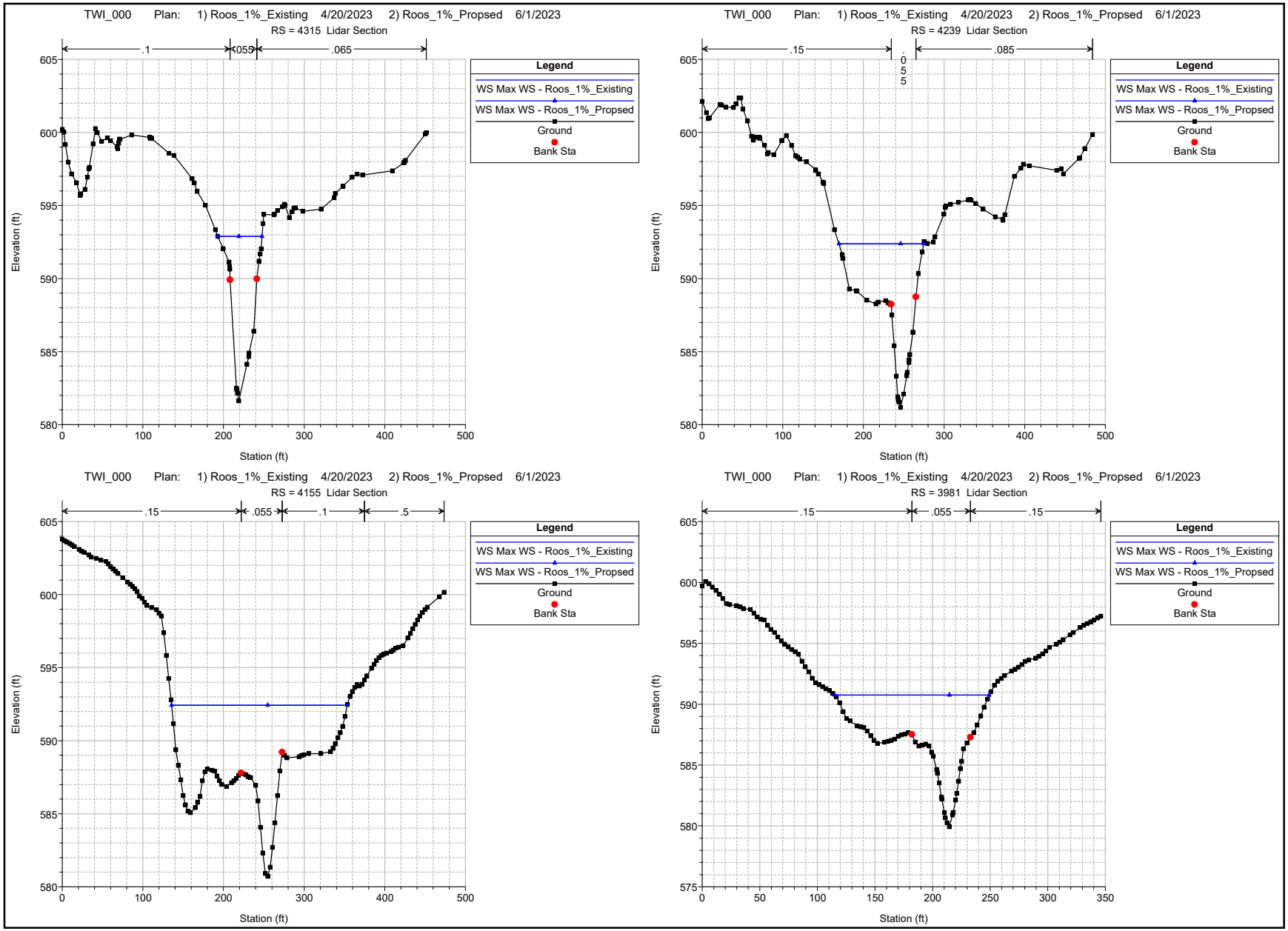

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6594 Lidar Section
.5
.15
.05
.075
Legend
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6562 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6532 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6498 Lidar Section
.15
.05
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

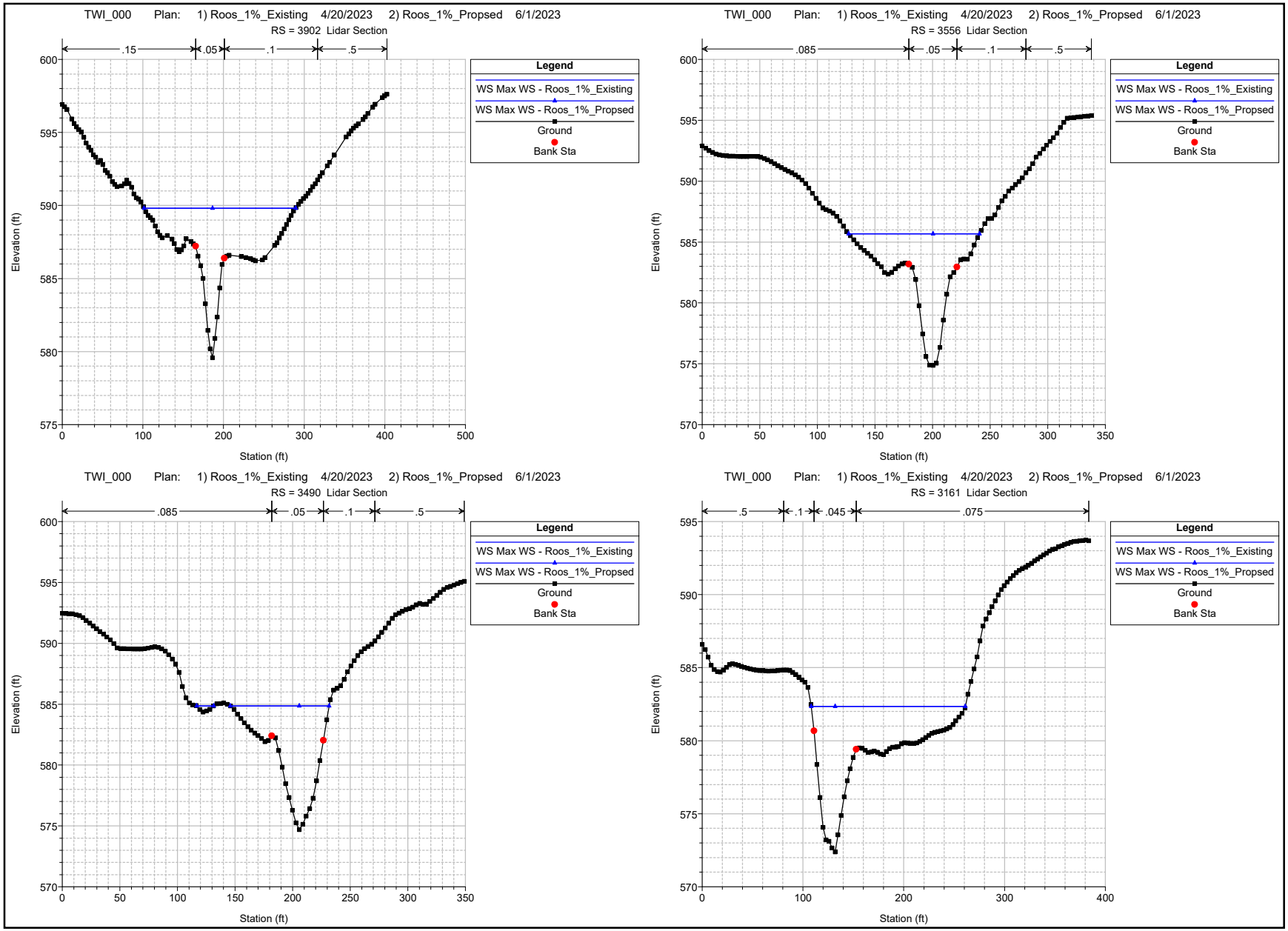

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6438 Lidar Section
.15
.05
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6319 Lidar Section
.15
.05
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6249 Survey Section
.15
.055
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6218 Survey Section
.15
.055
.15
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta

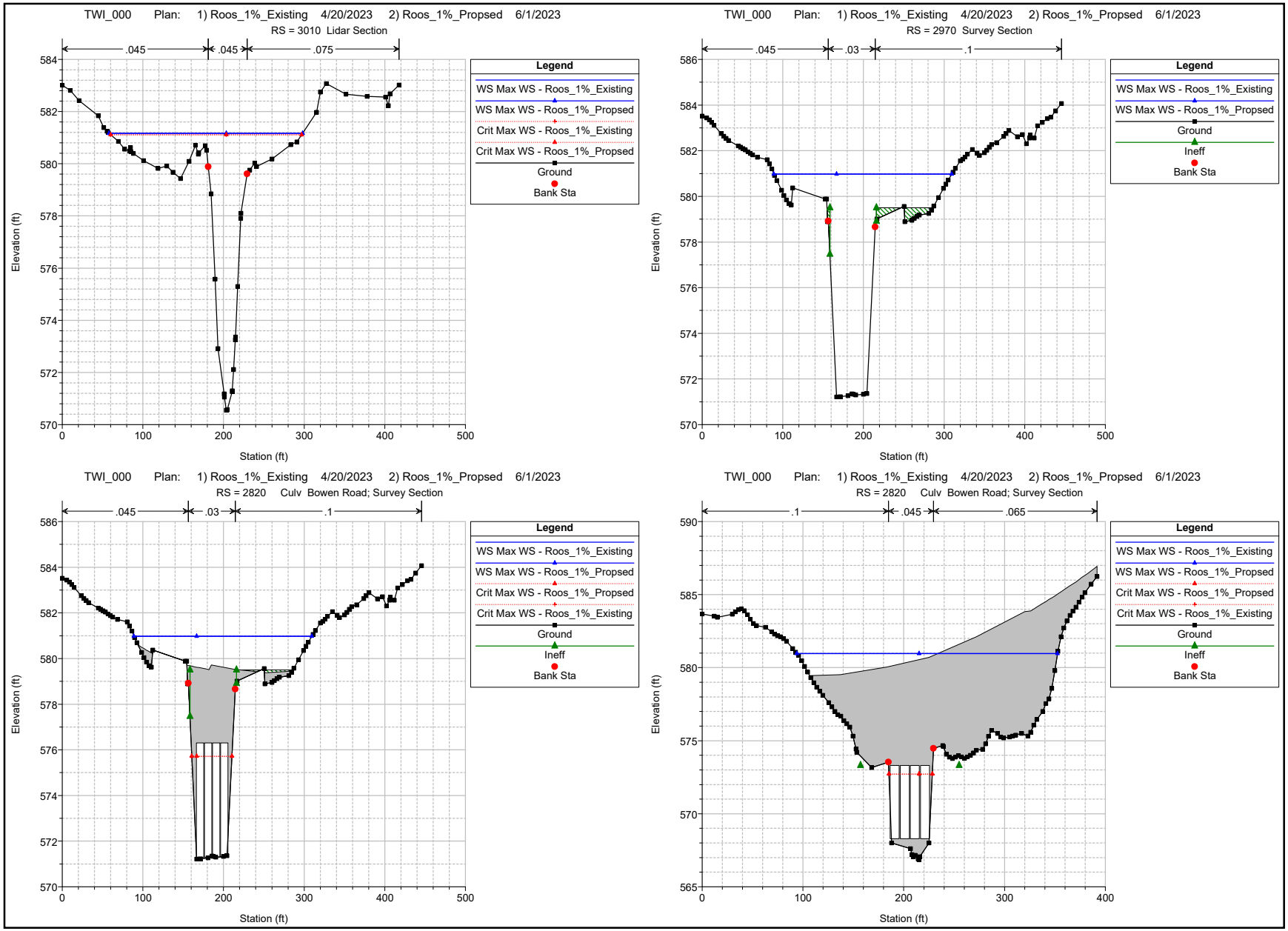

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6179 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6133 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 6059 Survey Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5935 Lidar Section
.5
.15
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

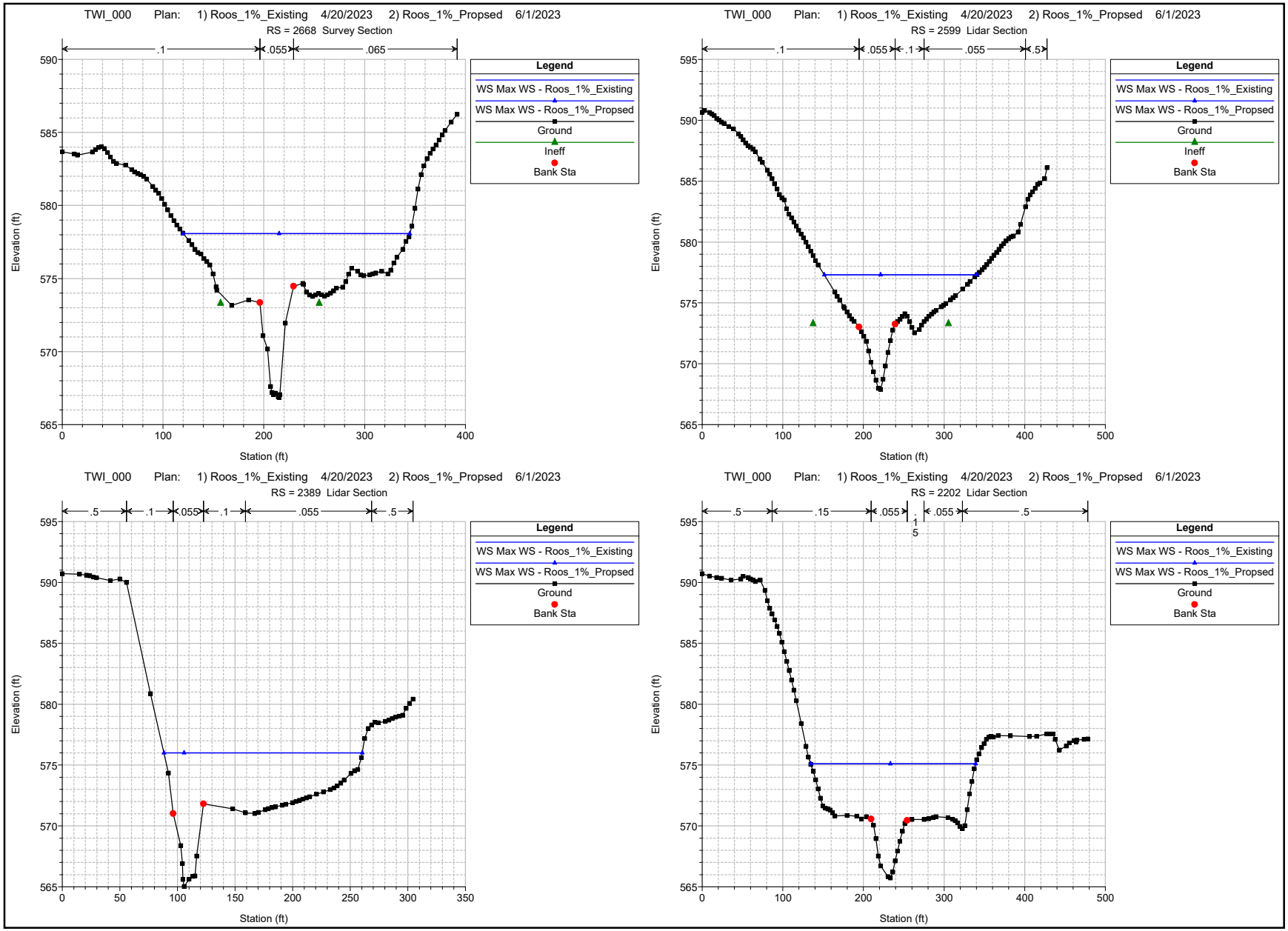

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5676 Lidar Section
.5
.15
.055
.15
.045
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5466 Lidar Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5296 Lidar Section
.15
.055
.11
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 5079 Lidar Section
.15
.05
.085
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

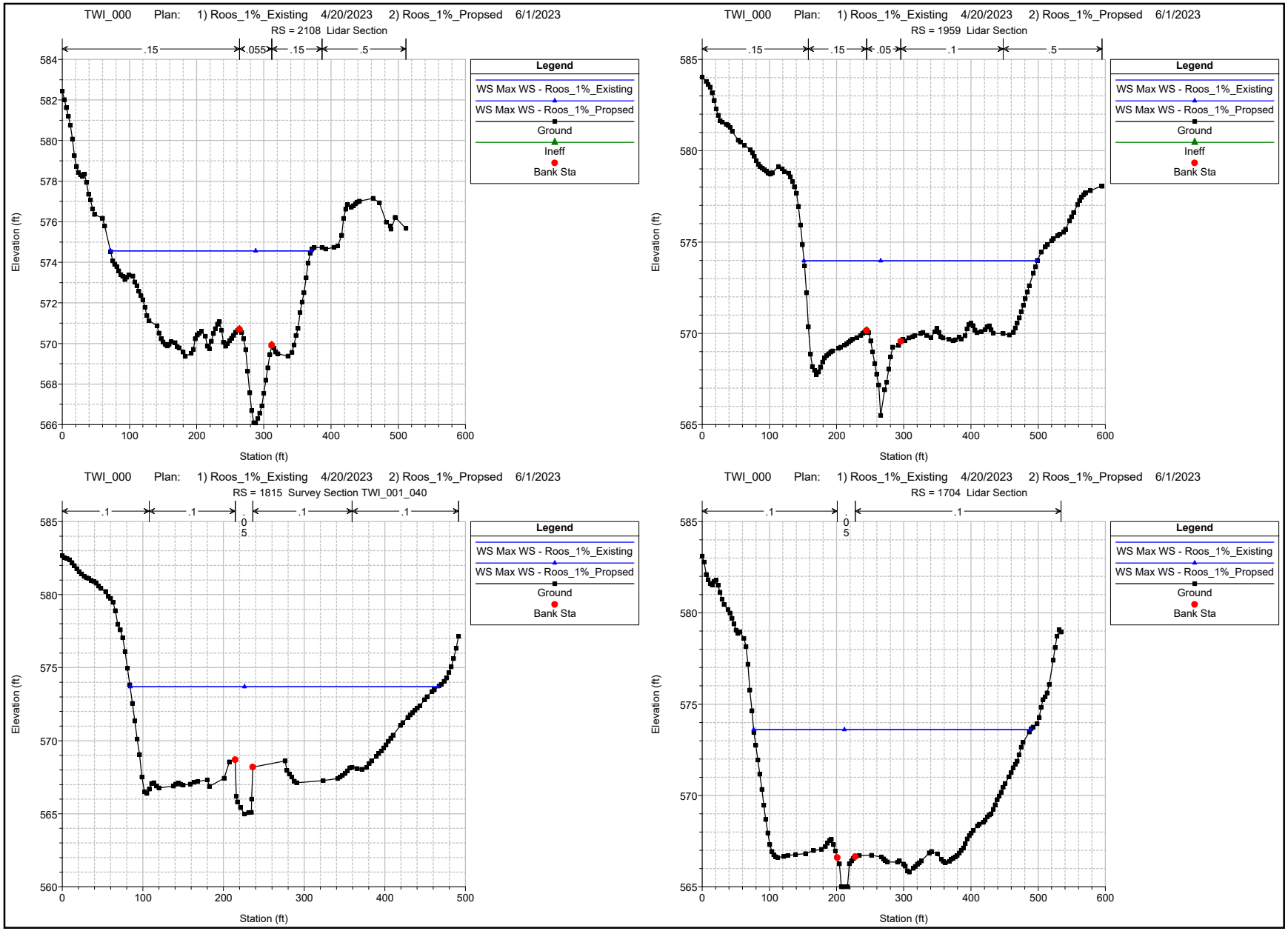

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4954 Lidar Section
.1
.05
.085
.5
Legend
WS Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4851 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4630 Lidar Section
.1
.055
.065
.055
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4515 Lidar Section
.1
.055
.055
.065
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

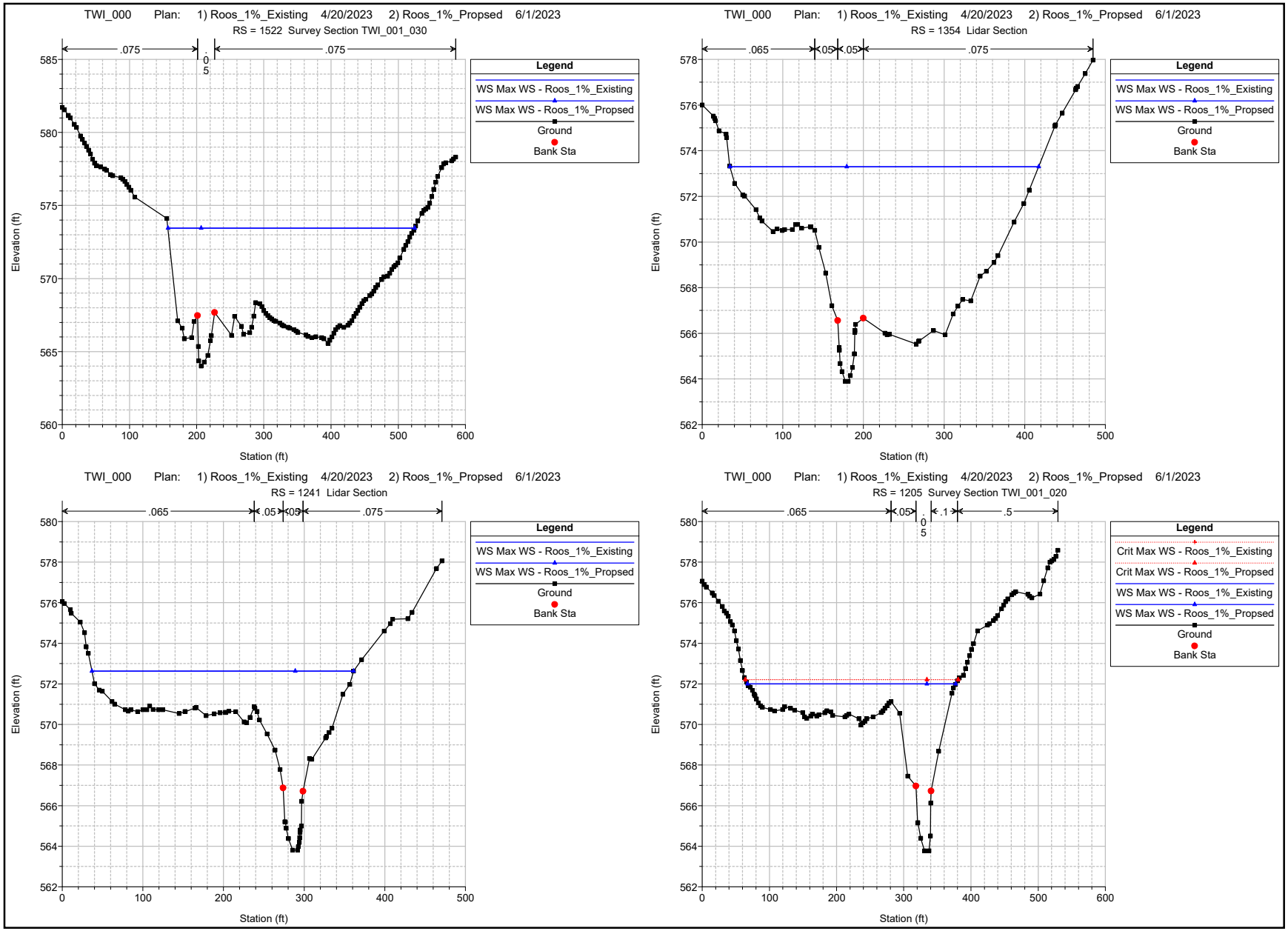

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4315 Lidar Section
.1
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4239 Lidar Section
.15
.055
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 4155 Lidar Section
.15
.055
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3981 Lidar Section
.15
.055
.15
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

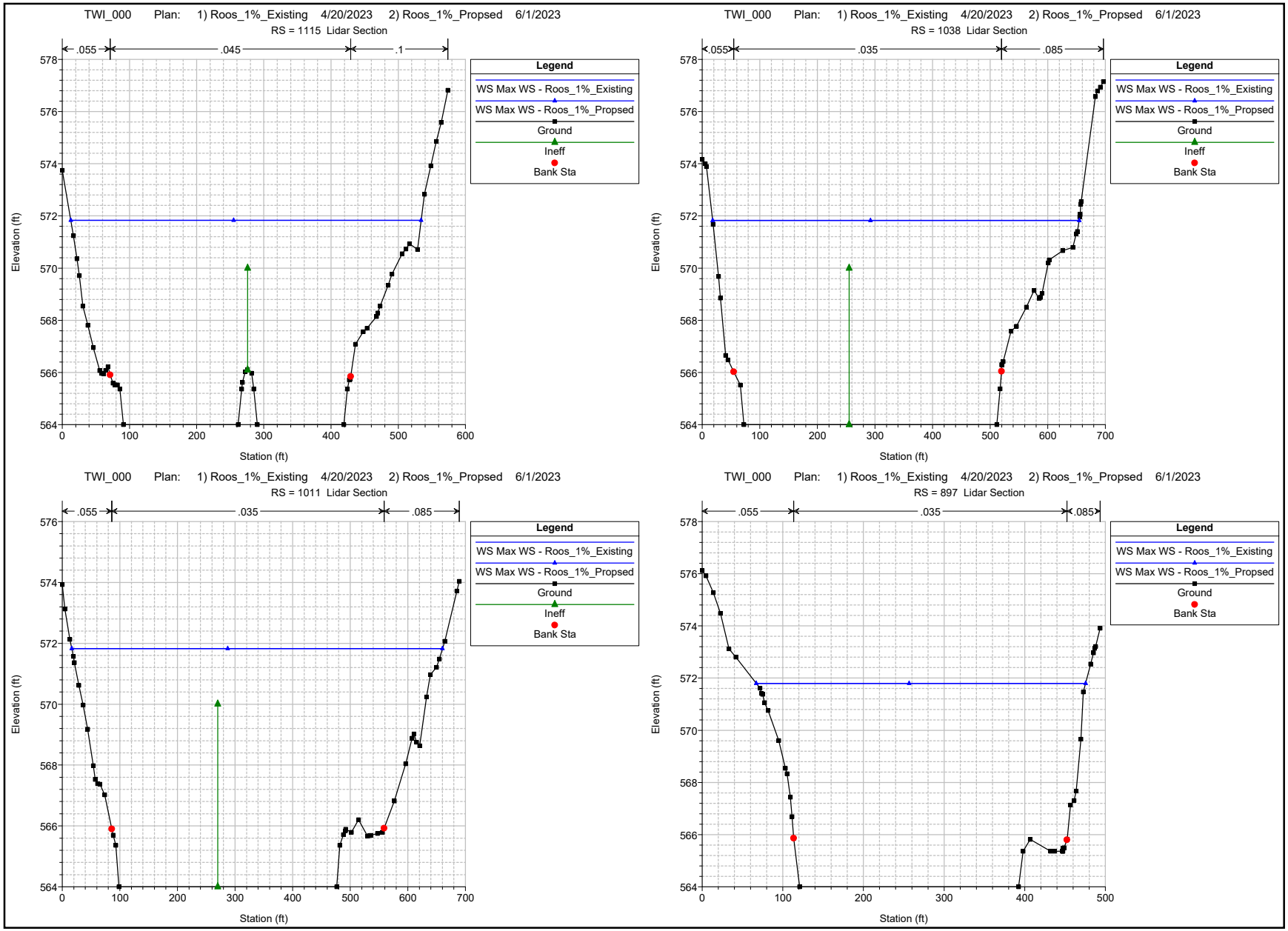

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3902 Lidar Section
.15
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3556 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3490 Lidar Section
.085
.05
.1
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3161 Lidar Section
.5
.1
.045
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

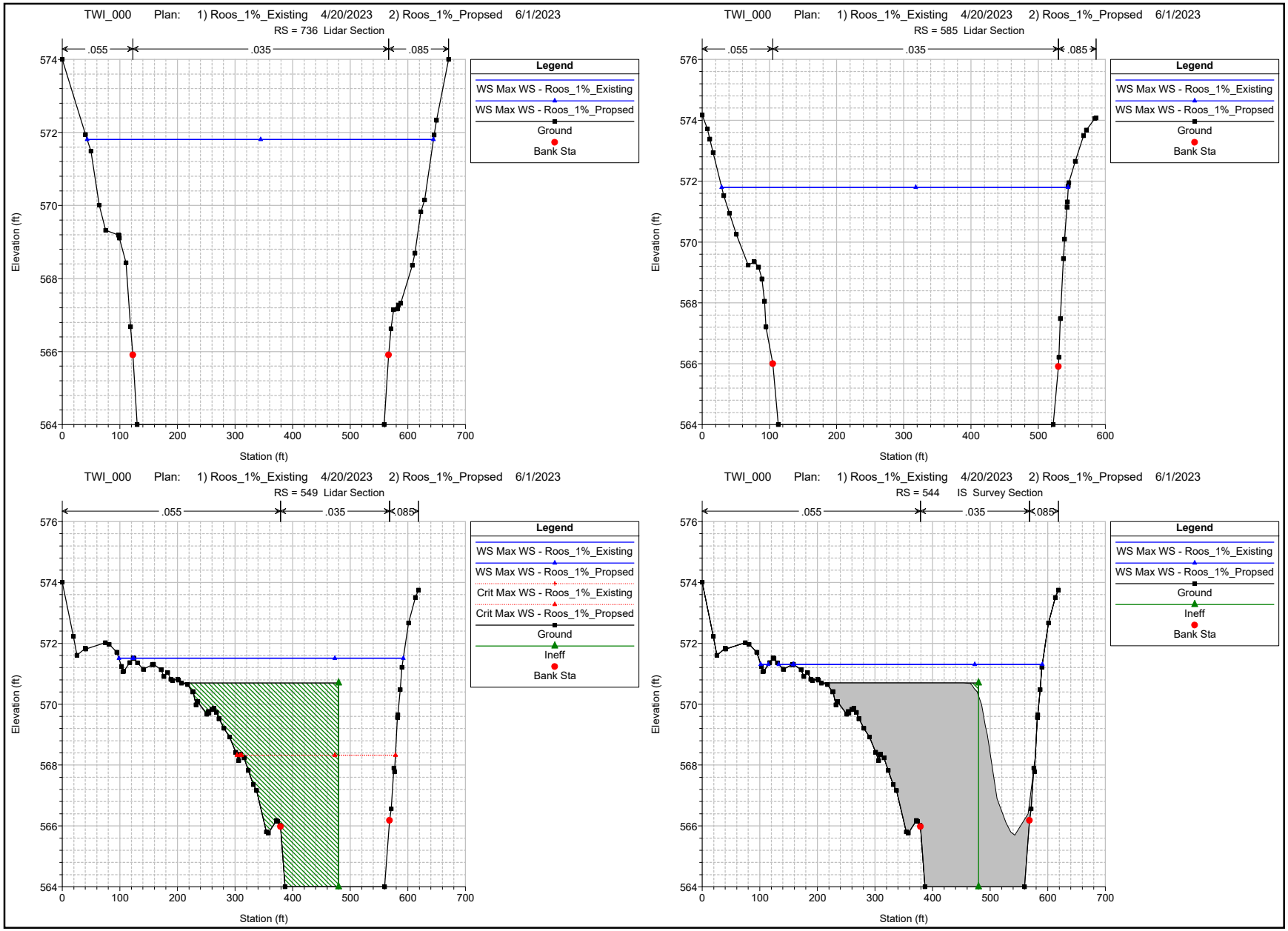

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 3010 Lidar Section
.045
.045
.075
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2970 Survey Section
.045
.03
.1
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2820 Culv Bowen Road; Survey Section
.045
.03
.1
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Ineff
Bank Sta
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2820 Culv Bowen Road; Survey Section
.1
.045
.065
Elevation (ft)
Station (ft)
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Ineff
Bank Sta

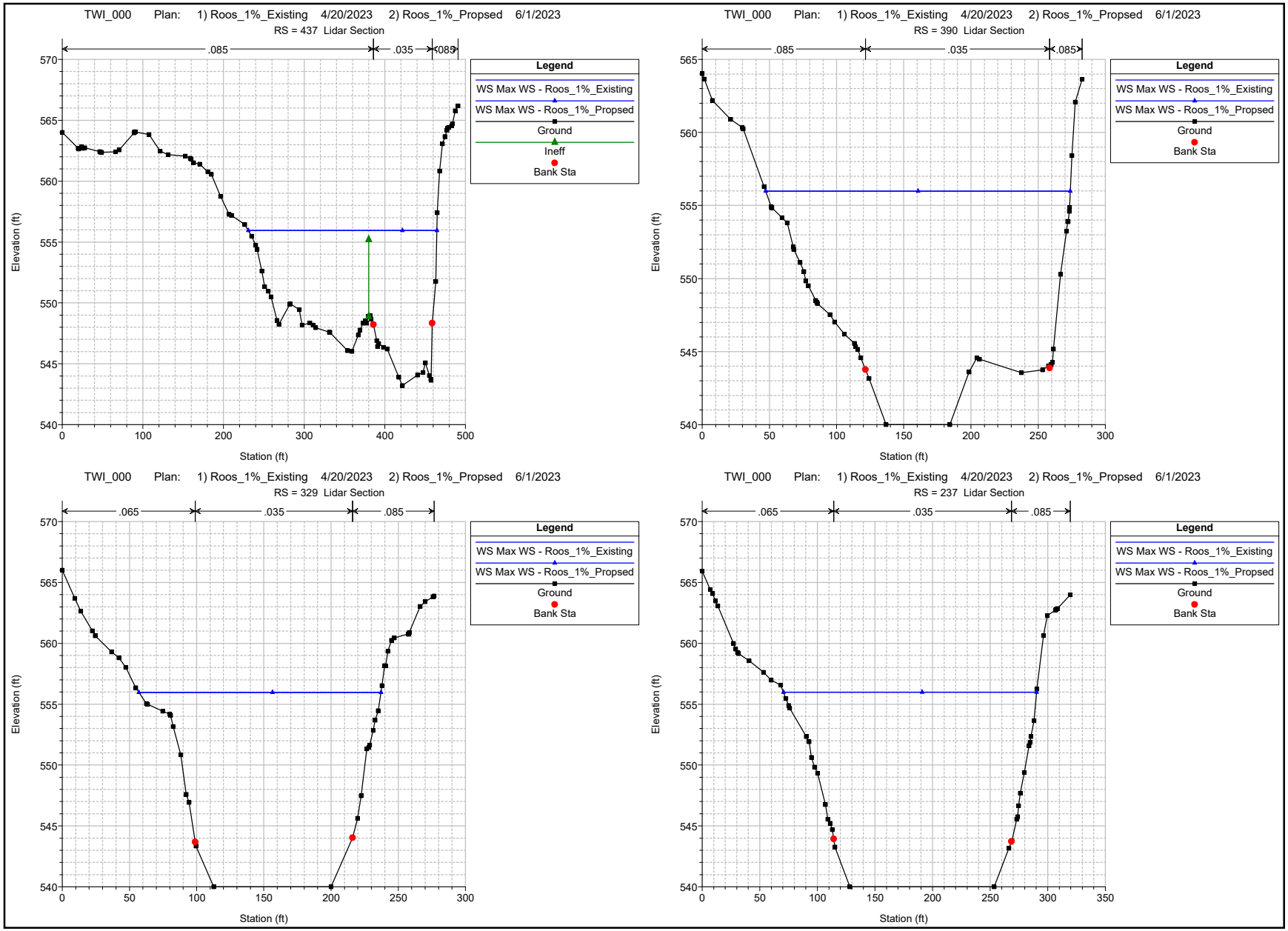

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2668 Survey Section
.1
.055
.065
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2599 Lidar Section
.1
.055
.1
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2389 Lidar Section
.5
.1
.055
.1
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2202 Lidar Section
.5
.15
.055
.1
.055
.5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

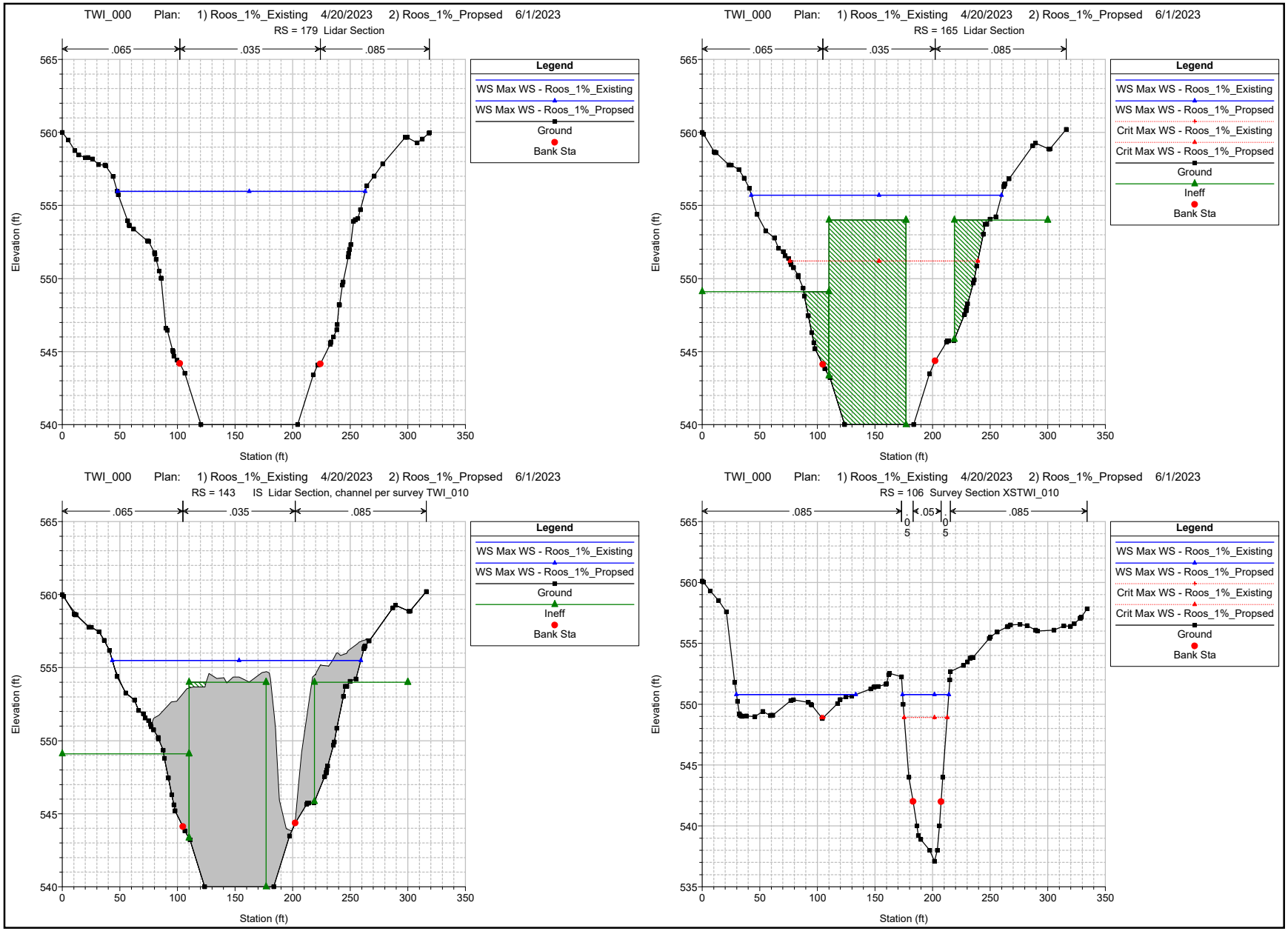

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 2108 Lidar Section
.15 .055 .15 .5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1959 Lidar Section
.15 .15 .05 .1 .5
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1815 Survey Section TWI_001_040
.1 .1 .05 .1 .1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1704 Lidar Section
.1 .05 .1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

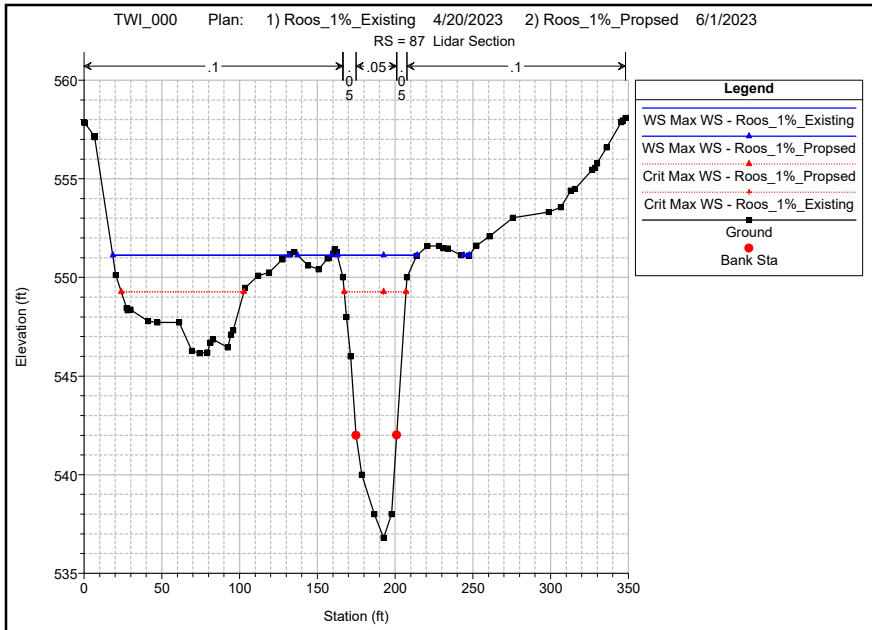

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1522 Survey Section TWI_001_030
.075
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1354 Lidar Section
.065
.05
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1241 Lidar Section
.065
.05
.05
.075
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1205 Survey Section TWI_001_020
.065
.05
.05
.1
.5
Legend
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)

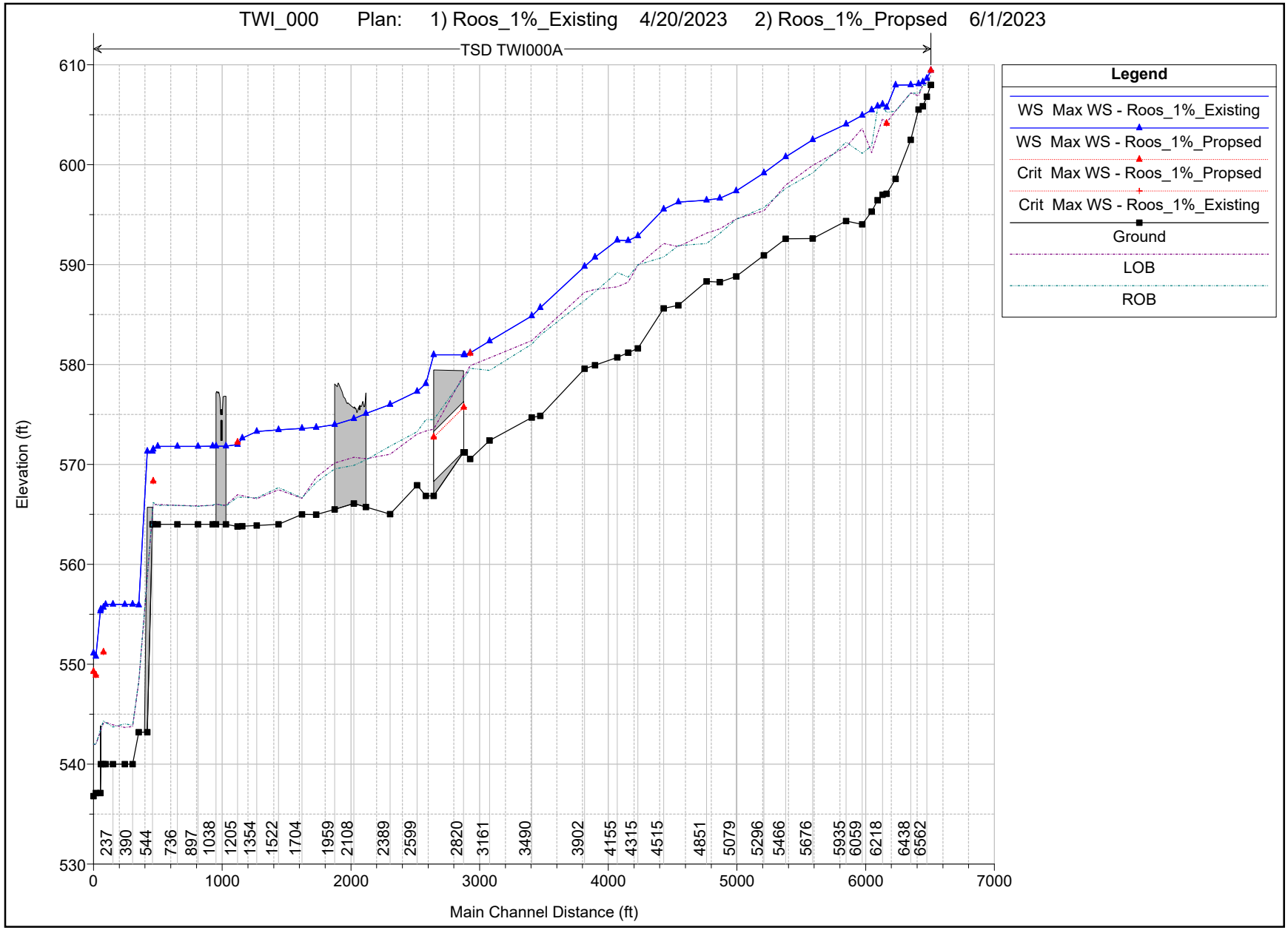

TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1115 Lidar Section
.055
.045
.1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1038 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 1011 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 897 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 736 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 585 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 549 Lidar Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 544 IS Survey Section
.055
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 437 Lidar Section
.085
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 390 Lidar Section
.085
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 329 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 237 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 179 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 165 Lidar Section
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 143 IS Lidar Section, channel per survey TWI_010
.065
.035
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 106 Survey Section XSTWI_010
.085
.05
.085
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Crit Max WS - Roos_1%_Propsed
Ground
Bank Sta
Elevation (ft)
Station (ft)


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
RS = 87 Lidar Section
.1
.05
.1
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
Bank Sta
Elevation (ft)
Station (ft)
560
555
550
545
540
535
0
50
100
150
200
250
300
350


TWI_000 Plan: 1) Roos_1%_Existing 4/20/2023 2) Roos_1%_Propsed 6/1/2023
TSD TWI000A
Legend
WS Max WS - Roos_1%_Existing
WS Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Propsed
Crit Max WS - Roos_1%_Existing
Ground
LOB
ROB
Elevation (ft)
610
600
590
580
570
560
550
540
530
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)
237
390
544
736
897
1038
1205
1354
1522
1704
1959
2108
2389
2599
2820
3161
3490
3902
4155
4315
4515
4851
5079
5296
5466
5676
5935
6059
6218
6438
6562

TWIN SPRINGS DRAW TRIBUTARY 2

(HEC-RAS VERSION 6.3)

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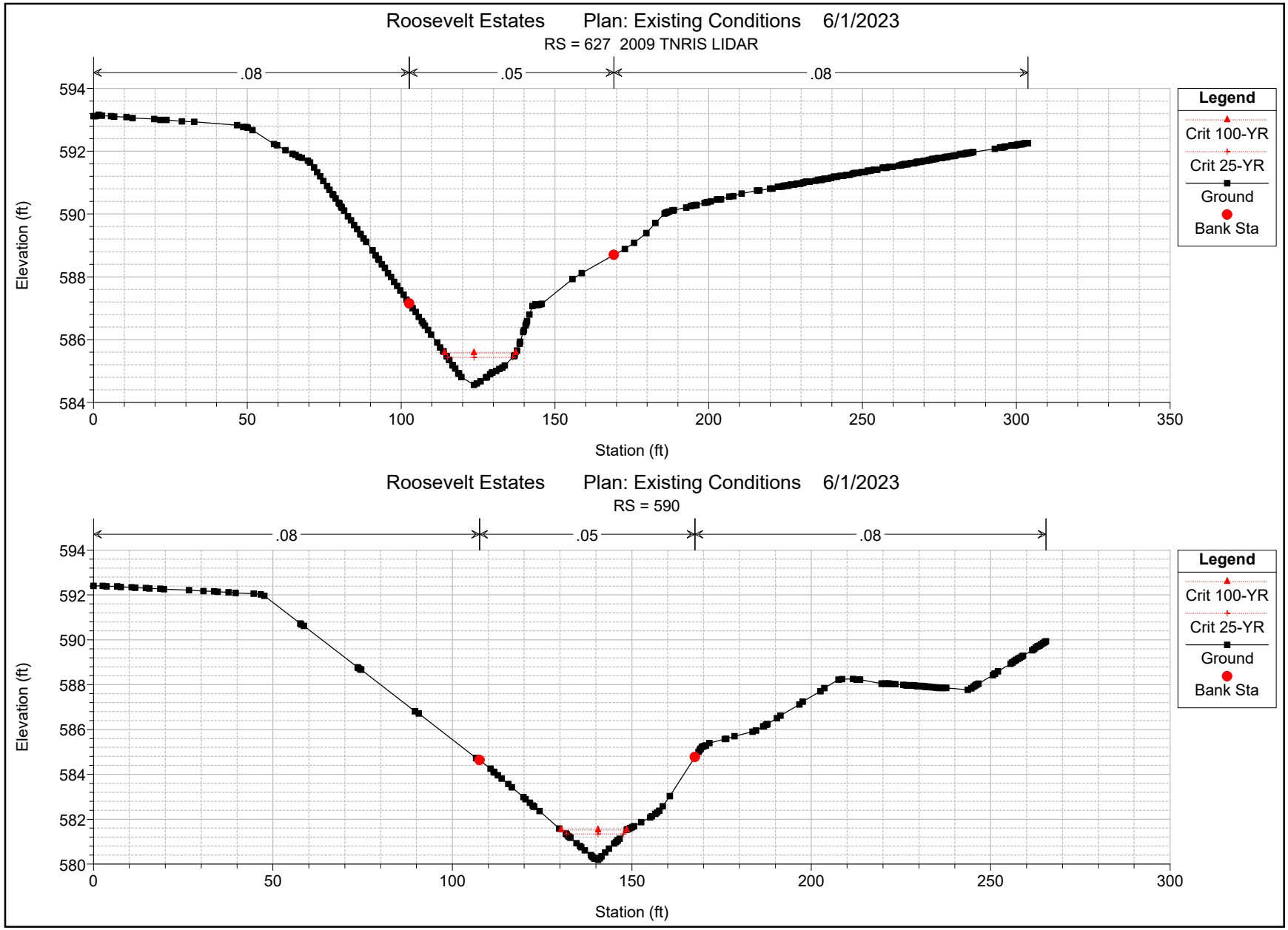
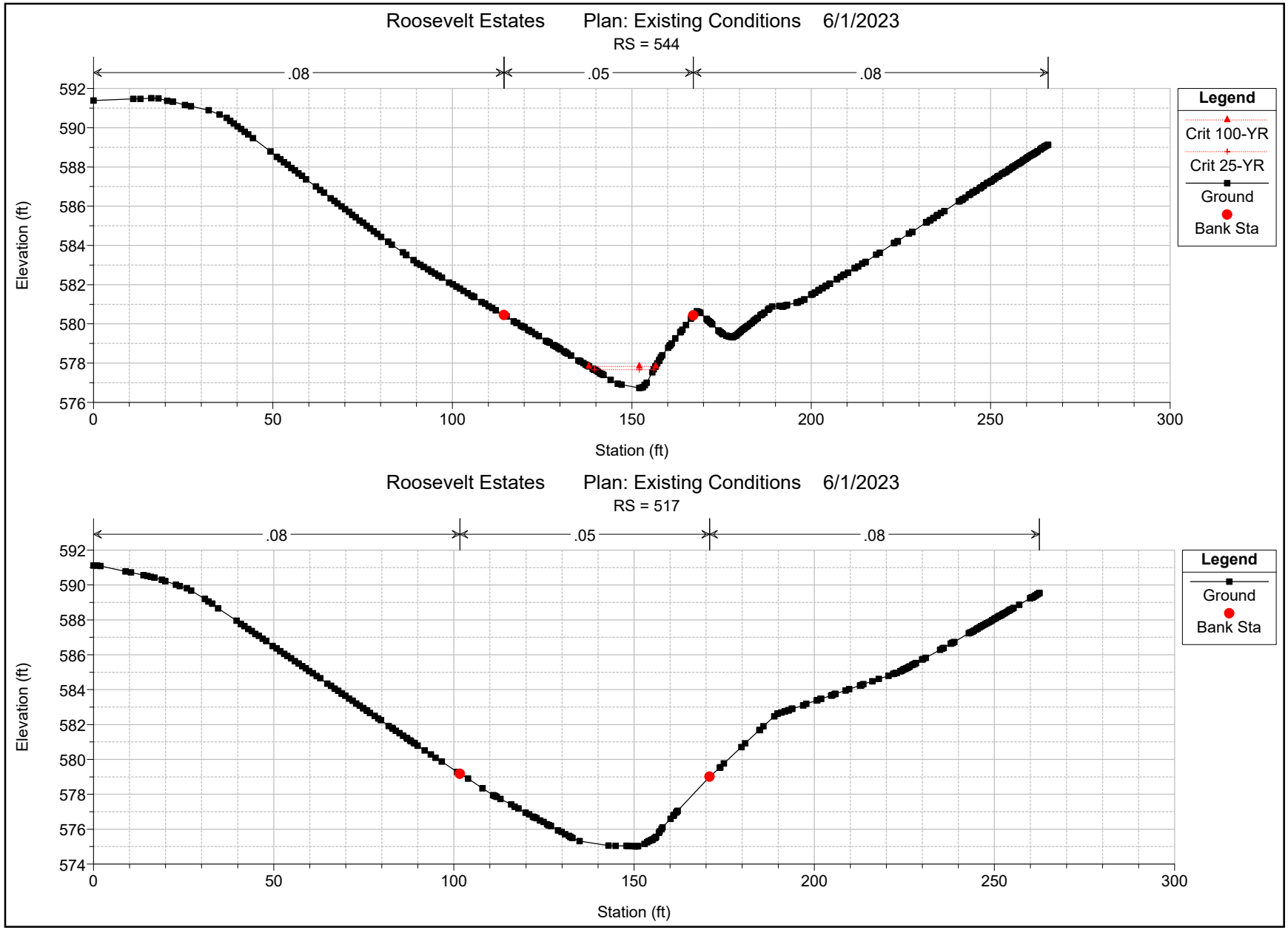
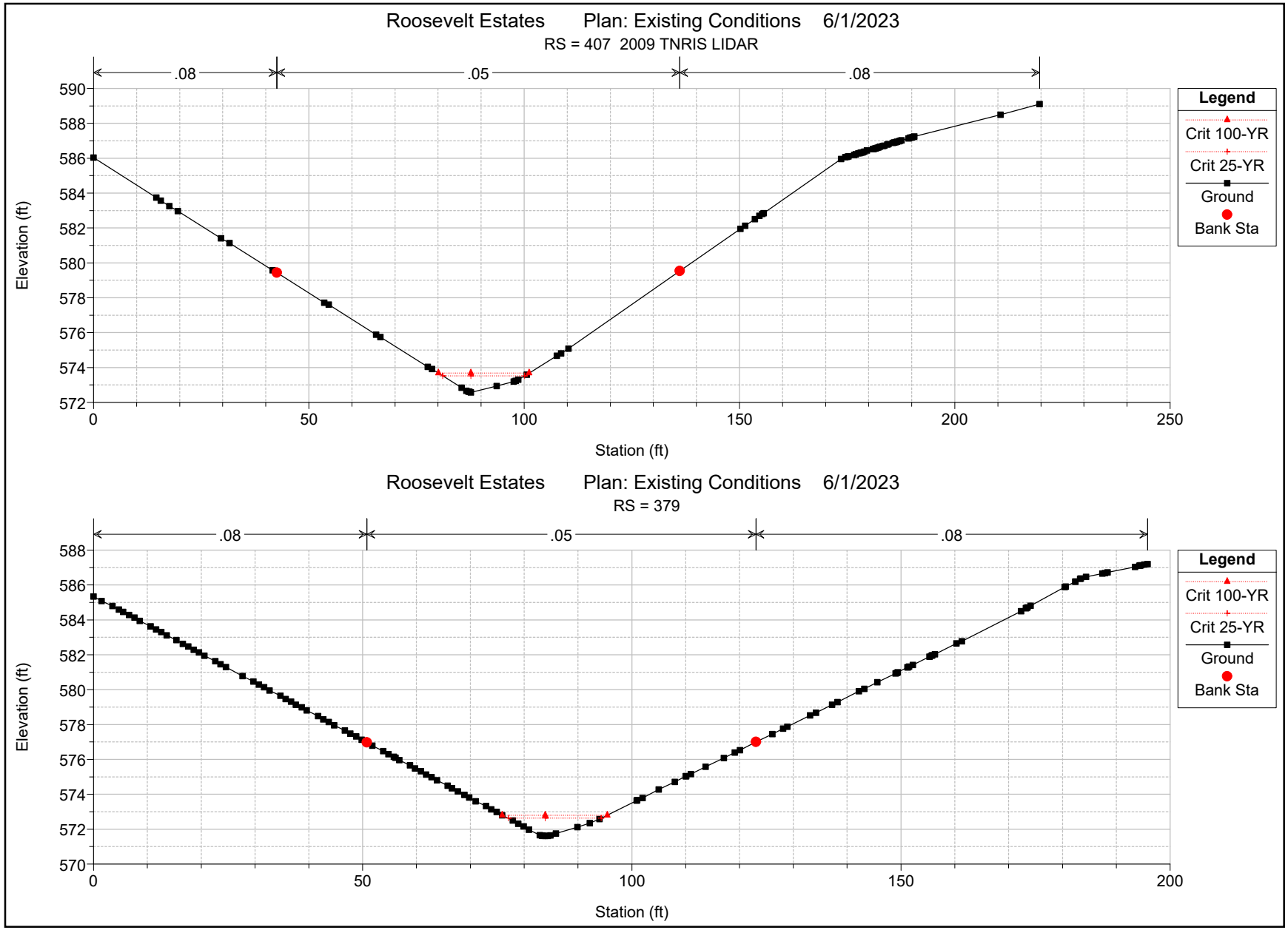
TBPE FIRM #F-11039 | TBPLS FIRM #10193890

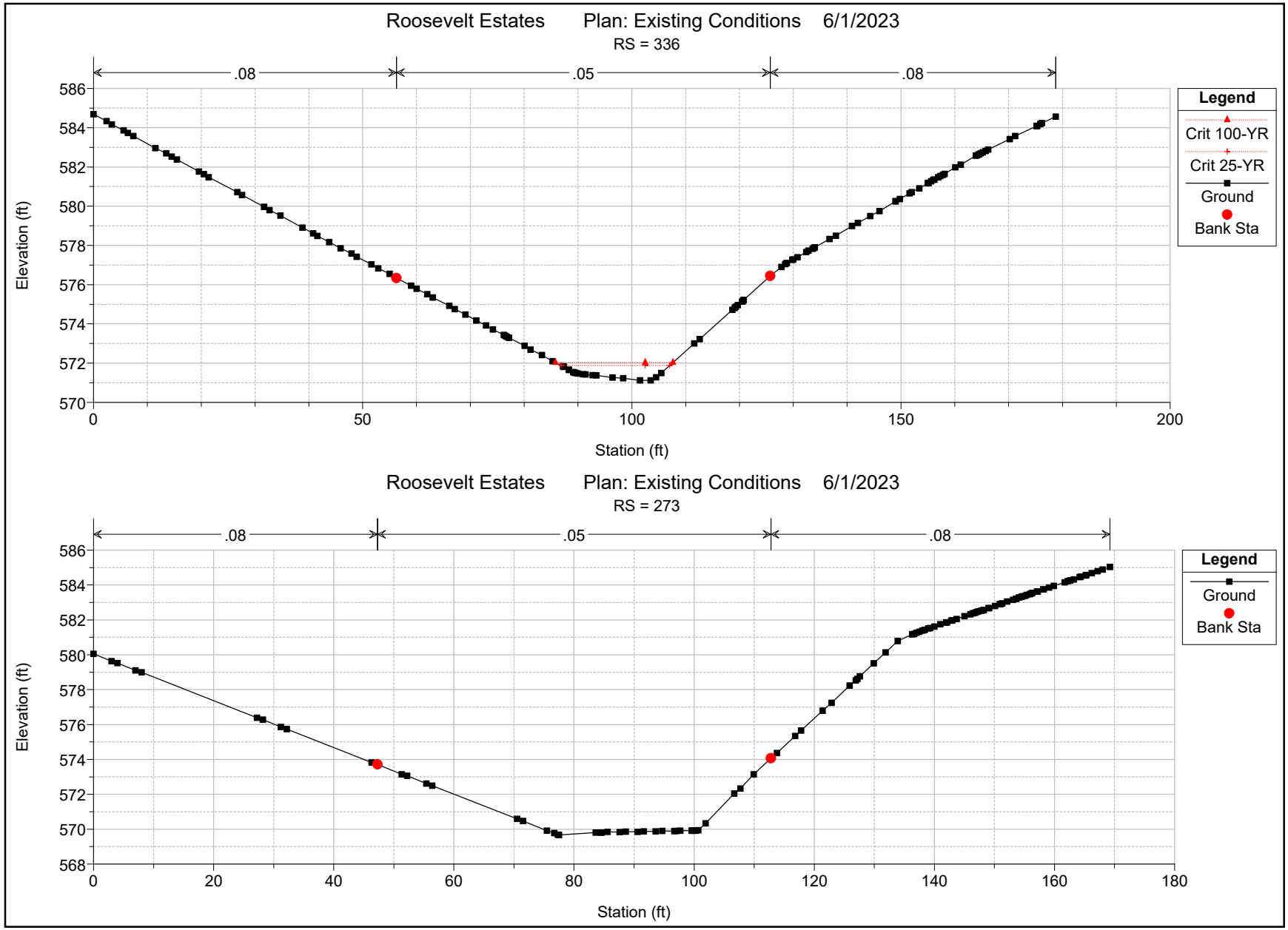
HEC-RAS Plan: Exist River: River 1 Reach: Reach 1

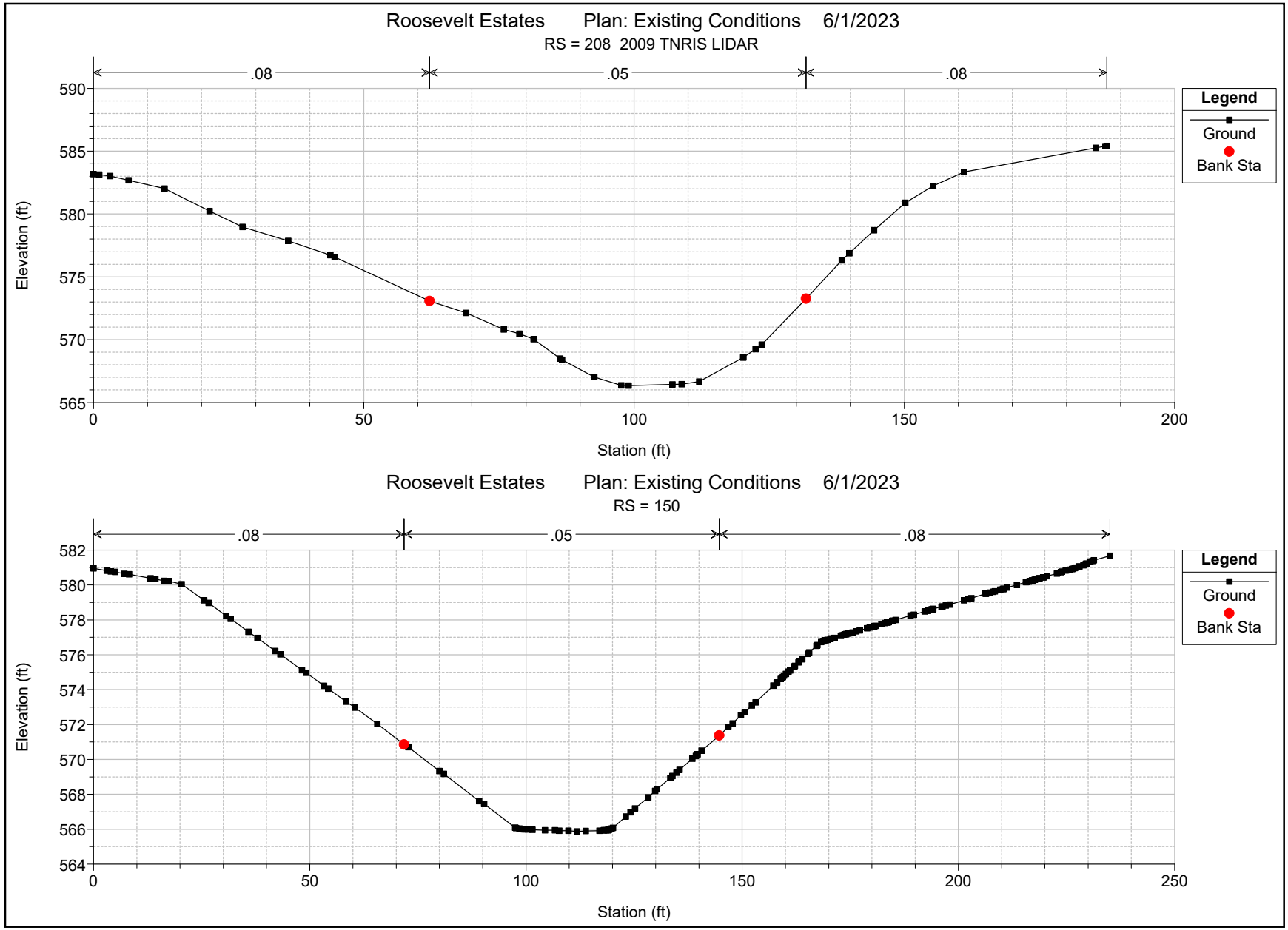
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	627	25-YR	42.44	584.56	585.43	585.43	585.69	0.047281	4.03	10.52	21.24	1.01
Reach 1	627	100-YR	60.37	584.56	585.57	585.57	585.88	0.044966	4.42	13.67	23.19	1.01
Reach 1	590	25-YR	42.44	580.19	581.34	581.34	581.65	0.045034	4.46	9.53	15.87	1.01
Reach 1	590	100-YR	60.37	580.19	581.52	581.52	581.87	0.042768	4.77	12.64	18.26	1.01
Reach 1	544	25-YR	42.44	576.74	577.67	577.67	577.97	0.044905	4.38	9.69	16.51	1.01
Reach 1	544	100-YR	60.37	576.74	577.84	577.84	578.19	0.043284	4.75	12.71	18.65	1.01
Reach 1	517	25-YR	42.44	575.02	575.90		575.99	0.011576	2.37	17.92	27.99	0.52
Reach 1	517	100-YR	60.37	575.02	576.07		576.18	0.011699	2.66	22.68	29.95	0.54
Reach 1	407	25-YR	42.44	572.57	573.52	573.52	573.79	0.046624	4.19	10.12	19.03	1.01
Reach 1	407	100-YR	60.37	572.57	573.68	573.68	574.00	0.043963	4.55	13.25	21.07	1.01
Reach 1	379	25-YR	42.44	571.61	572.90		573.03	0.014118	2.83	15.00	20.73	0.59
Reach 1	379	100-YR	60.37	571.61	573.53		573.59	0.004152	1.98	30.48	28.70	0.34
Reach 1	336	25-YR	42.44	571.12	572.82		572.85	0.001497	1.24	34.32	30.46	0.21
Reach 1	336	100-YR	60.37	571.12	573.50		573.51	0.000735	1.05	57.33	37.93	0.15
Reach 1	273	25-YR	42.44	569.67	572.83		572.83	0.000053	0.36	118.99	55.18	0.04
Reach 1	273	100-YR	60.37	569.67	573.50		573.50	0.000048	0.38	158.32	62.22	0.04
Reach 1	208	25-YR	42.44	566.34	572.83		572.83	0.000005	0.16	264.01	67.02	0.01
Reach 1	208	100-YR	60.37	566.34	573.50		573.50	0.000006	0.19	310.81	72.35	0.02
Reach 1	150	25-YR	42.44	565.88	572.83		572.83	0.000002	0.11	383.25	89.83	0.01
Reach 1	150	100-YR	60.37	565.88	573.50		573.50	0.000002	0.14	445.73	96.72	0.01
Reach 1	89	25-YR	42.44	566.08	572.83		572.83	0.000000	0.06	659.92	122.63	0.00
Reach 1	89	100-YR	60.37	566.08	573.50		573.50	0.000001	0.08	743.85	127.93	0.01
Reach 1	57	25-YR	42.44	565.97	572.83	566.27	572.83	0.000000	0.05	896.35	159.58	0.00
Reach 1	57	100-YR	60.37	565.97	573.50	566.31	573.50	0.000000	0.06	1005.18	165.22	0.00

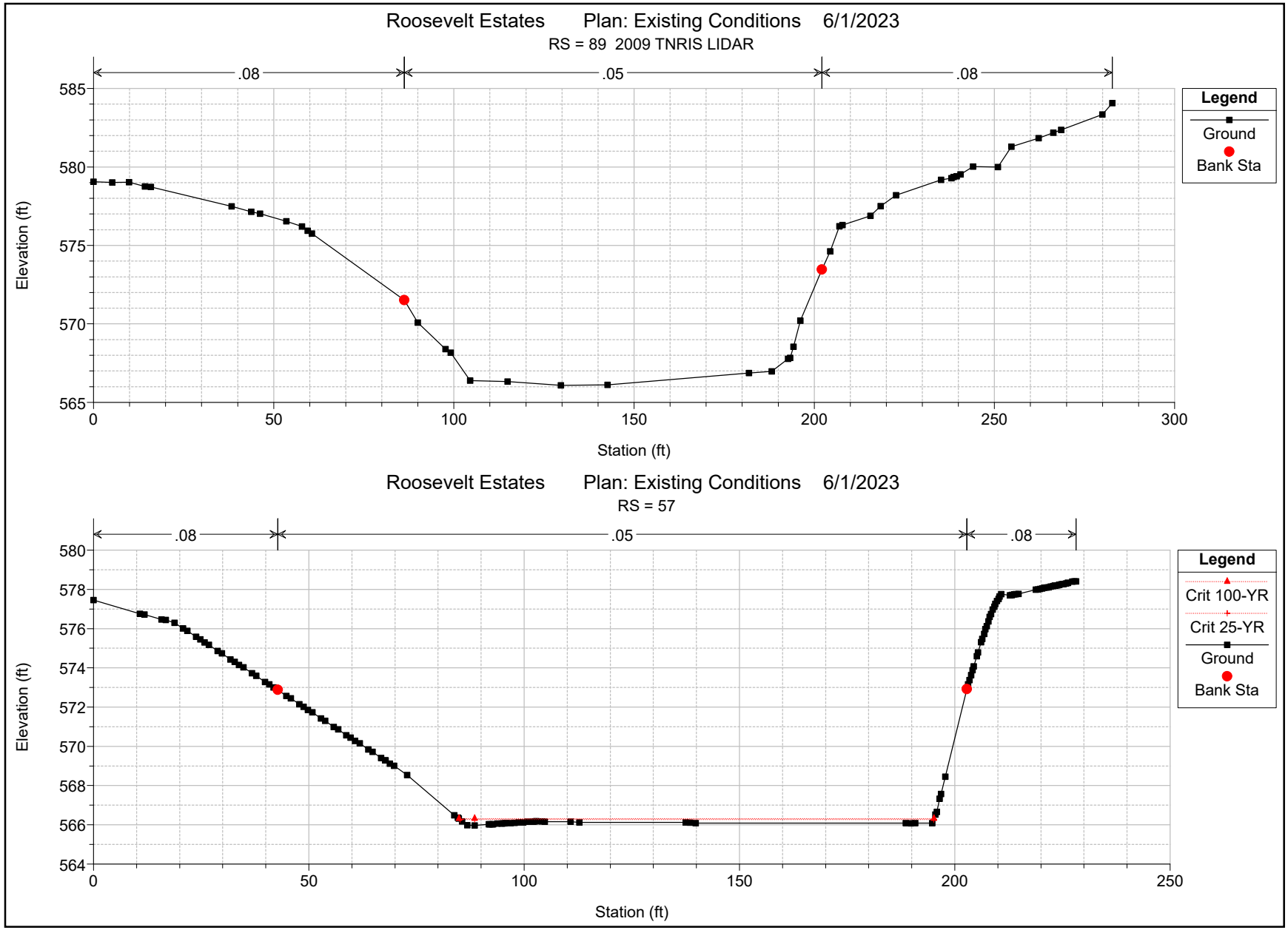

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 627 2009 TNRIS LIDAR
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 590
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta

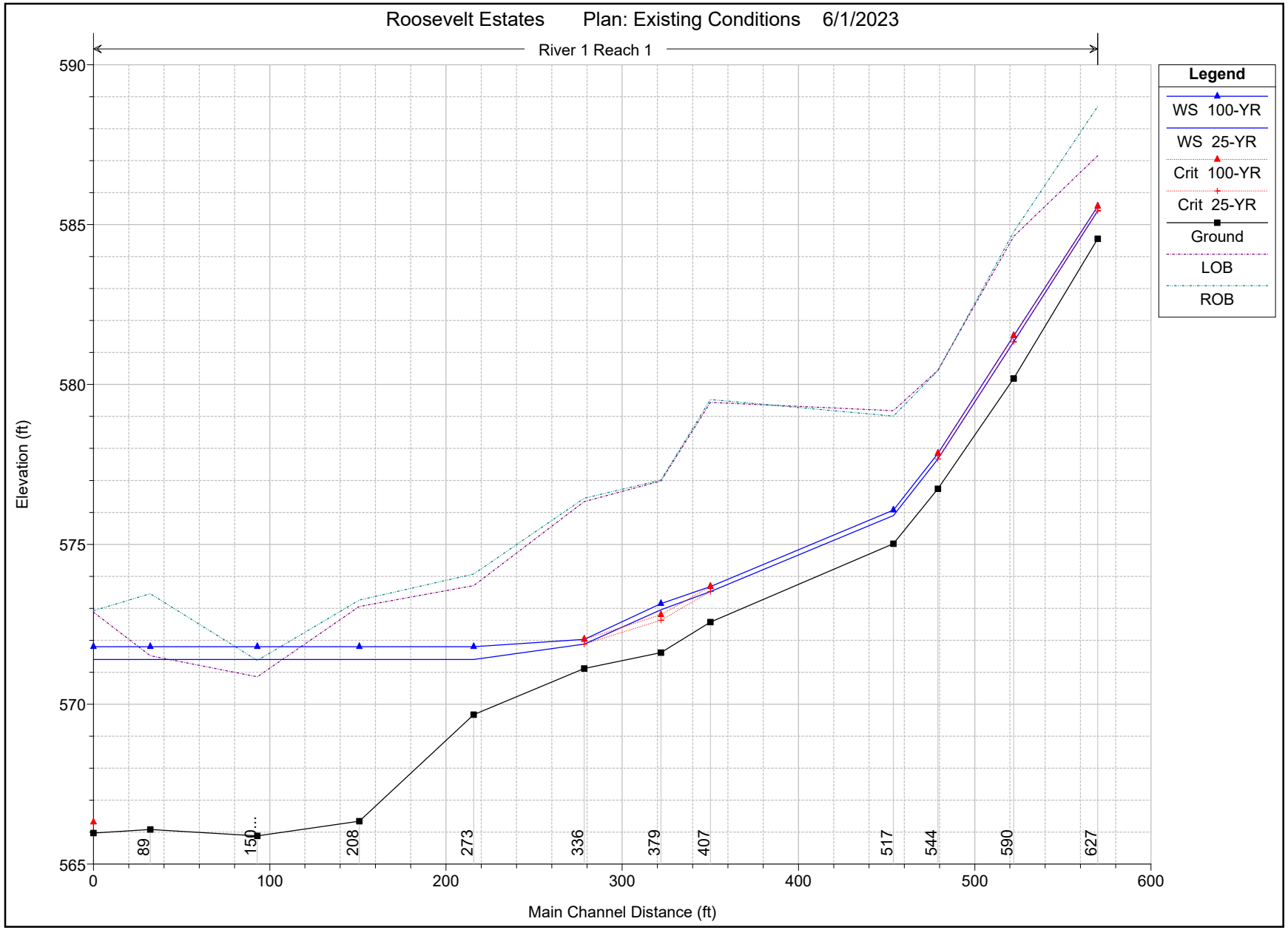

Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 544
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 517
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 407 2009 TNRIS LIDAR
.08
.05
.08
590
588
586
584
582
580
578
576
574
572
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 379
.08
.05
.08
588
586
584
582
580
578
576
574
572
570
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 336
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 273
.08
.05
.08
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 208 2009 TNRIS LIDAR
.08
.05
.08
590
585
580
575
570
565
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 150
.08
.05
.08
582
580
578
576
574
572
570
568
566
564
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 89 2009 TNRIS LIDAR
.08
.05
.08
585
580
575
570
565
0
50
100
150
200
250
300
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta
Roosevelt Estates Plan: Existing Conditions 6/1/2023
RS = 57
.08
.05
.08
580
578
576
574
572
570
568
566
564
0
50
100
150
200
250
Elevation (ft)
Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta


Roosevelt Estates Plan: Existing Conditions 6/1/2023
River 1 Reach 1
Legend
WS 100-YR
WS 25-YR
Crit 100-YR
Crit 25-YR
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
590
585
580
575
570
565
0
100
200
300
400
500
600
89
150
208
273
336
379
407
517
544
590
627

HEC-RAS Plan: Prop River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	627	25-YR	42.44	584.56	585.43	585.43	585.69	0.047265	4.03	10.52	21.24	1.01
Reach 1	627	100-YR	60.37	584.56	585.57	585.57	585.88	0.044993	4.42	13.66	23.18	1.01
Reach 1	590	25-YR	42.44	580.19	581.34	581.34	581.65	0.044336	4.43	9.58	15.91	1.01
Reach 1	590	100-YR	60.37	580.19	581.52	581.52	581.87	0.042607	4.77	12.66	18.28	1.01
Reach 1	544	25-YR	42.44	576.74	577.90		578.05	0.016735	3.05	13.92	19.47	0.64
Reach 1	544	100-YR	60.37	576.74	578.98		579.01	0.001739	1.43	42.07	33.33	0.23
Reach 1	517	25-YR	42.44	575.02	577.50	576.56	577.79	0.006338	4.31	9.85	48.94	0.48
Reach 1	517	100-YR	60.37	575.02	578.65	576.97	578.92	0.003554	4.17	14.47	63.66	0.39
Reach 1	454 Culvert Crossing		Culvert									
Reach 1	407	25-YR	42.44	572.57	573.53	573.53	573.86	0.041888	4.60	9.23	19.13	1.00
Reach 1	407	100-YR	60.37	572.57	573.70	573.70	574.12	0.039525	5.20	11.61	21.34	1.01
Reach 1	379	25-YR	42.44	571.61	572.96	572.63	573.07	0.011269	2.61	16.28	21.48	0.53
Reach 1	379	100-YR	60.37	571.61	573.16	572.81	573.29	0.011769	2.91	20.77	24.04	0.55
Reach 1	336	25-YR	42.44	571.12	571.88	571.88	572.14	0.046726	4.10	10.35	20.18	1.01
Reach 1	336	100-YR	60.37	571.12	572.03	572.03	572.34	0.043965	4.49	13.44	21.81	1.01
Reach 1	273	25-YR	65.36	569.67	571.39		571.42	0.001437	1.30	50.31	40.27	0.20
Reach 1	273	100-YR	92.98	569.67	571.79		571.82	0.001259	1.38	67.26	44.36	0.20
Reach 1	208	25-YR	65.36	566.34	571.40		571.40	0.000033	0.37	177.32	54.92	0.04
Reach 1	208	100-YR	92.98	566.34	571.80		571.80	0.000049	0.47	199.88	57.93	0.04
Reach 1	150	25-YR	65.36	565.88	571.40		571.40	0.000013	0.25	264.82	75.89	0.02
Reach 1	150	100-YR	92.98	565.88	571.80		571.80	0.000018	0.32	295.92	79.72	0.03
Reach 1	89	25-YR	65.36	566.08	571.40		571.40	0.000003	0.13	492.48	111.49	0.01
Reach 1	89	100-YR	92.98	566.08	571.80		571.80	0.000004	0.17	537.81	116.09	0.01
Reach 1	57	25-YR	65.36	565.97	571.40	566.32	571.40	0.000001	0.10	676.47	147.74	0.01
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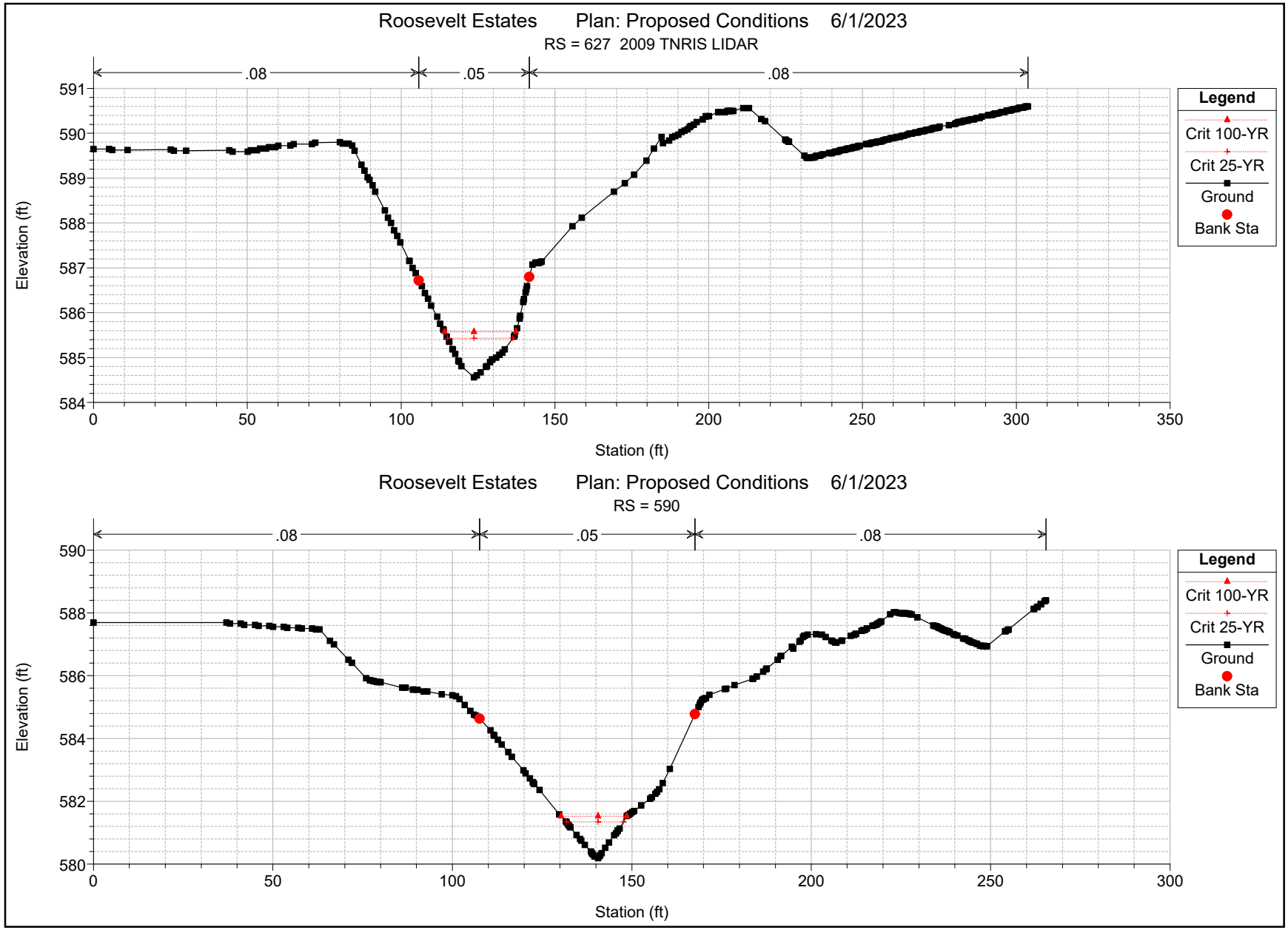
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Station (ft)
Legend
Crit 100-YR
Crit 25-YR
Ground
Bank Sta
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Station (ft)
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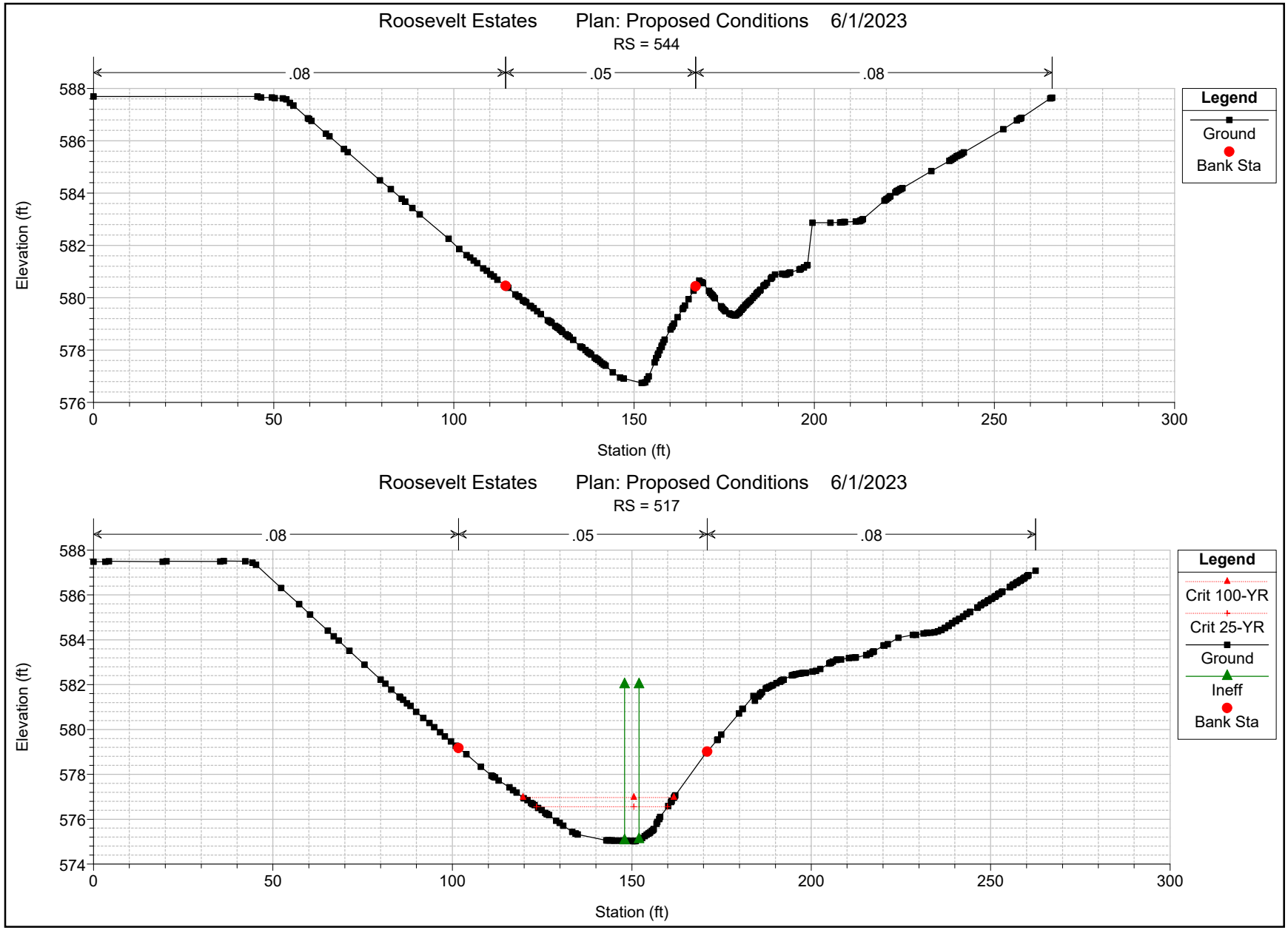
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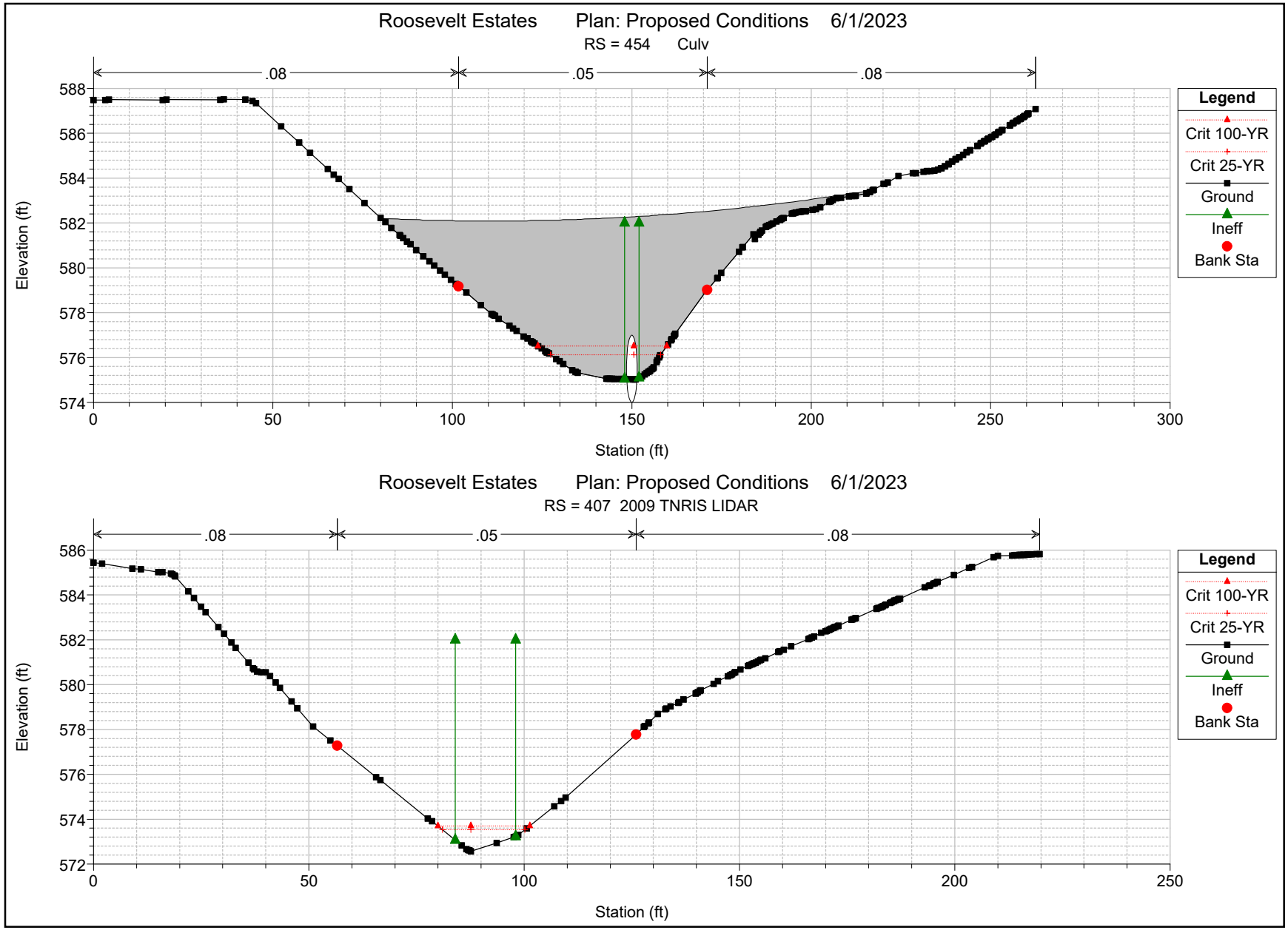
Bank Sta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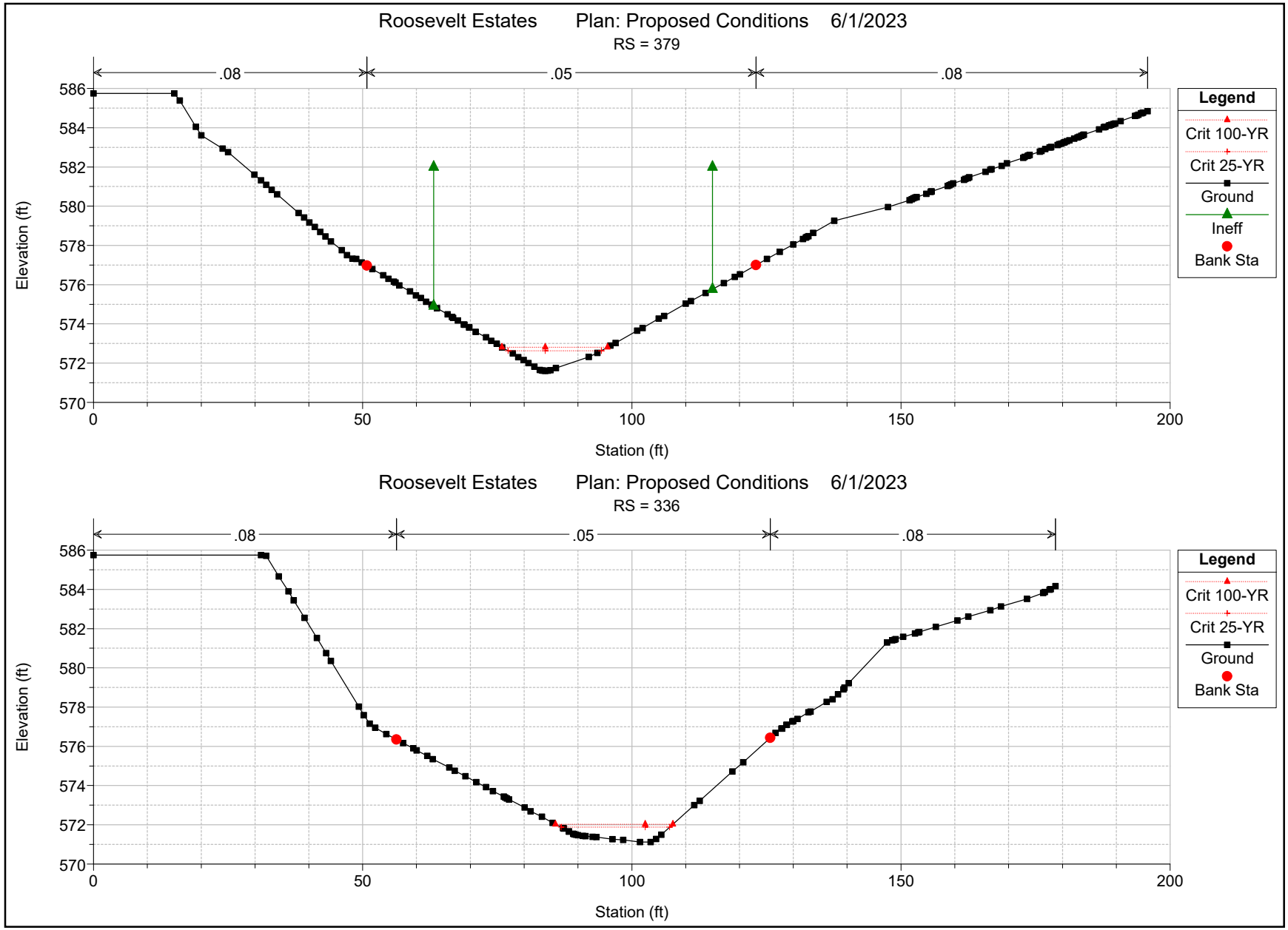
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Station (ft)
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Crit 25-YR
Ground
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Bank Sta
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Crit 25-YR
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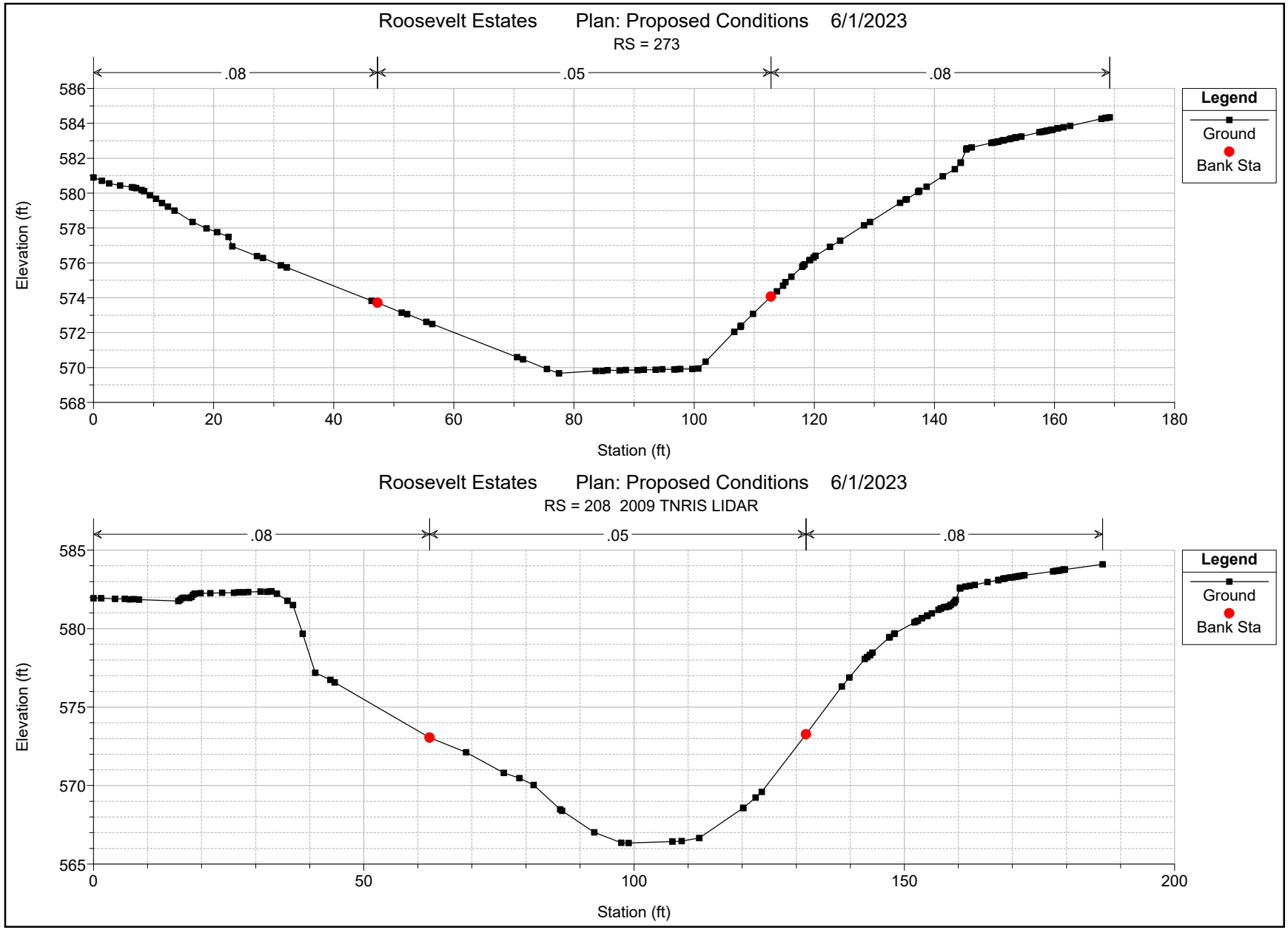
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Station (ft)
Legend
Ground
Bank Sta
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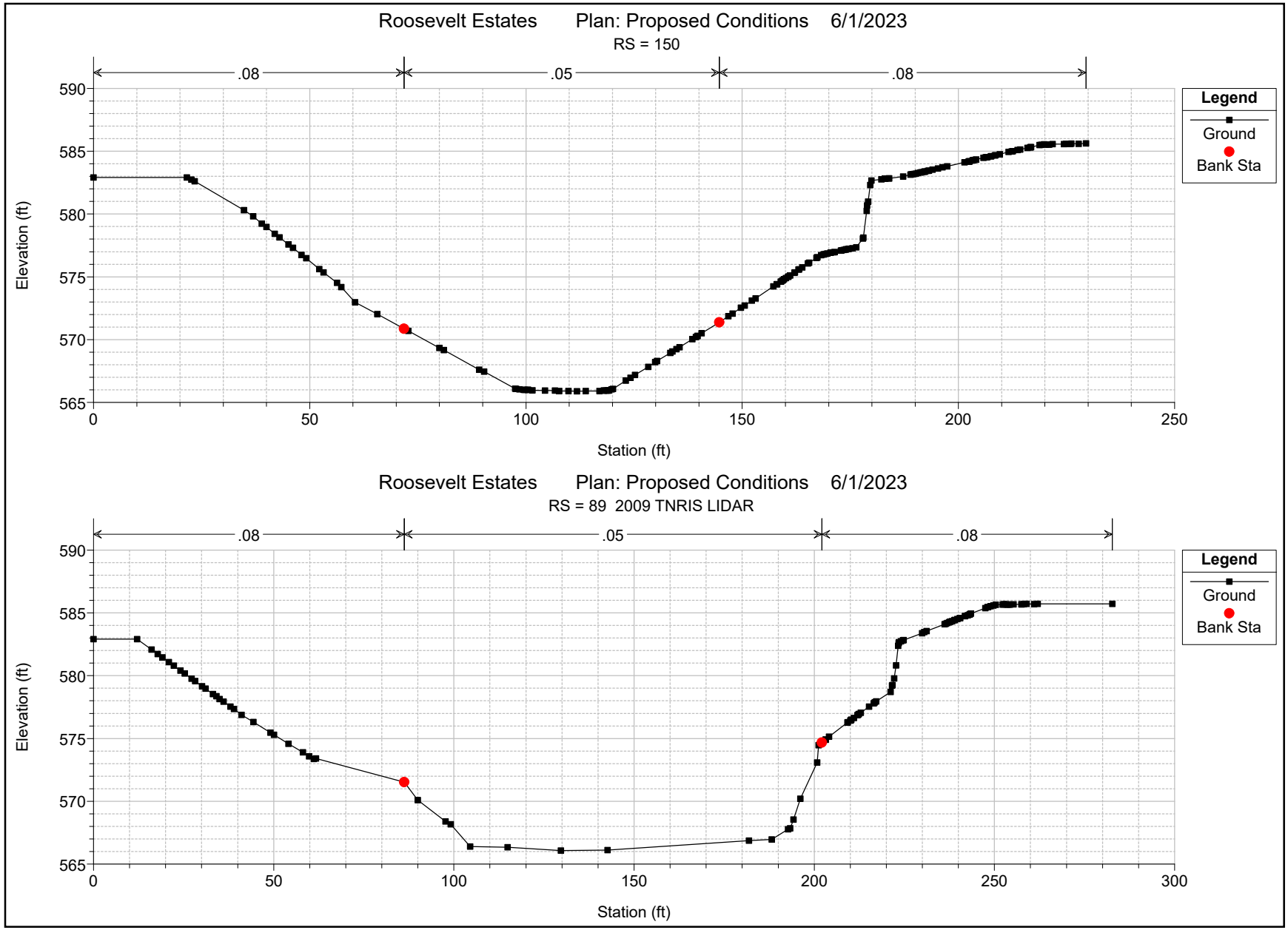
Legend
Ground
Bank Sta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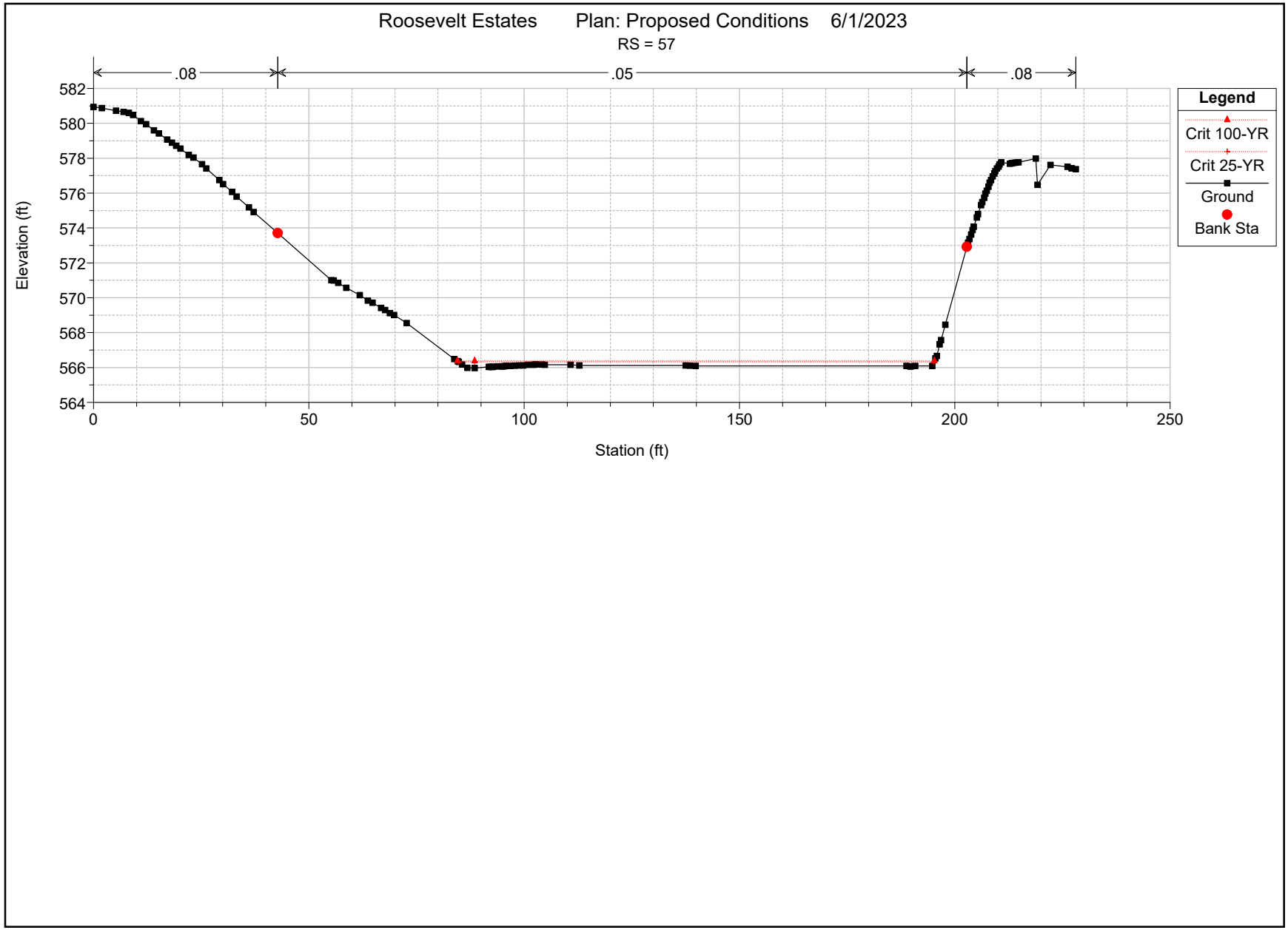
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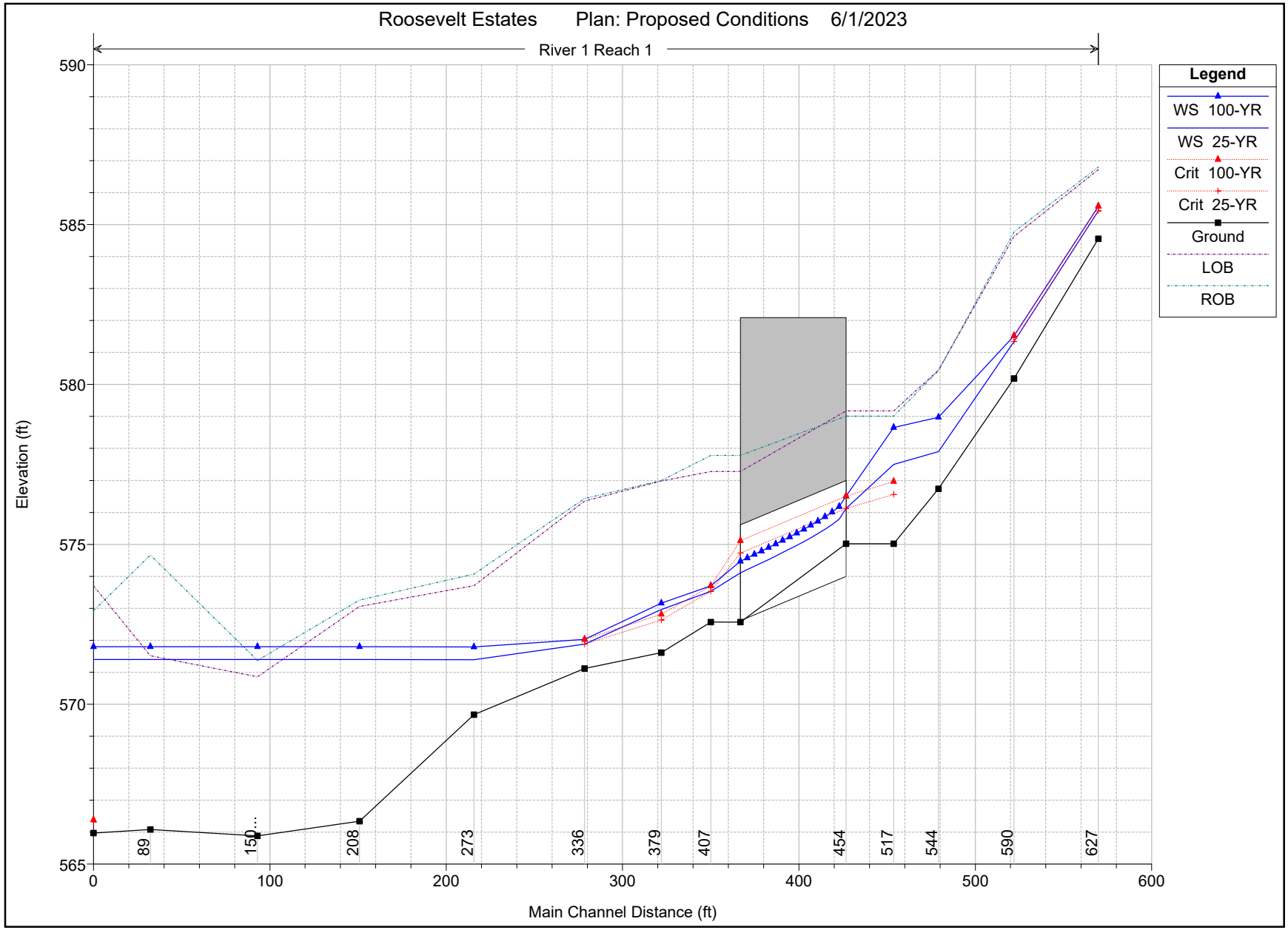
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River 1 Reach 1
Legend
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WS 25-YR
Crit 100-YR
Crit 25-YR
Ground
LOB
ROB
Elevation (ft)
590
585
580
575
570
565
0
100
200
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Main Channel Distance (ft)
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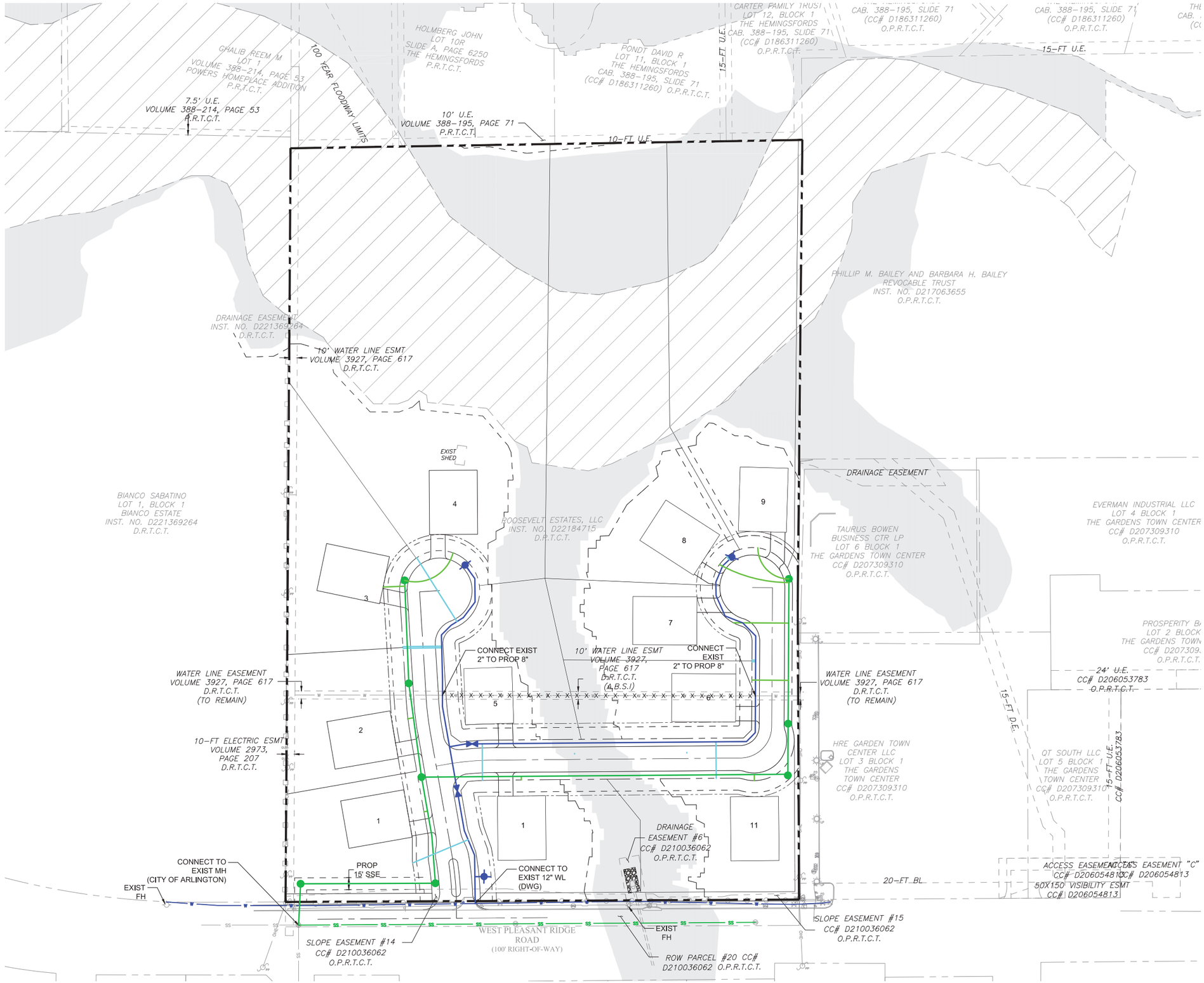

LEGEND

- PROJECT LOCATION
- EXISTING 12" WATERLINE
- EXISTING 8" SEWER LINE
- PROPOSED 8" WATERLINE
- PROPOSED 8" SEWER
- WATER LINE TO BE REMOVED

SHIELD ENGINEERING GROUP

TBPE FIRM #F-11039 - TBPLS FIRM #10193890

N

0 60 120 180

GRAPHIC SCALE IN FEET

CITY OF
DALWORTHINGTON GARDENS, TEXAS

ROOSEVELT ESTATES

PROPOSED WATER & SEWER LAYOUT

DESIGNED: JGD	SCALE:	DATE:	SHEET:
DRAWN: JGD	1" = 60'	JAN 2024	1OF 1

20240109 JOSE DELEON L:\JOBS\2021105.01 ROOSEVELT ESTATES\EXHIBITS\20230306 WATER & SEWER EXHIBIT TO CITY\WATER AND SEWER LAYOUT.DWG

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Kimley»Horn

January 23, 2024

Sandra Ma
Interim City Secretary
City of Dalworthington Gardens
2600 Roosevelt Drive
Dalworthington Gardens, TX 76016

RE: Seventh Preliminary Plat Submittal Review
Roosevelt Estates
KHA No. 068302505

Dear Sandra:

We have completed our review of the seventh submittal of the Preliminary Plat for the above referenced project. The Preliminary Plat was received via email for review on January 23, 2024.

The property is owned by Roosevelt Estates LLC and lies within the corporate boundary of the City. The proposed land use complies with the current zoning requirements and the Future Land Use Map.

All previous comments have been adequately addressed. Conformity of the Preliminary Plat submitted is contingent on Dalworthington Gardens City Council's approval of the zoning change application for the subject property.

If council approves the zoning change application, the Preliminary Plat as submitted conforms to the technical requirements listed in the Dalworthington Gardens Code of Ordinances and we recommend approval.

If council denies the zoning change application, the Preliminary Plat as submitted would not comply with the setback requirements listed in table 14.02.171 in the Dalworthington Gardens Code of Ordinances and we therefore recommend denial.

Please remember that the adequacy of the design work reflected in the plans reviewed and the responsibility to adhere to all applicable ordinances and codes remains with the design engineer.

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

Brandon Bell, P.E.

Brandon Bell, P.E.

Staff Agenda Report

Agenda Subject: Discussion and possible recommendation request for a concept plan with a Bowen Road planned development overlay for property located at 2500 and 2512 California Lane, Dalworthington Gardens, Tarrant County, Texas

Background Information: A Zone Change Application submitted by Trevor Turnbow was received on 7/17/2023 for properties located at 2500 California Lane and 2512 California Lane for a change from single family "SF" residential to garden home "GH" base zoning with a mixed-use "MU" overlay.

Per discussion with applicant, city staff, and attorney. Applicant submitted an ameded a zoning application on 1/16/2024 requesting to allow for the Bowen Road Overlay.

Notification of tonight's public hearing were sent to all property owners within 200' of the sujbect property as well as being posted in the Commercial Recorder. Of the 12 property owner notifications sent, 0 were returned with comments.

Per Local Government Code, Chapter 211, zone changes must comply with the City's Comprehensive Plan as follows:
Sec. 211.004. COMPLIANCE WITH COMPREHENSIVE PLAN. (a) Zoning regulations must be adopted in accordance with a comprehensive plan and must be designed to:
(1) lessen congestion in the streets;
(2) secure safety from fire, panic, and other dangers;
(3) promote health and the general welfare;
(4) provide adequate light and air;
(5) prevent the overcrowding of land;
(6) avoid undue concentration of population; or
(7) facilitate the adequate provision of transportation, water, sewers, schools, parks, and other public requirements.

The Future Land Use Map from the current 2005 adopted Plan shows these properties to remain as single family residential. However, in the latest Plan draft amendment from June 2023 includes changes to proposed Bowen Road future land uses as described below. The full description can be found in your packet.

The Bowen Road Planned Development Overlay may include Large Lot Residential uses but may also include a mixture of Medium Density Single Family Garden Homes, and Commercial Uses with a preference toward agricultural related businesses (vegetable and meat markets, farm and ranch supply, etc.) and restaurants. Garden Home developments shall include 10 percent open space for parks and community gardens. The Planned Development shall provide an orderly transition from commercial uses to the large lot Residential uses and incorporate suitable separation barriers with a preference to vegetated barriers in lieu of hardened barriers such as fences. Uses other than large lot residential uses shall be planned development.

The applicant has communicated to the City he desires to build garden homes with a few small foot print restaurants on the south end of the development.

Notification of tonight's public hearing was sent to all property owners within 200 feet of the subjet property as well as being posted in the Commercial Recorder. Of the 12 notificaitons sent, 1 was returend with comments. 0 were in favor of the zoning change and 1 was returned in opposition of the zoning change.

Scott McCaskey 2500 Texas and 2501 California spoke in opposition and concerns with traffic, water run-off and impervious service, and fencing.

Planning and Zoning recommends approval of the zone change application for concept plan with a Bowen Road Planned Development Overlay for property located at 2500 and 2512 California Lane.

Recommended Action/Motion: Motion to recommend approval of a Zone Change Application requesting for a concept plan with a Bowen Road planned development overlay for property located at 2500 and 2512 California Lane,

Dalworthington Gardens, Tarrant County, Texas

OR

Motion to recomment denial of a Zone Change Application requesting for a concept plan with a Bowen Road planned developemnt overlay for property located at 2500 and 2512 California Lane, Dalworthington Gardens, Tarrant County, Texas

Attachments:
Zone Change Application 7/17/2023
Amended Zone Change Application 1/16/2024
2005 Current Future Land Use Map
Bowen Road Corridor PD Overlay Verbiage from Comp Plan
2023 Draft Future Land Use Map
Bowen Road Overlay Ordinance
Notice of Public Hearing Response

Zone Change Application

General Information

- Prior to the submittal of an application, the applicant is encouraged to schedule a pre-application conference with City Staff.
- This application will not be scheduled for hearing until reviewed by the Director of Community Development or designee.
- Incomplete applications will not be reviewed.
- The application fee is $1,500.00 plus $50.00/acre if not SF zoned.

Applicant Information

☑ **Property Owner** ☐ **Authorized Representative** *(Notarized affidavit required including signature of legal owner(s))*

Name: TREVOR TURNBOW	**Phone Number:** 682-266-8929
Mailing Address: 4726 LENNON AVE. ARLINGTON, TX 76016	**Email Address:** TREVOR.TURNBOW@ICLOUD.COM

Subject Property Address and/or Location *(Use attachment, if necessary)*:
2500 & 2512 CALIFORNIA LN DALWORTHINGTON, TX 76015

Legal Description *(Use attachment, if necessary)*: DALWORTHINGTON GARDENS ADDN BLOCK 4 LOT 4AI
DALWORTHINGTON GARDENS ADDN BLOCK 4 LOT 4

Existing Use of Property: RAW LAND

Proposed Use of Property: Garden Homes as outlined in DWG City Ordinance

Current Zoning: SFR	**Comprehensive Plan Designation:** Garden Homes

Proposed Zoning: Garden Homes "GH" As Base Zoning with Mixed Use Overlay

Important Information Regarding Zone Change Requests

1. An application for a zone change on a property may only be made by the owner of that property and/or an authorized representative of the property owner. An authorized representative shall present a notarized affidavit from the property owner. If the subject property is owned by the City of Dalworthington Gardens, the City Administrator or designee may apply for the zone change on behalf of the City.

2. No application will be processed if a zoning violation exists on the property, unless such processing is authorized by City Council. Use of the subject property for any new activity not allowed by present zoning cannot occur before City Council's final approval of the requested zone change. Any such unauthorized use of the subject property is subject to prosecution in Municipal Court. **(continued)**

Zone Change Application (cont.)

3. If approved, a zone change is applied to the property, not the property owner.

4. The Planning & Zoning Commission makes recommendations to City Council. If the Planning & Zoning Commission recommends approval of a zone change request, the case must still go before City Council for final action.

5. Certain minimum building setbacks from some or all property lines must be maintained, and room for a minimum number of parking spaces must be reserved on a subject property, based on that property's zoning classification and the nature of its proposed use. A privacy fence may also be required between residential and non-residential zoning districts. These requirements are outlined in the City of Dalworthington Garden's Ordinances. It is the applicant's benefit to ensure that any proposed development will fit onto the subject property, in compliance with these and other applicable requirements of the City's Code of Ordinances.

6. The City is required to mail letters to owners of property within 200 feet of the subject property of the zone change request.

7. The applicant or an authorized representative should attend public hearings pertaining to the request and be prepared to present the case and answer any relevant questions from the Planning & Zoning Commission and City Council members.

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

Signature: _____ **Date:** 07/17/23

OFFICE USE ONLY

Case Number:	**Date of Application:**	**Date Paid:**
Affidavit attached?: Yes ☐ No ☐	**P&Z Meeting Date:**	

Zone Change Application

General Information

- Prior to the submittal of an application, the applicant is encouraged to schedule a pre-application conference with City Staff.
- This application will not be scheduled for hearing until reviewed by the Director of Community Development or designee.
- Incomplete applications will not be reviewed.
- The application fee is $1,500.00 plus $50.00/acre if not SF zoned.

Applicant Information

☒ **Property Owner** ☐ **Authorized Representative** *(Notarized affidavit required including signature of legal owner(s))*

Name: Trevor Turnbow	**Phone Number**: 682-266-8929
Mailing Address: PO Box 151567 Arlington, TX 76015	**Email Address:** trevor.turnbow@icloud.com

Subject Property Address and/or Location (*Use attachment, if necessary*)**:** 2500 & 2512 California Ln
Dalworthington Gardens, TX 76015

Legal Description (*Use attachment, if necessary*): Dalworthington Gardens Addn Block 4 Lot 4A1
Dalworthington Gardens Addn Block 4 Lot 4

Existing Use of Property: Raw Land

Proposed Use of Property: Bowen Road

Current Zoning: SFR	**Comprehensive Plan Designation**: Bowen Road Overlay

Proposed Zoning: Bowen Road Overlay

Important Information Regarding Zone Change Requests

1. An application for a zone change on a property may only be made by the owner of that property and/or an authorized representative of the property owner. An authorized representative shall present a notarized affidavit from the property owner. If the subject property is owned by the City of Dalworthington Gardens, the City Administrator or designee may apply for the zone change on behalf of the City.

2. No application will be processed if a zoning violation exists on the property, unless such processing is authorized by City Council. Use of the subject property for any new activity not allowed by present zoning cannot occur before City Council's final approval of the requested zone change. Any such unauthorized use of the subject property is subject to prosecution in Municipal Court. **(continued)**

Zone Change Application (cont.)

3. If approved, a zone change is applied to the property, not the property owner.

4. The Planning & Zoning Commission makes recommendations to City Council. If the Planning & Zoning Commission recommends approval of a zone change request, the case must still go before City Council for final action.

5. Certain minimum building setbacks from some or all property lines must be maintained, and room for a minimum number of parking spaces must be reserved on a subject property, based on that property's zoning classification and the nature of its proposed use. A privacy fence may also be required between residential and non-residential zoning districts. These requirements are outlined in the City of Dalworthington Garden's Ordinances. It is the applicant's benefit to ensure that any proposed development will fit onto the subject property, in compliance with these and other applicable requirements of the City's Code of Ordinances.

6. The City is required to mail letters to owners of property within 200 feet of the subject property of the zone change request.

7. The applicant or an authorized representative should attend public hearings pertaining to the request and be prepared to present the case and answer any relevant questions from the Planning & Zoning Commission and City Council members.

I hereby certify that I am the owner or duly authorized agent of the owner for the purposes of this application. I further certify that I have read and examined this application and know the same to be true and correct. If any of the information provided on this application is incorrect, the permit or approval may be revoked.

Signature: Trevor Turnbow /s/ **Date:** 1/18/24

OFFICE USE ONLY

Case Number:	**Date of Application:**	**Date Paid:**
Affidavit attached?: Yes ☐ No ☐	**P&Z Meeting Date:**	

CITY OF DALWORTHINGTON GARDENS

Tarrant County, Texas

FUTURE LAND USE PLAN MAP

March 17, 2005

LAND USE LEGEND

- Low Density Residential
- Medium Density Residential
- Public / Semi-Public
- Parks / Open Space
- Commercial / Retail & Office
- Planned Development Area- Garden Homes*
- Planned Development Area- Commercial*
- Required Buffer Area
- Pedestrian Pathway

*NOTE:
Uses other than Low Density Residential in the Planned Development Areas (as Garden homes in the Planned Development Area- Garden Homes or as office or retail uses in the Planned Development Area- Commercial) require plan approval.

Ⓢ Traffic Signal

Entry Feature

Note:
A Comprehensive Plan shall not constitute zoning regulations or establish zoning district boundaries.

NORTH

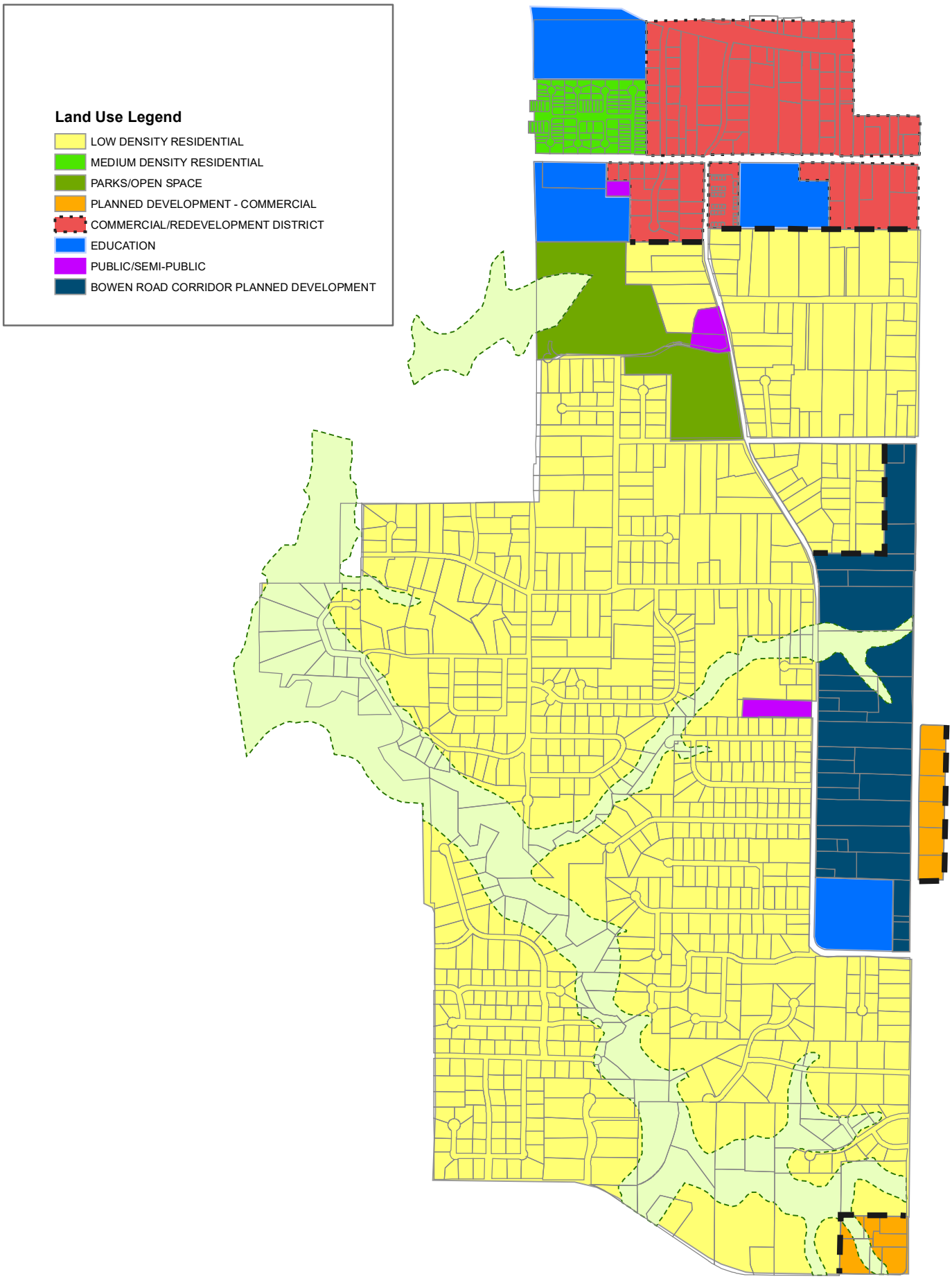
Graphic Scale
0 400' 800' 1600'
400' 200'
In Feet

Denotes 100 year Flood Plain Limits per FEMA maps

City Limit Line

Base map prepared by:
TEAGUE NALL AND PERKINS
CONSULTING ENGINEERS

Prepared by:
MPRG inc.
Municipal Planning Resources Group, Inc.


Land Use Legend
LOW DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
PARKS/OPEN SPACE
PLANNED DEVELOPMENT - COMMERCIAL
COMMERCIAL/REDEVELOPMENT DISTRICT
EDUCATION
PUBLIC/SEMI-PUBLIC
BOWEN ROAD CORRIDOR PLANNED DEVELOPMENT

Bowen Road Corridor Area (Planned Development Overlay)

The Bowen Road corridor will have a multi-use purpose. Its future development will focus on commercial as well as residential development. Existing large residential lots that have both Bowen and Roosevelt access may be subdivided to allow commercial development on the Bowen Corridor only. These said lots shall remain residential on the Roosevelt side with no vehicular traffic connection between them.

One Planned Development Area of higher intensity use is designated along Bowen Road. The area on the east side of Bowen Road, south of Mayfield, would be an ideal location for an office or retail development.

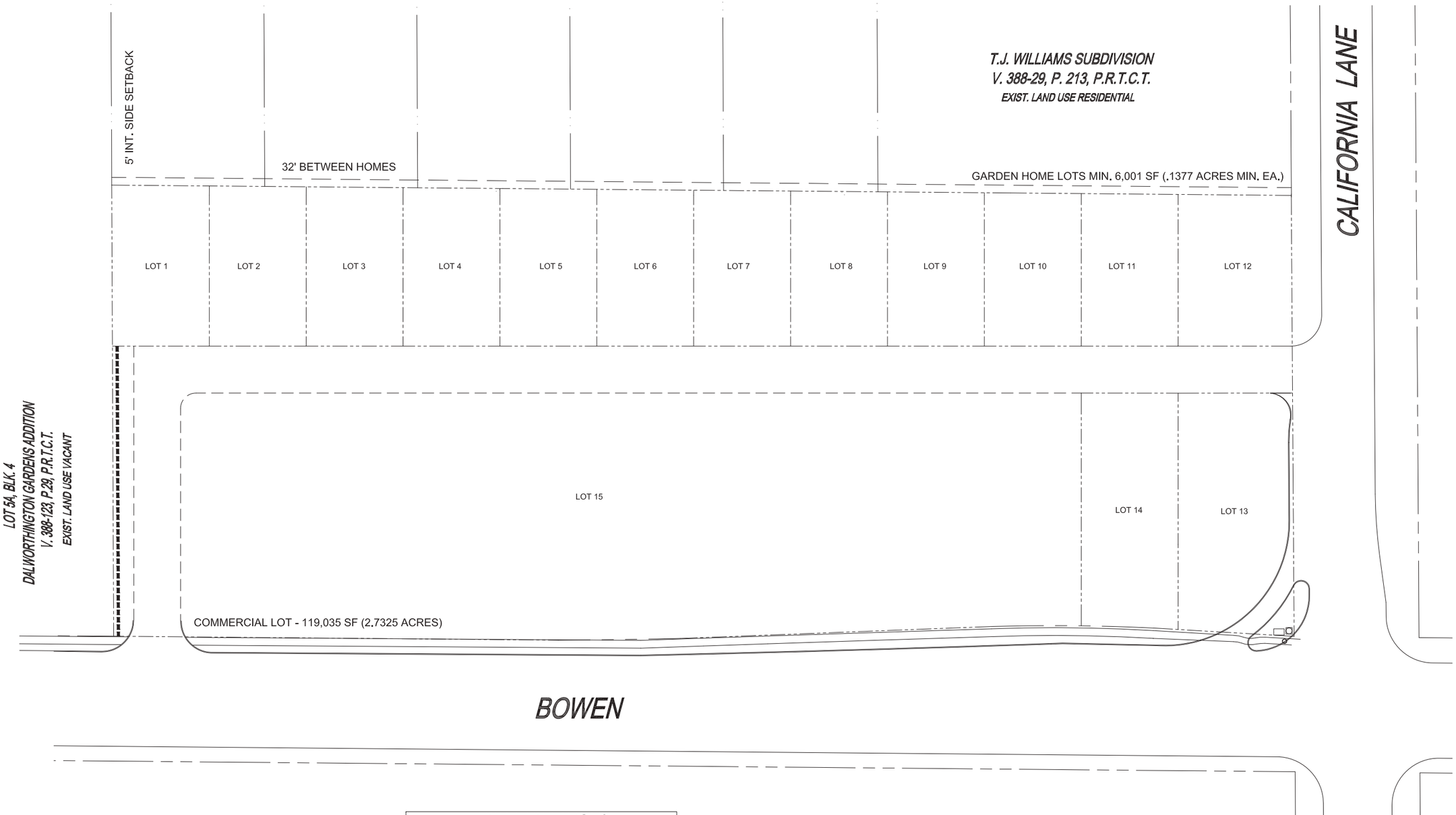
The west side of the Bowen Road corridor between Roosevelt Drive and Bowen Road from the Roosevelt Drive intersection to the California Lane intersection shall be designated as a Planned Development Overlay Area.

Such a community shall be defined as an organized mixed-use community that integrates agricultural and food service commercial businesses, with residential uses, and open spaces that might be used as parks or community gardens.

Most of the west side of the Bowen Road corridor between Roosevelt Drive and Bowen Road from the Roosevelt Drive intersection to the California Lane intersection shall be designated as a Planned Development. The exception to including all of the land between Roosevelt Drive and Bowen Road begins at the California Lane intersection. Here the Planned Development shall only extend approximately 290 feet to the west from the Bowen Road right-of-way line for a distance of approximately 1,042 feet south along Bowen Road. (See the Future Land Use Map.)

The Bowen Road Planned Development Overlay may include Large Lot Residential uses but may also include a mixture of Medium Density Single Family Garden Homes, and Commercial Uses with a preference toward agricultural related businesses (vegetable and meat markets, farm and ranch supply, etc.) and restaurants. Garden Home developments shall include 10 percent open space for parks and community gardens. The Planned Development shall provide an orderly transition from commercial uses to the large lot Residential uses and incorporate suitable separation barriers with a preference to vegetated barriers in lieu of hardened barriers such as fences. Uses other than large lot residential uses shall be planned development.

The decisions made now by the City as to the type of uses permitted along Bowen Road as it passes the core of the City are surely critical to the future of Dalworthington Gardens. Although it may be possible to attract some limited retail uses to this corridor, it is believed that such development would likely not be of a character clearly compatible with the residential development along Roosevelt Drive and would almost certainly tend toward the sort of intermittent strip development seen along Pioneer Parkway. The most promising area is at the intersection of Mayfield/Bowen between the Rush Creek tributaries. The light there affords good traffic flow in all directions. It is also highly probable that indecisiveness in the land use designation for Bowen Road will inhibit the build-out of the area between Bowen and Roosevelt south of California Lane as large lot residential developments. Dalworthington Gardens is a very small city surrounded by a very large one. Build-out of the area within Bowen Road, Roosevelt Drive, and California Lane as large lot residential properties is highly desirable in order to maintain a critical mass of large lot residential properties and identity of DWG as having such attractive land use. This is the surest path to maintaining the property values of the residential property in the City.



AREA TABULATIONS
TOTAL COMMERCIAL LOT = 2.733 ACRES (APPROX. 119,035 SF)
TOTAL RESIDENTIAL LOTS = 2.060 ACRES (APPROX. 89,733 SF) (MIN. LOT = 6,001 SF , MAX. LOT = 11,342 SF.)

N
TRUE

01 OVERALL CONCEPT PLAN
SCALE: NTS. ALL DIMENSIONS ARE APPROXIMATE

DESIGN DRAFTING
ARLINGTON, TX 76017
817.897.2221

PLANNED DEVELOPMENT DISTRICT FOR MIXED USE

DALWORTHINGTON GARDENS, TEXAS 76016

LOT 4 & 4A

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INTERIM REVIEW DOCUMENTS
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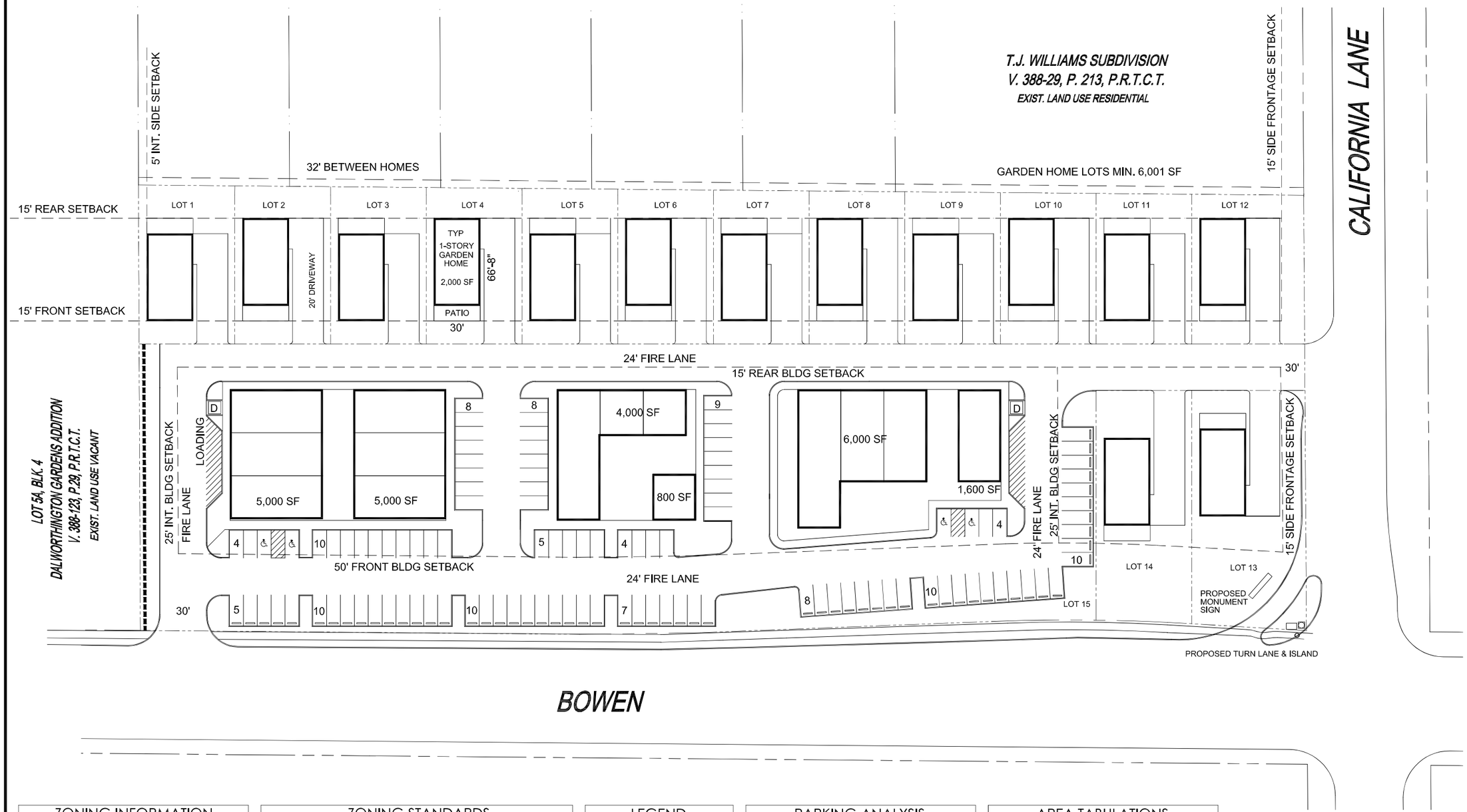
REVISIONS:

ISSUE DATE:
13 DEC 2023

PROJECT No.:
22028.100

SHEET TITLE:
OVERALL ARCHITECTURAL SITE PLAN

SHEET No.:
A1.02



ZONING INFORMATION

LOCATION:	LOTS 4 & 4A DALWORTHINGTON GARDENS ADDITION (S. BOWEN RD. & CALIFORNIA LN.)
CITY:	DALWORTHINGTON GARDENS, TX
COUNTY:	TARRANT
PROPERTY SIZE:	4.793 ACRES (208,783 S.F.)
LAND USE:	NONE (UNDEVELOPED LAND)
CURRENT ZONING:	SF-1 (SINGLE FAMILY)
PROPOSED ZONING:	MIXED USE OVERLAY DISTRICT – SINGLE FAMILY (GARDEN HOMEs) – RESTAURANT – RETAIL – OFFICE

ZONING STANDARDS

SINGLE FAMILY:		GARDEN HOME:	NON-RESIDENTIAL
MIN. AREA	= 21,780 SF	= 6,000 SF	
MIN. LIVING	= 1,250 SF	= 800-1,800 SF	= NONE
MAX. HEIGHT	= 35'	= 35'	= NONE
			= 45'
MIN. LOT WIDTH	= 80'	= 50'	
MAX. BUILDING	= 25%	= 50%	= NONE
MAX. IMPERVIOUS COVERAGE	= 40%	= 70%	= 25%
			= 40%
FRONT YARD	= 50'	= 15'	= 50'
SIDE INT. YARD	= 25'	= 5'	= 25'
SIDE EXT. YARD	= 35'	= 15'	= 35'
REAR YARD	= 25'	= 15'	= 25'
DBL. FRONTAGE REAR YARD	= 35'	= N/A	= 35'
LANDSCAPE	= NONE	= NONE	= 20%

LEGEND

LANDSCAPE AREA

LANDSCAPING

NON-RESIDENTIAL LOT SIZE
= 133,337 SF

TOTAL LANDSCAPING PROVIDED AT NON-RESIDENTIAL LOT
= 39,815 SF

NON-RESIDENTIAL LANDSCAPE COVERAGE
= 29.8 %

PARKING ANALYSIS

RESIDENTIAL
2 COVERED STALLS PER UNIT

NON-RESIDENTIAL

PERSONAL SERVICE	= 1/200 SF I.F.A.
RETAIL SHOP	= 1/200 SF I.F.A
DRIVE UP/TAKE OUT	= 1/75 SF I.F.A & O.F.A (MIN. 8 SPACES)
DRIVE UP/EAT IN	= 1/50 SF I.F.A & O.F.A (MIN. 12 SPACES)
DINE IN ONLY	= 1/100 SF I.F.A & O.F.A (MIN. 12 SPACES)
BUSINESS/PRO OFFICE	= 3 + 1/300 SF I.F.A

LOADING

RETAIL/COMMERCIAL	0-25K SF = 1, 25K-84K SF = 2
OFFICE/RESTAURANT	0-150K SF = 1

AREA TABULATIONS

COMMERCIAL LOT = 2.733 ACRES (APPROX. 119,035 SF)
RESIDENTIAL LOTS = 2.060 ACRES (APPROX. 89,733 SF)
(MIN. LOT = 6,001 SF)

TOTAL = 4.793 ACRES (APPROX. 208,783 S.F.)
RESIDENTIAL
SINGLE-STORY GARDEN HOMES X14 = 2,000 SF
TOTAL RESIDENTIAL = 28,000 SF
COMMERCIAL
SINGLE-STORY SHELL BLDG'S 5,000 SF +5,000 SF + 4,000 SF +800 SF +6,000 SF +1,600 SF = 22,400 SF

TOTAL DEVELOPMENT = 50,400 SF

PARKING:	RATE	REQUIRED	PROVIDED
RETAIL:	1 PER 200	112	112
RESIDENTIAL:	2 PER UNIT	28	28
LOADING:	1 PER BLDG	–	2

TRUE N

01 PRELIMINARY ARCH. SITE PLAN A
SCALE: NTS. ALL DIMENSIONS ARE APPROXIMATE

PLANNED DEVELOPMENT DISTRICT FOR MIXED USE

LOT 4 & 4A

DALWORTHINGTON GARDENS, TEXAS 76016

DESIGN DRAFTING
ARLINGTON, TX 76017
817.897.2221

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REVISIONS:

ISSUE DATE:
13 DEC 2023

PROJECT No.:
22028.100

SHEET TITLE:
PRELIMINARY ARCHITECTURAL SITE PLAN

SHEET No.:
A1.01

The Villages of DWG

Project Narrative

Introduction

This mixed-use planned development envisions a vibrant node of commercial and residential uses on 5 acres of vacant land at the high-traffic intersection of S. Bowen Road and California Lane. Currently zoned single-family residential yet situated along an approved commercial corridor, the site allows a thoughtful fusion of neighborhood-scale commerce and garden homes that align with both Ordinance No. 2023-18 and Dalworthington Gardens' growth management goals.

The Villages of DWG project comes from long-time Dalworthington Gardens resident Trevor Turnbow and his firm Turnbow Construction. For over 20 years prior to its transfer to Trevor, the land had been part of his family heritage and stories. Having witnessed DWG endure sweeping changes over the decades of personal history here, Trevor feels passionately about guiding the next chapter of positive yet sensitive development growth. As both a landowner deeply vested in this place as well as a developer attuned to responsible practices, Trevor Turnbow through Turnbow Construction and its affiliate Turnbow Fairytale LLC is dedicated to collaboratively seeing The Villages at DWG come to life in alignment with the City's Vision.

Honoring the City's History

As the only surviving New Deal subsistence homestead town in Texas, Dalworthington Gardens cherishes its roots while welcoming new development. The Villages of DWG concept seeks to continue that balance of history and progress through a carefully-designed mix of uses befitting DWG's heritage. 14 garden homes pay homage to the City's original homestead cottages, buffering nearby neighborhoods from more intense retail and offices. High-quality architectural designs will complement the development's placement along the new "Gates Gateway" into DWG.

Alignment with City Plans

The 2005 Comprehensive Plan encourages partnerships to enable fiscally and environmentally responsible growth. It also endorses beautification initiatives and redevelopment of aging sites. Located on vacant land at the intersection of two critical roadways, The Villages of DWG will transform an underutilized lot into an attractive commercial node offering contemporary conveniences to residents and visitors alike. Landscaping, lighting, and signage will enhance aesthetics and safety for all.

Traffic Mitigation Strategy

While the site's arterial placement suits a commercial node, Bowen Road's high southbound volumes necessitate circulation improvements. As such, the developer will proactively dedicate a 0.05 acre portion of land on the corner for the City to later build a deceleration lane. Though not essential currently, this concession reserves the option to enhance mobility long-term.

Responsible Site Design

Initial engineering consultation confirms the relatively flat topography limits major grading needs. The site also falls outside flood-prone areas. Upon concept approval, the developer will furnish professionally engineered grading and drainage plans meeting all City specifications for review, helping ensure responsible stormwater management.

Requested Concessions

In the spirit of win-win compromise, the developer seeks the following concessions from the City:

1) Waiver of all impact fees and replatting fees in exchange for the gifted deceleration lane land noted above, worth approximately $125,000. This mirrors concessions secured for similar developments in Arlington.

2) Additionally, the developer will construct an ornamental entrance sign on donated land near the site to welcome visitors to Dalworthington Gardens along the high-profile Bowen Road corridor.

We believe these community enhancements demonstrate good faith while saving taxpayer funds and enabling the City to meet its growth vision. We kindly request consideration of the requested concessions above in recognition of the significant value being provided to the public through The Villages of DWG.

Sincerely,

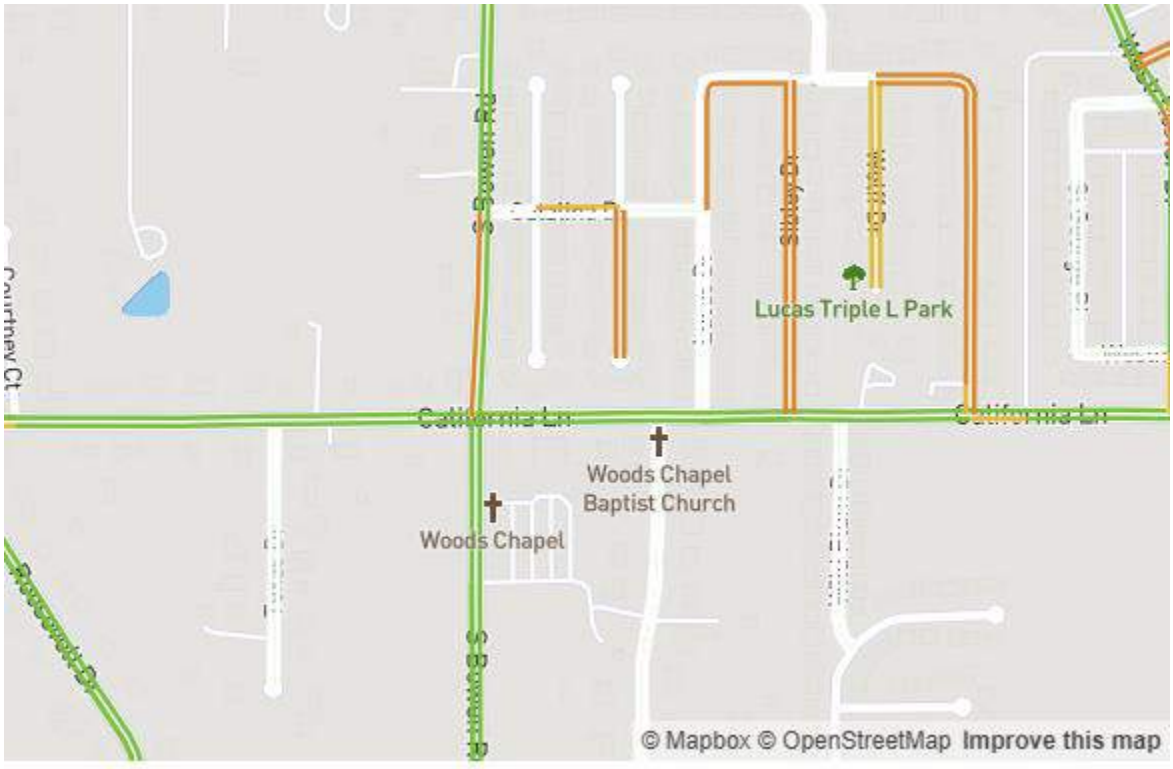
Trevor Turnbow

President Turnbow Construction

www.TurnbowConstruction.biz

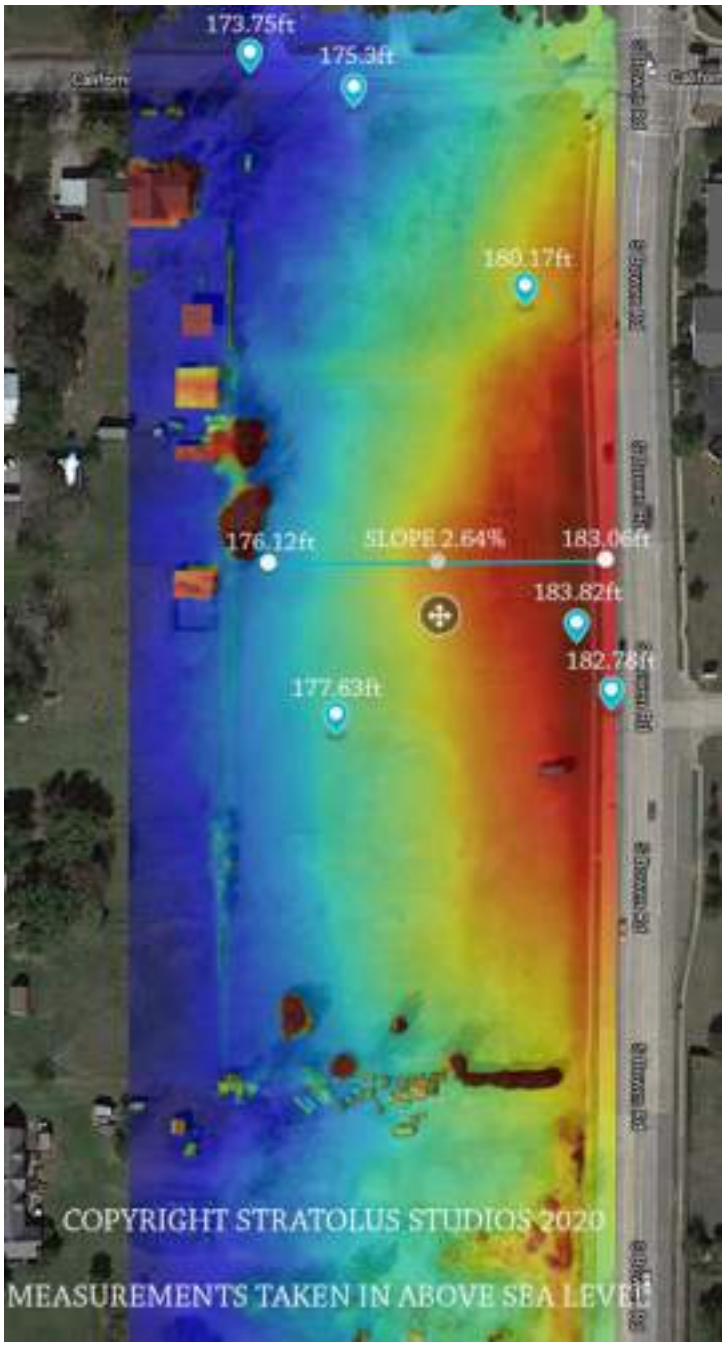
682-266-8929

Traffic Study provided by Mapbox OpenStreetMap

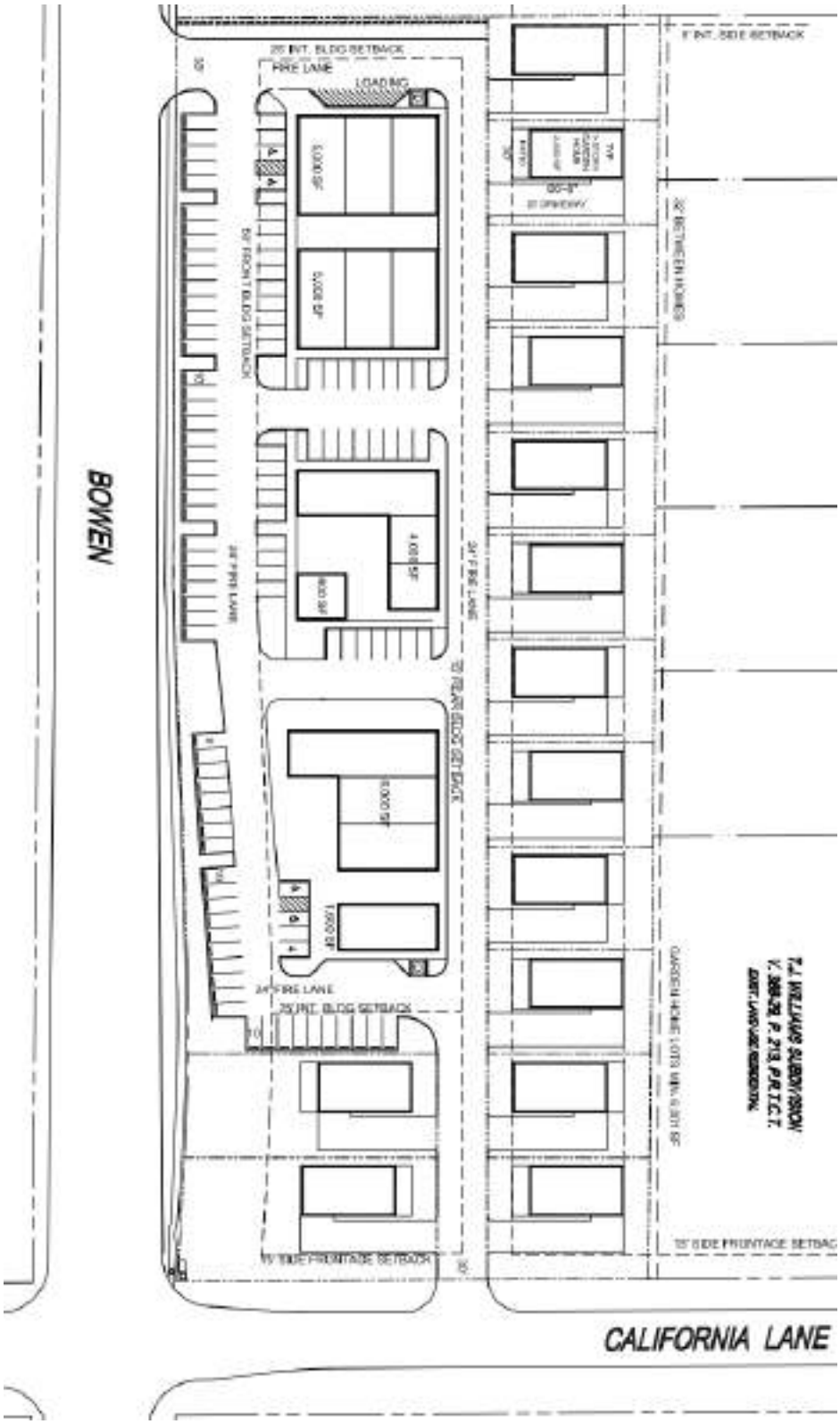


Ariels provided by Turnbow Construction

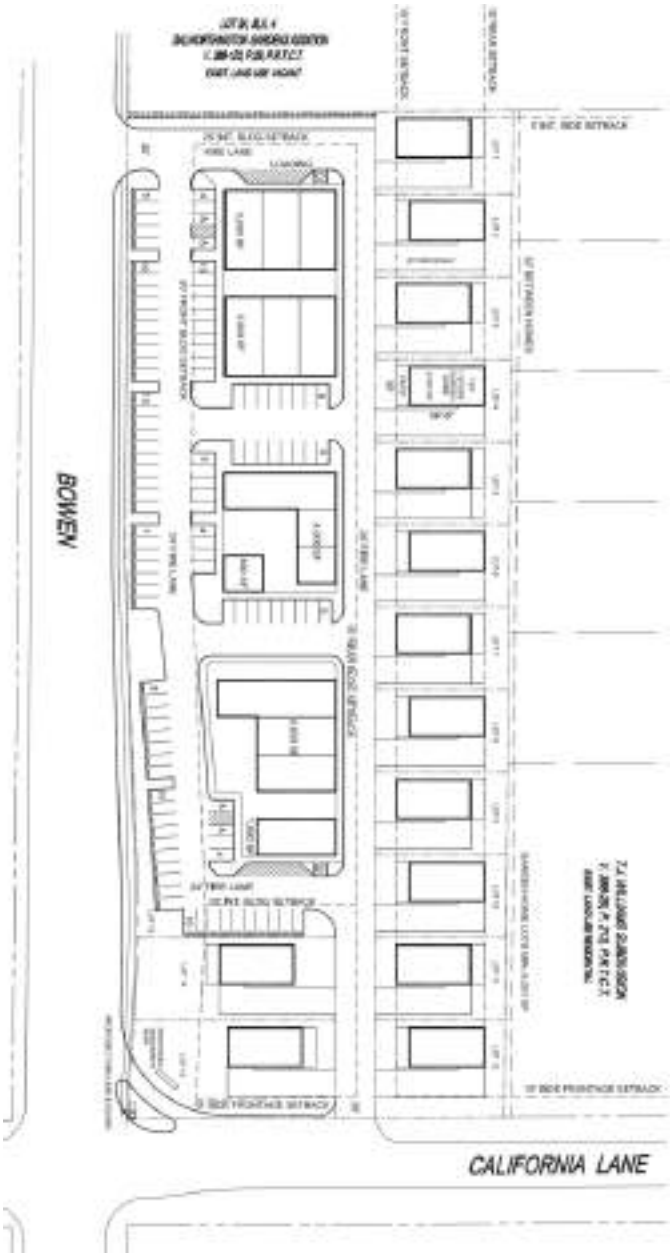
Topography Report



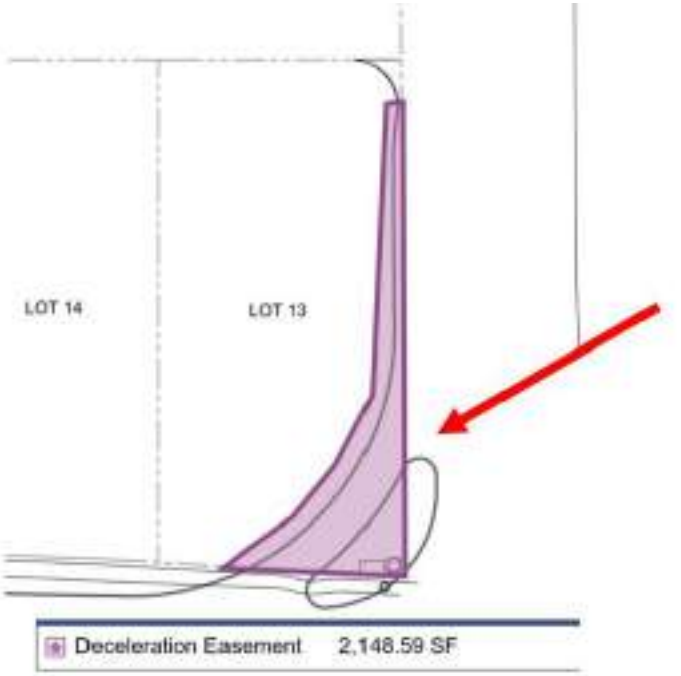
Concept Plans without Deceleration Lane or City Monument Sign



Concept Plan with Deceleration Lane & City Monument Sign

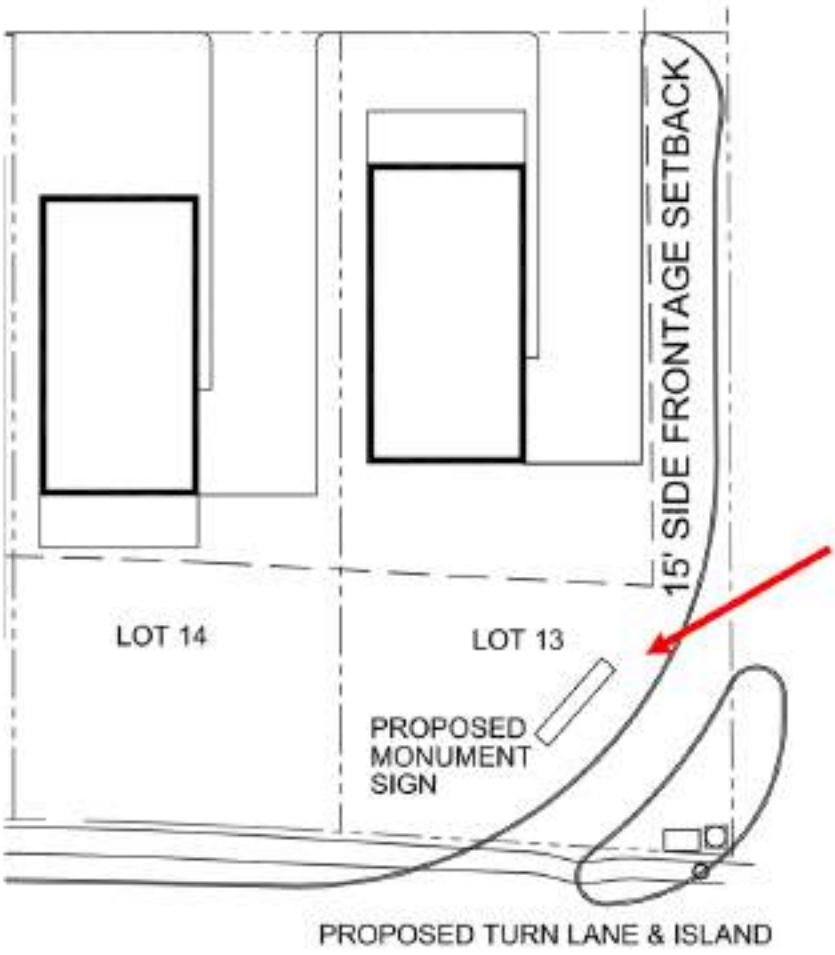


Deceleration Lane



Deceleration Lane provided to city as concession for no impact fees & no platting fees on this PD.

Monument Sign



Proposed City Monument Sign provided to city as concession for no impact fees & no platting fees on this PD.

Example of Deed w/ Impact & Replat Fee Waivers

D218160657 7/20/2018 4:21 PM PGS 6 Fee: $36.00 Submitter: CSC ERECORDING SOLUTIONS
Electronically Recorded by Tarrant County Clerk in Official Public Records Mary Louise Garcia

SPECIAL WARRANTY DEED WITH VENDOR'S LIEN LANGUAGE

GF# 17000230167 Stewart/drx/23

NOTICE OF CONFIDENTIALITY RIGHTS: IF YOU ARE A NATURAL PERSON, YOU MAY REMOVE OR STRIKE ANY OR ALL OF THE FOLLOWING INFORMATION FROM ANY INSTRUMENT THAT TRANSFERS AN INTEREST IN REAL PROPERTY BEFORE IT IS FILED FOR RECORD IN THE PUBLIC RECORDS: YOUR SOCIAL SECURITY NUMBER OR YOUR DRIVER'S LICENSE NUMBER.

THE STATE OF TEXAS §
§
COUNTY OF TARRANT §

THAT, CENTER STREET COMPLEX, LLC, a Texas limited liability company ("Grantor"), whose address is 4040 Vernon Way, Fort Worth, Texas 76244, for and in consideration of the sum of $10.00 cash in hand paid by **CENTER ST. FACTOR, LLC**, a Texas limited liability company ("Grantee"), whose address is 4040 Vernon Way, Fort Worth, Texas 76244, and other good and valuable consideration, and the further consideration of the execution and delivery by the said Grantee of its promissory note in the stated principal sum set forth therein ("Note"), payable to the order of PLAINSCAPITAL BANK, a Texas state bank ("Lender"), bearing interest, being payable and maturing as therein provided, and being secured by a vendor's lien and superior title retained herein in favor of said Lender and being also secured by, inter alia, that certain Deed of Trust, Security Agreement, Assignment of Leases, Assignment of Rents, and Financing Statement (Fixture) of even date herewith executed by Grantee in favor of Darrell G. Adams, Trustee for the benefit of the Lender, the receipt and sufficiency of which are hereby acknowledged by Grantor, has GRANTED, BARGAINED, SOLD AND CONVEYED, and by these presents does GRANT, BARGAIN, SELL and CONVEY unto Grantee, that certain tract of real property situated in Tarrant County, Texas, and described in Exhibit "A" attached hereto and made a part hereof for all purposes (the "Land") together with, all and singular, all improvements thereon (if any), and all rights and appurtenances pertaining thereto, including, without limitation, any right, title and interest of Grantor in and to adjacent streets, roads, alleys, or rights-of-way, strips and gores adjoining the Land, any development rights, air rights, and any other easements, interests, rights, powers and privileges appurtenant to the use and enjoyment of the Land. The Land and all rights, property and interests above described being hereinafter referred to collectively as the "Property."

This conveyance is being made by Grantor and accepted by Grantee subject to all easements, restrictions, rights, reservations, encumbrances and other matters described in Exhibit "B" attached hereto and made a part hereof (collectively, the "Permitted Exceptions").

TO HAVE AND TO HOLD the Property, together with, all and singular, the rights and appurtenances thereto in anywise belonging, to Grantee and Grantee's successors and assigns forever; and subject to the Permitted Exceptions, Grantor does hereby bind Grantor and Grantor's successors and assigns to warrant and forever defend, all and singular, the Property unto Grantee and Grantee's successors and assigns, against every person whomsoever lawfully claiming or to claim the same, or any part thereof by, through or under Grantor, but not otherwise, subject to the Permitted Exceptions.

DRAFT

Lender, at Grantee's request, has paid in cash to Grantor that portion of the purchase price of the Property that is evidenced by the Note. The first and superior vendor's lien against and superior title to the Property are retained for the benefit of Lender and are transferred to Lender without recourse against Grantor.

Unofficial Copy

EFFECTIVE as of the 19 day of July, 2018.

GRANTOR:

CENTER STREET COMPLEX, LLC,
a Delaware limited liability company

Name: Cary Moon
Title: President

THE STATE OF TEXAS §
§
COUNTY OF TARRANT §

This instrument was acknowledged before me on July 19, 2018, by Cary Moon, the President, of CENTER STREET COMPLEX, LLC, a Texas limited liability company, on behalf of said limited liability company.

DREX W. BAKER
ID # 4628522
Notary Public, State of Texas
My Commission Expires
10/05/2020

Notary Public, State of Texas

DOCUMENT PREPARED BY:

Husch Blackwell LLP
2001 Ross Avenue, Suite 2000
Dallas, Texas 75201
Attention: W. Brian Memory

Unofficial Copy

Exhibit "A" to the Deed

Legal Description

Lot 2R1A, Block 2, of Original Town of Arlington, an addition to the City of Arlington, Tarrant County, Texas, according to the Map or Plat thereof recorded in/under Clerk's File No. D216177186, Map/Plat Records, Tarrant County, Texas.

Unofficial Copy

Exhibit "B" to the Deed

Permitted Exceptions

1. Restrictive covenants recorded in/under Clerk's File No. D216177186, Map/Plat Records, Tarrant County, Texas. (Provisions, if any, based on race, color, religion, sex, handicap, familial status or national origins are nullified.)

2. Standby fees, taxes and assessments by any taxing authority for the year 2018 and subsequent years.

3. Terms, conditions, provisions and stipulations of Off-Premise Parking Agreement, by and between City of Arlington and Center Street Station, LLC, dated 12/22/2008, filed 01/16/2009, recorded in/under Clerk's File No. D209012721, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

4. Terms, conditions, provisions and stipulations of Off-Premise Parking Agreement, by and between City of Arlington and Center Street Station, LLC, dated 12/18/2008, filed 01/16/2009, recorded in/under Clerk's File No. D209019222, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

5. Terms, conditions, provisions and stipulations of Mutual Covenant to Maintain Private Water Lines, by and between Center Street Station and City of Arlington, dated 11/13/2009, filed 12/10/2009, recorded in/under Clerk's File No. D209322285, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

6. Terms, conditions, provisions and stipulations of Parking Agreement, by and between Center Street Station Downtown, LLC and CSSD Mushroom LLC, dated 03/11/2011, filed 04/25/2011, recorded in/under Clerk's File No. D211095535, Real Property Records, Tarrant County, Texas. As amended by First Amendment to Parking Agreement, by and between Center Street Station Downtown, LLC and RAH Arlington, LLC, effective 05/30/2013, filed 05/31/2013, recorded in/under Clerk's File No. D213138798, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

7. Terms, conditions, provisions and stipulations of First Amendment Off-Premise Parking Agreement, by and between City of Arlington, Center Street Station, LLC and CCSD Mushroom LLC, effective 07/19/2011, filed 11/04/2011, recorded in/under Clerk's File No. D211269338, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

Unofficial Copy

8. Terms, conditions, provisions and stipulations of Off-Premise Parking Agreement, by and between City of Arlington and Center Street Station, LLC, effective 07/19/2011, filed 11/04/2011, recorded in/under Clerk's File No. D211269339, Real Property Records, Tarrant County, Texas, and as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

9. The location of sidewalk, as shown on survey dated 05/14/2018 prepared by David Carlton Lewis RPLS No. 5647 of Spry Surveyors, Project No. 016-018-11.

Unofficial Copy

ORDINANCE NO. 2023-18

AN ORDINANCE OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, AMENDING DIVISION 7, "OVERLAY DISTRICT REGULATIONS' OF CHAPTER 14, "ZONING," OF THE CODE OF ORDINANCES, CITY OF DALWORTHINGTON GARDENS, TEXAS, TO CREATE A SECTION DEFINING AND GOVERNING THE STANDARDS AND REQUIREMENTS OF A BOWEN ROAD OVERLAY DISTRICT; PROVIDING THAT THIS ORDINANCE SHALL BE CUMULATIVE OF ALL ORDINANCES; PROVIDING A SEVERABILITY CLAUSE; PROVIDING A SAVINGS CLAUSE; PROVIDING A PENALTY; PROVIDING FOR PUBLICATION IN THE OFFICIAL NEWSPAPER; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, the City of Dalworthington Gardens is a Type-A general law municipality located in Tarrant County, created in accordance with the provisions of Chapter 6 of the Texas Local Government Code and operating pursuant to the enabling legislation of the State of Texas; and

WHEREAS, the City Council of the City of Dalworthington Gardens desires to amend Chapter 14 of its zoning regulations to create a Bowen Road overlay in Dalworthington Gardens; and

WHEREAS, the Planning and Zoning Commission of the City of Dalworthington Gardens, Texas held a public hearing on 5/22/2023, and the City Council of the City of Dalworthington Gardens, Texas, held a public hearing on 6/15/2023, with respect to the proposed rezoning as described herein; and

WHEREAS, the City Council finds and determines that the adoption of this Ordinance is in the best interests of and necessary to protect the health, safety, and welfare of the public; and

WHEREAS, the City Council has determined that the proposed ordinance amendment to the zoning ordinance is in the best interest of the citizens of the City.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS:

SECTION 1.

That Division 7, "Overlay District Regulations," of Chapter 14, "Zoning," of the Code of Ordinances, City of Dalworthington Gardens, Texas, is hereby amended by adding Section 14.02.275 to read as follows:

"§ 14.02.275 **"Bowen Road" overlay district ("PD-BR").**

(a) Purpose. The purpose of the Bowen Road zoning overlay district is to allow additional uses by planned development in appropriate SF districts to create a mixed-use community that

integrates predominantly agricultural and food service commercial businesses, with medium density residential uses, and open spaces. Appropriate areas would be adjacent to principal arterials to allow commercial uses compatible with nearby single family residential to take advantage of large traffic volumes while helping maintain the vision and character of the City.

(b) Use regulations. A building or premises in this zoning district shall only be used for the purposes permitted in the base district or overlaid by an approved final PD-BR plan from additional uses allowed in base districts Residential District ("GH"), Business Districts 1, 2, and 3, ("B-1", "B-2", and "B-3", respectively), The Mixed Use overlay district, ("MU"); special exceptions, or an agricultural use without a principal structure. Any portion of the PD-BR adjacent to a street, other than a principal arterial, across which exists Single Family ("SF") zoning, shall be restricted to SF zoning for 200 feet from the street's right-of-way line with no vehicular access to the principal arterial.

(c) Height regulations. Structures, other than SF, shall not exceed two stories.

(d) Applicability. All development, other than SF development, along Bowen Road between California Lane and Roosevelt shall be governed by this overlay district.

(e) Area regulations. The minimum gross land area which may be developed in this district shall be:

(1) For residential developments, four (4) acres; and

(2) For all other developments, two (2) acres.

(f) Density and coverage regulations.

(1) Density of development and maximum site coverage shall be established on the approved final plan with due regard to site and general area characteristics including land use, zoning, topography, thoroughfares and open space opportunity. In no case, however, shall maximum density and site coverage exceed the maximum percentages prescribed therefor in the applicable base district regulations.

(2) When common open space is provided for recreational purposes, the developer may propose that the percentage of the gross site area in common open space be added to the maximum site coverage percentages referred to in subsection (1) above. In no case, however, shall the additional percentage points added to the maximum site coverage regulations total more than the total percentage of the site in common open space. Such proposal shall be evaluated as part of the plan.

(g) Open space regulations. Provisions for public, private, and common open space shall be evaluated with due regard to density, site coverage, and physical characteristics of the site and, if deemed necessary, required as part of the plan. When common open space, common recreational areas, or common areas containing some other amenity to the development are

approved as a part of a final plan, as defined in section 14.02.272, such areas shall be retained and owned by the owner or owners of the residential units contained within the development or an owners' association of which they are members, and shall be perpetually maintained by the owner or owners or the association as a part of the development for the use and benefit of the residents of the development. Garden Home developments shall include a minimum of 10 percent open space, not including platted lots and streets.

(h) Screening. An orderly transition from commercial uses to the large lot residential uses will incorporate suitable separation barriers with a preference to vegetated barriers in lieu of hardened barriers such as fences.

(i) Setback regulations. Minimum setbacks shall be approved as a part of the development plan; provided however, that the minimum setbacks on the boundaries of a PD-BR district shall not be less than the requirements of the zoning district it abuts.

(j) Off-street parking regulations.

(1) Off-street parking facilities shall be provided at locations designated on the final plan.

(2) Minimum off-street parking requirements shall be established on the final plan, but shall not be less than the minimum requirements for permitted uses prescribed in Division 9 of this article.

(k) "PD-BR" planned development-redevelopment district.

(1) Development regulations. The regulations of this district as to use, height, density, coverage, open space, setback and parking, shall be the same as provided in section 14.02.275 hereof.

(2) Area regulations. The minimum gross land area which may be developed in this district is two (2) acres for SF properties. If the property does not fall under SF, then this subsection (j)(2) does not apply.

(3) Development standards and procedures. The standards and procedures for development in this district shall be as provided in this division for PD district development, but shall include also the following:

(A) In any PD-BR district where substandard streets or utilities are in existence, the property owner or developer shall install, rebuild, or improve all necessary streets and utilities at his sole expense, including off-site streets and utilities which are determined by the council to be necessary to serve the redevelopment, subject to the standard cost-sharing policies and ordinances which determine the development costs which the city may pay, and subject to any agreements for cost sharing which are mutually agreed upon by the property owner and the city. The city's participation in redevelopment shall in every instance be

conditioned upon the determination by the council, in its sole discretion, of the availability of public funds therefor at the time of such development.

(B) Installation, rebuilding, or improvement of necessary streets and utilities shall be required when new buildings are constructed within the PD-BR district.

(C) Uses conducted in existing buildings shall not require the construction of streets and utilities unless: additional construction, such as additional paved parking, must be done on the site, a change or expansion in use would require increased utility service; or, the council finds that such construction is necessary at the time the PD-BR plan is approved.

§14.02.276 through §14.02.320. (Reserved)"

SECTION 2.

This Ordinance shall be cumulative of all provisions of ordinances and of the Code of Ordinances, City of Dalworthington Gardens, Texas as amended, except where the provisions are in direct conflict with the provisions of other ordinances, in which event the conflicting provisions of the other ordinances are hereby repealed.

SECTION 3.

It is hereby declared to be the intention of the City Council that the phrases, clauses, sentences, paragraphs, and sections of this Ordinance are severable, and if any phrase, clause, sentence, paragraph, or section of this Ordinance shall be declared unconstitutional by the valid judgment or degree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs, and sections of this Ordinance, since the same would have been enacted by the City Council without incorporation in this Ordinance of any such unconstitutional phrase, clause, sentence, paragraph, or section.

SECTION 4.

Any person, firm or corporation who violates, disobeys, omits, neglects or refuses to comply with or who resists the enforcement of any of the provisions of this Ordinance shall be fined not more than Two Thousand Dollars ($2,000.00) for each offense. Each day that a violation is permitted to exist shall constitute a separate offense.

SECTION 5.

All rights and remedies of the City of Dalworthington Gardens are expressly saved as to any and all violations of the provisions of the Code of Ordinances, City of Dalworthington Gardens, Texas, as amended or revised herein, or any other ordinances affecting the matters regulated herein which have accrued at the time of the effective date of this Ordinance; and, as to such accrued violations and all pending litigation, both civil and criminal, whether pending in court

or not, under such ordinances, same shall not be affected by this Ordinance but may be prosecuted until final disposition by the courts.

SECTION 6.

The City Secretary of the City of Dalworthington Gardens is hereby directed to publish in the official newspaper of the City of Dalworthington, the caption, publication clause, and effective date clause of this ordinance in accordance with Section 52.011 of the Texas Local Government Code.

SECTION 7.

This Ordinance shall be in full force and effect from and after its passage and publication as provided by law, and it is so ordained.

PASSED AND APPROVED ON THIS 16th DAY OF November, 2023.

Laurie Bianco

Laurie Bianco, Mayor

ATTEST:

Sandra Ma
Interim City Secretary

SEAL

CITY OF DALWORTHINGTON GARDENS

JAN 3 1 2024

NOTICE OF PUBLIC HEARINGS

Re: Revision of zoning change request – Villages of DWG (Trevor Turnbow)

To Property Owners within 200' of 2500 & 2512 California Lane Dalworthington Gardens, Tarrant County, Texas

Notice is hereby given that the Dalworthington Gardens Planning and Zoning Commission will hold a public hearing on February 1, 2024 at 6:00 p.m. and the Dalworthington Gardens City Council will hold a public hearing on February 15, 2024 at 7:00 p.m., both to be held in the City Hall Council Chambers, 2600 Roosevelt Drive, Dalworthington Gardens, Texas to consider the following:

An application from Trevor Turnbow for a revision of zoning change request in accordance with Division 7 "Overlay District Regulations" of Chapter 14. "Zoning," 14.02.275 "Bowen Road" overlay District to allow for an overlay of PD-BR to the existing SF Zoning.

This notice has been sent to all owners of real property within 200 feet of the request as such ownership appears on the last approved city tax roll. All interested persons are encouraged to attend the public hearing and express their opinions on the amendment. If you are unable to attend but wish to have your opinions made part of the public record, please mail your opinions to the address below prior to the public hearing. Please include your name, address, and property description on all correspondence.

COMMENTS: Dont like berms as a separator!! If this is to take place, I/we want a nice privacy fence between our properties and this project. Maybe some stone posts with fencing in between posts. We have 3 properties on each side 2815 TX 2901 TX 2907 TX

I AM IN FAVOR: _____ I HAVE NO OBJECTIONS: _____ I HAVE OBJECTIONS: ✓

CYNTHIA FULTON (PRINTED NAME) Cynthia Fulton (SIGNATURE)

2916 Hyde Dr (ADDRESS) Arlington 76015 (DWG) (CITY, STATE, ZIP)

MAIL TO:
CITY OF DALWORTHINGTON GARDENS
CITY ADMINISTRATOR
2600 ROOSEVELT DRIVE
DALWORTHINGTON GARDENS, TX 76016

For questions: 817-385-6454 or sandra@cityofdwg.net

City Council

Staff Agenda Report **Agenda Item: 9f.**

Agenda Subject: Discussion and possible action regarding the 49th Tarrant County Community Development Block Grant (CDBG) program for Ambassador Row.		
Meeting Date: February 15, 2024	**Financial Considerations:** **Budgeted:** **☒Yes ☒No ☐N/A**	**Strategic Vision Pillar:** ☐Financial Stability ☐Appearance of City ☒Operations Excellence ☒Infrastructure Improvements/Upgrade ☒Building Positive Image ☐Economic Development ☐Educational Excellence

Background Information:
Three bidders submitted for this project, and a bid tabulation is being provided. The project came in over budget by $109,830.74. The recommended contractor is JR West Texas Concrete, LLC as provided in the attached award letter.

FY 23/24 budget included city paid construction costs of $38,840.80 for the General Fund and $3,377.46 for the Enterprise Fund. With the increase in construction costs of $152,049, this will increase total budgeted costs for city of $109,830.74, of which $86,660.26 is for the General Fund and $23,170.48 is for the Enterprise Fund.

Recommended Action/Motion: Recommend approval of Resolution 2024-03 awarding the 49th CDBG project for Ambassador Row to JR West Concrete, LLC in the amount of $332,049.

Attachments:

Topographic Recommendation for Award Letter
Resolution for Bid Approval
Original Bid January 2023
Budget Impact Spreadsheet
Bid Tabulation
Original Tarrant County Award Letter

TOPOGRAPHIC
LOYALTY INNOVATION LEGACY

February 5, 2024

Chief Greg Petty, Interim City Administrator
City of Dalworthington Gardens
2600 Roosevelt Drive
Dalworthington Gardens, TX 76016

RE: RECOMMENDATION FOR AWARD – B23-UC-48-0001-19-75
49th YEAR CDBG PROJECT – DALWORTHINGTON GARDENS
AMBASSADOR ROW SOUTH – CHASE CT. TO ROMAN CT.

Greg,

The bid opening for the above referenced 49th Year CDBG project was held at the offices of Tarrant County Community Development on Wednesday, January 17, 2024. The project involves reconstruction of the south side of Ambassador Row between Chase Court and Roman Court, including water line improvements. Three formal bids were received and are provided on the attached bid tabulation. The bids have been reviewed for accuracy and they appear to be in order.

The low bid for the project was $332,049.00 as submitted by JR West Texas Concrete, LLC (this amount includes $25,000 in miscellaneous paving and utility allowances to minimize change orders as this money is not anticipated to be used). The engineering estimate for the project was $252,218 (material and construction prices have continued to be inflated for smaller jobs – the engineering estimate increased prices 10% from the last project for the north side of the road). After consideration of the qualifications (DBE Certified) and experience of the low bidder on similar projects and receiving City staff input, it was determined that the low bidder was a contractor capable of performing the construction to the satisfaction of the Owner.

The 49th Year CDBG construction funds for this project amount to $180,000. The difference between the available CDBG funding and the bid price will result in the City being responsible for $152,049.00, which includes an allowance of $25,000 in change orders. Therefore, we suggest the City of Dalworthington Gardens recommend to Tarrant County the award of the 49th Year CDBG Project in the amount of $332,049.00 to:

JR West Texas Concrete, LLC
108 South Sherman St.
Rice, TX 75155

We appreciate your consideration of this recommendation. Please let us know if you have any questions.

Respectfully,

Kylon M. Wilson, P.E.
Principal

Cc: Brad Hearne, Tarrant County
JR West Texas Concrete, LLC

RESOLUTION 2024-03

A RESOLUTION AWARDING THE 49 TH YEAR CDBG PROJECT FOR AMBASSADOR ROW TO JR WEST TEXAS CONCRETE, LLC IN THE AMOUNT OF $332,049, AND TO APPROVE THE CITY'S CONSTRUCTION PORTION OF $152,049, WHICH IS THE CITY'S RESPONSIBILITY AND $180,000 COMING FROM TARRANT COUNTY THROUGH THE CDBG PROGRAM

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS:

I. The City is awarding the 49th Year CDBG Project for Ambassador Row to JR West Texas Concrete, LLC in the amount of $332,049.
2. The City approves the contribution of $152,049 which is the city's responsibility, and acknowledges $180,000 will come from Tarrant County through the CDBG program.

PASSED AND APPROVED ON February 15, 2024.

CITY OF DALWORTHINGTON GARDENS, TEXAS

_____
Laura Bianco, Mayor

ATTEST:

_____
Sandra Ma, City Secretary

TOPOGRAPHIC
LOYALTY INNOVATION LEGACY

Ambassador South Side (Chase Ct. to Roman Ct.) 2023-01-24

	Description: OVERALL	Unit Quantity	Unit	Unit Price	Total Price
Paving					
1	Mobilization/Signage	1	LS	$8,415.00	$8,415.00
2	Sawcut/Remove Conc. Curb & Gutter	610	LF	$4.40	$2,684.00
3	Sawcut/Remove 6" HMAC Pavement	1,074	SY	$7.70	$8,269.80
4	Sawcut/Remove Conc. Valley Gutter	350	SF	$3.30	$1,155.00
5	Sawcut/Remove 4" Conc. Sidewalk	96	SF	$165.00	$15,840.00
6	Unclassified Excavation	1	LS	$2,200.00	$2,200.00
7	4' Concrete Sidewalk	96	SF	$12.10	$1,161.60
8	5' Concrete Sidewalk (Exposed Aggr.)	1,150	SF	$15.00	$17,250.00
9	Mod Type 2 Curb Ramp w/ 5×2 ADA	3	EA	$2,500.00	$7,500.00
10	6" Reinforced Concrete Pavement with 6" curb	1,248	SY	$70.40	$87,859.20
11	6" Cement Stabilized Subgrade @ 32#/SY	1,315	SY	$8.00	$10,520.00
12	Cement	21	TN	$209.00	$4,389.00
13	F&I 4" White Parking Striping	315	LF	$2.20	$693.00
14	Yard/Median/Parkway Restoration	1	LS	$13,200.00	$13,200.00
15	Traffic Control	1	LS	$4,950.00	$4,950.00
				Sub-total	$186,086.60
Water Line Improvements					
15	Remove Existing 6" AC Water Line	60	LF	$16.50	$990.00
16	F&I 6" Gate Valve and Box	1	EA	$1,650.00	$1,650.00
17	F&I 6" C-900 PVC Water Line	60	LF	$121.00	$7,260.00
18	F&I 1" Short Water Service	1	EA	$1,980.00	$1,980.00
19	F&I 1" Long Water Service	1	EA	$3,080.00	$3,080.00
20	F&I MJ Ductile Iron Fittings	0.03	TN	$3,000.00	$90.00
21	Connect to Existing 6" Water Line	2	EA	$440.00	$880.00
				Sub-total	$15,930.00
Total Preliminary Construction Cost					**$202,016.60**
				Contingency	$20,201.66
		Design Services			$29,999.47
				Total	**$252,217.73**

The Opinion of Probable Construction Cost is made by an engineer, not a professional construction estimator, and is based off a preliminary layout without a detailed design.

49th CDBG Engineer's Opinion of Probable Construction Cost

	Application	Proposed BUDGET	Variance
Sub-Total Const. Cost	202,016.60	202,016.60	-
10% Contigencies	20,201.66	20,201.66	-
Engineering/Surv	29,999.47	30,000.00	0.53 [1]
Total Project Costs	**252,217.73**	**252,218.26**	**0.53**
Approved CDBG Award	175,000.00	180,000.00	5,000.00
City Leverage	47,218.26	42,218.26	(5,000.00)
City Paid Engineering	29,999.47	30,000.00	0.53
Total Estimated Funds Available	**252,217.73**	**252,218.26**	**0.53**

	BUDGET			Construction Bid JR West Texas Concrete			BID vs BUDGET		
Approved CDBG Award	180,000.00			180,000.00			-		
City Leverage	42,218.26			152,049.00			109,830.74		
City Paid Engineering	30,000.00			30,000.00			-		
Total Estimated Costs	**252,218.26**			**362,049.00**			**109,830.74**		
Water	17,523.00	8%		56,143.00	18%		38,620.00		
Sewer	-	0%			0%		-		
Street	195,438.76	92%		260,106.00	82%		64,667.24		
Sub-total Construction	212,961.76	100%		316,249.00	100%		103,287.24		
Allocation (Mobilization/Signage)	9,256.50			15,800.00			6,543.50		
Total Construction	**222,218.26**			**332,049.00**			**109,830.74**		
Water	17,777.46	8%		58,947.94	18%		41,170.48		
Sewer	-	0%		-	0%		-		
Street	204,440.80	92%		273,101.06	82%		68,660.26		
Total Construction Allocated	**222,218.26**	**100%**		**332,049.00**	**100%**		**109,830.74**		
Water	2,400.00	8%		5,400.00	18%		3,000.00		
Sewer	-	0%		-	0%		-		
Street	27,600.00	92%		24,600.00	82%		(3,000.00)		
Total Engineering Allocated	**30,000.00**	**100%**		**30,000.00**	**100%**		**-**		
	Grant	**City**	**TOTAL**	**Grant**	**City**	**TOTAL**	**Grant**	**City**	**TOTAL**
Water	14,400.00	5,777.46	20,177.46	32,400.00	31,947.94	64,347.94	18,000.00	26,170.48	44,170.48
Sewer	-	-	-	-	-	-	-	-	-
Enterprise Fund	**14,400.00**	**5,777.46**	**20,177.46**	**32,400.00**	**31,947.94**	**64,347.94**	**18,000.00**	**26,170.48**	**44,170.48**
Street - General Fund	**165,600.00**	**66,440.80**	**232,040.80**	**147,600.00**	**150,101.06**	**297,701.06**	**(18,000.00)**	**83,660.26**	**65,660.26**
Total 47th CDBG Project Cost	**180,000.00**	**72,218.26**	**252,218.26**	**180,000.00**	**182,049.00**	**362,049.00**	**-**	**109,830.74**	**109,830.74**
	Grant	**City-Eng**	**City-Const**	**TOTAL**	**Grant**	**City-Eng**	**City-Const**	**TOTAL**	**Grant**	**City-Eng**	**City-Const**	**TOTAL**
Water	14,400.00	2,400.00	3,377.46	20,177.46	32,400.00	5,400.00	26,547.94	64,347.94	18,000.00	3,000.00	23,170.48	44,170.48
Sewer	-	-	-	-	-	-	-	-	-	-	-	-
Enterprise Fund	**14,400.00**	**2,400.00**	**3,377.46**	**20,177.46**	**32,400.00**	**5,400.00**	**26,547.94**	**64,347.94**	**18,000.00**	**3,000.00**	**23,170.48**	**44,170.48**
Street	**165,600.00**	**27,600.00**	**38,840.80**	**232,040.80**	**147,600.00**	**24,600.00**	**125,501.06**	**297,701.06**	**(18,000.00)**	**(3,000.00)**	**86,660.26**	**65,660.26**
Total 47th CDBG Project Cost	**180,000.00**	**30,000.00**	**42,218.26**	**252,218.26**	**180,000.00**	**30,000.00**	**152,049.00**	**362,049.00**	**-**	**-**	**109,830.74**	**109,830.74**

Financial Impact of Bid vs Budget			
	General Fund	**Enterprise Fund**	**TOTAL**
CDBG Grant Revenue	(18,000.00)	$ 18,000.00	$ -
City Cash Outlay	83,660.26	$ 26,170.48	$ 109,830.74
Total CDBG Project Costs	**65,660.26**	**$ 44,170.48**	**$ 109,830.74**

BID TABULATION REPORT

AMBASSADOR ROW SOUTH (CHASE COURT TO ROMAN COURT) - DALWORTHINGTON GARDENS, TX

TARRANT COUNTY PROJECT B23-UC-48-0001-19-75

BID OPENED : Wednesday January 17, 2024 at 10:00 a.m.

PAVING AND WATER IMPROVEMENTS

				JR West Texas Concrete, LLC Rice, Texas		McClendon Construction Co., Inc. Burleson, Texas		Capko Concrete Structures, LLC Azle, Texas			
ITEM	DESCRIPTION	UNITS	QTY	UNIT PRICE	TOTAL COST	UNIT PRICE	TOTAL COST	UNIT PRICE	TOTAL COST	UNIT PRICE	TOTAL COST
1	MOBILIZATION / DEMOBILIZATION	LS	1	$ 15,800.00	$ 15,800.00	$ 23,650.00	$ 23,650.00	$ 10,000.00	$ 10,000.00	$ -	$ -
2	SAWCUT & REMOVE 6" REINFORCED CONCRETE VALLEY GUTTER	SF	227	$ 6.00	$ 1,362.00	$ 4.00	$ 908.00	$ 20.00	$ 4,540.00	$ -	$ -
3	SAWCUT & REMOVE CONCRETE CURB & GUTTER	LF	568	$ 12.00	$ 6,816.00	$ 7.00	$ 3,976.00	$ 30.00	$ 17,040.00	$ -	$ -
4	UNCLASSIFIED EXCAVATION	LS	1	$ 7,500.00	$ 7,500.00	$ 32,250.00	$ 32,250.00	$ 20,000.00	$ 20,000.00	$ -	$ -
5	SAWCUT AND REMOVE 6" HMAC PAVEMENT	SY	1,086	$ 18.00	$ 19,548.00	$ 16.00	$ 17,376.00	$ 40.00	$ 43,440.00	$ -	$ -
6	6" STABILIZED SUBGRADE @ 32#/SY	SY	1,315	$ 20.00	$ 26,300.00	$ 9.00	$ 11,835.00	$ 25.00	$ 32,875.00	$ -	$ -
7	CEMENT FOR STABILIZATION	TN	21.0	$ 390.00	$ 8,190.00	$ 400.00	$ 8,400.00	$ 400.00	$ 8,400.00	$ -	$ -
8	6" REINFORCED CONCRETE PAVEMENT WITH 6" CURB	SY	1,197	$ 115.00	$ 137,655.00	$ 95.00	$ 113,715.00	$ 84.00	$ 100,548.00	$ -	$ -
9	4" REINFORCED CONCRETE SIDEWALK	SF	1,140	$ 11.00	$ 12,540.00	$ 15.00	$ 17,100.00	$ 20.00	$ 22,800.00	$ -	$ -
10	SAWCUT, REMOVE & REPLACE HMAC TRANSITION PAVEMENT	SF	118	$ 25.00	$ 2,950.00	$ 20.00	$ 2,360.00	$ 24.00	$ 2,832.00	$ -	$ -
11	REMOVE EXISTING 6" AC WATER LINE & 2 SERVICES	LF	55	$ 162.00	$ 8,910.00	$ 150.00	$ 8,250.00	$ 50.00	$ 2,750.00	$ -	$ -
12	MOD. TYPE 2 CURB RAMP WITH 5'X2' TACTILE SURFACE	EA	2	$ 2,800.00	$ 5,600.00	$ 2,950.00	$ 5,900.00	$ 4,000.00	$ 8,000.00	$ -	$ -
13	FURNISH & INSTALL 6" PVC WATER LINE	LF	55	$ 351.00	$ 19,305.00	$ 320.00	$ 17,600.00	$ 200.00	$ 11,000.00	$ -	$ -
14	FURNISH & INSTALL DUCTILE IRON FITTINGS	TN	0.04	$ 16,200.00	$ 648.00	$ 15,000.00	$ 600.00	$ 10,000.00	$ 400.00	$ -	$ -
15	CONNECT TO EXISTING SYSTEM	EA	2	$ 5,400.00	$ 10,800.00	$ 4,500.00	$ 9,000.00	$ 2,500.00	$ 5,000.00	$ -	$ -
16	FURNISH & INSTALL 1" BULLHEAD SERVICE - LONG	EA	1	$ 3,456.00	$ 3,456.00	$ 3,250.00	$ 3,250.00	$ 5,000.00	$ 5,000.00	$ -	$ -
17	FURNISH & INSTALL 1" BULLHEAD SERVICE - SHORT	EA	1	$ 3,024.00	$ 3,024.00	$ 2,750.00	$ 2,750.00	$ 4,000.00	$ 4,000.00	$ -	$ -
18	TRAFFIC CONTROL	LS	1	$ 6,000.00	$ 6,000.00	$ 15,500.00	$ 15,500.00	$ 10,000.00	$ 10,000.00	$ -	$ -
19	YARD/MEDIAN/PARKWAY RESTORATION - SOD	LS	1	$ 5,800.00	$ 5,800.00	$ 19,500.00	$ 19,500.00	$ 10,000.00	$ 10,000.00	$ -	$ -
20	SAWCUT AND REMOVE 4" CONCRETE SIDEWALK	SF	195	$ 5.00	$ 975.00	$ 4.00	$ 780.00	$ 10.00	$ 1,950.00	$ -	$ -
21	FURNISH & INSTALL 4" WHITE PARKING STRIPING	LF	290	$ 3.00	$ 870.00	$ 4.00	$ 1,160.00	$ 10.00	$ 2,900.00	$ -	$ -
22	FURNISH & INSTALL ADA PARKING SYMBOL	EA	1	$ 1,200.00	$ 1,200.00	$ 350.00	$ 350.00	$ 1,000.00	$ 1,000.00	$ -	$ -
23	FURNISH & INSTALL VAN ACCESSIBLE SIGN	EA	1	$ 1,800.00	$ 1,800.00	$ 600.00	$ 600.00	$ 1,200.00	$ 1,200.00	$ -	$ -
24	MISCELLANEOUS PAVING ALLOWANCE	LS	1	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00	$ 15,000.00		
25	MISCELLANEOUS UTILITY ALLOWANCE	LS	1	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ -	$ -
	TOTAL BASE BID AMOUNT				$ 332,049.00		$ 341,810.00		$ 350,675.00		$ 0.00

TARRANT COUNTY

March 31, 2023

Honorable Laurie Bianco
City of Dalworthington Gardens
2600 Roosevelt Dr.
Dalworthington Gardens, TX 76016

RE: 2023 Community Development Block Grant (CDBG – 49th year) Allocation to Project

Dear Mayor;

Tarrant County, Texas receives an annual allocation of Community Development Block Grant funds from the U.S. Department of Housing and Urban Development annually. This is the 49th year that Tarrant County has assisted consortium cities with infrastructure improvements with this funding. This letter serves as formal notification to your City of the CDBG allocation to the following project and the city's obligation to cover the balance to complete the project.

Project Address: South side of 3300 block of Ambassador Row, DWG, Texas 76013

Project Description: South side of Ambassador Row from Chase Ct. to Roman Ct. - Removing existing asphalt paving, concrete sidewalk, concrete curb and gutter, and a 6" asbestos cement water line. Improvements include 6" reinforced concrete pavement with 6" cement stabilized subgrade, 4" exposed aggregate sidewalk along the back of curb, 3 accessible ramps, 4" concrete sidewalk to match existing, grass sod replacement in existing median, 6" PVC water line with new services, and parking striping. Project includes 60 LF of water line, 1,246 SF of sidewalk, and 1,248 SY for pavement reconstruction.

CDBG Allocation: $180,000 (2023 CDBG)

Estimated Project cost: $252,218

Thank you for your continued collaboration with Tarrant County to serve our citizens. Please direct any regulatory concerns to Susan Au at SAu@TarrantCountyTX.gov and any construction questions or concerns to Brad Hearne BLHearne@TarrantCountyTX.gov.

Sincerely,

James A. McClinton, Director

cc: Lola Hazel

ORDINANCE NO: 2024-03

AN ORDINANCE OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, AMENDING THE CODE OF ORDINANCES OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, CHAPTER 9 "PERSONNEL," ARTICLE 9.02 "OFFICERS AND EMPLOYEES," DIVISION 2 "CITY ADMINISTRATOR" TO REMOVE THE DIVISION IN ITS ENTIRETY; AMENDING CHAPTER 9 "PERSONNEL," ARTICLE 9.04 "POLICE," DIVISION 2 "POLICE DEPARTMENT" IN ITS ENTIRETY TO UPDATE DUTIES OF THE DIRECTOR OF PUBLIC SAFETY; PROVIDING THAT THIS ORDINANCE SHALL BE CUMULATIVE OF ALL ORDINANCES; PROVIDING A SEVERABILITY CLAUSE; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, the City of Dalworthington Gardens, Texas ("City") is a Type-A general law municipality located in Tarrant County, created in accordance with the provisions of Chapter 6 of the Texas Local Government Code and operating pursuant to the enabling legislation of the State of Texas; and

WHEREAS, the Code of Ordinances of the City sets forth the duties of the City Administrator and the Director of Public Safety; and

WHEREAS, the City Council wishes to remove the position of City Administrator; and

WHEREAS, the City Council wishes to change the duties of the Director of Public Safety to include the duties previously assigned to the City Administrator position.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF DALWORTHINGTON GARDENS, TEXAS, THAT:

SECTION 1.

Division 2 "City Administrator" of Article 9.02 "Officers and Employees" of Chapter 9 "Personnel" of the Code of Ordinances, City of Dalworthington Gardens, Texas, shall be removed in its entirety.

SECTION 2.

Section 9.04.036 "Duties of the director of public safety" of Division 2 "Police Department" of Article 9.04 "Police" of Chapter 9 "Personnel" of the Code of Ordinances, City of Dalworthington Gardens, Texas, shall be amended in its entirety to read as follows:

"

****

§ 9.04.036 **Duties of the director of public safety/city administrator.**

The director of public safety/city administrator, subject to the limitations defined in resolutions and ordinances of the City and state statutes, shall be the chief administrative officer of the City, responsible to the city council and mayor for the proper administration of the business affairs of the City, pursuant to the statutes of the state, the ordinances of the City, and the resolutions and directives of the city council, with power and duties as follows:

(1) General duties.

(A) Carry out directives of the city council and mayor which require administrative implementation. Coordinate with the mayor regularly on the status of the implementation of such directives and report promptly to the city council and mayor any difficulties encountered herein;

(B) Be responsible for the administration of all day-to-day operations of the city government including the monitoring of all City ordinances, resolutions, council meeting minutes and state statutes;

(C) Coordinate with the mayor and prepare a plan of administration, including an organization chart, which defines authority and responsibility for all nonstatutory positions of the City; and submit it to the city council for adoption as the official organization and administrative procedure plan for the City;

(D) Coordinate with the mayor and establish when necessary administrative procedures to increase the effectiveness and efficiency of city government according to current practices in local government, not inconsistent with subsection (C) above or directives of the mayor and city council; and submit such procedures to the city council for adoption;

(E) Serve as ex-officio nonvoting member of all boards, commissions and committees of the City, except as specified by the city council or state statutes;

(F) Keep informed concerning current federal, state, and county legislation and administrative rules affecting the City and submit appropriate reports and recommendations thereon to the council;

(G) Maintain awareness concerning the availability of federal, state and county funds for local programs. Assist department heads and the city council in obtaining these funds under the direction of the mayor and city council;

(H) Represent the City in matters involving legislative and intergovernmental affairs as authorized and directed as to that representation by the mayor and city council;

(I) Act as a spokesperson for the City with the responsibility of assuring that the news media are kept informed about the operations of the City;

(J) Establish and maintain procedures to facilitate communications between citizens and city government to ensure that complaints, grievances, recommendations and other matters receive prompt attention by the responsible official, and to assure that all such matters are expeditiously resolved;

(K) Promote the economic well-being and growth of the City through public and private sector cooperation.

(L) The director of public safety/city administrator shall be the city marshal and shall see that the laws and City ordinances are enforced as far as possible by those under their command, and shall see that police officers are on duty during the whole time of their watch. The director of public safety/city administrator shall inform the mayor in advance of any periods of absence during working hours. They shall obtain written approval from the mayor for any days off for vacation or training which would make the director of public safety/city administrator unavailable. The director of public safety/city administrator shall, from time-to-time and as often as may be required by the mayor, make a report in writing of the activities of the police department. The director of public safety/city administrator will be responsible to the city council and mayor for the department's operations and the efficient and effective utilization of the department's financial and human resources. They will inform the mayor and city council in a timely manner of all matters affecting the performance of the department of public safety and the wellbeing of the City.

(2) Responsibilities to the city council.

(A) Attend all meetings of the city council, assisting the mayor and the council as required in the performance of their duties;

(B) In coordination with the mayor, the city council, and the city secretary, ensure that appropriate agendas are prepared for all meetings of the council, all council committees, and all other appropriate committees and commissions of the City, together with such supporting material as may be required; with nothing herein being construed as to give the director of public safety/city administrator the authority to limit or in any way prevent matters from being considered by the council, or any of its committees and commissions;

(C) Assist in the preparation of ordinances and resolutions as requested by the mayor or aldermen, or as needed;

(D) Keep the city council and mayor regularly informed about the activities of the public safety/city administrator's office by oral or written report at regular and special meetings of the city council. Further, the director of public safety/ city administrator will timely notify the city council and mayor of any matters materially affecting the performance of their duties and the wellbeing of the City;

(E) In the event that action normally requiring council approval is critical at a time when the council cannot meet, the director of public safety/city administrator shall receive directives from the mayor.

(F) Obtain written approval from the mayor before any press releases are issued on behalf of the City. In the event that action normally requiring council approval is necessary at a time when the council cannot meet, the director of public safety/city administrator shall receive directives from the mayor.

(G) Obey the orders of the mayor or of the council and shall to the best of their ability preserve order, quiet, and peace throughout the City, and enforce all ordinances of the City.

(3) Personnel.

(A) Be responsible for the administrative direction and coordination of all employees of the City according to the established organization procedures;

(B) Recommend to the city council and mayor the appointment, promotion, and when necessary for the good of the City, the suspension or termination of department heads;

(C) In consultation with the mayor and appropriate department head, be responsible for the appointment, promotion, and when necessary for the good of the City, the suspension or termination of employees below the department head level;

(D) Serve as personnel officer for the City with responsibilities to see that complete and current personnel records, including specific job descriptions, for all City employees are kept; evaluate in conjunction with department heads the performance of all employees on a regular basis; recommend salary and wage scales for City employees not covered by collective bargaining agreements; develop and enforce high standards of performance by City employees; assure that City employees have proper working conditions; and work closely with department heads to promptly resolve personnel problems or grievances;

(E) Work closely with department heads to assure that employees receive adequate opportunities for training to maintain and improve their job-related knowledge and skills and act as the approving authority for requests by employees to attend conferences, meetings, training schools, etc., provided that funds have been budgeted for these activities.

(4) Budgeting and purchasing.

(A) Work with the mayor to prepare a draft annual City budget, in accordance with guidelines as may be provided by the city council and in coordination with

department heads, and pursuant to state statutes, for review and approval by the city council;

(B) Administer the budget as adopted by the city council;

(C) Work closely with the city council and mayor to maintain a positive fiscal position and surplus. Further, the director of public safety/city administrator will report regularly to the city council and mayor on the current fiscal position of the City;

(D) Supervise the accounting system of the City and ensure that the system employs methods in accordance with current professional accounting practices;

(E) Serve as the purchasing agent for the City, supervising all purchasing and contracting for supplies and services, subject to the purchasing procedures established by the council and any limitation contained in the state statutes.

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SECTION 3.

This Ordinance shall be cumulative of all provisions of ordinances of the City of Dalworthington Gardens, Texas, as amended, except where the provisions of this Ordinance are in direct conflict with the provisions of such ordinances and such Code, in which event the conflicting provisions of such ordinances and such Code are hereby repealed.

SECTION 4.

It is hereby declared to be the intention of the City Council that the phrases, clauses, sentences, paragraphs, and sections of this Ordinance are severable, and if any phrase, clause sentence, paragraph or section of this Ordinance shall be declared unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs and sections of this Ordinance, since the same would have been enacted by the City Council without the incorporation in this Ordinance of any such unconstitutional phrase, clause, sentence, paragraph or section.

SECTION 5.

This Ordinance shall be in full force and effect from and after its passage and publication as required by law, and it is so ordained.

PASSED AND APPROVED ON THIS ____ DAY OF _____, 2024.

APPROVED:

_____
Laurie Bianco, Mayor

ATTEST:

_____
Sandra Ma, City Secretary

APPROVED AS TO FORM AND LEGALITY:

_____
Cara Leahy White, City Attorney

City Council

Staff Agenda Report **A genda Item: 9g**

Agenda Subject: Discuss and possible action on upgrading our outdated SCADA system		
Meeting Date: February 15, 2024	**Financial Considerations:** $47,702 Upgrade SCADA System $2,840 Annual Monitoring Services $5,000 Modify Ground Storage Tank Fill Control **Budgeted:** **☒Yes ☒No ☐N/A** **Use of Budget Capital Surplus**	**Strategic Vision Pillar:** ☒ Financial Stability ☐ Appearance of City ☒ Operations Excellence ☒ Infrastructure Improvements/Upgrade ☐ Building Positive Image ☐ Economic Development ☐ Educational Excellence

Prior Council Action:
None

Background Information:
Our current SCADA system was installed approximately 15 years ago and is in desperate need of being upgraded.

Our current software runs on Windows 7, making it vulnerable to cyber threats. The SCADA hardware is outdated and no longer serviceable and replacement parts are virtually nonexistent.

The proposed system is cloud-based with 2-factor authentication for ensured security. This also allows for more users to be added with restricted "as needed" access. This proposed upgrade will allow us to move from a radio "line of sight" communication patch to a cellular network.

WE have an "unknown" capital surplus with funds available for this purchase.

Recommended Action/Motion:

- Motion to approve the purchase of a new SCADA communication system from WHECO Controls for $47,702
- Approve annual recurring charges of $2,840
- Approve $5,000 to have WHECO modify the ground storage tank fill control as phase 2 after the new SCADA system is up and operational.

Attachments: **WHECO SCADA Upgrade System**
QuickDATA Quote – Annual Monitoring
WHECO Modify Ground Storage Tank Fill Control

January 31, 2024

City of Dalworthington Gardens
Attn: Marcus Day
Via E-Mail

Reference: Update existing SCADA system to cellular communication and QuickDATA HMI service

Mr. Day,

We appreciate the opportunity to quote the above referenced job. Our scope of work shall include furnishing the equipment and technical services to replace the existing SCADA system communications and HMI system as provided and qualified below. Upon completion of the installation, credentialed users can access the system from any internet enabled web browser. Tank levels and pump starts/runtimes will be tracked and trended for performance analysis. Alarm conditions including but not limited to high/low water, pump fail, power loss or communications loss will notify designated personnel via voice, e-mail or text. WHECO can provide service support via remote access at all sites and QuickDATA HMI with the new communications system.

Equipment to be furnished and installed in existing enclosures:

- Cellular modem w/antenna and coax whip for CFW vault, Arlington Vault and pump station
- Cellular gateway PLC and modem, etc. as required to communicate with QuickDATA
- Submersible level transmitter for pump station ground storage tank
- Current transformers for 2 pumps to track starts and run times
- All miscellaneous materials and equipment as required for a working system

Technical services shall include the following:

- Physical installation of all WHECO furnished equipment
- Programming, testing and support as required
- Complete system evaluation

Not Included in this proposal

- Any equipment or service not specifically listed above
- Taxes or bonding cost if applicable

Labor and materials as itemized above all sites	$ 31,202.00
QuickDATA HMI initial programming, configuration and testing	$ 16,500.00

Delivery is estimated at 10-36 weeks (we may be able to shorten the delivery but cannot promise) after receipt of order. Installation scheduled upon receipt of required equipment, assembly completed and tested. Terms are 25% due with order, balance due upon completion. This quote is valid for thirty (30) days with letter of intent to award within fifteen (15) days. Please feel free to call me if you have any questions.

Sincerely;

Kent Meyerhoeffer
President

QUICKDATA™

8501 Jacksboro Hwy
Fort Worth, TX 76135
817-238-8220

QUOTE

Date	Estimate #
2/2/2024	1070

Name / Address
Dalworthington Gardens Attn: Marcus Day

P.O. No.	Terms	Project
	Net 15	

Description	Qty	Unit	Rate	Total
QuickData Monitoring services annual prepaid	200	tags	7.00	1,400.00T
Cellular communications @$30/month annual prepaid	4	Modems	360.00	1,440.00T
Exempt from Sales Tax			0.00%	0.00
Annual monitoring and cellular services			Total	$2,840.00

Customer Acceptance _____

February 9, 2024

City of Dalworthington Gardens
Attn: Marcus Day
Via E-Mail

Reference: Modify Ground Storage Tank Fill Control

Mr. Day,

We appreciate the opportunity to quote the above referenced job. Our scope of work shall include furnishing the equipment and technical services to modify the ground storage tank fill control with a submersible level transmitter and fill valve modifications to allow tiered flow rates and keep water flowing.

Equipment to be furnished and installed in existing enclosures:

- Submersible level transmitter for pump station ground storage tank
- All miscellaneous materials as required to control fill valve
- 1 float ball for high water alarm and 2 float balls for low level lock out to protect pumps

Technical services shall include the following:

- Physical installation of all WHECO furnished equipment
- Programming, testing and support as required
- Complete system evaluation

Not Included in this proposal

- Any equipment or service not specifically listed above
- Taxes or bonding cost if applicable

Labor and materials as itemized above all sites $ 5,000.00

Delivery is estimated at 10-36 weeks (we may be able to shorten the delivery but cannot promise) after receipt of order. Installation scheduled upon receipt of required equipment, assembly completed and tested. Terms are 25% due with order, balance due upon completion. This quote is valid for thirty (30) days with letter of intent to award within fifteen (15) days. Please feel free to call me if you have any questions.

Sincerely;

Kent Meyerhoeffer
President