Memorandum

Date:	March 13, 2019	Job No.: 18-507
To:	Mr. George Hanlon	
From:	Tara Schutter, P.E. / John Stolberg, PE (Atwell)	
Subject:	Richards Dam Breach / Inundation Analysis	

This report is to summarize the analysis of a possible dam break scenario of Richard's Reservoir. A development, Talon Pointe Subdivision, is being proposed downstream to the east of Richards Dam. Richard's Reservoir is located west of the intersection of 152^{nd} and Holly street in Thornton, CO. Richard's Dam is classified as a low hazard, non-jurisdictional dam as defined by the Colorado State Engineer's Office (SEO). The dam is approximately 14 feet in height with a normal storage of 93 ac-ft.

This analysis was completed at the request of the City of Thornton to analyze the impacts of a dam break on the proposed Talon Pointe Subdivision. The State Engineer's Office regulations and guidelines were used in preparation of this analysis.

The existing Richards reservoir dam lies on the east and north side of the reservoir with the max section and outlet of the dam location on the north side. In order to analyze the effects of a dam breach on the Talon Pointe Subdivision, a dam break scenario of the east embankment was studied. The inundation area from a dam break to the north would not impact the proposed subdivision. It should be noted that most dam breaks are studied at the max section of the dam where the outlet works is located.

In order to analyze the dam break, additional survey was completed by Atwell Group to prepare an accurate layout and cross section of the dam and to obtain accurate spillway and overflow pipe elevations. An exhibit of the survey and dam layout including a dam cross section is attached in **Appendix A** of this report.

The dam failure analysis of Richards Dam was conducted in accordance with the *Guidelines for Dam Breach Analysis* as prepared by the Colorado State Engineer's Office. The prescribed procedure utilizes methods of dam breach parameter development proposed by Froehlich (2008) and MacDonald & Langridge – Monopolis/Washington State (MLM-WA) (2007). **Appendix B** contains the supporting documentation developed within this analysis to facilitate the breach calculations. The breach bottom width of 36 feet with 1V:1H side slopes and a breach formation time of 0.42 hours were calculated using the Froehlich method. The SEO spreadsheet labeled "Estimation of Dam Breach Parameters using the Froehlich 2008 method" was implemented in support of this analysis, a copy of which has been included in **Appendix B**. A comparison of the breach parameters calculated by both methods is shown below in **Table 1**. The corresponding spreadsheet for each method is included within **Appendix B** of this report.

	Bottom Width (ft)	Time of Failure (hrs)	Estimated Peak Discharge (cfs)
Froelich	36.3	0.42	2,560
MLM-WA	30.9	0.37	2,093

Table 1: Richards Dam Failure Inundation - Comparison of Breach Parameters

In an effort to be conservative, the Froelich method was modeled using an estimated peak discharge of 2,560 cfs. A site visit to the dam as well as the downstream floodpath was performed. The flow path of the breach of the east dam of Richards Reservoir flows across an irrigation ditch immediately downstream of the dam. As the breach flow proceeds east, it crosses Holly Street and Monaco Street before entering the proposed Talon Pointe Subdivision.

Atwell had prepared a Hec-Ras model through the proposed subdivision prior to the breach analysis. Based on this history and set up of the model, Atwell then completed the routing of the breach flow downstream of the dam through the subdivision. The Hec-Ras Model, using a breach flow of 2,560 cfs, and associated inundation maps can be found in **Appendix C**.

The dam breach flow inundation proceeds east from the dam and overtops Holly Street by up to 15-1/2 inches. The highway department appears to have marked a culvert with a couple of reflectors, but any culvert is small, inconsequential to the dam breach flow and not modeled. The flow continues as sheet flow east toward Monaco. The proposed improvements to Monaco include adding twin 9' x 5' box culverts with a 10' type R inlet and grouted boulders on the downstream side. The culverts at Monaco are designed to pass the 100-year storm, but not the dam breach flow. If the culverts are not built, the flow over the road would be 15 inches deep. With the culverts, the overflow is reduced to 8-1/2". After passing Monaco, the flow passes through the subdivision in a dedicated swale, grass-lined with a meandering channel and riffle drops. The flow then passes over and under Oneida Street in five culverts in the subdivision. The center 10' x 5' culvert handles the channel flow. Two 54" diameter culverts and two 48" diameter culverts carry the overbank flows. Together the culverts pass the 100-year storm, but in the event of a dam breach, Oneida Street overflows 23 inches deep. A grouted boulder rundown is proposed on the upstream and downstream side of the Oneida culvert. The flow proceeds east through the subdivision in another dedicated swale having a meandering grass-lined channel and more riffle drops and lastly enters a grouted boulder rundown channel before passing through a 24' Conspan bridge at Quebec Street.

The 100-year floodplain does not inundate any buildable lots. The breach flow through the subdivision is contained in the proposed channel but encroaches onto the westerly edge of Tracts 2 and 3 (along Monaco Street) which are noted on the plat as Restricted, "Portions of this lot are in the floodplain." However, the encroachment is outside the building envelopes and would not impact the structures on the lots.

Appendix A

Tessara Water, Inc.
13101 Cavanaugh Road
Hudson, Colorado 80642
303.710.9108
Email: tara@tessarawater.com
Email: www.tessarawater.com

INUNDATION REPORT APPENDIX A

SITE PLAN

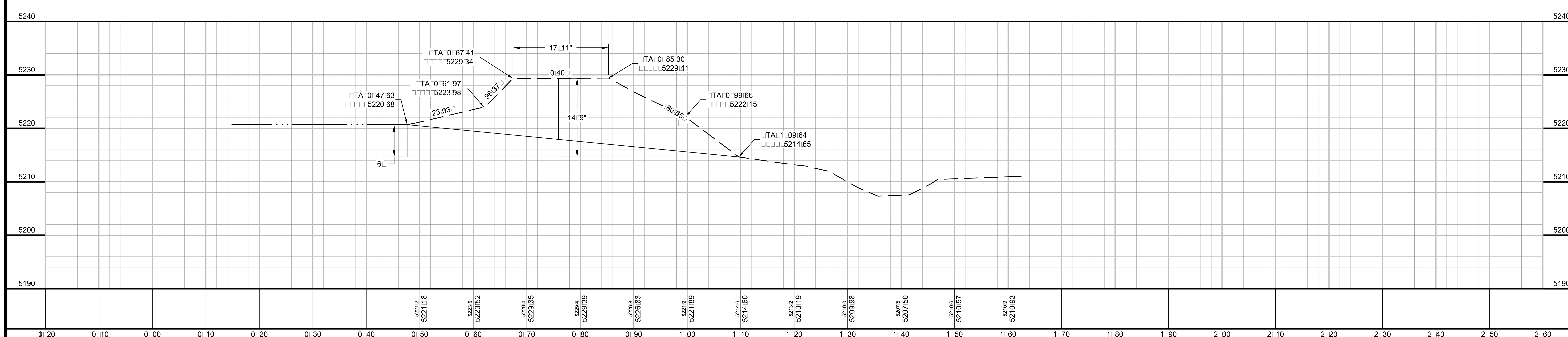
GEORGE HANLON RICHARD'S RESERVOIR

REVISIONS

Date:	13/MAR/19
Job No:	706
Drawn:	LD
Design:	TLS
Checked:	
Scale:	1" = 40'

Sheet:

Of:



INUNDATION REPORT APPENDIX A

DAM CROSS-SECTION PLAN and PROFILE

GEORGE HANLON RICHARD'S RESERVOIR

Tessara Water, Inc.
13101 Cavanaugh Road
Hudson, Colorado 80642
303.710.9108
Email: tara@tessarawater.com
Email: www.tessarawater.com

REVISIONS

Date:	13/MAR/19
Job No:	706
Drawn:	LD
Design:	TLS
Checked:	
Scale:	1"=10'H / 1"=10'V

Sheet:

Of:

Appendix B

ESTIMATION OF DAM BREACH PARAMETERS
USING THE FROEHLICH 2008 METHOD

PROJECT: **Richards Reservoir**

BREACH INPUT PARAMETERS:

Select Failure Mode From Drop-Down Menu:	OVERTOPPING	
Height of water over base elevation of breach (H_w) =	10.0	Feet
Volume of water in the reservoir at the time of failure (V_w) =	93.8	Acre-Feet
Reservoir Surface Area at Hw (A_s) =	11.7	Acres
Height of breach (H_b) =	14.8	Feet
Failure Mode Factor (K_o) =	1.3	
Breach Side-Slope Ratio (Z_b) =	1	Z(H):1(V)
Dam Size Class:	Minor	Assumes Full Reservoir At Time of Breach.

CALCULATED BREACH CHARACTERISTICS:

Average Breach Width (B_{avg}) =	51.0	Feet
Bottom Width of Breach (B_b) =	36.3	Feet
Breach Formation Time (T_f) =	0.42	Hours
Storage Intensity (SI) =	9.4	Acre Feet/Foot
Predicted Peak Flow (Q_p) =	2560	Cubic Feet per Second

RESULTS CHECK:

Average Breach Width Divided by Height of Breach (B_{avg}/H_b) =	3.46	If (B_{avg}/H_b) > 0.6, Full Breach Devlopment is Anticipated
Erosion Rate (ER), Calculated as (B_{avg}/T_f) =	120.3	
Erosion Rate Divided by Height of Water Over Base of Breach (ER/H_w) =	12.0	If 1.6 < (ER/H_w) < 21, Erosion Rate is Assumed Reasonable

Note: Storage volume of reservoir is outside the data set used to generate the emperical equations used in the Froehlich Method

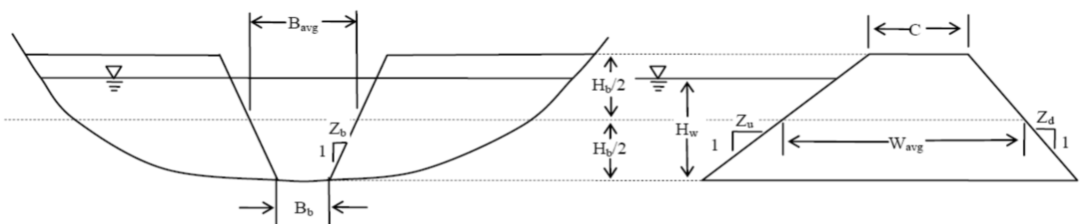


Figure 1- Breach Variable Definition Sketch

ESTIMATION OF DAM BREACH PARAMETERS
USING THE MACDONALD & LANGRIDGE-MONOPOLIS OR WASHINGTON STATE METHODS
WITH ALL FAILURE TIMES ESTIMATED BY WASHINGTON STATE METHOD

PROJECT: Richards Reservoir

BREACH INPUT PARAMETERS:

Select Embankment Type From Drop-Down Menu:	EARTHEN (COHESIVE)	
Height of water over base elevation of breach (H_w) =	10.0	Feet
Volume of water stored in reservoir at time of failure (V_w) =	93.8	Acre-Feet
Reservoir Surface Area at H_w (A_s) =	11.7	Acres
Crest width of dam (C) =	18.0	Feet
Height of breach from dam crest to base elevation of breach (H_b) =	14.8	Feet
Slope of upstream dam face (Z_u) =	1.0	Z(H):1(V)
Slope of downstream dam face (Z_d) =	1.7	Z(H):1(V)
Breach side-slope ratio (Z_b) =	0.5	Z(H):1(V)
Piping Orifice Coefficient (C_p) =	0.70	Used To Calculate Peak Discharge Through Piping Hole
Dam Size Class:	Minor	Assumes Full Reservoir At Time of Breach

CALCULATED BREACH CHARACTERISTICS:

Breach Formation Factor (BFF) =	937.5	
Embankment Volume Eroded (V_{er}) =	634.1	Cubic Yards
Average Dam Width (W_{avg}) =	37.5	Feet (In Direction of Flow)
Average Breach Width (B_{avg}) =	30.9	Feet
Bottom Width of Breach (B_b) =	23.5	Feet
Breach Formation Time (T_f) =	0.37	Hours
Storage Intensity (SI) =	9.4	Acre Feet/Foot
Peak Breach Discharge (Q_p) =	2093	Cubic Feet per Second

RESULTS CHECK:

Average Breach Width Divided by Height of Breach (Bavg/Hb) =	2.10	If (Bavg/Hb) > 0.6, Full Breach Development is Anticipated
Erosion Rate (ER), Calculated as (Bavg/Tf) =	84.2	
Erosion Rate Divided by Height of Water Over Base of Breach (ER/Hw) =	8.4	If 1.6 < (ER/Hw) < 21, Erosion Rate is Assumed Reasonable

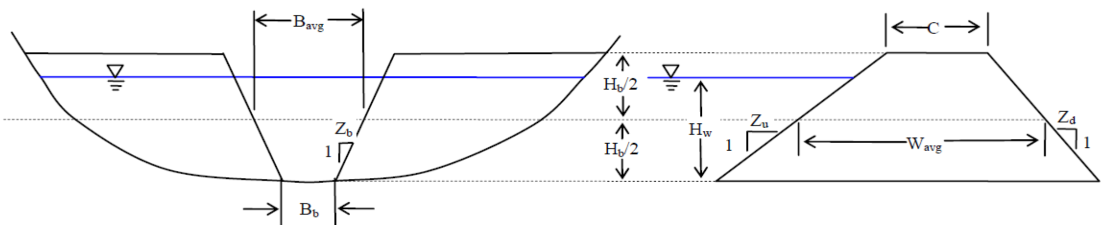


Figure 1- Breach Variable Definition Sketch

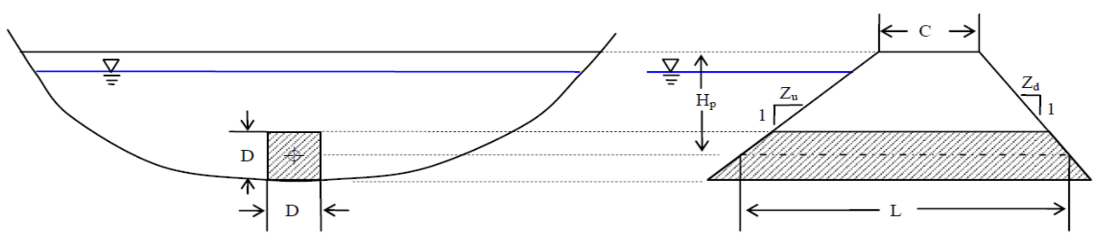


Figure 2 – Piping Hole Variable Definition Sketch

Appendix C

LEGEND

- EXISTING CONTOUR (6440)
- PROPOSED CONTOUR (6440)
- INDICATES PROPERTY CORNER ELEV. PER GRADING TEMPLATES (26.3, PROPERTY LINE, FL, R/W)
- CUT/FILL LINE
- FLOW DIRECTION ARROW
- EXISTING GAS LINE
- EXISTING POWER POLES
- DAM BREACH AREA OF INUNDATION
- 100 YEAR STORM
- SECTION LINES
- CENTERLINE OF CHANNEL

811.
Know what's below.
Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC

TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
01 CHANNEL PLANS

DATE 02-11-2019

REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK CH. CS
P.M. RW
JOB 17002140
SHEET NO. 01

CAD FILE: 17002140 - INUNDATION MAP.DWG

811
Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC
TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
02 CHANNEL PLANS

DATE 02-11-2019

REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK CH. CS
P.M. RW
JOB 17002140
SHEET NO. 02

CAD FILE: 17002140 - INUNDATION MAP.DWG

Know what's **below.** **Call** before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC
TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
03 CHANNEL PLANS

DATE 02-11-2019

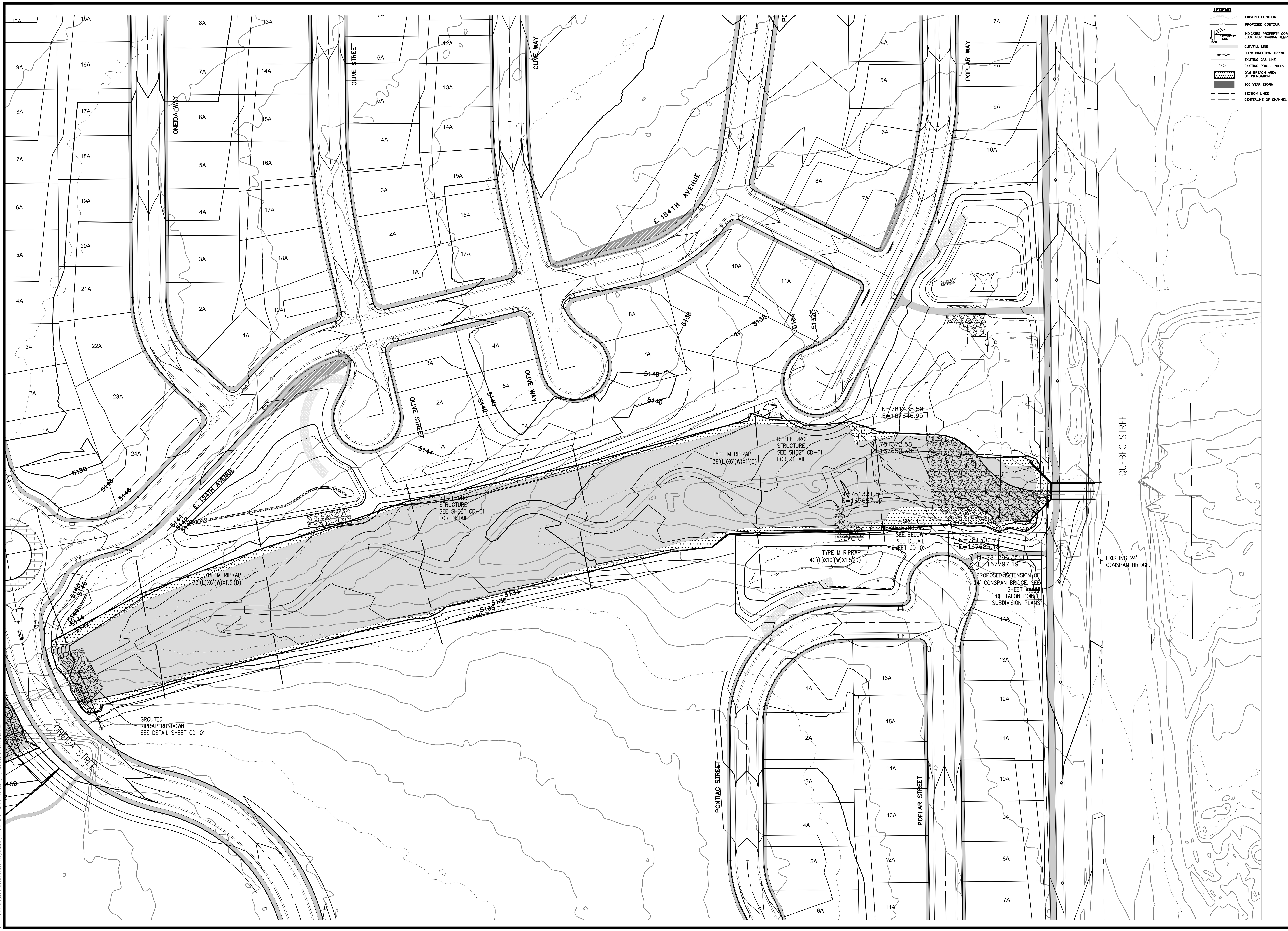
REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK	CH. CS
P.M. RW	
JOB 17002140	
SHEET NO. 03	

CAD FILE: 17002140 - INUNDATION MAP.DWG



811 Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:

CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER

9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012

(303)-877-2240

GEORGE HANLON, JR.

CLIENT

TALON POINTE LAND, LLC

TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO

CHANNEL CONSTRUCTION DRAWINGS

04 CHANNEL PLANS

DATE 02-11-2019

REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

COLORADO REGISTERED RICHARD J. ... 22076 PROFESSIONAL ENGINEER

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK	CH. CS
P.M. RW	
JOB 17002140	
SHEET NO. 04	

CAD FILE: 17002140 - INUNDATION MAP.DWG

811.
Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC

TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
01 CHANNEL PLANS

DATE 02-11-2019

REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

COLORADO REGISTERED RICHARD J. WEED 22076 PROFESSIONAL ENGINEER

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK	CH. CS
P.M. RW	
JOB 17002140	
SHEET NO. 01	

CAD FILE: 17002140 - INUNDATION MAP.DWG

811.
Know what's **below.**
Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC
TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
02 CHANNEL PLANS

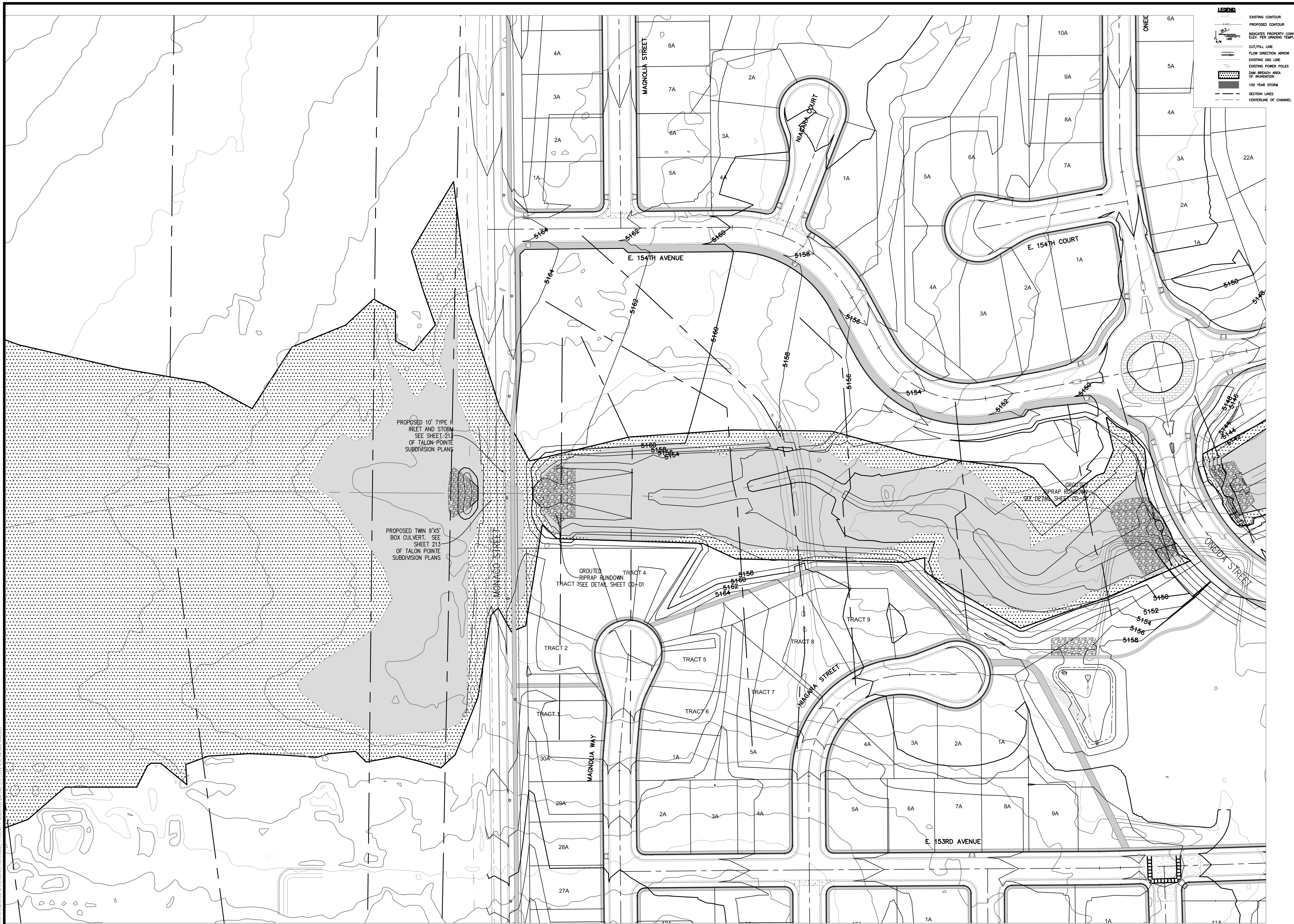
DATE 02-11-2019

REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION
COLORADO REGISTERED PROFESSIONAL ENGINEER RICHARD J. WEED 22076
FOR AND ON BEHALF OF ATWELL, LLC

DR. KK	CH. CS
P.M. RW	
JOB 17002140	
SHEET NO. 02	

CAD FILE: 17002140 - INUNDATION MAP.DWG



Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:

CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC
TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
03 CHANNEL PLANS

DATE 02-11-2019

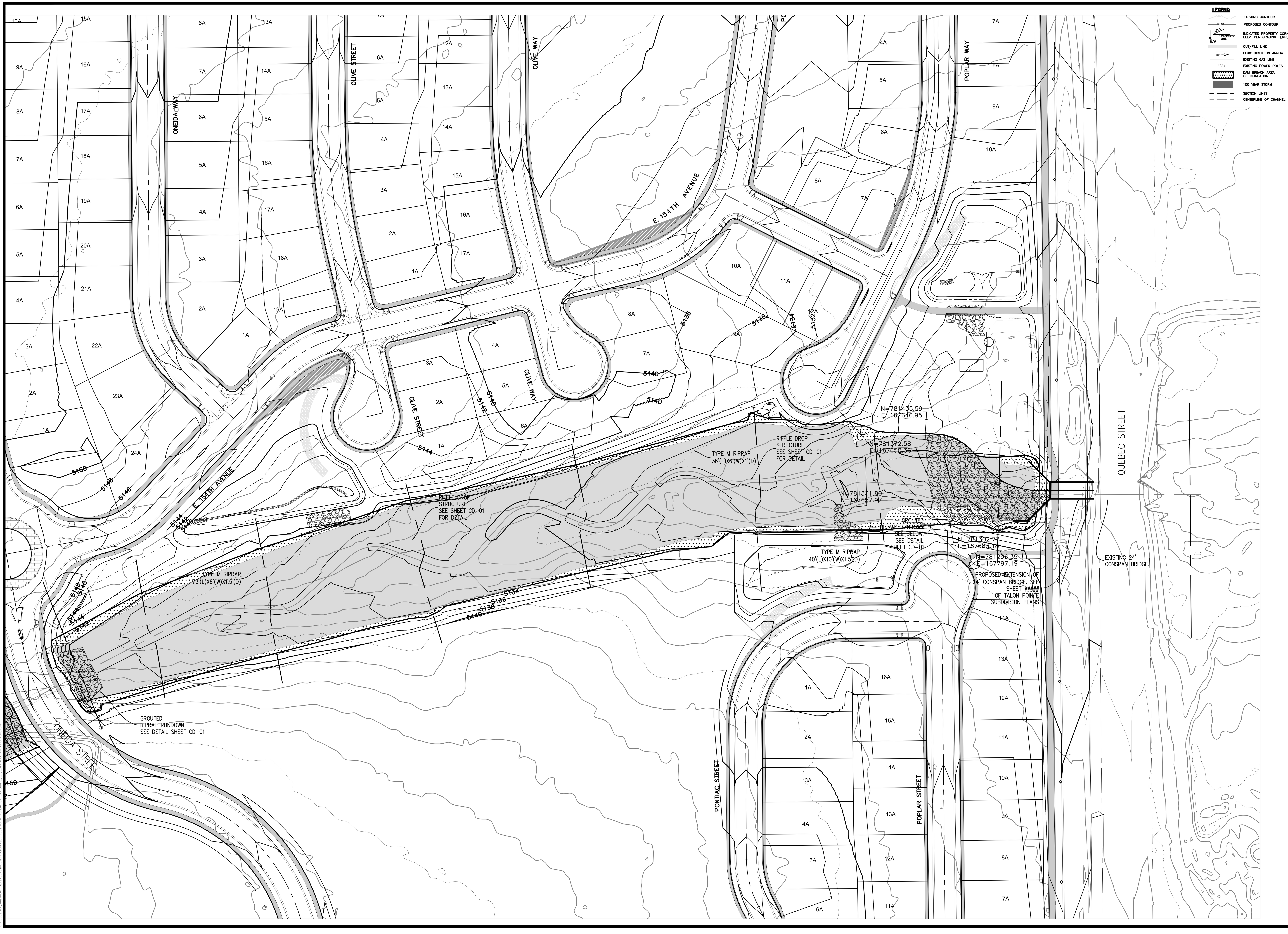
REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK	CH. CS
P.M. RW	
JOB 17002140	
SHEET NO. 03	

CAD FILE: 17002140 - INUNDATION MAP.DWG



811 Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:

CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
9200 E MINERAL AVENUE, SUITE 365
CENTENNIAL, CO 80012
(303)-877-2240
GEORGE HANLON, JR.

CLIENT
TALON POINTE LAND, LLC
TALON POINTE SUBDIVISION
CITY OF THORNTON, COLORADO
CHANNEL CONSTRUCTION DRAWINGS
04 CHANNEL PLANS

DATE 02-11-2019

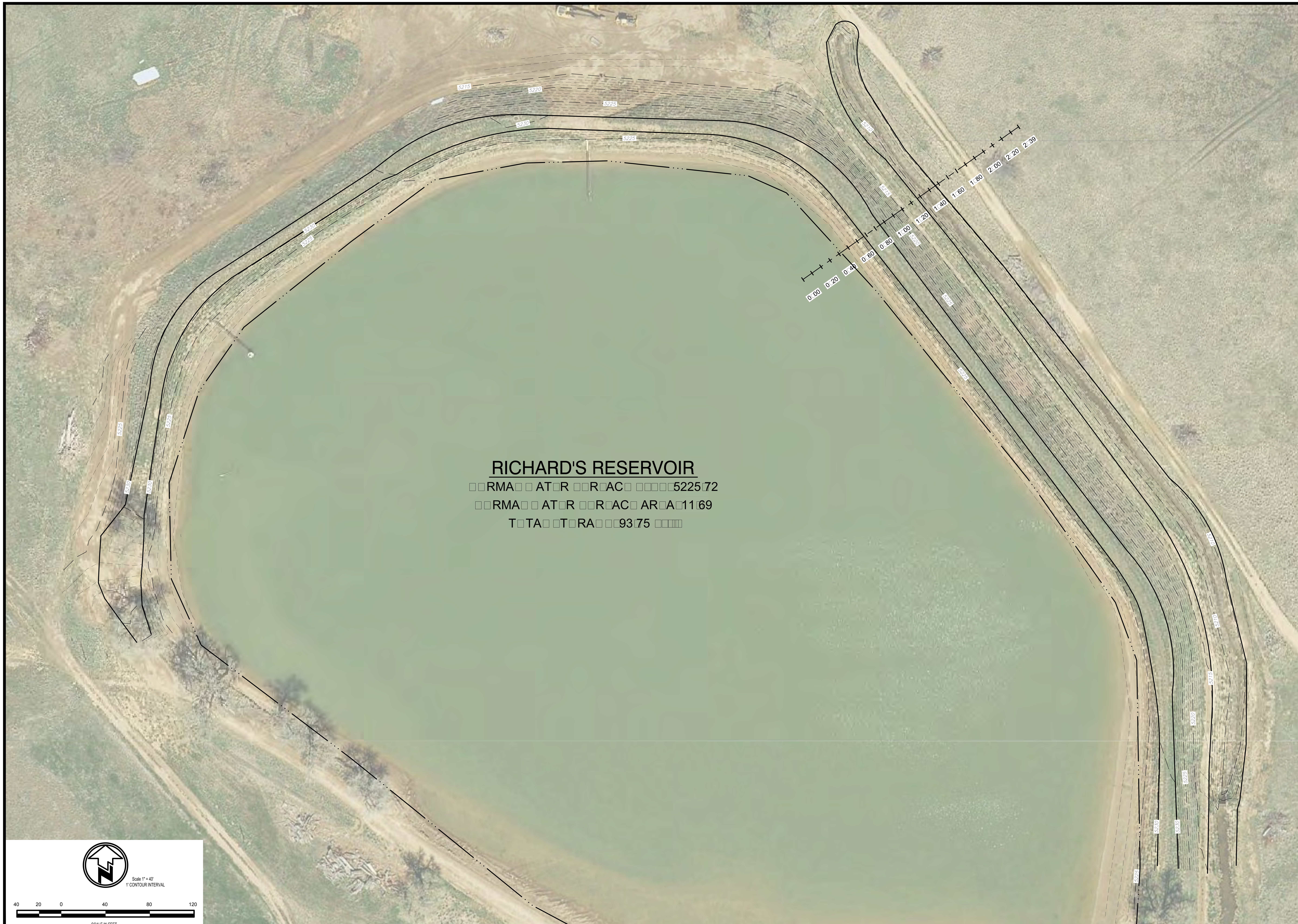
REVISIONS

PLANS UNDER REVIEW NOT FOR CONSTRUCTION

FOR AND ON BEHALF OF ATWELL, LLC

DR. KK | CH. CS
P.M. RW
JOB 17002140
SHEET NO. 04

CAD FILE: 17002140 - INUNDATION MAP.DWG



Tessara Water, Inc.
13101 Cavanaugh Road
Hudson, Colorado 80642
303.710.9108
Email: tara@tessarawater.com
Email: www.tessarawater.com

INUNDATION REPORT
APPENDIX A

SITE PLAN

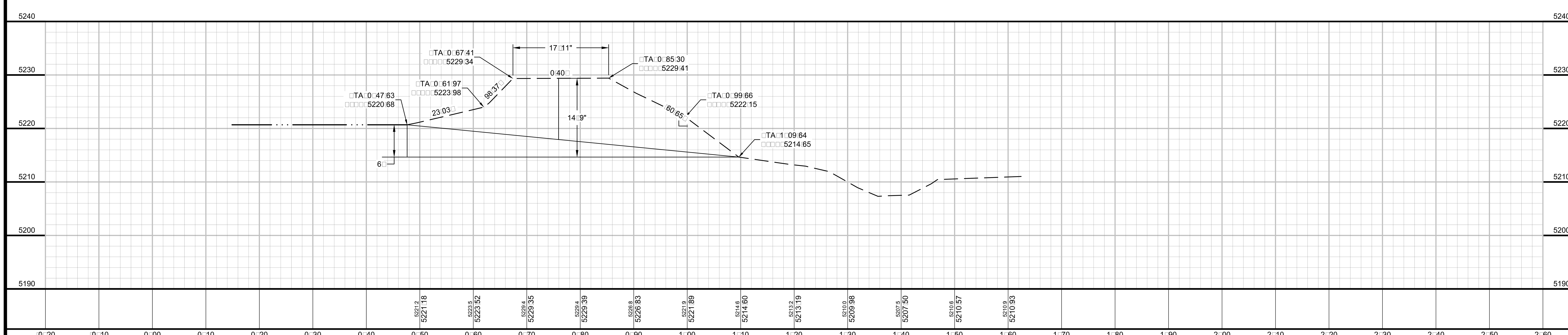
GEORGE HANLON
RICHARD'S RESERVOIR

REVISIONS

Date:	13/MAR/19
Job No:	706
Drawn:	LD
Design:	TLS
Checked:	
Scale:	1" = 40'

Sheet:

Of:



Tessara Water, Inc.
13101 Cavanaugh Road
Hudson, Colorado 80642
303.710.9108
Email: tara@tessarawater.com
Email: www.tessarawater.com

INUNDATION REPORT APPENDIX A

DAM CROSS-SECTION PLAN and PROFILE

GEORGE HANLON RICHARD'S RESERVOIR

REVISIONS

Date:	13/MAR/19
Job No:	706
Drawn:	LD
Design:	TLS
Checked:	
Scale:	1"=10'H / 1"=10'V

Sheet:

Of:

Begin forwarded message:

From: "Batka - DNR, John" <john.batka@state.co.us>
Date: May 2, 2022 at 4:30:57 PM MDT
To: Tara Schutter <tara@tessarawater.com>
Subject: Richard's Reservoir Dam Breach Analysis

Ms. Schutter,

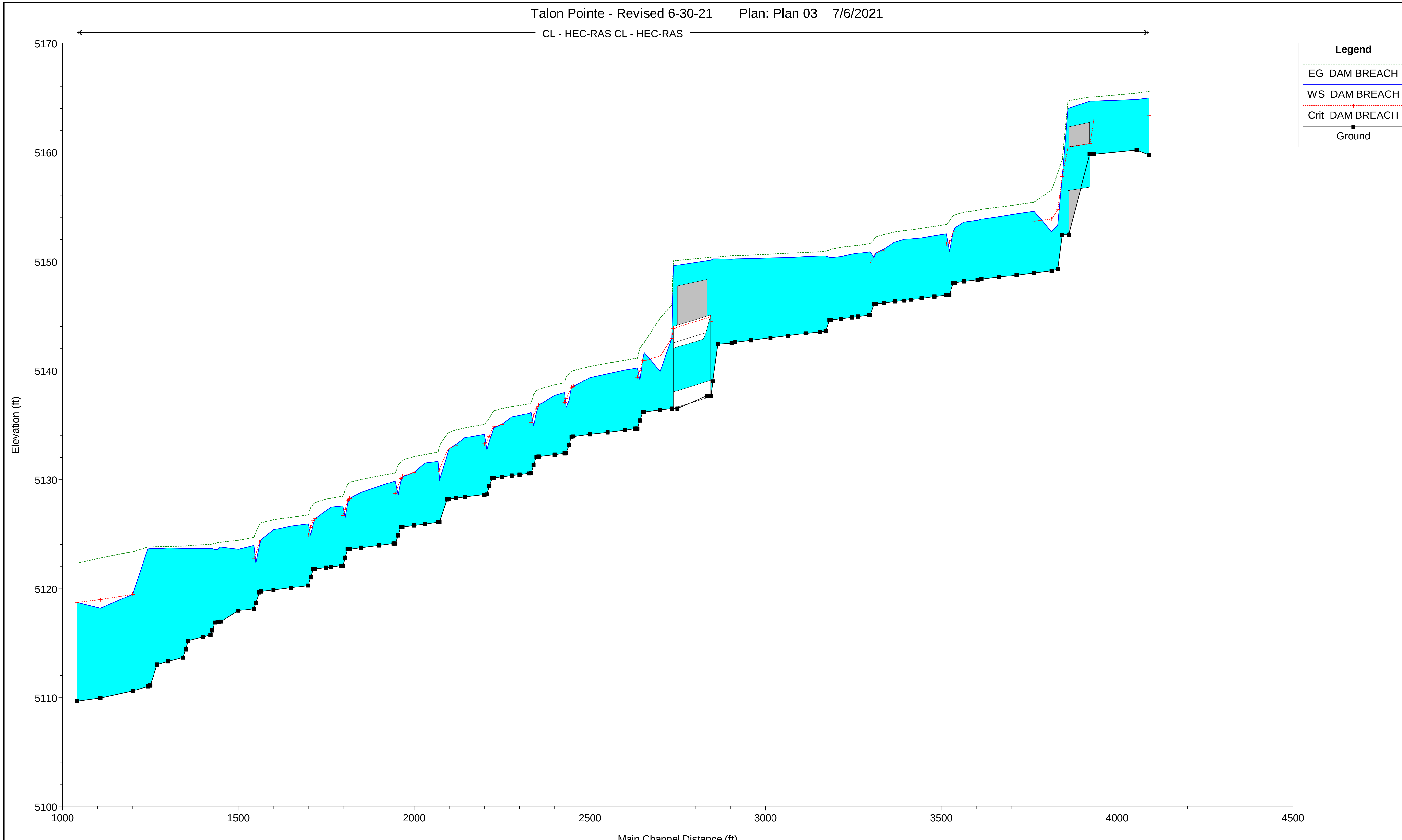
I reviewed your report that outlines the potential impacts from a sunny day breach of the Richard's dam on the proposed Talon Pointe subdivision located downstream. The subdivision is located in Thornton Colorado and based on your report dated March 4, 2020, the breach flows will be contained within the floodway as it passes through the development with the exception of minor flooding on two lots. Building envelopes on these lots will be restricted to areas outside of the inundation extent.

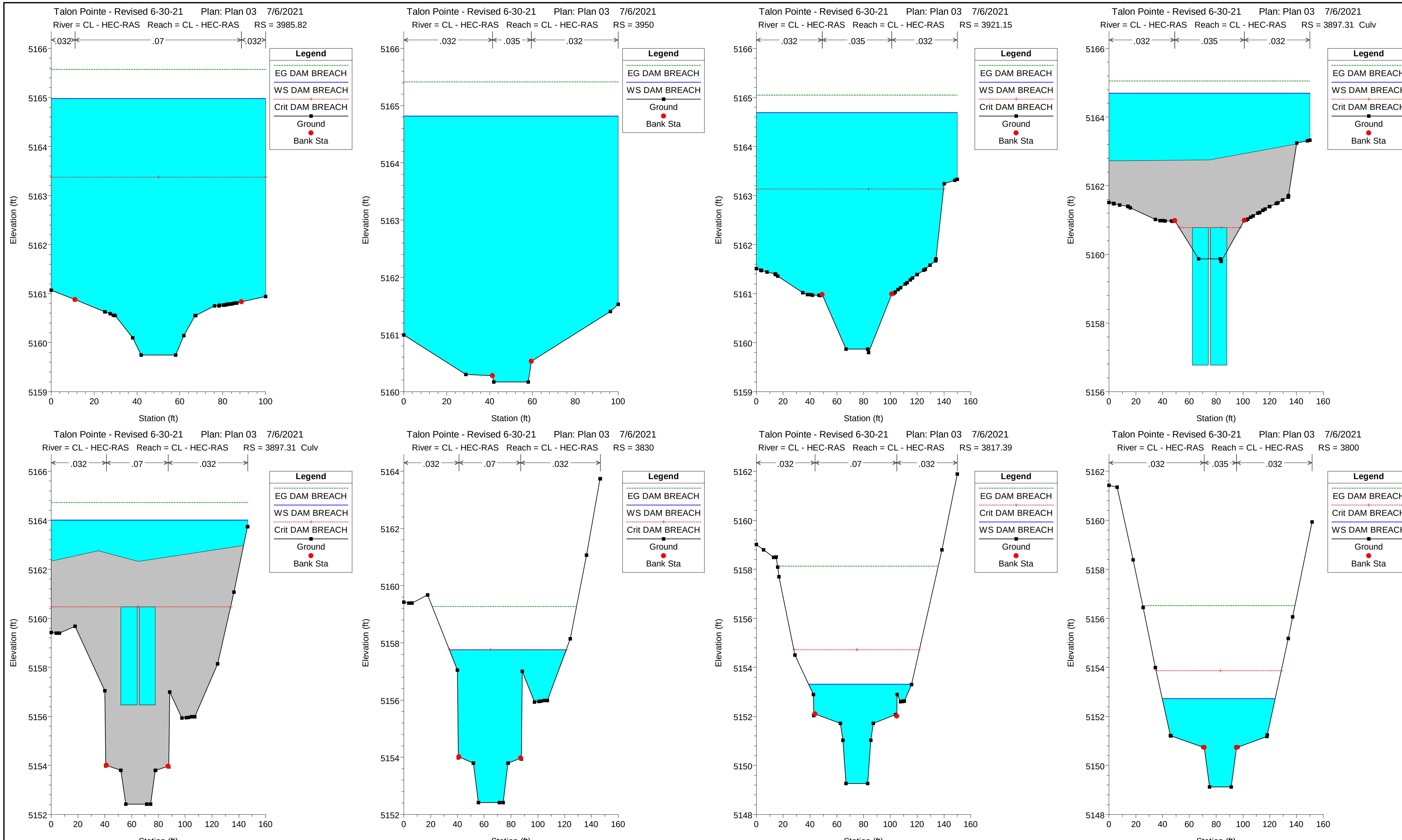
Thank you to your client and the City of Thornton for your efforts to minimize the consequences to the public caused by the failure of this dam. Let me know if you have any other questions.

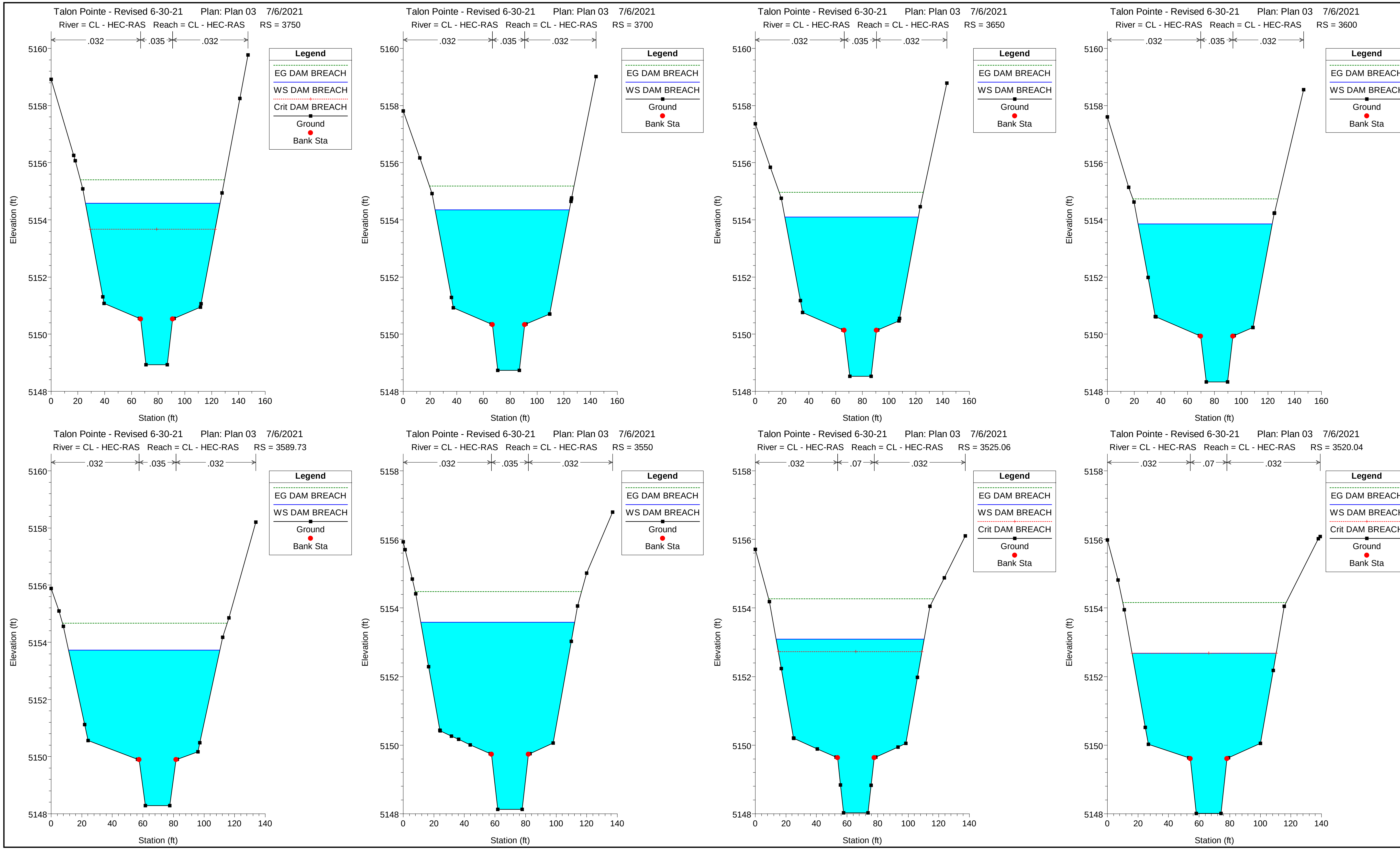
John Batka, P.E.
Dam Safety Engineer
Water Division One

P 970.352.8712 x 1251 | C 970.217.9383
**We have moved!*
1809 56th Avenue
Greeley, CO 80634
john.batka@state.co.us | dwr.colorado.gov/services/dam-safety

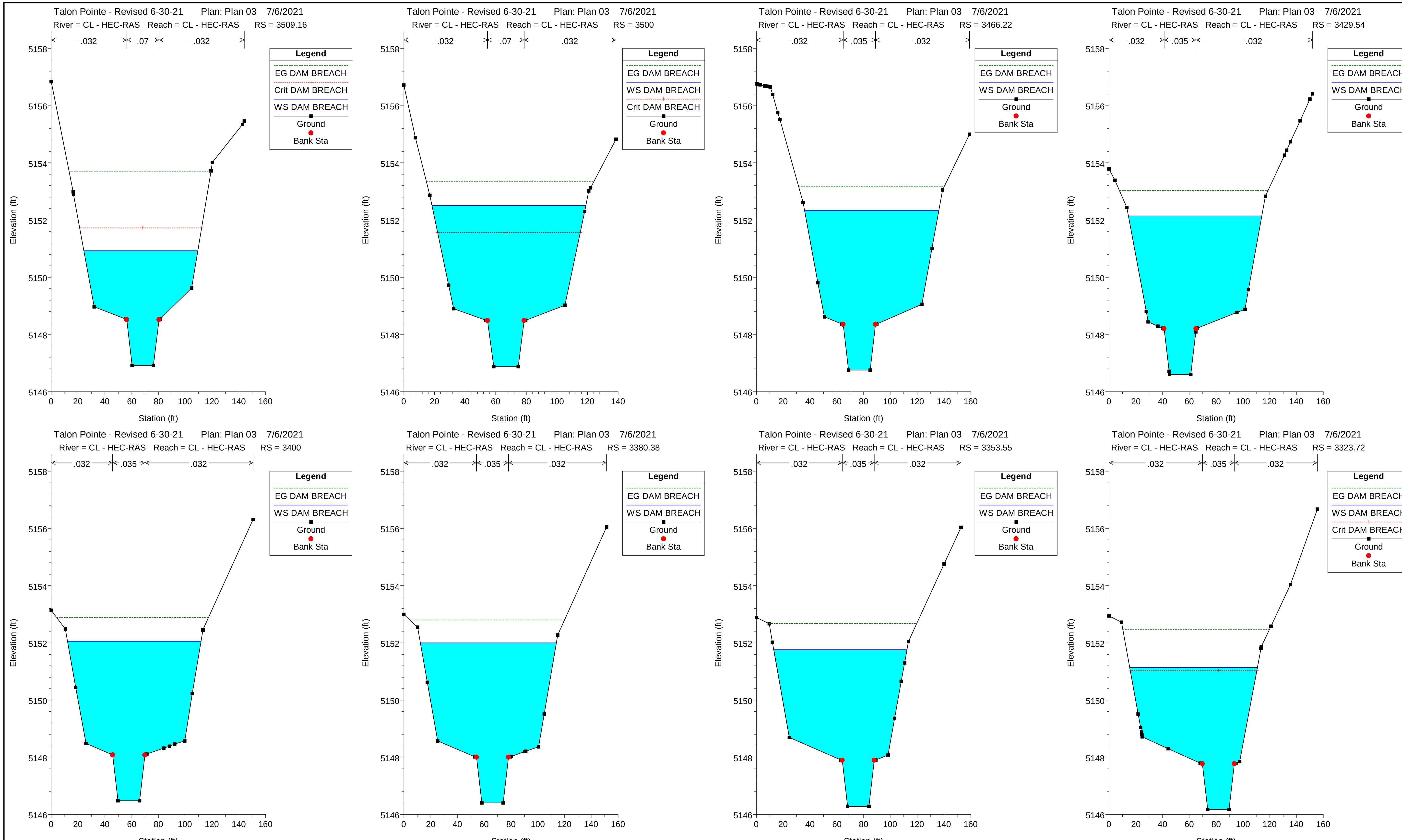

LIMITS OF RICHARDS DAM BREACH INNUNDATION
LIMITS OF RICHARDS DAM BREACH INNUNDATION

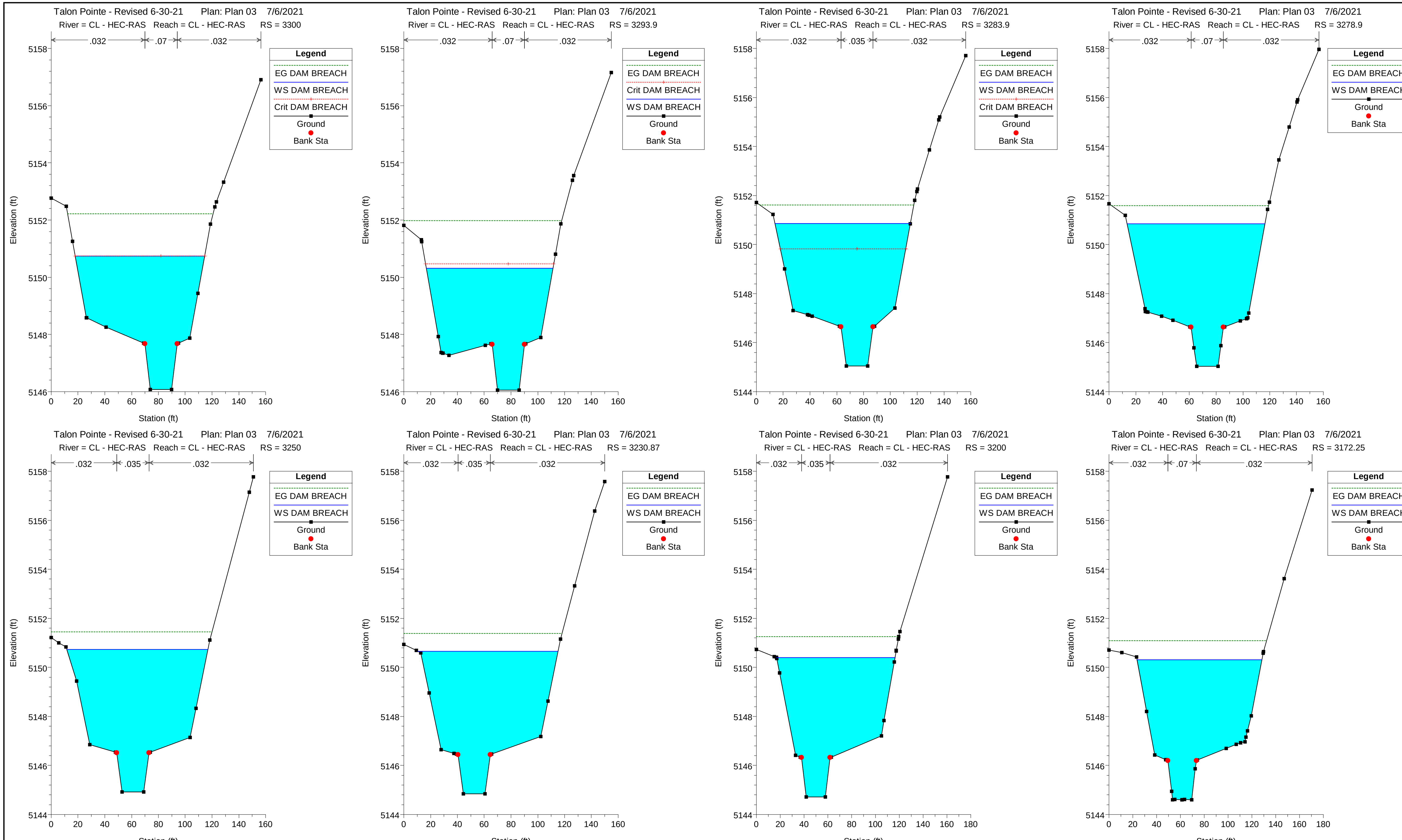

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
CL - HEC-RAS CL - HEC-RAS
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Elevation (ft)
5100
5110
5120
5130
5140
5150
5160
5170
1000
1500
2000
2500
3000
3500
4000
4500
Main Channel Distance (ft)

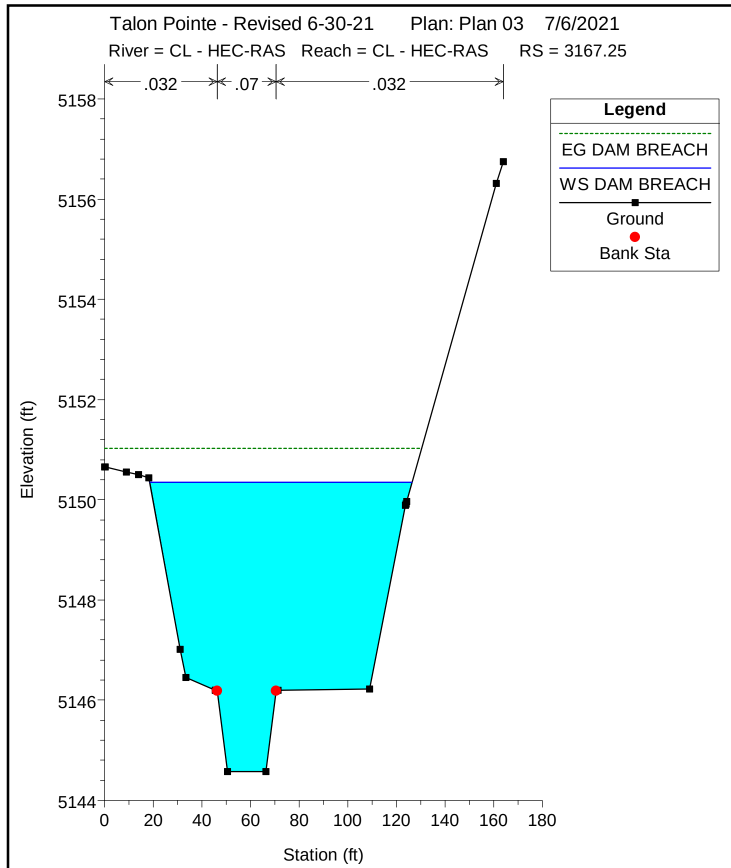

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3985.82
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3950
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3921.15
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3897.31 Culv
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3897.31 Culv
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3830
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3817.39
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3800
.032 .035 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

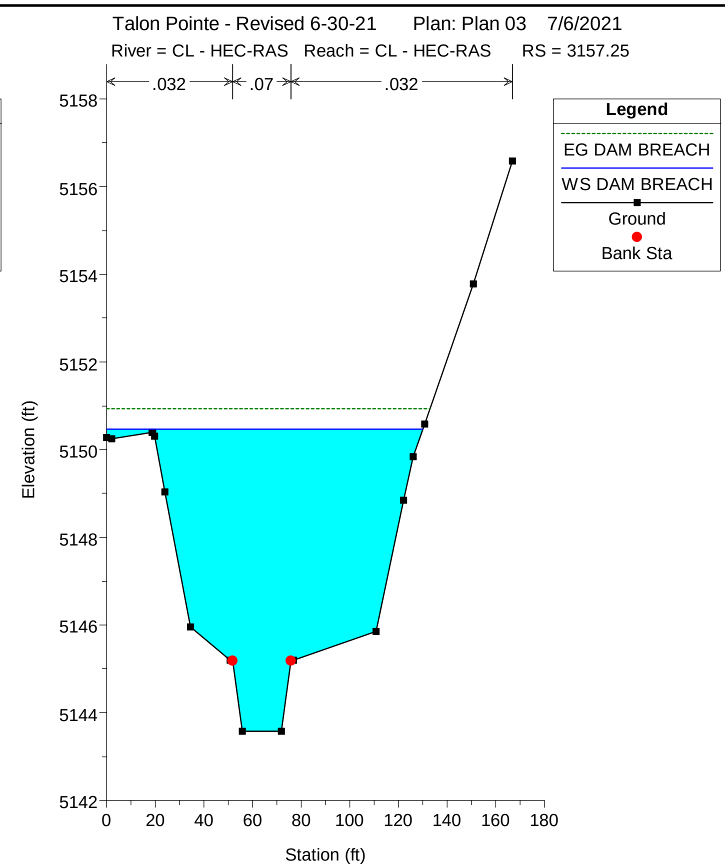


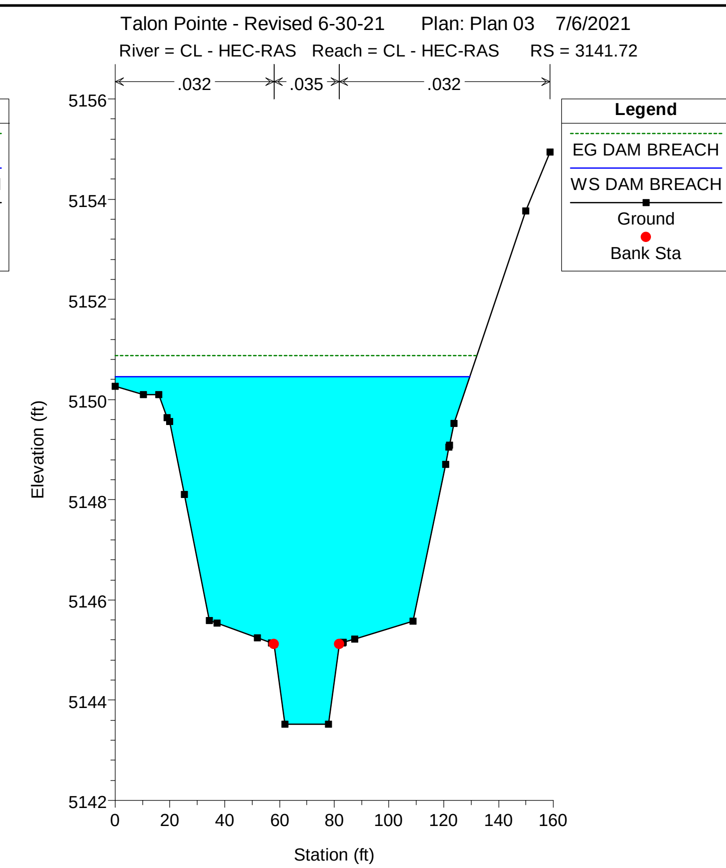
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3750
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3700
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3650
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3600
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3589.73
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3550
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3525.06
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3520.04
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

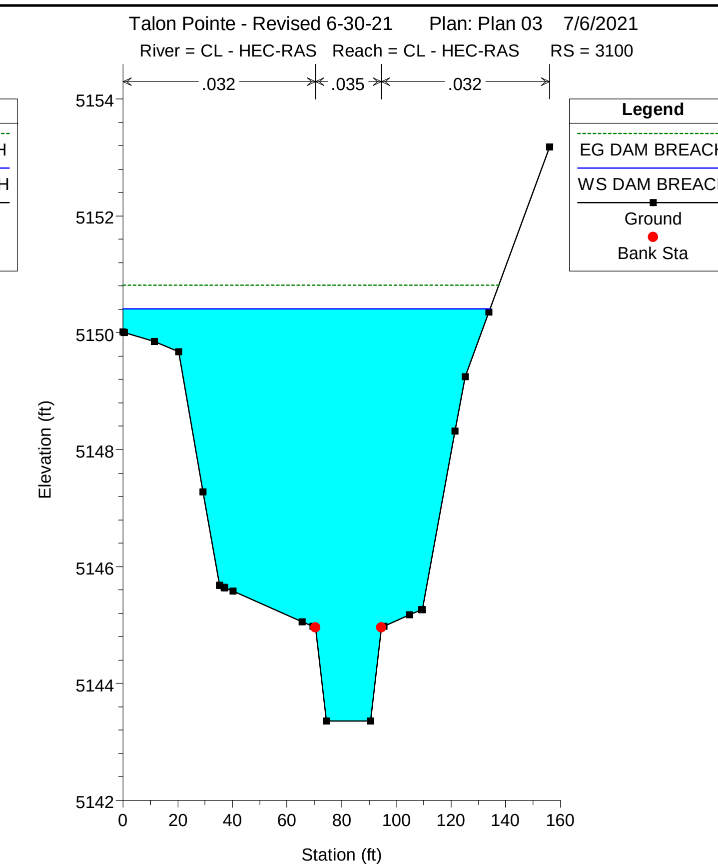

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3509.16
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3500
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3466.22
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3429.54
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3400
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3380.38
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3353.55
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3323.72
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

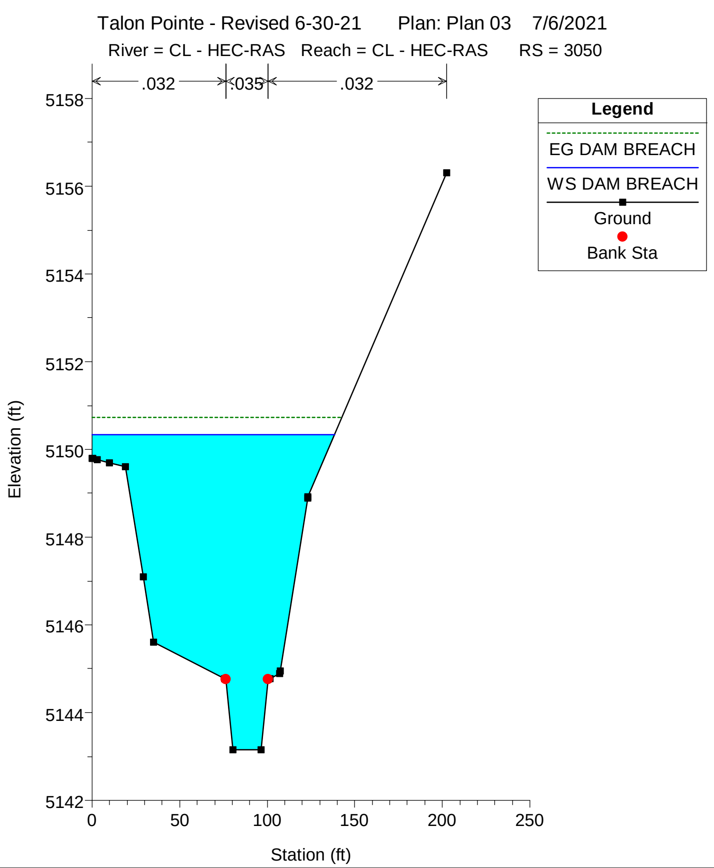

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3300
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3293.9
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3283.9
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3278.9
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3250
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3230.87
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3200
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3172.25
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

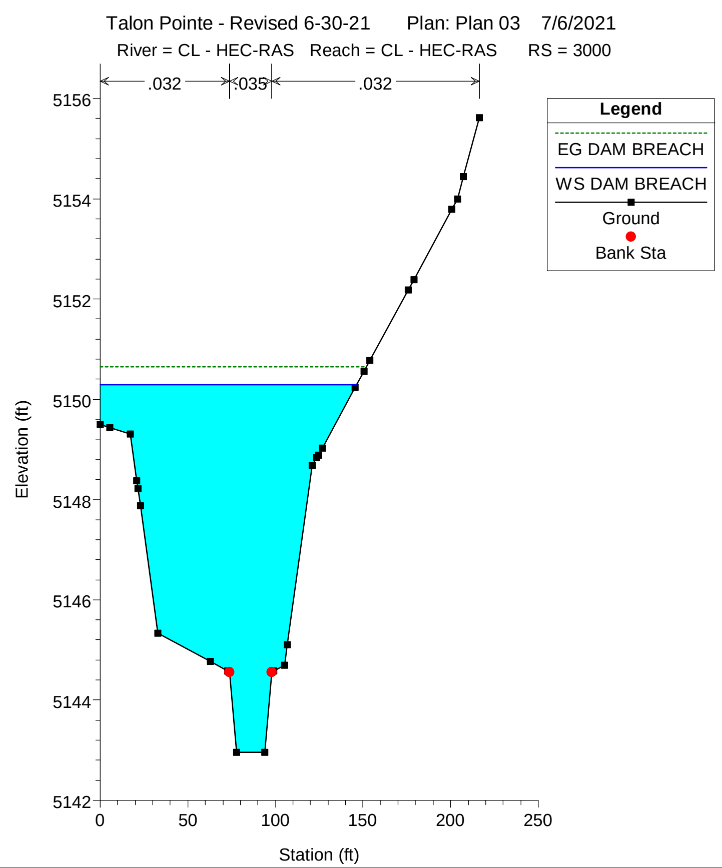

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3167.25
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

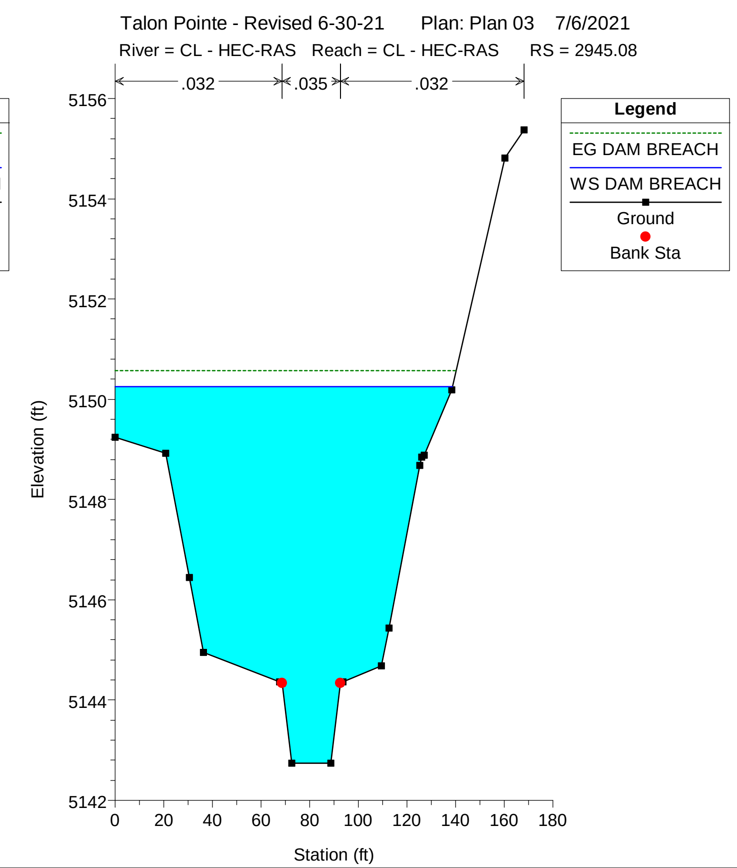

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3157.25
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

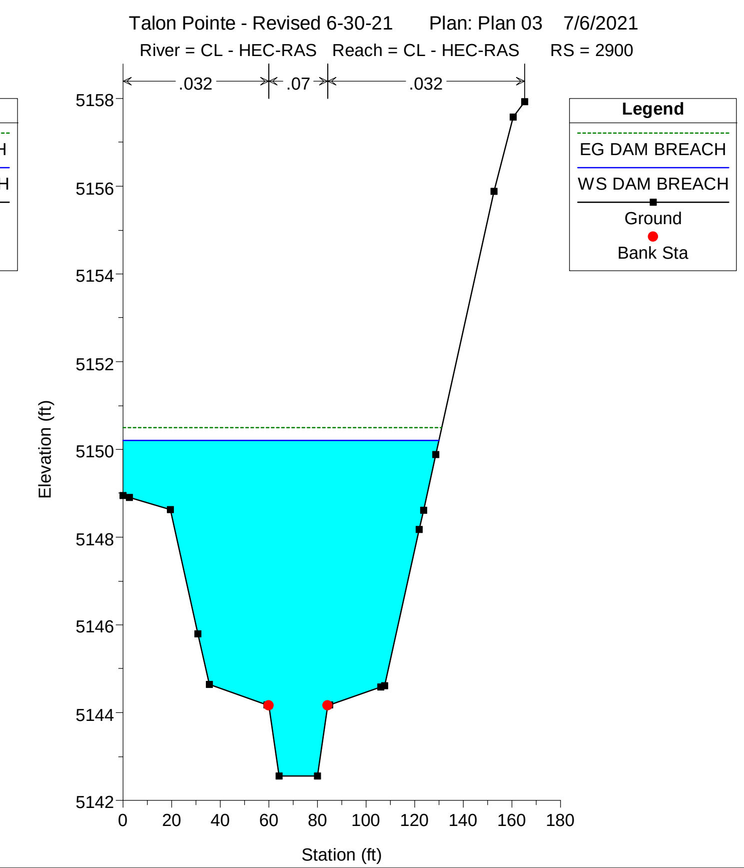

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3141.72
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

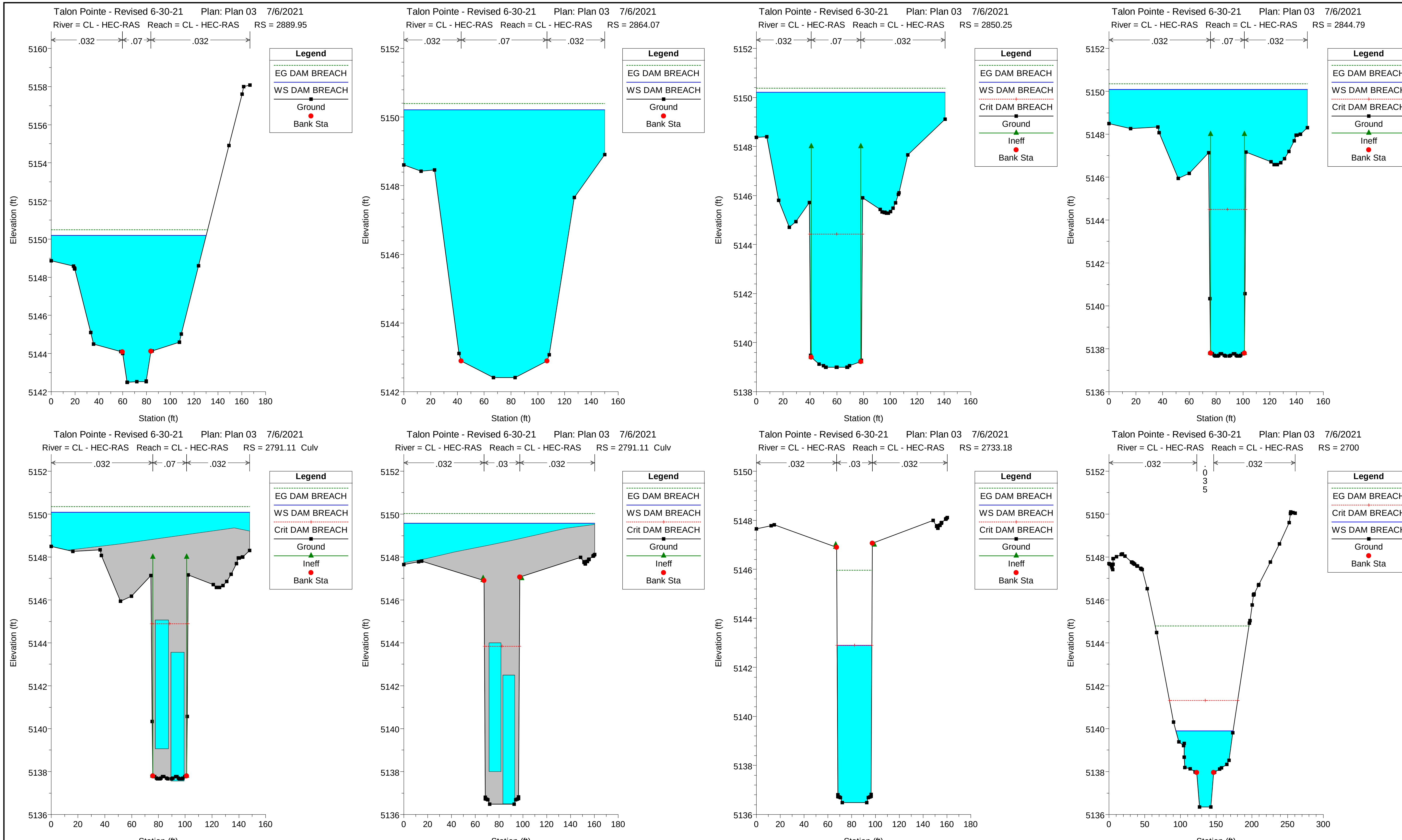

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3100
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

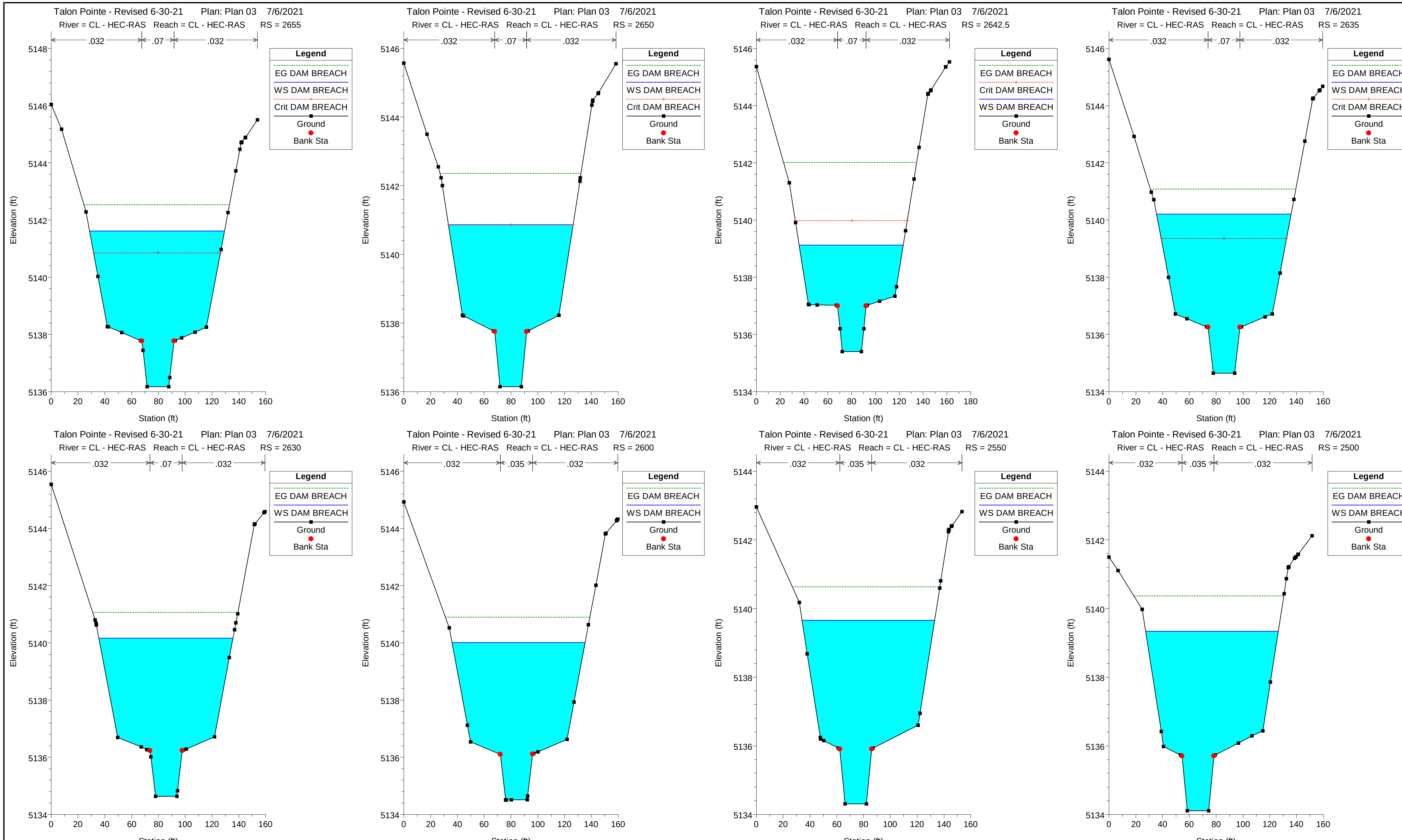

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3050
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

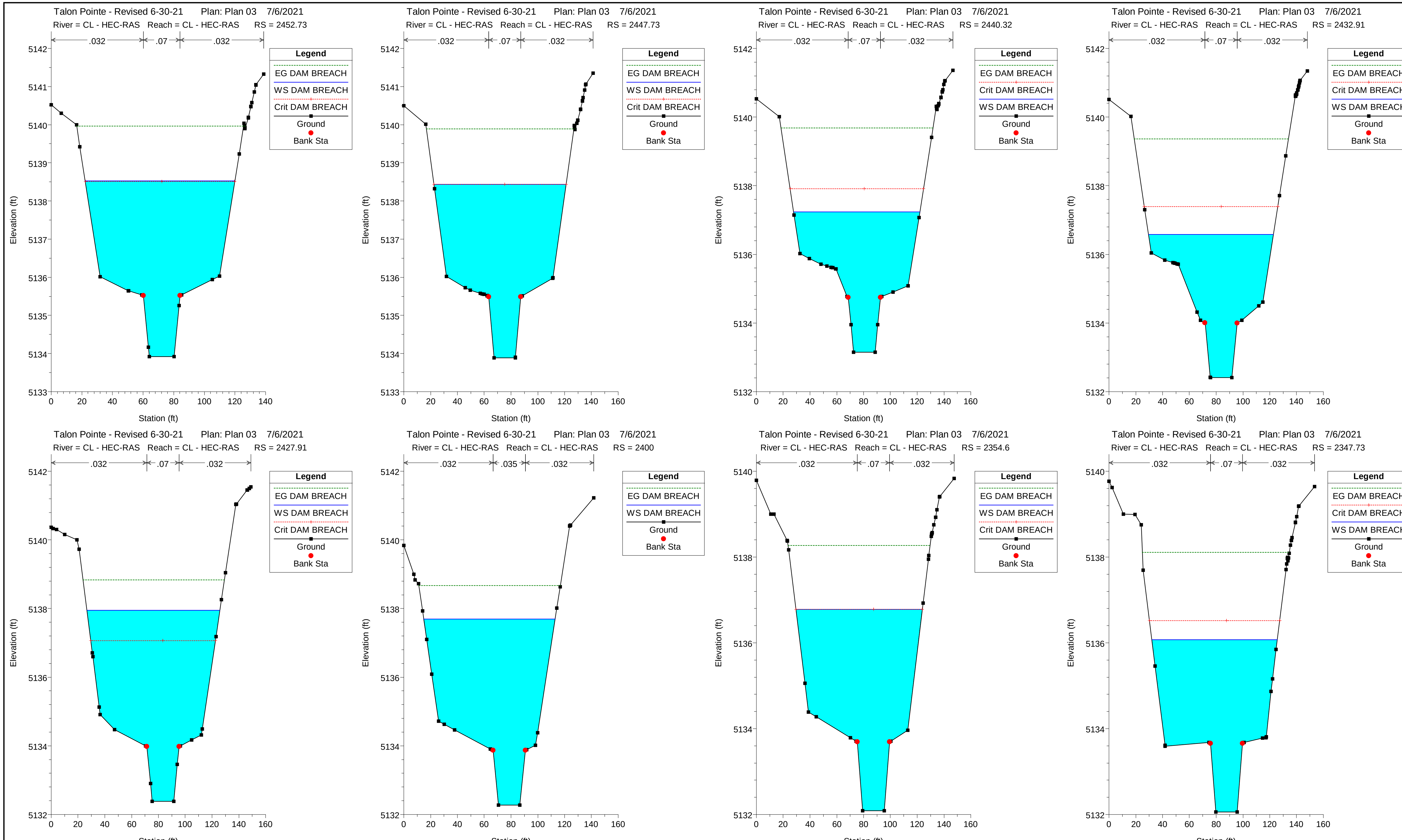

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 3000
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

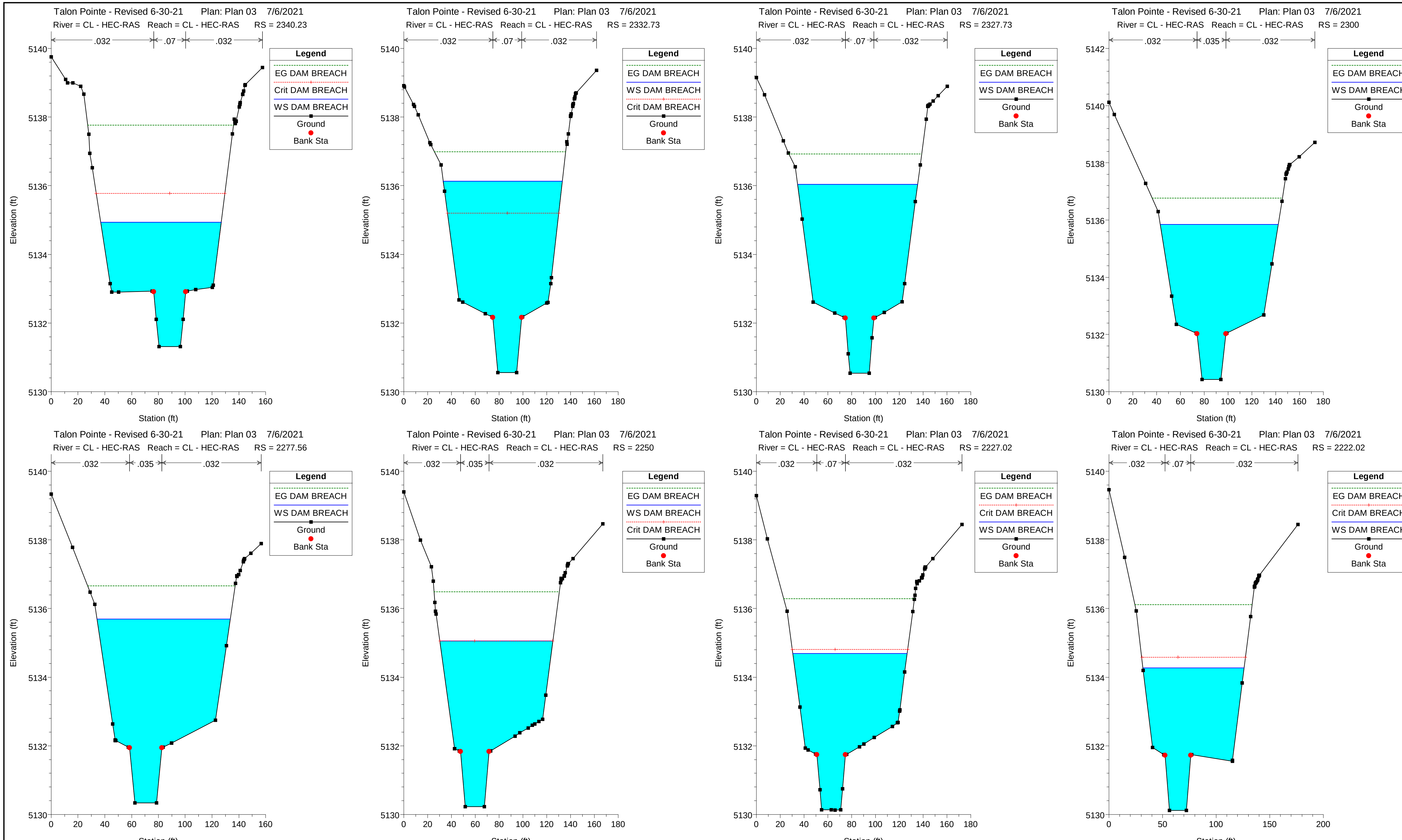

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2945.08
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

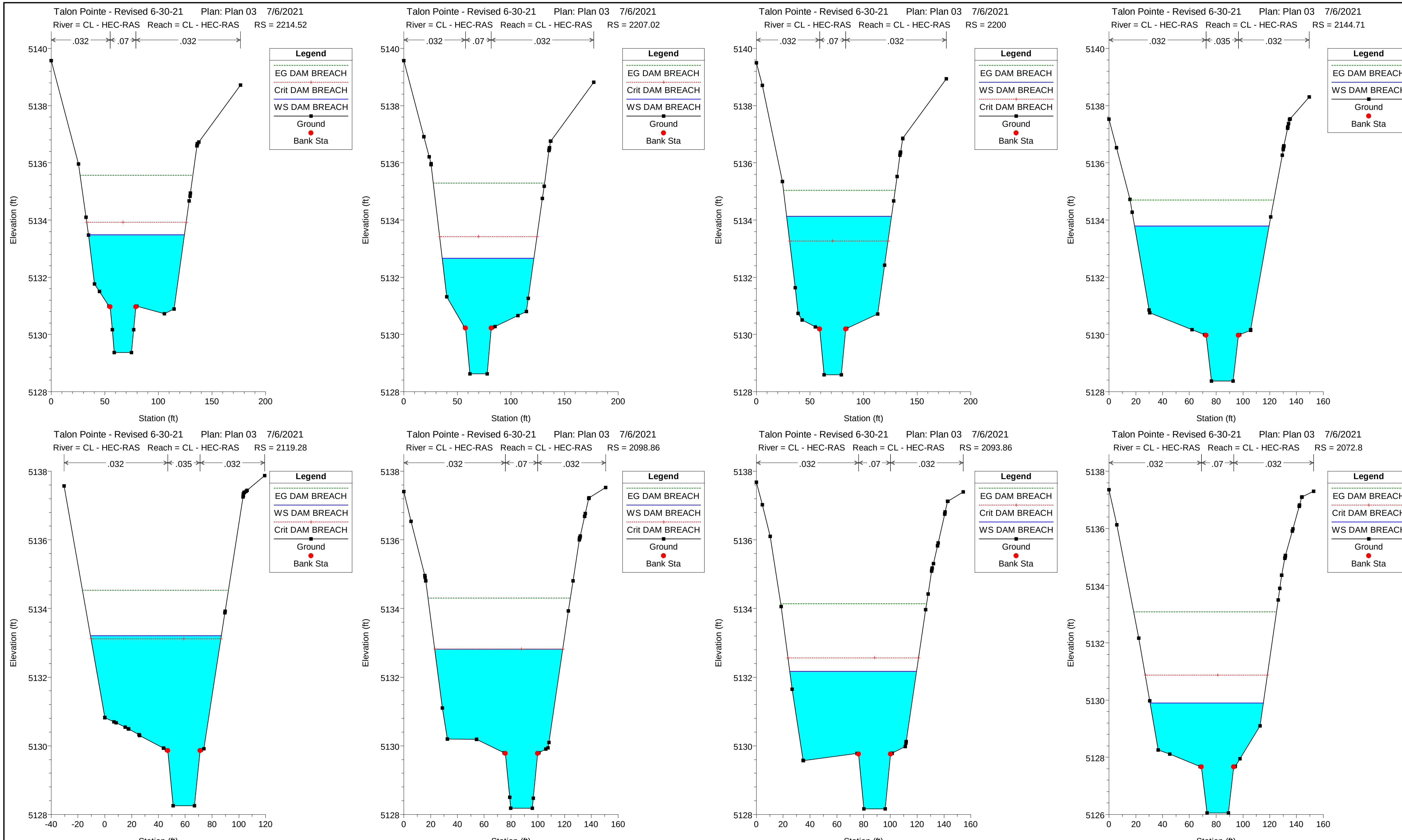

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2900
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

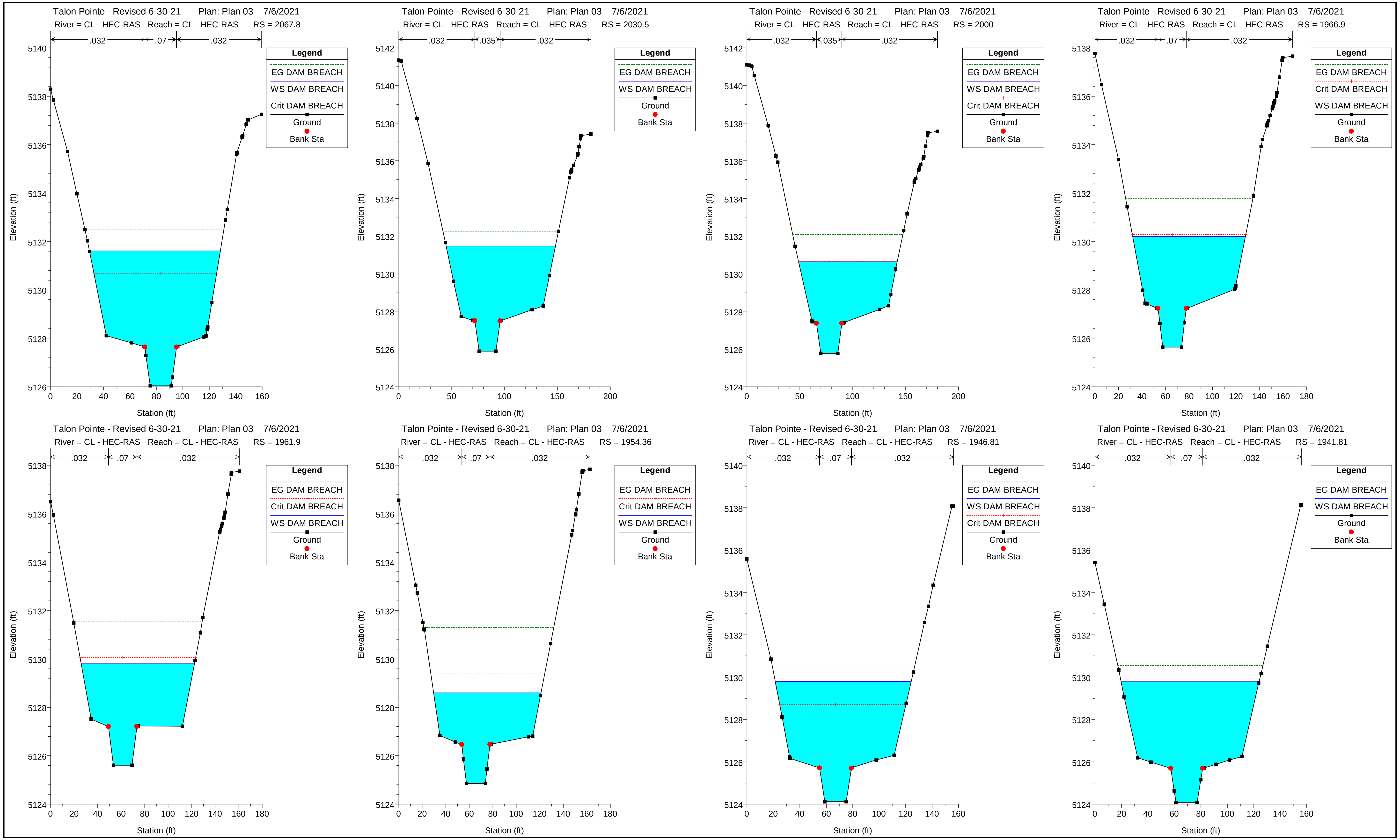

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2889.95
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2864.07
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2850.25
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2844.79
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2791.11 Culv
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2791.11 Culv
.032 .03 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2733.18
.032 .03 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2700
.032 .035 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2655
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2650
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2642.5
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2635
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2630
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2600
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2550
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2500
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

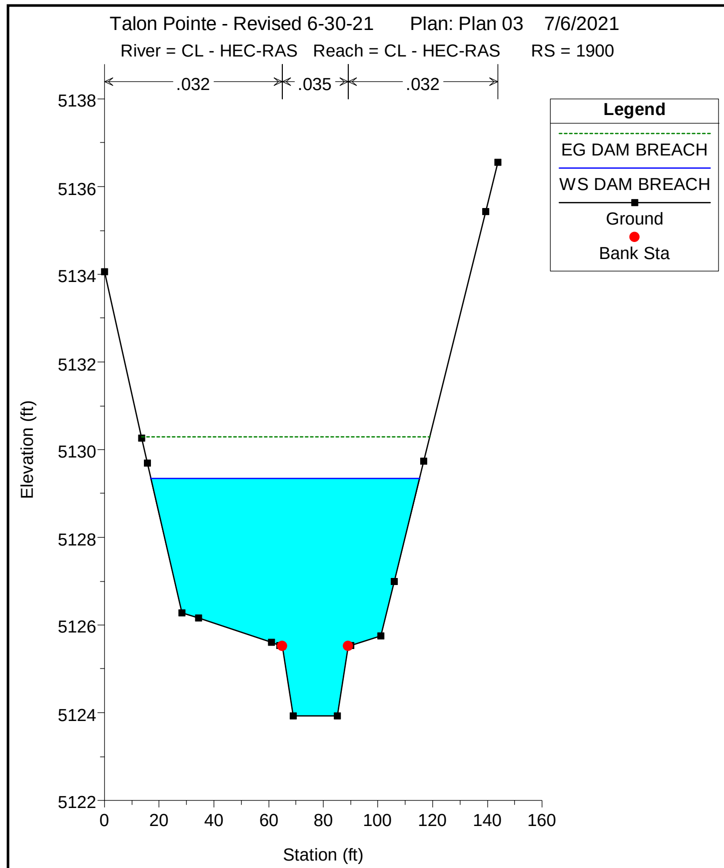

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2452.73
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2447.73
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2440.32
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2432.91
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2427.91
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2400
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2354.6
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2347.73
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

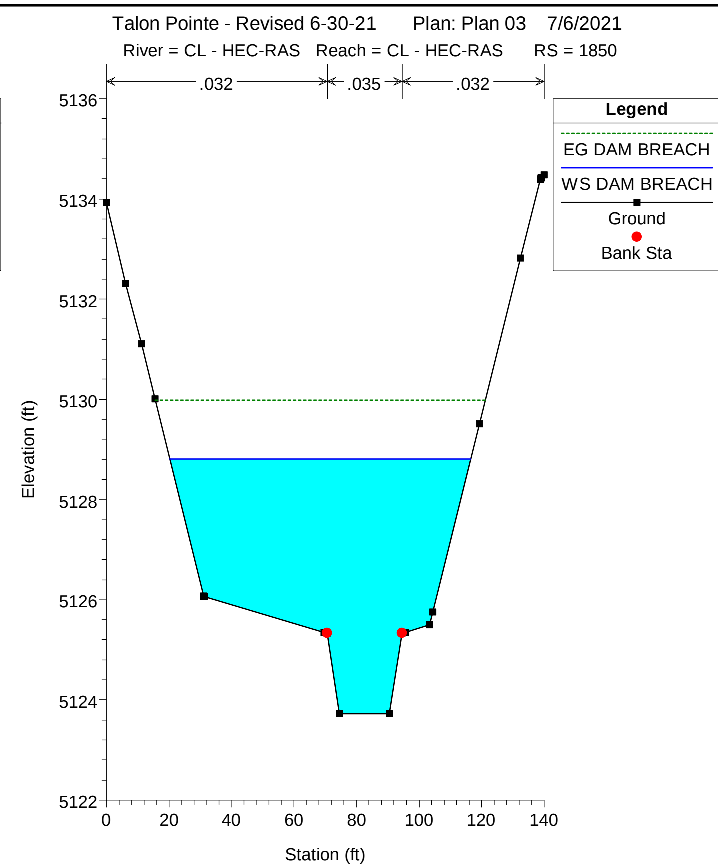

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2340.23
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2332.73
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2327.73
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2300
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2277.56
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2250
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2227.02
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2222.02
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

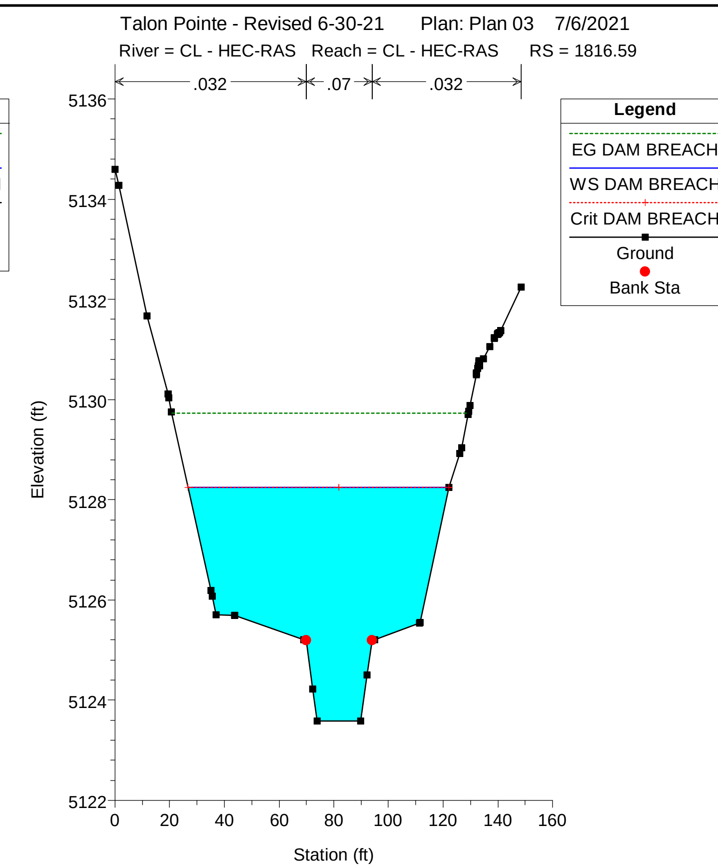

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2214.52
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2207.02
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2200
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2144.71
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2119.28
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2098.86
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2093.86
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2072.8
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

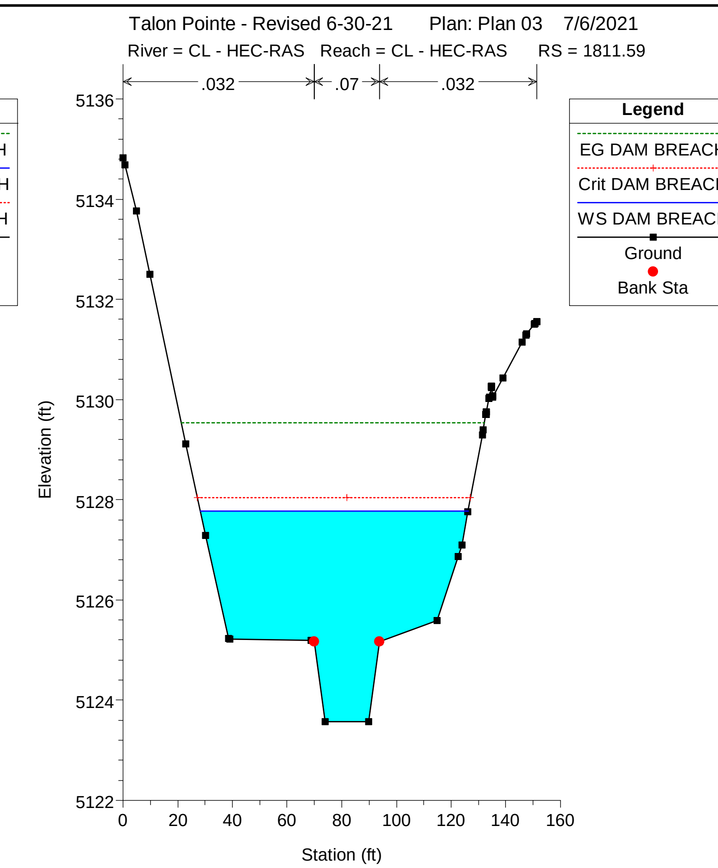


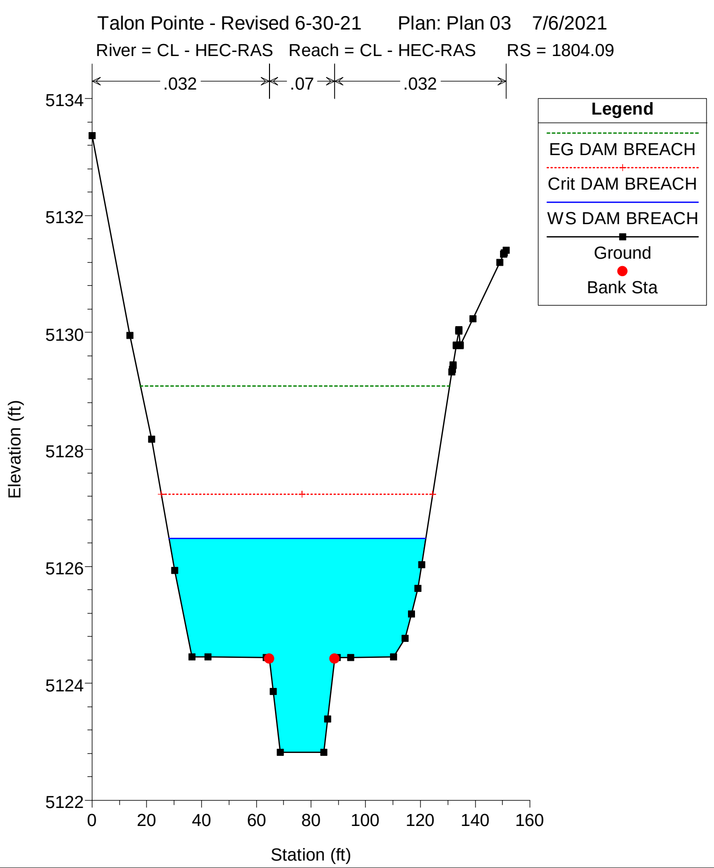
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2067.8
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2030.5
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 2000
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1966.9
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1961.9
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1954.36
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1946.81
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1941.81
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

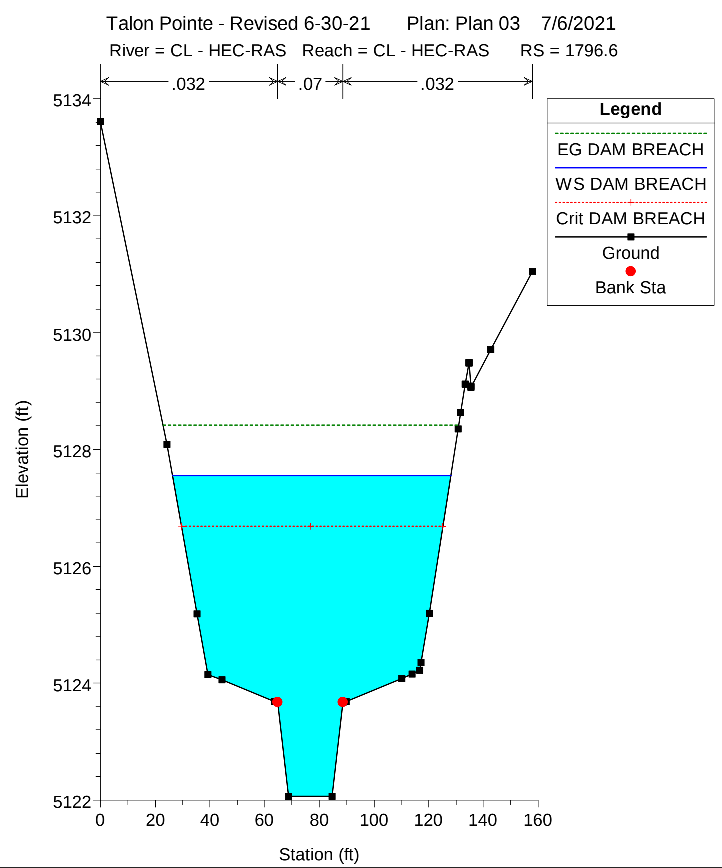

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1900
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

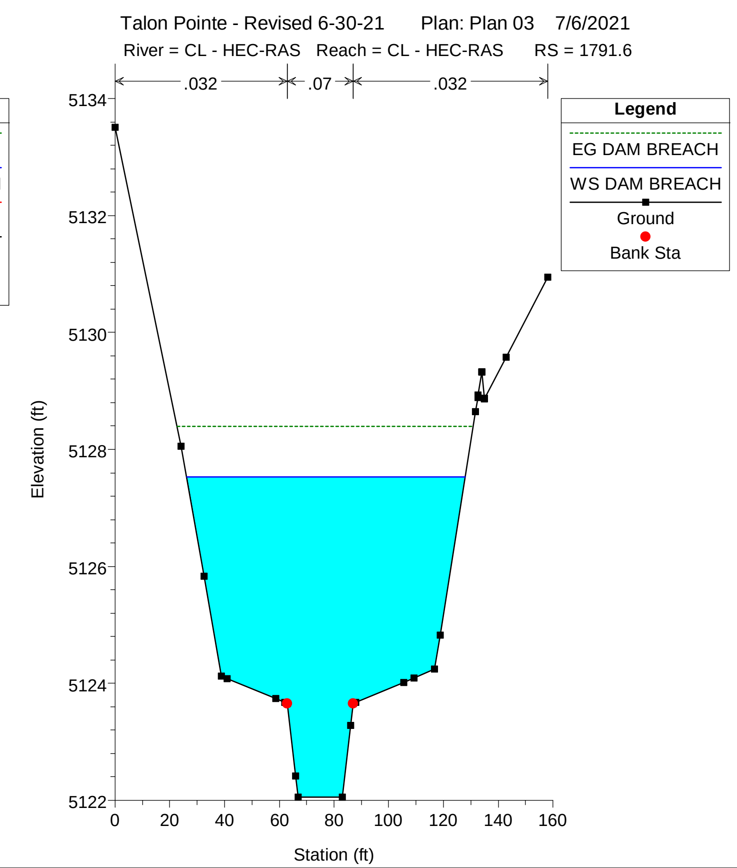

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1850
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

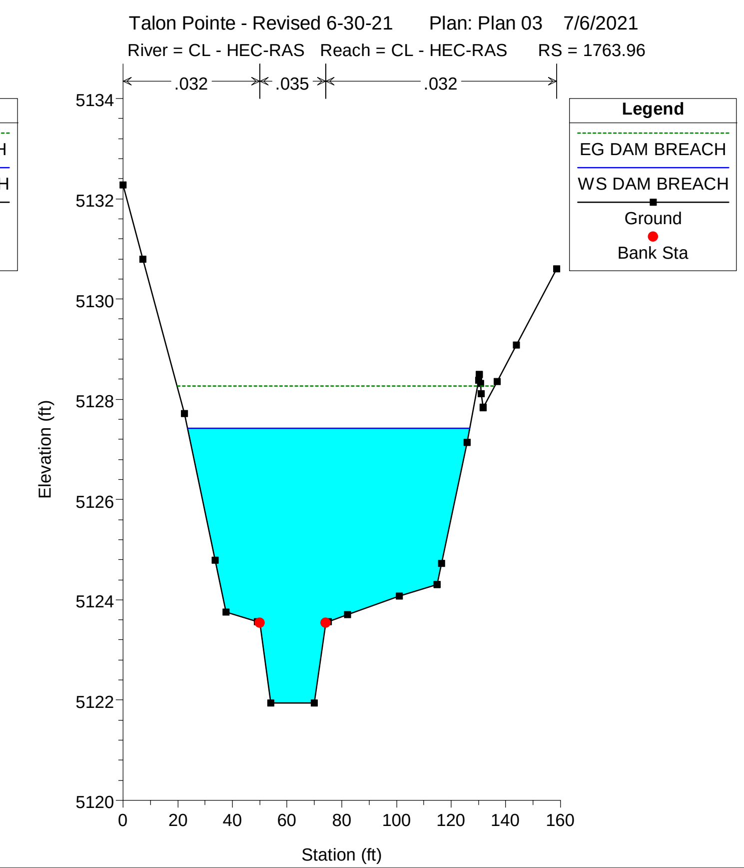

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1816.59
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

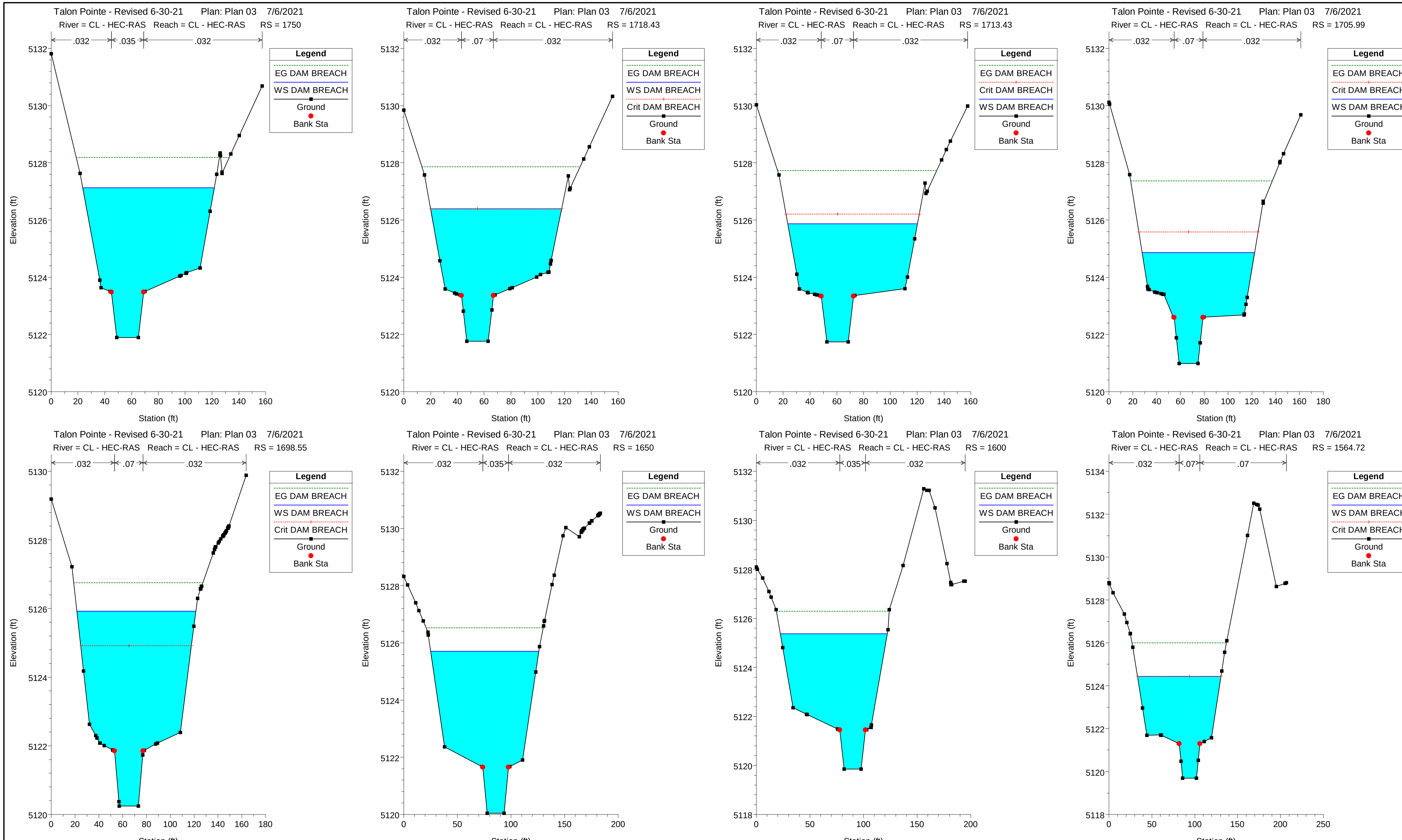

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1811.59
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1804.09
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

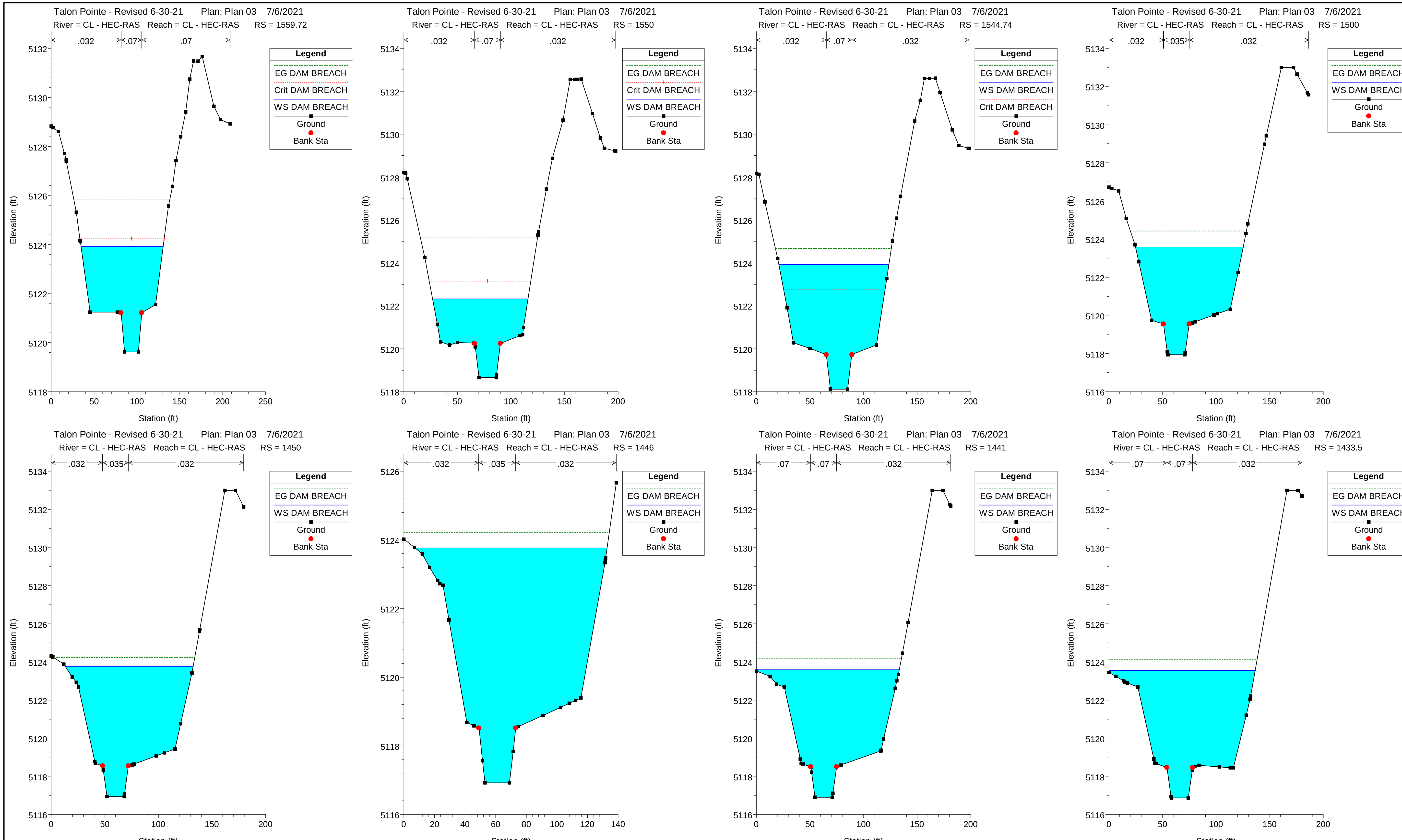

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1796.6
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1791.6
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

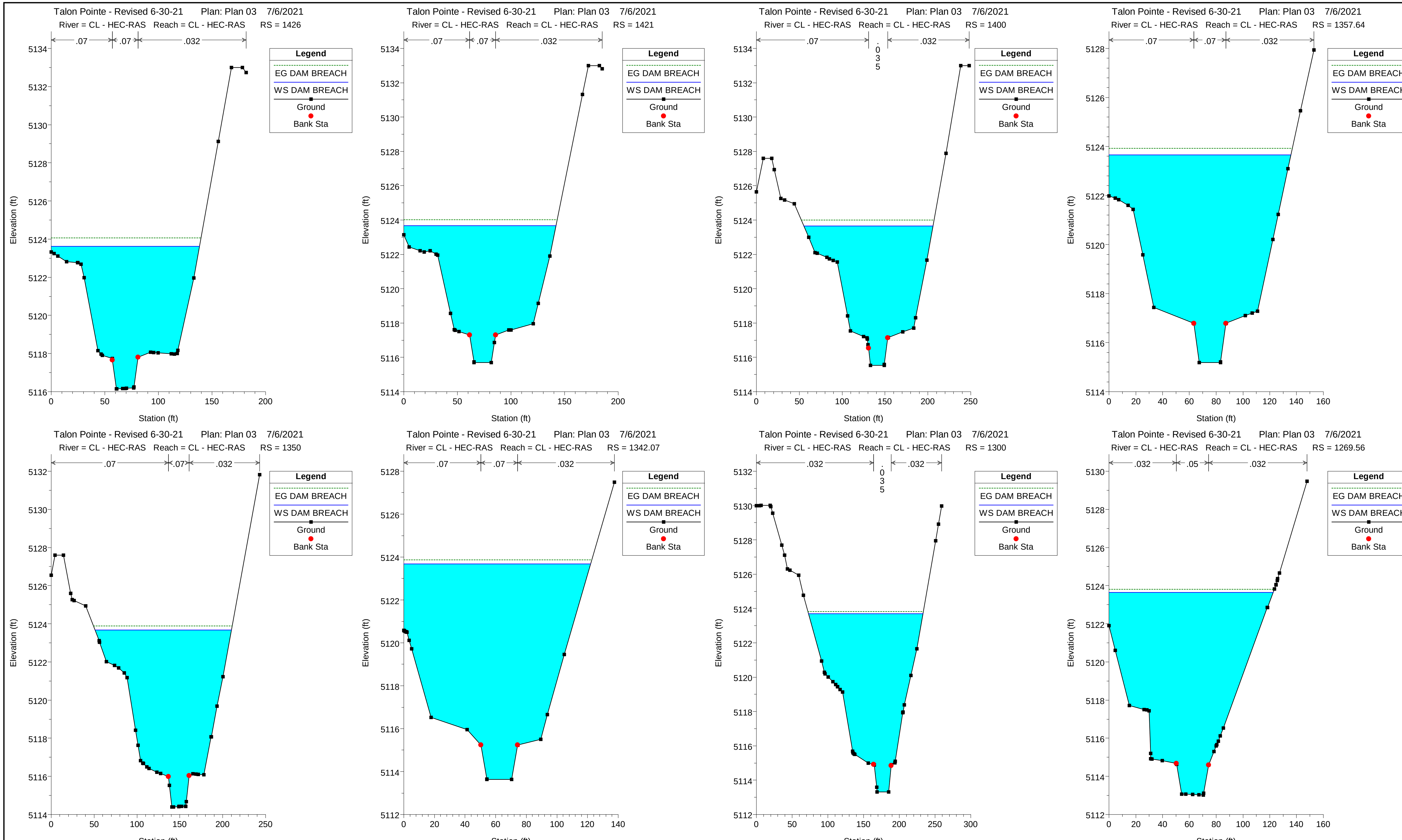

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1763.96
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

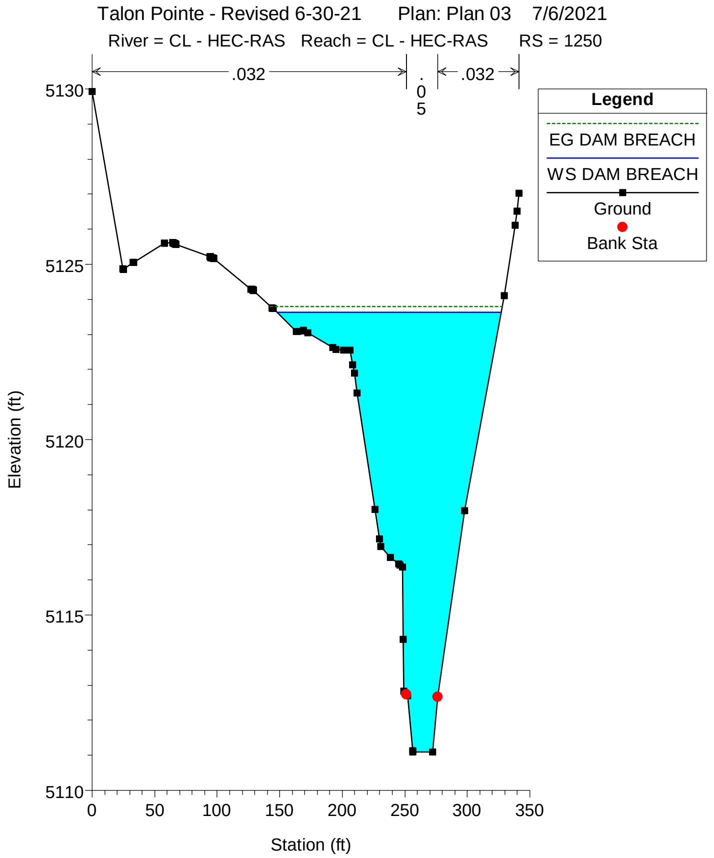


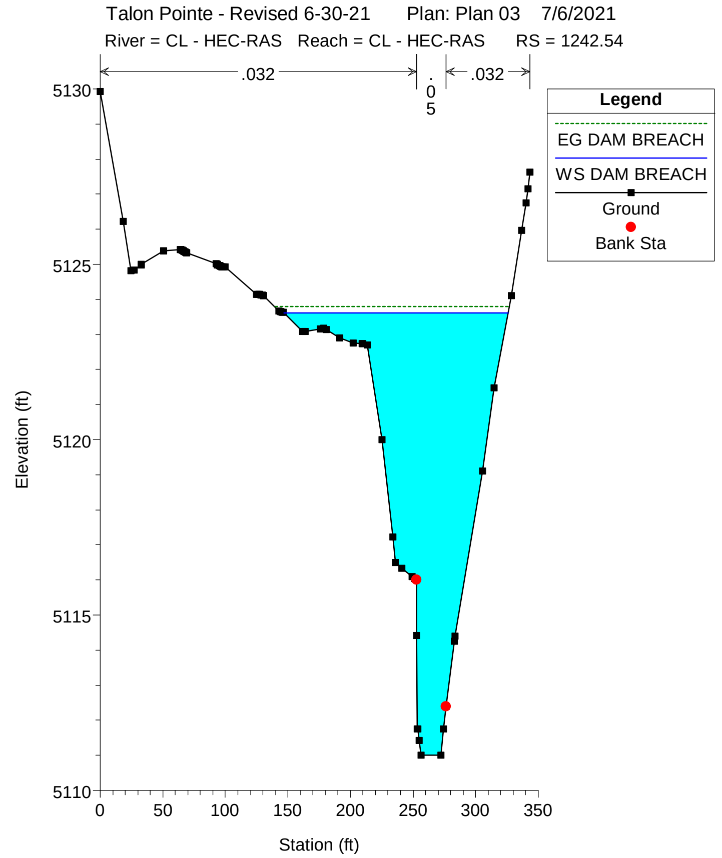
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1750
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1718.43
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1713.43
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1705.99
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1698.55
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1650
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1600
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1564.72
.032 .07 .07
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

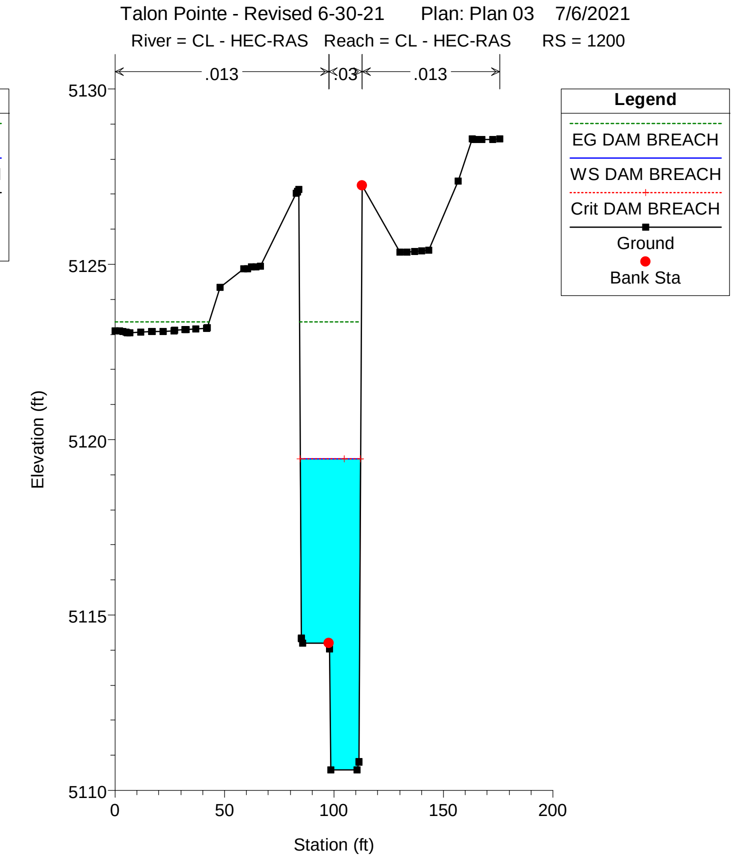


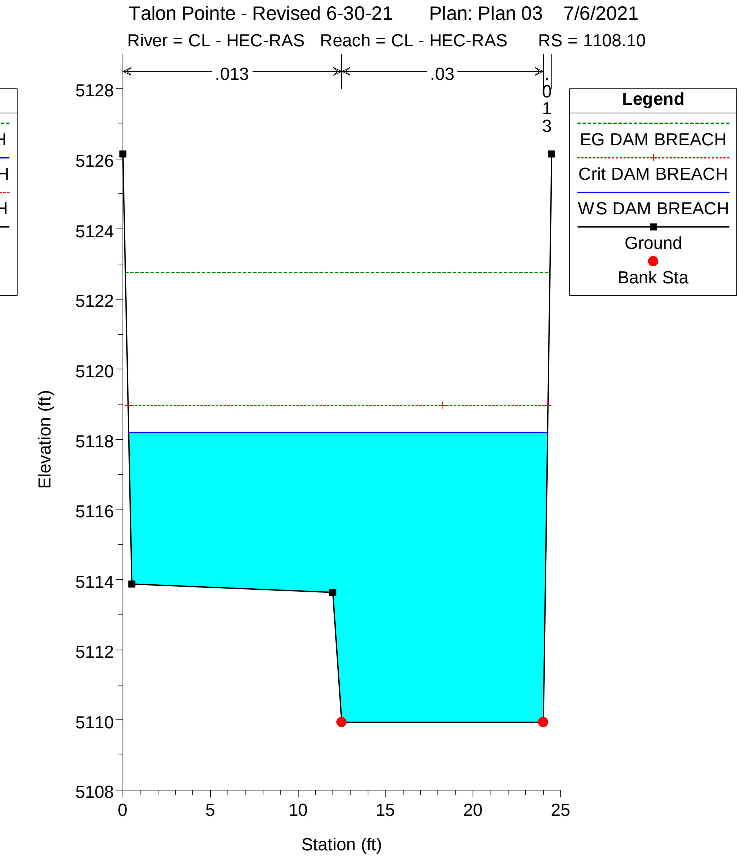
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1559.72
.032 .07 .07
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1550
.032 .07 .032
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1544.74
.032 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1500
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1450
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1446
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1441
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1433.5
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

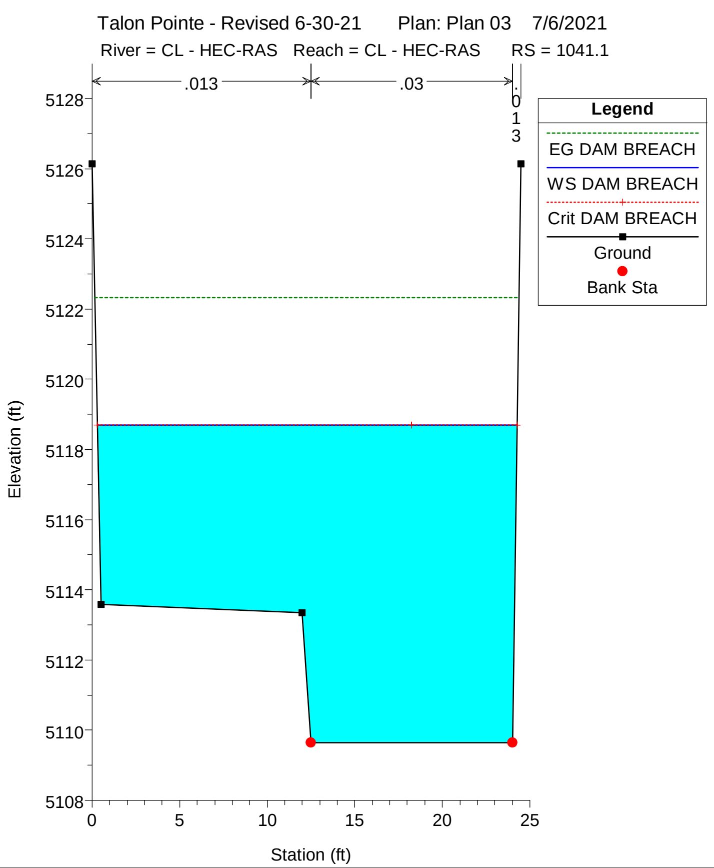

Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1426
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1421
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1400
.07 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1357.64
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1350
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1342.07
.07 .07 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1300
.032 .035 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)
Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1269.56
.032 .05 .032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1250
.032
.05
.032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1242.54
.032
.05
.032
Legend
EG DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1200
.013
.03
.013
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1108.10
.013
.03
.013
Legend
EG DAM BREACH
Crit DAM BREACH
WS DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)


Talon Pointe - Revised 6-30-21 Plan: Plan 03 7/6/2021
River = CL - HEC-RAS Reach = CL - HEC-RAS RS = 1041.1
.013
.03
.013
Legend
EG DAM BREACH
WS DAM BREACH
Crit DAM BREACH
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Plan: Plan 03 River: CL - HEC-RAS Reach: CL - HEC-RAS Profile: DAM BREACH

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	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
CL - HEC-RAS	3985.82	DAM BREACH	2560.00	5159.75	5164.98	5163.37	5165.57	0.007416	5.06	448.09	100.00	0.42	2.13	1.37	1.40
CL - HEC-RAS	3950	DAM BREACH	2560.00	5160.17	5164.82		5165.41	0.002977	6.43	415.41	100.00	0.53	0.86	0.73	0.65
CL - HEC-RAS	3921.15	DAM BREACH	2560.00	5159.80	5164.69	5163.13	5165.05	0.002044	5.19	540.66	150.00	0.43	0.57	0.42	0.35
CL - HEC-RAS	3897.31		Culvert												
CL - HEC-RAS	3830	DAM BREACH	2560.00	5152.42	5157.76	5157.76	5159.27	0.029754	10.03	261.48	87.27	0.83	8.42	1.08	2.29
CL - HEC-RAS	3817.39	DAM BREACH	2560.00	5149.27	5153.31	5154.72	5158.12	0.242220	17.75	146.14	76.80	2.08	33.48	5.91	7.03
CL - HEC-RAS	3800	DAM BREACH	2560.00	5149.13	5152.72	5153.86	5156.52	0.037382	17.98	173.53	84.23	1.74	7.56	3.62	3.60
CL - HEC-RAS	3750	DAM BREACH	2560.00	5148.93	5154.58	5153.67	5155.40	0.004267	8.37	362.67	100.54	0.64	1.40	0.81	0.79
CL - HEC-RAS	3700	DAM BREACH	2560.00	5148.73	5154.35		5155.19	0.004365	8.44	359.87	100.38	0.64	1.42	0.83	0.80
CL - HEC-RAS	3650	DAM BREACH	2560.00	5148.53	5154.10		5154.96	0.004567	8.58	354.34	99.97	0.66	1.47	0.86	0.81
CL - HEC-RAS	3600	DAM BREACH	2560.00	5148.33	5153.86		5154.73	0.004692	8.65	351.85	100.36	0.66	1.50	0.88	0.81
CL - HEC-RAS	3589.73	DAM BREACH	2560.00	5148.29	5153.73		5154.66	0.005120	8.93	340.73	98.93	0.69	1.61	0.94	0.87
CL - HEC-RAS	3550	DAM BREACH	2560.00	5148.13	5153.58		5154.48	0.004916	8.77	347.27	100.59	0.68	1.55	0.91	0.85
CL - HEC-RAS	3525.06	DAM BREACH	2560.00	5148.03	5153.09	5152.72	5154.26	0.011443	6.35	308.39	96.79	0.51	3.34	1.90	1.85
CL - HEC-RAS	3520.04	DAM BREACH	2560.00	5148.01	5152.68	5152.68	5154.16	0.016730	7.25	273.63	94.22	0.61	4.48	2.51	2.44
CL - HEC-RAS	3509.16	DAM BREACH	2560.00	5146.92	5150.92	5151.73	5153.68	0.046037	10.78	198.61	85.00	0.98	10.47	5.39	4.77
CL - HEC-RAS	3500	DAM BREACH	2560.00	5146.88	5152.51	5151.57	5153.36	0.006868	5.30	362.25	100.44	0.40	2.24	1.28	1.30
CL - HEC-RAS	3466.22	DAM BREACH	2560.00	5146.75	5152.33		5153.19	0.004507	8.54	356.03	100.19	0.65	1.46	0.79	0.86
CL - HEC-RAS	3429.54	DAM BREACH	2560.00	5146.60	5152.15		5153.03	0.004672	8.65	351.22	99.62	0.66	1.50	0.78	0.90
CL - HEC-RAS	3400	DAM BREACH	2560.00	5146.48	5152.06		5152.89	0.004349	8.38	359.87	99.68	0.64	1.41	0.80	0.85
CL - HEC-RAS	3380.38	DAM BREACH	2560.00	5146.40	5152.01		5152.80	0.004148	8.21	367.64	101.48	0.63	1.35	0.79	0.79
CL - HEC-RAS	3353.55	DAM BREACH	2560.00	5146.29	5151.76		5152.68	0.004978	8.84	344.10	99.36	0.68	1.58	0.93	0.81
CL - HEC-RAS	3323.72	DAM BREACH	2560.00	5146.17	5151.14	5151.03	5152.46	0.008253	10.65	289.14	95.34	0.87	2.36	1.34	1.02
CL - HEC-RAS	3300	DAM BREACH	2560.00	5146.08	5150.75	5150.75	5152.22	0.017280	7.36	273.46	96.69	0.62	4.63	2.55	2.28
CL - HEC-RAS	3293.9	DAM BREACH	2560.00	5146.05	5150.32	5150.47	5151.98	0.018274	7.11	263.75	94.53	0.63	4.45	2.89	2.22
CL - HEC-RAS	3283.9	DAM BREACH	2560.00	5145.05	5150.86	5149.83	5151.62	0.003753	8.01	377.92	101.16	0.60	1.27	0.76	0.68
CL - HEC-RAS	3278.9	DAM BREACH	2560.00	5145.03	5150.84		5151.59	0.005553	4.87	388.11	103.00	0.36	1.87	1.12	1.07
CL - HEC-RAS	3250	DAM BREACH	2560.00	5144.92	5150.73		5151.45	0.003595	7.84	388.55	105.24	0.59	1.21	0.67	0.73
CL - HEC-RAS	3230.87	DAM BREACH	2560.00	5144.84	5150.65		5151.39	0.003709	7.96	383.14	104.47	0.60	1.25	0.63	0.76
CL - HEC-RAS	3200	DAM BREACH	2560.00	5144.72	5150.41		5151.26	0.004371	8.51	357.38	99.60	0.64	1.44	0.66	0.87
CL - HEC-RAS	3172.25	DAM BREACH	2560.00	5144.60	5150.32		5151.09	0.006069	5.03	380.00	104.82	0.38	2.01	1.05	1.21
CL - HEC-RAS	3167.25	DAM BREACH	2560.00	5144.58	5150.34		5151.03	0.004871	4.54	407.01	107.78	0.34	1.63	0.87	1.04
CL - HEC-RAS	3157.25	DAM BREACH	2560.00	5143.58	5150.47		5150.94	0.003053	4.07	495.40	129.98	0.28	1.23	0.44	0.74
CL - HEC-RAS	3141.72	DAM BREACH	2560.00	5143.52	5150.46		5150.88	0.001803	6.28	512.34	129.51	0.43	0.73	0.32	0.43
CL - HEC-RAS	3100	DAM BREACH	2560.00	5143.36	5150.41		5150.81	0.001724	6.21	527.82	134.32	0.42	0.71	0.35	0.36
CL - HEC-RAS	3050	DAM BREACH	2560.00	5143.16	5150.33		5150.73	0.001657	6.16	537.41	138.43	0.41	0.70	0.36	0.27
CL - HEC-RAS	3000	DAM BREACH	2560.00	5142.96	5150.29		5150.65	0.001448	5.85	568.44	146.27	0.39	0.62	0.34	0.22
CL - HEC-RAS	2945.08	DAM BREACH	2560.00	5142.74	5150.25		5150.57	0.001222	5.46	595.41	138.69	0.36	0.54	0.28	0.27
CL - HEC-RAS	2900	DAM BREACH	2560.00	5142.56	5150.20		5150.50	0.001627	3.19	603.27	129.97	0.21	0.73	0.37	0.43
CL - HEC-RAS	2889.95	DAM BREACH	2560.00	5142.49	5150.19		5150.49	0.001564	3.14	610.62	130.08	0.20	0.71	0.37	0.42
CL - HEC-RAS	2864.07	DAM BREACH	2560.00	5142.41	5150.22		5150.39	0.001436	3.12	767.00	150.00	0.20	0.68	0.26	0.29
CL - HEC-RAS	2850.25	DAM BREACH	2560.00	5138.99	5150.21	5144.43	5150.38	0.000973	3.30	791.66	140.93	0.17	0.68	0.21	0.18
CL - HEC-RAS	2844.79	DAM BREACH	2560.00	5137.67	5150.09	5144.49	5150.34	0.001568	4.50	659.40	147.99	0.23	1.21	0.23	0.25
CL - HEC-RAS	2791.11		Culvert												
CL - HEC-RAS	2733.18	DAM BREACH	2560.00	5136.48	5142.90	5142.90	5145.97	0.010774	14.05	182.26	29.19	0.99	3.04		
CL - HEC-RAS	2700	DAM BREACH	2560.00	5136.35	5139.90	5141.31	5144.79	0.048085	20.22	155.95	80.04	1.97	9.61	3.69	4.47
CL - HEC-RAS	2655	DAM BREACH	2560.00	5136.17	5141.62	5140.85	5142.54	0.007828	5.53	348.78	100.73	0.43	2.47	1.42	1.41
CL - HEC-RAS	2650	DAM BREACH	2560.00	5136.15	5140.87	5140.87	5142.36	0.016780	7.31	272.76	93.12	0.61	4.54	2.49	2.49
CL - HEC-RAS	2642.5	DAM BREACH	2560.00	5135.40	5139.12	5139.98	5142.01	0.048787	10.54	195.52	87.36	1.00	10.27	5.55	5.18
CL - HEC-RAS	2635	DAM BREACH	2560.00	5134.65	5140.20	5139.35	5141.09	0.007321	5.42	355.47	100.35	0.42	2.36	1.35	1.35
CL - HEC-RAS	2630	DAM BREACH	2560.00	5134.63	5140.17		5141.06	0.007475	5.46	353.07	100.08	0.42	2.40	1.38	1.37

HEC-RAS Plan: Plan 03 River: CL - HEC-RAS Reach: CL - HEC-RAS Profile: DAM BREACH (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	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
CL - HEC-RAS	2600	DAM BREACH	2560.00	5134.50	5140.01		5140.90	0.004780	8.71	348.85	99.40	0.67	1.52	0.87	0.88
CL - HEC-RAS	2550	DAM BREACH	2560.00	5134.31	5139.66		5140.63	0.005471	9.13	333.89	98.94	0.71	1.69	0.90	0.99
CL - HEC-RAS	2500	DAM BREACH	2560.00	5134.11	5139.33		5140.37	0.006037	9.43	323.88	98.86	0.75	1.82	0.96	1.05
CL - HEC-RAS	2452.73	DAM BREACH	2560.00	5133.92	5138.52	5138.51	5139.96	0.016350	7.10	278.07	97.69	0.60	4.32	2.42	2.36
CL - HEC-RAS	2447.73	DAM BREACH	2560.00	5133.89	5138.44	5138.44	5139.89	0.016871	7.15	276.14	98.59	0.61	4.39	2.47	2.37
CL - HEC-RAS	2440.32	DAM BREACH	2560.00	5133.15	5137.23	5137.91	5139.68	0.041609	10.40	210.49	94.17	0.94	9.67	3.90	5.02
CL - HEC-RAS	2432.91	DAM BREACH	2560.00	5132.41	5136.58	5137.40	5139.37	0.051371	11.71	197.69	93.40	1.05	12.18	3.91	6.08
CL - HEC-RAS	2427.91	DAM BREACH	2560.00	5132.38	5137.95	5137.07	5138.83	0.007239	5.40	355.43	99.37	0.41	2.33	1.39	1.29
CL - HEC-RAS	2400	DAM BREACH	2560.00	5132.27	5137.69		5138.67	0.005341	9.11	334.77	98.14	0.71	1.68	0.99	0.82
CL - HEC-RAS	2354.6	DAM BREACH	2560.00	5132.09	5136.78	5136.78	5138.27	0.016874	7.31	273.32	94.36	0.61	4.55	2.54	2.36
CL - HEC-RAS	2347.73	DAM BREACH	2560.00	5132.06	5136.08	5136.52	5138.11	0.027360	8.33	235.10	93.69	0.76	6.24	3.68	3.27
CL - HEC-RAS	2340.23	DAM BREACH	2560.00	5131.31	5134.94	5135.78	5137.77	0.047574	10.21	198.06	90.07	0.98	9.73	5.36	5.05
CL - HEC-RAS	2332.73	DAM BREACH	2560.00	5130.56	5136.14	5135.20	5136.99	0.006807	5.24	362.37	100.11	0.40	2.20	1.30	1.29
CL - HEC-RAS	2327.73	DAM BREACH	2560.00	5130.54	5136.04		5136.92	0.007296	5.37	355.87	100.79	0.41	2.32	1.36	1.34
CL - HEC-RAS	2300	DAM BREACH	2560.00	5130.43	5135.85		5136.77	0.005065	8.86	342.28	98.97	0.69	1.59	0.88	0.93
CL - HEC-RAS	2277.56	DAM BREACH	2560.00	5130.34	5135.69		5136.66	0.005423	9.09	335.31	99.42	0.71	1.68	0.86	0.99
CL - HEC-RAS	2250	DAM BREACH	2560.00	5130.23	5135.05	5135.05	5136.49	0.009360	11.10	277.93	94.94	0.92	2.59	1.15	1.45
CL - HEC-RAS	2227.02	DAM BREACH	2560.00	5130.13	5134.69	5134.81	5136.28	0.019618	7.71	263.08	96.12	0.66	5.12	2.51	2.77
CL - HEC-RAS	2222.02	DAM BREACH	2560.00	5130.12	5134.27	5134.58	5136.11	0.022663	7.76	248.27	94.29	0.69	5.35	2.62	3.29
CL - HEC-RAS	2214.52	DAM BREACH	2560.00	5129.37	5133.49	5133.93	5135.56	0.025947	8.26	235.16	89.59	0.74	6.08	2.85	3.78
CL - HEC-RAS	2207.02	DAM BREACH	2560.00	5128.62	5132.67	5133.42	5135.29	0.041724	10.35	204.53	85.58	0.94	9.61	4.32	5.03
CL - HEC-RAS	2200	DAM BREACH	2560.00	5128.59	5134.13	5133.27	5135.04	0.007341	5.42	352.20	97.83	0.42	2.36	1.36	1.40
CL - HEC-RAS	2144.71	DAM BREACH	2560.00	5128.37	5133.80		5134.71	0.004999	8.81	345.19	100.53	0.68	1.57	0.94	0.79
CL - HEC-RAS	2119.28	DAM BREACH	2560.00	5128.26	5133.21	5133.12	5134.53	0.008369	10.69	290.19	97.76	0.87	2.38	1.32	0.99
CL - HEC-RAS	2098.86	DAM BREACH	2560.00	5128.18	5132.82	5132.82	5134.30	0.016661	7.20	274.63	95.57	0.61	4.43	2.56	2.11
CL - HEC-RAS	2093.86	DAM BREACH	2560.00	5128.16	5132.17	5132.57	5134.14	0.025197	7.99	240.66	94.74	0.73	5.74	3.54	2.76
CL - HEC-RAS	2072.8	DAM BREACH	2560.00	5126.06	5129.90	5130.88	5133.08	0.058931	11.83	184.49	84.56	1.10	12.80	6.42	5.18
CL - HEC-RAS	2067.8	DAM BREACH	2560.00	5126.04	5131.61	5130.69	5132.48	0.006806	5.24	361.17	99.10	0.40	2.20	1.31	1.30
CL - HEC-RAS	2030.5	DAM BREACH	2560.00	5125.89	5131.47		5132.27	0.004209	8.25	368.09	103.39	0.63	1.36	0.73	0.82
CL - HEC-RAS	2000	DAM BREACH	2560.00	5125.77	5130.63	5130.63	5132.07	0.009265	11.10	276.76	93.15	0.91	2.59	1.13	1.46
CL - HEC-RAS	1966.9	DAM BREACH	2560.00	5125.63	5130.21	5130.29	5131.77	0.018798	7.58	265.99	95.81	0.64	4.93	2.47	2.70
CL - HEC-RAS	1961.9	DAM BREACH	2560.00	5125.61	5129.80	5130.06	5131.56	0.021966	7.69	252.58	96.26	0.68	5.24	2.66	3.14
CL - HEC-RAS	1954.36	DAM BREACH	2560.00	5124.86	5128.59	5129.38	5131.30	0.046094	10.27	201.41	91.38	0.97	9.73	4.86	5.09
CL - HEC-RAS	1946.81	DAM BREACH	2560.00	5124.11	5129.80	5128.71	5130.57	0.005839	4.92	381.75	102.78	0.37	1.93	1.14	1.15
CL - HEC-RAS	1941.81	DAM BREACH	2560.00	5124.09	5129.78		5130.54	0.005755	4.89	385.00	104.27	0.37	1.90	1.12	1.13
CL - HEC-RAS	1900	DAM BREACH	2560.00	5123.93	5129.34		5130.30	0.005248	9.02	337.30	98.30	0.70	1.65	0.97	0.86
CL - HEC-RAS	1850	DAM BREACH	2560.00	5123.73	5128.80		5129.99	0.007138	10.05	304.17	96.14	0.81	2.09	1.21	1.03
CL - HEC-RAS	1816.59	DAM BREACH	2560.00	5123.59	5128.25	5128.25	5129.73	0.016838	7.26	274.13	95.35	0.61	4.50	2.51	2.39
CL - HEC-RAS	1811.59	DAM BREACH	2560.00	5123.57	5127.78	5128.05	5129.53	0.022604	7.83	252.25	97.89	0.70	5.42	3.16	2.77
CL - HEC-RAS	1804.09	DAM BREACH	2560.00	5122.82	5126.48	5127.23	5129.08	0.043138	9.78	206.16	93.89	0.94	8.90	4.82	4.73
CL - HEC-RAS	1796.6	DAM BREACH	2560.00	5122.07	5127.56	5126.69	5128.42	0.007027	5.26	360.45	101.70	0.41	2.23	1.30	1.33
CL - HEC-RAS	1791.6	DAM BREACH	2560.00	5122.05	5127.53		5128.39	0.007082	5.28	359.82	101.87	0.41	2.25	1.30	1.34
CL - HEC-RAS	1763.96	DAM BREACH	2560.00	5121.94	5127.42		5128.26	0.004598	8.51	357.75	103.08	0.66	1.46	0.77	0.87
CL - HEC-RAS	1750	DAM BREACH	2560.00	5121.89	5127.13		5128.19	0.006123	9.52	321.36	98.36	0.75	1.85	0.90	1.08
CL - HEC-RAS	1718.43	DAM BREACH	2560.00	5121.76	5126.40	5126.40	5127.87	0.017281	7.34	274.26	97.75	0.62	4.60	2.35	2.51
CL - HEC-RAS	1713.43	DAM BREACH	2560.00	5121.74	5125.87	5126.21	5127.73	0.024705	8.08	245.10	96.86	0.72	5.81	3.01	3.30
CL - HEC-RAS	1705.99	DAM BREACH	2560.00	5120.99	5124.86	5125.59	5127.37	0.039993	9.81	211.18	94.38	0.91	8.78	3.51	4.94
CL - HEC-RAS	1698.55	DAM BREACH	2560.00	5120.25	5125.92	5124.92	5126.75	0.006446	5.16	368.06	99.85	0.39	2.12	1.22	1.27
CL - HEC-RAS	1650	DAM BREACH	2560.00	5120.04	5125.70		5126.52	0.004266	8.38	362.66	100.70	0.64	1.40	0.83	0.75
CL - HEC-RAS	1600	DAM BREACH	2560.00	5119.85	5125.37		5126.29	0.004968	8.89	343.96	99.84	0.68	1.59	0.94	0.73
CL - HEC-RAS	1564.72	DAM BREACH	2560.00	5119.70	5124.44	5124.44	5126.00	0.018965	7.80	286.11	97.30	0.65	5.16	2.95	2.68

HEC-RAS Plan: Plan 03 River: CL - HEC-RAS Reach: CL - HEC-RAS Profile: DAM BREACH (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	Shear Chan	Shear LOB	Shear ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
CL - HEC-RAS	1559.72	DAM BREACH	2560.00	5119.62	5123.92	5124.24	5125.86	0.025658	8.47	259.20	95.90	0.74	6.29	3.76	3.26
CL - HEC-RAS	1550	DAM BREACH	2560.00	5118.65	5122.33	5123.16	5125.16	0.047314	10.28	197.89	89.05	0.98	9.82	5.47	4.86
CL - HEC-RAS	1544.74	DAM BREACH	2560.00	5118.12	5123.93	5122.75	5124.67	0.005430	4.82	389.98	102.59	0.36	1.83	1.10	1.09
CL - HEC-RAS	1500	DAM BREACH	2560.00	5117.94	5123.59		5124.42	0.004278	8.39	361.99	100.50	0.64	1.40	0.73	0.84
CL - HEC-RAS	1450	DAM BREACH	2560.00	5116.94	5123.77		5124.23	0.001836	6.26	493.68	119.51	0.43	0.73	0.29	0.46
CL - HEC-RAS	1446	DAM BREACH	2560.00	5116.92	5123.77		5124.22	0.001833	6.27	499.66	125.55	0.43	0.73	0.26	0.46
CL - HEC-RAS	1441	DAM BREACH	2560.00	5116.90	5123.58		5124.19	0.003905	4.50	486.25	133.24	0.31	1.52	0.48	0.95
CL - HEC-RAS	1433.5	DAM BREACH	2560.00	5116.87	5123.56		5124.11	0.003240	4.10	517.29	136.43	0.29	1.27	0.43	0.85
CL - HEC-RAS	1426	DAM BREACH	2560.00	5116.15	5123.63		5124.06	0.002307	3.74	584.74	138.29	0.25	1.01	0.36	0.66
CL - HEC-RAS	1421	DAM BREACH	2560.00	5115.70	5123.67		5124.02	0.001803	3.46	654.40	142.05	0.22	0.85	0.35	0.54
CL - HEC-RAS	1400	DAM BREACH	2560.00	5115.53	5123.65		5123.99	0.001160	5.66	688.01	150.73	0.35	0.56	0.24	0.35
CL - HEC-RAS	1357.64	DAM BREACH	2560.00	5115.19	5123.66		5123.92	0.001567	3.36	726.49	135.71	0.21	0.78	0.44	0.47
CL - HEC-RAS	1350	DAM BREACH	2560.00	5114.39	5123.67		5123.88	0.001164	3.08	841.25	159.00	0.18	0.64	0.31	0.37
CL - HEC-RAS	1342.07	DAM BREACH	2560.00	5113.64	5123.68		5123.87	0.000959	2.95	827.25	122.05	0.17	0.57	0.37	0.32
CL - HEC-RAS	1300	DAM BREACH	2560.00	5113.31	5123.70		5123.83	0.000323	3.51	937.64	160.26	0.19	0.20	0.10	0.09
CL - HEC-RAS	1269.56	DAM BREACH	2560.00	5113.02	5123.65		5123.81	0.000517	3.15	795.26	122.52	0.17	0.33	0.19	0.15
CL - HEC-RAS	1250	DAM BREACH	2560.00	5111.10	5123.64		5123.80	0.000554	3.65	854.15	179.03	0.18	0.41	0.09	0.17
CL - HEC-RAS	1242.54	DAM BREACH	2560.00	5111.00	5123.61		5123.79	0.000670	3.72	802.83	178.73	0.19	0.44	0.10	0.22
CL - HEC-RAS	1200	DAM BREACH	2560.00	5110.58	5119.45	5119.45	5123.36	0.005032	10.07	189.46	27.43	0.61	1.52	1.19	
CL - HEC-RAS	1108.10	DAM BREACH	2560.00	5109.93	5118.20	5118.97	5122.77	0.006525	16.36	150.82	23.93	1.00	3.37	1.14	0.05
CL - HEC-RAS	1041.1	DAM BREACH	2560.00	5109.65	5118.69	5118.69	5122.33	0.004508	14.43	169.28	23.98	0.85	2.54	0.89	0.04

APPENDIX E

Erosion Control

- Sediment Basin Calculations
- Erosion Control Blanket Calculations

Talon Pointe Subdivision
Sediment Basin Volume Calculations

Sediment Basin Volume Required				
EROSION CONTROL TYPE	BASIN NUMBER	DISTURBED TRIBUTARY AREA (ACRES)	VOLUME REQUIRED (CF/ACRE)	VOLUME REQUIRED (CF)
SEDIMENT BASIN	1	4.38	3,600	15,768
SEDIMENT BASIN	2	5.42	3,600	19,512
SEDIMENT BASIN	3	0.39	3,600	1,404
SEDIMENT BASIN	4	2.43	3,600	8,748
SEDIMENT BASIN	5	0.74	3,600	2,664
SEDIMENT BASIN	6	2.68	3,600	9,648
SEDIMENT BASIN	7	1.64	3,600	5,904
SEDIMENT BASIN	8	4.95	3,600	17,820
SEDIMENT BASIN	9	6.23	3,600	22,428
SEDIMENT BASIN	10	4.64	3,600	16,704
SEDIMENT BASIN	11	3.89	3,600	14,004
SEDIMENT BASIN	12	1.54	3,600	5,544
SEDIMENT BASIN	13	0.66	3,600	2,376
SEDIMENT BASIN	14	0.73	3,600	2,628
SEDIMENT BASIN	15	0.43	3,600	1,548
SEDIMENT BASIN	16	2.33	3,600	8,388
SEDIMENT BASIN	17	4.15	3,600	14,940
SEDIMENT BASIN	18	1.08	3,600	3,888
SEDIMENT BASIN	19	3.91	3,600	14,076
SEDIMENT BASIN	20	1.17	3,600	4,212
SEDIMENT BASIN	21	2.63	3,600	9,468
SEDIMENT BASIN	22	2.47	3,600	8,892
SEDIMENT BASIN	23	4.49	3,600	16,164
SEDIMENT BASIN	24	1.36	3,600	4,896
SEDIMENT BASIN	25	1.75	3,600	6,300
SEDIMENT BASIN	26	1.31	3,600	4,716
SEDIMENT BASIN	27	1.73	3,600	6,228
SEDIMENT BASIN	28	3.02	3,600	10,872
SEDIMENT BASIN	29	3.04	3,600	10,944
SEDIMENT BASIN	30	4.21	3,600	15,156
SEDIMENT BASIN	31	1.19	3,600	4,284
SEDIMENT BASIN	32	1.19	3,600	4,284
SEDIMENT BASIN	33	9.91	3,600	35,676
SEDIMENT BASIN	34	2.96	3,600	10,656
SEDIMENT BASIN	35	3.06	3,600	11,016
SEDIMENT BASIN	36	1.21	3,600	4,356
SEDIMENT BASIN	37	2.93	3,600	10,548
SEDIMENT BASIN	38	2.77	3,600	9,972
SEDIMENT BASIN	39	3.51	3,600	12,636

Sediment Basin Volume Provided

EROSION CONTROL TYPE	BASIN NUMBER	ELEVATION	CONTOUR AREA (SF)	VOLUME PROVIDED* (CF)
SEDIMENT BASIN	1	5160.0	3,038	0
		5164.0	7,531	20,470
SEDIMENT BASIN	2	5153.0	3,038	0
		5157.0	7,531	20,470
SEDIMENT BASIN	3	5159.0	388	0
		5163.0	2,481	5,134
SEDIMENT BASIN	4	5156.0	1,454	0
		5160.0	4,795	11,853
SEDIMENT BASIN	5	5154.0	388	0
		5158.0	2,481	5,134
SEDIMENT BASIN	6	5147.0	1,454	0
		5151.0	4,795	11,853
SEDIMENT BASIN	7	5147.0	644	0
		5151.0	3,121	6,910
SEDIMENT BASIN	8	5140.0	3,038	0
		5144.0	7,531	20,470
SEDIMENT BASIN	9	5142.0	3,038	0
		5146.0	7,531	20,470
SEDIMENT BASIN	10	5139.0	3,038	0
		5143.0	7,531	20,470
SEDIMENT BASIN	11	5135.0	2,588	0
		5139.0	6,793	18,099
SEDIMENT BASIN	12	5135.0	644	0
		5139.0	3,121	6,910
SEDIMENT BASIN	13	5135.0	388	0
		5139.0	2,481	5,134
SEDIMENT BASIN	14	5139.0	388	0
		5143.0	2,481	5,134
SEDIMENT BASIN	15	5141.0	388	0
		5145.0	2,481	5,134

Sediment Basin Volume Provided

EROSION CONTROL TYPE	BASIN NUMBER	ELEVATION	CONTOUR AREA (SF)	VOLUME PROVIDED* (CF)
SEDIMENT BASIN	16	5127.0	1,454	0
		5131.0	4,795	11,853
SEDIMENT BASIN	17	5128.0	2,588	0
		5132.0	6,793	18,099
SEDIMENT BASIN	18	5127.0	388	0
		5131.0	2,481	5,134
SEDIMENT BASIN	19	5158.0	2,588	0
		5162.0	6,793	18,099
SEDIMENT BASIN	20	5160.0	388	0
		5164.0	2,481	5,134
SEDIMENT BASIN	21	5155.0	1,454	0
		5159.0	4,795	11,853
SEDIMENT BASIN	22	5154.0	1,454	0
		5158.0	4,795	11,853
SEDIMENT BASIN	23	5156.0	3,038	0
		5160.0	7,531	20,470
SEDIMENT BASIN	24	5165.0	388	0
		5169.0	2,481	5,134
SEDIMENT BASIN	25	5164.0	644	0
		5168.0	3,121	6,910
SEDIMENT BASIN	26	5161.0	388	0
		5165.0	2,481	5,134

Sediment Basin Volume Provided

EROSION CONTROL TYPE	BASIN NUMBER	ELEVATION	CONTOUR AREA (SF)	VOLUME PROVIDED* (CF)
SEDIMENT BASIN	27	5159.0	644	0
		5163.0	3,121	6,910
SEDIMENT BASIN	28	5152.0	2,044	0
		5156.0	5,865	15,162
SEDIMENT BASIN	29	5147.0	2,044	0
		5151.0	5,865	15,162
SEDIMENT BASIN	30	5147.0	2,588	0
		5151.0	6,793	18,099
SEDIMENT BASIN	31	5144.0	388	0
		5148.0	2,481	5,134
SEDIMENT BASIN	32	5147.0	388	0
		5151.0	2,481	5,134
SEDIMENT BASIN	33	5141.0	388	0
		5145.0	2,481	5,134
SEDIMENT BASIN	34	5136.0	2,044	0
		5140.0	5,865	15,162
SEDIMENT BASIN	35	5126.0	2,044	0
		5130.0	5,865	15,162
SEDIMENT BASIN	36	5133.0	388	0
		5137.0	2,481	5,134
SEDIMENT BASIN	37	5125.0	2,044	0
		5129.0	5,865	15,162

Sediment Basin Volume Provided

EROSION CONTROL TYPE	BASIN NUMBER	ELEVATION	CONTOUR AREA (SF)	VOLUME PROVIDED* (CF)
SEDIMENT BASIN	38	5129.0	1,454	0
		5133.0	4,795	11,853
SEDIMENT BASIN	39	5129.0	2,044	0
		5133.0	5,865	15,162

* VOLUME PROVIDED above calculated by Prismoidal Method:
V = (A1 + A2 + SQRT[A1 X A2]) / 3

Sediment Basin Volume Summary

EROSION CONTROL TYPE	BASIN NUMBER	VOLUME REQUIRED (CF)	VOLUME PROVIDED (CF)	SEDIMENT BASIN SIZED PROPERLY
SEDIMENT BASIN	1	15,768	20,470	YES
SEDIMENT BASIN	2	19,512	20,470	YES
SEDIMENT BASIN	3	1,404	5,134	YES
SEDIMENT BASIN	4	8,748	11,853	YES
SEDIMENT BASIN	5	2,664	5,134	YES
SEDIMENT BASIN	6	9,648	11,853	YES
SEDIMENT BASIN	7	5,904	6,910	YES
SEDIMENT BASIN	8	17,820	20,470	YES
SEDIMENT BASIN	9	22,428	20,470	NO
SEDIMENT BASIN	10	16,704	20,470	YES
SEDIMENT BASIN	11	14,004	18,099	YES
SEDIMENT BASIN	12	5,544	6,910	YES
SEDIMENT BASIN	13	2,376	5,134	YES
SEDIMENT BASIN	14	2,628	5,134	YES
SEDIMENT BASIN	15	1,548	5,134	YES
SEDIMENT BASIN	16	8,388	11,853	YES
SEDIMENT BASIN	17	14,940	18,099	YES
SEDIMENT BASIN	18	3,888	5,134	YES
SEDIMENT BASIN	19	14,076	18,099	YES
SEDIMENT BASIN	20	4,212	5,134	YES
SEDIMENT BASIN	21	9,468	11,853	YES
SEDIMENT BASIN	22	8,892	11,853	YES
SEDIMENT BASIN	23	16,164	20,470	YES
SEDIMENT BASIN	24	4,896	5,134	YES
SEDIMENT BASIN	25	6,300	6,910	YES
SEDIMENT BASIN	26	4,716	5,134	YES
SEDIMENT BASIN	27	6,228	6,910	YES
SEDIMENT BASIN	28	10,872	15,162	YES
SEDIMENT BASIN	29	10,944	15,162	YES
SEDIMENT BASIN	30	15,156	18,099	YES
SEDIMENT BASIN	31	4,284	5,134	YES
SEDIMENT BASIN	32	4,284	5,134	YES
SEDIMENT BASIN	33	35,676	5,134	NO
SEDIMENT BASIN	34	10,656	15,162	YES
SEDIMENT BASIN	35	11,016	15,162	YES
SEDIMENT BASIN	36	4,356	5,134	YES
SEDIMENT BASIN	37	10,548	15,162	YES
SEDIMENT BASIN	38	9,972	11,853	YES
SEDIMENT BASIN	39	12,636	15,162	YES

Talon Pointe
Erosion Control Blanket - Shear Stress Calculations

Date: 05/12/2021

Shear Stress (lbs/sf) = 62.4 x D (ft) x S (ft/ft)

D = maximum flow depth for design* storm event
S = drainageway slope

* Design storm used for calculation is 5-year event.

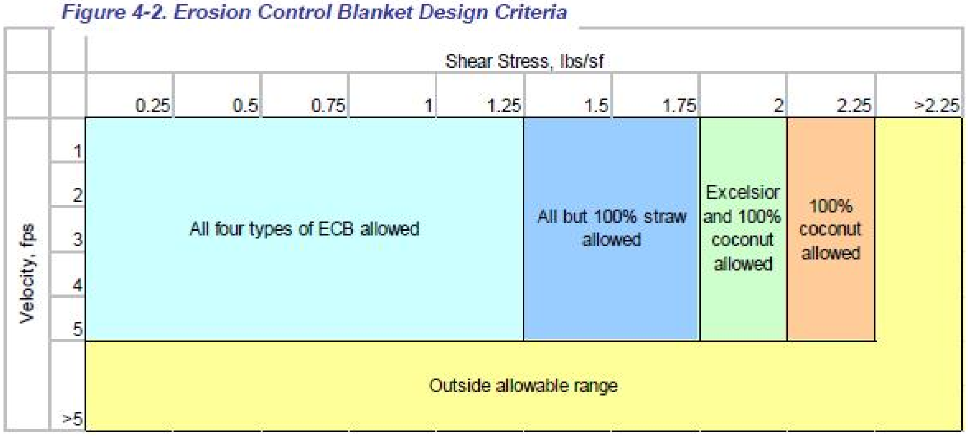
Shear Stress Calculations

Swale Location	5-Year Runoff (cfs)	D (ft)	S (ft/ft)	Velocity (ft/s)	Shear Stress (lbs/sf)	RECP Type
Swale B7	0.37	0.08	0.020	1.07	0.10	Straw/Coconut
Swale B8	12.13	0.58	0.020	3.34	0.72	Straw/Coconut
Swale B7 & B8 (combined)	12.50	0.59	0.020	3.37	0.74	Straw/Coconut

Table 4-2 Erosion Control Blanket Type

TYPE	COCONUT CONTENT	STRAW CONTENT	MIN. WEIGHT (lbs/sy)	MANNING'S N VALUE (varies with depth as shown)	ALLOWABLE MAX. SHEAR STRESS (lbs/sf)	ALLOWABLE MAX. VELOCITY (fps)
STRAW	0%	100%	0.5	0.018 for D>=2.0' 0.050 for D<=0.5'	Not allowed in drainageways or diversion ditches	
STRAW-COCONUT	30% MIN.	70% MAX.	0.5	0.018 for D>=2.0' 0.050 for D<=0.5'	1.75	5.0
COCONUT	100%	0%	0.5	0.018 for D>=2.0' 0.050 for D<=0.5'	2.25	5.0
EXCELSIOR	NA	NA	0.7	0.028 for D>=2.0' 0.066 for D<=0.5'	2.00	5.0

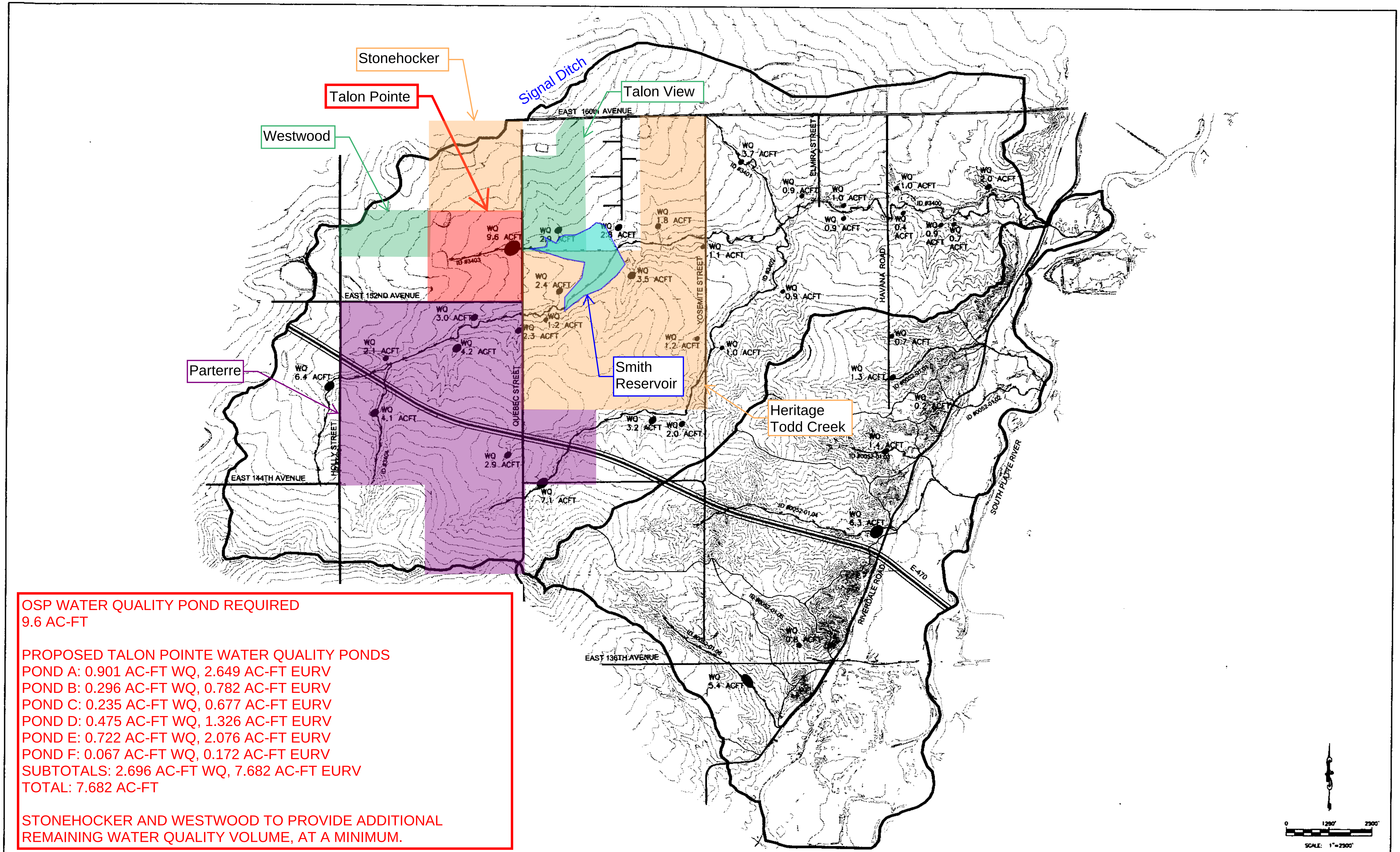
Figure 4-2. Erosion Control Blanket Design Criteria



APPENDIX F

Excerpts from Previous Drainage Reports

- OSP Water Quality Map with Surrounding Projects
- Todd Creek FHAD 1985
- Todd Creek OSP DFA 0052 2001
- Todd Creek OSP DFA 0052 2003
- Heritage Todd Creek Amendment 1 and 2 Final Drainage Report
- Quebec Street North Final Drainage Report
- Quebec Street South Final Drainage Report
- Talon View Drainage Report
- Westwood Final Drainage Report

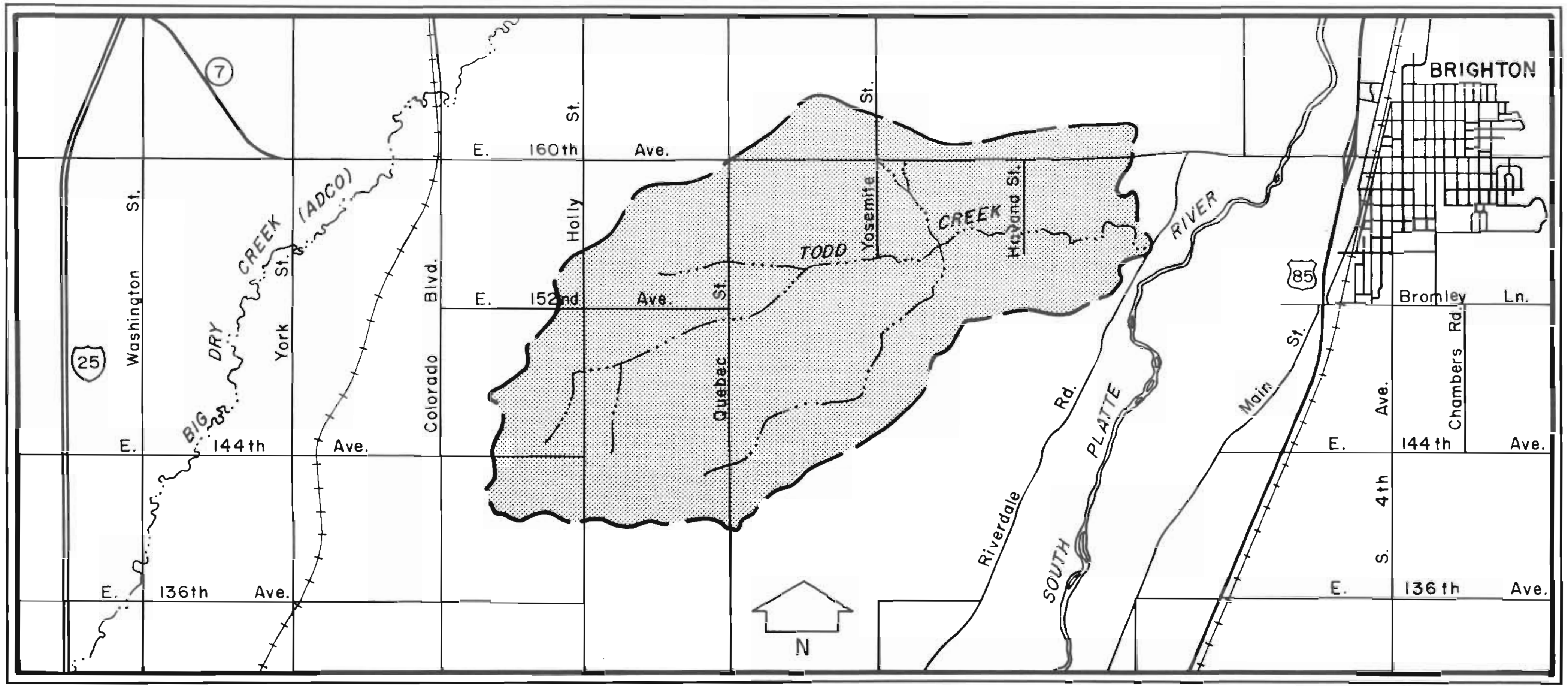


Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	WATER QUALITY BASINS	FIGURE VI-2

FLOOD HAZARD AREA DELINEATION

DECEMBER 1985

TODD CREEK



Urban Drainage And Flood Control District

Adams County

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

FLOOD HAZARD AREA DELINEATION

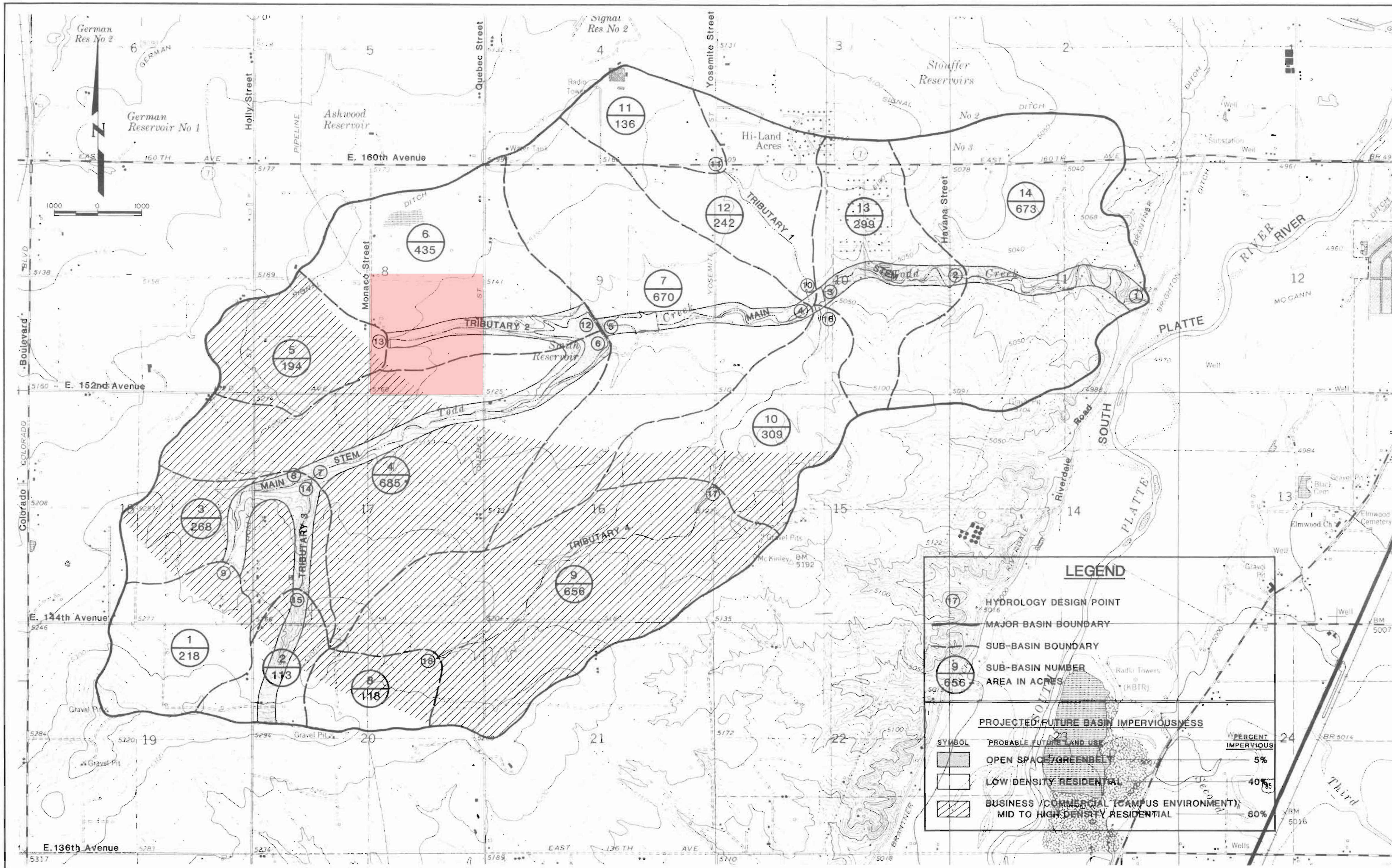
TODD CREEK

Prepared For:

Urban Drainage and Flood Control District
Adams County

Prepared By:

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340



BASE MAP UNITED STATES GEOLOGICAL SURVEY MAP BRIGHTON QUAD EASTLAKE QUAD	MULLER ENGINEERING COMPANY, INC. CONSULTING ENGINEERS 7000 WEST FOURTEENTH AVENUE LAKEWOOD, COLORADO 80215	DESIGNED CEL DATE 6/85; DRAWN BMG DATE 8/85; CHECKED CEL DATE 8/85; REVISED DATE	URBAN DRAINAGE AND FLOOD CONTROL DISTRICT ADAMS COUNTY, COLORADO	FLOOD HAZARD AREA DELINEATION TODD CREEK	FUTURE BASIN HYDROLOGY SUB-BASIN DELINEATION PERCENT IMPERVIOUS LAND USE	FIGURE 1

TABLE II

DRAINAGE BASIN PARAMETERS FOR CUHP

TODD CREEK

Sub-Basin	Area (mi^2)	L (mi)	L_{ca} (mi)	I_a*	Slope (ft/ft)	Detention Stg. Perv. (in)	Detention Stg. Imperv. (in)	f_i (in/hr)	f_o (in/hr)	α (sec^{-1})
1	.34	.83	.42	43	.032	.35	.05	3.50	.50	.0018
2	.18	.57	.34	40	.037	.35	.05	4.00	.60	.0018
3	.42	.85	.47	53	.022	.35	.10	3.75	.55	.0018
4	1.07	1.74	1.10	52	.016	.35	.10	3.00	.50	.0018
5	.30	.61	.40	58	.016	.35	.10	3.00	.50	.0018
6	.68	1.21	.64	37	.017	.35	.05	3.75	.55	.0018
7	1.05	1.67	.78	41	.016	.35	.05	3.75	.55	.0018
8	.18	.55	.28	53	.034	.35	.10	4.00	.60	.0018
9	1.03	1.67	.95	60	.019	.35	.10	3.50	.50	.0018
10	.48	1.23	.61	47	.022	.35	.05	3.50	.50	.0018
11	.21	.70	.42	40	.027	.35	.05	3.00	.50	.0018
12	.38	.95	.53	40	.024	.35	.05	3.75	.55	.0018
13	.47	.99	.47	37	.015	.35	.05	3.50	.50	.0018
14	1.05	1.69	.95	38	.011	.35	.05	3.75	.55	.0018

* I_a - percent impervious area for future basin conditions

upon a time distribution of rainfall recommended by the manual. Areal reductions of rainfall were applied to the most intense 15-minute period of the design storms based on Area-Depth Curves developed by NOAA. Table IV shows typical design storms used for hydrologic modeling and includes the areal rainfall adjustments.

Depression and detention storage values were obtained from the USDCM. Values of pervious detention were estimated at 0.35 inches and impervious detention varied from 0.05 inches to 0.1 inches.

Infiltration loss rates were estimated based on a preliminary inventory of soils prepared by the U.S.D.A. Soil Conservation Service (Reference 11). Infiltration losses were based on Horton's Equation:

$$f = f_o + (f_i - f_o)e^{-\alpha t}$$

where;

f = infiltration rate in inches/hour

f_i = initial infiltration rate in inches/hour

f_o = final infiltration rate in inches/hour

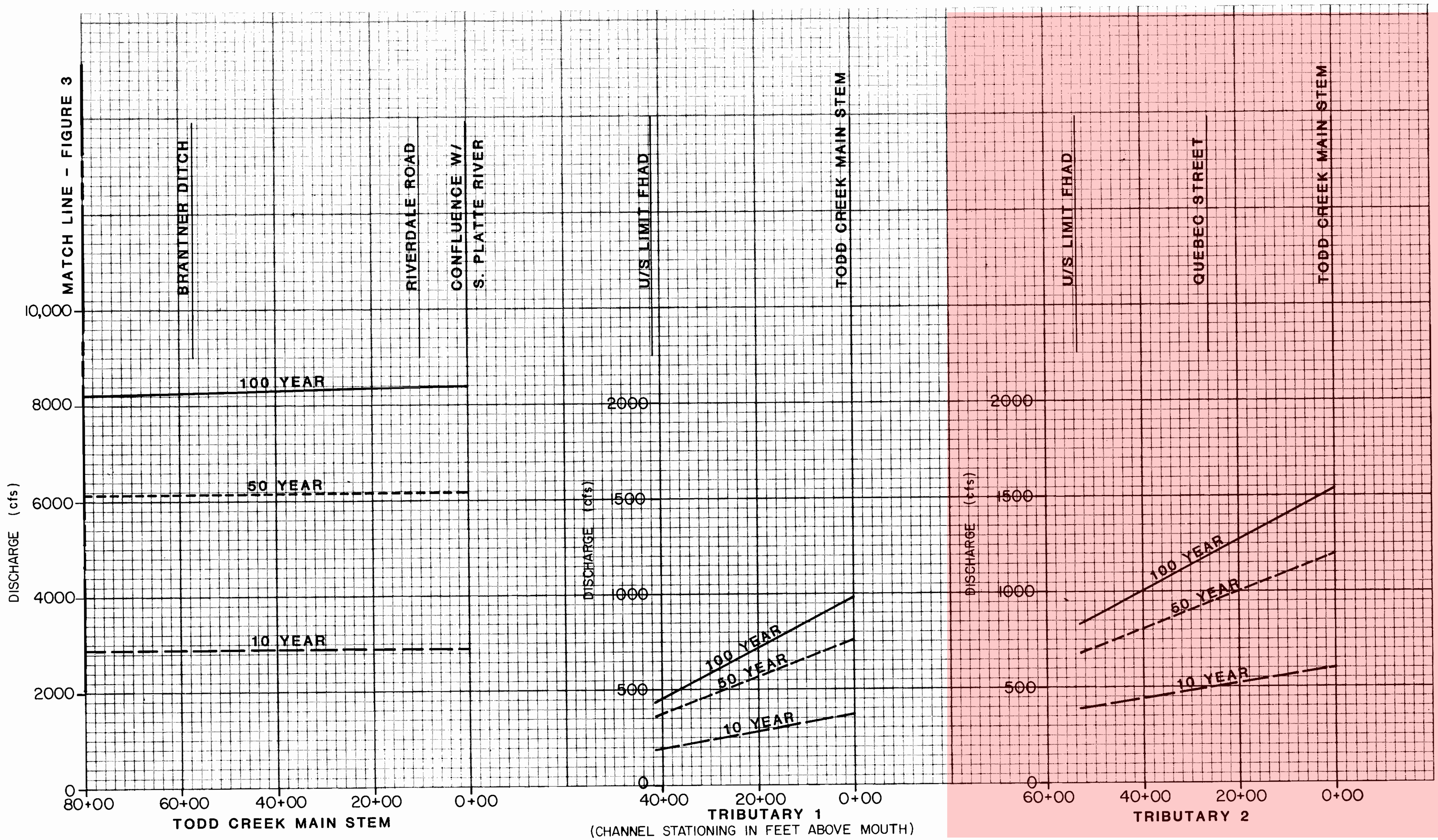
α = decay coefficient in per second units

t = time in seconds

The hydrology modeling results in Table I are also summarized in the form of discharge probability profiles (Figures 3 through 5) and 100-year flood hydrographs (Figures 6 and 7).

Hydraulic Analysis

A hydraulic analysis was completed along the channel of the studied streams to determine the water surface elevation for the 100-year runoff event. This hydraulic analysis was completed using the HEC-2 Water Surface Profile Computer Program developed by the U.S. Army Corps of Engineers (Reference 9).



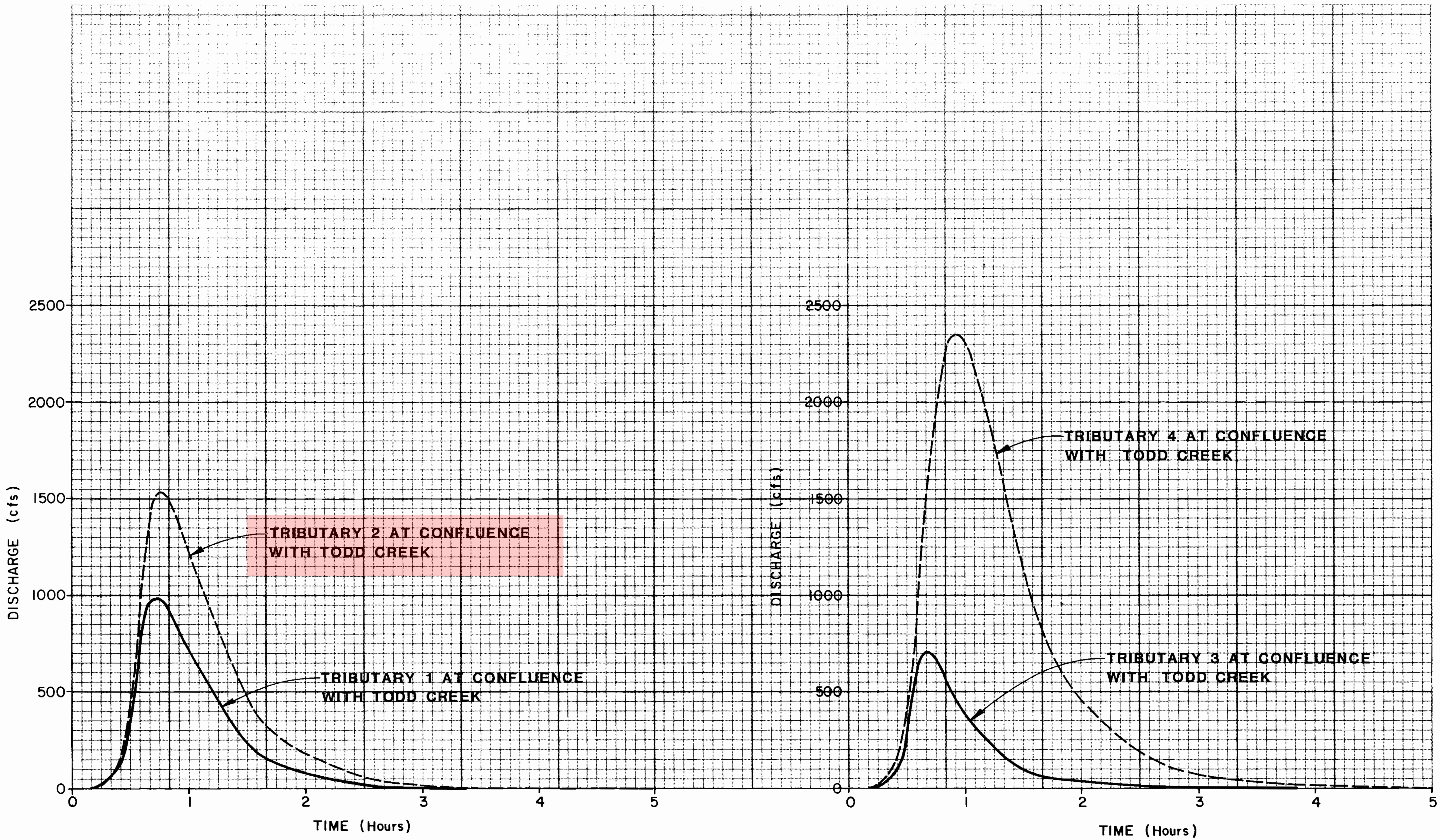
MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

BY CEL/BMG
CHKD CEL
DATE 9/85

URBAN DRAINAGE
& FLOOD CONTROL DISTRICT
ADAMS COUNTY

DISCHARGE PROBABILITY PROFILES
Todd Creek Main Stem
Tributary 1 & Tributary 2

FIGURE 4



MULLER ENGINEERING COMPANY, INC. CONSULTING ENGINEERS 7000 WEST FOURTEENTH AVENUE LAKEWOOD, COLORADO 80215 (303) 232-9340	BY CEL / JHK CHKD CEL DATE 6/85	URBAN DRAINAGE & FLOOD CONTROL DISTRICT ADAMS COUNTY	100-YEAR HYDROGRAPHS Todd Creek Tributaries 1 - 4	FIGURE 7

The existing topography in this area also creates problems. A flow split will occur at Riverdale Road, in which some flow will travel over the Brighton Ditch embankment directly into the South Platte River, and the remainder will travel northward along the west side of Riverdale Road. This confluence area has been analyzed two ways. The first method assumes all Todd Creek flow is conveyed directly into the South Platte River. The second method identifies that portion of the flow split traveling north along the west side of Riverdale Road. Floodplain limits for both methods are shown to the extent of the mapping limits. Refer to Sheets 13 and 25.

Tributary 1: The study reach for Tributary 1 begins at its confluence with the main stem (Cross Section No. 1.10) and ends just below the intersection of East 160th Avenue and Yosemite Street (Cross Section No. 1.25). Floodplain limits and the water surface profile for this reach are shown on Sheets 9 and 14.

The single stream crossing in this reach consists of a dirt access road near the upstream study limit. The narrow floodplain is generally well confined within the existing channel. The stream slope is generally steep (about 2%) and will result in high velocities and erosion during flood flows. Development along Tributary 1 is almost completely agricultural. A few oil and gas well installations are present, but located out of the floodplain. A small rural farming cluster is located near the upper study limit.

Two specific problem areas along Tributary 1 are discussed following:

1. A flow split may occur at the upper study limit. Field investigations of the area past the mapping limits indicate that floodwaters reaching the northwest corner of the East 160th Avenue and Yosemite Street intersection will likely split. A portion of the flow would travel over the intersection and head southeastward in the historic drainage pattern. The remainder of the flow would travel east along the north side of East 160th Avenue about 900 feet to the low point in the road. At this point, floodwaters would cross the road through a culvert and by overtopping and travel southward in a distinct swale. The flows would combine in an irrigation reservoir about 1500 feet downstream of the original flow split. Refer to Sheet 14.

2. The small online irrigation reservoir may be subject to severe spillway erosion. The embankment does not overtop, and because all flow is confined to the narrow spillway, the water surface rises about three feet above that level shown on the date of survey. No residential flooding occurs as a result of this rise, however. Refer to Sheet 14.

Tributary 2: The study reach for Tributary 2 begins at it confluence with the main stem (Cross Section No. 2.10) and ends immediately upstream of Monaco Street (Cross Section No. 2.24). Floodplain limits and the water surface profile for this reach are shown on Sheets 6, 15, and 16.

Stream crossings in this reach include Monaco Street and Quebec Street. The floodplain for this reach is generally well confined to the channel when not influenced by small reservoirs or streets. The average stream slope exceeds 1.5 percent, and will likely produce high velocities and erosion during flood flows.

Development along Tributary 2 is completely agricultural with the exception of a few oil and gas wells and related storage facilities. No residential development exists adjacent to this reach. With the exception of the two streets, a small online reservoir, and some minor earthwork in a storage yard just west of Quebec Street, the Tributary 2 floodplain has experienced no significant encroachment.

The following paragraphs describe specific problem areas along Tributary 2:

1. Both Monaco Street and Quebec Street are overtopped by 1 and 1.5 feet, respectively. Both overtoppings result from inadequate drainage culverts. Debris blockage is probably of greater concern for the smaller frequency events because the culvert capacities are very small compared to the 100-year flows. Both stream crossings are gravel roads, and therefore erosion and road washout potential from overtopping is high. Refer to Sheets 15 and 16.

2. A small online reservoir exists just east of Monaco Street. The spillway for this reservoir is inadequate and in poor condition. The backwater created by this condition causes a rise in the water surface of about 6 feet above that level shown on the date of survey. Although the embankment is not overtopped, erosion potential is high. A small metal shed on the north side of the reservoir will sustain shallow flooding. Refer to Sheet 15.

Tributary 3: The study reach for Tributary 3 begins at its confluence with the main stem (Cross Section No. 3.10) and ends about 900 feet downstream of East 144th Avenue (Cross Section No. 3.15). Floodplain limits and the water surface profile are shown on Sheets 3 and 17.

No stream crossings exist along the study reach of Tributary 3. The floodplain for this reach is well confined to the channel. The average stream slope approaches two percent and will likely produce high velocities and erosion during major events.

Development along Tributary 3 is mostly in the form of agricultural use, with some scattered areas of native begetation on undeveloped land. No significant floodplain encroachment has occurred along this study reach.

Tributary 4: The study reach for Tributary 4 begins at its confluence with the main stem (Cross Section No. 4.10) and ends 1100 feet upstream of Quebec Street (Cross Section No. 4.55). Floodplain limits and the water surface profile of this reach are shown on Sheets 9 and 18 through 22.

Stream crossings in this reach include Quebec Street, East 144th Avenue, Yosemite Street and a private road just upstream of Yosemite Street. The stream slope ranges from about 1.6 percent in the upper reach to less than 1 percent near the confluence with the main stem.

Development along Tributary 4 is primarily agricultural. A few oil and gas wells are located in and adjacent to the stream. Except for the streets, three old existing reservoir embankments, and some apparent minor grading work around one of the well facilities, no significant floodplain encroachment has occurred along the 2.7 mile study reach.

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft.)	FLOODWAY WIDTH[3] RIGHT (Ft.)	FLOODWAY WIDTH[3] TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
Upstream Study Limit	97	310+00	750	5234.5	5237.2	155	6.7	22	28	50	6.7	5237.5
	96	307+00	820	5226.1	5232.5	480	0.5			*		
Reservoir Embankment	95	304+75	820	5230.3	5232.1	630**	2.1			*		
	94	303+60	820	5217.7	5219.7	130++	6.6	30	28	58	6.7	5220.1
	93	298+05	880	5204.6	5206.7	125	6.8	36	22	58	7.8	5206.9
	92	293+00	1000	5194.6	5197.9	120	4.9	40	20	60	5.0	5198.3
	91	287+35	1000	5182.3	5196.5	480	0.4	66	39	105	0.8	5196.9
	90	287+20	1040	5180.3	5196.5	315	0.6	48	52	100	0.9	5196.9
Holly Street	89	285+30	1040	5179.4	5196.4	300	0.6	52	58	110	0.7	5196.9
	87	283+80	1040	5176.7	5180.9	70	7.0	21	19	40	7.0	5181.2
	86	278+10	1100	5169.2	5171.9	60	8.6	18	29	47	9.0	5172.0
	85	271+50	1180	5159.2	5162.6	100	5.6	47	17	64	5.6	5163.0
Confluence Trib #3	84	266+00	1950	5154.1	5158.2	185	5.9	74	42	116	5.8	5158.5
	83.1	263+00	2030	5148.3	5154.6	170	11.7	63	39	102	6.6	5155.0
	83	259+82	2030	5146.3	5150.4	145	7.7	42	44	86	7.8	5150.6
	82	259+00	2030	5145.4	5148.8	115	8.5	50	30	80	8.7	5148.8
	81	254+00	2210	5139.2	5143.2	160	5.9	57	47	104	5.6	5143.7
	80	253+63	2210	5136.8	5142.5	210	8.3	52	38	90	7.7	5142.7
	79	247+30	2210	5130.8	5135.1	175	7.0	99	13	112	6.5	5135.5
	78	242+70	2210	5127.7	5130.7	215	5.5	21	103	124	5.9	5131.0
	77	235+93	2410	5118.6	5122.4	155	9.5	37	48	85	8.3	5122.9
	76	229+60	2410	5110.5	5116.2	175	6.6	30	73	103	6.1	5116.6
Quebec Street	75	225+20	2410	5106.7	5114.7	340	4.2	45	95	140	3.4	5115.1
	73	224+05	2410	5106.5	5112.0	185	7.2	34	71	105	5.7	5112.4
	72	218+00	2640	5103.1	5108.5	180	6.7	92	22	114	5.5	5108.8

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

** Width includes island area(s) and/or other high ground between outer floodplain boundaries
* Floodway width = floodplain width
++ Width includes spillway floodplain

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT

FLOOD HAZARD AREA DELINEATION

ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA

TODD CREEK MAIN STEM

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft.)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
	71	212+30	2640	5099.7	5104.2	170	7.7	25	72	97	6.3	5104.7
	70	208+10	2640	5097.9	5103.0	305	3.2	120	40	160	3.6	5103.1
	69	203+00	2640	(5097.0)	5102.6	300	2.0			*		
	68	198+00	2800	(5096.0)	5102.4	415	1.3			*		
	67	192+70	2800	(5095.0)	5102.4	1460	0.7			*		
Confluence Trib #2	66	187+10	4310	(5093.0)	5102.4	1360	0.8			*		
Reservoir Embankment	65	186+20	4310	5098.2	5101.2	1420**	8.1			*		
	64	184+80	4480	5074.2	5079.8	160+	10.8			*		
	63	179+00	4480	(5070.0)	5079.2	300#	2.0			*		
	62	173+15	4480	(5068.0)	5079.2	630	0.9			*		
Reservoir Embankment	61	172+45	4480	5071.2	5078.4	675	7.7			*		
	60	172+00	4590	5062.2	5067.0	480++	7.6	83	43	126	8.2	5067.2
	59	167+85	4590	5057.8	5063.7	230	7.9	117	53	170	6.4	5064.1
	58	163+45	4590	5055.7	5061.3	310	6.5	46	112	158	6.2	5061.7
Yosemite Street	57	158+90	4780	5051.7	5059.1	320	6.4	150	50	200	5.2	5059.6
	55	157+80	4780	5051.5	5056.2	220	8.3	114	30	144	8.1	5056.5
	54	153+25	4780	5047.0	5052.9	340	5.5	44	181	225	5.2	5053.1
	53	147+50	4780	5042.7	5049.6	240	7.9	123	37	160	6.7	5049.9
	52	143+10	4970	5039.9	5047.0	230	7.6	44	118	162	7.0	5047.1
	51	139+35	4970	5037.6	5045.7	300	5.4	125	56	181	5.1	5045.8
	50	136+00	4970	(5035.6)	5044.3	380	4.7			*		
Confluence Trib #1, #4	49	128+20	8040	(5033.0)	5043.7	515	1.9			*		
Reservoir Embankment	48	127+80	8040	5039.3	5042.7	500	8.3			*		
	47	127+25	8130	5027.4	5036.2	445++	5.6	322	16	338	5.9	5036.6
	46	122+00	8130	5025.9	5034.9	220	7.6	65	105	170	6.8	5035.3

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

++ Includes spillway floodplain
() Estimated reservoir bottom
** Width includes island area(s) and/or other high ground between outer floodplain boundaries
+ Width does not include spillway floodplain
* Floodway width = floodplain width
# Does not include ineffective flow area in right overbank

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK MAIN STEM

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
	45	118+60	8130	5022.3	5034.5	320@	5.2	120	48	168	5.2	5034.8
Elmira Drive	44	114+20	8130	5022.2	5033.8	260	6.2	60	180	240	4.6	5034.3
	42	113+40	8130	5020.4	5030.4	200	10.6	51	104	155	8.7	5030.6
	41	110+95	8130	5015.4	5029.8	220	8.6	28	77	105	9.0	5029.5
	40	106+90	8130	5013.2	5027.5	155	12.3	90	42	132	8.8	5027.8
	39	101+90	8130	5012.6	5024.3	305	13.6	33	152	185	9.9	5024.4
	38	97+10	8130	5011.2	5021.1	230	12.2	133	30	163	9.7	5021.4
	37	89+80	8130	5008.4	5018.6	255	8.2	34	144	178	7.1	5018.9
Havana Street	36	86+00	8220	5006.6	5018.0	330	5.4	205	57	262	4.2	5018.5
	34	85+05	8220	5005.2	5016.0	400	5.4	240	25	265	4.2	5016.4
	33	80+50	8220	5002.2	5012.6	175	14.8	38	85	123	11.9	5013.0
	32	76+90	8220	4999.6	5011.3	310	6.5	218	18	236	5.5	5011.7
	31	72+70	8220	4998.1	5008.7	170	10.1	75	34	109	9.4	5009.0
	30	66+05	8220	4994.2	5005.9	245	10.1	68	97	165	7.9	5006.3
	29	61+50	8220	4994.2	5004.9	255	7.3	55	108	163	6.4	5005.3
Road Crossing	28	59+15	8220	4993.9	5004.7	325	4.5	112	71	183	4.8	5005.1
	26	58+70	8220	4990.8	5001.1	220	9.4	82	50	132	9.2	5001.2
Irrigation Flume for	25	57+15	8220	4988.2	5000.6	140#	8.1	36	66	102	8.5	5000.6
Brantner Ditch	23	56+75	8220	4987.8	4998.8	125	13.1	50	48	98	10.8	4999.3
	22	54+40	8220	4986.6	4998.3	230	8.1	135	65	200	6.5	4998.7
	21	48+60	8310	4984.6	4997.3	260	7.0	100	120	220	5.9	4997.7
	20	44+10	8310	4983.8	4995.6	205	9.1	118	28	146	8.0	4995.9
	19	38+85	8310	4982.4	4993.9	385	7.9	76	217	293	6.0	4994.4
	18	31+05	8310	4980.9	4992.4	460**	6.5	168	112	280	5.5	4992.7
	17	27+35	8310	4981.2	4992.4	505	2.7	260	45	305	3.3	4992.6

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

@ Cross section does not extend to high ground
# Does not include ineffective flow area in right overbank
** Width includes island areas and/or other high ground between outer floodplain boundaries

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK MAIN STEM

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
								FLOODWAY WIDTH[3]				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	LEFT (Ft.)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
	16	24+05	8310	4980.5	4992.3	580	1.8	168	132	300	2.9	4992.5
Breached Embankment	15	20+20	8310	4977.0	4988.9	475**	13.4	180	58	238	13.4	4988.7
	14.1	18+50	8310	4972.5	4982.8	520**	12.9	278	28	306	12.3	4983.0
	14	15+30	8340	4970.0	4980.4	320	5.9	161	62	223	6.9	4980.5
	13	12+50	8340	4968.6	4977.6	275##	9.3	170	70	240	9.3	4977.7
	12	11+00	8360	4966.2	4975.9	400##	7.6	260	65	325	6.3	4976.4
Riverdale Road	11	10+10	8360	4966.0	4975.6	620	2.9	365	82	447	4.0	4976.1
	9	9+55	8360	4964.6	4974.4	665	1.1	438	52	490	1.8	4974.6
Brighton Ditch	8	9+20	8360	4964.6	4974.4	960	1.4	456	115	571	1.8	4974.6

1 Distance in feet above confluence
2 Mean velocity in channel
3 From center of channel looking downstream
4 Mean velocity in floodway

** Width includes island areas and/or other high ground between outer floodplain boundaries
Width does not include shallow flooding areas

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK MAIN STEM

TABLE V

FLOODING SOURCE			100-YEAR FLOODPLAIN DATA					FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft.)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
Upstream Study Limit	1.25	40+85	430	5105.5	5106.4	170	3.7	100	10	110	3.7	5106.7
East 160th Avenue	1.24	39+00	430	5101.6	5103.0	95	6.4	9	39	48	6.5	5103.2
	1.23	36+05	430	5093.9	5095.6	55	5.3	16	26	42	5.4	5096.0
Road Crossing	1.22	34+60	560	5092.1	5094.2	115	2.5	30	30	60	4.6	5094.5
	1.20	34+25	560	5088.8	5091.2	65	6.2	11	25	36	6.1	5091.6
	1.19	30+00	560	5080.0	5082.2	50	7.5	22	13	35	8.1	5082.4
	1.18	27+00	680	5076.7	5080.1	100	2.4			*		
	1.17	22+45	680	(5070.0)	5079.8	350	0.4			*		
Reservoir Embankment	1.16	21+80	680	5073.1	5078.1	30@@	9.2			*		
	1.15	21+20	800	5064.3	5066.8	90+	6.3	13	32	45+	6.7	5067.1
	1.14	17+90	800	5059.2	5060.8	110	5.8	60	16	76	6.4	5061.1
	1.13	13+50	800	5050.2	5053.7	85	5.0	15	37	52	5.0	5054.1
	1.12	9+65	940	5045.9	5048.9	70	8.4	20	17	37	9.4	5048.9
	1.11	6+00	940	5040.3	5044.2	130	3.2	16	34	50	5.0	5044.5
	1.10	3+55	940	5037.3	5044.0	295	1.2			*		
Upstream Study Limit	2.24	53+20	830	5155.4	5158.9	505	0.9	43	117	160	1.5	5159.4
Monaco Street	2.22	52+50	830	5154.0	5158.8	595	0.5	150	250	400	0.5	5158.8
	2.21	48+80	830	5152.0	5158.8	820	0.5			*		
Reservoir Embankment	2.20	48+25	830	5157.2	5158.5	830**	4.3			*		
	2.19	47+75	830	5147.7	5149.8	200+	4.9	58	14	72	5.9	5150.0
	2.18	42+00	920	5139.0	5141.9	150	5.8	40	25	65	5.5	5142.3
	2.17	36+00	1010	5130.3	5133.0	90	6.3	38	22	60	8.1	5133.0

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

() Estimated reservoir bottom
@@ Floodplain confined to spillway
\+ Width does not include spillway floodplain
* Floodway width = floodplain width
** Width includes island areas and/or other high ground between outer floodplain boundaries

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK TRIBUTARIES 1 & 2

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
	2.16	31+00	1080	5120.0	5122.6	65	8.5	27	35	62	6.7	5123.1
Quebec Street	2.15	26+20	1160	5113.8	5119.8	185	2.7	30	70	100	2.4	5120.1
	2.13	25+35	1160	5112.4	5114.5	120	5.5	54	26	80	6.3	5114.8
	2.12	20+50	1300	5101.3	5104.3	80	8.8	38	15	53	9.2	5104.3
	2.11	16+00	1300	(5097.0)	5102.5	185	1.9			*		
	2.10	10+00	1470	(5095.0)	5102.4	550	0.5			*		
Upstream Study Limit	3.15	26+25	420	5206.4	5209.0	50	5.9	10	15	25	6.4	5209.3
	3.14	22+85	460	5201.2	5203.6	55	5.4	8	28	36	5.9	5203.9
	3.13	17+80	520	5191.3	5193.5	50	6.7	16	14	30	7.8	5193.7
	3.12	13+35	570	5182.3	5184.0	100	5.4	20	34	54	5.9	5184.3
	3.11	6+80	640	5170.3	5173.2	75	5.4	10	30	40	6.1	5173.5
	3.10	1+75	700	5160.8	5163.5	90	6.0	26	24	50	7.7	5163.7
Upstream Study Limit	4.55	145+00	500	5202.0	5204.1	70	7.7	25	15	40	7.3	5204.1
	4.54	144+00	530	5198.4	5201.1	65	7.5	11	23	34	7.0	5201.3
	4.53	139+50	620	5192.1	5194.6	70	8.3	23	20	43	7.6	5194.7
	4.52	134+50	750	5188.5	5191.6	260	2.4	25	55	80	3.5	5191.9
Quebec Street	4.51	134+15	750	5185.4	5191.5	210	2.8	32	48	80	2.8	5191.9
	4.49	133+30	750	5184.9	5185.3	150	2.4	68	30	98	6.2	5185.7
	4.48	132+90	750	5182.1	5184.2	120	4.2	76	9	85	5.6	5184.6
	4.47	127+75	890	5175.9	5178.5	110	6.6	17	54	71	5.9	5178.8
	4.46	125+80	890	5173.7	5175.6	120	5.5	22	61	83	7.0	5175.9

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

* Floodway width = floodplain width
() Estimated reservoir bottom

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK TRIBUTARIES 2,3, & 4

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION[1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL.[2] (FPS)	FLOODWAY WIDTH[3] LEFT (Ft.)	RIGHT (Ft.)	TOTAL (Ft.)	VEL.[4] (FPS)	FLOODWAY ELEV. (MSL)
	4.45	124+25	980	5168.1	5170.9	90	8.2	30	22	52	7.5	5171.2
	4.44	121+00	980	5164.1	5166.2	110	7.2	47	18	65	7.7	5166.5
	4.43	116+00	1100	5154.2	5157.5	65	9.9	32	12	44	8.9	5157.7
	4.42	109+30	1210	5146.6	5152.0	240	2.9	35	15	50	5.7	5152.0
	4.41	109+20	1330	5143.0	5152.0	240	3.1	35	15	50	4.8	5152.0
Breached Embankment	4.40	108+60	1330	5142.0	5149.3	30	11.6	14	14	28	11.6	5149.3
	4.39	108+10	1330	5142.0	5145.9	130#	9.7	18	28	46	9.2	5146.0
	4.38	104+20	1330	5135.1	5143.7	115	2.1	32	38	70	2.5	5144.1
	4.36	103+30	1330	5135.4	5139.1	90	5.7	41	16	57	6.2	5139.3
	4.35	96+50	1480	5130.1	5132.9	130	8.1	14	65	79	7.4	5133.3
	4.34	92+20	1550	5123.1	5126.4	125	7.1	18	51	69	7.3	5126.7
	4.33	84+80	1700	5113.8	5117.2	100	8.9	44	14	58	9.2	5117.5
	4.32	79+50	1800	5107.4	5112.6	140	6.2	34	46	80	5.9	5113.0
	4.31	75+65	1950	5106.8	5110.2	245	6.9	130	20	150	6.2	5110.5
	4.30	72+00	1950	5103.0	5106.1	140	7.6	22	66	88	8.1	5106.4
	4.29	68+00	2040	5098.1	5102.8	165	5.9	65	32	97	5.6	5103.2
Road Crossing	4.28	67+25	2040	5098.8	5101.6	155	7.5	45	55	100	8.7	5101.8
	4.27	65+30	2190	5093.9	5098.5	110	7.4	17	54	71	7.1	5098.9
Yosemite Street	4.26	59+45	2190	5090.7	5094.2	155	5.6	62	32	94	7.8	5094.3
	4.25	58+35	2270	5088.0	5092.3	115	10.1	74	15	89	9.4	5092.3
	4.24	52+15	2270	5082.6	5086.9	160	6.0	77	21	98	6.0	5087.3
Road Crossing	4.23	47+75	2270	5080.2	5082.9	210	7.3	48	61	109	8.8	5083.1
	4.22	47+10	2270	5078.6	5081.8	225	5.6	60	51	111	6.6	5082.1
	4.21	43+00	2270	5074.4	5077.4	160	8.2	81	14	95	8.1	5077.9
	4.20	39+50	2270	5068.8	5073.6	140	7.9	36	31	67	9.2	5073.6

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

Does not include ineffective flow area in right overbank

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK TRIBUTARY 4

TABLE V

FLOODING SOURCE				100-YEAR FLOODPLAIN DATA				FLOODWAY DATA				
IDENTIFICATION	CROSS SECTION	STATION [1]	100 yr. DISCHARGE (CFS)	THALWEG ELEV. (MSL)	FLOOD ELEV. (MSL)	FLOODPLAIN WIDTH (Ft.)	VEL. [2] (FPS)	FLOODWAY WIDTH [3] LEFT (Ft)	RIGHT (Ft.)	TOTAL (Ft.)	VEL. [4] (FPS)	FLOODWAY ELEV. (MSL)
	4.19	34+95	2270	5067.2	5072.6	190	3.5			*		
Reservoir Embankment	4.18	34+25	2270	5068.7	5071.5	575	7.0			*		
	4.17	30+00	2270	5058.5	5063.2	115	8.5	8	65	73	8.3	5063.5
	4.16	25+00	2350	5053.2	5058.4	95	9.5	24	31	55	9.2	5058.5
	4.15	20+00	2350	5048.4	5054.0	130	9.1	22	48	70	8.3	5054.3
	4.14	17+00	2350	5046.0	5050.6	105	9.6	24	51	75	9.9	5050.6
	4.13	16+80	2350	5042.9	5050.3	100	10.8	21	44	65	9.0	5050.3
	4.12	13+00	2350	5041.4	5046.2	80	10.6	42	23	65	9.7	5046.3
	4.11	9+45	2350	5038.8	5044.8	230	5.4	23	104	127	5.8	5044.8
	4.10	4+10	2350	5037.8	5044.0	160	3.3			*		

1 Distance in feet above confluence
2 Mean velocity in channel
3 From channel station line looking downstream
4 Mean velocity in floodway

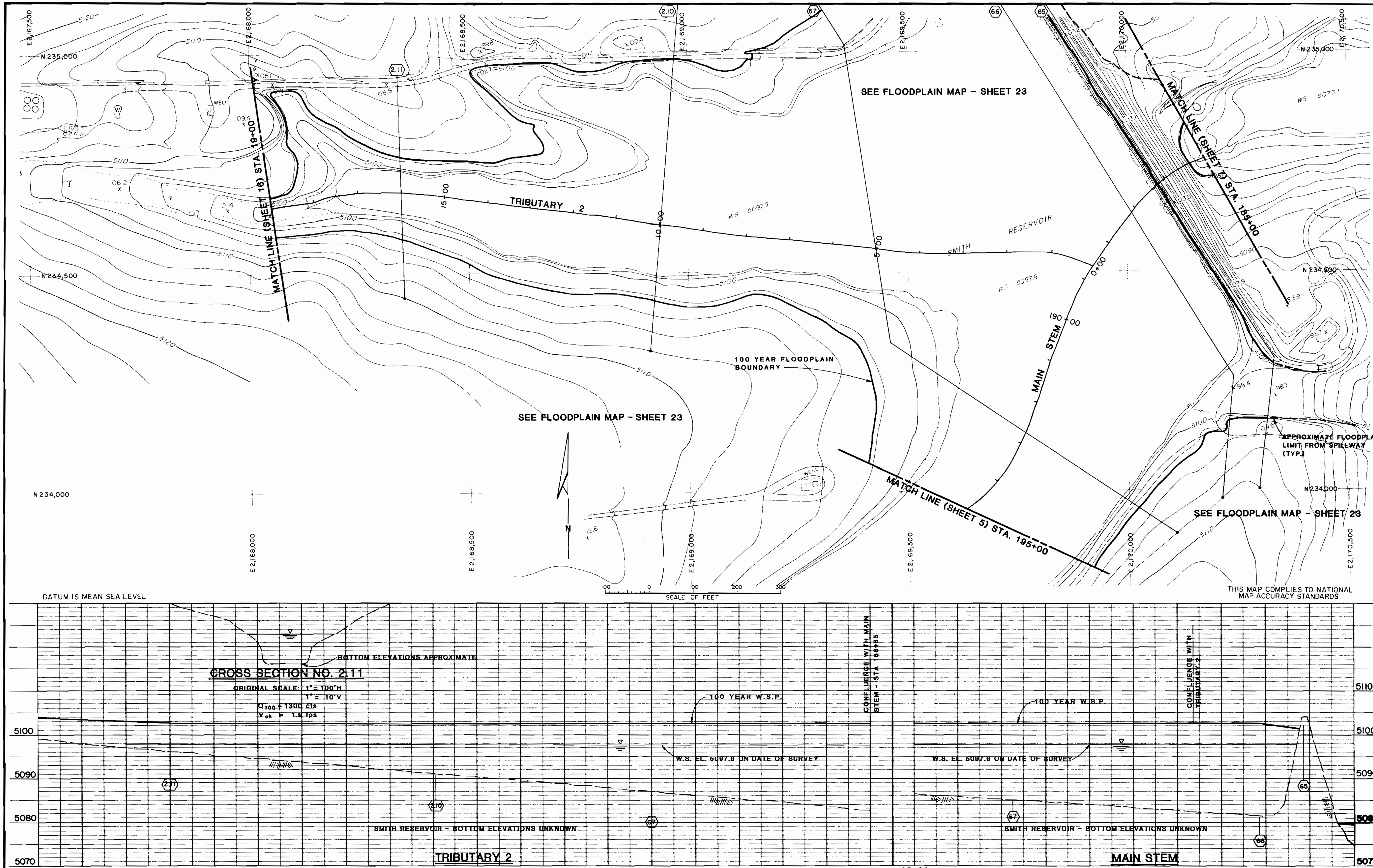
* Floodway width = floodplain width

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
FLOOD HAZARD AREA DELINEATION
ADAMS COUNTY, COLORADO

FLOODPLAIN AND FLOODWAY REFERENCE DATA
TODD CREEK TRIBUTARY 4

TABLE V



GROUND CONTROL SURVEY,
AERIAL PHOTOGRAPHY: JAN.6,1985
TOPOGRAPHIC MAPPING BY,
CONTOUR INTERVAL: 2 FT.

Delta Aerial Surveys, Inc.
2345 SO. FEDERAL BLVD, SUITE 195
DENVER, COLORADO, 80219

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

DESIGNED	CEL, ADS	DATE	9/85
DRAWN	JHK, BMG	DATE	9/85
CHECKED	LAM	DATE	12/85
REVISED		DATE	

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ADAMS COUNTY, COLORADO

FLOOD HAZARD AREA DELINEATION

TODD CREEK

PLAN AND PROFILE

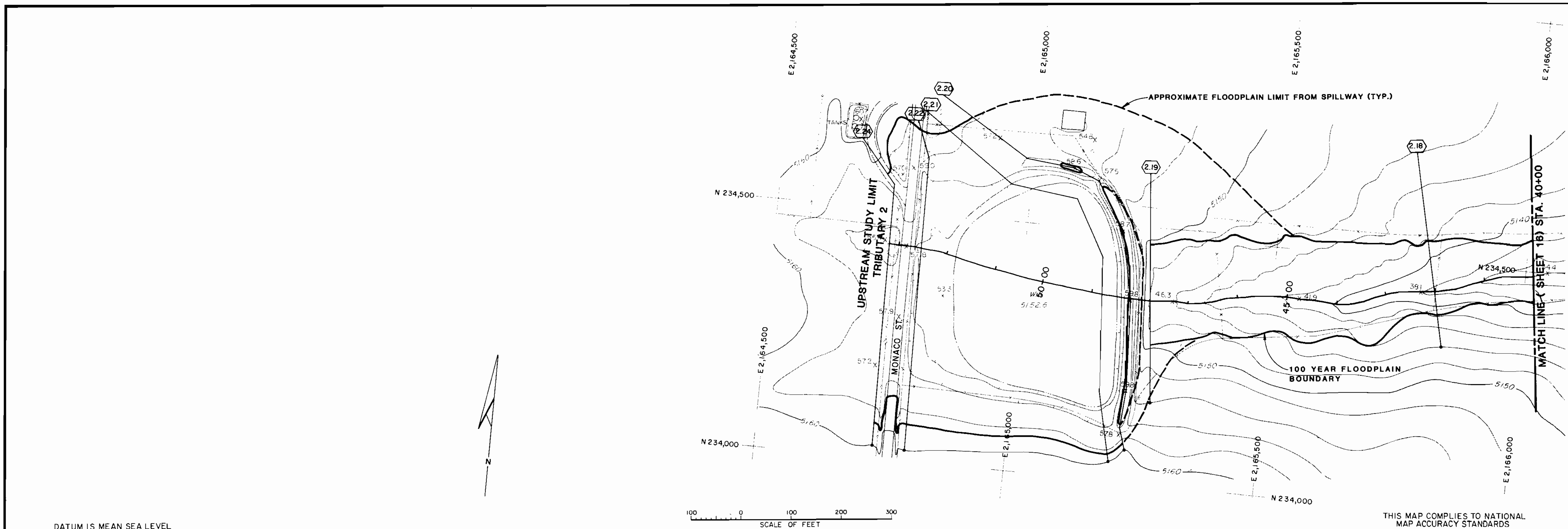
MAIN STEM - Sta 195+00 to Sta 185+00

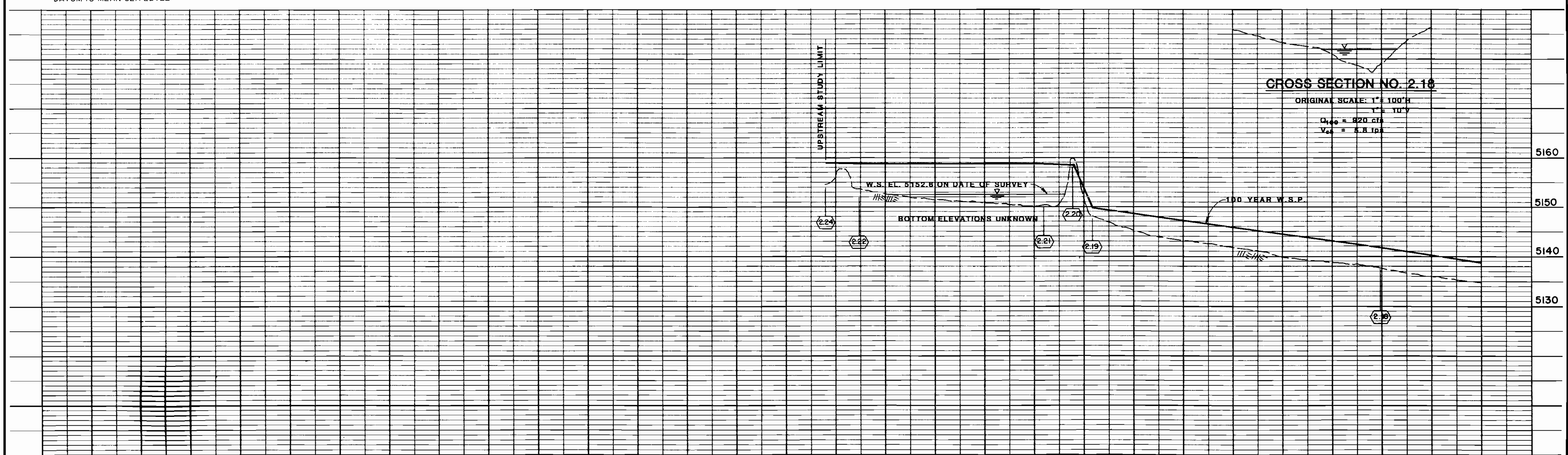
TRIBUTARY 2 - Sta 19+00 to Sta 0+00

DRAWING NO. ____

SHEET 6 OF 25

MEC JOB NO. 8515





GROUND CONTROL SURVEY;
AERIAL PHOTOGRAPHY: JAN.6,1985
TOPOGRAPHIC MAPPING BY;
CONTOUR INTERVAL = 2 FT.

Delta Aerial Surveys, Inc.
2345 SO. FEDERAL BLVD, SUITE 195
DENVER, COLORADO, 80219

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

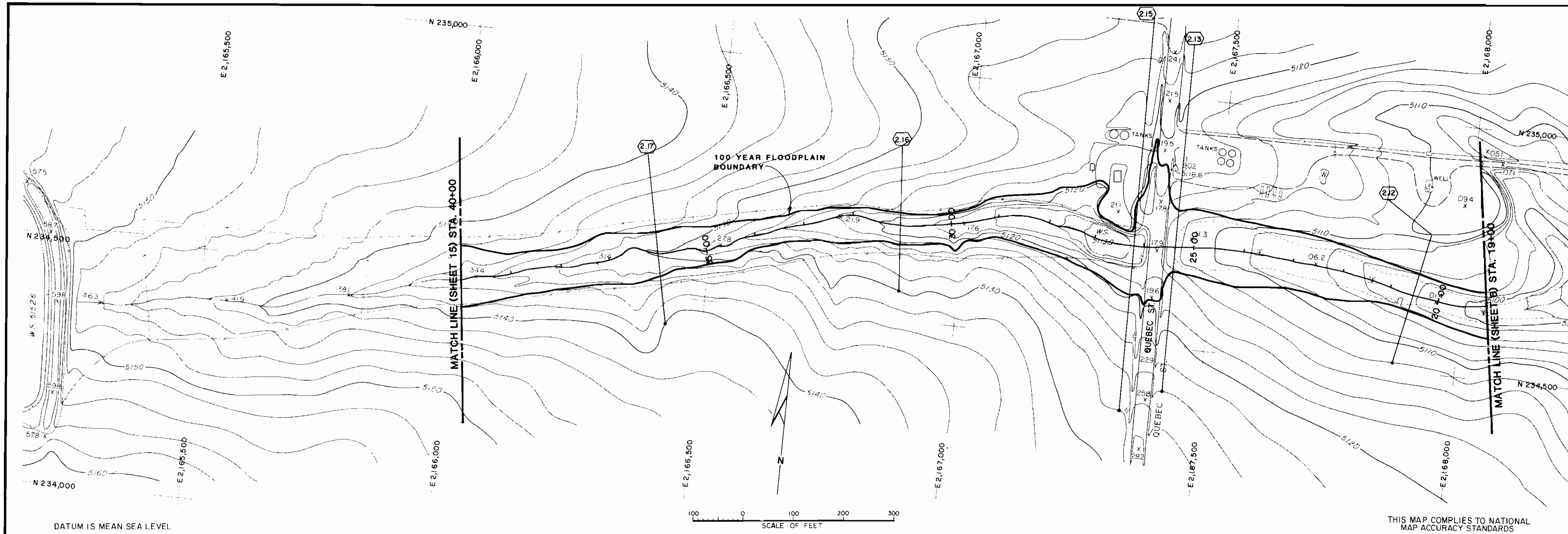
DESIGNED CEL, ADS DATE 9/85
DRAWN JHK, BMG DATE 9/85
CHECKED LAM DATE 12/85
REVISED DATE

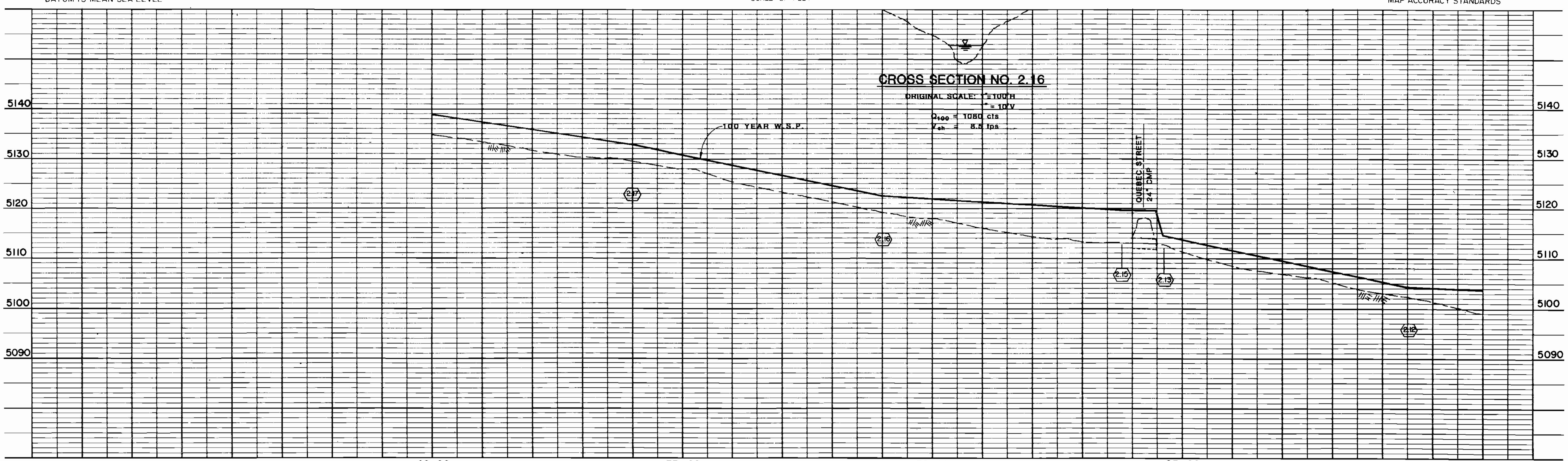
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
ADAMS COUNTY, COLORADO

FLOOD HAZARD AREA DELINEATION
TODD CREEK

PLAN AND PROFILE
TRIBUTARY 2
Sta 53+20 to Sta 40+00

DRAWING NO.
SHEET 15 OF 25
MEC JOB NO. 8515





GROUND CONTROL SURVEY;
AERIAL PHOTOGRAPHY: JAN. 6, 1985
TOPOGRAPHIC MAPPING BY,
CONTOUR INTERVAL = 2 FT.

Delta Aerial Surveys, Inc.
2345 SO. FEDERAL BLVD, SUITE 195
DENVER, COLORADO, 80219

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

DESIGNED	CEL, ADS	DATE	9/85
DRAWN	JHK, BMG	DATE	9/85
CHECKED	LAM	DATE	12/85
REVISED		DATE	

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ADAMS COUNTY, COLORADO

FLOOD HAZARD AREA DELINEATION

TODD CREEK

PLAN AND PROFILE
TRIBUTARY 2
Sta 40+00 to Sta 19+00

DRAWING NO. ____
SHEET 16 OF 25
MEC JOB NO. 8515

GROUND CONTROL SURVEY; AERIAL PHOTOGRAPHY - JAN.6,1985
TOPOGRAPHIC MAPPING BY; Delta Aerial Surveys, Inc.
2345 SO. FEDERAL BLVD, SUITE 195
DENVER, COLORADO, 80219
CONTOUR INTERVAL = 2 FT.

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

DESIGNED	CEL, ADS	DATE	9/85
DRAWN	JHK, BMG	DATE	9/85
CHECKED	LAM	DATE	12/85
REVISED		DATE	

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

ADAMS COUNTY, COLORADO

FLOOD HAZARD AREA DELINEATION

TODD CREEK

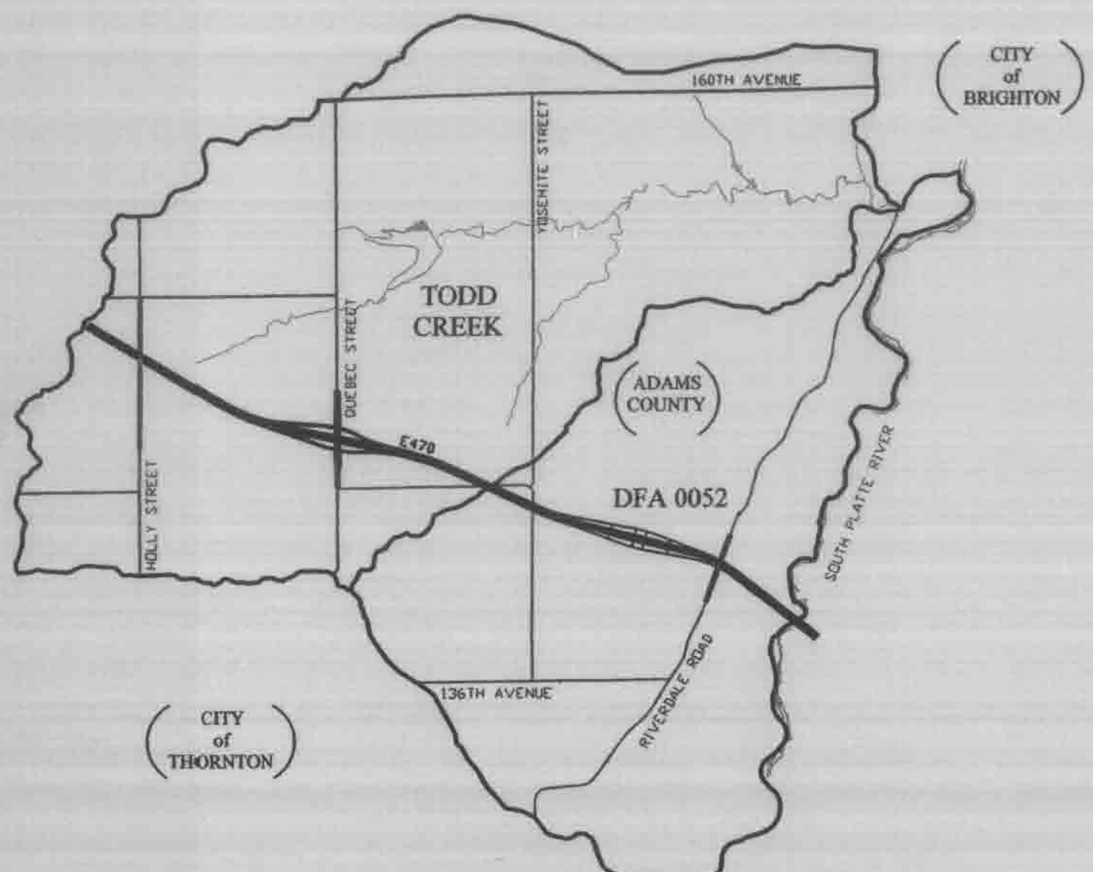
FLOODPLAIN MAP

TRIBUTARY 2, MAIN STEM AT SMITH RESERVOIR

DRAWING NO. ____
SHEET 23 OF 25
MEC JOB NO. 8515

TODD CREEK AND DFA 0052 WATERSHEDS
OUTFALL SYSTEMS PLANNING STUDY

ALTERNATIVES DEVELOPMENT AND EVALUATION REPORT



Sponsored by:

CITY OF THORNTON

ADAMS COUNTY

Urban Drainage and Flood Control District

Prepared by:

Kiowa Engineering Corporation

1776 So. Jackson Street, Suite 1120
Denver, Colorado 80210-3810
www.kiowaengineering.com

November 2001

TODD CREEK AND DFA 0052 WATERSHEDS
OUTFALL SYSTEMS PLANNING STUDY

ALTERNATIVES DEVELOPMENT AND EVALUATION REPORT

Prepared for:

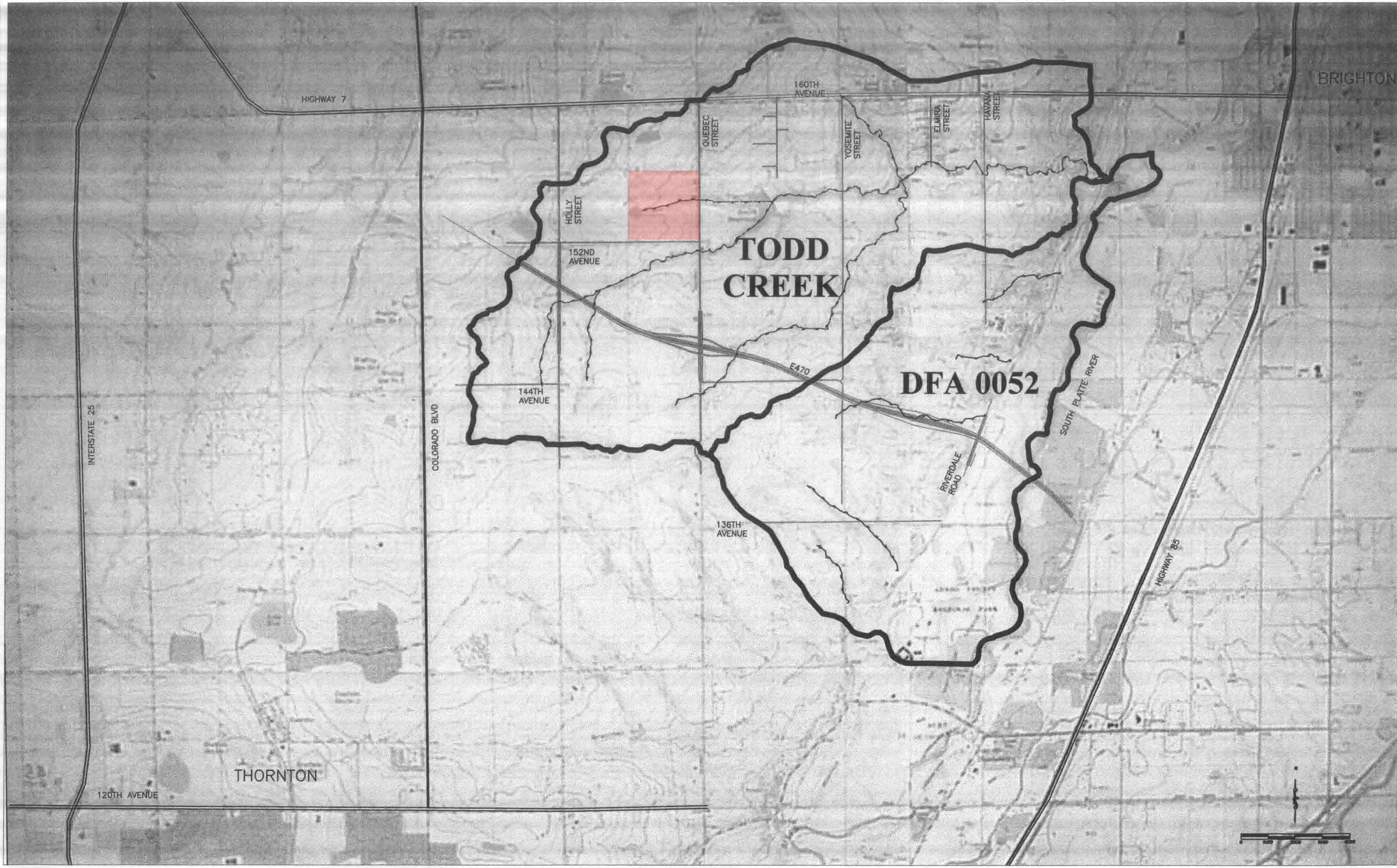
City of Thornton
Adams County
and
Urban Drainage and Flood Control District
2480 West 26th Avenue, Suite 156B
Denver, Colorado 80211

Prepared by:

Kiowa Engineering Corporation
1776 South Jackson Street, Suite 1120
Denver, Colorado 80210

Kiowa Project No. 00058

November, 2001



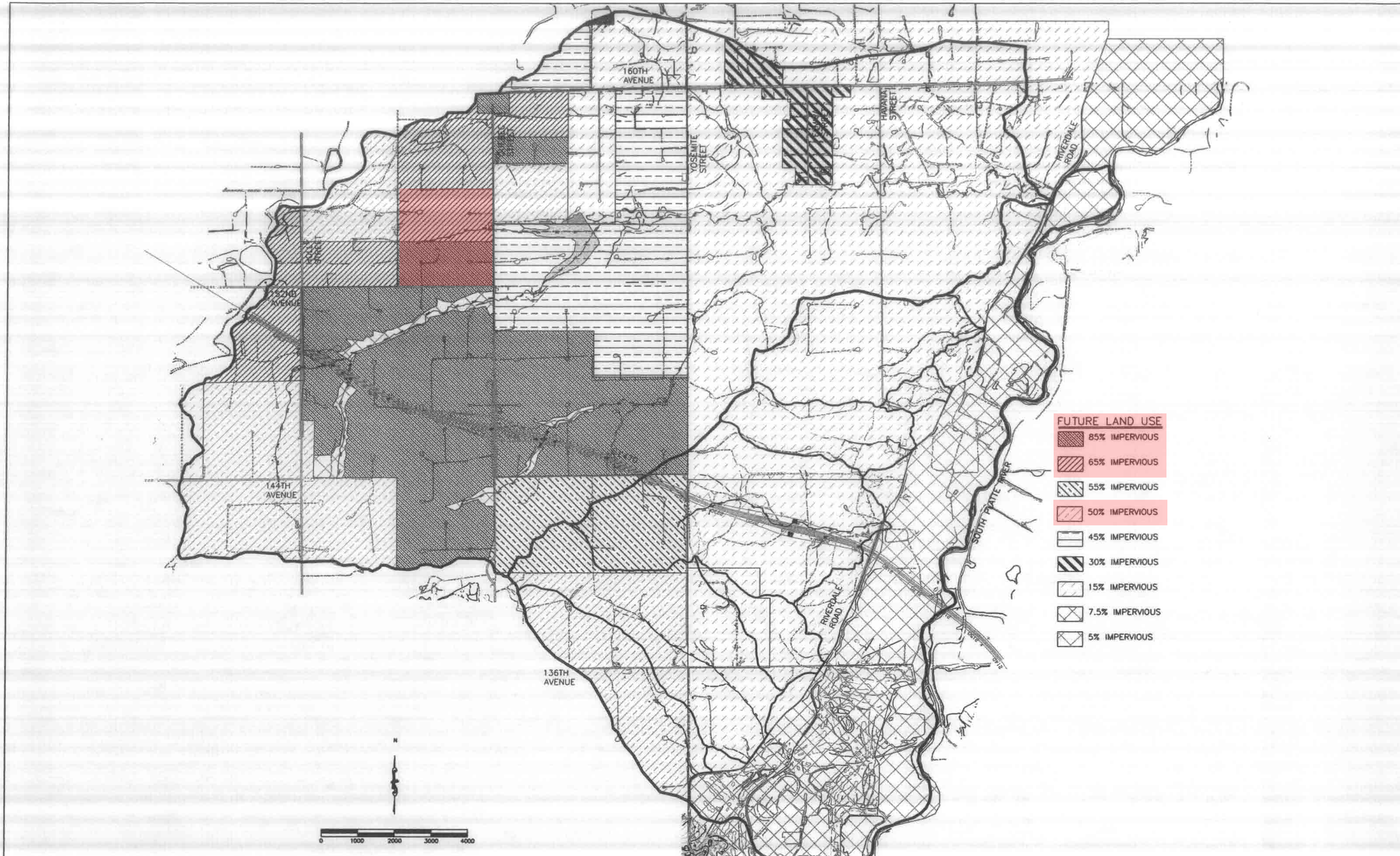
Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	VICINITY MAP	FIGURE ES-1

ADAMS COUNTY 1995 TWO-FOOT CONTOUR INTERVALS	Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	RECOMMENDED PLAN	FIGURE ES-2

Table III-4

Existing Flow and Future Flow at Selected Design Points

LOCATION	EXISTING CONDITIONS CONVEYANCE ELEMENT	100-year PEAK (CFS)	50-year PEAK (CFS)	10-year PEAK (CFS)	5-year PEAK (CFS)	2-year PEAK (CFS)	Annual PEAK (CFS)	FUTURE CONDITIONS CONVEYANCE ELEMENT	100-year PEAK (CFS)	50-year PEAK (CFS)	10-year PEAK (CFS)	5-year PEAK (CFS)	2-year PEAK (CFS)	Annual PEAK (CFS)
Todd Creek Outfall at Riverdale Road	101	4310	3147	1029	563	73	1	101	7279	5705	2640	1953	946	183
Todd Creek at Brantner Ditch	103	4097	2988	977	535	67	1	103	7186	5578	2614	1965	972	190
Todd Creek at Havana Street	105	4026	2933	958	523	64	3	105	7104	5523	2599	1960	976	192
Todd Creek d/s of Trib 1+4	107	3906	2839	919	499	52	0	107	6997	5453	2582	1973	1000	198
Todd Creek u/s of Trib 1+4	141	2448	1784	575	307	22	0	141	4575	3588	1730	1354	718	130
Todd Creek at Yosemite Street	108	2466	1795	566	304	24	0	108	4604	3636	1781	1394	745	135
Todd Creek d/s of Smith Reservoir	110	1986	1446	456	236	21	0	110	3768	2985	1469	1155	630	179
Todd Creek at Quebec Street	112	1204	877	276	144	7	0	112	2206	1738	852	663	355	90
Todd Creek d/s of Trib 3	114	853	625	203	113	7	0	114	1641	1316	646	497	252	61
Todd Creek at E470	197	462	339	111	62	5	0	197	875	697	333	251	118	26
Todd Creek at Holly Street	115	444	326	106	60	6	0	115	854	682	325	244	115	26
Todd Creek at 144th Avenue	117	215	167	67	43	5	0	117	558	471	266	204	109	34
Trib 1 Outfall	145	489	370	139	88	18	0	145	618	479	197	136	44	5
Trib 1 at Yosemite Street	128	212	166	72	50	13	0	128	307	249	123	90	36	7
Trib 2 Outfall	146	693	515	182	107	10	0	146	1608	1308	687	550	307	81
Trib 2 at Quebec Street	121	383	285	101	60	7	0	121	921	754	406	322	177	47
Trib 3 Outfall	143	300	219	70	40	4	0	143	575	463	237	184	98	25
Trib 3 at E470	198	302	221	70	40	6	0	198	586	474	245	191	102	30
Trib 4 Outfall	144	1051	759	235	120	14	0	144	1829	1432	685	520	268	64
Trib 4 at Yosemite Street	130	898	654	200	101	7	0	130	1740	1386	696	545	301	72
Trib 4 at E470	199	474	353	115	64	2	0	199	1003	821	448	353	191	45
Trib 4 at Quebec Street	138	292	221	77	45	3	0	138	731	611	359	288	164	46
DFA 1 at 136th Avenue	502	101	77	32	22	2	0	502	276	229	132	103	55	16
DFA 1 at Riverdale Road	505	309	222	74	46	4	0	505	638	515	276	212	105	25
DFA 2 at 136th Avenue	509	428	321	120	77	13	0	509	836	670	341	260	120	24
DFA 2 at Riverdale Road	511	573	419	147	90	8	0	511	938	730	334	247	99	17
DFA 3 at Riverdale Road	512	155	119	51	34	5	0	512	177	139	64	45	12	0
DFA 4 at E470 (60-inch RCP)	514	315	240	93	58	4	0	514	658	532	303	241	125	29
DFA 4 at E470 (72-inch RCP)	517	249	192	82	54	6	0	517	290	227	105	75	20	0
DFA 4 at Riverdale Road	520	813	595	204	121	11	0	520	813	595	204	127	38	11
DFA 5 at Riverdale Road	523	297	227	92	61	13	0	523	304	232	95	64	15	0
DFA 6 at Riverdale Road	525	53	41	17	12	0	0	525	58	45	21	15	4	0
DFA 7 at Havana Street	526	174	136	63	45	12	0	526	174	136	63	45	12	0
DFA 7 at Riverdale Road	530	462	349	136	89	16	0	530	482	365	147	99	23	0



ADAMS COUNTY 1995 TWO-FOOT CONTOUR INTERVALS	Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	FUTURE IMPERVIOUSNESS	FIGURE III-2

analysis indicates that the opening currently has the capacity to pass the 100-year flood event. No overtopping of this structure is expected; however, the structural integrity should be analyzed.

Riverdale Road
Field measurements were taken defining the opening as a 32-foot span bridge. The bridge is on average 7-feet above the channel. Hydraulic analysis indicates that the opening currently has the capacity to pass only the 5-year flood event. At the 10-year flood event the road would overtop by 1.2-feet and at the 100-year by 3.9-feet. The FHAD indicates that Riverdale Road would overtop during the 100-year event but does not offer a flow depth at this crossing. In the FHAD it is referred to as a "troublesome area" because of its inadequate capacity, it has a barrier to flow by dead-ending into the Brighton Ditch, and a flow split at the ditch intersection. Under today's develop conditions the crossing has a 10-year capacity and the 100-year event would overtop by 2.3-feet. In order to provide full 10-year capacity at this crossing it would require the width be expanded by two times, and for 100-year capacity it would require expanding the width by five times.

Tributary 1
Yosemite Street
Field measurements were taken defining the opening as a 24-inch CMP with 2½-feet of cover. Hydraulic analysis indicates that the opening currently has the capacity to pass only the 1-year flood event. At the 10-year flood event the road would overtop by 0.3-feet and at the 100-year by 0.6-feet. The FHAD indicates that flows would split at this location. Some flow would overtop the road and the remainder would travel east along 160th to a low spot where it would overtop the road. Under today's develop conditions the culvert has a 2-year capacity and the 100-year event would overtop by 0.5-feet. In order to provide full 10-year capacity at this crossing it would require six 24-inch CMP's, and for 100-year capacity it would require fifteen 24-inch CMP's.

Tributary 2
Quebec Street
Field observations indicate that there is no culvert or crossing structure at this location. All flows would overtop the road. There is a 4-foot road embankment that would provide a small amount of detention. At the 10-year flood event the road would overtop by 1.3-feet and at the 100-year by 2.1-feet. The FHAD indicates that Quebec Street would overtop by 1.5-feet during the 100-year event. Under today's develop conditions the 100-year event would overtop by 1.2-feet. In order to provide full 10-year capacity at this crossing it would require four 48-inch CMP's, and for 100-year capacity it would require eight 48-inch CMP's.

Tributary 3
There are no road crossings on Tributary 3.

Tributary 4
Quebec Street
Field observations indicate that there is no culvert or crossing structure at this location. All flows would overtop the road. There is a 4½-foot road embankment that would provide a small amount of detention. At the 10-year flood event the road would overtop by 1.0-feet and at the 100-year by 1.8-feet. The FHAD indicates that Quebec Street would overtop by 2.0-feet during the 100-year event. Under today's develop conditions the 100-year event would overtop by 1.0-feet. In order to provide full 10-year capacity at this crossing it would require three 48-inch CMP's, and for 100-year capacity it would require six 48-inch CMP's.

Yosemite Street
Field measurements were taken defining the opening as a twin 12'x9' RCBC. Hydraulic analysis indicates that the opening currently has the capacity to pass the full 100-year flood event. The FHAD indicates that no crossing structure was in place in 1985.

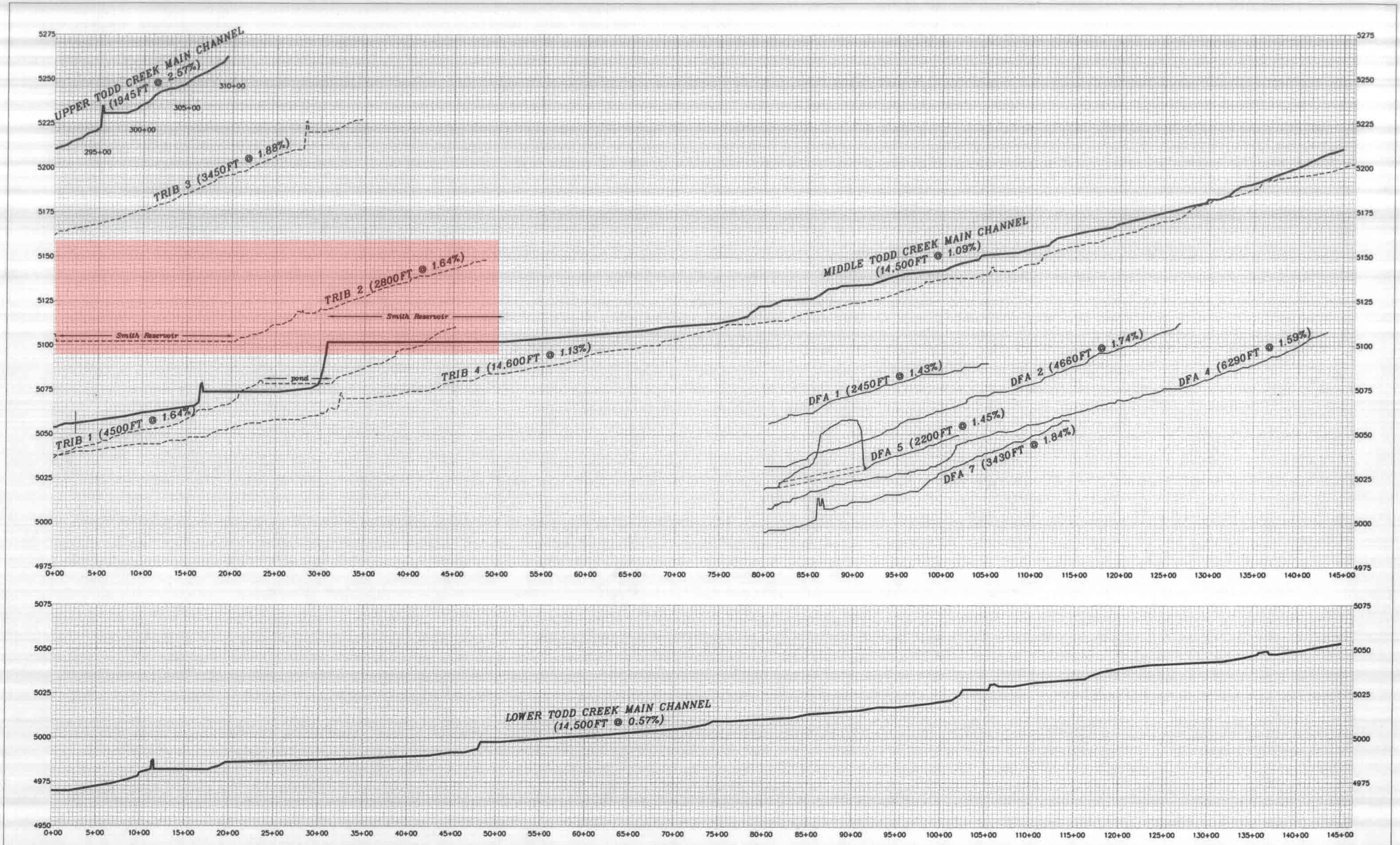
DFA 1
Riverdale Road
Field measurements were taken defining the opening as a 48-inch CMP with 5-feet of cover. Hydraulic analysis indicates that the opening currently has the capacity to pass the 2-year flood event. At the 10-year flood event the road would overtop by 0.6-feet and at the 100-year by 1.4-feet. Under today's develop conditions the culvert has a 10-year capacity and the 100-year event would overtop by 0.7-feet. In order to provide full 10-year capacity at this crossing it would require two 48-inch CMP's, and for 100-year capacity it would require five 48-inch CMP's.

DFA 2
Riverdale Road
Field measurements were taken defining the opening as a 60-inch CMP with 5-feet of cover. Hydraulic analysis indicates that the opening currently has the capacity to pass the 5-year flood event. At the 10-year flood event the road would overtop by 0.5-feet and at the 100-year by 1.7-feet. Under today's develop conditions the culvert has a 10-year capacity and the 100-year event would overtop by 1.0-feet. In order to provide full 10-year capacity at this crossing it would require adding a 48-inch CMP, and for 100-year capacity it would require four 60-inch CMP's.

DFA 3
Riverdale Road
Field observations indicate that there is no culvert or crossing structure at this location. All flows would overtop the road. There is little road embankment so no detention would occur. In order to provide 2-year capacity at this crossing it would require a 24-inch CMP, for 5-year capacity it would require a 36-inch CMP, for 10-year capacity it would require a 42-inch CMP, and for 100-year capacity it would require a 60-inch CMP.

DFA 4
Riverdale Road
Field measurements were taken defining the opening as a 4'x6' RCBC with 2-feet of cover. Hydraulic analysis indicates that the opening currently has the capacity to pass the 10-year flood event. At the 100-year flood event the road would overtop by 1.5-feet. In order to provide full 100-year capacity at this crossing it would require three to four times the existing capacity depending on upstream detention provided by E470.

DFA 5
Riverdale Road
Field observations indicate that there is no culvert or crossing structure at this location. All flows would overtop the road. There is little road embankment so no detention would occur. In order to provide 2-



Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	CHANNEL SLOPES	FIGURE IV-3

Table V-1

Proposed Detention Facility Alternatives for Todd Creek

Detention Location	Frequency	Existing cfs	Future cfs	Storage ac-ft	Outflow cfs
E470-1: where Todd Creek crosses Holly	100-year	444	854	27.6	445
(353.9 ac at DP115)	10-year	106	325	16.8	105
	2-year	6	115	11.3	6
E470-2: where Todd Creek crosses E470	100-year	462	875	28.1	464
(368.2 ac at DP197)	10-year	111	333	17.2	112
	2-year	5	118	12.3	5
E470-3: where Trib 3 crosses E470	100-year	302	586	16.1	304
(207.6 ac at DP198)	10-year	70	245	10.4	73
	2-year	6	102	7.8	6
E470-4: where Sub 59 crosses E470	100-year	137	329	8.1	139
(81.4 ac at DP196)	10-year	44	179	5.5	40
	2-year	3	99	5.0	3
E470-5: where Sub 38 crosses E470	100-year	147	473	10.1	149
(98.3 ac at DP133)	10-year	46	266	6.5	43
	2-year	3	149	5.8	3
E470-6: where Trib 4 crosses E470	100-year	473	1003	26.9	471
(314.3 ac at DP199)	10-year	115	448	18.1	115
	2-year	2	191	15.8	2
E470-7: where Sub 35 crosses E470	100-year	181	277	4.1	185
(73.9 ac at DP195)	10-year	59	141	3.0	60
	2-year	4	71	3.3	4
Yosemite Trib 4: Trib 4 at Yosemite	100-year	896	1741	66.3	899
(771.8 ac at DP130)	10-year	200	696	49.9	200
	2-year	7	301	38.9	7
Quebec Main: Todd Creek at Quebec	100-year	1203	2206	87.8	1200
(1068.9 ac at DP112)	10-year	276	852	64.3	277
	2-year	7	355	49.7	7
Quebec Trib 2: Trib 2 at Quebec	100-year	477	1163	46.2	479
(305.8 ac at DP120)	10-year	128	493	28.6	131
	2-year	9	224	20.5	9
Smith Reservoir: Todd Creek at reservoir	100-year	1983	3768	163.1	1985
(1880.8 ac at DP110)	10-year	456	1469	116.0	460
	2-year	21	630	84.2	22
Yosemite Main: Todd Creek at Yosemite	100-year	2462	4604	199.6	2457
(2418.7 ac at DP108)	10-year	566	1781	139.9	565
	2-year	24	745	101.2	24
Trib 1: Trib 1 at Todd Creek Farms reservoir	100-year	534	691	12.9	530
(333.6 ac at DP126)	10-year	165	239	5.1	169
	2-year	24	126	2.9	23

Table V-2

Proposed Detention Facility Alternatives for DFA 0052

Detention Location	Frequency	Existing cfs	Future cfs	Storage ac-ft	Outflow cfs
DFA1-A: 500 feet upstream of Riverdale Road	10-year	75	274	6.5	75
(353.9 ac at DP115)	5-year	48	216	5.5	48
	2-year	5	110	3.0	5
DFA1-B: 800 feet upstream of Riverdale Road	10-year	75	274	12.1	75
(368.2 ac at DP197)	5-year	48	216	11.2	48
	2-year	5	110	6.2	5
DFA1-C: 2500 feet upstream of Riverdale Road	10-year	40	130	3.6	124
(207.6 ac at DP198)	5-year	25	102	3.6	80
	2-year	2	52	3.5	14
DFA1-D: at 136th Avenue	10-year	18	54	3.3	18
(81.4 ac at DP196)	5-year	12	43	2.6	12
	2-year	0	23	1.4	0
DFA1-E: downstream of 136th Avenue	10-year	32	132	5.9	32
(98.3 ac at DP133)	5-year	22	103	4.6	22
	2-year	2	55	2.6	2
DFA2-A: at Riverdale Road	10-year	147	334	28.0	147
(314.3 ac at DP199)	5-year	90	247	20.9	90
	2-year	8	99	10.4	8
DFA2-B: 1600 feet upstream of Riverdale Road	10-year	120	341	17.6	132
(73.9 ac at DP195)	5-year	77	260	17.2	77
	2-year	13	120	9.1	13
DFA2-C: 3200 feet upstream of Riverdale Road	10-year	76	145	7.5	76
(771.8 ac at DP130)	5-year	53	106	5.4	53
	2-year	12	45	2.4	12
DFA3-A: at 136th Avenue	10-year	51	64	5.3	51
(1068.9 ac at DP112)	5-year	34	45	3.5	34
	2-year	5	12	1.0	5

Longitudinal Slope Stabilization

As the watershed develops, runoff will increase, erosion will increase and sediments will be transported downstream. At some point, the channel will naturally erode to a stable slope. From past experience, the UDFCD has identified a stable slope in urban areas in the Denver region generally as 0.4%. If this were allowed to develop in the Todd Creek watershed the channel would be extremely deep posing a hazard and degrading water quality for years to come. To prevent channel degradation, drop or check structures are used to stabilize longitudinal slopes. To determine quantity and location of the structures requires establishing a set of design parameters. Typically check structures are smaller and can accommodate a vertical drop of 3 to 4 feet. Drop structures are larger and can be designed to handle a drop of up to 8 feet. To locate the placement of each structure requires estimating a stable slope for use in the design. Using a design slope of 0.4%, will be used in the areas that have an upstream drainage area of one square mile or greater. A maximum slope of 0.8% will be used in the design of areas with upstream drainage areas less than or equal to 130 acres. For the reaches in between these design parameters, a design slope of 0.6% will be applied.

Detailed structural design for these structures is not determined during this stage of the study. The most common check structures are made of concrete with riprap placed upstream and downstream of the structure. Other designs incorporate riprap, grouted boulders, or sheet pile. For the purpose of cost estimating the common concrete structure is assumed. Drop structure design can also vary. The two most common designs are concrete vertical structures or grouted sloping boulder structures. For the purpose of cost estimating the grouted sloping boulder structures are assumed.

Bank Stabilization

Bank stabilization will be required where specific erosion problem areas have been noted in the field or identified by local residents from the area. Not a great deal of erosion was observed during the field visits to the study area. Minor erosion near roadways was observed in a couple locations. Other areas of erosion may stabilize over the long term with or without the implementation of longitudinal slope stabilization. Monitoring of the channel will be an ongoing requirement as it is expected to change as the watershed develops for several years to come.

Water Quality

Improvement of urban stormwater quality is an important issue in watershed planning, especially in highly urbanized drainage areas. Many pollutants are associated with sediments present in stormwater runoff. Airborne pollutants contribute to these by deposition onto the urban landscape. Other sources of pollutants include lawn chemicals, oil and grease, pet feces, lawn clippings, and other items often found on urban land surfaces. Some of these pollutants can be limited by programs such as erosion control at construction sites, educational programs to inform the public as to proper use of lawn chemicals, oil recycling programs, and seasonal collection of leaf litter and debris as part of normal street sweeping programs. Even with these programs in place, normal erosion along drainageways can generate large quantities of sediment that can settle out along downstream channel reaches.

Several methods for the control of stormwater quality have been identified for use in this region. The UDFCD, in cooperation with many cities and counties in the Denver region, have developed a manual of Best Management Practices (BMPs) (See Reference 7, Vol. 3). Channels may be lined to prevent erosion, drop/check structures can be used to control degradation and erosion of channel grades, and on-site water-quality facilities and erosion control during and after construction can be implemented to deal with runoff from newly developed areas.

The implementation of water quality basins is recommended with each of the proposed detention facilities. On-site and regional water quality facilities have been sized at various locations throughout the watersheds. The required size of each facility is directly proportional to upstream drainage area. A summary of the required water quality capture volume for each sub-basin is presented in Table V-4.

Channelization

Channel alternatives were designed based on peak flow rates for each reach from the hydrologic models. Manning's equation, with the appropriate "n" value, was used to size and set the slope of the channels. Channel hydraulic parameters were checked to insure the channels would comply with UDFCD criteria. No channelization alternatives were proposed within Todd Creek upstream of Riverdale Road because the watershed is currently mostly undeveloped and the opportunity to preserve a natural channel still exists. Channelization alternatives are focused along the outfalls to the *South Platte River*. The addition of the golf course, agricultural fields and the Brantner and Brighton Ditches has virtually eliminated historic drainage paths between Riverdale Road and the river. A primary goal of this study is to establish dedicated flow paths to the river.

Full channelization options are channels that fully convey the 100-year peak flow rate. The floodplain is reduced and contained within the channel limits. Due to proper floodplain regulation and the timeliness of this study being in front of development, this is not a favorable option. For this study, the practical channel alternatives are riprap, grass lined, wetland, or stabilized natural vegetation channels.

Riprap-lined channels provide reduced right-of-way, relatively high velocity criteria, and allow for deep cross-sections. Higher roughness of the riprap allows for a steeper channel that still maintains a sub-critical flow regime. A steeper channel requires fewer drop structures.

Grass-lined channels have the benefit of not requiring expensive riprap lining material along the entire length of the channel. However, the criteria for grass-lined channels requires that the velocities are kept below 5 fps, the depth at full flow remains below 5', and side slopes must be 4:1 or flatter. To meet these requirements, grass-lined channels require a relatively wide right-of-way and frequent drop structures in steep areas. Multi-frequency channels generally have a hard-lined low-flow channel with a grass-lined overflow area that contains the 100-year peak flows. Grass-lined channels in areas where a significant base flow exists must include some provision for erosion control.

Wetland channels are shallow, slow-flowing channels that are intended to provide an area for wetland vegetation to thrive, as well as providing an adequate conveyance for flood flows. In mature conditions the wetland vegetation should fill the channel, except for a meandering low-flow section, which can be allowed to form naturally. Perennial base flow is generally required in order to keep the wetland species alive. Wetland channels must be designed to be stable for both the initial condition where the vegetation has not yet been established, and the mature condition where the vegetation significantly affects the channel roughness and capacity. In order to maintain slow velocities, the longitudinal slope of wetland channels must be flat, which requires more grade-control structures than other channel types. In general, wetland channels are more expensive, but provide excellent mitigation opportunities.

The topography between Riverdale Road and the *South Platte River* is very flat. All channels were designed with a minimum slope of 0.4-percent to reduce sediment deposition. Due to the flatness of this area, the need for erosion control and bank protection is reduced. Adams County Parks Department has a strong interest in this corridor and would like to see channels designed as natural in appearance as possible. Grass-lined and wetland channels were analyzed in the alternatives. Adams County Parks Department has expressed interest in creating a wetlands channel at the *Todd Creek* outfall. Adams County Parks Department will be asked to assist in the subsequent preliminary design portion of the study.

It should be noted that hydrology has only been defined up to Riverdale Road. Due to the flatness of the *South Platte* floodplain and flexibility in proposed channel alignments, hydrology has not been defined east of Riverdale Road. It is expected that this additional area will have minimal impacts on design peak discharges. Potential increases in runoff volume are of no concern as detention is not proposed in this area. Once final channel alignments have been selected hydrology and hydraulics will be defined accordingly. Alternatives will be re-evaluated based on revised hydrology to ensure sizes are not affected.

Table V-3
Summary of Technical Criteria

Facility		Criteria
Grass-Lined Channel	Maximum Velocity	5 fps
	Maximum Flow Depth	5 feet
	Minimum Roughness	.035
	Maximum Side Slope	4H : 1V
Riprap Channel	Maximum Velocity	7 fps
	Maximum Flow Depth	7 feet
	Minimum Roughness	.030
	Maximum Side Slope	2½H : 1V
Low-Flow Sections	Maximum Velocity	5 fps
	Maximum Flow Depth	2 feet
	Design Capacity	5-year discharge
	Minimum Roughness	.035
Roadway Crossings	Local or Collector	10-year
	Major Arterial	100-year
	Concrete Pipe Culvert Roughness	.013
	Concrete Box Culvert Roughness	.015
	CMP Roughness	.024

Revegetation

Criteria for "bioengineered" vegetation should be in the form of performance specifications. This requires that vegetation be designed to withstand specific velocity, depth, and roughness criteria. All disturbed areas should be revegetated with plant species recommended by the local government in which the proposed improvements are to be located. Areas in the bottoms of wetland channels should be planted with wetland-type vegetation and upland areas planted with dry-land grass species according to UDFCD or local sponsor practices. Detention basin areas should be planted with dry land species except for the permanent pool fringe area where wetland/riparian vegetation could be used. Existing trees and desirable vegetation should be saved wherever possible. Large cottonwoods and/or willow trees should be protected during construction activities.

Diversions

Existing diversions are not common to this study area. Implementation of diversions is a favorable alternative in *DFA 0052* where historic flow paths have been eliminated It is also beneficial to minimize the number of large outfalls to the river, both environmentally and economically. Based on proximity, it is possible to divert some of the *DFA 0052* sub-watershed flows to a combined proposed channel that leads to the *South Platte River*. *DFA 1, 2, 3, 4, 5, 6, 7*, and *Todd Creek* all require defined outfall paths from Riverdale Road to the river.

Maintenance

All drainageways and other stormwater facilities will require periodic maintenance to ensure operation as designed. Routine mowing, debris pick up, and repair of minor erosion are the commonly needed maintenance measures. Use of native-type grasses helps reduce mowing requirements and is encouraged. Signs and educational programs can help reduce debris dumping in drainageways.

Routine inspection of drop structures, riprapped areas, and crossing structures is required to detect deficiencies prior to flood events and potential damages after flood events. To be considered eligible for UDFCD maintenance assistance, all facilities must be designed to current UDFCD criteria.

Following initial construction of the master plan facilities will require substantial maintenance in the following years. As the channel continues to change and stabilize each year after master plan implementation, maintenance requirements should diminish.

V.6 Viable Alternatives

The alternative improvement concepts for each of the planning reaches were screened to limit the options considered to those that are feasible and technically sound. Alternatives focus on controlling flood peaks, water quality, and sediment and erosion. Future conditions hydrology was used to develop alternatives.

Cost estimates for each of the plans were prepared. The list of alternative plans and associated costs are presented here to allow the project sponsors to objectively evaluate the desirability of each concept with respect to the needs of their constituents when compiling their selected plan. The primary focus of the alternative development process is to offset increased flood magnitudes, offset urban impacts on water quality, and eliminate erosion especially where adjacent structures are potentially threatened.

Alternative Outfall Systems

The study area consists of *Todd Creek* and *DFA 0052* which are both large drainage areas. In order to focus discussion on smaller areas, the watersheds were broken into specific reaches based on hydrology, hydraulics, and jurisdiction. *Todd Creek* was broken into seven reaches along the main channel as well as its four main tributaries. Alternatives for *Todd Creek* are shown in Figure V-1. *DFA 0052* was broken into seven sub-watersheds, each of which is a distinct reach. Alternatives for *DFA 0052* are shown in Figure V-2.

Todd Creek

Reach 1 of *Todd Creek*. This reach extends from the *South Platte River* to the *Todd Creek* crossing at Riverdale Road and Brighton Ditch up to station 59+00 half way between Brantner Ditch and Havana Street. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brighton Ditch, resizing the Riverdale Road crossing, redesigning the outlet configuration of the private pond 1000 feet upstream of Riverdale Road, stabilizing the longitudinal slope through the reach, and adding water quality basins to the major outfalls to the creek.

Table V-4

Water Quality Capture Volumes (ac-ft)

Basin #	I (imp.value)	6-hour WQCV (in)	12- hour WQCV (in)	24-hour WQCV (in)	40-hour WQCV (in)	Area (sq. mi.)	Area (acres)	6-hour Required Storage (acre-feet)	12-hour Required Storage (acre-feet)	24-hour Required Storage (acre-feet)	40-hour Required Storage (acre-feet)
1	0.150	0.065	0.075	0.084	0.093	0.064	41.1	0.224	0.256	0.288	0.320
2	0.150	0.065	0.075	0.084	0.093	0.190	121.8	0.663	0.758	0.852	0.947
3	0.150	0.065	0.075	0.084	0.093	0.199	127.6	0.694	0.794	0.893	0.992
4	0.152	0.066	0.075	0.085	0.094	0.198	127.0	0.697	0.796	0.896	0.995
5	0.150	0.065	0.075	0.084	0.093	0.148	94.6	0.515	0.588	0.662	0.735
6	0.150	0.065	0.075	0.084	0.093	0.170	109.0	0.593	0.678	0.763	0.847
7	0.150	0.065	0.075	0.084	0.093	0.087	55.7	0.303	0.346	0.390	0.433
8	0.219	0.086	0.099	0.111	0.123	0.150	96.1	0.691	0.789	0.888	0.987
9	0.153	0.066	0.076	0.085	0.095	0.187	119.4	0.660	0.755	0.849	0.943
10	0.223	0.087	0.100	0.112	0.125	0.142	90.9	0.662	0.756	0.851	0.945
11	0.150	0.065	0.075	0.084	0.093	0.113	72.5	0.395	0.451	0.507	0.564
12	0.150	0.065	0.075	0.084	0.093	0.037	23.5	0.128	0.146	0.164	0.183
13	0.301	0.106	0.122	0.137	0.152	0.131	83.6	0.741	0.846	0.952	1.058
14	0.196	0.080	0.091	0.103	0.114	0.151	96.6	0.642	0.734	0.825	0.917
15	0.271	0.100	0.114	0.128	0.142	0.203	129.9	1.077	1.231	1.385	1.539
16	0.150	0.065	0.075	0.084	0.093	0.177	113.1	0.616	0.703	0.791	0.879
17	0.150	0.065	0.075	0.084	0.093	0.190	121.8	0.663	0.758	0.852	0.947
18	0.150	0.065	0.075	0.084	0.093	0.160	102.4	0.557	0.637	0.717	0.796
19	0.595	0.164	0.187	0.211	0.234	0.157	100.3	1.371	1.567	1.763	1.959
20	0.633	0.173	0.198	0.223	0.248	0.097	61.8	0.893	1.020	1.148	1.275
21	0.450	0.135	0.154	0.174	0.193	0.116	74.3	0.836	0.956	1.075	1.195
22	0.450	0.135	0.154	0.174	0.193	0.103	65.7	0.739	0.845	0.951	1.056
23	0.391	0.124	0.142	0.160	0.177	0.188	120.0	1.242	1.420	1.597	1.775
24	0.450	0.135	0.154	0.174	0.193	0.123	78.4	0.882	1.008	1.135	1.261
25	0.350	0.116	0.133	0.150	0.166	0.179	114.8	1.113	1.272	1.431	1.590
26	0.523	0.149	0.170	0.191	0.213	0.106	67.6	0.838	0.958	1.077	1.197
27	0.576	0.160	0.183	0.206	0.228	0.089	57.1	0.761	0.870	0.978	1.087
28	0.722	0.200	0.228	0.257	0.285	0.119	76.3	1.270	1.452	1.633	1.815
29	0.464	0.138	0.157	0.177	0.197	0.057	36.5	0.419	0.479	0.538	0.598
30	0.603	0.166	0.190	0.214	0.237	0.189	121.2	1.677	1.917	2.156	2.396
31	0.588	0.163	0.186	0.209	0.232	0.098	63.0	0.853	0.975	1.097	1.219
32	0.741	0.206	0.236	0.265	0.295	0.143	91.4	1.572	1.797	2.022	2.246
33	0.791	0.226	0.258	0.290	0.323	0.062	39.7	0.747	0.854	0.961	1.067
34	0.826	0.242	0.276	0.311	0.345	0.085	54.7	1.102	1.259	1.416	1.574
35	0.677	0.186	0.212	0.239	0.265	0.115	73.9	1.143	1.306	1.469	1.633
36	0.799	0.229	0.262	0.295	0.328	0.045	28.8	0.550	0.629	0.708	0.786
37	0.760	0.213	0.244	0.274	0.305	0.094	60.2	1.071	1.224	1.377	1.530
38	0.834	0.246	0.281	0.316	0.351	0.154	98.3	2.012	2.299	2.587	2.874
39	0.839	0.248	0.283	0.319	0.354	0.121	77.6	1.603	1.832	2.061	2.290
40	0.744	0.208	0.237	0.267	0.297	0.192	123.0	2.128	2.432	2.736	3.040
41	0.682	0.187	0.214	0.240	0.267	0.160	102.4	1.596	1.824	2.052	2.280
42	0.592	0.163	0.187	0.210	0.233	0.123	79.0	1.076	1.229	1.383	1.537
43	0.710	0.196	0.224	0.252	0.280	0.090	57.3	0.935	1.068	1.202	1.335
44	0.850	0.253	0.290	0.326	0.362	0.097	61.8	1.305	1.492	1.678	1.865
45	0.686	0.188	0.215	0.242	0.269	0.197	125.9	1.975	2.257	2.540	2.822
46	0.500	0.144	0.165	0.186	0.206	0.152	97.4	1.172	1.339	1.507	1.674
47	0.306	0.107	0.123	0.138	0.153	0.032	20.2	0.181	0.206	0.232	0.258
48	0.722	0.200	0.228	0.257	0.285	0.141	90.0	1.497	1.711	1.925	2.139
49	0.709	0.195	0.223	0.251	0.279	0.018	11.5	0.187	0.214	0.241	0.268
50	0.570	0.159	0.181	0.204	0.226	0.163	104.6	1.382	1.579	1.777	1.974
51	0.695	0.191	0.218	0.246	0.273	0.154	98.8	1.573	1.797	2.022	2.247
52	0.694	0.191	0.218	0.245	0.272	0.064	41.2	0.655	0.748	0.842	0.935
53	0.488	0.142	0.162	0.183	0.203	0.119	76.2	0.902	1.031	1.160	1.289
54	0.466	0.138	0.158	0.177	0.197	0.111	71.1	0.817	0.934	1.051	1.168
55	0.500	0.144	0.165	0.186	0.206	0.211	135.0	1.624	1.856	2.088	2.320
56	0.650	0.178	0.203	0.229	0.254	0.114	73.0	1.082	1.237	1.391	1.546
57	0.508	0.146	0.167	0.188	0.208	0.112	71.6	0.871	0.995	1.119	1.244
58	0.838	0.247	0.283	0.318	0.353	0.022	14.3	0.295	0.337	0.379	0.421
59	0.823	0.240	0.275	0.309	0.343	0.127	81.4	1.631	1.864	2.097	2.330
60	0.656	0.179	0.205	0.231	0.256	0.061	39.3	0.588	0.672	0.755	0.839
61	0.778	0.221	0.252	0.284	0.315	0.075	47.7	0.877	1.002	1.127	1.252
62	0.550	0.154	0.176	0.198	0.220	0.126	80.5	1.035	1.183	1.331	1.479
						7.80	**4991.4**	**58.6**	**67.0**	**75.3**	**83.7**

Reach 2 of *Todd Creek*. This reach extends from station 59+00 up to the confluence with Tributary 1 and Tributary 4. Alternatives in this reach include stabilizing the longitudinal slope and adding water quality basins or other structural BMPs to the major outfalls. The Havana Street crossing has hydraulic capacity in excess of the 100-year event.

Reach 3 of *Todd Creek*. This reach extends from the confluence with Tributary 1 and Tributary 4 up to Yosemite Street that defines the limits of current development and the future jurisdictional boundary between Adams County and Thornton. Alternatives in this reach include stabilizing the longitudinal slope through the reach and adding a regional water quality basin or other structural BMPs to the main creek for all upstream drainage areas.

Reach 4 of *Todd Creek*. This reach extends from Yosemite Street to the outlet of Smith Reservoir. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach. Yosemite Street has recently been revised to greater than 100-year capacity.

Reach 5 of *Todd Creek*. This reach extends from Smith Reservoir to station 230+00. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and increasing the capacity of the road crossing beneath Quebec Street (currently 1-year capacity).

Reach 6 of *Todd Creek*. This reach extends from station 230+00 to the confluence with Tributary 3. Alternatives in this reach include water quality basins or other structural BMPs and stabilizing the longitudinal slope through the reach.

Reach 7 of *Todd Creek*. This reach extends from the confluence with Tributary 3 up to 144th Avenue. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and increasing the capacity of the road crossing beneath Holly Street.

Trib 1 Reach. This reach extends from the confluence with *Todd Creek* to the upstream study limits at Yosemite Street and 160th Avenue. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and increasing the capacity of the road crossing beneath 160th Avenue.

Trib 2 Reach. This reach extends from the confluence with *Todd Creek* at Smith Reservoir to the upstream study limits. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and increasing the capacity of the road crossing beneath Quebec Street.

Trib 3 Reach. This reach extends from the confluence with *Todd Creek* to the upstream study limits. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

Trib 4A Reach. This reach extends from the confluence with *Todd Creek* to Yosemite Street on Tributary 4. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

Trib 4B Reach. This reach extends from Yosemite Street to the upstream study limits. Alternatives in this reach include regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and increasing the capacity of the road crossing beneath Quebec Street.

DFA 0052

DFA 1 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits at 136th Avenue. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brantner Ditch, regional flood detention, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

DFA 2 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brantner Ditch, regional flood detention, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

DFA 3 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brantner Ditch, regional flood detention, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and providing a road crossing beneath Riverdale Road.

DFA 4 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, analyzing regional flood detention provided by E470, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

DFA 5 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brantner Ditch, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and providing a road crossing beneath Riverdale Road.

DFA 6 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, adding a crossing structure beneath Brantner Ditch, water quality basins or other structural BMPs, stabilizing the longitudinal slope through the reach, and providing a road crossing beneath Riverdale Road.

DFA 7 Reach. This reach extends from the outfall at Riverdale Road to the upstream study limits. Alternatives in this reach include establishing a formal outfall path from Riverdale Road to the *South Platte River*, water quality basins or other structural BMPs, and stabilizing the longitudinal slope through the reach.

ADAMS COUNTY 1995 TWO-FOOT CONTOUR INTERVALS	Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	TODD CREEK ALTERNATIVES AND REACH DELINEATIONS	FIGURE V-1

Reach 6 of *Todd Creek* (Figure VI-6)

This reach of *Todd Creek* extends from station 230+00 to 259+00 where Tributary 3 enters *Todd Creek*. Alternatives considered in this reach include water quality enhancement, channel stabilization and floodplain preservation.

Recommended Plan:

- Add 7 check structures to stabilize 2,900 feet of channel
- Add 1 small water quality basin at a tributary outfall to *Todd Creek*
- Preserve the natural channel and floodplain through local regulations

Reach 7 of *Todd Creek* (Figure VI-7)

This reach of *Todd Creek* extends from station 259+00 to 310+00 at 144th Avenue. Alternatives considered in this reach include flood control, water quality enhancement, increased road crossing capacity, channel stabilization and floodplain preservation.

Regional flood control was analyzed at Holly Street (E470-1) and E470 (E470-2). Upstream drainage area, flood reduction, and required surface area are nearly identical at each facility. Due to the closeness in location these facilities are nearly interchangeable. The general flood control plan for the *Todd Creek* watershed is to check future flows at the E470 crossing back to existing magnitudes and re-check it as it moves downstream through the watershed. If future flows at Yosemite can be held to existing levels then the peaks at the *Todd Creek* outfall can be held to existing levels since development east of Yosemite is nearly fully built out. The highest density future development is expected to occur upstream of E470 which makes this a good location for flood mitigation. Also, several of the smaller drainage crossings for E470 have been undersized for peaks closer to existing magnitudes than projected future flows. This forces the need for flood detention at E470.

E470 is also used to establish the upstream start for water quality enhancement. A regional water quality basin will be incorporated into each proposed detention facility. Downstream of E470 smaller water quality basins will be placed at the smaller tributary outfalls to maintain "clean" water as it enters the main channel and continues downstream through the watershed. Channel stability also helps to enhance water quality and check structures will be implemented.

Increasing the capacity of Holly Street above its current 5-year capacity was also analyzed. To achieve full 100-year capacity would require an 8'x10' box culvert at a cost of $36,000. 10-year capacity would require a 6'x6' box culvert at a cost of $16,000.

Recommended Plan:

- Add regional flood detention at E470
- Add 1 regional water quality basin at E470 on *Todd Creek*
- Add 2 small water quality basins at tributary outfalls to *Todd Creek*
- Add 8'x10' box culvert at Holly Street to increase to 100-year capacity
- Add 23 check structures to stabilize 5,100 feet of channel
- Preserve the natural channel and floodplain through local regulations

Trib 1 Reach (Figure VI-8)

Tributary 1 has a reach length of 4500 feet and outfalls to *Todd Creek* at station 117+00. This tributary extends through the Todd Creek Farms residential development. Alternatives considered in this reach include regional flood control, increased road crossing capacity, water quality enhancement, channel stabilization, and floodplain preservation.

The flood detention alternative is an expansion of the existing basin on Trib 1. Peak reduction on Tributary 1 can be achieved; however, due to the relatively small drainage area the impacts on *Todd Creek* are not significant.

Water quality can be achieved either by a large regional water quality basin near the mouth, or through several smaller local basins at the tributary outfalls. A convenient location for water quality is a modification of the existing Trib 1 basin.

Increasing the capacity of 160th/Yosemite Street above its current 1-year capacity was also analyzed. To achieve full 100-year capacity would require a 5'x7' box culvert at a cost of $32,000. 10-year capacity would require a 54" pipe at a cost of $15,000. 5-year capacity would require a 48" pipe at a cost of $13,500.

Recommended Plan:

- Add 1 regional water quality basin at existing Todd Creek Farms pond
- Add 5'x7' box culvert at 160th/Yosemite Street to increase to 100-year capacity
- Add 16 check structures to stabilize 4,500 feet of channel
- Preserve the natural channel and floodplain through local regulations

Trib 2 Reach (Figure VI-9)

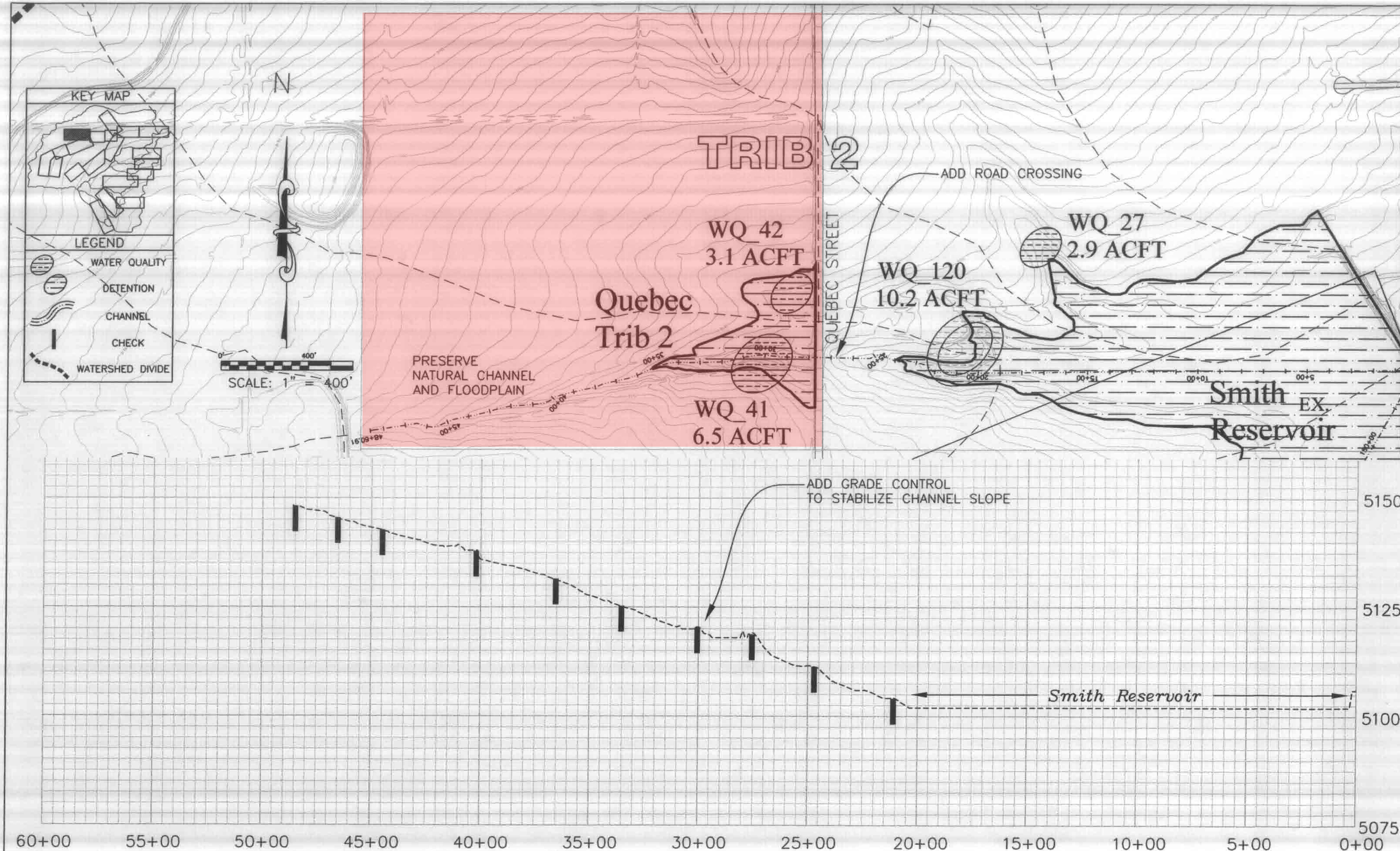
Tributary 2 has a reach length of 2800 feet and outfalls to *Todd Creek* within Smith Reservoir. Alternatives considered in this reach include regional flood control, increased road crossing capacity, water quality enhancement, channel stabilization, and floodplain preservation.

Quebec Trib 2 is located just upstream of Quebec Street on Tributary 2. This facility would store flood flows from a majority of the Tributary 2 drainage area. It requires 46 acre-feet of storage at a cost $1.6 million. The location of this facility in the far upstream part of the watershed would require additional downstream detention to effectively reduce peaks at the *Todd Creek* outfall back to existing magnitudes. The other detention alternative shown in this reach is the Smith Reservoir expansion. Discussion for this alternative is contained in Reach 5 of *Todd Creek*.

Water quality can be achieved either by a large regional water quality basin near Smith Reservoir, or through several smaller local basins at the tributary outfalls. Quebec Street currently has no culvert for drainage. To achieve full 100-year capacity would require a 6'x14' box culvert at a cost of $38,000. 10-year capacity would require a 6'x7' box culvert at a cost of $19,000. 5-year capacity would require a 6'x6' box culvert at a cost of $16,000.

Recommended Plan:

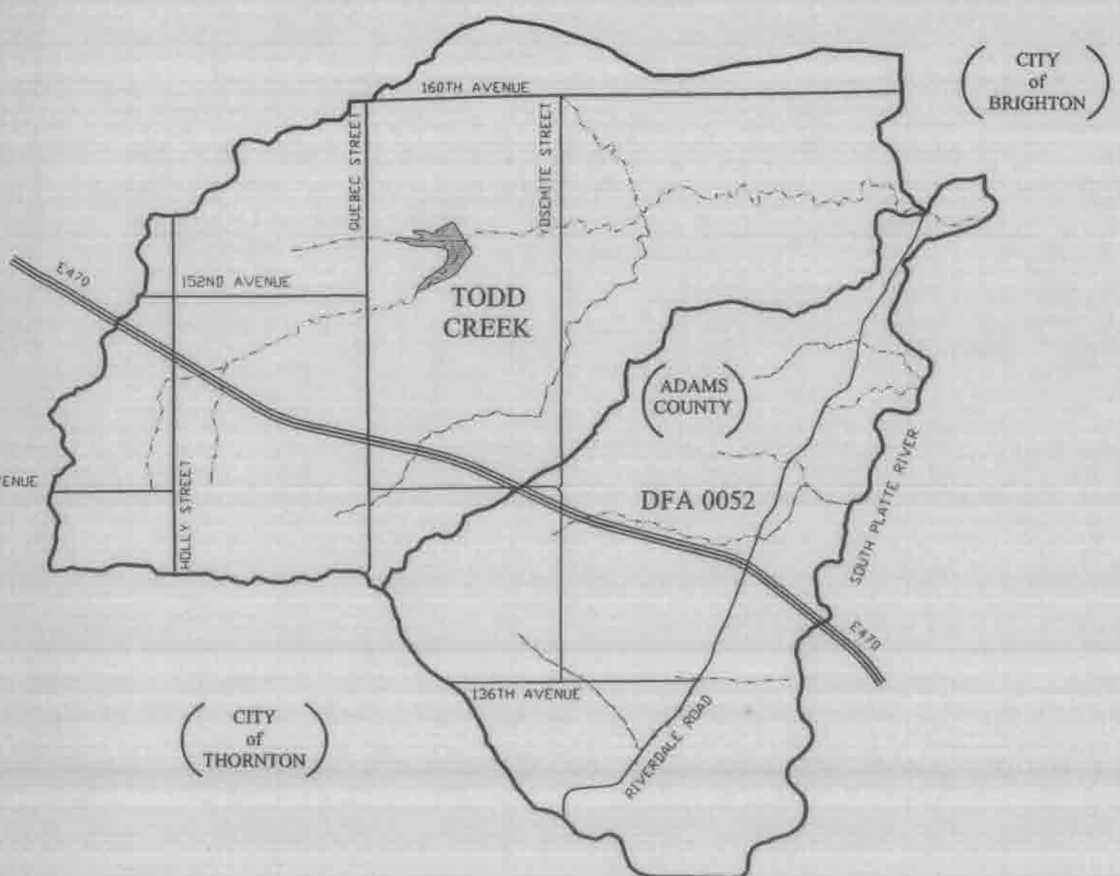
- Add 1 regional water quality basin at Quebec Street by combining two local basins
- Add 1 small water quality basin at tributary outfalls to Tributary 2
- Add 6'x7' box culvert at Quebec Street to increase to 10-year capacity
- Add 10 check structures to stabilize 2,800 feet of channel
- Preserve the natural channel and floodplain through local regulations



Kiowa Engineering Corporation 1776 South Jackson Street, Suite 1120 Denver, Colorado 80210 (303)-692-0369	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	TRIB 2 ALTERNATIVES	FIGURE VI-9

TODD CREEK AND DFA 0052 WATERSHEDS
OUTFALL SYSTEMS PLANNING STUDY

PRELIMINARY DESIGN REPORT



Sponsored by:

CITY OF THORNTON

ADAMS COUNTY

Urban Drainage and Flood Control District

Prepared by:

Kiowa Engineering Corporation

7175 West Jefferson Avenue, Suite 3400
Lakewood, Colorado 80235
www.kiowaengineering.com

December 2003

TODD CREEK AND DFA 0052 WATERSHEDS
OUTFALL SYSTEMS PLANNING STUDY

PRELIMINARY DESIGN REPORT

December 2003

Prepared for:

Adams County
City of Thornton
and
Urban Drainage and Flood Control District
2480 West 26th Avenue, Suite 156B
Denver, Colorado 80211

Prepared by:

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 3400
Lakewood, Colorado 80235

Table ES-1
Master Plan Summary by Political Jurisdiction

Outfall # or Sub-basin #	Length (miles)	Catchment Area (sq.mi.)	Political Jurisdiction (1)	Recommended Improvements	Estimated Total Cost
Todd Creek Main Channel 3400	3.05	2.62	Thornton	27 checks, 28.7 ac-ft water quality, Holly and Quebec Crossing, Detention 310 (19.2 ac-ft), Detention 307 (181.7 ac-ft)	$6,558,580
	3.18	1.70	Adams County	7 checks, 7.8 ac-ft water quality, Riverdale Crossing, 10-yr channel	$5,129,884
3401	0	0.34	Thornton		
	0.86	0.29	Adams County	14 checks, 3.7 ac-ft water quality, Yosemite/160th Crossing	$1,041,254
3402	1.65	1.12	Thornton	16 checks, 16.4 ac-ft water quality, Quebec Crossing, Detention 304 (6.8 ac-ft), Detention 305 (18.3 ac-ft), Detention 306 (6.9 ac-ft)	$2,487,681
	1.12	0.42	Adams County	7 checks, 1.9 ac-ft water quality	$1,132,086
3403	0.92	0.98	Thornton	6 checks, 12.5 ac-ft water quality, Quebec Crossing	$1,124,908
	0	0	Adams County		
3404	0.69	0.33	Thornton	7 checks, 4.1 ac-ft water quality, Detention 302 (11.7 ac-ft), Detention 303 (7.8 ac-ft)	$989,668
	0	0	Adams County		
Totals:	11.47	7.80			**$18,464,062**

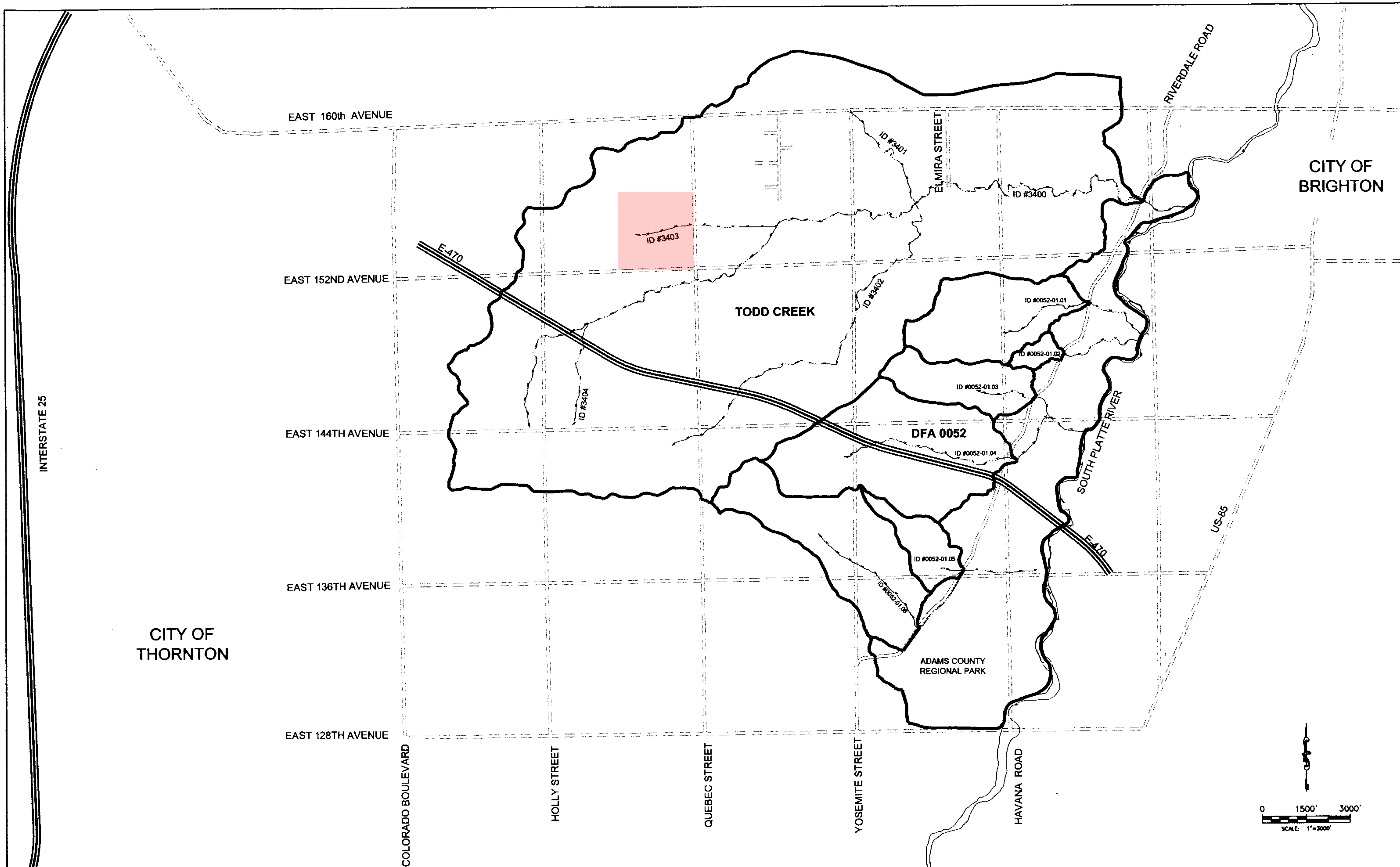
(1) Political Jurisdiction anticipates future City of Thornton boundaries to extend east to Yosemite Street.

Table ES-1 (con't)
Master Plan Summary by Political Jurisdiction

Outfall # or Sub-basin #	Length (miles)	Catchment Area (sq.mi.)	Political Jurisdiction (1)	Recommended Improvements	Estimated Total Cost
0052-01.01	0	0	Thornton		
	1.26	0.47	Adams County	8 checks, 2 drops, 2.0 ac-ft water quality, Riverdale Crossing, 10-yr channel	$1,472,819
0052-01.02	0	0	Thornton		
	0.59	0.05	Adams County	2 checks, 0.2 ac-ft water quality, Riverdale Crossing, 100-yr channel	$862,243
0052-01.03	0	0	Thornton		
	0.60	0.27	Adams County	2 checks, 1.4 ac-ft water quality, Riverdale Crossing, 100-yr channel	$622,290
0052-01.04	0.06	0.24	Thornton	1 check	$44,874
	1.97	0.65	Adams County	4 checks, 6.3 ac-ft water quality, 10-year channel	$2,044,460
0052-01.05	0	0	Thornton		
	0.66	0.16	Adams County	2 drops, 0.8 ac-ft water quality, Riverdale Crossing, 100-yr channel, Detention 331 (5.7 ac-ft)	$1,704,965
0052-01.06	0.30	0.35	Thornton	6 checks	$236,775
	1.09	0.30	Adams County	4 checks, 2 drops, 5.4 ac-ft water quality, Riverdale Crossing,	$2,503,208
Totals:	1.65	2.49 (2)			**$ 9,491,633**

(1) Political Jurisdiction anticipates future City of Thornton boundaries to extend east to Yosemite Street.

(2) This area accounts for the six tributary areas draining to Riverdale Road. An additional area of 1.95 sq.mi. is found downstream of Riverdale Road to the South Platte River. The total area within DFA 0052 is 4.44 sq.mi. All of this additional area lies within Adams County.

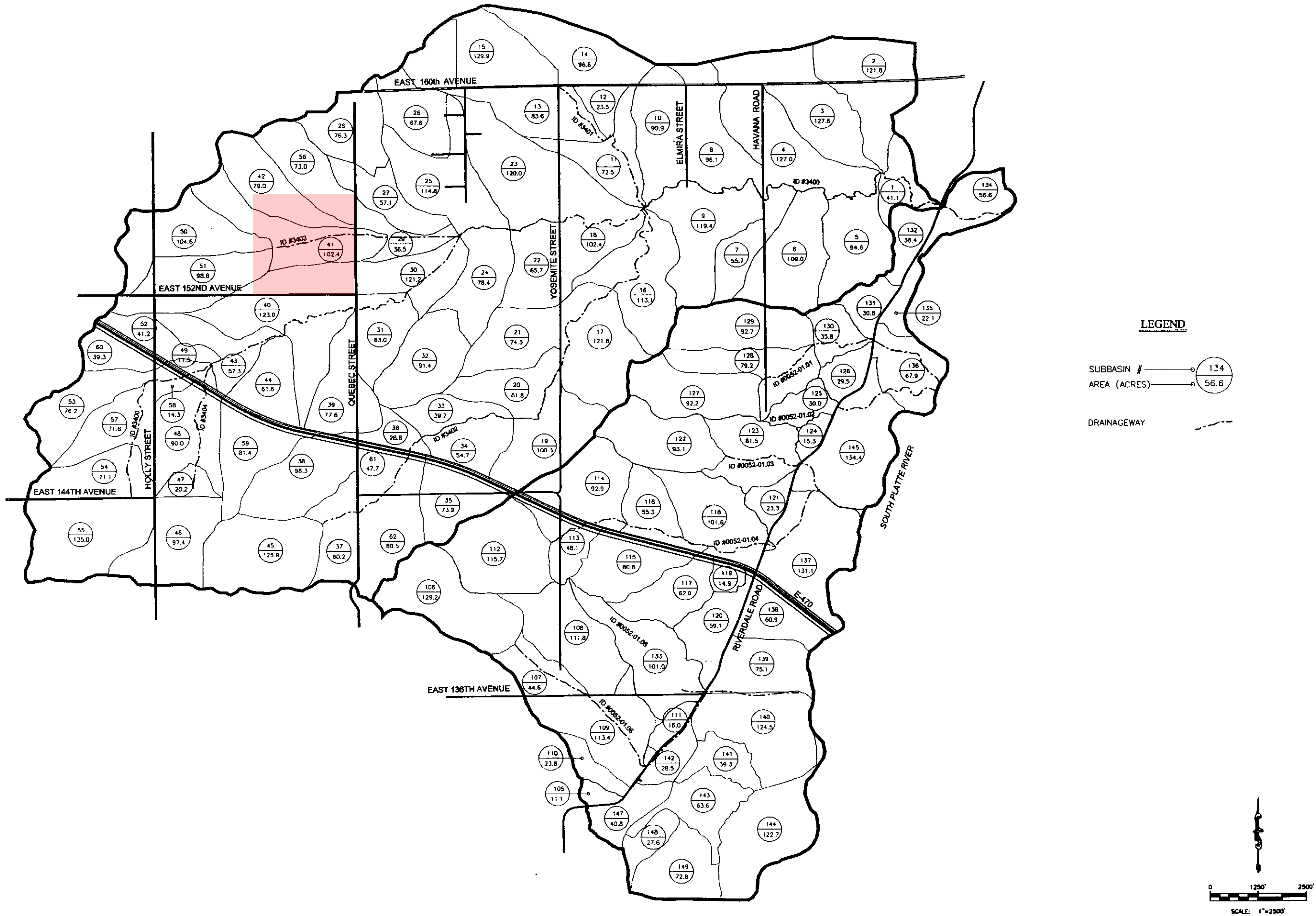


Project mapping provided by Adams County **Date: 1995** Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00058	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TOOD CREEK AND DFA 0052 WATERSHEDS	VICINITY MAP	FIGURE II-1 Vicinity Map.dwg/Dec 11, 2003

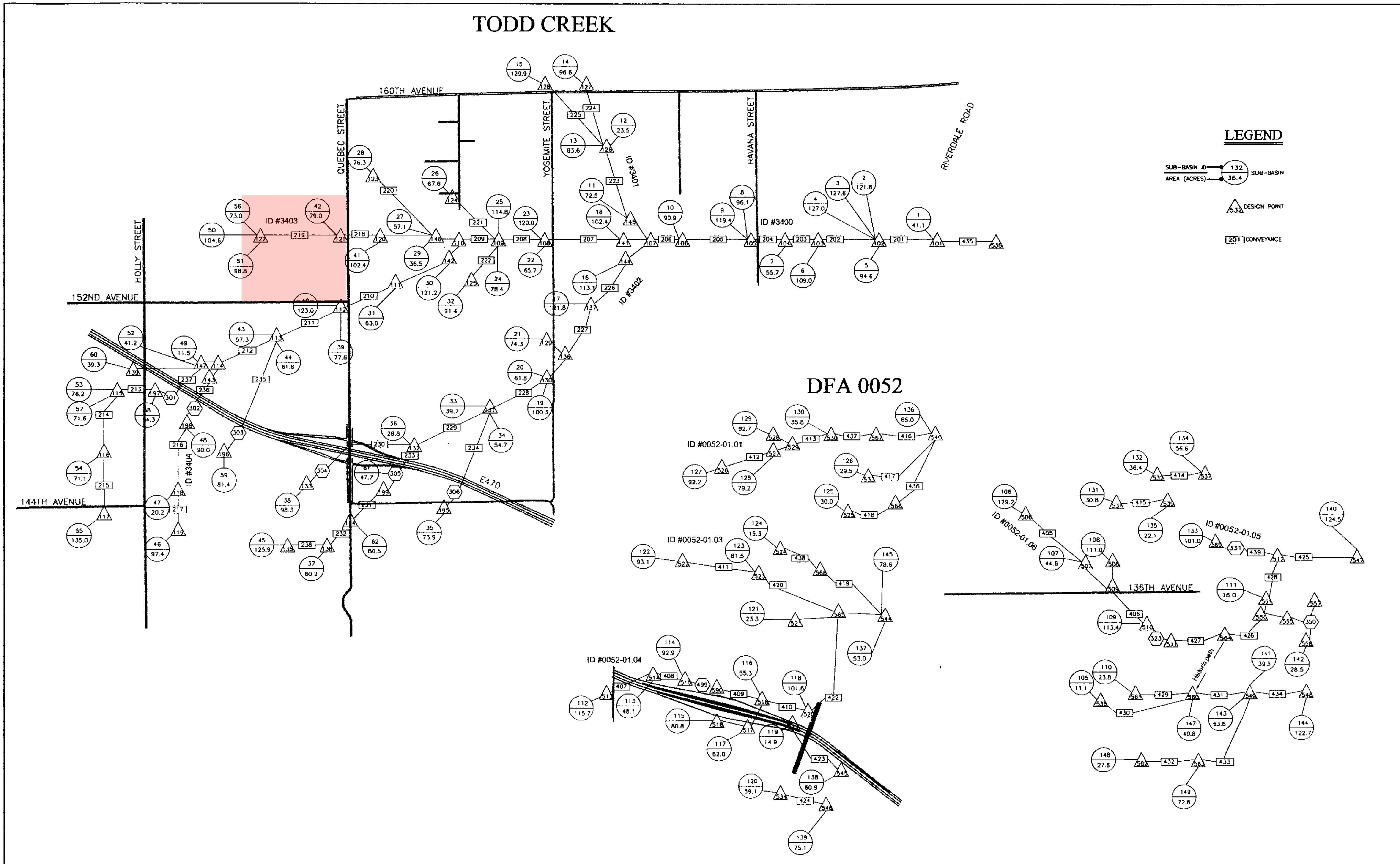
Table III-4

Existing Flow and Future Flow at Selected Design Points

LOCATION	CONVEYANCE ELEMENT	EXISTING CONDITIONS 100-year PEAK (CFS)	EXISTING CONDITIONS 50-year PEAK (CFS)	EXISTING CONDITIONS 10-year PEAK (CFS)	EXISTING CONDITIONS 5-year PEAK (CFS)	EXISTING CONDITIONS 2-year PEAK (CFS)	EXISTING CONDITIONS Annual PEAK (CFS)	CONVEYANCE ELEMENT	FUTURE CONDITIONS 100-year PEAK (CFS)	FUTURE CONDITIONS 50-year PEAK (CFS)	FUTURE CONDITIONS 10-year PEAK (CFS)	FUTURE CONDITIONS 5-year PEAK (CFS)	FUTURE CONDITIONS 2-year PEAK (CFS)	FUTURE CONDITIONS Annual PEAK (CFS)
Todd Creek Outfall at Riverdale Road	101	4310	3147	1029	563	73	1	101	7279	5705	2640	1953	946	183
Todd Creek at Brantner Ditch	103	4097	2988	977	535	67	1	103	7186	5578	2614	1965	972	190
Todd Creek at Havana Street	105	4026	2933	958	523	64	3	105	7104	5523	2599	1960	976	192
Todd Creek d/s of Trib 1+4	107	3906	2839	919	499	52	0	107	6997	5453	2582	1973	1000	198
Todd Creek u/s of Trib 1+4	141	2448	1784	575	307	22	0	141	4575	3588	1730	1354	718	130
Todd Creek at Yosemite Street	108	2466	1795	566	304	24	0	108	4604	3636	1781	1394	745	135
Todd Creek d/s of Smith Reservoir	110	1986	1446	456	236	21	0	110	3768	2985	1469	1155	630	179
Todd Creek at Quebec Street	112	1204	877	276	144	7	0	112	2206	1738	852	663	355	90
Todd Creek d/s of Trib 3	114	853	625	203	113	7	0	114	1641	1316	646	497	252	61
Todd Creek at E-470	197	462	339	111	62	5	0	197	875	697	333	251	118	26
Todd Creek at Holly Street	115	444	326	106	60	6	0	115	854	682	325	244	115	26
Todd Creek at 144th Avenue	117	215	167	67	43	5	0	117	558	471	266	204	109	34
Trib I Outfall	145	489	370	139	88	18	0	145	618	479	197	136	44	5
Trib 1 at Yosemite Street	128	212	166	72	50	13	0	128	307	249	123	90	36	7
Trib 2 Outfall	146	693	515	182	107	10	0	146	1608	1308	687	550	307	81
Trib 2 at Quebec Street	121	383	285	101	60	7	0	121	921	754	406	322	177	47
Trib 3 Outfall	143	300	219	70	40	4	0	143	575	463	237	184	98	25
Trib 3 at E-470	198	302	221	70	40	6	0	198	586	474	245	191	102	30
Trib 4 Outfall	144	1051	759	235	120	14	0	144	1829	1432	685	520	268	64
Trib 4 at Yosemite Street	130	898	654	200	101	7	0	130	1740	1386	696	545	301	72
Trib 4 at E-470	199	474	353	115	64	2	0	199	1003	821	448	353	191	45
Trib 4 at Quebec Street	138	292	221	77	45	3	0	138	731	611	359	288	164	46
DFA1 at 136th Avenue	502	101	77	32	22	2	0	502	276	229	132	103	55	16
DFA 1 at Riverdale Road	505	309	222	74	46	4	0	505	638	515	276	212	105	25
DFA 2 at 1 36th Avenue	509	428	321	120	77	13	0	509	836	670	341	260	120	24
DFA 2 at Riverdale Road	511	573	419	147	90	8	0	511	938	730	334	247	99	17
DFA 3 at Riverdale Road	512	155	119	51	34	5	0	512	177	139	64	45	12	0
DFA 4 at E-470 (60-inch RCP)	514	315	240	93	58	4	0	514	658	532	303	241	125	29
DFA 4 at E-470 (72-inch RCP)	517	249	192	82	54	6	0	517	290	227	105	75	20	0
DFA 4 at Riverdale Road	520	813	595	204	121	11	0	520	813	595	204	127	38	11
DFA 5 at Riverdale Road	523	297	227	92	61	13	0	523	304	232	95	64	15	0
DFA 6 at Riverdale Road	525	53	41	17	12	0	0	525	58	45	21	15	4	0
DFA 7 at Havana Street	526	174	136	63	45	12	0	526	174	136	63	45	12	0
DFA 7 at Riverdale Road	530	462	349	136	89	16	0	530	482	365	147	99	23	0



Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	SUBWATERSHED DELINEATION	FIGURE III-3 Subwatershed Delin.dwg/Dec 11, 2003



Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	SWMM MODEL SCHEMATIC	FIGURE III-4 SWMM Schematic.dwg/Dec. 11, 2003

Table IV-2

Todd Creek Drainage Structure Inventory [Future Master Plan Hydrology and Sizes]

Road Crossing	Imminent Overtopping Capacity (cfs)	(freq)	Q_{100} (cfs)	Size (1)	Type
Holly Street	890	100-year	854	12'x6'	RCBC
Quebec Street	1506	100-year	1454	Twin 11'x8'	RCBC
Yosemite Street	8718	100-year+	1732	72' span	Bridge
Havana Street	15485	100-year+	3515	117' span	Bridge
Brantner Ditch Flume	14094	100-year+	3635	104' span	Bridge
Riverdale Road	1872	10-year	3961	Quad 8'x4'	RCBC
Yosemite Street (3401)	332	100-year	307	Twin 6'x4'	RCBC
Quebec Street (3403)	997	100-year	921	Twin 8'x6'	RCBC
Quebec Street (3402)	806	100-year	731	Twin 9'x5'	RCBC
Yosemite Street	2275	100-year+	1110	Twin 12'x9'	RCBC
Riverdale Road (01.06)	446	100-year	446	Twin 6'x4'	RCBC
Riverdale Road (01.05)	89	100-year	89	42"	RCP
Riverdale Road (01.04)	1200	100-year	547	Twin 8'x6'	RCBC
Riverdale Road (01.03)	95	10-year	304	48"	RCP
Riverdale Road (01.02)	59	100-year	60	42"	RCP
Riverdale Road (01.01)	166	10-year	483	60"	RCP

(1) all box culvert dimensions shown as Width' x Height'

4.3 Floodplain Description

The following information was found and reviewed describing the floodplain limits along *Todd Creek*:

"Flood Hazard Area Delineation, Todd Creek," prepared by Muller Engineering Company, Inc., for Adams County and Urban Drainage and Flood Control District, December 1985. – Reference 1

"Flood Insurance Rate Map, Adams County, Colorado, Map Number 08001C0055 G", prepared by Federal Emergency Management Agency, August 16, 1995. – Reference 12

"Flood Insurance Rate Map, Adams County, Colorado, Map Number 080010010 B", prepared by Federal Emergency Management Agency, December 15, 1989. - Reference 13

"Flood Insurance Study, Adams County, Colorado, and Incorporated Areas", prepared by Federal Emergency Management Agency, August 16, 1995. – Reference 14

The 100-year regulatory floodplain for *Todd Creek* was determined in the 1985 Flood Hazard Area Delineation (FHAD) report (Reference 1). The FHAD hydrology was based upon a fully-developed condition projected by the planners at that time. This included the construction of E-470 and the higher density development that is anticipated to follow. The peak discharges used in the FHAD are generally within thirty percent of the future condition flows developed under this study for *Todd Creek*. Due to the relative magnitude between the two studies, the previously published floodplain will not be altered by this study. In the 1985 study, as well as this study, no structures have been identified within the 100-year floodplain. In the lower portion of the watershed, where most of the development has occurred since 1985, it also appears that all structures have been built outside of the floodplain.

FEMA published Flood Insurance Rate Maps dated August 16, 1995 (Reference 12) and December 15, 1989 (Reference 13). The *Todd Creek* floodplain is labeled as Zone A, which indicates no base flood elevations were determined. Zone A floodplains are also delineated for Tributaries 3403 and 3402, but not for Tributaries 3401 and 3404. In comparing the shape of the floodplains between the FHAD and the FIRM, it does not appear that the 1995 FIRM adopted the 1985 FHAD. Since no Flood Insurance Study booklet is available on *Todd Creek*, it cannot be determined if the FHAD floodplain was considered in the FEMA delineation. For the purpose of this study and future regulation of the floodplain, it is recommended that, both the FEMA regulatory floodplain and FHAD be used in identifying the floodplain limits for *Todd Creek*, whichever is larger.

Comparing the current study effort to the FHAD report shows that the peak flows from this study are slightly less than those published in 1985. The following table compares the results of the two studies for *Todd Creek*.

Table IV-3

Comparison to FHAD Floodplain Data

Location	FHAD Q_{100} (cfs)	Existing Q_{100} (cfs)	Future Q_{100} (cfs)	Master Plan Q_{100} (cfs)
Riverdale Road	8360	4310	7279	3961
Havana Street	8220	4026	7104	3515
D/S of 3401+3402	8040	3906	6997	3283
U/S of 3401+3402	4970	2448	4575	1739
Yosemite Street	4780	2466	4604	1732
Quebec Street	2410	1204	2206	1454
Holly Street	1040	444	854	854

4.4 Channel Stability Analysis

In urban and developing areas channel stability is a common problem. As impervious areas increase there are significant increases in base flows, as well as in the frequently occurring low flows and runoff peaks. Maximum velocities in easily eroded soils are only 2.5 to 3 feet per second. In this watershed, soils are not classified as easily eroded and should be able to carry a maximum of 5 to 7 feet per second without eroding. Average velocities found in this watershed reach 5 fps during the 5-year event, and climb to 8 fps during the 100-year event. As urbanization continues, the frequency of these events will increase along with higher base flows.

To mitigate urbanization effects, a system of check and drop structures has been developed to stabilize the longitudinal slope for future flow rates. Based on existing soils, vegetation, and anticipated flows, this watershed shows some natural resistance to erosion. A design plan was formulated to utilize the natural stability and enhance it, where necessary, to withstand fully developed watershed conditions.

Areas with small upstream drainage tend to stabilize at steeper slopes than areas with large upstream drainage. The stable design slope of 0.4% is consistent with reaches in the Denver metro area that receive runoff from large upstream areas. Combining this information, the following design criteria were produced for locating check structures in this study:

Table IV-4
Check/Drop Structure Design Criteria

Upstream Drainage Area	Stable Design Slope
<130AC	1.0%
130-320AC	0.8%
320-640AC	0.6%
>640AC	0.4%

TODD CREEK

Future Time of Concentration

Velocity calculated per Figure 3-2 in UDFCD Manual
using short grass pasture and lawns in rural (<20%)
using grassed waterways in urban (>20%)

Subarea No.	Length (ft)	initial S1 (ft/ft)	Weighted Slope (ft/ft)		C5	*Initial overland flow* L (ft)	S (%)	Ti (min)	*Travel time in channel* L (ft)	V (fps)	Tt (min)	*Check Urbanized Tc* (minimum)	Tc (min)
1	2850	0.0365	0.0364		0.20	500	3.65	23.5	2350	1.42	27.6		51.1
2	4117	0.0138	0.0138		0.20	500	1.38	32.5	3617	0.79	76.3		108.8
3	5870	0.0227	0.0226		0.20	500	2.27	27.6	5370	1.07	83.6		111.2
4	6997	0.0173	0.0172		0.20	500	1.73	30.2	6497	0.90	120.3		150.5
5	4407	0.0275	0.0274		0.20	500	2.75	25.9	3907	1.19	54.7		80.6
6	4192	0.0260	0.0259		0.20	500	2.60	26.4	3692	1.15	53.5		79.9
7	4102	0.0275	0.0275		0.20	500	2.75	25.8	3602	1.19	50.4		76.3
8	5821	0.0232	0.0231	urban	0.25	300	2.32	20.0	5521	2.19	42.0	42.3	62.0
9	5518	0.0217	0.0217		0.20	500	2.17	28.0	5018	1.04	80.4		108.4
10	3728	0.0354	0.0353	urban	0.25	300	3.54	17.4	3428	2.87	19.9	30.7	37.3
11	3528	0.0232	0.0232		0.20	500	2.32	27.4	3028	1.08	46.7		74.1
12	1889	0.0206	0.0206		0.20	500	2.06	28.5	1389	1.02	22.7		51.2
13	4543	0.0205	0.0204	urban	0.20	500	2.05	28.5	4043	1.02	66.1	35.2	94.6
14	3438	0.0177	0.0177		0.25	500	1.77	28.3	2938	0.91	53.8		82.1
15	3981	0.0234	0.0233	urban	0.20	500	2.34	27.3	3481	1.09	53.2	32.1	80.5
16	4493	0.0314	0.0313		0.20	500	3.14	24.8	3993	1.29	51.6		76.3
17	4716	0.0271	0.0271		0.20	500	2.71	26.0	4216	1.19	59.0		85.0
18	3918	0.0179	0.0178		0.20	500	1.79	29.9	3418	0.92	61.9		91.8
19	3566	0.0227	0.0226	urban	0.60	300	2.27	11.9	3266	2.18	25.0	29.8	36.8
20	3150	0.0225	0.0225	urban	0.47	300	2.25	15.0	2850	2.16	22.0	27.5	37.0
21	2914	0.0254	0.0253	urban	0.20	500	2.54	26.6	2414	1.14	35.3	26.2	61.9
22	2988	0.0284	0.0284	urban	0.20	500	2.84	25.6	2488	1.21	34.3	26.6	59.8
23	5032	0.0203	0.0202	urban	0.20	500	2.03	28.6	4532	1.01	74.8	38.0	103.4
24	3175	0.0261	0.0261	urban	0.20	500	2.61	26.3	2675	1.15	38.8	27.6	65.1
25	4443	0.0227	0.0227	urban	0.36	300	2.27	17.6	4143	2.07	33.4	34.7	50.9
26	2917	0.0336	0.0335	urban	0.48	300	3.36	12.9	2617	2.07	21.1	26.2	34.0
27	2798	0.0204	0.0203	urban	0.48	300	2.04	15.2	2498	2.07	20.1	25.5	35.4
28	3129	0.0294	0.0293	urban	0.67	300	2.94	9.4	2829	2.07	22.8	27.4	32.1
29	1081	0.0141	0.0141	urban	0.28	300	1.41	22.8	781	2.07	6.3	16.0	29.1
30	3460	0.0140	0.0140	urban	0.46	300	1.40	17.8	3160	2.07	25.4	29.2	43.3
31	3125	0.0259	0.0258	urban	0.45	300	2.59	14.8	2825	2.07	22.7	27.4	37.5
32	3188	0.0201	0.0200	urban	0.63	300	2.01	11.6	2888	2.07	23.3	27.7	34.9
33	3367	0.0236	0.0236	urban	0.72	300	2.36	8.9	3067	2.20	23.2	28.7	32.1
34	2627	0.0213	0.0213	urban	0.73	300	2.13	9.0	2327	2.11	18.4	24.6	27.3
35	2141	0.0439	0.0419	urban	0.64	300	4.39	8.8	1841	2.55	12.0	21.9	20.8
36	2532	0.0257	0.0256	urban	0.72	300	2.57	8.7	2232	2.87	13.0	24.1	21.6
37	2675	0.0370	0.0369	urban	0.63	300	3.70	9.5	2375	2.95	13.4	24.9	22.9
38	3778	0.0296	0.0296	urban	0.73	300	2.96	8.0	3478	2.75	21.1	31.0	29.1
39	3405	0.0496	0.0469	urban	0.73	300	4.96	6.8	3105	3.40	15.2	28.9	22.0
40	4714	0.0193	0.0192	urban	0.69	300	1.93	10.3	4414	2.05	35.9	36.2	46.2
41	5632	0.0194	0.0193	urban	0.58	300	1.94	13.0	5332	2.07	42.9	41.3	55.9
42	4857	0.0210	0.0209	urban	0.59	300	2.10	12.4	4557	2.07	36.7	37.0	49.1
43	3797	0.0205	0.0205	urban	0.69	300	2.05	10.1	3497	2.09	27.9	31.1	37.9
44	3138	0.0236	0.0235	urban	0.77	300	2.36	7.7	2838	2.50	18.9	27.4	26.7
45	3664	0.0349	0.0348	urban	0.64	300	3.49	9.5	3364	2.86	19.6	30.4	29.1
46	2602	0.0342	0.0341	urban	0.50	300	3.42	12.4	2302	2.84	13.5	24.5	25.9
47	1325	0.0438	0.0419	urban	0.35	300	4.38	14.3	1025	3.13	5.5	17.4	19.8
48	3232	0.0325	0.0324	urban	0.69	300	3.25	8.6	2932	2.85	17.1	28.0	25.8
49	1248	0.0304	0.0304	urban	0.69	300	3.04	8.8	948	1.50	10.5	16.9	19.4
50	4317	0.0127	0.0127	urban	0.57	300	1.27	15.2	4017	1.74	38.5	34.0	53.7
51	4808	0.0183	0.0182	urban	0.64	300	1.83	11.7	4508	2.00	37.6	36.7	49.3
52	3336	0.0246	0.0245	urban	0.64	300	2.46	10.6	3036	2.24	22.6	28.5	33.2
53	4096	0.0234	0.0234	urban	0.48	300	2.34	14.6	3796	2.20	28.8	32.8	43.3
54	3099	0.0210	0.0209	urban	0.47	300	2.10	15.3	2799	2.10	22.2	27.2	37.6
55	3127	0.0221	0.0220	urban	0.50	300	2.21	14.4	2827	2.15	21.9	27.4	36.3
56	3081	0.0214	0.0214	urban	0.64	300	2.14	11.1	2781	2.07	22.4	27.1	33.5
57	3775	0.0238	0.0238	urban	0.50	300	2.38	14.0	3475	2.20	26.3	31.0	40.3
58	1319	0.0349	0.0348	urban	0.73	300	3.49	7.6	1019	2.83	6.0	17.3	13.6
59	2855	0.0420	0.0409	urban	0.73	300	4.20	7.2	2555	3.10	13.7	25.9	20.9
60	1880	0.0255	0.0255	urban	0.64	300	2.55	10.5	1580	1.77	14.9	20.4	25.4
61	1810	0.0243	0.0242	urban	0.69	300	2.43	9.5	1510	2.70	9.3	20.1	18.8
62	3100	0.0381	0.0380	urban	0.69	300	3.81	8.2	2800	2.70	17.3	27.2	25.5

TODD CREEK

Existing land use is more than 50% open space. However, substantial residential development has been constructed east of Yosemite. This development is large lot, with approx. 1 house per 2.5 acres.

Subarea No.	Area (ac)	Existing % Impervious 5 %	15 %	30 %	40 %	85 %	Composite %
1	41.1	87.1	12.9				6.29
2	121.8	88.3	11.7				6.17
3	127.6	37.4	62.6				11.26
4	127.0	3.3	95.7	1			14.82
5	94.6	56	44				9.40
6	109.0	37.5	62.5				11.25
7	55.7		100				15.00
8	96.1	12.5	41.5	46			20.65
9	119.4		97.9	2.1			15.32
10	90.9	5.4	46.1	48.5			21.74
11	72.5	5.9	94.1				14.41
12	23.5		100				15.00
13	83.6	51.2	48.8				9.88
14	96.6	24.3	45.2	30.5			17.15
15	129.9	31.6	65.7			2.7	13.73
16	113.1		100				15.00
17	121.8		100				15.00
18	102.4		100				15.00
19	100.3	66.5	33.5				8.35
20	61.8	100					5.00
21	74.3	100					5.00
22	65.7	100					5.00
23	120.0	93.7	6.3				5.63
24	78.4	100					5.00
25	114.8	65.7	34.3				8.43
26	67.6	85	15				6.50
27	57.1	100					5.00
28	76.3	100					5.00
29	36.5	100					5.00
30	121.2	100					5.00
31	63.0	50.4	49.6				9.96
32	91.4	100					5.00
33	39.7	100					5.00
34	54.7	100					5.00
35	73.9	100					5.00
36	28.8	100					5.00
37	60.2	100					5.00
38	98.3	100					5.00
39	77.6	75.6	24.4				7.44
40	123.0	100					5.00
41	102.4	80.8	19.2				6.92
42	79.0	51.4	48.6				9.86
43	57.3	100					5.00
44	61.8	100					5.00
45	125.9	100					5.00
46	97.4	99	1				5.10
47	20.2	89.7	10.3				6.03
48	90.0	75.7	24.3				7.43
49	11.5	99	1				5.10
50	104.6	73.2	26.8				7.68
51	98.8	81	19				6.90
52	41.2	97.5	2.5				5.25
53	76.2	77.9	22.1				7.21
54	71.1	82.2	17.8				6.78
55	135.0	100					5.00
56	73.0	89.6	10.4				6.04
57	71.6	87.5	12.5				6.25
58	14.3	88.7	11.3				6.13
59	81.4	100					5.00
60	39.3	98.8	1.2				5.12
61	47.7	100					5.00
62	80.5	100					5.00
	4991.4				existing composite:		8.68

Adams County, Thornton, E470, and current development plans were used to project future land use. Significant commercial and high density residential is anticipated along the E470 corridor.

Subarea No.	Area (ac)	Future % Impervious 5 %	7.5 %	15 %	30 %	45 %	50 %	55 %	65 %	85 %	Composite %
1	41.1			100							15.00
2	121.8			100							15.00
3	127.6			100							15.00
4	127.0			99	1						15.15
5	94.6			100							15.00
6	109.0			100							15.00
7	55.7			100							15.00
8	96.1			54.2	45.8						21.87
9	119.4			97.9	2.1						15.32
10	90.9			51.5	48.5						22.28
11	72.5			100							15.00
12	23.5			100							15.00
13	83.6			49.6		50.4					30.13
14	96.6			69.5	30.5						19.58
15	129.9			59.6		40.4					27.13
16	113.1			100							15.00
17	121.8			100							15.00
18	102.4			100							15.00
19	100.3			36.5						63.5	59.45
20	61.8					54.3				45.7	63.28
21	74.3					100					45.00
22	65.7					100					45.00
23	120.0			19.7		80.3					39.10
24	78.4					100					45.00
25	114.8			55.2		9.4	20.6		2.1	12.7	34.97
26	67.6			23.6		13.8			53.5	9.1	52.26
27	57.1						83.1		16.9		52.54
28	76.3						2.6		66.3	31.1	70.83
29	36.5					71.5	28.5				46.43
30	121.2					60.5			2.4	37.1	60.32
31	63.0					65.5				34.5	58.80
32	91.4					27.2				72.8	74.12
33	39.7	7.4								92.6	79.08
34	54.7	3								97	82.60
35	73.9							57.6		42.4	67.72
36	28.8	6.4								93.6	79.88
37	60.2	10.5						2		87.5	76.00
38	98.3						4.5			95.5	83.43
39	77.6	1.4								98.6	83.88
40	123.0	13.2								86.8	74.44
41	102.4						42.7		35.5	21.8	62.96
42	79.0						38.8		61.2		59.18
43	57.3	17.5								82.5	71.00
44	61.8									100	85.00
45	125.9	1					44.5			54.5	68.63
46	97.4						100				50.00
47	20.2	64.8					7.4			27.8	30.57
48	90.0	10.7					12.2			77.1	72.17
49	11.5	17.6								82.4	70.92
50	104.6						54.4		44.8	0.8	57.00
51	98.8								77.4	22.6	69.52
52	41.2	6.8							50.8	42.4	69.40
53	76.2			19.4			43.5		37.1		48.78
54	71.1			9.8			90.2				46.57
55	135.0						100				50.00
56	73.0								100		65.00
57	71.6						94.6		5.4		50.81
58	14.3								6.2	93.8	83.76
59	81.4						7.6			92.4	82.34
60	39.3								97.2	2.8	65.56
61	47.7	9								91	77.80
62	80.5							100			55.00
	4991.4									future composite:	46.70

Todd Creek SWMM Output for Existing Conditions

100-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	4310	(DIRECT	FLOW)	1	55
102	4341	(DIRECT	FLOW)	1	50
103	4097	(DIRECT	FLOW)	1	45
104	4041	(DIRECT	FLOW)	1	45
105	4026	(DIRECT	FLOW)	1	40
106	3940	(DIRECT	FLOW)	1	35
107	3906	(DIRECT	FLOW)	1	30
108	2466	(DIRECT	FLOW)	1	25
109	2321	(DIRECT	FLOW)	1	20
110	1986	(DIRECT	FLOW)	1	20
111	1230	(DIRECT	FLOW)	1	25
112	1204	(DIRECT	FLOW)	1	20
113	1066	(DIRECT	FLOW)	1	10
114	853	(DIRECT	FLOW)	1	10
115	444	(DIRECT	FLOW)	1	5
116	285	(DIRECT	FLOW)	1	0
117	215	(DIRECT	FLOW)	D	50
118	220	(DIRECT	FLOW)	0	50
119	189	(DIRECT	FLOW)	0	45
120	478	(DIRECT	FLOW)	1	15
121	383	(DIRECT	FLOW)	1	10
122	335	(DIRECT	FLOW)	0	50
123	129	(DIRECT	FLOW)	0	45
124	122	(DIRECT	FLOW)	0	45
125	142	(DIRECT	FLOW)	0	50
126	534	(DIRECT	FLOW)	0	55
127	211	(DIRECT	FLOW)	0	40
128	212	(DIRECT	FLOW)	0	50
129	134	(DIRECT	FLOW)	0	45
130	898	(DIRECT	FLOW)	1	15
131	774	(DIRECT	FLOW)	1	10
132	646	(DIRECT	FLOW)	1	0
133	147	(DIRECT	FLOW)	0	50
134	419	(DIRECT	FLOW)	D	55
135	198	(DIRECT	FLOW)	0	50
136	980	(DIRECT	FLOW)	1	15
137	1046	(DIRECT	FLOW)	1	25
138	292	(DIRECT	FLOW)	0	55
139	50	(DIRECT	FLOW)	0	55
141	2448	(DIRECT	FLOW)	1	35
142	1338	(DIRECT	FLOW)	1	25
143	300	(DIRECT	FLOW)	1	5
144	1051	(DIRECT	FLOW)	1	35
145	489	(DIRECT	FLOW)	1	5
146	693	(DIRECT	FLOW)	1	10
147	503	(DIRECT	FLOW)	1	10
195	181	(DIRECT	FLOW)	0	40
196	137	(DIRECT	FLOW)	0	45
197	462	(DIRECT	FLOW)	1	10
198	302	(DIRECT	FLOW)	1	0
199	474	(DIRECT	FLOW)	1	0
201	4298	9		1	55
202	4062	8.7		1	50
203	4037	6.6		1	45
204	4005	7.6		1	45
205	3870	7.4		1	40
206	3887	6.2		1	35
207	2377	5		1	35
208	2303	3.8		1	25
209	1967	4		1	25
210	1175	3.9		1	25
211	1006	2.4		1	20
212	827	3		1	15
213	442	2		1	10
214	267	1.3		1	10
215	193	0.6		1	5
216	170	1		1	10
217	184	1.4		0	50
218	379	2.3		1	15
219	296	1.9		1	15
220	110	1		1	0
221	78	0.9		1	15
222	115	1.1		1	10
223	489	2.4		1	5
224	194	1.3		0	50
225	198	1.4		1	0
226	968	3.3		1	35
227	932	3.7		1	25
228	735	3		1	20
229	572	2		1	15
230	139	1.6		1	0
231	405	1.9		1	0
232	287	1.2		0	55
233	470	2		1	5
234	134	0.9		0	55
235	113	1.4		1	5
236	300	1.4		1	5
237	458	2.1		1	15
238	187	1		D	55

50-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	3147	(DIRECT	FLOW)	2	0
102	3167	(DIRECT	FLOW)	1	50
103	2988	(DIRECT	FLOW)	1	50
104	2954	(DIRECT	FLOW)	1	45
105	2933	(DIRECT	FLOW)	1	45
106	2870	(DIRECT	FLOW)	1	35
107	2839	(DIRECT	FLOW)	1	35
108	1795	(DIRECT	FLOW)	1	25
109	1693	(DIRECT	FLOW)	1	25
110	1446	(DIRECT	FLOW)	1	20
111	892	(DIRECT	FLOW)	1	30
112	877	(DIRECT	FLOW)	1	20
113	782	(DIRECT	FLOW)	1	15
114	625	(DIRECT	FLOW)	1	10
115	326	(DIRECT	FLOW)	1	5
116	211	(DIRECT	FLOW)	1	0
117	167	(DIRECT	FLOW)	0	45
118	170	(DIRECT	FLOW)	0	50
119	148	(DIRECT	FLOW)	0	40
120	356	(DIRECT	FLOW)	1	15
121	285	(DIRECT	FLOW)	1	10
122	260	(DIRECT	FLOW)	0	50
123	101	(DIRECT	FLOW)	0	40
124	95	(DIRECT	FLOW)	0	45
125	110	(DIRECT	FLOW)	0	50
126	413	(DIRECT	FLOW)	0	55
127	169	(DIRECT	FLOW)	0	40
128	166	(DIRECT	FLOW)	0	50
129	105	(DIRECT	FLOW)	0	45
130	654	(DIRECT	FLOW)	1	20
131	563	(DIRECT	FLOW)	1	15
132	482	(DIRECT	FLOW)	1	0
133	114	(DIRECT	FLOW)	0	45
134	316	(DIRECT	FLOW)	0	55
135	153	(DIRECT	FLOW)	0	50
136	707	(DIRECT	FLOW)	1	20
137	759	(DIRECT	FLOW)	1	25
138	221	(DIRECT	FLOW)	0	55
139	39	(DIRECT	FLOW)	0	55
141	1704	(DIRECT	FLOW)	1	35
142	972	(DIRECT	FLOW)	1	25
143	219	(DIRECT	FLOW)	1	5
144	759	(DIRECT	FLOW)	1	35
145	370	(DIRECT	FLOW)	1	5
146	515	(DIRECT	FLOW)	1	10
147	359	(DIRECT	FLOW)	1	15
195	143	(DIRECT	FLOW)	0	40
196	107	(DIRECT	FLOW)	0	40
197	339	(DIRECT	FLOW)	1	10
198	221	(DIRECT	FLOW)	1	0
199	353	(DIRECT	FLOW)	1	0
201	3131	8.4		2	0
202	2964	7.7		1	55
203	2946	5.8		1	50
204	2926	6.8		1	45
205	2820	6.7		1	45
206	2826	5.3		1	35
207	1727	4.5		1	35
208	1678	3.3		1	30
209	1433	3.5		1	25
210	854	3.5		1	30
211	736	2		1	25
212	603	2.6		1	15
213	324	1.7		1	10
214	194	1.1		1	10
215	135	0.5		1	5
216	124	0.9		1	10
217	142	1.2		0	50
218	281	2.1		1	20
219	220	1.6		1	15
220	82	0.8		1	0
221	57	0.8		1	15
222	85	0.9		1	10
223	370	2.1		1	5
224	151	1.1		0	50
225	152	1.2		1	0
226	701	2.9		1	40
227	672	3.2		1	30
228	532	2.5		1	25
229	417	1.7		1	20
230	105	1.3		1	0
231	301	1.6		1	0
232	216	1		1	0
233	350	1.7		1	5
234	99	0.8		0	55
235	84	1.2		1	5
236	219	1.2		1	5
237	337	1.8		1	15
238	142	0.8		0	55

10-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	1029	(DIRECT	FLOW)	2	10
102	1039	(DIRECT	FLOW)	2	0
103	977	(DIRECT	FLOW)	1	55
104	965	(DIRECT	FLOW)	1	55
105	958	(DIRECT	FLOW)	1	50
106	932	(DIRECT	FLOW)	1	40
107	919	(DIRECT	FLOW)	1	35
108	566	(DIRECT	FLOW)	1	30
109	534	(DIRECT	FLOW)	1	30
110	456	(DIRECT	FLOW)	1	30
111	276	(DIRECT	FLOW)	1	40
112	276	(DIRECT	FLOW)	1	25
113	253	(DIRECT	FLOW)	1	15
114	203	(DIRECT	FLOW)	1	10
115	106	(DIRECT	FLOW)	1	5
116	70	(DIRECT	FLOW)	0	55
117	67	(DIRECT	FLOW)	0	40
118	65	(DIRECT	FLOW)	0	45
119	61	(DIRECT	FLOW)	0	35
120	128	(DIRECT	FLOW)	1	15
121	101	(DIRECT	FLOW)	1	10
122	106	(DIRECT	FLOW)	0	40
123	41	(DIRECT	FLOW)	0	35
124	39	(DIRECT	FLOW)	0	35
125	44	(DIRECT	FLOW)	0	40
126	165	(DIRECT	FLOW)	0	50
127	78	(DIRECT	FLOW)	0	35
128	72	(DIRECT	FLOW)	0	35
129	43	(DIRECT	FLOW)	0	35
130	200	(DIRECT	FLOW)	1	25
131	175	(DIRECT	FLOW)	1	20
132	159	(DIRECT	FLOW)	1	5
133	46	(DIRECT	FLOW)	0	40
134	106	(DIRECT	FLOW)	0	50
135	62	(DIRECT	FLOW)	0	40
136	215	(DIRECT	FLOW)	1	25
137	233	(DIRECT	FLOW)	1	35
138	77	(DIRECT	FLOW)	0	50
139	16	(DIRECT	FLOW)	0	40
141	575	(DIRECT	FLOW)	1	40
142	299	(DIRECT	FLOW)	1	35
143	70	(DIRECT	FLOW)	1	0
144	235	(DIRECT	FLOW)	1	50
145	139	(DIRECT	FLOW)	1	5
146	182	(DIRECT	FLOW)	1	10
147	121	(DIRECT	FLOW)	1	15
195	59	(DIRECT	FLOW)	0	35
196	44	(DIRECT	FLOW)	0	35
197	111	(DIRECT	FLOW)	1	10
198	70	(DIRECT	FLOW)	0	55
199	115	(DIRECT	FLOW)	1	0
201	1024	6.5		2	10
202	968	4.9		2	5
203	962	3.6		1	55
204	955	4.7		1	55
205	913	4.8		1	50
206	915	3.2		1	40
207	554	2.6		1	40
208	529	1.9		1	35
209	452	2		1	35
210	265	2.6		1	40
211	233	1		1	30
212	196	1.5		1	20
213	105	0.9		1	10
214	62	0.6		1	15
215	44	0.3		1	5
216	39	0.4		1	10
217	54	0.7		0	45
218	100	1.3		1	15
219	77	0.9		1	15
220	28	0.4		1	0
221	19	0.5		1	15
222	28	0.5		1	10
223	139	1.3		1	5
224	61	0.6		0	45
225	60	0.7		0	55
226	215	1.7		1	50
227	203	1.7		1	35
228	164	1.4		1	30
229	131	0.9		1	25
230	37	0.7		0	55
231	98	0.8		1	5
232	73	0.5		0	55
233	114	0.9		1	5
234	31	0.4		0	55
235	28	0.6		1	0
236	70	0.6		1	0
237	110	0.9		1	15
238	50	0.4		0	55

5-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	563	(DIRECT	FLOW)	2	15
102	571	(DIRECT	FLOW)	2	0
103	535	(DIRECT	FLOW)	1	55
104	528	(DIRECT	FLOW)	1	50
105	523	(DIRECT	FLOW)	1	50
106	507	(DIRECT	FLOW)	1	40
107	499	(DIRECT	FLOW)	1	35
108	304	(DIRECT	FLOW)	1	25
109	283	(DIRECT	FLOW)	1	15
110	236	(DIRECT	FLOW)	1	30
111	140	(DIRECT	FLOW)	1	50
112	144	(DIRECT	FLOW)	1	35
113	138	(DIRECT	FLOW)	1	15
114	113	(DIRECT	FLOW)	1	10
115	60	(DIRECT	FLOW)	1	5
116	40	(DIRECT	FLOW)	0	55
117	43	(DIRECT	FLOW)	0	40
118	40	(DIRECT	FLOW)	0	45
119	39	(DIRECT	FLOW)	0	35
120	75	(DIRECT	FLOW)	1	15
121	60	(DIRECT	FLOW)	1	10
122	68	(DIRECT	FLOW)	0	40
123	26	(DIRECT	FLOW)	0	35
124	25	(DIRECT	FLOW)	0	35
125	29	(DIRECT	FLOW)	0	40
126	107	(DIRECT	FLOW)	0	50
127	55	(DIRECT	FLOW)	0	35
128	50	(DIRECT	FLOW)	0	40
129	27	(DIRECT	FLOW)	0	35
130	101	(DIRECT	FLOW)	1	35
131	91	(DIRECT	FLOW)	1	25
132	90	(DIRECT	FLOW)	1	5
133	30	(DIRECT	FLOW)	0	40
134	61	(DIRECT	FLOW)	0	55
135	40	(DIRECT	FLOW)	0	40
136	107	(DIRECT	FLOW)	1	30
137	119	(DIRECT	FLOW)	1	40
138	45	(DIRECT	FLOW)	0	50
139	10	(DIRECT	FLOW)	0	40
141	307	(DIRECT	FLOW)	1	40
142	151	(DIRECT	FLOW)	1	45
143	40	(DIRECT	FLOW)	0	55
144	120	(DIRECT	FLOW)	1	55
145	88	(DIRECT	FLOW)	1	10
146	107	(DIRECT	FLOW)	1	5
147	68	(DIRECT	FLOW)	1	15
195	39	(DIRECT	FLOW)	0	35
196	28	(DIRECT	FLOW)	0	40
197	62	(DIRECT	FLOW)	1	10
198	40	(DIRECT	FLOW)	0	50
199	64	(DIRECT	FLOW)	1	5
201	560	5.7		2	15
202	529	3.8		2	5
203	526	2.8		1	55
204	522	3.5		1	55
205	494	4.1		1	50
206	496	2.3		1	40
207	294	1.8		1	40
208	281	1.3		1	30
209	235	1.4		1	35
210	135	2.2		1	30
211	123	0.7		1	40
212	107	1.1		1	25
213	59	0.6		1	10
214	33	0.4		1	20
215	24	0.2		1	10
216	21	0.3		1	15
217	33	0.5		0	45
218	59	1		1	15
219	45	0.7		1	15
220	16	0.3		1	5
221	10	0.3		1	15
222	15	0.4		1	10
223	88	1		1	10
224	40	0.5		0	50
225	39	0.6		1	0
226	110	1.2		2	0
227	102	1.2		1	45
228	84	0.9		1	40
229	69	0.6		1	30
230	22	0.5		1	0
231	55	0.6		1	10
232	42	0.4		1	0
233	63	0.6		1	10
234	17	0.3		0	55
235	16	0.5		1	5
236	40	0.4		0	55
237	61	0.7		1	15
238	29	0.3		1	0

2-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	73	(DIRECT	FLOW)	2	5
102	74	(DIRECT	FLOW)	1	55
103	67	(DIRECT	FLOW)	2	0
104	65	(DIRECT	FLOW)	1	55
105	64	(DIRECT	FLOW)	1	50
106	56	(DIRECT	FLOW)	1	40
107	52	(DIRECT	FLOW)	1	35
108	24	(DIRECT	FLOW)	1	35
109	24	(DIRECT	FLOW)	1	10
110	21	(DIRECT	FLOW)	1	10
111	9	(DIRECT	FLOW)	1	5
112	7	(DIRECT	FLOW)	0	45
113	6	(DIRECT	FLOW)	1	40
114	7	(DIRECT	FLOW)	1	25
115	6	(DIRECT	FLOW)	0	40
116	4	(DIRECT	FLOW)	0	40
117	5	(DIRECT	FLOW)	0	40
118	3	(DIRECT	FLOW)	1	0
119	4	(DIRECT	FLOW)	0	35
120	9	(DIRECT	FLOW)	1	20
121	7	(DIRECT	FLOW)	1	20
122	10	(DIRECT	FLOW)	0	40
123	3	(DIRECT	FLOW)	0	40
124	3	(DIRECT	FLOW)	0	40
125	3	(DIRECT	FLOW)	0	40
126	24	(DIRECT	FLOW)	1	0
127	16	(DIRECT	FLOW)	0	35
128	13	(DIRECT	FLOW)	0	40
129	3	(DIRECT	FLOW)	0	40
130	7	(DIRECT	FLOW)	0	40
131	2	(DIRECT	FLOW)	0	55
132	4	(DIRECT	FLOW)	1	20
133	3	(DIRECT	FLOW)	0	40
134	4	(DIRECT	FLOW)	0	45
135	4	(DIRECT	FLOW)	0	40
136	10	(DIRECT	FLOW)	0	40
137	13	(DIRECT	FLOW)	1	0
138	3	(DIRECT	FLOW)	0	40
139	0	(DIRECT	FLOW)	0	0
141	22	(DIRECT	FLOW)	1	55
142	11	(DIRECT	FLOW)	1	0
143	4	(DIRECT	FLOW)	0	55
144	14	(DIRECT	FLOW)	1	10
145	18	(DIRECT	FLOW)	1	25
146	10	(DIRECT	FLOW)	1	20
147	5	(DIRECT	FLOW)	1	30
195	4	(DIRECT	FLOW)	0	35
196	3	(DIRECT	FLOW)	0	40
197	5	(DIRECT	FLOW)	1	20
198	6	(DIRECT	FLOW)	0	35
139	2	(DIRECT	FLOW)	0	50
201	73	2.7		2	5
202	65	1.5		2	10
203	65	1.1		2	0
204	63	1.2		1	55
205	54	1.6		1	55
206	52	0.7		1	45
207	19	0.4		2	5
208	22	0.3		1	40
209	19	0.3		1	30
210	6	0.5		1	15
211	4	0.1		2	35
212	6	0.2		1	45
213	5	0.1		1	20
214	2	0.1		1	25
215	1	0		1	35
216	1	0		1	45
217	3	0.1		1	0
218	7	0.3		1	30
219	5	0.2		1	25
220	1	0.1		1	10
221	1	0.1		1	15
222	1	0.1		1	20
223	18	0.4		1	25
224	10	0.2		0	55
225	8	0.2		1	10
226	8	0.3		1	50
227	4	0.2		1	15
228	2	0.1		3	35
229	2	0.1		2	50
230	2	0.1		1	20
231	2	0.1		1	15
232	2	0.1		1	30
233	2	0.1		1	40
234	1	0		1	5
235	1	0.1		1	10
236	4	0.1		0	55
237	5	0.1		1	30
238	2	0.1		1	20

0.4" Average

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	1	(DIRECT	FLOW)	3	25
102	1	(DIRECT	FLOW)	2	35
103	1	(DIRECT	FLOW)	1	40
104	2	(DIRECT	FLOW)	1	15
105	3	(DIRECT	FLOW)	1	10
106	3	(DIRECT	FLOW)	0	35
107	0	(DIRECT	FLOW)	2	45
108	0	(DIRECT	FLOW)	0	0
109	0	(DIRECT	FLOW)	0	0
110	0	(DIRECT	FLOW)	0	0
111	0	(DIRECT	FLOW)	0	0
112	0	(DIRECT	FLOW)	0	0
113	0	(DIRECT	FLOW)	0	0
114	0	(DIRECT	FLOW)	0	0
115	0	(DIRECT	FLOW)	0	0
116	0	(DIRECT	FLOW)	0	0
117	0	(DIRECT	FLOW)	0	0
118	0	(DIRECT	FLOW)	0	0
119	0	(DIRECT	FLOW)	0	0
120	0	(DIRECT	FLOW)	0	0
121	0	(DIRECT	FLOW)	0	0
122	0	(DIRECT	FLOW)	0	0
123	0	(DIRECT	FLOW)	0	0
124	0	(DIRECT	FLOW)	0	0
125	0	(DIRECT	FLOW)	0	0
126	0	(DIRECT	FLOW)	0	55
127	2	(DIRECT	FLOW)	0	35
128	0	(DIRECT	FLOW)	0	0
129	0	(DIRECT	FLOW)	0	0
130	0	(DIRECT	FLOW)	0	0
131	0	(DIRECT	FLOW)	0	0
132	0	(DIRECT	FLOW)	0	0
133	0	(DIRECT	FLOW)	0	0
134	0	(DIRECT	FLOW)	0	0
135	0	(DIRECT	FLOW)	0	0
136	0	(DIRECT	FLOW)	0	0
137	0	(DIRECT	FLOW)	0	0
138	0	(DIRECT	FLOW)	0	0
139	0	(DIRECT	FLOW)	0	0
141	0	(DIRECT	FLOW)	0	0
142	0	(DIRECT	FLOW)	0	0
143	0	(DIRECT	FLOW)	0	0
144	0	(DIRECT	FLOW)	0	0
145	0	(DIRECT	FLOW)	2	45
146	0	(DIRECT	FLOW)	0	0
147	0	(DIRSCT	FLOW)	0	0
195	0	(DIRECT	FLOW)	0	0
196	0	(DIRECT	FLOW)	0	0
197	0	(DIRECT	FLOW)	0	0
198	0	(DIRECT	FLOW)	0	0
199	0	(DIRECT	FLOW)	0	0
201	1	0.2		3	25
202	1	0.1		2	35
203	1	0.1		1	40
204	2	0.2		1	15
205	1	0.2		1	15
206	0	0		5	25
207	0	0		0	0
208	0	0		0	0
209	0	0		0	0
210	0	0		0	0
211	0	0		0	0
212	0	0		0	0
213	0	0		0	0
214	0	0		0	0
215	0	0		0	0
216	0	0		0	0
217	0	0		0	0
218	0	0		0	0
219	0	0		0	0
220	0	0		0	0
221	0	0		0	0
222	0	0		0	0
223	0	0		2	45
224	0	0		0	55
225	0	0		0	0
226	0	0		0	0
227	0	0		0	0
228	0	0		0	0
229	0	0		0	0
230	0	0		0	0
231	0	0		0	0
232	0	0		0	0
233	0	0		0	0
234	0	0		0	0
235	0	0		0	0
236	0	0		0	0
237	0	0		0	0
238	0	0		0	0

Todd Creek SWMM Output for Future Conditions

100-year

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	7279	(DIRECT	FLOW)	1	35
102	7401	(DIRECT	FLOW)	1	30
103	7186	(DIRECT	FLOW)	1	25
104	7109	(DIRECT	FLOW)	1	25
105	7104	(DIRECT	FLOW)	1	20
106	7077	(DIRECT	FLOW)	1	15
107	6997	(DIRECT	FLOW)	1	10
108	4604	(DIRECT	FLOW)	1	5
109	4338	(DIRECT	FLOW)	1	0
110	3768	(DIRECT	FLOW)	1	0
111	2253	(DIRECT	FLOW)	1	10
112	2206	(DIRECT	FLOW)	1	5
113	2055	(DIRECT	FLOW)	0	55
114	1641	(DIRECT	FLOW)	0	50
115	854	(DIRECT	FLOW)	0	50
116	589	(DIRECT	FLOW)	0	45
117	558	(DIRECT	FLOW)	0	35
118	451	(DIRECT	FLOW)	0	40
119	438	(DIRECT	FLOW)	0	35
120	1163	(DIRECT	FLOW)	0	50
121	921	(DIRECT	FLOW)	0	50
122	999	(DIRECT	FLOW)	0	40
123	259	(DIRECT	FLOW)	0	40
124	211	(DIRECT	FLOW)	0	40
125	425	(DIRECT	FLOW)	0	35
126	691	(DIRECT	FLOW)	0	50
127	225	(DIRECT	FLOW)	0	40
128	307	(DIRECT	FLOW)	0	40
129	301	(DIRECT	FLOW)	0	35
130	1740	(DIRECT	FLOW)	1	0
131	1591	(DIRECT	FLOW)	0	55
132	1392	(DIRECT	FLOW)	0	45
133	473	(DIRECT	FLOW)	0	35
134	938	(DIRECT	FLOW)	0	45
135	591	(DIRECT	FLOW)	0	35
136	1841	(DIRECT	FLOW)	1	0
137	1887	(DIRECT	FLOW)	1	5
138	731	(DIRECT	FLOW)	0	40
139	139	(DIRECT	FLOW)	0	40
141	4575	(DIRECT	FLOW)	1	10
142	2420	(DIRECT	FLOW)	1	5
143	575	(DIRECT	FLOW)	0	50
144	1829	(DIRECT	FLOW)	1	15
145	618	(DIRECT	FLOW)	1	0
146	1608	(DIRECT	FLOW)	0	50
147	961	(DIRECT	FLOW)	0	55
195	277	(DIRECT	FLOW)	0	40
196	329	(DIRECT	FLOW)	0	40
197	875	(DIRECT	FLOW)	0	55
198	586	(DIRECT	FLOW)	0	45
199	1003	(DIRECT	FLOW)	0	50
201	7246	10.3		1	35
202	7009	10.6		1	30
203	7087	8.3		1	25
204	7057	9.1		1	25
205	6878	8.9		1	20
206	6971	7.9		1	15
207	4441	6.3		1	10
208	4314	5.1		1	5
209	3740	5.4		1	5
210	2152	4.7		1	10
211	1899	3.3		1	5
212	1555	4		1	0
213	845	2.9		0	55
214	506	1.9		0	55
215	391	1		0	45
216	299	1.4		0	50
217	394	2.1		0	40
218	905	3		0	55
219	719	2.9		0	50
220	205	1.4		0	55
221	120	1.1		1	5
222	261	1.7		0	45
223	618	2.7		1	0
224	204	1.3		0	50
225	272	1.7		0	50
226	1701	4.2		1	20
227	1729	5		1	5
228	1461	4.2		1	5
229	1150	2.9		0	55
230	386	2.7		0	40
231	868	2.9		0	50
232	691	2		0	45
233	1015	3.1		0	50
234	208	1.2		0	50
235	240	2		0	50
236	575	2.1		0	50
237	871	3		0	55
238	504	1.8		0	40

50-year

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	5705	(DIRECT	FLOW)	1	40
102	5804	(DIRECT	FLOW)	1	30
103	5579	(DIRECT	FLOW)	1	30
104	5549	(DIRECT	FLOW)	1	25
105	5523	(DIRECT	FLOW)	1	20
106	5522	(DIRECT	FLOW)	1	15
107	5453	(DIRECT	FLOW)	1	10
108	3636	(DIRECT	FLOW)	1	0
109	3440	(DIRECT	FLOW)	1	0
110	2985	(DIRECT	FLOW)	1	0
111	1771	(DIRECT	FLOW)	1	10
112	1738	(DIRECT	FLOW)	1	5
113	1646	(DIRECT	FLOW)	0	55
114	1316	(DIRECT	FLOW)	0	50
115	682	(DIRECT	FLOW)	0	50
116	475	(DIRECT	FLOW)	0	45
117	471	(DIRECT	FLOW)	0	35
118	369	(DIRECT	FLOW)	0	40
119	361	(DIRECT	FLOW)	0	35
120	946	(DIRECT	FLOW)	0	50
121	754	(DIRECT	FLOW)	0	50
122	833	(DIRECT	FLOW)	0	40
123	221	(DIRECT	FLOW)	0	40
124	176	(DIRECT	FLOW)	0	40
125	363	(DIRECT	FLOW)	0	35
126	544	(DIRECT	FLOW)	0	50
127	181	(DIRECT	FLOW)	0	40
128	249	(DIRECT	FLOW)	0	40
129	249	(DIRECT	FLOW)	0	35
130	1386	(DIRECT	FLOW)	1	0
131	1286	(DIRECT	FLOW)	0	55
132	1142	(DIRECT	FLOW)	0	45
133	406	(DIRECT	FLOW)	0	35
134	775	(DIRECT	FLOW)	0	45
135	505	(DIRECT	FLOW)	0	35
136	1459	(DIRECT	FLOW)	1	0
137	1483	(DIRECT	FLOW)	1	5
138	611	(DIRECT	FLOW)	0	40
139	116	(DIRECT	FLOW)	0	40
141	3588	(DIRECT	FLOW)	1	10
142	1890	(DIRECT	FLOW)	1	5
143	463	(DIRECT	FLOW)	0	50
144	1432	(DIRECT	FLOW)	1	20
145	479	(DIRECT	FLOW)	1	0
146	1308	(DIRECT	FLOW)	0	50
147	765	(DIRECT	FLOW)	0	55
195	230	(DIRECT	FLOW)	0	40
196	278	(DIRECT	FLOW)	0	35
197	697	(DIRECT	FLOW)	0	55
198	474	(DIRECT	FLOW)	0	45
199	821	(DIRECT	FLOW)	0	50
201	5682	9.7		1	40
202	5504	9.8		1	35
203	5510	7.5		1	30
204	5508	8.4		1	25
205	5348	8.2		1	20
206	5440	7.1		1	15
207	3488	5.7		1	10
208	3411	4.6		1	5
209	2955	4.8		1	5
210	1694	4.3		1	10
211	1506	2.9		1	5
212	1237	3.6		1	0
213	673	2.6		0	55
214	401	1.7		0	55
215	313	0.9		0	45
216	235	1.3		0	50
217	323	1.9		0	40
218	737	2.8		0	55
219	588	2.7		0	50
220	168	1.2		0	55
221	94	1		1	5
222	215	1.6		0	45
223	479	2.4		1	0
224	160	1.1		0	50
225	215	1.5		0	50
226	1340	3.8		1	20
227	1367	4.5		1	10
228	1177	3.8		1	5
229	928	2.6		0	55
230	326	2.5		0	40
231	713	2.6		0	50
232	573	1.8		0	45
233	831	2.8		0	50
234	169	1		0	50
235	199	1.8		0	50
236	463	1.8		0	50
237	693	2.7		0	55
238	419	1.6		0	40

10-year

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	2640	(DIRECT	FLOW)	1	45
102	2689	(DIRECT	FLOW)	1	40
103	2614	(DIRECT	FLOW)	1	35
104	2602	(DIRECT	FLOW)	1	30
105	2599	(DIRECT	FLOW)	1	25
106	2597	(DIRECT	FLOW)	1	20
107	2582	(DIRECT	FLOW)	1	15
108	1781	(DIRECT	FLOW)	0	55
109	1694	(DIRECT	FLOW)	0	55
110	1469	(DIRECT	FLOW)	0	55
111	866	(DIRECT	FLOW)	1	10
112	852	(DIRECT	FLOW)	1	0
113	819	(DIRECT	FLOW)	0	55
114	646	(DIRECT	FLOW)	0	45
115	325	(DIRECT	FLOW)	0	45
116	236	(DIRECT	FLOW)	0	40
117	266	(DIRECT	FLOW)	0	30
118	203	(DIRECT	FLOW)	0	35
119	210	(DIRECT	FLOW)	0	30
120	493	(DIRECT	FLOW)	0	50
121	406	(DIRECT	FLOW)	0	45
122	502	(DIRECT	FLOW)	0	35
123	136	(DIRECT	FLOW)	0	35
124	100	(DIRECT	FLOW)	0	35
125	230	(DIRECT	FLOW)	0	30
126	239	(DIRECT	FLOW)	0	45
127	85	(DIRECT	FLOW)	0	35
128	123	(DIRECT	FLOW)	0	35
129	140	(DIRECT	FLOW)	0	30
130	696	(DIRECT	FLOW)	1	0
131	659	(DIRECT	FLOW)	0	55
132	623	(DIRECT	FLOW)	0	45
133	266	(DIRECT	FLOW)	0	30
134	440	(DIRECT	FLOW)	0	40
135	313	(DIRECT	FLOW)	0	30
136	722	(DIRECT	FLOW)	1	0
137	723	(DIRECT	FLOW)	1	10
138	359	(DIRECT	FLOW)	0	35
139	70	(DIRECT	FLOW)	0	35
141	1730	(DIRECT	FLOW)	1	10
142	920	(DIRECT	FLOW)	1	10
143	237	(DIRECT	FLOW)	0	45
144	685	(DIRECT	FLOW)	1	25
145	197	(DIRECT	FLOW)	1	0
146	687	(DIRECT	FLOW)	0	45
147	364	(DIRECT	FLOW)	0	50
195	141	(DIRECT	FLOW)	0	35
196	179	(DIRECT	FLOW)	0	30
197	333	(DIRECT	FLOW)	0	50
198	245	(DIRECT	FLOW)	0	40
199	448	(DIRECT	FLOW)	0	45
201	2631	8		1	45
202	2583	7.3		1	40
203	2590	5.5		1	35
204	2588	6.6		1	30
205	2533	6.5		1	25
206	2568	5.1		1	20
207	1692	4.4		1	10
208	1679	3.3		1	0
209	1459	3.5		1	0
210	829	3.5		1	10
211	737	2		1	5
212	597	2.6		0	55
213	320	1.7		0	50
214	185	1.1		0	50
215	150	0.6		0	40
216	106	0.8		0	45
217	180	1.4		0	35
218	387	2.3		0	50
219	312	1.9		0	45
220	94	0.9		0	50
221	45	0.7		1	0
222	117	1.1		0	40
223	197	1.5		1	0
224	66	0.7		0	45
225	95	0.9		0	45
226	652	2.8		1	25
227	680	3.2		1	10
228	600	2.7		1	0
229	483	1.8		0	55
230	199	1.9		0	35
231	386	1.8		0	45
232	327	1.3		0	40
233	439	1.9		0	45
234	89	0.7		0	45
235	114	1.4		0	45
236	237	1.3		0	45
237	328	1.7		0	55
238	238	1.1		0	35

5-year

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	1953	(DIRECT	FLOW)	1	50
102	1998	(DIRECT	FLOW)	1	40
103	1965	(DIRECT	FLOW)	1	35
104	1957	(DIRECT	FLOW)	1	30
105	1960	(DIRECT	FLOW)	1	30
106	1981	(DIRECT	FLOW)	1	20
107	1973	(DIRECT	FLOW)	1	15
108	1394	(DIRECT	FLOW)	1	.0
109	1330	(DIRECT	FLOW)	0	55
110	1155	(DIRECT	FLOW)	0	55
111	670	(DIRECT	FLOW)	1	10
112	663	(DIRECT	FLOW)	1	5
113	640	(DIRECT	FLOW)	0	55
114	497	(DIRECT	FLOW)	0	50
115	244	(DIRECT	FLOW)	0	50
116	179	(DIRECT	FLOW)	0	40
117	204	(DIRECT	FLOW)	0	30
118	158	(DIRECT	FLOW)	0	35
119	165	(DIRECT	FLOW)	0	30
120	394	(DIRECT	FLOW)	0	45
121	322	(DIRECT	FLOW)	0	45
122	410	(DIRECT	FLOW)	0	35
123	112	(DIRECT	FLOW)	0	35
124	79	(DIRECT	FLOW)	0	35
125	189	(DIRECT	FLOW)	0	30
126	167	(DIRECT	FLOW)	0	45
127	61	(DIRECT	FLOW)	0	35
128	90	(DIRECT	FLOW)	0	35
129	108	(DIRECT	FLOW)	0	30
130	545	(DIRECT	FLOW)	1	0
131	525	(DIRECT	FLOW)	0	55
132	496	(DIRECT	FLOW)	0	45
133	224	(DIRECT	FLOW)	0	30
134	352	(DIRECT	FLOW)	0	40
135	253	(DIRECT	FLOW)	0	30
136	565	(DIRECT	FLOW)	1	0
137	559	(DIRECT	FLOW)	1	10
138	288	(DIRECT	FLOW)	0	35
139	57	(DIRECT	FLOW)	0	35
141	1354	(DIRECT	FLOW)	1	10
142	711	(DIRECT	FLOW)	1	10
143	184	(DIRECT	FLOW)	0	45
144	520	(DIRECT	FLOW)	1	25
145	136	(DIRECT	FLOW)	1	0
146	550	(DIRECT	FLOW)	0	45
147	275	(DIRECT	FLOW)	0	55
195	117	(DIRECT	FLOW)	0	35
196	151	(DIRECT	FLOW)	0	35
197	251	(DIRECT	FLOW)	0	50
198	191	(DIRECT	FLOW)	0	40
199	353	(DIRECT	FLOW)	0	45
201	1948	7.5		1	50
202	1931	6.5		1	40
203	1950	4.9		1	35
204	1948	6		1	30
205	1920	6		1	30
206	1962	4.5		1	20
207	1330	4.1		1	10
208	1316	2.9		1	0
209	1146	3.1		1	0
210	641	3.2		1	10
211	570	1.7		1	5
212	455	2.3		1	0
213	240	1.4		0	50
214	139	0.9		0	55
215	113	0.5		0	45
216	78	0.7		0	50
217	140	1.2		0	35
218	305	2.1		0	50
219	247	1.7		0	50
220	76	0.8		0	50
221	35	0.6		1	0
222	94	1		0	40
223	136	1.2		1	0
224	44	0.5		0	50
225	67	0.8		0	50
226	500	2.5		1	25
227	531	2.8		1	10
228	478	2.4		1	5
229	379	1.6		1	0
230	163	1.7		0	35
231	301	1.6		0	45
232	260	1.1		0	40
233	346	1.7		0	50
234	70	0.6		0	45
235	94	1.2		0	45
236	184	1.1		0	45
237	248	1.5		0	55
238	187	1		0	35

2-year

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	946	(DIRECT	FLOW)	2	5
102	973	(DIRECT	FLOW)	1	55
103	972	(DIRECT	FLOW)	1	45
104	973	(DIRECT	FLOW)	1	45
105	976	(DIRECT	FLOW)	1	40
106	999	(DIRECT	FLOW)	1	25
107	1000	(DIRECT	FLOW)	1	20
108	745	(DIRECT	FLOW)	1	0
109	720	(DIRECT	FLOW)	0	55
110	630	(DIRECT	FLOW)	0	50
111	356	(DIRECT	FLOW)	1	15
112	355	(DIRECT	FLOW)	1	10
113	341	(DIRECT	FLOW)	0	55
114	252	(DIRECT	FLOW)	0	50
115	115	(DIRECT	FLOW)	0	50
116	84	(DIRECT	FLOW)	0	40
117	109	(DIRECT	FLOW)	0	30
118	78	(DIRECT	FLOW)	0	35
119	87	(DIRECT	FLOW)	0	30
120	224	(DIRECT	FLOW)	0	50
121	177	(DIRECT	FLOW)	0	50
122	242	(DIRECT	FLOW)	0	35
123	69	(DIRECT	FLOW)	0	35
124	43	(DIRECT	FLOW)	0	35
125	119	(DIRECT	FLOW)	0	30
126	56	(DIRECT	FLOW)	0	45
127	19	(DIRECT	FLOW)	0	35
128	36	(DIRECT	FLOW)	0	35
129	54	(DIRECT	FLOW)	0	30
130	301	(DIRECT	FLOW)	1	10
131	288	(DIRECT	FLOW)	1	0
132	273	(DIRECT	FLOW)	0	50
133	149	(DIRECT	FLOW)	0	30
134	191	(DIRECT	FLOW)	0	40
135	153	(DIRECT	FLOW)	0	30
136	310	(DIRECT	FLOW)	1	10
137	297	(DIRECT	FLOW)	1	20
138	164	(DIRECT	FLOW)	0	35
139	34	(DIRECT	FLOW)	0	35
141	718	(DIRECT	FLOW)	1	15
142	377	(DIRECT	FLOW)	1	10
143	98	(DIRECT	FLOW)	0	45
144	268	(DIRECT	FLOW)	1	35
145	44	(DIRECT	FLOW)	1	10
146	307	(DIRECT	FLOW)	0	45
147	132	(DIRECT	FLOW)	0	55
195	71	(DIRECT	FLOW)	0	35
196	99	(DIRECT	FLOW)	0	35
197	118	(DIRECT	FLOW)	0	55
198	102	(DIRECT	FLOW)	0	40
199	191	(DIRECT	FLOW)	0	50
201	946	6.4		2	5
202	957	4.9		1	55
203	968	3.7		1	45
204	971	4.7		1	45
205	964	4.9		1	40
206	993	3.3		1	25
207	712	2.9		1	15
208	708	2.2		1	5
209	621	2.3		1	0
210	340	2.7		1	15
211	298	1.2		1	10
212	228	1.7		1	0
213	113	0.9		0	55
214	63	0.6		1	0
215	52	0.3		0	45
216	34	0.4		0	55
217	71	0.8		0	35
218	171	1.6		0	55
219	138	1.3		0	50
220	44	0.6		0	50
221	17	0.4		1	10
222	53	0.7		0	45
223	44	0.7		1	10
224	12	0.2		0	55
225	24	0.4		0	55
226	263	1.8		1	35
227	290	2.1		1	20
228	264	1.8		1	10
229	208	1.1		1	5
230	100	1.3		0	35
231	164	1.1		0	50
232	145	0.8		0	45
233	188	1.2		0	50
234	38	0.4		0	50
235	57	1		0	45
236	98	0.8		0	45
237	117	1		1	0
238	105	0.7		0	40

0.4" Average

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR	/MIN)
101	221	(DIRECT	FLOW)	2	45
102	228	(DIRECT	FLOW)	2	30
103	233	(DIRECT	FLOW)	2	20
104	234	(DIRECT	FLOW)	2	15
105	235	(DIRECT	FLOW)	2	10
106	240	(DIRECT	FLOW)	1	55
107	241	(DIRECT	FLOW)	1	45
108	199	(DIRECT	FLOW)	1	10
109	195	(DIRECT	FLOW)	1	0
110	179	(DIRECT	FLOW)	0	45
111	88	(DIRECT	FLOW)	1	20
112	90	(DIRECT	FLOW)	0	35
113	86	(DIRECT	FLOW)	1	0
114	61	(DIRECT	FLOW)	0	50
115	26	(DIRECT	FLOW)	0	45
116	19	(DIRECT	FLOW)	0	45
117	34	(DIRECT	FLOW)	0	30
118	19	(DIRECT	FLOW)	0	40
119	28	(DIRECT	FLOW)	0	30
120	59	(DIRECT	FLOW)	0	55
121	47	(DIRECT	FLOW)	0	55
122	80	(DIRECT	FLOW)	0	35
123	23	(DIRECT	FLOW)	0	35
124	13	(DIRECT	FLOW)	0	35
125	43	(DIRECT	FLOW)	0	30
126	8	(DIRECT	FLOW)	1	0
127	3	(DIRECT	FLOW)	0	35
128	7	(DIRECT	FLOW)	0	35
129	16	(DIRECT	FLOW)	0	30
130	72	(DIRECT	FLOW)	1	30
131	69	(DIRECT	FLOW)	1	15
132	66	(DIRECT	FLOW)	1	0
133	54	(DIRECT	FLOW)	0	30
134	48	(DIRECT	FLOW)	0	50
135	53	(DIRECT	FLOW)	0	30
136	75	(DIRECT	FLOW)	1	30
137	71	(DIRECT	FLOW)	1	50
138	46	(DIRECT	FLOW)	0	40
139	11	(DIRECT	FLOW)	0	35
141	186	(DIRECT	FLOW)	1	35
142	104	(DIRECT	FLOW)	0	40
143	25	(DIRECT	FLOW)	0	50
144	64	(DIRECT	FLOW)	2	15
145	5	(DIRECT	FLOW)	1	40
146	81	(DIRECT	FLOW)	0	55
147	30	(DIRECT	FLOW)	1	5
195	24	(DIRECT	FLOW)	0	35
196	36	(DIRECT	FLOW)	0	35
197	26	(DIRECT	FLOW)	1	5
198	30	(DIRECT	FLOW)	0	35
199	45	(DIRECT	FLOW)	1	0
201	221	4.5		2	45
202	228	2.7		2	30
203	233	2		2	20
204	234	2.4		2	15
205	235	3		2	10
206	240	1.6		1	55
207	186	1.4		1	35
208	190	1.1		1	15
209	169	1.2		1	5
210	84	2		1	35
211	71	0.5		1	30
212	53	0.8		1	10
213	25	0.4		1	10
214	13	0.2		1	20
215	11	0.1		0	55
216	6	0.1		1	15
217	17	0.3		0	40
218	45	0.8		1	5
219	36	0.6		1	0
220	12	0.3		1	0
221	4	0.2		1	25
222	13	0.3		0	50
223	5	0.2		1	40
224	1	0.1		1	5
225	3	0.1		1	15
226	64	0.9		2	15
227	71	1		1	50
228	63	0.8		1	35
229	50	0.5		1	25
230	29	0.6		0	40
231	39	0.5		1	5
232	36	0.3		0	50
233	45	0.5		1	5
234	9	0.2		1	0
235	16	0.5		0	55
236	25	0.3		0	50
237	26	0.4		1	10
238	27	0.3		0	45

Todd Creek SWMM Output for Master Plan Conditions

100-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	3961	(DIRECT	FLOW)	1	40
102	3974	(DIRECT	FLOW)	1	35
103	3635	(DIRECT	FLOW)	1	30
104	3559	(DIRECT	FLOW)	1	30
105	3515	(DIRECT	FLOW)	1	30
106	3352	(DIRECT	FLOW)	1	25
107	3283	(DIRECT	FLOW)	1	20
108	1732	(DIRECT	FLOW)	1	45
109	1686	(DIRECT	FLOW)	1	40
110	3199	(DIRECT	FLOW)	0	50
111	1525	(DIRECT	FLOW)	1	10
112	1454	(DIRECT	FLOW)	1	10
113	1254	(DIRECT	FLOW)	1	5
114	960	(DIRECT	FLOW)	1	5
115	854	(DIRECT	FLOW)	0	50
116	589	(DIRECT	FLOW)	0	45
117	558	(DIRECT	FLOW)	0	35
118	451	(DIRECT	FLOW)	0	40
119	438	(DIRECT	FLOW)	0	35
120	1163	(DIRECT	FLOW)	0	50
121	921	(DIRECT	FLOW)	0	50
122	999	(DIRECT	FLOW)	0	40
123	259	(DIRECT	FLOW)	0	40
124	211	(DIRECT	FLOW)	0	40
125	425	(DIRECT	FLOW)	0	35
126	691	(DIRECT	FLOW)	0	50
127	225	(DIRECT	FLOW)	0	40
128	307	(DIRECT	FLOW)	0	40
129	301	(DIRECT	FLOW)	0	35
130	1110	(DIRECT	FLOW)	1	10
131	962	(DIRECT	FLOW)	1	10
132	764	(DIRECT	FLOW)	1	5
133	473	(DIRECT	FLOW)	0	35
134	938	(DIRECT	FLOW)	0	45
135	591	(DIRECT	FLOW)	0	35
136	1180	(DIRECT	FLOW)	1	5
137	1295	(DIRECT	FLOW)	1	10
138	731	(DIRECT	FLOW)	0	40
139	139	(DIRECT	FLOW)	0	40
141	1739	(DIRECT	FLOW)	1	55
142	1679	(DIRECT	FLOW)	1	10
143	324	(DIRECT	FLOW)	1	15
144	1331	(DIRECT	FLOW)	1	20
145	618	(DIRECT	FLOW)	1	0
146	1608	(DIRECT	FLOW)	0	50
147	541	(DIRECT	FLOW)	1	10
195	277	(DIRECT	FLOW)	0	40
196	329	(DIRECT	FLOW)	0	40
197	875	(DIRECT	FLOW)	0	55
198	586	(DIRECT	FLOW)	0	45
199	1003	(DIRECT	FLOW)	0	50
201	3931	8.9		1	40
202	3616	8.3		1	40
203	3554	6.3		1	35
204	3512	7.2		1	30
205	3327	7.1		1	30
206	3277	5.7		1	25
207	1696	4.4		1	55
208	1679	3.3		1	45
209	1534	3.6		1	50
210	1427	4.1		1	15
211	1211	2.6		1	15
212	942	3.2		1	10
213	845	2.9		0	55
214	506	1.9		0	55
215	391	1		0	45
216	299	1.4		0	50
217	394	2.1		0	40
218	905	3		0	55
219	719	2.9		0	50
220	205	1.4		0	55
221	120	1.1		1	5
222	261	1.7		0	45
223	618	2.7		1	0
224	204	1.3		0	50
225	272	1.7		0	50
226	1221	3.7		1	25
227	1148	4.1		1	15
228	936	3.4		1	20
229	730	2.3		1	20
230	194	1.9		1	0
231	868	2.9		0	50
232	691	2		0	45
233	523	2.1		1	15
234	94	0.7		1	30
235	107	1.3		1	30
236	324	1.5		1	15
237	501	2.2		1	25
238	504	1.8		0	40
301	501	0.1	19.2	1	20
302	324	0.1	11.7	1	10
303	111	0.1	7.8	1	10
304	199	0.1	6.8	0	50
305	524	0.1	18.3	1	10
306	98	0.1	6.9	1	10
307	1539	0.1	181.7	1	45

50-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	3027	(DIRECT	FLOW)	1	45
102	3031	(DIRECT	FLOW)	1	35
103	2782	(DIRECT	FLOW)	1	45
104	2738	(DIRECT	FLOW)	1	45
105	2712	(DIRECT	FLOW)	1	45
106	2613	(DIRECT	FLOW)	1	40
107	2583	(DIRECT	FLOW)	1	40
108	1378	(DIRECT	FLOW)	1	55
109	1350	(DIRECT	FLOW)	1	50
110	2603	(DIRECT	FLOW)	0	50
111	1271	(DIRECT	FLOW)	1	15
112	1223	(DIRECT	FLOW)	1	10
113	1089	(DIRECT	FLOW)	1	5
114	847	(DIRECT	FLOW)	1	5
115	682	(DIRECT	FLOW)	0	50
116	475	(DIRECT	FLOW)	0	45
117	471	(DIRECT	FLOW)	0	35
118	369	(DIRECT	FLOW)	0	40
119	361	(DIRECT	FLOW)	0	35
120	946	(DIRECT	FLOW)	0	50
121	754	(DIRECT	FLOW)	0	50
122	833	(DIRECT	FLOW)	0	40
123	221	(DIRECT	FLOW)	0	40
124	176	(DIRECT	FLOW)	0	40
125	363	(DIRECT	FLOW)	0	35
126	544	(DIRECT	FLOW)	0	50
127	181	(DIRECT	FLOW)	0	40
128	249	(DIRECT	FLOW)	0	40
129	249	(DIRECT	FLOW)	0	35
130	955	(DIRECT	FLOW)	1	15
131	855	(DIRECT	FLOW)	1	10
132	704	(DIRECT	FLOW)	1	0
133	406	(DIRECT	FLOW)	0	35
134	775	(DIRECT	FLOW)	0	45
135	505	(DIRECT	FLOW)	0	35
136	997	(DIRECT	FLOW)	1	10
137	1077	(DIRECT	FLOW)	1	15
138	611	(DIRECT	FLOW)	0	40
139	116	(DIRECT	FLOW)	0	40
141	1381	(DIRECT	FLOW)	2	5
142	1376	(DIRECT	FLOW)	1	10
143	289	(DIRECT	FLOW)	1	10
144	1104	(DIRECT	FLOW)	1	25
145	479	(DIRECT	FLOW)	1	0
146	1308	(DIRECT	FLOW)	0	50
147	482	(DIRECT	FLOW)	1	10
195	230	(DIRECT	FLOW)	0	40
196	278	(DIRECT	FLOW)	0	35
197	697	(DIRECT	FLOW)	0	55
198	474	(DIRECT	FLOW)	0	45
199	821	(DIRECT	FLOW)	0	50
201	3006	8.3		1	50
202	2778	7.5		1	50
203	2735	5.6		1	45
204	2710	6.7		1	45
205	2599	6.6		1	45
206	2577	5.1		1	45
207	1354	4.1		2	5
208	1344	3		1	55
209	1239	3.2		2	0
210	1204	3.9		1	15
211	1051	2.4		1	20
212	832	3		1	15
213	673	2.6		0	55
214	401	1.7		0	55
215	313	0.9		0	45
216	235	1.3		0	50
217	323	1.9		0	40
218	737	2.8		0	55
219	588	2.7		0	50
220	168	1.2		0	55
221	94	1		1	5
222	215	1.6		0	45
223	479	2.4		1	0
224	160	1.1		0	50
225	215	1.5		0	50
226	1028	3.4		1	30
227	977	3.8		1	20
228	834	3.2		1	20
229	660	2.2		1	15
230	180	1.8		1	0
231	713	2.6		0	50
232	573	1.8		0	45
233	483	2		1	10
234	86	0.7		1	25
235	99	1.3		1	30
236	299	1.4		1	10
237	450	2.1		1	20
238	419	1.6		0	40
301	450	0.1	12.6	1	15
302	290	0.1	8.1	1	5
303	103	0.1	5.9	1	5
304	185	0.1	5.3	0	50
305	483	0.1	12.7	1	5
306	90	0.1	5.2	1	5
307	1243	0.1	164.2	1	55

10-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	1295	(DIRECT	FLOW)	1	55
102	1302	(DIRECT	FLOW)	1	45
103	1211	(DIRECT	FLOW)	1	40
104	1191	(DIRECT	FLOW)	1	35
105	1181	(DIRECT	FLOW)	1	30
106	1136	(DIRECT	FLOW)	1	20
107	1112	(DIRECT	FLOW)	2	0
108	620	(DIRECT	FLOW)	2	15
109	615	(DIRECT	FLOW)	2	10
110	1357	(DIRECT	FLOW)	0	45
111	765	(DIRECT	FLOW)	1	20
112	749	(DIRECT	FLOW)	1	15
113	688	(DIRECT	FLOW)	1	5
114	542	(DIRECT	FLOW)	1	0
115	325	(DIRECT	FLOW)	0	45
116	236	(DIRECT	FLOW)	0	40
117	266	(DIRECT	FLOW)	0	30
118	203	(DIRECT	FLOW)	0	35
119	210	(DIRECT	FLOW)	0	30
120	493	(DIRECT	FLOW)	0	50
121	406	(DIRECT	FLOW)	0	45
122	502	(DIRECT	FLOW)	0	35
123	136	(DIRECT	FLOW)	0	35
124	100	(DIRECT	FLOW)	0	35
125	230	(DIRECT	FLOW)	0	30
126	239	(DIRECT	FLOW)	0	45
127	85	(DIRECT	FLOW)	0	35
128	123	(DIRECT	FLOW)	0	35
129	140	(DIRECT	FLOW)	0	30
130	606	(DIRECT	FLOW)	1	15
131	559	(DIRECT	FLOW)	1	5
132	499	(DIRECT	FLOW)	0	55
133	266	(DIRECT	FLOW)	0	30
134	440	(DIRECT	FLOW)	0	40
135	313	(DIRECT	FLOW)	0	30
136	629	(DIRECT	FLOW)	1	15
137	639	(DIRECT	FLOW)	1	20
138	359	(DIRECT	FLOW)	0	35
139	70	(DIRECT	FLOW)	0	35
141	611	(DIRECT	FLOW)	2	25
142	812	(DIRECT	FLOW)	1	20
143	191	(DIRECT	FLOW)	0	55
144	623	(DIRECT	FLOW)	1	35
145	197	(DIRECT	FLOW)	1	0
146	687	(DIRECT	FLOW)	0	45
147	307	(DIRECT	FLOW)	1	5
195	141	(DIRECT	FLOW)	0	35
196	179	(DIRECT	FLOW)	0	30
197	333	(DIRECT	FLOW)	0	50
198	245	(DIRECT	FLOW)	0	40
199	448	(DIRECT	FLOW)	0	45
201	1287	6.8		1	55
202	1294	5.3		1	50
203	1199	4		1	40
204	1178	5.1		1	40
205	1124	5.1		1	40
206	1110	3.5		2	5
207	606	2.7		2	25
208	610	2		2	15
209	567	2.2		2	15
210	735	3.3		1	20
211	651	1.9		1	15
212	519	2.4		1	5
213	320	1.7		0	50
214	185	1.1		0	50
215	150	0.6		0	40
216	106	0.8		0	45
217	180	1.4		0	35
218	387	2.3		0	50
219	312	1.9		0	45
220	94	0.9		0	50
221	45	0.7		1	0
222	117	1.1		0	40
223	197	1.5		1	0
224	66	0.7		0	45
225	95	0.9		0	45
226	597	2.7		1	35
227	602	3		1	25
228	534	2.5		1	15
229	434	1.7		1	10
230	135	1.5		0	50
231	386	1.8		0	45
232	327	1.3		0	40
233	343	1.7		1	0
234	58	0.5		1	20
235	78	1.1		1	10
236	191	1.1		0	55
237	285	1.6		1	5
238	238	1.1		0	35
301	286	0.1	3.2	1	5
302	192	0.1	2.8	0	55
303	88	0.1	2.7	0	50
304	147	0.1	2.7	0	40
305	345	0.1	4.2	0	55
306	64	0.1	2.4	0	55
307	572	0.1	122.7	2	10

5-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	907	(DIRECT	FLOW)	2	0
102	921	(DIRECT	FLOW)	1	45
103	870	(DIRECT	FLOW)	1	40
104	859	(DIRECT	FLOW)	1	35
105	852	(DIRECT	FLOW)	1	35
106	836	(DIRECT	FLOW)	1	20
107	820	(DIRECT	FLOW)	1	15
108	385	(DIRECT	FLOW)	0	40
109	370	(DIRECT	FLOW)	2	25
110	1084	(DIRECT	FLOW)	0	45
111	603	(DIRECT	FLOW)	1	20
112	595	(DIRECT	FLOW)	1	15
113	556	(DIRECT	FLOW)	1	5
114	431	(DIRECT	FLOW)	1	0
115	244	(DIRECT	FLOW)	0	50
116	179	(DIRECT	FLOW)	0	40
117	204	(DIRECT	FLOW)	0	30
118	158	(DIRECT	FLOW)	0	35
119	165	(DIRECT	FLOW)	0	30
120	394	(DIRECT	FLOW)	0	45
121	322	(DIRECT	FLOW)	0	45
122	410	(DIRECT	FLOW)	0	35
123	112	(DIRECT	FLOW)	0	35
124	79	(DIRECT	FLOW)	0	35
125	189	(DIRECT	FLOW)	0	30
126	167	(DIRECT	FLOW)	0	45
127	61	(DIRECT	FLOW)	0	35
128	90	(DIRECT	FLOW)	0	35
129	108	(DIRECT	FLOW)	0	30
130	495	(DIRECT	FLOW)	1	15
131	469	(DIRECT	FLOW)	1	5
132	427	(DIRECT	FLOW)	0	55
133	224	(DIRECT	FLOW)	0	30
134	352	(DIRECT	FLOW)	0	40
135	253	(DIRECT	FLOW)	0	30
136	508	(DIRECT	FLOW)	1	15
137	506	(DIRECT	FLOW)	1	20
138	288	(DIRECT	FLOW)	0	35
139	57	(DIRECT	FLOW)	0	35
141	359	(DIRECT	FLOW)	2	40
142	633	(DIRECT	FLOW)	1	20
143	154	(DIRECT	FLOW)	0	55
144	484	(DIRECT	FLOW)	1	35
145	136	(DIRECT	FLOW)	1	0
146	550	(DIRECT	FLOW)	0	45
147	243	(DIRECT	FLOW)	1	5
195	117	(DIRECT	FLOW)	0	35
196	151	(DIRECT	FLOW)	0	35
197	251	(DIRECT	FLOW)	0	50
198	191	(DIRECT	FLOW)	0	40
199	353	(DIRECT	FLOW)	0	45
201	903	6.3		2	0
202	861	4.7		1	50
203	957	3.5		1	40
204	851	4.4		1	35
205	815	4.7		1	35
206	817	3		1	20
207	359	2		2	40
208	366	1.5		2	30
209	345	1.7		2	30
210	580	3.1		1	20
211	521	1.6		1	15
212	411	2.2		1	10
213	240	1.4		0	50
214	139	0.9		0	55
215	113	0.5		0	45
216	78	0.7		0	50
217	140	1.2		0	35
218	305	2.1		0	50
219	247	1.7		0	50
220	76	0.8		0	50
221	35	0.6		1	0
222	94	1		0	40
223	136	1.2		1	0
224	44	0.5		0	50
225	67	0.8		0	50
226	467	2.4		1	35
227	482	2.7		1	20
228	442	2.3		1	15
229	362	1.6		1	10
230	117	1.4		0	50
231	301	1.6		0	45
232	260	1.1		0	40
233	293	1.5		0	55
234	50	0.5		1	15
235	70	1.1		1	10
236	154	1		0	55
237	225	1.4		1	5
238	137	1		0	35
301	226	0.1	2.1	1	5
302	155	0.1	2	0	50
303	80	0.1	2	0	50
304	134	0.1	2.1	0	40
305	295	0.1	2.8	0	55
306	58	0.1	1.8	0	50
307	350	0.1	107.8	2	20

2-year

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	400	(DIRECT	FLOW)	2	20
102	413	(DIRECT	FLOW)	2	5
103	405	(DIRECT	FLOW)	1	55
104	405	(DIRECT	FLOW)	1	50
105	404	(DIRECT	FLOW)	1	45
106	401	(DIRECT	FLOW)	1	35
107	399	(DIRECT	FLOW)	1	30
108	180	(DIRECT	FLOW)	0	45
109	140	(DIRECT	FLOW)	0	35
110	612	(DIRECT	FLOW)	0	45
111	337	(DIRECT	FLOW)	1	20
112	337	(DIRECT	FLOW)	1	10
113	320	(DIRECT	FLOW)	1	5
114	232	(DIRECT	FLOW)	0	55
115	115	(DIRECT	FLOW)	0	50
116	84	(DIRECT	FLOW)	0	40
117	109	(DIRECT	FLOW)	0	30
118	78	(DIRECT	FLOW)	0	35
119	87	(DIRECT	FLOW)	0	30
120	224	(DIRECT	FLOW)	0	50
121	177	(DIRECT	FLOW)	0	50
122	242	(DIRECT	FLOW)	0	35
123	69	(DIRECT	FLOW)	0	35
124	43	(DIRECT	FLOW)	0	35
125	119	(DIRECT	FLOW)	0	30
126	56	(DIRECT	FLOW)	0	45
127	19	(DIRECT	FLOW)	0	35
128	36	(DIRECT	FLOW)	0	35
129	54	(DIRECT	FLOW)	0	30
130	287	(DIRECT	FLOW)	1	15
131	278	(DIRECT	FLOW)	1	10
132	266	(DIRECT	FLOW)	0	55
133	149	(DIRECT	FLOW)	0	30
134	191	(DIRECT	FLOW)	0	40
135	153	(DIRECT	FLOW)	0	30
136	295	(DIRECT	FLOW)	1	15
137	283	(DIRECT	FLOW)	1	25
138	164	(DIRECT	FLOW)	0	35
139	34	(DIRECT	FLOW)	0	35
141	149	(DIRECT	FLOW)	1	0
142	355	(DIRECT	FLOW)	1	20
143	87	(DIRECT	FLOW)	0	55
144	261	(DIRECT	FLOW)	1	45
145	44	(DIRECT	FLOW)	1	10
146	307	(DIRECT	FLOW)	0	45
147	124	(DIRECT	FLOW)	1	5
195	71	(DIRECT	FLOW)	0	35
196	99	(DIRECT	FLOW)	0	35
197	118	(DIRECT	FLOW)	0	55
198	102	(DIRECT	FLOW)	0	40
199	191	(DIRECT	FLOW)	0	50
201	400	5.2		2	20
202	398	3.4		2	5
203	402	2.5		1	55
204	403	3.1		1	50
205	393	3.7		1	50
206	396	2.1		1	40
207	141	1.2		1	5
208	117	0.8		0	50
209	97	0.9		3	15
210	324	2.7		1	25
211	289	1.2		1	20
212	217	1.6		1	10
213	113	0.9		0	55
214	63	0.6		1	0
215	52	0.3		0	45
216	34	0.4		0	55
217	71	0.8		0	35
218	171	1.6		0	55
219	138	1.3		0	50
220	44	0.6		0	50
221	17	0.4		1	10
222	53	0.7		0	45
223	44	0.7		1	10
224	12	0.2		0	55
225	24	0.4		0	55
226	257	1.8		1	45
227	277	2		1	25
228	257	1.7		1	20
229	210	1.2		1	10
230	82	1.2		0	50
231	164	1.1		0	50
232	145	0.8		0	45
233	176	1.1		1	0
234	32	0.4		1	15
235	53	0.9		1	5
236	97	0.7		0	55
237	113	0.9		1	5
238	105	0.7		0	40
301	114	0.1	0.6	1	0
302	90	0.1	0.9	0	50
303	66	0.1	1	0	45
304	96	0.1	1.1	0	40
305	178	0.1	1.1	0	55
306	41	0.1	0.9	0	50
307	98	0.1	75.7	3	5

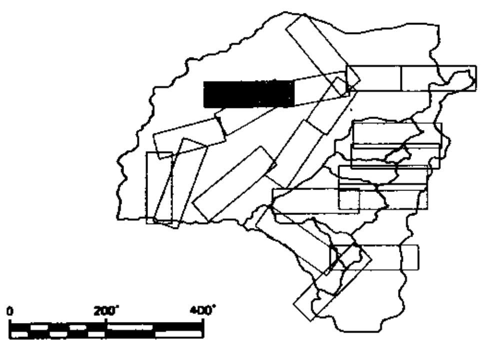
0.4" Average

CONVEYAN ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR /MIN)	
101	82	(DIRECT	FLOW)	3	5
102	83	(DIRECT	FLOW)	2	55
103	86	(DIRECT	FLOW)	2	40
104	87	(DIRECT	FLOW)	2	35
105	88	(DIRECT	FLOW)	2	25
106	91	(DIRECT	FLOW)	2	15
107	92	(DIRECT	FLOW)	2	5
108	40	(DIRECT	FLOW)	0	50
109	34	(DIRECT	FLOW)	0	40
110	178	(DIRECT	FLOW)	0	45
111	87	(DIRECT	FLOW)	1	30
112	90	(DIRECT	FLOW)	0	35
113	86	(DIRECT	FLOW)	1	5
114	61	(DIRECT	FLOW)	0	55
115	26	(DIRECT	FLOW)	0	45
116	19	(DIRECT	FLOW)	0	45
117	34	(DIRECT	FLOW)	0	30
118	19	(DIRECT	FLOW)	0	40
119	28	(DIRECT	FLOW)	0	30
120	59	(DIRECT	FLOW)	0	55
121	47	(DIRECT	FLOW)	0	55
122	80	(DIRECT	FLOW)	0	35
123	23	(DIRECT	FLOW)	0	35
124	13	(DIRECT	FLOW)	0	35
125	43	(DIRECT	FLOW)	0	30
126	8	(DIRECT	FLOW)	1	0
127	3	(DIRECT	FLOW)	0	35
128	7	(DIRECT	FLOW)	0	35
129	16	(DIRECT	FLOW)	0	30
130	71	(DIRECT	FLOW)	1	35
131	68	(DIRECT	FLOW)	1	20
132	66	(DIRECT	FLOW)	0	55
133	54	(DIRECT	FLOW)	0	30
134	48	(DIRECT	FLOW)	0	50
135	53	(DIRECT	FLOW)	0	30
136	74	(DIRECT	FLOW)	1	35
137	70	(DIRECT	FLOW)	1	55
138	46	(DIRECT	FLOW)	0	40
139	11	(DIRECT	FLOW)	0	35
141	31	(DIRECT	FLOW)	1	25
142	103	(DIRECT	FLOW)	0	40
143	24	(DIRECT	FLOW)	0	55
144	63	(DIRECT	FLOW)	2	15
145	5	(DIRECT	FLOW)	1	40
146	81	(DIRECT	FLOW)	0	55
147	29	(DIRECT	FLOW)	1	5
195	24	(DIRECT	FLOW)	0	35
196	36	(DIRECT	FLOW)	0	35
197	26	(DIRECT	FLOW)	1	5
198	30	(DIRECT	FLOW)	0	35
199	45	(DIRECT	FLOW)	1	0
201	82	2.9		3	5
202	83	1.7		2	55
203	86	1.2		2	40
204	87	1.4		2	35
205	88	2		2	25
206	91	1		2	15
207	31	0.5		1	25
208	26	0.3		1	5
209	3	0.1		7	35
210	83	2		1	40
211	70	0.5		1	30
212	53	0.8		1	15
213	25	0.4		1	10
214	13	0.2		1	20
215	11	0.1		0	55
216	6	0.1		1	15
217	17	0.3		0	40
218	45	0.8		1	5
219	36	0.6		1	0
220	12	0.3		1	0
221	4	0.2		1	25
222	13	0.3		0	50
223	5	0.2		1	40
224	1	0.1		1	5
225	3	0.1		1	15
226	63	0.9		2	15
227	70	1		1	55
228	63	0.8		1	40
229	50	0.5		1	30
230	28	0.6		0	50
231	39	0.5		1	5
232	36	0.3		0	50
233	44	0.5		1	10
234	9	0.2		1	5
235	17	0.5		1	0
236	24	0.3		0	55
237	26	0.4		1	15
238	27	0.3		0	45
301	26	0.1	0	1	10
302	28	0.1	0.2	0	45
303	30	0.1	0.2	0	40
304	40	0.1	0.3	0	35
305	45	0.1	0.2	1	5
306	22	0.1	0.1	0	40
307	3	0.1	28.4	7	0

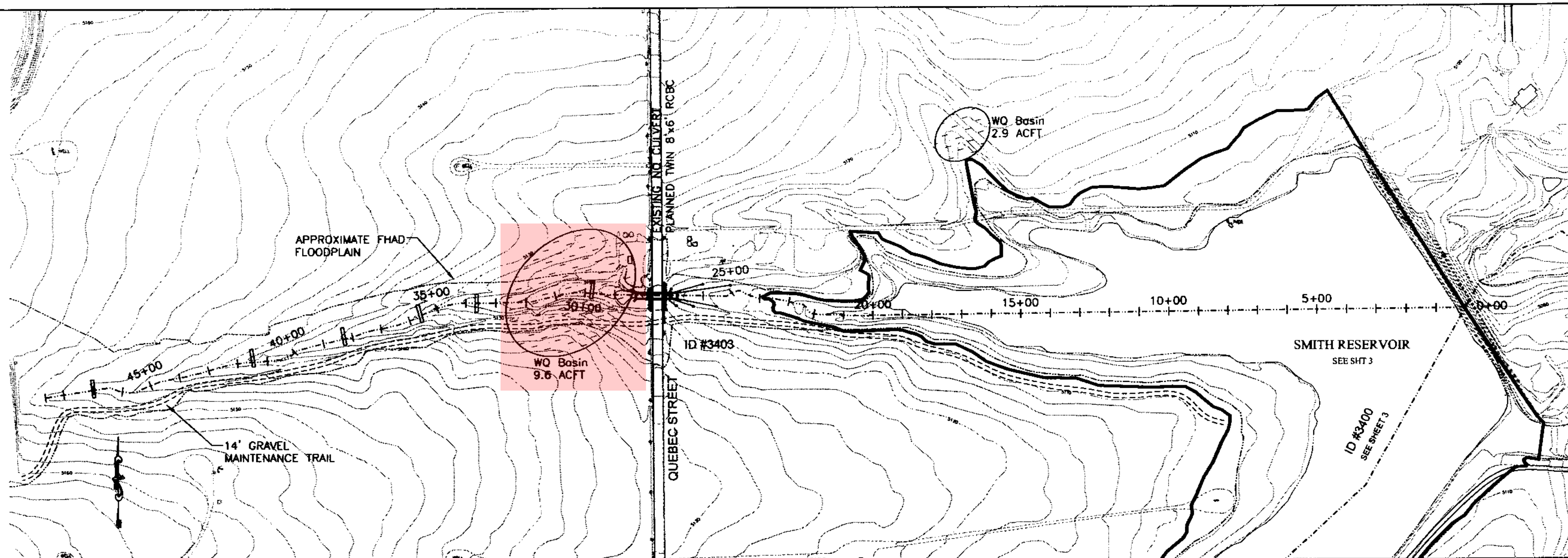
"This drawing is for master planning purposes and represents preliminary and conceptual engineering. This drawing shall not be used for construction."

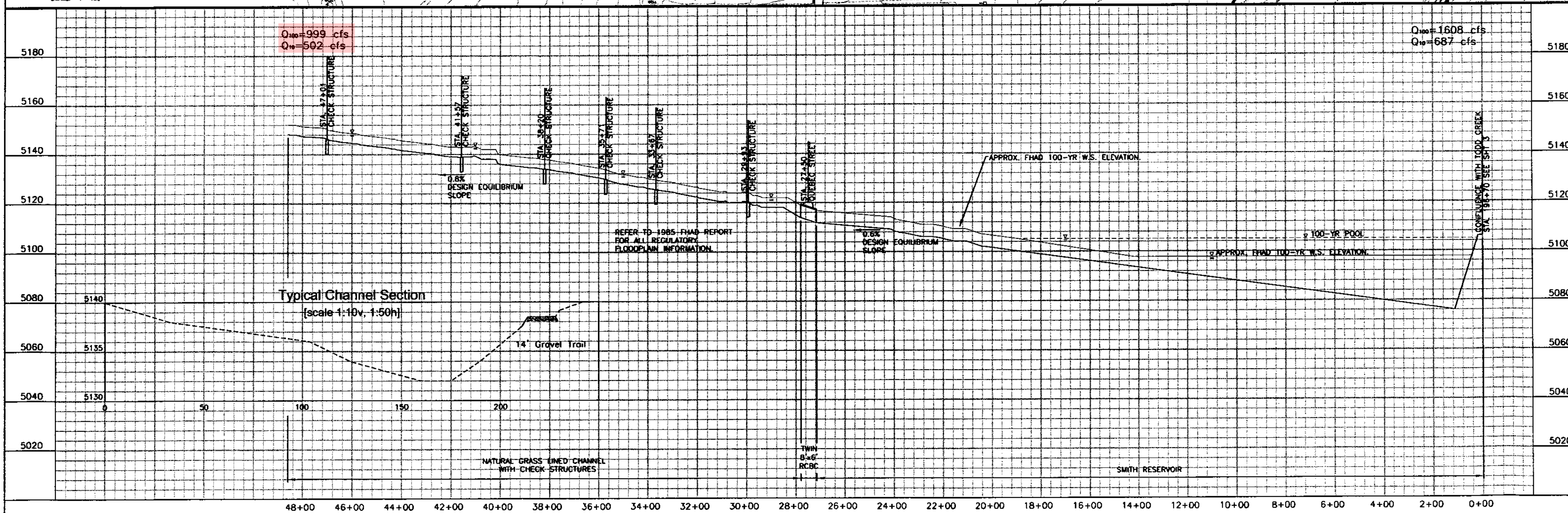
"Alternatives to this master plan will be considered by the local reviewing agency and the Urban Drainage and Flood Control District provided the alternative offers equal or greater hydraulic capacity, stream stability, and water-quality protection. Any alternative to this master plan must comply with all requirements of the local jurisdiction and the Urban Drainage and Flood Control District."

"Adams County and the City of Thornton manage and regulate all land development and redevelopment within the 100-year floodplains of this watershed so as to prevent future flood damages by following the recommendations of this plan."



SCALE: 1"=400'





Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	UDFCD ID No. 3403 STA 48+60 to 0+00	SHEET 11 00058Trib2PP.dwg/Dec 11, 2003

NOV 19 2001

STATE OF COLORADO

OFFICE OF THE STATE ENGINEER
Division of Water Resources
Department of Natural Resources

1313 Sherman Street, Room 818
Denver, Colorado 80203
Phone: (303) 866-3581
FAX: (303) 866-3589

http://water.state.co.us/default.htm

Bill Owens
Governor

Greg E. Walcher
Executive Director

Hal D. Simpson, P.E.
State Engineer

November 14, 2001

Mr. Chris J. Pauley, P.E.
Anderson Consulting Engineers, Inc.
2900 South College Avenue, Suite 3B
Fort Collins, CO 80525

When replying, please refer to:
SMITH IRRIGATION DAM
Water Division 1, DAMID: 020325

SUBJECT: Acceptance of the Hydrologic Adequacy Report for Smith Irrigation Dam

Dear Mr. Pauley:

We appreciate you giving us the opportunity to review your report titled "Hydrologic Adequacy of Smith Irrigation Reservoir Dam on Todd Creek, Adams County, Colorado" and dated May 18, 2001. This investigation was performed: to verify the current hazard classification for the dam; to determine the appropriate inflow design flood (IDF) to be used to size the spillways at this project site; and, to determine whether or not an incremental damage analysis (IDA) could justify an IDF with a lesser magnitude than the required IDF. The study report was prepared in accordance with the appropriate provisions of the State of Colorado's "Rules and Regulations for Dam Safety and Dam Construction". We have completed our review of the final draft of the aforementioned study report and the supplement data contained in a report dated September 25, 2001 and we find the overall results of your investigation to be acceptable.

The existing Smith Irrigation Dam has a current hazard classification of Class II, which indicates that if the dam were failure it has the potential of causing significant property damage downstream but loss of life is not anticipated. Based on your study results, it was determined that a house located along Todd Creek approximately 1.25 miles downstream of the dam could be significantly damaged by the flood generated by the occurrence of a dam failure. This house is identified as the El Mira Street Blue House. It was estimated that a dambreak failure flood could have a peak discharge of 7,270 cfs, a flow depth of 4.7 feet and an average velocity of 7.3 feet per second at the location of this house. Based on these study results, you are recommending that the hazard classification of this dam be upgraded to Class 1 because the magnitude of the estimated dambreak flood at the Blue House has the potential of causing loss of life. We concur with these findings and with your recommended hazard classification upgrade. The Smith Irrigation Dam is now considered to be Class I structure.

As stated above, the Smith Irrigation Dam has now been reclassified to a Class I structure. In accordance with Rule 4.A.(6) of the Rules and Regulations, the dam height and reservoir size places the dam in the small dam size category. For all existing small, Class I structures, Rule 6.A.(4)(a)(I) of the Rules and Regulations requires that the spillway and reservoir system have the capability of safely accommodating the IDF generated by the occurrence of 75 percent of the probable maximum precipitation (PMP) rainstorm event without overtopping the dam. The results of the hydrology study showed that the required IDF for the Smith Irrigation Dam could have an estimated peak inflow of 16,142 cfs and a total runoff volume of 3,684 acre-feet. The procedures and methodologies used in the hydrology study are

considered to be acceptable. The overall results of the hydrology study, as presented above, are considered to be acceptable and the aforementioned IDF can be used for the purpose of designing the modifications to the spillway.

This investigation also included the performance of an incremental damage analysis (IDA) to determine whether or not the flooding generated by the occurrence of storm event between the 75 percent of the PMP event and an 100-year rainstorm event could be considered to be the appropriate inflow design flood (IDF) for this structure. The results of your study show that a spillway, with a bottom width of 115 feet and with an invert elevation of 5,102 feet, can accommodate a flood equivalent to slightly less than the flood generated by the occurrence of approximately 17 percent of probable maximum precipitation (PMP) rainstorm event. It is further estimated that the occurrence of the 17 percent of the PMP flood could cause the dam to be slightly overtopped, which could lead to an eventual overtopping failure of the dam embankment. The results of the IDA, performed in accordance with Rule 5.A.(5)(c) of the Rules and Regulations, shows that there is no additional loss of life or significant property damage along the downstream floodplain when comparing the base flow flood with no dam in-place and the dam failure flood due to overtopping during the occurrence of the base flow flood. The study also shows that the 17 percent of the PMP flood is approximately equal to the flood generated by the occurrence of an 100-year rainstorm event, which is the minimum size flood the spillways for all existing Class I dams are required to accommodate, in accordance with Rule 6.A.(5)(b)(VIII) of the Rules and Regulations. Based on these results, the flooding generated by the occurrence of a 17 percent of the PMP storm event can be considered to be a reasonable and appropriate IDF for this project. We concur with these findings and results. And, this revised IDF can be used for the purpose of designing the modifications to the spillway. The results of the IDA show that the IDF generated by the occurrence of the 17 percent of the PMP storm event could have an estimated peak inflow of 3,509 cfs and a total runoff volume of 632 acre-feet.

The following items should be taken into consideration when deciding whether or not to size the spillway capacity at this dam to accommodate the flooding produced by the occurrence of the 17 percent of the PMP rainstorm event per the results of the IDA or for the required IDF of 75 percent of the PMP.

- The results of the hydrology study and IDA are based on the present condition and development in the drainage basin upstream of the dam and along the potential floodplain downstream of the dam. Future development in these areas could render the results of this investigation invalid and require a new hydrology study and IDA be performed. The results of the new investigation could require the spillway to be enlarged again.
- With the smaller spillway, the dam has the potential of being overtopped and breached during the occurrence of higher frequency storm event than the required IDF as required by Rule 6.A.(4)(a)(I) of the Rules and Regulations. By providing a larger spillway at this time with relatively little effort and additional expense, the potential of the dam being overtopped and breached would be reduced. And, the dam owner could also possibly avoid the very costly expense of rebuilding the dam in the future and the possibility of losing the services of the reservoir for an extended period of time.

The design and construction documents for the modification of the existing spillways at this dam site to bring the spillway capacity into compliance with the Rules and Regulations should be prepared and submitted to this office for the review and approval of the State Engineer. The design of the spillway should include not be limited to an analyses to determine what measures are required to assure that the spillway can safely pass the required discharges without jeopardizing the safety of the dam and structural integrity of the spillway. Calculations showing the routing of the IDF through the proposed spillway channel should also be provided with the design documents. The spillway channel, as minimum, should be provided with a concrete cutoff wall/control structure to prevent erosive action in the spillway discharge channel from backcutting into the reservoir, which could allow the uncontrolled release of the reservoir and to provide a means to define and control the required spillway width. As part of the spillway design effort, consideration should also be given to preparing the design and construction documents for the abandonment of the existing spillway at the left abutment of the dam.

You are reminded that the owner of the Smith Irrigation Dam, is liable for the safety of the structure and for any loss of life and/or damages caused by a failure of the dam or appurtenant structures. Acceptance of this hydrology study and IDA report does not relieve the owner from this liability or from any other statutory obligations. Therefore, it is in the owner's best interest to operate and maintain the facility in a manner such that the safety of the dam and the general public are not jeopardized.

If you have any questions concerning this matter or any dam safety related issues, please do not hesitate to contact Mark Haynes in our Denver office at (303) 866-3581 Ext. 276. We look forward to working with you on the new spillway design effort at this project and to achieving a successful completion of the proposed modifications to the dam and appurtenant structures.

Sincerely,

Jack G. Byers
Assistant State Engineer

xc: Dick Stenzel, Division Engineer
Dennis Miller, Dam Safety Field Engineer
Mark Haynes, Design Review Engineer
David Lindsay, Design Consultant, TST, Inc. Consulting Engineers
Gene Osborne, The Equinox Group, Dam Owner Representative

JGB/MRH/gla:c:word/damsafety/Smith Irrigation Accept 11-01.doc

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

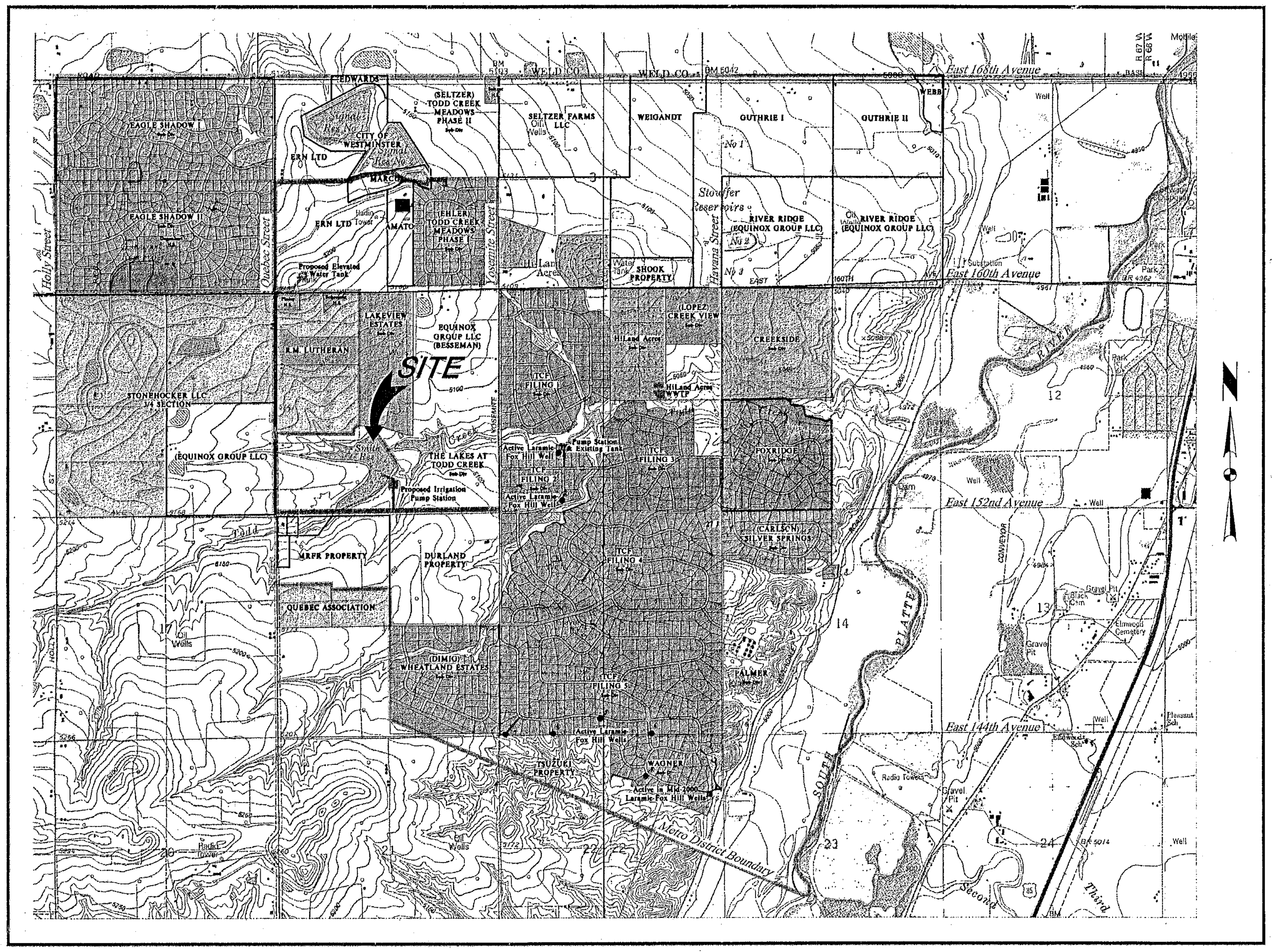
2000-2001 SMITH RESERVOIR IMPROVEMENTS

SMITH IRRIGATION DAM
DAM ID 020325

WATER DIVISION 1, WATER DISTRICT 2

LOCATED IN
ADAMS COUNTY

JULY 2001



VICINITY MAP

SCALE 1" = 2000'

OWNER:

THE EQUINOX GROUP, LLC
6041 SOUTH SYRACUSE WAY, SUITE 200
GREENWOOD VILLAGE, CO 80111

ENGINEER:

TST, INC. CONSULTING ENGINEERS
748 WHALERS WAY, BUILDING D
FORT COLLINS, CO 80525

SHEET INDEX:

(crossed out:)

DESCRIPTION	SHEET
COVER SHEET AND PLAN INDEX	1
EXISTING GRADE AND OUTLET STRUCTURES	2
EXISTING STRUCTURES ABANDONMENT PLAN & PROFILE	3
PROPOSED RESERVOIR GRADING PLAN	4
PROPOSED SPILLWAY GRADING AND REHABILITATION PLAN	5
PROPOSED OUTLET STRUCTURES PLAN & PROFILE	6
CONSTRUCTION AND RESERVOIR CAPACITY DETAILS	7
CONSTRUCTION DETAILS	8
CONSTRUCTION DETAILS	9

DESCRIPTION	
COVER SHEET AND PLAN INDEX	1
EXISTING GRADE AND OUTLET STRUCTURES	2
EXISTING STRUCTURES ABANDONMENT PLAN & PROFILE	3
PROPOSED RESERVOIR GRADING PLAN	4
PROPOSED SPILLWAY GRADING AND REHABILITATION PLAN	5
EXISTING SPILLWAY ABANDONMENT AND PROPOSED EMERGENCY SPILLWAY	5A
PROPOSED EMERGENCY SPILLWAY GRADING	5B
REINFORCEMENT MAT/EROSION CONTROL DETAILS	5C
DAM BREACH GRADING REPAIR PLAN	5D
PROPOSED OUTLET STRUCTURES PLAN & PROFILE	6
CONSTRUCTION AND RESERVOIR CAPACITY DETAILS	7
CONSTRUCTION DETAILS	8
CONSTRUCTION DETAILS	9

GENERAL NOTES:

1. THE TYPE, SIZE, NUMBER, AND LOCATION OF ALL UNKNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND LOCATION OF ALL UNDERGROUND UTILITIES, WHETHER SHOWN OR NOT ON THE DRAWINGS. CONTACT THE UTILITY NOTIFICATION CENTER (1-800-922-1987) AND ANY OTHER PERTINENT UTILITY LOCATING SERVICES AT LEAST 48 HOURS PRIOR TO BEGINNING THE WORK.

2. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL UTILITIES ADJACENT TO OR AFFECTED BY THE WORK TO COORDINATE SCHEDULES. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR MEETING THE REQUIREMENTS OF ANY UTILITY WHOSE FACILITIES ARE AFFECTED BY THE WORK.

3. WORK AROUND MANY OF THE UNDERGROUND UTILITIES WILL REQUIRE A REPRESENTATIVE FROM THAT UTILITY TO BE PRESENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ARRANGING ALL OBSERVATIONS AND INSPECTIONS WITH THOSE UTILITIES.

4. IF DEWATERING IS NECESSARY FOR THE INSTALLATION OF THE UTILITIES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING A CONSTRUCTION SITE DEWATERING PERMIT FROM THE STATE OF COLORADO.

5. ALL AREAS DISTURBED BY CONSTRUCTION, WHETHER PUBLIC OR PRIVATE, SHALL BE RETURNED TO A CONDITION EQUAL TO OR BETTER THAN BEFORE THE DISTURBANCE OCCURRED.

6. ALL VALVES AND FITTINGS SHALL BE DUCTILE IRON WITH MECHANICAL JOINTS.

7. ALL PIPE SHALL BE CLASS 50 DUCTILE IRON.

8. ALL PIPE SHALL HAVE A TRACER WIRE ATTACHED. TRACER WIRE SHALL BE EXTENDED INTO ALL VALVE BOXES AND MANHOLES.

9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MEETING THE REQUIREMENTS OF ALL FEDERAL, STATE, COUNTY, AND LOCAL LAWS AND REGULATIONS WHILE PERFORMING THE WORK.

10. THE STAGE-STORAGE/SURFACE AREA CURVES FOR SMITH RESERVOIR ARE SHOWN ON DETAIL SHEET 7 OF 9.

11. THE CREST OF THE DAM SHALL BE REGRADED TO AN UNIFORM GRADE (WITH A CROSS SLOPE TO THE UPSTREAM EDGE OF THE DAM FOR DRAINAGE) TO REPAIR ANY DAMAGE CAUSED BY THE TREE REMOVAL OR OTHER CONSTRUCTION ACTIVITIES. THE ENTIRE CREST OF THE DAM SHALL HAVE A 6" CDOT CLASS 6 GRAVEL SURFACE.

GRADING AND EROSION CONTROL NOTES:

1. SILT FENCES, STRAW BALE BARRIERS, OR OTHER STRUCTURAL METHODS OF CONTAINING SEDIMENT WILL BE EMPLOYED BY THE CONTRACTOR ON AN AS NEEDED BASIS TO PROTECT ADJACENT PROPERTY.

2. ALL AREAS DISTURBED BY CONSTRUCTION SHALL BE RESEEDED WITH A COVER CROP UPON COMPLETION OF THE PIPELINE INSTALLATION. THE RECOMMENDED SPECIES AND APPLICATION RATES ARE AS FOLLOWS:

SPECIES DRILLED POUNDS/ACRE

ANNUAL RYE GRASS 20
CEREAL RYE 40
WHEAT - WINTER 40
WHEAT - SPRING 60
BARLEY 60

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL EROSION CONTROL FACILITIES, INCLUDING RESEEDED AREAS, UNTIL A HEALTHY STAND OF VEGETATION HAS BEEN ESTABLISHED.

[signature] COLORADO PE NO. 32135
DAVE B. LINDSAY

APPROVED ON THE 30th DAY OF JULY, 2001.

HAL D. SIMPSON
STATE ENGINEER

BY: [signature] P.E. #16900
DEPUTY

STATE ENGINEER OF COLORADO

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID B. LINDSAY 32135 7-19-01

THESE PLANS REPRESENT THE AS-CONSTRUCTED CONDITIONS OF SMITH RESERVOIR DAM TO THE BEST OF OUR KNOWLEDGE AND JUDGMENT, BASED IN PART ON INFORMATION FURNISHED BY OTHERS AS OF THE 2ND DAY OF MAY, 2003.

[signature] COLORADO PE NO. 32135
DAVE B. LINDSAY

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID B. LINDSAY 32135 5-2-03

REVISIONS | By | Date | Description

DRAWN C.E.M.
CHECKED D.B.L.
DESIGNED C.E.M.
FILENAME SEO Cover

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID B. LINDSAY 32135 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS
COVER SHEET AND PLAN INDEX

TST
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE NOT TO SCALE
DATE 7/17/01 Rev.
SHEET 1 OF 9

C-1052A

DRAWINGS OF RECORD

GENERAL NOTES:

1. THE CONTOURS SURROUNDING THE RESERVOIR ARE AT 2 FOOT INTERVALS. THE REVISED CONTOURS FOR THE INTERIOR OF THE RESERVOIR HAVE BEEN SET AT 1 FOOT INTERVALS FOR THE GRADING DETAIL.

2. ALL TREE REMOVAL PROCEDURES ARE TO BE IN ACCORDANCE WITH THE CONSTRUCTION NOTES ON THESE DRAWINGS.

3. THE CONTOURS USED FOR THIS PROJECT WERE GENERATED FROM THREE SEPARATE SURVEYS. ALL OF THE CONTOURS SURROUNDING THE RESERVOIR WERE GENERATED FROM AERIAL PHOTOS BY INTRASEARCH IN APRIL OF 1999. THE CONTOURS ON THE INTERIOR OF THE RESERVOIR WERE GENERATED BY TST, INC. CONSULTING ENGINEERS USING G.P.S. IN MARCH AND JULY OF 2000. ALL CONTOURS SHOWN FOR THIS PROJECT ARE ON THE NAVD 88 DATUM.

scale 100 0 100 200 feet
1"=100'

By	Date	Description
MWT	[illegible]	ADDED NOTE FOR STATE REQUEST
MWT	[illegible]	REMOVED PIPE, AS BUILT

DRAWN M.W.T.
CHECKED D.B.L.
DESIGNED M.W.T.
FILENAME SEO Sheets 2-3

COLORADO REGISTERED PROFESSIONAL ENGINEER 32136 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

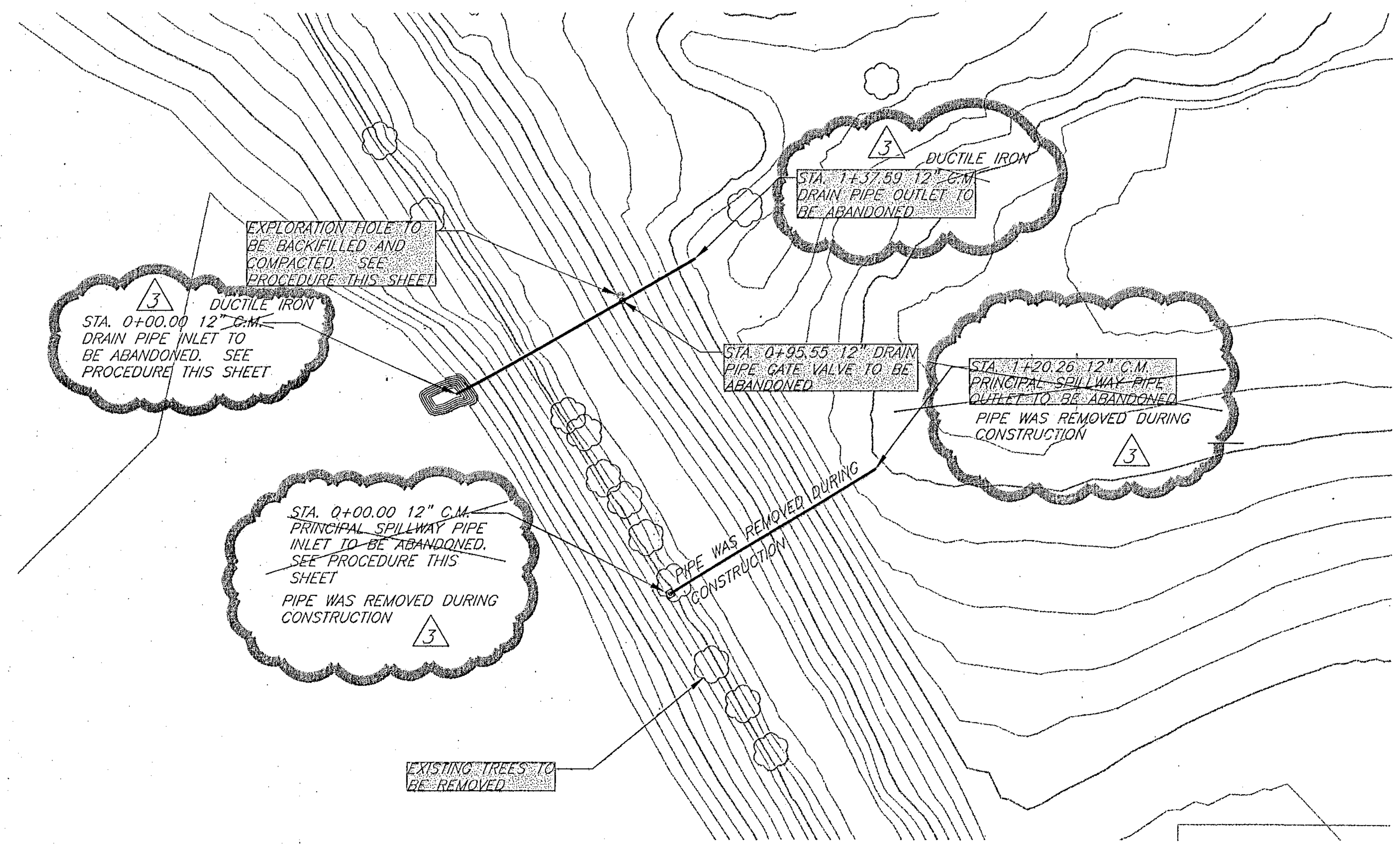
2000-2001 SMITH RESERVOIR IMPROVEMENTS EXISTING GRADE AND OUTLET STRUCTURES

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE 1" = 100'
DATE 7/17/01 Rev. 4/16/03
SHEET 2 OF 9

C-1052A

DRAWINGS OF RECORD



GENERAL NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING A PROPOSED PLAN TO THE OFFICE OF THE STATE ENGINEER REGARDING THE TWO EXISTING CONDUITS THAT ARE TO BE FILLED WITH CONCRETE AND ABANDONED. THE PLAN SHALL INCLUDE THE NECESSARY DETAILS TO ENSURE THAT THE CONDUITS ARE COMPLETELY FILLED WITH CONCRETE. THE PLAN SHALL BE SUBMITTED TO THE FOLLOWING ADDRESS:

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES
ATTENTION: MARK HAYNES, P.E.
818 CENTENNIAL BUILDING
1313 SHERMAN STREET
DENVER, COLORADO 80203

PROCEDURE FOR ABANDONMENT:

12-INCH PRINCIPAL SPILLWAY
1. CONCRETE INLET STRUCTURE TO BE REMOVED AND DISCARDED.
2. INLET AND OUTLET OF PIPE TO BE EXPOSED AND CLEANED.
3. INLET OF PIPE TO BE CUT-OFF 2 FEET BELOW THE DAM SURFACE.
4. ENTIRE LENGTH OF PIPE TO BE JETTED OUT.
5. ENTIRE LENGTH OF PIPE TO BE FILLED WITH CONCRETE.
6. INLET TO BE BURIED UNDER APPROVED FILL AND GRADED TO A PROPOSED SLOPE.

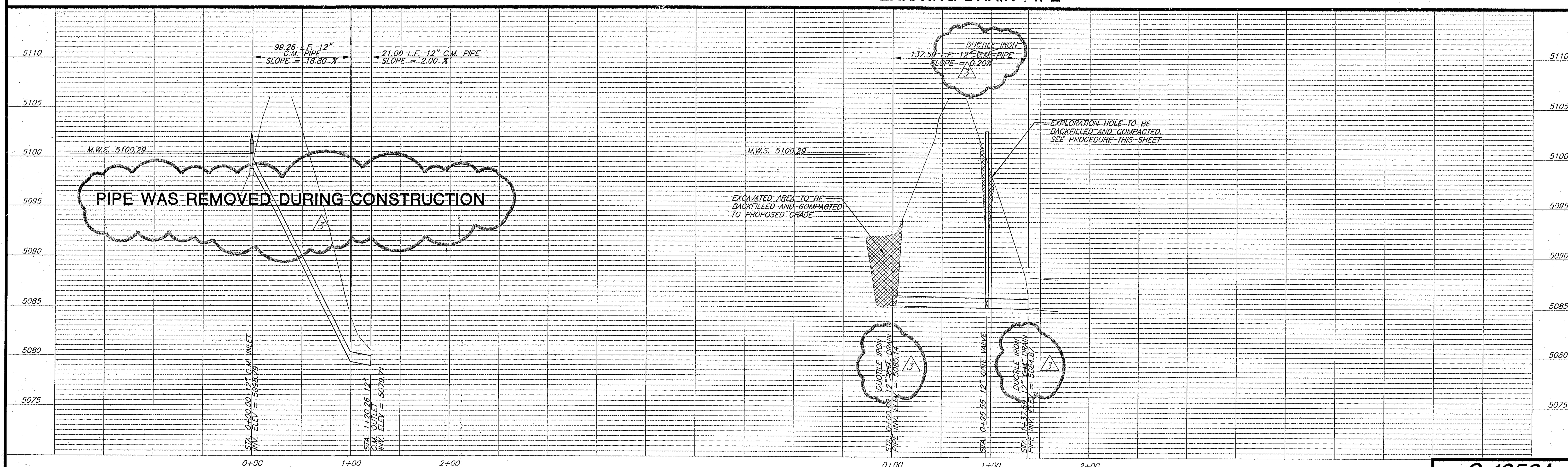
12-INCH RESERVOIR DRAIN PIPE
1. INLET AND OUTLET OF PIPE TO BE EXPOSED AND CLEANED.
2. 12-INCH GATE VALVE TO BE OPENED.
3. ENTIRE LENGTH OF PIPE TO BE JETTED OUT.
4. ENTIRE LENGTH OF PIPE TO BE FILLED WITH CONCRETE.
5. INLET TO BE BURIED UNDER APPROVED FILL AND GRADED TO A PROPOSED SLOPE.
6. EXPLORATION HOLES ON THE DOWNSTREAM FACE OF THE DAM (NEAR THE 12-INCH GATE VALVE) ARE TO BE BACKFILLED AND COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698 AT A MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT.

N

50 0 50 100
scale 1"=50' feet

EXISTING PRINCIPAL SPILLWAY

EXISTING DRAIN PIPE



REVISIONS
By | Date | Description
MWT | 4/16/03 | 3 REMOVED PIPE, EXISTING PIPE MATERIAL AS BUILT

DRAWN C.E.M.
CHECKED D.B.L.
DESIGNED C.E.M.
FILENAME SEO Sheets 2-3

COLORADO REGISTERED PROFESSIONAL ENGINEER 32135 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

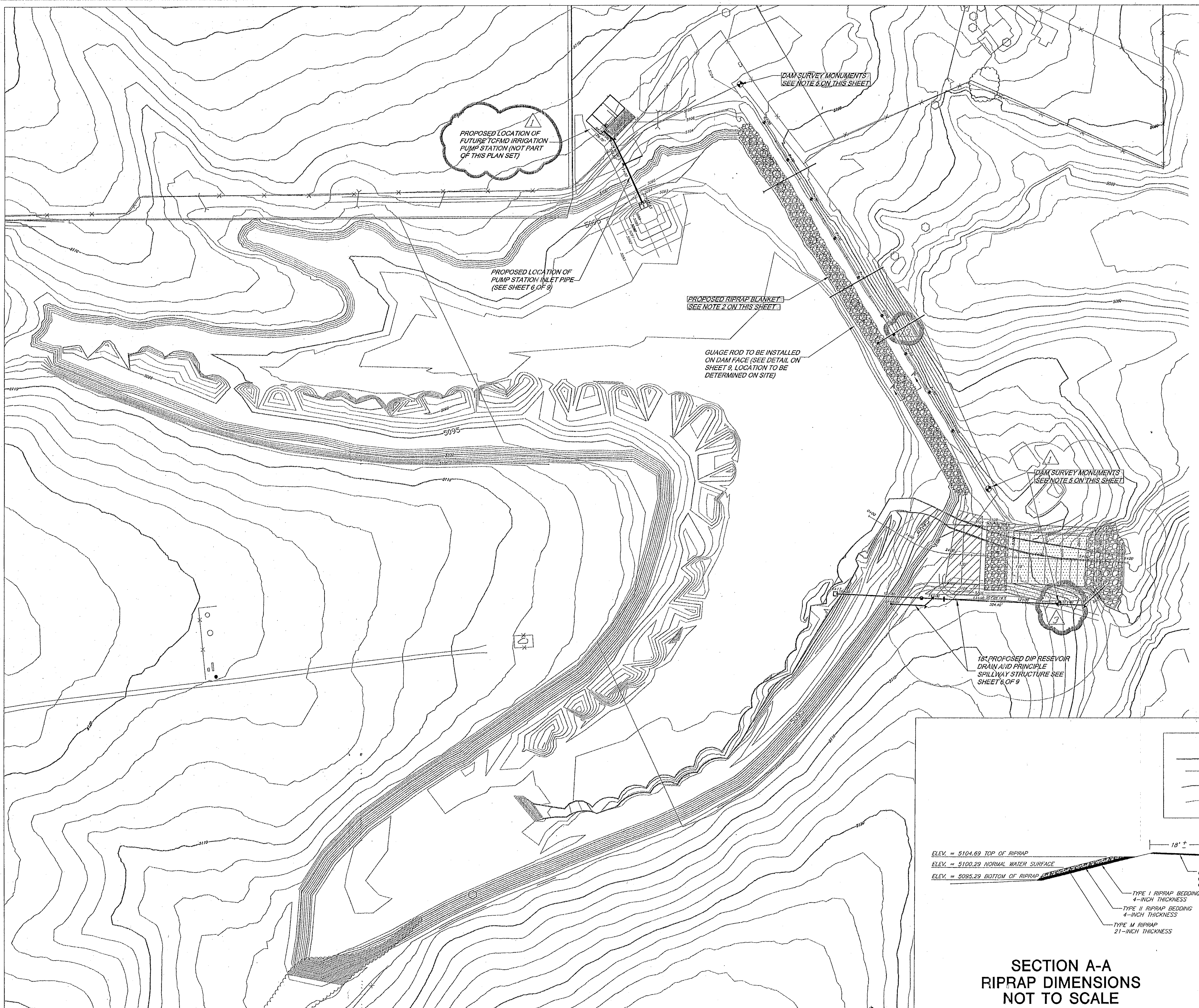
2000-2001 SMITH RESERVOIR IMPROVEMENTS
EXISTING STRUCTURES ABANDONMENT PLAN & PROFILE

TST
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE HOR. 1" = 50' VER. 1" = 5'
DATE 7/17/01 Rev. 4/16/03
SHEET 3 OF 9

C-1052A

DRAWINGS OF RECORD



GENERAL NOTES:

1. THE CONTOURS SURROUNDING THE RESERVOIR ARE AT 2 FOOT INTERVALS. THE REVISED CONTOURS FOR THE INTERIOR OF THE RESERVOIR HAVE BEEN SET AT 1 FOOT INTERVALS FOR THE GRADING DETAIL.

2. ANY EXISTING CONCRETE RUBBLE RIPRAP AND SILT PUSHED ONTO THE UPSTREAM FACE OF THE DAM DURING THE REHABILITATION OF THE RESERVOIR INTERIOR IS TO BE REMOVED AND REPLACED WITH THE PROPOSED RIPRAP AND BEDDING MATERIAL.

3. THE EXACT LOCATION OF THE RIPRAP BLANKET WILL BE DETERMINED BY FIELD CONDITIONS AND RECOMMENDATIONS FROM THE ENGINEER AND THE STATE ENGINEERS OFFICE.

4. DAM STATION MARKERS ARE TO BE PLACED ON THE DOWNSTREAM FACE OF THE DAM EVERY 100 FEET AS SHOWN ON THIS CONSTRUCTION DRAWING. THE STATION MARKERS WILL BE INSTALLED AFTER ALL OF THE RESERVOIR REHABILITATION WORK IS COMPLETED. CONSTRUCTION DETAILS FOR THE STATION MARKERS ARE SHOWN ON SHEET 9 OF 9.

5. THE EXACT LOCATION OF THE SURVEY MONUMENTS WILL BE DETERMINED BY FIELD CONDITIONS AND RECOMMENDATIONS FROM THE ENGINEER AND THE STATE ENGINEERS OFFICE. CONSTRUCTION DETAILS FOR THE STATION. MARKERS ARE SHOWN ON SHEET 9 OF 9.

LEGEND

5090	Proposed major contour
	Proposed minor contour
5080	existing major contour
5081	existing minor contour

REVISIONS

By	Date	Description
MWT	5/8/02	1 REVISED PRINCIPAL AND EMERGENCY SPILLWAY
		REVISED NOTE
MWT	5/8/03	2 ADDED SURVEY MONUMENT; REVISED MONUMENT LOCATION
		AS BUILT

DRAWN C.E.M.
CHECKED D.B.L.
DESIGNED C.E.M.
FILENAME SED Sheets 4-6

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID B LINDSAY 32135 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS PROPOSED IMPROVEMENTS

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE 1" = 100'
DATE 3/6/02 Rev. 6/21/02
SHEET 4 OF 9

C-1052A

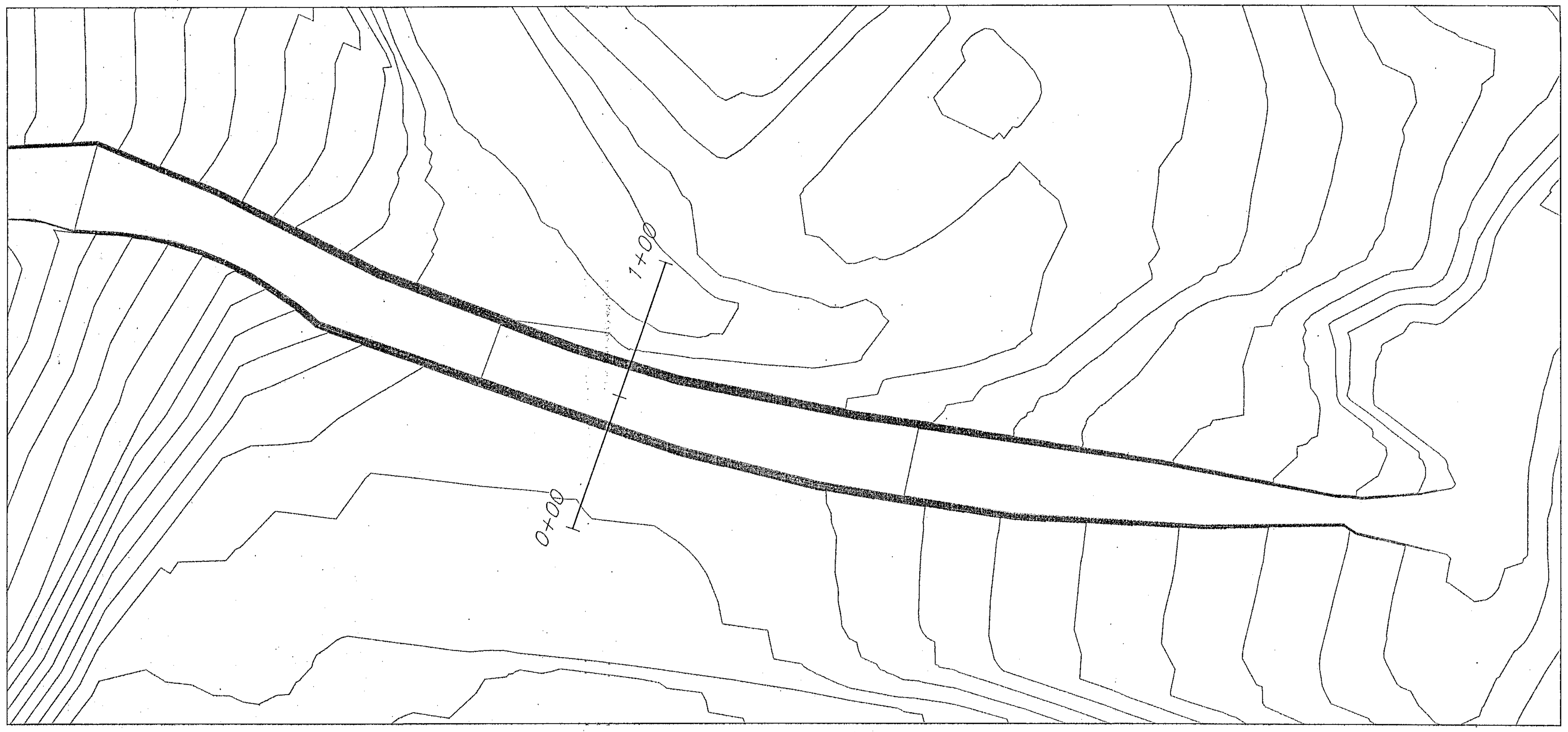
DRAWINGS OF RECORD

GENERAL NOTES:

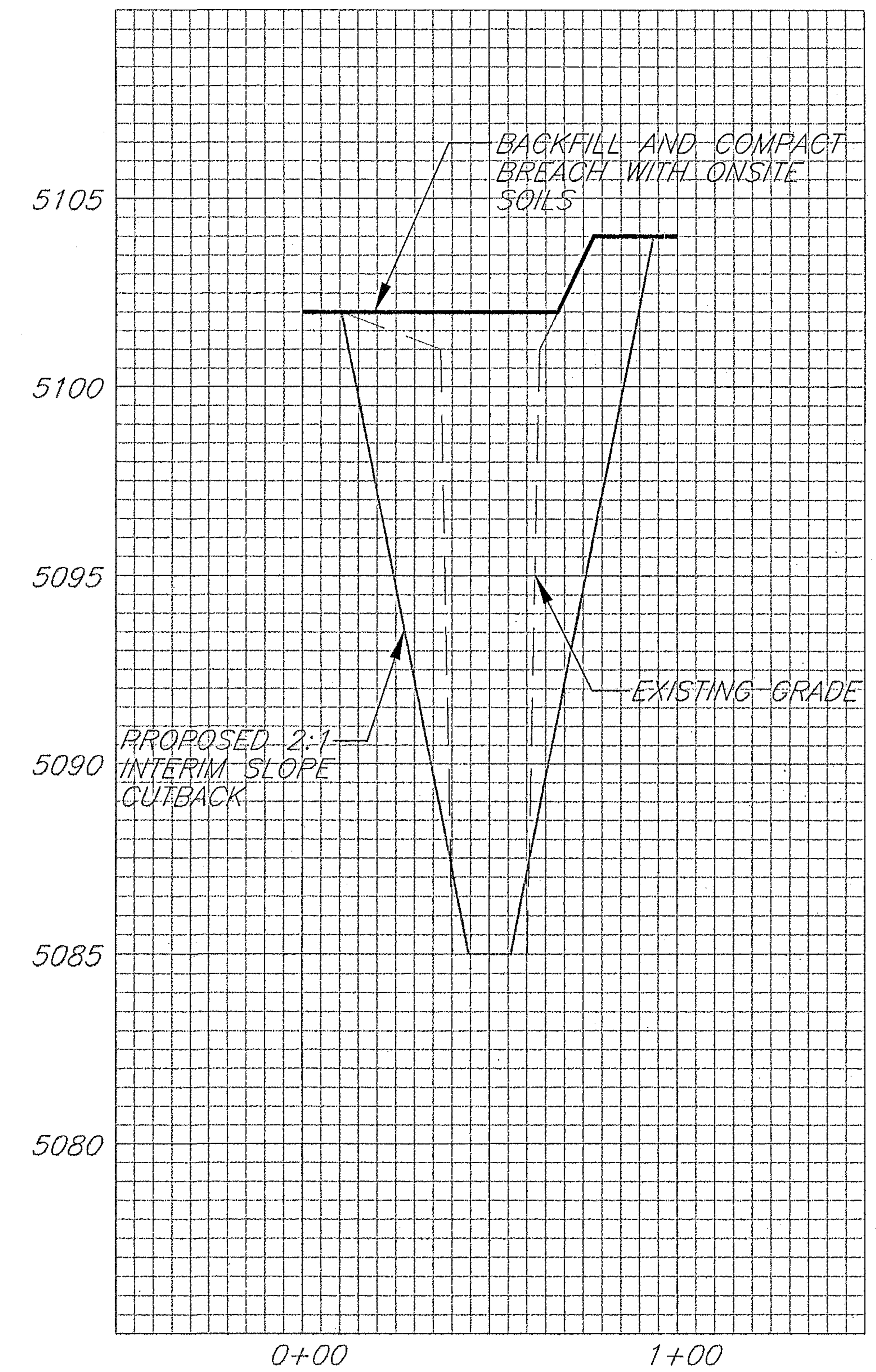
1. THE EXISTING RESERVOIR SECONDARY SPILLWAY IS TO BE SLOPED BACK AT A 2:1 INTERIM GRADE.

2. THE ONSITE MATERIAL USED TO BACKFILL THE BREACH SHALL BE PLACED IN LOOSE LIFTS NOT TO EXCEED 8-INCHES IN THICKNESS. THE MATERIAL SHALL BE COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTMD698 AND AT A MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT.

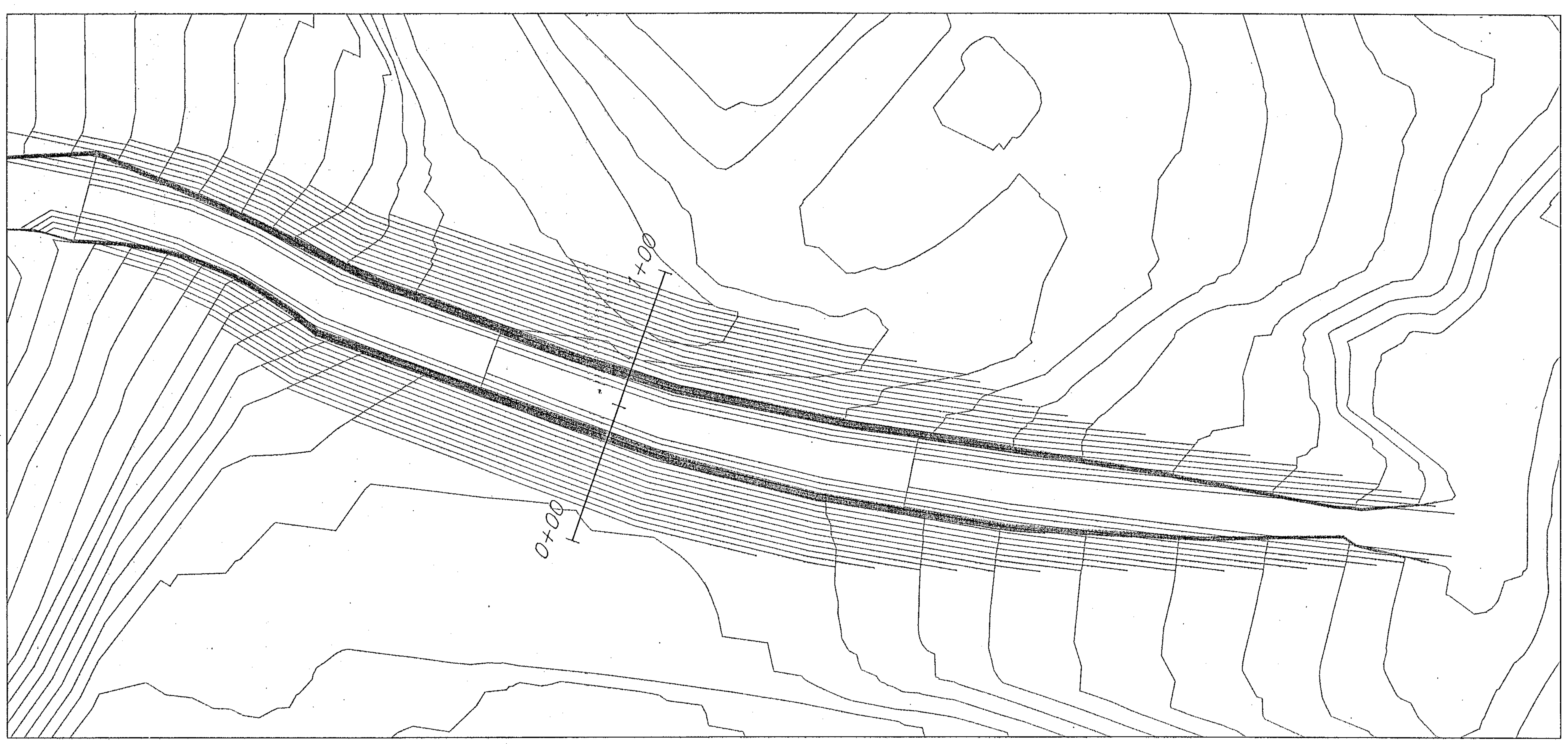
3. THE BREACH BACKFILL MATERIAL SHALL BE BENCHED AND KEYED INTO THE SIDE SLOPES OF THE BREACH SECTION.



EXISTING SECONDARY SPILLWAY CONDITION



PROPOSED BACKFILLED CONDITION



INTERIM SECONDARY SPILLWAY GRADING PRIOR TO BACKFILLING

EXISTING SECONDARY SPILLWAY TO BE GRADED TO INTERIM CONDITION AND THEN BACKFILLED WITH ONSITE MATERIAL. SEE SHEET 5B FOR PROPOSED FINAL GRADING OF THE SPILLWAY

DRAWN	C.E.M.
CHECKED	D.B.L.
DESIGNED	C.E.M.
FILENAME	SEO Sheet 5

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS
PROPOSED SPILLWAY GRADING/REHABILITATION PLAN

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO.	0910-002
SCALE	HORIZ. 1" = 30' VERT. 1" = 3'
DATE	7/17/01 Rev. 5/10/02
SHEET	5 OF 9

C-1052A

DRAWINGS OF RECORD

LEGEND

EXISTING CONTOURS — 5080 — 5081

PROPOSED CONTOURS 5100 5098

COLORADO REGISTERED PROFESSIONAL ENGINEER — DAVID B. LINDSAY — 32135 — 5-9-03

100 0 100 200
scale 1"=100' feet

C-1052A

REVISIONS		
By	Date	Description
MWT	6/21/02	⚠1 REVISED SPILLWAY & NOTES

DRAWN H.L.

CHECKED D.N.T.

DESIGNED H.L.

FILENAME Spillway Grading Plan

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR SPILLWAY GRADING PLAN EXISTING SPILLWAY ABANDONMENT AND PROPOSED EMERGENCY SPILLWAY

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

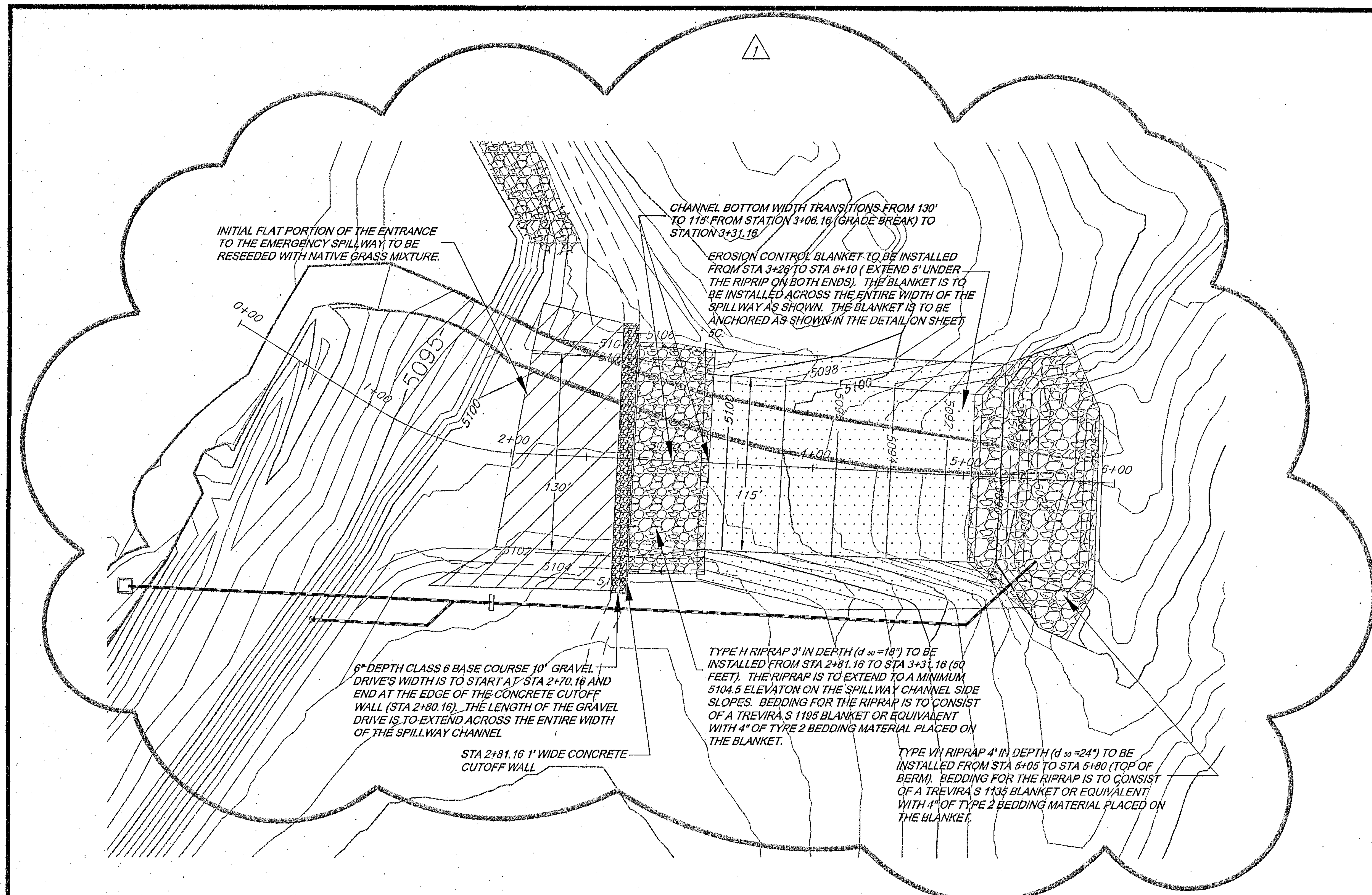
JOB NO. 0910-002

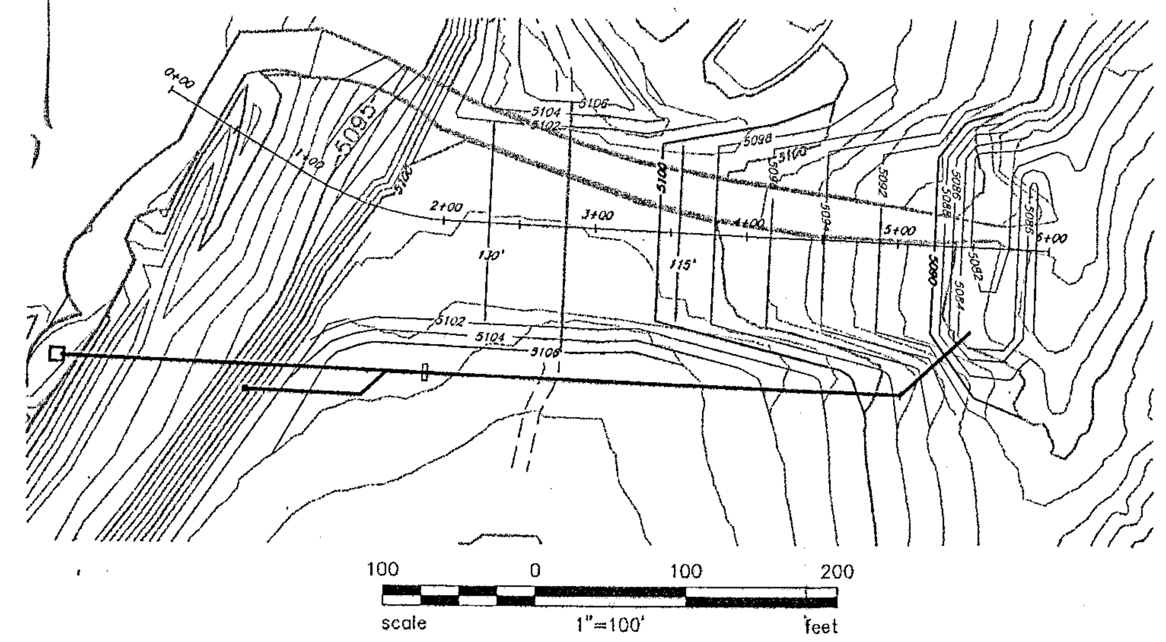
SCALE 1" = 100'

DATE 12/12/01 Rev. 6/21/02

SHEET 5A OF 9

DRAWINGS OF RECORD



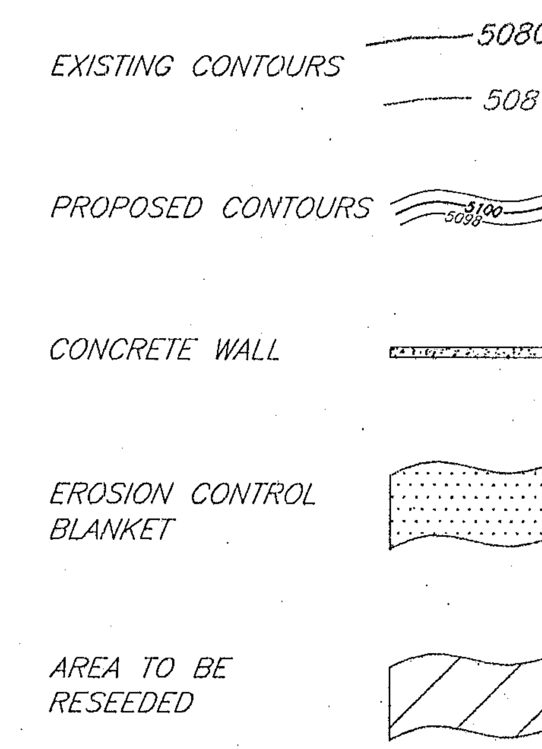


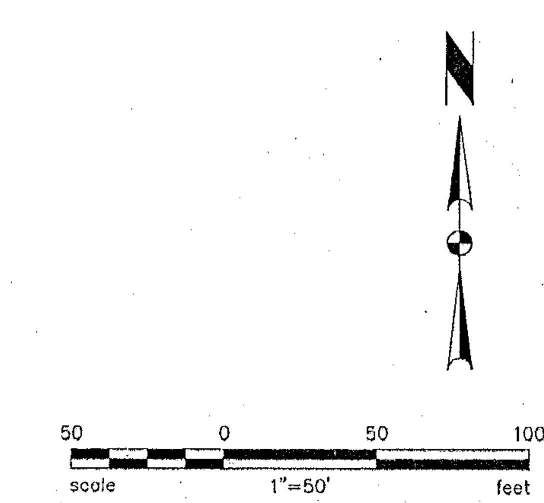
Spillway Grading Plan View For Reference

(See Plan View To The Left For Final Design)

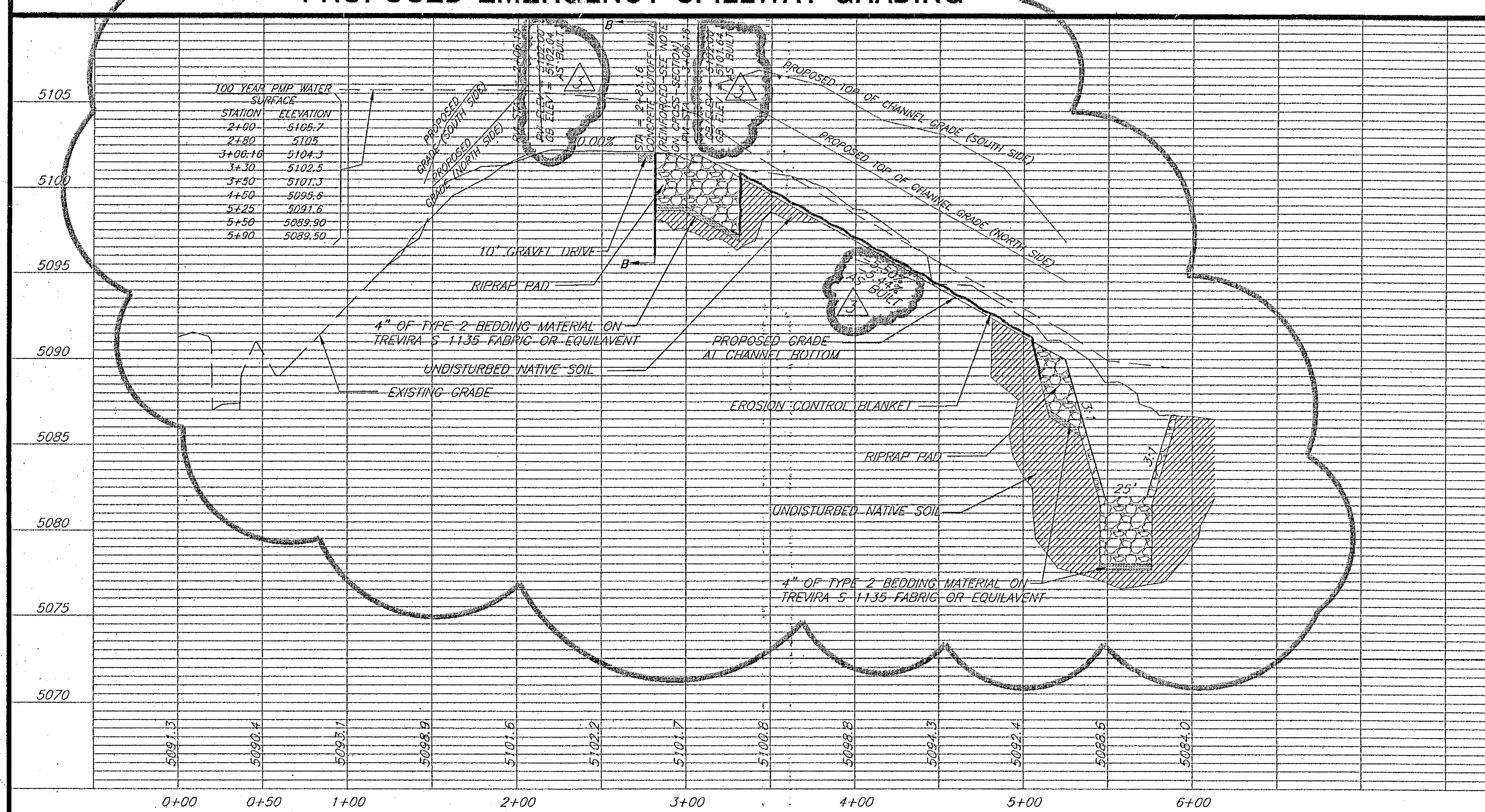
COLORADO REGISTERED PROFESSIONAL ENGINEER 32135 5-9-07

LEGEND



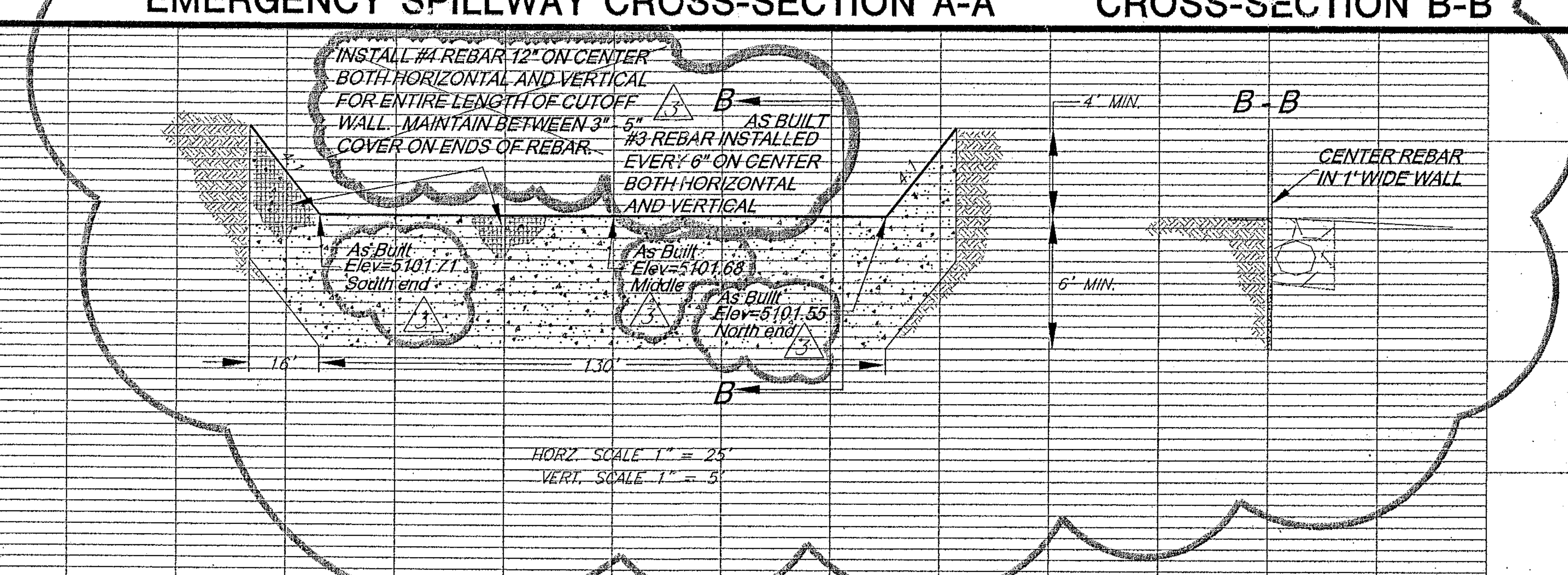


PROPOSED EMERGENCY SPILLWAY GRADING



EMERGENCY SPILLWAY CROSS-SECTION A-A

CROSS-SECTION B-B



REVISIONS			
By	Date		Description
MWT		△	REVISED EMERGENCY SPILLWAY
MWT		△	USED #3 REBAR 6" OC; AS BUILTS

DRAWN: H.L.
CHECKED: D.N.T.
DESIGNED: H.L.
FILENAME: Spillway Grading Plan

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR SPILLWAY GRADING PROPOSED EMERGENCY SPILLWAY GRADING PLAN & PROFILE

TST
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

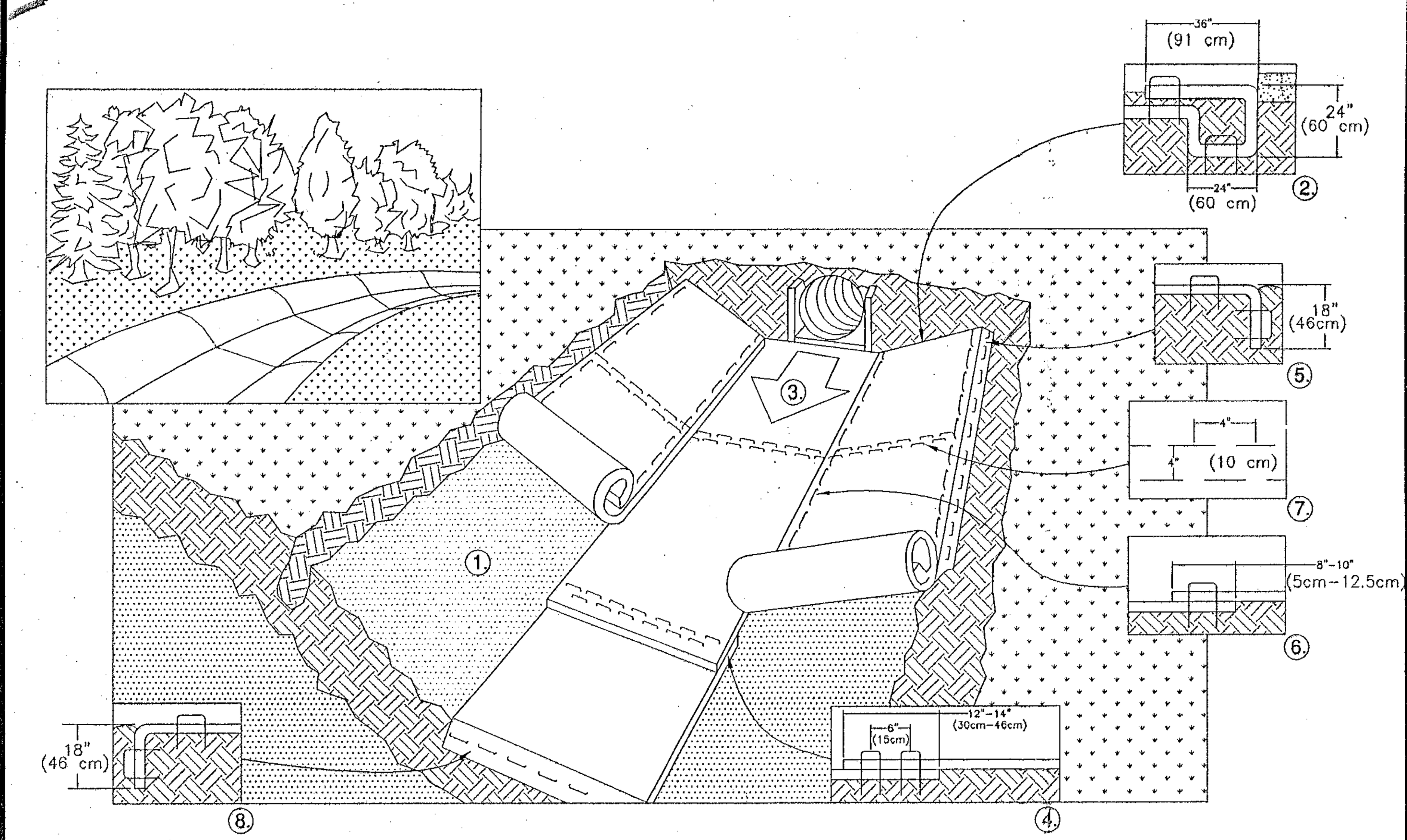
JOB NO. 0910-002
SCALE HOR. 1" = 50' VER. 1" = 5'
DATE 12/12/01 Rev. 6/21/02
SHEET 5B OF 9

C-1052A

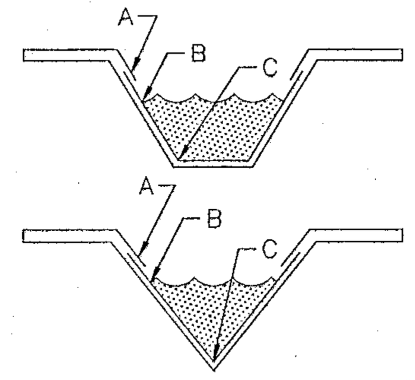
DRAWINGS OF RECORD

SPILLWAY CHANNEL INSTALLATION

△1



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 24" (60cm) DEEP X 24" (60cm) WIDE TRENCH WITH APPROXIMATELY 36" (91cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 36" (122cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL CENTER BLANKET IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING OPTIONAL DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE BLANKETS END OVER END (SHINGLE STYLE) WITH A 12"-14" (30cm-35cm) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 6" (20cm) APART AND 4" (10cm) ON CENTER TO SECURE BLANKETS.
5. FULL LENGTH EDGE OF BLANKETS AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 18" (46cm) DEEP X 18" (46cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT BLANKETS MUST BE OVERLAPPED APPROXIMATELY 8"-10" (20cm-25cm) (DEPENDING ON BLANKET TYPE) AND STAPLED. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH™ ON THE BLANKET BEING OVERLAPPED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9m-12m) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10cm) APART AND 4" (10cm) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE BLANKETS MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 18" (46cm) DEEP X 18" (46cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.



CRITICAL POINTS

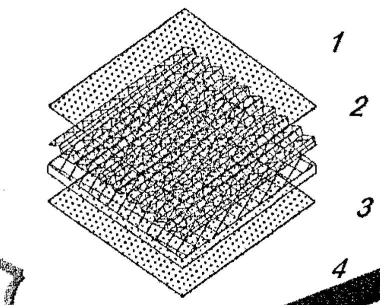
A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTE:
* HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.

** IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 cm) MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

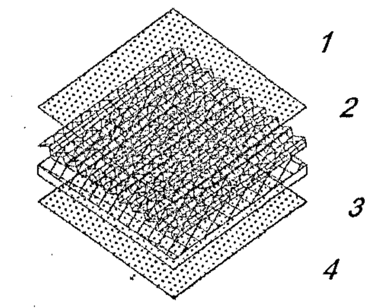
REINFORCEMENT MAT - EROSION PROTECTION BLANKET
(North American Greens C550)

△1



1. Top Netting [illegible] lbs./1000 sq. ft. Heavy UV Stabilized black polypropylene
2. Center Netting 24 [illegible] sq. ft. Heavy UV Stabilized, Corrugated, black polypropylene
3. Matrix Material 100% UV Stabilized polypropylene fibers
4. Bottom Net 24 lbs./1000 sq. ft. Heavy UV Stabilized black polypropylene

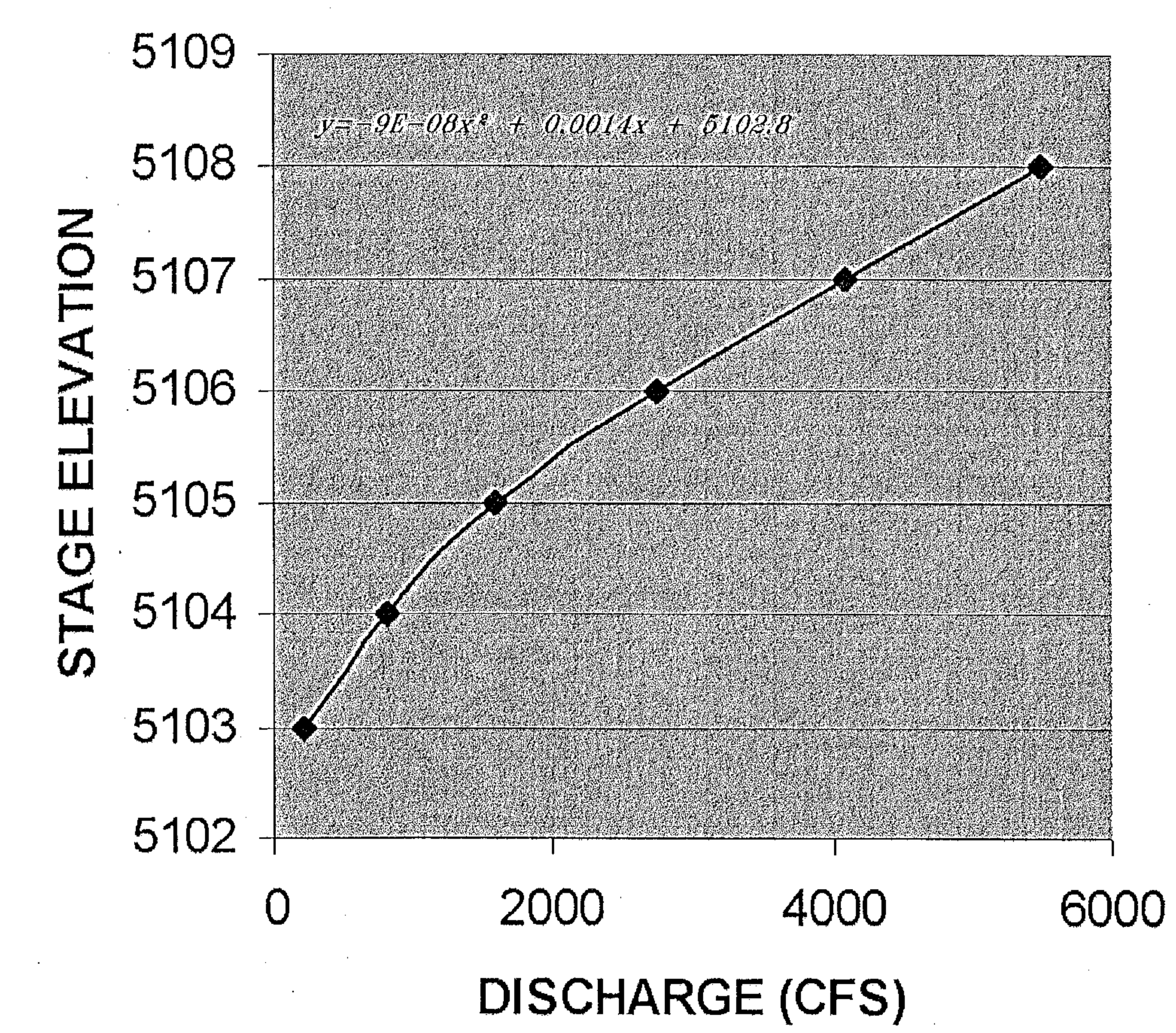
REINFORCEMENT MAT - EROSION PROTECTION BLANKET
(North American Greens C350)



1. Top Netting 8 lbs./1000 sq. ft. Heavy UV Stabilized black polypropylene
2. Center Netting 24 lbs./1000 sq. ft. Heavy UV Stabilized, Corrugated, black polypropylene
3. Matrix Material 100% Coconut fiber
4. Bottom Net 8 lbs./1000 sq. ft. Heavy UV Stabilized black polypropylene

△1

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1
SMITH RESERVOIR EMERGENCY SPILLWAY DISCHARGE CURVE



Q (cfs)	Stage Elevation
210.0	5103
800.0	5104
1600	5105
2750	5106
4100	5107
5500	5108

COLORADO REGISTERED PROFESSIONAL ENGINEER 32135 5-9-03

REVISIONS			
By	Date		Description
MWT	6/21/02	△	REVISED DETAIL; ADDED CURVE; X-ED OUT DETAIL

DRAWN H.L.
CHECKED D.N.T.
DESIGNED H.L.
FILENAME Spillway Grading Plan

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS
REINFORCEMENT MAT - EROSION CONTROL BLANKET DETAILS

TST
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE N.T.S.
DATE 12/12/01 Rev. 6/21/02
SHEET 5C OF 9

DRAWINGS OF RECORD

General Notes:

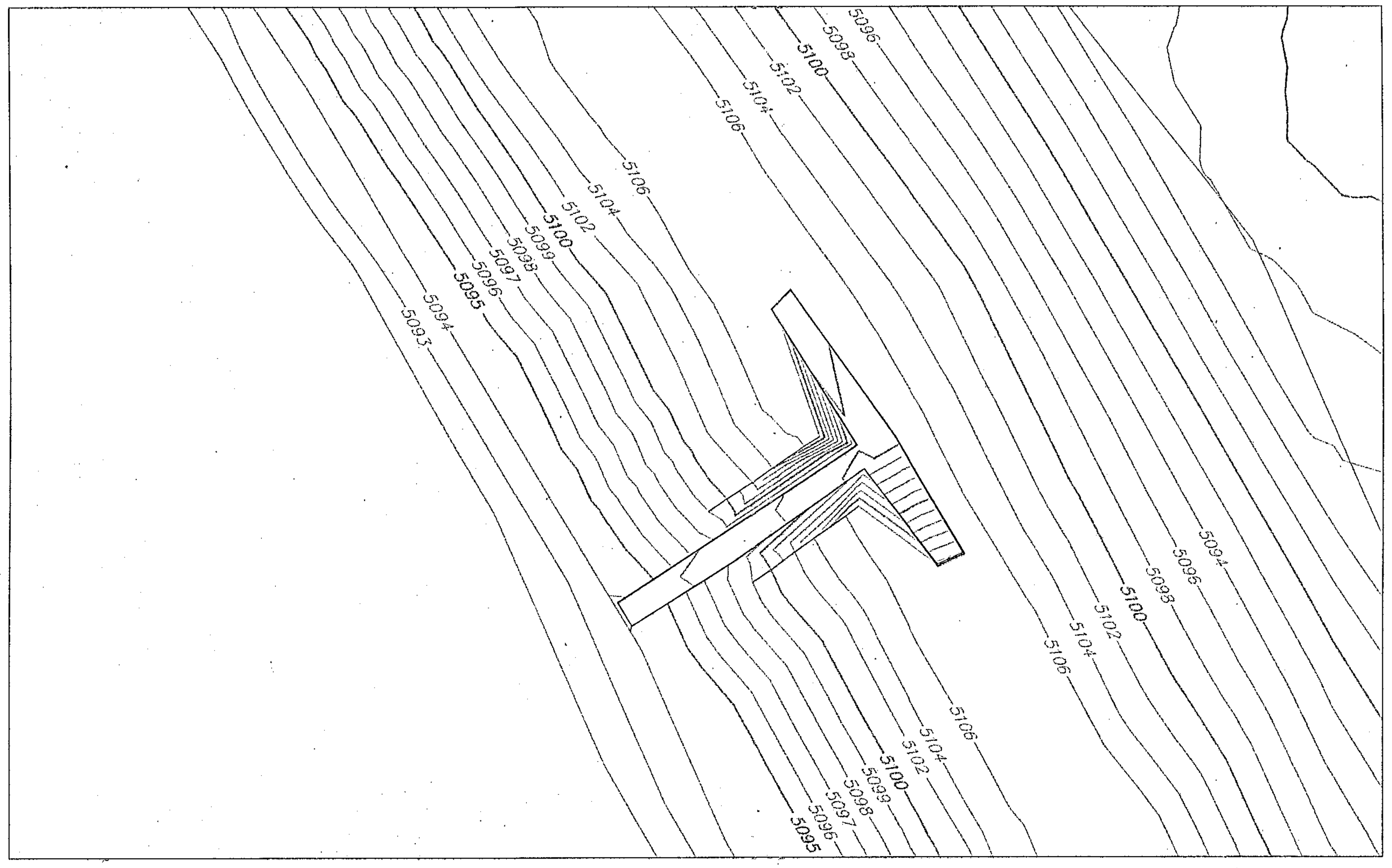
1) THE EXISTING BREACH IS TO BE SLOPED BACK AT A 2:1 INTERIM GRADE.

2) EXISTING TOP SOIL THAT WILL BE DISTURBED DURING CONSTRUCTION SHALL BE STOCKPILED SEPERATELY AND REPLACED AS TOP SOIL.

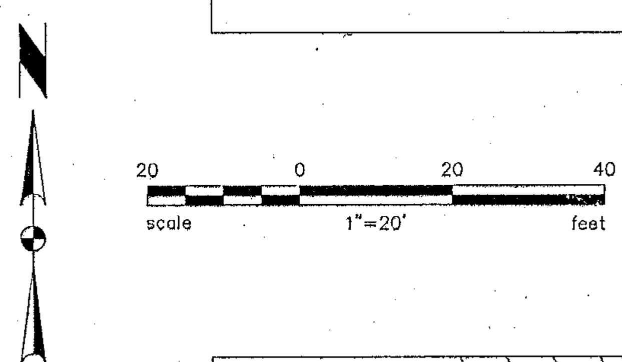
3) THE ONSITE MATERIAL USED TO BACKFILL THE BREACH SHALL BE PLACED IN LOOSE LIFTS NOT TO EXCEED 8-INCHES IN THICKNESS. THE MATERIAL SHALL BE COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM0698 AND AT A MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT.

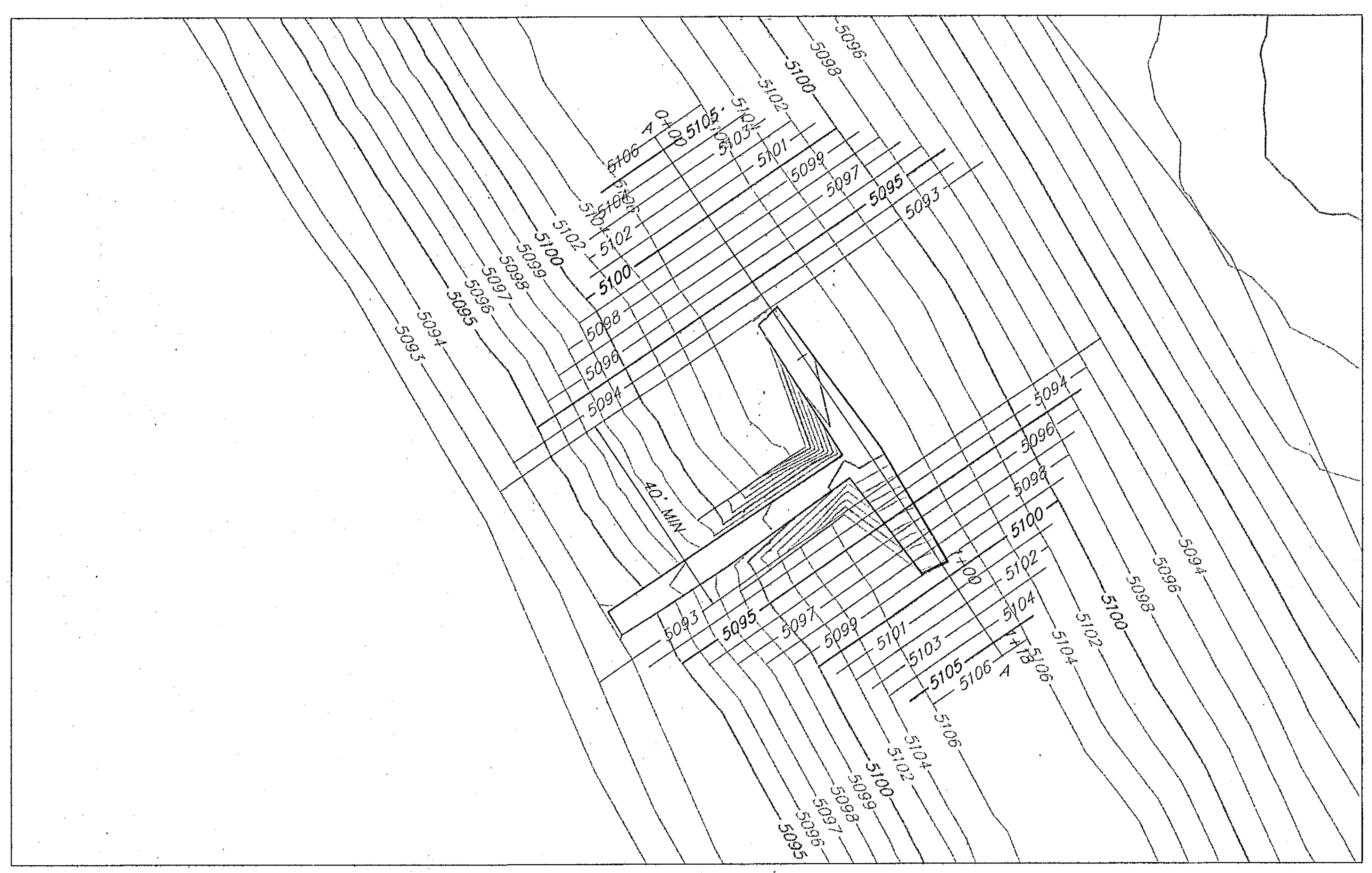
4) THE BREACH BACKFILL MATERIAL SHALL BE BENCHED AND KEYED INTO THE SIDE SLOPES OF THE BREACH SECTION.

5) THE PROPOSED FINAL GRADE SHALL MATCH THE ORIGINAL DIMENSION OF THE DAM.

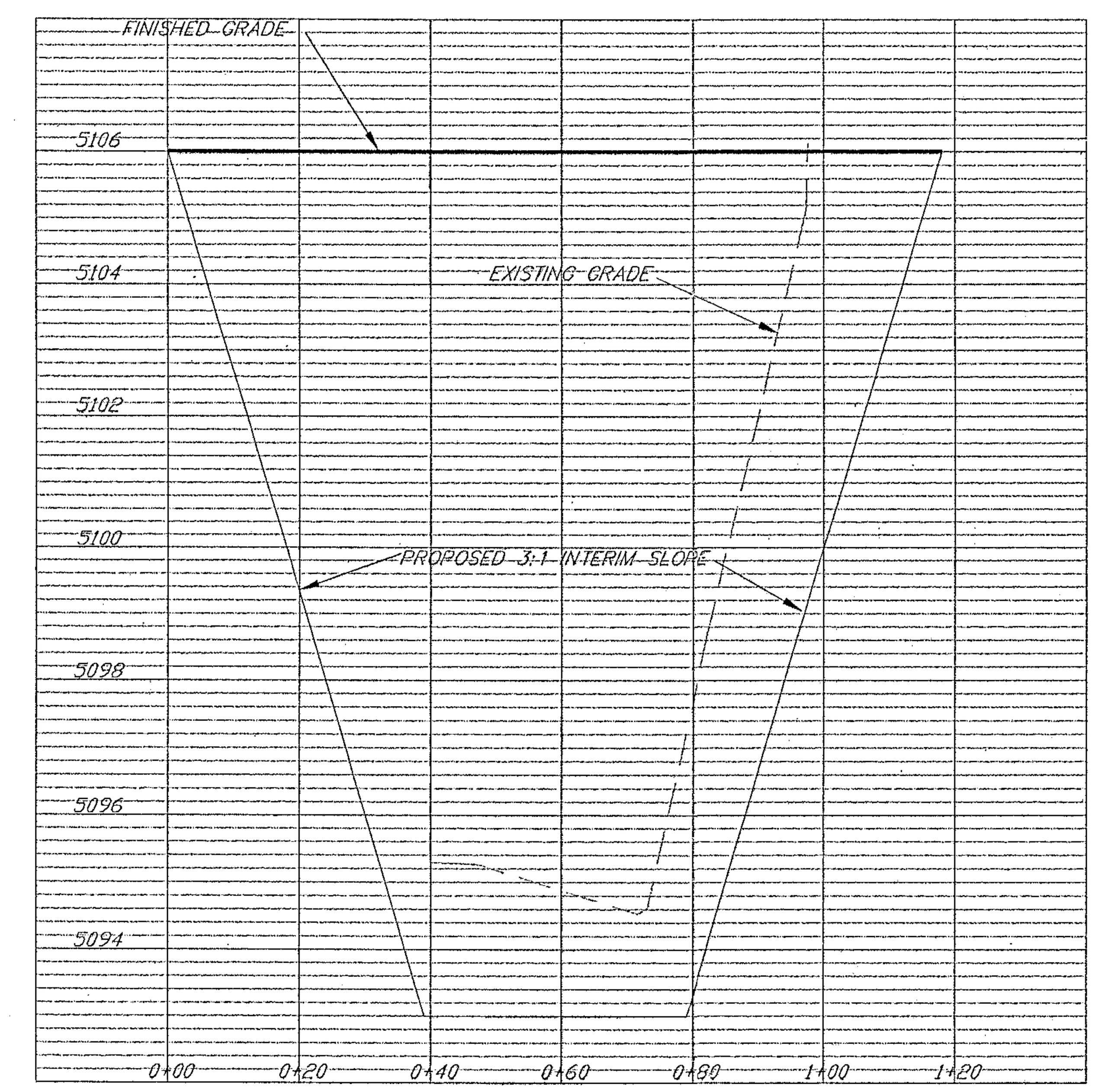


EXISTING CONDITION





PROPOSED INTERIM GRADING PRIOR TO BACKFILLING



CROSS SECTION A-A

REVISIONS

By	Date	Description
		THE BREACH WAS CREATED AFTER CONSTRUCTION HAD STARTED. THIS PLAN WAS PART OF A REQUIRED SEPERATE SUBMITTAL TO THE STATE ON HOW TO REPAIR THE CREATED BREACH.

DRAWN M.W.T.

CHECKED D.B.L.

DESIGNED M.W.T.

FILENAME SED Sheets 5D

COLORADO REGISTERED PROFESSIONAL ENGINEER DAVID B LINDSAY 32135 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS
DAM BREACH GRADING REPAIR PLAN

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-009

SCALE HOR. 1" = 20'
VER. 1" = 2'

DATE 7/17/01
Rev. 3/11/03

SHEET 5D OF 9

C-1052A

DRAWINGS OF RECORD

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS
PROPOSED OUTLET STRUCTURES PLAN & PROFILE

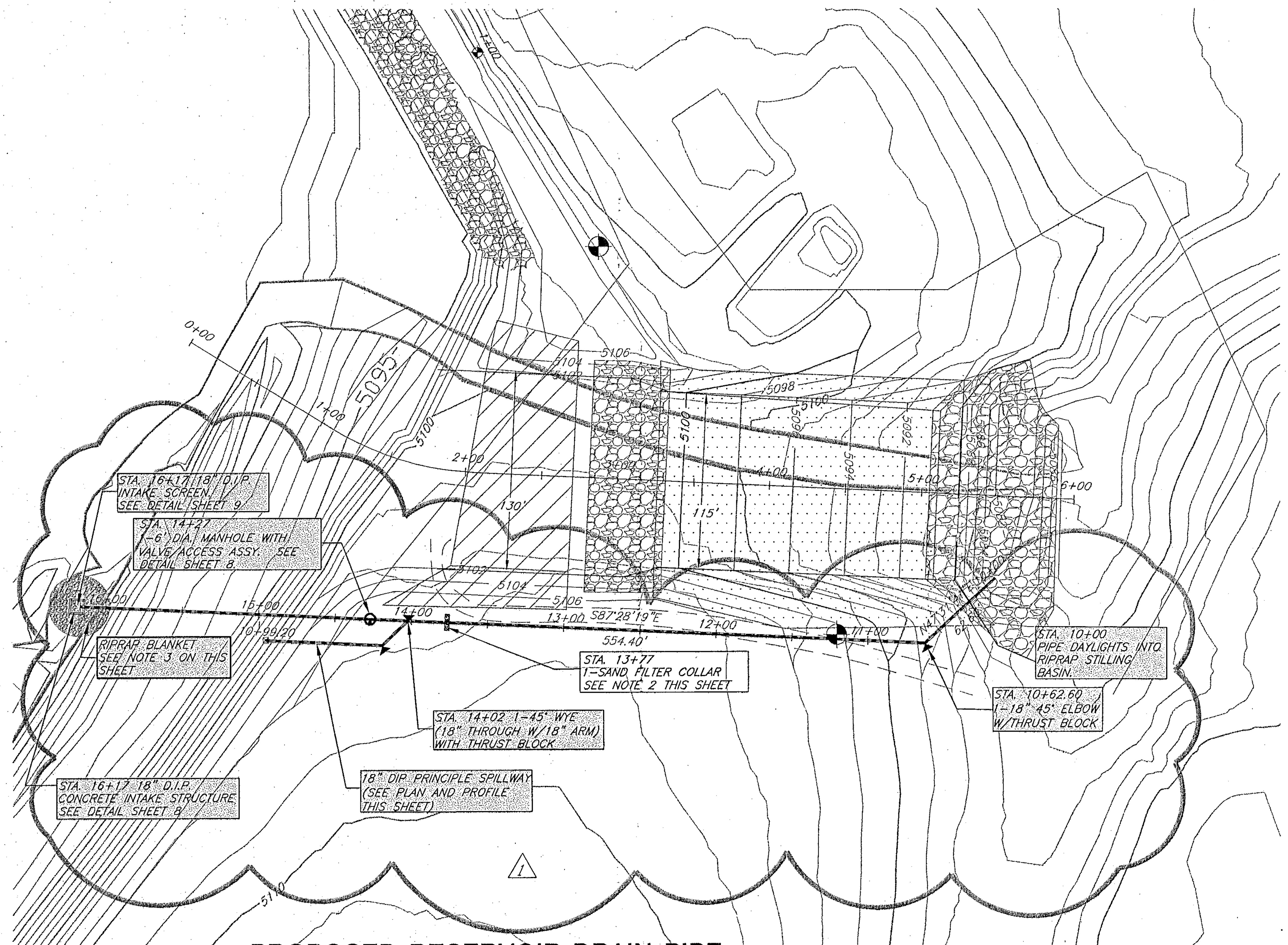
GENERAL NOTES:

1. NO GRANULAR BEDDING SHALL BE USED BENEATH ANY OF THE OUTLET WORKS CONDUITS. ALL OF THE DUCTILE IRON PIPE SHALL HAVE A CONCRETE BEDDING.
2. THE SAND FILTER COLLAR AT STA 13+77 SHALL BE CONSTRUCTED OF A GRANULAR FILTER MEETING THE SPECIFICATION REQUIREMENTS FOR AN ASTM C33 SAND. THE COLLAR SHOULD HAVE A MINIMUM THICKNESS OF 3 FEET AND ENVELOPE THE 18-INCH CONDUIT BY A MINIMUM OF 4.5 FEET IN ALL DIRECTIONS AS MEASURED FROM THE OUTSIDE OF THE CONDUIT. (1)
3. A RIPRAP BLANKET IS TO BE PLACED AROUND THE INTAKE TO PREVENT EMBANKMENT SLOUGHING. THE RIPRAP AND BEDDING CLASSIFICATION WILL BE THE SAME AS SHOWN FOR THE 18" D.I.P. OUTLET AS SHOWN ON SHEET 8. THE LOCATION OF THE RIPRAP BLANKET WILL BE DETERMINED BY FIELD CONDITIONS AND RECOMMENDATIONS FROM THE ENGINEER AND THE STATE ENGINEERS OFFICE.

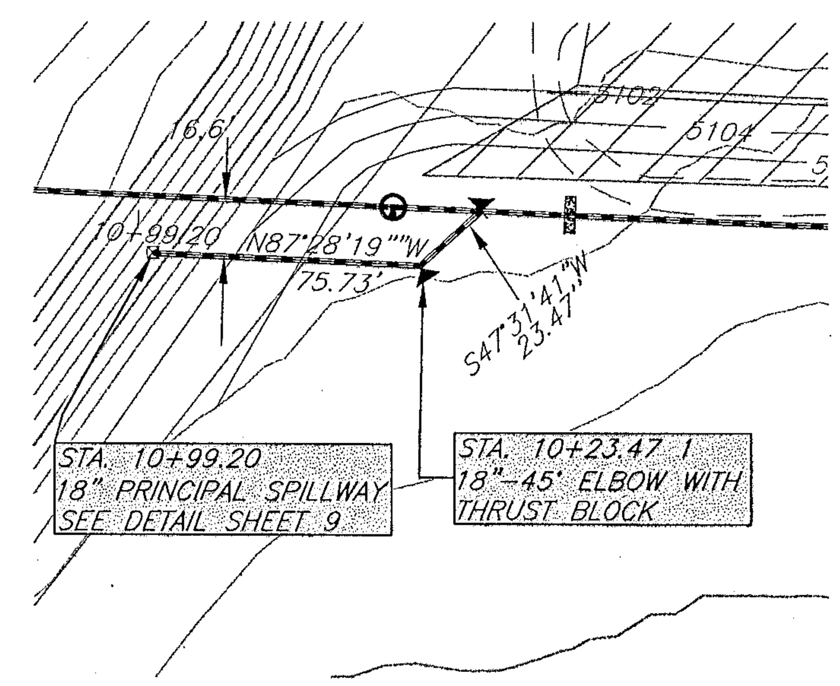
scale 1"=50' — 50, 0, 50, 100 feet

LEGEND

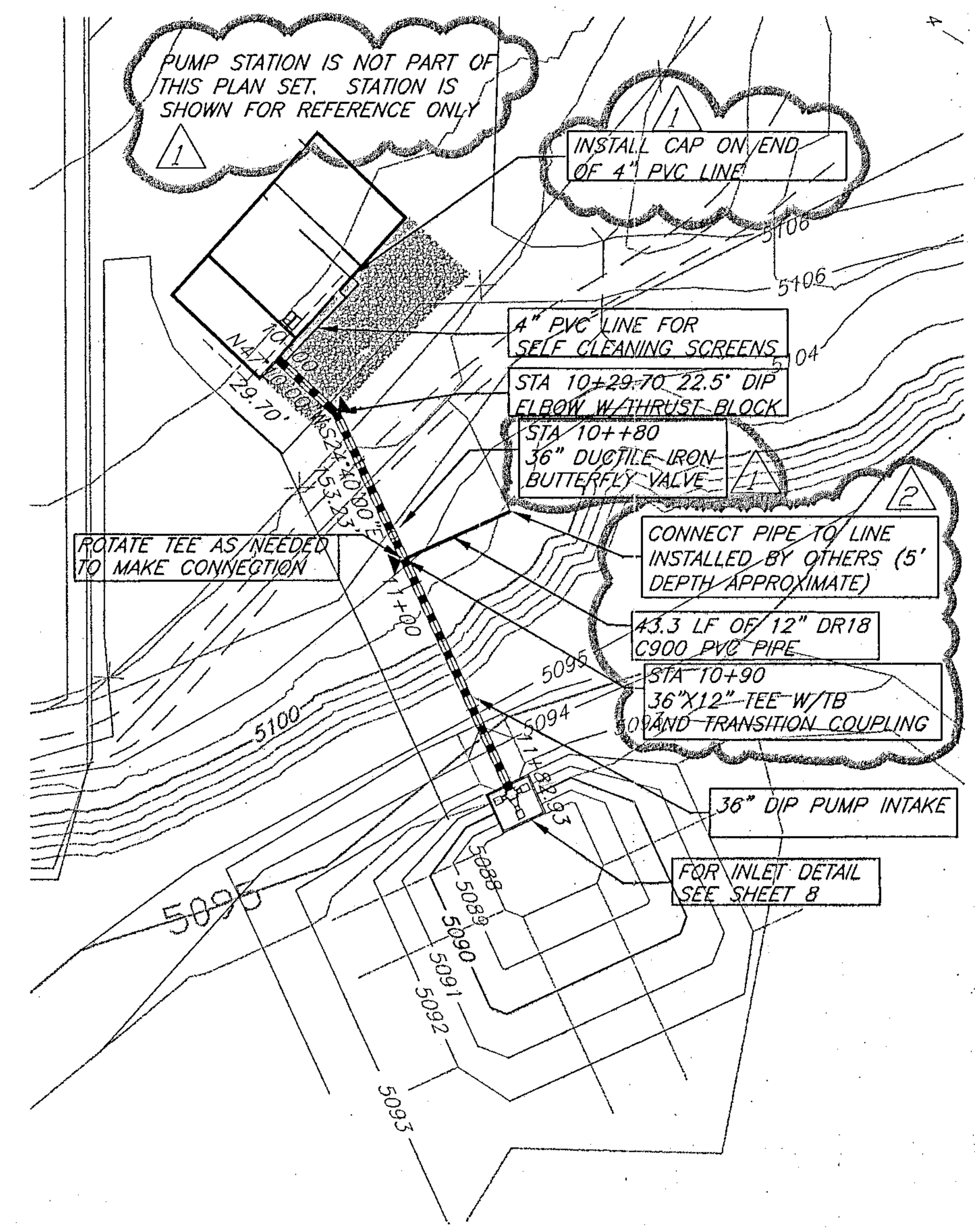
5090	Proposed major contour
	Proposed minor contour
5080	existing major contour
5081	existing minor contour



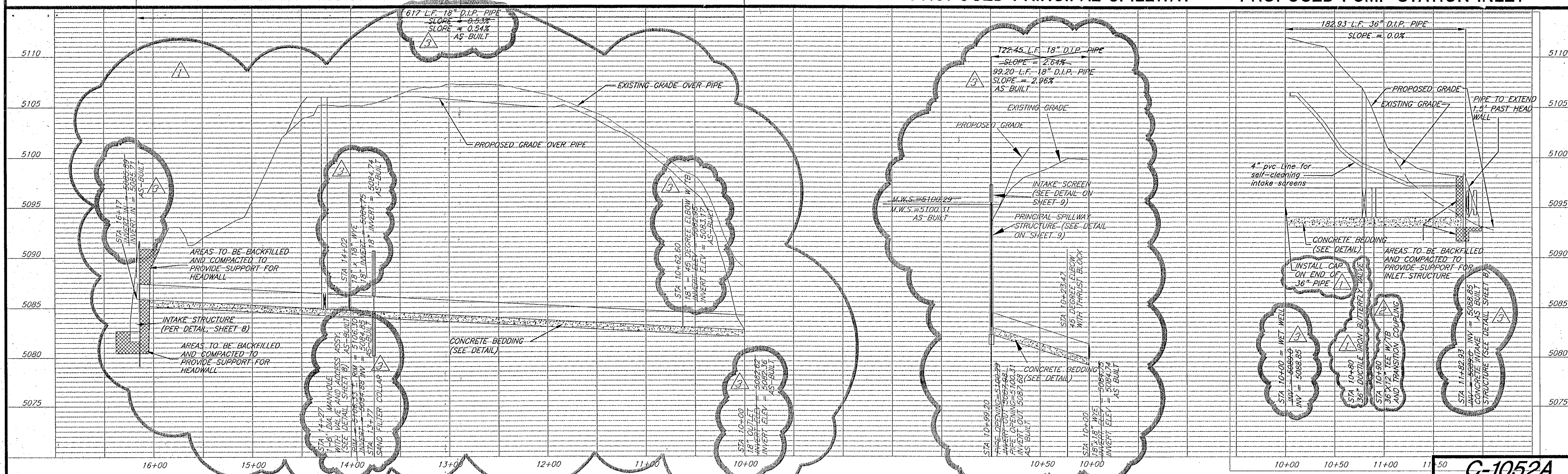
PROPOSED RESERVOIR DRAIN PIPE



PROPOSED PRINCIPAL SPILLWAY



PROPOSED PUMP STATION INLET



C-1052A

REVISIONS		
By	Date	Description
MWT	6/21/02	(1) REVISED PLAN & PROFILES; ADDED & REVISED NOTES
MWT	8/12/02	(2) REVISED PER CHANGE ORDER #1
MWT	5/2/03	(3) REVISED PRINCIPAL SPILLWAY PIPE ALIGNMENT, AS BUILT

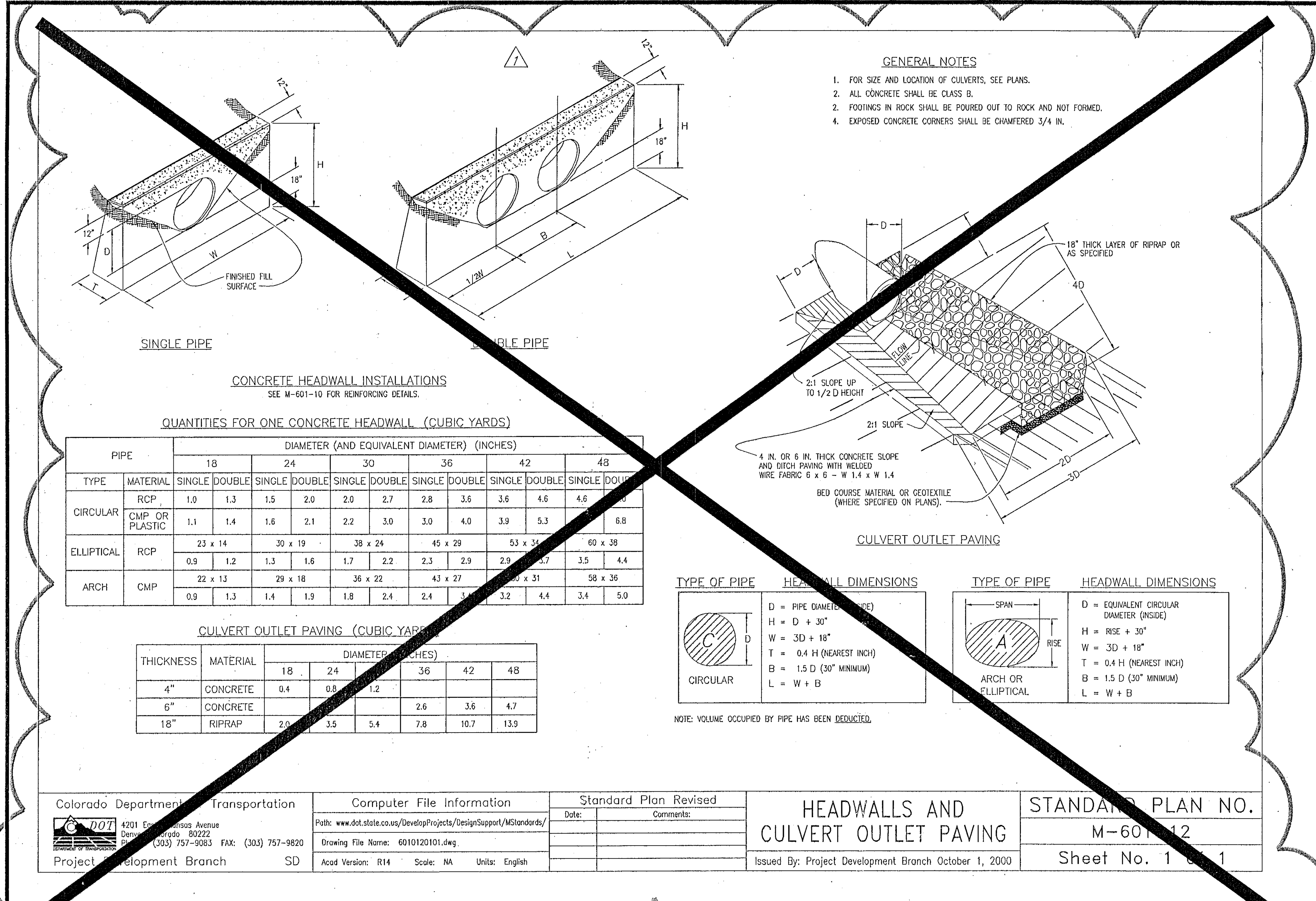
DRAWN	C.E.M.
CHECKED	D.B.L.
DESIGNED	C.E.M.
FILENAME	SEO Sheets 4-6

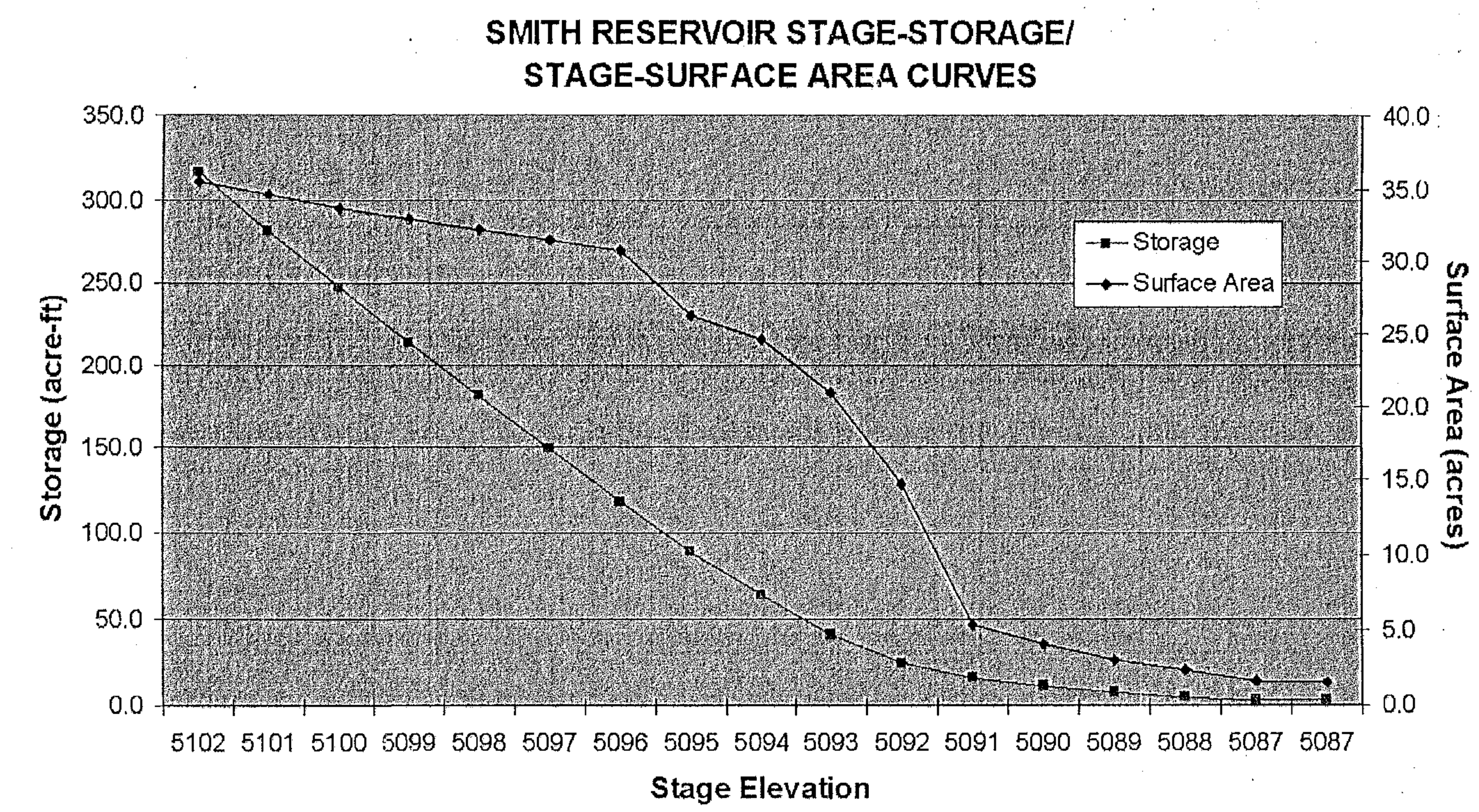
COLORADO REGISTERED PROFESSIONAL ENGINEER — DAVID B LINDSAY 32135 — 5-9-03

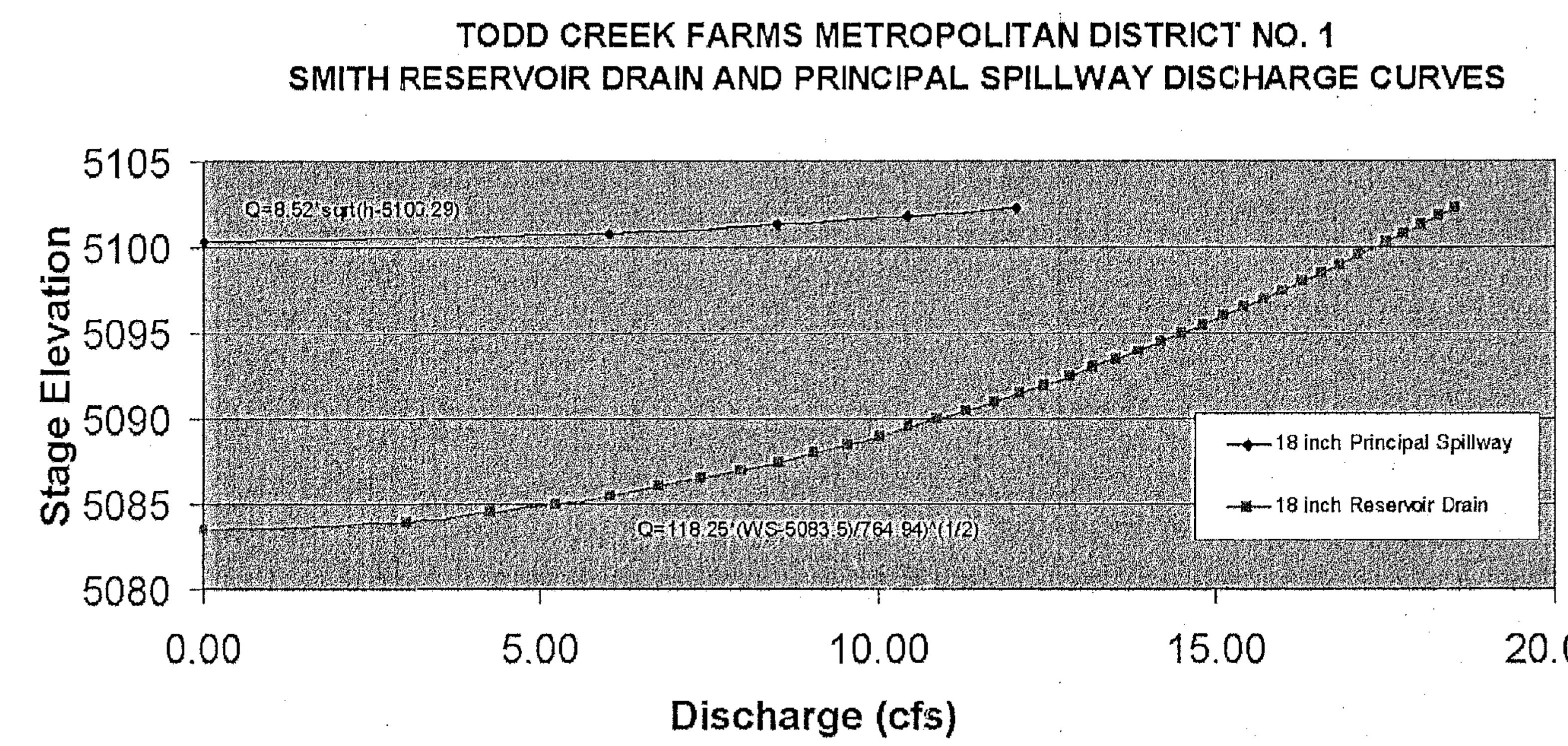
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO.	0910-002
SCALE	HOR. 1" = 50' VER. 1" = 5'
DATE	7/17/01 Rev. 6/21/02
SHEET	6 OF 9

DRAWINGS OF RECORD

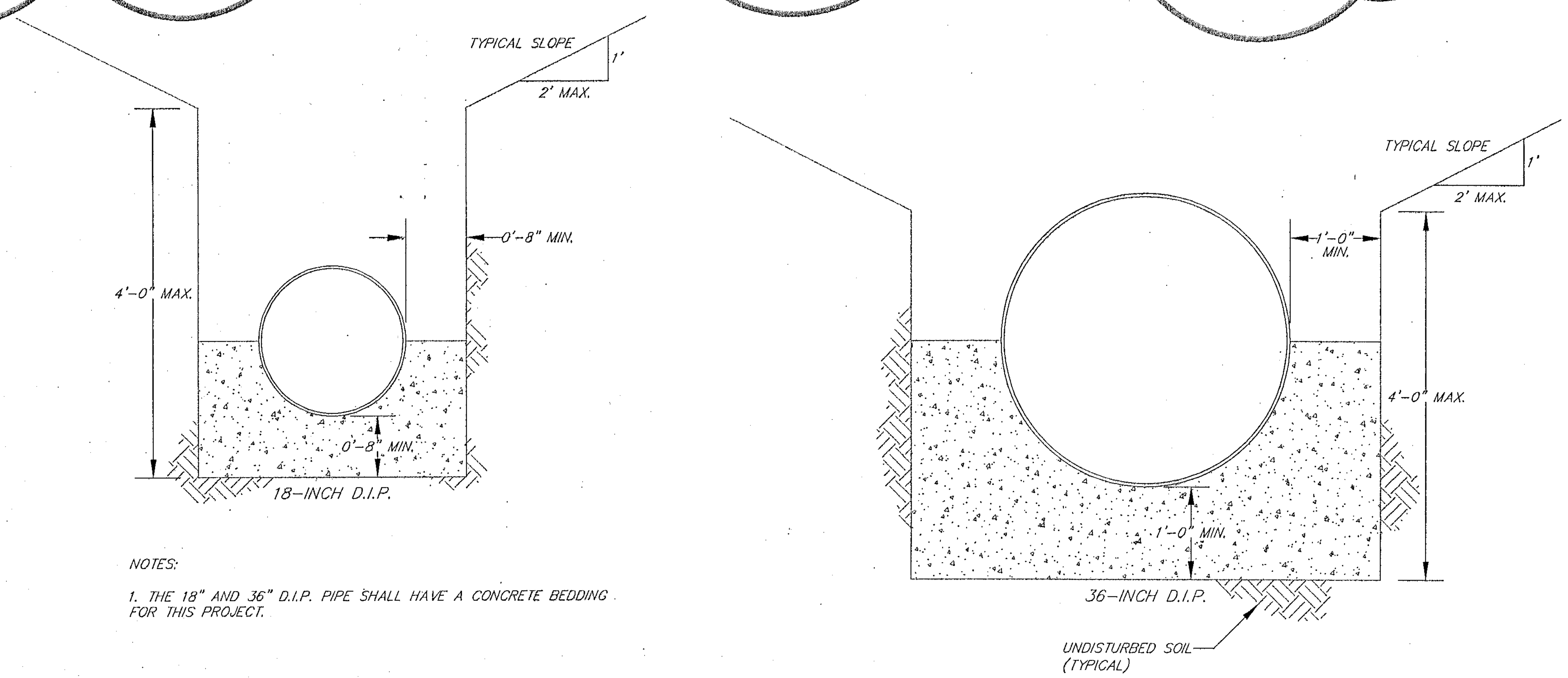






STAGE-STORAGE AND SURFACE AREA QUANTITIES

Stage Elevation	Storage (acre-ft)	Surface Area (acres)
5102	316.2	35.6
5101	281.2	34.7
5100	247.0	33.7
5099	213.6	33.0
5098	181.0	32.2
5097	149.1	31.5
5096	118.0	30.8
5095	89.6	26.3
5094	64.1	24.6
5093	41.3	20.9
5092	23.7	14.6
5091	16.0	5.3
5090	11.2	4.1
5089	7.6	3.0
5088	5.0	2.3
5087	3.1	1.6
5086.78	2.8	1.5



NOTES:

1. THE 18" AND 36" D.I.P. PIPE SHALL HAVE A CONCRETE BEDDING FOR THIS PROJECT.

PIPE TRENCH DETAILS

REVISIONS: △ X-ED OUT DETAIL — MWT

DRAWN: C.E.M.
CHECKED: D.B.L.
DESIGNED: C.E.M.
FILENAME: SEO Sheet 7

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

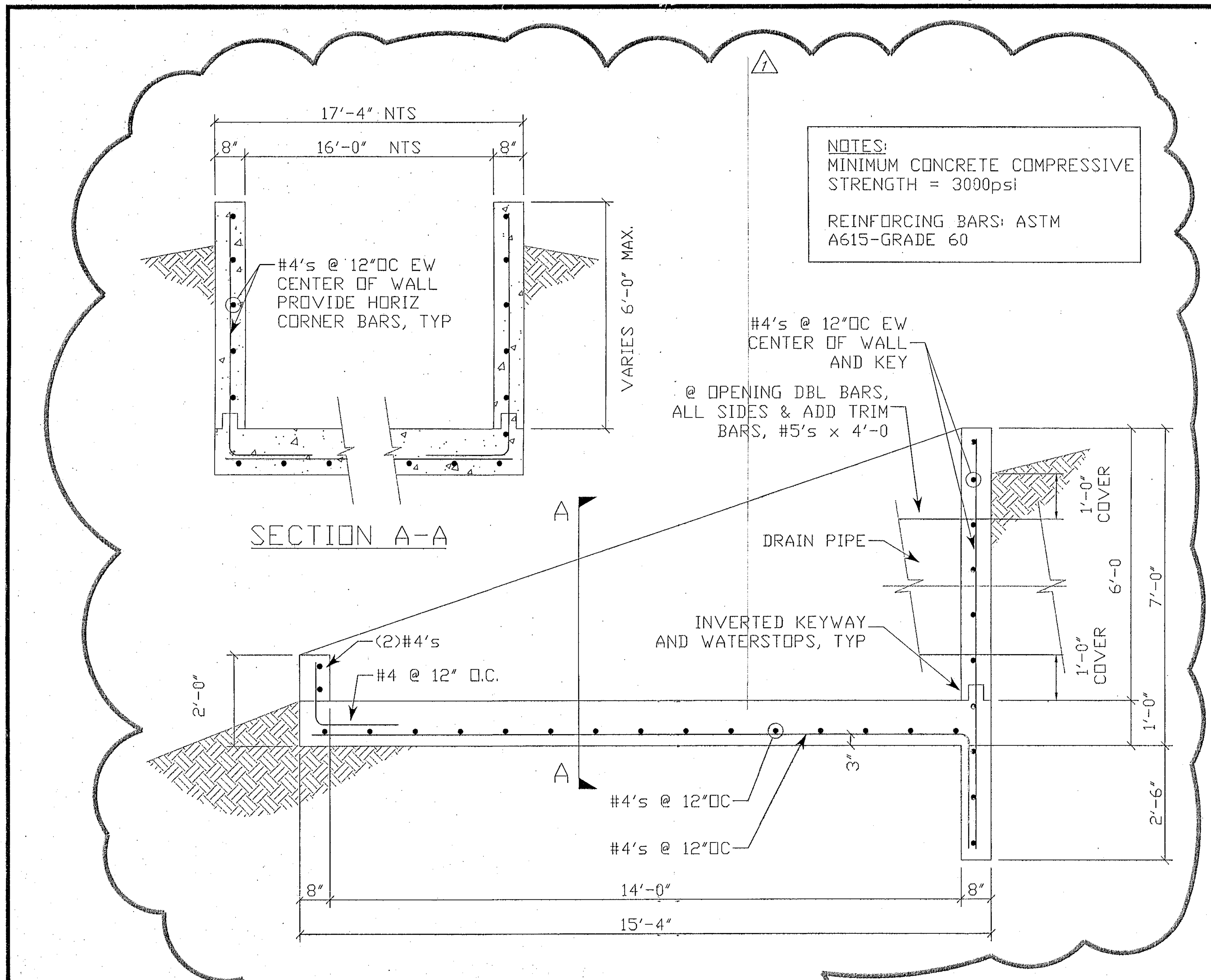
2000-2001 SMITH RESERVOIR IMPROVEMENTS CONSTRUCTION AND RESERVOIR CAPACITY DETAILS

TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

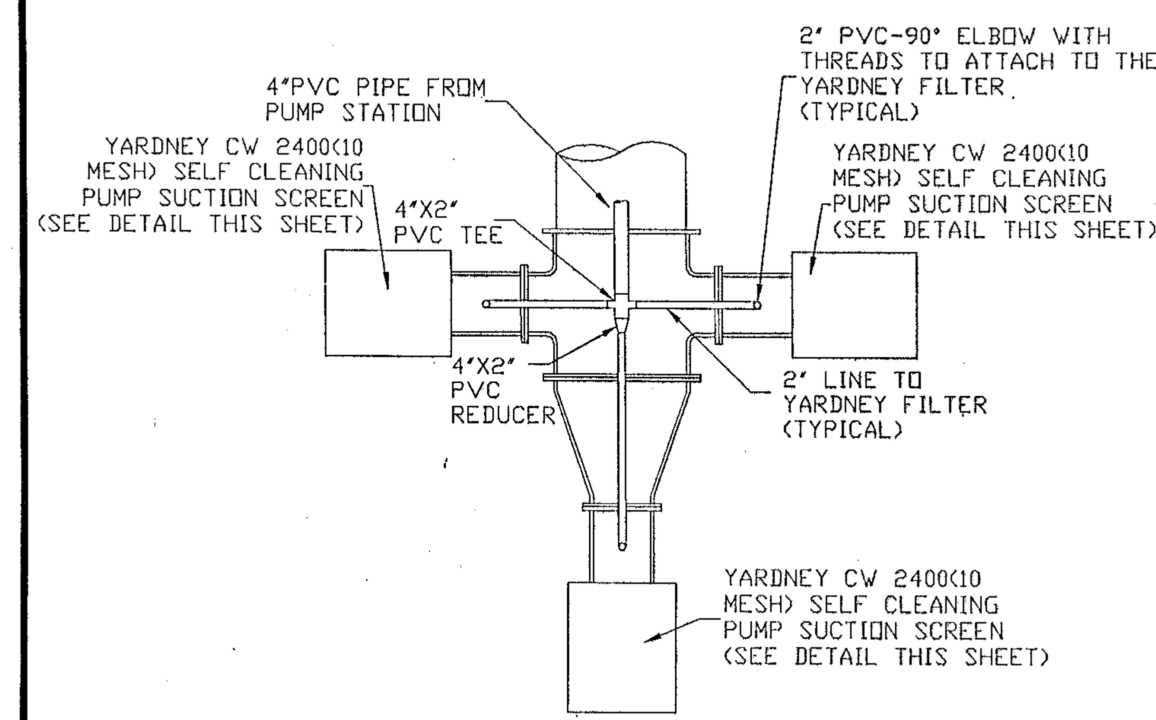
JOB NO. 0910-002
SCALE: NOT TO SCALE
DATE: 7/17/01 Rev. 6/21/02
SHEET 7 OF 9

C-1052A

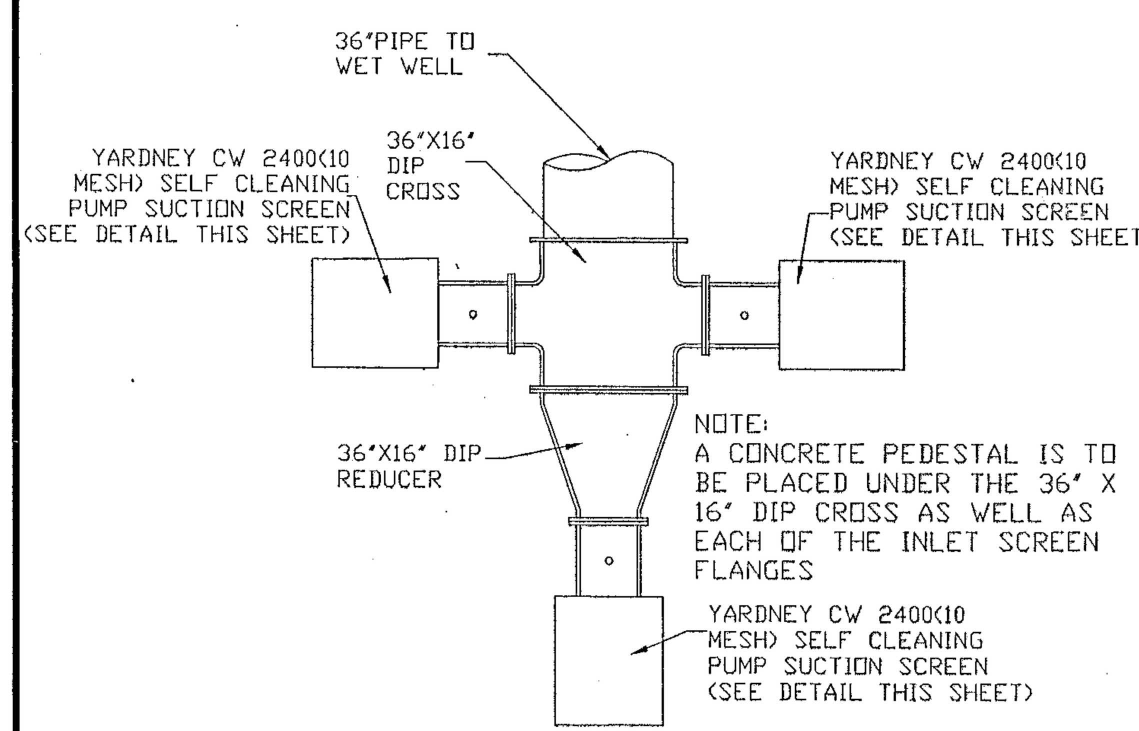
DRAWINGS OF RECORD



36" D.I.P. INTAKE STRUCTURE HEADWALL



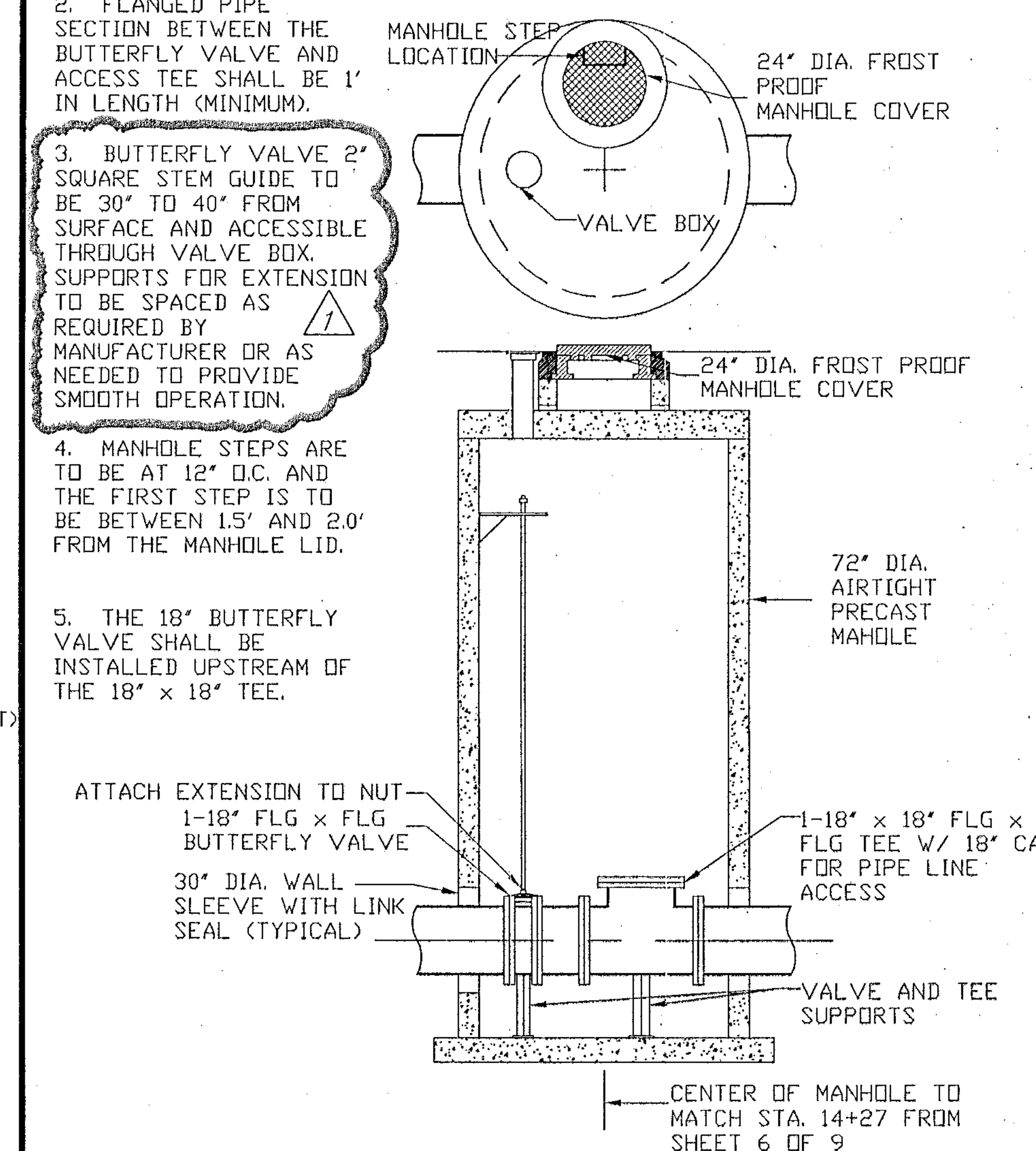
D.I.P. INTAKE STRUCTURE WITH ATTACHED PRESSURE RETURN LINE FOR SCREENS



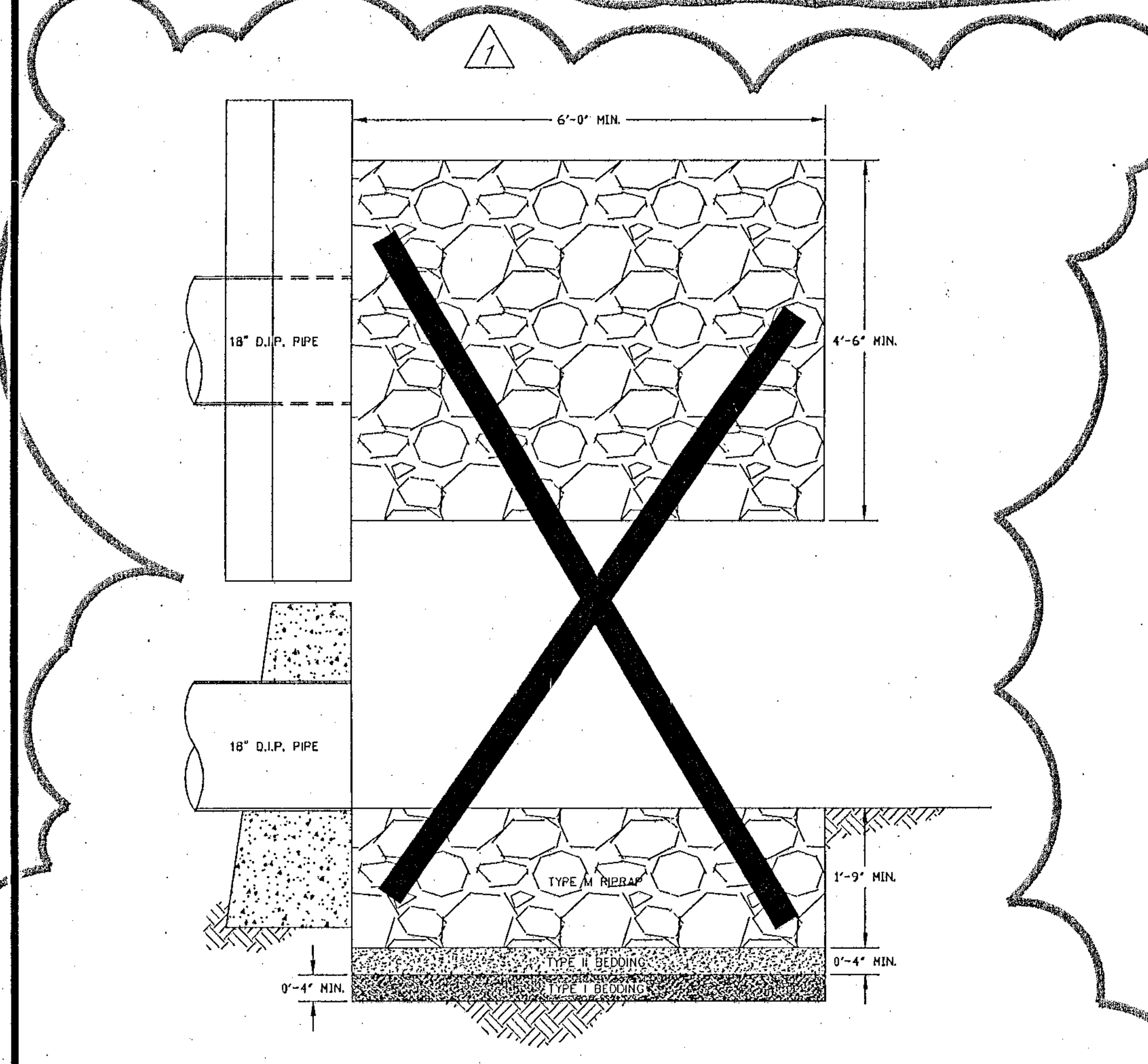
D.I.P. INTAKE STRUCTURE WITH SELF CLEANING SCREENS

NOTES:

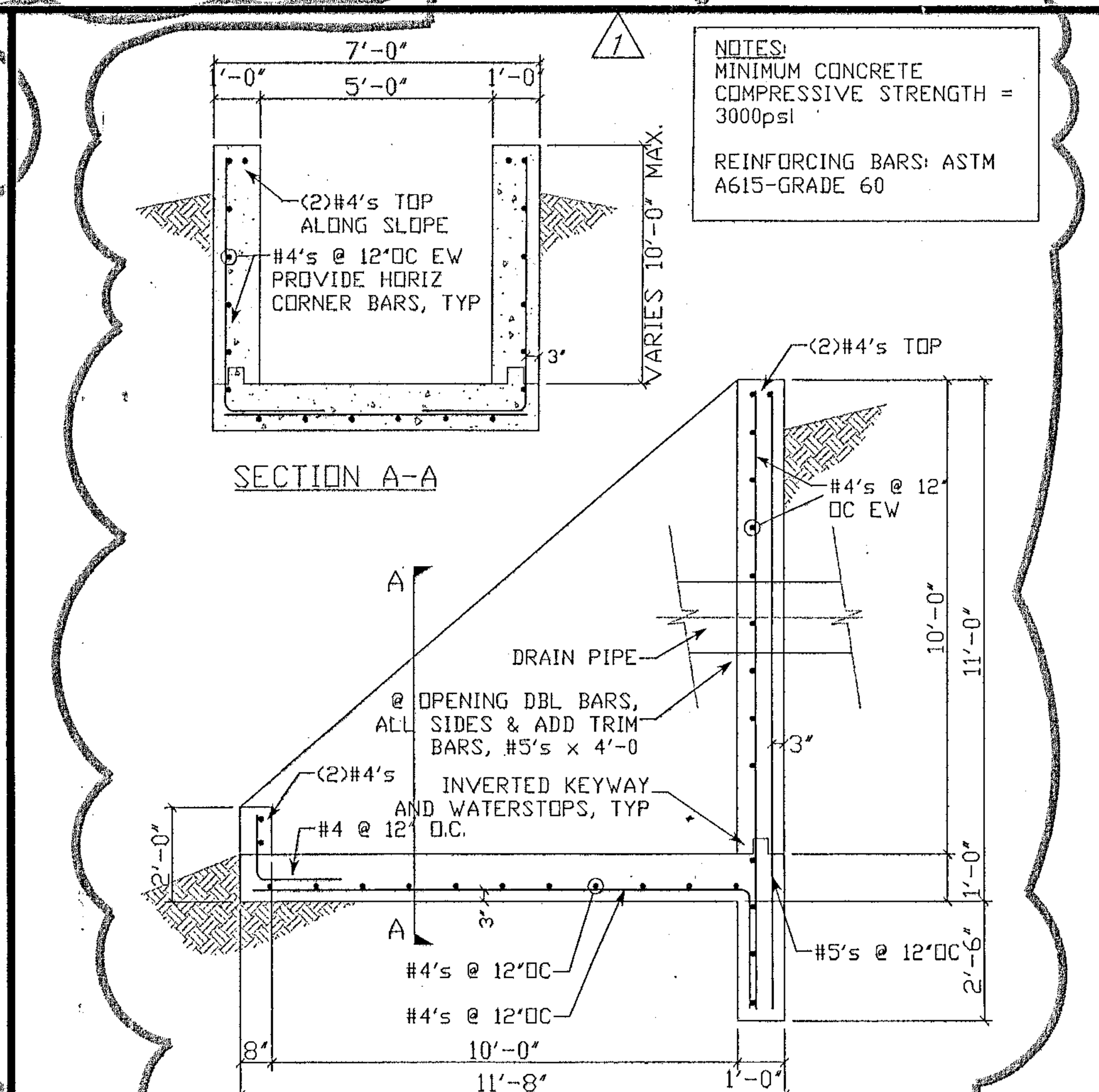
1. FLANGED FITTINGS SHALL BE AT LEAST 6" FROM INSIDE WALLS OF MANHOLE.
2. FLANGED PIPE SECTION BETWEEN THE BUTTERFLY VALVE AND ACCESS TEE SHALL BE 1' IN LENGTH (MINIMUM).
3. BUTTERFLY VALVE 2" SQUARE STEM GUIDE TO BE 30" TO 40" FROM SURFACE AND ACCESSIBLE THROUGH VALVE BOX. SUPPORTS FOR EXTENSION TO BE SPACED AS REQUIRED BY MANUFACTURER OR AS NEEDED TO PROVIDE SMOOTH OPERATION.
4. MANHOLE STEPS ARE TO BE AT 12" O.C. AND THE FIRST STEP IS TO BE BETWEEN 1.5' AND 2.0' FROM THE MANHOLE LID.
5. THE 18" BUTTERFLY VALVE SHALL BE INSTALLED UPSTREAM OF THE 18" x 18" TEE.



18-INCH DRAIN LINE VALVE/ACCESS MANHOLE DETAIL



18-INCH D.I.P. PIPE OUTLET RIPRAP PAD DETAIL



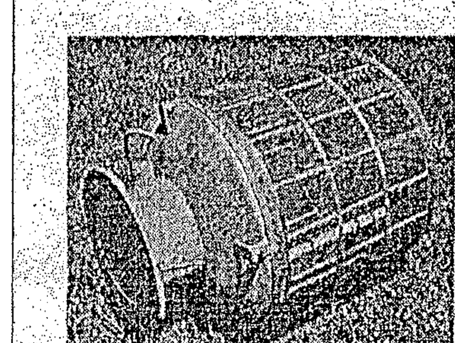
18" DIP Reservoir Drain Inlet Structure

Yardney

WATER FILTRATION SYSTEMS

Pre-Engineered And Custom Designed Systems Are Available For Immediate Delivery

Yardney Self Cleaning Pump Suction Screens



Self-cleaning water powered pump suction screens remove debris from pump intakes. Continuous self-cleaning action keeps fouling debris from pumps and system hardware. Units are constructed of galvanized steel or epoxy coated steel and stainless steel filtration mesh. Units are simple in operation and are effective in the removal of coarse solids.

1-800-4-FAXCAT
(1-800-432-9228)
DOCUMENT # 100106

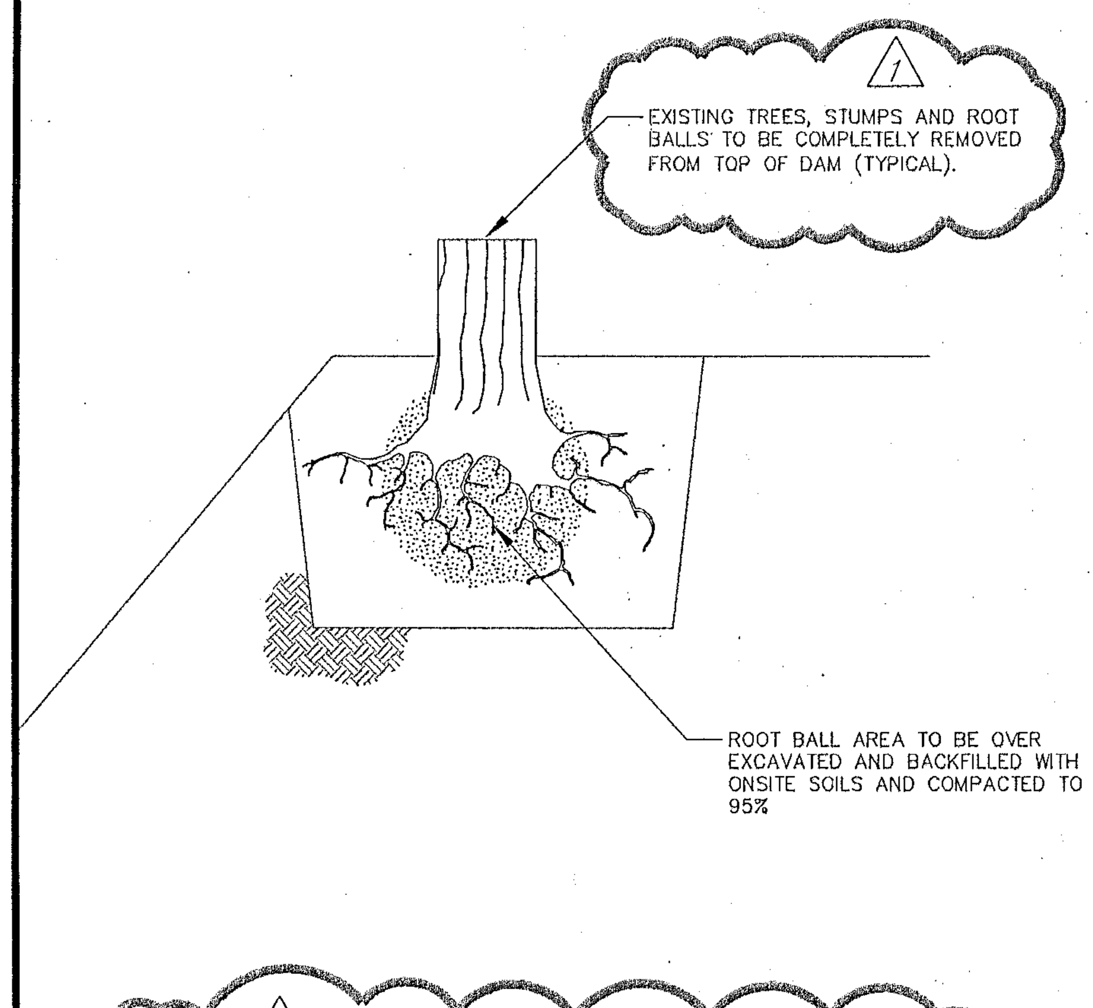
MODEL	MAX FLOW GPM 10 & 18 MESH	MAX FLOW GPM 30 MESH	FLANGE SIZE	RECOMMENDED MIN. OPER. PRESSURE	WEIGHT LBS.
CW2400	2,600	1,800	16"	65	223

Home | Applications and Theories | Cooling Tower Filtration Systems | Centrifugal Separators
Self Cleaning Pump Suction Screens | Automatic Backwashing Filters | High Rate Basket Strainers
Maxi-Flush® Automatic Backwashing Screen Filter | Spin Flow® Vortex Action Screen Filter

"Cleaning The Waters Of The World Since 1965"

http://www.yardneywater.thomasregister.com/olc/yardneywater/suction.htm 3/19/0

YARDNEY SELF CLEANING SCREEN



TREE & STUMP REMOVAL DETAIL

REVISIONS: By: MWT; Date: 4/24/02; Description: OLX-ED OUT DETAIL, REVISED INLET STRUCTURES, REVISED NOTES

DRAWN: C.E.M.
CHECKED: D.B.L.
DESIGNED: C.E.M.
FILENAME: SEO Sheet 8

COLORADO REGISTERED PROFESSIONAL ENGINEER, DAVID B LINDSAY, 32135, 5-9-03

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

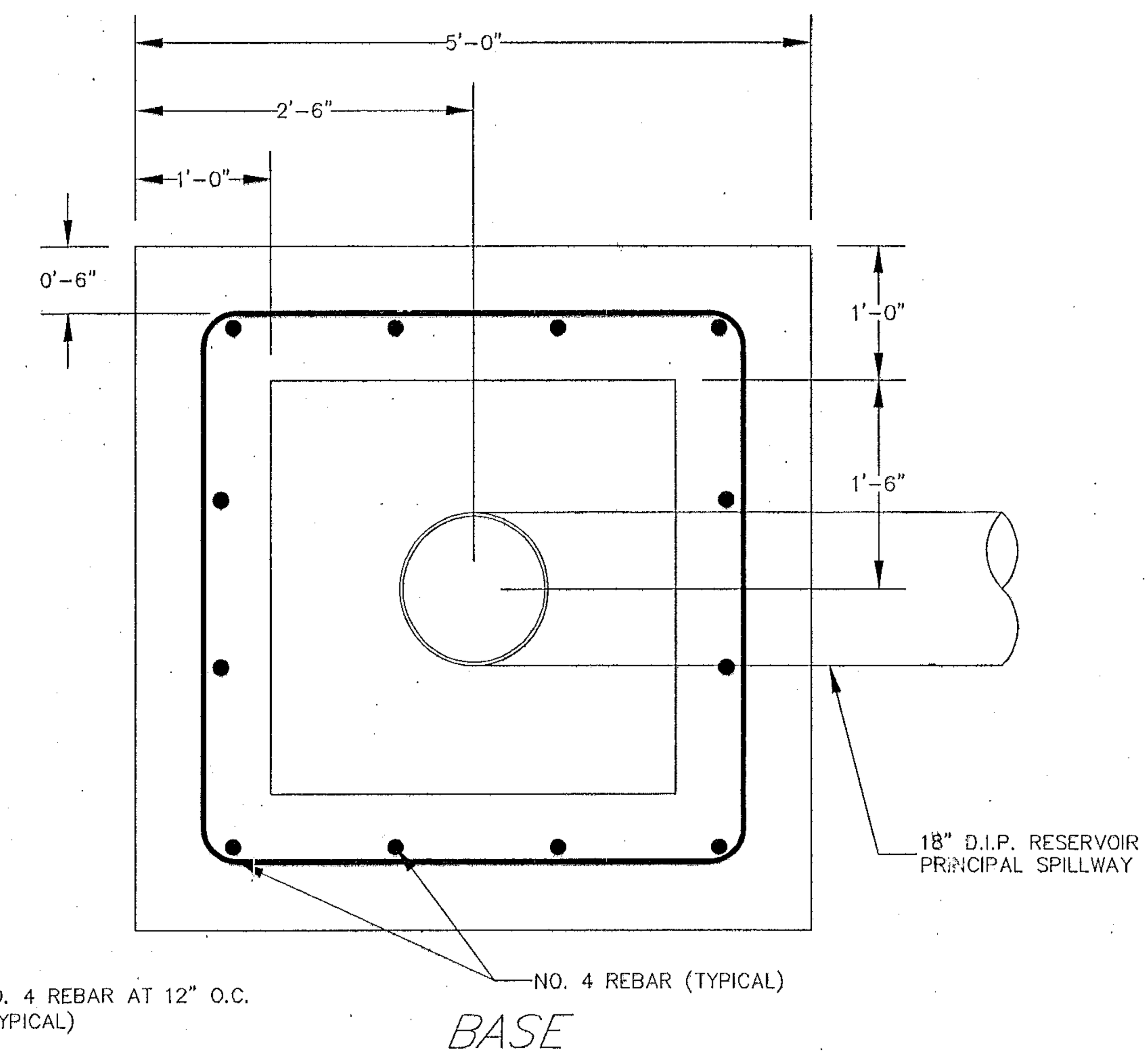
2000-2001 SMITH RESERVOIR IMPROVEMENTS CONSTRUCTION DETAILS

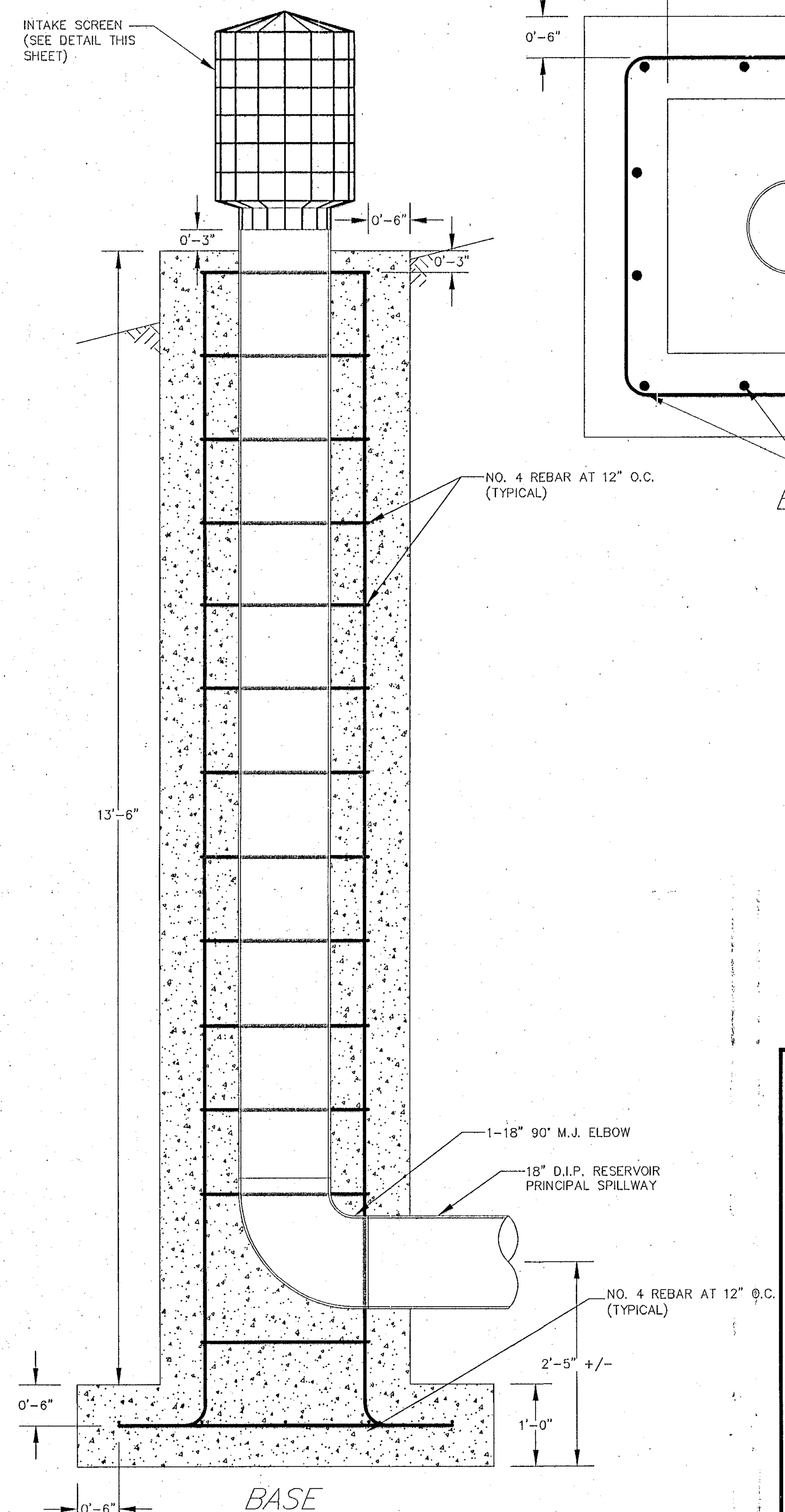
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE: NOT TO SCALE
DATE: 7/17/01 Rev. 6/21/02
SHEET 8 OF 9

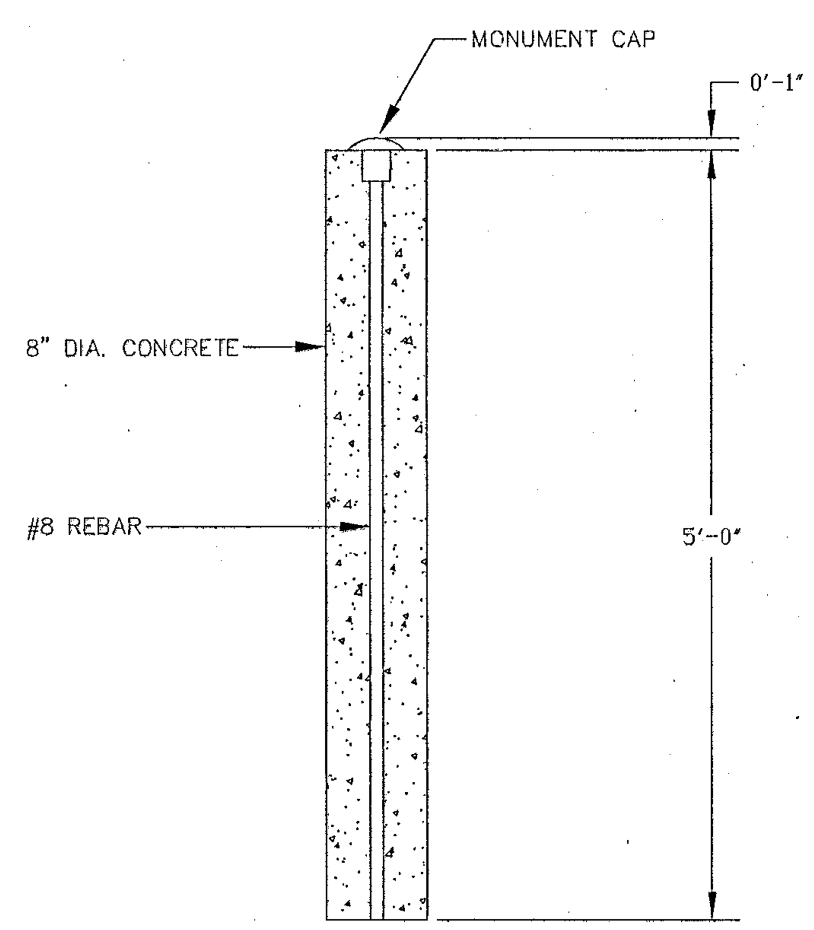
C-1052A

DRAWINGS OF RECORD





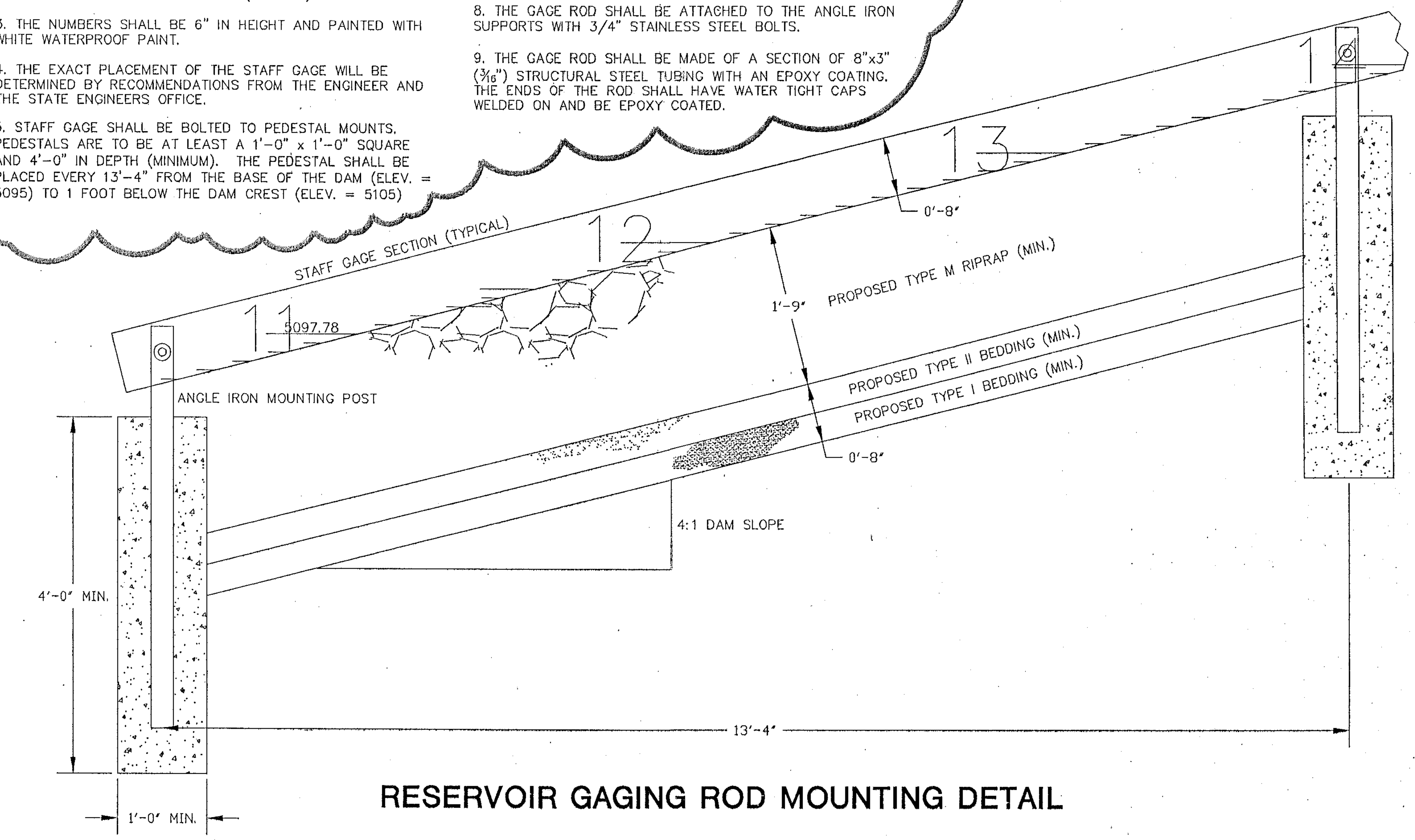
PRINCIPAL SPILLWAY INLET STRUCTURE



SURVEY MONUMENT - STATION MARKER DETAIL

NOTES:

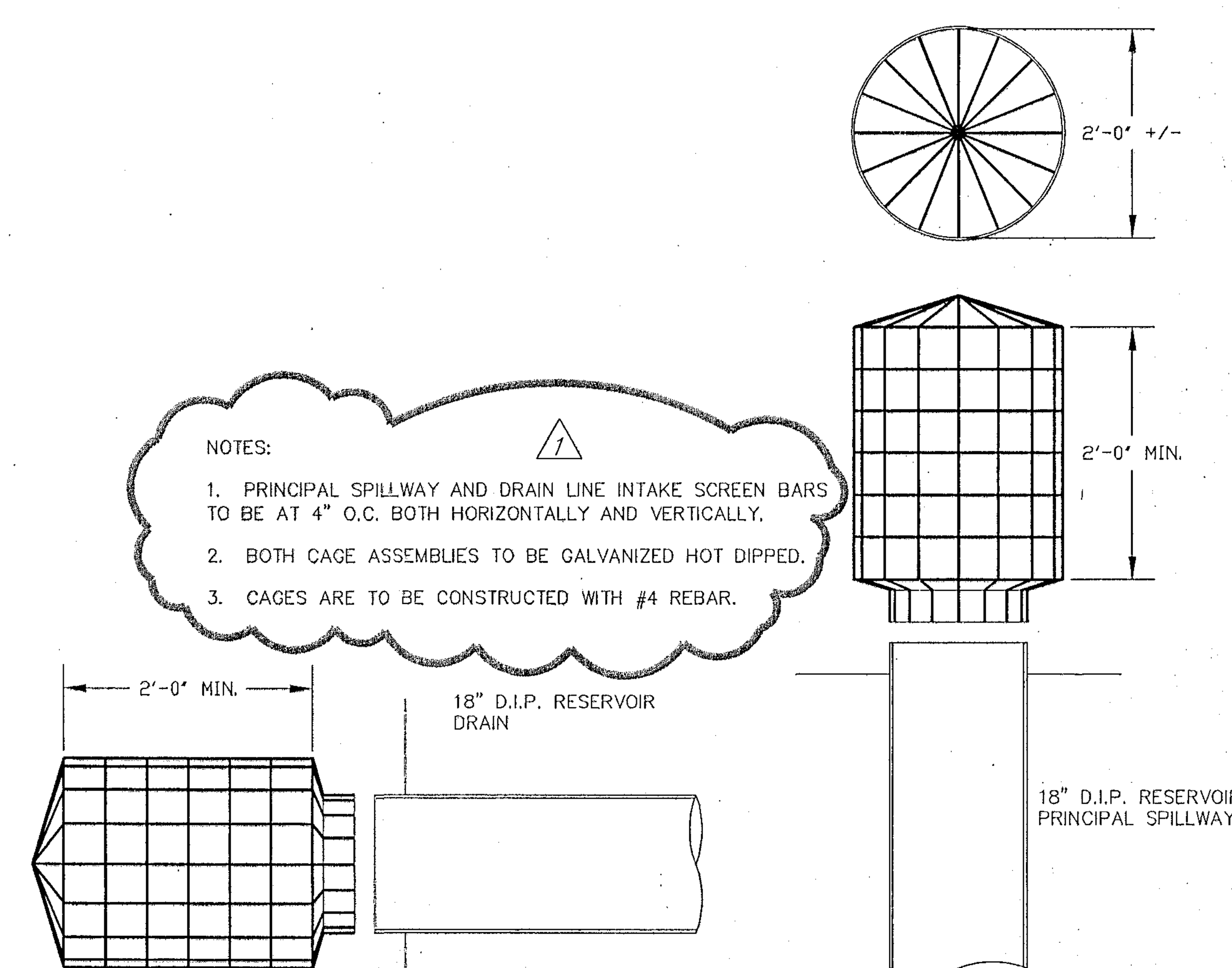
1. THE STAFF GAGE SHALL BE LOCATED ON THE UPSTREAM FACE OF THE DAM WHERE THE NUMBERS ARE LEGIBLE FROM THE SHORELINE.
2. THE WATER LEVEL INDICATORS SHALL BE CALIBRATED TO THE RESERVOIR OUTLET ELEVATION (5086.78).
3. THE NUMBERS SHALL BE 6" IN HEIGHT AND PAINTED WITH WHITE WATERPROOF PAINT.
4. THE EXACT PLACEMENT OF THE STAFF GAGE WILL BE DETERMINED BY RECOMMENDATIONS FROM THE ENGINEER AND THE STATE ENGINEERS OFFICE.
5. STAFF GAGE SHALL BE BOLTED TO PEDESTAL MOUNTS. PEDESTALS ARE TO BE AT LEAST A 1'-0" x 1'-0" SQUARE AND 4'-0" IN DEPTH (MINIMUM). THE PEDESTAL SHALL BE PLACED EVERY 13'-4" FROM THE BASE OF THE DAM (ELEV. = 5095) TO 1 FOOT BELOW THE DAM CREST (ELEV. = 5105)
6. THE ANGLE IRON SUPPORTS (SIZE = 3"x3"x3/16") ARE TO BE GALVANIZED HOT DIPPED.
7. THE GAGE ROD SHALL BE EMBEDDED INTO THE RIPRAP TO PROTECT IT FROM ICE ACTION.
8. THE GAGE ROD SHALL BE ATTACHED TO THE ANGLE IRON SUPPORTS WITH 3/4" STAINLESS STEEL BOLTS.
9. THE GAGE ROD SHALL BE MADE OF A SECTION OF 8"x3" (3/16") STRUCTURAL STEEL TUBING WITH AN EPOXY COATING. THE ENDS OF THE ROD SHALL HAVE WATER TIGHT CAPS WELDED ON AND BE EPOXY COATED.



RESERVOIR GAGING ROD MOUNTING DETAIL

NOTES:

1. PRINCIPAL SPILLWAY AND DRAIN LINE INTAKE SCREEN BARS TO BE AT 4" O.C. BOTH HORIZONTALLY AND VERTICALLY.
2. BOTH CAGE ASSEMBLIES TO BE GALVANIZED HOT DIPPED.
3. CAGES ARE TO BE CONSTRUCTED WITH #4 REBAR.



OUTLET STRUCTURES INTAKE SCREENS

REVISIONS
By	Date	Description
MWT	6/21/02	REVISED NOTES

DRAWN C.E.M.
CHECKED D.B.L.
DESIGNED C.E.M.
FILENAME SEO Sheet 9

COLORADO REGISTERED PROFESSIONAL ENGINEER 32135

TODD CREEK FARMS METROPOLITAN DISTRICT NO. 1

2000-2001 SMITH RESERVOIR IMPROVEMENTS CONSTRUCTION DETAILS

TST
TST, INC.
Consulting Engineers
748 Whalers Way, Bldg. D
Fort Collins, Colorado
970-226-0557

JOB NO. 0910-002
SCALE NOT TO SCALE
DATE 7/17/01 Rev. 6/21/02
SHEET 9 OF 9

C-1052A

DRAWINGS OF RECORD