Stantec

Memo

To:	Brian Nerbonne Minnesota DNR	From:	Michael Adams Jr Fairfax VA Office
File:	175654021	Date:	October 28, 2014

Reference: Chester Creek 60% Design Memo

Stantec Consulting Services Inc. (Stantec) is pleased to provide this design memo for the Chester Creek stream restoration project located in Duluth, Minnesota. This memo summarizes the existing site conditions, site assessment information and design methodology for the project. It is intended to provide background information for the interpretation of the plan set.

PROJECT SETTING

The project is located along Chester Creek near the Chester Bowl ski hill in Duluth, Minnesota. Storms that occurred in June, 2012 caused flooding that damaged the existing channel, a dam and a bridge. Site 1 has been defined as the lower reach where the low head dams will be removed and Site 2 is the upstream site where the new bridge was installed.

PROJECT GOALS

The goal of this project is to stabilize the channel in the vicinity of two low-head dams (Site 1) and upstream in the vicinity of the replacement bridge (Site 2). It is the desire of MNDNR to stabilize these channels using Natural Channel Design Techniques, as referenced in Part 654 of the National Engineering Handbook, thus this goal will be met by following the procedures referenced therein. Specifically, the channel will be designed with geomorphic principles germane to the stable morphology in mind.

EXISTING CONDITIONS

Both sites were heavily impacted by the June 2012 floods. Site 1, which extends from just upstream of the limits of a pool previously formed by the upper low-head dam, exhibits damage to that particular structure as well as a second low-head dam downstream, though it is our understanding one of the dams was damaged prior to the 2012 flood. The upper part of Reach 1 serves as the tail-out area for the Chester Bowl ski hill. This area was a small pond prior to the flood but it now is free flowing down to the low-head dam. The channel is significantly modified through the second low-head dam, but is moderately stable from that point downstream.

Site 2 was heavily damaged during the June 2012 floods including the wash-out of a pedestrian/ski bridge in the middle of the reach. A new bridge was constructed sometime in 2014; activities associated with the construction of the bridge significantly altered the characteristics of the channel. Boulder riprap was placed on both sides of the channel beneath the bridge. Though not typically elements of natural channel design, the boulders do appear to have stabilized the bank in that vicinity. The stabilization reach, therefore, begins just downstream of the new bridge.

A geomorphic survey was performed for each site. The results of the survey are included in Attachment A. Where not impacted by the dams, Site 1 classifies as a B4c in the upper reach and a C4 in the lower reach, with the difference being highly affected by upper channel side slopes and concomitant floodplain access. Site 2 classifies as an F4 channel and has little floodplain access.

Consultant's Report

Reference: Chester Creek 60% Design Memo

DESIGN METHODOLOGY AND RESTORATION APPROACH

The methodology employed for the restoration design of Chester Creek is fundamentally Natural Channel Design (NCD), which uses an analog of a stable system to develop dimensionless ratios to design a new reach. The stable system, referred to as a reference reach or reference condition, is typically from a nearby stream, ideally within the same watershed, but minimally from the same valley type and sediment regime. Cross section, profile and plan form morphometry are normalized based on the bankfull dimensions of the channel and then scaled up or down depending on the size of the channel to be restored. Careful attention is paid to the transition from the upstream condition to the restored reach and again from the restored reach back to the downstream reach.

For Chester Creek, the reference condition was a composite of reference conditions measured in the Duluth area. The dimensionless ratios were applied and modifications were made to preserve a smooth transition. The proposed deign in included in the drawings in Attachment B.

Sediment transport was evaluated based on transport competence, which is aimed at evaluating the ability of the stream to transport a particular size of particle. Sediment transport capacity, which evaluates the amount of sediment a particular stream can carry, was beyond the scope of this project. Based on a visual reconnaissance of the system, Site 1 is deficient at transporting sediment under its current morphometric condition; however, this is a result of the backwater and flat channel immediately upstream of the low-head dam. The restoration proposed for Site 1 will alleviate this condition and promote an appropriate sediment regime. Site 2 is incising due to excess shear on the channel bottom so the design includes armored riffles that will resist the bed shear and hold the grade at the designed elevation.

PROPOSED CONDITIONS

The proposed design for Site 1 consists of a re-meandered channel within the old pond upstream of the upper low-head dam that then progresses through the depositional area behind both dams and ties into a relatively stable channel downstream of the lower dam. Riffles are armored with either existing bed material, mini cross vanes and/or boulder clusters. The type of stabilization method is dependent on the slope of the individual riffle, with steeper riffles constructed with boulder mini-vanes. In the upper portion of the reach, toe wood is proposed for the outsides of the bends. The sheets is Appendix B depict the proposed design for Site 1.

Site 2 consists of a re-constructed channel within the footprint of the existing Chester Creek alignment. The reach begins just downstream of the new bridge across the channel. The proposed stream consists of three constructed riffle/pool sequences that tie into a riffle downstream. J-hook steps are proposed to provide grade control for each riffle.

The following table summarizes the dimensions and pertinent dimensionless ratios for the proposed Site 1 and Site 2 channels.

Reference: Chester Creek 60% Design Memo

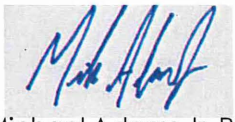
Table 1: Proposed Channel Dimensions and Dimensionless Ratios

Parameter	Site 1	Site 2
Wbkf (ft)	26.5	24.5
Dbkf (ft)	1.3	1.2
Dmax (ft)	2.1	2.0
Area (ft^2)	35.0	30
Slope (ft/ft)	0.017	0.029
P-P Spacing Ratio (dimensionless)	3-5.5	2-4.5
W/D Ratio (dimensionless)	20	20

OPINION OF PROBABLE COST

Experience on previous project of this ilk suggest that the probable cost will be approximately $494,000.00. A breakdown of this cost derivation is included in Attachment C. The quantities shown in the cost estimate are included to guide the user in understanding the elements that are likely to be included; however, they should not be interpreted as a bid schedule or final quantities. Other elements not yet considered may be necessary to construct the project. A construction contingency of 20% is included to account for all or some of these unknowns, depending on their magnitude.

STANTEC CONSULTING SERVICES INC.

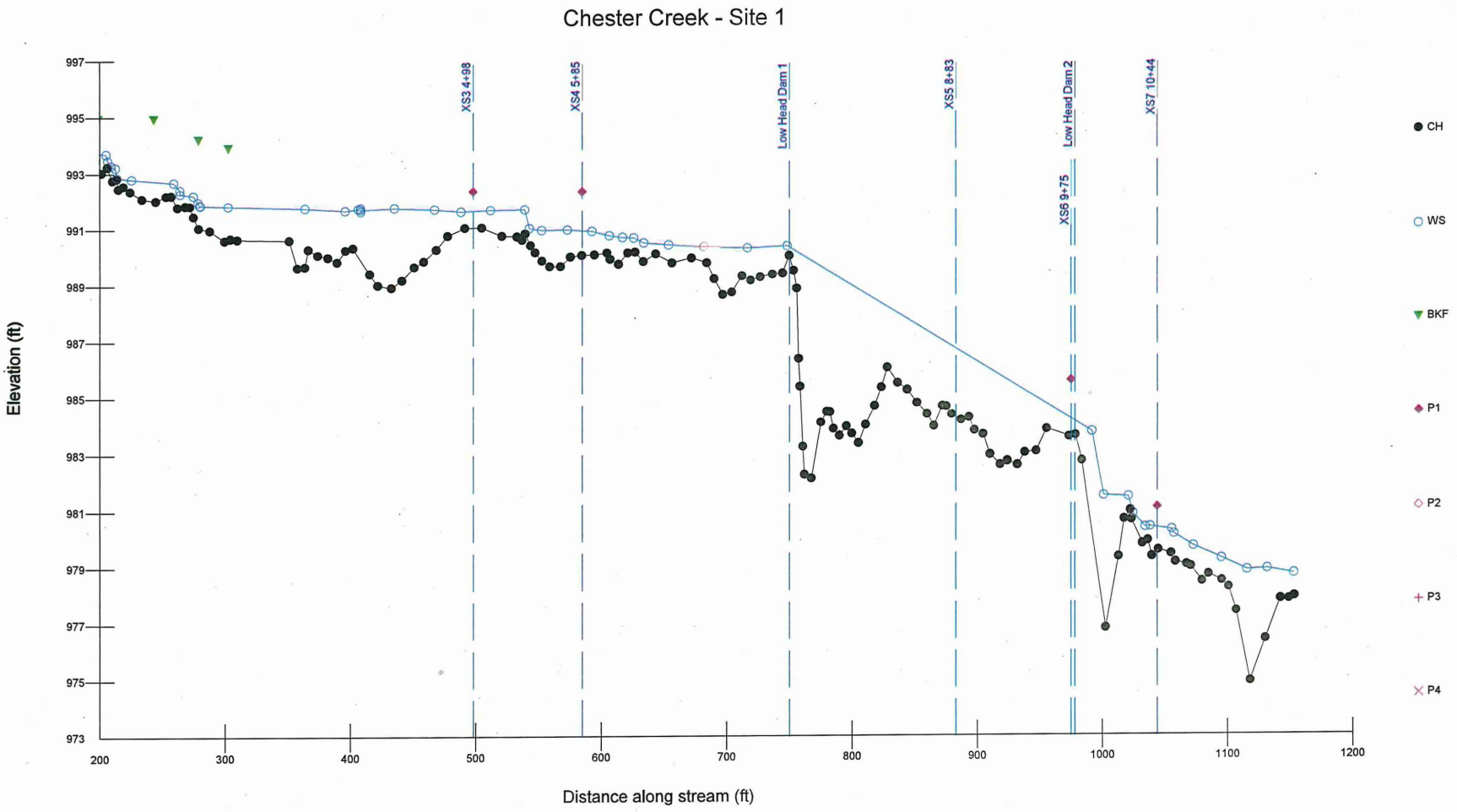


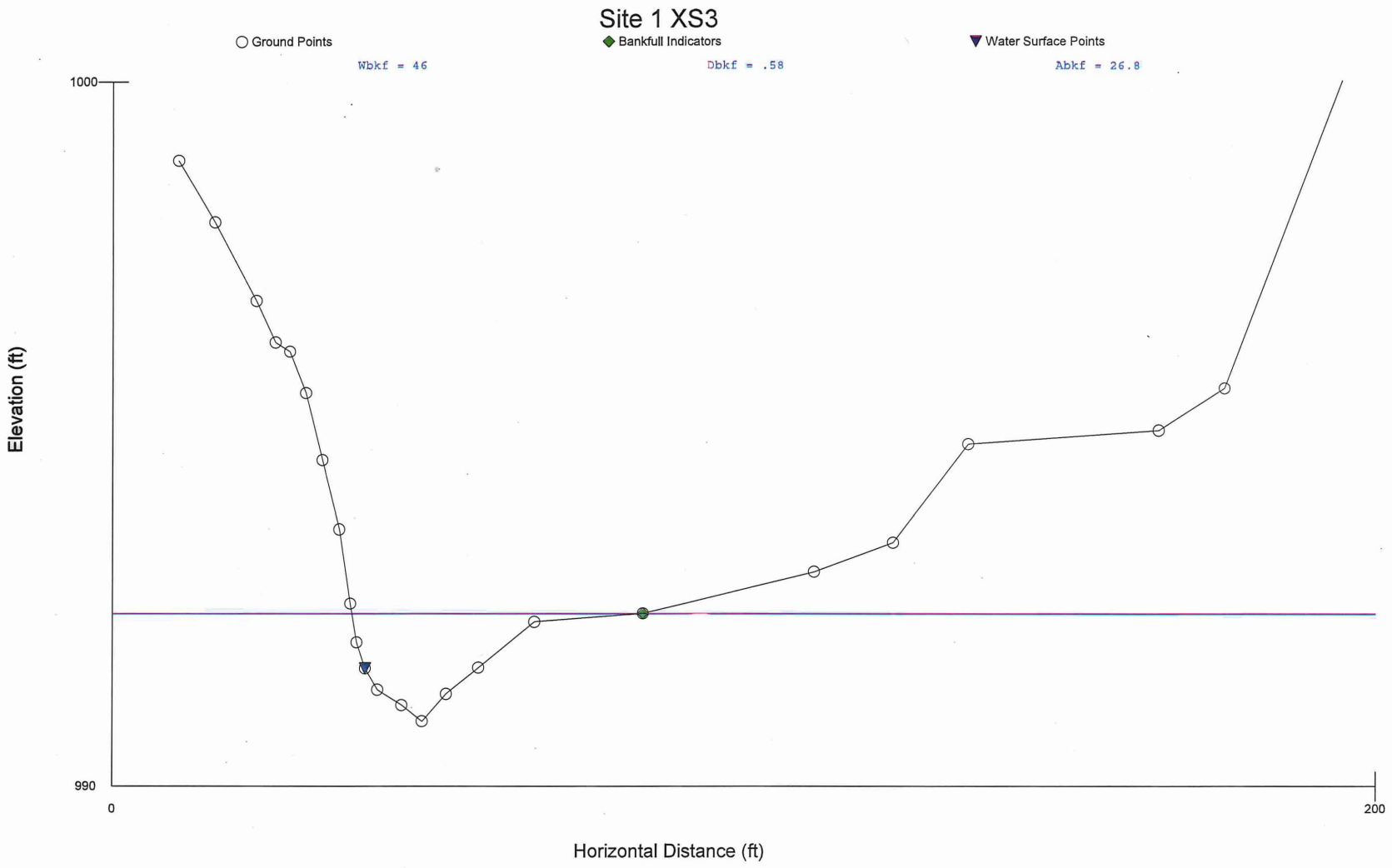
Michael Adams Jr, PE, LEED AP
Senior Associate
Phone: 571-420-2929
Fax: (703) 263-1221
Michael.Adams@stantec.com

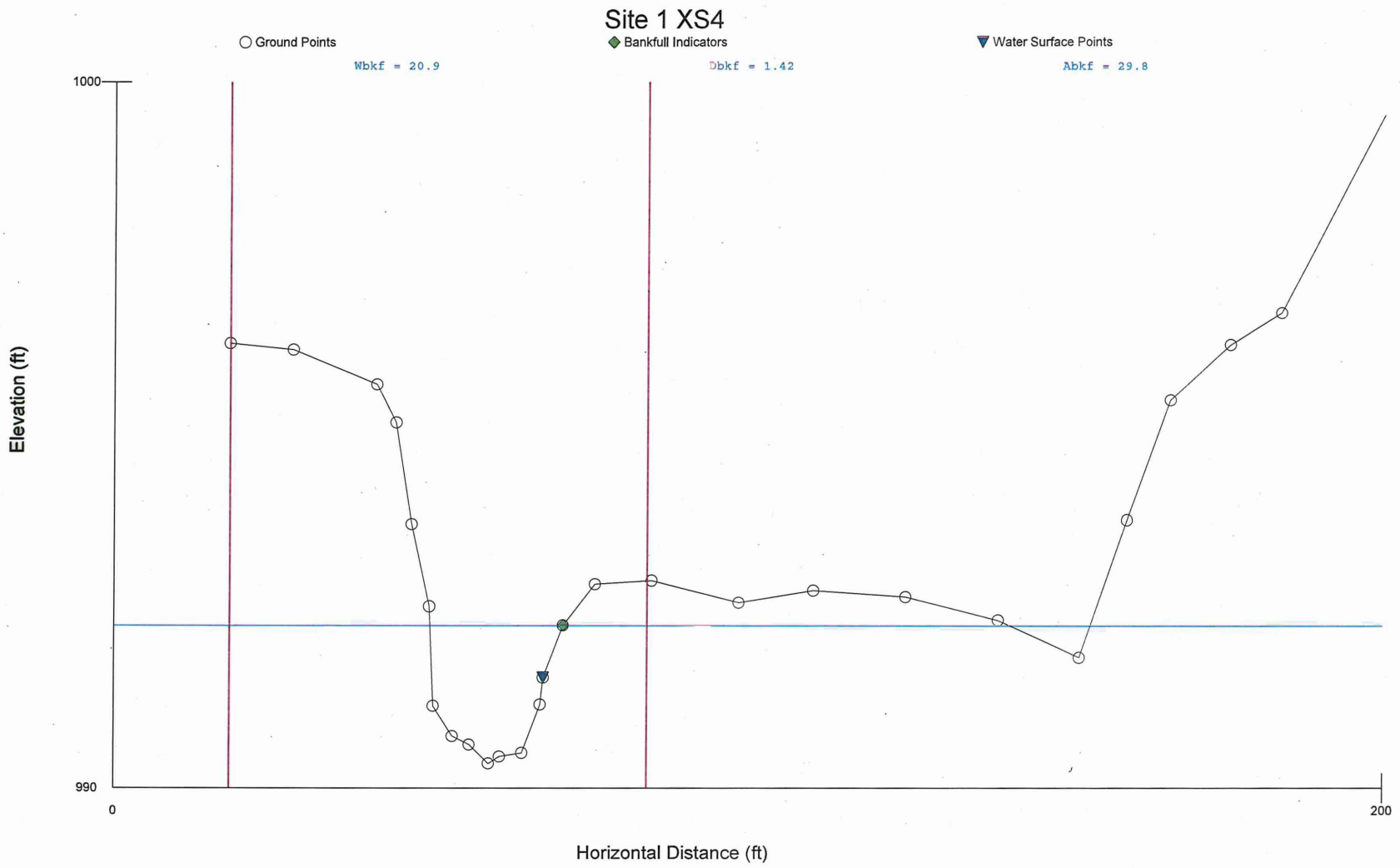
Attachments: Assessment Data, 60% Design Drawings, Opinion of Probable Cost

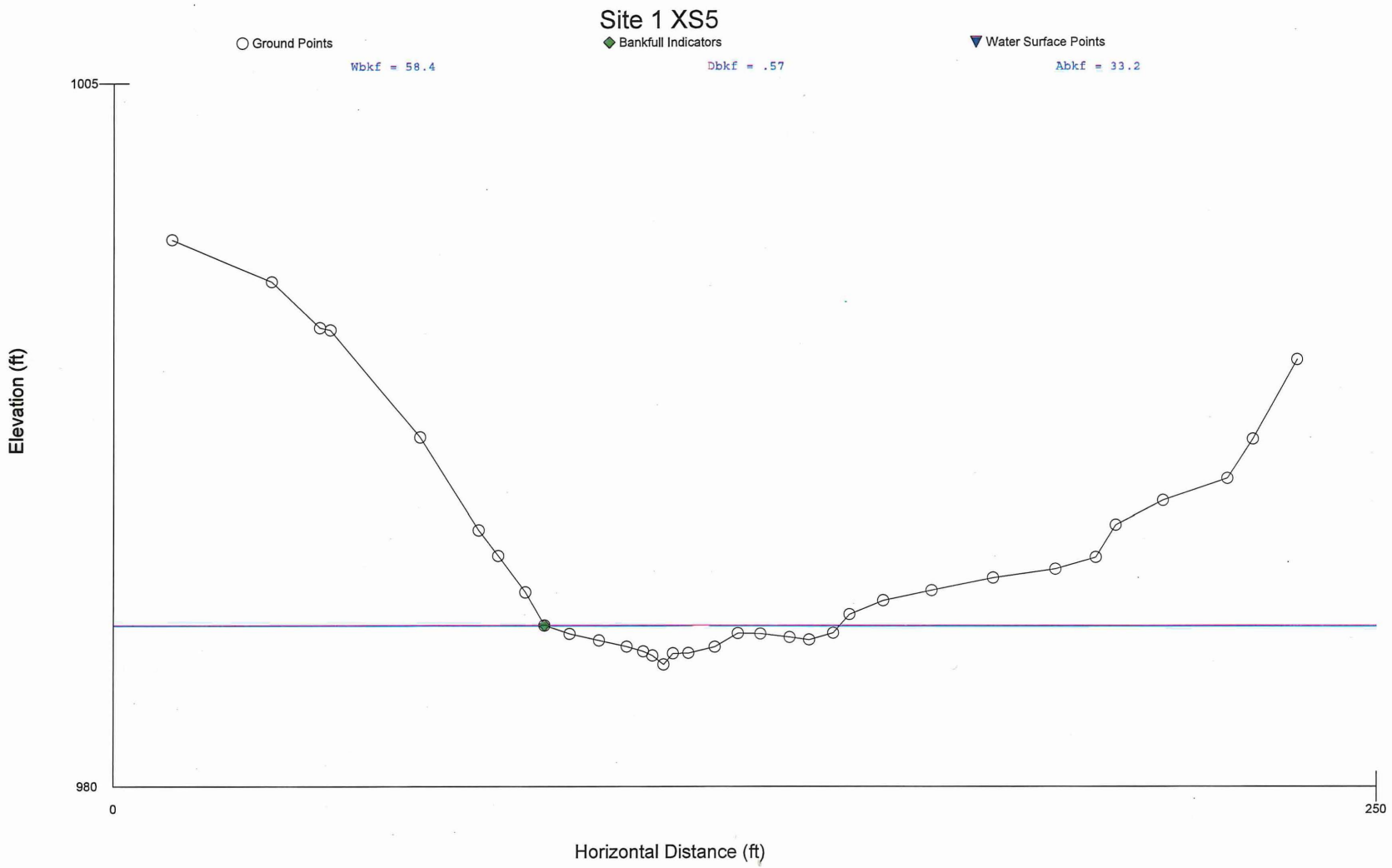
c. Mike Geenen, PE

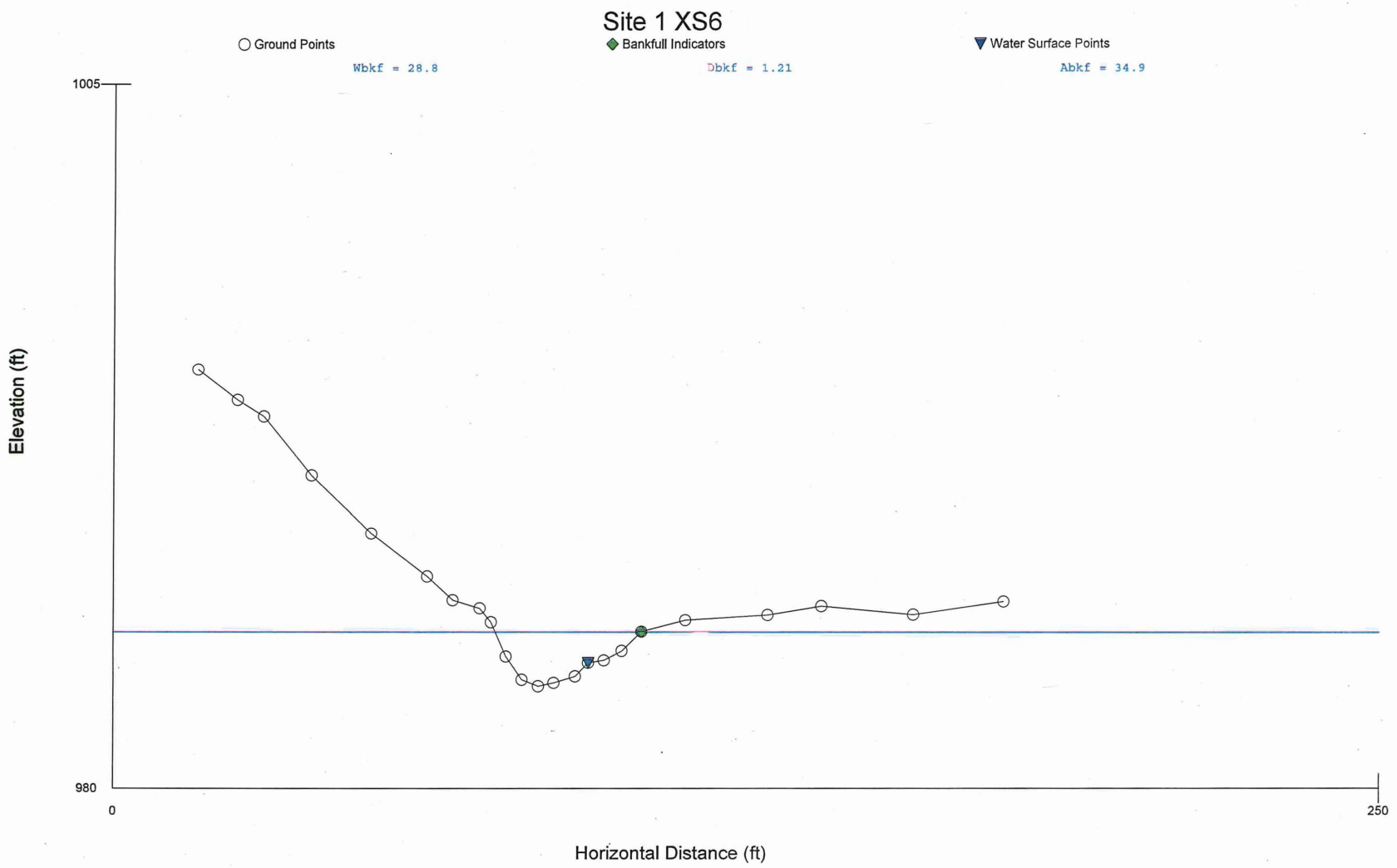
Attachment A: Existing Conditions Geomorphic Data

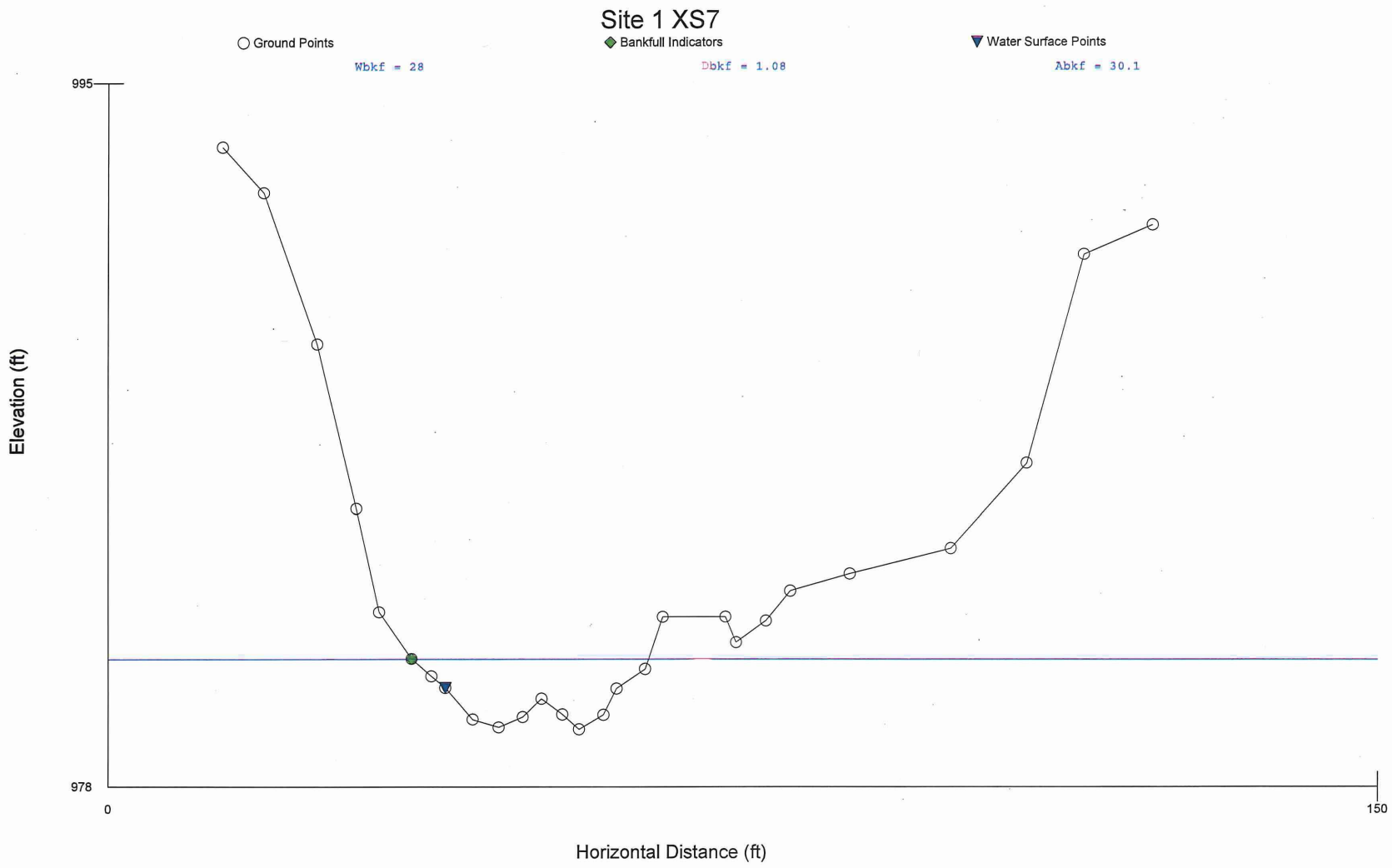

Chester Creek - Site 1
Elevation (ft)
997
995
993
991
989
987
985
983
981
979
977
975
973
XS3 4+98
XS4 5+85
Low Head Dam 1
XS5 8+83
XS6 9+75
Low Head Dam 2
XS7 10+44
200
300
400
500
600
700
800
900
1000
1100
1200
Distance along stream (ft)
CH
WS
BKF
P1
P2
P3
P4


Site 1 XS3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 46
Dbkf = .58
Abkf = 26.8
1000
990
0
200
Elevation (ft)
Horizontal Distance (ft)


Site 1 XS4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 20.9
Dbkf = 1.42
Abkf = 29.8
1000
990
0
200
Elevation (ft)
Horizontal Distance (ft)


Site 1 XS5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 58.4
Dbkf = .57
Abkf = 33.2
1005
980
0
250
Elevation (ft)
Horizontal Distance (ft)


Site 1 XS6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 28.8
Dbkf = 1.21
Abkf = 34.9
1005
980
0
250
Elevation (ft)
Horizontal Distance (ft)

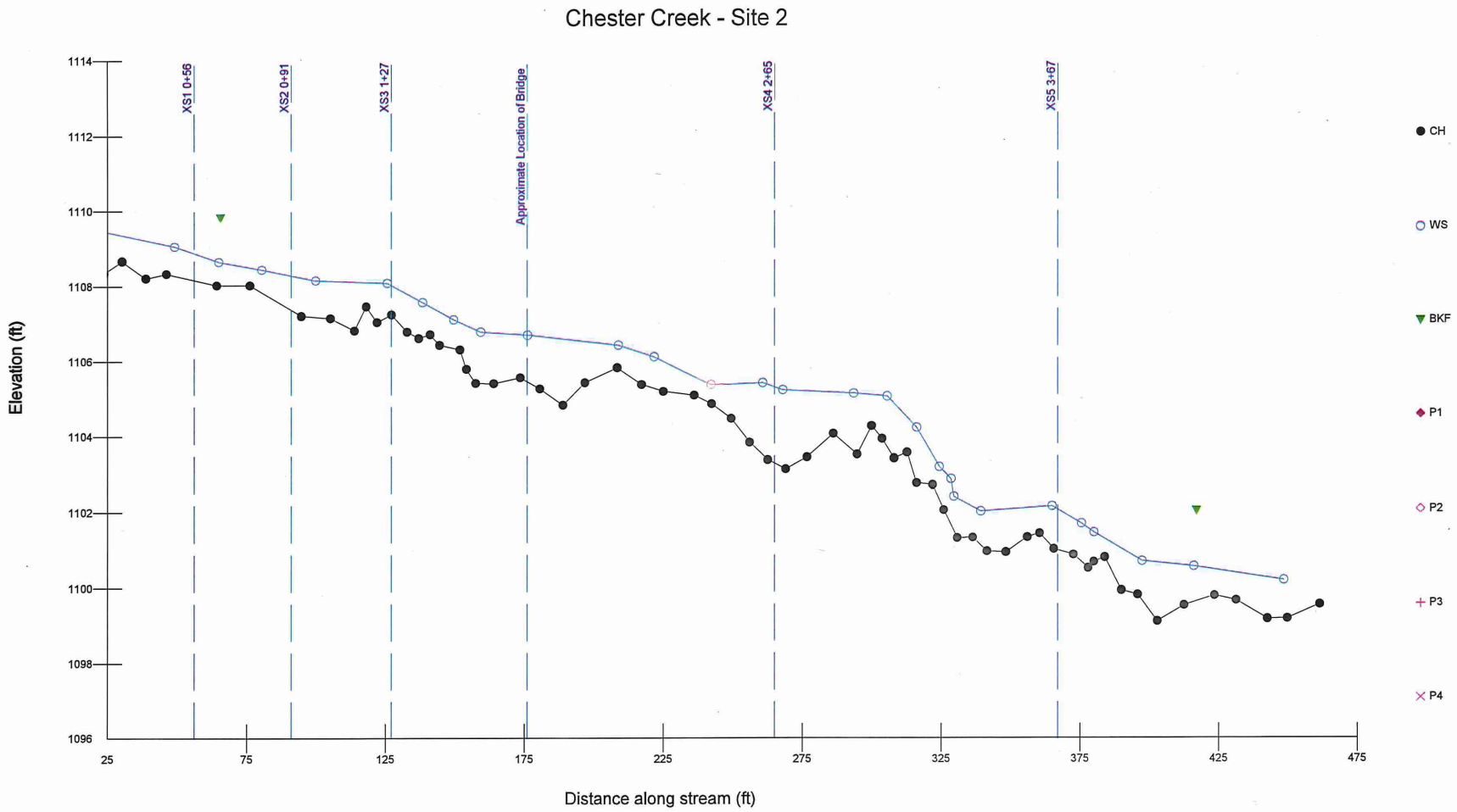

Site 1 XS7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 28
Dbkf = 1.08
Abkf = 30.1
995
978
0
150
Elevation (ft)
Horizontal Distance (ft)

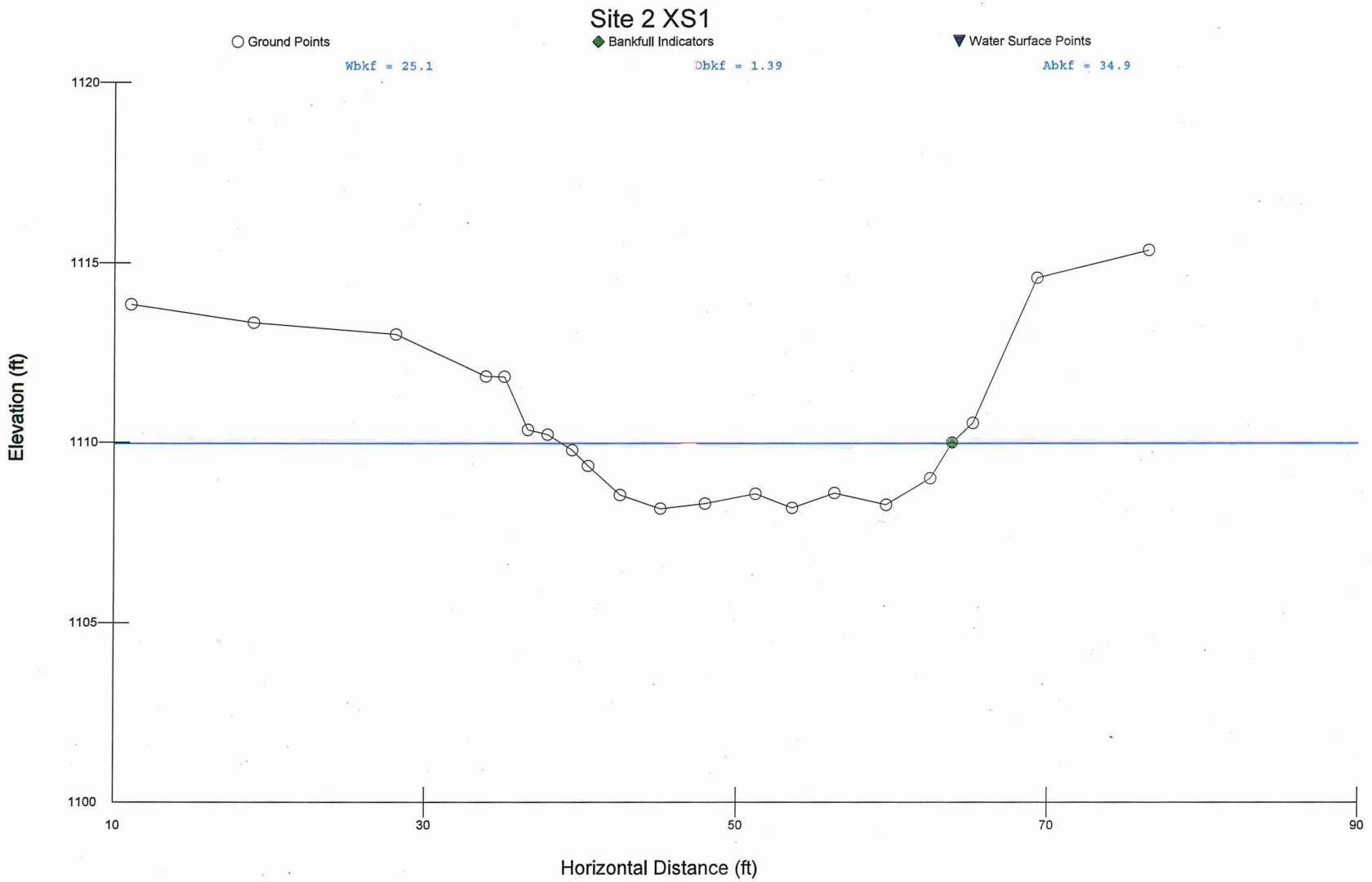
Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

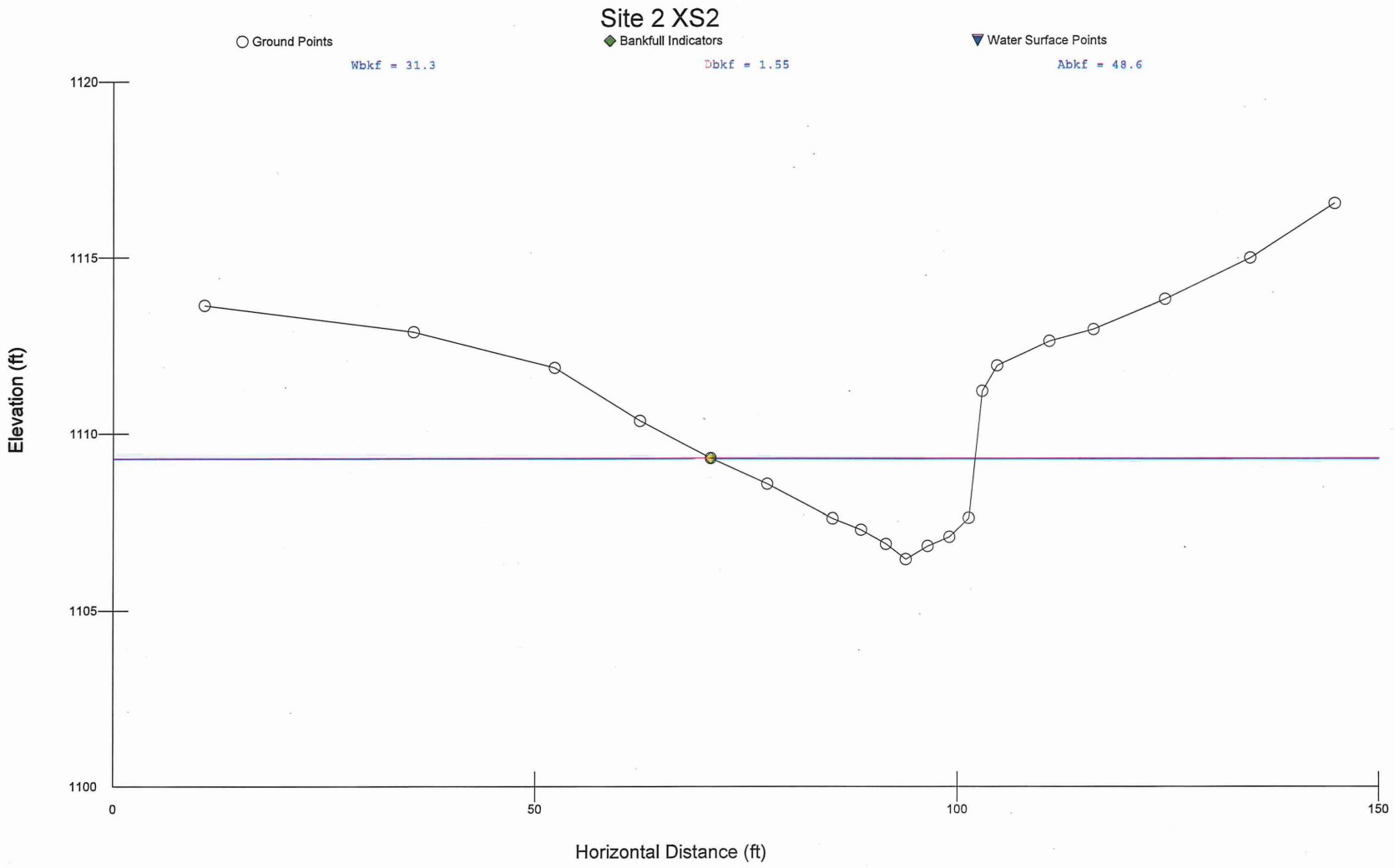
Stream:	**Chester Creek Site 1**				
Basin:	**Lake Superior**	Drainage Area:	**4160** acres	**6.5**	mi^2
Location:	**Duluth, Minnesota**				
Twp.&Rge:	**;**	Sec.&Qtr.:	**;**		
Cross-Section Monuments (Lat./Long.):	**46.81306 Lat / 92.09417 Long**			Date:	**06/29/14**
Observers:				Valley Type:	VIII(a)

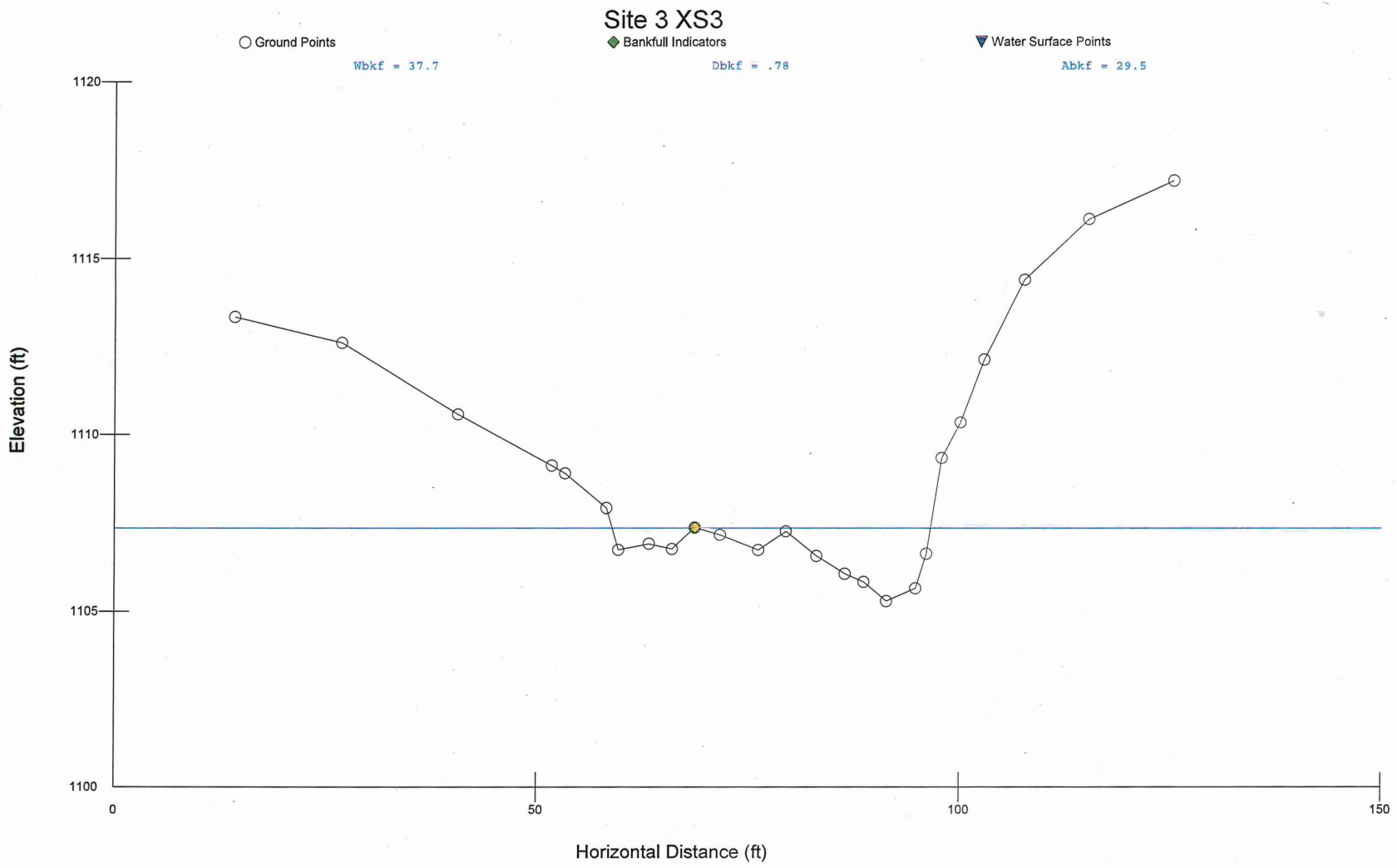
Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**27.98**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d_{bkf} = A / W_{bkf}).	**1.08**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**30.12**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**25.91**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**1.7**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**50.34**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.8**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**45**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.02**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.1**	

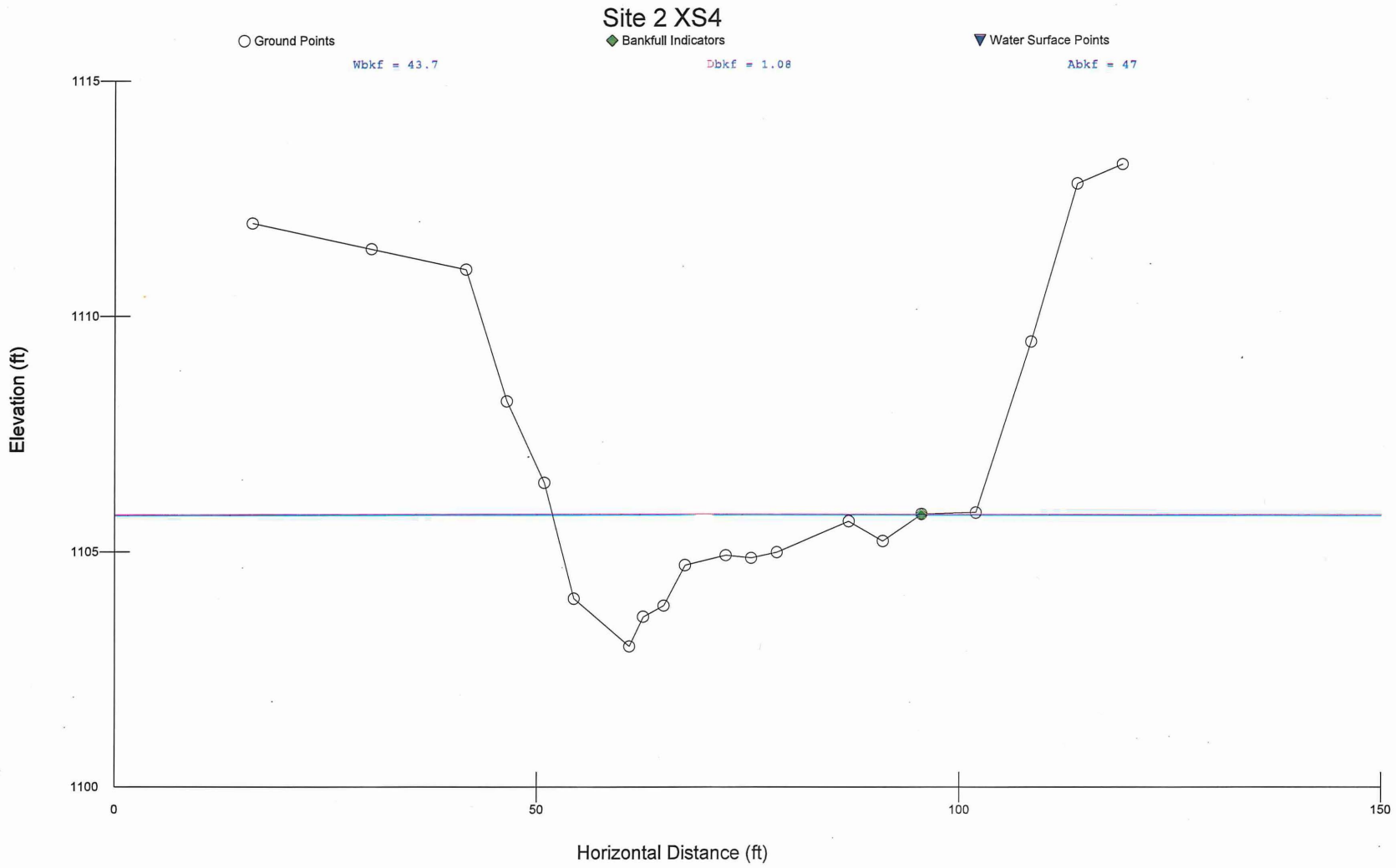
Stream Type **B 4** (See **Figure 2-14**)

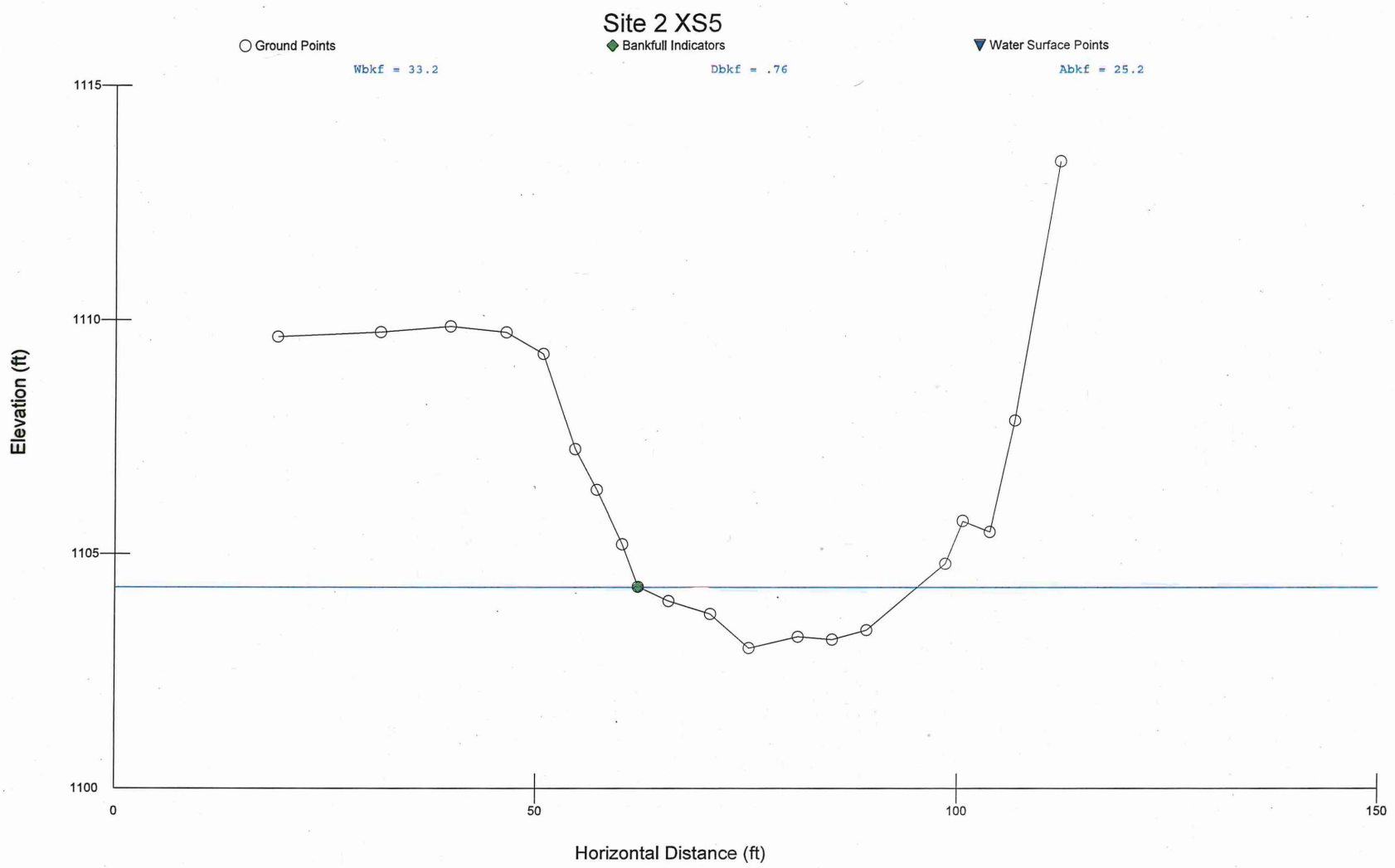

Chester Creek - Site 2
XS1 0+56
XS2 0+91
XS3 1+27
Approximate Location of Bridge
XS4 2+65
XS5 3+67
Elevation (ft)
1114
1112
1110
1108
1106
1104
1102
1100
1098
1096
25
75
125
175
225
275
325
375
425
475
Distance along stream (ft)
CH
WS
BKF
P1
P2
P3
P4


Site 2 XS1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.1
Dbkf = 1.39
Abkf = 34.9
1120
1115
1110
1105
1100
Elevation (ft)
10
30
50
70
90
Horizontal Distance (ft)


Site 2 XS2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 31.3
Dbkf = 1.55
Abkf = 48.6
Elevation (ft)
1120
1115
1110
1105
1100
0
50
100
150
Horizontal Distance (ft)


Site 3 XS3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 37.7
Dbkf = .78
Abkf = 29.5
Elevation (ft)
1120
1115
1110
1105
1100
0
50
100
150
Horizontal Distance (ft)


Site 2 XS4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 43.7
Dbkf = 1.08
Abkf = 47
1115
1110
1105
1100
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

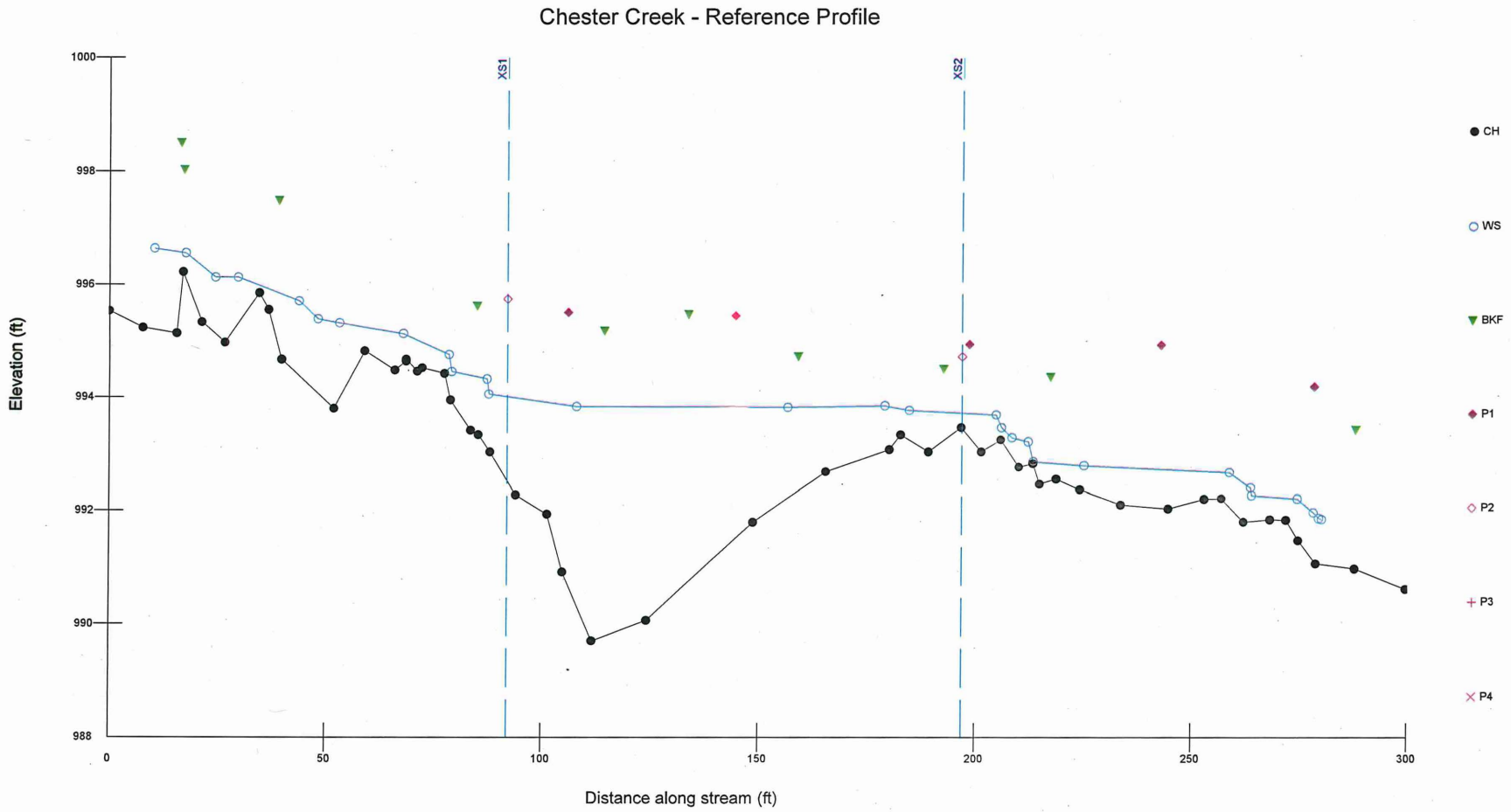

Site 2 XS5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 33.2
Dbkf = .76
Abkf = 25.2
1115
1110
1105
1100
Elevation (ft)
0
50
100
150
Horizontal Distance (ft)

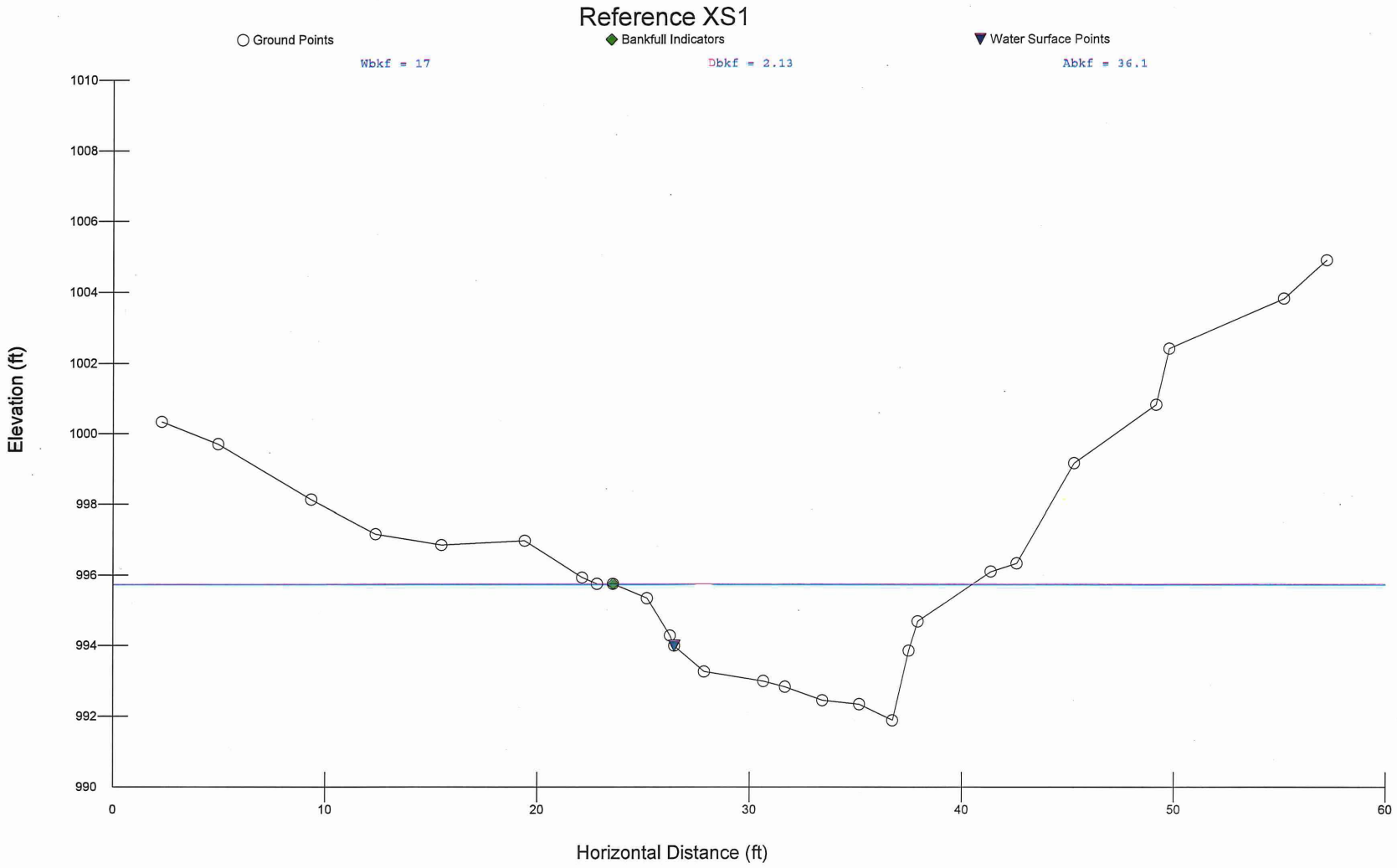
Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

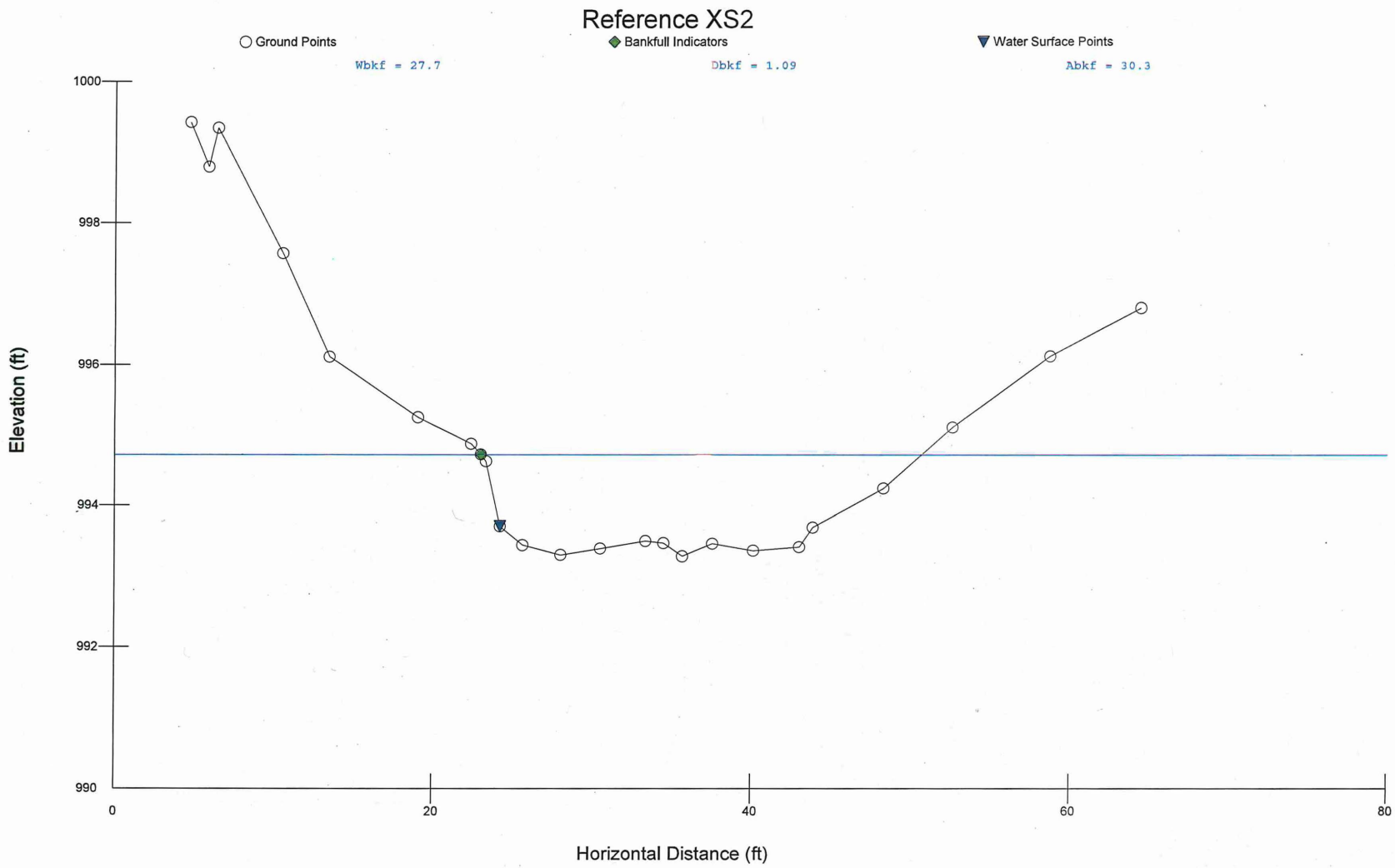
Stream:	**Chester Creek Site 2**				
Basin:	**Lake Superior**	Drainage Area:	**4160** acres	**6.5**	mi^2
Location:	**Duluth, Minnesota**				
Twp.&Rge:	**;**	Sec.&Qtr.:	**;**		
Cross-Section Monuments (Lat./Long.):	**46.81333 Lat / 92.09889 Long**			Date:	**10/16/14**
Observers:	**MG, MFA**			Valley Type:	VIII(a)

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**25.1**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.39**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**34.87**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**18.06**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**1.83**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**31.37**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.25**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**45**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.022**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1**	

Stream Type **F 4b** (See **Figure 2-14**)


Chester Creek - Reference Profile
XS1
XS2
1000
998
996
994
992
990
988
Elevation (ft)
0
50
100
150
200
250
300
Distance along stream (ft)
CH
WS
BKF
P1
P2
P3
P4


Reference XS1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17
Dbkf = 2.13
Abkf = 36.1
Elevation (ft)
1010
1008
1006
1004
1002
1000
998
996
994
992
990
0
10
20
30
40
50
60
Horizontal Distance (ft)


Reference XS2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 27.7
Dbkf = 1.09
Abkf = 30.3
1000
998
996
994
992
990
Elevation (ft)
0
20
40
60
80
Horizontal Distance (ft)

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Chester Creek - Reference Site**				
Basin:	**Lake Superior**	Drainage Area:	**4160** acres	**6.5**	mi^2
Location:	**Duluth, Minnesota**				
Twp.&Rge:	**;**	Sec.&Qtr.:	**;**		
Cross-Section Monuments (Lat./Long.):	**46.81306 Lat / 92.09639 Long**			Date:	**06/28/14**
Observers:				Valley Type:	VIII(a)

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**27.7**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section (d_{bkf} = A / W_{bkf}).	**1.09**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**30.32**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**25.41**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**1.45**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**45.88**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.66**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**45**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.02932**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.09**	

Stream Type **B 4** (See **Figure 2-14**)

Table A1. Chester Creek Reference Data

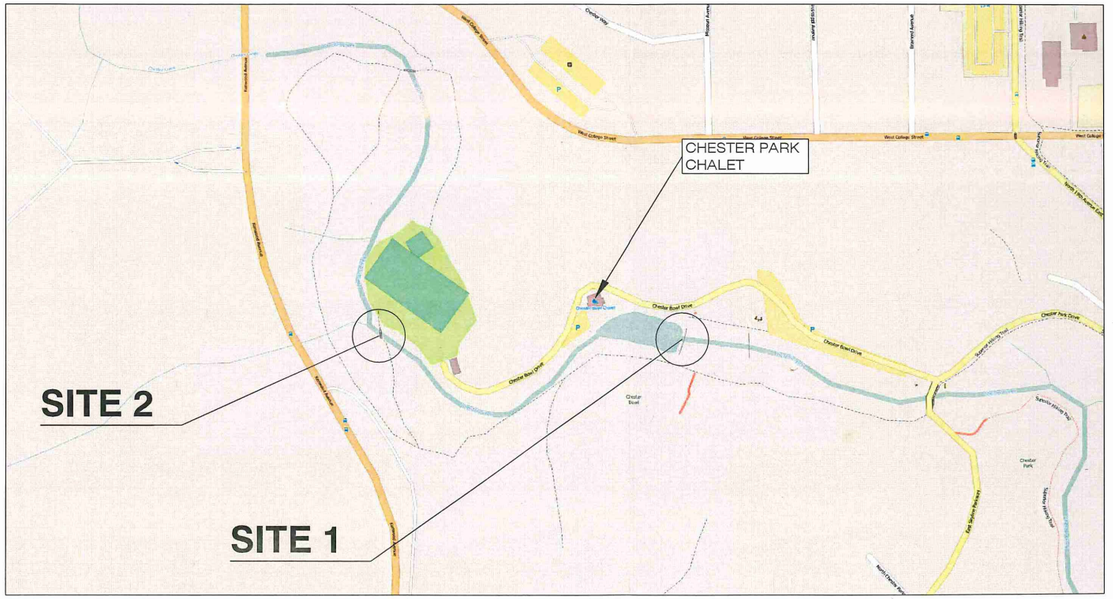
Reach	Basin Creek	UT to Trickery Creek	Mitchell River Headwaters	Little Mill Seat
Drainage Area	6.8	0.43	6.2	1.5
Valley Type	VII	II	VII	II
Stream Type	C4b	B4c	B4	B4a
Wbkf (ft)	30.7	7.92	36.9	19
Abkf (ft^2)	57.4	7.17	75.5	16
WDR	18	16	18	18
D50	33	45	32	55
ER	2.8	2.9	1.95	1.95
Bank Erosion (ton/yr/ft)	0.0065	0.0045	0.0055	0.0055
Slope (ft/ft)	0.023	0.018	0.025	0.05
Pool-Pool Spacing Ratio	6-8	5-6	1.5-3	1-2
MWR Ratio	9-12	7-10	4-6	n/a
BELT Ratio	3-6	2-4	2-4	n/a
ROC Ratio	2-4	2-3	2-4	n/a

Attachment B: 60% Design Drawings

CHESTER CREEK
STREAM RESTORATION PROJECT
60% PRELIMINARY DESIGN

DULUTH, MINNESOTA
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

SEPTEMBER 26, 2014



LOCATION MAP
NTS

SHEET INDEX

SHEET NUMBER	SHEET TITLE
1	TITLE SHEET
2	SITE 1 STREAM PLAN AND PROFILE – CONTOURS
3	SITE 1 STREAM PLAN AND PROFILE – AERIAL
4	SITE 1 CROSS-SECTIONS
5	SITE 2 STREAM PLAN AND PROFILE – CONTOURS
6	SITE 2 STREAM PLAN AND PROFILE – AERIAL
7	SITE 2 CROSS-SECTIONS
8	NOTES AND DETAILS
9	PLANTING PLAN

Stantec

Stantec Consulting Services Inc.
4500 DALY DRIVE SUITE 100
FAIRFAX, VA
Tel. 703.263.1220
www.stantec.com

Consultants

Legend

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS.

BASE MAPPING WAS PROVIDED BY MINNESOTA DNR. STANTEC MAKES NO WARRANTY REGARDING THE ACCURACY OF ANY SURVEY DATA SHOWN HEREIN.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.24
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

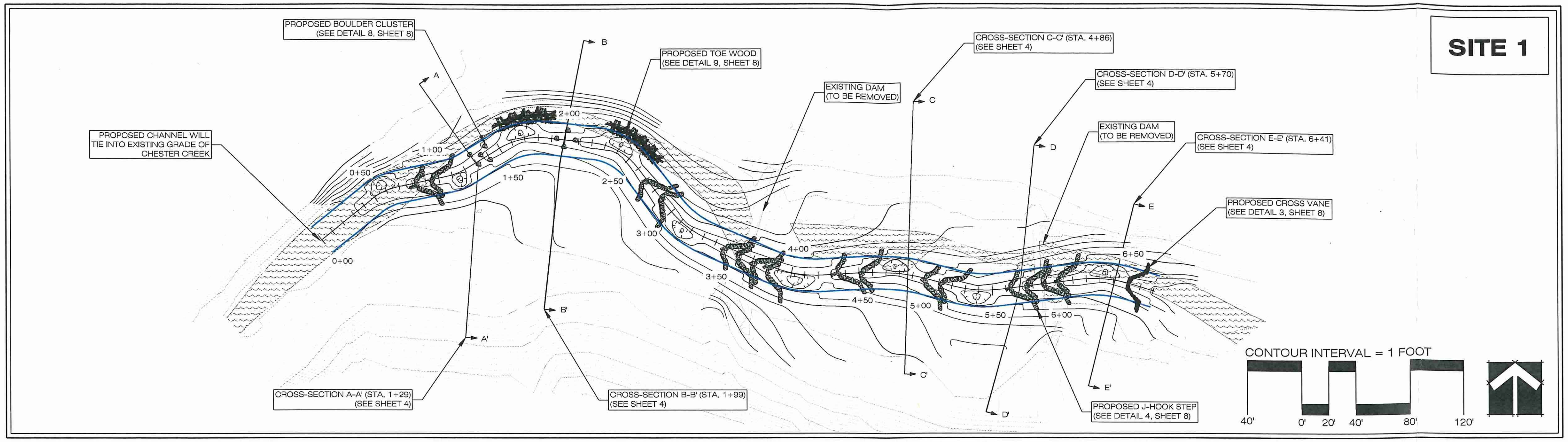
Client/Project
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

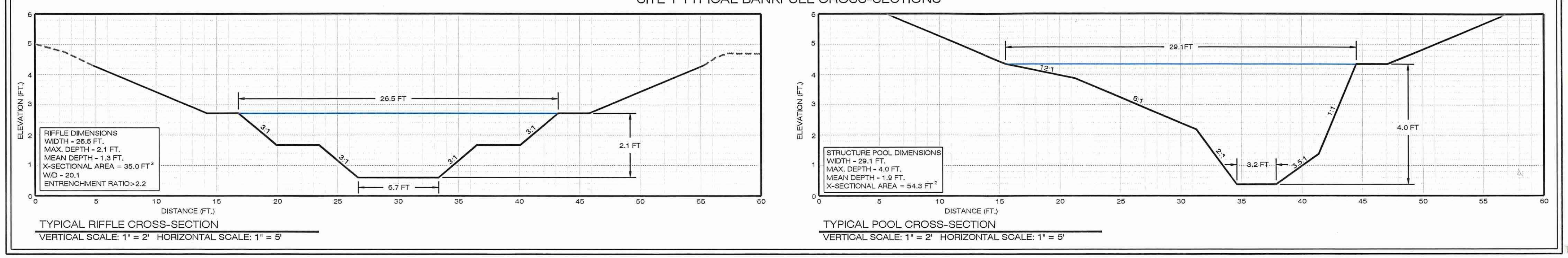
Title
TITLE SHEET

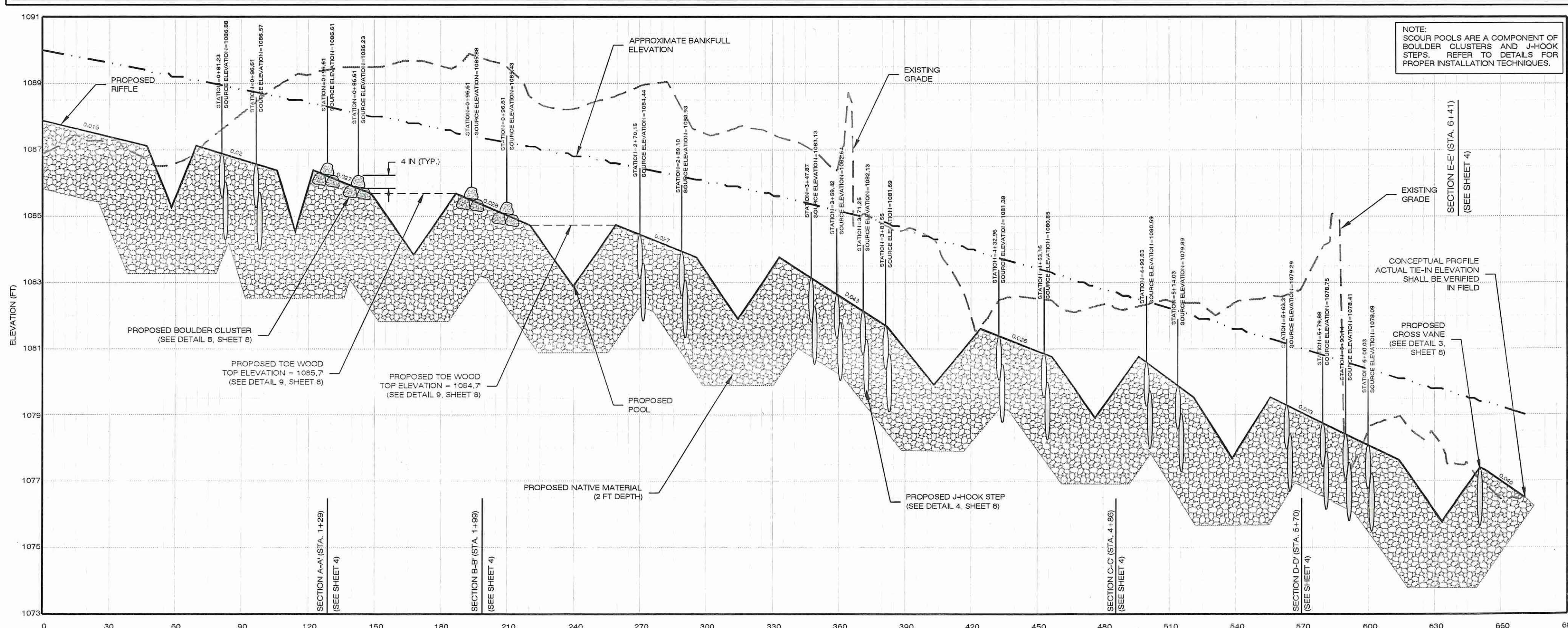
Project No.	Scale	
175654021	NTS	
Drawing No.	Sheet	Revision
	1 of 9	0

SITE 1



SITE 1 TYPICAL BANKFULL CROSS-SECTIONS





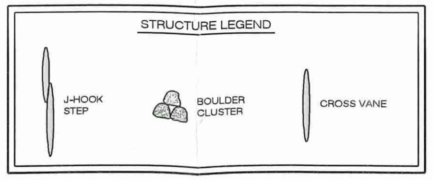
SITE 1 LONGITUDINAL PROFILE (0+00 - 6+90)

VERTICAL SCALE: 1"=2' HORIZONTAL SCALE: 1"=30'

PROPOSED CONDITIONS

SITE 1 OF THE CHESTER CREEK STREAM RESTORATION PROJECT WILL INCLUDE PRIORITY I RESTORATION OF THE EXISTING UNSTABLE STREAM CHANNEL. TO THE GREATEST EXTENT PRACTICABLE, THE DESIGN CHANNEL GEOMETRY, PATTERN, AND PROFILE WILL UTILIZE NATURAL CHANNEL DESIGN PRINCIPLES IN ORDER TO PROMOTE LONG TERM STABILITY. GEOMORPHIC ASSESSMENTS WERE USED FOR DESIGN OF A ROSGEN C-TYPE CHANNEL. CONSISTENT WITH THIS STREAM TYPE, OVERALL BANKFULL SLOPE OF THE DESIGN CHANNEL IS APPROXIMATELY 1.7%. INSTALLATION OF J-HOOK STEP STRUCTURES ALLOW SHORTER CHANGES IN GRADE, WHERE NECESSARY, AND VERTICAL ENERGY DISSIPATION WHERE THE VALLEY DOES NOT ALLOW LATERAL DISSIPATION. USE OF TOE WOOD STRUCTURES AND BOULDER CLUSTERS ALSO PROVIDE STABILIZATION, GRADE CONTROL, AND ENERGY DISSIPATION, AND THEY HAVE BEEN SPECIFICALLY DESIGNED TO OPTIMIZE HABITAT AND SUPPORT AQUATIC LIFE USE WITHIN THE REACH. TOE WOOD IS TYPICALLY USED IN BEND POOLS WHERE EDGE HABITAT MAY DEVELOP SLOWLY AND WHERE THERE MAY BE LITTLE NATURAL STRUCTURE. THE PROTRUDING WOODY ENDS PROVIDE COMPLEXITY, COVER, AND INTERSTITIAL SPACE ESSENTIAL FOR COLONIZATION, SURVIVAL, AND REPRODUCTION OF MACROINVERTEBRATES AND MANY OTHER AQUATIC ORGANISMS. BOULDER CLUSTERS ALSO DISSIPATE ENERGY AND CREATE COMPLEXITY IN STRAIGHTER SEGMENTS OF STREAM. THEY PROVIDE SHADE AND PROTECTION, AS COVER OBJECTS, AND CREATE EDDIES IMMEDIATELY DOWNSTREAM, WHICH ARE IMPORTANT TO FISH, MACROINVERTEBRATES, AND OTHER AQUATIC LIFE. RIPARIAN BUFFER PLANTINGS AFFORD WATER QUALITY BENEFITS AND HELP TO MAINTAIN BANK STABILITY THROUGHOUT THE PROJECT AREA WHILE PROMOTING THE GROWTH OF NATIVE, NON-INVASIVE SPECIES.

STRUCTURE LEGEND



Stantec

Stantec Consulting Services Inc.
4500 DALY DRIVE SUITE 100
FAIRFAX, VA
Tel. 703.263.1220
www.stantec.com

Consultants

Legend

- EXISTING TOPOGRAPHY
- PROPOSED TOPOGRAPHY
- EXISTING STREAM CHANNEL LIMITS
- PROPOSED BANKFULL LIMITS
- PROPOSED STREAM CENTERLINE
- PROPOSED COIR LIFT WOOD TOE PROTECTION
- PROPOSED J-HOOK STEP
- CROSS-SECTIONS
- PROPOSED BOULDER CLUSTER
- PROPOSED ROCK CROSS VANE

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MTA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

Client/Project

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

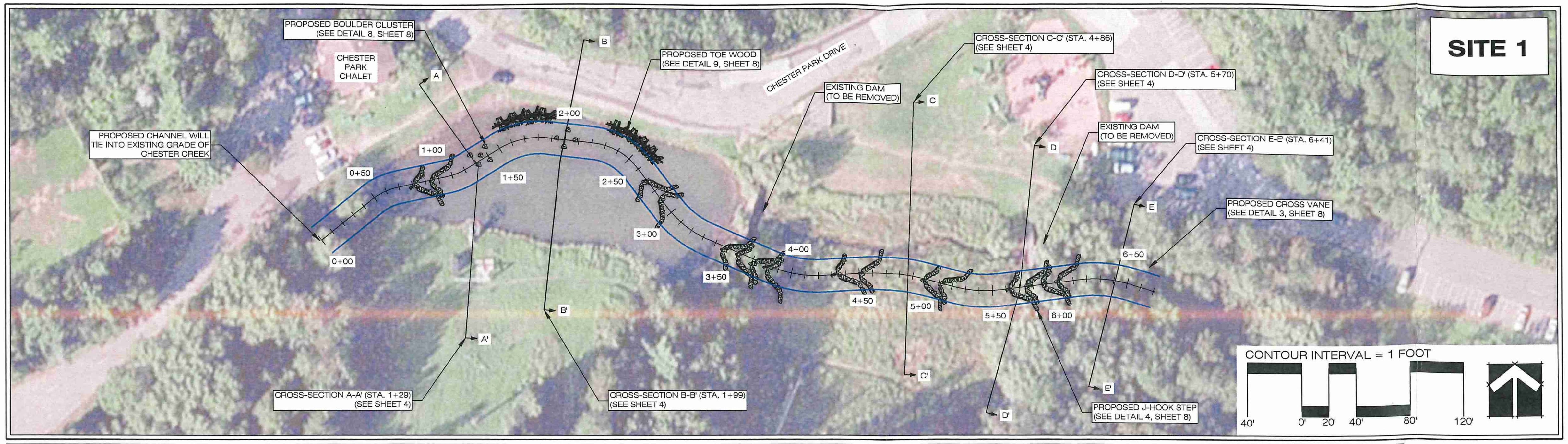
500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title

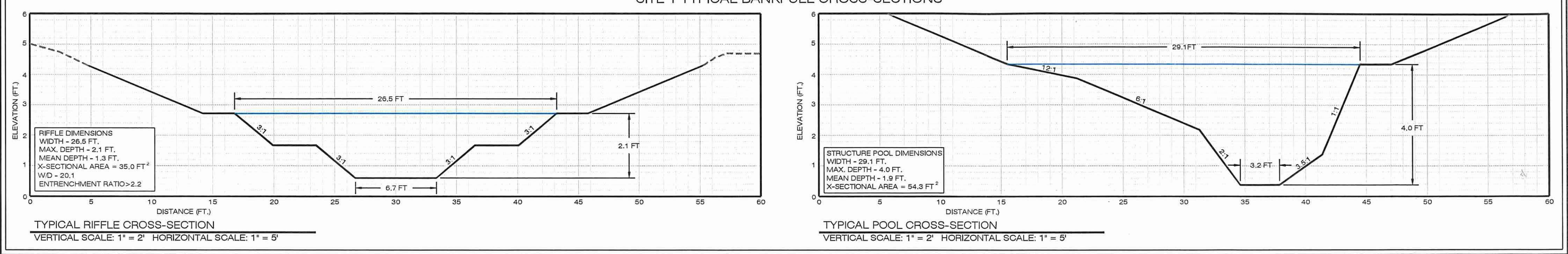
SITE 1 STREAM PLAN AND PROFILE - CONTOURS

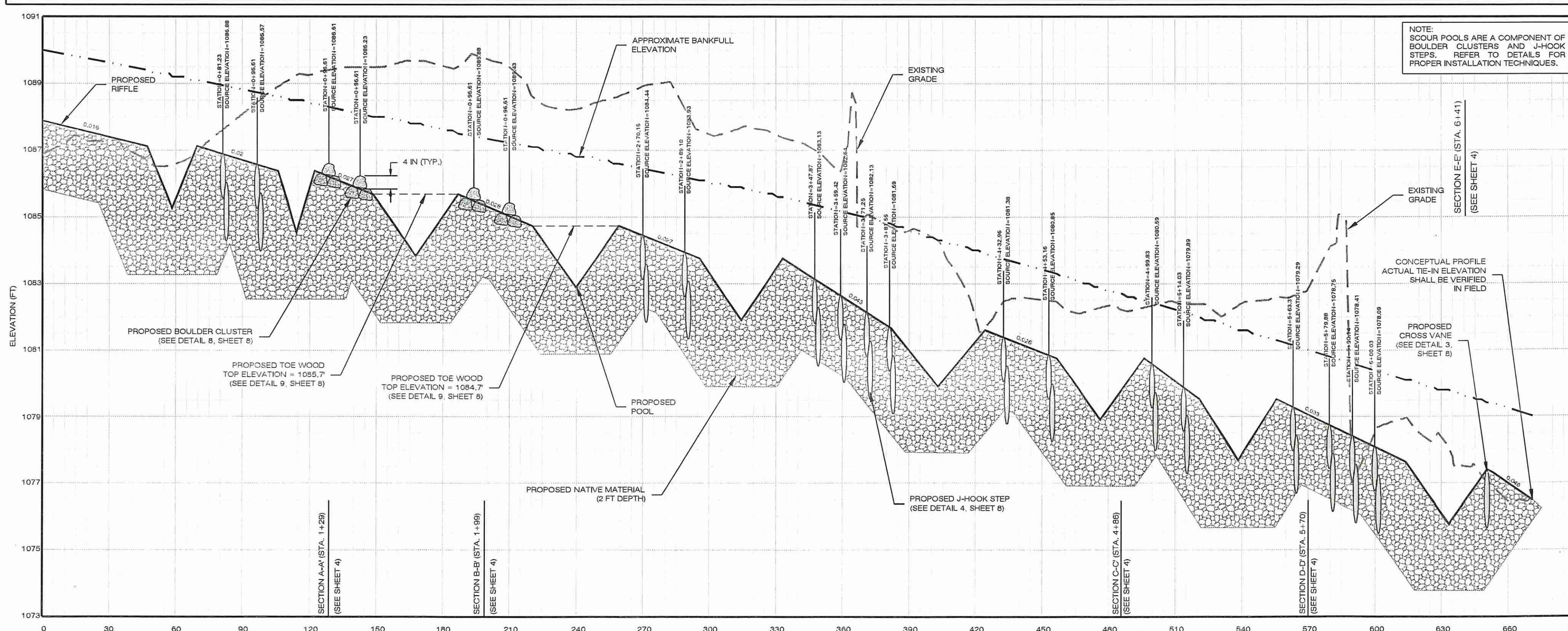
Project No.	Scale	
175654021	1"=40' (PLAN VIEW)	
Drawing No.	Sheet	Revision
	2 of 9	0

SITE 1



SITE 1 TYPICAL BANKFULL CROSS-SECTIONS





SITE 1 LONGITUDINAL PROFILE (0+00 - 6+90)

VERTICAL SCALE: 1"=2' HORIZONTAL SCALE: 1"=30'

PROPOSED CONDITIONS

SITE 1 OF THE CHESTER CREEK STREAM RESTORATION PROJECT WILL INCLUDE PRIORITY I RESTORATION OF THE EXISTING UNSTABLE STREAM CHANNEL. TO THE GREATEST EXTENT PRACTICABLE, THE DESIGN CHANNEL GEOMETRY, PATTERN, AND PROFILE WILL UTILIZE NATURAL CHANNEL DESIGN PRINCIPLES IN ORDER TO PROMOTE LONG TERM STABILITY. GEOMORPHIC ASSESSMENTS WERE USED FOR DESIGN OF A ROSGEN C-TYPE CHANNEL. CONSISTENT WITH THIS STREAM TYPE, OVERALL BANKFULL SLOPE OF THE DESIGN CHANNEL IS APPROXIMATELY 1.7%. INSTALLATION OF J-HOOK STEP STRUCTURES ALLOW SHORTER CHANGES IN GRADE, WHERE NECESSARY, AND VERTICAL ENERGY DISSIPATION WHERE THE VALLEY DOES NOT ALLOW LATERAL DISSIPATION. USE OF TOE WOOD STRUCTURES AND BOULDER CLUSTERS ALSO PROVIDE STABILIZATION, GRADE CONTROL, AND ENERGY DISSIPATION, AND THEY HAVE BEEN SPECIFICALLY DESIGNED TO OPTIMIZE HABITAT AND SUPPORT AQUATIC LIFE USE WITHIN THE REACH. TOE WOOD IS TYPICALLY USED IN BEND POOLS WHERE EDGE HABITAT MAY DEVELOP SLOWLY AND WHERE THERE MAY BE LITTLE NATURAL STRUCTURE. THE PROTRUDING WOODY ENDS PROVIDE COMPLEXITY, COVER, AND INTERSTITIAL SPACE ESSENTIAL FOR COLONIZATION, SURVIVAL, AND REPRODUCTION OF MACROINVERTEBRATES AND MANY OTHER AQUATIC ORGANISMS. BOULDER CLUSTERS ALSO DISSIPATE ENERGY AND CREATE COMPLEXITY IN STRAIGHTER SEGMENTS OF STREAM. THEY PROVIDE SHADE AND PROTECTION, AS COVER OBJECTS, AND CREATE EDDIES IMMEDIATELY DOWNSTREAM, WHICH ARE IMPORTANT TO FISH, MACROINVERTEBRATES, AND OTHER AQUATIC LIFE. RIPARIAN BUFFER PLANTINGS AFFORD WATER QUALITY BENEFITS AND HELP TO MAINTAIN BANK STABILITY THROUGHOUT THE PROJECT AREA WHILE PROMOTING THE GROWTH OF NATIVE, NON-INVASIVE SPECIES.

STRUCTURE LEGEND

J-HOOK STEP — BOULDER CLUSTER — CROSS VANE

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

- EXISTING STREAM CHANNEL LIMITS
- PROPOSED BANKFULL LIMITS
- PROPOSED STREAM CENTERLINE
- PROPOSED COIR LIFT WOOD TOE PROTECTION
- PROPOSED J-HOOK STEP
- CROSS-SECTIONS
- PROPOSED BOULDER CLUSTER

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY NOT FOR CONSTRUCTION

Client/Project

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

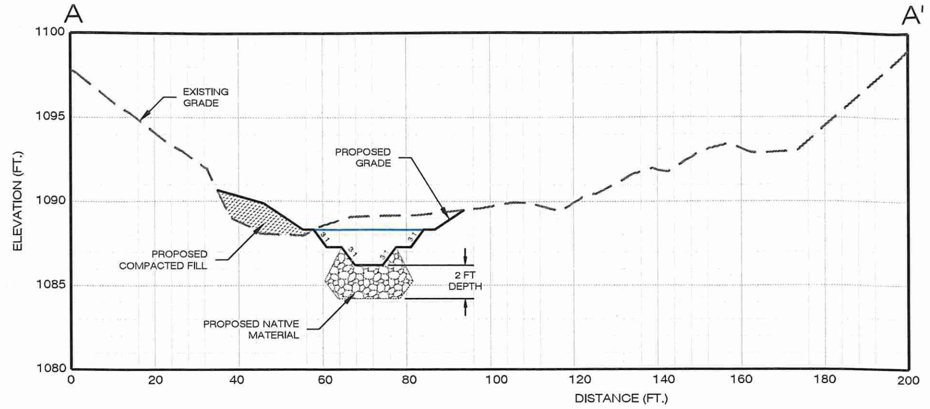
500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title

SITE 1 STREAM PLAN AND PROFILE - AERIAL

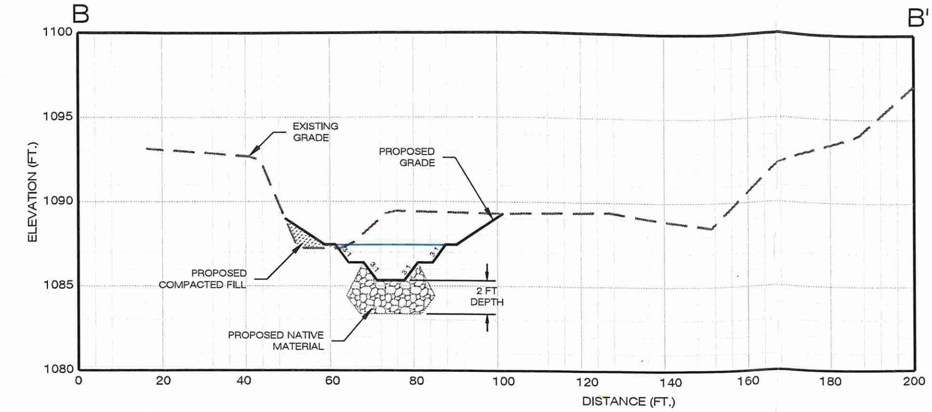
Project No.	Scale	
175654021	1"=40' (PLAN VIEW)	
Drawing No.	Sheet	Revision
	3 of 9	0

ORIGINAL SHEET - ARCH D



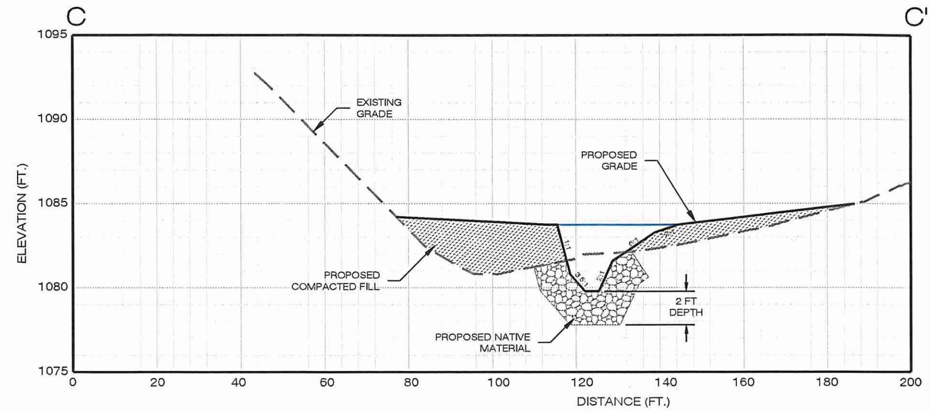
CROSS-SECTION A-A' (STA. 1+29)

VERTICAL SCALE: 1" = 5' HORIZONTAL SCALE: 1" = 20'



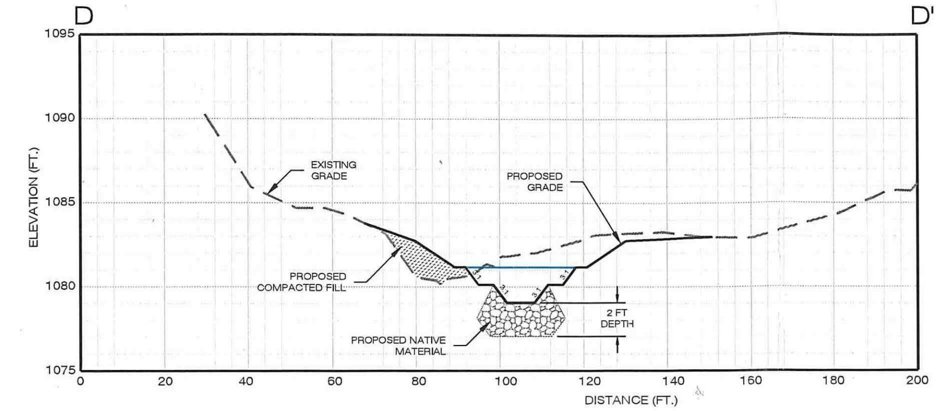
CROSS-SECTION B-B' (STA. 1+99)

VERTICAL SCALE: 1" = 5' HORIZONTAL SCALE: 1" = 20'



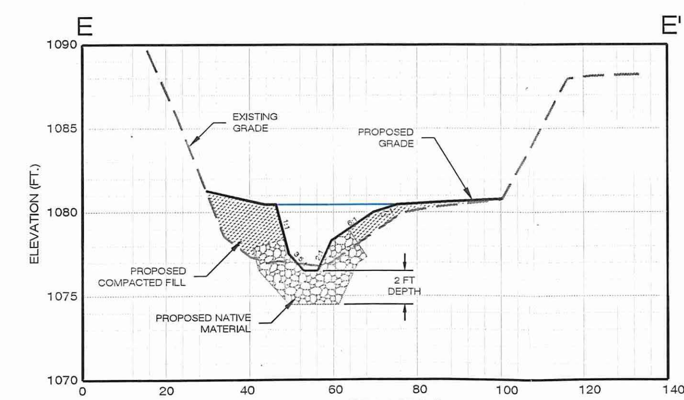
CROSS-SECTION C-C' (STA. 4+86)

VERTICAL SCALE: 1" = 5' HORIZONTAL SCALE: 1" = 20'



CROSS-SECTION D-D' (STA. 5+70)

VERTICAL SCALE: 1" = 5' HORIZONTAL SCALE: 1" = 20'



CROSS-SECTION E-E' (STA. 6+41)

VERTICAL SCALE: 1" = 5' HORIZONTAL SCALE: 1" = 20'

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	CJM	MFA	MG	14.06.26

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

Client/Project

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

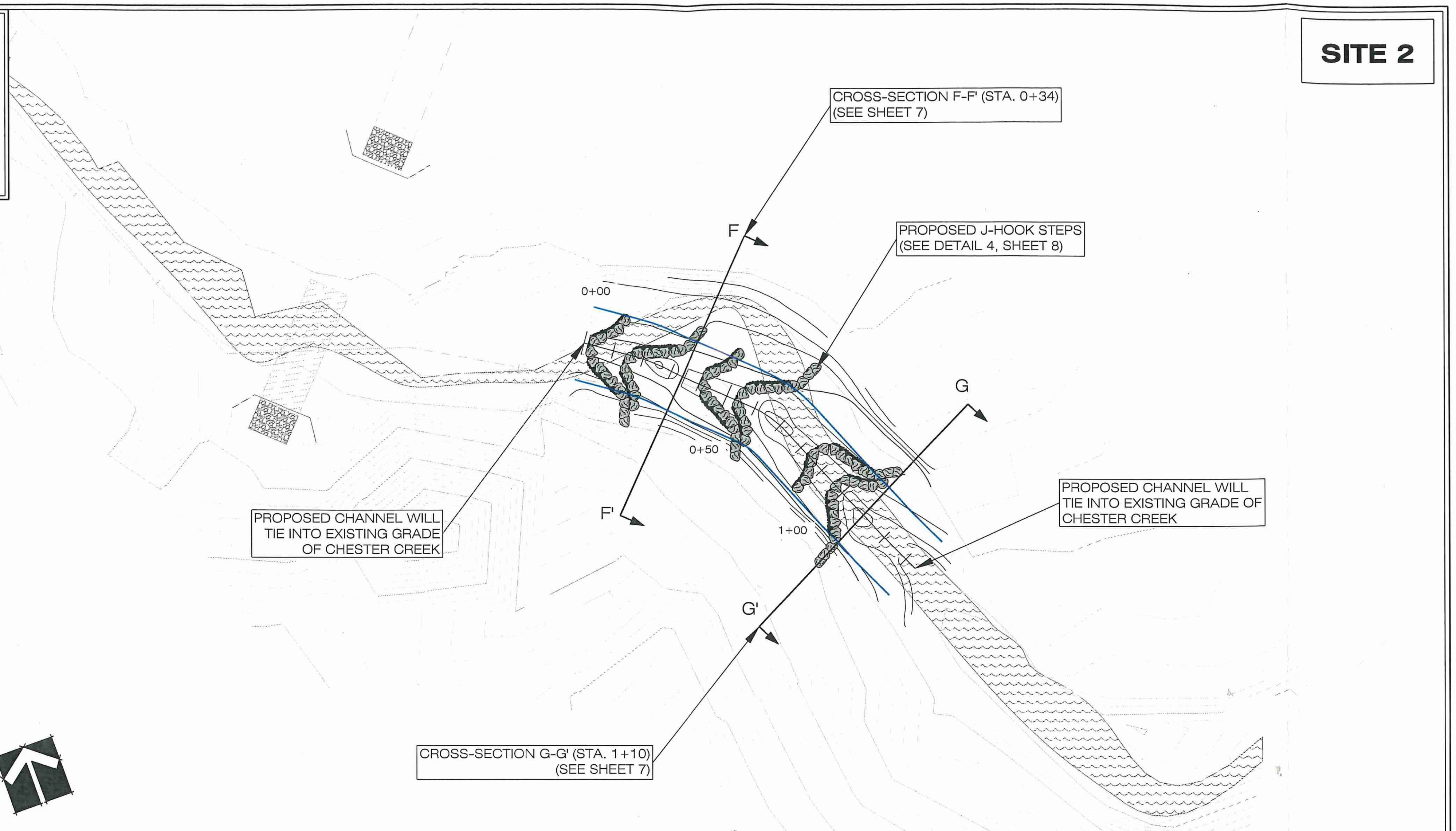
Title

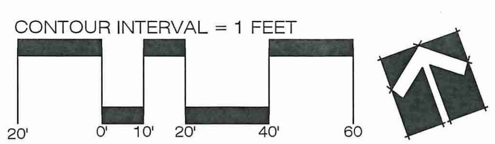
SITE 1 CROSS-SECTIONS

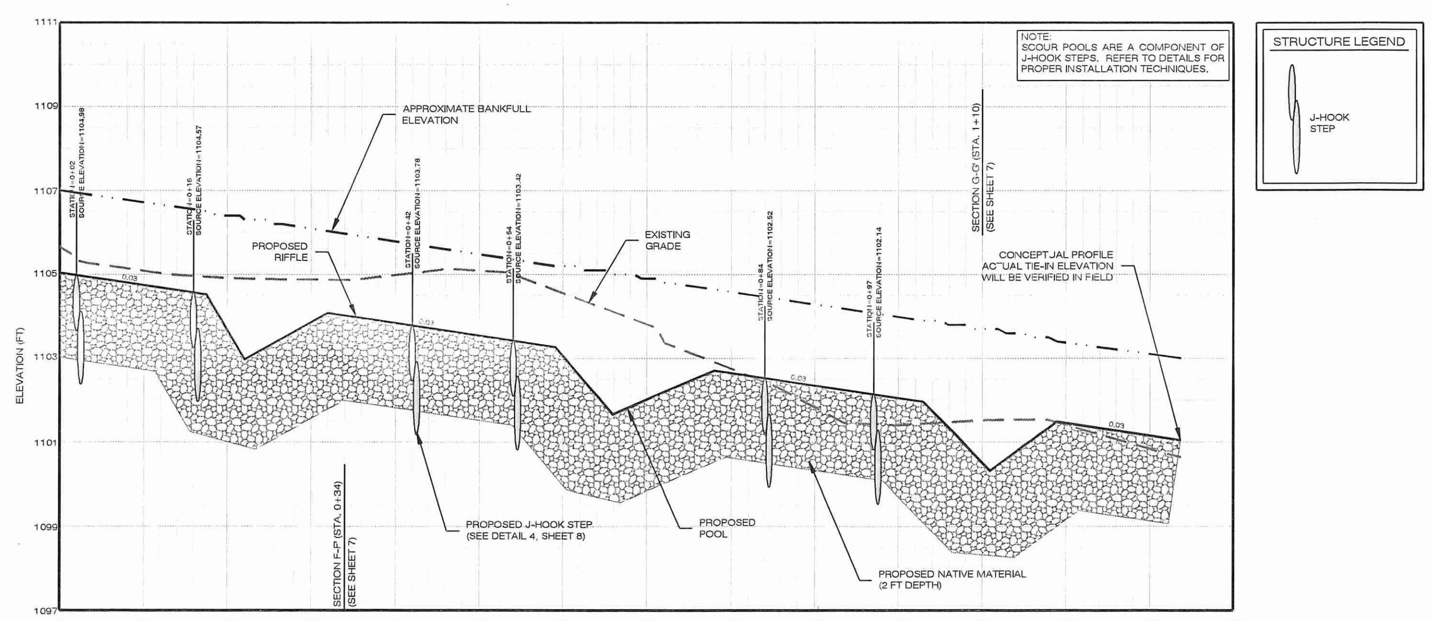
Project No.	Scale	
175654021	AS SHOWN	
Drawing No.	Sheet	Revision
	4 of 9	0

PROPOSED CONDITIONS

SITE 2 OF THE CHESTER CREEK STREAM RESTORATION PROJECT WILL INCLUDE PRIORITY II RESTORATION OF THE EXISTING UNSTABLE STREAM CHANNEL. TO THE GREATEST EXTENT PRACTICABLE, THE DESIGN CHANNEL GEOMETRY, PATTERN, AND PROFILE WILL UTILIZE NATURAL CHANNEL DESIGN PRINCIPLES IN ORDER TO PROMOTE LONG TERM STABILITY. GEOMORPHIC ASSESSMENTS WERE USED FOR DESIGN OF A ROSGEN B-TYPE CHANNEL. CONSISTENT WITH THIS STREAM TYPE, OVERALL BANKFULL SLOPE OF THE DESIGN CHANNEL IS APPROXIMATELY 2.9%. INSTALLATION OF J-HOOK STEP STRUCTURES ALLOW SHORTER CHANGES IN GRADE, WHERE NECESSARY, AND VERTICAL ENERGY DISSIPATION WHERE THE VALLEY DOES NOT ALLOW LATERAL DISSIPATION. ALONG WITH GRADE CONTROL, THESE STRUCTURES WILL PROVIDE HABITAT FOR THE COLONIZATION, SURVIVAL, AND REPRODUCTION OF MACROINVERTEBRATES AND FISH. FOLLOWING THE STREAM RESTORATION IMPLEMENTATION, ALL DISTURBED AREAS WILL BE PLANTED WITH NATIVE SPECIES. THESE PLANTINGS AFFORD WATER QUALITY BENEFITS AND HELP TO MAINTAIN BANK STABILITY THROUGHOUT THE PROJECT AREA WHILE PROHIBITING THE GROWTH OF NON-NATIVE SPECIES.







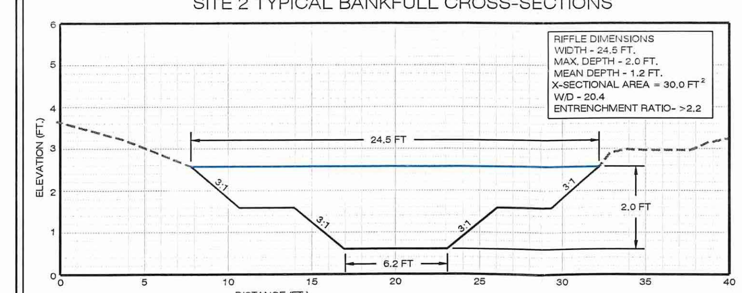
UPPER REACH TYPICAL LONGITUDINAL PROFILE (0+00 - 1+40)

VERTICAL SCALE: 1"=2' HORIZONTAL SCALE: 1"=10'

STRUCTURE LEGEND

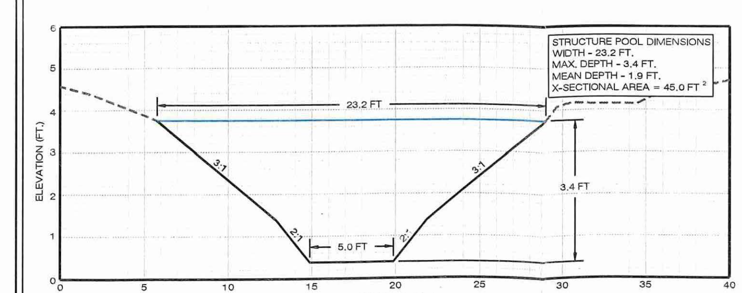
J-HOOK STEP

SITE 2 TYPICAL BANKFULL CROSS-SECTIONS



TYPICAL RIFFLE CROSS-SECTION

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 5'



TYPICAL POOL CROSS-SECTION

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 5'

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

- EXISTING TOPOGRAPHY
- PROPOSED TOPOGRAPHY
- EXISTING STREAM CHANNEL LIMITS
- PROPOSED BANKFULL LIMITS
- PROPOSED STREAM CENTERLINE
- PROPOSED J-HOOK STEP
- CROSS-SECTIONS

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY NOT FOR CONSTRUCTION

Client/Project

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title

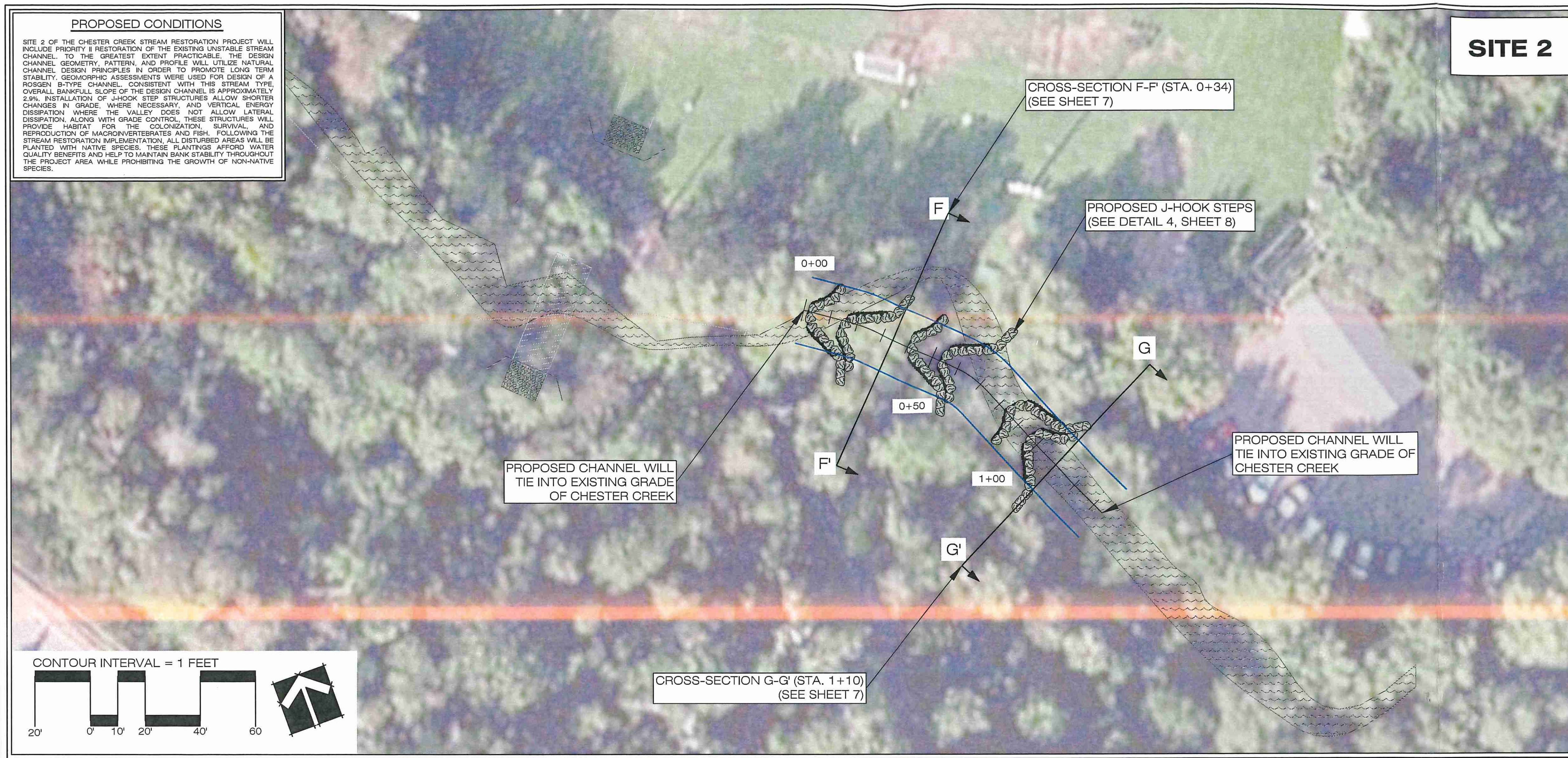
SITE 2 STREAM PLAN AND PROFILE - CONTOURS

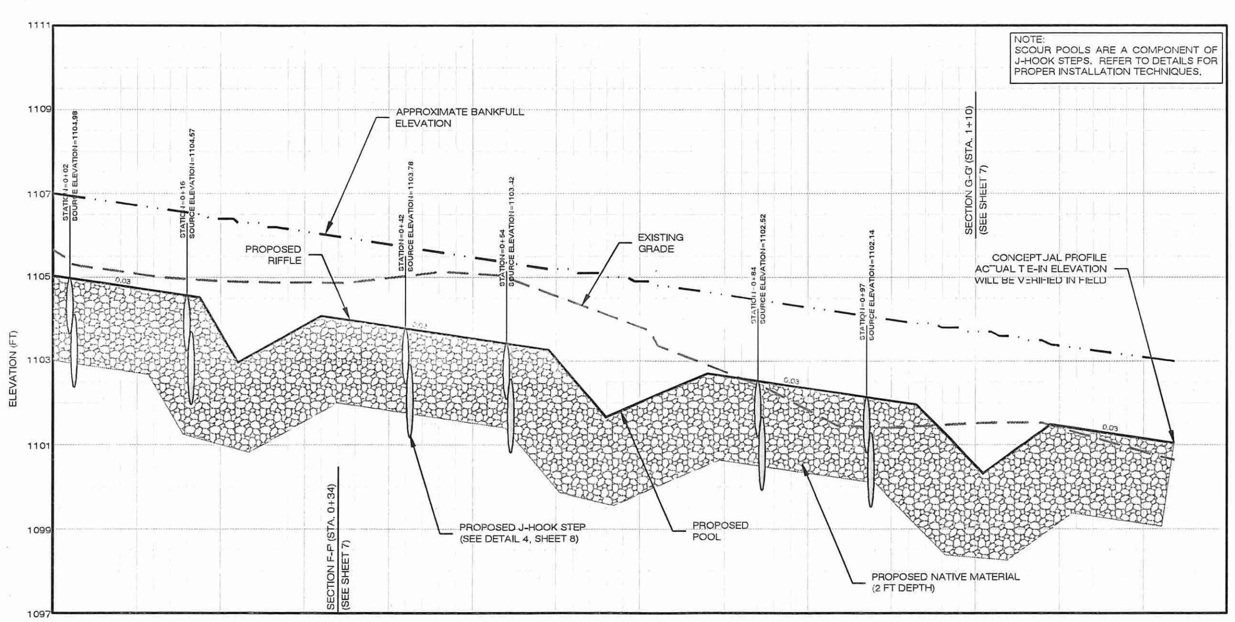
Project No.	Scale	
175654021	1"=20' (PLAN VIEW)	
Drawing No.	Sheet	Revision
	5 of 9	0

PROPOSED CONDITIONS

SITE 2 OF THE CHESTER CREEK STREAM RESTORATION PROJECT WILL INCLUDE PRIORITY II RESTORATION OF THE EXISTING UNSTABLE STREAM CHANNEL. TO THE GREATEST EXTENT PRACTICABLE, THE DESIGN CHANNEL GEOMETRY, PATTERN, AND PROFILE WILL UTILIZE NATURAL CHANNEL DESIGN PRINCIPLES IN ORDER TO PROMOTE LONG TERM STABILITY. GEOMORPHIC ASSESSMENTS WERE USED FOR DESIGN OF A ROSGEN B-TYPE CHANNEL. CONSISTENT WITH THIS STREAM TYPE, OVERALL BANKFULL SLOPE OF THE DESIGN CHANNEL IS APPROXIMATELY 2.9%. INSTALLATION OF J-HOOK STEP STRUCTURES ALLOW SHORTER CHANGES IN GRADE, WHERE NECESSARY, AND VERTICAL ENERGY DISSIPATION WHERE THE VALLEY DOES NOT ALLOW LATERAL DISSIPATION. ALONG WITH GRADE CONTROL, THESE STRUCTURES WILL PROVIDE HABITAT FOR THE COLONIZATION, SURVIVAL, AND REPRODUCTION OF MACROINVERTEBRATES AND FISH. FOLLOWING THE STREAM RESTORATION IMPLEMENTATION, ALL DISTURBED AREAS WILL BE PLANTED WITH NATIVE SPECIES. THESE PLANTINGS AFFORD WATER QUALITY BENEFITS AND HELP TO MAINTAIN BANK STABILITY THROUGHOUT THE PROJECT AREA WHILE PROHIBITING THE GROWTH OF NON-NATIVE SPECIES.

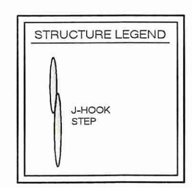
SITE 2



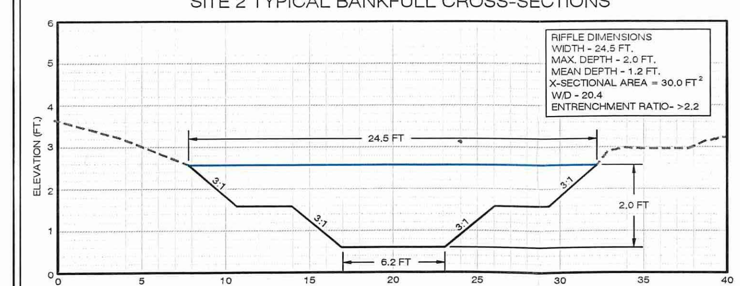


UPPER REACH TYPICAL LONGITUDINAL PROFILE (0+00 - 1+40)

VERTICAL SCALE: 1"=2' HORIZONTAL SCALE: 1"=10'

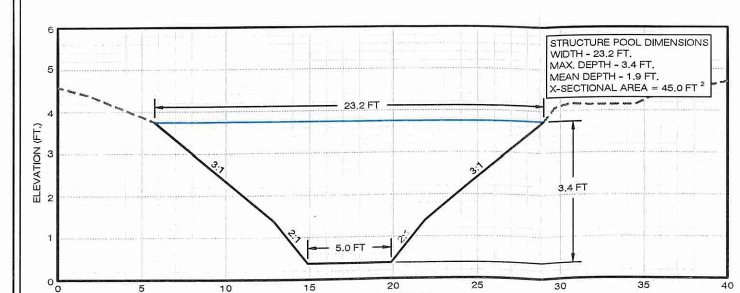


SITE 2 TYPICAL BANKFULL CROSS-SECTIONS



TYPICAL RIFFLE CROSS-SECTION

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 5'



TYPICAL POOL CROSS-SECTION

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 5'

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

- EXISTING TOPOGRAPHY
- PROPOSED TOPOGRAPHY
- EXISTING STREAM CHANNEL LIMITS
- PROPOSED BANKFULL LIMITS
- PROPOSED STREAM CENTERLINE
- PROPOSED J-HOOK STEP
- CROSS-SECTIONS

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

Client/Project

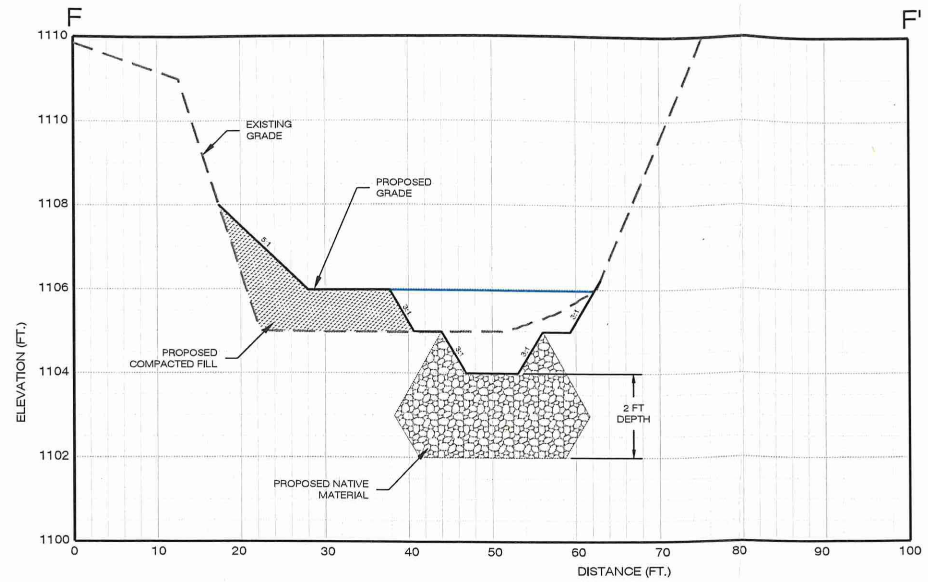
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title

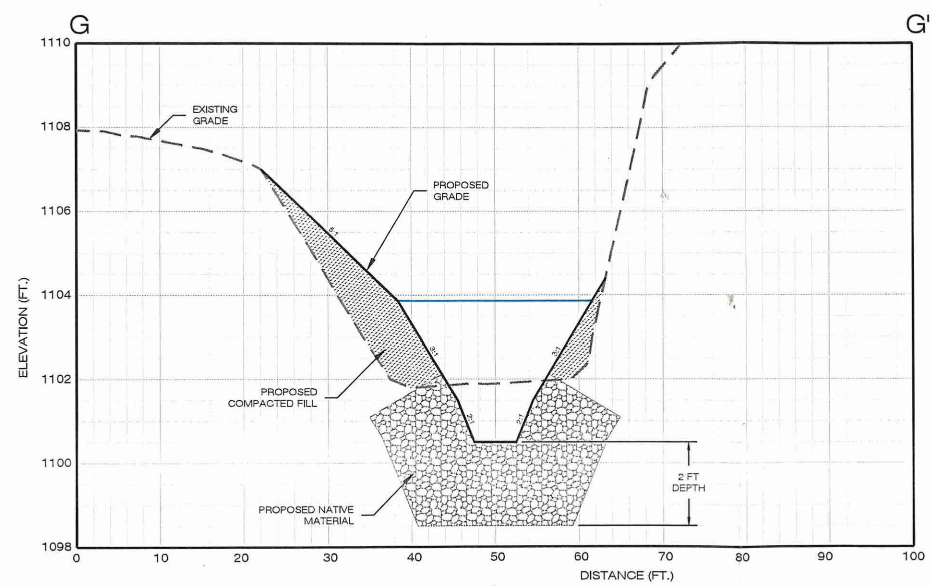
SITE 2 STREAM PLAN AND PROFILE - AERIAL

Project No.	Scale	
175654021	1"=20' (PLAN VIEW)	
Drawing No.	Sheet	Revision
	6 of 9	0



CROSS-SECTION F-F' (STA. 0+30)

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 10'



CROSS-SECTION G-G' (STA. 1+10)

VERTICAL SCALE: 1" = 2' HORIZONTAL SCALE: 1" = 10'

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

Client/Project

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title

SITE 2 CROSS-SECTIONS

Project No. 175654021

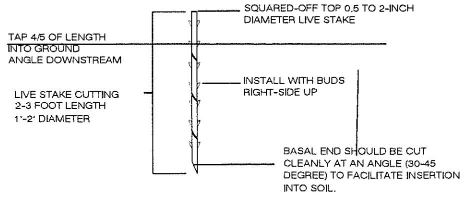
Scale AS SHOWN

Drawing No.

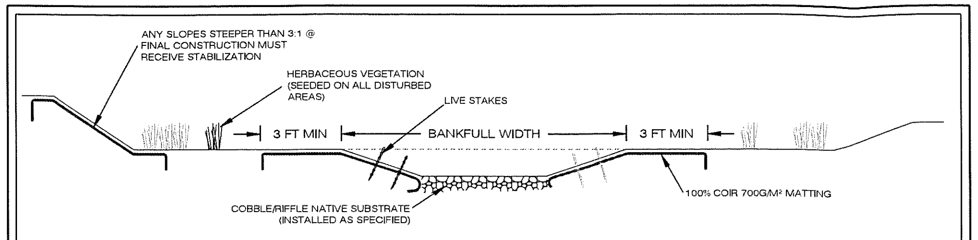
Sheet 7 of 9

Revision 0

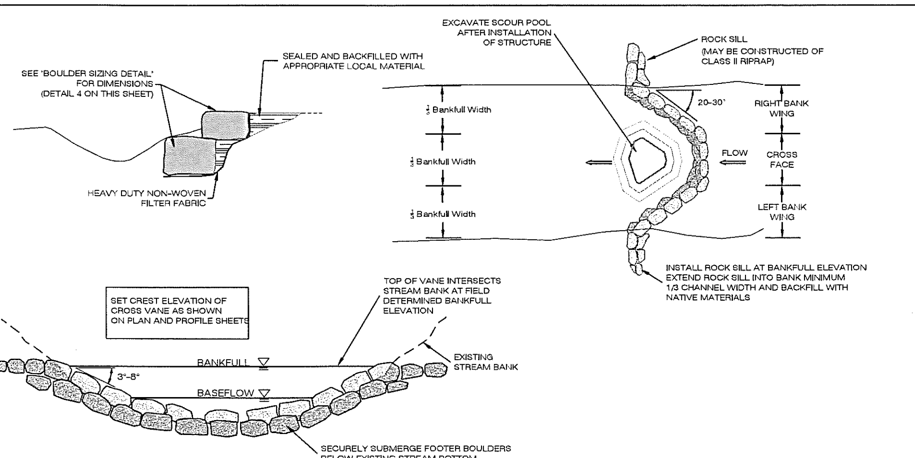
ORIGINAL SHEET - ARCH D



1/8 LIVE STAKE INSTALLATION
NTS



2/8 DETAIL: TYPICAL CHANNEL STABILIZATION
NTS



CONSTRUCTION SPECIFICATIONS

1. EXCAVATE TRENCH ALONG THE BOTTOM OF THE STREAM BED AND TO THE BANKFULL ELEVATION IN THE STREAMBANK FOR THE CENTER SECTION AND WINGS OF THE VANE. THE TRENCH SHOULD BE PERPENDICULAR TO THE STREAMBANK FOR THE CENTER SECTION AND EXCAVATED TO THE DESIGN ANGLE FOR EACH ARM.

NOTE: VANE WINGS SHOULD BE PROPERLY TIED INTO THE BANK AT BANKFULL ELEVATION.

2. PLACE ONE OR TWO COURSES OF FOOTER BOULDERS TO THE MINIMUM SPECIFIED FOOTER DEPTH.

3. PLACE VANE ROCKS ON TOP OF FOOTER ROCKS SO THAT EACH HALF OF THE VANE ROCK RESTS ON ONE HALF OF A FOOTER ROCK BELOW. OFFSET THE VANE ROCK IN THE UPSTREAM DIRECTION AND PLACE SO THEY SLOPE SLIGHTLY AGAINST THE FLOW DIRECTION.

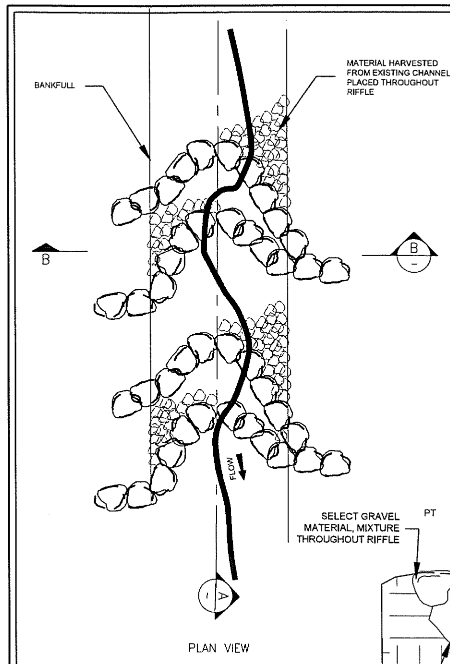
4. EXTEND THE STRUCTURE INTO THE BANK A MINIMUM 1/3 CHANNEL WIDTH AND ARMOR UPSTREAM AND DOWNSTREAM AS NEEDED FOR STABILITY.

5. AT THE BANKFULL ELEVATION, CREATE A SILL OF PLACED ROCK PERPENDICULAR TO THE STREAMBANK EXTENDING AWAY FROM THE VANE WING ARM A MINIMUM 1/3 CHANNEL WIDTH. CLASS II RIPRAP MAY BE USED FOR SILL CONSTRUCTION ONLY.

6. SEAL THE STRUCTURE ON THE UPSTREAM SIDE WITH GEOTEXTILE FABRIC, BACKFILL WITH APPROPRIATE LOCAL MATERIAL AND TOP-DRESS WITH NATIVE CHANNEL MATERIALS.

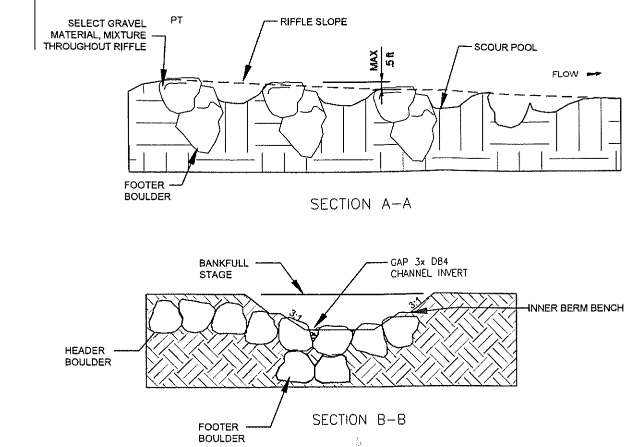
7. EXCAVATE THE SCOUR POOL TO THE DESIGN DEPTH.

3/8 DETAIL : TYPICAL CROSS-VANE
NTS



NOTES:

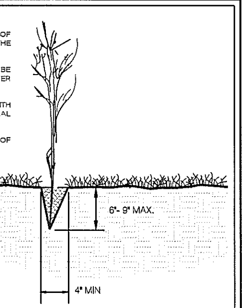
1. THE MAXIMUM AMOUNT OF DROP FROM ONE STEP VANE TO THE NEXT SHALL BE NO GREATER THAN .5 FT. THE COMBINED AMOUNT OF DROP OVER ALL THE MINI-STEP VANES SHALL NOT EXCEED THE TOTAL AMOUNT OF FALL IN THE RIFFLE SLOPE.
2. VANES SHALL BE EQUALLY SPACED IN THE RIFFLE AS A FUNCTION OF THE RIFFLE LENGTH. BOULDERS SHALL WEIGH APPROXIMATELY 1 TO 2 TONS (APPROXIMATE DIMENSION.
3. FOOT BOULDERS ARE TO BE USED AT EACH MINI-STEP VANE ARM THE SAME SIZE AS THE HEADER.
4. A HYDRAULIC EXCAVATOR WITH A BUCKET THAT CONTAINS A HYDRAULIC THUMB SHALL BE USED TO PLACE BOULDERS AND LOGS WITH THE SUPERVISION OF THE ENGINEER.
5. 1/2 OF THE WAY ACROSS THE CHANNEL FROM THE OUTSIDE BANK THE HEADER ROCK SHALL BE PLACED AT .2 FT ABOVE THE CHANNEL INVERT ELEVATION.
6. THERE SHALL BE A GAP BETWEEN THE HEADER ROCKS OF APPROXIMATELY 2 TIMES THE D84 OF THE CHANNEL BED.
7. THE BOULDERS SHALL SLOPE FROM THE BED ELEVATION, AT THE HEAD OF THE VANE, TO 1/2 BANKFULL ELEVATION AT A SLOPE OF 3%-5%. HEADER AND FOOTER BOULDERS SHALL BE TIED SECURELY INTO THE BANK IN SUCH A WAY THAT IT ELIMINATES THE POSSIBILITY OF STREAMFLOW DIVERTING AROUND THEM.
8. ANY SOIL DISTURBED DURING THE PLACEMENT OF RIFFLE, SHALL BE SEEDED USING TEMPORARY AND PERMANENT SEEDING METHODS.
9. THE THALWEG OR LOW POINT SHALL ALTERNATE LEFT AND RIGHT OF ℄ BY 1 FT.
10. THE GAP BETWEEN THE HEADER AND FOOTER BOULDERS SHALL BE CHINKED BY HAND WITH GRAVEL AND COBBLE FROM THE UPSTREAM DIRECTION.
11. THE HORIZONTAL ANGLE OF THE HEADER BOULDERS OF THE VANE AND THE BANK SHALL BE BETWEEN 30-40 DEGREES.
12. SELECT GRAVEL MATERIAL CAN BE HARVESTED FROM EXISTING RIFFLES ON-SITE DIRECTED BY ON-SITE DNR REPRESENTATIVE SHOULD HAVE A GRADATION WITH A D50 – 71MM, D84 – 143MM, AND A D100 – 357MM OR BE APPROVED BY ON-SITE DNR REPRESENTATIVE.
13. THE ELEVATION OF THE STRUCTURES CAN BE INTERPOLATED FROM THE DESIGN PROFILE AT THE LOCATION AND STATIONING OF EACH INDIVIDUAL STRUCTURE.



4/8 DETAIL: J-HOOK STEP
NTS

NOTES:

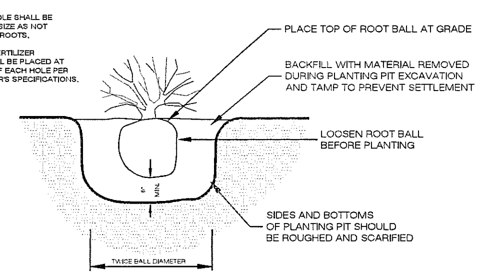
1. BARE ROOT PLANTING HOLE SHALL BE OF SUFFICIENT SIZE AS NOT TO CRAMP THE ROOTS.
2. AGRIFORM FERTILIZER TABLET(S) SHALL BE PLACED AT THE BOTTOM OF EACH HOLE PER MANUFACTURER'S SPECIFICATIONS.
3. PLANTING HOLE SHALL BE TAMPED WITH FOOT TO SECURE BARE ROOT PLANT MATERIAL IN SOIL.
4. ROOTS TO BE PLACED IN A MINIMUM of 9" OF SOIL.



5/8 TUBELING / BAREROOT INSTALLATION
NTS

NOTES

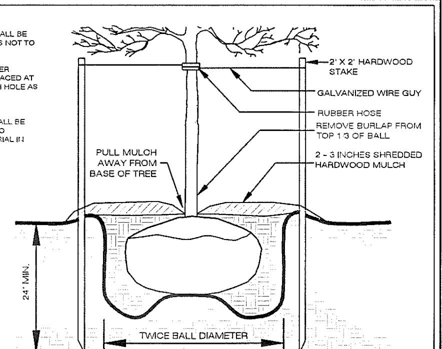
1. PLANTING HOLE SHALL BE OF SUFFICIENT SIZE AS NOT TO CRAMP THE ROOTS.
2. AGRIFORM FERTILIZER TABLET(S) SHALL BE PLACED AT THE BOTTOM OF EACH HOLE PER MANUFACTURER'S SPECIFICATIONS.



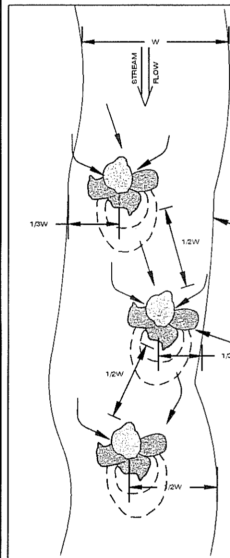
6/8 1 GALLON TREE AND SHRUB INSTALLATION
NTS

NOTES:

1. PLANTING HOLE SHALL BE OF SUFFICIENT SIZE AS NOT TO CRAMP THE ROOTS.
2. AGRIFORM FERTILIZER TABLETS SHALL BE PLACED AT THE BOTTOM OF EACH HOLE AS PER MANUFACTURE'S SPECIFICATIONS.
3. PLANTING HOLE SHALL BE TAMPED WITH FOOT TO SECURE PLANT MATERIAL IN SOIL.



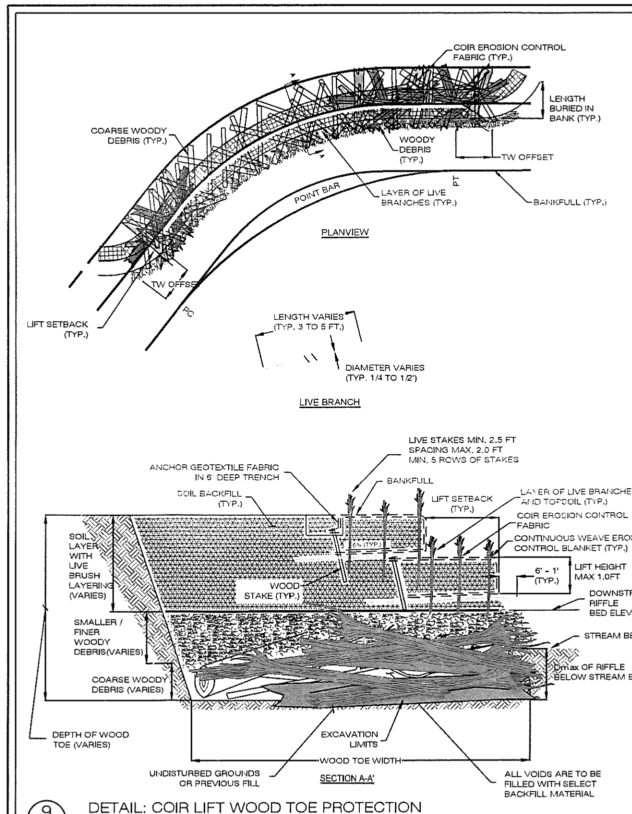
7/8 DETAIL: 1 INCH CALIPER PLANT INSTALLATION
NTS



NOTES:

1. CLUSTERS ARE COMPRISED OF 9 BOULDERS, MIN. DIMENSION 36".
2. THE CLUSTERS SHOULD BE PLACED IN A LONG STRAIGHT SEGMENT OF STREAM.
3. BOULDERS SHOULD NOT BE PLACED IN POOLS.
4. BOULDERS SHOULD PROTRUDE SIX INCHES ABOVE BASE FLOW WATER LEVEL.

8/8 DETAIL: BOULDER CLUSTER
NTS



NOTES:

1. COARSE WOODY DEBRIS SHALL CONSIST OF LOGS, ROOTWADS, AND LARGE BRANCHES NOT SUITABLE FOR CONSTRUCTION OF LOG STRUCTURES. ALL MATERIALS ARE TO BE APPROVED BY ON SITE DNR REPRESENTATIVE.
2. COARSE WOODY DEBRIS SHALL BE CONSTRUCTED WITH THE LARGEST MATERIAL PLACED FIRST. NO LOGS SHALL BE PLACED PARALLEL TO THE FLOW OF WATER, UNLESS DIRECTED BY ENGINEER. LOGS SHALL BE PLACED IN A CROSSING PATTERN OR WEAVE SUCH THAT EACH LOG IS ANCHORED BY ANOTHER LOG.
3. SMALL/FINE WOODY DEBRIS SHALL CONSIST OF MEDIUM TO SMALL LIMBS AND CAN BE BRANCHES, BUSHES, AND/OR LOGS. INVASIVE SPECIES SHALL NOT BE USED.
4. SMALL/FINE WOODY DEBRIS SHALL BE PLACED ABOVE THE COARSE WOODY DEBRIS WITH THE LARGEST MATERIAL BEING PLACED FIRST AND THE SMALLEST MATERIAL PLACED LAST.
5. ALL WOODY DEBRIS SHALL BE COMPACTED WITH THE EXCAVATOR BUCKET IN ORDER TO REDUCE THE PRESENCE OF VOIDS IN THE SMALL/FINE WOODY DEBRIS LAYER.
6. THE HORIZONTAL LOCATIONS OF ALL WOODY DEBRIS ARE LOCATED ON THE PLAN AND PROFILE SHEETS AND WILL BE PROVIDED TO THE CONTRACTOR DURING STAKEOUT. NO LOCATIONS OF WOODY DEBRIS SHALL VARY FROM THE PLAN LOCATIONS WITHOUT DIRECTION FROM THE STAMPING ENGINEER.
7. GRAVEL LEVELING BASE SHALL BE INSTALLED ABOVE THE HIGHEST ELEVATION OF THE WOODY DEBRIS BEFORE THE SOIL LIFTS ARE INSTALLED.
8. THE SOIL BACKFILL USED FOR LIFTS AND TOPSOIL USED FOR LAYERING WITH THE LIVE BRANCHES SHALL BE FREE OF ANY LARGE ROOTS OR WOODY DEBRIS AND SHALL GENERALLY BE FREE FROM ANY GRAVEL OR COBBLE MATERIAL.
9. SOIL BACKFILL SHALL BE COMPACTED SUCH THAT FUTURE SETTLING WILL BE KEPT TO A MINIMUM; YET, NOT SUCH THAT THE UNDERLYING BRUSH IS DISPLACED OR DAMAGED.
10. THE TOP OF THE BACKFILL FOR THE FIRST LIFT SHALL BE SLOPED AT APPROXIMATELY 5% AWAY FROM THE STREAM.
11. PLACE A LAYER OF TOPSOIL AND LIVE BRANCHES ON TOP OF EACH SOIL LIFT SUCH THAT APPROXIMATELY 6 INCHES TO 1 FOOT OF EACH LIVE BRANCH WILL BE EXPOSED AND THE REMAINDER (2' TO 4') OF EACH LIVE BRANCH WILL BE COVERED BY THE NEXT SOIL LIFT.
12. LIVE BRANCHES SHALL BE OF THE SPECIES SPECIFIED FOR LIVE STAKES OR APPROVED BY THE STAMPING ENGINEER.
13. PLACE A LAYER of 9.5 FEET WIDE GEOCOIR DEKOWE 700 EROSION CONTROL BLANKET, OR EQUIVALENT, ON TOP OF THE TOPSOIL AND LIVE BRANCHES SUCH THAT 2.5 FEET OF THE BLANKET WILL BE BURIED BELOW THE NEXT SOIL LIFT. ALLOW THE REMAINING 4.5 FEET OF BLANKET TO HANG OVER THE PRECEDING SOIL LIFT OR COIR FIBER LOGS.
14. PLACE A LAYER of 9.5 FEET WIDE NON-WOVEN COIR MATTING OVER THE EROSION CONTROL BLANKET TO THE SAME LIMITS.
15. SOIL CAN BE COMPACTED BY STACKING A PIECE OF 2 X 6 SAWN LUMBER EDGEWAYS UP TO THE LIFT HEIGHT SPECIFIED IN THE STRUCTURE TABLE AND SECURING WITH WOODEN STAKES TO PROVIDE A RIGID BACKSTOP FOR COMPACTING SOIL LIFT.
16. PLACE SOIL BACKFILL UP TO THE LIFT HEIGHT SPECIFIED OF NO GREATER THAN 1.0 FT BEING CAREFUL NOT TO PUSH/PULL OR TEAR THE FABRIC PREVIOUSLY PLACED.
17. THE TOP OF THE SOIL BACKFILL SHALL BE FLAT WITHIN THE LIFT SETBACK DISTANCE SPECIFIED IN THE STRUCTURE TABLE. BEYOND THE LIFT SETBACK DISTANCE, THE SOIL BACKFILL SHALL BE SLOPED AT AN APPROXIMATE 5% SLOPE AWAY FROM THE STREAM.
18. TOP DRESS THE SOIL LIFT WITH TOPSOIL FROM THE FACE OF THE SOIL LIFT BACK INTO THE FLOODPLAIN AT LEAST 4FT.
19. REMOVE THE SAWN LUMBER AND WOODEN STAKES FROM THE FACE OF THE SOIL LIFT AND WRAP THE FACE AND TOP OF THE SOIL LIFT USING THE WOVEN AND NON-WOVEN COIR MATTING HANGING OVER THE PREVIOUS LIFT/COIR FIBER LOGS.
20. THE EROSION CONTROL FABRIC SHALL BE PULLED AS TIGHT AS POSSIBLE WITHOUT TEARING OR EXCESSIVELY DISTORTING THE FABRIC.
21. SECURE THE EROSION CONTROL AND NON-WOVEN MATTING IN PLACE BY STAKING THE END OF THE EROSION CONTROL FABRIC WITH WOODEN STAKES ON 1.5-FOOT CENTERS.
22. BEGIN CONSTRUCTION OF THE NEXT SOIL LIFT BY REPEATING THE PREVIOUS NOTES STARTING WITH NOTE 11.
23. THE OVERALL SLOPE CREATED BY THE LIVE BRUSH LAYERING SHALL MATCH THE PROPOSED CROSS SECTION SHAPE FOR THE OUTER BANK OF THE THE TYPICAL POOL CROSS-SECTION FOR EACH REACH.
24. THE COIR BLANKETS AND GEOTEXTILE FABRIC USED FOR THE UPPER MOST SOIL LIFT WILL BE SECURED WITHIN A 6 INCH DEEP TRENCH AS SHOWN IN DETAIL.
25. THE SURFACE OF THIS STRUCTURE SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR ELEVATIONS SHALL BE WITHIN 0.1 FT OF THE GRADES AND ELEVATIONS INDICATED OR APPROVED BY THE STAMPING ENGINEER.
26. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
27. SOD MAT MAY BE USED INSTEAD OF THE COIR LIFTS ABOVE THE WOOD TOE IF IT IS AVAILABLE AND APPROVED BY THE STAMPING ENGINEER.
28. THE CONTRACTOR MAY SUGGEST AN ALTERNATIVE TO UPPER BANK STABILIZATION AS A HAND OR COMPUTER DRAFTED DETAIL TO BE APPROVED AT THE DISCRETION OF DESIGN STAMPING ENGINEER. THIS WILL BE CONSIDERED A NO COST CHANGE ORDER.
29. THE LOWER BANK STABILIZATION IS CRITICAL TO THE DESIGN INTENT OF THIS PROJECT. VARIANCE FROM WOOD TOE BANK STABILIZATION WILL ONLY BE CONSIDERED IF THE WOOD IS NOT AVAILABLE ONSITE.
30. ON-SITE AVAILABILITY OF WOODY DEBRIS WILL BE SOLELY THE DECISION OF THE ENGINEER.

9/8 DETAIL: COIR LIFT WOOD TOE PROTECTION
NTS

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

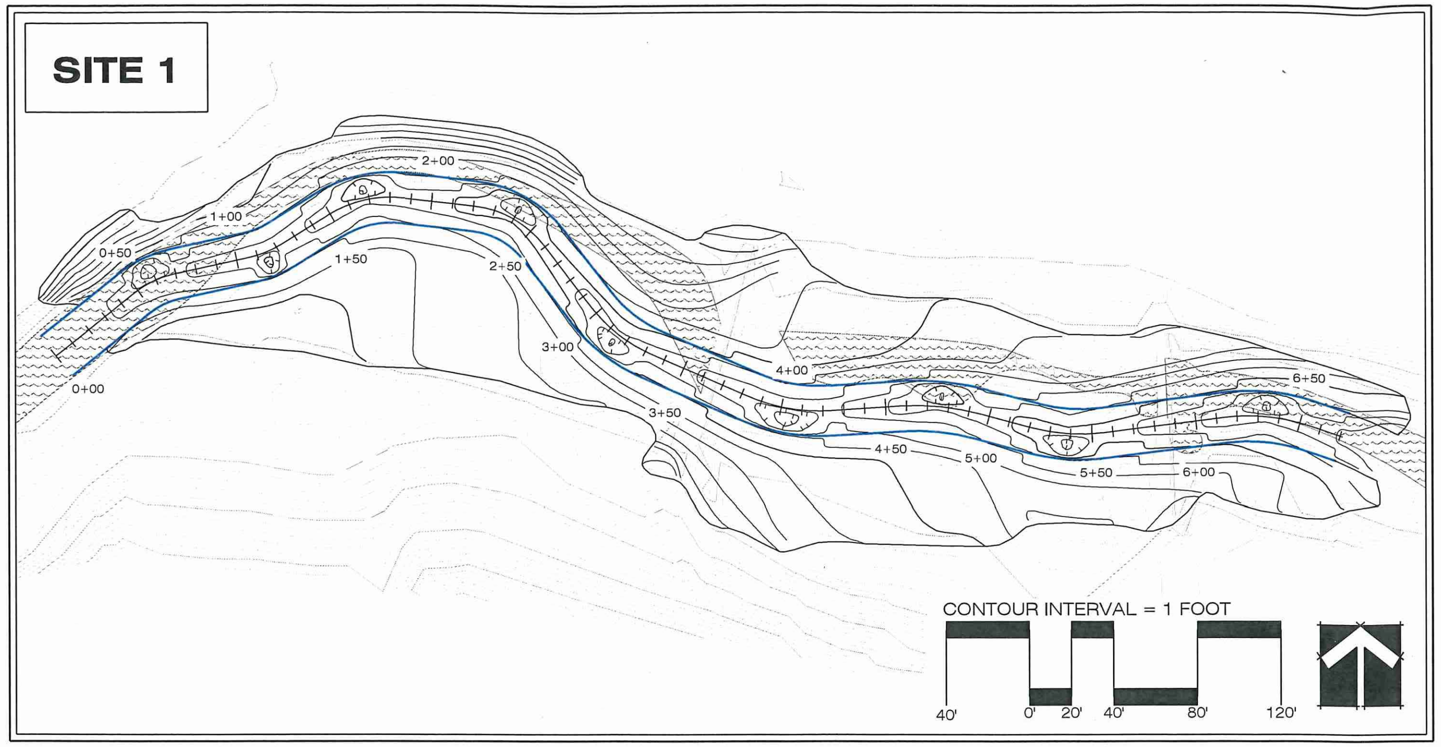
PRELIMINARY
NOT FOR
CONSTRUCTION

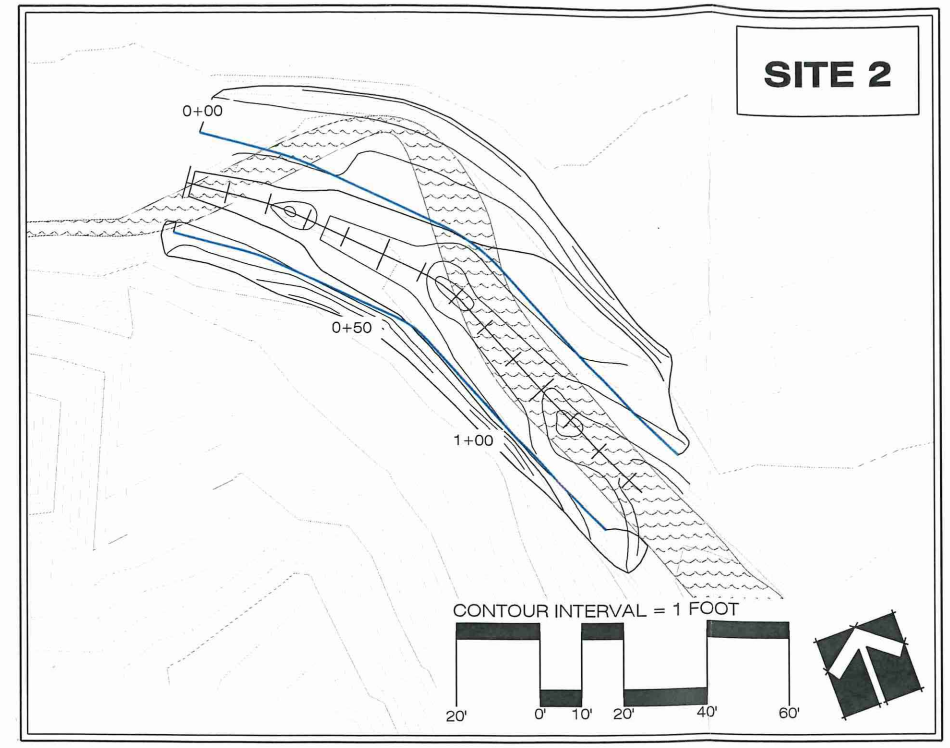
Client/Project
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title
NOTES AND DETAILS

Project No.	Scale	
175654021	NTS	
Drawing No.	Sheet	Revision
	8 of 9	0





PLANTING SCHEDULE

LEGEND	QUANTITY	BOTANICAL NAME	COMMON NAME	SPECIFICATION	MINIMUM HEIGHT	INDICATOR	REMARKS
		RIPARIAN STABILIZATION SEED MIX (1.16 ACRES)					
	0.09%	ACHILLEA MILLEFOLIUM	YARROW	SEED	-	FACU	SEED MIX SHALL BE APPLIED ON ALL DISTURBED AREAS AT A RATE OF 67 LBS./AC. SELECT COVER CROP ACCORDING TO DATES SHOWN BELOW. CONTRACTOR RESPONSIBLE FOR DETERMINING EXACT AMOUNT OF DISTURBED AREA.
	5.97%	ELYMUS TRACHYCAULUS	SLENDER WHEATGRASS	SEED	-	FACU	
	0.05%	ANAPHALIS MARGARITACEA	PEARLY EVERLASING	SEED	-	FACU	
	5.97%	BROMUS CILIATUS	FRINGED BROME	SEED	-	FACW	
	0.39%	CALAMAGROSTIS CANADENSIS	BLUE JOINT GRASS	SEED	-	OBL	
	1.49%	DANTHONIA SPICATA	POVERTY OATS	SEED	-	-	
	0.12%	DOELLINGERIA UMBELLATA	FLAT-TOPPED ASTER	SEED	-	FACW	
	3.73%	ELYMUS CANADENSIS	CANADA WILD RYE	SEED	-	FACU	
	0.06%	EURYBIA MACROPHYLLA	LARGE-LEAVED ASTER	SEED	-	UPL	
	0.42%	OLIGONEURON RIGIDUM	STIFF GOLDENROD	SEED	-	-	
	2.60%	POA PALUSTRIS	FOWL BLUEGRASS	SEED	-	FACW	
	0.18%	POTENTILLA ARGUTA	PRAIRIE CINQUEFOIL	SEED	-	-	
	0.47%	ROSA BLANDA	EARLY WILD ROSE	SEED	-	FACU	
	0.78%	RUDBECKIA HIRTA	BLACK-EYED SUSAN	SEED	-	FACU	
	0.75%	SCHIZACHNE PURPURASCENS	FALSE MELIC	SEED	-	FACU	
	0.18%	SOLIDAGO NEMORALIS	GRAY GOLDENROD	SEED	-	-	
	0.12%	SOLIDAGO PTARMICOIDES	UPLAND WHITE ASTER	SEED	-	-	
	0.09%	SYMPHYOTRICHUM CILIOLATUM	LINDLEY'S ASTER	SEED	-	-	
	0.42%	SYMPHYOTRICHUM LAEVE	SMOOTH BLUE ASTER	SEED	-	FACU	
	1.49%	VICIA AMERICANA	AMERICAN VETCH	SEED	-	FACU	
	74.63%	COVER CROP (SEE TABLE BELOW)		SEED	-	-	
		RIPARIAN BUFFER PLANT PALETTE (1.16 ACRES)					
	19	ABIES BALSAMEA	BALSAM FIR	#1 CONTAINER	24 INCHES	FAC	PLANT DENSITY BASED ON 400 STEMS/ACRE PLUS MORTALITY. SPACE PLANTS AT +/- 8 FEET ON CENTER. PLANT ACCORDING TO INDICATOR STATUS. DISTRIBUTE RANDOMLY AMONG SPECIES.
	48	ABIES BALSAMEA	BALSAM FIR	BAREROOT/TUBELING	12 INCHES	FAC	
	1	ACER SACCHARINUM	SILVER MAPLE	1 INCH CALIPER	8 FEET	FACW	
	19	ACER SACCHARINUM	SILVER MAPLE	#1 CONTAINER	24 INCHES	FACW	
	48	ACER SACCHARINUM	SILVER MAPLE	BAREROOT/TUBELING	12 INCHES	FACW	
	1	BETULA PAPYRIFERA	PAPER BIRCH	1 INCH CALIPER	8 FEET	FACU	
	19	BETULA PAPYRIFERA	PAPER BIRCH	#1 CONTAINER	24 INCHES	FACU	
	48	BETULA PAPYRIFERA	PAPER BIRCH	BAREROOT/TUBELING	12 INCHES	FACU	
	19	CORNUS ALTERNIFOLIA	ALTERNATE-LEAF DOGWOOD	#1 CONTAINER	24 INCHES	FACU	
	45	CORNUS ALTERNIFOLIA	ALTERNATE-LEAF DOGWOOD	BAREROOT/TUBELING	12 INCHES	FACU	
	19	CORYLUS AMERICANA	AMERICAN HAZELNUT	#1 CONTAINER	24 INCHES	FACU	
	45	CORYLUS AMERICANA	AMERICAN HAZELNUT	BAREROOT/TUBELING	12 INCHES	FACU	
	19	ILEX VERTICILLATA	COMMON WINTERBERRY	#1 CONTAINER	24 INCHES	FACW	
	45	ILEX VERTICILLATA	COMMON WINTERBERRY	BAREROOT/TUBELING	12 INCHES	FACW	
	19	PINUS STROBUS	EASTERN WHITE PINE	#1 CONTAINER	24 INCHES	FACU	
	48	PINUS STROBUS	EASTERN WHITE PINE	BAREROOT/TUBELING	12 INCHES	FACU	
	19	POPULUS TREMULOIDES	QUAKING ASPEN	#1 CONTAINER	24 INCHES	FACU	
	48	POPULUS TREMULOIDES	QUAKING ASPEN	BAREROOT/TUBELING	12 INCHES	FACU	
	19	PRUNUS VIRGINIANA	CHOKE CHERRY	#1 CONTAINER	24 INCHES	FACU	
	45	PRUNUS VIRGINIANA	CHOKE CHERRY	BAREROOT/TUBELING	12 INCHES	FACU	
	1	QUERCUS RUBRA	NORTHERN RED OAK	1 INCH CALIPER	8 FEET	FACU	
	19	QUERCUS RUBRA	NORTHERN RED OAK	#1 CONTAINER	24 INCHES	FACU	
	48	QUERCUS RUBRA	NORTHERN RED OAK	BAREROOT/TUBELING	12 INCHES	FACU	
	19	TILIA AMERICANA	AMERICAN BASSWOOD	#1 CONTAINER	24 INCHES	FACU	
	48	TILIA AMERICANA	AMERICAN BASSWOOD	BAREROOT/TUBELING	12 INCHES	FACU	
	19	VIBURNUM LENTAGO	NANNY-BERRY	#1 CONTAINER	24 INCHES	FAC	
	45	VIBURNUM LENTAGO	NANNY-BERRY	BAREROOT/TUBELING	12 INCHES	FAC	
		LIVE STAKES (805 L.F.)					
	537	CORNUS SERICEA	REDOSIER DOGWOOD	LIVE STAKE	2 FEET	FACW	LIVE STAKE QUANTITIES BASED ON DOUBLE ROW ON EACH SIDE OF THE LENGTH OF THE STREAM SPACED 3' APART.
	537	SALIX DISCOLOR	PUSSY WILLOW	LIVE STAKE	2 FEET	-	
		COVER CROP					
							PLANTING DATE
	100%	AVENA SATIVA	OATS	SEED	-		OCT. 16 - AUG.1
	100%	TRITICUM AESTIVUM	WINTER WHEAT	SEED	-		AUG. 2 - OCT. 15

PLANTING AND SEEDING NOTES

SEEDBED PREPARATION

1. IMMEDIATELY FOLLOWING THE FINAL COMPLETION AND ACCEPTANCE OF FINE GRADING ACTIVITIES, SEEDBED PREPARATION SHALL COMMENCE.
2. FERTILIZER SHALL BE GRANULAR, NON-BURNING PRODUCT GUARANTEED ANALYSIS PROFESSIONAL FERTILIZER WITH AN ANALYSIS OF 10-10-10.
3. FERTILIZER SHALL BE DELIVERED TO THE SITE IN ORIGINAL UNOPENED CONTAINERS SHOWING WEIGHT, ANALYSIS, AND NAME OF MANUFACTURER. STORE IN A MANNER TO PREVENT WETTING AND/OR DETERIORATION.
4. FERTILIZER SHALL BE APPLIED AT A RATE OF 150 LBS / ACRES TO THE FINAL SEEDBED.

SEEDING

1. SEEDING OPERATIONS SHALL IMMEDIATELY FOLLOW SEEDBED PREPARATION.
2. THE STABILIZATION SEED MIX SHALL BE APPLIED TO ALL DISTURBED AREAS PER THE RATES AND SEED MIX SPECIFICATIONS SHOWN ON THE PLANTING PLAN.
3. CONTRACTOR SHALL NOT PERFORM SEEDING APPLICATION WHEN THE SOIL IS FROZEN.
4. SEEDED AREAS SHALL BE INSPECTED BY THE DESIGNER AT THE COMPLETION OF THE SEEDING OPERATIONS AND ACCEPTED SUBJECT TO COMPLIANCE WITH SPECIFIED MATERIALS AND INSTALLATION REQUIREMENTS.

SHRUB AND TREE INSTALLATION

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LAYOUT OF ALL WORK COVERED UNDER THESE PLANS.

2. ALL PLANT MATERIAL, UNLESS OTHERWISE SPECIFIED, SHALL BE UNIFORMLY BRANCHED AND HAVE A VIGOROUS ROOT SYSTEM. PLANT MATERIAL SHALL BE HEALTHY, VIGOROUS, AND FREE FROM DEFECTS, DECAY, DISEASES, INSECT PEST EGGS, AND ALL FORMS OF INFESTATION. ALL PLANT MATERIAL SHALL BE FRESH, FREE FROM TRANSPLANT SHOCK OR VISIBLE WILT. PLANTS DEEMED UNHEALTHY SHALL BE REJECTED.

3. ALL PLANT MATERIAL SHALL MEET THE MINIMUM SPECIFICATIONS AND STANDARDS DESCRIBED IN THE CURRENT ISSUE OF 'THE AMERICAN STANDARD FOR NURSERY STOCK', PUBLISHED BY THE AMERICAN ASSOCIATION OF NURSERYMEN, 1250 I STREET, N.W., SUITE 500, WASHINGTON, D.C. 20005.

4. ALL CONTAINER STOCK SHALL HAVE BEEN PROPAGATED IN A CONTAINER LONG ENOUGH FOR THE ROOT SYSTEM TO HAVE DEVELOPED SUFFICIENTLY TO HOLD ITS SOIL. CONTAINER STOCK WITH POORLY DEVELOPED ROOT SYSTEMS SHALL NOT BE ACCEPTED.

5. PLANTS SHALL BE PREPARED FOR SHIPMENT IN A MANNER THAT SHALL NOT CAUSE DAMAGE TO THE BARK, BUDS, BRANCHES, STEMS, OR OVERALL SHAPE OF THE STOCK. CONTAINER GROWN PLANTS SHALL BE TRANSPORTED IN THE CONTAINERS IN WHICH THEY HAVE BEEN GROWN.

6. PLANTS NOT INSTALLED ON THE DAY OF ARRIVAL AT THE SITE SHALL BE STORED AND PROTECTED BY THE CONTRACTOR. OUTSIDE STORAGE AREAS SHALL BE SHADED AND PROTECTED FROM THE WIND AND SUN. PLANTS STORED ON SITE SHALL BE PROTECTED FROM ANY DRYING AT ALL TIMES BY COVERING THE BALLS OR ROOTS WITH MOIST SAWDUST, WET BURLAP, WOOD CHIPS, SHREDDED BARK, PEAT MOSS, OR OTHER SIMILAR MULCHING MATERIAL.

7. NO SUBSTITUTIONS IN SIZE OR VARIETY OF PLANT MATERIAL SHALL OCCUR WITHOUT THE PRIOR APPROVAL OF THE ENGINEER OR LANDSCAPE ARCHITECT.

8. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD AND NOTIFY THE ENGINEER OR LANDSCAPE ARCHITECT OF ANY VARIANCE FROM PLAN.

9. NO PLANTING SHALL OCCUR WHEN THE SOIL IS FROZEN.

10. PLANTS SHALL ONLY BE INSTALLED DURING THEIR DORMANCY PERIOD.

11. WHERE SPECIFIED MULCH SHALL BE APPLIED TO A DEPTH OF 2 TO 3 INCHES. SHREDDED HARDWOOD MULCH SHALL BE USED UNLESS SPECIFIED OTHERWISE BY OWNER. MULCH SHALL BE PULLED AWAY FROM THE BASE OF TREES AND SHRUBS.

PLANTING SEQUENCE

1. HOLES FOR INDIVIDUAL PLANTINGS SHALL BE EXCAVATED TO PRODUCE VERTICAL SIDES AND FLAT BOTTOMS. ALL PLANTING HOLES SHALL HAVE ROUGHED, SCARIFIED SIDES AND BOTTOMS.

2. THE CONTRACTOR SHALL APPLY AGRIFORM FOREST STARTER TABLETS OR EQUIVALENT PRODUCT TO EACH PLANT AS PER MANUFACTURER'S DIRECTIONS ON LABEL AT TIME OF PLANTING. TABLETS ARE NOT REQUIRED FOR PLANTS WITHIN BIOFILTER BASIN.

3. CONTAINERIZED PLANTS SHALL BE SET IN THE PLANTING PIT AT THE PROPER DEPTH ON TAMPED SOIL. SOIL REMOVED FROM THE PLANTING PIT SHALL THEN BE FILLED AROUND THE ROOTS AND TAMPED.

4. THE CONTRACTOR SHALL RESTORE DISTURBED AREAS TO INDICATED FINAL GRADES IF DISTURBED BY THE INSTALLATION OF SHRUBS AND TREES.

LIVE STAKE INSTALLATION

1. LIVE STAKES SHALL BE INSTALLED DURING THEIR DORMANCY PERIOD.

2. LIVE STAKES NOT INSTALLED ON THE DAY OF ARRIVAL AT THE SITE SHALL BE STORED OUT OF DIRECT SUNLIGHT IN A COOL, WET PLACE UNDER STRAW OR BURLAP.

3. LIVE STAKES SHALL BE SOAKED IN WATER BEFORE PLANTING TO INCREASE SURVIVAL AND GROWTH RATE AND SHALL NOT BE ALLOWED TO DRY OUT DURING CONSTRUCTION.

4. IF SOILS ARE FIRM OR ROCKY, CONTRACTOR SHALL DRIVE A PILOT HOLE PRIOR TO INSTALLATION.

4. LIVE STAKES SHALL BE PLANTED AT NEAR RIGHT ANGLES TO THE GROUND SURFACE, ANGLED SLIGHTLY DOWNSTREAM, WITH APPROXIMATELY $\frac{4}{5}$ OF LENGTH UNDERGROUND AND BUDS ORIENTED UP.

PROJECT MAINTENANCE AND WARRANTY

1. CONTRACTOR SHALL MAINTAIN INSTALLED SHRUBS AND TREES WITHIN THE PROJECT LIMITS UNTIL FINAL ACCEPTANCE OF THE PROJECT BY THE ENGINEER.

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY HERBIVORY PROTECTION NEEDED TO ATTAIN SPECIFIED SURVIVAL RATES.

3. THE CONTRACTOR SHALL GUARANTEE 100% SURVIVAL FOR ALL PLANTED WOODY PLANTS, AND 80% COVERAGE OF ALL SEEDED AREAS AFTER THE FIRST COMPLETE GROWING SEASON. REPLACEMENT RATES TO BE DETERMINED BY AVERAGING MORTALITY RATES FOUND IN RANDOM SAMPLE PLOTS. THE OWNER RESERVES THE RIGHT TO DETERMINE DIFFERENT MORTALITY RATES THROUGHOUT THE SITE.

Stantec

Stantec Consulting Services Inc.
5209 Center Street
Williamsburg VA
Tel. 757.220.6869
www.stantec.com

Consultants

Legend

- EXISTING TOPOGRAPHY
- PROPOSED TOPOGRAPHY
- EXISTING STREAM CHANNEL LIMITS
- PROPOSED BANKFULL LIMITS
- PROPOSED STREAM CENTERLINE

Notes

THESE PLANS ARE CONCEPTUAL IN NATURE AND ARE INTENDED TO SHOW THE PROPOSED APPROACH FOR RESTORING THESE SECTIONS OF CHESTER CREEK. THE GRADING IS APPROXIMATE AND IS INCLUDED ONLY TO PROVIDE APPROXIMATE LIMITS OF IMPACT. ACTUAL PROFILE ELEVATIONS WILL BE DETERMINED DURING SUBSEQUENT DESIGN EFFORTS

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name:	CJM	MFA	MG	14.06.26
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR
CONSTRUCTION

Client/Project
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 LAFAYETTE ROAD
ST. PAUL, MN 55155-4040

Title
PLANTING PLAN

Project No. 175654021
Scale 1"=40' (PLAN VIEW)
Drawing No.
Sheet 9 of 9
Revision 0

Attachment C: Opinion of Probable Cost

Chester Creek Opinion of Probable Cost

1	Mobilization/Demobilization	LS	1.0	$ 18,000.00	$ 18,000.00
2	Clearing and Grubbing	AC	1.8	$ 500.00	$ 900.00
3	Floodplain Excavation/Grading	CY	1,600.0	$ 15.00	$ 24,000.00
4	Channel Excavation	CY	1,390.0	$ 25.00	$ 34,750.00
5	Boulder Cross Vane (Equipment, Labor, and Incidentals)	EA	1.0	$ 6,000.00	$ 6,000.00
6	Constructed Boulder Riffles (Equipment, Labor, and Incidentals)	EA	9.0	$ 10,000.00	$ 90,000.00
7	WTLBL (Materials, Equipment, Labor, and Incidentals)	LF	100.0	$ 55.00	$ 5,500.00
8	Construction Entrance	EA	2.0	$ 10,000.00	$ 20,000.00
9	Boulders (3.0' x 2.0' x 4.0') (Rock Only)	Tons	910.0	$ 50.00	$ 45,500.00
10	8-14" Stone (Rock Only)	Tons	620.0	$ 50.00	$ 31,000.00
11	3-8" Stone (Rock Only)	Tons	640.0	$ 50.00	$ 32,000.00
12	1.5-3" Stone (Rock Only)	Tons	200.0	$ 50.00	$ 10,000.00
13	Non-woven Geotextile Fabric (Structures)	SY	539.0	$ 2.00	$ 1,078.00
14	Woven Coir Fiber 700 g Erosion Control Blanket and 12" Wooden Stakes	SY	4,140.0	$ 6.00	$ 24,840.00
15	Permanent Seeding	Lbs	80.0	$ 50.00	$ 4,000.00
16	Temporary Seeding	Lbs	180.0	$ 5.00	$ 900.00
17	Construction Staking	LS	1.0	$ 2,000.00	$ 2,000.00
18	Pump Around	LS	1.0	$ 5,000.00	$ 5,000.00
19	Straw Mulching	Bales	130.0	$ 10.00	$ 1,300.00
20	Erosion Control	LS	1.0	$ 5,000.00	$ 5,000.00
21	Live Stakes	EA	2,000.0	$ 4.00	$ 8,000.00
22	Bare Root Seedlings	EA	800.0	$ 10.00	$ 8,000.00
				Construction	**$ 377,768.00**
				Construction Contingency (20%)	$ 75,553.60
				Construction Sub Total	$ 453,321.60
				CONSTRUCTION BUDGET	**$ 454,000.00**
				CONSTRUCTION OBSERVATION	**$ 40,000.00**
				PROJECT BUDGET	**$ 494,000.00**