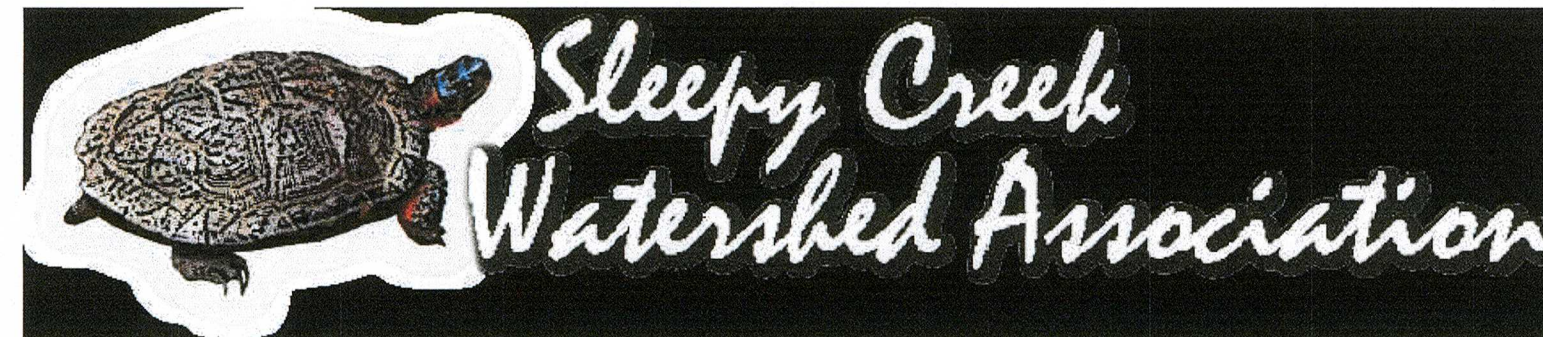


Sleepy Creek Streambank Stabilization Project

Morgan County, West Virginia

April 13, 2018

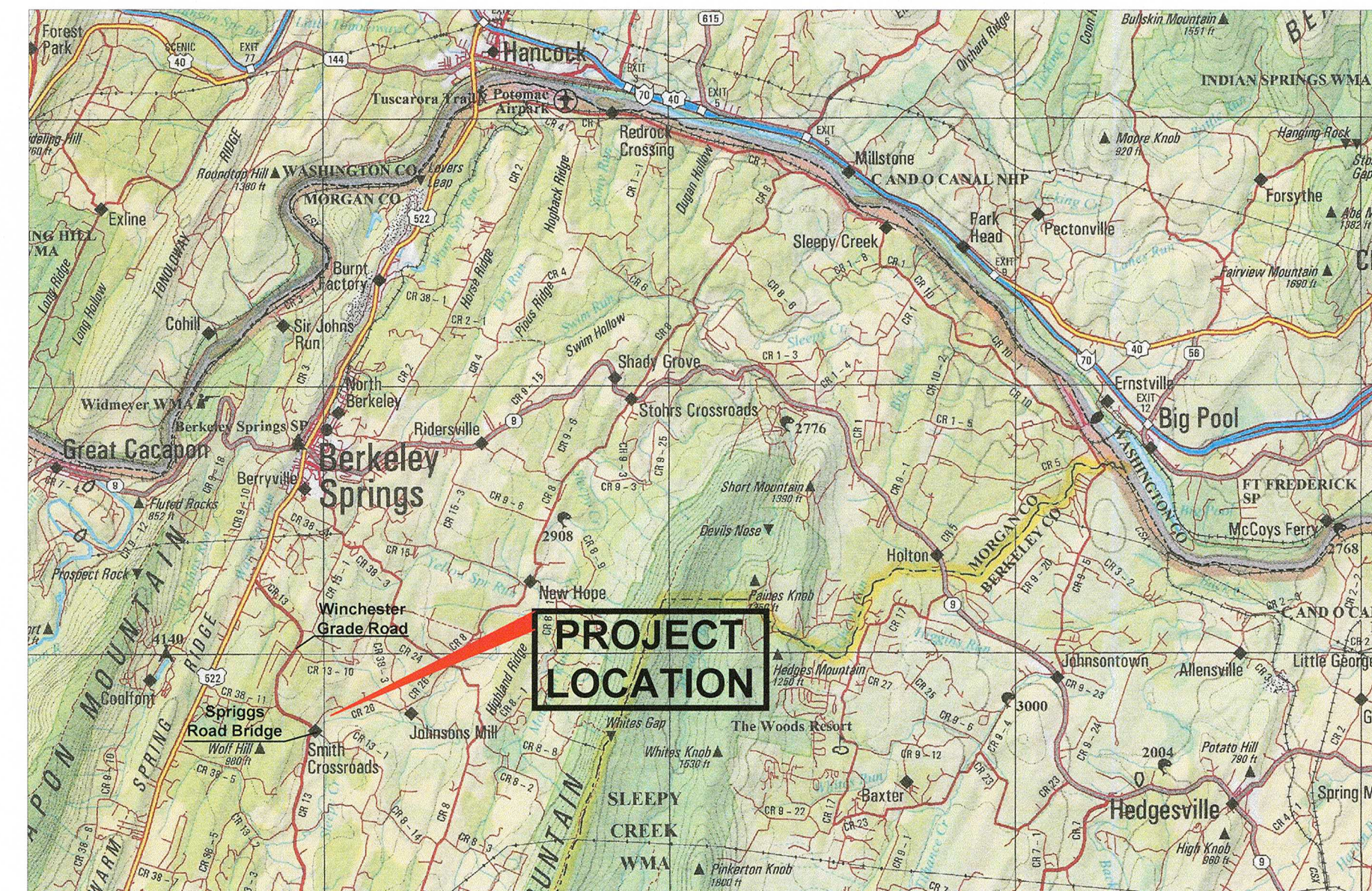
Prepared for:



Prepared by:



NOTE:
EROSION AND SEDIMENT CONTROL WILL BE STRICTLY ENFORCED WITH APPROVED
PLAN SET SHALL BE KEPT AT PROJECT SITE DURING ALL CONSTRUCTION ACTIVITIES



SCALE: 1 inch = 2 miles

SHEET INDEX:

- SHEET NO. 1: SHEET INDEX & VICINITY MAP
SHEET NO. 2: EXISTING CONDITIONS PLAN
SHEET NO. 3: STREAM RESTORATION PLAN
SHEET NO. 4; STREAM GEOMORPHIC ANALYSIS RESULTS
SHEET NO. 5; CONSTRUCTION DETAILS
SHEET NO. 6: PROJECT SPECIFICATIONS
SHEET NO. 7: PLANT SCHEDULE & INSTALLATION DETAILS
SHEET NO. 8: SEDIMENT & EROSION CONTROL DETAILS

Construction Sequence

- 1) Authorized person shall submit erosion and sediment control plans to the Eastern Panhandle Conservation District (EPCD) for review and approval (304) 263-4376 email address EPCD@wvca.us prior to construction. If required, redline erosion and sediment control plan on Sheet 8 of this plan set per EPCD requirements. Authorized person shall submit the approved erosion and sediment control plans to Morgan County.
- 2) Authorized person shall contact the Morgan County Planning Commission (Alma Gorse, County Planner, at (304) 258-8540, ext.1303) and obtain required building/grading permit, if required, prior to construction.
- 3) Notify property owners on both sides of the creek at least ten (10) days prior to construction. See Sheet 3 of 8 regarding permission to install the W-Weir.
- 4) Install erosion and sediment control practices.
- 5) Install stream access points in locations approved by the engineer.
- 6) Install stream diversions at each work area prior to its construction.
- 7) Install boulder revetments and riprap toe revetments in locations approved by the engineer.
- 7) Install soil lifts behind the revetments and install plantings and vegetatively stabilize soil lifts.
- 8) Install the W-Weir in a specific location approved by the engineer.
- 9) Install the four (4) J-Hook vanes and securely tie the arms of the J-Hook vanes into the revetments.
- 10) Obtain permission from the EPCD to remove the erosion and sediment control practices.
- 11) Remove the erosion and sediment control practices and clean up/vegetatively stabilize all disturbed areas by applying 40 pounds of Annual Rye Grass (*Lolium multiflorum*) per acre followed with straw mulch.



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

"The Soil Conservation District makes no representation as to the existence or Non-existence of any utilities at the construction site. Shown on these construction drawings are those utilities which have been identified. It is the responsibility of the landowners or operators and contractors to assure themselves that no hazard exists or damage will occur to utilities"



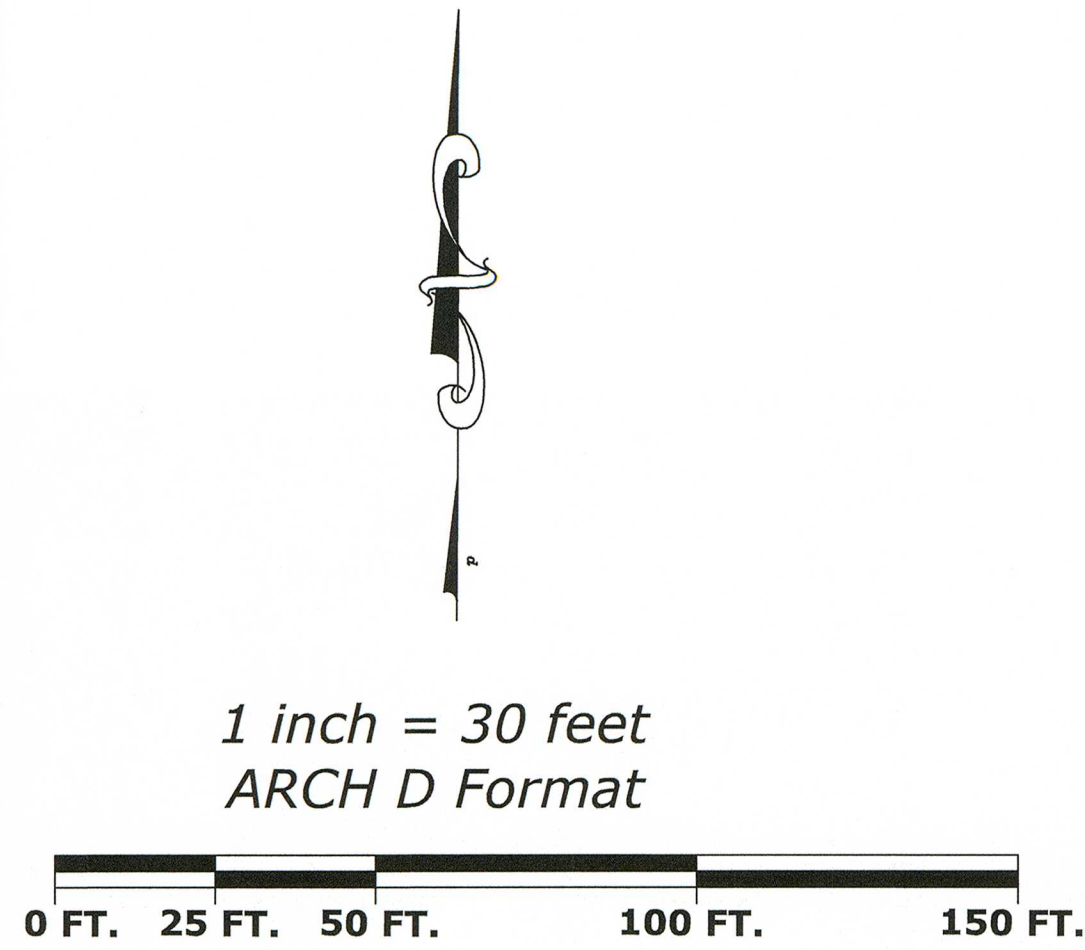
This stream restoration plan is in general conformance with Natural Channel Design principals that were applied to the extent practical for this site.

RED-LINE CERTIFICATION

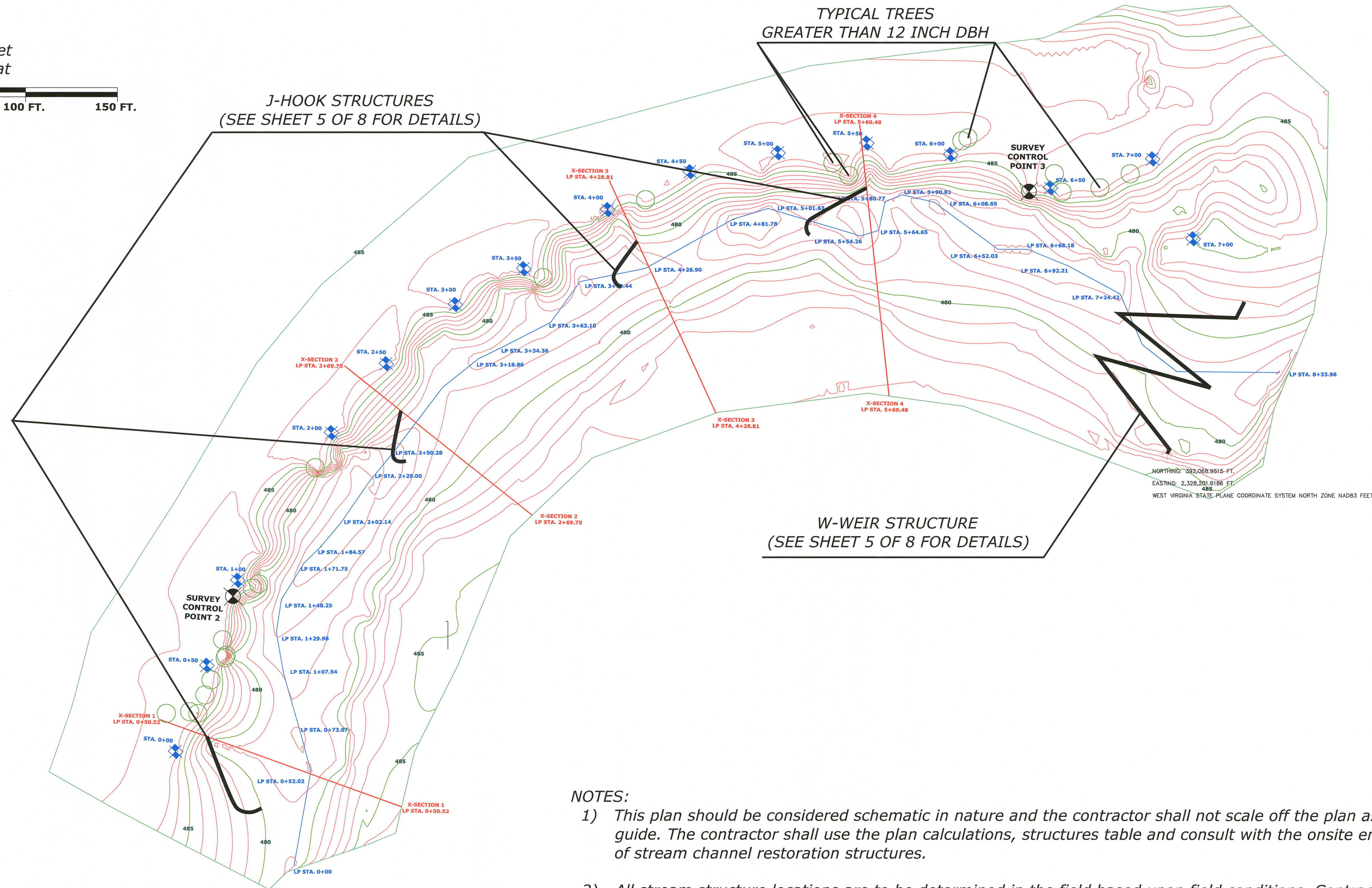
PROJECT MEETS NRCS STANDARDS
AND SPECIFICATIONS

SIGNATURE _____

DATE _____



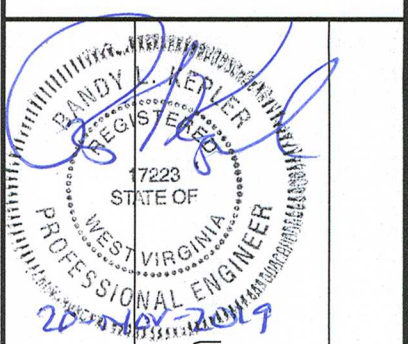
- NOTES:
- 1) W-Weir requires permission from the property owner on the east side of the creek as well as the property owner on the west side of the creek. The Sleepy Creek Watershed Association will coordinate with the property owner on the east side of the creek to obtain permission to securely tie the W-Weir structure into the stream bank. If permission is not granted from the property owner the W-Weir will be deleted from the project.
 - 2) Up to 250 feet of boulder revetment and 150 feet of riprap revetment shall be installed at locations determined by the Engineer and in accordance with the details provided on Sheet 5 of 8.
 - 3) Elevations for all rock structures will be provided by the Engineer prior to their construction.
 - 4) No disturbance shall occur within the critical root zone as defined on Sheet 8 of trees greater than 12 inches Diameter At Breast Height.



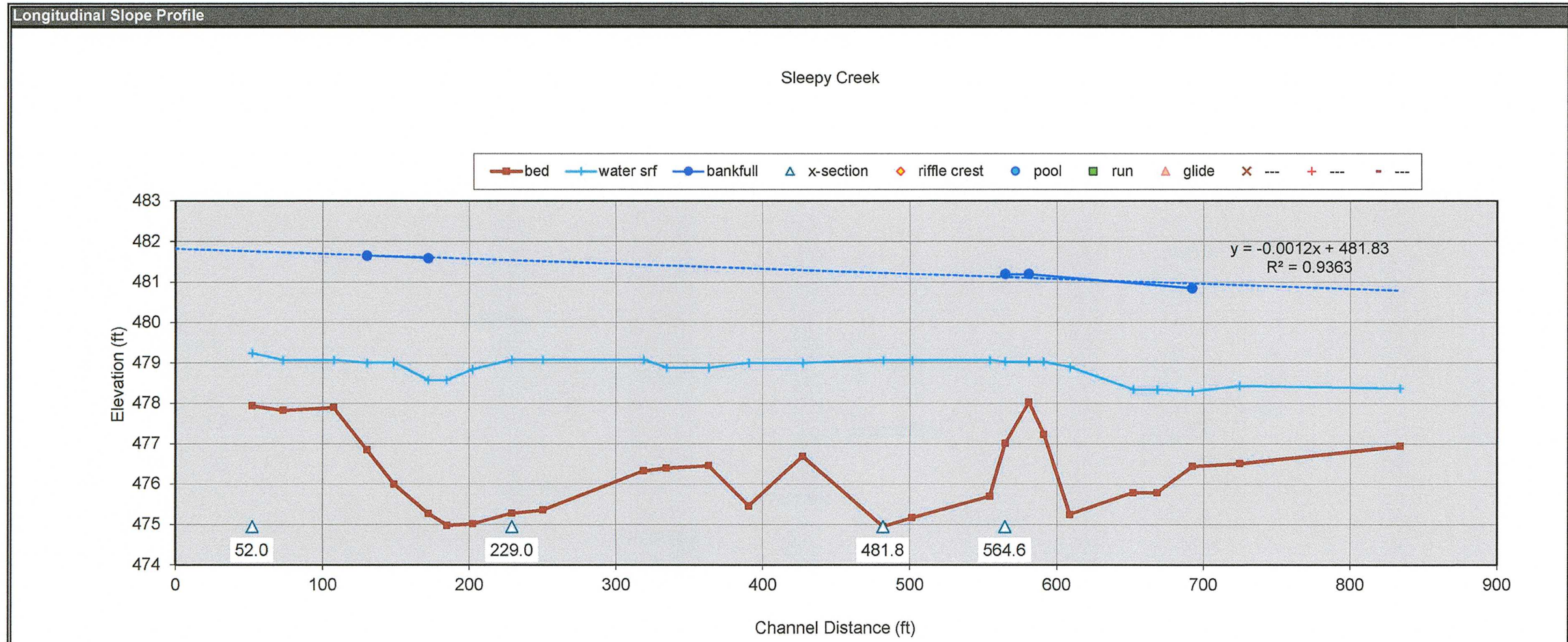
- NOTES:
- 1) This plan should be considered schematic in nature and the contractor shall not scale off the plan as they are a general guide. The contractor shall use the plan calculations, structures table and consult with the onsite engineer for placement of stream channel restoration structures.
 - 2) All stream structure locations are to be determined in the field based upon field conditions. Contractor to field verify existing conditions, proposed structures and computations to ensure that they still relate to field conditions prior to placement of structures. Any discrepancies shall be brought to the attention of the onsite engineer.

DATE:	May 18th, 2017	SCALE:	1 inch = 30 feet
REVISION DATE:	June 27th, 2017	DESIGN BY:	A. McCullough & T. Hogan
REVISION TYPE:	Tree & Structure Labels	DRAWN BY:	A. McCullough
REVISION DATE:	March 6th, 2018	CHECKED BY:	T. Hogan & A. McCullough
REVISION TYPE:	Review Plan Revisions	SS PROJECT NO:	17004
REVISION DATE:	November 18th, 2019	REVISION TYPE:	Review Plan Revisions
REVISION TYPE:	Review Plan Revisions	SHEET	3 OF 8
		NUMBER	

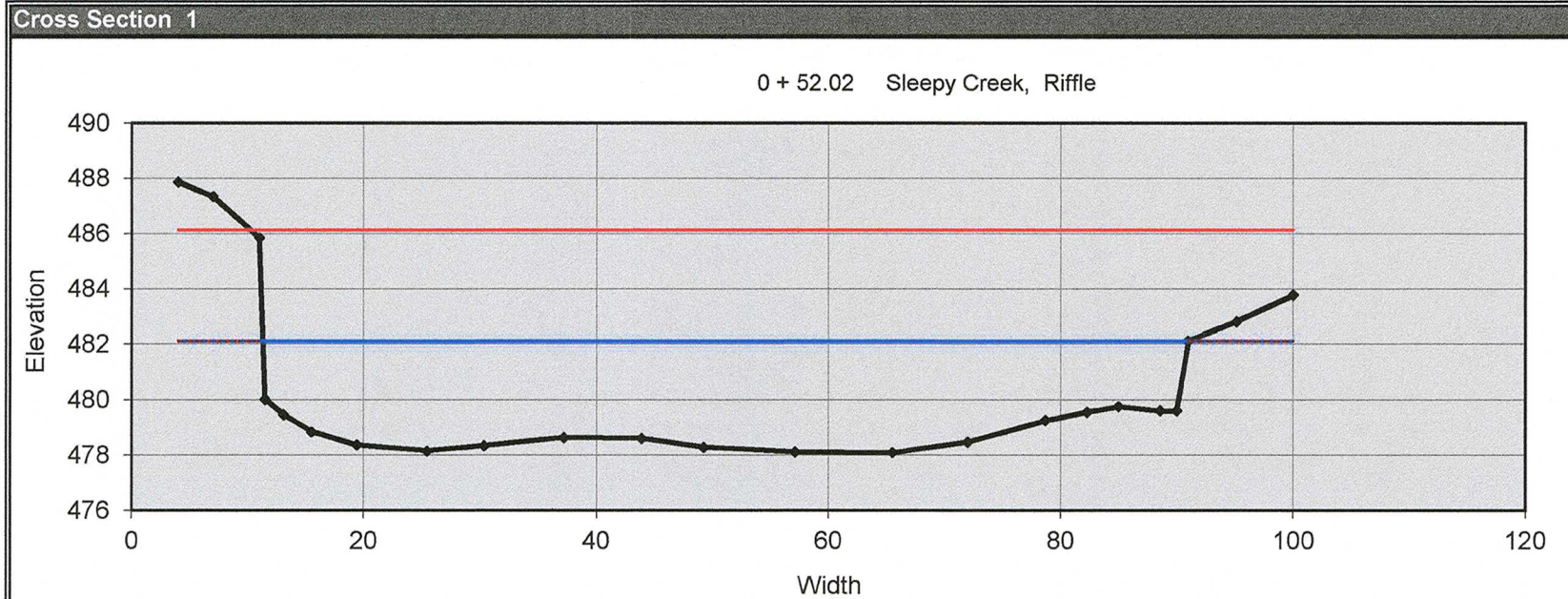
SUSTAINABLE SCIENCE LLC
Ecological Engineering Services
410 S. Second Street
Denton Maryland 21629
Phone: (410) 324-1516
www.sustainable-science.com



STREAM RESTORATION PLAN
Sleepy Creek Streambank Stabilization
Sleepy Creek Watershed Association
Morgan County, West Virginia

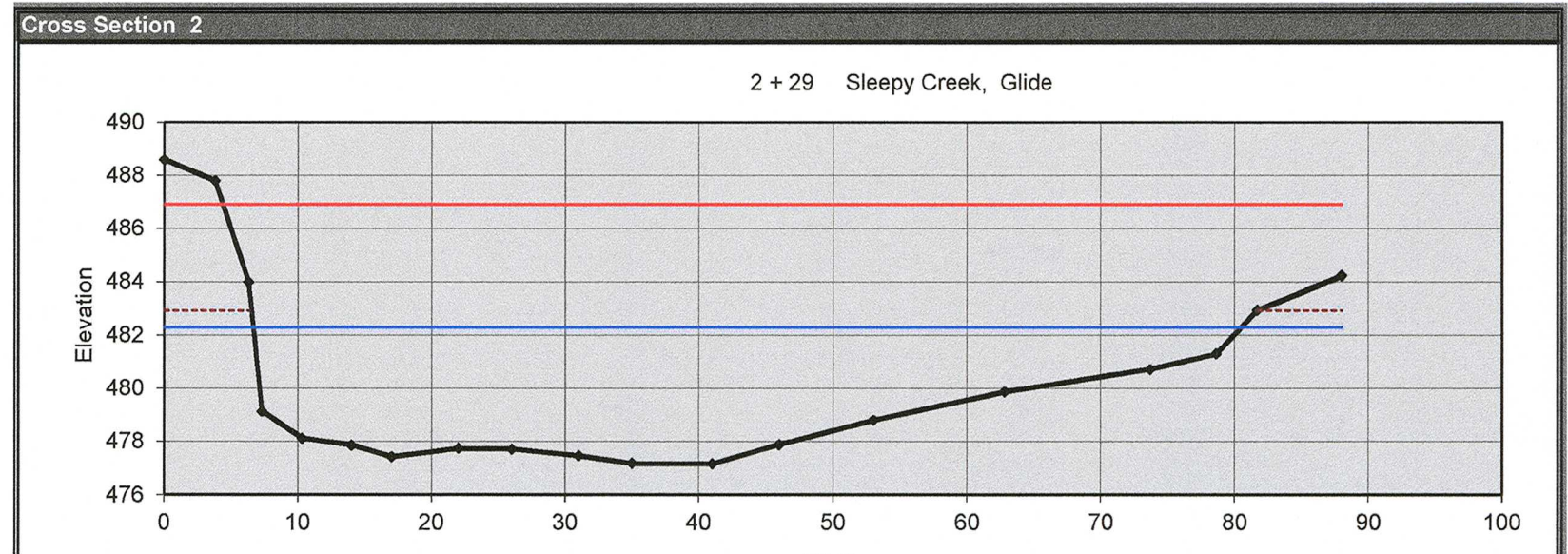


notes	cross section ID	distance	station	Benchmark Elevation		FS	bed	water	FS	bankfull	user defined			azimuth	ELEV				
				BS	HI						FS	FS	FS		bed	water	bankfull	---	---
back sight to benchmark	1	52.02	52.02	487.71	487.71										477.93	479.23			
		21.05	73.0746	487.71	487.71										477.82	479.06			
		34.47	107.5427	487.71	487.71										477.89	479.06			
		22.44	129.9807	487.71	487.71										476.84	478.99	481.65		
		18.27	148.2539	487.71	487.71										475.99	479			
		23.49	171.746	487.71	487.71										475.28	478.57	481.59		
		12.82	184.5674	487.71	487.71										474.97	478.57			
		17.57	202.1352	487.71	487.71										475.01	478.83			
	2	26.87	229.0044	487.71	487.71										475.27	479.07			
		21.27	250.2764	487.71	487.71										475.35	479.07			
		68.58	318.8566	487.71	487.71										476.32	479.07			
		15.51	334.3524	487.71	487.71										476.39	478.87			
		28.73	363.0957	487.71	487.71										476.45	478.87			
		27.35	390.4422	487.71	487.71										475.45	478.99			
		36.46	426.9029	487.71	487.71										476.68	478.99			
	3	54.88	481.7802	487.71	487.71										474.94	479.06			
		19.85	501.6259	487.71	487.71										475.16	479.06			
		52.63	554.2582	487.71	487.71										475.69	479.06			
	4	10.39	564.6494	487.71	487.71										477	479.02	481.19		
		16.12	580.7696	487.71	487.71										478.02	479.02	481.19		
		10.04	590.8076	487.71	487.71										477.22	479.02			
		17.84	608.6487	487.71	487.71										475.24	478.99			
		43.38	652.0313	487.71	487.71										475.78	478.33			
		16.15	668.1829	487.71	487.71										475.78	478.33			
		24.03	692.2089	487.71	487.71										476.43	478.29	480.84		
		32.22	724.4245	487.71	487.71										476.53	478.42			
		109.56	833.9846	487.71	487.71										476.93	478.36			



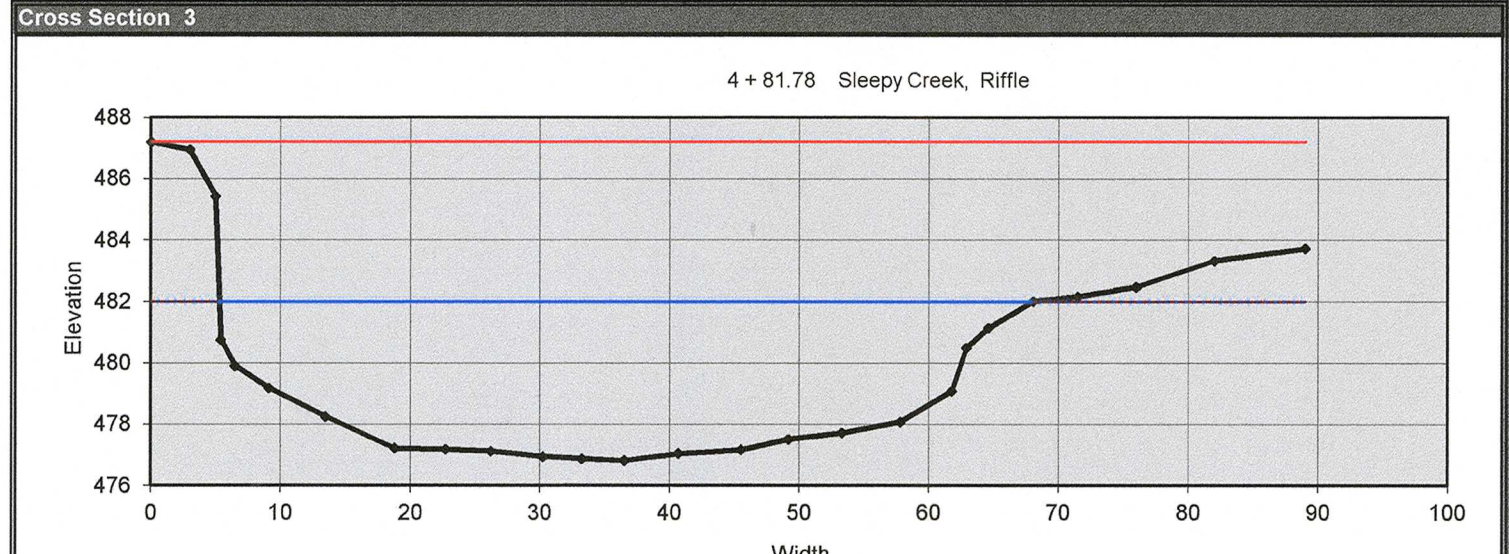
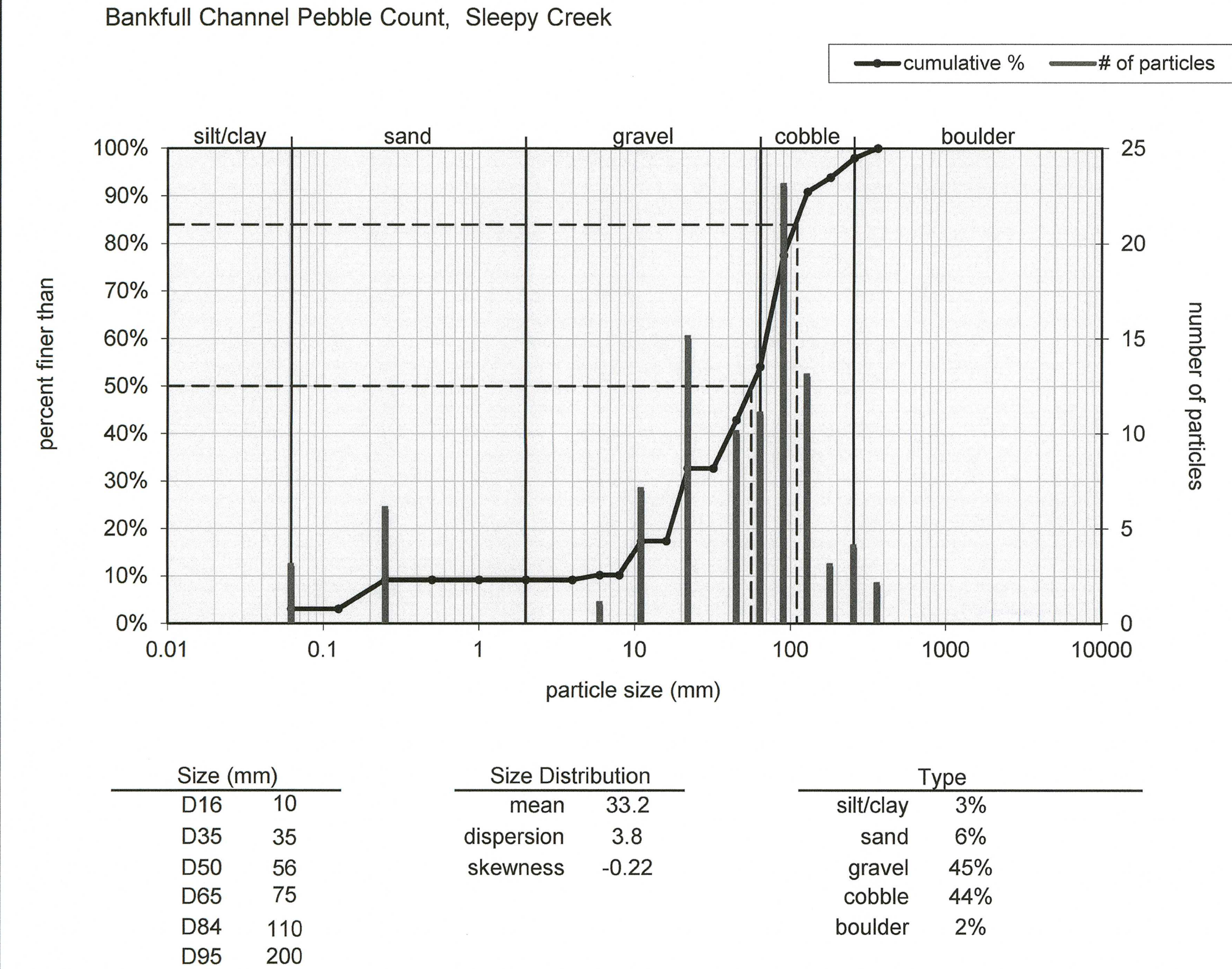
Bankfull Dimensions	Flood Dimensions	Materials
275.3 x-section area (ft.sq.)	W flood prone area (ft)	56 D50 Channel (mm)
79.7 width (ft)	entrenchment ratio	110 D84 Channel (mm)
3.5 mean depth (ft)	low bank height (ft)	12 threshold grain size (mm):
4.0 max depth (ft)	low bank height ratio	
83.6 wetted perimeter (ft)		
3.3 hyd radi (ft)		
23.1 width-depth ratio		
Bankfull Flow	Flow Resistance	Forces & Power
3.8 velocity (ft/s)	0.030 Manning's roughness	0.12 channel slope (%)
1047.9 discharge rate (cfs)	0.07 D'Arcy-Weisbach fric.	0.26 shear stress (lb/sq.ft.)
0.37 Froude number	8.6 resistance factor u/u*	0.36 shear velocity (ft/s)
	9.6 relative roughness	0.98 unit strm power (lb/ft/s)

Cross Section	Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bk	Notes
reference ID 1	4		492.28	4.43	487.85		
instrument height 492.28	7		492.28	4.95	487.33		
longitudinal station 52.0	11		492.28	6.45	485.83		TOB
	11.5		492.28	12.26	480.02		
	13.1		492.28	12.82	479.46		LEOW
	15.5		492.28	13.44	478.84		
	19.4		492.28	13.92	478.36		
	25.4		492.28	14.13	478.15		
	30.3		492.28	13.95	478.33		
	37.2		492.28	13.65	478.63		
	43.9		492.28	13.68	478.6		
	49.2		492.28	14	478.28		
	57.1		492.28	14.17	478.11		
	65.5		492.28	14.2	478.08		
	72		492.28	13.81	478.47		
	78.7		492.28	13.04	479.24		
	82.3		492.28	12.73	479.55		REOW
	85		492.28	12.53	479.75		TO SBAR
	88.6		492.28	12.68	479.6		BOB
	90		492.28	12.68	479.6		
	91		492.28	10.18	482.1		TOB&BF
	95.1		492.28	9.49	482.79		
	100		492.28	8.53	483.75		



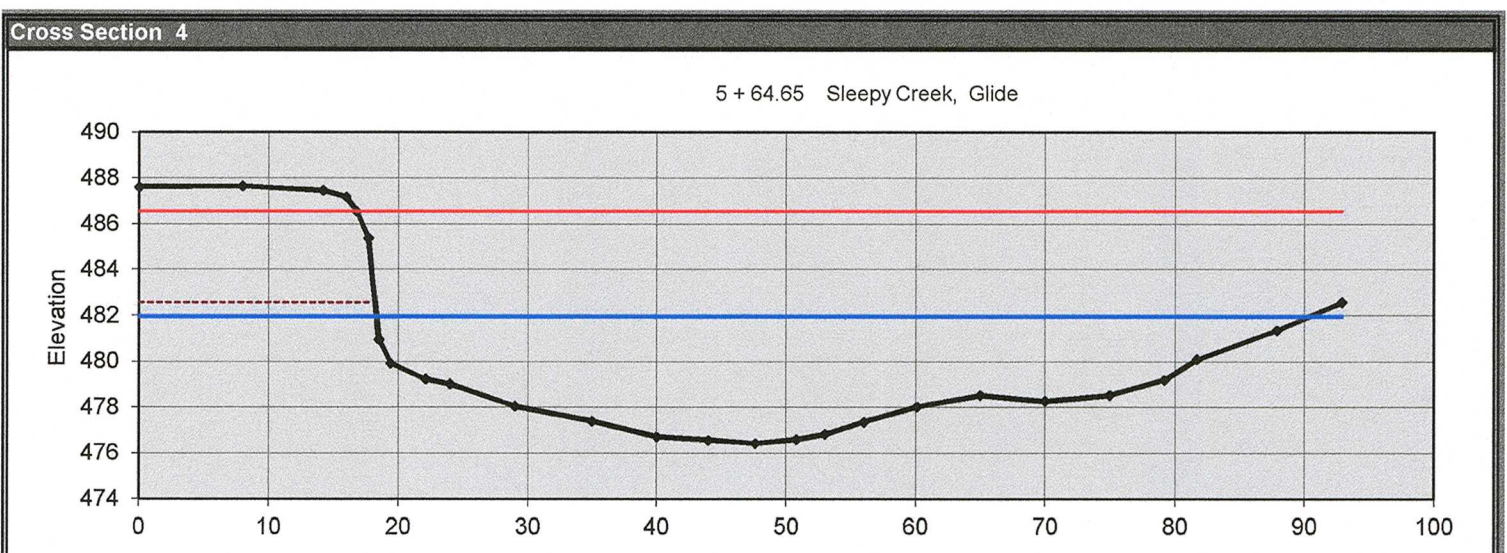
Bankfull Dimensions	Flood Dimensions	Materials
268.1 x-section area (ft.sq.)	W flood prone area (ft)	56 D50 Channel (mm)
73.9 width (ft)	entrenchment ratio	110 D84 Channel (mm)
3.6 mean depth (ft)	low bank height (ft)	13 threshold grain size (mm):
5.1 max depth (ft)	low bank height ratio	
77.2 wetted perimeter (ft)		
3.5 hyd radi (ft)		
20.3 width-depth ratio		
Bankfull Flow	Flow Resistance	Forces & Power
3.8 velocity (ft/s)	0.031 Manning's roughness	0.12 channel slope (%)
1023.5 discharge rate (cfs)	0.07 D'Arcy-Weisbach fric.	0.26 shear stress (lb/sq.ft.)
0.36 Froude number	8.8 resistance factor u/u*	0.37 shear velocity (ft/s)
	10.1 relative roughness	1.04 unit strm power (lb/ft/s)

Cross Section	Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bk	Notes
reference ID 2	0		490.99	2.4	488.59		
instrument height 490.99	3.8		490.99	3.2	487.79		TOB
longitudinal station 229.0	6.3		490.99	7	483.99		
	7.3		490.99	11.85	479.14		BOB
	10.3		490.99	12.88	478.11		
	14		490.99	13.13	477.86		
	17		490.99	13.57	477.42		
	22		490.99	13.25	477.74		
	26		490.99	13.28	477.71		
	31		490.99	13.53	477.46		
	35		490.99	13.39	477.17		
	41		490.99	13.83	477.16		
	46		490.99	13.11	477.88		
	53		490.99	12.19	478.8		
	62.8		490.99	11.12	479.87		REOW
	73.7		490.99	10.28	480.71		TO BAR
	78.6		490.99	9.7	481.29		BOB
	81.7		490.99	8.06	482.93		TOB&BF
	88		490.99	6.77	484.22		



Bankfull Dimensions	Flood Dimensions	Materials
252.1 x-section area (ft.sq.)	W flood prone area (ft)	56 D50 Channel (mm)
62.8 width (ft)	entrenchment ratio	110 D84 Channel (mm)
4.0 mean depth (ft)	low bank height (ft)	14 threshold grain size (mm):
5.2 max depth (ft)	low bank height ratio	
65.6 wetted perimeter (ft)		
3.8 hyd radi (ft)		
15.6 width-depth ratio		
Bankfull Flow	Flow Resistance	Forces & Power
4.1 velocity (ft/s)	0.031 Manning's roughness	0.12 channel slope (%)
1028.4 discharge rate (cfs)	0.07 D'Arcy-Weisbach fric.	0.29 shear stress (lb/sq.ft.)
0.37 Froude number	9.0 resistance factor u/u*	0.39 shear velocity (ft/s)
	11.1 relative roughness	1.23 unit strm power (lb/ft/s)

Cross Section	Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bk	Notes
reference ID 3	0		490.51	3.32	487.19		
instrument height 490.51	3		490.51	3.87	486.94		TOB
longitudinal station 481.8	5		490.51	5.08	485.43		
	5.4		490.51	9.76	480.75		BOB
	6.5		490.51	10.61	479.9		
	9.1		490.51	11.33	479.18		LEOW
	13.5		490.51	12.27	478.24		
	18.8		490.51	13.3	477.21		
	22.7		490.51	13.34	477.17		
	26.2		490.51	13.4	477.11		
	30.2		490.51	13.58	476.93		
	33.2		490.51	13.65	476.86		
	36.5		490.51	13.71	476.8		
	40.7		490.51	13.48	477.03		
	45.5		490.51	13.36	477.15		
	49.2		490.51	13.01	477.5		
	53.3		490.51	12.81	477.7		
	57.8		490.51	12.45	478.06		
	61.8		490.51	11.44	479.07		REOW
	62.8		490.51	10.04	480.47		
	64.6		490.51	9.38	481.13		
	68.1		490.51	8.61	482		TOB&BF
	71.5		490.51	8.37	482.14		
	76		490.51	8.05	482.46		
	82		490.51	7.2	483.31		
	89		490.51	6.8	483.71		



Bankfull Dimensions	Flood Dimensions	Materials
263.9 x-section area (ft.sq.)	W flood prone area (ft)	56 D50 Channel (mm)
72.1 width (ft)	entrenchment ratio	110 D84 Channel (mm)
3.7 mean depth (ft)	low bank height (ft)	13 threshold grain size (mm):
5.6 max depth (ft)	low bank height ratio	
74.2 wetted perimeter (ft)		
3.8 hyd radi (ft)		
19.7 width-depth ratio		
Bankfull Flow	Flow Resistance	Forces & Power
3.9 velocity (ft/s)	0.031 Manning's roughness	0.12 channel slope (%)
1022.7 discharge rate (cfs)	0.07 D'Arcy-Weisbach fric.	0.27 shear stress (lb/sq.ft.)
0.36 Froude number	8.9 resistance factor u/u*	0.37 shear velocity (ft/s)
	10.1 relative roughness	1.06 unit strm power (lb/ft/s)

Cross Section	Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bk	Notes
reference ID 4	0		490.84	3.24	487.6		
instrument height 490.84	8		490.84	3.2	487.64		
longitudinal station 564.6	14.2		490.84	3.39	487.45		
	16		490.84	3.68	487.16		TOB
	16.8		490.84	4.31	486.53		
	17.7		490.84	5.46	485.38		
	18.5		490.84	9.89	480.95		
	19.4		490.84	10.94	479.9		
	22.1		490.84	11.63	479.21		
	24		490.84	11.84	479		LEOW
	29		490.84	12.81	478.03		
	35		490.84	13.46	477.38		
	40		490.84	14.15	476.99		
	44		490.84	14.29	476.55		
	47.6		490.84	14.44	476.4		
	50.8		490.84	14.26	476.58		
	53		490.84	14.04	476.8		
	56		490.84	13.51	477.33		
	60.1		490.84	12.83	478.01		
	65		490.84	12.34	478.5		
	70		490.84	12.69	478.25		
	75		490.84	12.39	478.51		
	79.2		490.84	11.86	479.18		REOW
	81.7		490.84	10.77	480.07		
	87.9		490.84	9.48	481.36		
	92.9		490.84	8.29	482.55		BF

Bankfull Stage	FS 8.89	= 481.95 elev
	elevation	461.12

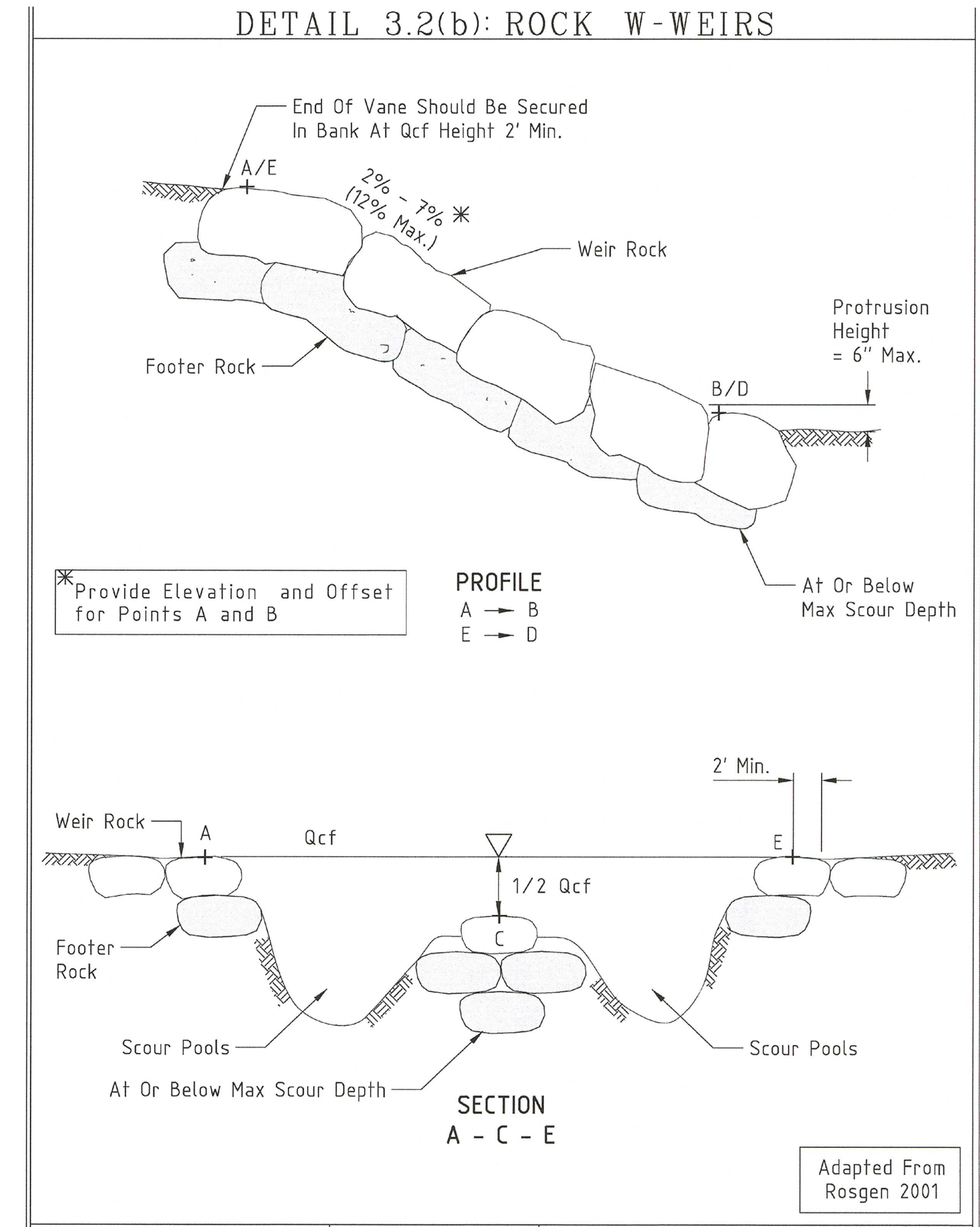
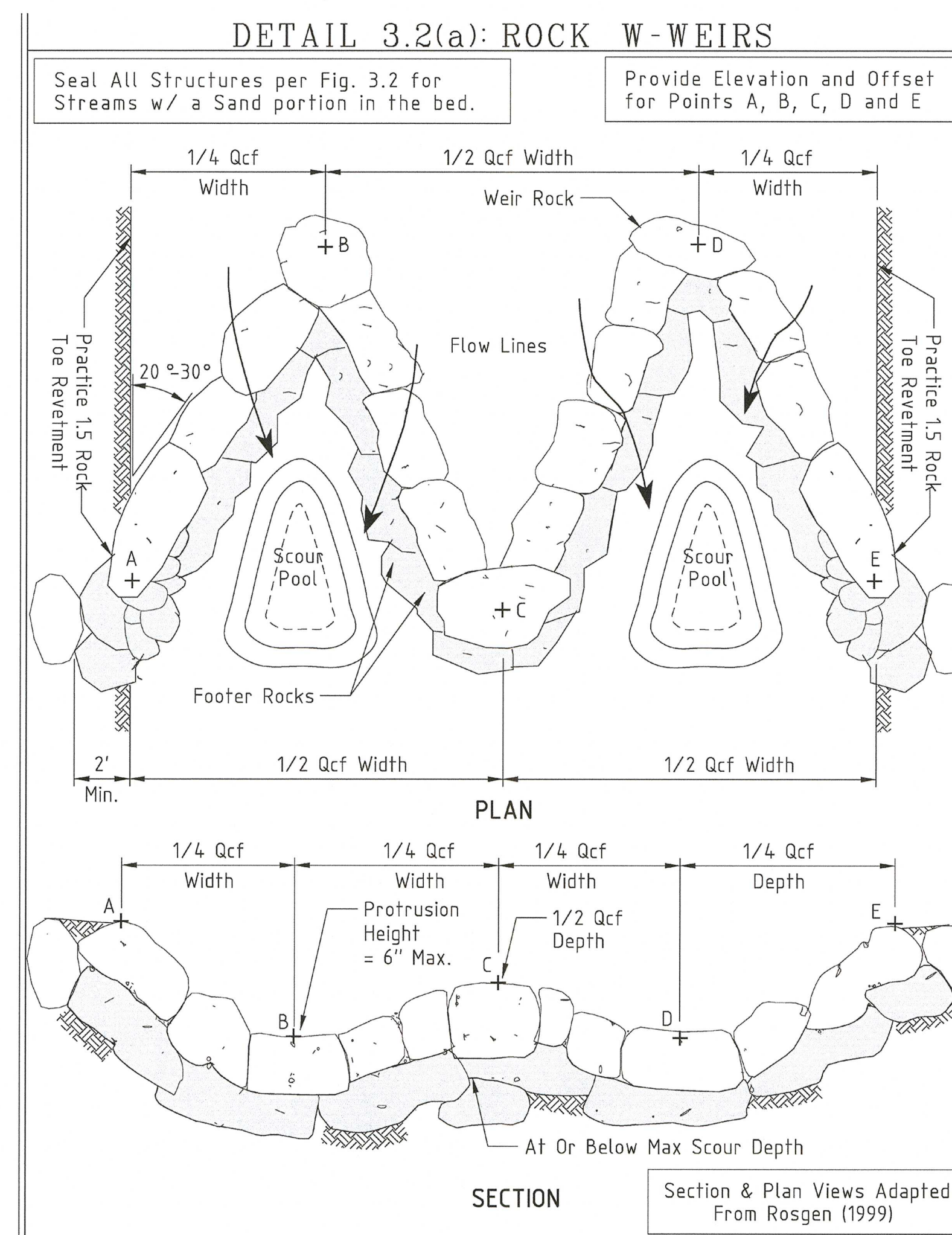
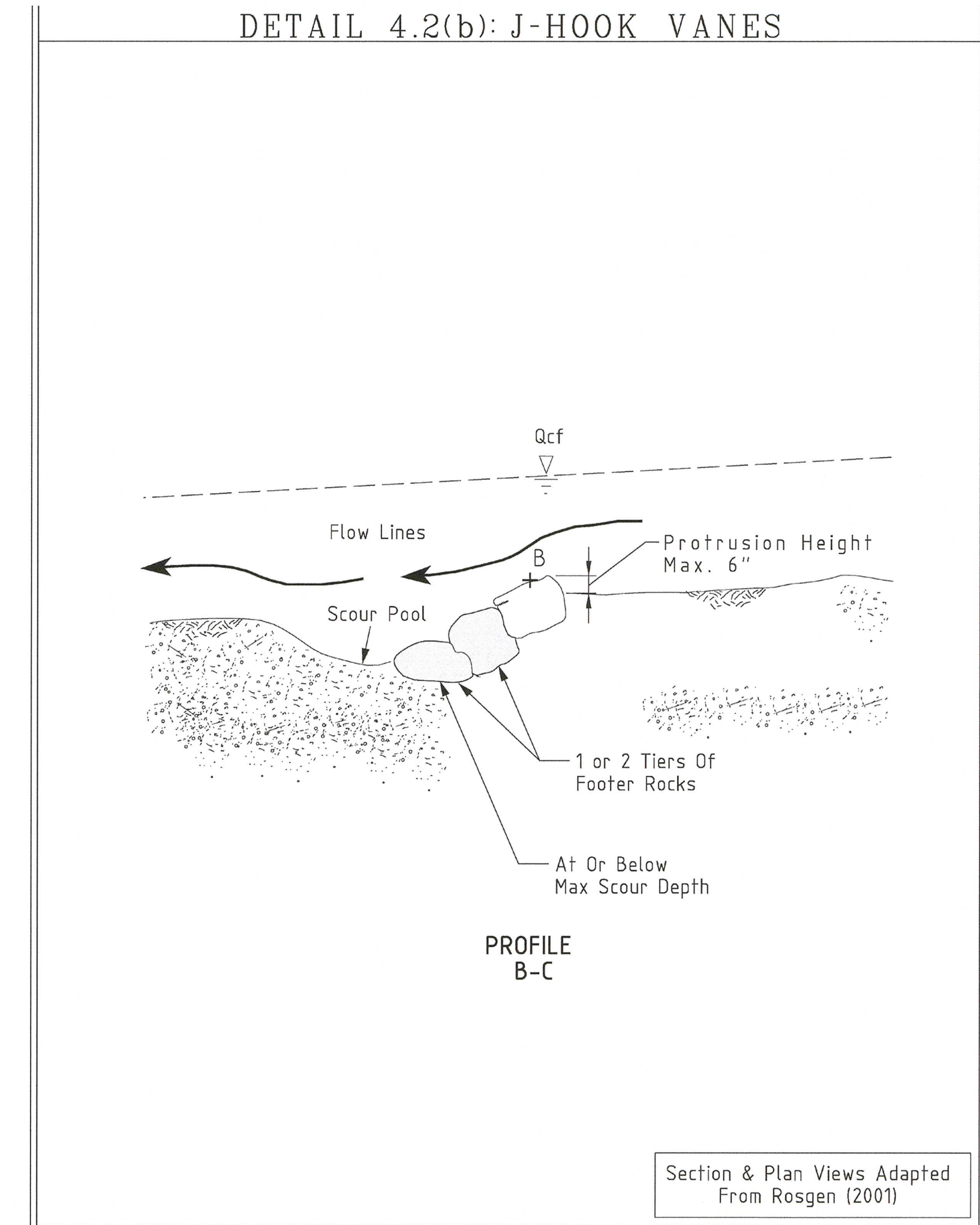
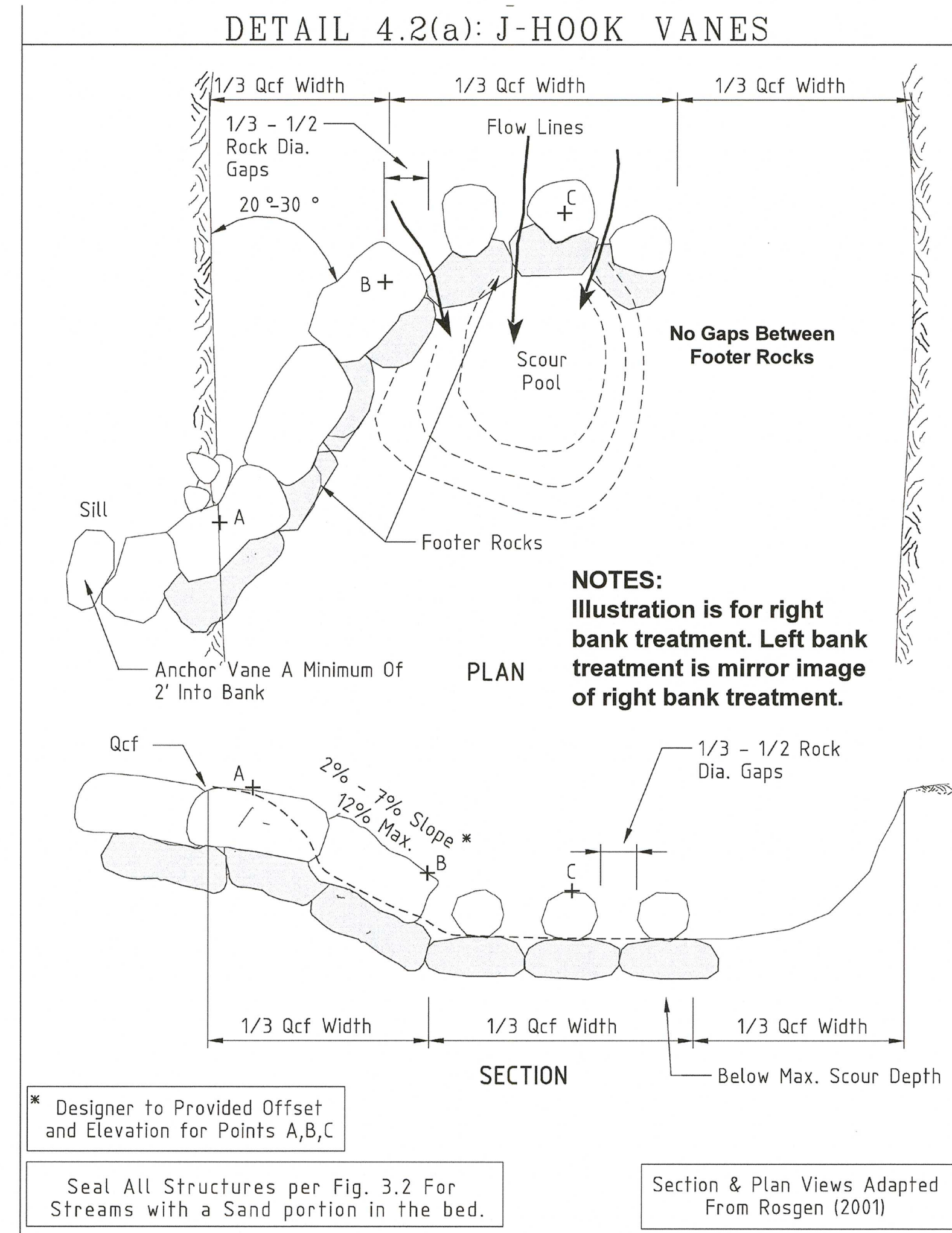
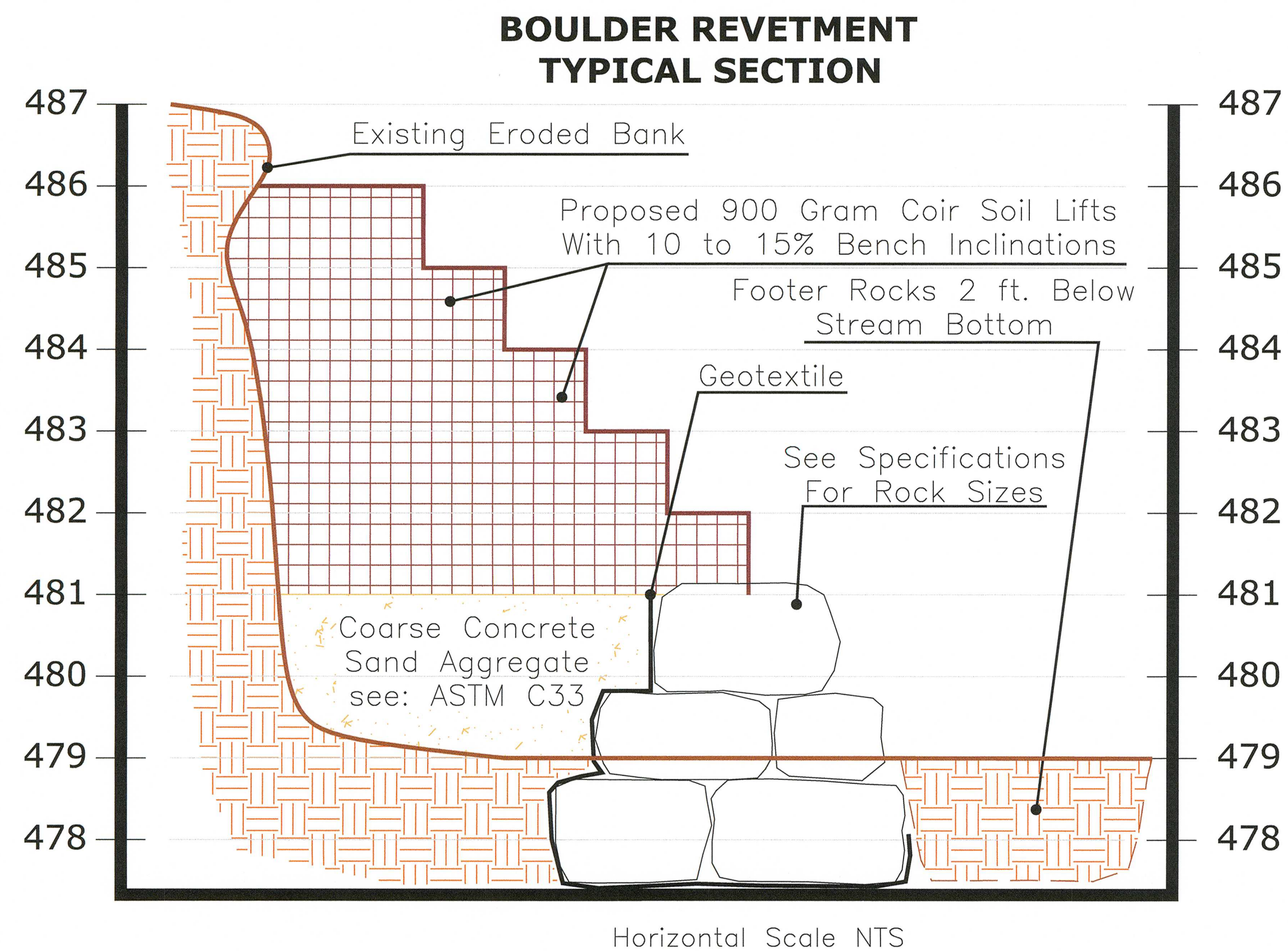
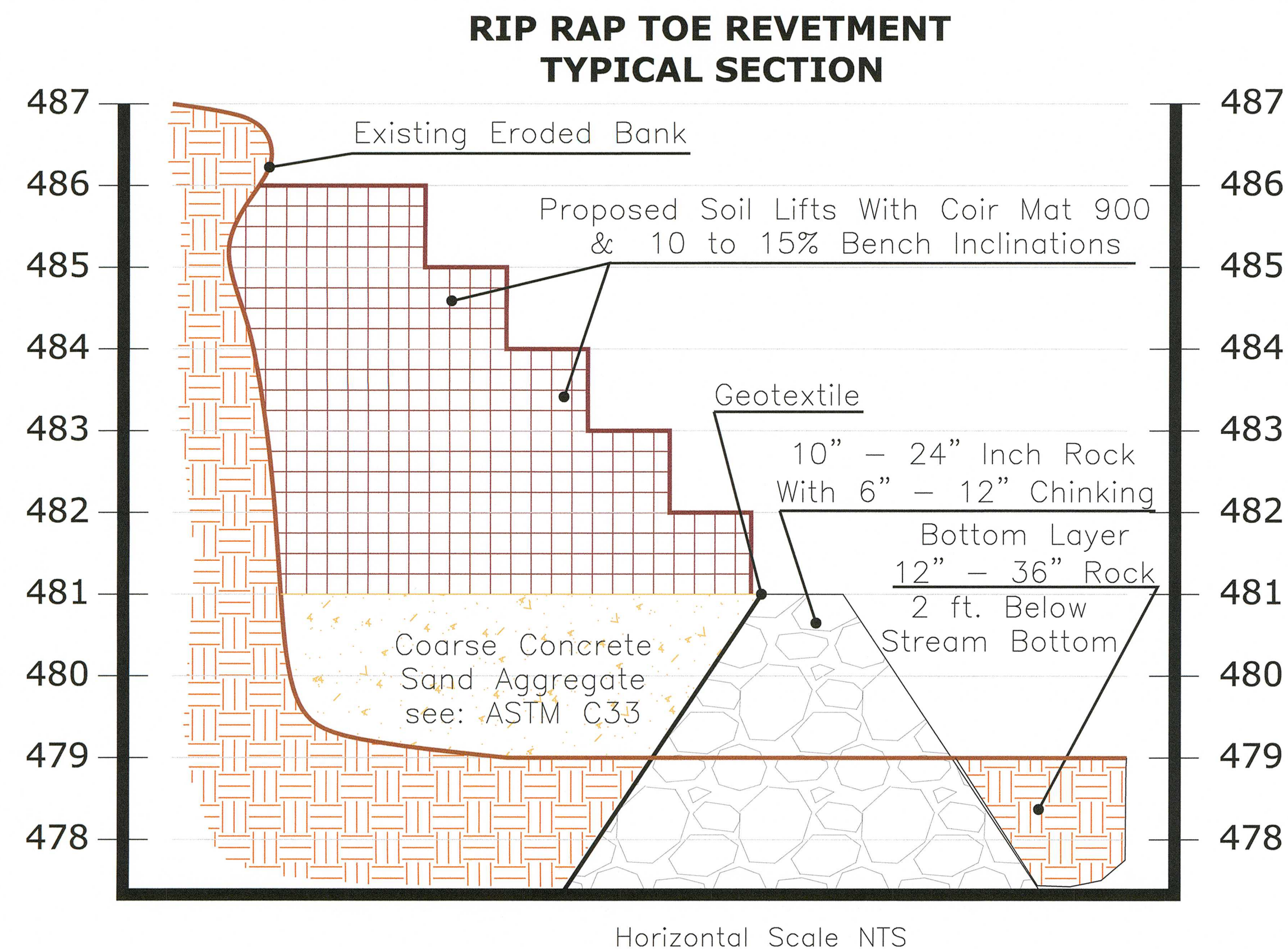
Low Bank Height	FS 8.29	= 482.55 e
	elevation	

Flood Prone Area	width fpa	76.1
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Channel Slope	percent slope	0.12	---
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Flow Resistance	Manning's "n"	0.031	0.036
D'Arcy - Weisbach "f"			0.10

Note:	
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GEOTEXTILE FABRIC

- A. Description: This work shall consist of furnishing, hauling, maintaining, stockpiling and installing geotextile fabric in the stream channel as specified in this plan set.
- B. Requirements:
1. NONWOVEN GEOTEXTILE FABRIC
 - a. Weight – 4.5 oz. per SY per ASTM D-5261
 - b. Minimum tensile strength of 120 lbs. per ASTM D-4632
 - c. Apparent Opening Size (AOS) of 70 US Sieve per ASTM D-4751
 - d. Trapezoidal tear strength of 45 lbs. as determined by ASTM D 4533
 - e. Puncture resistance greater than 100 pounds.
 - f. Water Flow Rate of 120 gpm/sf (gallons per minute, per square foot) per ASTM-D4491
 - g. UV Resistance @ 500 hours – 70% per ASTM D-4355

J-HOOK VANE WITH SILL

- A. Description: This work shall consist of furnishing, transporting, installing, and maintaining J-hook With Sill structures within the Sleepy Creek stream channel. Four J-hook vanes shall be installed, at the following stations along the baseline that has been staked at the top of the left bank by the Engineer; 0+59, 2+50, 4+07, and 5+50.
- B. Requirements:
1. Footer Rock -- Footer rock shall meet the Specifications for "Rock" contained in this plan set. Footer rock consists of rock placed with the bottom 2 feet below the invert of the proposed channel to provide support for the top rock and prevent downstream scour.
 2. Top Rock -- Top rock shall meet the Specifications for "Rock" contained in this plan set. Top rock consists of rock placed upon the footer rock.
 3. Sill Rocks -- Sill rock shall meet the Specification for "Rock" contained in this plan set. Sill rock consists of a single row of rock set perpendicular to the vane arm at the end of the vane arm/stream bank key in location and elevation, as specified in the structure table in this plan set. Sill rock shall extend a minimum of 2 feet into the stream bank at the end of the structure arm perpendicular to stream flow.
 4. Geotextile Fabric -- Geotextile fabric shall meet the specifications for 'Geotextile Fabric' contained in this plan set.
- C. Installation:
1. The vane shall be constructed in a "J" formation so that adjoining rocks taper up in elevation towards the stream bank in the downstream direction. The vane side is to be angled 15-30 degrees from the stream

- bank towards mid-channel such that the vane ties into the nodes shown in the structure tables on the grading plan. The vane and hook shall each comprise 1/3 the bankfull channel width. The J-hook vane shall not extend more than 2/3 the distance across the bankfull channel. J-hook vane #1 shall extend approximately 53 feet across the channel from the left bank, J-hook vane #2 shall extend approximately 49 feet across the channel from the left bank, J-hook vane #3 shall extend approximately 42 feet across the channel from the left bank, and J-hook vane #4 shall extend approximately 48 feet across the channel from the left bank.
2. The footer rocks shall be installed by excavating a trench to accommodate both the footer rocks and a 2-foot area upstream. In the event that bedrock is present in the area of installation, footer rock shall still be required unless approval for elimination of footer rock is obtained from the Engineer. Where bedrock is friable and weathered and can be trenched, footer rock will be required. In areas where bedrock is resistant and blasting would be required, the Engineer shall determine whether or not to eliminate footer rock.
 3. The rocks shall abut one another except for the outer 1/3 hook. Gaps between the hook rocks shall be 1/3 to 1/2 the intermediate axis diameter of the top rocks. The bottom elevation of the footer rock shall be 2 feet below the stream grade immediately below the J-hook structure. Footer rocks shall be firmly embedded into the trench bottom.
 4. The contractor must receive approval of all footer rock placement and elevation by the Engineer prior to placement of top rocks. The trench behind the footer rocks shall be backfilled with stream bed material to the height of the footer rock, with the geotextile fabric between the rock and the stream bed material.
 5. Top rocks shall be placed so that they lean on the footer rocks and fit tightly against each other. Care shall be taken when placing top rocks so that the seams between top rocks do not line up with the seams between the footer rocks. Starting at or near the thalweg, adjacent rocks shall taper up at a slope of approximately 7-10 percent to the end top rocks, which shall be placed flush with the bankfull elevation. Vane arms shall be at a consistent slope, undulations along the slope of the vane arm shall not be acceptable.
 6. The outermost top rocks on each end of the J-vane with sill shall be installed with at least one top rock buried into the stream bank.
 7. The trench behind the top rocks shall be backfilled with stream bed material.
 8. Excavate a scour pool downstream of the hook section to a water depth of three feet or to bed rock, whichever occurs first.

- B. Clean-up
1. Upon completion of work, reshape slopes and stream bottom to specified elevations.
 2. Remove unsuitable and surplus rocks and excavated materials to fill areas

or approved off-site locations.

- C. Measurement and Payment: Contractor shall be paid on a lump sum basis for each J-hook vane constructed and accepted by the Engineer.

BOULDER REVETMENT

- A. Description: This work shall consist of furnishing, transporting, installing, and maintaining boulder revetments along the Sleepy Creek stream channel. Up to 250 linear feet of boulder revetment shall be installed, at locations directed by the Engineer and in accordance with the detail provided on this sheet.
- B. Requirements:
1. Footer Rock -- Footer rock shall meet the Specifications for "Rock" contained in this plan set. Footer rock consists of rock placed with the bottom 2 feet below the invert of the proposed channel to provide support for the top rock and prevent downstream scour.
 2. Top Rock -- Top rock shall meet the Specifications for "Rock" contained in this plan set. Top rock consists of rocks placed upon the footer rocks.
 3. Geotextile Fabric -- Geotextile fabric shall meet the specifications for 'Geotextile Fabric' contained in this plan set.
- C. Installation
1. Boulder revetment shall be installed by excavating a trench to accommodate the footer rocks. In the event that bedrock is present in the area of installation, footer rock shall still be required unless approval for elimination of footer rock is obtained from the Engineer. Where bedrock is friable and weathered and can be trenched, footer rock will be required. In areas where bedrock is resistant and blasting would be required, the Engineer shall determine whether or not to eliminate footer rock.
 2. Place non-woven geotextile fabric in the footer trench. The geotextile fabric shall be cut to a sufficient size such that it will extend from the bottom of the footer trench to the top of the back side of the boulder revetment.
 3. Footer rocks shall be placed at the bottom of the trench and shall abut one another to eliminate gaps between footers. All gaps shall be sealed using smaller rock size. . Footer rocks shall be firmly embedded into the stream bottom substrate. Footer rocks shall be placed so that the bottoms of the rocks are 2 feet below existing grade.
 4. Contractor must receive approval of all footer rock placement and elevation by Engineer prior to placement of top rocks.
 5. Top rocks shall be placed so that they lean on the footer rocks and fit tightly against each other to eliminate gaps. Care shall be taken when placing top rocks that the seams between top rocks do not line up with the seams between the footer rocks. Continue placing rows of top rocks until location and elevation specified in this plan set is achieved. Each row of

- top rocks shall be set 6 to 12 inches farther towards the bank than the lower row. Top rocks shall be set so that the downstream top edge of the rock is placed at the bankfull elevation (to be provided by the Engineer).
6. Back fill behind with earth fill that has been approved by the Engineer, as needed.
 7. Once the specified rock toe protection height is achieved, pull the geotextile fabric over the top rock. After inspection and approval, trim geotextile flush with the top rock elevation and stream bed material.

- D. Clean-up
1. Upon completion of work, reshape slopes and stream bottom to specified elevations.
 2. Remove unsuitable and surplus rocks and excavated materials to fill areas or approved off-site locations.

- E. Measurement and Payment: Contractor shall be paid on a linear foot basis, up to 250 linear feet, upon completion of 50% and 100% of the total linear footage.

RIPRAP TOE REVETMENT

- F. Description: This work shall consist of furnishing, transporting, installing, and maintaining riprap toe revetments along the Sleepy Creek stream channel. Up to 150 linear feet of boulder revetment shall be installed, at various locations directed by the Engineer and in accordance with the detail provided in this plan set.

- G. Requirements:
- Riprap toe revetments shall be constructed in accordance with Section 3.23 – Riprap of the West Virginia Erosion and Sediment Control Best Management Practices Manual (Revised 2016) and as shown on the detail contained in this plan set. The riprap toe revetment shall consist of a base layer of granular filter material on which filter fabric shall be placed. Large riprap (12"-36") shall be placed over the filter fabric, and

Geotextile Fabric -- Geotextile fabric shall meet the specifications for 'Geotextile Fabric' contained in this plan set and in accordance with Section 3.24 – Geotextiles of the West Virginia Erosion and Sediment Control Best Management Practices Manual (Revised 2016).

- H. Installation
8. Boulder revetment shall be installed by excavating a trench to accommodate the footer rocks. In the event that bedrock is present in the area of installation, footer rock shall still be required unless approval for elimination of footer rock is obtained from the Engineer. Where bedrock is

- friable and weathered and can be trenched, footer rock will be required. In areas where bedrock is resistant and blasting would be required, the Engineer shall determine whether or not to eliminate footer rock.
9. Place non-woven geotextile fabric in the footer trench. The geotextile fabric shall be cut to a sufficient size such that it will extend from the bottom of the footer trench to the top of the back side of the boulder revetment.
 10. Footer rocks shall be placed at the bottom of the trench and shall abut one another to eliminate gaps between footers. All gaps shall be sealed using smaller rock size. . Footer rocks shall be firmly embedded into the stream bottom substrate. Footer rocks shall be placed so that the bottoms of the rocks are 2 feet below existing grade.
 11. Contractor must receive approval of all footer rock placement and elevation by Engineer prior to placement of top rocks.
 12. Top rocks shall be placed so that they lean on the footer rocks and fit tightly against each other to eliminate gaps. Care shall be taken when placing top rocks that the seams between top rocks do not line up with the seams between the footer rocks. Continue placing rows of top rocks until location and elevation specified in this plan set is achieved. Each row of top rocks shall be set 6 to 12 inches farther towards the bank than the lower row. Top rocks shall be set so that the downstream top edge of the rock is placed at the bankfull elevation (to be provided by the Engineer).
 13. Back fill behind with earth fill that has been approved by the Engineer, as needed.
 14. Once the specified rock toe protection height is achieved, pull the geotextile fabric over the top rock. After inspection and approval, trim geotextile flush with the top rock elevation and stream bed material.

- I. Clean-up
3. Upon completion of work, reshape slopes and stream bottom to specified elevations.
 4. Remove unsuitable and surplus rocks and excavated materials to fill areas or approved off-site locations.

- J. Measurement and Payment: Contractor shall be paid on a linear foot basis, up to 250 linear feet, upon completion of 50% and 100% of the total linear footage.

ROCK

- A. Description: This work shall consist of furnishing, transporting, stockpiling, maintaining and placing of rocks for: Boulder toe revetments, J-hook vanes, and W-weir.

- B. Requirements:
1. Rock shall consist of angular flat rock of appropriate color (e.g., green/gray, brown/gray, dark gray, and/or dark brown in color) obtained from an approved source.
 2. Rock shall not be harvested from streams or rivers outside a commercial quarry operation.
 3. All rock shall be free from laminations, weak cleavages and shall not disintegrate from the action of air, salt water and in handling and placing.
 4. Granular sedimentary rock shall be unacceptable.
 5. Concrete shall not be considered as an alternative for rock.
 6. White rock is not acceptable.
 7. Rock sizes shall be as specified in this plan set for construction of rock features. Footer rock and top rock sizes apply to both the J-hook vanes and the W-weir. The boulder toe rock sizes are for both the footer rocks and top rocks of the boulder revetment. Rock sizes shall be as shown in table below:

Rock	A-Axis Dimension	B-Axis Dimension	C-Axis Dimension
Footer Rock	3-5 ft	2-4 ft	1.5-2.5 ft
Top Rock	3-5 ft	2-4 ft	1.5-2.5 ft
Boulder Toe Rock	4-5 ft	2-4 ft	2-2.5 ft

1. The vane shall be constructed in a "W" formation looking downstream. Both sides of the W-Weir are vanes directed from the bankfull bank (Points A and E) upstream toward the bed (Points B and D) with 20-30 degree departure angles from the bed. From Points B and D located at 1/4 and 3/4 distances across the bankfull channel, two additional vane arms slope up to the center of the bankfull channel at Point C and extending approximately 2 feet downstream from Points A and E. The elevation of the top of the top rock at Point C is 1/2 the difference between the bed elevation and the bankfull elevation. The elevations of Points A, B, C, D, and E and the vane arm lengths and slopes are shown in the structures table located on the grading plan.
11. The footer rocks shall be installed by excavating a trench to accommodate both the footer rocks and a 2-foot area upstream. In the event that bedrock is present in the area of installation, footer rock shall still be required unless approval for elimination of footer rock is obtained from the Engineer. Where bedrock is friable and weathered and can be trenched, footer rock will be required. In areas where bedrock is resistant and blasting would be required, the Engineer shall determine whether or not to eliminate footer rock.
12. The rocks shall abut one another. Gaps between the hook rocks shall be not be allowed. The bottom elevation of the footer rock shall be 2 feet below the stream grade immediately below the W-Weir structure. Footer rocks shall be firmly embedded into the trench bottom.
13. The contractor must receive approval of all footer rock placement and elevation by the Engineer prior to placement of top rocks. The trench behind the footer rocks shall be backfilled with stream bed material to the height of the footer rock, with the geotextile fabric between the rock and the stream bed material.
14. Top rocks shall be placed so that they lean on the footer rocks and fit tightly against each other. Care shall be taken when placing top rocks so that the seams between top rocks do not line up with the seams between the footer rocks. Vane arms shall be at a consistent slope, undulations along the slope of the vane arm shall not be acceptable.
15. The outermost top rocks on each end of the W-Weir shall be installed with at least one top rock buried into the stream bank.
16. The trench behind the top rocks shall be backfilled with stream bed material.
17. Excavate two scour pool downstream of and between the W-Weir as shown on the detail to a water depth of three feet or to bed rock, whichever occurs first.

- D. Clean-up
3. Upon completion of work, reshape slopes and stream bottom to specified elevations.
 4. Remove unsuitable and surplus rocks and excavated materials to fill areas or approved off-site locations.

- E. Measurement and Payment: Contractor shall be paid on a lump sum basis for the one W-Weir constructed and accepted by the Engineer.

SOIL LIFTS

- A. Description: Soil lifts are proposed for Sleepy Creek in an attempt to minimize bank grading, minimize disturbance to trees, and minimize impacts to the adjacent agricultural field. The intent is to install the soil lifts on a steep slope from the top of the boulder revetment or rock toe revetment up to the bottom of the tree root overhangs. Approximately 250 linear feet of soil lifts are proposed above boulder revetments and 150 linear feet of soil lifts are proposed above rock toe protection, for a maximum total of 400 linear feet of soil lifts.
- B. Requirements:
1. Topsoil: Fertile, friable, loamy soil, containing not less than 1.5% organic matter; reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than 2 inch, coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances; suitable for the germination of seeds and the support of vegetative growth.
 2. Staples: 0.125 inch diameter new steel wire formed into a "U" shape not less than 6 inches in length with a throat of 1 inch in width.
 3. Geotextile Fabric: (see Geotextile Fabric specification)
 4. Plant Material: (see Planting Schedule on Detail Sheet)

C. Installation

1. Excavate a trench along the toe of the streambank to accommodate the toe protection measure to be used, either boulder revetment or rock toe revetment.
2. Next, install the aggregate filter and toe protection. Place a lift of fill, behind the aggregate filter and compact properly. The aggregate filter should exhibit a 10-15 degree slope away from the proposed streambank toe.
3. Place a batter board and jig (see detail XXX) and lay natural fiber matting along bottom of bench. Overlap adjacent matting by 1 foot.
4. Drape excess fabric over front of jig. Place select fill to a vertical depth of between 6 and 24 inches and a minimum of 4 feet in length along a 10- to 15-degree angle away from the proposed streambank toe.
5. Tamp soil firmly. Apply seed mixture to front portion of lift that will be left exposed.
6. Pull natural fiber matting over to cover lift and staple in place.
7. After the soil lift is completed, install the containerized shrubs.

8. Repeat the previous steps until the bottom of the tree root overhang has been reached

On both terminal ends of the soil lifts, excess matting shall be used to fold over the ends of the lift and stapled firmly. Backfill or fill adjacent to the end of the lift and compact to secure it firmly.

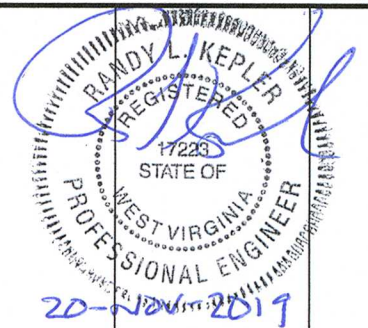
W-WEIR

- A. Description: This work shall consist of furnishing, transporting, stockpiling, maintaining and placing of rocks for a W-Weir. The W-Weir shall be installed between Stations 7+00 and 8+00. The exact positioning will be determined in the field between the Engineer and Contractor.
- B. Requirements: (see requirements for J-Hook Vane)
- C. Installation:

PROJECT SPECIFICATIONS

Sleepy Creek Streambank Stabilization
Sleepy Creek Watershed Association

Morgan County, West Virginia



DATE:	June 16th, 2015	SCALE:	As Shown		
REVISION DATE:	March 6th, 2018	DESIGN BY:	A. McCullough & T. Hogan		
REVISION TYPE:	Review	Plan Revisions	DRAWN BY:	A. McCullough	
REVISION DATE:	October 18th, 2019	CHECKED BY:	T. Hogan & A. McCullough		
REVISION TYPE:	Engineer Revisions	SS PROJECT NO:	17004		
REVISION DATE:		SHEET	6	OF	8
REVISION TYPE:		NUMBER			

Item Number: ERNMX-181 or approved equivalent
Height: 1.0 – 6.3 Ft
Seeding Rate: 1 lb per 1,000 sq ft

Mix Composition

Plant to be vertical from existing grade

Soil firmed and not compacted with foot at several positions around planting hole

Existing Grade

Top of plug/tubling set at one (1) inch below existing grade

Root mass not forced into planting hole. Roots shall not be compressed, J-shaped, twisted, screwed or balled up.

One ten (10) gram tablet of Agriform 18:6:12 placed prior to plant installation

Planting hole same dimension and slightly larger than plug/tubling soil mass without air cavities

Common Name	Scientific Name	Number	Size	Spacing
Low Bush Blueberry	<i>Vaccinium angustifolium</i>	50	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Black-Haw	<i>Viburnum prunifolium</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Arrowwood	<i>Viburnum dentatum</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Redbud	<i>Cercis canadensis</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Northern Spicebush	<i>Lindera benzoin</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Hydrangea	<i>Hydrangea arborescens</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Pink Azalea	<i>Rhododendron periclymenoides</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Fragrant Sumac	<i>Rhus aromatica</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Forsythia	<i>Forsythia intermedia</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Black Chokeberry	<i>Aronia melanocarpa</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center
Gray dogwood	<i>Cornus racemosa</i>	45	4 In. Deep X 2.25 In. Dia. Tubelings	2-Ft. On Center

6) While gently holding the top of tree/shrub, apply firm foot pressure in several different positions immediately around the tree/shrub to firm the soil and eliminate air pockets. The final placement shall result in the top of the root mass being one (1) inch below the soil surface with the planting hole being totally closed with firmed, uncompacted soil without any air pockets.

Figure 7.01.1

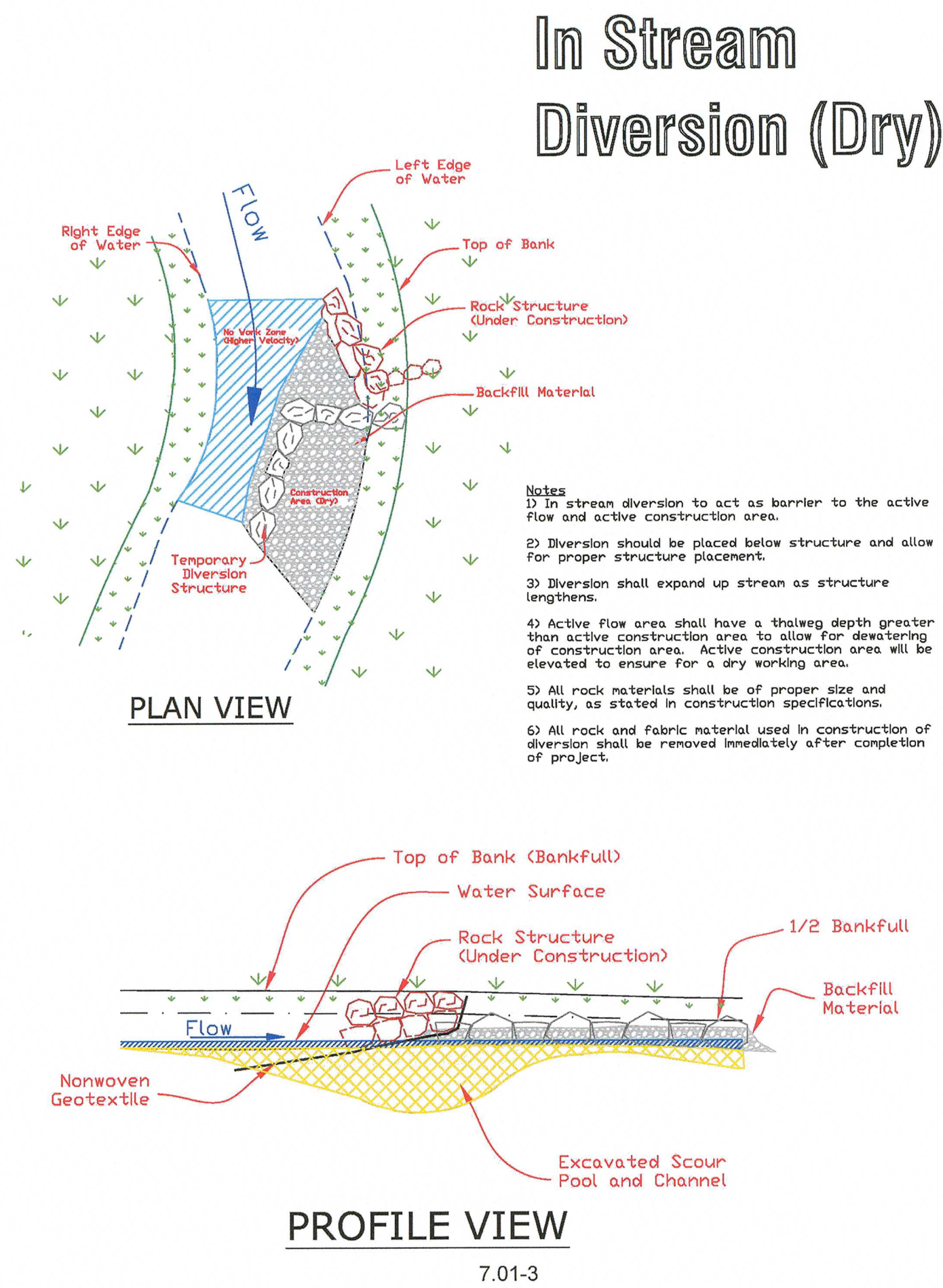


Figure 7.01.2

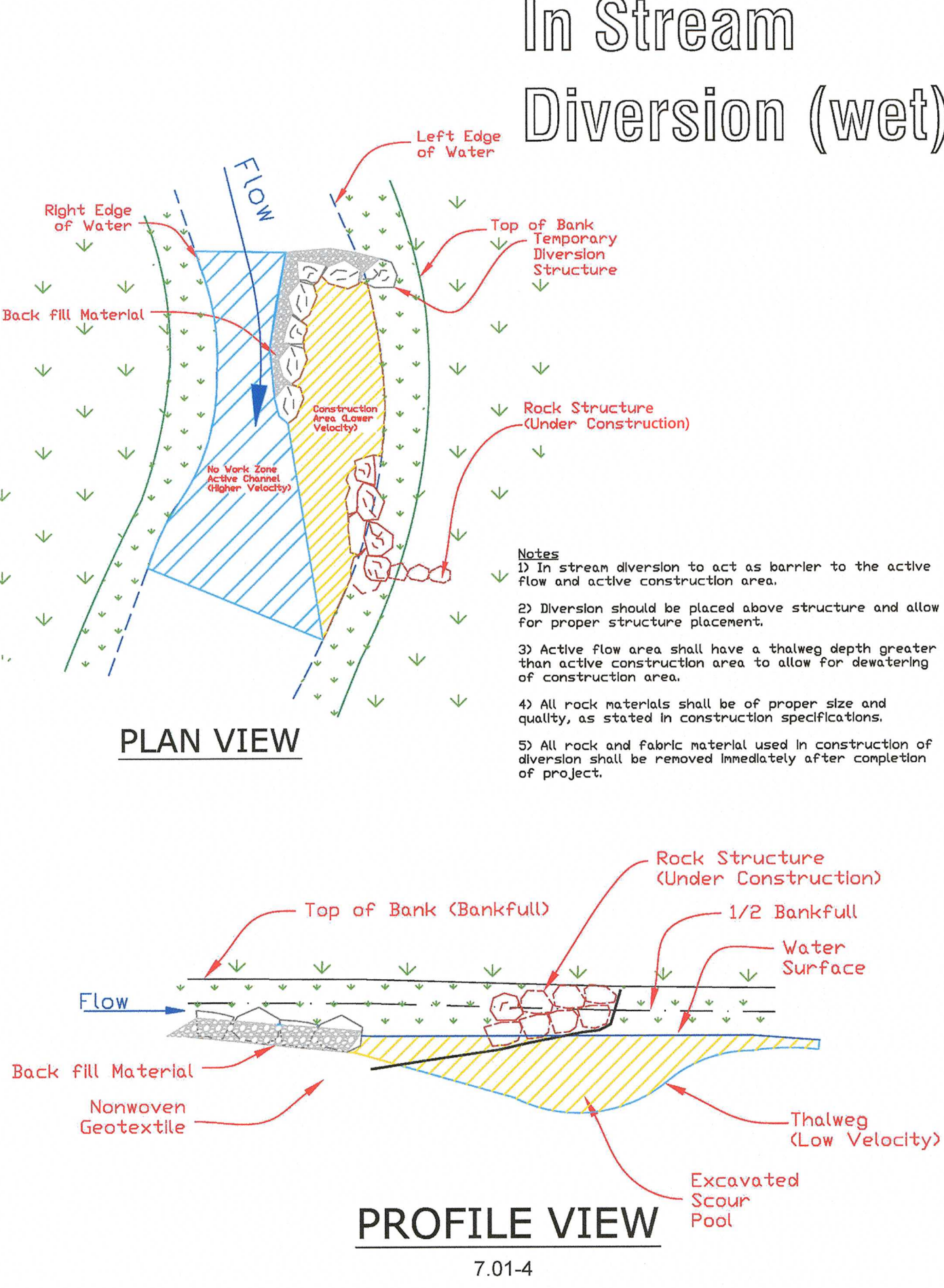


FIGURE 3.01.2

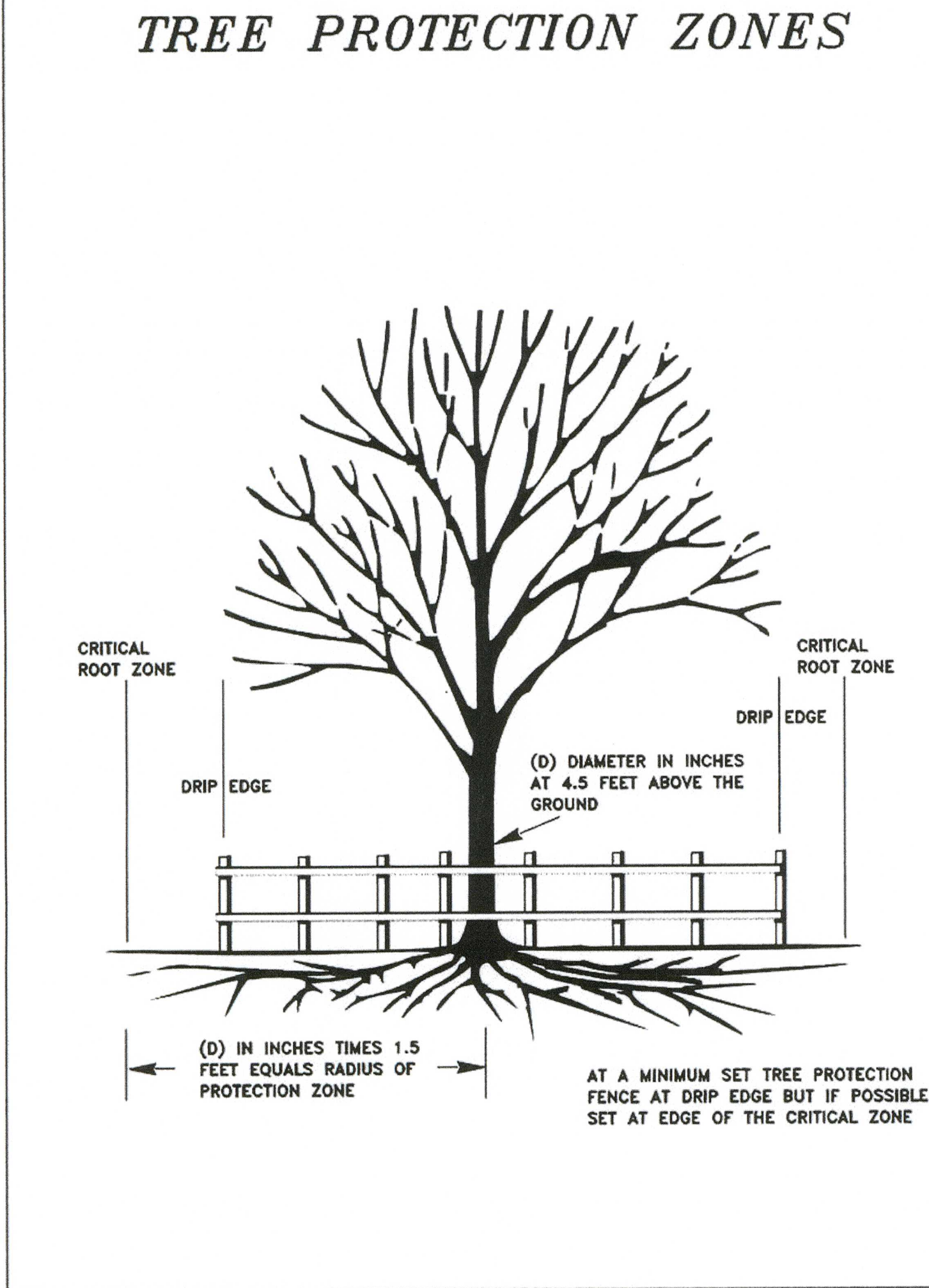


FIGURE 3.02.1

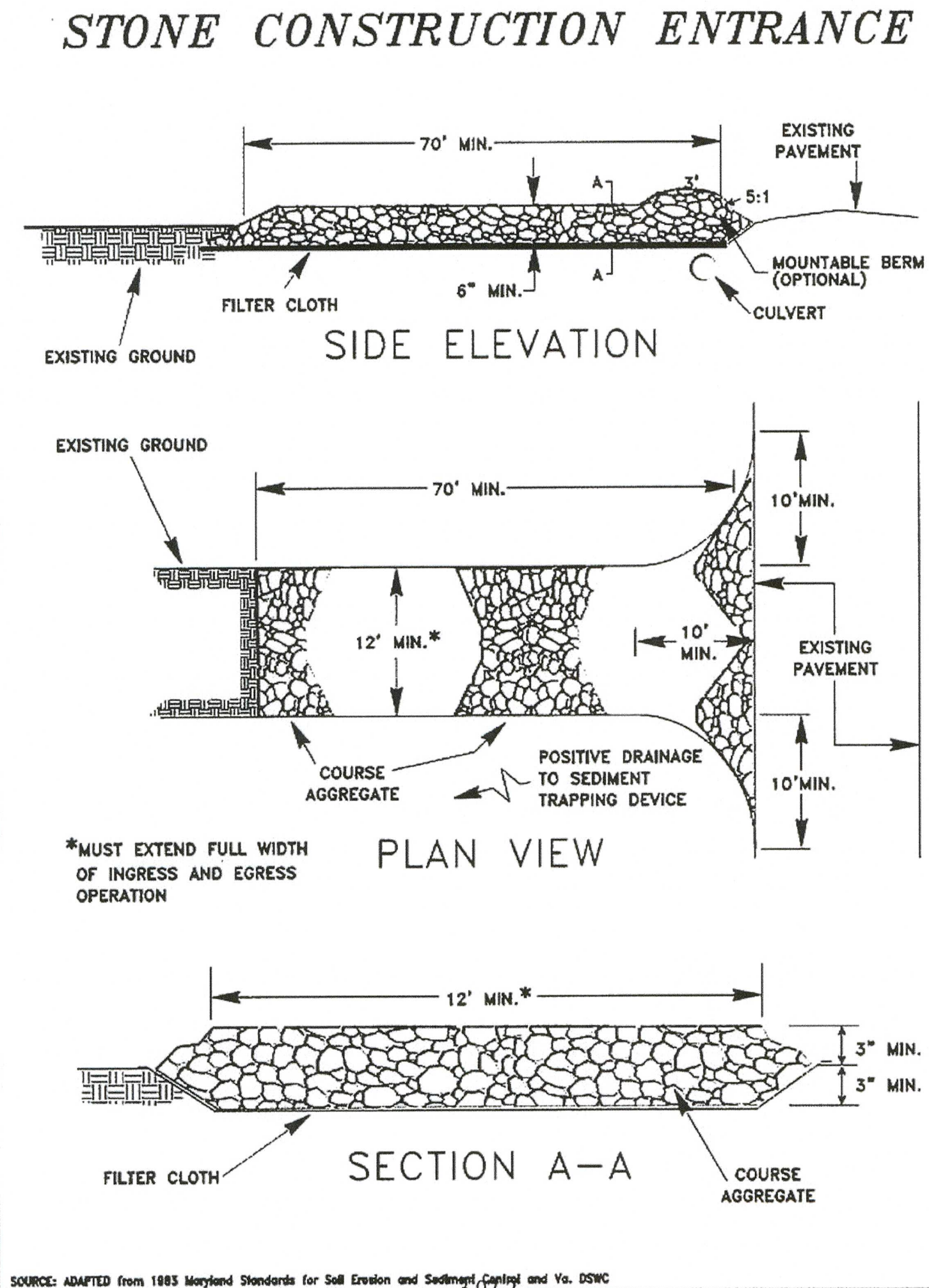
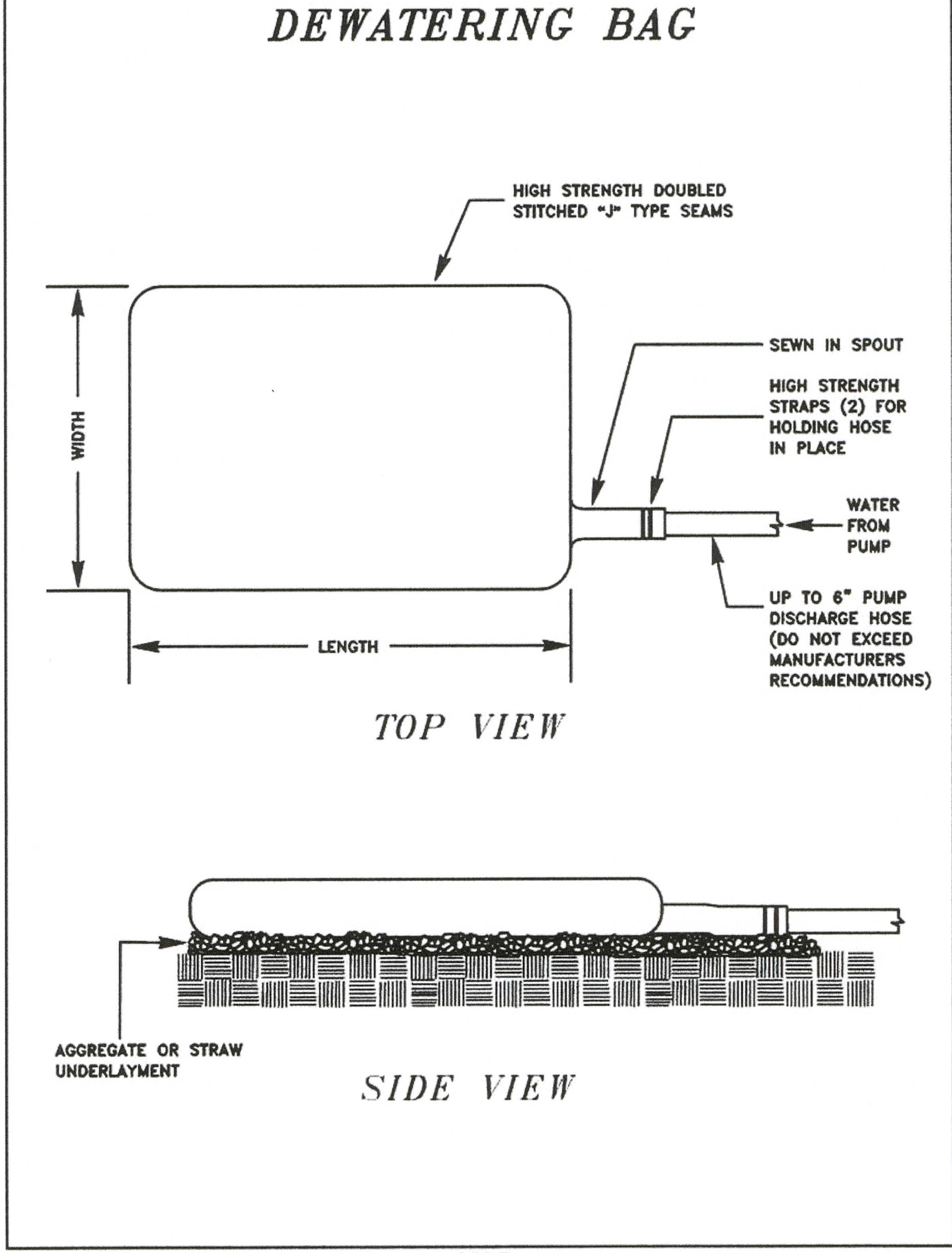


FIGURE 3.22-3



DATE:	June 19th, 2017	SCALE:	As Shown
REVISION DATE:	March 6th, 2018	DESIGN BY:	A. McCullough & T. Hogan
REVISION TYPE:	Review Plan Revisions	DRAWN BY:	A. McCullough
REVISION DATE:	NONE	CHECKED BY:	T. Hogan & A. McCullough
REVISION TYPE:	NONE	SS PROJECT NO:	17004
REVISION DATE:	NONE	SHEET	8
REVISION TYPE:	NONE	NUMBER	8

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SEDIMENT & EROSION CONTROL DETAIL
Sleepy Creek Streambank Stabilization
Sleepy Creek Watershed Association
Morgan County, West Virginia

Professional Engineer Seal:
Ramon L. Keener
Professional Engineer
State of Maryland
No. 17004
Exp. 12/31/2019