Appendices

Appendix A. Photolog

Photo 1 - Upstream outfall and top of stream reach. Looking at the right bank.

Photo 2 - Clay cascade in upstream section of stream.

Photo 3 - Deeply entrenched clay bottom channel. Looking upstream.

Photo 4 - Clay channel sides with groundwater seeping out of overlaying soils.

Photo 5 - Series of clay cascades and pools in the entrenched channel. Looking upstream.

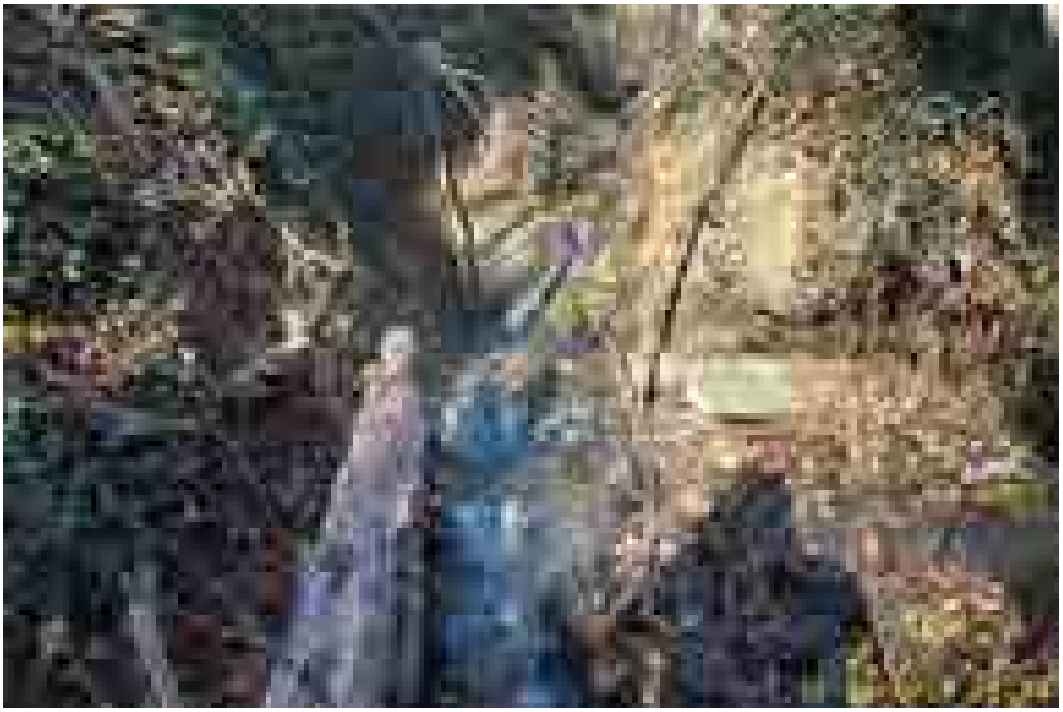


Photo 6 - Buried gravel layers and cut timber showing evidence of historic sedimentation since colonization.

Photo 7 - Debris jam in clay channel.

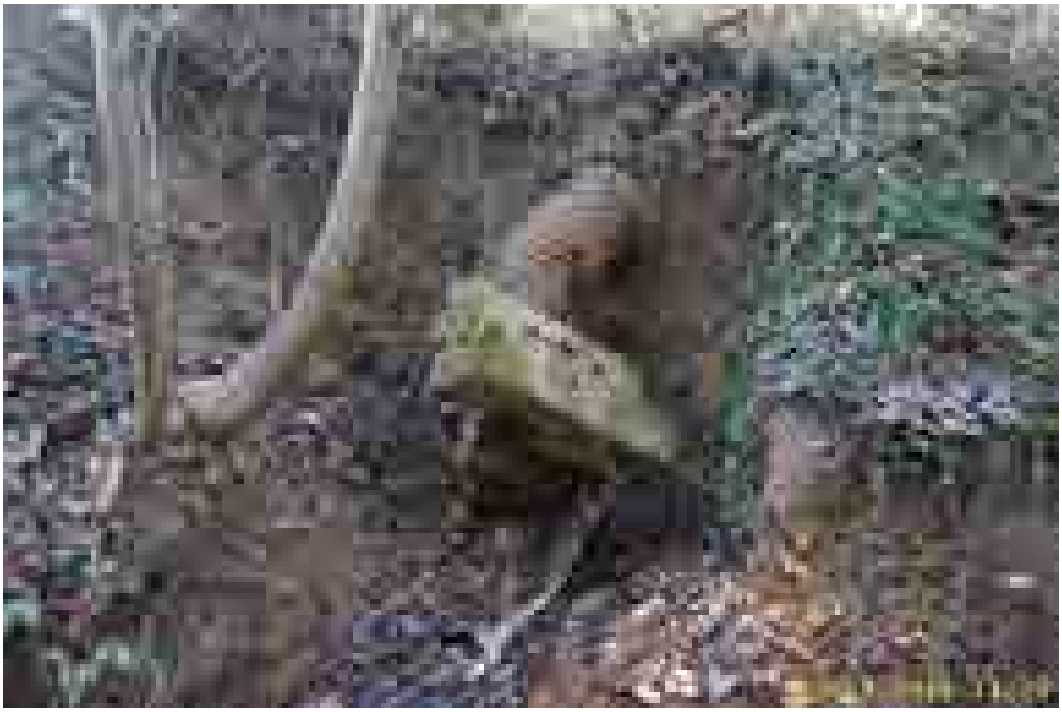


Photo 8 - Destroyed corrugated metal pipe endwall on right bank.

Photo 9 - Downstream end section to the culvert under Southern Avenue.

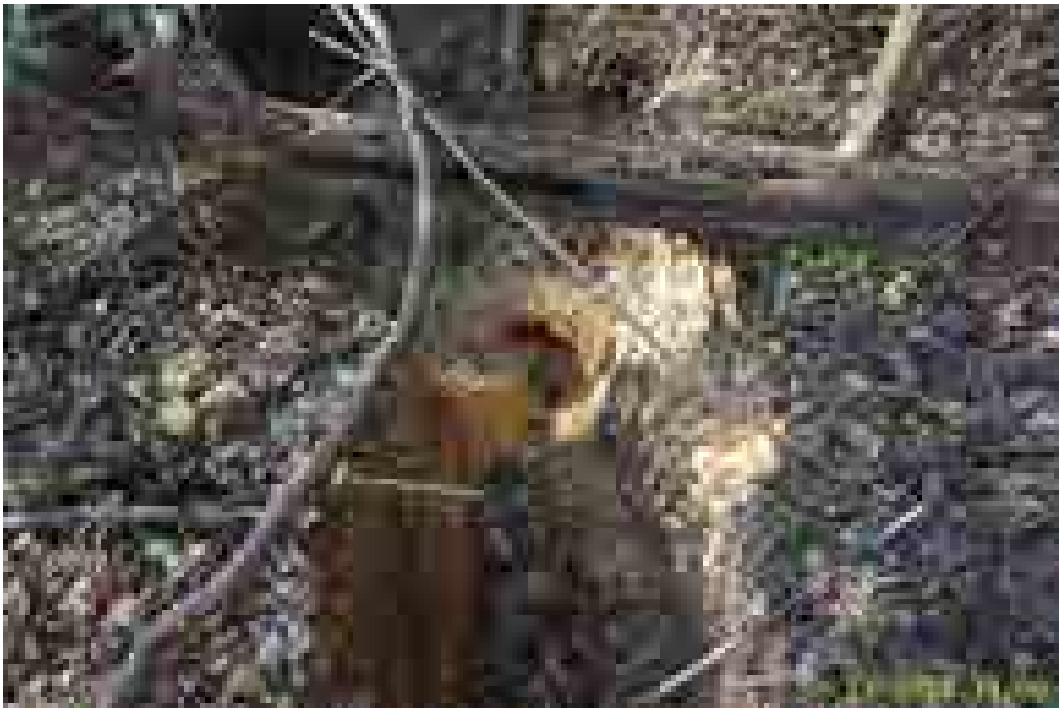
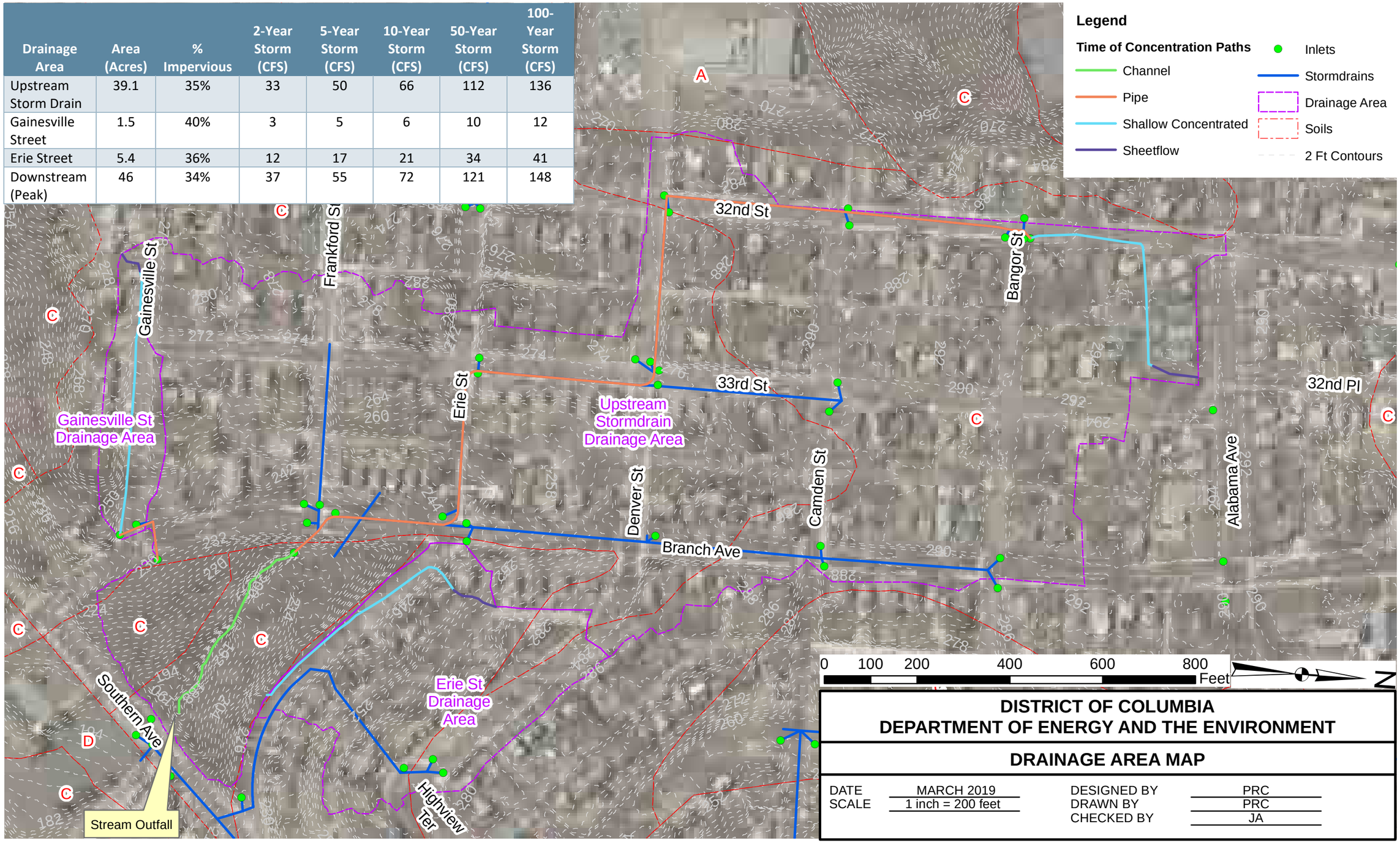


Photo 10 - Gully from Erie Street.

Appendix B. Drainage Area Map and Hydrology Calculations

Drainage Area	Area (Acres)	% Impervious	2-Year Storm (CFS)	5-Year Storm (CFS)	10-Year Storm (CFS)	50-Year Storm (CFS)	100-Year Storm (CFS)
Upstream Storm Drain	39.1	35%	33	50	66	112	136
Gainesville Street	1.5	40%	3	5	6	10	12
Erie Street	5.4	36%	12	17	21	34	41
Downstream (Peak)	46	34%	37	55	72	121	148



DISTRICT OF COLUMBIA
DEPARTMENT OF ENERGY AND THE ENVIRONMENT

DRAINAGE AREA MAP

DATE	MARCH 2019	DESIGNED BY	PRC
SCALE	1 inch = 200 feet	DRAWN BY	PRC
		CHECKED BY	JA

WinTR-55 Current Data Description

--- Identification Data ---

User: PC
Project: Branch Ave Stream Restoration
SubTitle: Existing Condition Hydrology
State: Washington D.C.
County: District of Columbia NOAA_C
Filename: P:\7018-001 Branch Avenue Park Stream Restoration\Task 3\Calculations\Hydrology\BranchAve_Hydrol

Date: 8/6/2019
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
US SD	US Stormdrains	Outlet	39.11	82	.753
Gainesv St	Gainesville Street SD	Outlet	1.45	84	0.1
Erie St	Surface water from ErieSt	Outlet	5.38	86	.149

Total area: 45.94 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.14	4.04	4.83	6.04	7.12	8.33	2.6

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: NOAA_C
Dimensionless Unit Hydrograph: <standard>

PC Branch Ave Stream Restoration
Existing Condition Hydrology
District of Columbia NOAA_C County, Washington D.C.

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)	5-Yr (cfs)	(hr)	10-Yr (cfs)	(hr)	50-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS										
US SD	33.22	12.53	50.22	12.52	65.69	12.51	111.50	12.53	136.10	12.49
Gainesv St	3.18	12.12	4.64	12.12	5.95	12.12	9.78	12.12	11.78	12.12
Erie St	11.52	12.14	16.52	12.14	20.93	12.15	33.75	12.14	40.54	12.14
REACHES										
OUTLET	36.64		55.13		71.82		121.47		147.85	

PC

Branch Ave Stream Restoration
Existing Condition Hydrology
District of Columbia NOAA_C County, Washington D.C.

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
US SD	39.11	0.753	82	Outlet	US Stormdrains
Gainesv St	1.45	0.100	84	Outlet	Gainesville Street SD
Erie St	5.38	0.149	86	Outlet	Surface water from ErieSt

Total Area: 45.94 (ac)

PC

Branch Ave Stream Restoration
Existing Condition Hydrology
District of Columbia NOAA_C County, Washington D.C.

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
US SD							
SHEET	100	0.0019	0.240				0.616
SHALLOW	512	0.0125	0.025				0.063
CHANNEL	2292	0.0354	0.013	7.07	9.42	17.685	0.036
CHANNEL	449	0.0530	0.050	1.46	4.39	3.282	0.038
					Time of Concentration		.753
Gainesv St							
SHEET	60	0.0579	0.011				0.009
SHALLOW	571	0.0689	0.025				0.030
CHANNEL	161	0.0069	0.013	1.77	4.71	4.969	0.009
					Time of Concentration		0.1
Erie St							
SHEET	100	0.1255	0.240				0.115
SHALLOW	60	0.1853	0.050				0.002
SHALLOW	467	0.0396	0.025				0.032
					Time of Concentration		.149

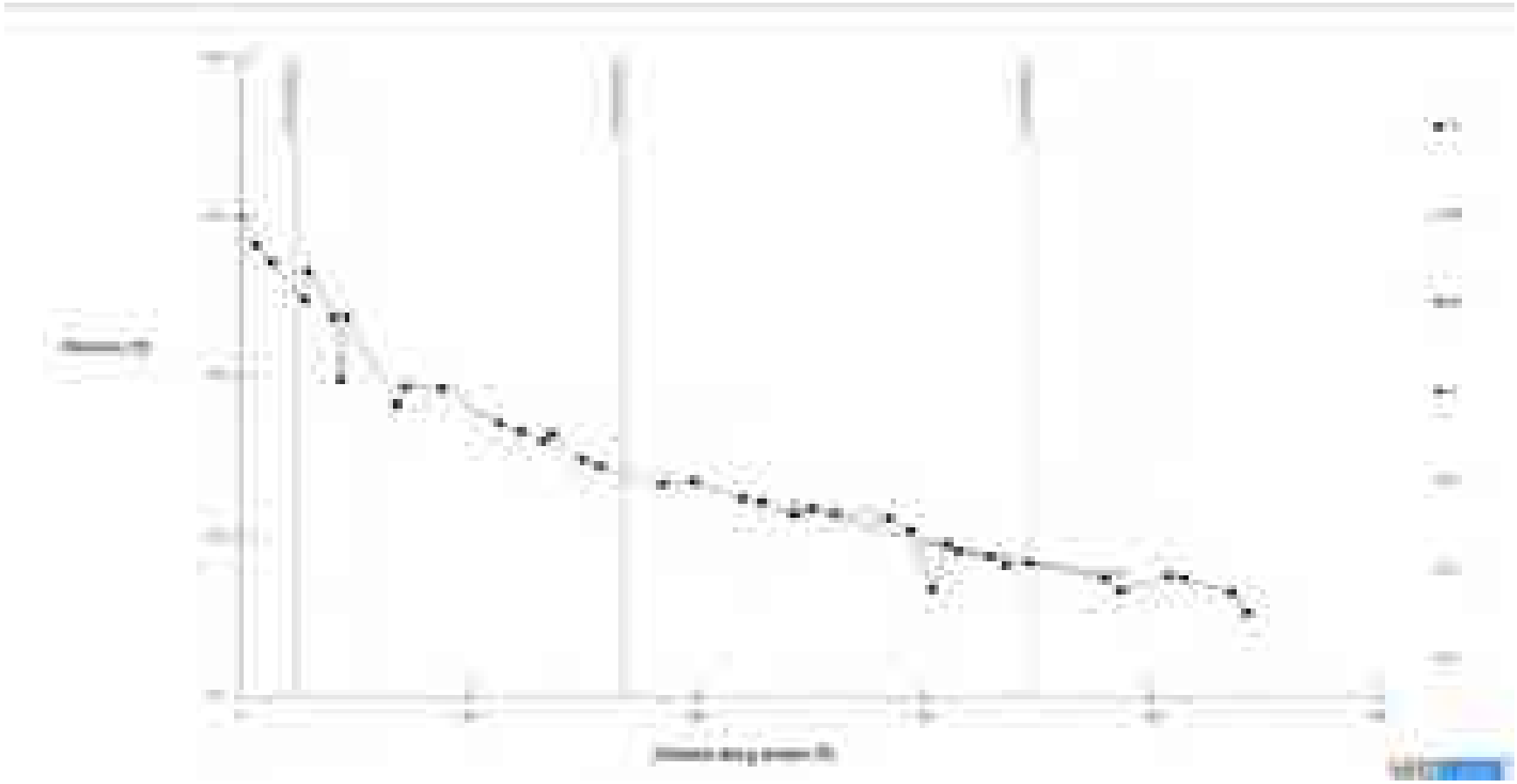
PC

Branch Ave Stream Restoration
Existing Condition Hydrology
District of Columbia NOAA_C County, Washington D.C.

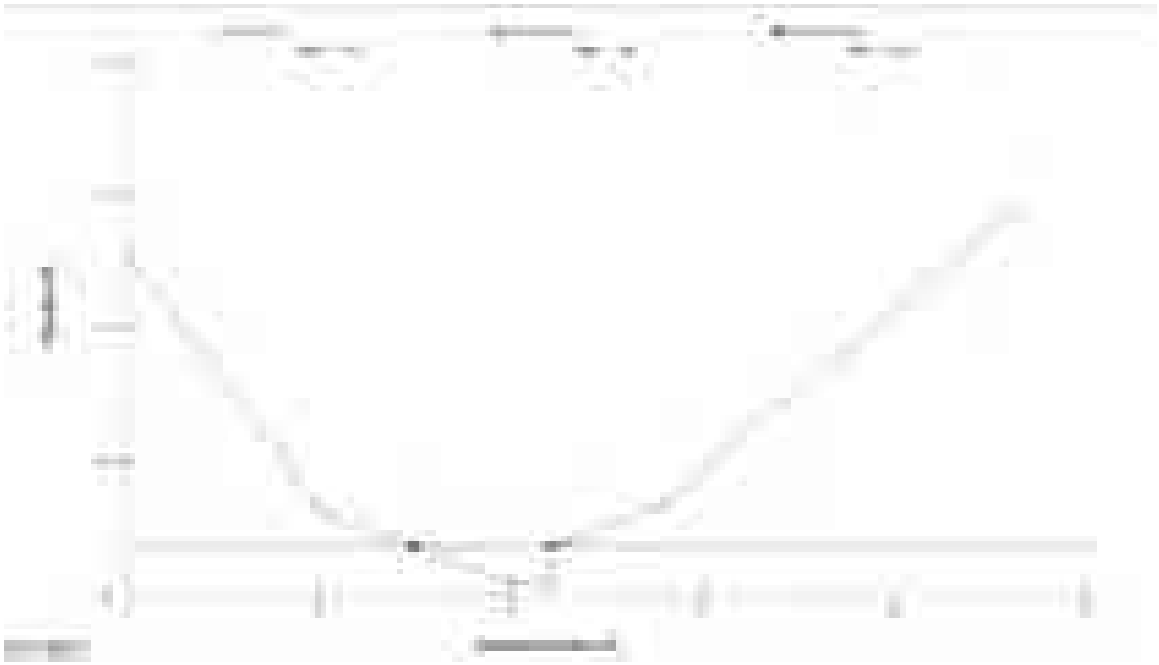
Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
US SD	Open space; grass cover > 75%	(good)	A	.004	39
	Open space; grass cover > 75%	(good)	C	20.052	74
	Open space; grass cover > 75%	(good)	D	.609	80
	Paved; curbs and storm sewers		A	.001	98
	Paved; curbs and storm sewers		C	13.619	98
	Paved; curbs and storm sewers		D	.15	98
	Woods	(good)	A	.014	30
	Woods	(good)	C	4.648	70
	Woods	(good)	D	.011	77
	Total Area / Weighted Curve Number			39.11	82
				=====	==
Gainesv St	Open space; grass cover > 75%	(good)	C	.828	74
	Paved; curbs and storm sewers		C	.583	98
	Woods	(good)	C	.039	70
	Total Area / Weighted Curve Number			1.45	84
				====	==
Erie St	Open space; grass cover > 75%	(good)	C	.864	74
	Open space; grass cover > 75%	(good)	D	2.55	80
	Paved; curbs and storm sewers		C	1.343	98
	Paved; curbs and storm sewers		D	.619	98
	Total Area / Weighted Curve Number			5.38	86
				====	==

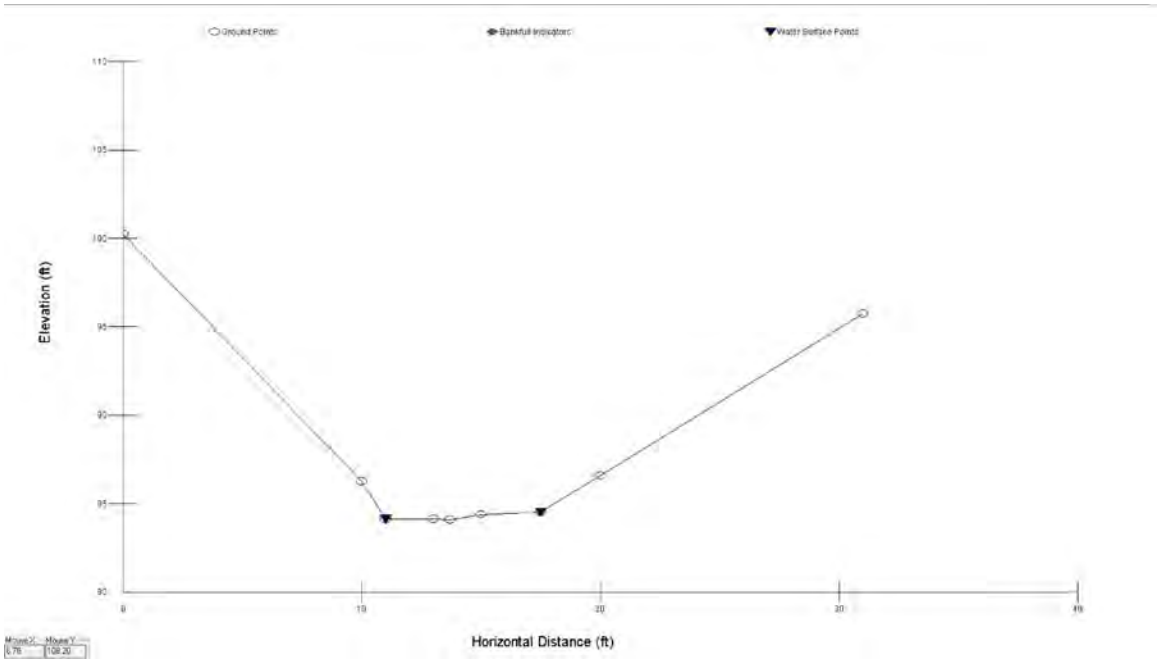
Appendix C. Geomorphic Survey



Existing Stream Profile



Cross Section 1



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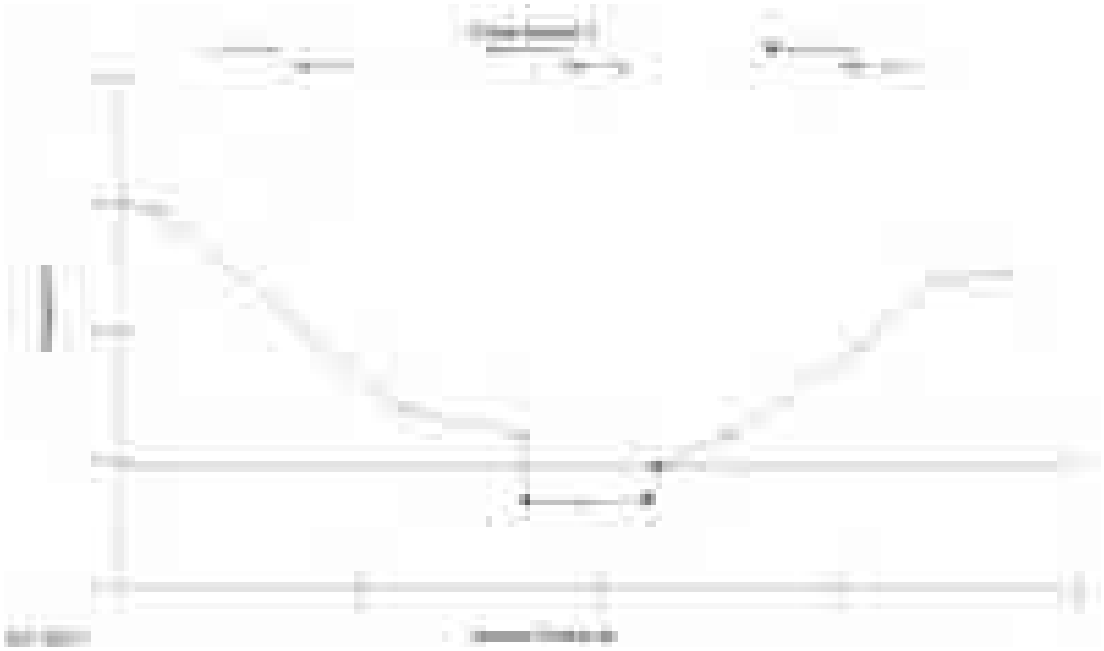

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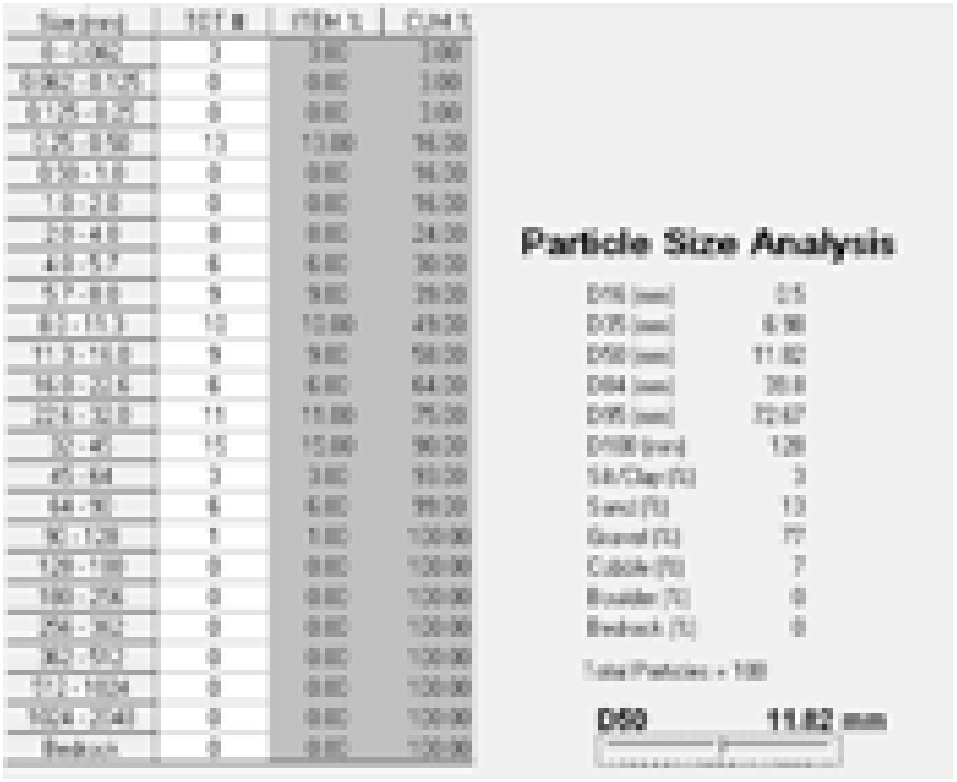

Size [mm]	TOT #	ITEM %	CUM %
[illegible]	3	3.00	3.00
[illegible]	0	0.00	3.00
[illegible]	0	0.00	3.00
[illegible]	13	13.00	16.00
[illegible]	0	0.00	16.00
[illegible]	0	0.00	16.00
[illegible]	8	8.00	24.00
[illegible]	6	6.00	30.00
[illegible]	9	9.00	39.00
[illegible]	10	10.00	49.00
[illegible]	9	9.00	58.00
[illegible]	6	6.00	64.00
[illegible]	11	11.00	75.00
[illegible]	15	15.00	90.00
[illegible]	3	3.00	93.00
[illegible]	6	6.00	99.00
[illegible]	1	1.00	100.00
[illegible]	0	0.00	100.00
[illegible]	0	0.00	100.00
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[illegible]	0	0.00	100.00
[illegible]	0	0.00	100.00
[illegible]	0	0.00	100.00
[illegible]	0	0.00	100.00

Particle Size Analysis

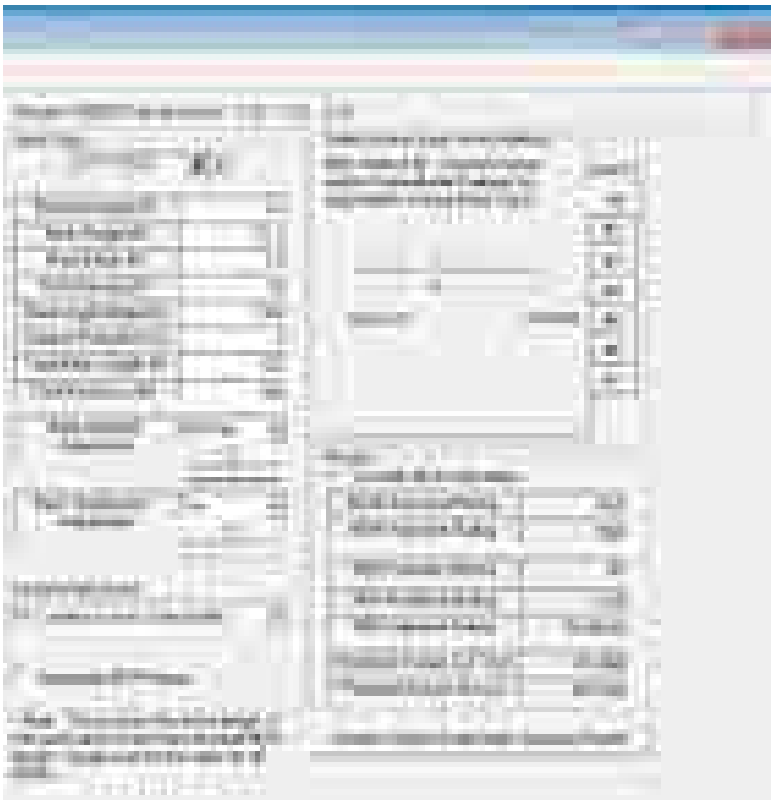
D16 [mm]	2.5
D35 [mm]	6.50
D50 [mm]	11.82
D84 [mm]	20.8
D95 [mm]	32.67
D100 [mm]	128
Silt/Clay [%]	3
Sand [%]	13
Gravel [%]	77
Cobble [%]	7
Boulder [%]	0
Bedrock [%]	0

Total Particles = 100

D50 11.82 mm

Cross Section 3 Pebble Count

Cross Section 1 RIVERMorph Results



Cross Section 2 RIVERMorph Results

Cross Section 3 RIVERMorph Results

Appendix D. Wetland Delineation Report

Revision History Table

Version	Date	Notes
Rev 0	03/08/2019	Draft report submitted to Actaeon for review and comment.

Table of Contents

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Appendices

1. Introduction

Straughan Environmental, Inc., (SEI) under contract to Actaeon, evaluated the potential presence of jurisdictional water resources and identified permitting issues[1] applicable to Branch Avenue Park Stream Restoration at Branch Avenue in Washington, DC (Figure 1). The purpose of the proposed project is to restore the stream that flows through Branch Avenue Park which will result in the restoration of natural hydrology, prevention of erosion, reduction of stormwater pollution and will enhance and create wildlife habitat. This project will also provide the community with a walking trail for safe access through the park. This memorandum provides the results of the completed office and field investigation to identify waters of the U. S. and state, including wetlands, conducted on January 2nd and 17th, 2019. The project vicinity is shown on Figure 1, the study area is illustrated on Figure 2, and the results of the field investigation are presented on Figure 3.

2. Methods

Prior to the field investigation, SEI performed a desktop survey of publicly available data to identify potential jurisdictional waters, including wetlands, using United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps; United States Department of Agriculture (USDA), National Resources Conservation Service (NRCS), Soil Survey Geographic database (SSURGO) maps; Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM); United States Geological Survey (USGS) topographic maps; and Environmental Systems Research Institute (ESRI) aerial mapping (see Figure 2).

SEI conducted a field investigation on January 2nd and 17th, 2019 to further refine and ground-truth the results of the desktop survey. SEI identified and delineated the waters using methodology described in the *Army Corps of Engineers Wetland Delineation Manual 1987*, appropriate *Regional Supplement*, *Regional Guidance Letter No. 05-05: Ordinary High-Water Mark Identification,* and applicable supplements, court rulings, and federal policies. SEI also conducted a specimen tree survey within the study area. Trees within 50 feet of the area of work were surveyed, identified by species, measured (Diameter at Breast Height (DBH) in inches), and given a condition rating (good, fair, poor). Field data sheets and representative photographs are located in Appendix A and B, respectively.

3. Results

The NWI map for this area does not identify any potential jurisdictional waters, including wetlands within the study area. The SSURGO soils map does not identify any hydric soils within the study area. The FEMA FIRM map shows the study area is located within the Zone X flood

[1] This report discusses resources potentially regulated under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) as administered by the United States Army Corps of Engineers. This report does not include discussion of other resources potentially present within the project area that may be subject to additional regulatory constraints, permits, approvals, or authorizations. Examples of such resources include roadside and specimen trees; woodlands/forests; rare, threatened, and endangered species, etc.

zone on Map Panel 1100010077C. Zone X flood zones are defined as areas that have a minimal flood hazard; they are determined to be between the limits of the 100-year and 500-year flood.

Wetlands/waterways are not shown on the USGS topographic maps for the study area. Wetlands/waterways do not appear to be present within the study area on available aerial photography.

District water quality standards include the following surface water use categories.

Categories of Uses that Determine Water Quality Standards	**Classes of Water**
Primary contact recreation	A
Secondary contact recreation and aesthetic enjoyment	B
Protection and propagation of fish, shellfish, and wildlife	C
Protection of human health related ..... to consumption of fish and shellfish	D
Navigation	E

The project reach is a tributary to Oxon Run. Oxon Run's current use is B, C, D. It's designated use is A, B, C, D.

During the field investigation, SEI identified one wetland, two waterways, and 87 trees, eight of which are heritage trees with a DBH greater than 31.8 inches (see Figure 3). These environmental features are briefly described in Tables 1 and 2 below. Datasheets and photographic documentation are attached.

If these systems were to be permanently or temporarily impacted by the project, an authorization from the United States Army Corps of Engineers (USACE) and a water quality certificate from the Washington, DC Department of Energy and the Environment (DOEE) may be required.

Limits of waterways and wetlands as depicted are based on best professional judgement and are subject to review by regulatory agencies and their representatives. Limits of jurisdictional waters are not considered final until reviewed by the USACE.

Table 1. Delineated Wetland Summary

System ID	Cowardin Classification	Hydrologic Indicator(s)	Vegetation				Hydric Soil Indicator(s)	Wetland of Special State Concern
			Common Name	Scientific Name	Indicator Status	Hydrophytic Indicator(s)		
WP002	PEM	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8)	**American Elm** English Ivy	***Ulmus americana*** *Hedera helix*	**FAC** FACU	Dominance Test	Depleted Matrix (F3)	N/A

Table 2. Delineated Waterway Summary

Stream ID	Use Class	Closure Period	Cowardin Classification	Flow Type	Nexus to TNW	Common Substrate	Stream Characteristics	Avg. Bank Width	Avg. Bank Height
WL004	B, C, D	N/A	---	Perennial	Waterway flows into an unnamed tributary to Oxon Run	Silt Sand Clay Gravel Cobble	Highly eroded stream with a visible clay aquitard. Flows east from a culvert under Branch Avenue, through the study area, and exits through a culvert under Southern Avenue.	10 ft	5 ft
WL005	B, C, D	N/A	---	Ephemeral	Flows into WL004 which flows into and unnamed tributary to Oxon Run	Silt Sand Gravel Concrete	Highly eroded stream channel that flows into WL004. The average bank height is less than 1 ft throughout most of the channel, except for the beginning and end which reached up to 5-10 ft. Water begins to flow at WL005-010.	3 ft	3 ft

Figure 1. Vicinity Map

Figure 2. Published Information Map

Figure 3. Delineated Resources Map

References

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World Imagery Base Map. Esri, DeLorme, HERE, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, TomTom.

Appendices

Appendix A. Wetland Delineation and Stream Characterization Datasheets

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Remarks:

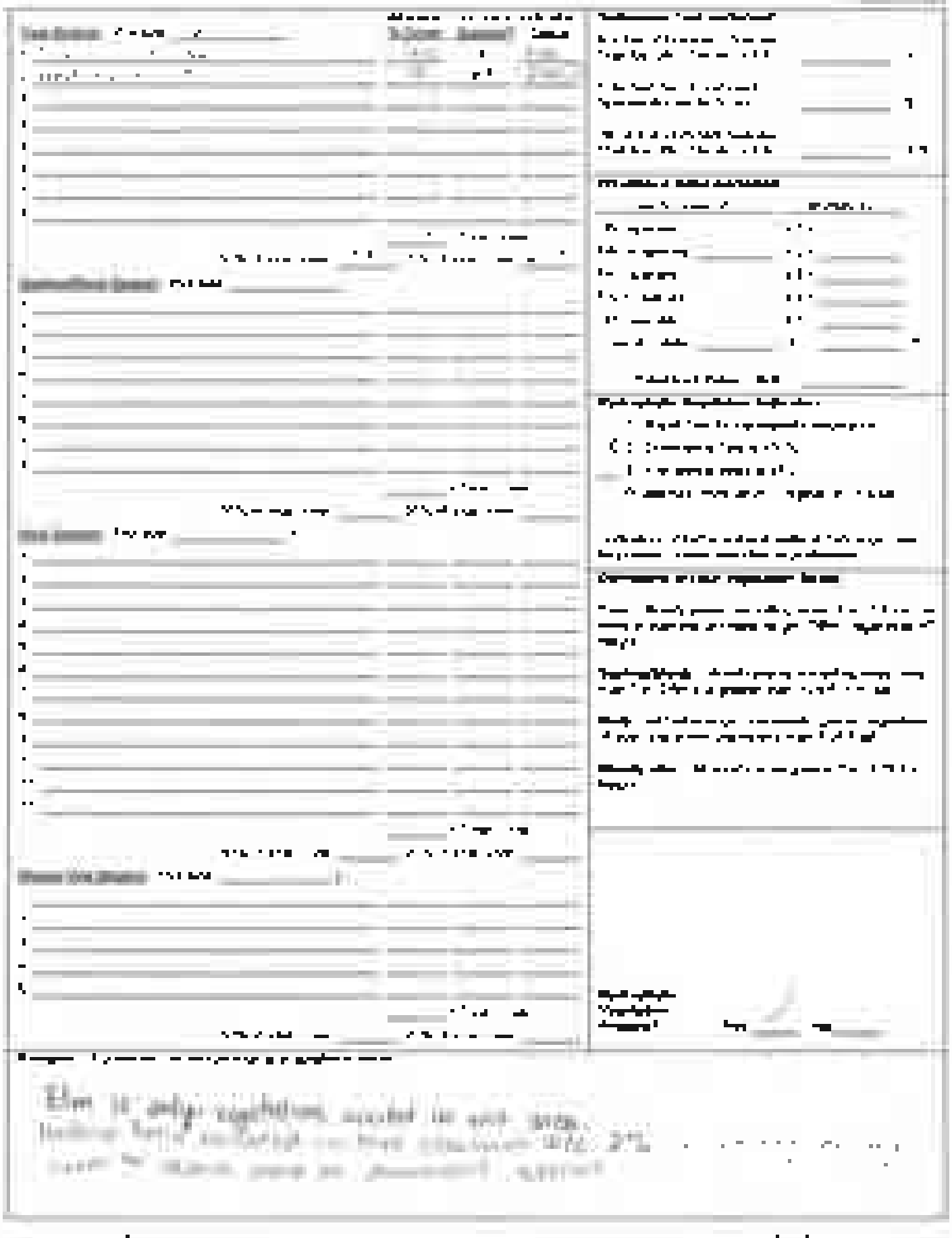
HYDROLOGY

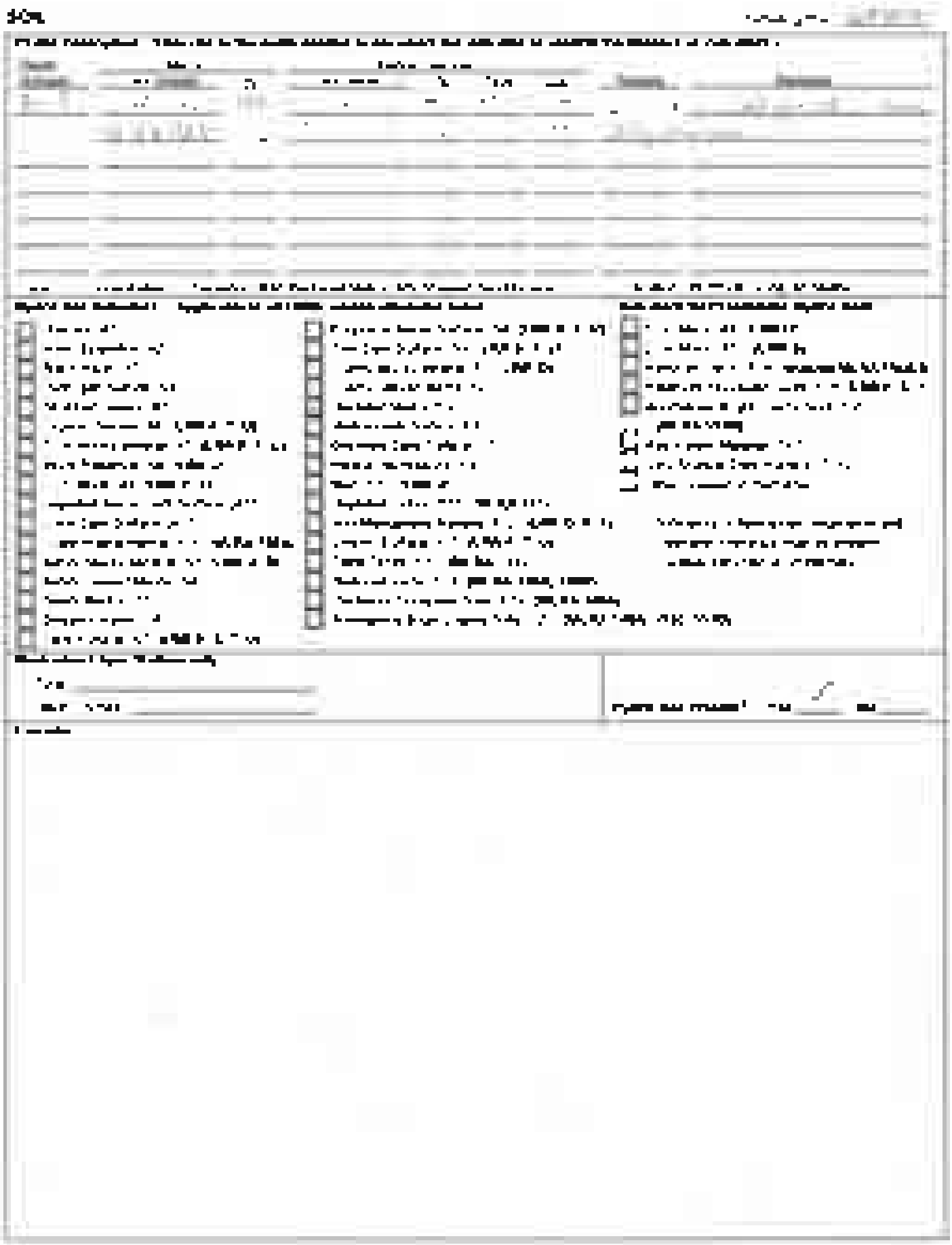
Wetland Hydrology Indicators:

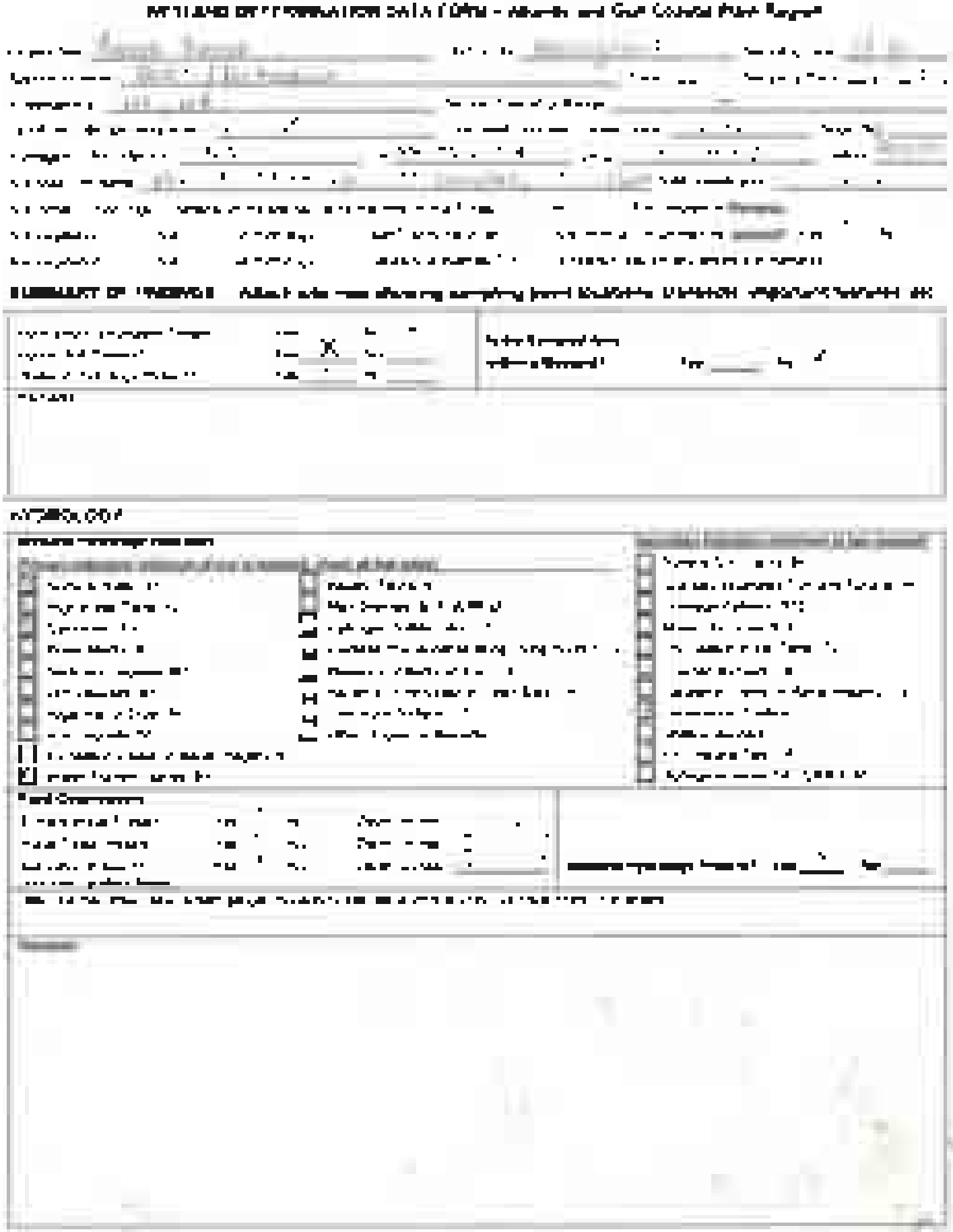
Secondary Indicators (minimum of two required)

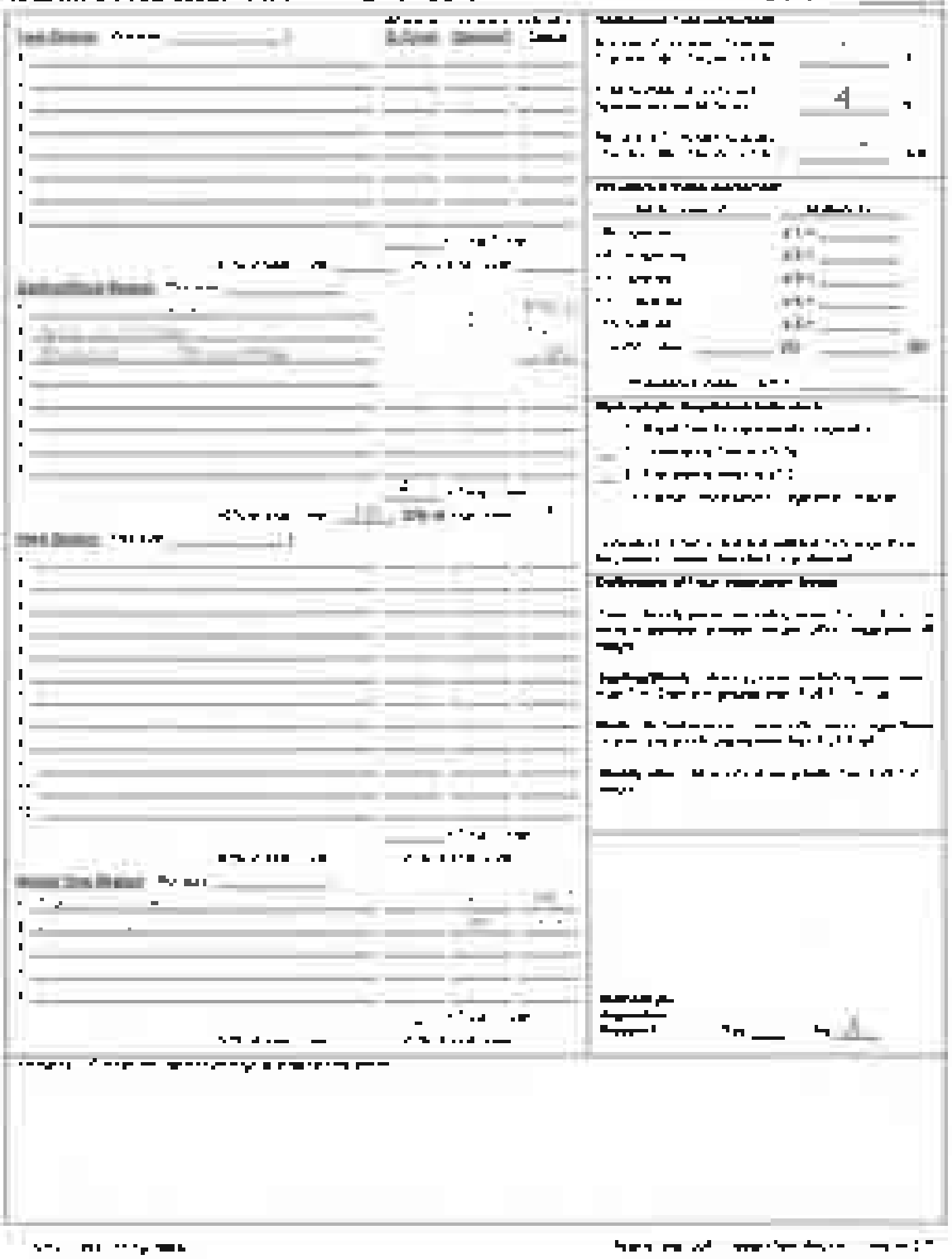
Field Observations:

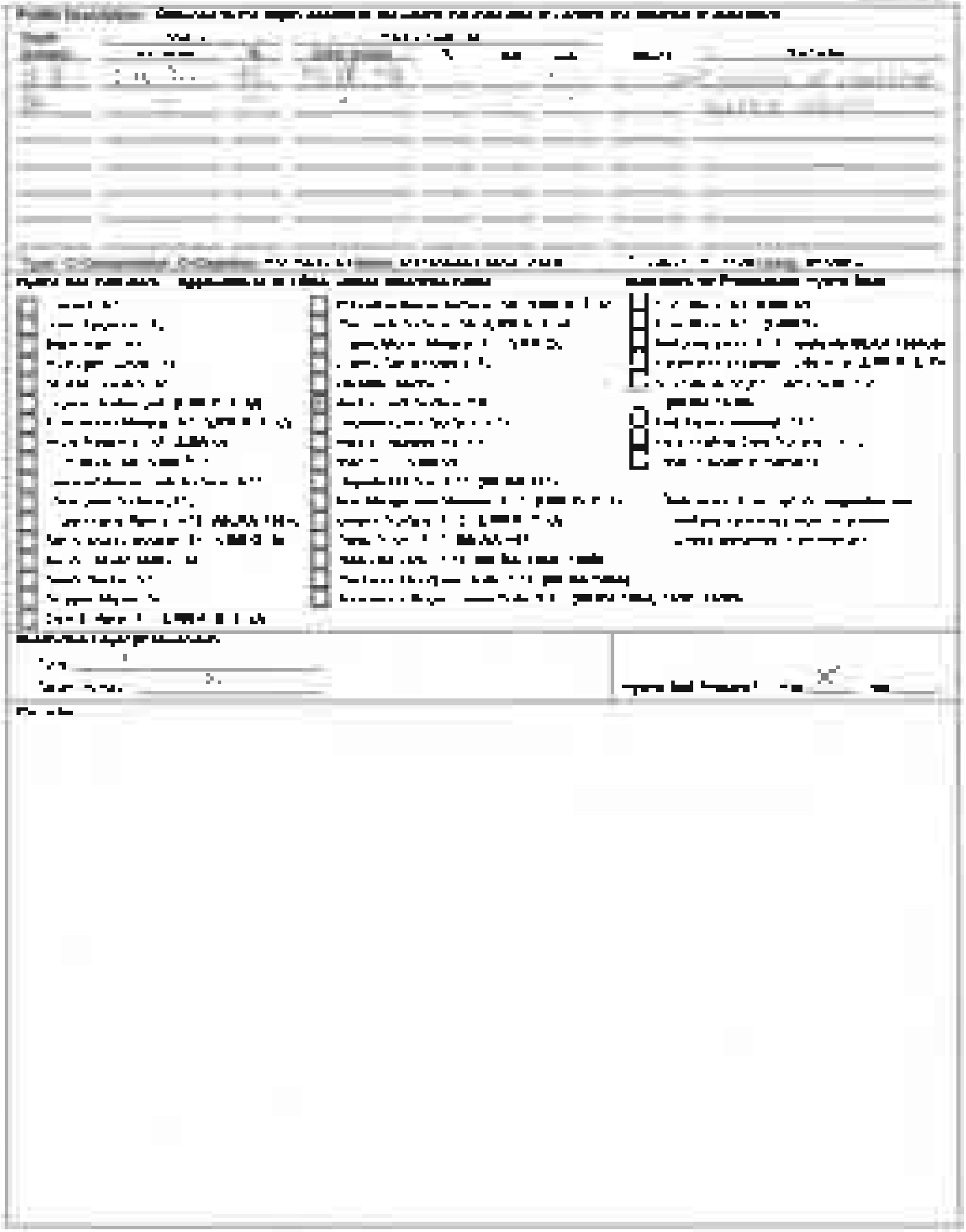
Remarks:

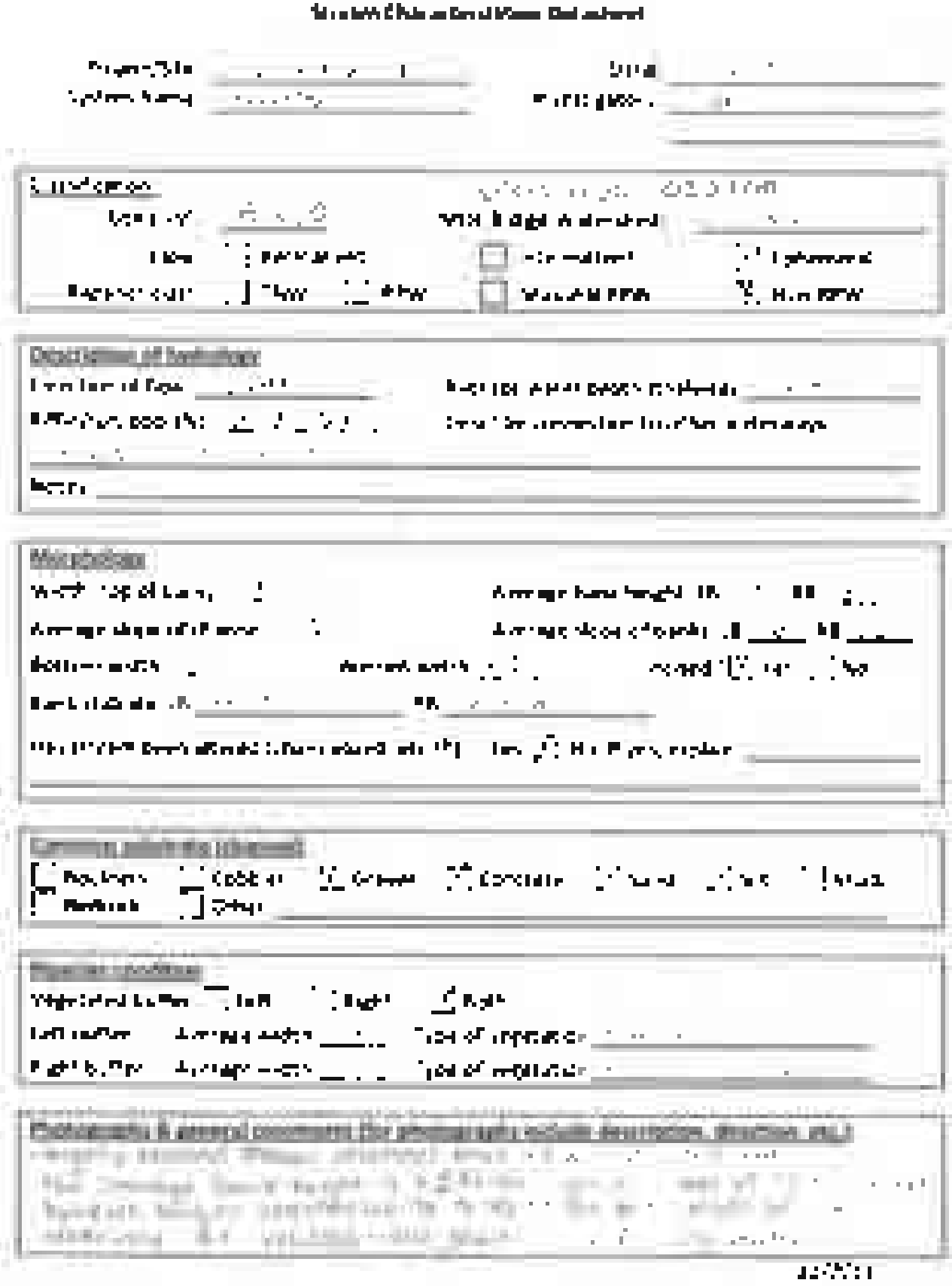












Appendix B- Photographic Documentation

WP002-Overview of wetland, facing north

WP002-Draining into WL004, facing south

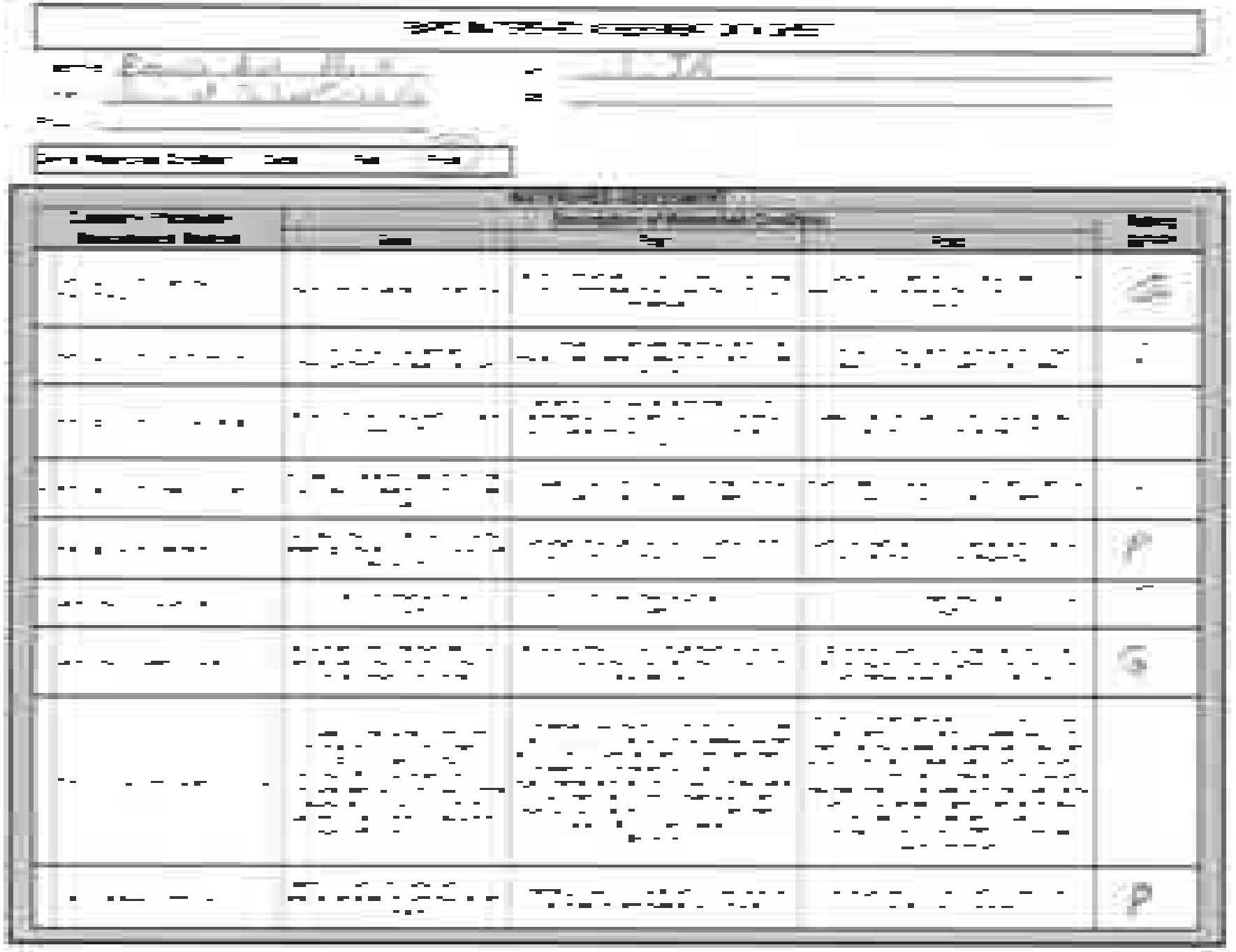
WL004-Facing upstream (north west), north of WL005

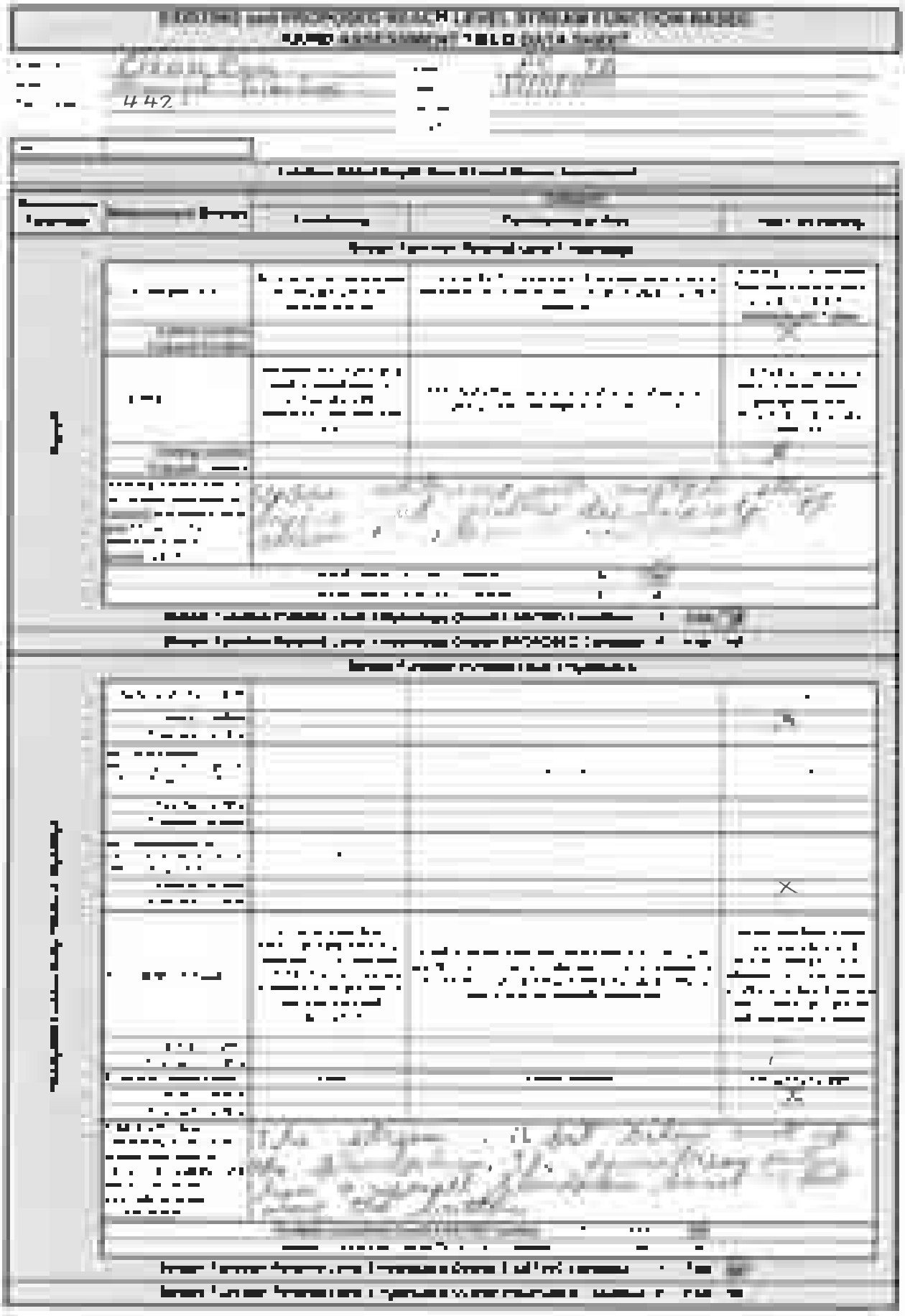
WL004-Facing downstream (south east), south of WL005

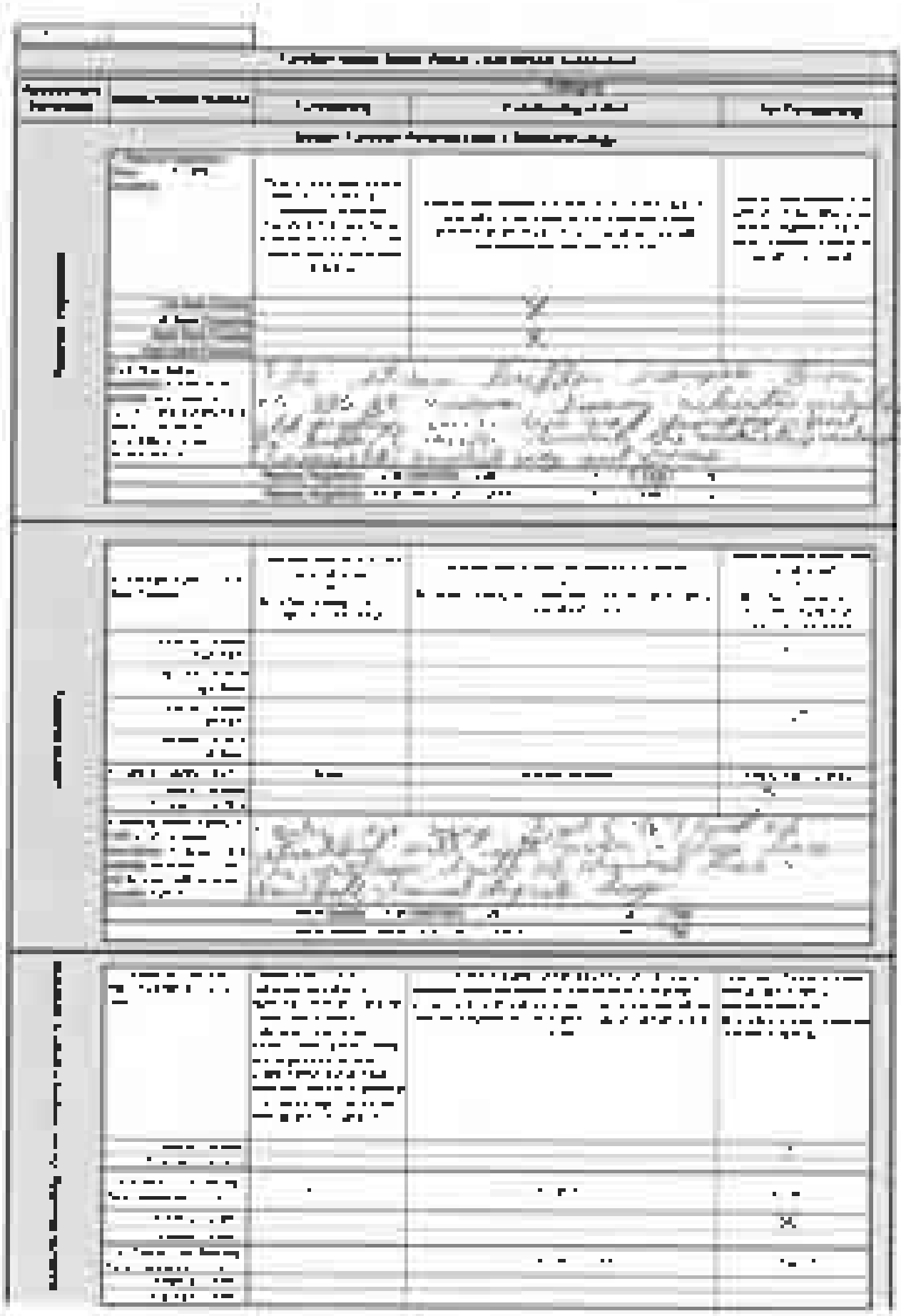
WL005-Facing upstream (north east), towards Erie Street

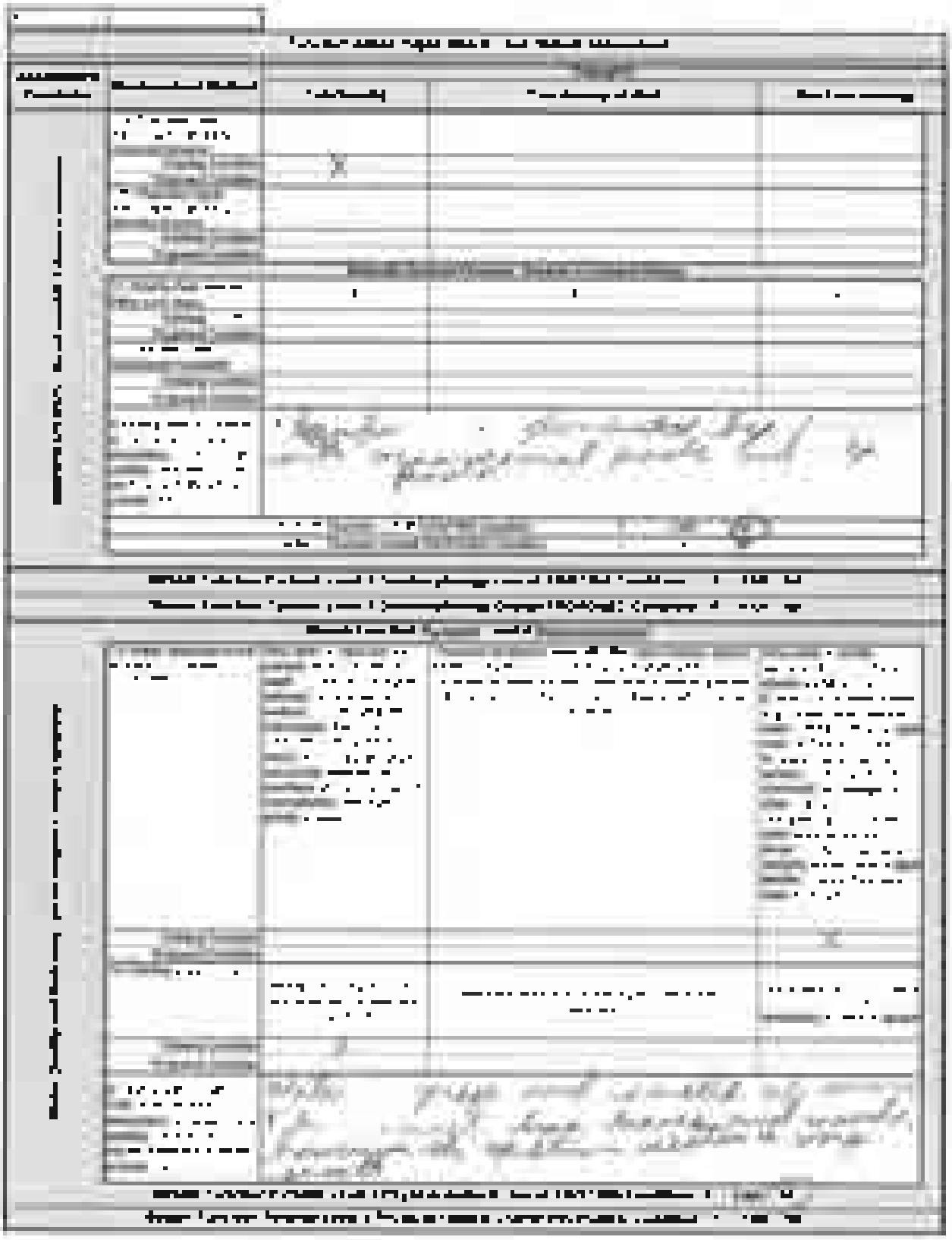
WL005-Facing downstream (south west), towards WL004

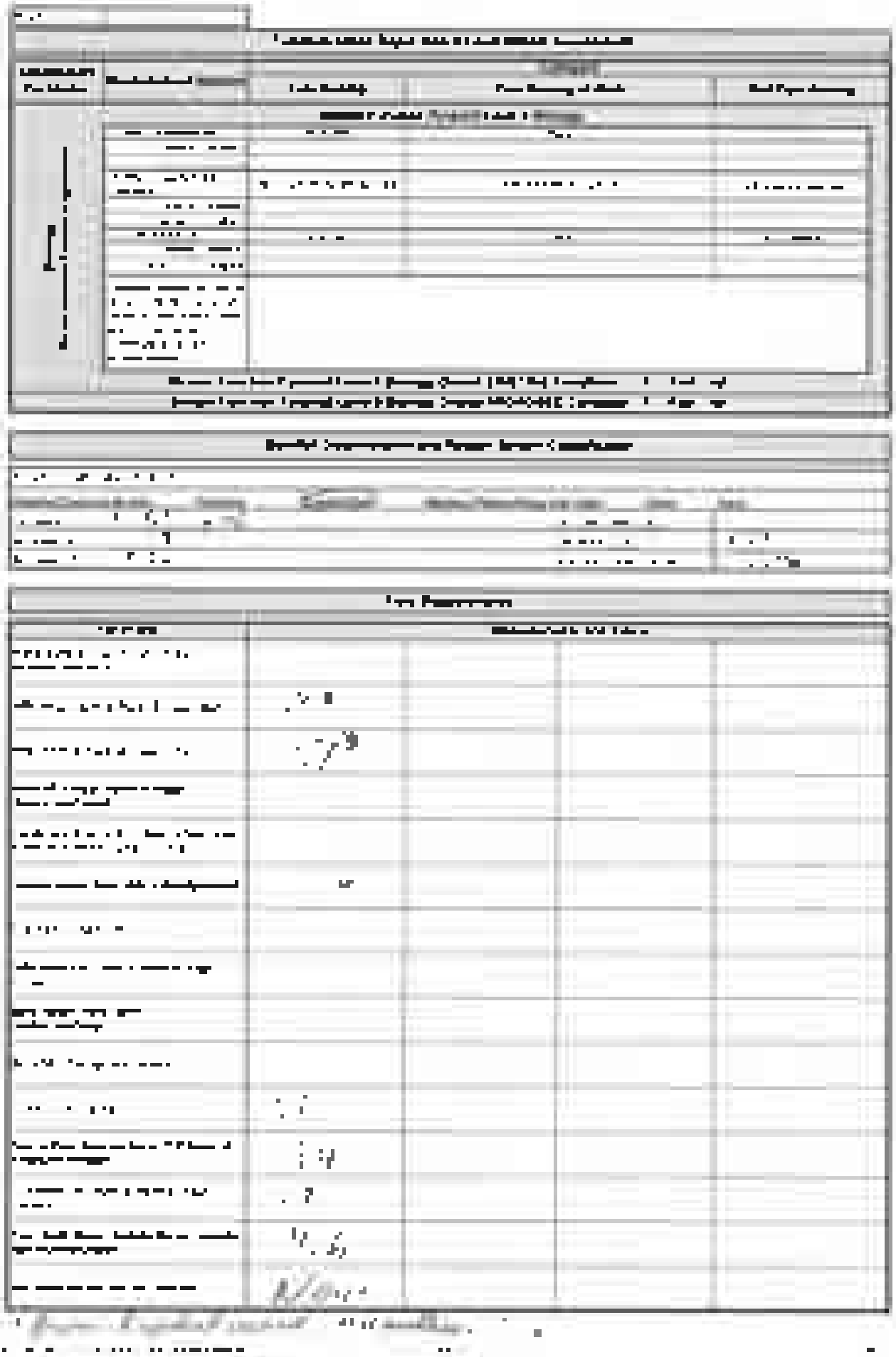
Appendix E. Functional Assessment

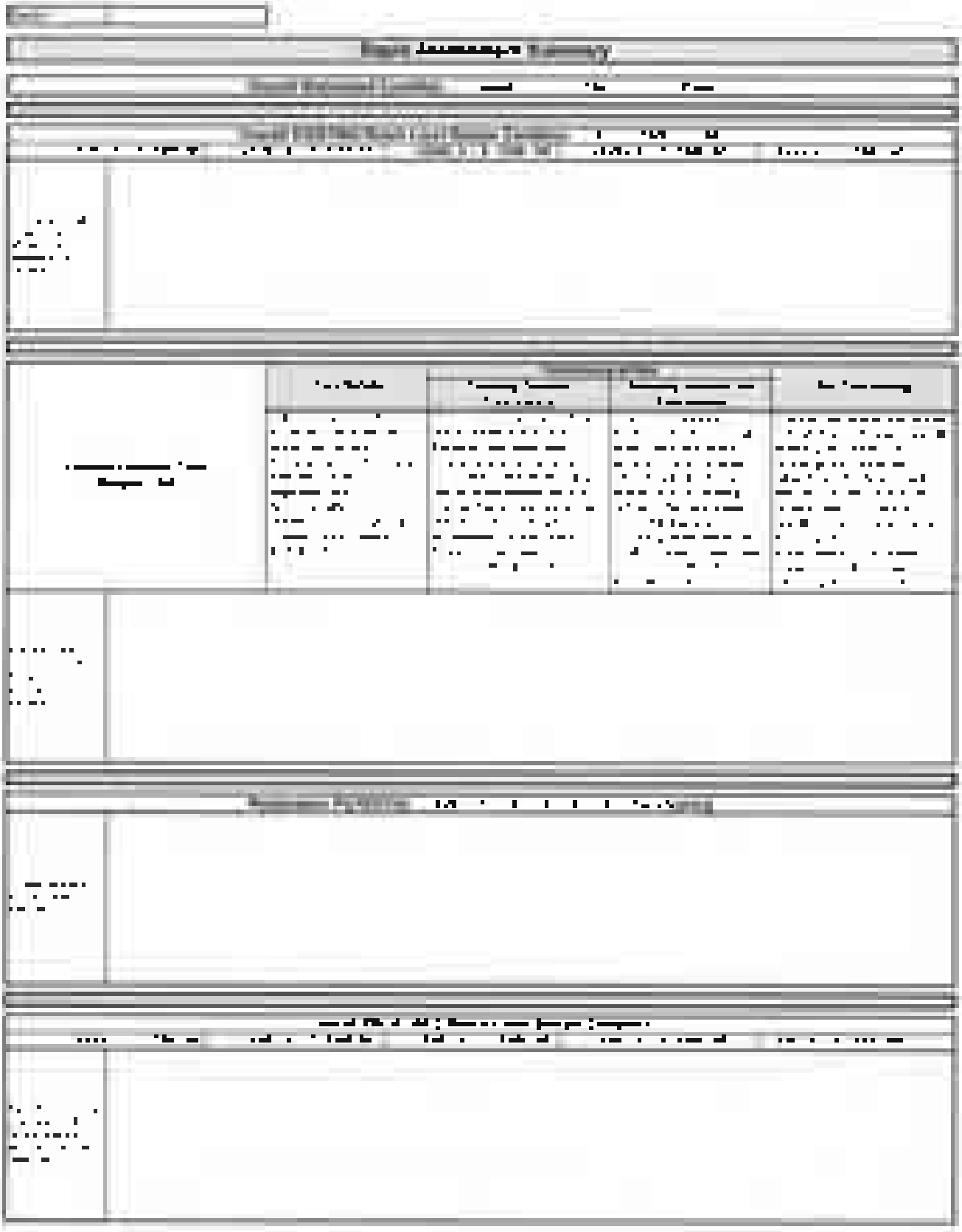






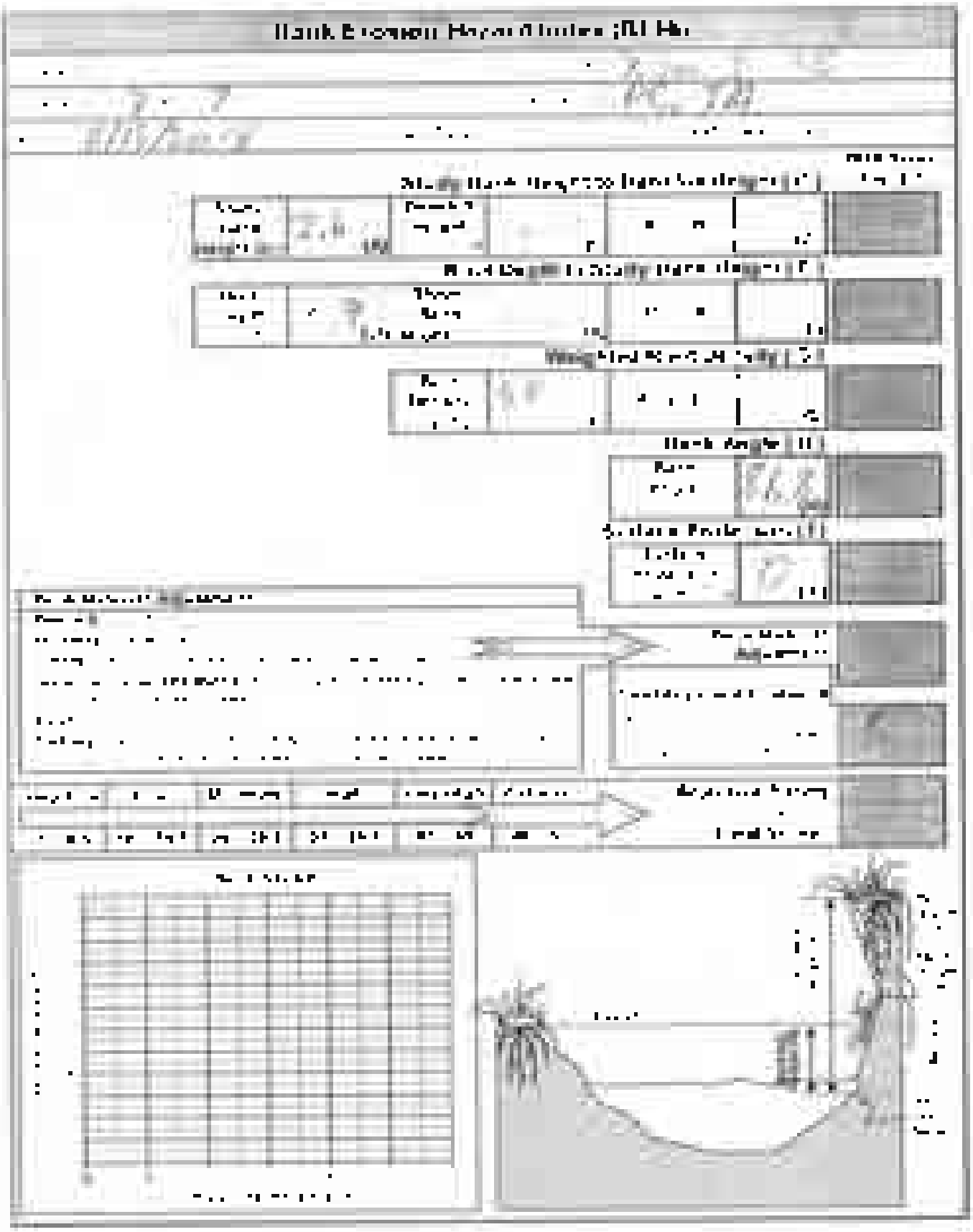




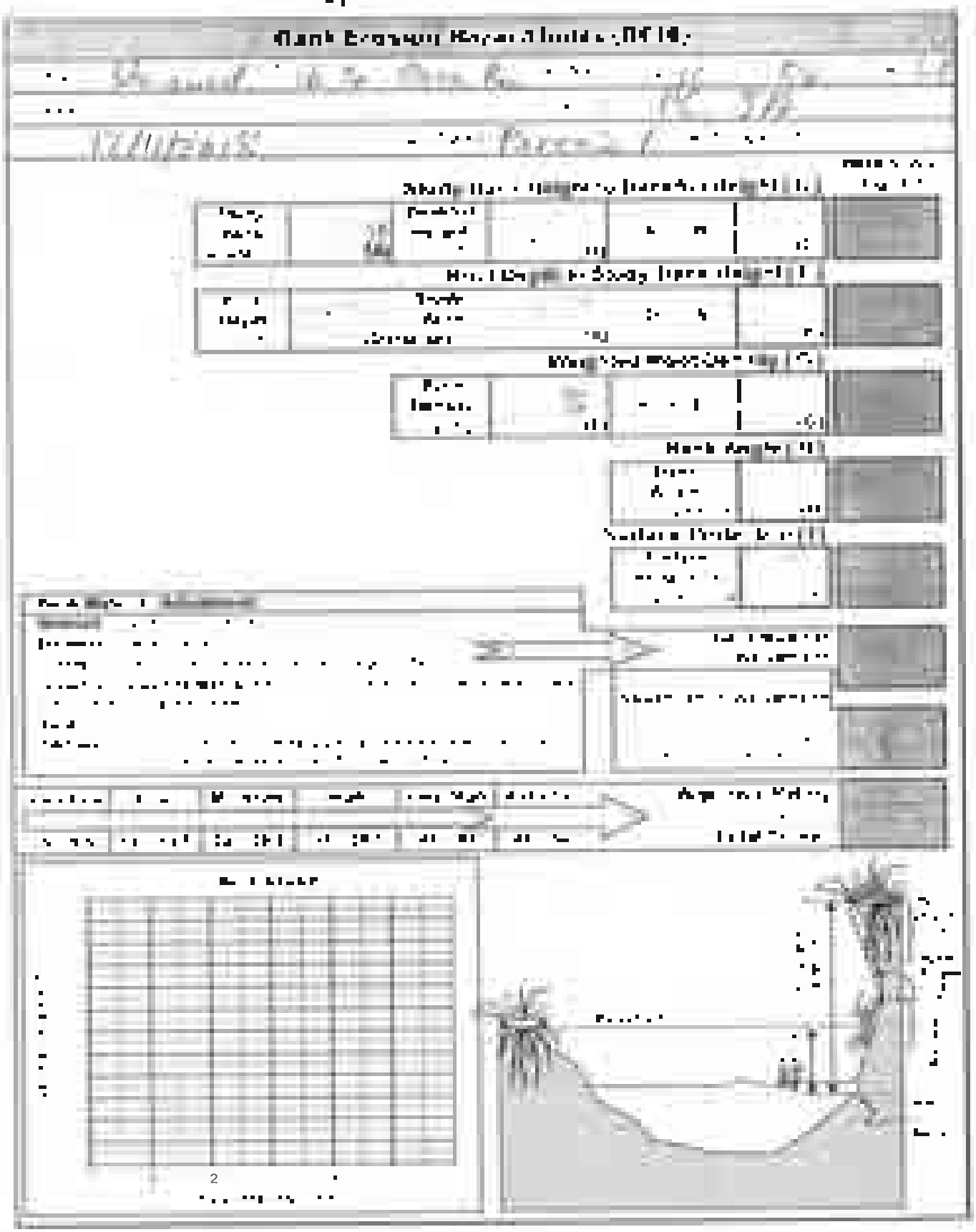


Appendix F. Nutrient Credit Estimation

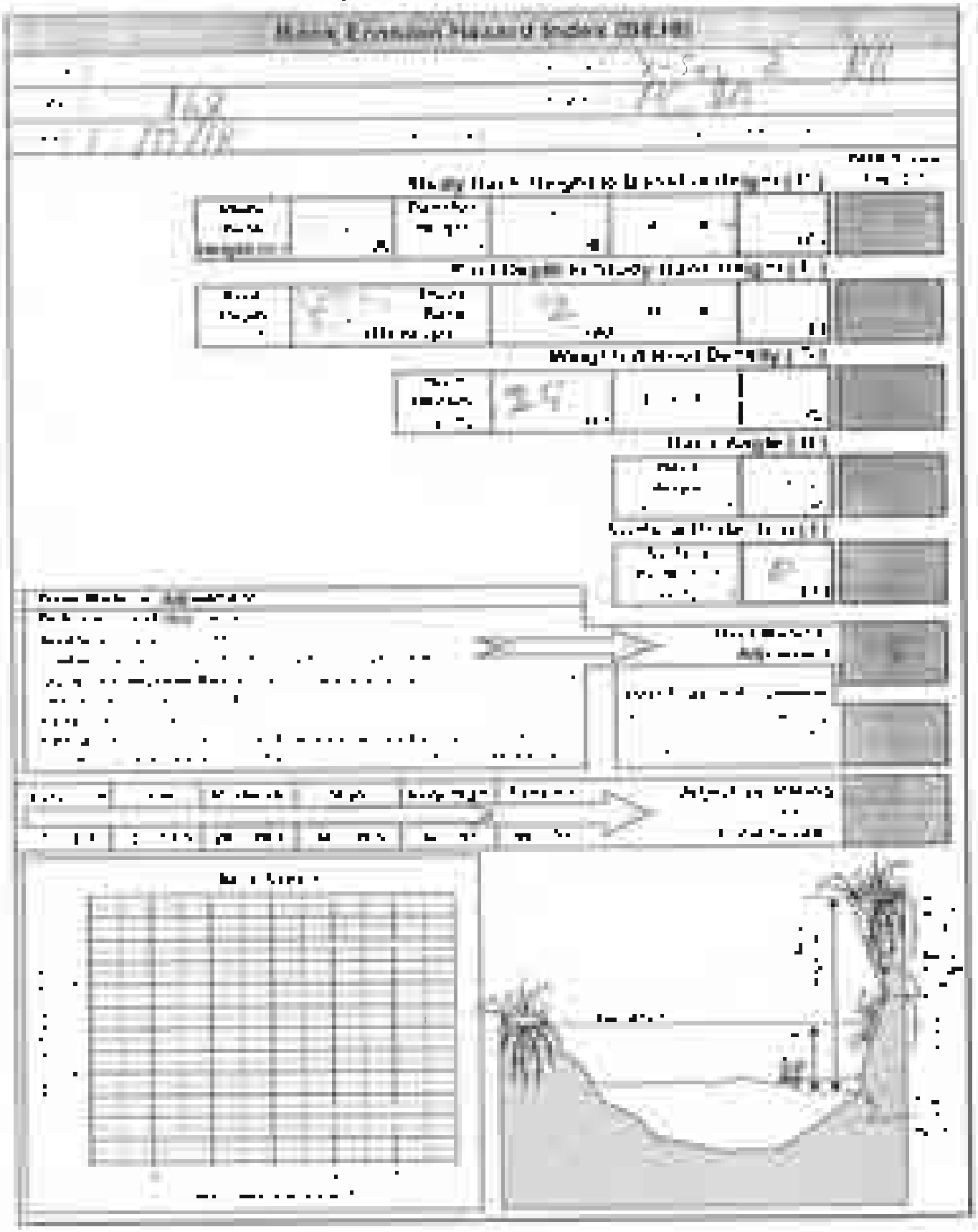
Updated BEHI Worksheet



Updated REHI Worksheet



Updated ISFHI Worksheet



Project Name: Branch Avenue Park Stream Restoration
Computed by: PRC
Location: Southeast, Washington, D.C.
Watershed: Potomac River

Reach	Bank Length (ft)	Total Bank Length (ft)	Bank Height (ft)	Erosion (ton/yr) from RIVERMorph	Phosphorus Loading Rate (lb P/Ton Sediment)	Total Phosphorus (lb/yr)	Nitrogen Loading Rate (lb N/Ton Sediment)	Total Nitrogen (lb/yr)	Practice Efficiency Rate	Prevented Sediment (Ton/yr)*	Prevented Phosphorus (lb/yr)	Prevented Nitrogen (lb/yr)
1	76	152	12.24	14.33	1.05	15.05	2.28	32.68	50%	0.4	7.5	16.3
2	236	472	11.2	40.72	1.05	42.76	2.28	92.85	50%	1.2	21.4	46.4
3	130	260	2.6	23.76	1.05	24.95	2.28	54.17	50%	0.7	12.5	27.1
Total	442	884		78.82		82.76		179.70		**2.4**	**41.4**	**89.9**

**As this project is in the coastal plain, it includes a Sediment Delivery Ratio of 0.061*

Appendix G. Structure Design Calculations

Project Name: Branch Avenue Park Stream Restoration
Computed by: PRC
Location: Southeast, Washington, D.C.
Watershed: Potomac River

REGENERATIVE SPSC CALCULATOR
(Based on Anne Arundel County SPSC Guidelines, 2012)

Restoration Location	RSC Structure Sizing			
Stationing	Weirs	4¼ ft Cascades	5 ft Cascades	Riffle*
Design Flow (cfs) (100-yr Storm)*	136	136	136	1
Weir/Cascade?	Weir	Cascade	Cascade	Weir
Width (ft)	15	15	15	10
Length (ft)	15	15	18	5
Parabolic Depth (ft)	2	2	2	0.5
Vertical Drop (ft)	1	4.25	5	0.5
Average side slopes (X:1)	3.8	3.8	3.8	10.0
Slope (ft/ft)	0.07	0.28	0.28	0.10
D50 (in)	12	30	30	9
Rock Unit Weight (lbs/cf)	165	165	165	165
Depth of flow (ft)	1.86	1.26	1.27	0.27
Manning's n Value	0.056	0.050	0.050	0.182
Top Width at Depth	14.5	11.9	12.0	7.3
Flow area (sf)	17.9	10.0	10.1	1.3
Wetted Perimeter (ft)	15.1	12.3	12.3	7.4
Flow (cfs)	137.95	138.11	139.09	1.09
Froude	0.99	2.17	2.15	0.28
Velocity	7.69	13.81	13.74	0.82
Isbash Maximum Velocity (ft/s)	12.3	14.0	14.0	10.7

**Riffles are designed for the 1-Inch storm*

Project Name:	Branch Avenue Park Stream Restoration
Computed by:	PRC
Location:	Southeast, Washington, D.C.
Watershed:	Potomac River

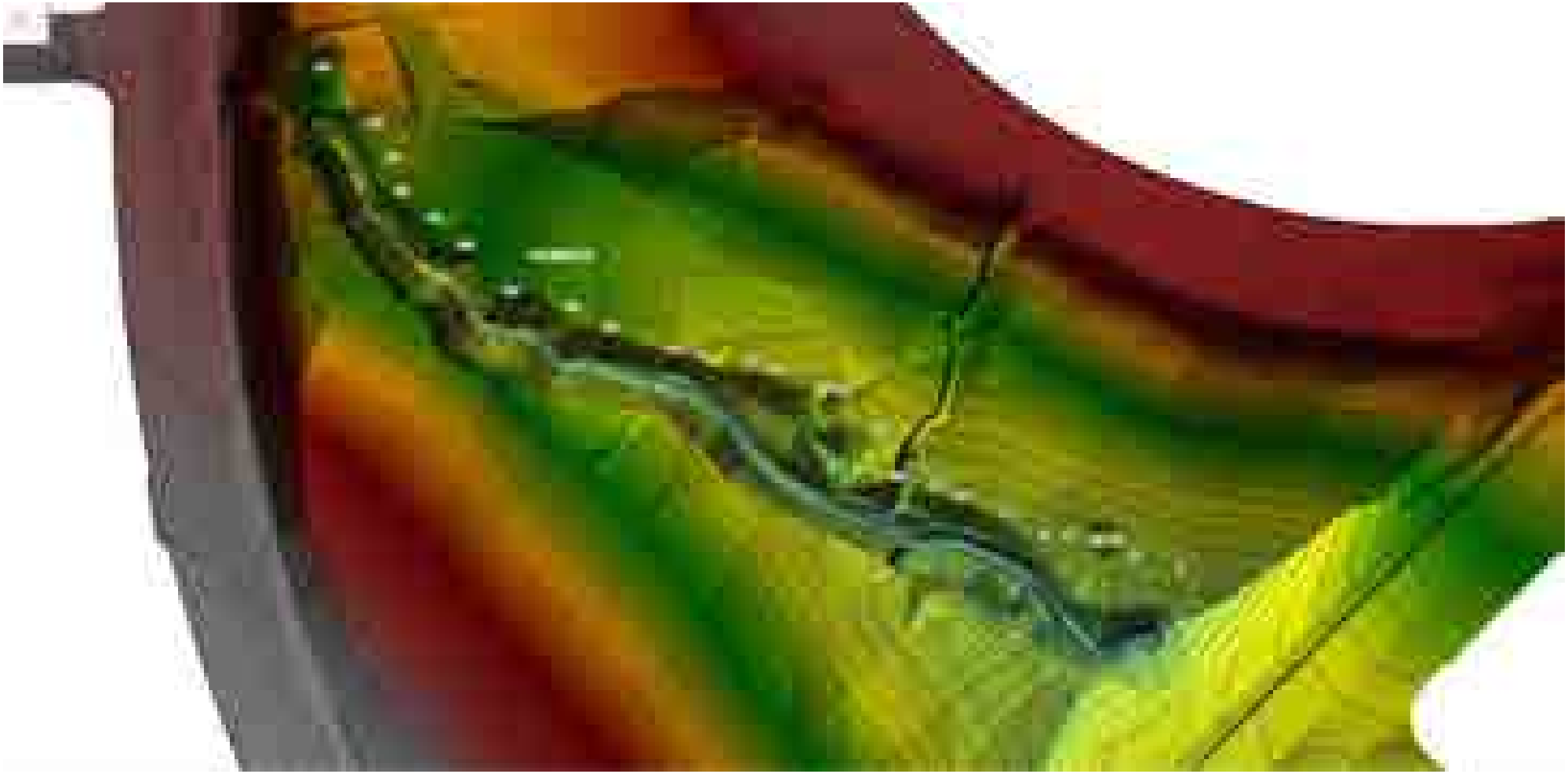
REGENERATIVE SPSC CALCULATOR

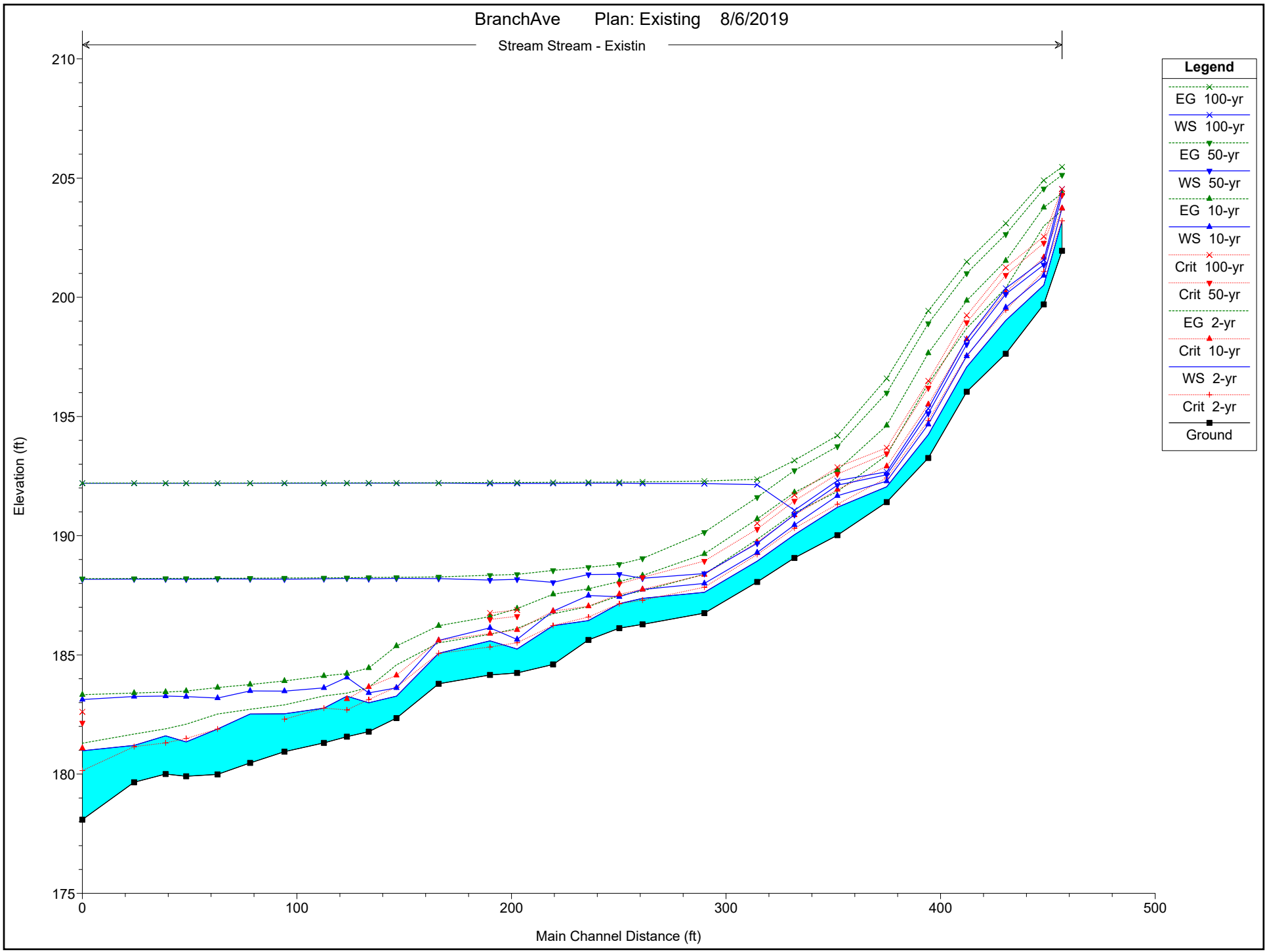
(Based on Anne Arundel County SPSC Guidelines, 2012)

Restoration Location — Erie St SPSC Structure Sizing

Stationing	5 ft Cascades	6 ft Cascades
Design Flow (cfs) (100-yr Storm)*	39	39
Weir/Cascade?	Cascade	Cascade
Width (ft)	10	10
Length (ft)	10	10
Parabolic Depth (ft)	2	2
Vertical Drop (ft)	5	6
Average side slopes (X:1)	2.5	2.5
Slope (ft/ft)	0.50	0.60
D50 (in)	30	30
Rock Unit Weight (lbs/cf)	165	165
Depth of flow (ft)	0.75	0.72
Manning's n Value	0.050	0.050
Top Width at Depth	6.1	6.0
Flow area (sf)	3.1	2.9
Wetted Perimeter (ft)	6.4	6.2
Flow (cfs)	39.49	39.64
Froude	2.62	2.86
Velocity	12.90	13.76
Isbash Maximum Velocity (ft/s)	14.0	14.0

Appendix H. Hydraulic Analysis (HEC-RAS Models)




BranchAve Plan: Existing 8/6/2019
Stream Stream - Existin
Legend
EG 100-yr
WS 100-yr
EG 50-yr
WS 50-yr
EG 10-yr
WS 10-yr
Crit 100-yr
Crit 50-yr
EG 2-yr
Crit 10-yr
WS 2-yr
Crit 2-yr
Ground
Elevation (ft)
210
205
200
195
190
185
180
175
0
100
200
300
400
500
Main Channel Distance (ft)

HEC-RAS Plan: Existing River: Stream Reach: Stream - Existin

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream - Existin	459	2-yr	33.00	201.95	203.21	203.21	203.64	0.022295	5.29	6.24	7.34	1.01	1.06	1.06
Stream - Existin	459	10-yr	66.00	201.95	203.73	203.73	204.36	0.020563	6.39	10.33	8.28	1.01	1.38	1.38
Stream - Existin	459	50-yr	112.00	201.95	204.29	204.29	205.13	0.019548	7.35	15.25	9.23	1.01	1.68	1.68
Stream - Existin	459	100-yr	136.00	201.95	204.54	204.54	205.47	0.019328	7.73	17.58	9.65	1.01	1.81	1.81
Stream - Existin	451	2-yr	33.00	199.70	200.51	201.08	202.99	0.238072	12.64	2.61	5.01	3.09	7.09	7.09
Stream - Existin	451	10-yr	66.00	199.70	200.91	201.67	203.77	0.161174	13.56	4.87	6.07	2.67	7.14	7.14
Stream - Existin	451	50-yr	112.00	199.70	201.36	202.28	204.56	0.119283	14.33	7.81	6.89	2.37	7.20	7.20
Stream - Existin	451	100-yr	136.00	199.70	201.57	202.55	204.90	0.108302	14.65	9.28	7.27	2.29	7.26	7.26
Stream - Existin	433	2-yr	33.00	197.63	199.03	199.46	200.39	0.079738	9.35	3.53	3.86	1.73	3.43	3.43
Stream - Existin	433	10-yr	66.00	197.63	199.57	200.21	201.53	0.080489	11.23	5.88	4.74	1.78	4.52	4.52
Stream - Existin	433	50-yr	112.00	197.63	200.13	200.93	202.64	0.079617	12.71	8.81	5.80	1.82	5.43	5.43
Stream - Existin	433	100-yr	136.00	197.63	200.37	201.25	203.10	0.078384	13.24	10.27	6.26	1.82	5.76	5.76
Stream - Existin	415	2-yr	33.00	196.04	197.08	197.57	198.70	0.105353	10.22	3.23	4.37	2.10	4.20	4.20
Stream - Existin	415	10-yr	66.00	196.04	197.53	198.24	199.86	0.100476	12.23	5.40	5.10	2.10	5.43	5.43
Stream - Existin	415	50-yr	112.00	196.04	198.03	198.94	201.00	0.095839	13.84	8.09	5.88	2.08	6.47	6.47
Stream - Existin	415	100-yr	136.00	196.04	198.24	199.24	201.49	0.093942	14.45	9.41	6.23	2.07	6.86	6.86
Stream - Existin	397	2-yr	33.00	193.26	194.24	194.83	196.38	0.154697	11.75	2.81	4.08	2.50	5.70	5.70
Stream - Existin	397	10-yr	66.00	193.26	194.67	195.50	197.66	0.143896	13.87	4.76	4.91	2.48	7.18	7.18
Stream - Existin	397	50-yr	112.00	193.26	195.13	196.20	198.90	0.134383	15.59	7.18	5.70	2.45	8.41	8.41
Stream - Existin	397	100-yr	136.00	193.26	195.33	196.49	199.43	0.130993	16.25	8.37	6.05	2.43	8.89	8.89
Stream - Existin	377	2-yr	33.00	191.41	192.05	192.42	193.38	0.131440	9.23	3.57	7.42	2.34	3.81	3.81
Stream - Existin	377	10-yr	66.00	191.41	192.29	192.91	194.62	0.149569	12.26	5.38	7.85	2.61	6.03	6.03
Stream - Existin	377	50-yr	112.00	191.41	192.55	193.45	196.00	0.156016	14.88	7.53	8.24	2.75	8.14	8.14
Stream - Existin	377	100-yr	136.00	191.41	192.68	193.69	196.60	0.156420	15.88	8.57	8.42	2.78	8.98	8.98
Stream - Existin	354	2-yr	33.00	190.02	191.19	191.32	191.85	0.032385	6.50	5.07	5.59	1.20	1.59	1.59
Stream - Existin	354	10-yr	66.00	190.02	191.67	191.94	192.74	0.036689	8.31	7.95	6.36	1.31	2.36	2.36
Stream - Existin	354	50-yr	112.00	190.02	192.12	192.59	193.74	0.043566	10.22	10.96	7.08	1.45	3.37	3.37
Stream - Existin	354	100-yr	136.00	190.02	192.31	192.87	194.20	0.046698	11.04	12.32	7.39	1.51	3.85	3.85
Stream - Existin	334	2-yr	33.00	189.07	190.04	190.31	190.96	0.060676	7.68	4.30	6.36	1.65	2.38	2.38
Stream - Existin	334	10-yr	66.00	189.07	190.45	190.87	191.81	0.056785	9.37	7.04	7.06	1.65	3.16	3.16
Stream - Existin	334	50-yr	112.00	189.07	190.88	191.46	192.73	0.055712	10.92	10.26	7.77	1.67	3.95	3.95
Stream - Existin	334	100-yr	136.00	189.07	191.07	191.71	193.16	0.056416	11.60	11.72	8.07	1.70	4.35	4.35
Stream - Existin	317	2-yr	33.00	188.06	188.93	189.21	189.85	0.066020	7.67	4.31	6.91	1.71	2.43	2.43
Stream - Existin	317	10-yr	66.00	188.06	189.29	189.73	190.70	0.064552	9.53	6.93	7.65	1.77	3.35	3.35
Stream - Existin	317	50-yr	112.00	188.06	189.68	190.28	191.61	0.063160	11.15	10.05	8.37	1.79	4.21	4.21
Stream - Existin	317	100-yr	136.00	188.06	192.14	190.52	192.36	0.002710	3.79	35.84	12.66	0.40	0.38	0.38
Stream - Existin	292	2-yr	33.00	186.75	187.62	187.84	188.39	0.050175	7.01	4.71	6.89	1.50	1.98	1.98
Stream - Existin	292	10-yr	66.00	186.75	188.00	188.37	189.23	0.052009	8.91	7.40	7.46	1.58	2.87	2.87
Stream - Existin	292	50-yr	112.00	186.75	188.41	188.94	190.14	0.052875	10.56	10.61	8.10	1.63	3.71	3.71
Stream - Existin	292	100-yr	136.00	186.75	192.19		192.29	0.000968	2.59	52.41	14.03	0.24	0.17	0.17
Stream - Existin	264	2-yr	33.00	186.28	187.37	187.29	187.69	0.015903	4.49	7.35	8.93	0.87	0.76	0.76

HEC-RAS Plan: Existing River: Stream Reach: Stream - Existin (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream - Existin	264	10-yr	66.00	186.28	187.75	187.75	188.33	0.019886	6.12	10.79	9.42	1.01	1.28	1.28
Stream - Existin	264	50-yr	112.00	186.28	188.21	188.25	189.05	0.020419	7.32	15.31	10.01	1.04	1.69	1.69
Stream - Existin	264	100-yr	136.00	186.28	192.19		192.26	0.000530	2.08	65.47	15.31	0.18	0.10	0.10
Stream - Existin	253	2-yr	33.00	186.12	187.15	187.15	187.49	0.022114	4.66	7.08	10.76	1.01	0.87	0.87
Stream - Existin	253	10-yr	66.00	186.12	187.44	187.54	188.08	0.027978	6.42	10.28	11.25	1.19	1.50	1.50
Stream - Existin	253	50-yr	112.00	186.12	188.38	187.98	188.80	0.008708	5.22	21.47	12.50	0.70	0.82	0.82
Stream - Existin	253	100-yr	136.00	186.12	192.20		192.25	0.000325	1.72	78.90	17.55	0.14	0.07	0.07
Stream - Existin	238	2-yr	33.00	185.63	186.44	186.59	187.03	0.042259	6.17	5.35	8.66	1.38	1.57	1.57
Stream - Existin	238	10-yr	66.00	185.63	187.49	187.04	187.77	0.007039	4.26	15.48	10.54	0.62	0.58	0.58
Stream - Existin	238	50-yr	112.00	185.63	188.37		188.67	0.004920	4.41	25.41	12.00	0.53	0.55	0.55
Stream - Existin	238	100-yr	136.00	185.63	192.20		192.24	0.000280	1.63	83.50	18.34	0.13	0.06	0.06
Stream - Existin	222	2-yr	33.00	184.60	186.22	186.23	186.73	0.022591	5.68	5.81	5.93	1.01	1.18	1.18
Stream - Existin	222	10-yr	66.00	184.60	186.83	186.83	187.54	0.021303	6.75	9.77	7.05	1.01	1.51	1.51
Stream - Existin	222	50-yr	112.00	184.60	188.04		188.55	0.009268	5.70	19.66	9.37	0.69	0.95	0.95
Stream - Existin	222	100-yr	136.00	184.60	192.20		192.24	0.000383	1.65	84.08	24.96	0.15	0.07	0.06
Stream - Existin	205	2-yr	33.00	184.24	185.25	185.51	186.11	0.059337	7.45	4.43	6.70	1.62	2.27	2.27
Stream - Existin	205	10-yr	66.00	184.24	185.65	186.05	186.94	0.054898	9.12	7.24	7.31	1.62	3.01	3.01
Stream - Existin	205	50-yr	112.00	184.24	188.17	186.62	188.38	0.002794	3.66	30.61	11.33	0.39	0.36	0.36
Stream - Existin	205	100-yr	136.00	184.24	192.20	186.88	192.23	0.000231	1.50	90.47	31.57	0.12	0.05	0.05
Stream - Existin	192	2-yr	33.00	184.16	185.59	185.33	185.86	0.010244	4.19	7.87	7.12	0.70	0.62	0.62
Stream - Existin	192	10-yr	66.00	184.16	186.13	185.89	186.60	0.012423	5.51	11.99	7.97	0.79	0.97	0.97
Stream - Existin	192	50-yr	112.00	184.16	188.14	186.49	188.34	0.002658	3.62	30.93	12.48	0.38	0.35	0.35
Stream - Existin	192	100-yr	136.00	184.16	192.19	186.76	192.23	0.000247	1.55	87.71	31.10	0.12	0.05	0.05
Stream - Existin	169	2-yr	33.00	183.79	185.07	185.07	185.50	0.021098	5.31	6.22	7.14	1.00	1.05	1.05
Stream - Existin	169	10-yr	66.00	183.79	185.61	185.61	186.22	0.019694	6.28	10.51	8.72	1.01	1.33	1.33
Stream - Existin	169	50-yr	112.00	183.79	188.20		188.27	0.000799	2.25	60.33	27.66	0.23	0.13	0.10
Stream - Existin	169	100-yr	136.00	183.79	192.21		192.22	0.000052	0.89	196.42	39.94	0.06	0.02	0.01
Stream - Existin	149	2-yr	33.00	182.35	183.27	183.65	184.58	0.123978	9.19	3.59	7.10	2.28	3.73	3.73
Stream - Existin	149	10-yr	66.00	182.35	183.62	184.14	185.37	0.095559	10.63	6.21	7.91	2.11	4.35	4.35
Stream - Existin	149	50-yr	112.00	182.35	188.21		188.25	0.000330	1.77	71.68	19.86	0.15	0.07	0.06
Stream - Existin	149	100-yr	136.00	182.35	192.20		192.22	0.000052	0.97	168.10	28.63	0.06	0.02	0.02
Stream - Existin	136	2-yr	37.00	181.78	182.99	183.13	183.64	0.035246	6.44	5.74	7.15	1.27	1.60	1.60
Stream - Existin	136	10-yr	72.00	181.78	183.41	183.66	184.45	0.037572	8.20	8.78	7.53	1.34	2.33	2.33
Stream - Existin	136	50-yr	121.00	181.78	188.19		188.25	0.000412	1.95	73.41	22.77	0.16	0.09	0.07
Stream - Existin	136	100-yr	148.00	181.78	192.20		192.21	0.000058	1.03	184.75	33.30	0.07	0.02	0.02
Stream - Existin	126	2-yr	37.00	181.57	183.27	182.69	183.40	0.003788	2.83	13.08	10.67	0.45	0.27	0.27
Stream - Existin	126	10-yr	72.00	181.57	184.06	183.15	184.21	0.003159	3.18	22.76	14.55	0.43	0.30	0.28
Stream - Existin	126	50-yr	121.00	181.57	188.21		188.24	0.000108	1.35	113.86	27.65	0.10	0.04	0.02
Stream - Existin	126	100-yr	148.00	181.57	192.20		192.21	0.000023	0.88	240.64	35.88	0.05	0.01	0.01
Stream - Existin	115	2-yr	37.00	181.31	182.77	182.77	183.28	0.021496	5.72	6.47	6.48	1.01	1.18	1.18
Stream - Existin	115	10-yr	72.00	181.31	183.62		184.12	0.012598	5.68	12.68	8.15	0.80	1.02	1.02

HEC-RAS Plan: Existing River: Stream Reach: Stream - Existin (Continued)

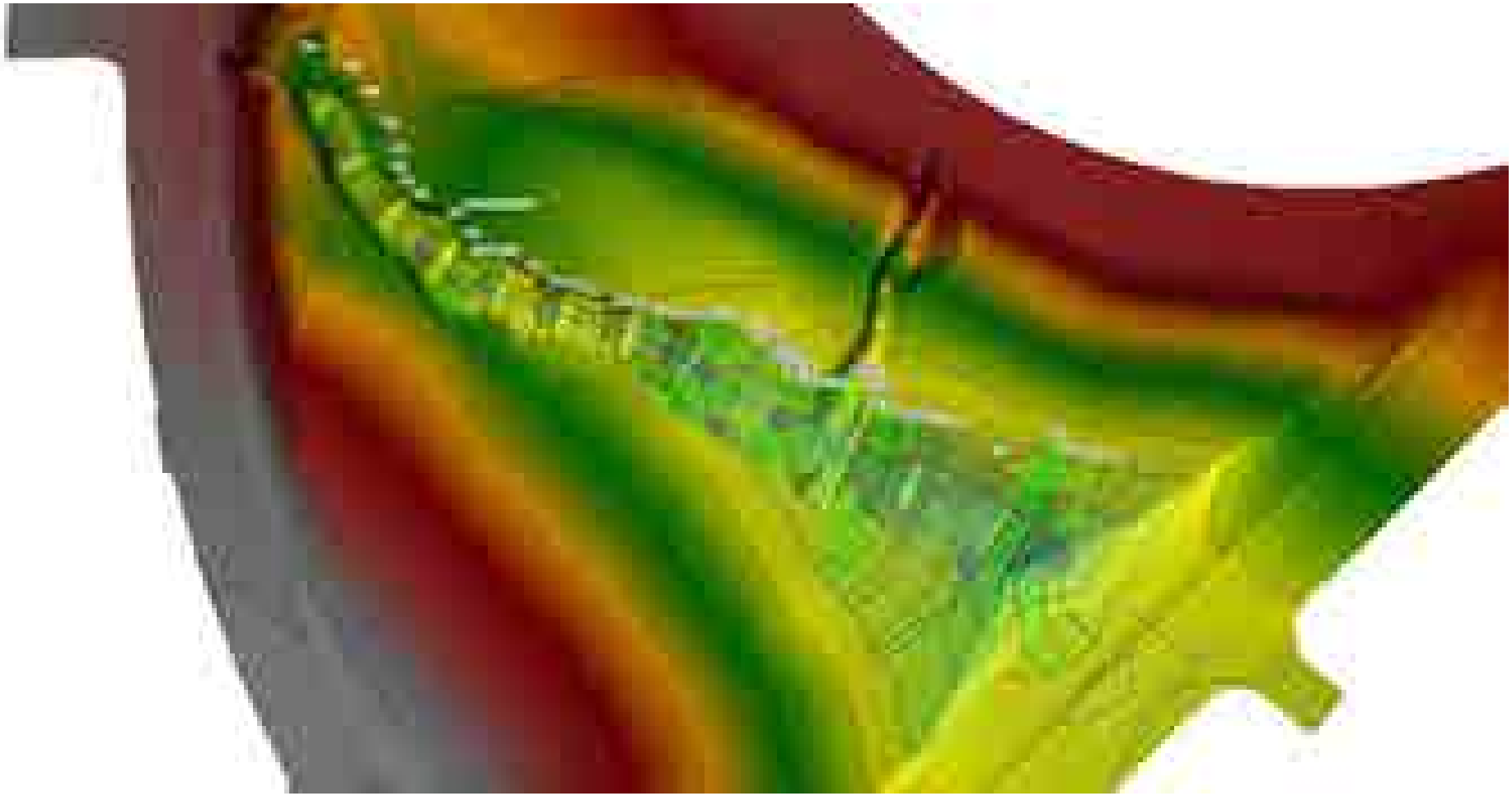
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream - Existin	115	50-yr	121.00	181.31	188.19		188.23	0.000230	1.71	82.89	22.50	0.13	0.06	0.04
Stream - Existin	115	100-yr	148.00	181.31	192.20		192.21	0.000040	1.04	196.13	33.50	0.06	0.02	0.01
Stream - Existin	97	2-yr	37.00	180.94	182.53	182.30	182.90	0.013176	4.90	7.55	6.01	0.77	0.83	0.83
Stream - Existin	97	10-yr	72.00	180.94	183.48		183.91	0.008557	5.26	13.86	7.30	0.66	0.83	0.76
Stream - Existin	97	50-yr	121.00	180.94	188.17		188.23	0.000271	1.95	79.11	20.70	0.14	0.08	0.05
Stream - Existin	97	100-yr	148.00	180.94	192.20		192.21	0.000047	1.14	229.96	59.42	0.06	0.02	0.01
Stream - Existin	81	2-yr	37.00	180.47	182.52		182.72	0.005647	3.61	10.26	6.65	0.51	0.42	0.42
Stream - Existin	81	10-yr	72.00	180.47	183.49		183.76	0.005115	4.16	17.32	8.15	0.50	0.51	0.50
Stream - Existin	81	50-yr	121.00	180.47	188.18		188.22	0.000198	1.63	104.74	32.19	0.11	0.06	0.03
Stream - Existin	81	100-yr	148.00	180.47	192.20		192.21	0.000031	0.89	269.81	49.20	0.05	0.01	0.01
Stream - Existin	66	2-yr	37.00	179.99	181.89	181.89	182.52	0.025078	6.36	5.82	4.71	1.01	1.44	1.44
Stream - Existin	66	10-yr	72.00	179.99	183.19		183.63	0.010565	5.34	13.64	8.75	0.69	0.89	0.79
Stream - Existin	66	50-yr	121.00	179.99	188.19		188.21	0.000154	1.49	120.20	30.87	0.10	0.05	0.03
Stream - Existin	66	100-yr	148.00	179.99	192.20		192.21	0.000032	0.93	311.95	79.54	0.05	0.02	0.01
Stream - Existin	51	2-yr	37.00	179.91	181.35	181.49	182.09	0.033399	6.91	5.36	5.29	1.21	1.75	1.75
Stream - Existin	51	10-yr	72.00	179.91	183.25		183.49	0.003523	3.93	19.57	11.14	0.44	0.43	0.31
Stream - Existin	51	50-yr	121.00	179.91	188.17		188.21	0.000154	1.69	107.98	28.63	0.11	0.06	0.03
Stream - Existin	51	100-yr	148.00	179.91	192.20		192.21	0.000028	0.96	301.71	61.51	0.05	0.02	0.01
Stream - Existin	42	2-yr	37.00	180.00	181.61	181.31	181.90	0.010058	4.36	8.49	6.99	0.70	0.65	0.65
Stream - Existin	42	10-yr	72.00	180.00	183.27		183.44	0.002083	3.31	23.07	10.71	0.35	0.29	0.22
Stream - Existin	42	50-yr	121.00	180.00	188.18		188.21	0.000118	1.57	117.25	29.81	0.10	0.05	0.02
Stream - Existin	42	100-yr	148.00	180.00	192.20		192.21	0.000021	0.89	366.61	93.89	0.05	0.01	0.00
Stream - Existin	27	2-yr	37.00	179.66	181.20	181.15	181.68	0.019665	5.54	6.67	6.21	0.94	1.10	1.10
Stream - Existin	27	10-yr	72.00	179.66	183.25		183.40	0.002166	3.12	24.27	11.56	0.34	0.27	0.23
Stream - Existin	27	50-yr	121.00	179.66	188.18		188.20	0.000104	1.36	127.41	36.86	0.09	0.04	0.02
Stream - Existin	27	100-yr	148.00	179.66	192.20		192.21	0.000024	0.88	317.29	118.20	0.05	0.01	0.00
Stream - Existin	2	2-yr	37.00	178.09	180.98	180.15	181.30	0.010266	4.51	8.21	4.00	0.55	0.69	0.68
Stream - Existin	2	10-yr	72.00	178.09	183.13	181.09	183.33	0.003453	3.74	21.49	8.60	0.35	0.40	0.33
Stream - Existin	2	50-yr	121.00	178.09	188.17	182.15	188.20	0.000215	1.70	113.00	29.61	0.10	0.06	0.04
Stream - Existin	2	100-yr	148.00	178.09	192.20	182.61	192.21	0.000039	0.94	285.88	54.91	0.05	0.02	0.01

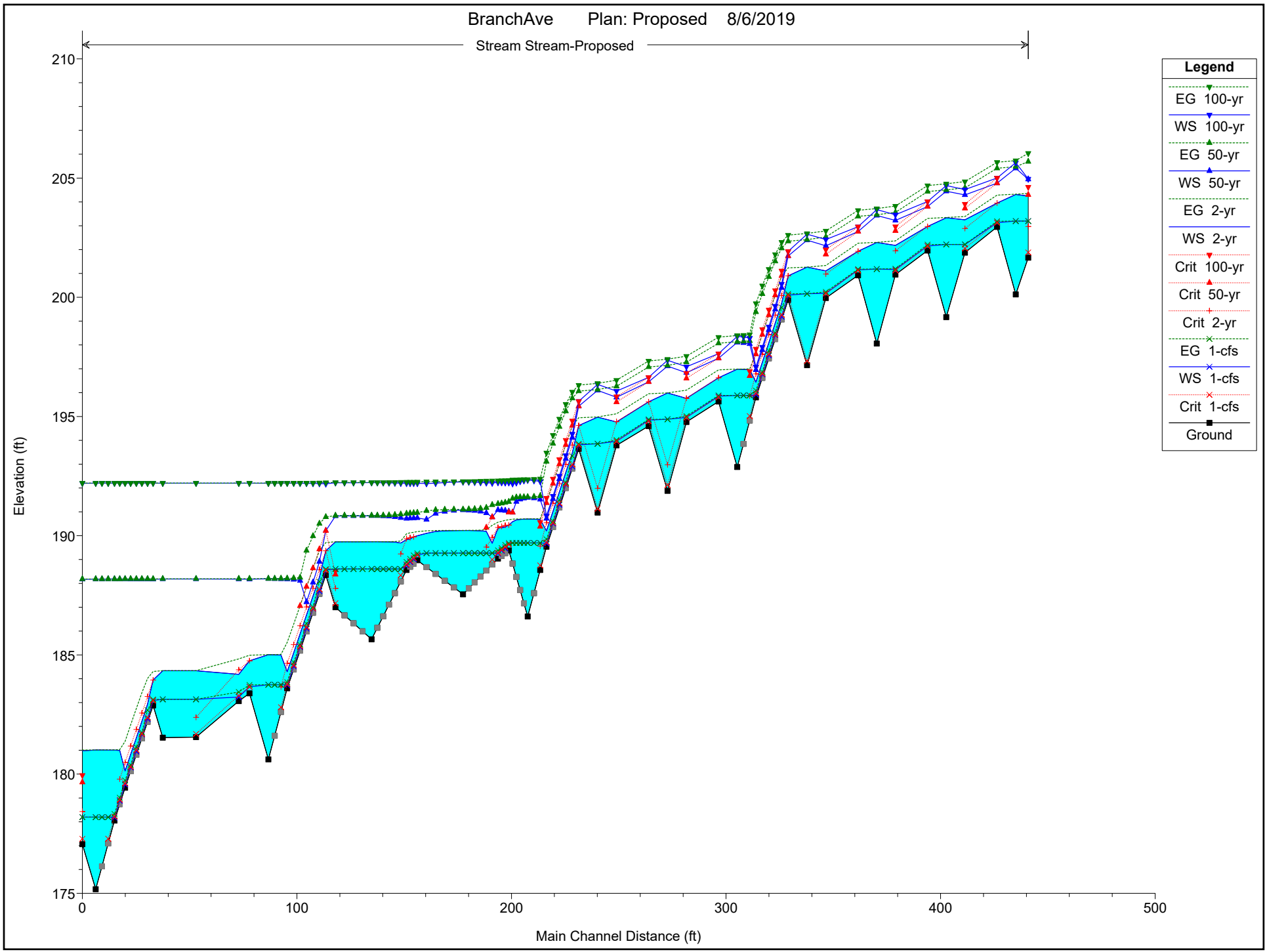
HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
178.08	0.00	0.00	0.00	1
179.83	15.00	15.00	0.00	1
180.64	30.00	30.00	0.00	1
181.37	45.00	45.00	0.00	1
182.24	60.00	60.00	0.00	1
182.95	70.00	70.00	0.00	1
184.72	90.00	90.00	0.00	1
186.30	105.00	105.00	0.00	1
188.03	120.00	120.00	0.00	1
190.11	135.00	135.00	0.00	1
192.52	150.00	150.00	0.00	1
194.00	158.53	158.53	0.00	Overtopping




BranchAve Plan: Proposed 8/6/2019
Stream Stream-Proposed
Elevation (ft)
Main Channel Distance (ft)
210
205
200
195
190
185
180
175
0
100
200
300
400
500
Legend
EG 100-yr
WS 100-yr
EG 50-yr
WS 50-yr
EG 2-yr
WS 2-yr
Crit 100-yr
Crit 50-yr
Crit 2-yr
EG 1-cfs
WS 1-cfs
Crit 1-cfs
Ground

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	527	2-yr	33.00	201.66	204.24	202.97	204.35	0.001396	2.67	12.66	7.52	0.31	0.19	0.19
Stream-Proposed	527	50-yr	112.00	201.66	204.95	204.30	205.69	0.006657	6.94	16.51	8.90	0.70	1.18	1.15
Stream-Proposed	527	100-yr	136.00	201.66	204.96	204.62	206.04	0.009676	8.39	16.59	8.94	0.84	1.72	1.68
Stream-Proposed	527	1-cfs	1.00	201.66	203.20	201.88	203.20	0.000009	0.15	6.93	6.23	0.02	0.00	0.00
Stream-Proposed	521	2-yr	33.00	200.12	204.31		204.32	0.000112	0.85	39.78	13.97	0.09	0.02	0.02
Stream-Proposed	521	50-yr	112.00	200.12	205.41		205.48	0.000452	2.09	56.14	15.73	0.18	0.10	0.08
Stream-Proposed	521	100-yr	136.00	200.12	205.65		205.73	0.000552	2.39	59.87	16.20	0.20	0.13	0.10
Stream-Proposed	521	1-cfs	1.00	200.12	203.20		203.20	0.000000	0.04	25.22	12.11	0.00	0.00	0.00
Stream-Proposed	512	2-yr	33.00	202.95	203.95	203.95	204.29	0.054521	4.65	7.10	10.63	1.00	2.21	2.21
Stream-Proposed	512	50-yr	112.00	202.95	204.79	204.79	205.41	0.045728	6.35	17.68	14.65	1.01	3.38	3.30
Stream-Proposed	512	100-yr	136.00	202.95	205.00	205.00	205.66	0.041412	6.53	21.03	18.26	0.98	3.44	2.86
Stream-Proposed	512	1-cfs	1.00	202.95	203.13	203.13	203.19	0.094512	1.91	0.52	4.58	1.00	0.67	0.67
Stream-Proposed	497	2-yr	33.00	201.87	203.25	202.88	203.39	0.014160	2.93	11.25	12.14	0.54	0.79	0.79
Stream-Proposed	497	50-yr	112.00	201.87	204.30	203.73	204.59	0.013867	4.34	26.01	16.24	0.58	1.42	1.31
Stream-Proposed	497	100-yr	136.00	201.87	204.52	203.91	204.85	0.013536	4.65	29.70	16.85	0.59	1.56	1.40
Stream-Proposed	497	1-cfs	1.00	201.87	202.21	202.05	202.22	0.006195	0.76	1.31	5.92	0.28	0.09	0.09
Stream-Proposed	488	2-yr	33.00	199.17	203.34		203.35	0.000105	0.79	42.00	14.76	0.08	0.02	0.02
Stream-Proposed	488	50-yr	112.00	199.17	204.45		204.51	0.000438	1.91	59.44	16.92	0.17	0.09	0.08
Stream-Proposed	488	100-yr	136.00	199.17	204.69		204.76	0.000538	2.17	63.56	17.62	0.19	0.11	0.10
Stream-Proposed	488	1-cfs	1.00	199.17	202.22		202.22	0.000000	0.04	26.42	12.94	0.00	0.00	0.00
Stream-Proposed	480	2-yr	33.00	201.96	202.97	202.97	203.31	0.055357	4.68	7.05	10.61	1.01	2.24	2.24
Stream-Proposed	480	50-yr	112.00	201.96	203.81	203.81	204.44	0.045498	6.36	17.64	14.70	1.01	3.39	3.27
Stream-Proposed	480	100-yr	136.00	201.96	204.02	204.02	204.69	0.042327	6.58	20.84	16.33	0.99	3.49	3.24
Stream-Proposed	480	1-cfs	1.00	201.96	202.15	202.15	202.21	0.095573	1.96	0.51	4.33	1.01	0.70	0.70
Stream-Proposed	465	2-yr	33.00	200.95	202.18	201.95	202.36	0.023446	3.47	9.51	11.71	0.68	1.16	1.16
Stream-Proposed	465	50-yr	112.00	200.95	203.22	202.79	203.56	0.017325	4.69	24.58	18.19	0.65	1.68	1.40
Stream-Proposed	465	100-yr	136.00	200.95	203.46	202.97	203.83	0.016250	4.89	28.95	18.71	0.64	1.76	1.49
Stream-Proposed	465	1-cfs	1.00	200.95	201.16	201.13	201.20	0.043400	1.50	0.67	4.70	0.70	0.38	0.38
Stream-Proposed	456	2-yr	33.00	198.06	202.30		202.30	0.000060	0.61	54.38	19.29	0.06	0.01	0.01
Stream-Proposed	456	50-yr	112.00	198.06	203.43		203.46	0.000241	1.45	77.54	21.57	0.13	0.05	0.05
Stream-Proposed	456	100-yr	136.00	198.06	203.68		203.72	0.000292	1.65	82.93	21.94	0.15	0.06	0.06
Stream-Proposed	456	1-cfs	1.00	198.06	201.19		201.19	0.000000	0.03	34.18	16.80	0.00	0.00	0.00
Stream-Proposed	447	2-yr	33.00	200.92	201.93	201.93	202.27	0.055114	4.67	7.07	10.65	1.01	2.23	2.23
Stream-Proposed	447	50-yr	112.00	200.92	202.76	202.76	203.39	0.045669	6.40	17.54	14.50	1.01	3.42	3.31
Stream-Proposed	447	100-yr	136.00	200.92	202.96	202.96	203.65	0.043524	6.65	20.62	16.10	1.00	3.58	3.34
Stream-Proposed	447	1-cfs	1.00	200.92	201.15	201.13	201.18	0.040795	1.41	0.71	5.24	0.67	0.34	0.34
Stream-Proposed	432	2-yr	33.00	199.97	201.11	200.97	201.34	0.031855	3.85	8.57	11.38	0.78	1.46	1.46
Stream-Proposed	432	50-yr	112.00	199.97	202.16	201.80	202.53	0.020632	4.90	23.65	23.16	0.70	1.88	1.28
Stream-Proposed	432	100-yr	136.00	199.97	202.42	201.99	202.78	0.016678	4.90	29.92	23.99	0.65	1.78	1.25
Stream-Proposed	432	1-cfs	1.00	199.97	200.16	200.16	200.22	0.111202	2.01	0.50	4.59	1.07	0.75	0.75
Stream-Proposed	423	2-yr	33.00	197.15	201.26		201.27	0.000042	0.51	64.20	23.15	0.05	0.01	0.01

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	423	50-yr	112.00	197.15	202.40		202.42	0.000166	1.22	91.91	25.80	0.11	0.03	0.03
Stream-Proposed	423	100-yr	136.00	197.15	202.65		202.68	0.000200	1.39	98.48	26.29	0.12	0.04	0.04
Stream-Proposed	423	1-cfs	1.00	197.15	200.15	197.33	200.15	0.000000	0.02	40.25	20.00	0.00	0.00	0.00
Stream-Proposed	415	2-yr	33.00	199.89	200.90	200.90	201.23	0.044609	4.64	7.11	10.88	1.01	1.77	1.77
Stream-Proposed	415	50-yr	112.00	199.89	201.73	201.73	202.35	0.035899	6.34	17.69	14.45	1.00	2.68	2.62
Stream-Proposed	415	100-yr	136.00	199.89	201.93	201.93	202.61	0.034828	6.63	20.67	16.41	1.00	2.84	2.61
Stream-Proposed	415	1-cfs	1.00	199.89	200.09	200.09	200.15	0.074299	1.93	0.52	4.40	0.99	0.54	0.54
Stream-Proposed	412.00*	2-yr	33.00	199.07	199.75	200.08	200.88	0.253811	8.54	3.87	8.81	2.27	6.82	6.82
Stream-Proposed	412.00*	50-yr	112.00	199.07	200.40	200.91	202.06	0.148636	10.33	10.85	12.24	1.93	7.94	7.94
Stream-Proposed	412.00*	100-yr	136.00	199.07	200.55	201.11	202.31	0.138471	10.64	12.78	13.04	1.90	8.16	8.16
Stream-Proposed	412.00*	1-cfs	1.00	199.07	199.19	199.27	199.57	0.942945	4.94	0.20	2.84	3.26	4.17	4.17
Stream-Proposed	409.00*	2-yr	33.00	198.25	198.92	199.25	200.10	0.266137	8.70	3.79	8.71	2.33	7.11	7.11
Stream-Proposed	409.00*	50-yr	112.00	198.25	199.49	200.09	201.51	0.196630	11.39	9.83	11.85	2.21	9.87	9.87
Stream-Proposed	409.00*	100-yr	136.00	198.25	199.63	200.28	201.80	0.184445	11.80	11.53	12.54	2.17	10.24	10.24
Stream-Proposed	409.00*	1-cfs	1.00	198.25	198.42	198.44	198.51	0.161346	2.49	0.40	4.20	1.42	0.96	0.96
Stream-Proposed	406.00*	2-yr	33.00	197.44	198.09	198.44	199.29	0.271576	8.76	3.77	8.71	2.35	7.21	7.21
Stream-Proposed	406.00*	50-yr	112.00	197.44	198.63	199.25	200.86	0.226483	11.97	9.36	11.69	2.36	11.00	11.00
Stream-Proposed	406.00*	100-yr	136.00	197.44	198.76	199.47	201.18	0.214996	12.46	10.92	12.31	2.33	11.54	11.54
Stream-Proposed	406.00*	1-cfs	1.00	197.44	197.57	197.62	197.76	0.434794	3.48	0.29	3.83	2.24	2.03	2.03
Stream-Proposed	403.00*	2-yr	33.00	196.62	197.27	197.61	198.47	0.272876	8.77	3.76	8.72	2.35	7.24	7.24
Stream-Proposed	403.00*	50-yr	112.00	196.62	197.79	198.43	200.14	0.245316	12.31	9.10	11.58	2.45	11.71	11.71
Stream-Proposed	403.00*	100-yr	136.00	196.62	197.91	198.65	200.48	0.236473	12.86	10.57	12.22	2.44	12.40	12.40
Stream-Proposed	403.00*	1-cfs	1.00	196.62	196.76	196.80	196.88	0.201403	2.69	0.37	4.08	1.57	1.14	1.14
Stream-Proposed	400	2-yr	33.00	195.80	196.44	196.79	197.65	0.275464	8.81	3.74	8.68	2.37	7.31	7.31
Stream-Proposed	400	50-yr	112.00	195.80	196.96	197.61	199.38	0.256612	12.50	8.96	11.54	2.50	12.12	12.12
Stream-Proposed	400	100-yr	136.00	195.80	197.08	197.83	199.74	0.248977	13.09	10.39	12.17	2.50	12.89	12.89
Stream-Proposed	400	1-cfs	1.00	195.80	195.92	195.98	196.09	0.351119	3.28	0.31	3.79	2.04	1.76	1.76
Stream-Proposed	397.00*	2-yr	33.00	194.83	196.96	195.86	197.00	0.001473	1.55	21.23	14.81	0.23	0.12	0.12
Stream-Proposed	397.00*	50-yr	112.00	194.83	198.05	196.70	198.17	0.002856	2.88	39.29	19.45	0.34	0.37	0.34
Stream-Proposed	397.00*	100-yr	136.00	194.83	198.29	196.89	198.44	0.002980	3.15	44.17	21.33	0.35	0.43	0.36
Stream-Proposed	397.00*	1-cfs	1.00	194.83	195.88	195.02	195.88	0.000029	0.14	7.35	10.67	0.03	0.00	0.00
Stream-Proposed	394.00*	2-yr	33.00	193.85	196.98		196.99	0.000241	0.90	36.83	17.50	0.11	0.03	0.03
Stream-Proposed	394.00*	50-yr	112.00	193.85	198.09		198.15	0.000735	1.94	57.97	20.70	0.20	0.12	0.12
Stream-Proposed	394.00*	100-yr	136.00	193.85	198.34		198.41	0.000844	2.18	63.17	21.56	0.22	0.15	0.14
Stream-Proposed	394.00*	1-cfs	1.00	193.85	195.88		195.88	0.000001	0.05	19.30	14.33	0.01	0.00	0.00
Stream-Proposed	391	2-yr	33.00	192.88	196.98		196.99	0.000059	0.60	55.32	20.02	0.06	0.01	0.01
Stream-Proposed	391	50-yr	112.00	192.88	198.11		198.14	0.000235	1.42	79.26	22.41	0.13	0.05	0.05
Stream-Proposed	391	100-yr	136.00	192.88	198.36		198.40	0.000283	1.61	84.92	22.91	0.14	0.06	0.06
Stream-Proposed	391	1-cfs	1.00	192.88	195.88		195.88	0.000000	0.03	34.71	17.48	0.00	0.00	0.00
Stream-Proposed	382	2-yr	33.00	195.63	196.62	196.62	196.95	0.054474	4.62	7.14	10.85	1.00	2.19	2.19
Stream-Proposed	382	50-yr	112.00	195.63	197.44	197.44	198.07	0.044706	6.36	17.67	14.74	1.00	3.37	3.22

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	382	100-yr	136.00	195.63	197.64	197.64	198.33	0.041913	6.66	20.63	15.84	0.99	3.55	3.27
Stream-Proposed	382	1-cfs	1.00	195.63	195.85	195.81	195.88	0.037983	1.40	0.72	5.07	0.66	0.33	0.33
Stream-Proposed	367	2-yr	33.00	194.77	195.76	195.77	196.11	0.056970	4.72	6.99	10.60	1.03	2.29	2.29
Stream-Proposed	367	50-yr	112.00	194.77	196.84	196.60	197.27	0.027120	5.32	21.25	18.37	0.79	2.28	1.89
Stream-Proposed	367	100-yr	136.00	194.77	197.09	196.82	197.53	0.022291	5.39	26.38	20.91	0.74	2.21	1.69
Stream-Proposed	367	1-cfs	1.00	194.77	194.96	194.96	195.02	0.095509	1.93	0.52	4.50	1.01	0.68	0.68
Stream-Proposed	358	2-yr	33.00	191.88	195.99	192.97	195.99	0.000062	0.61	53.94	19.61	0.07	0.01	0.01
Stream-Proposed	358	50-yr	112.00	191.88	197.11		197.14	0.000244	1.45	77.40	21.93	0.13	0.05	0.05
Stream-Proposed	358	100-yr	136.00	191.88	197.36		197.40	0.000294	1.65	82.90	22.32	0.15	0.06	0.06
Stream-Proposed	358	1-cfs	1.00	191.88	194.88	192.13	194.88	0.000000	0.03	33.71	17.03	0.00	0.00	0.00
Stream-Proposed	350	2-yr	33.00	194.60	195.62	195.62	195.96	0.055129	4.68	7.05	10.58	1.01	2.24	2.24
Stream-Proposed	350	50-yr	112.00	194.60	196.45	196.45	197.08	0.045604	6.34	17.69	14.72	1.01	3.37	3.29
Stream-Proposed	350	100-yr	136.00	194.60	196.64	196.64	197.33	0.043185	6.66	20.53	15.72	1.00	3.58	3.38
Stream-Proposed	350	1-cfs	1.00	194.60	194.85	194.81	194.88	0.038179	1.42	0.70	4.85	0.66	0.34	0.34
Stream-Proposed	335	2-yr	33.00	193.79	194.77	194.78	195.11	0.057434	4.70	7.02	10.80	1.03	2.28	2.28
Stream-Proposed	335	50-yr	112.00	193.79	195.81	195.61	196.27	0.029288	5.45	20.69	17.75	0.82	2.41	2.06
Stream-Proposed	335	100-yr	136.00	193.79	196.06	195.84	196.52	0.023574	5.49	25.83	20.69	0.76	2.30	1.77
Stream-Proposed	335	1-cfs	1.00	193.79	193.96	193.96	194.02	0.094207	1.91	0.52	4.62	1.00	0.67	0.67
Stream-Proposed	326	2-yr	33.00	190.97	194.97	191.99	194.98	0.000064	0.62	53.16	19.38	0.07	0.01	0.01
Stream-Proposed	326	50-yr	112.00	190.97	196.10		196.13	0.000254	1.48	76.06	21.31	0.14	0.05	0.05
Stream-Proposed	326	100-yr	136.00	190.97	196.35		196.39	0.000305	1.68	81.43	21.66	0.15	0.06	0.06
Stream-Proposed	326	1-cfs	1.00	190.97	193.86	191.14	193.86	0.000000	0.03	32.94	16.75	0.00	0.00	0.00
Stream-Proposed	317	2-yr	33.00	193.64	194.62	194.62	194.95	0.043235	4.59	7.19	11.00	1.00	1.73	1.73
Stream-Proposed	317	50-yr	112.00	193.64	195.43	195.43	196.06	0.036362	6.37	17.59	14.44	1.01	2.71	2.65
Stream-Proposed	317	100-yr	136.00	193.64	195.64	195.64	196.32	0.033873	6.62	20.64	15.63	0.99	2.82	2.67
Stream-Proposed	317	1-cfs	1.00	193.64	193.81	193.81	193.85	0.055135	1.70	0.59	4.84	0.86	0.42	0.42
Stream-Proposed	314.00*	2-yr	33.00	192.82	193.47	193.80	194.60	0.252959	8.53	3.87	8.85	2.27	6.80	6.80
Stream-Proposed	314.00*	50-yr	112.00	192.82	194.12	194.62	195.77	0.148798	10.29	10.88	12.41	1.94	7.90	7.90
Stream-Proposed	314.00*	100-yr	136.00	192.82	194.27	194.82	196.03	0.137930	10.64	12.78	13.06	1.90	8.15	8.15
Stream-Proposed	314.00*	1-cfs	1.00	192.82	192.90	192.98	193.34	1.629530	5.30	0.19	3.61	4.08	5.31	5.31
Stream-Proposed	311.00*	2-yr	33.00	192.00	192.65	192.99	193.82	0.264192	8.68	3.80	8.75	2.32	7.06	7.06
Stream-Proposed	311.00*	50-yr	112.00	192.00	193.23	193.81	195.22	0.195839	11.33	9.89	12.03	2.20	9.77	9.77
Stream-Proposed	311.00*	100-yr	136.00	192.00	193.36	194.01	195.51	0.183388	11.76	11.56	12.61	2.17	10.18	10.18
Stream-Proposed	311.00*	1-cfs	1.00	192.00	192.15	192.17	192.23	0.137726	2.35	0.43	4.33	1.32	0.84	0.84
Stream-Proposed	308.00*	2-yr	33.00	191.18	191.84	192.18	193.02	0.268113	8.73	3.78	8.71	2.34	7.15	7.15
Stream-Proposed	308.00*	50-yr	112.00	191.18	192.38	193.00	194.57	0.225371	11.89	9.42	11.87	2.35	10.88	10.88
Stream-Proposed	308.00*	100-yr	136.00	191.18	192.50	193.20	194.90	0.213842	12.41	10.96	12.40	2.33	11.46	11.46
Stream-Proposed	308.00*	1-cfs	1.00	191.18	191.30	191.36	191.51	0.502676	3.65	0.27	3.79	2.39	2.26	2.26
Stream-Proposed	305.00*	2-yr	33.00	190.36	191.02	191.36	192.21	0.270225	8.75	3.77	8.73	2.35	7.19	7.19
Stream-Proposed	305.00*	50-yr	112.00	190.36	191.54	192.19	193.86	0.243360	12.22	9.17	11.74	2.44	11.56	11.56
Stream-Proposed	305.00*	100-yr	136.00	190.36	191.66	192.38	194.21	0.233568	12.81	10.62	12.24	2.42	12.28	12.28

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	305.00*	1-cfs	1.00	190.36	190.51	190.54	190.62	0.184032	2.60	0.38	4.16	1.51	1.06	1.06
Stream-Proposed	302	2-yr	33.00	189.54	190.20	190.54	191.40	0.270276	8.76	3.77	8.69	2.35	7.21	7.21
Stream-Proposed	302	50-yr	112.00	189.54	190.72	191.38	193.11	0.253740	12.40	9.03	11.67	2.49	11.95	11.95
Stream-Proposed	302	100-yr	136.00	189.54	190.84	191.58	193.48	0.245611	13.04	10.43	12.16	2.48	12.77	12.77
Stream-Proposed	302	1-cfs	1.00	189.54	189.68	189.73	189.85	0.370032	3.37	0.30	3.69	2.09	1.86	1.86
Stream-Proposed	299.00	2-yr	33.00	188.56	190.68	189.56	190.71	0.001333	1.47	22.39	15.83	0.22	0.11	0.11
Stream-Proposed	299.00	50-yr	112.00	188.56	191.52	190.38	191.67	0.003402	3.06	37.27	20.44	0.37	0.43	0.37
Stream-Proposed	299.00	100-yr	136.00	188.56	192.28	190.56	192.39	0.001729	2.68	53.55	22.38	0.28	0.29	0.24
Stream-Proposed	299.00	1-cfs	1.00	188.56	189.70	188.75	189.70	0.000019	0.11	8.72	11.75	0.02	0.00	0.00
Stream-Proposed	296.00*	2-yr	33.00	187.59	190.69		190.71	0.000220	0.87	38.16	18.32	0.11	0.03	0.03
Stream-Proposed	296.00*	50-yr	112.00	187.59	191.57		191.64	0.000853	2.04	55.44	21.20	0.22	0.14	0.13
Stream-Proposed	296.00*	100-yr	136.00	187.59	192.31		192.37	0.000570	1.95	72.06	23.66	0.18	0.12	0.10
Stream-Proposed	296.00*	1-cfs	1.00	187.59	189.70		189.70	0.000001	0.05	21.34	15.35	0.01	0.00	0.00
Stream-Proposed	293	2-yr	33.00	186.61	190.70		190.70	0.000051	0.57	58.19	21.24	0.06	0.01	0.01
Stream-Proposed	293	50-yr	112.00	186.61	191.59		191.63	0.000247	1.45	78.50	24.28	0.14	0.05	0.05
Stream-Proposed	293	100-yr	136.00	186.61	192.33		192.36	0.000192	1.45	97.15	26.34	0.12	0.05	0.04
Stream-Proposed	293	1-cfs	1.00	186.61	189.70		189.70	0.000000	0.03	38.22	18.59	0.00	0.00	0.00
Stream-Proposed	291.40*	2-yr	33.00	187.16	190.69		190.70	0.000107	0.75	43.96	18.94	0.09	0.02	0.01
Stream-Proposed	291.40*	50-yr	112.00	187.16	191.57		191.62	0.000461	1.85	62.19	22.64	0.18	0.08	0.07
Stream-Proposed	291.40*	100-yr	136.00	187.16	192.31		192.36	0.000330	1.81	80.02	25.55	0.16	0.07	0.06
Stream-Proposed	291.40*	1-cfs	1.00	187.16	189.70		189.70	0.000000	0.04	26.67	15.87	0.01	0.00	0.00
Stream-Proposed	289.80*	2-yr	33.00	187.72	190.69		190.70	0.000260	1.05	31.80	17.02	0.13	0.03	0.03
Stream-Proposed	289.80*	50-yr	112.00	187.72	191.52		191.62	0.000945	2.47	48.17	22.00	0.26	0.15	0.12
Stream-Proposed	289.80*	100-yr	136.00	187.72	192.28		192.36	0.000601	2.31	66.20	25.73	0.22	0.12	0.09
Stream-Proposed	289.80*	1-cfs	1.00	187.72	189.70		189.70	0.000001	0.06	17.12	13.13	0.01	0.00	0.00
Stream-Proposed	288.20*	2-yr	33.00	188.27	190.66		190.70	0.000717	1.57	21.79	16.05	0.21	0.07	0.06
Stream-Proposed	288.20*	50-yr	112.00	188.27	191.43		191.61	0.002147	3.49	36.74	22.67	0.40	0.30	0.21
Stream-Proposed	288.20*	100-yr	136.00	188.27	192.22		192.35	0.001085	3.00	56.83	27.71	0.29	0.20	0.13
Stream-Proposed	288.20*	1-cfs	1.00	188.27	189.70		189.70	0.000007	0.10	9.63	10.35	0.02	0.00	0.00
Stream-Proposed	286.60*	2-yr	33.00	188.83	190.59		190.69	0.002824	2.64	14.10	17.90	0.41	0.21	0.13
Stream-Proposed	286.60*	50-yr	112.00	188.83	190.97	190.97	191.56	0.011738	6.43	22.02	22.77	0.88	1.16	0.69
Stream-Proposed	286.60*	100-yr	136.00	188.83	192.19		192.34	0.001810	3.64	56.48	31.74	0.38	0.31	0.19
Stream-Proposed	286.60*	1-cfs	1.00	188.83	189.70		189.70	0.000070	0.24	4.15	7.49	0.06	0.00	0.00
Stream-Proposed	285	2-yr	33.00	189.38	190.45	190.45	190.67	0.013682	4.42	12.30	27.87	0.86	0.69	0.37
Stream-Proposed	285	50-yr	112.00	189.38	191.02	190.98	191.42	0.014926	6.57	28.85	29.86	0.98	1.27	0.88
Stream-Proposed	285	100-yr	136.00	189.38	192.22		192.32	0.001826	3.48	66.87	33.35	0.38	0.29	0.22
Stream-Proposed	285	1-cfs	1.00	189.38	189.64	189.64	189.69	0.025834	1.90	0.53	3.70	0.89	0.23	0.23
Stream-Proposed	283.33*	2-yr	33.00	189.27	190.36	190.43	190.65	0.017154	4.87	11.10	28.59	0.95	0.84	0.41
Stream-Proposed	283.33*	50-yr	112.00	189.27	191.05		191.39	0.011884	6.10	31.51	30.90	0.88	1.08	0.74
Stream-Proposed	283.33*	100-yr	136.00	189.27	192.23		192.32	0.001658	3.36	69.99	34.37	0.36	0.27	0.20
Stream-Proposed	283.33*	1-cfs	1.00	189.27	189.46	189.53	189.62	0.097289	3.13	0.32	2.88	1.65	0.67	0.67

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	281.67*	2-yr	33.00	189.15	190.34	190.39	190.60	0.015327	4.74	11.57	29.52	0.90	0.78	0.37
Stream-Proposed	281.67*	50-yr	112.00	189.15	191.07		191.36	0.009812	5.72	34.06	31.95	0.80	0.93	0.64
Stream-Proposed	281.67*	100-yr	136.00	189.15	192.23		192.31	0.001512	3.24	73.19	35.38	0.34	0.25	0.19
Stream-Proposed	281.67*	1-cfs	1.00	189.15	189.38	189.41	189.48	0.051209	2.58	0.39	2.85	1.24	0.43	0.43
Stream-Proposed	280	2-yr	33.00	189.04	190.32	190.35	190.56	0.013452	4.57	12.16	30.46	0.84	0.72	0.33
Stream-Proposed	280	50-yr	112.00	189.04	191.08		191.34	0.008331	5.40	36.49	33.00	0.74	0.82	0.56
Stream-Proposed	280	100-yr	136.00	189.04	192.23		192.31	0.001389	3.13	76.39	36.39	0.33	0.23	0.17
Stream-Proposed	280	1-cfs	1.00	189.04	189.25	189.29	189.38	0.070776	2.95	0.34	2.62	1.44	0.56	0.56
Stream-Proposed	277.17*	2-yr	33.00	188.79	189.68	189.93	190.44	0.053500	6.97	4.74	8.00	1.60	1.91	1.91
Stream-Proposed	277.17*	50-yr	112.00	188.79	190.78	190.78	191.29	0.011850	6.19	24.86	28.93	0.88	1.10	0.62
Stream-Proposed	277.17*	100-yr	136.00	188.79	192.21		192.30	0.001098	2.92	73.51	36.27	0.30	0.20	0.13
Stream-Proposed	277.17*	1-cfs	1.00	188.79	189.27	189.00	189.27	0.000710	0.54	1.87	5.89	0.17	0.01	0.01
Stream-Proposed	274.33*	2-yr	33.00	188.54	190.18	189.52	190.25	0.002033	2.09	16.49	18.15	0.35	0.14	0.11
Stream-Proposed	274.33*	50-yr	112.00	188.54	190.95	190.34	191.17	0.003565	3.91	34.38	27.27	0.50	0.41	0.27
Stream-Proposed	274.33*	100-yr	136.00	188.54	192.22		192.30	0.000728	2.48	75.69	36.30	0.25	0.14	0.09
Stream-Proposed	274.33*	1-cfs	1.00	188.54	189.27		189.27	0.000065	0.22	4.62	9.43	0.05	0.00	0.00
Stream-Proposed	271.50*	2-yr	33.00	188.29	190.20		190.23	0.000750	1.39	24.50	21.01	0.21	0.06	0.05
Stream-Proposed	271.50*	50-yr	112.00	188.29	191.02		191.14	0.001656	2.80	44.35	27.62	0.34	0.21	0.16
Stream-Proposed	271.50*	100-yr	136.00	188.29	192.23		192.29	0.000472	2.02	82.51	35.22	0.19	0.10	0.07
Stream-Proposed	271.50*	1-cfs	1.00	188.29	189.27		189.27	0.000013	0.12	8.69	13.23	0.03	0.00	0.00
Stream-Proposed	268.67*	2-yr	33.00	188.04	190.21		190.23	0.000322	1.00	33.78	24.20	0.14	0.03	0.03
Stream-Proposed	268.67*	50-yr	112.00	188.04	191.05		191.12	0.000846	2.13	55.94	28.98	0.25	0.12	0.10
Stream-Proposed	268.67*	100-yr	136.00	188.04	192.24		192.28	0.000291	1.65	93.96	34.56	0.15	0.06	0.05
Stream-Proposed	268.67*	1-cfs	1.00	188.04	189.27		189.27	0.000004	0.07	14.16	17.26	0.01	0.00	0.00
Stream-Proposed	265.83*	2-yr	33.00	187.79	190.22		190.22	0.000157	0.75	44.43	27.56	0.10	0.02	0.02
Stream-Proposed	265.83*	50-yr	112.00	187.79	191.07		191.11	0.000474	1.68	69.24	30.90	0.19	0.07	0.06
Stream-Proposed	265.83*	100-yr	136.00	187.79	192.25		192.28	0.000185	1.36	108.61	35.31	0.12	0.04	0.03
Stream-Proposed	265.83*	1-cfs	1.00	187.79	189.27		189.27	0.000001	0.05	21.07	21.44	0.01	0.00	0.00
Stream-Proposed	263	2-yr	33.00	187.54	190.22		190.22	0.000084	0.59	56.45	31.01	0.08	0.01	0.01
Stream-Proposed	263	50-yr	112.00	187.54	191.07		191.10	0.000285	1.37	84.14	33.54	0.15	0.05	0.04
Stream-Proposed	263	100-yr	136.00	187.54	192.26		192.28	0.000123	1.14	125.70	36.80	0.10	0.03	0.02
Stream-Proposed	263	1-cfs	1.00	187.54	189.27		189.27	0.000001	0.03	29.41	25.47	0.01	0.00	0.00
Stream-Proposed	258.80*	2-yr	33.00	187.83	190.21		190.22	0.000166	0.77	43.36	27.01	0.10	0.02	0.02
Stream-Proposed	258.80*	50-yr	112.00	187.83	191.05		191.10	0.000503	1.73	67.41	30.25	0.19	0.08	0.07
Stream-Proposed	258.80*	100-yr	136.00	187.83	192.25		192.28	0.000195	1.40	106.24	34.76	0.13	0.04	0.04
Stream-Proposed	258.80*	1-cfs	1.00	187.83	189.27		189.27	0.000001	0.05	20.31	21.23	0.01	0.00	0.00
Stream-Proposed	254.60*	2-yr	33.00	188.11	190.20		190.22	0.000369	1.06	31.96	23.30	0.15	0.03	0.03
Stream-Proposed	254.60*	50-yr	112.00	188.11	191.01		191.09	0.000983	2.29	52.73	28.10	0.27	0.14	0.11
Stream-Proposed	254.60*	100-yr	136.00	188.11	192.23		192.27	0.000325	1.74	90.43	33.89	0.16	0.07	0.05
Stream-Proposed	254.60*	1-cfs	1.00	188.11	189.27		189.27	0.000005	0.08	12.90	16.99	0.02	0.00	0.00

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	250.40*	2-yr	33.00	188.40	190.18		190.22	0.000919	1.57	22.28	20.54	0.24	0.07	0.06
Stream-Proposed	250.40*	50-yr	112.00	188.40	190.93		191.08	0.002130	3.22	40.38	27.02	0.40	0.27	0.19
Stream-Proposed	250.40*	100-yr	136.00	188.40	192.20		192.27	0.000530	2.21	80.27	35.75	0.21	0.11	0.07
Stream-Proposed	250.40*	1-cfs	1.00	188.40	189.27		189.27	0.000022	0.14	7.16	12.65	0.03	0.00	0.00
Stream-Proposed	246.20*	2-yr	33.00	188.68	190.10		190.20	0.003451	2.65	14.58	20.93	0.45	0.23	0.15
Stream-Proposed	246.20*	50-yr	112.00	188.68	190.68		191.04	0.007538	5.23	28.76	27.96	0.72	0.76	0.48
Stream-Proposed	246.20*	100-yr	136.00	188.68	192.19		192.27	0.000795	2.62	80.51	37.34	0.26	0.15	0.10
Stream-Proposed	246.20*	1-cfs	1.00	188.68	189.27		189.27	0.000206	0.32	3.10	8.30	0.09	0.00	0.00
Stream-Proposed	242	2-yr	33.00	188.97	190.00		190.17	0.012023	4.09	13.97	30.84	0.81	0.59	0.34
Stream-Proposed	242	50-yr	112.00	188.97	190.75		190.97	0.007724	5.09	38.09	33.35	0.72	0.74	0.54
Stream-Proposed	242	100-yr	136.00	188.97	192.20		192.25	0.000868	2.65	89.63	37.54	0.27	0.16	0.12
Stream-Proposed	242	1-cfs	1.00	188.97	189.19	189.19	189.26	0.032554	2.13	0.47	3.31	1.00	0.29	0.29
Stream-Proposed	240.33*	2-yr	33.00	188.83	189.95	189.95	190.14	0.011734	4.19	13.61	30.70	0.80	0.61	0.32
Stream-Proposed	240.33*	50-yr	112.00	188.83	190.73		190.95	0.007154	5.05	38.76	33.39	0.70	0.71	0.51
Stream-Proposed	240.33*	100-yr	136.00	188.83	192.20		192.25	0.000831	2.63	90.77	37.61	0.26	0.16	0.12
Stream-Proposed	240.33*	1-cfs	1.00	188.83	189.01	189.06	189.17	0.096442	3.20	0.31	2.71	1.66	0.69	0.69
Stream-Proposed	238.67*	2-yr	33.00	188.70	189.86	189.92	190.12	0.015084	4.71	11.82	30.49	0.90	0.77	0.36
Stream-Proposed	238.67*	50-yr	112.00	188.70	190.73		190.94	0.006598	4.97	39.59	33.43	0.67	0.68	0.48
Stream-Proposed	238.67*	100-yr	136.00	188.70	192.20		192.25	0.000797	2.61	91.97	37.67	0.26	0.15	0.12
Stream-Proposed	238.67*	1-cfs	1.00	188.70	188.90	188.93	189.03	0.066032	2.87	0.35	2.65	1.40	0.53	0.53
Stream-Proposed	237	2-yr	33.00	188.56	189.84	189.88	190.08	0.012691	4.53	12.23	30.60	0.83	0.70	0.31
Stream-Proposed	237	50-yr	112.00	188.56	190.72		190.93	0.006052	4.88	40.54	33.44	0.64	0.65	0.45
Stream-Proposed	237	100-yr	136.00	188.56	192.20		192.25	0.000766	2.59	93.22	37.74	0.25	0.15	0.11
Stream-Proposed	237	1-cfs	1.00	188.56	188.76	188.80	188.90	0.074833	3.08	0.32	2.44	1.49	0.61	0.61
Stream-Proposed	234.33*	2-yr	33.00	188.08	189.69	189.24	189.78	0.003104	2.54	16.35	20.62	0.43	0.21	0.15
Stream-Proposed	234.33*	50-yr	112.00	188.08	190.75		190.90	0.002506	3.58	48.44	36.16	0.43	0.33	0.21
Stream-Proposed	234.33*	100-yr	136.00	188.08	192.20		192.25	0.000446	2.13	105.05	41.24	0.20	0.10	0.07
Stream-Proposed	234.33*	1-cfs	1.00	188.08	188.60	188.34	188.61	0.000931	0.58	1.72	5.83	0.19	0.02	0.02
Stream-Proposed	231.67*	2-yr	33.00	187.59	189.73		189.76	0.000651	1.37	29.36	23.64	0.20	0.06	0.05
Stream-Proposed	231.67*	50-yr	112.00	187.59	190.79		190.87	0.001051	2.54	61.42	39.28	0.29	0.16	0.10
Stream-Proposed	231.67*	100-yr	136.00	187.59	192.21		192.24	0.000254	1.69	121.80	44.76	0.15	0.06	0.04
Stream-Proposed	231.67*	1-cfs	1.00	187.59	188.61		188.61	0.000029	0.16	7.26	14.45	0.04	0.00	0.00
Stream-Proposed	229.00*	2-yr	33.00	187.11	189.74		189.75	0.000226	0.88	44.37	28.14	0.12	0.02	0.02
Stream-Proposed	229.00*	50-yr	112.00	187.11	190.82		190.86	0.000501	1.83	79.93	40.22	0.19	0.08	0.06
Stream-Proposed	229.00*	100-yr	136.00	187.11	192.22		192.24	0.000154	1.33	143.21	48.26	0.12	0.04	0.03
Stream-Proposed	229.00*	1-cfs	1.00	187.11	188.61		188.61	0.000004	0.07	16.35	20.24	0.01	0.00	0.00
Stream-Proposed	226.33*	2-yr	33.00	186.62	189.74		189.75	0.000093	0.63	61.74	32.69	0.08	0.01	0.01
Stream-Proposed	226.33*	50-yr	112.00	186.62	190.83		190.85	0.000257	1.39	102.51	43.90	0.14	0.05	0.04
Stream-Proposed	226.33*	100-yr	136.00	186.62	192.22		192.24	0.000093	1.08	169.24	51.62	0.09	0.02	0.02
Stream-Proposed	226.33*	1-cfs	1.00	186.62	188.61		188.61	0.000001	0.04	28.09	25.51	0.01	0.00	0.00
Stream-Proposed	223.67*	2-yr	33.00	186.14	189.75		189.75	0.000044	0.47	81.61	38.39	0.06	0.01	0.01

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	223.67*	50-yr	112.00	186.14	190.83		190.85	0.000136	1.06	128.56	48.19	0.10	0.03	0.02
Stream-Proposed	223.67*	100-yr	136.00	186.14	192.22		192.23	0.000058	0.88	200.09	54.37	0.07	0.02	0.01
Stream-Proposed	223.67*	1-cfs	1.00	186.14	188.61		188.61	0.000000	0.03	42.42	30.57	0.00	0.00	0.00
Stream-Proposed	221	2-yr	37.00	185.66	189.75		189.75	0.000029	0.41	103.72	44.52	0.05	0.00	0.00
Stream-Proposed	221	50-yr	121.00	185.66	190.84		190.85	0.000094	0.93	150.67	52.96	0.09	0.02	0.02
Stream-Proposed	221	100-yr	148.00	185.66	192.22		192.23	0.000046	0.81	212.39	58.15	0.06	0.01	0.01
Stream-Proposed	221	1-cfs	1.00	185.66	188.61		188.61	0.000000	0.02	59.21	35.56	0.00	0.00	0.00
Stream-Proposed	216.75*	2-yr	37.00	185.99	189.75		189.75	0.000032	0.43	95.70	40.74	0.05	0.00	0.00
Stream-Proposed	216.75*	50-yr	121.00	185.99	190.83		190.85	0.000101	0.97	143.21	48.12	0.09	0.02	0.02
Stream-Proposed	216.75*	100-yr	148.00	185.99	192.22		192.23	0.000048	0.84	216.73	55.80	0.07	0.01	0.01
Stream-Proposed	216.75*	1-cfs	1.00	185.99	188.61		188.61	0.000000	0.02	52.09	34.79	0.00	0.00	0.00
Stream-Proposed	212.50*	2-yr	37.00	186.33	189.75		189.75	0.000036	0.46	87.83	39.95	0.05	0.01	0.00
Stream-Proposed	212.50*	50-yr	121.00	186.33	190.83		190.85	0.000109	1.01	133.61	44.34	0.10	0.02	0.02
Stream-Proposed	212.50*	100-yr	148.00	186.33	192.22		192.23	0.000051	0.87	202.05	53.53	0.07	0.02	0.01
Stream-Proposed	212.50*	1-cfs	1.00	186.33	188.61		188.61	0.000000	0.02	45.09	34.41	0.00	0.00	0.00
Stream-Proposed	208.25*	2-yr	37.00	186.66	189.74		189.75	0.000044	0.48	80.38	39.61	0.06	0.01	0.01
Stream-Proposed	208.25*	50-yr	121.00	186.66	190.83		190.85	0.000123	1.05	126.00	44.50	0.10	0.03	0.02
Stream-Proposed	208.25*	100-yr	148.00	186.66	192.22		192.23	0.000055	0.89	191.39	50.46	0.07	0.02	0.01
Stream-Proposed	208.25*	1-cfs	1.00	186.66	188.61		188.61	0.000000	0.03	38.17	34.50	0.00	0.00	0.00
Stream-Proposed	204	2-yr	37.00	187.00	189.74	187.79	189.75	0.000087	0.67	56.25	39.91	0.08	0.01	0.01
Stream-Proposed	204	50-yr	121.00	187.00	190.83	188.38	190.84	0.000146	1.10	119.51	44.53	0.11	0.03	0.02
Stream-Proposed	204	100-yr	148.00	187.00	192.22	188.52	192.23	0.000061	0.90	184.56	48.75	0.07	0.02	0.01
Stream-Proposed	204	1-cfs	1.00	187.00	188.61	187.17	188.61	0.000001	0.04	27.10	33.35	0.01	0.00	0.00
Stream-Proposed	199	2-yr	37.00	188.35	189.37	189.37	189.71	0.044141	4.71	7.85	11.65	1.01	1.81	1.81
Stream-Proposed	199	50-yr	121.00	188.35	190.21	190.21	190.79	0.032005	6.14	20.66	21.82	0.95	2.48	1.81
Stream-Proposed	199	100-yr	148.00	188.35	192.18		192.23	0.001069	2.08	92.04	42.14	0.20	0.21	0.14
Stream-Proposed	199	1-cfs	1.00	188.35	188.56	188.56	188.60	0.060784	1.68	0.59	5.37	0.89	0.42	0.42
Stream-Proposed	196.00*	2-yr	37.00	187.56	188.26	188.58	189.37	0.247629	8.48	4.36	9.88	2.25	6.71	6.71
Stream-Proposed	196.00*	50-yr	121.00	187.56	188.91	189.43	190.51	0.144775	10.15	11.93	13.96	1.91	7.68	7.49
Stream-Proposed	196.00*	100-yr	148.00	187.56	192.19		192.22	0.000495	1.64	120.00	47.14	0.14	0.12	0.08
Stream-Proposed	196.00*	1-cfs	1.00	187.56	187.68	187.75	188.07	1.357448	5.05	0.20	3.55	3.77	4.72	4.72
Stream-Proposed	193.00*	2-yr	37.00	186.77	187.46	187.80	188.62	0.255404	8.61	4.30	9.75	2.29	6.92	6.92
Stream-Proposed	193.00*	50-yr	121.00	186.77	188.04	188.64	189.99	0.183447	11.18	10.83	12.77	2.14	9.42	9.42
Stream-Proposed	193.00*	100-yr	148.00	186.77	192.19		192.22	0.000265	1.35	148.78	51.71	0.11	0.08	0.05
Stream-Proposed	193.00*	1-cfs	1.00	186.77	186.94	186.95	187.02	0.139357	2.24	0.45	4.88	1.31	0.79	0.79
Stream-Proposed	190.00*	2-yr	37.00	185.98	186.67	187.01	187.85	0.256956	8.69	4.26	9.58	2.30	7.03	7.03
Stream-Proposed	190.00*	50-yr	121.00	185.98	187.22	187.86	189.38	0.211119	11.79	10.27	12.45	2.29	10.57	10.57
Stream-Proposed	190.00*	100-yr	148.00	185.98	192.20		192.21	0.000156	1.15	178.66	55.68	0.09	0.05	0.03
Stream-Proposed	190.00*	1-cfs	1.00	185.98	186.11	186.17	186.31	0.468617	3.58	0.28	3.77	2.32	2.16	2.16
Stream-Proposed	187.00*	2-yr	37.00	185.18	185.88	186.22	187.07	0.255444	8.74	4.23	9.41	2.30	7.08	7.08
Stream-Proposed	187.00*	50-yr	121.00	185.18	188.12	187.06	188.24	0.003598	3.05	46.47	28.95	0.35	0.50	0.35

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	187.00*	100-yr	148.00	185.18	192.20		192.21	0.000098	0.99	209.91	58.84	0.07	0.04	0.02
Stream-Proposed	187.00*	1-cfs	1.00	185.18	185.33	185.37	185.44	0.184081	2.60	0.38	4.16	1.51	1.06	1.06
Stream-Proposed	184.00*	2-yr	37.00	184.39	185.09	185.43	186.29	0.255689	8.80	4.21	9.25	2.30	7.15	7.15
Stream-Proposed	184.00*	50-yr	121.00	184.39	188.16		188.22	0.001086	2.05	71.54	32.12	0.20	0.21	0.14
Stream-Proposed	184.00*	100-yr	148.00	184.39	192.20		192.21	0.000064	0.86	242.96	60.34	0.06	0.03	0.02
Stream-Proposed	184.00*	1-cfs	1.00	184.39	184.52	184.57	184.69	0.352168	3.29	0.30	3.76	2.04	1.77	1.77
Stream-Proposed	181	2-yr	37.00	183.60	184.29	184.65	185.52	0.258485	8.89	4.16	9.09	2.32	7.28	7.28
Stream-Proposed	181	50-yr	121.00	183.60	188.18		188.21	0.000449	1.53	98.12	35.02	0.14	0.11	0.07
Stream-Proposed	181	100-yr	148.00	183.60	192.20		192.21	0.000043	0.76	278.15	61.16	0.05	0.02	0.01
Stream-Proposed	181	1-cfs	1.00	183.60	183.74	183.77	183.86	0.215801	2.81	0.36	3.87	1.63	1.23	1.23
Stream-Proposed	178.33*	2-yr	37.00	182.61	184.99	183.66	185.02	0.000981	1.36	27.15	17.09	0.19	0.09	0.09
Stream-Proposed	178.33*	50-yr	121.00	182.61	188.18		188.20	0.000194	1.24	116.82	36.02	0.10	0.05	0.04
Stream-Proposed	178.33*	100-yr	148.00	182.61	192.20		192.21	0.000026	0.69	301.18	63.02	0.04	0.01	0.01
Stream-Proposed	178.33*	1-cfs	1.00	182.61	183.75	182.81	183.75	0.000018	0.11	8.91	11.96	0.02	0.00	0.00
Stream-Proposed	175.67*	2-yr	37.00	181.61	185.00		185.01	0.000156	0.77	47.82	21.22	0.09	0.02	0.02
Stream-Proposed	175.67*	50-yr	121.00	181.61	188.19		188.20	0.000079	0.97	141.91	36.95	0.07	0.02	0.02
Stream-Proposed	175.67*	100-yr	148.00	181.61	192.20		192.21	0.000015	0.61	329.58	64.69	0.03	0.01	0.00
Stream-Proposed	175.67*	1-cfs	1.00	181.61	183.75		183.75	0.000001	0.04	23.78	16.90	0.01	0.00	0.00
Stream-Proposed	173	2-yr	37.00	180.62	185.01		185.01	0.000036	0.51	73.29	25.18	0.05	0.01	0.01
Stream-Proposed	173	50-yr	121.00	180.62	188.19		188.20	0.000032	0.77	173.41	37.77	0.05	0.01	0.01
Stream-Proposed	173	100-yr	148.00	180.62	192.20		192.21	0.000008	0.53	363.39	66.02	0.03	0.00	0.00
Stream-Proposed	173	1-cfs	1.00	180.62	183.75		183.75	0.000000	0.02	44.02	21.38	0.00	0.00	0.00
Stream-Proposed	164	2-yr	37.00	183.39	184.75	184.75	184.99	0.013202	4.45	12.88	25.96	0.84	0.69	0.40
Stream-Proposed	164	50-yr	121.00	183.39	188.17		188.20	0.000228	1.69	124.99	39.53	0.14	0.06	0.04
Stream-Proposed	164	100-yr	148.00	183.39	192.20		192.21	0.000031	0.96	329.00	74.13	0.06	0.02	0.01
Stream-Proposed	164	1-cfs	1.00	183.39	183.66	183.66	183.74	0.031783	2.27	0.44	2.72	1.00	0.31	0.31
Stream-Proposed	159	2-yr	37.00	183.06	184.18	184.37	184.83	0.044131	7.08	8.03	25.47	1.46	1.86	0.85
Stream-Proposed	159	50-yr	121.00	183.06	188.18		188.19	0.000174	1.54	141.94	41.53	0.12	0.05	0.03
Stream-Proposed	159	100-yr	148.00	183.06	192.20		192.21	0.000027	0.92	358.43	79.13	0.05	0.01	0.01
Stream-Proposed	159	1-cfs	1.00	183.06	183.23	183.30	183.45	0.120767	3.69	0.27	2.21	1.86	0.90	0.90
Stream-Proposed	139	2-yr	37.00	181.55	184.33	182.38	184.34	0.000113	0.72	52.32	27.55	0.09	0.01	0.01
Stream-Proposed	139	50-yr	121.00	181.55	188.18		188.19	0.000031	0.76	188.54	42.68	0.06	0.01	0.01
Stream-Proposed	139	100-yr	148.00	181.55	192.20		192.21	0.000007	0.50	439.93	91.40	0.03	0.00	0.00
Stream-Proposed	139	1-cfs	1.00	181.55	183.14	181.68	183.14	0.000001	0.04	22.73	21.35	0.01	0.00	0.00
Stream-Proposed	123	2-yr	37.00	181.53	184.33		184.34	0.000084	0.62	60.43	31.45	0.08	0.01	0.01
Stream-Proposed	123	50-yr	121.00	181.53	188.18		188.19	0.000024	0.67	209.90	46.75	0.05	0.01	0.01
Stream-Proposed	123	100-yr	148.00	181.53	192.20		192.21	0.000005	0.44	489.09	96.98	0.02	0.00	0.00
Stream-Proposed	123	1-cfs	1.00	181.53	183.14		183.14	0.000001	0.04	26.19	24.85	0.01	0.00	0.00
Stream-Proposed	119	2-yr	37.00	182.88	183.95	183.95	184.30	0.043608	4.78	7.74	11.14	1.01	1.84	1.84
Stream-Proposed	119	50-yr	121.00	182.88	188.18		188.19	0.000183	1.08	144.25	44.33	0.09	0.05	0.04
Stream-Proposed	119	100-yr	148.00	182.88	192.20		192.21	0.000021	0.56	420.50	98.01	0.03	0.01	0.01

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	119	1-cfs	1.00	182.88	183.09	183.09	183.13	0.057534	1.73	0.58	4.76	0.88	0.43	0.43
Stream-Proposed	116.40*	2-yr	37.00	182.19	182.93	183.26	184.01	0.208293	8.33	4.44	9.02	2.09	6.26	6.26
Stream-Proposed	116.40*	50-yr	121.00	182.19	188.18		188.19	0.000117	0.95	168.09	47.37	0.07	0.04	0.02
Stream-Proposed	116.40*	100-yr	148.00	182.19	192.20		192.21	0.000016	0.51	470.58	103.86	0.03	0.01	0.00
Stream-Proposed	116.40*	1-cfs	1.00	182.19	182.31	182.38	182.68	1.383740	4.88	0.21	3.91	3.76	4.50	4.50
Stream-Proposed	113.80*	2-yr	37.00	181.50	182.22	182.56	183.41	0.242491	8.78	4.22	8.91	2.25	7.03	7.03
Stream-Proposed	113.80*	50-yr	121.00	181.50	188.18		188.19	0.000078	0.85	193.17	50.50	0.06	0.03	0.02
Stream-Proposed	113.80*	100-yr	148.00	181.50	192.20		192.21	0.000012	0.47	522.72	109.72	0.03	0.01	0.00
Stream-Proposed	113.80*	1-cfs	1.00	181.50	181.67	181.69	181.76	0.138956	2.32	0.43	4.47	1.32	0.83	0.83
Stream-Proposed	111.20*	2-yr	37.00	180.81	181.52	181.87	182.75	0.255816	8.90	4.16	8.97	2.30	7.28	7.28
Stream-Proposed	111.20*	50-yr	121.00	180.81	188.18		188.19	0.000055	0.76	219.45	54.04	0.05	0.02	0.01
Stream-Proposed	111.20*	100-yr	148.00	180.81	192.20		192.21	0.000009	0.43	576.86	115.69	0.02	0.01	0.00
Stream-Proposed	111.20*	1-cfs	1.00	180.81	180.95	181.01	181.14	0.454547	3.48	0.29	3.95	2.28	2.06	2.06
Stream-Proposed	108.60*	2-yr	37.00	180.12	180.82	181.18	182.07	0.261938	8.95	4.13	9.01	2.33	7.38	7.38
Stream-Proposed	108.60*	50-yr	121.00	180.12	188.18		188.19	0.000040	0.70	246.95	57.85	0.05	0.02	0.01
Stream-Proposed	108.60*	100-yr	148.00	180.12	192.20		192.21	0.000007	0.40	633.01	121.56	0.02	0.01	0.00
Stream-Proposed	108.60*	1-cfs	1.00	180.12	180.28	180.30	180.39	0.183608	2.60	0.38	4.16	1.51	1.06	1.06
Stream-Proposed	106	2-yr	37.00	179.43	180.13	180.49	181.37	0.262388	8.92	4.15	9.11	2.33	7.35	7.35
Stream-Proposed	106	50-yr	121.00	179.43	188.18		188.19	0.000030	0.65	275.76	65.06	0.04	0.01	0.01
Stream-Proposed	106	100-yr	148.00	179.43	192.20		192.21	0.000006	0.37	691.18	127.55	0.02	0.00	0.00
Stream-Proposed	106	1-cfs	1.00	179.43	179.57	179.61	179.74	0.343650	3.29	0.30	3.69	2.02	1.76	1.76
Stream-Proposed	103.50*	2-yr	37.00	178.74	180.99	179.79	181.03	0.001380	1.47	27.58	25.08	0.21	0.13	0.09
Stream-Proposed	103.50*	50-yr	121.00	178.74	188.18		188.18	0.000021	0.56	304.20	57.18	0.03	0.01	0.01
Stream-Proposed	103.50*	100-yr	148.00	178.74	192.20		192.21	0.000006	0.39	623.12	99.13	0.02	0.00	0.00
Stream-Proposed	103.50*	1-cfs	1.00	178.74	178.88	178.92	179.01	0.248148	2.89	0.35	3.98	1.73	1.34	1.34
Stream-Proposed	101	2-yr	37.00	178.05	181.01		181.02	0.000351	0.95	45.19	27.55	0.11	0.05	0.03
Stream-Proposed	101	50-yr	121.00	178.05	188.18		188.18	0.000016	0.53	315.64	50.26	0.03	0.01	0.01
Stream-Proposed	101	100-yr	148.00	178.05	192.20		192.21	0.000006	0.40	569.48	76.46	0.02	0.00	0.00
Stream-Proposed	101	1-cfs	1.00	178.05	178.18	178.22	178.33	0.314977	3.11	0.32	3.99	1.93	1.58	1.58
Stream-Proposed	98.00*	2-yr	37.00	177.09	181.01		181.02	0.000146	0.81	49.21	21.14	0.08	0.03	0.02
Stream-Proposed	98.00*	50-yr	121.00	177.09	188.18		188.18	0.000014	0.57	302.35	47.48	0.03	0.01	0.01
Stream-Proposed	98.00*	100-yr	148.00	177.09	192.20		192.21	0.000006	0.44	539.71	73.26	0.02	0.00	0.00
Stream-Proposed	98.00*	1-cfs	1.00	177.09	178.20	177.29	178.20	0.000028	0.14	7.19	9.70	0.03	0.00	0.00
Stream-Proposed	95.00*	2-yr	37.00	176.13	181.01		181.02	0.000063	0.67	58.81	19.33	0.06	0.01	0.01
Stream-Proposed	95.00*	50-yr	121.00	176.13	188.18		188.18	0.000012	0.60	291.05	45.34	0.03	0.01	0.00
Stream-Proposed	95.00*	100-yr	148.00	176.13	192.20		192.21	0.000005	0.47	514.58	69.74	0.02	0.00	0.00
Stream-Proposed	95.00*	1-cfs	1.00	176.13	178.20		178.20	0.000002	0.06	16.02	11.48	0.01	0.00	0.00
Stream-Proposed	92	2-yr	37.00	175.17	181.01		181.02	0.000030	0.58	68.31	18.66	0.05	0.01	0.01
Stream-Proposed	92	50-yr	121.00	175.17	188.18		188.18	0.000010	0.63	281.73	43.25	0.03	0.01	0.00
Stream-Proposed	92	100-yr	148.00	175.17	192.20		192.21	0.000004	0.51	494.09	66.45	0.02	0.00	0.00
Stream-Proposed	92	1-cfs	1.00	175.17	178.20		178.20	0.000000	0.04	25.11	12.16	0.00	0.00	0.00

HEC-RAS Plan: Proposed River: Stream Reach: Stream-Proposed (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Shear Total
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(lb/sq ft)
Stream-Proposed	86	2-yr	37.00	177.06	180.98	178.43	181.01	0.000291	1.48	29.55	11.22	0.14	0.05	0.04
Stream-Proposed	86	50-yr	121.00	177.06	188.17	179.66	188.18	0.000040	1.16	182.92	34.45	0.06	0.02	0.01
Stream-Proposed	86	100-yr	148.00	177.06	192.20	179.95	192.21	0.000014	0.83	374.84	63.84	0.04	0.01	0.00
Stream-Proposed	86	1-cfs	1.00	177.06	178.20	177.29	178.20	0.000032	0.20	5.04	6.32	0.04	0.00	0.00

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
178.08	0.00	0.00	0.00	1
179.83	15.00	15.00	0.00	1
180.64	30.00	30.00	0.00	1
181.37	45.00	45.00	0.00	1
182.24	60.00	60.00	0.00	1
182.95	70.00	70.00	0.00	1
184.72	90.00	90.00	0.00	1
186.30	105.00	105.00	0.00	1
188.03	120.00	120.00	0.00	1
190.11	135.00	135.00	0.00	1
192.52	150.00	150.00	0.00	1
194.00	158.53	158.53	0.00	Overtopping

Appendix I. Geotechnical Investigation Report

ECS Capitol Services, PLLC

Geotechnical Engineering Report

Branch Avenue Stream Restoration

Branch Avenue and Southern Avenue
Southeast, Washington, DC 20020

ECS Project Number 37:2479

February 27, 2019

ECS CAPITOL SERVICES, PLLC

February 27, 2020

Mr. [illegible], PE
Water Resources Engineer
Straughan Environmental, Inc.
10245 Old Columbia Road
Columbia, MD 21046

ECS Project No. 37:2978

Reference: Geotechnical Engineering Report
Branch Avenue Stream Restoration
Southeast, Washington, DC 20020

Dear Mr. [illegible]:

ECS Capitol Services, PLLC (ECS) has completed the subsurface exploration, laboratory testing, and infiltration testing for the above-referenced project.

A report, including the results of our subsurface exploration, soil boring data, laboratory testing, infiltration testing results, and a boring location diagram are enclosed herein. The results presented are intended for use by your office and for use by other professionals involved in the design and construction stages of the project described above.

It has been a pleasure to be of service to Straughan Environmental, Inc. on this project. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully,

ECS Capitol Services, PLLC

[illegible], P.E.
Project Engineer
[illegible]

[illegible]

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EXECUTIVE SUMMARY

The following summarizes our subsurface exploration, particularly those which may have a cost impact on the proposed project and stormwater management (SWM) facilities. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

The subsurface exploration included two hand auger borings and two infiltration tests (referred as GEO-1 and GEO-2), at locations provided and staked-out by your office. The hand augers were scheduled to be advanced to a depth of 20± feet below existing site grades; however, due to hand auger refusal on the gravels encountered in the natural clay soils, the hand augers were terminated at depths of 5.3± (at GEO-1) and 5.8± (at GEO-2). The infiltration tests were performed at 4± feet below existing site grades, as requested by your office.

In general, beneath the surface material, existing fill materials were encountered consisting of clays to a depth of approximately 3± feet below existing site grades. The existing fill materials were underlain by natural alluvial soils generally consisting of clays and gravels, which extended to the hand auger refusal depths. Groundwater was not encountered during our subsurface exploration.

It is our understanding the project will include the restoration of the existing stream and the potential development of a series of SWM facilities. As discussed, some grading efforts will be performed around the stream to reduce erosion and improve the natural habitat of the stream. In general, the soils encountered during our subsurface exploration appear to be suitable for re-use during the restoration of the existing stream. As for the proposed SWM facilities, limited information has been provided at this time. The infiltration test results are enclosed herein and should be reviewed by the project civil engineer to determine an appropriate factor of safety to apply to the measured infiltration rates. Variable subsurface conditions were also encountered on the site and the project civil engineer should take this into account when determining infiltration rates for each facility.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information and construction recommendations for the proposed stream restoration. The recommendations enclosed within this report are based on project information supplied by your office. This report contains the results of our subsurface exploration and laboratory testing program, site characterization, infiltration test results, and recommendations for the planned stream restoration.

1.2 SCOPE OF SERVICES

The purpose of the exploration was to determine the suitability of the on-site materials for re-use around the existing stream and help determine the feasibility of stormwater infiltration on the site. A series of two hand auger borings and two infiltration tests (referred as GEO-1 and GEO-2) were performed at locations provided and staked-out by your office. Due to limited site access in the heavily wooded parcel, this hand auger exploration was proposed and requested to limit costs with the understanding that the scheduled depths of 20± feet may not be achieved. Hand auger refusal was encountered at depths of 5.3± feet (GEO-1) and 5.8± feet (GEO-2) due to gravels in the natural clay soils. The infiltration tests were performed at a depth of 4± feet, as requested by your office.

A laboratory-testing program was also implemented to characterize the physical and engineering properties of the subsurface soils. This report discusses our exploratory and testing procedures, presents our findings and includes the following.

- Observations from our site reconnaissance including current site conditions, surface drainage features, and surface topographic conditions.
- A review of the published geologic conditions and their relevance to your planned development.
- A subsurface characterization and a description of the field exploration and laboratory tests performed. Groundwater concerns relative to the planned construction are summarized.
- Final logs of the soil borings and records of the field exploration prepared in accordance with the standard practice for geotechnical engineering. A boring location plan is included, and the results of the laboratory tests are plotted on the final boring logs and included on a separate test report sheet.
- Tabulated results for the in-situ infiltration tests.
- Evaluation of the on-site soil characteristics encountered in the soil borings. Specifically, the suitability of the on-site materials for re-use as fill. We will also include compaction requirements and suitable material guidelines.
- Recommendations for additional testing and/or consultation that might be of value to complete the geotechnical assessment and related engineering for this project.

1.3 AUTHORIZATION

Our services were provided in general accordance with ECS Proposal No. 37:2281-GP dated April 13, 2018 and sub-contract agreement executed on January 24, 2019.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The site is a heavily wooded parcel surrounded primarily by residential homes and is bound by Branch Avenue, Erie Street, and Southern Avenue in southeast, Washington, DC. A stream runs through the center of the wooded parcel near Frankford Street towards Fairhill Drive.

Based on the existing conditions plan dated January 24, 2019, the site appears to slope down from approximately EL. +235 feet (northwestern portion of parcel, intersection of Branch Avenue and Erie Street) to approximately EL. +184 feet (center portion of parcel, along the existing stream towards Fairhill Drive). From that point, the site appears to slope back up to EL. +236 feet (southwestern portion of parcel, intersection of Branch Avenue and Gainesville Street). Please see the attached Site Location Diagram in Appendix A for further details (included below for reference).

Figure 1. Site Location

2.2 PROPOSED CONSTRUCTION

Per our correspondence, we understand the project will include the restoration of the existing stream and the potential development of a series of stormwater management facilities. As discussed, some grading efforts (including minimal cut and fill) will be performed around the stream to reduce erosion potential and to improve the natural habitat of the stream. In general, if the soils encountered are suitable, we understand the design team will plan to re-use it around the stream; however, should the soils encountered be found unsuitable, the cut and fill will be limited around the stream.

Furthermore, as discussed with your office, the proposed development may include the design and construction of a series of stormwater management facilities. At this time further details on the proposed storwmater management facilities have yet to be determined and are contingent with the infiltration test results presented in this report.

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of feasibility of stormwater infiltration on the site and geotechnical recommendations.

3.1.1 Hand Auger/Wildcat DCP Borings

The subsurface conditions were explored by two hand auger borings (referred as GEO-1 and GEO-2) within the limits of the property. The hand auger locations were determined and staked-out in the field by your office. Hand auger borings were scheduled to be advanced to a depth of 20± feet below existing site grades; however, despite several offset attempts, hand auger refusal was encountered at depths of 5.3± (GEO-1) and 5.8± (GEO-2) due to gravels in the natural clay soils. An approximate three-inch diameter hand auger was used to collect soil samples at both locations. A representative of ECS recorded the soil types encountered at the hand auger locations and obtained soil samples for visual classification and testing in our soils laboratory. The hand auger boring logs are attached to this report. Following hand auger operations, the auger holes were backfilled with the auger spoils generated during the drilling process.

In addition, "WILDCAT" Dynamic Cone Penetrometer (WDCP) testing was performed to continually test the relative density or consistency of the soils at the hand auger locations. The number of blows of the 35-pound hammer required to drive the penetrometer through continuous 10 cm (4-inch) increments are recorded. The results of the "WILDCAT" soundings produce an approximate 1:1 relationship when compared to the Standard Penetration Test (N-value). The "WILDCAT" Dynamic Cone Log for the soundings performed at GEO-1 and GEO-2 can be found in Appendix B of this report.

3.1.2 Infiltration Testing

At the infiltration test locations (referred as GEO-1 and GEO-2), an auger probe boring (no samples taken) was advanced. As indicated in previous sections of this report, the infiltration test locations were determined and staked-out in the field by your office. As requested by your office, the infiltration tests, at both locations, were performed at a depth of 4± feet below existing site grades. ECS used the Johnson Permeameter™ to perform a constant head infiltration test which is in general accordance with the publication entitled "DOEE (District Department of Energy and the Environment) Stormwater Guidebook, Appendix O."

Each hole is prepared in general accordance with the information contained in the Johnson Permeameter™ Instruction Manual dated June 14, 2014. A schematic of the equipment used is included in Appendix D of this report for reference. The test is then performed in general accordance with the same manual and the test results are recorded during testing of each location. The final design rate chosen is ultimately the discretion of the design engineer; however, is typically the average of the last three to four readings taken during the test or the last reading, as appropriate, based on the test results. The results of the infiltration tests are included in Appendix B of this report for reference.

3.2 REGIONAL/SITE GEOLOGY

The proposed site is located in the Atlantic Coastal Plain Physiographic Province of Washington, D.C. This Coastal Plain Province is characterized by a series of southeasterly dipping layers of relatively consolidated, sandy, clay deposits, with lesser amounts of gravel. At the extreme eastern edge, these Coastal Plain deposits are estimated to be approximately 250 feet thick and are underlain by the eastward continuation of the crystalline rock of the Piedmont Physiographic Province. Colluvial deposits cover the side of some slopes, and alluvial deposits can be found along streams in the area.

The Quaternary Terrace deposits consist predominantly of clays or sands, with varying quantities of silt and gravel. Portions of Terrace deposits often contain cobbles. Clay deposits with low to medium plasticity can also be encountered within the Quaternary deposits. The silts and clays of the Potomac Formation are often referred to as “marine clays”, and typically have high plasticity characteristics and significant shrink-swell potential. Furthermore, the Potomac Formation soils are highly overconsolidated and fissured, and contain pre-existing failure surfaces referred to as "slickensides".

The Cretaceous Age Potomac Group deposits consist generally of very dense or hard, inter-lensed, discontinuous, sand, silt and clay layers that generally slope to the southeast at roughly 50 to 80 feet per mile, or approximately 0.5 to 0.8 degrees. The sand layers generally consist of fine to medium sand, with varying amounts of clay and silt. However, in isolated areas, significant amounts of gravel can also be encountered. The occurrences of the sand layers are discontinuous, both laterally and vertically.

Figure 2. General Site Geology

Geologic map for Figure 2 obtained from the U.S. Geologic Service website, https://ngmdb.usgs.gov/maps/mapview/

3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soils encountered during our subsurface exploration. For subsurface information at a specific location, refer to the Boring Logs in Appendix B.

Table 1. Subsurface Stratigraphy

Approximate Depth Range (feet)	Elevation (feet)	Stratum	General Description
0 to 0.3 ft (Surface cover)	N/A	N/A	**Surficial Materials** • Approximately 4 inches of topsoil
0.3 to 3.0 ft	EL. +207.0 to 192.0	I	**Existing Fills** • Generally CLAYS (CL) with varying amounts of gravel and root fragments
3.0 to 5.8 ft	EL. 192.0 to 189.2	II	**Alluvial Soils** • Generally CLAYS (CL) and GRAVELS (GC) with varying amounts of sand

3.4 GROUNDWATER OBSERVATIONS

During the subsurface exploration, the boreholes were observed for the presence of groundwater during advancement, before removal of the hand augers, and after removal of the hand augers. Groundwater was not observed in the soil borings performed. In hand auger drilling operations, the groundwater position can often be determined by observing water flowing into or out of the boreholes. Furthermore, visual observation of the soil samples retrieved during hand auger drilling explorations can often be used in evaluating the groundwater conditions. It should be noted that the site may be subject to shallower perched water conditions where water becomes trapped within the existing fill overlying less permeable soil layers.

In general, the highest groundwater observations are normally encountered in late winter and early spring. Variations in the location of the long-term water table may occur as a result of changes in precipitation, surface water runoff, adjacent construction, and other factors not immediately apparent at the time of this report's preparation.

Cave-ins were also not observed after the completion of the hand auger borings. In general, if observed, cave-ins of the boreholes can also be an indicator of groundwater movement into the boring location.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. The following paragraphs briefly discuss the results of the completed laboratory testing program. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties.

A geotechnical engineer visually classified each soil sample from the test borings on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer/engineering geologist grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses in the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

The soil samples obtained by ECS during the current exploration will be retained in our laboratory for a period of 60 days from the date the borings were completed, after which they will be discarded unless other instructions are provided as to their disposition.

5.0 DESIGN RECOMMENDATIONS

5.1 STORMWATER MANAGEMENT FACILITIES

Per our correspondence with your office, we understand a system of stormwater management (SWM) facilities may be considered as part of the project development. The results of our infiltration testing are summarized in Table 2 below

5.1.1 Stormwater Management Facilities

At this time limited information and details regarding the proposed stormwater management facilities have been provided; however, we anticipate the soil conditions will generally be suitable for the stormwater management facilities. This suitability should be further analyzed by the project civil engineer.

We recommend initial subgrade preparation over proposed stormwater management facility locations is performed in a way so that these areas are isolated from construction traffic and stock piling in order to maintain the natural condition of the subgrade soils. We recommend isolating these areas by setting up a barrier around the perimeter of the facility footprint using flagging/tape, orange-fence, or silt fence. During facility construction, subgrade preparation for all SWM facilities should consist of stripping all vegetation, rootmat, topsoil, and any other soft or unsuitable material from the facility footprint. Further, should infiltration be necessary, as the facility excavation proceeds, care must be employed to assure that the facility soil subgrade are not densified or smeared during final excavation. As final subgrade elevations are reached, we recommend the subgrade be roughed open with a multiple-toothed bucket and a layer of medium to coarse grained, open graded sand should be worked into/sprinkled into the roughed-up subgrade so as to promote infiltration (should it be necessary, rather than impede it by smearing a skin across the subgrade interface). We also recommend a minimum 6-inch layer of open graded clean wash stone be placed across the entire facility footprint to help establish working subgrades and to reduce the loading impact on the subgrade soils.

5.1.2 Infiltration Test Results

The individual infiltration tests are included in Appendix B and are summarized below. Refer to Appendix C for detailed soils laboratory data.

Table 2. Field Infiltration Rates

Infiltration Test Location	Depth of Infiltration Test (ft)	Elevation of Infiltration Test (ft)	Laboratory Classification	Measured Field K_{sat} (in/hr)[(1)]
GEO-1	4.0	+203.0	GC	2.32
GEO-2	4.0	+191.0	GC	2.43

Notes: (1) If the measured infiltration rate is less than 0.50 in/hr, the project civil engineer should review the enclosed data to determine an appropriate factor of safety to apply to the measured infiltration rates.

Approximate test elevations are based on the existing conditions plan dated January 24, 2019. The two infiltration tests were performed at locations and depths provided to us by your office. The data collected during the performance of this subsurface exploration and infiltration testing program should be reviewed by the project civil engineer for incorporation into the design of the proposed stormwater management facilities.

It is important to note that the saturated hydraulic conductivity (K_{sat}) rate (traditionally presented in units of inches/hour for SWM applications) is different than the traditional standpipe test infiltration rate (also presented in units of inches/hour for SWM applications). The standpipe test measures soil conductivity with a falling head in which the height of a column of water in the test hole drops during the testing period. The referenced Johnson Permeameter™ measures the saturated hydraulic conductivity (K_{sat}) property of the soil in which the height of a column of water in the test hole is maintained at the same level throughout the testing period. While both test methods present infiltration values in units of inches/hour, the constant head K_{sat} values can be an order of magnitude slower than the falling head standpipe values which have traditionally been utilized for SWM design practice in the project vicinity. The civil engineer should take this into account when using the values included herein and apply a conversion factor should it be necessary.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK OPERATIONS

In general, the soils encountered during our subsurface exploration appear to be suitable for re-use during the restoration of the existing stream. Due to erosion control concerns around the existing stream, we recommend Fill materials be wrapped in filter fabric. For the filter fabric we recommend a non-woven product such as Mirafi 140N with an AOS of 70 (U.S. Sieve). An equivalent geotextile fabric can also be used. The following earthwork recommendations may be followed by the Contractor during construction.

6.1.1 Fill Materials

Product Submittals: Prior to placement of Fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow may be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Fill should consist of inorganic soils classified as CL, ML, SM, SC, SW, SP, GW, GP, GM, and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as Gravels (GW and GP), which contain void space in their mass may be used when properly encapsulated with filter fabric.

6.1.2 Compaction

Fill Compaction: Fill within the embankment limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -1 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D698). ECS should be called on to document that proper fill compaction has been achieved.

Fill Placement Considerations: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

6.2 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project.

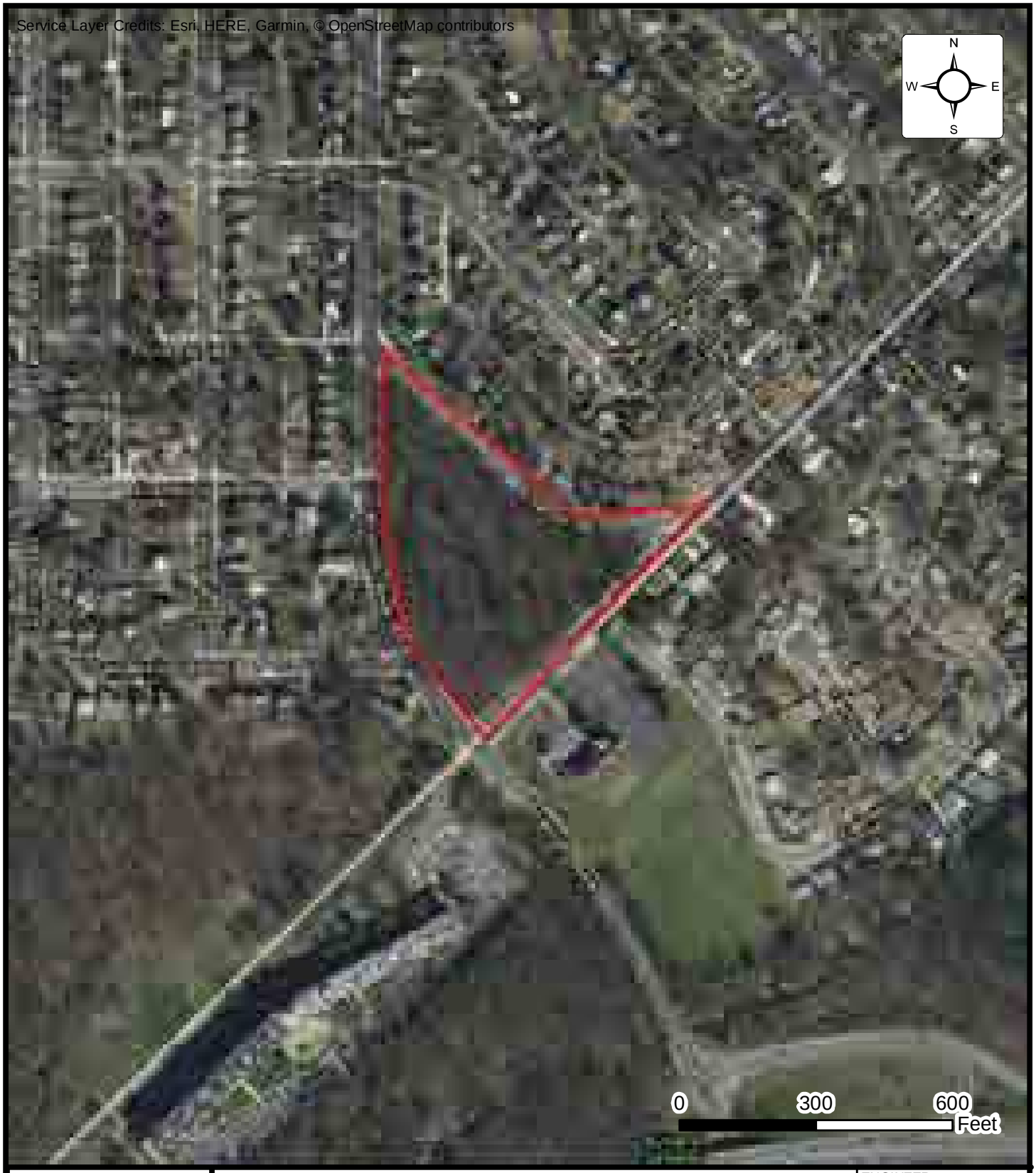
The description of the proposed project is based on information provided to ECS by Straughan Environmental, Inc. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately in order to review and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork are an extension of and integral to the geotechnical design recommendation. We recommend the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Drawings & Reports

Site Location Diagram
Boring Location Diagram



Site Location Diagram

BRANCH AVE STREAM RESTORATION

BRANCH AVE SE AND SOUTHERN AVE SE

Straughan Environmental, Inc.

ENGINEER	CIO/SFP
SCALE	1 " = 300 '
PROJECT NO.	37:2479
SHEET	1 OF 2
DATE	2/21/2019

BRANCH AVENUE STREAM RESTORATION

SOUTHEAST, WASHINGTON, DC

ECS

BORING LOCATION DIAGRAM

STRAUGHAN

ECS REVISIONS

ENGINEER	DRAFTING
CIO	RAC

SCALE: 1"=60'

PROJECT NO.: 37:2479

SHEET: 2 OF 2

DATE: 02/19/19

W:\Geotechnical_e-projects\2400-2499\2479 Branch Avenue Park Design Build\a-Drafting\37:2479_BLD.dwg bld_11x17_landscape_clr, 2/20/2019 1:05:43 PM

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs (GEO-1 and GEO-2)
Wildcat Dynamic Cone Logs (GEO-1 and GEO-2)
Infiltration Test Results (GEO-1 and GEO-2)

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	FILL[3] MAN-PLACED SOILS
GW	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GP	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GM	**SILTY GRAVEL** gravel-sand-silt mixtures
GC	**CLAYEY GRAVEL** gravel-sand-clay mixtures
SW	**WELL-GRADED SAND** gravelly sand, little or no fines
SP	**POORLY-GRADED SAND** gravelly sand, little or no fines
SM	**SILTY SAND** sand-silt mixtures
SC	**CLAYEY SAND** sand-clay mixtures
ML	**SILT** non-plastic to medium plasticity
MH	**ELASTIC SILT** high plasticity
CL	**LEAN CLAY** low to medium plasticity
CH	**FAT CLAY** high plasticity
OL	**ORGANIC SILT or CLAY** non-plastic to low plasticity
OH	**ORGANIC SILT or CLAY** high plasticity
PT	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION		**PARTICLE SIZES**
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	**SPT[5] (BPF)**	**CONSISTENCY[7] (COHESIVE)**
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT[5]	**DENSITY**
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

WATER LEVELS[6]		
	WL	Water Level (WS)(WD)
		(WS) While Sampling
		(WD) While Drilling
	SHW	Seasonal High WT
	ACR	After Casing Removal
	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

[1] Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.

[2] To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

*[3] Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).

[6] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7] Minor deviation from ASTM D 2488-09 Note 16.

[8] Percentages are estimated to the nearest 5% per ASTM D 2488-09.

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CLIENT	Job #:	BORING #	SHEET
Straughan Environmental, Inc.	37:2479	GEO-1	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
Branch Avenue Stream Restoration	Straughan Environmental, Inc.

SITE LOCATION: Branch Ave and Southern Ave, SE, Washington, DC

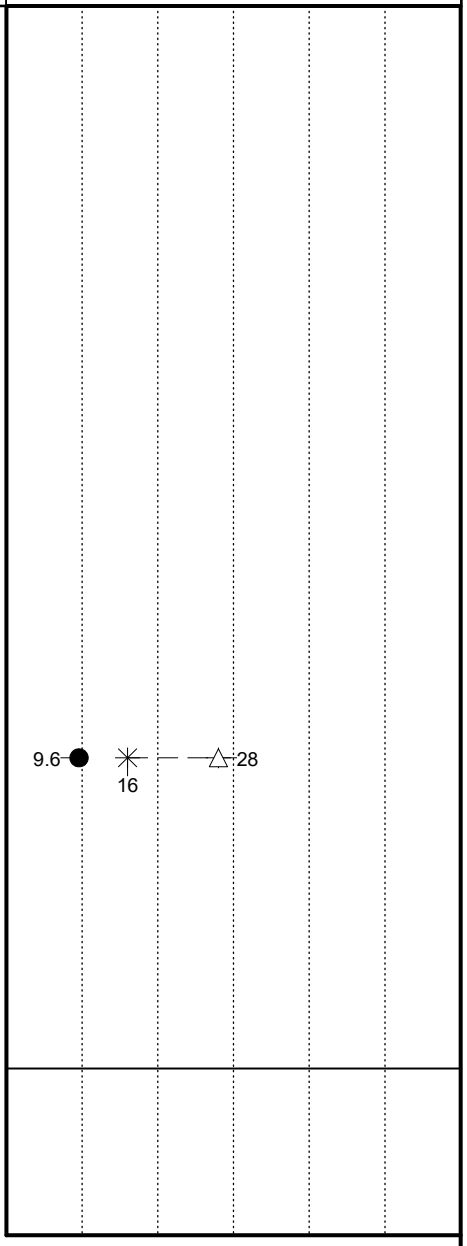
NORTHING	EASTING	STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION (100%)

SURFACE ELEVATION 207

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]		207	
					(CL FILL) SANDY LEAN CLAY, contains root fragments, brown, moist			
1							206	
	S-1		6	6				
2					(CL) SANDY LEAN CLAY, trace gravel, brown, moist		205	
	S-2		6	6				
3					(GC) CLAYEY GRAVEL WITH SAND, orangish/ reddish brown, moist		204	
	S-3		6	6				
4					(CL) SANDY LEAN CLAY, brown, moist (trace gravel within sample S-5)		203	
	S-4		6	6				
5	S-5		3.6	4			202	
					HAND AUGER REFUSAL @ 5.3'			
6							201	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL N/A WS ☐ WD ☒	BORING STARTED 02/07/19	CAVE IN DEPTH N/A
WL(SHW) N/A WL(ACR) N/A	BORING COMPLETED 02/07/19	HAMMER TYPE Manual
WL N/A	RIG Hand Augers FOREMAN David/Travis	DRILLING METHOD HA/WDCP

CLIENT	Job #:	BORING #	SHEET
Straughan Environmental, Inc.	37:2479	GEO-2	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
Branch Avenue Stream Restoration	Straughan Environmental, Inc.

SITE LOCATION: Branch Ave and Southern Ave, SE, Washington, DC

NORTHING	EASTING	STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▰ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 195

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4.00"]		195	
1					(CL FILL) SANDY LEAN CLAY, contains root fragments, brown, moist (trace gravel within sample S-2)		194	
2	S-1		6	6			193	
3	S-2		6	6			192	
4	S-3		6	6	(GC) CLAYEY GRAVEL WITH SAND, orangish/ reddish brown, moist		191	
5	S-4		6	6	(CL) SANDY LEAN CLAY, trace gravel, brown, moist		190	
	S-5		6	6				
6	S-6		3.6	4	HAND AUGER REFUSAL @ 5.8'		189	

12.7 ● ✳ 16 — △ 28

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL N/A WS ☐ WD ☒	BORING STARTED 02/07/19	CAVE IN DEPTH N/A
▽ WL(SHW) N/A ▼ WL(ACR) N/A	BORING COMPLETED 02/07/19	HAMMER TYPE Manual
▽ WL N/A	RIG Hand Augers FOREMAN David/Travis	DRILLING METHOD HA/WDCP

WILDCAT DYNAMIC CONE LOG

ECS CAPITOL SERVICES, PLLC
655 15th Street, NW, Suite 310
Washington, DC 20005

PROJECT NUMBER: 2479
DATE STARTED: 02-07-2019
DATE COMPLETED: 02-07-2019

HOLE #: GEO-1
CREW: DHS/TJF
PROJECT: Branch Avenue Stream Restoration
ADDRESS: Branch Ave and Southern Ave
LOCATION: Southeast, Washington, DC

SURFACE ELEVATION: 207
WATER ON COMPLETION: N/A
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	2	8.9	••	2	VERY LOOSE	SOFT
- 1 ft	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	3	13.3	•••	3	VERY LOOSE	SOFT
-	3	13.3	•••	3	VERY LOOSE	SOFT
- 2 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	3	13.3	•••	3	VERY LOOSE	SOFT
- 3 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 1 m	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 4 ft	2	7.7	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
-	1	3.9	•	1	VERY LOOSE	VERY SOFT
- 5 ft	2	7.7	••	2	VERY LOOSE	SOFT
-	2	7.7	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 6 ft	4	15.4	••••	4	VERY LOOSE	SOFT
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

ECS CAPITOL SERVICES, PLLC
655 15th Street, NW, Suite 310
Washington, DC 20005

PROJECT NUMBER: 2479
DATE STARTED: 02-07-2019
DATE COMPLETED: 02-07-2019

HOLE #: GEO-2
CREW: DHS/TJF
PROJECT: Branch Avenue Stream Restoration
ADDRESS: Branch Ave and Southern Ave
LOCATION: Southeast, Washington, DC

SURFACE ELEVATION: 195
WATER ON COMPLETION: N/A
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	2	8.9	••	2	VERY LOOSE	SOFT
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
- 1 ft	2	8.9	••	2	VERY LOOSE	SOFT
-	2	8.9	••	2	VERY LOOSE	SOFT
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 2 ft	3	13.3	•••	3	VERY LOOSE	SOFT
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 3 ft	3	13.3	•••	3	VERY LOOSE	SOFT
- 1 m	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 4 ft	3	11.6	•••	3	VERY LOOSE	SOFT
-	2	7.7	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 5 ft	4	15.4	••••	4	VERY LOOSE	SOFT
-	2	7.7	••	2	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 6 ft	2	7.7	••	2	VERY LOOSE	SOFT
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name…..: GloverRE-deep-WT

Project Name……..:	Branch Avenue Stream Restoration	**Boring No……..:**	GEO-1	**Solution and Terminology (R. E. Glover Solution)***	
Project No……..:	37:2479	**Investigators……:**	DHS	$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]	
Project Location...:	Branch Ave SE and Southern Ave SE	**Date……..:**	2/7/2019	$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]	
Boring Depth……..:	4 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*** **	$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C:	20
Boring Diameter...:	10.2 **cm**	**WCU Susp. Ht. S:**	26.0 **cm**	Q: Rate of flow of water from the borehole	
Boring Radius r…..:	5.08 **cm**	**Const. Wtr. Ht. H:**	36.0 **cm**	H: Constant height of water in the borehole	
Soil/Water Tmp. T:	14 **°C**	**H/r**……..:**	7.1	r: Radius of the cylindrical borehole	
Dyn. Visc. @ T…….:	0.001170 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,250		1:16:00 PM								
1,150	2,100	1:21:00 PM	0:05:00	5.00	420.00	17.9	1.79E-03	154.9	2.54	5.08
3,250		1:21:00 PM								
1,150	2,100	1:26:00 PM	0:05:00	5.00	420.00	17.9	1.79E-03	154.9	2.54	5.08
3,250		1:26:00 PM								
1,200	2,050	1:31:00 PM	0:05:00	5.00	410.00	17.5	1.75E-03	151.2	2.48	4.96
3,250		1:31:00 PM								
1,250	2,000	1:36:00 PM	0:05:00	5.00	400.00	17.1	1.71E-03	147.5	2.42	4.84
3,250		1:36:00 PM								
1,240	2,010	1:41:00 PM	0:05:00	5.00	402.00	17.2	1.72E-03	148.2	2.43	4.86
3,250		1:41:00 PM								
1,250	2,000	1:46:00 PM	0:05:00	5.00	400.00	17.1	1.71E-03	147.5	2.42	4.84
3,250		1:46:00 PM								
1,300	1,950	1:51:00 PM	0:05:00	5.00	390.00	16.6	1.66E-03	143.8	2.36	4.72
3,250		1:51:00 PM								
1,370	1,880	1:56:00 PM	0:05:00	5.00	376.00	16.0	1.60E-03	138.6	2.27	4.55

Natural Moisture……..:	9.6%	**Consistency……..:**	Very Loose	**Total Time (min)**	**Enter $Ksat_B$ Value:**	**16.3**	**1.63E-03**	**141.2**	**2.32**	**4.63**
USDA Txt./USCS Class.:	GC	**Water Table Depth...:**	N/A			Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.				
Struct./% Pass. #200...:	20.3%	**Init. Saturation Time.:**	N/A	40.00						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

Constant-Head Borehole Permeameter Test

Glover Solution (Deep WT or Impervious Layer)

File Name…..: GloverRE-deep-WT

Project Name……..:	Branch Avenue Stream Restoration	**Boring No……..:**	GEO-2	**Solution and Terminology (R. E. Glover Solution)***	
Project No……..:	37:2479	**Investigators……:**	DHS	$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solution]	
Project Location...:	Branch Ave SE and Southern Ave SE	**Date……..:**	2/7/2019	$Ksat_B = QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Temperature-corrected]	
Boring Depth……..:	4 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	10.0 **cm*** **	$Ksat_B$: (Coefficient of Permeability, K) @ Base Tmp. T_B °C:	20
Boring Diameter...:	10.2 **cm**	**WCU Susp. Ht. S:**	26.0 **cm**	Q: Rate of flow of water from the borehole	
Boring Radius r…..:	5.08 **cm**	**Const. Wtr. Ht. H:**	36.0 **cm**	H: Constant height of water in the borehole	
Soil/Water Tmp. T:	14 **°C**	**H/r**……..:**	7.1	r: Radius of the cylindrical borehole	
Dyn. Visc. @ T…….:	0.001170 **kg/m·s**	**Dyn. Visc. @ T_B.:**	0.001003 **kg/m·s**	V: Dynamic viscosity of water @ T °C/Dyn. Visc. of water @ T_B °C	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (µm/sec)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
3,250		1:15:00 PM								
1,100	2,150	1:20:00 PM	0:05:00	5.00	430.00	18.4	1.84E-03	158.6	2.60	5.20
3,250		1:20:00 PM								
1,090	2,160	1:25:00 PM	0:05:00	5.00	432.00	18.4	1.84E-03	159.3	2.61	5.23
3,250		1:25:00 PM								
1,150	2,100	1:30:00 PM	0:05:00	5.00	420.00	17.9	1.79E-03	154.9	2.54	5.08
3,250		1:30:00 PM								
1,180	2,070	1:35:00 PM	0:05:00	5.00	414.00	17.7	1.77E-03	152.7	2.50	5.01
3,250		1:35:00 PM								
1,180	2,070	1:40:00 PM	0:05:00	5.00	414.00	17.7	1.77E-03	152.7	2.50	5.01
3,250		1:40:00 PM								
1,200	2,050	1:45:00 PM	0:05:00	5.00	410.00	17.5	1.75E-03	151.2	2.48	4.96
3,250		1:45:00 PM								
1,240	2,010	1:50:00 PM	0:05:00	5.00	402.00	17.2	1.72E-03	148.2	2.43	4.86
3,250		1:50:00 PM								
1,250	2,000	1:55:00 PM	0:05:00	5.00	400.00	17.1	1.71E-03	147.5	2.42	4.84

Natural Moisture……..:	12.7%	**Consistency……..:**	Very Loose	**Total Time (min)**	**Enter $Ksat_B$ Value:**	**17.1**	**1.71E-03**	**147.9**	**2.43**	**4.85**
USDA Txt./USCS Class.:	GC	**Water Table Depth...:**	N/A			Notes: $Ksat_B$ is determ. by averag. and/or Rndng. the results for the final three or four stabilized values and analyzing the Flow Rate Q vs Total Elapsed Time Graph.				
Struct./% Pass. #200...:	29.1%	**Init. Saturation Time.:**	N/A	40.00						

*Glover, R. E. l953. Flow from a test-hole located above groundwater level. pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least 2X the depth of the water in the borehole. **H/r ≥5 to ≥10. ***JP-M1: h = 15cm, JP-M2: h = 10cm. Johnson Permeameter, LLC Revised 5/26/2014

APPENDIX C – Laboratory Testing

Laboratory Testing Summary
Liquid and Plastic Limits Test Report
Particle Size Distribution Report

Laboratory Testing Summary

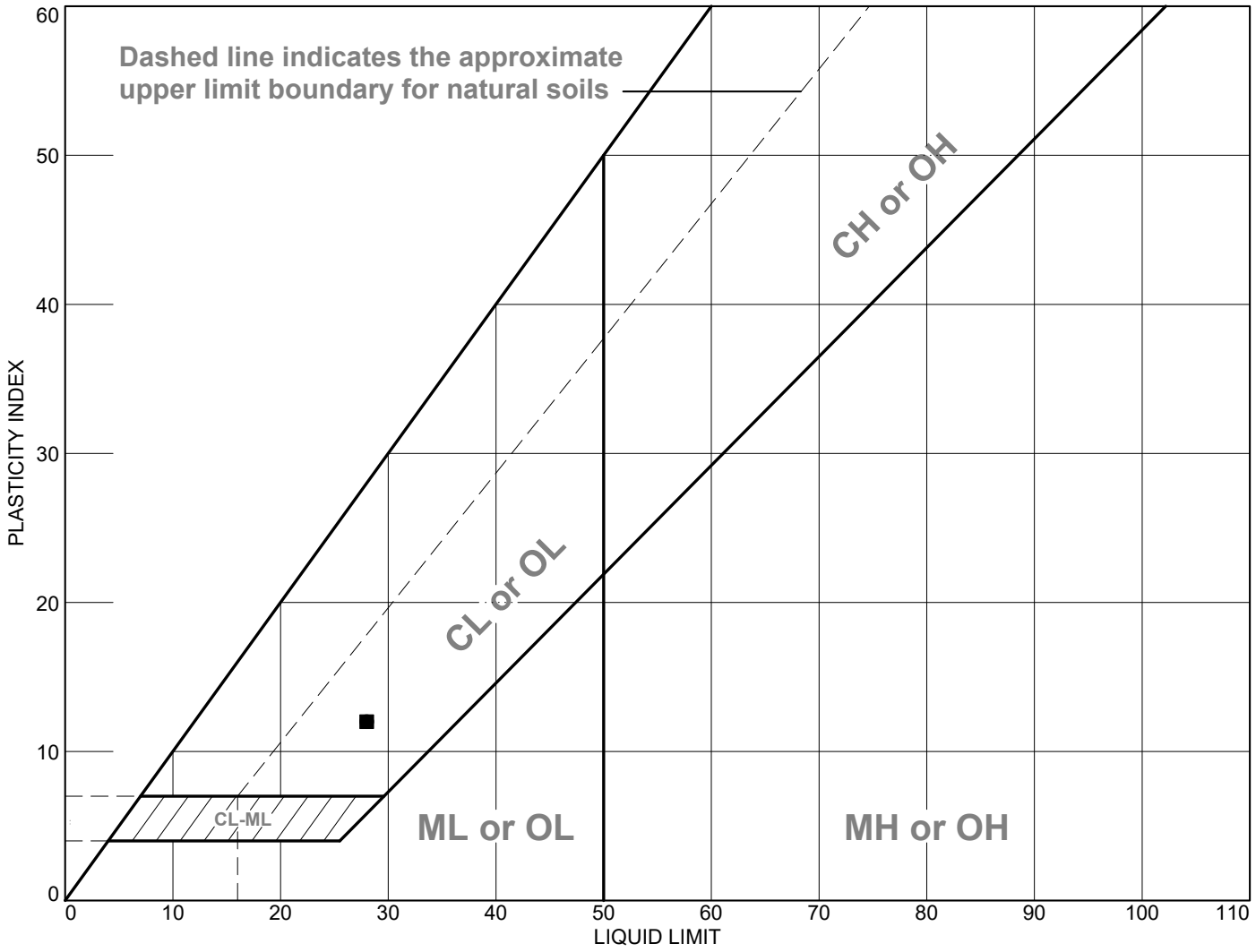
Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
GEO-1												
	S-3	3.5 - 4.0	9.6	GC	28	16	12	20.3				
GEO-2												
	S-3	3.5 - 4.0	12.7	GC	28	16	12	29.1				

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No.	**37:2479**
Project Name:	**Branch Avenue Stream Restoration**
PM:	**Christian I. Olivera**
PE:	**Stephen F. Patt**
Printed On:	**Thursday, February 21, 2019**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	(GC) CLAYEY GRAVEL WITH SAND, orangish/ reddish brown	28	16	12	29.6	20.3	GC
■	(GC) CLAYEY GRAVEL WITH SAND, orangish/ reddish brown	28	16	12	40.8	29.1	GC

Project No. 2479 **Client:** Straughan Environmental, Inc.

Project: Branch Avenue Stream Restoration

● **Source of Sample:** GEO-1 **Depth:** 3.50-4.00 **Sample Number:** S-3

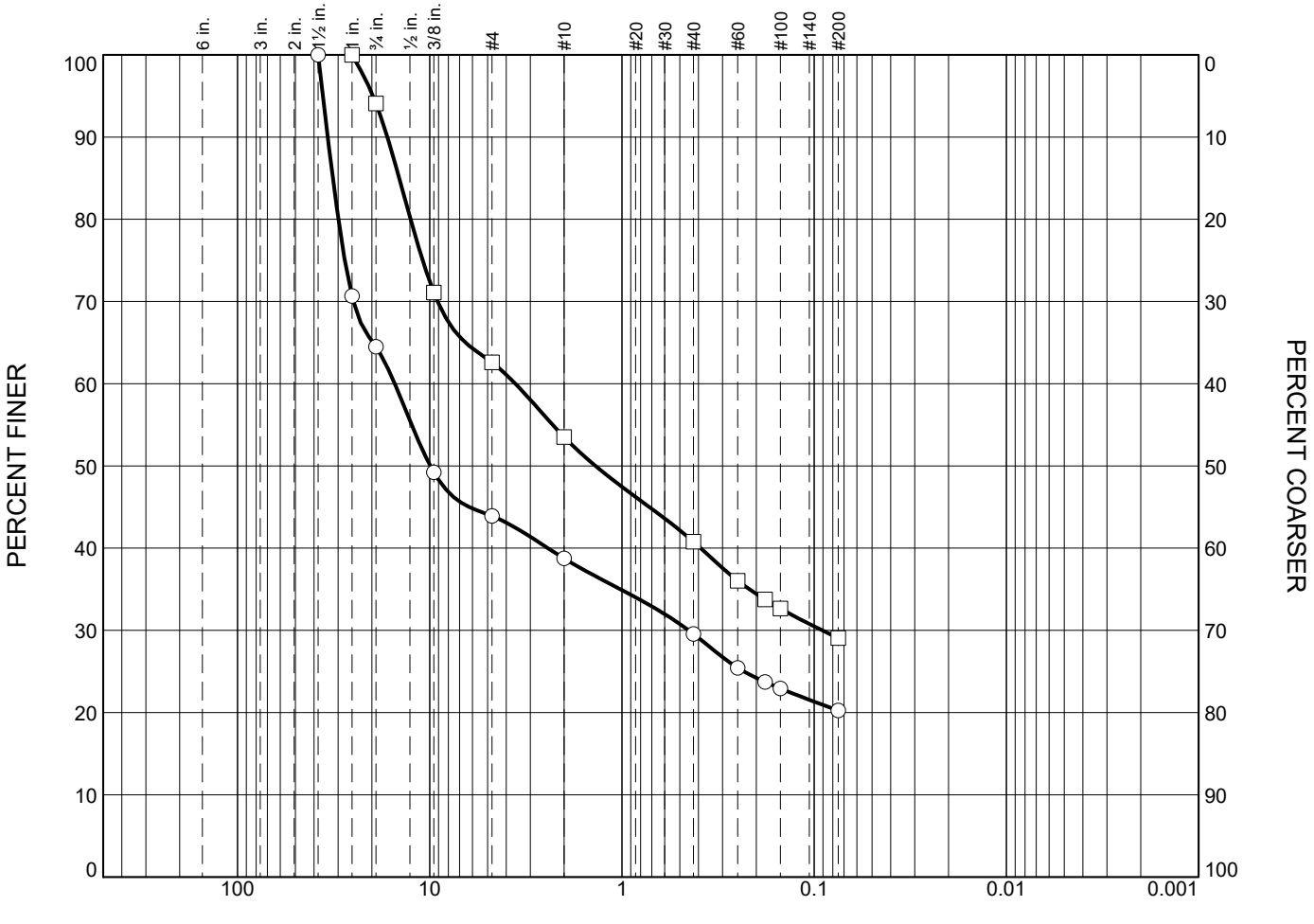
■ **Source of Sample:** GEO-2 **Depth:** 3.50-4.00 **Sample Number:** S-3

Remarks:

Figure 1 of 2

Tested By: ● HTN1 ■ HT1 **Checked By:** CIO

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	35.5	20.6	5.2	9.1	9.3	20.3	
□	0.0	5.9	31.5	9.1	12.7	11.7	29.1	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	GEO-1	S-3	3.50-4.00	(GC) CLAYEY GRAVEL WITH SAND, orangish/reddish	GC
				brown	
□	GEO-2	S-3	3.50-4.00	(GC) CLAYEY GRAVEL WITH SAND, orangish/reddish	GC
				brown	

Client: Straughan Environmental, Inc.

Project: Branch Avenue Stream Restoration

Project No.: 2479

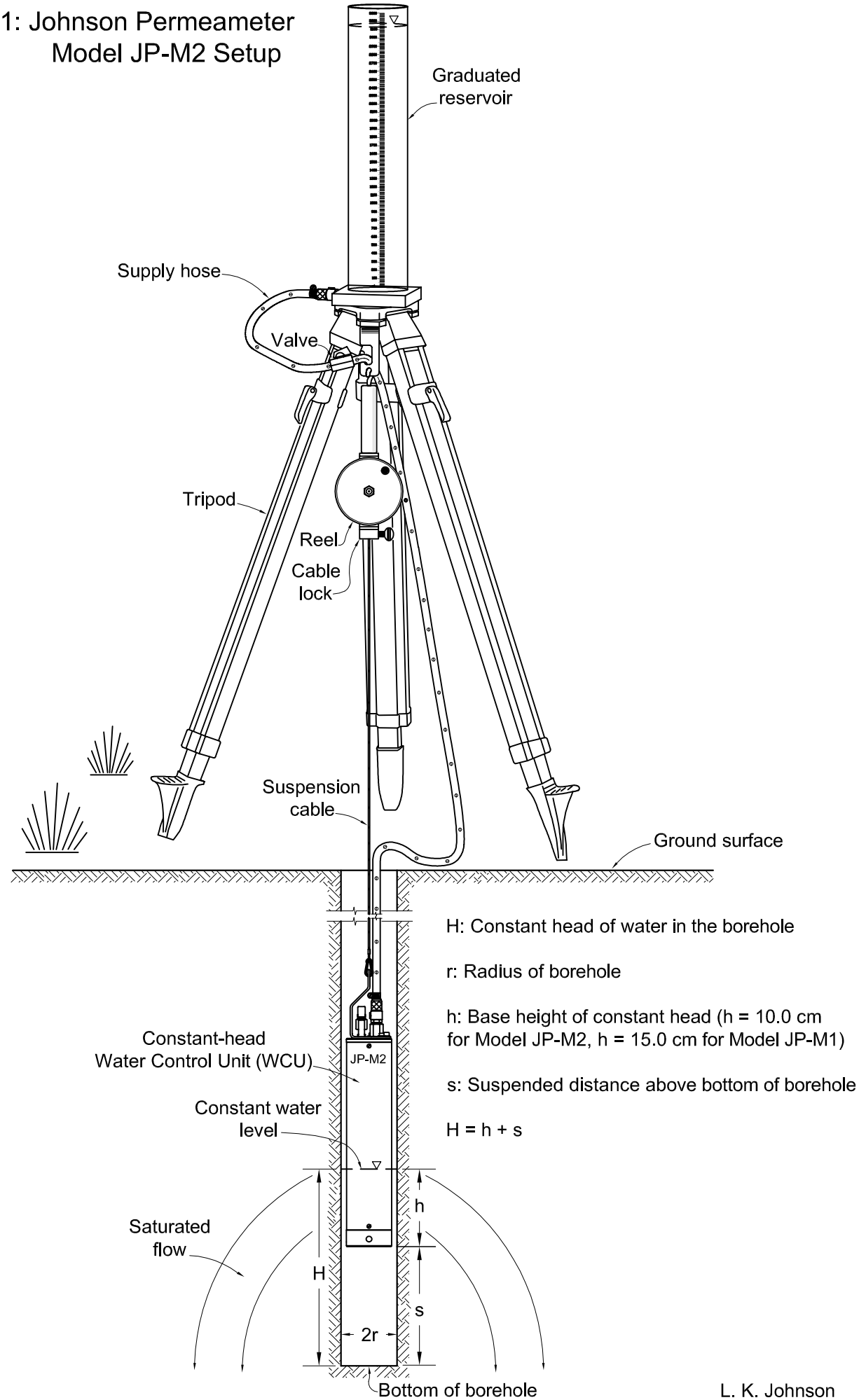
Figure 2 of 2

Tested By: HTN1 **Checked By:** CIO

APPENDIX D – Supplemental Report Documents

Johnson Permeameter ™ Equipment Schematic

Drawing 1: Johnson Permeameter Model JP-M2 Setup



L. K. Johnson

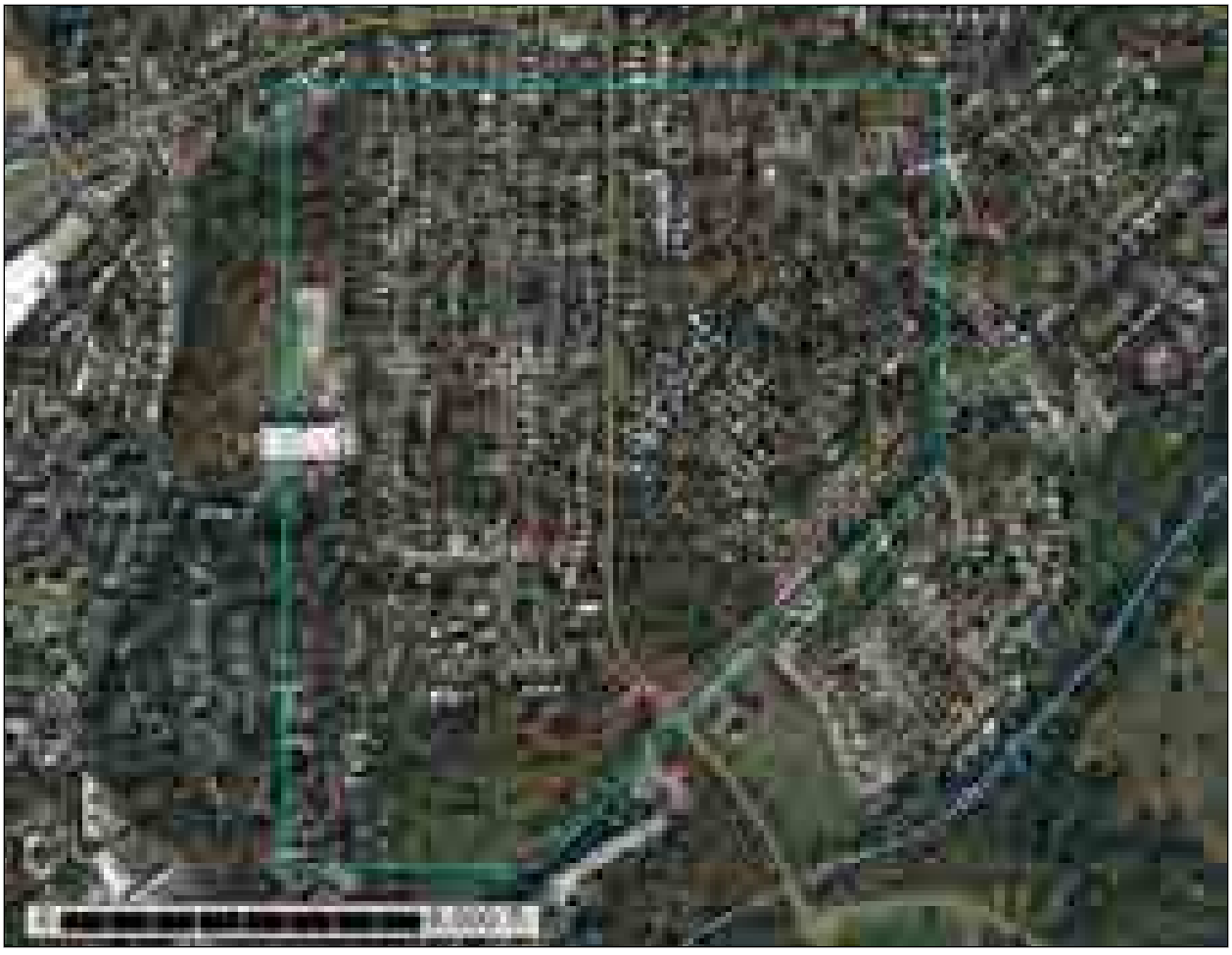
Appendix J. Soils Report

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for District of Columbia, and Prince George's County, Maryland



December 7, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:6,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 12, Sep 10, 2018

Soil Survey Area: Prince George's County, Maryland
Survey Area Data: Version 16, Sep 11, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	25.0	19.6%
CdB	Chillum-Urban land complex, 0 to 8 percent slopes	1.8	1.4%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	52.7	41.3%
CdD	Chillum-Urban land complex, 15 to 40 percent slopes	21.4	16.8%
MvC	Muirkirk variant complex, 8 to 15 percent slopes	6.3	5.0%
MvD	Muirkirk variant complex, 15 to 40 percent slopes	9.6	7.5%
U1	Udorthents	5.2	4.1%
U7	Udorthents, gravelly, smoothed	5.0	3.9%
Subtotals for Soil Survey Area		**127.0**	**99.7%**
Totals for Area of Interest		**127.3**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CbD	Chillum-Urban land complex, 5 to 15 percent slopes	0.1	0.1%
CbE	Chillum-Urban land complex, 15 to 25 percent slopes	0.1	0.1%
CdD	Christiana-Downer-Urban land complex, 5 to 15 percent slopes	0.2	0.2%
RuB	Russett-Christiana-Urban land complex, 0 to 5 percent slopes	0.0	0.0%
Subtotals for Soil Survey Area		**0.4**	**0.3%**
Totals for Area of Interest		**127.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the

characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered

practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

District of Columbia

BeB—Beltsville-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 49s9
Elevation: 10 to 650 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 64 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 40 percent
Beltsville and similar soils: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Flats

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Beltsville

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 25 inches: silt loam
H3 - 25 to 50 inches: silt loam
H4 - 50 to 72 inches: sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Sassafras
Percent of map unit: 5 percent
Hydric soil rating: No

Bourne
Percent of map unit: 5 percent
Hydric soil rating: No

Chillum
Percent of map unit: 5 percent
Hydric soil rating: No

Matapeake
Percent of map unit: 5 percent
Hydric soil rating: No

CdB—Chillum-Urban land complex, 0 to 8 percent slopes

Map Unit Setting
National map unit symbol: 49sq
Elevation: 20 to 650 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 40 percent
Chillum and similar soils: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Properties and qualities
Slope: 0 to 8 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Chillum

Typical profile
A - 0 to 2 inches: silt loam

E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Beltsville

Percent of map unit: 5 percent
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Hydric soil rating: No

Sassafras

Percent of map unit: 5 percent
Hydric soil rating: No

Bourne

Percent of map unit: 5 percent
Hydric soil rating: No

CdC—Chillum-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 49sr
Elevation: 20 to 370 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 61 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Chillum and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chillum

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Bourne

Percent of map unit: 5 percent
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Hydric soil rating: No

Sassafras

Percent of map unit: 5 percent

Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

CdD—Chillum-Urban land complex, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 49ss
Elevation: 20 to 600 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 45 to 64 degrees F
Frost-free period: 160 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Chillum and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chillum

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent
Hydric soil rating: No

Sassafras

Percent of map unit: 5 percent
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Hydric soil rating: No

MvC—Muirkirk variant complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 49vm
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 48 to 61 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Muirkirk variant and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Muirkirk Variant

Typical profile

H1 - 0 to 11 inches: loamy sand
H2 - 11 to 31 inches: sandy loam
H3 - 31 to 60 inches: clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

MvD—Muirkirk variant complex, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 49vn
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 48 to 61 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Muirkirk variant and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Muirkirk Variant

Typical profile

H1 - 0 to 11 inches: loamy sand
H2 - 11 to 31 inches: sandy loam
H3 - 31 to 60 inches: clay

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Hydric soil rating: No

U1—Udorthents

Map Unit Composition

Udorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: 10 inches to
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

U7—Udorthents, gravelly, smoothed

Map Unit Setting

National map unit symbol: 49wl
Mean annual precipitation: 38 to 44 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 150 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Typical profile

H1 - 0 to 5 inches: gravelly loam
H2 - 5 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 10 inches to
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Prince George's County, Maryland

CbD—Chillum-Urban land complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2ndwl
Elevation: 10 to 370 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Chillum and similar soils: 50 percent
Urban land: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chillum

Setting

Landform: Interfluves
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over gravelly fluviomarine deposits

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Russett

Percent of map unit: 10 percent
Landform: Broad interstream divides, drainhead complexes, interfluves, swales
Landform position (two-dimensional): Summit, footslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Beltsville

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Landform: Hillslopes, knolls
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

CbE—Chillum-Urban land complex, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2ndwm
Elevation: 10 to 370 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Chillum and similar soils: 50 percent
Urban land: 25 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chillum

Setting

Landform: Interfluves
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty eolian deposits over gravelly fluviomarine deposits

Typical profile

A - 0 to 2 inches: silt loam
E - 2 to 9 inches: gravelly loam
Bt1 - 9 to 12 inches: gravelly loam
Bt2 - 12 to 24 inches: clay loam
2BC - 24 to 34 inches: loamy sand
3C - 34 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Russett

Percent of map unit: 10 percent
Landform: Drainhead complexes, broad interstream divides, swales, interfluves
Landform position (two-dimensional): Footslope, summit
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Croom

Percent of map unit: 10 percent
Landform: Hillslopes, knolls
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Beltsville

Percent of map unit: 5 percent
Landform: Broad interstream divides
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

CdD—Christiana-Downer-Urban land complex, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2ndxh
Elevation: 10 to 390 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Christiana and similar soils: 30 percent
Downer and similar soils: 25 percent
Urban land: 20 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Christiana

Setting

Landform: Interfluves, swales, drainhead complexes, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey fluviomarine deposits

Typical profile

A - 0 to 6 inches: silt loam
BE - 6 to 10 inches: silt loam
Bt1 - 10 to 21 inches: silty clay loam
Bt2 - 21 to 49 inches: silty clay
BC - 49 to 80 inches: clay loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Downer

Setting

Landform: Interfluves, knolls
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 12 inches: loamy sand
Bt - 12 to 31 inches: sandy loam
BC - 31 to 38 inches: loamy sand
C - 38 to 72 inches: sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Human transported material

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 10 inches to
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Udorthents

Percent of map unit: 5 percent
Hydric soil rating: No

Issue

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Galestown

Percent of map unit: 5 percent
Landform: Dunes, interfluves, knolls, terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve, riser
Hydric soil rating: No

Sassafras

Percent of map unit: 5 percent
Landform: Hillslopes, interfluves
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Croom

Percent of map unit: 5 percent
Landform: Interfluves, hillslopes
Hydric soil rating: No

RuB—Russett-Christiana-Urban land complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ndxg
Elevation: 10 to 390 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 30 percent
Russett and similar soils: 30 percent
Christiana and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Russett

Setting

Landform: Broad interstream divides, interfluves, drainhead complexes, swales
Landform position (two-dimensional): Footslope, summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy fluviomarine deposits

Typical profile

A - 0 to 4 inches: fine sandy loam
Bt1 - 4 to 7 inches: loam
Bt2 - 7 to 13 inches: loam
Bt3 - 13 to 46 inches: clay loam
BCg1 - 46 to 57 inches: sandy clay loam
BCg2 - 57 to 77 inches: silty clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Christiana

Setting

Landform: Hillslopes, interfluves, drainhead complexes, swales
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey fluviomarine deposits

Typical profile

A - 0 to 6 inches: silt loam
BE - 6 to 10 inches: silt loam
Bt1 - 10 to 21 inches: silty clay loam
Bt2 - 21 to 49 inches: silty clay
BC - 49 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Udorthents

Percent of map unit: 5 percent
Hydric soil rating: No

Hammonton

Percent of map unit: 5 percent
Landform: Depressions, interfluves, swales
Landform position (two-dimensional): Summit
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

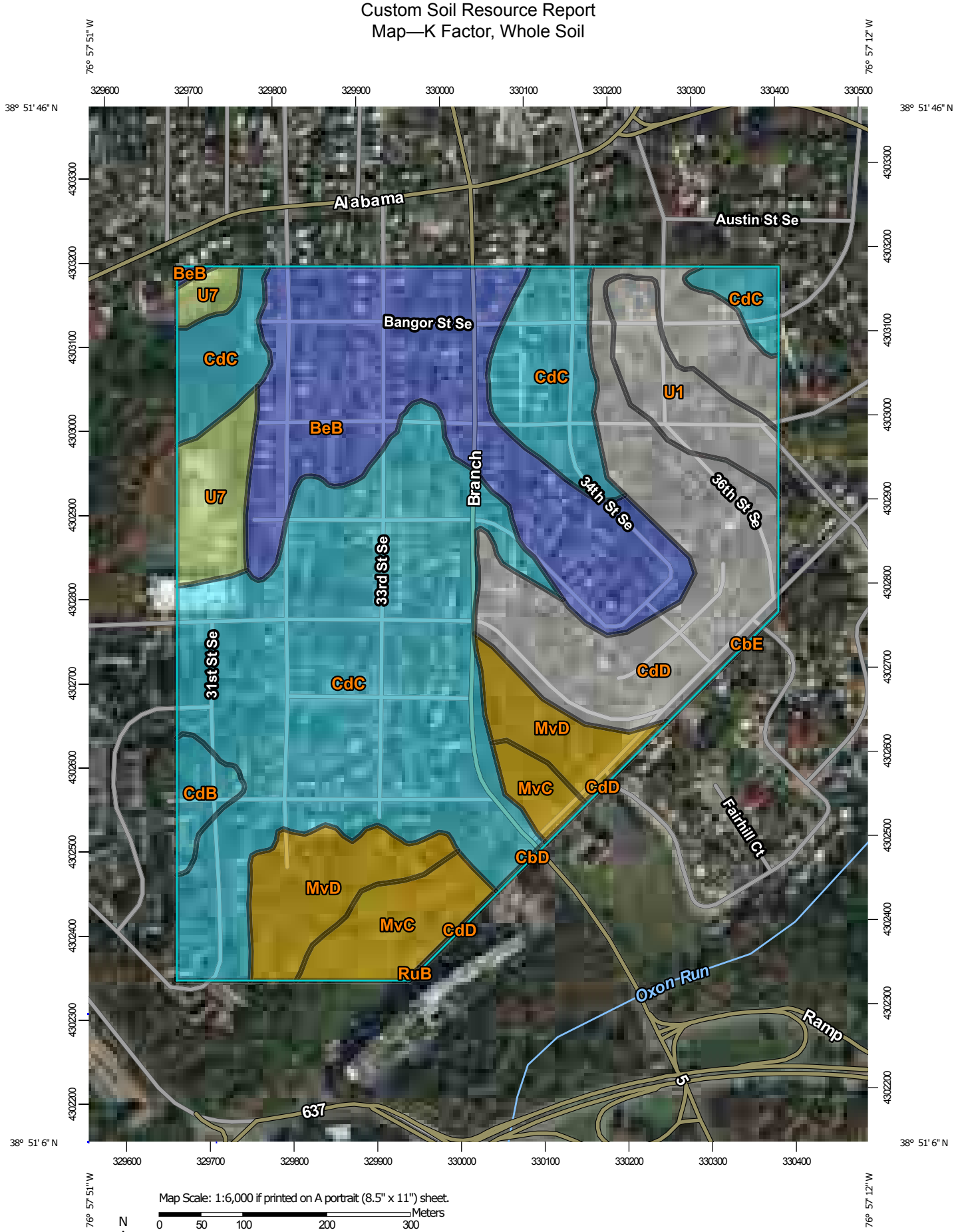
Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.



Map Scale: 1:6,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 12, Sep 10, 2018

Soil Survey Area: Prince George's County, Maryland
Survey Area Data: Version 16, Sep 11, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	.49	25.0	19.6%
CdB	Chillum-Urban land complex, 0 to 8 percent slopes	.37	1.8	1.4%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	.37	52.7	41.3%
CdD	Chillum-Urban land complex, 15 to 40 percent slopes		21.4	16.8%
MvC	Muirkirk variant complex, 8 to 15 percent slopes	.15	6.3	5.0%
MvD	Muirkirk variant complex, 15 to 40 percent slopes	.15	9.6	7.5%
U1	Udorthents		5.2	4.1%
U7	Udorthents, gravelly, smoothed	.24	5.0	3.9%
Subtotals for Soil Survey Area			**127.0**	**99.7%**
Totals for Area of Interest			**127.3**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CbD	Chillum-Urban land complex, 5 to 15 percent slopes	.32	0.1	0.1%
CbE	Chillum-Urban land complex, 15 to 25 percent slopes	.32	0.1	0.1%
CdD	Christiana-Downer-Urban land complex, 5 to 15 percent slopes		0.2	0.2%
RuB	Russett-Christiana-Urban land complex, 0 to 5 percent slopes		0.0	0.0%
Subtotals for Soil Survey Area			**0.4**	**0.3%**
Totals for Area of Interest			**127.3**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Map Scale: 1:6,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: District of Columbia
Survey Area Data: Version 12, Sep 10, 2018

Soil Survey Area: Prince George's County, Maryland
Survey Area Data: Version 16, Sep 11, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 3, 2015—Feb 22, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeB	Beltsville-Urban land complex, 0 to 8 percent slopes	C	25.0	19.6%
CdB	Chillum-Urban land complex, 0 to 8 percent slopes	C	1.8	1.4%
CdC	Chillum-Urban land complex, 8 to 15 percent slopes	C	52.7	41.3%
CdD	Chillum-Urban land complex, 15 to 40 percent slopes		21.4	16.8%
MvC	Muirkirk variant complex, 8 to 15 percent slopes	C	6.3	5.0%
MvD	Muirkirk variant complex, 15 to 40 percent slopes	C	9.6	7.5%
U1	Udorthents		5.2	4.1%
U7	Udorthents, gravelly, smoothed	A	5.0	3.9%
Subtotals for Soil Survey Area			**127.0**	**99.7%**
Totals for Area of Interest			**127.3**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CbD	Chillum-Urban land complex, 5 to 15 percent slopes	C	0.1	0.1%
CbE	Chillum-Urban land complex, 15 to 25 percent slopes	C	0.1	0.1%
CdD	Christiana-Downer-Urban land complex, 5 to 15 percent slopes	D	0.2	0.2%
RuB	Russett-Christiana-Urban land complex, 0 to 5 percent slopes	D	0.0	0.0%
Subtotals for Soil Survey Area			**0.4**	**0.3%**
Totals for Area of Interest			**127.3**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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