PENNSYLVANIA TURNPIKE COMMISSION
POLLUTANT REDUCTION PLAN
FOR THE
OHIO RIVER DRAINAGE BASIN
NPDES PERMIT NO. PAI139602

PENNSYLVANIA TURNPIKE COMMISSION, PENNSYLVANIA

OCTOBER 2022
REVISED FEBRUARY 2023
REVISED JULY 2023
REVISED OCTOBER 26, 2023

PREPARED BY

SKELLY AND LOY, INC.
HARRISBURG, PENNSYLVANIA

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PREPARED FOR

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OCTOBER 25, 2022
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BMP	Best Management Practices
CAST	Chesapeake Assessment Scenario Tool
CWA	Clean Water Act
GIS	Geographic Information System
GWLF	Generalized Watershed Loading Function
HUC	Hydrologic Unit Code
ID	Identification
IDD&E	Illicit Discharge Detection and Elimination
lbs/yr	Pounds per Year
LF	Linear Feet
LRG	Land Reclamation Group, LLC
M&M	Maintenance and Monitoring
MS3	Municipal Separate Storm Sewer
MS4	Municipal Separate Storm Sewer System
NHD	National Hydrology Dataset
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
ORPRP	Ohio River Pollutant Reduction Plan
PA DEP	Pennsylvania Department of Environmental Protection
PA DCNR	Pennsylvania Department of Conservation and Natural Resources
PennDOT	Pennsylvania Department of Transportation
PRP	Pollutant Reduction Plan
PTC	Pennsylvania Turnpike Commission
SCM	Stormwater Control Measure
SPI	Site Protection Instrument
TN	Total Nitrogen

TP	Total Phosphorus
TSS	Total Suspended Solids (Sediment)
UA	Urbanized Area
UNT	unnamed tributary
USGS	United States Geological Survey
WLA	Waste Load Allocation

1.0 EXECUTIVE SUMMARY

A. RESULTS

The pollutants of concern are sediment and phosphorus. Existing pollutant loads for the Pennsylvania Turnpike Commission's (PTC) MS4-regulated area were estimated using the MapShed model. The Pennsylvania Department of Environmental Protection (PA DEP) declared that if the sediment (TSS) reduction goal is obtained, the permittee may presume that the total phosphorus (TP) reduction goal is also met. Consequently, the PTC is reporting sediment reduction. Originally, a single Pollution Reduction Plan (PRP) Best Management Practice (BMP) was proposed to meet the PTC sediment reduction goal for the PTC's entire Ohio River Drainage Basin obligation. The planned pollution reduction project described in the October 25, 2022, version of this PRP was a stream restoration and floodplain reconnection of a 988-foot segment of Deer Creek located in Indiana Township, Allegheny County, Pennsylvania. A new 850 linear-foot (LF) stream restoration project will replace the original proposal and a contingency project, a Stormwater Control Measure (SCM) retrofit, is included in the PRP to supplement sediment reduction should the proposed stream restoration not fully achieve the anticipated sediment reduction volume.

Stream restoration of the unnamed tributary (UNT) to Pierson Run in Boyce Park (Boyce Park), located in Plum Borough, Allegheny County, Pennsylvania, is replacing the originally planned restoration project. The Boyce Park project is managed by the Allegheny County Parks Department, and 850 linear feet of the UNT to Pierson Run, a second order impaired stream will be restored. The stream restoration will reduce sediment by 97,750 pounds per year (lbs/yr). The reduction achieved by the stream restoration alone is sufficient to satisfy PTCs Ohio River pollution reduction obligation.

In the event that the Boyce Park project results in less than the estimated sediment pollution reduction, the PRP includes a contingency Stormwater Control Measure (SCM) retrofit project to augment the stream restoration. PTC will retrofit a SCM serving the Greensburg Maintenance facility if additional sediment pollution reduction is required. The SCM is a dry detention basin, ID # G-006.97-NB-0534-BDD. The retrofit will convert the SCM from a dry detention basin to an extended dry detention basin. Existing pollutant loads, required reduction targets, and achieved reductions are summarized in **Table 1** below.

TABLE 1
PTC OHIO RIVER DRAINAGE BASIN: EXISTING POLLUTANT LOADS, REQUIRED REDUCTION TARGETS, AND ACHIEVED REDUCTIONS

POLLUTANT	EXISTING LOAD	REQUIRED REDUCTION %	REQUIRED REDUCTION (LBS/YR)	BOYCE PARK REDUCTION (LBS/YR)	EXCESS REDUCTION (LBS/YR)	G-006.97-NB-0534-BDD CONTINGENCY REDUCTION (LBS/YR)
Sediment (TSS)	1,833,004	5%	91,650	97,750*	6,100	27,225
Phosphorus (TP)	510	2.5%	12.8	Presumed	Presumed	Presumed

* *The sediment reduction total represents the default value based on the MapShed effectiveness factor for stream restoration of 115 lbs/lf/yr. x 850 LF stream restoration*

B. PURPOSE

The Ohio River Pollutant Reduction Plan (ORPRP) was prepared to comply with PA DEP National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. PAI139602, effective November 1, 2021, through October 31, 2026. The purpose of a PRP is to provide a basis for implementation of specific projects to capture and reduce pollutants conveyed by stormwater runoff before they reach streams, rivers, lakes, etc. (a.k.a., surface waters). Each PRP provides the background, assumptions, analysis, and methodology to establish a justifiable baseline of current pollutant load generation and then identifies BMPs with site locations, planning-level concept designs, costs, and implementation schedules. It also offers a framework for funding installation, operation, and maintenance activities that provides regulators with assurance that the identified project(s) will materialize within the scheduled timeframe. This PTC ORPRP assesses the urban watersheds within the Ohio River Drainage Basin through which the Pennsylvania Turnpike passes where the surface waters' designated use status has non-attaining, and the impairment cause is sediment or phosphorus (generically referred to as nutrients).

C. PRP LAYOUT

The Executive Summary is followed by two sections. Section 2.0 (Introduction) describes the PTC's characteristics influencing PRP decisions. Topics within Section 2.0 include Hydrology, Topography and Geology, Soils, and Land Use.

Section 3.0 (Required PRP Components) provides technical data, analysis and substantiation, and proposed BMP specifics. It is organized and titled to match the titles and sequence of the PA DEP's PRP Instructions per the directions. The subsections are:

A. Public Participation

B. Map

C. Pollutants of Concern

D. Existing Loading for Pollutants of Concern

E. BMPs to Achieve the Minimum Required Reductions in Pollutant Loading

F. Funding Mechanism(s)

G. Responsible Parties for Operation and Maintenance (O&M) of BMPs

The PTC opted to use the presumptive approach to report pollutant reduction. Under this approach, it is assumed that if the required sediment reduction is achieved, phosphorus and nitrogen reductions are also reached. Therefore, only sediment load reduction is reported.

2.0 INTRODUCTION

A. LOCATION

1. Contextual Location

The Pennsylvania Turnpike is a limited-access toll road network that crosses the state from the Pennsylvania-Ohio border northwest of Pittsburgh to the Pennsylvania-New Jersey border east of Philadelphia. The network also serves regions north and south of Pittsburgh and north of Philadelphia and is comprised of the segments listed in **Table 2**, Turnpike System Roadways.

TABLE 2
PENNSYLVANIA TURNPIKE SYSTEM ROADWAYS

ROADWAY NAME	ROUTE NO.	DESCRIPTION	MILES
Turnpike Mainline	I-76/I-276	Ohio to New Jersey Connector	359
Beaver Valley Expressway	I-376	PA-51 to US-422	16.3
Southern Beltway	PA-576	South of Pittsburgh International Airport to I-79	5.7
Mon/Fayette Expressway	PA-43	Pittsburgh to Uniontown Connector	51.4
Amos K. Hutchinson Bypass (a.k.a., Greensburg Bypass)	PA-66	I-70 to US-22 Connector	13.3
Northeast Extension	I-476	Philadelphia-Allentown-Wilkes Barre-Scranton Connector	110.1
TOTAL LENGTH			**556**

2. MS4 Regulated Area

The MS4 NPDES Permit applies only to urban runoff from land within the Urbanized Areas (UAs), as defined by the 2010 Census, which flows through a municipally owned and operated stormwater system with an identifiable concentrated discharge (outfall) to a surface water. The MS4 Permit also applies to non-municipal entities specified by PA DEP that are public-sector organizations and function similarly to municipal governments relative to operations of stormwater infrastructure and contributing drainage areas. The PTC is one of the organizations within this group of non-traditional MS4s.

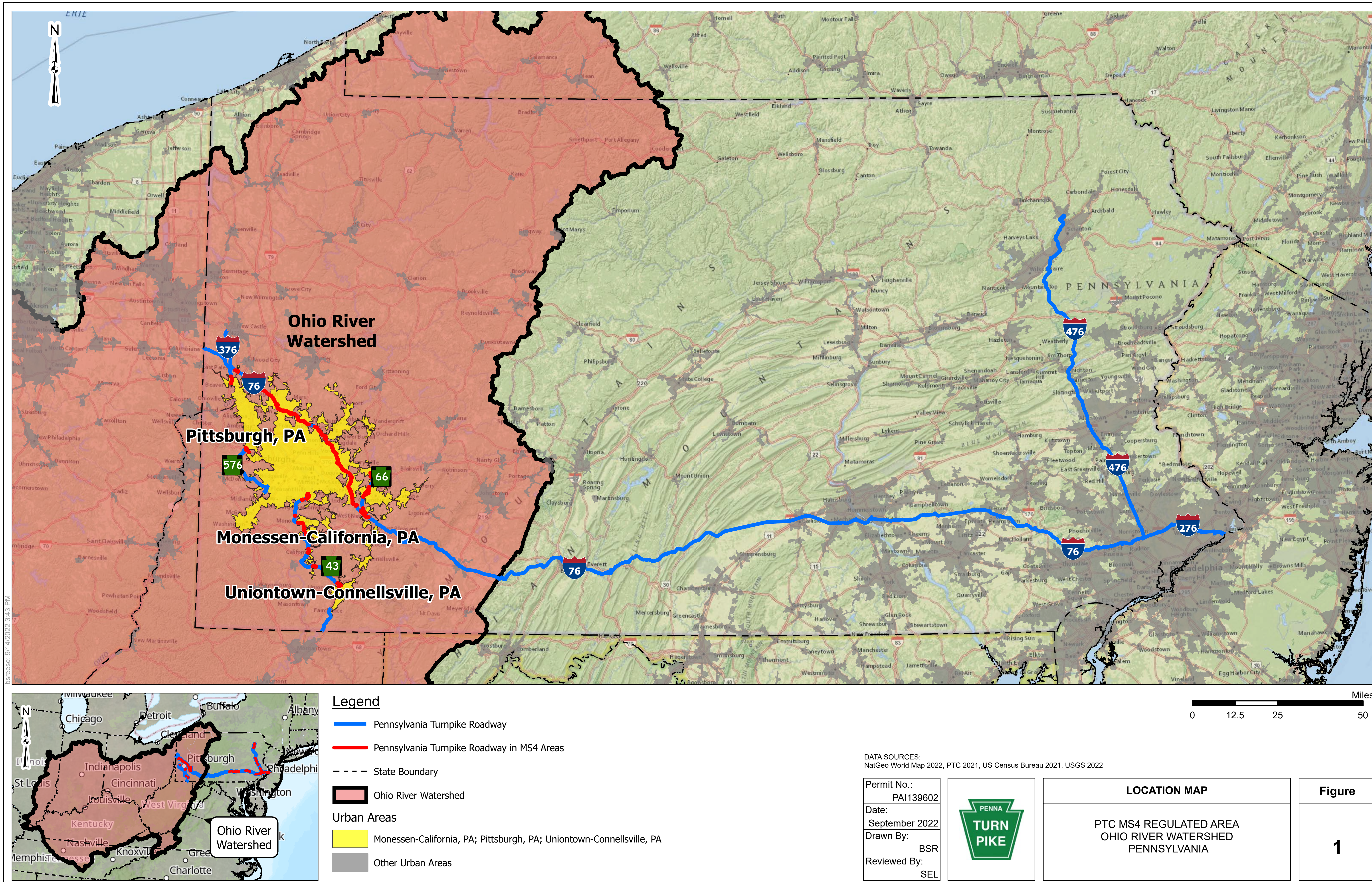
The MS4 regulated area for the PTC includes UAs as defined by the U.S. Census Bureau in its 2010 ten-year census plus the upland contributory drainage area that is under the jurisdiction of the PTC. The basis for the UA criteria, the 2010 Census, is specified in the PTC's MS4 Permit and the additional upgradient area contributing to the UA is stipulated in FAQ #10 of PA DEP's *MS4 NPDES Permits Frequently Asked Questions* (revised December 2, 2021).

The storm sewer system consists of the PTC-owned and -operated stormwater conveyance network, including the roadway, inlets/catch basins, curbs, gutters, ditches, man-made channels, or storm drains.

3. Ohio River Drainage Basin Location

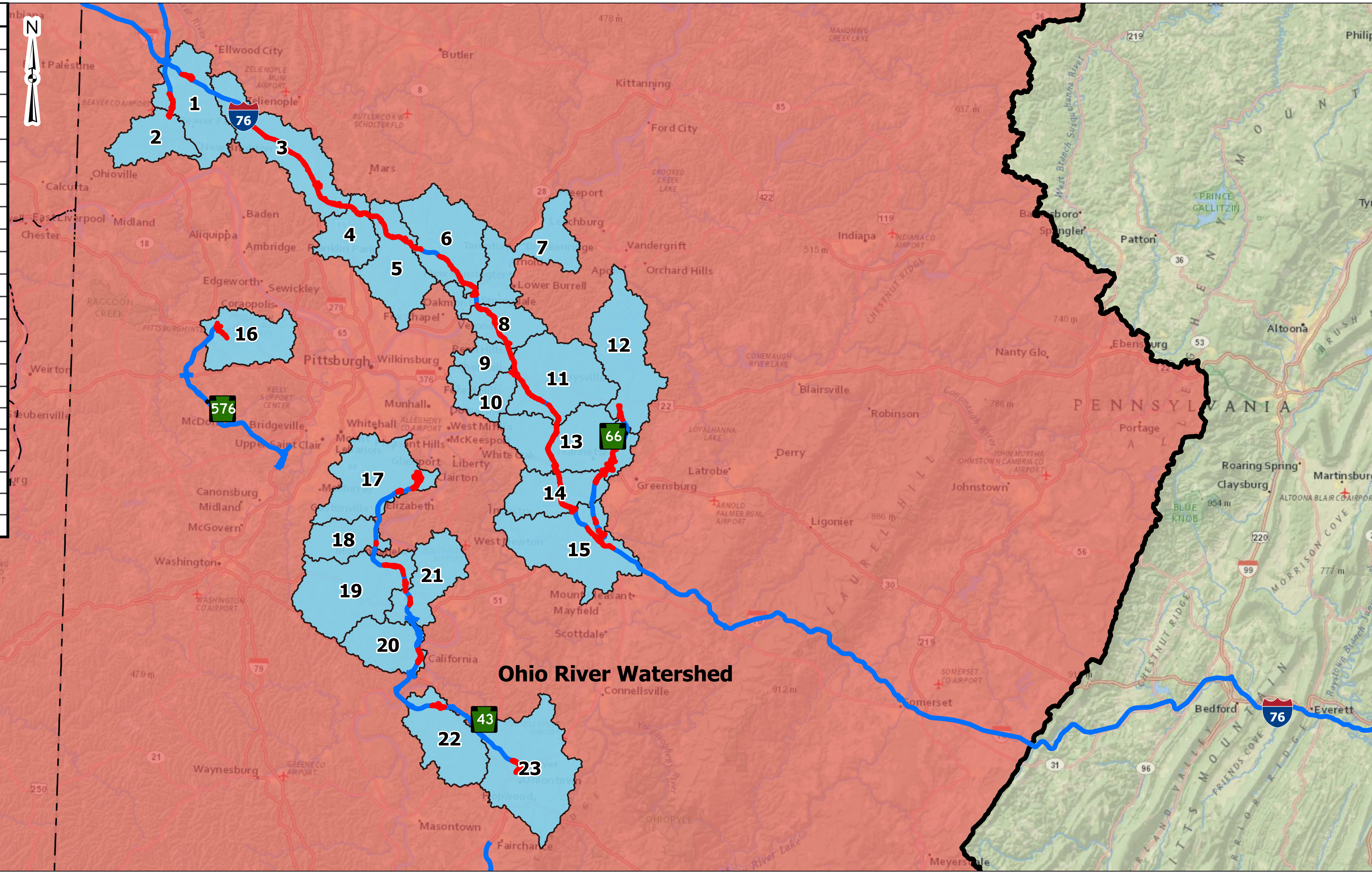
This PRP is focused on the regulated portion of the 556-mile Pennsylvania Turnpike located in or contributing runoff to the UAs within the Ohio River Drainage Basin. The PTC Ohio-River MS4-regulated area includes a total of 71.5 miles of the Turnpike corridor: approximately 52.5 miles of the Turnpike Mainline roadway, 9 miles of the Mon-Fayette Expressway, 6 miles of the Amos K. Hutchinson Bypass, 2 miles of the Beaver Valley Expressway, and 2 miles of the Southern Beltway. Of the 71.5 miles within the MS4-regulated area, approximately 64 miles are part of the Pittsburgh UA, 5.5 miles are part of the Monessen-California UA, and 2 miles are part of the Uniontown-Connellsville UA.

The following figures and tables provide locational detail from the regional to more-detailed perspective. **Figure 1** is a location map that identifies the PTC's Ohio River MS4-regulated portion of the Turnpike. The applicable roadway segments are highlighted on the Location Map. **Figure 2** identifies the Hydrologic Unit Code (HUC) 12 watersheds that the PTC's Ohio River MS4-regulated area passes through. **Table 3** provides locational references for PTC's Ohio River regulated roadway segments to the nearest intersecting road or stream as well as providing Turnpike roadway segment length, latitude, and longitude of the segment midpoint and references to the UA, county, and HUC 12 watershed the PTC regulated-MS4 traverses.



Ohio River Watershed
Pittsburgh, PA
Monessen-California, PA
Uniontown-Connellsville, PA
PENNSYLVANIA
376
76
576
66
43
476
276
Miles
0 12.5 25 50
Ohio River Watershed
Legend
Pennsylvania Turnpike Roadway
Pennsylvania Turnpike Roadway in MS4 Areas
State Boundary
Ohio River Watershed
Urban Areas
Monessen-California, PA; Pittsburgh, PA; Uniontown-Connellsville, PA
Other Urban Areas
DATA SOURCES:
NatGeo World Map 2022, PTC 2021, US Census Bureau 2021, USGS 2022
Permit No.: PAI139602
Date: September 2022
Drawn By: BSR
Reviewed By: SEL
PENNA TURN PIKE
LOCATION MAP
PTC MS4 REGULATED AREA
OHIO RIVER WATERSHED
PENNSYLVANIA
Figure
1

HUC 12 ID	HUC 12 NAME
1	Beaver River-Ohio River
2	Brady Run
3	Brush Creek
4	Pine Creek-North Park Lake
5	Little Pine Creek-Pine Creek
6	Deer Creek
7	Chartiers Run-Allegheny River
8	Plum Creek
9	Thompson Run
10	Sawmill Run-Turtle Creek
11	Haymakers Run-Turtle Creek
12	Beaver Run Reservoir-Beaver Run
13	Brush Creek
14	Little Sewickley Creek
15	Lower Sewickely Creek
16	Montour Run
17	Piney Fork-Peters Creek
18	Mingo Creek-Monongahela River
19	Pigeon Creek
20	Pike Run
21	Maple Creek-Monongahela River
22	Dunlap Creek
23	Cove Run-Redstone Creek



Legend

- Pennsylvania Turnpike Roadway
- Pennsylvania Turnpike Roadway in MS4 Areas
- State Boundary
- Ohio River Watershed
- MS4 Planning Area HUC 12 Watersheds

DATA SOURCES:
NatGeo World Map 2022, PTC 2021, US Census Bureau 2021, USGS 2022

Permit No.:	PAI139602
Date:	September 2022
Drawn By:	BSR
Reviewed By:	SEL

PENNA TURNPIKE

HUC 12 WATERSHEDS

PTC MS4 REGULATED AREA
OHIO RIVER WATERSHED
PENNSYLVANIA

Figure

2

TABLE 3
PTC OHIO RIVER DRAINAGE BASIN REGULATED/PLANNING AREA MS4 SEGMENTS

PTC ROADWAY NAME	URBANIZED AREA	COUNTY	HUC12 NUMBER	HUC12 NAME	NEAREST CROSS-FEATURE BEGIN (WEST/SOUTH)	MILE POST BEGIN (WEST/SOUTH)	NEAREST CROSS-FEATURE END (EAST/NORTH)	MILE POST END (EAST/NORTH)	DISTANCE (MILES)	APPROXIMATE MIDPOINT (MILE POST)	LATITUDE	LONGITUDE
Turnpike Mainline	Pittsburgh, Pennsylvania	Beaver	050301040103	Beaver River-Ohio River	Foxwood Road	11.82	Big Beaver Boulevard	12.85	1.03	12.34	N40°49'5.12"	W80°19'58.66"
		Beaver Butler	050301050408	Brush Creek (North)	0.75 mile east of Sunflower Road	20.4	0.6 mile east of Middle Road	40.78	20.38	30.59	N40°39'23.01"	W80° 4'47.33"
		Allegheny	050100090201	Pine Creek-North Park Lake								
			050100090202	Little Pine Creek-Pine Creek								
			050100090303	Deer Creek	Gibsonia Road	42.65	Freeport Road	47.9	5.25	45.28	N40°33'51.45"	W79°51'9.69"
			05010009030	Chartiers Run-Allegheny River								
			050100090304	Plum Creek	Hulton Road	48.75	0.45 mile northwest of Murrysville Road	60.15	11.4	54.45	N40°27'52.18"	W79°45'42.38"
			050200050703	Thompson Run								
		Westmoreland	050200050701	Haymakers Run-Turtle Creek								
			050200050702	Brush Creek (South)	1.0 mile northwest of Harvison Road	60.67	0.8 mile southeast of Liberty Hill Road	71.85	11.18	66.26	N40°19'32.61"	W79°41'3.40"
			050200061103	Little Sewickley Creek								
			050200061104	Lower Sewickley Creek	0.2 mile southeast of Glenn Fox Road	74.03	Sportsman Road	77.17	3.14	75.6	N40°13'9.69"	W79°36'8.48"
Subtotal Turnpike Mainline MS4 Regulated/Planning Area Length									*52.38*			
BVE[1]	Pitts[2]	Beaver	050301040103	Beaver River-Ohio River	Wallace Run Road	28.85	Constitution Boulevard	31	2.15	29.925	N40°46'36.29"	W80°21'23.99"
			050301040102	Brady Run								
Subtotal Beaver Valley Expressway MS4 Regulated/Planning Area Length									*2.15*			

TABLE 3
(CONTINUED)

PTC ROADWAY NAME	URBANIZED AREA	COUNTY	HUC12 NUMBER	HUC12 NAME	NEAREST CROSS-FEATURE BEGIN (WEST/SOUTH)	MILE POST BEGIN (WEST/SOUTH)	NEAREST CROSS-FEATURE END (EAST/NORTH)	MILE POST END (EAST/NORTH)	DISTANCE (MILES)	APPROXIMATE MIDPOINT (MILE POST)	LATITUDE	LONGITUDE
SB[3]	Pitts[2]	Allg[4]	050301010304	Montour Run	576/I-376 Interchange	0	0.5 mile east of Harper Road (along I-376)	N/A	1.7	N/A	N40°28'59.29"	W80°15'45.31"
Subtotal Southern Beltway – MS4 Regulated/Planning Area Length									*1.7*			
Amos K.[5]	Pittsburgh, PA	Westmoreland	050200061104	Lower Sewickley Creek	PA 66B/US 119	0	North Center Avenue	0.7	0.7	0.35	N40°13'45.45"	W79°35'51.51"
			050200061103		None	1.4	None	1.8	0.4	1.06	N 40°14'43.0"	W79°36'30.37"
			050200050702	Brush Creek (South)	0.5 mile southwest of Walton Tea Room Road	5.2	North Greengate Road	8.8	3.6	7.0	N40°18'57.52	W79°35'18.22"
			050100080203	Beaver Run Reservoir-Beaver Run	0.5 mile south if Sheridan Road	12.05	Pittsburgh-Buffalo Highway	13.4	1.35	12.725	N40°23'17.58"	W79°34'11.31"
Subtotal Amos K. Hutchinson Bypass – MS4 Regulated/Planning Area Length									*6.05*			
Mon-Fayette Expressway	Union-Con[6]	Fayette	050200050601	Cove Run-Redstone Creek	Interchange	±13.4	Old Pittsburgh Road	14.6	1.2	14.0	N39°55'24.31"	W79°43'55.54"
			050200050506	Dunlap Creek	Davidson Siding Road	22.8	0.4 mile northwest of PA 166	23.9	1.1	23.35	N39°59'47.02"	W79°52'14.33"
	Monessen-California, PA	Washington	050200050801	Pike Run	0.5 mile north of Malden Road	31.2	None	32.53	1.33	31.87	N40° 3'41.32"	W79°54'8.90"
			050200050803	Maple Creek-Monongahela River	Old PA 71	37.1	None	37.8	0.7	37.45	N40° 7'55.69"	W79°55'23.39"
			050200050804	Pigeon Creek	Walnut Ridge Road	38.5	0.3 mile north of Coyle Curtin Road	39.5	1.0	39.0	N40° 9'14.75"	W79°55'53.47"
					Taylor Run Road	40.1	Railroad Tracks	42.27	2.17	41.19	N40°10'46.86"	W79°56'58.18"
		Allegheny	050200050505	Mingo Creek-Monongahela River	Union Street	44.85	Union Street	45.06	0.21	44.96	N40°12'33.65"	W79°59'3.99"
	Pitts[2]		050200050806	Piney Fork-Peters Creek	Gill Hall Road	50.7	None	51.0	0.3	50.85	N40°16'41.33"	W79°56'50.40"
					None	52.14	0.25 mile north of Peters Creek Road	53.3	1.16	52.72	N40°17'17.88"	W79°54'58.55"
Subtotal Mon-Fayette Expressway – MS4 Regulated/Planning Area Length									*9.17*			
TOTAL OHIO RIVER DRAINAGE BASIN MS4 PLANNING AREA LENGTH									**71.45**			

[1]BVE = Beaver Valley Expressway
[2]Pitts = Pittsburgh, PA
[3]SB = Southern Beltway
[4] Allg = Allegheny

[5]Amos K. = Amos K. Hutchinson Bypass (a.k.a. Greensburg Bypass)
[6] Union-Con = Uniontown-Connellsville, PA

B. HYDROLOGY

The United States Geological Survey (USGS) developed a hierarchical system to classify hydrology by the region size draining to the watercourse. The HUCs are comprised of 2 to 14 digits and include regions (2 digits), subregions (4 digits), basins (6 digits), subbasins (8 digits), watersheds (10 digits), subwatersheds (12 digits) and reach codes (14 digits). HUC14 watersheds, or reach codes, aid in identifying specific outfalls within the HUC12 watersheds. The PRP has been prepared based on the subwatershed (HUC12) level. HUC12s are generally in the 40- to 60-square-mile size (but can be larger or smaller). The PTC MS4 is contributory to 68 HUC12 watersheds statewide. Of those, the Turnpike's MS4 crosses 23 HUC12 watersheds within the Ohio River Drainage Basin, and PTC MS4 Outfalls are located on 99 Ohio River Drainage Basin Surface Waters. (See **Table 4** below and **Figure 2**, PTC MS4 HUC12 Watersheds, p. 7. Table 4 is arranged alphabetically by HUC12 Watershed name.)

TABLE 4
PTC MS4 OHIO RIVER DRAINAGE BASIN
HUC12 WATERSHEDS AND SURFACE WATERS

HUC12 CODE	HUC12 WATERSHED NAME	SUBJECT SURFACE WATERS WITHIN HUC12 WATERSHED
050301040103	Beaver River-Ohio River	• Clarks Run • Wallace Run • unnamed tributary to Wallace Run • Walnut Bottom Run
050100080203	Beaver Run Reservoir-Beaver Run	• 1 unnamed tributary to Beaver Creek
050301040102	Brady Run	• Brady Run
050301050408	Brush Creek (North)	• Brush Creek • 11 Unnamed Tributaries to Brush Creek
050200050702	Brush Creek (South)	• Brush Creek • 7 Unnamed Tributaries to Brush Creek (South) • 4 Unnamed Tributaries to Tinkers Run
050100090304	Chartiers Run- Allegheny River	• Allegheny River
050200050601	Cove Run- Redstone Creek	• Redstone Creek • 4 Unnamed Tributaries to Redstone Creek • 1 unnamed tributary to Fans Run
050100090303	Deer Creek	• Cedar Run • Deer Creek
050200050506	Dunlap Creek	• Dunlap Creek • 3 Unnamed Tributaries to Dunlap Creek
050200050701	Haymakers Run- Turtle Creek	• Thompson Run • 1 unnamed tributary to Thompson Run • Turtle Creek • 1 unnamed tributary to Turtle Creek • Lyons Run • 1 unnamed tributary to Lyons Run • Byers Run • 1 unnamed tributary to Byers Run

TABLE 4
(CONTINUED)

HUC12 CODE	HUC12 WATERSHED NAME	SUBJECT SURFACE WATERS WITHIN HUC12 WATERSHED
050100090202	Little Pine Creek-Pine Creek	• Montour Run • 4 Unnamed Tributaries to Montour Run • Willow Run • 1 unnamed tributary to Willow Run • Crouse Run • 2 Unnamed Tributaries to Crouse Run
050200061103	Little Sewickley Creek	• Little Sewickley Creek • 3 Unnamed Tributaries to Little Sewickley Creek
050200061104	Lower Sewickley Creek	• Sewickley Creek • Wilson Run • 3 Unnamed Tributaries to Sewickley Creek
050200050803	Maple Creek- Monongahela River	• Maple Creek
050200050805	Mingo Creek-Monongahela River	• Mingo Creek • Froman Run
050100090202	Montour Run	• 4 Unnamed Tributaries to Montour Run
050200050804	Pigeon Creek	• Taylors Run • 2 Unnamed Tributaries to Taylors Run • 3 Unnamed Tributaries to Pigeon Creek
050200050801	Pike Run	• Pike Run • 1 unnamed tributary to Pike Run
050100090201	Pine Creek-North Park Lake	• North Fork Pine Creek • 1 unnamed tributary to North Fork Pine Creek
050200050806	Piney Fork-Peters Creek	• Peters Creek • 2 Unnamed Tributaries to Peters Creek • Lewis Run
050100090305	Plum Creek	• Plum Creek • 2 Unnamed Tributaries Plum Creek • Bodies Run
050200050704	Sawmill Run- Turtle Creek	• 1 unnamed tributary to Turtle Creek
050200050703	Thompson Run	• 2 Unnamed Tributaries to Thompson Run

Surface waters of Pennsylvania have been classified into four designated uses (aquatic life, fish consumption, potable water supply, and recreation), as found in Pennsylvania Title 25 Environmental Protection, Chapter 93 Water Quality Standards (Chapter 93). Every two years the surface waters are qualitatively evaluated and classified as having water quality supportive of their designated use (attaining) or having water quality deficient for support of the designated use (non-attaining). Non-attaining surface waters are tracked on the Clean Water Act (CWA) Section 303(d) List. The PTC's Permit stipulates use of the 2014 version as the basis for the PTC's pollutant load reductions.

Appendix B, PTC MS4 Ohio River Drainage Basin Receiving Surface Waters Table, identifies the PTC MS4 HUC14 receiving surface waters. Use of the HUC14 reach codes facilitates distinguishing one unnamed tributary from another one. The table provides outfalls, surface water name, reach code, the impairment status of the receiving surface water, and the cause of impairment if it is non-attaining. Of the 99 receiving surface waters, 28 are non-attaining due to sediment and/or nutrient impairment and are listed in **Table 5**, PTC MS4 Ohio River Drainage Basin Sediment and Nutrient Impaired Non-Attaining Receiving Surface Waters Summary (p. 13).

Receiving Surface Water Names are reported by the HUC12 watershed where they are located. HUC12 watersheds are arranged geographically along the Turnpike Mainline from west to east and along the other roadways from south to north. Note that there are a number of surrogate names for sediments and nutrients. Surrogate names for sediments include Siltation, Suspended Solids, and Turbidity. Surrogate names for nutrients include Organic Enrichment/Low D.O. and Excessive Algal Growth. The Impairment Cause column also includes additional sources of impairment if identified on the CWA Section 303(d) List for the surface water.

The number of surface waters and the extent of the region covered preclude identification of all the individual surface waters on a small-scale report-sized exhibit. However, the HUC14 receiving waters are shown as lines on the MS4 maps for the entire PTC MS4-regulated area previously submitted to and on file at PA DEP (see Section 3.B, Map).

C. TOPOGRAPHY AND GEOLOGY

The section of the Turnpike that runs through the Ohio River Basin is within the Appalachian Plateaus Physiographic Province. The Appalachian Plateaus Province is comprised of sedimentary rocks such as sandstones, conglomerates, and shales with interwoven beds of coal throughout. The province is divided into sections that capture the topographic characteristics of the region in more detail.

The portion of the Turnpike within the Ohio River Basin runs through the following sections: Northwestern Glaciated Plateau, Pittsburgh Low Plateau, Waynesburg Hills, Allegheny Mountain, and Allegheny Front. The Northwestern Glaciated Plateau is characterized by broad, rounded upland and deep, steep-sided linear valleys. The underlying rock is comprised of shale, siltstone, and sandstone, and the approximate elevation ranges from 900 to 2,200 feet. The Pittsburgh Low Plateau is dominated by a smooth to irregular, undulating surface with narrow valleys. This region also features strip mines and reclaimed land. The underlying rock consists of shale, siltstone, sandstone, limestone, and coal. The approximate elevation ranges from 660 to 2,340 feet. The Waynesburg Hills Section is very hilly with narrow hilltops and steep-sloped, narrow valleys. The underlying rock in this section includes sandstone shale, red beds, and limestone. The approximate elevation ranges from 848 to 1,638 feet. The Allegheny Mountain section is characterized by wide ridges separated by broad valleys. The underlying rock in this region includes sandstone, siltstone, shale, and conglomerate. The approximate elevation ranges from 775 to 3,210 feet. The east part Allegheny Front Section is characterized by rounded linear hills rising by steps to an escarpment and hills cut by narrow valleys. The west part of the Allegheny Front Section features undulating hills sloping away from escarpment. The underlying rock type includes shale, siltstone, and sandstone. The average elevation ranges from 540 to 2,980 feet.

TABLE 5
PTC MS4 OHIO RIVER DRAINAGE BASIN SEDIMENT AND NUTRIENT IMPAIRED NON-ATTAINING RECEIVING SURFACE WATERS SUMMARY

URBAN AREA	RECEIVING SURFACE WATER NAME (MOST DOWNSTREAM SEWERSHED #)	HUC12 CODE	HUC12 NAME	REACH CODE AT MOST DOWNSTREAM OUTFALL	CHAPTER 93 DESIGNATED USE	IMPAIRMENT CAUSE	SURFACE WATER NAME DOWNSTREAM OF RECEIVING SURFACE WATER
PITTSBURGH PENNSYLVANIA	Brady Run (11549)	050301040102	Brady Run	05030104000018	TSF[3]	Siltation	Beaver River
	Clarks Run (11009)	050301040103	Beaver River-Ohio River	05030104000027	WWF[2]	Siltation	
	Walnut Bottom Run (11537)			05030104000030	WWF[2]	Siltation; Water/Flow Variability	
	Brush Creek – North (11010)	050301050408	Brush Creek (North)	05030105000516	WWF[2]	Nutrients; Siltation; Cause Unknown; Water/Flow Variability	Connoquenessing Creek
	UNT to Brush Creek (11069)			05030105000559	WWF[2]	Nutrients; Siltation	Brush Creek
	Montour Run (11182)	050100090202	Little Pine Creek-Pine Creek	05010009000137	TSF[3]	Siltation	Pine Creek
	Crouse Run (11190)			05010009000130	TSF[3]	Nutrients	
	UNT to Crouse Run (11192)			05010009000131	TSF[3]	Nutrients	Crouse Run
	Deer Creek (11219)	050100090303	Deer Creek	05010009000092	WWF[2]	Siltation; Flow Alterations; Turbidity; TDS; Metals; Nutrients	Allegheny River
	Allegheny River (11221)	050100090304	Chartiers Run-Allegheny River	05010009000007	WWF[2]	PCB; Chlordane	
	Plum Creek (11237)	050100090305	Plum Creek	0 5010009000082	WWF[2]	Nutrients; Siltation	
	UNT to Thompson Run (911260)	050200050703	Thompson Run	05020005001822	WWF[2]	Siltation	Thompson Run
	UNT to Turtle Creek (11261)	050200050704	Sawmill Run-Turtle Creek	05020005000672	WWF[2]	Siltation	Turtle Creek
	Turtle Creek (11306)	050200050701	Haymakers Run-Turtle Creek	05020005000486	TSF[3]	Nutrients; Siltation; Metals	Monongahela River
	Byers Run (11350)			05020005000619	TSF[3]	Siltation	Turtle Creek
	UNT to Byers Run (11427)			05020005001895	TSF[3]	Siltation	Byers Run
	UNT to Lyons Run (11365)			05020005000621	TSF[3]	Siltation	Lyons Run
	Thompson Run (11276)			05020005000664	TSF[3]	Siltation	Abers Creek
	Brush Creek – South (11362))	050200050702	Brush Creek (South)	05020005000556	TSF[3]	Siltation	Turtle Creek
	UNT to Brush Creek (11337)			05020005000605	TSF[3]	Siltation	Brush Creek
	UNT Tinkers Run (11374)			05020005000538	TSF[3]	Siltation	Tinkers Run
	UNT to Little Sewickley Creek (11458)	050200061103	Little Sewickley Creek	05020006000832	TSF[3]	Siltation; Water/Flow Variability	Little Sewickley Creek
	UNT to Sewickley Creek (11512)	050200061104	Lower Sewickley Creek	05020006004235	WWF[2]	Nutrients	Sewickley Creek
	UNT to Beaver Run (11609)	050100080203	Beaver Run Reservoir-Beaver Run	05010008000478	HQ-CWF[4]	Siltation	Beaver Run
	UNT to Montour Run (11628)	050301010304	Montour Run	05030101001520	TSF[3]	Organic Enrichment/Low D.O.; Metals	Montour Run

TABLE 5
(CONTINUED)

URBAN AREA	RECEIVING SURFACE WATER NAME (MOST DOWNSTREAM SEWERSHED #)	HUC12 CODE	HUC12 NAME	REACH CODE AT MOST DOWNSTREAM OUTFALL	CHAPTER 93 DESIGNATED USE	IMPAIRMENT CAUSE	SURFACE WATER NAME DOWNSTREAM OF RECEIVING SURFACE WATER
UNIONTOWN-CONNELLSVILLE, PA	UNT to Redstone Creek (12014)	050200050601	Cove Run-Redstone Creek	05020005002922	WWF[2]	Siltation; pH; Metals; Organic Enrichment/Low D.O; Suspended Solids	Redstone Creek
	UNT to Redstone Creek (12003)			05020005002953	WWF[2]		
MONESSEN-CALIFORNIA, PA	Maple Creek	050200050803	Maple Creek-Monongahela River	05020005001489	WWF[2]	Organic Enrichment/Low D.O.; Metals; Siltation; Water/Flow Variability	Monongahela River

1. CWF – Cold Water Fishes
2. WWF – Warm Water Fishes
3. TSF – Trout Stocking
4. HQ-CWF – High Quality Waters-Cold Water Fishes

D. SOILS

This discussion is a generalized impression of the character of the PTC soils. Site-specific soils investigations will be required for design development.

Soils are foundational for stormwater pollution management. Well-drained soils with moderate permeability are ideal for successful implementation of infiltrative stormwater BMPs. Good soil fertility supports vigorous plant growth that is integral to infiltrative stormwater BMP effectiveness in pollution reduction. Soil characteristics along degraded streams guide the design response and are predictive of the effectiveness of sediment reduction. Soils with high levels of silt and very fine sand (loamy) tend to be more erodible. So, while loamy soils require careful management during construction to prevent sediment discharges, restorative projects that stabilize such soils can produce significant sediment reductions.

The Turnpike runs through several soil associations situated in the Ohio River Basin. Soil associations are groups of soil series that are commonly found together. Starting from the western end of the Mainline, the underlying soil associations of the Turnpike include the Ravenna-Canfield (RC) series, Hanover-Alvira (HA) series, Gilpin-Wharton (GW) series, and Hazleton-Cookport (HC) series. The Mon-Fayette Expressway also runs through the Guernsey-Culleoka (GC) series.

The westernmost 25 miles of the Turnpike Mainline and the Beaver Valley Expressway are situated in Lawrence and Beaver counties where the dominant Ravena and Cranfield soils were intermixed with other soils by the glaciers. Due to its formation, the RC series is located on both level areas and on steep slopes. The soil ranges from moderately deep to deep, somewhat poorly to moderately well-drained silt loam, and is comprised of neutral till. Both Ravena and Cranfield soils are noted to have a fragipan layer at a depth of 15 to 30 inches. Fragipan is a thick layer of soil that is cement-like and restricts water flow and root penetration. Permeability of this series is moderately high above the fragipan and moderately low in the fragipan and below. The major limitations for stormwater management facility construction include seasonal wetness, widely variable permeability, flooding in the lowlands, low available water capacity on hillsides, and slope. If sites for infiltrative BMPs are under consideration in this region, site-specific evaluation is necessary. The general takeaway is that interaction with perched water tables and other soil drainage problems may prevent successful infiltration.

The next segment of Mainline cuts through the southwestern corner of Butler County and diagonally across the northern part of Allegheny County. The HA series separates the RC and GW soils and is a narrow band, only a few miles wide where the Turnpike crosses it. The HA series is generally deep, somewhat poorly to moderately well-drained silt loam, and comprised of leached till.

The GW series is moderately deep to deep, moderately well- to well-drained, medium-textured silt loam and is underlain by shale, sandstone, and siltstone. It is located on undulating to hilly uplands and with numerous small streams. Wharton generally dominates the ridges and Gilpin is on the side slopes. Wharton soils are noted to have high water tables and are subject to erosion. Depth to bedrock is a limitation to Gilpin soils. The abundance of streams, the erosive nature of the soils, and the limited depth to a constraining feature suggest that restorative landscape and stream projects may be more effective than infiltrative BMPs for pollution reduction in the region.

The GC series is located near the Mon-Fayette Expressway through Washington and Fayette counties. Some areas are moderately deep and well-drained, ideal for infiltrative BMPs. Other areas, with high percentages of Guernsey soils, have seasonal highwater tables, which may interfere with consistent effectiveness of infiltrative BMPs. The GC series coincides with an area historically noted for strip-mining land use. While there is no longer an abundance of active mining, the residual land depressions collect acidic water. Vegetation is sparse. The known hazardous nature of the acid mine drainage may dictate extra precautions in order to design compatible stormwater management solutions.

On a similar note, soils in the greater Pittsburgh area are highly influenced by heavy industrial, commercial, and residential land use. The disturbance and compaction associated with intensely developed land use alter soils' natural characteristics and make desktop analysis less effective as a site identification tool. Potential sites in densely developed areas require secondary follow up even at early stages of site evaluation for PRP BMPs.

In general terms it appears the soils surrounding the Turnpike within the Ohio River Basin fairly consistently have constraints that point toward proposed BMPs that do not rely on infiltration as the primary means to effectively reduce sediment pollution. Alternatives such as the managed release concept (MRCs) might be warranted in the Ohio River Basin due to the preponderance of characteristics that interfere with storm water infiltration. Site-specific soil testing is warranted before committing to an infiltrative BMP solution. It also appears that some areas that easily erode and have an abundance of streams are good candidates for landscape and stream restorations that could both reduce sediment discharge and aid in improving water quality.

E. LAND USE

The Turnpike is its own unique use. It is a limited-access road with user service and roadway maintenance support facilities. More than half of the corridor length traverses rural, agricultural, and forested land. The remainder crosses more metropolitan regions with urban character. New construction in the Ohio River Drainage Basin consists of bridge and infrastructure repair/replacement, roadway widening, and redevelopment of existing service plazas and maintenance facilities. Generally, the Turnpike is split evenly between impervious surfaces and pervious surfaces (vegetated). The ratio fluctuates to more strongly impervious where the roadway passes through urbanized environments and less impervious in rural and suburban settings.

The land uses depicted by the aerial photograph background of the MS4 maps are described below in **Table 6**, PTC MS4 Ohio River Land Use Distribution Table. The land uses were derived from the pollutant load estimating model (MapShed) utilized in preparation of the

PRP (see **Appendix D**, Mapshed Urban Area Tool Results). The Land Use Distribution Table includes the Turnpike itself, but the reported categories reflect the land use through which the roadway passes. Mapshed names are cross-referenced to the Chesapeake Assessment Scenario Tool (CAST) program and are provided in accordance with the PA DEP PRP preparation instructions to refer to CAST names and definitions.

TABLE 6
PTC MS4 OHIO RIVER LAND USE DISTRIBUTION TABLE SUMMARY

LAND USE		OHIO RIVER DRAINAGE BASIN
MAPSHED NAME	CAST NAME	PLANNING AREA (ACRES)
Hay/Pasture	Pasture	20
Cropland	Double Cropped Land	5
Forest	True Forest	165
Wetland	Non-tidal Floodplain Wetland	0
Disturbed	Regulated Construction	2
Turfgrass (Includes golf courses and large expanses of turf)	MS4 Turfgrass	2
Open Land	Mixed Open	158
Bare Rock	Non-Regulated Buildings and Other	0
Sandy Areas	Non-Regulated Buildings and Other	0
Unpaved Roads	No Equivalent	0
Low-Density (LD) Mixed	MS4 Buildings and Other	163
Medium Density (MD) Mixed	MS4 Buildings and Other	354
High-Density (HD) Mixed	MS4 Buildings and Other	551
Low-Density (LD) Residential	MS4 Buildings and Other	12
Medium Density (MD) Residential	MS4 Buildings and Other	4
High-Density (HD) Residential	MS4 Buildings and Other	0
Water	Water	0
TOTAL		**1,436**

3.0 REQUIRED PRP COMPONENTS

A. PUBLIC PARTICIPATION

The PTC invited public involvement and participation in the development of the Ohio River PRP as specified in their approved Permit and outlined below.

- The initial draft Ohio River PRP was posted on the PTC's Clean Water Website from September 24, 2022, to October 24, 2022.
- Notice of the initial draft Ohio River PRP was published in the *Pennsylvania Bulletin* on September 24, 2022. The announcement directed the public to its website to review the PRP, and a 30-day comment period was provided.
- A copy of public comments that were received are included in Appendix F, Public Review Comments.
- Following approval by PA DEP, a complete copy of the Ohio River PRP will be posted on the PTC's Clean Water Website **www.paturnpike.com/responsibility-matters/clean-water** and will continue to be published on the website for the duration of permit coverage.

Should there be revisions to the PTC's Ohio River PRP that modifies the location, type, or number of proposed BMPs, the PTC will identify the revision(s) on its website and provide a 30-day period for the acceptance of public comments. Subsequently, a copy of public comments received and the PTC's record of consideration of the comments will be provided with PTC's Ohio River PRP to PA DEP.

The verbiage of the Notification placed in the *Pennsylvania Bulletin* is presented below. A copy of the *Pennsylvania Bulletin* notification is provided in **Appendix A** .

PENNSYLVANIA BULLETIN NOTIFICATION FOR THE PENNSYLVANIA TURNPIKE COMMISSION OHIO RIVER DRAINAGE BASIN PRP

Draft National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Pollution Reduction Plans for the Pennsylvania Turnpike Commission

Notice is hereby given that the Pennsylvania Turnpike Commission will receive public comment(s) on three proposed Pollution Reduction Plans (PRPs) required for their 2021-2026 National Pollutant Discharge Elimination System (NPDES) Individual Permit to discharge stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) Permit No. PAI139602.

The Pennsylvania Turnpike Commission has developed PRPs for the Chesapeake Bay, Delaware River, and Ohio River Watersheds. The PRPs determine existing sediment pollutant loadings associated with stormwater runoff and proposes potential Best Management Practices to reduce the pollutant loads to meet the requirements of the MS4 Permit, for each watershed.

The proposed PRPs can be reviewed online by visiting **https://www.paturnpike.com/responsibility-matters/clean-water** then selecting "MS4" at the top of the page and navigating to "MS4 Documentation" under "MS4 Resources".
Written comments on the PRPs will be accepted for a period of 30 days from the date of this public notice by mail to Mr. James Kaiser, Pennsylvania Turnpike Commission,700 South Eisenhower Blvd., Middletown, PA 17057 or by e-mail at jkaiser@paturnpike.com. All comments will be tabulated and considered with the final PRPs.

B. MAP

The PTC's MS4 map that is the basis for the PRP was submitted as part of the MS4 Annual Report for the period ending June 30, 2018, and is on file as part of the publicly accessible record with PA DEP. The sidebar graphic on the next page summarizes the information provided narratively in the following section. The map is a Geographic Information System (GIS) product created using ESRi Arc Map and serves the following purposes:

1. Inventory of the PTC's existing stormwater network
2. Regulated area identification including delineation of the following components listed in the PA DEP PRP Instructions:
    a. Land uses and/or impervious and pervious surfaces
    b. Outfalls
    c. Storm sewershed boundaries
    d. Planning areas
    e. Locations of proposed BMPs
3. Framework for inspections and documenting maintenance practices and Illicit Discharge Detection and Elimination (IDD&E) activities

4. Future project identification that show the location of proposed pollutant-reducing projects

1. MS4 Base Map

The base map information was acquired from various publicly available sources including Bing Maps, County Parcel Information provided by the PTC, PA DEP, Pennsylvania Department of Conservation and Natural Resources (PA DCNR), Pennsylvania Department of Transportation (PennDOT), and the U.S. Census Bureau that are detailed in **Appendix C**, MS4 Map Layers and Data Sources. The information from these sources is shown on the map unedited. There are variations in the locations of duplicated information. However, the composite of the information sufficiently provides the required data elements including land uses, impervious/pervious surfaces, locations and names of surface waters that receive discharges from the MS4 outfalls, public and private property lines, municipal boundaries, and the UA boundary according to the 2010 Census. The PTC and its consultant, Skelly and Loy, Inc., *A Terracon Company* (Skelly and Loy) make no claims as to the accuracy of the public-source data.

MS4 MAP SUMMARY

Purposes
- Inventory
- Regulated area identification
- Framework for inspections
- Future project identification

MS4 Base Map
- GIS-Based
- Compiled from publicly available sources

Municipal Separate Storm Sewer System
- Digitized from PTC construction plan archive and aerial photographs

Outfalls and Sewersheds
- Produced by professionals
- Color-coded:
  - o Green for Attaining
  - o Red for Non-Attaining

Planning Areas
- Demarcated through GIS Analysis

2. Municipal Separate Storm Sewer System

The stormwater sewer collection system shown on the MS4 maps, consisting of the surface stormwater conveyances (PTC roadway, catch basins/inlets, pipes, manholes, intakes and discharges, ditches, swales, and similar municipally owned or PennDOT components that are connected to the system and located within the PTC property), was digitized based on historical PTC construction plans and desktop analysis of aerial photographs and topography. During the analysis, some segments of the Turnpike were under construction and other areas contained documented and/or aerial images that showed conflicting information. These areas were flagged as areas of "Insufficient Data" because positions of the stormwater sewer system could not be conclusively located using desktop source information.

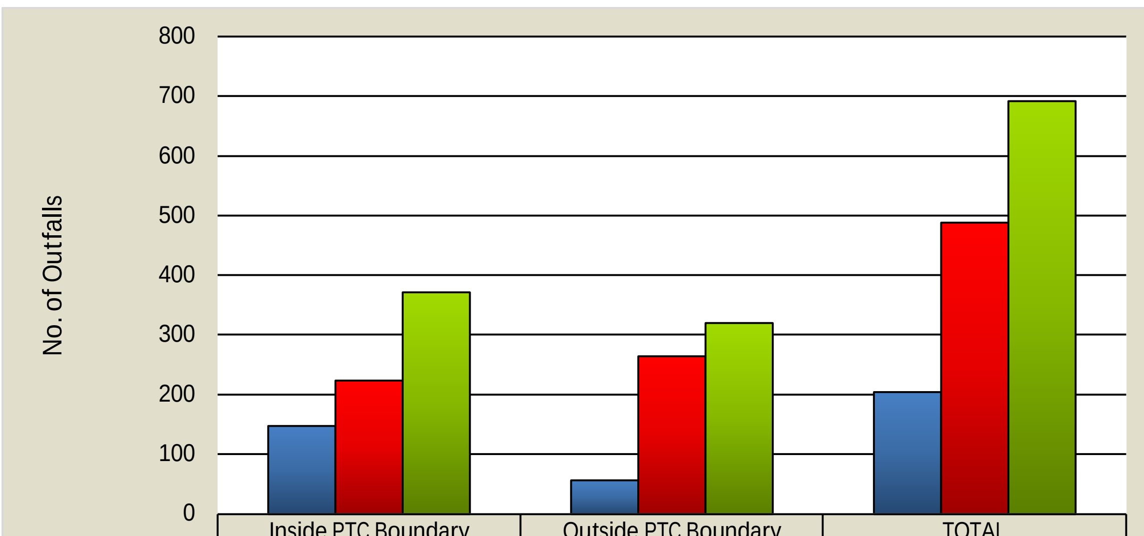
The stormwater sewer system and Insufficient Data areas will be updated on an ongoing basis, and updated mapping will be provided as part of Annual Reports during the permit term as required by the PTC's approved MS4 Permit.

3. Outfalls

The outfalls were located by the PTC's consultant, Skelly and Loy, by plotting the path that storm runoff will follow by gravity between the PTC's MS4 and the receiving surface water (a.k.a., rain traces). In establishing rain traces, surface topography with enclosed depression characteristics (such as stormwater basins, sinkholes, and ponds) were ignored, in accordance with PA DEP directions, to assume flooded conditions.

Statewide, PTC discharges to 1,727 outfalls; 886 outfalls are located within the PTC boundary, and 841 are outside the PTC territory. **(Appendix B**, PTC MS4 Ohio River Drainage Basin Receiving Surface Waters Table, provides the comprehensive list of outfalls, receiving surface waters, and surface water statistics.) There are 692 outfalls within the Ohio River Drainage Basin. **Figure 3**, PTC Ohio River Outfall Summary, provides a synopsis of the outfalls by location within the PTC MS4 (or beyond) and by impairment status of the receiving surface waters at the outfall location.

FIGURE 3
PTC OHIO RIVER OUTFALL SUMMARY

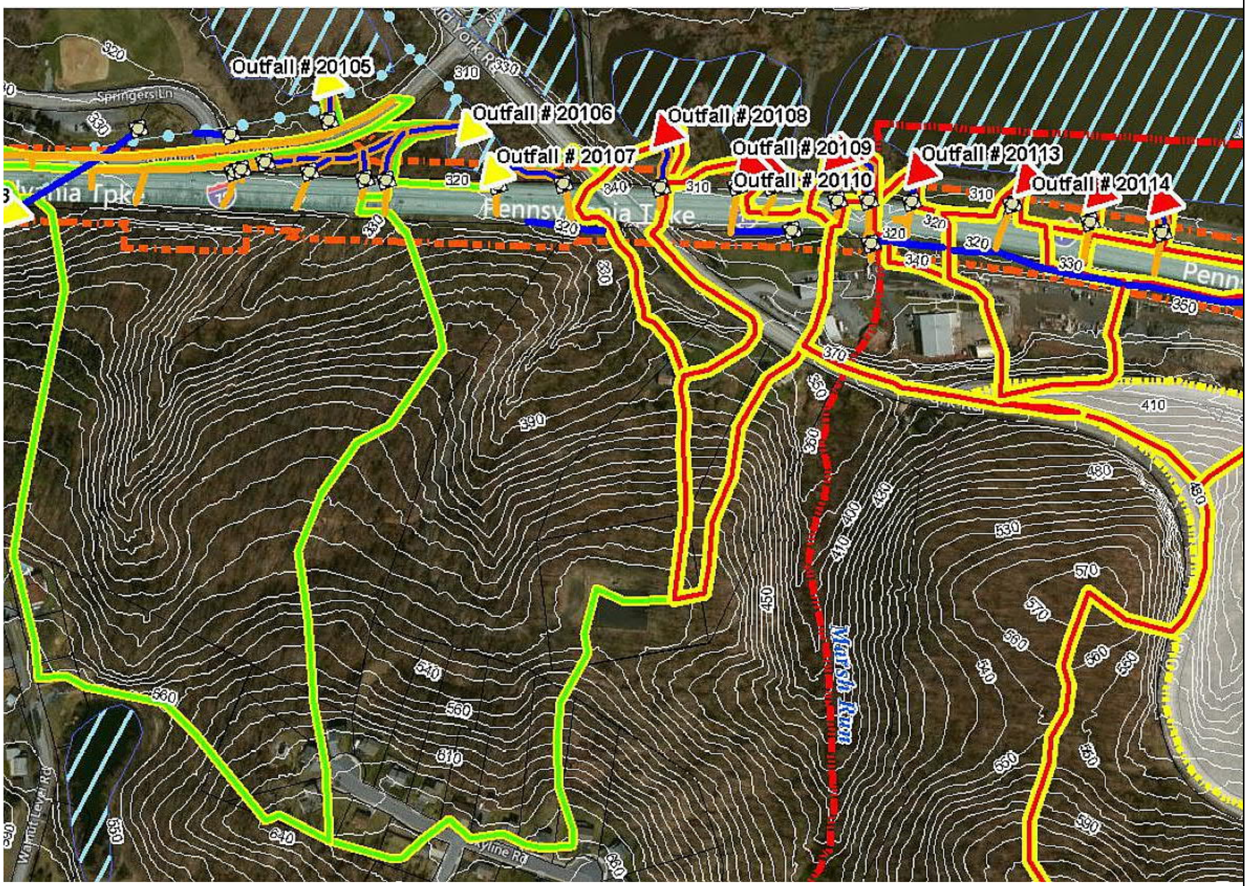


	Inside PTC Boundary	Outside PTC Boundary	TOTAL
Attaining	148	56	204
Non Attaining	224	264	488
TOTAL	372	320	692

Of the 692 total outfalls, 372 are located within PTC-owned or -operated property. The remaining 320 outfalls discharge to surface waters beyond the PTC boundary and outside PTC purview. Outfalls within the PTC right-of-way have been field-verified during IDD&E screenings.

4. Storm Sewersheds

Storm sewersheds were produced by qualified staff using professional judgment to delineate contributory drainage area to each outfall. Sewersheds were color-coded to correspond to the impairment/attainment status (in accordance with PA DEP's Integrated Water Quality Monitoring and Assessment Report) of the receiving surface water at the PTC MS4 outfall location. Sewersheds discharging to surface waters attaining their designated Chapter 93 use are color-coded "green." Sewersheds discharging to non-attaining surface waters are color-coded "red with a yellow halo." (See Photograph 1 below.)



Photograph 1 – Sample from 500-scale PTC MS4 Map: The image shows green-colored sewersheds discharging to attaining surface waters at yellow-colored outfalls and red-colored sewersheds discharging to non-attaining surface waters at red-colored outfalls.

5. Numbering System

The numbering code has five digits. The first digit refers to the major drainage basin in which the outfall is located. The next number refers to the sewershed's UA. The final three digits are the sewershed identification (ID) number. (See **Table 7**, PTC Sewershed Numbering Code, below.)

TABLE 7
SEWERSHED NUMBERING CODE

DIGIT 1	MAJOR DRAINAGE BASIN	DIGIT 2	URBANIZED AREA	DIGITS 3 THROUGH 5 (SEQUENTIAL SEWERSHED ID)
1	Ohio River Basin	1	Pittsburgh	001 to 999
		2	Uniontown-Connellsville	
		3	California-Monessen	
2	Chesapeake Bay Basin	1	Harrisburg	
		2	Lancaster	
		3	Wilkes Barre-Scranton	
3	Delaware River Basin	1	Philadelphia	
		2	Allentown	

The three-digit outfall ID was generated using the latitude/longitude coordinates of the outfall locations relative to their geographic position within each UA. A numbering routine to assign a “next number” based on longitudinal values for west-east Turnpike segments and latitudinal values for the north-south segments, supplemented with operator input on curving and transitional Turnpike segments, resulted in Sewershed IDs that generally follow the Turnpike System Roadway mile marker direction as shown below (**Table 8**, Turnpike Milepost Direction). In areas where there are multiple roadway segments or particularly dramatic changes in direction, sequential numbering might have sequencing gaps. This is because the following east or south coordinate is located on another road segment or curve within the same UA. Out-of-sequence numbering may also occur to accommodate new outfalls discovered during outfall screenings.

TABLE 8
TURNPIKE MILEPOST DIRECTION

TURNPIKE ROADWAY NAME	ROUTE NUMBER	MILE POST DIRECTION (LOWEST TO HIGHEST VALUE)
Turnpike Mainline	I-76/I-276	West to East
Beaver Valley Expressway	I-376	**Nominally:** West to East **Geographically:** North to South
Southern Beltway	PA-576	**Nominally:** West to East **Geographically:** North to South
Mon/Fayette Expressway	PA-43	South to North
Amos K. Hutchinson Bypass (a.k.a., Greensburg Bypass)	PA-66	South to North
Northeast Extension	I-476	South to North

Sewersheds contain structures and conveyances. The numbers are not shown on the map to preserve map legibility, but these features are numbered, too. The first five numbers of each component of the storm sewer system within a sewershed uses that sewershed's ID number to tie those features to the sewershed. The number is followed by a period and suffix codes that identify the type of structure or conveyance, etc.

Once established, the numbering needs to remain constant so that activities occur at the same location and records stay connected perpetually. Newly discovered outfalls will most often result in splitting an established sewershed. Additionally, there are a few instances where the same sewershed identification number was inadvertently duplicated. In these cases, a prefix number "9" is added to one of the two sewersheds to differentiate them and their affiliated storm sewer components. For example, if an established sewershed with the number 22024 is split, one will retain 22024 and the other will become 922024.

6. Planning Areas

Planning Areas were derived through GIS analysis that merged and clipped the sewershed, the 2010 UA, and the upstream contributory area to the limits of the PTC right-of-way. Planning Areas represent the portion of the PTC where pollutant reduction is required. In the Ohio River Basin, the Planning Area includes only the sewersheds that are impaired by sediment or nutrients which correspond to the pollutants of concern listed below.

C. POLLUTANTS OF CONCERN

Pollutants of concern within the overall PRP Planning Area are sediment and total phosphorus. PA DEP established pollutant removal targets in the PTC's approved permit. Pollutant removal goals for the Ohio River Drainage Basin are listed in **Table 9.**

TABLE 9
POLLUTANT REDUCTION TARGETS FOR THE
OHIO RIVER DRAINAGE BASIN IN PTC PERMIT PAI139602

POLLUTANT	REDUCTION TARGET
Sediment (TSS)	5%
Phosphorus (TP)	2.5%

1. MS4 Reduction Goals

The PTC has opted to use the presumptive approach. BMP projects to reduce pollutants will report only sediment reduction required to achieve 5% sediment reduction.

a. Presumptive Approach to Pollutant Reduction

In accordance with PA DEP's PRP Instructions (3800-PM-BCW0100k, Rev. 3/2017) Section I.B., a presumption of nutrient removal compliance may be assumed if the permit-required sediment removal is achieved (5% in the Ohio River Drainage Basin).

D. EXISTING LOADING FOR POLLUTANTS OF CONCERN

1. Synopsis

Existing loading totals for sediment and phosphorus were calculated by HUC12 watershed using the MapShed model. Analysis at HUC12 watershed scale is consistent with the requirement to apply the MapShed model to sufficiently sized (>10-square-mile) watersheds.

Table 10 lists the existing pollutant loads for each of the UAs and HUC 12 watersheds where the PTC MS4 is located. (Also see MapShed Urban Area Tool Results, **Appendix D1,** Planning Area Existing Loads.) A detailed discussion of the approach, the computer model, and other supporting calculations are provided below.

TABLE 10
EXISTING POLLUTANT LOAD
BY URBANIZED AREA AND HUC12 WATERSHED FOR REGULATED PTC MS4

URBAN AREA	WATERSHED NAME (HUC CODE)		SEDIMENT TSS (LBS/YR)	PHOSPHORUS TP (LBS/YR)
PITTSBURGH, PENNSYLVANIA	Brady Run	(050301040102)	14,761.5	6.7
	Beaver River-Ohio River	(050301040103)	84,087.3	27.4
	Brush Creek (North)	(050301050408)	226,821.9	67.2
	Little Pine Creek-Pine Creek	(050100090202)	143,243.0	36.4
	Deer Creek	(050100090303)	31,389.6	9.8
	Chartiers Run-Allegheny River	(050100090304)	20,958.2	5.3
	Plum Creek	(050100090305)	162,363.2	34.3
	Sawmill Run-Turtle Creek	(050200050704)	27,506.8	9.0
	Haymakers Run-Turtle Creek	(050200050701)	189,277.9	50.1
	Brush Creek (South)	(050200050702)	543,918.3	139.4
	Little Sewickley Creek	(050200061103)	55,327.8	20.3
	Lower Sewickley Creek	(050200061104)	78,725.3	29.1
	Beaver Run Reservoir-Beaver Run	(050100080203)	67,500.3	21.5
	Montour Run	(050100090202)	113,572.3	32.1
	Subtotal – Pittsburgh, Pennsylvania		**1,759,453.4**	**488.6**
UNIONTOWN-CONNELLSVILLE, PA	Cove Run-Redstone Creek	(050200050601)	54,447.0	14.9
	Subtotal – Uniontown-Connellsville, Pennsylvania		**54,447.0**	**14.9**
MONESSEN-CALIFORNIA, PA	Maple Creek-Monongahela River	(050200050803)	19,103.2	6.5
	Subtotal – Monessen-California, Pennsylvania		**19,103.2**	**6.5**
OHIO RIVER DRAINAGE BASIN PTC MS4 TOTAL			**1,833,003.6**	**510.0**

2. Calculating MS4 Existing Pollutant Load

Calculating the existing pollutant load includes first determining what areas are regulated by the MS4 permit. The regulated portion of the PTC property includes the roadway and facilities that are in a UA or drain into a UA called planning areas. The initial planning area pollutant loads may be determined through accepted computer modeling (like MapShed) or by using the PA DEP Simplified Method (a spreadsheet application of generalized county-based pollutant loading rates that can be applied to planning areas to produce pollutant load estimates). The total pollutant load may be adjusted to recognize other conditions that could decrease MS4 pollutant- reduction obligations. Adjustments include 1) reducing the planning area through parsing and 2) reducing the modeled pollutant load equivalent to the capacity for pollution treatment in existing stormwater BMPs in excess of their required construction stormwater discharge NPDES Permit obligations.

The PTC used MapShed to generate pollutant loads and made no adjustments to decrease its MS4 pollutant load-reduction obligations.

a. MapShed Discussion

MapShed is a PA DEP- approved GIS-based modeling method. Data layers were downloaded from the MapShed website and serve as the basis for calculating existing pollutant loads. PTC performed Pollutant Load Calculations in 2017 to align with PA DEP instructions at the time and performed their pollutant modeling using MapShed. The results of the 2017 model represent identical criteria that municipal MS4 permittees applied.

i. MapShed Urban Area Tool

MapShed's Urban Area Tool analyzes the intensely developed portions of watershed to determine the existing pollutant loads generated by the PTC MS4 regulated area (Planning Area). The Urban Area Tool is reliant on access to a data layer and look-up table defining municipal boundaries referred to as the UA data layer. The turnpike is linear, and it crosses numerous municipalities. The PTC's boundaries do not coincide with municipal boundaries, and the MS4 Planning Area is only a portion of the entire PTC right-of-way. In order to access the underlying database, it was necessary to create and associate the PTC Planning Area as a substitution for MapShed's UA data layer.

In addition to the substitution for the built-in municipal layers that did not coincide with the planning area, limited adaptations were made to MapShed and are listed to the right.

MODIFICATIONS TO MAPSHED

- MapShed-provided data layers were re-projected and clipped to the municipal boundary to gain performance, reduce inconsistencies, and provide platform stability.
- Consultant-created Planning Areas were substituted for the MapShed-provided UA data layer.
- HUC12 watersheds from the USGS were substituted for MapShed-provided smaller watersheds.

The Urban Area Tool provides four categories of information:

1. **Watershed Total Pollutant Load** – The annual load of sediment, phosphorus, and nitrogen generated by the entire HUC12 watershed, expressed in pounds per year. Pollutant loading rates are generated at the HUC-12 watershed level.
2. **MS4 Total Pollutant Load** – The MS4 portion of the watershed's pollutant load. The MS4 Pollutant Load is the load generated when no adjustments are made to the planning area (planning area with no parsing).
3. **MS4 Regulated Pollutant Load** – Subset of MS4 total load reflecting any acreage reductions from the Planning Areas. This category would be used if parsing is applied to reduce the size of the planning area.
4. **Unregulated Pollutant Load** – Counterpart to the Regulated Pollutant Load that represents the portion of the pollutant load conveyed by another MS4 permittee (and not conveyed through the PTC MS4 stormwater sewer system).

The Regulated Pollutant Load portion of the Urban Area Tool allows the user to simulate parsing by inputting an adjusted percentage of land area within land use categories to reflect a smaller regulatory area resulting from exclusions (parsing). There was no parsing for the PTC (see Subsection d, Planning Area Deductions - Parsing, below).

GIS analysis was used to generate a substitute boundary for the Urban Area data layer. Therefore, the Regulated Pollutant Load and its counterpart, Unregulated Pollutant Load, categories of the Urban Area Tool were unnecessary. The Watershed Total Pollutant Load feature does not address PTC-relevant loading. The MS4 Total Pollutant Load feature of the Urban Area Tool is the only necessary Urban Area Tool feature that is needed for reporting.

b. Planning Area Determination

As stated in Section 3.B, Map (p. 19), the limits of the planning areas were created using GIS analysis to identify the portion of the PTC property within and contributing to the 2010 UA that is also served by the PTC separate storm sewer. In the Ohio River Drainage Basin, the planning area is synonymous with the regulated PTC MS4 because all sewersheds were included regardless of the impairment status of the receiving surface water. The PTC Planning Area was substituted for the Urban Area data layers in the MapShed model and consists of 1,436 acres.

c. Pollutant Load Calculation

Calculating the existing pollutant load includes determining which HUC12 watersheds require modeling. Applicable HUC12 watersheds are those containing planning areas (segments of the Turnpike that are in a UA or drain into the UA). MapShed analyzes data affecting pollution loads including streams, land cover, soils, topography/terrain, long-term precipitation data, and a few data sets like discharges from wastewater treatment plants and animal populations, which are not relevant to the PTC. Loading rates are generated for pollutants of concern based on the character of the entire HUC12. The HUC12 loading rate is applied to the planning area(s) within the HUC12 to estimate the existing pollution generated by each planning area.

d. Planning Area Deductions - Parsing

Per the PA DEP PRP Instructions, it is acceptable to decrease the area from the first analysis by excluding/parsing areas that possess their own NPDES permit such as an industrial site covered by a PAG-03 permit, regions under the jurisdiction of another regulated MS4, and areas that do not contribute drainage to the permittee's Municipal Separate Storm Sewer (MS3). The smaller region remaining following the parsing exercise represents the MS4 Planning Area that is subject to pollutant reduction removal.

The PTC PRP did not perform any parsing.

e. Existing Stormwater Facility Pollutant Load Adjustments

In addition to land area excluded from the MS4 planning area, the pollutant load baseline is permitted to be further decreased to reflect the runoff pollution treatment provided by the PTC's existing stormwater management facilities in excess of the pollutant reduction required by their respective NPDES permits for construction stormwater discharges.

The PTC's PRP does not quantify/take reduction credit for pollutant removal accomplished by existing facilities to reduce the sediment reduction target. Therefore, the pollutant loads generated by the MapShed model represent the existing load baseline used to generate pollutant reduction targets. It is noted that currently PTC has more than 450 basin and basin-like SCMs widely disbursed across the Turnpike's roadway system that remove sediment and other pollutants from stormwater. The decision to not quantify reductions achieved by the existing SCM facilities is a very conservative approach and means that the proposed PRP project results in pollution reduction significantly exceeding the PTC's MS4 minimum compliance threshold. Consistent with PTCs sustainability goals and in support of permit compliance, PTC also continues to construct water-quality-enhancing SCMs as part of new construction of its bridges, parking, buildings, and roadways.

Table 10, Existing Pollutant Load By Urbanized Area and HUC12 Watershed for Regulated PTC MS4 (page 25) presents the results from MapShed's Urban Area Tool. The results tables generated by the model are provided in **Appendix D.**

E. BMPs TO ACHIEVE THE MINIMUM REQUIRED REDUCTIONS IN POLLUTANT LOADING

The PTC is planning a single BMP project to meet the required sediment reduction target. The project is the Boyce Park project, an 850-LF stream restoration. A second project, a SCM retrofit at the PTC's Greensburg Maintenance facility, is included in the PRP as a contingency project that can optionally be implemented to augment sediment pollution reduction if the Boyce Park stream restoration project results in less than the target sediment reduction requirement of sediment reduction goals. The contingency project is an existing dry detention basin that could be modified to perform as an extended dry detention basin. The projects are summarized in **Table 11**, Proposed Ohio River Drainage Basin BMPs, below.

TABLE 11
PROPOSED OHIO RIVER DRAINAGE BASIN BMPs AND ACHIEVED SEDIMENT REDUCTION

BMP OPTIONS	TREATED AREA	SEDIMENT REDUCTION (LBS/YR)
Boyce Park Stream Restoration	850 LF	97,750*
Contingent Greensburg Maintenance Facility SCM Retrofit (G-006.97-NB-0534-BDD) Retrofit	36.8 Ac.	27,225
* *The sediment reduction total represents the default value based on the MapShed effectiveness factor for stream restoration of 115 lbs/lf/yr. x 850 LF stream restoration*.		

1. Boyce Park Stream Restoration

PTC and PennDOT collaboratively contracted a full-delivery vendor, Land Reclamation Group, LLC (LRG), to locate PA DEP-acceptable pollution reduction projects; obtain required permits and approvals; and construct, operate, and maintain the project(s) perpetually to meet PTC's sediment reduction obligation in the Ohio River Drainage Basin.

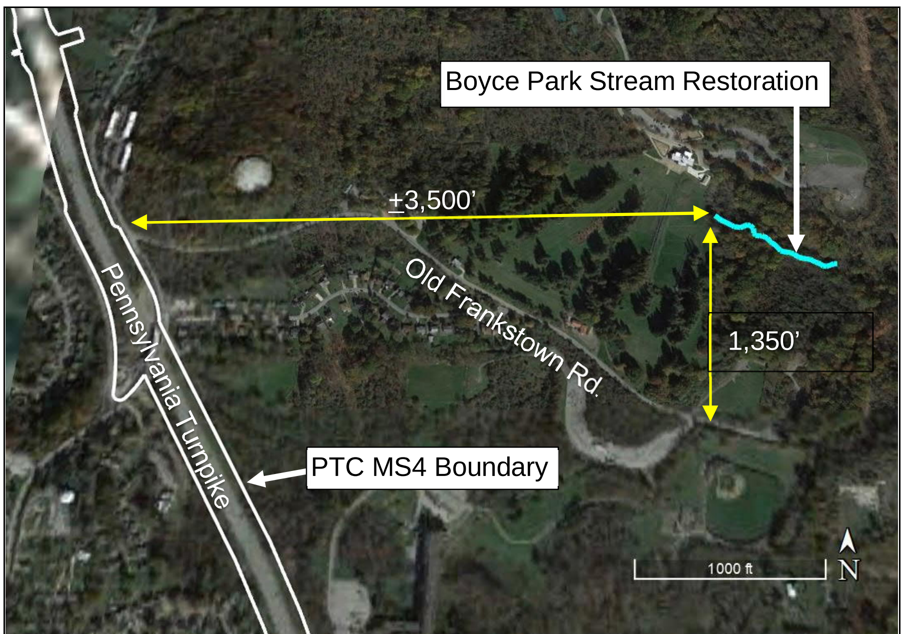


FIGURE 4
BOYCE PARK STREAM RESTORATION LOCATION

LRG identified the Boyce Park project to meet PTC's sediment reduction goal. The BMP is a stream restoration of an 850-foot segment of an unnamed tributary (UNT) to Pierson Run in Boyce Park in Plum Borough Allegheny County, Pennsylvania. The stream lies within property owned by Allegheny County and managed by the Allegheny County Parks Department. The project is approximately 3,500 feet (0.66 miles) east of the PTC MS4-regulated area, and 1,350 (0.25 miles) north of Old Frankstown Road (see **Figure 4**). The project meets PA DEP's site location criteria for stream restoration projects because it is within one mile of the PTC MS4 boundary. The segment of UNT to Pierson Run proposed for restoration is inside and receives drainage from the Pittsburgh UA. The Turnpike is in the Haymakers Run-Turtle Creek watershed, the HUC-12 that includes UNT to Pierson Run. The proposed stream restoration will offset sediment pollution associated with the Turnpike's stormwater runoff.

The reach of UNT to Pierson Run proposed for restoration was first listed as impaired in 2006 and is still listed in *Pennsylvania's* 2022 *Integrated Water Quality Reports* as non-attaining for aquatic life with impairment caused by sediment. This segment's designated use is Trout Stocking (TSF). The stream is eroded and has minimal bank protection. A Bank Assessment for Non-point source Consequences of Sediment (BANCS) model with field assessments to confirm the existing level of stream degradation was performed and backed by photo documentation.

LRG staff reviewed the proposed project to ensure that the eligibility requirements listed in PA DEP's *Considerations of Stream Restoration Projects in Pennsylvania for Eligibility as an MS4 Best Management Practice* (May 11, 2018) will be met. Because the PTC used MapShed to calculate the MS4 loading rates, a default rate of 115 lbs/lf/yr may be applied to the proposed length of restoration to calculate the anticipated sediment reduction generated by the project. **Table 11** on page 29 summarizes the expected sediment pollution reduction for the Boyce Park project and the commitment PTC is providing for MS4 pollutant reduction compliance.

PA DEP's minimum qualifying criteria for using a stream restoration project to fulfil sediment reduction goals are itemized in italics below. Supporting documentation is provided in **Appendix E.**

1. *Siting:*

   - *Permittee must document existing channel or streambank erosion and an actively enlarging or incising urban stream condition prior to restoration (an existing problem).*

     The BANCS method, which uses the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) assessments, was utilized to empirically assess the stream banks and erosion issues within the stream channel. The BEHI and NBS results verify the visual assessment of the existing condition of the stream, confirming that the stream channel is actively eroding. The average BEHI rating was 38.52 (very high erosion potential) and the average NBS score was 5, extreme. The erosion rate was calculated to be 2.53 feet per year. The summary is provided in **Appendix E**.

   - *Effectiveness is most readily demonstrated for projects in 1st-3rd order streams (small). Larger scale projects will require additional documentation.*

     The selected stream segment is a 2^{nd}-order stream.

   - *The project must address at least 100 linear feet of stream channel.*

The project length is approximately 850 feet, which is longer than the 100-foot minimum.

- *Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.*

The proposed restoration will be designed to withstand current conditions, and governmental regulatory requirements will prevent new development from discharging runoff at rates exceeding the currently existing conditions. The contributory area to the project is entirely within Plum Borough, and the stormwater ordinance requirements are summarized in the table below.

TABLE 12
PLUM BOROUGH STORMWATER MANAGEMENT ORDINANCE SUMMARY

MUNICIPALITY	RATE CONTROL	VOLUME CONTROL	APPLIES TO	COMMENT
Plum Borough, Allegheny County	X	X	Earth Disturbance >1 acre	Ordinance 934-18

- *The project must address both sides of the channel on sites where a need to do so is evident.*

BMPs will be implemented on both streambanks to minimize erosion.

2. *Techniques:*

- *The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.*

The design maximizes floodplain reconnection through the regrading and a combination of approaches to either raise the floodplain and channel elevation through valley fill or to lower them to reconnect the stream to the groundwater table (where appropriate). Log grade-control structures crossing the stream channel are proposed to maintain the new elevations. Coir logs will provide extra protection along the toe of the stream banks, and the area disturbed during construction will be heavily planted with native vegetation to permanently stabilize the restoration.

- *Streambank or streambed armoring may be used where necessary to maintain channel stability, but the length of stream that is armored (such as with riprap and gabions) may not be included in the load reduction calculation.*

LRG does not propose to armor streambanks or the streambed; no riprap or gabions are proposed for bank stabilization.

- *Projects should maximize floodplain reconnection, with a minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.*

The maximization of the floodplain will result in bank height ratios of 1.0 or less. The restored bank heights are designed to be very low (6”-12”) to maximize overbank flooding events into the floodplain and slow the velocity of the elevated runoff.

- *A permanent 35-foot minimum riparian buffer.*

A 35-foot riparian buffer will be maintained along the stream within the project limits on both streambanks.

Appendix E contains the *Pollutant Reduction Plan Sawmill Run Municipal Separate Storm Sewer System Projec*t (*PRP Sawmill Run MS4*). The Boyce Park project is one of three projects documented in the *PRP Sawmill Run MS4.* The other two projects serve the Pittsburgh Water and Sewer Authority (“PWSA”) and the Pennsylvania Department of Transportation (“PennDOT”), who engaged LRG through the same contract. The following information is provided in the *PRP Sawmill Run MS4.* Page and appendix citations refer to the *PRP Sawmill Run MS4* document.

- Boyce Park Executive Summary: Section B.1.3 (page 4)
- Boyce Park Average BEHI and NBS Scores for Site Variables: Table 1 (page 7)
- Boyce Park Existing Pollutant Loads: Table 2 (page 8)
- Boyce Park Anticipated Sediment Reductions: Table 3C (page 10)
- Boyce Park Project Maps (Location, Soils, Land Use, BEHI Index, Near Bank Stress, and Urbanized Area): Appendix A Figures (second urbanized area map and third map in other categories)
- Example Site Protection Instrument (SPI): Appendix B
- Boyce Park Stream Restoration Plan: Appendix C (third set of design plans)
- Boyce Park BANCS Evaluation Appendix D (pages D1-174 to D1-211)
- Boyce Park Existing Conditions Photographs (Pictures of UNT to Pierson Run): Appendix D (pages D1-212 to D1-215)
- Boyce Park Anticipated Project Schedule: Appendix E
- Boyce Park Soil Bulk Density Test Results: Appendix F (page F4)
- Boyce Park Sediment Credit Summary: Appendix G (page G-4)
- Boyce Park Sample Monitoring Plan: Appendix H

In addition to the project’s sediment reduction effectiveness, the project was selected for the following reasons:

1. **Prevents Stream Degradation/Restores Stream Health**: The ultimate purpose of the MS4 program is to ensure that surface waters are healthy. UNT to Pierson Run in Boyce Park is non-attaining and already on the integrated 303.D list with impairment caused by sediment. The proposed stream restoration provides meaningful sediment reduction and progress toward reestablishing the stream’s attaining status. Additionally, the practices required by PA DEP to ensure eligibility for pollution reduction credits for stream restoration mandate introducing biodiversity and eco-system sustainability. While it is true that implementation of widely distributed new and

retrofit SCMs will also improve stream health, benefits will be incremental, necessitate many projects, and require a long period of time to realize desired pollutant reductions in comparison to a single stream restoration project. The outcome of stream restoration is that more streams will attain or preserve their designated use more effectively than possible through implementation of other types of projects.

2. **Achievable implementation schedule**: PTC adheres to internal procedures for capital budget planning and a structured bid and procurement process for outsourcing of design, permitting, and construction. PTC has been making accommodations to prioritize expenditures for the capital investment so the allocation for the Boyce Park restoration project is in the current budget. However, typical timing for a single uncontroversial contract from inception through construction is three to six years. The turnaround time is dependent on many factors (e.g., regulatory approvals) outside PTC's control. The variables and number of projects could destroy the schedule if PTC needed to process hundreds of smaller projects to meet its pollutant reduction obligations. While PTC is also proposing a SCM retrofit, having a single, meaningful pollution reduction project that can meet all reduction obligations adds predictability to the schedule.
3. **Effective**: The PTC is sensitive to budget because of its fiduciary responsibility to Turnpike users. It is important that projects perform well and are constructed for the best price, since ultimately it is Turnpike travelers who pay for improvements.
4. **Environmentally Sensitive**: A single construction site minimizes the overall amount of disturbed land and concentrates fewer construction vehicles and equipment at a single area. The simplicity minimizes potential for sediment releases from construction activity and air pollution and automotive fluid discharges from construction vehicles/equipment that multiply when construction takes place at numerous widely distributed construction locations. Additionally, stream restorations are designed to be self-sustaining, and therefore require fewer site visits for maintenance and less use of herbicides, pesticides, etc. over their life cycle. Finally, the habitat created by the restoration itself is environmentally beneficial.
5. **Safety**: Construction activity for a stream restoration project like the Boyce Park restoration project is off the roadway. Generally, Stormwater Control Measures (SCMs) that capture and treat stormwater are located in close proximity to the travel lanes. As previously expressed, in order to be as effective for pollution reduction, many SCMs would be required to be constructed or renovated. Even though jersey barriers direct traffic and

JUSTIFICATION FOR SELECTED POLLUTION REDUCTION PROJECT

- Prevents Stream Degradation/Restores Stream Health
- Achievable implementation schedule
- Effective
- Environmentally Sensitive
- Safety
- Environmental Justice Benefits
- Consistent with PTC Sustainability Plan and Clean Water Initiative
- Diversification of PTC's Stormwater Management Response

provide a protected area for contractors, each construction site would create safety hazards for both the Turnpike travelers and for construction contractors due to the disruptive traffic patterns. The proposed project selection eliminates hundreds of opportunities for traffic accidents because the project is separated from the active roadway.

6. **Consistent with PTC Sustainability Plan and Clean Water Initiative**: The previous bullets exemplify the PTC's mission to incorporate the organization's economic, environmental, and social impact in decision making and to implement sustainable practices throughout the PTC system.
7. **Diversification of PTC's Stormwater Management Response**: The Turnpike already supports an inventory of approximately 430 widely dispersed SCMs that attenuate runoff and pollution from the roadway. These SCMs are engineered structures or devices designed to slow down, hold, infiltrate, and/or treat stormwater runoff before it enters waterbodies and groundwater. Stream restorations add diversity to the PTC stormwater management response.

2. Contingency Project: Greensburg Maintenance Facility SCM Retrofit (SCM ID G-006.97-NB-0534-BDD)

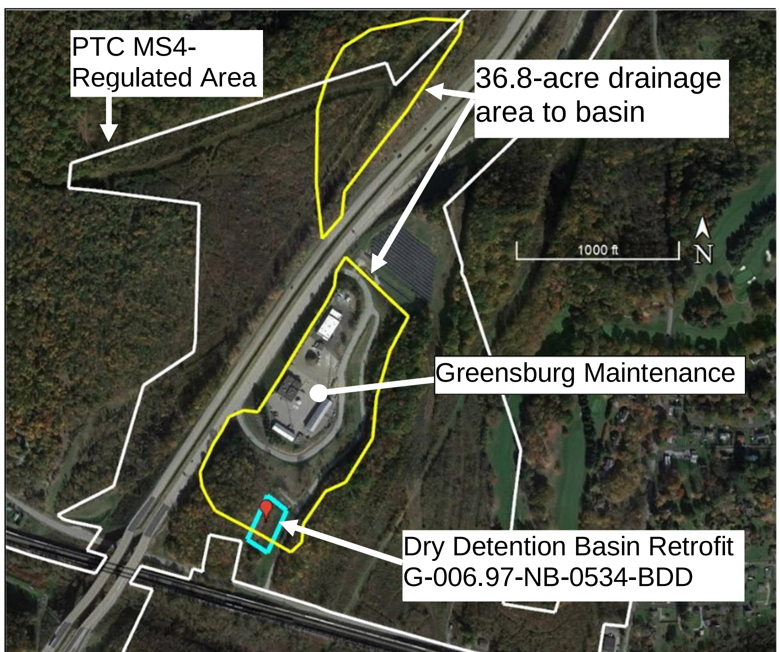


FIGURE 5
GREENSBURG MAINTENANCE SCM RETROFIT LOCATION

The Boyce Park Project achieve the PTC's total sediment reduction goal. However, PTC identified a SCM retrofit of the existing dry detention basin located at the Greensburg Maintenance Facility as a contingency project in case the Boyce Park Project cannot fulfill the entire sediment reduction necessary for permit compliance. The existing basin is located southeast of the Maintenance building, totally within the PTC MS4 regulated area. The SCM is in Hempfield Township, Westmoreland County, Pennsylvania, ±450 feet east of the northbound lane of the Amos K. Hutchinson Bypass (a.k.a., Greensburg Bypass), 200 feet north of Radebaugh Rd., and west of the Maintenance facility's secondary access drive (see **Figure 5**)

The basin at the Greensburg Maintenance facility was originally designed in 1992 and constructed in 1993, predating the NPDES for Construction Stormwater permit. The basin was designed to manage the 25-year storm event, to safely discharge the 100-year event, and it was intended to drain-to-dry in approximately 25 hours following a 100-year storm event. Discharge from the basin is via a multi-stage concrete riser, then through a 30-inch pipe, discharging to an existing channel south of the basin. The riser provides the emergency overflow; there is no other emergency spillway. The original drainage area to the basin was 45.4 acres. The northern part of the original drainage is intercepted and treated by new basins reducing the treated drainage area to 36.8 acres.

Photograph 2 -Existing Stormwater Control Measure G-006.97-NB-0534-BDD: The existing dry detention basin at the Greensburg Maintenance Facility could be retrofitted to add a forebay to increase sediment pollutant removal capabilities

As stated in Section 2. e. Existing Stormwater Facility Pollutant Load Adjustments, PTC did not quantify deductions for any of its existing SCMs, so SCM retrofit quantification includes the entire pollutant reduction achieved by the retrofit project. If required, the dry detention basin could be retrofitted to perform as an extended dry detention basin. Based on the existing sediment loading rate for the Brush Creek (South) watershed (HUC-12 Code: 050200050702), in which the SCM is located, and applying the effectiveness rate values from *PADEP's National Pollutant Discharge Elimination System (NPDES) Stormwater Discharges From Small Municipal Separate Strom Sewer Systems BMP Effectiveness Value* (3800-PM-BCW0100m Rev 6/2018) to the treated drainage area, the retrofit could reduce the annual sediment load by and estimated 27,225 pounds.

3. Alternatives Considered

The PTC considered an abundance of options to accomplish pollution reduction. PTC initially analyzed sediment reduction through modifications of existing stormwater management facilities and capitalizing on landforms within the right-of-way that had spatial and physical characteristics that could be modified to hold runoff, allow sediment to settle, and provide infiltration. A list of criteria used to search and evaluate potential locations for

CRITERIA USED TO SEARCH AND EVALUATE PRP PROJECTS

- Simplicity of ownership
  - 1st PTC-owned properties
  - 2nd Land owned by an adjacent MS4
- Spatial and physical characteristics to support appropriately responsive BMP
- Modifications to existing stormwater management facilities
  - 1st Facilities constructed prior to 2003
  - 2nd Facilities constructed between 2003 and 2010
- Ease of Access
- Simplicity of Permitting
- Project achievable within time frame established by permit

PRP Projects is listed in the above sidebar. A total of 106 opportunity sites were identified. In order to achieve the same volume of sediment reduction accomplished by the selected Boyce Park stream restoration project, PTC identified that 22 projects would be required. The projects included 1 detention basin, 3 dry extended basins, 16 vegetated swales, and 2 stream restorations (480 LF). Some of the projects included treatment trains consisting of multiple SCM types at a single project location. The estimated cost was just under $8 million.

A significant determinative factor in project selection is achievability with the permit's time frame. While individual projects were achievable within the time frame established by the permit, collectively the time to design, permit, and construct the projects exceeded the schedule. (See the section on Impacts to Project Schedule provided below.)

a. Impacts to Project Schedule

There are two significant factors to project schedule: 1) internally required PTC procedures and 2) design/permitting timing. The second item has been previously discussed in this report. While PTC can prioritize design schedules, once the pre-construction permit applications are initiated, schedules are heavily influenced by the regulatory approval process and often include delays beyond PTC's control. As previously stated, the larger the number of projects, the greater the uncertainty for the schedule. The focus of the discussion below provides some of the internal complexities of scheduling within the PTC.

The PTC is a State Commission; its primary purpose is to construct, finance, and maintain the Pennsylvania Turnpike. It is an independent commission, not part of another state agency. It operates under the leadership of a five-member board (four members are appointed by the Governor with $^{2}/_{3}$ Senate approval, and one member is the current Secretary of PennDOT).

The PTC planning process intertwines time frame and costs. The cost of new construction activity is tied to its projected schedule for allocating funds. According to PTC Policy and Procedure [(PTC 502005539(02/01)]:

> "The Ten-Year Capital Plan ("Capital Plan") is the process for identifying both short and long-term needs, establishing priorities and examining long-term financial implications and the overall effectiveness of funding such long-term needs and debt."

The Capital Plan is updated annually, allowing for modification based on new conditions/ information. Projects are generally coordinated by matching their priority and available funds. Typically, a capital project will methodically move from long-term planning (10+ years) to construction.

The PTC outsources design, permitting, and construction services and has a structured bid and procurement process it follows to employ consultants and contractors. PTC staff manages the procurement process. The process ensures project quality as well as compliance with all ancillary regulation pertaining to the Commission's actions as a public governmental body. The integration of these requirements causes all but the most urgent emergency response activities to be completed more slowly than projects managed by local municipal governments or completed by the private-market sector.

Typical timing for a single uncontroversial contract from inception through construction is provided in **Table 13**, below. (Complex projects can require a longer time frame.)

TABLE 13
PTC MS4 TYPICAL BID PROCESS

ID	DESCRIPTION	TIME EXPENDED
Project origination	Project added to Capital Plan	Varies (1 to 10+ years)
Project initiation	Project moved from planning to Request for Proposal (RFP) for Design	12 months
Design and Permitting	Notice to Proceed to shovel-ready bid package	12-24 months
Construction	Bidding through Final Construction	12-36 months
TOTAL		**36 to 72 months (Excluding time on Capital Plan prior to bid process)**

If the Ohio River Drainage Basin PRP proposed 22 projects, some, but not all, could be processed simultaneously. This PRP focuses solely on the Ohio River Drainage Basin. The Turnpike also traverses the Chesapeake Bay Basin and the Delaware River Basin, which are included under the jurisdiction of the same MS4 permit with the same deadlines. The sheer number of projects; the extent of geographic regions involved; the number of projects (including those in the other major drainage basins); and the number of agencies, authorizations, and approvals realistically make use of widely dispersed small-scale pollution-reduction projects unrealistic. The only reasonable solution is to focus on a few large and effective stream restoration projects. The benefits of stream restoration as a solution for sediment pollution are itemized starting on page 32.

F. FUNDING MECHANISM(S)

The PTC contracted LRG as part of an agreement for full-delivery of pollution-reducing projects in collaboration with PennDOT. The contract price includes locating and selecting project(s), securing land and easements or rights required for project implementation, designing the project, obtaining required permits and approvals, justifying project eligibility and pollution reduction credits including pre- and post-construction testing and monitoring, constructing the project, and providing for perpetual operations and maintenance (O&M) of the project. When complete the project will meet PTC's sediment reduction obligation in the Ohio River Drainage Basin.

PTC reserved adequate funds, including a contingency buffer, in its capital budget in anticipation of this obligation. The organization will pay for the project from the Commission's general funds. The contract contains contract payment milestones; when the contractor satisfies that portion of work, PTC will release payment. The structure of the contract provides legal protections for PTC to compel work completion tied both to work quality and adherence to schedule. The PTC is confident in its capability to fund the project.

G. RESPONSIBLE PARTIES FOR OPERATION AND MAINTENANCE OF BMPs

As stated in the previous section, LRG will be responsible for providing ongoing O&M. The following excerpt is taken from the *Sawmill Run Watershed Pollutant Reduction Plan*, Land Reclamation Group, LLC, August 4, 2023.

LRG is responsible for maintenance during the Maintenance and Monitoring (M&M) period associated with Chapter 105 permit conditions, which includes fixing damage to the stream banks due to flood events, invasive species control, and performing inspections after major flood events that have the potential to damage the stream system during the establishment period covered by the permit. Following the M&M period, when the long-term O&M period begins, LRG will act as the initial long-term steward unless responsibility is formally and legally delegated to another qualified, watershed-focused entity to assume long-term stewardship responsibilities. PTC can use legal remedies to enforce these contractual O&M obligations

A copy of the Example Site Protection Instrument (SPI) and Operations and Maintenance are located in **Appendix E** The SPI will be recorded at the county courthouse along with any secondary negotiated easements.

APPENDICES

APPENDIX A –
PUBLIC NOTICE COPY OF PA BULLETIN

From:	Bulletin
To:	McLaughlin, Jeanmarie
Cc:	Noss, Nicholas; Hoffman, Nathan; Kaiser, James
Subject:	RE: PA Turnpike Commission -- Public Notice (Draft PRP Plans - MS4 Permit)
Date:	Tuesday, September 13, 2022 11:19:06 AM

ALERT - This email is from an **External Source**. Be careful opening attachments, clicking links or responding.

Hello Ms. McLaughlin:

Thank you for sending notice PRP Plans – MS4 Permits. As requested, we will publish this in the September 24, 2022 issue of the *Pennsylvania Bulletin.* Take care and have a great day!

Corinne Marut
Editorial Assistant
Legislative Reference Bureau
Pennsylvania Code & Bulletin Office
647 Main Capitol Building
Harrisburg, PA 17120-0033
717-783-1530
cmarut@palrb.us

From: McLaughlin, Jeanmarie <jmclaugh@paturnpike.com>
Sent: Tuesday, September 13, 2022 10:58 AM
To: Bulletin <bulletin@palrb.us>
Cc: Noss, Nicholas <nnoss@paturnpike.com>; Hoffman, Nathan <nhoffman@paturnpike.com>; Kaiser, James <jkaiser@paturnpike.com>
Subject: PA Turnpike Commission -- Public Notice (Draft PRP Plans - MS4 Permit)

Ms. Marut,

Please find attached the Pennsylvania Turnpike Commission's Public Notice for its "Draft National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Pollution Reduction Plans for the Pennsylvania Turnpike Commission" to be published in the September 24, 2022 issue of the Pennsylvania Bulletin. If you have any questions regarding the Notice, please feel free to contact Nick Noss (717-831-7129) or Nate Hoffman (717-831-7119), I have copied them on this email as well. I believe you spoke with them this morning. We greatly appreciate your help and assistance. If you require any additional information, please let us know.

Jeanmarie McLaughlin
Assistant Counsel IV

Pennsylvania Turnpike Commission
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Draft National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Pollution Reduction Plans for the Pennsylvania Turnpike Commission

Notice is hereby given that the Pennsylvania Turnpike Commission will receive public comment(s) on three proposed Pollution Reduction Plans (PRPs) required for their 2021-2026 National Pollutant Discharge Elimination System (NPDES) Individual Permit to discharge stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) Permit No. PAI139602.

The Pennsylvania Turnpike Commission has developed PRPs for the Chesapeake Bay, Delaware River and Ohio River Watersheds. The PRPs determine existing sediment pollutant loadings associated with stormwater runoff and proposes potential Best Management Practices to reduce the pollutant loads to meet the requirements of the MS4 Permit, for each watershed.

The proposed PRPs can be reviewed online by visiting **https://www.paturnpike.com/responsibility-matters/clean-water** then selecting "MS4" at the top of the page and navigating to "MS4 Documentation" under "MS4 Resources".

Written comments on the PRPs will be accepted for a period of 30 days from the date of this public notice by mail to Mr. James Kaiser, Pennsylvania Turnpike Commission,700 South Eisenhower Blvd., Middletown, PA 17057 or by e-mail at jkaiser@paturnpike.com. All comments will be tabulated and considered with the final PRPs.

APPENDIX B –
PTC MS4 OHIO RIVER DRAINAGE BASIN
RECEIVING SURFACE WATERS TABLE

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11001	40.81915952	-80.33838448	Clarks Run	WWF	Yes	25	195	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	50301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11002	40.81898909	-80.33706859	Clarks Run	WWF	Yes	25	195	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11003	40.81878808	-80.33564791	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11004	40.81864507	-80.33514215	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11005	40.81840941	-80.33436523	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11006	40.8183193	-80.33405873	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11007	40.81805578	-80.33349272	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11008	40.81788532	-80.33314944	Clarks Run	WWF	Yes	26	196	Non-Attaining	Erosion from Derelict Land - Siltation	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11009	40.81205554	-80.32473108	Clarks Run	WWF	No	27	196	Non-Attaining	Erosion from Derelict Land - Siltation	Non-Urban	Beaver River-Ohio River	050301040103	05030104000027	N/A	N/A	N/A	N/A	N/A	N/A
11010	40.75368854	-80.21383731	Brush Creek	WWF	Yes	43	197	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	50301050408	05030105000505	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11027	40.73824775	-80.18939085	Brush Creek	WWF	No	46	197	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000509	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11038	40.73425795	-80.1739407	Brush Creek	WWF	No	48	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000510	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11044	40.73395058	-80.16917522	Brush Creek	WWF	Yes	48	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000511	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11046	40.73319896	-80.16782221	Brush Creek	WWF	Yes	48	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000511	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11047	40.73048243	-80.16674902	Brush Creek	WWF	No	49	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000512	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11048	40.72871454	-80.16475705	Brush Creek	WWF	No	49	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000512	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11051	40.72691363	-80.16073924	Brush Creek	WWF	No	50	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000513	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11054	40.7263233	-80.16005485	Brush Creek	WWF	No	50	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000513	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11055	40.72575384	-80.15947405	Brush Creek	WWF	No	50	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000513	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11056	40.72545143	-80.15870718	Brush Creek	WWF	No	50	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000513	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11057	40.72409163	-80.15709041	Brush Creek	WWF	No	50	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000513	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11058	40.72237631	-80.15150507	Brush Creek	WWF	No	51	198	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Brush Creek	050301050408	05030105000514	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11062	40.72171803	-80.1494753	Brush Creek	WWF	Yes	51	198	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11063	40.72149747	-80.14898439	Brush Creek	WWF	Yes	51	198	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11064	40.72091864	-80.14744685	Brush Creek	WWF	Yes	51	198	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11065	40.71862476	-80.14287074	Brush Creek	WWF	No	52	199	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11066	40.71831896	-80.14160451	Brush Creek	WWF	No	52	199	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11067	40.71781486	-80.14033176	Brush Creek	WWF	No	52	199	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000515	N/A	N/A	N/A	N/A	N/A	N/A
11068	40.71705931	-80.13841881	Brush Creek	WWF	No	52	199	Non-Attaining	Agriculture - Nutrients ; Road Runoff - Siltation ; Agriculture - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000516	N/A	N/A	N/A	N/A	N/A	N/A
11077	40.70879894	-80.12673532	Brush Creek	WWF	Yes	54	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11078	40.70870685	-80.12659435	Brush Creek	WWF	Yes	54	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11079	40.70865297	-80.12653451	Brush Creek	WWF	Yes	54	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11080	40.70687841	-80.12467313	Brush Creek	WWF	Yes	55	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11081	40.70564852	-80.12435997	Brush Creek	WWF	Yes	55	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11082	40.70315449	-80.12264408	Brush Creek	WWF	No	55	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11083	40.70027905	-80.12051747	Brush Creek	WWF	No	56	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11084	40.70000441	-80.11933232	Brush Creek	WWF	Yes	56	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11085	40.69907267	-80.11879818	Brush Creek	WWF	Yes	56	199	Non-Attaining	Construction - Siltation ; Agriculture - Cause Unknown ; Urban Runoff/Storm Sewers - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability	Pittsburgh, PA	Brush Creek	050301050408	05030105000518	N/A	N/A	N/A	N/A	N/A	N/A
11095	40.68177402	-80.10809716	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11096	40.68150579	-80.10714024	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11097	40.68020772	-80.10629535	Brush Creek	WWF	Yes	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11098	40.67939031	-80.10623047	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11099	40.67898758	-80.10588489	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11100	40.6787574	-80.10454428	Brush Creek	WWF	Yes	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11101	40.67842673	-80.10435359	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11103	40.6772967	-80.10375027	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11104	40.67626722	-80.10322497	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000522	N/A	N/A	N/A	N/A	N/A	N/A
11105	40.67525482	-80.10271244	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11106	40.67422233	-80.10223173	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11109	40.67303579	-80.10161627	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11110	40.67258701	-80.10137041	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11111	40.67155791	-80.10081175	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11112	40.67080229	-80.10028528	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11113	40.67057591	-80.10023276	Brush Creek	WWF	No	60	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11114	40.66955935	-80.09971976	Brush Creek	WWF	No	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11116	40.66903884	-80.09944777	Brush Creek	WWF	No	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11117	40.66848031	-80.09910218	Brush Creek	WWF	Yes	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11118	40.66749112	-80.0988779	Brush Creek	WWF	Yes	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11119	40.66796988	-80.098873	Brush Creek	WWF	Yes	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000523	N/A	N/A	N/A	N/A	N/A	N/A
11124	40.66523943	-80.09767814	Brush Creek	WWF	No	61	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000524	N/A	N/A	N/A	N/A	N/A	N/A
11133	40.65777411	-80.08981772	Brush Creek	WWF	No	63	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000526	N/A	N/A	N/A	N/A	N/A	N/A
11134	40.65511504	-80.08485058	Brush Creek	WWF	No	<Null>	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000526	N/A	N/A	N/A	N/A	N/A	N/A
11135	40.65424431	-80.07970659	Brush Creek	WWF	No	64	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000527	N/A	N/A	N/A	N/A	N/A	N/A
11136	40.65472133	-80.0746208	Brush Creek	WWF	Yes	64	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000528	N/A	N/A	N/A	N/A	N/A	N/A
11140	40.65374529	-80.06778104	Brush Creek	WWF	Yes	65	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000529	N/A	N/A	N/A	N/A	N/A	N/A
11141	40.65359455	-80.06682888	Brush Creek	WWF	Yes	65	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000529	N/A	N/A	N/A	N/A	N/A	N/A
11128	40.66326974	-80.09681174	Brush Creek	WWF	No	62	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000547	N/A	N/A	N/A	N/A	N/A	N/A
11129	40.66275323	-80.0964859	Brush Creek Stream Culvert	WWF	No	62	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000547	N/A	N/A	N/A	N/A	N/A	N/A
11131	40.66203453	-80.09593972	Brush Creek	WWF	No	62	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000547	N/A	N/A	N/A	N/A	N/A	N/A

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11132	40.66133588	-80.09555207	Brush Creek	WWF	No	62	201	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000547	N/A	N/A	N/A	N/A	N/A	N/A
11102	40.67767787	-80.10395949	Brush Creek	WWF	No	59	200	Non-Attaining	Construction - Siltation ; Urban Runoff/Storm Sewers - Water/Flow Variability ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11107	40.67598584	-80.10212198	UNT to Brush Creek	WWF	Yes	60	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11108	40.67594265	-80.10209614	UNT to Brush Creek	WWF	Yes	60	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11115	40.67681271	-80.09981338	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11120	40.67702308	-80.0991028	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11123	40.67706692	-80.09824052	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11125	40.67740791	-80.09797451	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11126	40.67737171	-80.09787396	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11130	40.67837981	-80.096805	UNT to Brush Creek	WWF	Yes	59	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000553	N/A	N/A	N/A	N/A	N/A	N/A
11087	40.68958026	-80.11228708	UNT to Brush Creek	WWF	No	57	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000554	N/A	N/A	N/A	N/A	N/A	N/A
11088	40.689574	-80.11218299	UNT to Brush Creek	WWF	No	57	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000554	N/A	N/A	N/A	N/A	N/A	N/A
11089	40.68999466	-80.11192305	UNT to Brush Creek	WWF	Yes	57	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000554	N/A	N/A	N/A	N/A	N/A	N/A
11090	40.69006424	-80.11149442	UNT to Brush Creek	WWF	Yes	57	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000554	N/A	N/A	N/A	N/A	N/A	N/A
11091	40.69077827	-80.11121141	UNT to Brush Creek	WWF	No	57	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105000554	N/A	N/A	N/A	N/A	N/A	N/A
11069	40.71725129	-80.13836909	UNT to Brush Creek	WWF	Yes	52	199	Non-Attaining	Agriculture - Nutrients ; Road Runoff - Siltation ; Agriculture - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000559	N/A	N/A	N/A	N/A	N/A	N/A
11070	40.71755636	-80.13788079	UNT to Brush Creek	WWF	Yes	52	199	Non-Attaining	Agriculture - Nutrients ; Road Runoff - Siltation ; Agriculture - Siltation	Pittsburgh, PA	Brush Creek	050301050408	05030105000559	N/A	N/A	N/A	N/A	N/A	N/A
11059	40.72180356	-80.15029373	Brush Creek	WWF	No	51	198	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000562	N/A	N/A	N/A	N/A	N/A	N/A
11015	40.74854273	-80.20711768	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11016	40.74859818	-80.20636041	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11017	40.74853775	-80.20615098	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11019	40.74816564	-80.2052492	Brush Creek	WWF	Yes	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11020	40.74788369	-80.20480961	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11021	40.74747394	-80.20422836	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11022	40.74709544	-80.20361185	Brush Creek	WWF	No	44	197	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Brush Creek	050301050408	05030105000832	Yes	Brush Creek (Butler)	Organic Enrichment/Low D.O. ; DO/BOD	Yes	N/A	No WLA for PTC
11092	40.68771127	-80.11043083	UNT to Brush Creek	WWF	Yes	58	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105005781	N/A	N/A	N/A	N/A	N/A	N/A
11093	40.68786093	-80.11036714	UNT to Brush Creek	WWF	Yes	58	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105005781	N/A	N/A	N/A	N/A	N/A	N/A
11094	40.68795229	-80.10999686	UNT to Brush Creek	WWF	Yes	58	200	Non-Attaining	Road Runoff - Siltation ; Small Residential Runoff - Cause Unknown	Pittsburgh, PA	Brush Creek	050301050408	05030105005781	N/A	N/A	N/A	N/A	N/A	N/A
11150	40.65048787	-80.03837223	UNT to North Fork Pine Creek	CWF	No	68	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11151	40.65017868	-80.03786854	UNT to North Fork Pine Creek	CWF	No	68	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11152	40.64868465	-80.0354962	UNT to North Fork Pine Creek	CWF	Yes	69	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11153	40.64647623	-80.03331001	UNT to North Fork Pine Creek	CWF	No	69	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11154	40.6454771	-80.03168915	UNT to North Fork Pine Creek	CWF	No	69	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11155	40.64526911	-80.03124707	UNT to North Fork Pine Creek	CWF	No	69	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000157	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11156	40.64386572	-80.02941732	North Fork Pine Creek	CWF	Yes	70	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000154	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11157	40.64269823	-80.02932142	North Fork Pine Creek	CWF	Yes	70	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000154	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11158	40.64172651	-80.02896044	North Fork Pine Creek	CWF	No	70	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000154	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11159	40.64317373	-80.01577419	UNT to North Fork Pine Creek	CWF	Yes	71	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000156	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11160	40.64433494	-80.01572967	UNT to North Fork Pine Creek	CWF	Yes	71	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000156	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11161	40.64256029	-80.01527551	UNT to North Fork Pine Creek	CWF	No	71	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000156	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11162	40.64092981	-80.01506812	UNT to North Fork Pine Creek	CWF	No	71	202	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Pine Creek-North Park Lake	050100090201	05010009000156	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11187	40.61200805	-79.94980943	Crouse Run	TSF	No	81	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000130	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11188	40.61032459	-79.94956139	Crouse Run	TSF	No	81	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000130	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11189	40.61030496	-79.94952584	Crouse Run	TSF	No	81	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000130	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11190	40.60932729	-79.9494763	Crouse Run	TSF	No	81	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000130	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11191	40.61070286	-79.9495013	Crouse Run	TSF	No	81	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000130	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11192	40.60681819	-79.94312411	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000131	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11193	40.60691582	-79.94293519	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000131	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11194	40.60755439	-79.94225869	UNT to Crouse Run	TSF	Yes	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000131	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11195	40.60759415	-79.94205573	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000131	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11175	40.61830705	-79.98432549	Montour Run	TSF	No	<Null>	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000137	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11182	40.61408525	-79.98281993	Montour Run	TSF	No	<Null>	203	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000137	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11171	40.63220283	-79.98763258	Montour Run	TSF	Yes	75	203	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11173	40.62971524	-79.98615615	Montour Run	TSF	Yes	75	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11174	40.62930722	-79.98591506	Montour Run	TSF	Yes	75	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11176	40.62348801	-79.98412041	Montour Run	TSF	No	76	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11177	40.62429305	-79.98394771	Montour Run	TSF	Yes	76	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11178	40.625322	-79.9839303	Montour Run	TSF	No	76	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11180	40.62566246	-79.98385359	Montour Run	TSF	No	76	203	Non-Attaining	Road Runoff - Siltation	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000138	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11172	40.63317605	-79.98759169	Montour Run	TSF	Yes	75	203	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000139	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
911172	40.63313695	-79.59148922	Montour Run	TSF	Yes	75	203	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000139	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11169	40.63325277	-79.98944296	UNT to Montour Run	TSF	Yes	75	203	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009000140	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11170	40.6332044	-79.98887743	UNT to Montour Run	TSF	No	75	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000140	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11196	40.6042619	-79.9410508	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11197	40.6035156	-79.93870279	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11198	40.60323832	-79.93807729	UNT to Crouse Run	TSF	No	82	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11199	40.60247728	-79.93636757	UNT to Crouse Run	TSF	No	83	204	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11200	40.60297338	-79.93476898	UNT to Crouse Run	TSF	No	83	205	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11201	40.60296221	-79.93459288	UNT to Crouse Run	TSF	No	83	205	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000812	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11163	40.63938982	-80.00498925	UNT to Montour Run	TSF	No	72	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	50100090202	05010009000957	N/A	N/A	Pathogens	N/A	N/A	N/A
11164	40.63956614	-80.00280032	UNT to Montour Run	TSF	No	73	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000957	N/A	N/A	Pathogens	N/A	N/A	N/A
11165	40.63959246	-80.00257037	UNT to Montour Run	TSF	No	73	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009000957	N/A	N/A	Pathogens	N/A	N/A	N/A
11166	40.63971733	-79.99748958	UNT to Montour Run	TSF	Yes	73	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009001015	N/A	N/A	Pathogens	N/A	N/A	N/A
11167	40.63971027	-79.99684161	UNT to Montour Run	TSF	Yes	73	203	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009001015	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11168	40.6397395	-79.99681275	UNT to Montour Run	TSF	Yes	73	203	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Little Pine Creek-Pine Creek	050100090202	05010009001015	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11179	40.62861487	-79.98398393	UNT to Montour Run	TSF	No	75	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009001023	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11181	40.62845227	-79.98384499	UNT to Montour Run	TSF	No	75	203	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Little Pine Creek-Pine Creek	050100090202	05010009001023	Yes	Pine Creek Watershed	Pathogens	Yes	N/A	No WLA for PTC
11213	40.58855624	-79.87618639	Deer Creek	CWF	No	90	206	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Suspended Solids ; Construction - Turbidity ; Source Unknown - Nutrients ; Habitat Modification - Other Habitat Alterations	Pittsburgh, PA	Deer Creek	050100090303	05010009000097	N/A	N/A	N/A	N/A	N/A	N/A

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11214	40.58788822	-79.8756798	Deer Creek	CWF	No	90	206	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Suspended Solids ; Construction - Turbidity ; Source Unknown - Nutrients ; Habitat Modification - Other Habitat Alterations	Pittsburgh, PA	Deer Creek	050100090303	05010009000097	N/A	N/A	N/A	N/A	N/A	N/A
11215	40.58678449	-79.87462754	Deer Creek	CWF	No	90	206	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Suspended Solids ; Construction - Turbidity ; Source Unknown - Nutrients ; Habitat Modification - Other Habitat Alterations	Pittsburgh, PA	Deer Creek	050100090303	05010009000097	N/A	N/A	N/A	N/A	N/A	N/A
11216	40.5864576	-79.87408995	Deer Creek	CWF	No	90	206	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Suspended Solids ; Construction - Turbidity ; Source Unknown - Nutrients ; Habitat Modification - Other Habitat Alterations	Pittsburgh, PA	Deer Creek	050100090303	05010009000097	N/A	N/A	N/A	N/A	N/A	N/A
11217	40.58633882	-79.87312745	Deer Creek	CWF	No	90	206	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Suspended Solids ; Construction - Turbidity ; Source Unknown - Nutrients ; Habitat Modification - Other Habitat Alterations	Pittsburgh, PA	Deer Creek	050100090303	05010009000097	N/A	N/A	N/A	N/A	N/A	N/A
11218	40.53784088	-79.8424327	Deer Creek	WWF	No	<Null>	<Null>	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Turbidity ; Subsurface Mining - TDS ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - TDS ; Source Unknown - Nutrients	Pittsburgh, PA	Deer Creek	050100090303	05010009000092	N/A	N/A	N/A	N/A	N/A	N/A
11219	40.54630832	-79.83326916	Deer Creek	WWF	No	<Null>	207	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Turbidity ; Subsurface Mining - TDS ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - TDS ; Source Unknown - Nutrients	Non-Urban	Deer Creek	050100090303	05010009000092	N/A	N/A	N/A	N/A	N/A	N/A
11220	40.55085559	-79.83039575	Deer Creek	WWF	Yes	97	207	Non-Attaining	Construction - Siltation ; Construction - Flow Alterations ; Construction - Turbidity ; Subsurface Mining - TDS ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - TDS ; Source Unknown - Nutrients	Non-Urban	Deer Creek	050100090303	05010009000092	N/A	N/A	N/A	N/A	N/A	N/A
11221	40.53514992	-79.82302749	Allegheny River	WWF	No	100	208	Non-Attaining	Source Unknown - PCB	Non-Urban	Chartiers Run-Allegheny River	50100090304	05010009000007	Yes	Allegheny River	PCB ; Chlordane	Yes	N/A	No WLA for PTC
11222	40.53954141	-79.82177614	Allegheny River	WWF	No	99	208	Non-Attaining	Source Unknown - PCB	Non-Urban	Chartiers Run-Allegheny River	050100090304	05010009000007	Yes	Allegheny River	PCB ; Chlordane	Yes	N/A	No WLA for PTC
11223	40.53965632	-79.82092863	Allegheny River	WWF	No	99	208	Non-Attaining	Source Unknown - PCB	Non-Urban	Chartiers Run-Allegheny River	050100090304	05010009000007	Yes	Allegheny River	PCB ; Chlordane	Yes	N/A	No WLA for PTC
11224	40.51735422	-79.81989743	Plum Creek	WWF	No	<Null>	208	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	50100090305	05010009000079	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11225	40.51820633	-79.81697219	Plum Creek	WWF	No	<Null>	208	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000079	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11226	40.51825661	-79.80682766	Plum Creek	WWF	No	103	208	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000079	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11230	40.51145654	-79.79573406	Plum Creek	WWF	No	105	209	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000080	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11231	40.51195677	-79.79405467	Plum Creek	WWF	No	105	209	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000080	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11232	40.50198538	-79.79154109	Plum Creek	WWF	No	<Null>	209	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000081	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11233	40.50717131	-79.79163196	Plum Creek	WWF	No	105	209	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000081	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11236	40.50026525	-79.78855337	Plum Creek	WWF	No	106	209	Non-Attaining	Abandoned Mine Drainage - Metals ; Urban Runoff/Storm Sewers - Other Inorganics (Sulfates, etc.) ; Urban Runoff/Storm Sewers - Oil and Grease	Pittsburgh, PA	Plum Creek	050100090305	05010009000081	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11237	40.49483886	-79.78535527	Plum Creek	WWF	No	107	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000082	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11239	40.49469502	-79.78414165	Plum Creek	WWF	No	107	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000082	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11238	40.49042741	-79.78409006	Plum Creek	WWF	No	108	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000083	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11240	40.48888323	-79.78111991	Plum Creek	WWF	Yes	108	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11241	40.48887736	-79.78093722	Plum Creek	WWF	Yes	108	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11242	40.48886077	-79.7802418	Plum Creek	WWF	Yes	108	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11243	40.48879502	-79.78019717	Plum Creek	WWF	Yes	108	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11244	40.48719918	-79.777469	Plum Creek	WWF	No	109	209	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11245	40.48614325	-79.77407988	Plum Creek	WWF	No	109	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11246	40.48533891	-79.77313292	Plum Creek	WWF	No	109	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11247	40.48482261	-79.77199535	Plum Creek	WWF	No	109	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11248	40.48455142	-79.77112488	Plum Creek	WWF	No	110	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000084	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11249	40.48395663	-79.77032264	Plum Creek	WWF	No	110	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000085	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11250	40.4833573	-79.76971628	Plum Creek	WWF	No	110	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000085	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11251	40.48294409	-79.76867452	Plum Creek	WWF	No	110	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000085	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11252	40.47945849	-79.76491599	Plum Creek	WWF	No	111	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000085	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11256	40.47823136	-79.7631905	Plum Creek	WWF	No	111	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000085	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11253	40.46381654	-79.76388969	UNT to Thompson Run	WWF	No	112	210	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Thompson Run	050200050703	05020005000683	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11254	40.47215541	-79.76393256	UNT to Plum Creek	WWF	No	111	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000589	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11255	40.47330957	-79.76365209	UNT to Plum Creek	WWF	No	111	210	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Plum Creek	050100090305	05010009000589	Yes	Plum Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11257	40.46377937	-79.7618727	UNT to Thompson Run	WWF	Yes	113	210	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Thompson Run	050200050703	05020005000683	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11258	40.46382276	-79.7618537	UNT to Thompson Run	WWF	Yes	113	210	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Thompson Run	050200050703	05020005000683	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11259	40.46405272	-79.7610446	UNT to Thompson Run	WWF	Yes	113	210	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Thompson Run	050200050703	05020005000683	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11260	40.46400029	-79.76101147	UNT to Thompson Run	WWF	Yes	113	210	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Thompson Run	050200050703	05020005000683	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
911260	40.45888898	-79.45387337	UNT to Thompson Run	WWF	No	113	210	Non-Attaining	Channelization - Siltation	Pittsburgh, PA	Thompson Run	050200050703	05020005001822	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	N/A
11261	40.43431771	-79.75956012	UNT to Turtle Creek	WWF	No	<Null>	211	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Sawmill Run-Turtle Creek	50200050704	05020005000672	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11262	40.43829761	-79.75874856	UNT to Turtle Creek	WWF	No	116	211	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Sawmill Run-Turtle Creek	050200050704	05020005000672	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11263	40.43781161	-79.75770546	UNT to Turtle Creek	WWF	No	116	211	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Sawmill Run-Turtle Creek	050200050704	05020005000672	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11305	40.40870258	-79.72486352	Turtle Creek	TSF	No	122	212	Non-Attaining	Small Residential Runoff - Nutrients ; Small Residential Runoff - Siltation ; Abandoned Mine Drainage - Metals ; Removal of Vegetation - Nutrients ; Removal of Vegetation - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000486	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11306	40.40857908	-79.72413762	Turtle Creek	TSF	No	122	212	Non-Attaining	Small Residential Runoff - Nutrients ; Small Residential Runoff - Siltation ; Abandoned Mine Drainage - Metals ; Removal of Vegetation - Nutrients ; Removal of Vegetation - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000486	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11307	40.40833654	-79.72321242	Turtle Creek	TSF	Yes	122	212	Non-Attaining	Small Residential Runoff - Nutrients ; Small Residential Runoff - Siltation ; Abandoned Mine Drainage - Metals ; Removal of Vegetation - Nutrients ; Removal of Vegetation - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000486	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11309	40.40849339	-79.72234562	Turtle Creek	TSF	Yes	122	212	Non-Attaining	Small Residential Runoff - Nutrients ; Small Residential Runoff - Siltation ; Abandoned Mine Drainage - Metals ; Removal of Vegetation - Nutrients ; Removal of Vegetation - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000486	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11301	40.41254806	-79.7276412	Turtle Creek	TSF	Yes	121	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11302	40.41207932	-79.72703473	Turtle Creek	TSF	Yes	121	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11303	40.41187253	-79.72607455	Turtle Creek	TSF	No	121	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11304	40.41157938	-79.72520065	Turtle Creek	TSF	No	121	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11308	40.40986216	-79.72258899	Turtle Creek	TSF	No	122	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11310	40.40920025	-79.72228248	Turtle Creek	TSF	No	122	212	Non-Attaining	Urban Runoff/Storm Sewers - Nutrients ; Urban Runoff/Storm Sewers - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000487	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11350	40.3969299	-79.69375659	Byers Run	TSF	Yes	125	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11354	40.39654967	-79.6930507	Byers Run	TSF	Yes	125	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11357	40.39609884	-79.69229941	Byers Run	TSF	Yes	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11359	40.39550492	-79.6917416	Byers Run	TSF	Yes	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11360	40.39491562	-79.69151918	Byers Run	TSF	No	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11361	40.39433046	-79.69136774	Byers Run	TSF	No	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000619	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11368	40.3922092	-79.68884778	Byers Run	TSF	No	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11376	40.39093877	-79.68764309	Byers Run	TSF	Yes	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11379	40.39106285	-79.68686357	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11380	40.39112062	-79.68682304	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11383	40.39038475	-79.68602693	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11386	40.38996826	-79.68558202	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11389	40.389548	-79.68512524	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11390	40.38913092	-79.68465635	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11393	40.38874478	-79.6841848	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11395	40.38810055	-79.68362109	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11398	40.38788627	-79.68323496	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11403	40.38704808	-79.68228702	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11407	40.38644301	-79.68170542	Byers Run	TSF	Yes	127	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11413	40.38537485	-79.68044873	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11414	40.38498338	-79.67997013	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11418	40.38456746	-79.67950294	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11423	40.38394894	-79.67875959	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11428	40.37042447	-79.67787767	Byers Run	TSF	No	130	214	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11429	40.37201421	-79.67792273	Byers Run	TSF	No	130	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11431	40.37318365	-79.67767978	Byers Run	TSF	No	130	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11432	40.37304769	-79.67765442	Byers Run	TSF	No	130	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11433	40.38327522	-79.67785039	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11434	40.3735387	-79.6775058	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11435	40.37372865	-79.6774077	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11436	40.38293056	-79.67734141	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11437	40.37428976	-79.67662831	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11439	40.37489482	-79.67634229	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11440	40.37553373	-79.6758841	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11441	40.38172686	-79.6758445	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11582	40.32488758	-79.57833464	UNT to Brush Creek	WWF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11374	40.31871157	-79.68584985	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11382	40.31775177	-79.68396225	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11385	40.31768615	-79.68377832	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11391	40.31562328	-79.6821746	UNT to Tinkers Run	TSF	No	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11399	40.31526925	-79.68084627	UNT to Tinkers Run	TSF	Yes	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11405	40.31506934	-79.6797691	UNT to Tinkers Run	TSF	Yes	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11406	40.31522104	-79.67969814	UNT to Tinkers Run	TSF	Yes	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11411	40.31522468	-79.67885918	UNT to Tinkers Run	TSF	Yes	139	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11416	40.31562428	-79.67774549	UNT to Tinkers Run	TSF	No	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11417	40.31567686	-79.67773595	UNT to Tinkers Run	TSF	No	138	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000538	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11362	40.331931	-79.68955195	Brush Creek 101	TSF	Yes	136	215	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000556	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11363	40.33202624	-79.68894469	Brush Creek 102	TSF	Yes	136	215	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000556	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11442	40.38115342	-79.67522868	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11364	40.33090325	-79.68869688	UNT to Brush Creek	TSF	Yes	136	215	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000556	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11443	40.3766662	-79.67508852	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11444	40.37721284	-79.67487761	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11445	40.38028412	-79.67473158	Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11580	40.32456365	-79.5765643	UNT to Brush Creek	TSF	No	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11581	40.32460603	-79.57680451	UNT to Brush Creek	TSF	No	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11446	40.37939403	-79.67461125	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11583	40.32467059	-79.57717027	UNT to Brush Creek	TSF	No	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11447	40.37825133	-79.6745738	Byers Run	TSF	No	129	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000620	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11365	40.39303125	-79.68976787	Byers Run	TSF	No	126	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005000621	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11584	40.32478523	-79.57775694	UNT to Brush Creek	TSF	No	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11585	40.32506239	-79.57877841	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11586	40.32523383	-79.5792774	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11269	40.44123609	-79.74363954	Thompson Run	TSF	No	<Null>	211	Non-Attaining	Channelization - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000664	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11587	40.32554048	-79.58072597	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11588	40.32583539	-79.58199814	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11272	40.44033704	-79.74274051	Thompson Run	TSF	No	<Null>	211	Non-Attaining	Channelization - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000664	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11589	40.32585105	-79.58212578	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11590	40.32587339	-79.58173866	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11591	40.32590781	-79.58200917	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11592	40.32590822	-79.5821046	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11593	40.325911	-79.58292087	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11594	40.32596501	-79.58292763	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000574	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11337	40.33616336	-79.69327105	UNT to Brush Creek	TSF	No	135	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11276	40.43783146	-79.74034184	Thompson Run	TSF	No	<Null>	211	Non-Attaining	Channelization - Siltation	Pittsburgh, PA	Haymakers Run-Turtle Creek	050200050701	05020005000664	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11338	40.34093103	-79.69339606	UNT to Brush Creek	TSF	No	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11339	40.33924169	-79.69333748	UNT to Brush Creek	TSF	No	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11340	40.33746993	-79.69325052	UNT to Brush Creek	TSF	No	135	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11341	40.34029493	-79.69331443	UNT to Brush Creek	TSF	No	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11342	40.33967366	-79.6931894	UNT to Brush Creek	TSF	Yes	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11343	40.34148861	-79.69323906	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11344	40.3384592	-79.69306721	UNT to Brush Creek	TSF	Yes	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11345	40.33878046	-79.6930346	UNT to Brush Creek	TSF	Yes	135	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11346	40.33691499	-79.69297034	UNT to Brush Creek	TSF	No	135	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11347	40.34225952	-79.6927806	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11348	40.34290304	-79.69246814	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11349	40.34346433	-79.69228462	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11351	40.34407927	-79.69207204	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11355	40.34453352	-79.69147853	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11356	40.34509028	-79.69140361	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11358	40.3454786	-79.69068968	UNT to Brush Creek	TSF	No	134	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11367	40.34871746	-79.68773056	UNT to Brush Creek	TSF	Yes	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11369	40.34911568	-79.68733664	UNT to Brush Creek	TSF	Yes	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11370	40.34929502	-79.6872963	UNT to Brush Creek	TSF	Yes	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11371	40.3494312	-79.68727572	UNT to Brush Creek	TSF	Yes	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11372	40.34998647	-79.68723658	UNT to Brush Creek	TSF	No	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11373	40.35109287	-79.68689472	UNT to Brush Creek	TSF	No	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11375	40.35135906	-79.68663535	UNT to Brush Creek	TSF	No	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11377	40.35215214	-79.68626536	UNT to Brush Creek 170	TSF	No	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11378	40.35304002	-79.68588776	UNT to Brush Creek	TSF	No	133	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11381	40.35381172	-79.6853734	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11384	40.35458928	-79.68497729	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11388	40.35541283	-79.68443554	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11392	40.35635249	-79.68329828	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11397	40.35702874	-79.68270158	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11400	40.35692009	-79.68198479	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11401	40.35697939	-79.68192832	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11402	40.35703666	-79.68183312	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11404	40.35718341	-79.68134857	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11408	40.35754015	-79.68077161	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11409	40.35781705	-79.6803118	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11424	40.38317745	-79.67871622	UNT to Byers Run	TSF	No	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005001895	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11427	40.38307985	-79.67852878	UNT to Byers Run	TSF	Yes	128	213	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Non-Urban	Haymakers Run-Turtle Creek	050200050701	05020005001895	Yes	Turtle Creek Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11448	40.30021749	-79.67119231	UNT to Little Sewickley	TSF	Yes	141	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	50200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11449	40.29496797	-79.6709797	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11450	40.29905853	-79.67092173	UNT to Little Sewickley	TSF	No	141	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11451	40.30071757	-79.67087803	UNT to Little Sewickley	TSF	Yes	141	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11452	40.29742507	-79.67073579	UNT to Little Sewickley STREAM CULVERT	TSF	No	141	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11453	40.29623065	-79.67058932	UNT to Little Sewickley	TSF	Yes	141	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11454	40.29515574	-79.67034901	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11455	40.29398185	-79.67010396	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11457	40.29028898	-79.66938491	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11458	40.27066191	-79.66879739	UNT to Little Sewickley	TSF	No	145	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11459	40.29093012	-79.6693648	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11460	40.2892878	-79.66929557	UNT to Little Sewickley	TSF	Yes	142	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11461	40.29195866	-79.66934421	UNT to Little Sewickley	TSF	No	142	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Habitat Modification - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11462	40.28673558	-79.6691063	UNT to Little Sewickley	TSF	Yes	143	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11463	40.27385079	-79.668696	UNT to Little Sewickley	TSF	Yes	145	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11464	40.27218849	-79.66863985	UNT to Little Sewickley	TSF	Yes	145	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11465	40.28462684	-79.66876662	UNT to Little Sewickley	TSF	No	143	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11466	40.28372649	-79.6687098	UNT to Little Sewickley	TSF	Yes	143	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11467	40.2809835	-79.66850036	UNT to Little Sewickley	TSF	Yes	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11468	40.27819327	-79.66840224	UNT to Little Sewickley	TSF	Yes	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11469	40.27935473	-79.66842913	UNT to Little Sewickley	TSF	No	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11470	40.27790941	-79.66832781	UNT to Little Sewickley	TSF	Yes	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11471	40.2769599	-79.66824641	UNT to Little Sewickley	TSF	Yes	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11513	40.21915184	-79.6018689	Sewickley Creek	WWF	Yes	156	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000437	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11514	40.21881636	-79.60101322	Sewickley Creek	WWF	Yes	156	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000437	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11515	40.21835674	-79.59964629	Sewickley Creek	WWF	No	156	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000437	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11516	40.21791266	-79.59876257	Sewickley Creek	WWF	No	156	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000437	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11517	40.21703635	-79.59648734	Sewickley Creek	WWF	Yes	157	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000437	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11518	40.21236829	-79.59350613	Wilson Run	WWF	No	157	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11519	40.21193732	-79.59254411	Wilson Run	WWF	No	157	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11520	40.21188079	-79.58928514	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11521	40.21208796	-79.58370639	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11522	40.21200922	-79.58336545	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11523	40.21186106	-79.58206934	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11524	40.21147088	-79.58183871	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11525	40.21128167	-79.58172496	Wilson Run	WWF	No	158	219	Non-Attaining	Abandoned Mine Drainage - Metals	Non-Urban	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11526	40.21035862	-79.57973873	Wilson Run	WWF	No	159	219	Non-Attaining	Abandoned Mine Drainage - Metals	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11527	40.20963568	-79.57832806	Wilson Run	WWF	No	159	219	Non-Attaining	Abandoned Mine Drainage - Metals	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006000661	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11483	40.23438009	-79.62191353	UNT to Sewickley Creek	WWF	No	153	218	Non-Attaining	Road Runoff - Nutrients	Non-Urban	Lower Sewickley Creek	50200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11484	40.23352473	-79.62115504	UNT to Sewickley Creek	WWF	No	153	218	Non-Attaining	Road Runoff - Nutrients	Non-Urban	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11485	40.23264594	-79.61995454	UNT to Sewickley Creek	WWF	No	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11486	40.23233362	-79.61939166	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11487	40.23197558	-79.61895199	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11488	40.23188791	-79.61876048	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11489	40.23171913	-79.61853824	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11490	40.23159672	-79.61837362	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11491	40.23140899	-79.61810998	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11492	40.23122991	-79.61784545	UNT to Sewickley Creek	WWF	Yes	153	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11493	40.23087761	-79.61752498	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11494	40.23069232	-79.61734306	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11495	40.23008314	-79.61681023	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11496	40.2295896	-79.61584916	UNT to Sewickley Creek	WWF	Yes	154	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11497	40.22948707	-79.61578711	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11535	40.77602732	-80.3581352	WALNUT BOTTOM RUN	WWF	Yes	774	220	Non-Attaining	Urban Runoff/Storm Sewers - Siltation ; Habitat Modification - Water/Flow Variability	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000030	N/A	N/A	N/A	N/A	N/A	N/A
11536	40.77546604	-80.35562976	WALNUT BOTTOM RUN	WWF	Yes	774	220	Non-Attaining	Urban Runoff/Storm Sewers - Siltation ; Habitat Modification - Water/Flow Variability	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000030	N/A	N/A	N/A	N/A	N/A	N/A
11537	40.77515796	-80.3547393	WALNUT BOTTOM RUN	WWF	No	774	220	Non-Attaining	Urban Runoff/Storm Sewers - Siltation ; Habitat Modification - Water/Flow Variability	Pittsburgh, PA	Beaver River-Ohio River	050301040103	05030104000030	N/A	N/A	N/A	N/A	N/A	N/A
11538	40.7656208	-80.36403905	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	50301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11539	40.76547865	-80.36385909	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11540	40.76542991	-80.36380768	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11541	40.76481874	-80.36311926	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11542	40.76480137	-80.36310299	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11543	40.76475829	-80.36304726	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11544	40.76448141	-80.36277583	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11545	40.76383758	-80.36197756	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11546	40.76305979	-80.36097337	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11547	40.76305709	-80.36100444	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11548	40.76303456	-80.36098269	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11549	40.76269969	-80.36060733	Brady	TSF	No	776	220	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Brady Run	050301040102	05030104000018	N/A	N/A	N/A	N/A	N/A	N/A
11498	40.22797626	-79.61535158	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Non-Urban	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11499	40.22657317	-79.61244425	UNT to Sewickley Creek	WWF	No	154	218	Non-Attaining	Road Runoff - Nutrients	Non-Urban	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11552	40.22325255	-79.59270791	Sewickley Creek	WWF	No	777	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Upper Sewickley Creek	050200061104	05020006000438	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11553	40.22644108	-79.58977152	Sewickley Creek	WWF	No	777	219	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - pH	Pittsburgh, PA	Upper Sewickley Creek	050200061104	05020006000438	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11500	40.22591245	-79.6098835	UNT to Sewickley Creek	WWF	No	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11501	40.22550286	-79.60922502	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC

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SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11502	40.22492221	-79.60870442	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11503	40.2246052	-79.60802568	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11504	40.22463699	-79.6079951	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11505	40.22421805	-79.60724372	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11506	40.22377445	-79.60664001	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11507	40.22361563	-79.60626305	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11508	40.22300818	-79.60582982	UNT to Sewickley Creek	WWF	Yes	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11509	40.22241314	-79.60564093	UNT to Sewickley Creek	WWF	No	155	218	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11510	40.22014078	-79.6036822	UNT to Sewickley Creek	WWF	Yes	156	219	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11511	40.21990696	-79.60336152	UNT to Sewickley Creek	WWF	Yes	156	219	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11512	40.21947808	-79.60275877	UNT to Sewickley Creek	WWF	Yes	156	219	Non-Attaining	Road Runoff - Nutrients	Pittsburgh, PA	Lower Sewickley Creek	050200061104	05020006004235	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11472	40.2749343	-79.66813663	UNT to Little Sewickley	TSF	Yes	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11473	40.27417723	-79.66806271	UNT to Little Sewickley	TSF	Yes	145	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11474	40.27602818	-79.66806466	UNT to Little Sewickley	TSF	No	144	216	Non-Attaining	Grazing Related Agric - Siltation ; Road Runoff - Water/Flow Variability	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006000832	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11456	40.28758214	-79.66976744	UNT to Little Sewickley	TSF	Yes	143	216	Non-Attaining	Road Runoff - Water/Flow Variability ; Grazing Related Agric - Siltation	Pittsburgh, PA	Little Sewickley Creek	050200061103	05020006002067	Yes	Sewickley Creek Watershed	Metals ; pH ; TDS	Yes	N/A	No WLA for PTC
11410	40.35798351	-79.68019262	UNT to Brush Creek	TSF	No	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11412	40.35830293	-79.67986762	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11415	40.35906488	-79.67908867	UNT to Brush Creek	TSF	Yes	132	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11419	40.3638813	-79.67853048	UNT to Brush Creek	TSF	Yes	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11420	40.36296011	-79.67849113	UNT to Brush Creek	TSF	Yes	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11421	40.36442045	-79.6784641	UNT to Brush Creek 148	TSF	Yes	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11422	40.36315585	-79.67841075	UNT to Brush Creek	TSF	No	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11425	40.36458797	-79.67814735	UNT to Brush Creek	TSF	Yes	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11426	40.3621838	-79.67806591	UNT to Brush Creek	TSF	Yes	131	214	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005000605	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11605	40.33974244	-79.58025201	UNT to Brush Creek	TSF	No	795	123	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001933	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11595	40.32760463	-79.58034857	UNT to Brush Creek	TSF	Yes	793	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11596	40.32883402	-79.58064953	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11597	40.32941016	-79.58066392	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11598	40.3296985	-79.58066235	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11599	40.3299526	-79.5794836	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11600	40.33195829	-79.58004319	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11601	40.3334589	-79.58018072	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11602	40.33432748	-79.58026611	UNT to Brush Creek	TSF	Yes	794	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11603	40.33461972	-79.58014498	UNT to Brush Creek	TSF	No	795	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11604	40.33502265	-79.58012545	UNT to Brush Creek	TSF	No	795	222	Non-Attaining	Bank Modifications - Siltation ; Golf Courses - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001956	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11366	40.33092583	-79.68754912	UNT to Brush Creek	TSF	No	136	215	Non-Attaining	Agriculture - Siltation ; Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001981	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11387	40.32843404	-79.68374012	UNT to Brush Creek	TSF	No	137	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001981	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11573	40.31260466	-79.59496463	UNT to Brush Creek	TSF	No	790	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001982	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11574	40.31271824	-79.58817701	UNT to Brush Creek	TSF	No	791	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001983	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11575	40.31339324	-79.58993957	UNT to Brush Creek	TSF	Yes	791	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001983	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11576	40.3137378	-79.59081212	UNT to Brush Creek	TSF	Yes	791	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001983	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11577	40.31382028	-79.59190751	UNT to Brush Creek	TSF	Yes	791	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001983	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11578	40.31401596	-79.59241555	UNT to Brush Creek	TSF	Yes	791	222	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001983	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11430	40.3168518	-79.67612312	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005001998	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11438	40.31032266	-79.67474072	UNT to Tinkers Run	TSF	No	139	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005002002	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11394	40.31394859	-79.68187358	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005002004	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC
11396	40.31093926	-79.68138706	UNT to Tinkers Run	TSF	No	<Null>	215	Non-Attaining	Bank Modifications - Siltation	Pittsburgh, PA	Brush Creek	050200050702	05020005002004	Yes	Brush Creek (Westmoreland)_Turtle Creek Watershed	Metals ; pH	Yes (Turtle Cr)	Yes (Brush Cr)	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
11606	40.38789188	-79.57565899	UNT to Beaver Creek	HQ-CWF (HIGH QUALITY-COLD WATER FISHES)	No	<Null>	223	Non-Attaining	Road Runoff - Siltation	Non-Urban	Beaver Run Reservoir-Beaver Run	50100080203	05010008000479	Yes	Kiskiminetas-Conemaugh River Watersheds TMDL	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
11607	40.39398426	-79.57177248	UNT to Beaver Creek	HQ-CWF (HIGH QUALITY-COLD WATER FISHES)	No	804	223	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Beaver Run Reservoir-Beaver Run	050100080203	05010008000479	Yes	Kiskiminetas-Conemaugh River Watersheds TMDL	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
11608	40.39438353	-79.57169772	UNT to Beaver Creek	HQ-CWF (HIGH QUALITY-COLD WATER FISHES)	No	804	223	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Beaver Run Reservoir-Beaver Run	050100080203	05010008000479	Yes	Kiskiminetas-Conemaugh River Watersheds TMDL	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
11609	40.39593171	-79.57048496	UNT to Beaver Creek	HQ-CWF (HIGH QUALITY-COLD WATER FISHES)	Yes	804	223	Non-Attaining	Road Runoff - Siltation	Pittsburgh, PA	Beaver Run Reservoir-Beaver Run	050100080203	05010008000478	Yes	Kiskiminetas-Conemaugh River Watersheds TMDL	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
11618	40.29201852	-79.91533914	Peters Creek	TSF	No	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11619	40.29218963	-79.91140821	UNT to Peters Creek	TSF	No	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11620	40.29218573	-79.91501843	Peters Creek	TSF	No	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11622	40.2924327	-79.91373318	Peters Creek	TSF	Yes	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11623	40.29250638	-79.91303487	Peters Creek	TSF	Yes	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11624	40.2925871	-79.91356205	Peters Creek	TSF	Yes	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11625	40.29524665	-79.90968108	Peters Creek	TSF	No	913	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11626	40.29526202	-79.90967361	Peters Creek	TSF	No	913	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000442	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11617	40.29076461	-79.91720306	Peters Creek	TSF	Yes	912	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000443	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11611	40.27955368	-79.94281865	Peters Creek	TSF	Yes	908	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000444	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11613	40.27911627	-79.93834702	Peters Creek	TSF	Yes	909	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Non-Urban	Piney Fork-Peters Creek	050200050806	05020005000444	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11614	40.2810119	-79.93619151	Peters Creek	TSF	Yes	909	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Non-Urban	Piney Fork-Peters Creek	050200050806	05020005000444	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11610	40.28093141	-79.95232264	Peters Creek	TSF	No	<Null>	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005000445	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11627	40.29659488	-79.91964354	Lewis Run	TSF	No	913	224	Non-Attaining	Source Unknown - Pathogens	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005001573	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11615	40.28472434	-79.92041312	UNT to Peters Creek	TSF	Yes	911	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005002051	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11616	40.28474883	-79.92070676	UNT to Peters Creek	TSF	Yes	911	224	Non-Attaining	Source Unknown - Cause Unknown ; Abandoned Mine Drainage - Metals	Pittsburgh, PA	Piney Fork-Peters Creek	050200050806	05020005002051	Yes	Peters Creek Watershed	Metals	Yes	N/A	No WLA for PTC
11628	40.47658824	-80.25475466	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	50100090202	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11629	40.47869235	-80.25719086	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	050100090202	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11630	40.47917545	-80.25778762	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	050100090202	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11632	40.48209151	-80.26336342	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	050301010304	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11633	40.48336219	-80.26649892	UNT to Montour Run	TSF	Yes	914	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	050100090202	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11638	40.48752572	-80.27289459	UNT to Montour Run	TSF	Yes	<Null>	225	Non-Attaining	Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals	Non-Urban	Montour Run	050100090202	05030101001520	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11634	40.48605586	-80.26375787	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Habitat Modification - Siltation	Pittsburgh, PA	Montour Run	050100090202	05030101003702	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11635	40.48625674	-80.26383146	UNT to Montour Run	TSF	No	914	225	Non-Attaining	Habitat Modification - Siltation	Pittsburgh, PA	Montour Run	050301010304	05030101003702	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11636	40.48901362	-80.2641642	UNT to Montour Run	TSF	Yes	914	225	Non-Attaining	Habitat Modification - Siltation	Pittsburgh, PA	Montour Run	050100090202	05030101003702	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11637	40.48904721	-80.26407335	UNT to Montour Run	TSF	Yes	914	225	Non-Attaining	Habitat Modification - Siltation	Pittsburgh, PA	Montour Run	050301010304	05030101003702	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
11631	40.48148833	-80.25879705	UNT to Montour Run	TSF	Yes	914	225	Non-Attaining	Habitat Modification - Siltation	Pittsburgh, PA	Montour Run	050100090202	05030101003714	Yes	Montour Run Watershed	Metals ; pH	Yes	N/A	No WLA for PTC
12001	39.81405164	-79.77989654	UNT to Georges Creek	WWF	No	<Null>	227	Non-Attaining	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation	Non-Urban	Muddy Run-Georges Creek	050200050203	05020005000949	N/A	N/A	N/A	N/A	N/A	N/A
12007	39.91782826	-79.71987662	Redstone Creek	WWF	Yes	832	228	Non-Attaining	Abandoned Mine Drainage - Metals	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005000756	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12015	39.91863206	-79.72091755	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Abandoned Mine Drainage - Metals	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005000756	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12016	39.92307595	-79.7238926	Redstone Creek	WWF	No	<Null>	228	Non-Attaining	Abandoned Mine Drainage - Metals	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005000756	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
12008	39.91773485	-79.72637346	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12009	39.91778407	-79.7246756	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12010	39.91822416	-79.72429323	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12011	39.9183857	-79.72334337	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12012	39.91845734	-79.72272728	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12013	39.91848558	-79.72211498	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12014	39.91850617	-79.72177279	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002922	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12002	39.91251168	-79.73374005	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002953	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12003	39.91258875	-79.73091929	UNT to Redstone Creek	WWF	No	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002953	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12004	39.91268146	-79.73349029	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Uniontown--Connellsville, PA	Cove Run-Redstone Creek	050200050601	05020005002953	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12005	39.91288014	-79.73501199	UNT to Redstone Creek	WWF	No	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Non-Urban	Cove Run-Redstone Creek	050200050601	05020005002953	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
12006	39.91755619	-79.72797368	UNT to Redstone Creek	WWF	Yes	832	228	Non-Attaining	Road Runoff - Siltation ; Abandoned Mine Drainage - pH ; Abandoned Mine Drainage - Metals ; Small Residential Runoff - Organic Enrichment/Low D.O. ; Urban Runoff/Storm Sewers - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Suspended Solids	Non-Urban	Cove Run-Redstone Creek	050200050601	05020005002953	Yes	Redstone Creek Watershed	Metals ; pH ; Siltation ; Suspended Solids	Yes	N/A	No WLA for PTC
13008	39.99880281	-79.89213892	Dunlap Creek	WWF	No	853	231	Non-Attaining	Source Unknown - Pathogens	Non-Urban	Dunlap Creek	050200050506	05020005000342	N/A	N/A	N/A	N/A	N/A	N/A
13017	40.130021	-79.92305325	Maple Creek	WWF	Yes	880	233	Non-Attaining	Small Residential Runoff - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals ; Road Runoff - Siltation ; Natural Sources - Water/Flow Variability	Monessen--California, PA	Maple Creek-Monongahela River	050200050803	05020005001489	N/A	N/A	N/A	N/A	N/A	N/A

SEWERSHED NUMBER	OUTFALL LATITUDE (Decimal Degrees)	OUTFALL LONGITUDE (Decimal Degrees)	STREAM NAME	DESIGNATED USE (Chapter 93)	WITHIN PTC BOUNDARY	MAP NUMBER (100 Scale)	MAP NUMBER (500 Scale)	NON-ATTAINING STATUS	POLLUTANT NAME (Source-Cause)	URBANIZED AREA (2010)	HUC12 NAME	HUC12 CODE	REACH CODE	Approved TMDL	TMDL NAME	TMDL CAUSE	TMDL SPECIFIC	TMDL GENERAL	WLA
13018	40.13018884	-79.92375486	Maple Creek	WWF	Yes	880	233	Non-Attaining	Small Residential Runoff - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals ; Road Runoff - Siltation ; Natural Sources - Water/Flow Variability	Non-Urban	Maple Creek-Monongahela River	050200050803	05020005001489	N/A	N/A	N/A	N/A	N/A	N/A
13019	40.13033608	-79.92426285	Maple Creek	WWF	Yes	880	233	Non-Attaining	Small Residential Runoff - Organic Enrichment/Low D.O. ; Abandoned Mine Drainage - Metals ; Road Runoff - Siltation ; Natural Sources - Water/Flow Variability	Monessen--California, PA	Maple Creek-Monongahela River	050200050803	05020005001489	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX C –
MS4 MAP LAYERS AND DATA SOURCES

PENNSYLVANIA TURNPIKE COMMISSSION

MS4 Map Layers and Data Sources

LAYER	SOURCE
2010 Urbanized Area	PA DEP (Referenced to US Census Bureau)
Basemap	Microsoft Bing Aerial photography
BMP -Existing	Skelly and Loy, Inc.
Discharge Point	Skelly and Loy, Inc.
Discharge Point Other	Skelly and Loy, Inc.
Elevation Data (contours)	PA DCNR
Flow Arrows	Skelly and Loy, Inc.
Inlets	PTC Record Drawings, Skelly and Loy, Inc.
Inlets - Other	PTC Record Drawings, Skelly and Loy, Inc.
Intake Points	PTC Record Drawings, Skelly and Loy, Inc.
Intake Points-Other	PTC Record Drawings, Skelly and Loy, Inc.
Lakes	Pennsylvania Fish and Boat Commission
Manholes	PTC Record Drawings, Skelly and Loy, Inc.
PTC Boundary	PTC Record Drawings, Skelly and Loy, Inc.
Municipal Boundaries	Penn DOT
NWI (Wetlands)	US Fish and Wildlife Service
Observation Points	Skelly and Loy, Inc.
Outfall - Impaired	PTC Record Drawings, Skelly and Loy, Inc.
Outfall - Unimpaired	PTC Record Drawings, Skelly and Loy, Inc.
Parcels	PTC
Pipes	PTC Record Drawings, Skelly and Loy, Inc.
Pipes-Other	PTC Record Drawings, Skelly and Loy, Inc.
Planning Area	Skelly and Loy, Inc.
Proposed BMPs	Skelly and Loy, Inc.
Proposed Drainage Area	Skelly and Loy, Inc.
Rain Traces	Skelly and Loy, Inc.
Storm Sewershed - Impaired	Skelly and Loy, Inc.
Storm Sewershed - Unimpaired	Skelly and Loy, Inc.
Stream	PA DEP
Stream Impaired	PA DEP
Surface Water Conveyance	PTC Record Drawings, Skelly and Loy, Inc.

1. The projection of information shown on the Maps is NAD 1983 State Plane Pennsylvania South US Feet

APPENDIX D –
MAPSHED URBAN AREA TOOL RESULTS

APPENDIX D1
Planning Area Existing Loads

MapShed Results

BRADY RUN PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	2	52.20	26.10	0.20	0.09	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	12	4213.20	351.10	13.40	1.12	2.50	0.21
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	48.00	9.60	1.30	0.25	0.20	0.03
MD Mixed	2	103.80	51.90	2.80	1.38	0.30	0.15
HD Mixed	5	259.50	51.90	6.90	1.38	0.80	0.15
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		10084.82		5.0		1.4	0.005
Groundwater				94.1		1.5	0.003
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	26	14761.5		123.7		6.7	

Print | Export to JPEG | Exit

MapShed Results

BEAVER RIVER – OHIO RIVER PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	30	642.00	21.40	2.40	0.08	0.30	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	22	6831.00	310.50	23.30	1.06	3.70	0.17
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	15	138.00	9.20	3.60	0.24	0.50	0.03
MD Mixed	22	1115.40	50.70	27.10	1.23	2.90	0.13
HD Mixed	35	1774.50	50.70	43.10	1.23	4.60	0.13
LD Residential	2	18.40	9.20	0.50	0.24	0.10	0.03
MD Residential	2	101.40	50.70	2.50	1.23	0.30	0.13
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		73466.64		36.7		9.6	0.010
Groundwater				263.5		5.4	0.007
Point Sources				0.0		0.0	0.000
Septic Systems				16.2		0.0	0.001
Totals	**128**	**84087.3**		**418.9**		**27.4**	

Print | Export to JPEG | Exit

MapShed Results

BRUSH CREEK (NORTH) PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	15	169.50	11.30	1.10	0.07	0.20	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	27	3734.10	138.30	21.90	0.81	2.40	0.09
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	27	280.80	10.40	7.60	0.28	0.80	0.03
MD Mixed	47	2749.50	58.50	67.20	1.43	7.10	0.15
HD Mixed	86	5031.00	58.50	123.00	1.43	12.90	0.15
LD Residential	2	20.80	10.40	0.60	0.28	0.10	0.03
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						

Source	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)	Source Weighting
Farm Animals		0.0	0.0	0.000
Tile Drainage	0.00	0.0	0.0	0.000
Stream Bank	214836.19	107.4	31.1	0.021
Groundwater		833.3	12.6	0.010
Point Sources		0.0	0.0	0.000
Septic Systems		16.8	0.0	0.001
Totals (Source Area: 204 ac)	226821.9	1178.9	67.2	

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MapShed Results

LITTLE PINE CREEK – PINE CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	2	39.80	19.90	0.20	0.09	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	7	2027.20	289.60	7.80	1.11	1.10	0.16
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	78.40	11.20	2.00	0.29	0.20	0.03
MD Mixed	35	1967.00	56.20	43.10	1.23	4.90	0.14
HD Mixed	49	2753.80	56.20	60.30	1.23	6.90	0.14
LD Residential	2	22.40	11.20	0.60	0.29	0.10	0.03
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		136354.44		68.2		17.0	0.010
Groundwater				238.6		6.2	0.007
Point Sources				0.0		0.0	0.000
Septic Systems				21.0		0.0	0.001
Totals	**102**	**143243.0**		**441.8**		**36.4**	

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MapShed Results

DEER CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	5	1451.00	290.20	5.90	1.18	0.90	0.17
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	2	23.80	11.90	0.60	0.30	0.10	0.03
MD Mixed	5	304.00	60.80	7.70	1.53	0.80	0.16
HD Mixed	10	608.00	60.80	15.30	1.53	1.60	0.16
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		29002.78		14.5		3.9	0.004
Groundwater				131.1		2.5	0.002
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	22	31389.6		175.1		9.8	

Print | Export to JPEG | Exit

MapShed Results

CHARTIERS RUN – ALLEGHENY RIVER PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	2	801.20	400.60	2.80	1.38	0.40	0.22
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	5	408.00	81.60	10.40	2.08	1.10	0.22
HD Mixed	2	163.20	81.60	4.20	2.08	0.40	0.22
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		19585.77		9.8		2.5	0.001
Groundwater				43.1		0.9	0.001
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	9	20958.2		70.3		5.3	

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MapShed Results

PLUM CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	7	2370.20	338.60	6.80	0.97	1.80	0.25
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	5	152.00	30.40	0.60	0.12	0.10	0.02
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	2	1112.00	556.00	3.40	1.70	0.60	0.30
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	74.90	10.70	2.00	0.29	0.20	0.03
MD Mixed	15	906.00	60.40	20.60	1.37	2.30	0.15
HD Mixed	27	1630.80	60.40	37.00	1.37	4.10	0.15
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	2	120.80	60.40	2.70	1.37	0.30	0.15
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		155996.45		78.0		20.2	0.015
Groundwater				218.3		4.7	0.010
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	65	162363.2		369.4		34.3	

Print | Export to JPEG | Exit

MapShed Results

SAWMILL RUN – TURTLE CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	2	408.80	204.40	1.30	0.64	0.30	0.16
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	2	916.20	458.10	2.80	1.41	0.50	0.24
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	2	18.40	9.20	0.50	0.25	0.10	0.03
MD Mixed	12	610.80	50.90	14.30	1.19	1.60	0.13
HD Mixed	15	765.00	51.00	17.90	1.19	2.00	0.13
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		24787.59		12.4		3.1	0.005
Groundwater				56.8		1.4	0.004
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	33	27506.8		106.0		9.0	

Print | Export to JPEG | Exit

MapShed Results

HAYMAKERS RUN – TURTLE CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	2	420.00	210.00	1.50	0.75	0.40	0.19
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	10	240.00	24.00	1.20	0.12	0.20	0.02
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	10	3679.00	367.90	14.20	1.42	2.10	0.21
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	78.00	15.60	2.00	0.40	0.20	0.04
MD Mixed	30	2481.00	82.70	62.70	2.09	6.90	0.23
HD Mixed	37	3063.60	82.80	77.30	2.09	8.50	0.23
LD Residential	2	31.20	15.60	0.80	0.40	0.10	0.04
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		179285.08		89.6		23.6	0.010
Groundwater				398.5		8.1	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				32.9		0.0	0.001
Totals	**96**	**189277.9**		**680.7**		**50.1**	

Print | Export to JPEG | Exit

MapShed Results

BRUSH CREEK (SOUTH) PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	5	780.00	156.00	2.70	0.54	0.70	0.14
Cropland	5	8684.00	1736.80	25.60	5.12	5.50	1.09
Forest	94	1663.80	17.70	7.50	0.08	0.90	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	2	73.20	36.60	1.20	0.59	0.10	0.06
Open Land	30	8211.00	273.70	30.60	1.02	4.80	0.16
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	54	502.20	9.30	12.40	0.23	1.60	0.03
MD Mixed	116	5742.00	49.50	149.60	1.29	16.20	0.14
HD Mixed	133	6583.50	49.50	171.60	1.29	18.60	0.14
LD Residential	2	18.60	9.30	0.50	0.23	0.10	0.03
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		511660.02		255.8		72.4	0.037
Groundwater				1148.6		18.5	0.018
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	**441**	**543918.3**		**1806.1**		**139.4**	

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MapShed Results

LITTLE SEWICKLEY CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	2	371.60	185.80	1.20	0.59	0.30	0.17
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	10	2490.00	249.00	9.70	0.97	1.60	0.16
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	88.20	12.60	2.20	0.32	0.20	0.03
MD Mixed	12	854.40	71.20	24.10	2.01	2.50	0.21
HD Mixed	25	1777.50	71.10	50.00	2.00	5.30	0.21
LD Residential	2	25.20	12.60	0.60	0.32	0.10	0.03
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		49720.94		24.9		7.5	0.019
Groundwater				208.5		2.8	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				12.8		0.0	0.001
Totals	**58**	**55327.8**		**334.0**		**20.3**	

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MapShed Results

LOWER SEWICKLEY CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	2	318.00	159.00	1.10	0.56	0.30	0.16
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	7	1765.40	252.20	7.10	1.02	1.20	0.17
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	10	130.00	13.00	3.40	0.34	0.40	0.04
MD Mixed	17	1218.90	71.70	39.10	2.30	4.10	0.24
HD Mixed	30	2151.00	71.70	69.00	2.30	7.20	0.24
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		73142.04		36.6		11.7	0.013
Groundwater				338.0		4.2	0.003
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	66	78725.3		494.3		29.1	

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MapShed Results

BEAVER RUN RESERVOIR – BEAVER RUN PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	2	45.80	22.90	0.20	0.12	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	5	1826.50	365.30	7.10	1.41	1.20	0.23
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	106.40	15.20	2.80	0.40	0.30	0.04
MD Mixed	7	569.10	81.30	16.80	2.40	1.80	0.25
HD Mixed	15	1219.50	81.30	36.00	2.40	3.80	0.25
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		63733.04		31.9		9.3	0.012
Groundwater				349.0		5.1	0.003
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	**36**	**67500.3**		**443.8**		**21.5**	

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MapShed Results

MONTOUR RUN PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	140.00	70.00	0.30	0.16	0.10	0.05
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	15	4789.50	319.30	15.90	1.06	2.60	0.17
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	46.00	9.20	1.30	0.25	0.20	0.03
MD Mixed	15	826.50	55.10	24.60	1.64	2.60	0.17
HD Mixed	57	3140.70	55.10	93.50	1.64	9.70	0.17
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						

Source	Source Area (ac)	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)	Source Weighting
Farm Animals			0.0	0.0	0.000
Tile Drainage		0.00	0.0	0.0	0.000
Stream Bank		104629.60	52.3	13.2	0.009
Groundwater			152.5	3.7	0.007
Point Sources			0.0	0.0	0.000
Septic Systems			0.0	0.0	0.000
Totals	94	113572.3	340.4	32.1	

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MapShed Results

COVE RUN – REDSTONE CREEK PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	49.50	9.90	1.30	0.26	0.20	0.03
MD Mixed	12	634.80	52.90	13.60	1.13	1.60	0.13
HD Mixed	15	793.50	52.90	17.10	1.14	2.00	0.13
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		52969.20		26.5		7.7	0.004
Groundwater				223.9		3.4	0.002
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	32	54447.0		282.4		14.9	

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MapShed Results

MAPLE CREEK – MONONGAHELA RIVER PLANNING AREA

Select input data file: W:\Projects\2012 Projects and Proposals\R12-0564.015 PTC MS4\MapShed\Ohio -Mapshed Runfiles\Ohio'

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: (87280)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	5	215.00	43.00	0.70	0.13	0.20	0.03
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	2	1635.60	817.80	4.20	2.12	0.90	0.45
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	50.00	10.00	1.30	0.26	0.20	0.03
MD Mixed	2	105.80	52.90	2.70	1.33	0.30	0.14
HD Mixed	10	529.00	52.90	13.30	1.33	1.40	0.14
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		16567.78		8.3		2.2	0.003
Groundwater				69.1		1.3	0.002
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	**24**	**19103.2**		**99.6**		**6.5**	

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APPENDIX D2
Land Use Area Distribution Summary

LAND USE DISTRIBUTION SUMMARY

PTC MS4 PLANNING AREA

(ACRES)

LAND USE		WATERSHED NAME																
MAPSHED NAME	**CAST NAME**	**Brady Run**	**Beaver River-Ohio River**	**Brush Creek (North)**	**Little Pine Creek-Pine Creek**	**Deer Creek**	**Chartiers Run-Allegheny River**	**Plum Creek**	**Haymakers Run-Turtle Creek**	**Sawmill Run-Tutrle Creek**	**Brsuh Creek (South)**	**Little Sewickley Creek**	**Lower Sewickley Creek**	**Beaver Run Resevoir-Beaver Run**	**Montour Run**	**Cove Run-Redstone Creek**	**Maple Creek-Monongahela River**	**Total Ohio River Basin**
Hay/Pasture	Pasture	0	0	0	0	0	0	7	2	2	5	2	2	0	0	0	0	**20**
Cropland	Double Cropped Land	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	**5**
Forest	True Forest	2	30	15	2	0	0	5	10	0	94	0	0	2	0	0	5	**165**
Wetland	Non-tidal Floodplain Wetland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Disturbed	Regulated Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Turfgrass	MS4 Turfgrass	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**
Open Land	Mixed Open	12	22	27	7	5	2	2	10	2	30	10	7	5	15	0	2	**158**
Bare Rock	Non-Regulated Buildings and Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Sandy Areas	Non-Regulated Buildings and Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Unpaved Roads	No Equivalent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Low-Density (LD) Mixed	MS4 Buildings and Other	5	15	27	7	2	0	7	5	2	54	7	10	7	5	5	5	**163**
Medium Density (MD) Mixed	MS4 Buildings and Other	2	22	47	35	5	5	15	30	12	116	12	17	7	15	12	2	**354**
High-Density (HD) Mixed	MS4 Buildings and Other	5	35	86	49	10	2	27	37	15	133	25	30	15	57	15	10	**551**
Low-Density (LD) Residential	MS4 Buildings and Other	0	2	2	2	0	0	0	2	0	2	2	0	0	0	0	0	**12**
Medium Density (MD) Residential	MS4 Buildings and Other	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**4**
High-Density (HD)Residential	MS4 Buildings and Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Water	Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL		**26**	**128**	**204**	**102**	**22**	**9**	**65**	**96**	**33**	**441**	**58**	**66**	**36**	**94**	**32**	**24**	**1436**

APPENDIX E –
SAWMILL RUN WATERSHED
POLLUTANT REDUCTION PLAN,
LAND RECLAMATION GROUP, LLC,
AUGUST 4, 2023

Sawmill Run Watershed Pollutant Reduction Plan

City of Pittsburgh
Allegheny County, Pennsylvania
August 4, 2023

Prepared for:
Commonwealth of Pennsylvania Department of Transportation,
Pittsburgh Water and Sewage Authority
Pennsylvania Turnpike Commission

Prepared By:
Land Reclamation Group, LLC
632 Hunt Valley Circle
New Kensington, PA 15068

Contents

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Graphs

Appendices

Executive Summary

Land Reclamation Group, LLC ("LRG") has prepared a Best Management Practice Design Plan for the Pittsburgh Sewer and Water Authority ("PWSA") and the Pennsylvania Department of Transportation ("PennDOT") in the Sawmill Run Watershed. Additional work is also being done in the Ohio Watershed for the Pennsylvania Turnpike Commission ("PTC"). These projects will reduce the sediment loading to the watersheds, as obligated by their respective MS4 permits. This design plan provides site-specific BMP data to supplement the Pollutant Reduction Plans for Municipal Separate Strom Sewer System (MS4).

The project proposes the use of stream restoration and floodplain restoration to reduce the sediment loading rates at the selected BMP sites at two locations within the Sawmill Run Watershed (12-Digit HUC 050301010301), and one location in the Haymakers Run-Turtle Creek Watershed (12-Digit HUC 050200050701). LRG has investigated several BMP sites to determine the best possible option for the project. This plan includes a summary of the site conditions and data for the selected BMP sites.

The selected sites contain streams that are impaired due to the impacts of stormwater runoff and land use. The selected restoration projects will be designed with sustainability in mind, along with increasing functionality to reduce sediment loads through the process of stabilizing stream banks and reconnecting the streams to the floodplain. Stream restoration will include channel restoration, floodplain grading and grade control structures to restore the channels and reconnect them with the floodplain. Woody debris will be used as the primary material for the grade control in the form of log grade control structures and floodplain features. The reconstructed streams will be designed to have low bank heights and low erosion rates.

This plan, along with the baseline sediment loadings, reductions, and effectiveness calculations were calculated in accordance to the Pennsylvania Department of Environmental Protection ("PA DEP") guidance document 3800-PM-BCW0100K- National Pollutant Discharges Elimination Systems (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Pollutant Reduction Plan (PRP) Instructions and the Credit Determination Protocol 1 of the "*Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects.*"

Results of the investigation show that the restoration of the two selected sites in Sawmill Run and one in Haymakers Run-Turtle Creek will exceed the contracted sediment reduction target of 331,950 lb/yr. These BMPs will also lower the nitrogen and phosphorus loading rates. The calculated reductions for all three sites are provided in Table 3(a, b, c): Anticipated Sediment Reductions at Proposed BMP Sites. These calculations show the relation between the Sawmill Run/Haymakers Run-Turtle Creek Watershed Restoration and the improved water quality of the entire watershed.

Section A – Pollutants of Concern

The proposed BMPs are located within the Sawmill Run and Haymakers Run-Turtle Creek Watersheds. Both watersheds are listed as impaired for siltation and nutrients by the PA DEP. According to the approved PRP instructions, the assumption can be made that meeting the sediment reduction goals for the watersheds will also accomplish nutrient reduction goals.

Section B- Prospective BMP Sites and Eligibility

The selected projects in the Sawmill Run Watershed are all located on property owned by the City of Pittsburgh. One of the sites is owned by two entities, the City of Pittsburgh and the other is the Pittsburgh Public School System. These sites are in public parks and reside within the urbanized area of the City of Pittsburgh. Streams located in these parks have been impacted and are severely eroded by urban stormwater runoff. The proposed PTC site is located on private property located 0.70 miles away from the turnpike in Plum Bourgh. The property is within the one-mile buffer of the Turnpike urbanized area.

The locations of the selected BMPs and data are provided in the appendix. The figures include Figure 1: Location Maps, Figure 2: Soils Map, Figure 3: Land Usage Map, Figure 4: Bank Erosion Hazard Index Ratings Map, and Figure 5: Near-Bank Stress Rating Map. The general approaches to restoration are found in Appendix C: Design Plans and the site-specific loading and reductions are summarized in Sections C and D and in Appendix D: Supporting Calculations.

B.1.1. Moore Park

Moore Park is located on Pioneer Avenue just southwest of the Liberty Tubes. The park is situated between the Pittsburgh South Brook Middle School and Our Lady of Loreto Catholic Parish on the south and the Southcrest Heights Apartments on the north. The property is owned by the City of Pittsburgh and the Public School District of Pittsburgh. LRG is currently in the process of negotiating an agreement with both entities to allow work to be done on the property. The stream is 1,981 LF from the headwaters at the Moore Park Soccer Fields, flowing east towards the west busway terminating in a stormwater basin along the busway. The bank walls reach upwards of 6 feet in some portions of the tributary. Eroded drainage channels are also found along the hillside draining into the stream. LRG is proposing stream and floodplain restoration and the construction of two bioretention/raingarden facilities at the headwater to reduce the sediment load of the stream and increase the stormwater detention volume.

B.1.2 Crane Avenue

The Crane Avenue project is in the Beechview Greenway near the Vanucci Field just south of Brashear High School. The property is owned by the City of Pittsburgh. LRG is in the process of negotiating an agreement with the city to allow work to be done in the park. Roughly 1,722 LF of stream is in the park. The stream begins with spring west of the High School driveway near the top of the hill on the south side of Crane Avenue. Runoff from the High School property is discharged to the unnamed tributary. A second unnamed tributary starting from a spring also enters the stream on the property from the south. Both segments of the stream have signs of severe erosion with minimal to no surface cover. LRG is proposing stream and floodplain restoration project to reduce the sediment load of the stream. Additionally, LRG is proposing to construct a bioretention/raingarden. The rain garden will collect, store, and treat stormwater from the high school property.

B.1.3 Unnamed Tributary to Pierson Run Boyce Park

Pierson Run is in Boyce Park in Plum Borough Allegheny County. The stream lies within property owned by Allegheny County and managed by the Allegheny County Parks Department. LRG is in the process of negotiating an agreement with the Parks Department and the County to authorize the work to be completed on the County's property. The project would entail working on 850 LF of the unnamed tributary of Pierson Run. This portion of stream is eroded with minimal bank protection.

The creek is listed as impaired for siltation, metal, and pH by the Department of Environmental Protection. LRG is proposing stream restoration to reduce the sediment load of the stream. Based on the mapping and field investigations the stream is a second order stream. The proposed work will be a stream restoration project proposing to reestablish the waterway while preserving and adding additional plantings to the riparian areas adjacent to the stream.

B.2 MS4 Eligibility

All of the proposed BMPs meet the criteria for stream restoration projects created in the "*Considerations of Stream Restoration Projects in Pennsylvania for Eligibility as an MS4 Best Management Practice*" document. The required criteria are:

- Documentation of existing and active streambank erosion (Section C, Appendices A and D);
- 100 linear feet minimum of stream channel (Table 2, Appendices A and D);
- Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function;
    - The first step in the design process is an existing conditions watershed assessment which accounts for the drainage area and differences in land cover within and upstream of the project area. In the modeling, steady-state peak flows are determined from the watershed assessment to design for the worst-case scenario 100-year event. By nature, the floodplain restoration designs act in such a way that peak flows are attenuated during storm events relative to the pre-design conditions. Easier access to a wide and hydraulically rough floodplain decreases flow velocity, which in turn increases residence time within the project area. This increased residence time flattens the runoff hydrograph relative to the existing conditions. Model results are also used to design grade and erosion control structures in areas that demonstrate high shear stresses to ensure that the integrity of the channel's form and function is maintained even during strong storm events.
- Addresses both sides of the channel;
- Maximizes floodplain reconnection through the regrading and a combination of approaches to either raise the floodplain and channel elevation through valley fill or to lower them to reconnect the stream to the groundwater table (where appropriate). The restored bank heights are designed to be very low (6"-12") in order to maximize overbank flooding events into the floodplain; and,
- Includes a minimum permanent 35' riparian buffer on all sites.

Section C Determination of Existing Loading for Pollutants of Concern

In order to determine the existing loading of each site, field measurements and data was collected to calculate the erosion rates and sediment loads for each proposed BMP. All data was collected following protocols set in the "*Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*" document.

C.1 Data Collection

For each proposed BMP, the selected streams were walked to determine the eligibility of the site. The streams potential for restoration was determined through an analysis of the land cover, severity of erosion and vegetation cover. Following the BANCs method, Bank Erosion Hazard Index (BEHI) assessments and Near-Bank Stress (NBS) assessments were used to assess the current conditions of the streams. An assessment was taken whenever a change in any of the measures criteria was observed in the stream. A Trimble Geo7 Handheld GPS unit was used to collect points used to determine the length of each of the banks.

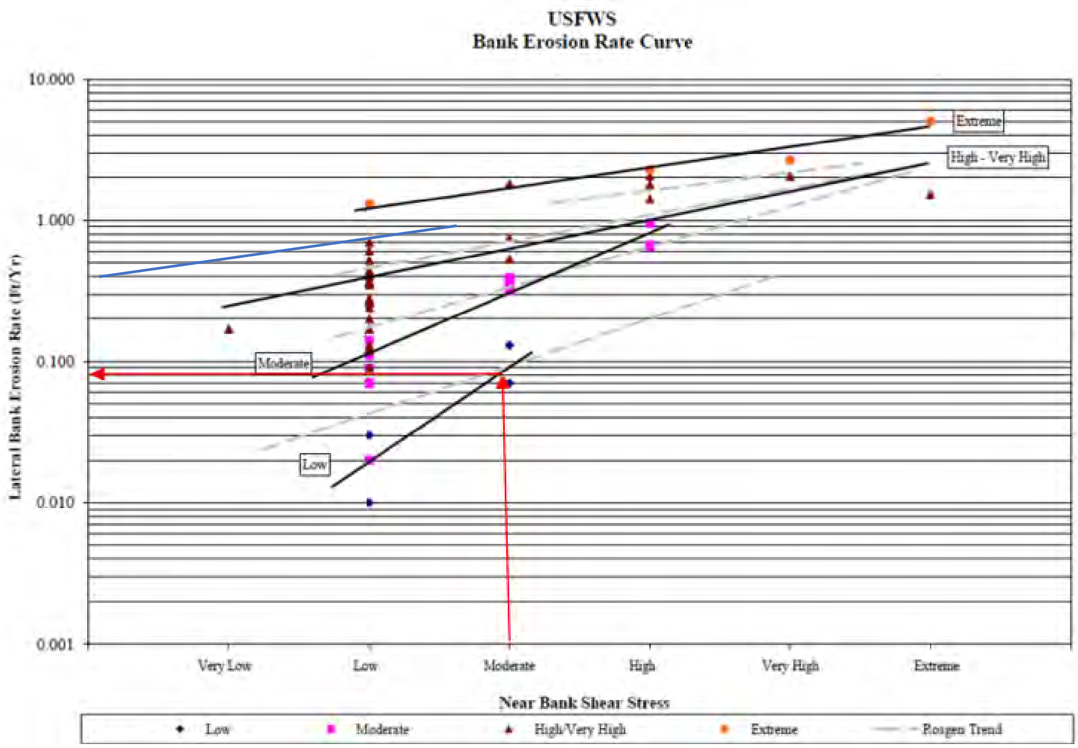
While in the field, soil samples were taken along the bank to test the soil bulk density of each site. Standard core sampling methods were used for each sample. The samples were analyzed by Ackenheil Engineers Inc. Results from the analysis are in Appendix F. Soil Bulk Density Sampling Results and are summarized in Table 2. Baseline Data Summary. An average of the sites bulk density was used for all sediment load calculations. Soil bulk density testing occurred at or near the bank full elevation as determined in the field.

AerdiA was hired to fly each site with a drone to obtain topographic and longitudinal profiles to aid in the design and development of each project.

C.2 Data Analysis

Data collected through field assessments was analyzed using Microsoft Excel and ESRI ArcGIS ArcMap. The BEHI and NBS data collected in the field was put into a spreadsheet created by Stream Mechanics to establish scores for the stream reaches. GPS points were then transferred to ArcMap to calculate the length of the reaches. The results of these calculations were then transferred to another Microsoft Excel Sheet to account for the efficiency factors and Land-River Delivery Factors set by the PADEP in the *“National Pollutant Discharge Elimination System (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Systems Pollutant Reduction Plan (PRP) Instructions”.*

The erosion rates for each bank were calculated using the Rosgen’s Bank and Nonpoint Source Consequences of Sediment (BANCS) Method and the Bank Erosion Curve Created by U.S. Fish and Wildlife Service below.



C.3 Results

Results of the collected field data are summarized in Table 1. The BEHI and NBS scores range from low to extreme with an average rating of high.

Table 1: Average Site Variables			
	BMPs		
	Moore Park	Crane Avenue	Boyce Park
Ave. Bank Height (ft)	2.89	4.81	2.66
Ave. BEHI	38.39	39.51	38.52
Ave. NBS	3.55, Mod-High	3.75, Mod-High	5, Extreme
Ave. Erosion Rate (ft/yr)	1.21	1.23	2.53
Stream Length (ft)	1,981.00	1,722.00	850.00

Using the data collected, the total annual sediment load was calculated for all three sites. The TP and TN loads were calculated using the default concentrations of 1.05 lb TP/ ton TSS and 2.28 lb TN/ton TSS listed in the *"Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects"* document. The land-river sediment delivery factor of 0.181 was used in accordance with the standard set by the PA DEP in the document *"National Pollutant Discharge Elimination System (NPDES) Stormwater Discharges from Small Municipal*

Separate Storm Sewer Systems Pollutant Reduction Plan (PRP) Instructions". The calculated rates indicate that the selected streams are all highly suspect to erosion.

Table 2: Existing Loads				
Variable		**BMP**		
		Moore Park	**Crane Ave**	**Boyce Park**
total annual loads (lb/yr)		1,046,371.17	2,873,544.56	1,560,215.02
Land-River Delivery Factor	**TSS**	0.181		
	TP	0.418		
	TN	0.695		
Bulk Density		89.08	99.25	73.93
Delivered TSS (lb/yr)		189,393.18	520,111.56	282,398.92
Delivered TP (lb/yr)		41.56	114.14	61.97
Delivered TN (lb/yr)		150.06	412.08	223.74

Section D Selected BMPs to Achieve Reductions

In addition to the BANCS method, additional methods of sediment load calculations were tested to find the maximum sediment reductions. The Pittsburgh Sewer and Water Authority and the Pennsylvania Turnpike utilized the modeling software MapShed to calculate the sediment loading for their NPDES permit. This allows them to use a default rate of 115 lb/ft/yr as stated by the Expert Panel Protocols. PennDOT also has an MS4 NPDES permit but used the Simplified Method to calculate their loading rates. Since they did not use MapShed, their default rate of sediment reduction is 44.88 lb/ft/yr. Additional calculations were made to find if more reduction was achieved using the BANCS Method or the default rate.

After the sediment loss was calculated at each site following the BANCS method, efficiency rates of 50%, 75% and 90% were calculated to find the allotted sediment reduction for each BMP. The efficiency rates were chosen with regards to PA DEP guidance that states these rates may be used if there is adequate documentation of a secondary method to validate the BANCS Method assessment, pre-construction monitoring data, a post-construction monitoring plan, and a minimum of one year of post-construction monitoring data.

Three stormwater best management practices are planned. LRG is proposing Bioretention-Raingarden with an underdrain on C/D Soils. This effectiveness value for the BMP permits the applicant to consider crediting for reductions of sediment at 55% of the loading. Two storm water facilities will be constructed at the Moore Park property, and one will be constructed at the Beechview Greenway along Crane Avenue. The facilities will address stormwater flows and assist in sediment reduction.

In the following charts sediment load reductions are provided for the Rain Garden. LRG provided reduction values for each of the partners taking credit in Sawmill Run. PennDOT's calculations required the loads to be evaluated by using the simplified method. The areas were determined and the land loading rates for "all other counties" were utilized to evaluate the loading. The impervious or pervious loading was used following the guidance provided by the PA DEP. The pollutant loading reductions were calculated based upon the BMP Effectiveness values found on PA DEP Document form 3800-PM-BCW0100M.

The loading calculations and reduction for PWSA were evaluated using the MapShed Models. Once again, sediment reductions are based on the BMP Effectiveness Values found on PA DEP form 3800-PM-BCW0100M.

The results of these calculations will be included in the final PRP Tables 3A-C: Anticipated Sediment Reductions at Proposed BMPs.

Table 3A-1: PWSA Anticipated Sediment Reductions at Moore Park		
Variables		**Sediment Amount**
TSS Loading (lb/yr)		189,393.18
Protocol 1: TSS Reduction (lb/yr)	**50% Efficiency**	94,696.59
	75% Efficiency	142,044.89
	115 lb/ft Default	**227,815.00**
Raingarden Sediment Reductions (lb/yr)		470.38
Total Annual Reduction (lb/yr)	**50% efficiency**	95,166.97
	75% Efficiency	142,515.27
	115 lb/ft Default	**228,285.38***

* Default Rate of 115lbs/ft was greater than the BANCS Methods at 50%, 75% and 90% efficiency rates

Table 3A-2: PennDOT Anticipated Sediment Reductions at Moore Park		
Variables		**Sediment Amount**
TSS Loading (lb/yr)		189,393.18
Protocol 1: TSS Reduction (lb/yr)	**50% Efficiency**	**94,696.59**
	75% Efficiency	142,044.89
Raingarden Sediment Reductions (lb/yr)		1,427.82
Total Annual Reduction (lb/yr)	**50% efficiency**	**96,124.41**
	75% Efficiency	143,472.70

Table 3B-1: PWSA Anticipated Sediment Reductions at Crane Avenue		
Variables		**Sediment Amount**
TSS Loading (lb/yr)		520,111.56
Protocol 1: TSS Reduction (lb/yr)	**50% Efficiency**	**260,055.78**
	75% Efficiency	390,083.67
	115 lb/ft Default	198,030.00
Raingarden Sediment Reductions (lb/yr)		187.81
Total Annual Reduction (lb/yr)	**50% efficiency**	**260,243.59**
	75% Efficiency	390,271.48
	115 lb/ft Default	198,217.81

Table 3B-2: PennDOT Anticipated Sediment Reductions at Crane Avenue		
Variables		**Sediment Amount**
TSS Loading (lb/yr)		520,111.56
Protocol 1: TSS Reduction (lb/yr)	**50% Efficiency**	**260,055.78**
	75% Efficiency	390,083.67
Raingarden Sediment Reductions (lb/yr)		1,559.11
Total Annual Reduction (lb/yr)	**50% efficiency**	**261,614.89**
	75% Efficiency	391,642.78

Table 3C: PTC Anticipated Sediment Reductions at Boyce Park		
Total Annual Reduction (lb/yr)	**115 lb/ft Default**	**97,750.00**

The efficiency percentages were chosen based on the DEP guidance document *PRP/TMDL Plan*. Under section D. BMP Effectiveness of the PRP/TMDL Plan, the guidance states that "*sediment reduction from streambank restoration projects when existing loads are calculated using modeling at a local scale may be estimated using the Protocols outlined in Section 5 of the report and must then apply the 50% efficiency uncertainty factor*".

At 50% effectiveness the following reductions will be achieved:

PennDOT (2 sites: Moore/Crane) = **357,739.30** lbs/yr (*331,950.00 required*) *
PWSA (2 sites: Moore/Crane) = **488,999.35** lbs/yr*
*Includes additional sediment reductions from the stormwater BMPs below

The statement of work also states that "*If post-construction monitoring is conducted for at least one year after project completion and it can be shown that a higher efficiency is justified, the permittee may request a re-evaluation of the project efficiency (up to 90%). An efficiency higher than 75% will not be considered by DEP until at least one year after the project has been implemented.*" Based on this, there is a potential that the following reduction numbers may be achieved:

PennDOT = 535,115.49 lbs/yr (75%)* up to 641,541.20 lbs/yr (90%)*
PWSA = 619,027.24 lbs/yr (75%)* up to 697,043.98 lbs/yr (90%)*
*Includes additional sediment reductions from the stormwater BMPs below

These goals will require additional coordination with the DEP to determine the extent of monitoring requirements and the cost effectiveness of obtaining these higher reductions. The 50% reduction will be sufficient to achieve the required reductions at this time.

A summary sheet, for each entity, of the proposed BMPs and the calculations showing how the sediment reduction amount was determined is found in Appendix G: Summary Credit Sheets.

Stormwater BMPs

Volume/rate BMPs are also being proposed at both sites on the unnamed tributaries to Sawmill Run. The bioretention/raingardens with an underdrain at the headwaters of the stream in Moore Park and Crane Avenue begin a treatment train of best management practices to treat stormflow and reduce storm surge in the Sawmill Run Watershed. LRG has included the storm water facilities as a holistic approach of stormwater management. Additionally, PWSA is addressing stormwater management to the community on a watershed wide campaign to address storm surge and runoff in the Sawmill Run Watershed. The preliminary calculations are below.

The capacity required to reduce the ten (10) year twenty-four (24) hour storm event down to the two (2) year twenty-four (24) hour storm event will occur on the reconstructed floodplain. The floodplain restoration that will be completed in conjunction with the stream restoration and bioretention/raingarden are designed to accommodate the additional capacity necessary. The following table summarizes the stormwater volume management:

<table>
<tr><th colspan="4">Table 4: Anticipated Stormwater Reductions at Moore Park</th></tr>
<tr><th colspan="2" rowspan="2"></th><th rowspan="2">Flow Rate and Volume</th><th></th></tr>
<tr><th>25-yr Flow Rate Reduction (CFS)*</th></tr>
<tr><td rowspan="3">Pre-construction Flow Rate (CFS)</td><td>1-yr</td><td>48.12</td><td rowspan="3">-18</td></tr>
<tr><td>10-yr</td><td>86.09</td></tr>
<tr><td>25-yr</td><td>102.13</td></tr>
<tr><td>Pre-construction Watershed Volume (CF)</td><td>10-yr</td><td>73,528</td><td></td></tr>
<tr><td rowspan="3">Post-construction Flow Rate (CFS)</td><td>1-yr</td><td>39.61</td><td>10-yr Volume Management (CF)</td></tr>
<tr><td>10-yr</td><td>71.03</td><td rowspan="2">92,108</td></tr>
<tr><td>25-yr</td><td>84.13</td></tr>
<tr><td>Post-construction Volume-Floodplain Storage (CF)</td><td>10-yr</td><td>92,108</td><td></td></tr>
</table>

<table>
<tr><th colspan="8">Table 5: Anticipated Stormwater Rain Garden Reductions</th></tr>
<tr><th colspan="2" rowspan="2"></th><th rowspan="2">Crane Avenue</th><th rowspan="2">Moore Park 1</th><th rowspan="2">Moore Park 2</th><th colspan="3">10-yr Flow Rate Reduction (CFS)*</th></tr>
<tr><th>Crane</th><th>Moore Park 1</th><th>Moore Park 2</th></tr>
<tr><td rowspan="2">Pre-construction Flow Rate (CFS)</td><td>10-yr</td><td>43.29</td><td>5.31</td><td>5.32</td><td rowspan="2">5.24</td><td rowspan="2">2.39</td><td rowspan="2">1.99</td></tr>
<tr><td>100-yr</td><td>72.96</td><td>10.2</td><td>11.57</td></tr>
<tr><td rowspan="2">Post-construction Flow Rate (CFS)</td><td>10-yr</td><td>38.05</td><td>2.92</td><td>3.33</td><td colspan="3" rowspan="2"></td></tr>
<tr><td>100-yr</td><td>72.45</td><td>9.02</td><td>11.42</td></tr>
</table>

Refer to Appendix C for designs of the Moore Park and Crane Avenue Raingarden.

Hydraulic analysis was evaluated for the baseflow, 2-, 10-, and 25-year events. The PADEP spread sheet for volume calculation was utilized to evaluate the estimated runoff from the site. The form provided a volume for each of the events. The flood plain was designed to store events up to and exceeding the 10-year storm event. Refer Appendix D2 for the estimated calculations.

Volume Reduction Calculations: Floodplain restoration will achieve increased flood storage through the reestablishment of floodplain as a stormwater BMP. The volume of soil removed as part of the floodplain restoration will be available for storage of flood flows and is capable of conveying flood flows at lower elevations, thus reducing water surface elevations and flooding.

Peak Rate Mitigation Calculations: Peak rate is primarily controlled through the infiltration of runoff and additional storage from runoff and receiving waters in the floodplain. The shallow depth and high floodplain roughness will increase the travel time, reducing downstream peak rates.

Section E Operations and Maintenance

E.1 Site Protection

LRG's property acquisition approach will be to work with prospective landowners (public or private) to establish a site protection instrument. The instrument can be in the form of a conservation easement, deed restrictions, or resources management plan. The instrument will identify and preserve the BMPs; identifying the entity responsible for the long-term operation and maintenance of the BMP; and granting reasonable access for inspection to EPA, PennDOT, PWSA, PADEP, PTC, CCD, and other potential Municipal Partners. The instrument will also identify the entity responsible for long-term maintenance of the BMPs.

The instrument will be recorded at the county courthouse to protect the project site as required. As part of this process, LRG performs due diligence on the property, acquires title insurance, and addresses concerns with the title, such as pre-existing easements, or liens. Any required secondary easements are also negotiated currently regarding access and construction concerns.

The instrument will be executed after all permits and approvals for the project are received, but prior to the start of any restoration activities at the site. The instrument will restrict activities that conflict with the scope and objectives of the project. An example of an instrument is included in Appendix B: Site Protection Instrument. Any final instruments will be subject to review and approval by all parties prior to finalization.

E.2 Maintenance and Monitoring

Following construction and acceptance of the BMPs by the partners, LRG will begin the required five-year maintenance and monitoring (M&M) period. LRG will inspect the BMPs annually to perform monitoring and maintenance to ensure the viability of the project through the M&M period. The need to perform maintenance will be assessed during the visit, and if deemed necessary, appropriate action will be taken to repair any deficient BMPs in part, or whole. Maintenance will include the control of invasive species to promote the success of riparian planting areas. LRG will also perform inspections after major flooding events that have the potential to cause damage to the BMPs.

During the five-year monitoring period, LRG will prepare reports to submit to PennDOT, the PTC, and PWSA by December 31 of each year. At minimum, these reports will include:

- Visual observations of the BMPs, including things such as stream bank and channel stability
- Description of the general conditions of the restoration and stormwater BMPs
- Photos taken at ground level, drone aerials, and at fixed monitoring locations
- Assessments of vegetative cover for floodplain restoration BMPs
- BEHI and NBS assessments for stream channel restoration BMPs
- Hydrologic data from stream and floodplain restoration BMPs
- Discussion of maintenance and monitoring activities
- Proposed additional maintenance schedule for following year, if applicable

The anticipated schedule for implementation of the BMPs design plan is included as Appendix E.

E.3 Long Term Operation and Maintenance

Long term operation and maintenance (O&M) will commence once the five-year monitoring is completed. LRG will act as the long-term steward initially until responsibilities can be turned over to another qualified entity. LRG will prepare an Operation and Maintenance Plan that identifies types of maintenance activities, maintenance frequencies, personnel, and equipment requirements, and estimated annual maintenance costs to provide long term O&M of the BMPs. The plan will include provisions that LRG will obtain, and record fully executed instruments in the chain of title for the BMPs that make these obligations legally binding and enforceable by PennDOT, PWSA and PADEP. If the entity is a municipality, then LRG will obtain a fully executed and binding agreement with an appropriate resolution from the municipal entity. This agreement between LRG and the municipality will be enforceable by PennDOT, PADEP, PWSA, and or other potential Municipal Partners.

E.4 Financial Assurances

LRG will maintain a performance bond, a maintenance bond, and/or insurance to protect the BMPs during the construction and five-year M&M periods. Long-term management assurances shall be funded through an endowment and provided to the long-term steward. The long-term management assurances endowment will be fully funded no later than before the five-year M&M period is complete. The amount of the long-term management endowment principle will be calculated utilizing The Nature Conservancy Long-Term Stewardship Calculator. The endowment amount will be based on anticipated long-term management activities broken into component elements.

Section F Summary and Conclusion

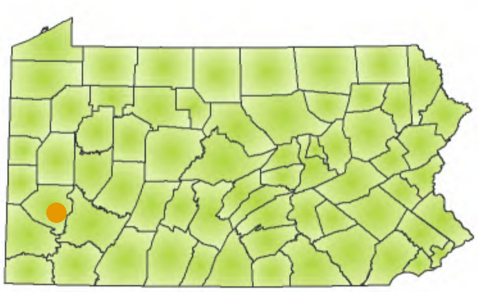
According to the calculation results, the three proposed BMPs efficiency will result in 357,739.30 lbs/yr (50%) reduction for PennDOT, this exceeds the reduction goal of 331,950 lbs/yr. Additionally, reductions of 488,999.35 lbs/yr (50%) for PWSA, and 97,750.00 lbs/yr default rate for the PTC will be recognized. Following PA DEP recommendations, an assumed efficiency value of 50% was applied to the loading rates. Higher efficiency may be applied to the calculations after post-restoration conditions are assessed and validated.

Appendix A: Figures

Figure 1 Location Maps

Figure 1
Project Location

Moore Park Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania



Project Location

N

0 750 1,500 3,000 Feet

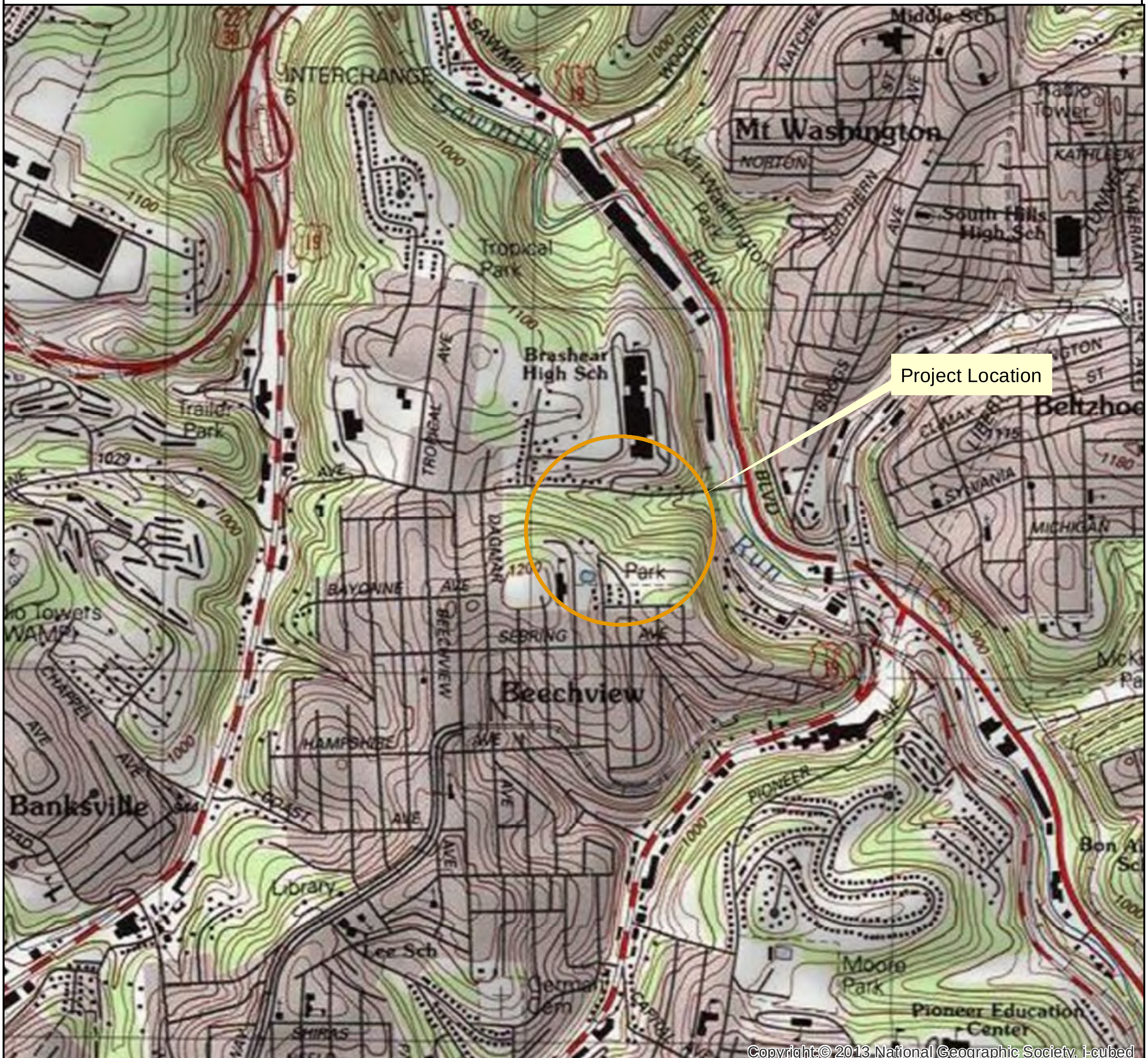
Scale: 1:24,000

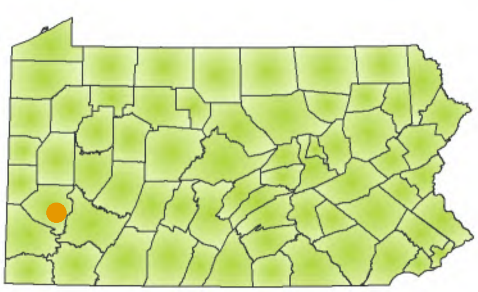
Map Source: USGS Quadrangle

Created by:
Hunt Valley Environmental, LLC

Figure 1
Project Location

Crane Avenue Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania





Project Location

N

0 650 1,300 2,600 Feet

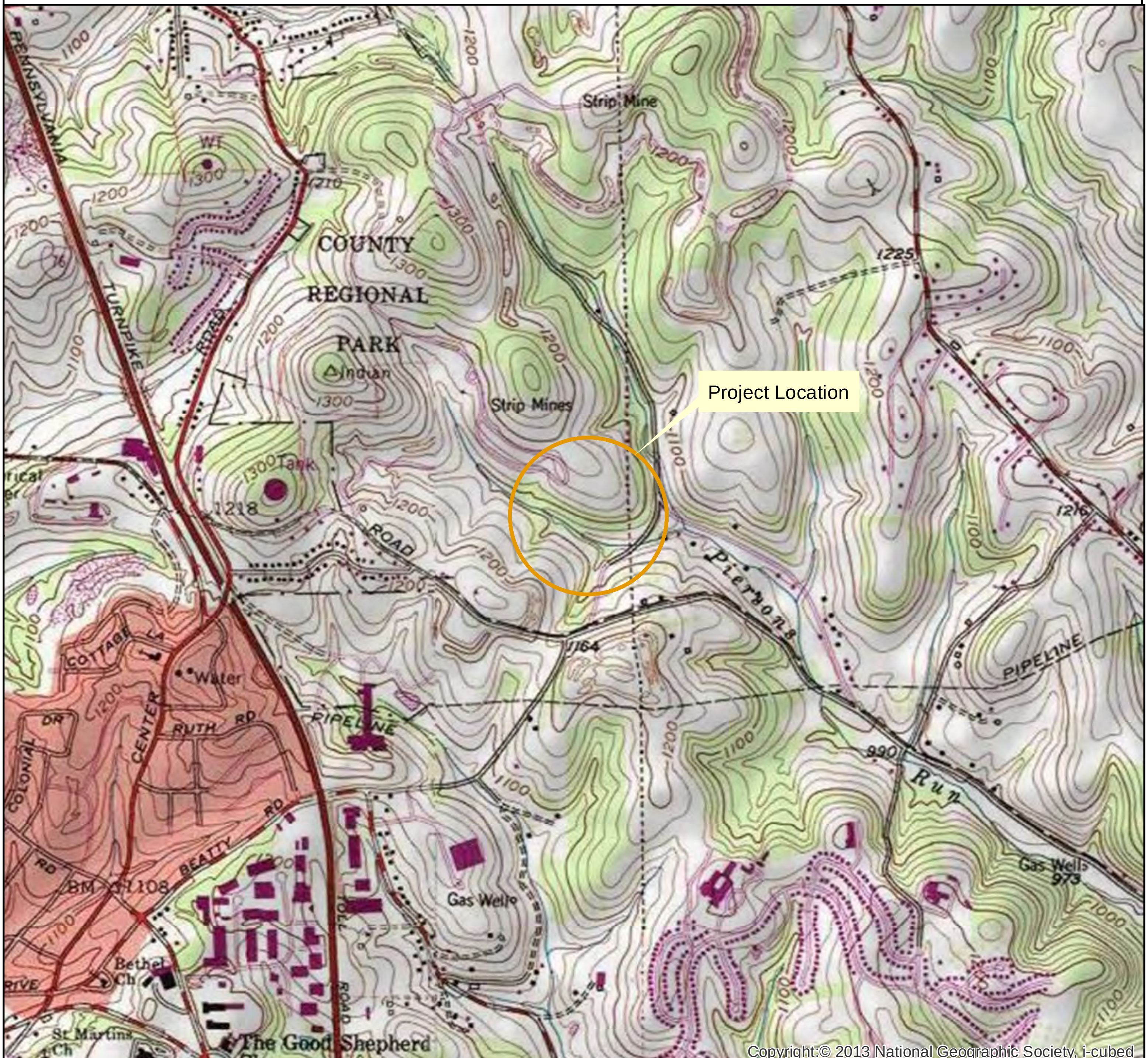
Scale: 1:24,000

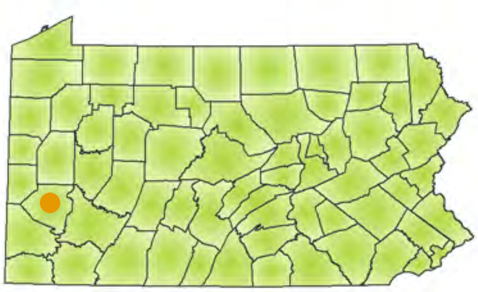
Map Source: USGS Quadrangle

Created by:
Hunt Valley Environmental, LLC

Figure 1
Project Location

Boyce Park Stream Restoration Project,
Plum Borough Allegheny County, Pennsylvania





Project Location

N

0 750 1,500 3,000 Feet

Scale: 1:24,000

Map Source: USGS Quadrangle

Created by:
Hunt Valley Environmental, LLC

Figure 2 Soil Maps

Figure 2
Soils Map

Moore Park Stream RestorationSite
City of Pittsburgh, Allegheny County, Pennsylvania

N

0 220 440 880 Feet

Project Location

Map Source: NRCS Soil Survey
Allegheny County

Created by:
Hunt Valley Environmental, LLC

Figure 2
Soils Map

Crane Avenue Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania

N

0 215 430 860 Feet

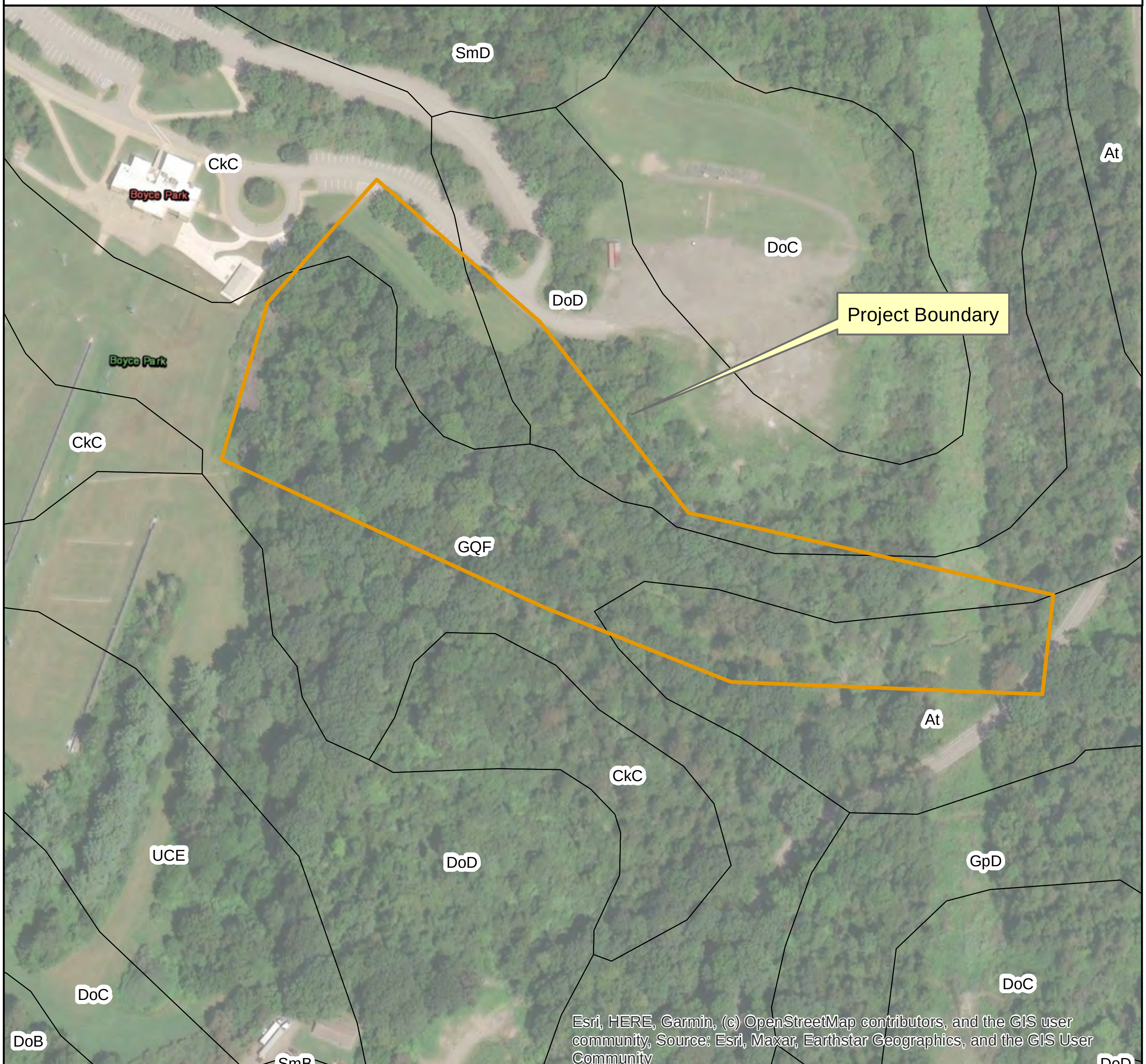
Project Location

Map Source: NRCS Soil Survey
Allegheny County

Created by:
Hunt Valley Environmental, LLC

Figure 2
Soils Map

Boyce Park Stream Restoration Site
Plum Borough, Allegheny County, Pennsylvania



N

0 120 240 480
Feet

Project Location

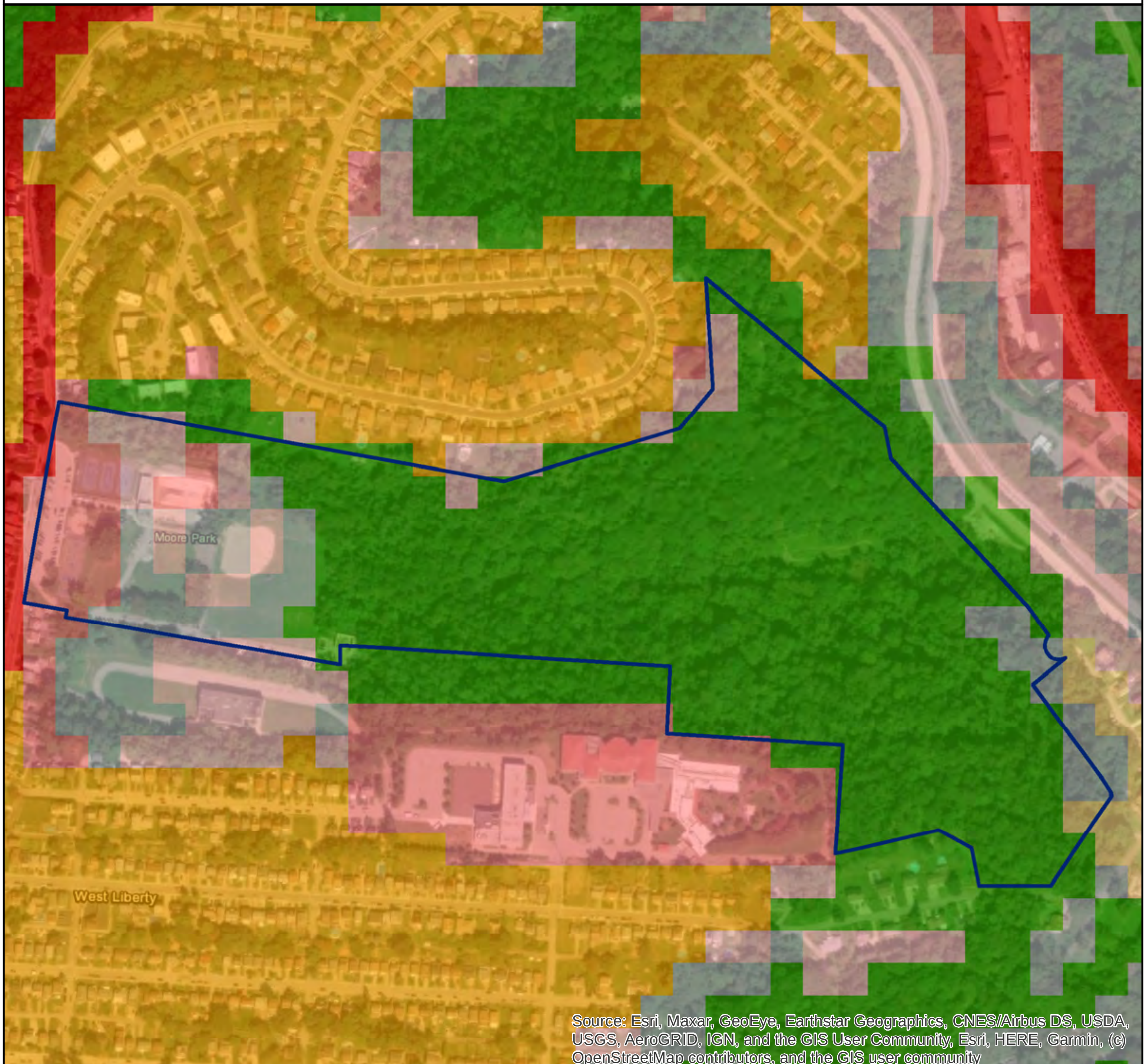
Map Source: NRCS Soil Survey
Allegheny County

Created by:
Hunt Valley Environmental, LLC

Figure 3 Land Use Maps

Figure 3
Land Use Map

Moore Park Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania



Legend

- Water
- Low Density Mixed
- High Density Mixed
- Hay/Pasture
- Cropland
- Conif Forest
- Mixed Forest
- Decid Forest
- Wooded Wetland
- Emergent Wetland
- Disturbed
- Turf Grass/Golf courses
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Medium Density Mixed
- Open Land
- Property Boundary

N

0 0.025 0.05 0.1 0.15 0.2 Miles

Figure 3
Land Use Map

Crane Avenue Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania

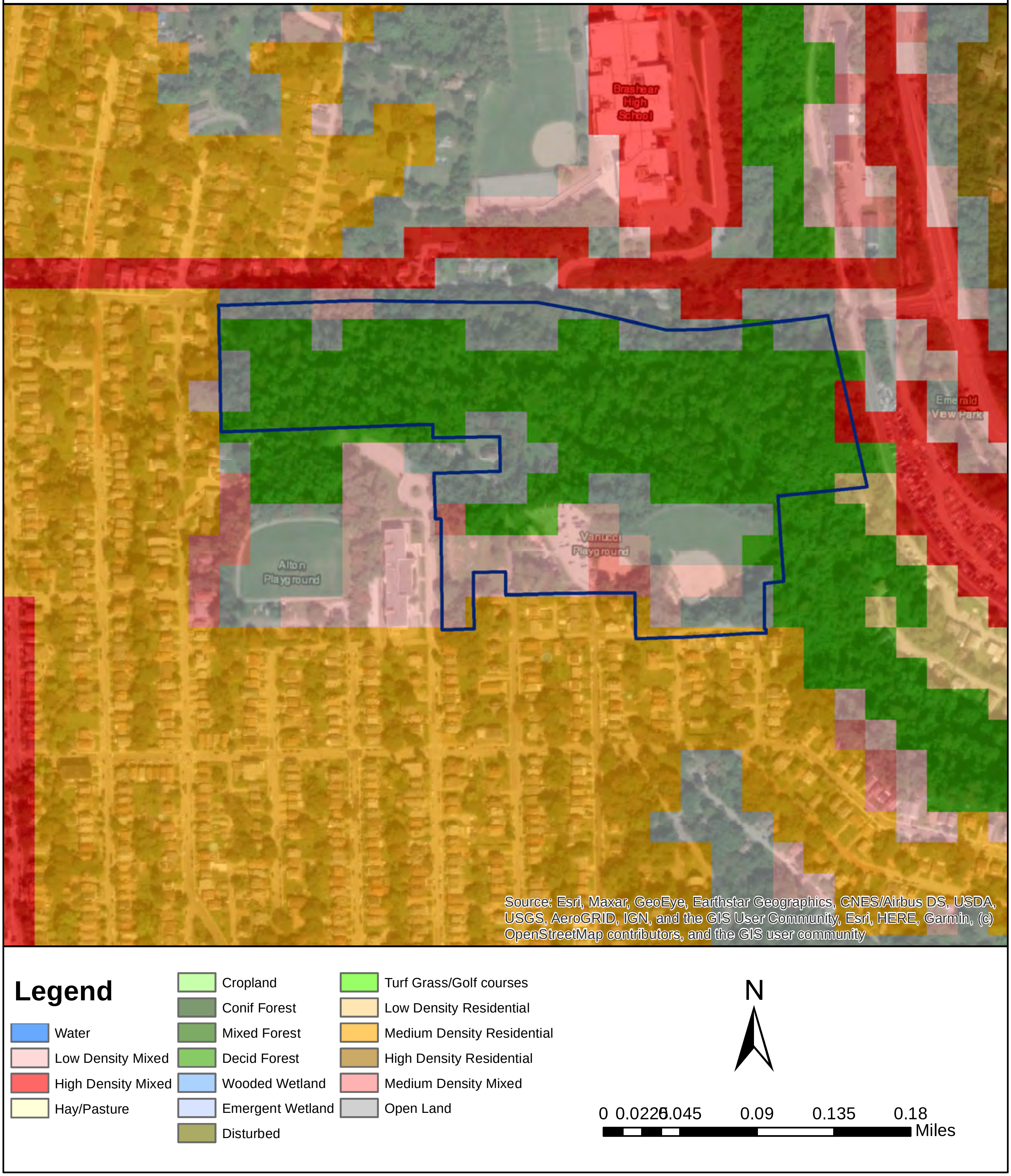
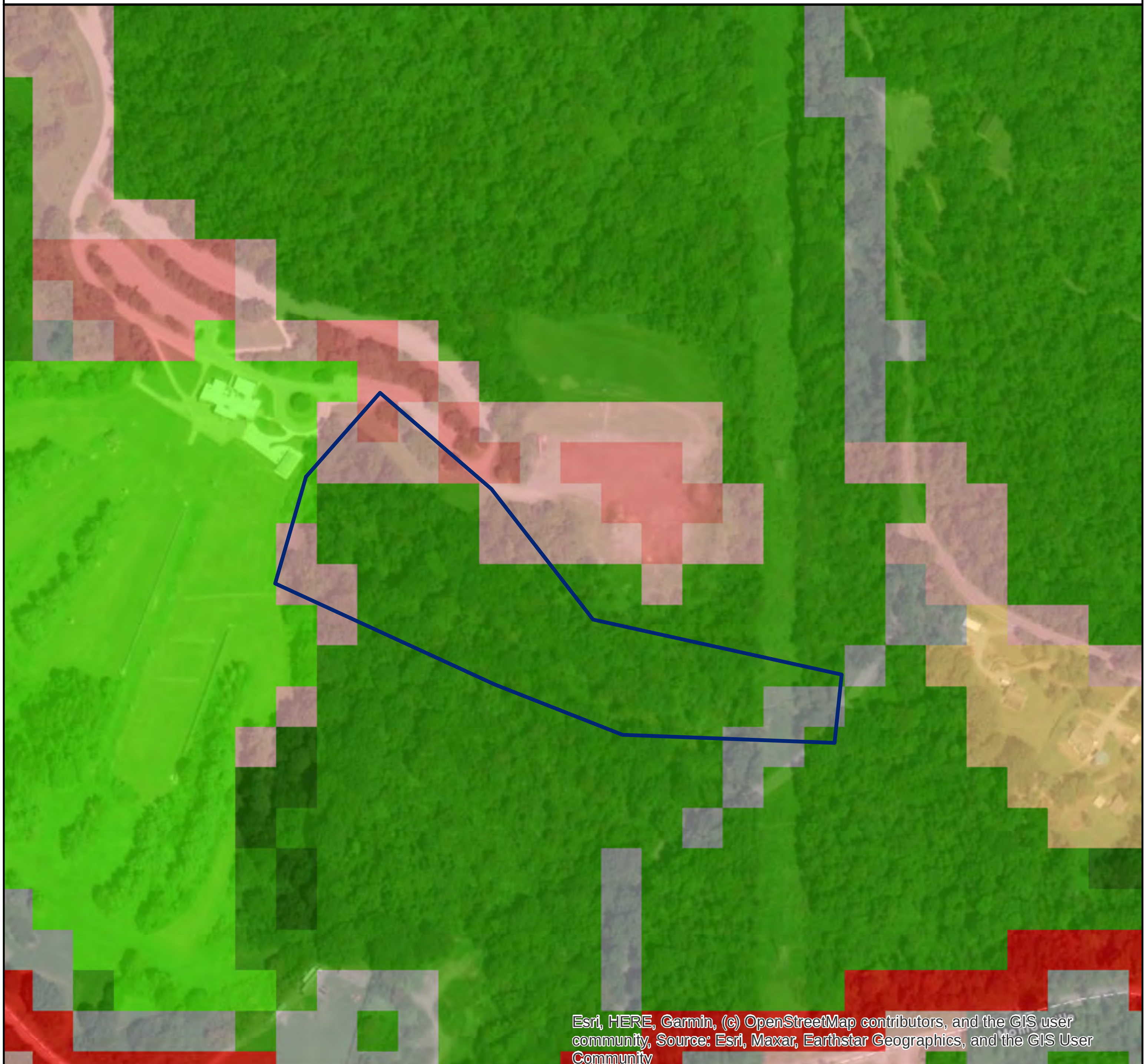


Figure 3
Land Use Map

Boyce Park Stream Restoration Site
Plum Borough, Allegheny County, Pennsylvania



Legend

Value

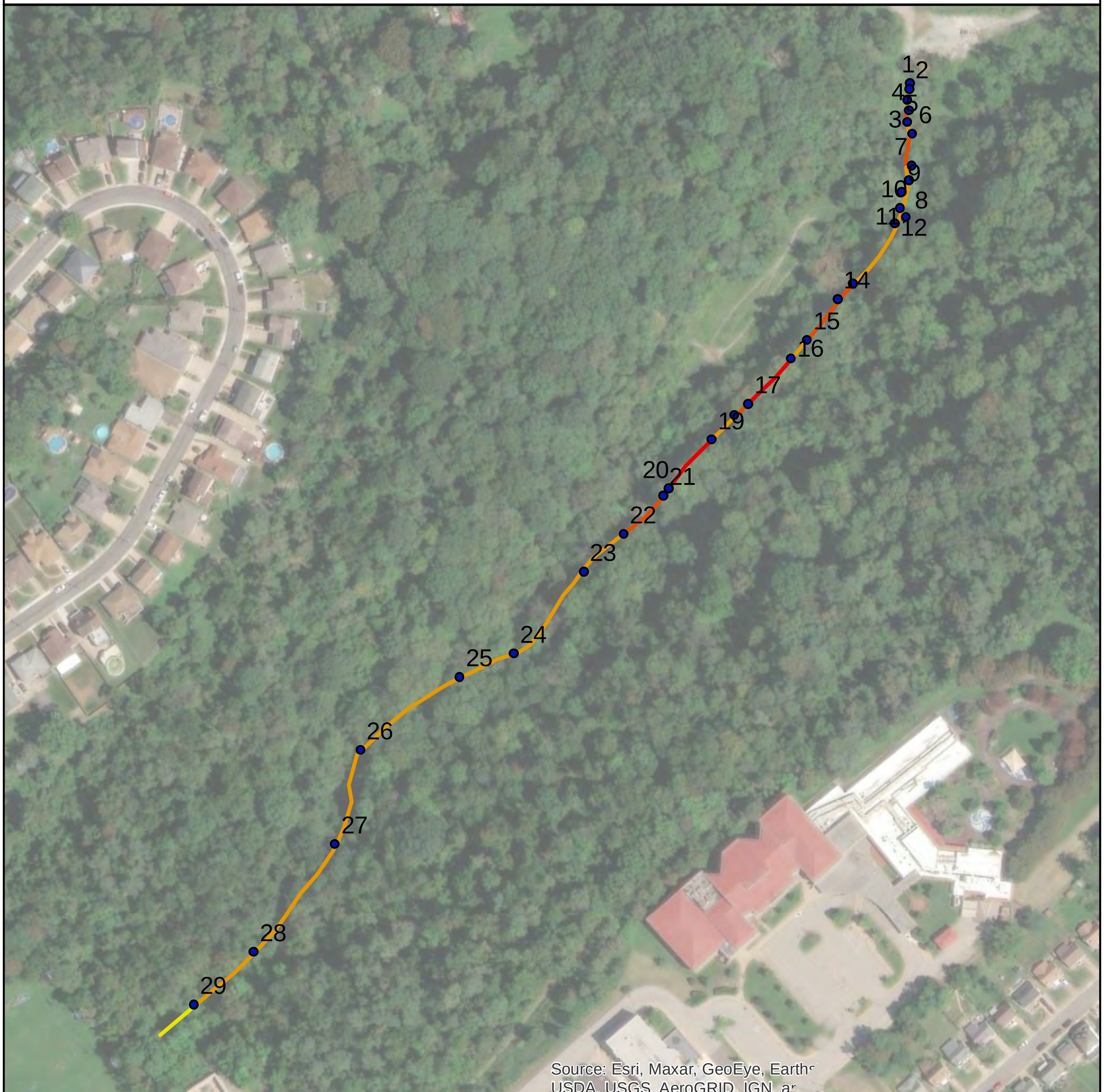
- Water
- Low Density Mixed
- High Density Mixed
- Hay/Pasture
- Cropland
- Conif Forest
- Mixed Forest
- Decid Forest
- Wooded Wetland
- Emergent Wetland
- Disturbed
- Turf Grass/Golf courses
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Medium Density Mixed
- Open Land

N

0 0.02 0.04 0.08 0.12 0.16 Miles

Figure 4 Bank Erosion Hazard Index

Figure 4
Bank Erosion Hazard Index
Moore Park
City of Pittsburgh, Allegheny County, Pennsylvania

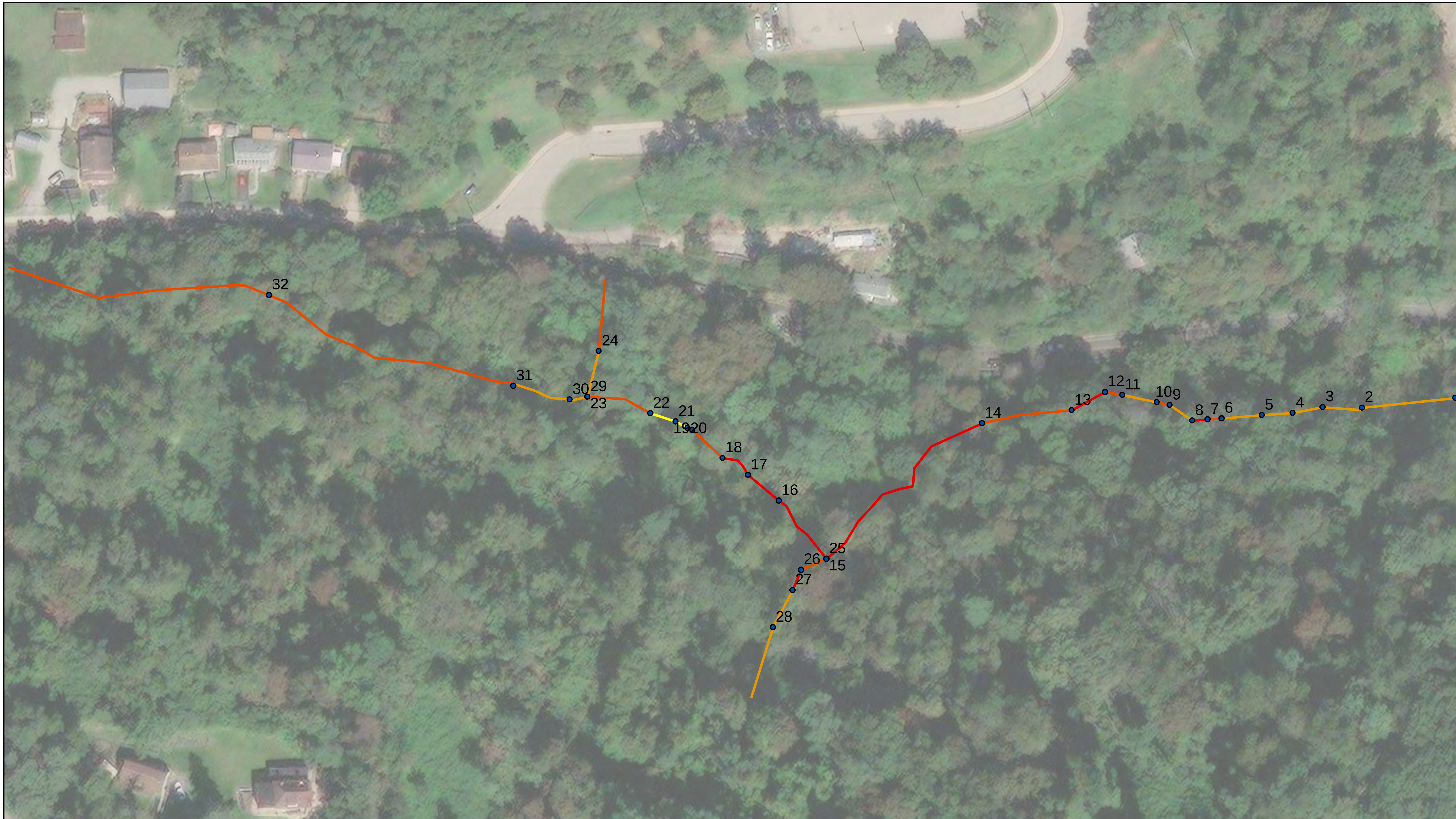


Feature ID.
Very Low
Low
Moderate
High
Very High
Extreme

0 110 220 440
Feet

N

Hunt Valley Environmental
632 Hunt Valley Circle
New Kensington, PA 15068



Hunt Valley Environmental
632 Hunt Valley Circle
New Kensington, PA 15068

Legend

- Very Low
- Low
- Moderate
- High
- Very High
- Extreme
- Feature ID.

Figure 4
Bank Erosion Hazard Index Map
Crane Avenue Stream Restoration Site
The City of Pittsburgh, Allegheny County

0 50 100 200 Feet

N

Figure 4
Bank Erosion Hazard Index
Boyce Park
Plum Borough, Allegheny County, Pennsylvania

Feature ID
Extreme
Very High
High

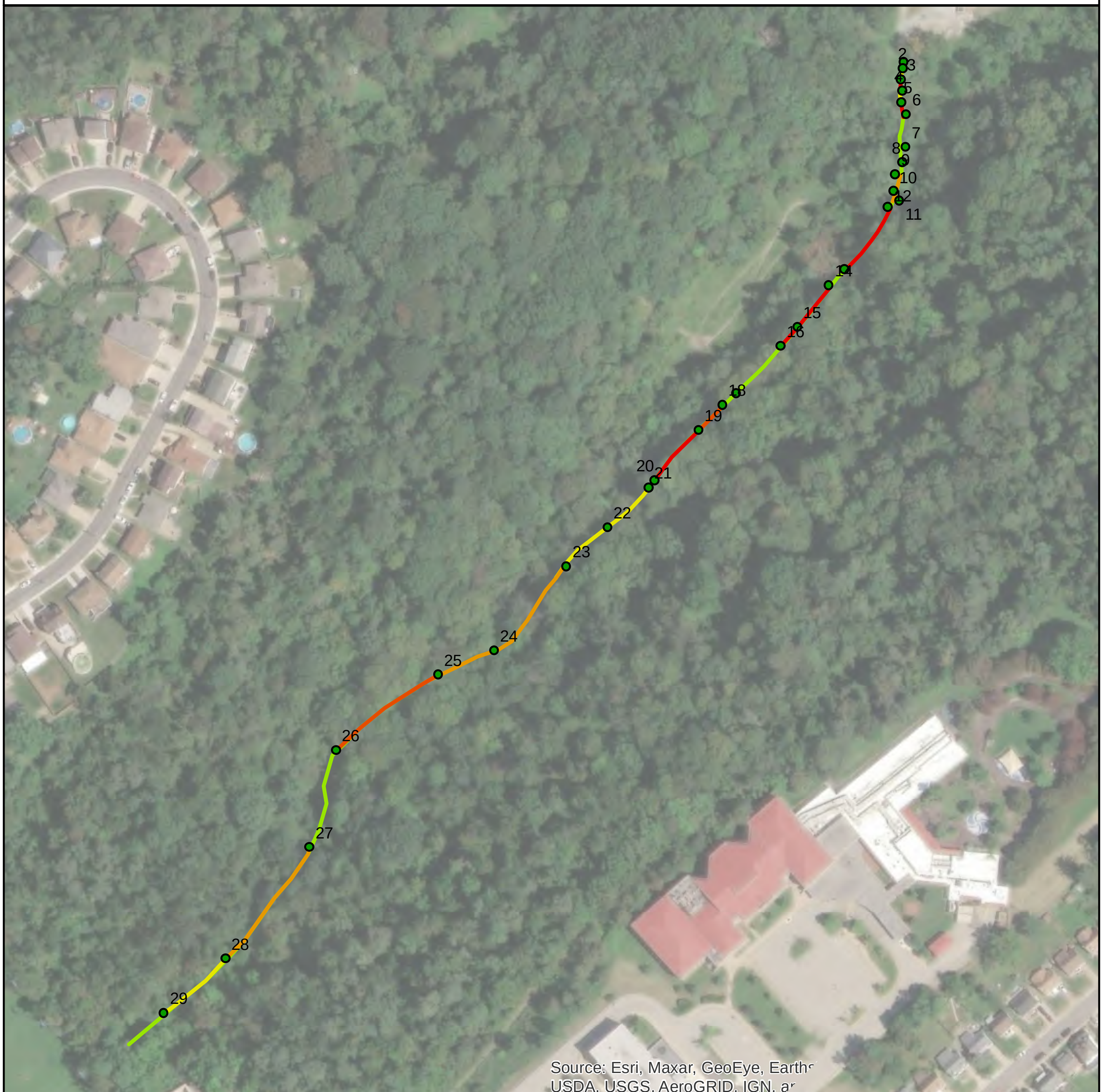
0 55 110 220
Feet

N

Hunt Valley Environmental
632 Hunt Valley Circle
New Kensington, PA 15068

Figure 5 Near-Bank Stress Maps

Figure 5
Near-Bank Stress
Moore Park Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania



- data points
- Very Low
- Low
- Moderate
- High
- Very High
- Extreme

0 105 210 420 Feet

N

Hunt Valley Environmental
632 Hunt Valley Circle
New Kensington, PA 15068

Hunt Valley Environmental 632 Hunt Valley Circle New Kensington, PA 15068	**Legend** Data Points · High Low · Very High Moderate · Extreme	Figure 5 Near-Bank Stress Crane Avenue Stream Restoration Site The City of Pittsburgh, Allegheny County	0 55 110 220 Feet	N

Figure 5
Near Bank Stress
Boyce Park
Plum Borough, Allegheny County, Pennsylvania

Feature ID
Extreme

0 55 110 220
Feet

N

Hunt Valley Environmental
632 Hunt Valley Circle
New Kensington, PA 15068

Figure 6 Urbanized Area Map

Figure 6A
Urbanized Area Map

Sawmill Run

The City of Pittsburgh, Allegheny County, Pennsylvania

Legend

Property Boundary

Urbanized Area

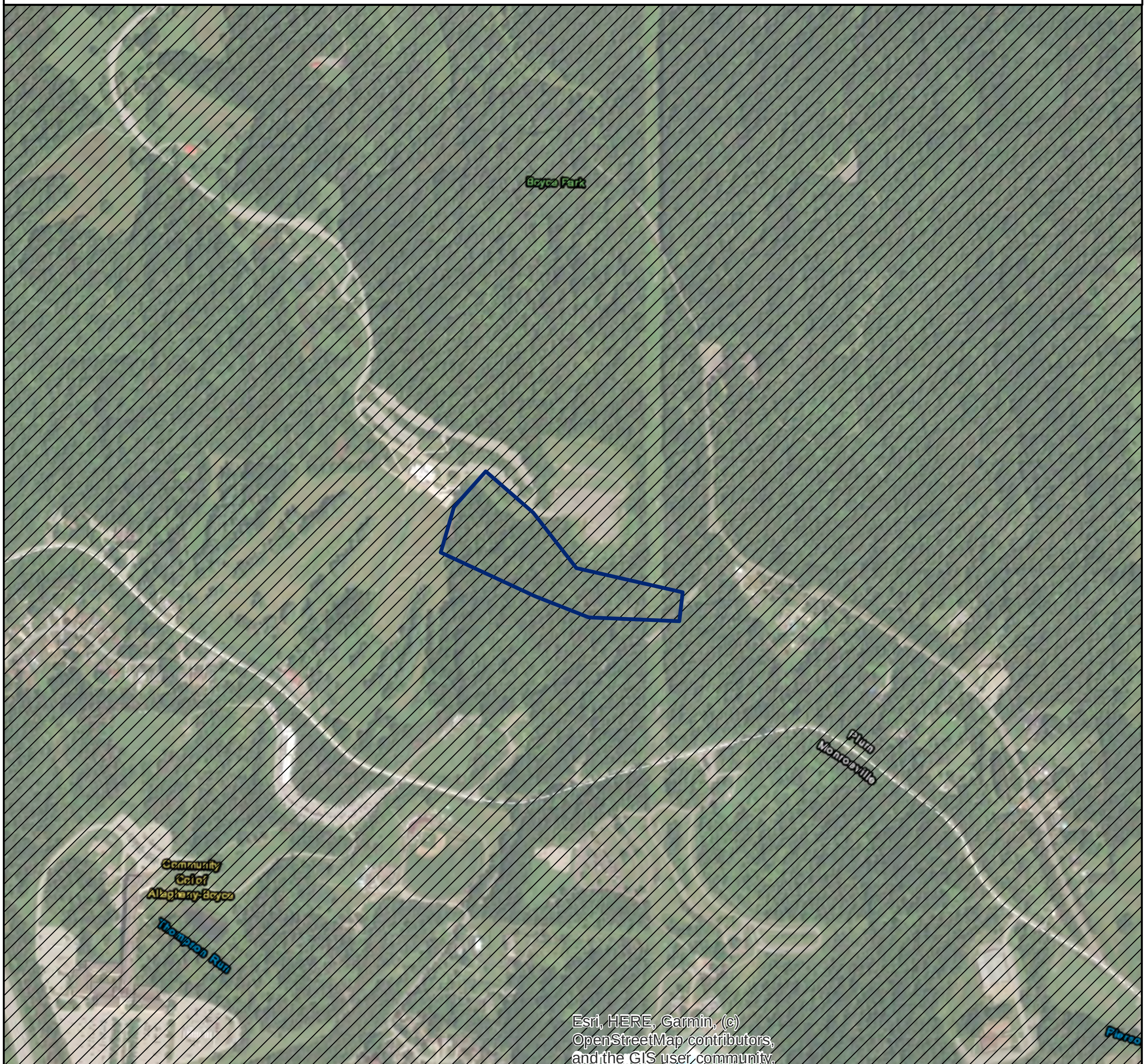
N

0 800 1,600 3,200 Feet

Created by:
Hunt Valley Environmental, LLC

Figure 6B
Urbanized Area Map

Boyce Park
Plum Borough, Allegheny County, Pennsylvania



Legend

Project Boundary

Urbanized Area

N

0 420 840 1,680
Feet

Created by:
Hunt Valley Environmental, LLC

Appendix B: Example Site Protection Instrument

Sawmill Run MS4 Projects Land Use Discussion

Date: October 11, 2020
Time: 10:00-10:35
Location: Teams Call

List of Attendees

NAME	ORGANIZATION	TITLE
Michael Barrick	Hunt Valley Environmental	Project Manager
Allision Traynor	Hunt Valley Environmental	Project Engineer
Chris Hornstein	Pittsburgh Public Works	Director
Genesis Martinez	Pittsburgh Public Works	Exe Assist DPW Director
Ana Flores-Bennet	PWSA	Associate Project Manager

General Discussion

Mike B of Hunt Valley Environmental opened the discussion of the project, discussing with the project partners that Land Reclamation Group (LRG) was contracted by PennDOT and PWSA to write the Pollutant Reduction Plan and to construct the Best Management Practices for sediment reduction in Saw Mill Run. LRG has contracted with Hunt Valley Environmental (HVE) to complete this work.

HVE has identified two project areas in Sawmill run to complete the proposed sediment reduction in Sawmill Run. The Project Areas were presented to DPW via the Team's meeting. One area is on a property adjacent to the Moore Park Property. It is a land area owned by the City of Pittsburgh and Pittsburgh School District. This project is refenced as the Moore Park Project. The Second property is the Beechview Greenway at Vannucci Field owned solely by the City of Pittsburgh. At this park, the project area is adjacent Crane Avenue, so it is referenced as the Crane Avenue Project. Mike reviewed the proposed project areas and the concept of the plans being submitted in the PRP for the planned sediment reduction discussing the proposed Best Management Practices. Other items that were discussed included:

- Drainage,
- Property protection
    - A Conservation Easement (CE)
    - A Resource Management Plan (RMP)
- Long-term O&M/ Endowment Funding

Further discussion of property protection continued. Chris H suggested PWSA could hold the long-term property protection CE

HVE Anticipated the property was protected with some type of long-term Protection, as they are parks in the city. Mike explained the RMP and the benefit to the city and operations as the RSM gives them a document in the office that provides O&M needs, and annual inspection requirements. Chris H agreed to the development of the RMP. He requested HVE develop a draft RMP and Conservation Easement.

Other items that were reviewed were drainage findings. The Ana and Chris requested HVE provide information of items identified for further discussion. This includes the drainage from the Pittsburgh Regional Transit Storm Pond, and the storm system along Crane Ave.

Prepared By:

Hunt Valley Environmental, LLC
Michael Barrick

Project Manager

Meeting Minutes prepared by Hunt Valley Environmental, LLC shall be deemed accurate as the record of matters discussed and conclusions reached. Corrections shall be reported to Michael Barrick at Hunt Valley Environmental, LLC within five (5) calendar days of distribution of this document.

Site Protection Instrument

Pittsburgh Sewage and Water Authority was able to provide a deed for the Moore Park Property. LRG will be able to provide a Conservation Easement for Moore Park as the property is owned by the Pittsburgh School District and the City of Pittsburgh. The Conservation Easement will be filed at the County Courthouse.

A deed for Beechview Greenway and Vannucci Park was not available. A specific description for the property including the park is not available. Development of a Conservation Easement could be developed but coordination with the City is ongoing to determine the needed final documents. This property is solely owned and managed by the City of Pittsburgh.

A Resource Management Plan will be developed Land Reclamation Group for both Project properties. This document will be developed the LRG for the day-to-day operations of the Department of Public Works. It will provide the as-built plans of the reestablished waterways on both properties. In addition to as-built plans it will provide operation and maintenance guidance and details of the best management practices used to stabilize the channels. The Beechview Greenway which is owned by the City of Pittsburgh and Moore Park property is Co-owned by the City of Pittsburgh and the Pittsburgh Area School District.

The Deer Creek project will include a conservation easement on the Independence property.

These legal documents are under review with the City Solicitor and LRG's legal representative.

CONSERVATION EASEMENT MOORE PARK

THIS CONSERVATION EASEMENT is made this _____ day of ___________, 20__, by ***The City of Pittsburgh and the School District of Pittsburgh*** (hereinafter "Grantors");

WITNESSETH:

WHEREAS, the Grantor grants an easement to the Grantee/Sponsor for the land developed by the Sponsor into a mitigation bank, the Grantee will monitor the site to the condition listed will be adhered to within the boundary of the said property covered by the easement; and

WHEREAS, Grantor is the fee simple owner of certain tracts of land located in **the City of Pittsburgh**, and being ***a portion of*** the property conveyed to the Grantor by deed recorded in **deed book volume XXXX Deed Page XXXX Instrument number XXXXXXX** in the land records of **Allegheny County**, Pennsylvania, more particularly described on Exhibit A attached hereto and incorporated by reference, hereinafter referred to as the "Property"; and

WHEREAS, **Land Reclamation Group** (the "Sponsor") entered into the Municipal Separate Storm Sewer System Contract with PWSA and PennDOT to reduce sediment discharges to the Sawmill Run Watershed and developer of the Sawmill Run PRP that identifies the Moore Park as a site for Sediment Reduction; and

WHEREAS, Sponsor may serve as the grantee of this Conservation Easement; and

WHEREAS, the Sawmill Run PRP includes Restoration Work governing the area on the Property indicated on Exhibit B attached hereto (the "Scaled Plat"); and

WHEREAS, pursuant to the Sawmill Run PRP, Sponsor proposes to create, maintain, and preserve a self-sustaining natural aquatic system located on the Restoration Work Area; and

WHEREAS, the Sawmill Run PRP requires that this Conservation Easement be executed and recorded in order that the Restoration Work Area shall remain substantially in its natural condition forever; and

WHEREAS, the Grantor has entered into an agreement with the Sponsor. to restore aquatic resources on the land of the proposed Restoration Work Area within the Property; and

WHEREAS, the Restoration Work Area may contain land, functions, values, and services that serve as storm water management best management practices were permitted by one or more of the Agencies; and

WHEREAS, under Federal and State law, the Agencies have issued one or more permits (collectively, the "Permits") for water quality with the expected result of the reduction of sediment loading to Sawmill Run from the Restoration Work located within the Restoration Work Area; and

WHEREAS, pursuant to the Saw Mill Run PRP, the Sponsor proposes to create, maintain, and preserve a high-quality, self-sustaining natural aquatic system and buffer located on the Restoration Work Area described in **Exhibit A** and present on the plat plan attached as **Exhibit B** attached hereto, which contains or will contain land, functions, values, and services that may serve as compensation and mitigation for sediment loading to waters of the United States and/or waters of the Commonwealth that were permitted by the Third Parties; and

WHEREAS, under Federal and State law, the PA DEP has issued a permit, (the "Permits"), for the reduction of sediment loading within the waters of the United States and/or the Commonwealth of Pennsylvania expected to result from the development of the self-sustaining natural aquatic system located on site within the Restoration Work Area; and

WHEREAS, because the Restoration Work Area may serve as mitigation for the reduction of sediment loading, the Agencies are third-party beneficiaries under this Conservation Easement; and

WHEREAS, the Grantor, the Sponsor and grantee agree to the creation of these conservation-based covenants and intend the Restoration Work Area shall be preserved and maintained in a natural condition in perpetuity. The Grantor and Sponsor will follow the Pennsylvania Conservation and Preservation Easements Act, 32 Pa. Cons. Stat. Ann. 5051 et seq.

WHEREAS, the Grantors agree to grant to the Sponsor, PennDOT and the PWSA certain rights with respect to the Property and the creation and monitoring of the Restoration Work Area.

NOW, THEREFORE, in consideration of the mutually-held interests in preservation of the environment, as well as the terms, conditions, and restrictions contained herein, and pursuant to the laws of the Commonwealth, Grantor does agree to the following terms and conditions:

1. PURPOSE.

Pursuant to the Pennsylvania Conservation and Preservation Easements Act, Grantor hereby grants to Grantee an easement over the Restoration Work Area for the following purposes:

To preserve and protect the native flora, fauna, soils, water table and drainage patterns, and other conservation values of the Restoration Work Area.

To preserve the Restoration Work Area in its scenic and open condition; and in general,

To assure that the Restoration Work Area, including its air space and subsurface, will be retained in perpetuity in its natural condition as provided herein and to prevent any use of the Restoration Work Area that will impair or interfere with its natural resource functions and values, Grantor intends that this Conservation Easement will confine the use of the Restoration Work Area to such activities as are consistent with the purpose of this Conservation Easement.

To accomplish the purpose of this Conservation Easement, the following rights are created in accordance with Pennsylvania law:

A. Grantee, Sponsor and the Agencies shall have the right to enter upon the Property to inspect the Conservation Area at reasonable times to monitor the conservation area for compliance with and otherwise enforce the terms of this Conservation Easement; provided that, except in cases where Grantee determines that immediate entry is necessary to prevent, terminate, or mitigate a violation of this Conservation Easement; such entry shall, when practicable, be upon reasonable prior notice to the Grantor, any successor or assign, and Grantee, Sponsor and Agencies shall not unreasonably interfere with the use and quiet enjoyment of the Property by the Grantor, its successors and assigns, in accordance with the terms of this Conservation Easement;

B. To allow the Grantee, the Sponsor and the Agencies to enforce the terms of this Conservation Easement by appropriate legal proceedings in accordance with applicable law so as to prevent any activity on or use of the Property that is inconsistent with the purpose of this Conservation Easement and to require the restoration of such areas or features of the Restoration Work Area that may be damaged by any inconsistent activity or use; and

C. To allow the Grantee, the Sponsor, or their authorized representatives, to enter upon the Property and its Restoration Work Area at reasonable times, upon prior notice to the property owner; and upon prior notice and written approval by the applicable Agencies to take any appropriate environmental or conservation management measures consistent with the terms and purposes of this Conservation Easement, including:

1) Planting of native vegetation (i.e. trees, shrubs, grasses and forbs);
2) Restoring, altering or maintaining: the topography; hydrology; drainage; structural integrity; streambed; water quantity; water quality; any relevant feature of any stream, wetland, water body, or vegetative buffer within the Restoration Work Area as provided in the PRP approved by the Agencies; or
3) Performing such other activities as may be required by any Agency to maintain or restore the Restoration Work Area as required by the PRP approved by the Agencies or any related permit issued by any Agency in connection therewith.

2. PERMITTED USES

This Conservation Easement will not prevent the Grantor, any subsequent owner of the Property, and the personal representatives, heirs, successors, and assigns of either the Grantor or any subsequent Property owner, from making use of the area(s) that are not included in the Restoration Work Area, or from using the Restoration Work Area in any way that is not expressly prohibited by, or inconsistent with, the terms of this Conservation Easement.

A. **Maintenance of Existing Utility Facilities**. Existing Utilities lie within the Conservation Easement any required maintenance or repairs due to catastrophic failure of the existing systems are permitted.
    a. **Restoration to as-built conditions will be required** upon completion of said of said maintenance or repairs.

3. RESTRICTIONS

Any activity in or use of the Restoration Work Area inconsistent with the purpose of the Conservation Easement by the Grantor, any subsequent owner of the Property, and the personal representatives, heirs, successors, and assigns of either the Grantor or subsequent Property owner, is prohibited. Without limiting the generality of the foregoing, and except when an approved purpose Section 1 above, or as necessary to accomplish mitigation approved under the aforementioned Mitigation Plan, the following activities and uses are expressly prohibited in, on, over, or under the Restoration Work Area, subject to all of the express terms and conditions below:

A. **Structures.** The construction of new man-made structures, including but not limited to the construction, removal, placement, preservation, maintenance, or alteration of any buildings, roads, utility lines, billboards, or other advertising. This restriction does not include bat boxes, bird nesting boxes, bird feeders, and the placement of signs for safety purposes or boundary demarcation.

B. **Demolition.** The demolition of fencing structures constructed for the purpose of demarcation of the Restoration Work Area or for public safety.

C. **Soils.** The removal, excavation, disturbance, or dredging of soil, sand, peat, gravel, or aggregate material of any kind; or any change in the topography of the land, including any discharges of dredged or fill material, ditching, extraction, drilling, driving of piles, mining, or excavation of any kind.

D. **Drainage.** The drainage or disturbance of the water level or the water table, except for pre-existing or approved project-related stormwater discharges and any maintenance associated with those stormwater discharges. All pre-existing or approved project-related drainage/stormwater discharge features should be shown on the accompanying plat map or approved plan and attached to this Conservation Easement.

E. **Waste or Debris.** The storage, dumping, depositing, abandoning, discharging, or releasing of any gaseous, liquid, solid, or hazardous waste substance, materials or debris of whatever nature on, in, over, or underground or into surface or ground water.

F. **Non-Native Species.** The planting or introduction of non-native species. Existing non-native species on site are waived of this restriction

G. **Herbicides, Insecticides and Pesticides.** The use of herbicides, insecticides, or pesticides, or other chemicals, except for as may be necessary to control invasive species that threaten the natural character of the Restoration Work Area. State-approved municipal application programs necessary to protect the public health and welfare are not included in this prohibition.

H. **Removal of Vegetation.** The mowing, cutting, pruning, or removal of any kind; disturbance, destruction, or the collection of any trees, shrubs, or other vegetation, except for pruning, cutting or removal for:

1) safety purposes; or
2) control in accordance with accepted scientific forestry management practices for diseased or dead vegetation; or
3) control of non-native species and noxious weeds; or
4) scientific or nature study.

I. **Agricultural Activities.** Conversion of, or expansion into, any portion of the Restoration Work Area for use of agricultural, horticultural, aqua-cultural, livestock production or grazing activities. This prohibition also includes conversion from one type of these activities to another (e.g., from agricultural to silvicultural).

J. **Access by Vehicle.** Unless authorized by the site restoration plan or site maintenance plan. Any temporary crossing or temporary access roads planned for maintenance of the site within the Restoration Work Area must adhere to the site maintenance plan. Due to the terrain the need to access other areas within the property for maintenance will be permitted with the appropriate permit.

K. **Other.** Other acts, uses, excavation, or discharges that adversely affect fish or wildlife habitat or the preservation of lands, waterways, or other aquatic resources within the Restoration Work Area.

4. INSPECTION, ENFORCEMENT AND ACCESS RIGHTS

The Agencies and their authorized representatives shall have the right to enter and go upon the Property, to inspect the Restoration Work Area and take actions necessary to verify compliance with this Conservation Easement. When practicable, such entry shall be upon prior reasonable notice to the Grantor or the then current owner of the Property. The Grantor grants to the Agencies a discretionary right to enforce this Conservation Easement in a judicial action against any person(s) or other entity(ies) violating or attempting to violate these restrictive covenants: provided, however, that no violation of these restrictive covenants shall result in a forfeiture or reversion of title. In any enforcement action, an enforcing Agency shall be entitled to require a complete restoration for any violation, as well as any other judicial remedy such as civil penalties. Nothing herein shall limit the right of the applicable Agencies to modify, suspend, or revoke any permit.

5. RECORDING AND EXECUTION BY PARTIES

The Grantor agrees that this Conservation Easement shall be recorded within 120 days of the approval of the as-built plans of the Mitigation Bank in the Land Records of the county or counties where the Property is located. Further, if anticipated activities in the Restoration Work Area are agreed upon for future phases of the site, as spelled out in the “Reserved Rights,” the Grantor must submit plans to the applicable Agencies for review and approval prior to any work in the Restoration Work Area.

6. NOTICE OF TRANSFER OF PROPERTY INTERESTS

No transfer of the rights of this Conservation Easement, or of any other property interests pertaining to the Restoration Work Area or the underlying property it occupies, shall occur without sixty (60) calendar days prior written notice to the Agencies.

7. MODIFICATIONS

The restrictions contained in this Conservation Easement are required by the attached Mitigation Plan. There shall be no changes or alterations to the provisions in this Conservation Easement without prior written approval from the Agencies. The Agencies shall be provided with a 60-day advance written notice of any legal action concerning this Conservation Easement or of any action to extinguish, void, or modify this Conservation Easement in whole or in part, including transfer of title to, or establishment of any other legal claims over, the Property. This Conservation Easement is intended to survive foreclosure, bankruptcy, condemnation, or judgments affecting the Property.

8. RESERVED RIGHTS

A. The Grantor and any holders of easements or other property rights for the operation and maintenance of pre-existing or project-related structures or infrastructure such as roads, utilities, drainage ditches, or stormwater facilities that are present on, over or under the Restoration Work Area reserve the right, within the terms and conditions of their permits, their agreements, and the law, to continue with such operation and maintenance. All pre-existing or approved project-related structures or infrastructure shall be shown on the accompanying plat map or approved plan and attached to this instrument.

B. If the authorized project requires any related or unanticipated infrastructure modifications, utility relocation, drainage ditches, or stormwater controls within the identified Restoration Work Area, or if situations require measures to remove threats to life or property within the identified Restoration Work Area, said activities must be approved in writing by the applicable Agencies. Approval is subject to the sole discretion of the applicable Agencies. If approved, said activities must be identified on amended Exhibits A and C and must be recorded and specifically noted as an "amendment" and copies of the recorded amended Exhibits must be provided to the Agencies within 60 days of approval by the Agencies. Approval of said activity by the applicable Agencies is in addition to any Clean Water Act Section 404 permit or other authorization that may be required in order to legally implement said activity. The Grantor accepts the obligation to place any other responsible party on reasonable prior notice of their need to request such Agency approval

9. SEVERABILITY

If any portion of this Conservation Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this instrument, or application of such provision to persons or circumstances other that those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

10.
SITE RESTORATION

If the work required by a Restoration plan including maintenance or remedial work, under the Department of Army permit and the Pennsylvania Code Title 25 Environmental Protection Chapter 105 Dam Safety and Waterway Management Permit for the authorized project occurs within the Restoration Work Area, then the Grantor is allowed to construct the Restoration Work Area in accordance with the authorized plan, a copy of which is incorporated by reference.

11. COAL RIGHTS NOTICE.

The following notice is given to and accepted by Grantor for the purpose and with the intention of compliance with the requirements of the Pennsylvania Conservation and Preservation Declarations Act. Nothing herein shall imply the presence or absence of workable coal seams or the severance of coal interests from the Property.

NOTICE: THIS DECLARATION MAY IMPAIR THE DEVELOPMENT OF COAL INTERESTS INCLUDING WORKABLE COAL SEAMS OR COAL INTERESTS WHICH HAVE BEEN SEVERED FROM THE PROPERTY.

12. DURATION; COVENANT RUNNING WITH THE LAND

THIS CONSERVATION EASEMENT VESTS A SERVITUDE RUNNING WITH THE LAND THAT SHALL REMAIN IN EFFECT IN PERPETUITY. THIS CONSERVATION EASEMENT IS BINDING UPON THE UNDERSIGNED GRANTOR AND, UPON RECORDATION IN THE PUBLIC RECORDS, ALL SUBSEQUENT OWNERS OF THE PROPERTY OR ANY PORTION OF THE PROPERTY THAT INCLUDES THE RESTORATION WORK AREA WILL BE BOUND BY ITS TERMS, WHETHER OR NOT SUCH SUBSEQUENT OWNER HAD ACTUAL NOTICE OF THIS CONSERVATION EASEMENT AND WHETHER OR NOT THE DEED OF TRANSFER

OF THE PROPERTY SPECIFICALLY REFERS TO THE TRANSFER BEING UNDER AND SUBJECT TO THIS CONSERVATION EASEMENT.

13. MINERAL SUBORDINATION

The Grantor controls the gas and mineral rights of the property. The Grantor agrees to subordinate these rights to the deed restriction for the protection of the area described in Exhibit A and presented on the plan in Exhibit B.

NOTICE TO PARTIES WITH EMINENT DOMAIN AUTHORITY:

14. EMINENT DOMAIN

Exercise of eminent domain by any party ("Condemning Party") to take land held as part of this Bank may remove restrictions that the Sponsor, the Corps, and PADEP intend will protect the Mitigation Bank Site and preserve the land serving as Compensation for other permitted impacts, in perpetuity. Where the Condemning Party (1) intends to take action(s) that will have impacts on Mitigation Bank land associated with Debited Credits; and (2) is required to obtain a Corps and/or PADEP permit for such impacts, the Corps and PADEP have discretion to increase the Condemning Party's wetland and/or stream Compensation requirements, as part of the permitting process, in order to account for the loss of Credits already Debited from this Bank."

IN WITNESS WHEREOF said GRANTOR has executed this Conservation Easement the day and year first above written.

GRANTOR (if entity):

City of Pittsburgh ______
Name of entity

By: ________________________

Pittsburgh School District ______
Name of entity

By: ________________________

Name: ________________

Title:

Grantee (if entity)

Land Reclamation Group, LLC ___________
Name of entity

By:________________________________

Name: Andrew Dzurko_____________

Title: President

COMMONWEALTH OF PENNSYLVANIA)
) : SS
COUNTY OF ______________________)

On ________________, before me, a Notary Public for the Commonwealth aforesaid, personally appeared ______________________________, who acknowledged himself/herself to be, and that s/he, as member ***City of Pittsburgh*** the Grantor, being authorized to do so, executed, in my presence, the foregoing Conservation Easement for the purposes herein contained

IN WITNESS WHEREOF, I have set my hand and official seal.

____
Notary Public
My commission expires:

[SEAL]

COMMONWEALTH OF PENNSYLVANIA)
) : SS
COUNTY OF ______________________)

On ________________, before me, a Notary Public for the Commonwealth aforesaid, personally appeared ______________________________, who acknowledged himself/herself to be, XXXXX and that s/he, as member ***Pittsburgh School District*** the Grantor, being authorized to do so, executed, in my presence, the foregoing Conservation Easement for the purposes herein contained

IN WITNESS WHEREOF, I have set my hand and official seal.

____
Notary Public
My commission expires:

[SEAL]

ACCEPTANCE OF CONSERVATION EASEMENT

The undersigned accepts the rights and responsibilities of the Sponsor conferred by this Conservation Easement.

[NAME OF SPONSOR ENTITY]

By:___________________________________
Name:_________________________________
Title:_________________________________

COMMONWEALTH OF PENNSYLVANIA)
) : SS
COUNTY OF ____________________)

On ___________, before me, a Notary Public for the Commonwealth aforesaid, personally appeared _____________________, who acknowledged himself/herself to be Andrew Dzurko of ***Land Reclamation Group, LLC***, and that s/he, as such officer, being authorized to do so, executed, in my presence, the foregoing Acceptance of Conservation Easement for the purposes herein contained

IN WITNESS WHEREOF, I have set my hand and official seal.

____
Notary Public
My commission expires:

[SEAL]

EXHIBIT A

LEGAL DESCRIPTION OF THE PROPERTY

EXHIBIT B

Plan of the Conservation Easement

EXHIBIT C

Natural Resource Management Plan

ACKNOWLEDGEMENTS

EXECUTIVE SUMMARY

This Natural Resource Management Plan (NRMP) coordinates agency efforts to achieve the resource preservation and the mission of the City of Pittsburgh This plan is necessary to clarify and update the City's natural resource management philosophy, vision and direction moving forward and promote the stewardship of natural resources.

The 2022 NRMP is structured around four management themes containing recommended actions:

1) **Inventory and Planning – *Knowing what we have***
2) **Protecting Natural Resources – *Do no harm***
3) **Managing and Restoring Ecosystems – *Helping our land and waters heal***
4) **Fostering Stewardship and Expanding Natural Resources – *Spreading the word***

These themes can be tied back to the seven plan elements of the original NRMP: Natural Resource Management Planning, Vegetation, Wildlife, Water Resources, Air Quality, Human Impact on Parklands, and Education.

These management themes embody the key issues facing our natural resources. city parks are isolated natural areas impacted by many stresses. Park staff, volunteers and citizens are charged with protecting these remaining natural areas to preserve the natural resources in biodiversity, natural communities and ecosystems. But the remaining natural areas are not enough. It will be up to many partners to expand natural areas over time in order to sustain our native species and communities and increase the ecological services and quality of life benefits they provide. The City Parks can provide refuge for species, act as a source of locally native species and provide the templates for natural communities for restoration efforts elsewhere.

TABLE OF CONTENTS

INTRODUCTION

Purpose and Vision

The purpose of this Natural Resource Management Plan (NRMP) is to coordinate agency-wide efforts to achieve the resource preservation the mission of the Pittsburgh's Department of Public Works.

> City of Pittsburgh Public Works Mission Statement: P*roviding creative, customer-friendly service while preserving the City's infrastructure by maintaining City streets, preserving park facilities and rehabilitating public facilities*

Much of the responsibility for preserving Pittsburgh's rich natural heritage rests with the City of Pittsburgh. These landholdings include forests at various areas of the city, waterways on parks properties at various areas within the city limits. They also include dozens of community parks and numerous lakefront parks. This plan is structured to support several guiding principles that will inform all aspects of natural resource management on parkland:

- Stewardship of our natural resources
- Preserve biodiversity and sustain wild and healthy ecosystems
- Protect, restore, and expand ecosystem services
- Manage resources adaptively and learn through experience
- Preserve a legacy of natural heritage for present and future generations

Natural resources include living organisms; non-living components, such as air, water, and soil; the ecosystems they form; and the services they provide.

These services include cleaning our air and water, supporting biodiversity, and providing healthy, open spaces to enjoy nature that contribute to a high quality of life for residents. Environmental services provided by City of Pittsburgh parks are invaluable.

Natural resources are assets that requires active management to retain its function and value. In urbanized areas like the City of Pittsburgh, factors such as disturbance from human land uses including development, encroachments and recreation, over-browsing by white-tailed deer and competition from non-native invasive species place tremendous stress on natural areas and impact their ability to function as high-quality ecosystems. Identifying and removing stressors is the first step towards helping the land heal. The City must seek and commit resources for the protection, assessment, monitoring, planning, restoration, and management of natural resources in order to fully achieve its policy vision for natural resource preservation.

Residents expect and rely on natural areas to provide recreational opportunities as well as environmental services and benefits. Many residents may not understand that natural resources is not self-sustaining and requires management in order to provide benefits for future generations. The City must continue to cultivate a broad understanding of the issues that are impacting natural resources and build support for greater stewardship as outlined in this and other plans. Communication with staff, residents and partners will be a critical factor in the success of preserving natural resources and achieving effective natural resource management.

Background

This plan is necessary to clarify the City's natural resource management philosophy, vision, and direction moving forward. The revised plan is designed to be more strategic in nature and focuses on higher level, evergreen actions that address the stewardship of our natural resources.

Plan Structure

The 2022 NRMP is structured around four management themes containing recommended actions:

1) **Inventory and Planning – *Knowing what we have***
2) **Protecting Natural Resources – *Do no harm***
3) **Managing Wild Populations and Restoring Ecosystems – *Helping our waters heal***
4) **Fostering Stewardship and Expanding Natural Resources – *Spreading the word***

These management themes can be tied back to the seven plan elements of the original NRMP: Natural Resource Management Planning, Vegetation, Wildlife, Water Resources, Air Quality, Human Impact on Parklands, and Education, The management themes are logical groupings of actions that are intended to help staff and partners focus on when and how we manage resources.

The actions are those tasks that staff and partners must undertake to inventory, plan, protect, and manage natural resources and foster stewardship among stakeholders. Underneath many of the actions are nested concepts that provide additional issues that must be considered and addressed in order to comply with this plan.

Implementation

Implementation of the NRMP will be through the annual work plans as well as through the strategic plan goals. Although the Natural Resource Management Protection in the Department of Public Works has the lead role implementing this NRMP, all divisions, sites, and staff are responsible for implementation and for ensuring that policies and practices support natural resource protection. Staff will report on accomplishments and plans annually and also through stewardship updates.

There is broad recognition of the City's obligation and responsibility to protect and manage the natural resources under its care. Implementation of the NRMP requires resources in both staff and funding. These needs will be defined over time through inventories, site-level resource management plans, periodic agency needs assessments and other processes. Securing the necessary staff and funding to meet NRMP goals and implement the recommended actions of this plan will require the education of numerous stakeholders, access to new and alternative methods of funding (including resources funding streams), and strong advocacy and support from City residents and elected officials. Working collaboratively with partners will also play a key role in accomplishing many aspects of this plan.

This plan's management themes embody the key issues facing our natural resources. City of Pittsburgh's parks are isolated natural areas impacted by many stresses. City staff, volunteers and citizens are charged with protecting these remaining natural areas to preserve the city's natural resources in biodiversity, natural communities, and ecosystems. But the remaining natural areas are not enough. It will be up to many partners to expand natural areas over time in order to sustain our native species and communities and increase the ecological services and quality of life benefits they provide. The parks can provide refuge for species, act as a source of locally native species and provide the templates for natural communities for restoration efforts elsewhere.

INVENTORY AND PLANNING
Knowing what we have

Effective stewardship begins with a fuller understanding of the natural resources under the City's care. The following actions address how the City collects natural resource data and integrates this knowledge into park planning and decision- making. A comprehensive natural resources inventory has not been conducted for all parkland, but the two parks parks have been surveyed and areas of significance have been identified. Consolidating and streamlining this information in a Geographic Information System (GIS) database and communicating the significance of natural areas to staff, partners, elected officials, and citizens is of critical importance to preserving their long- term health.

1. Conduct natural resource inventories of vegetative communities, rare and significant species, habitats and ecological features such as wetlands and their contributing landscapes to identify, map, and monitor biodiversity.
   a. Inventories should be conducted in advance of park acquisition, planning, projects and management activities, with the intent of protecting resources.
   b. Develop a natural resource geodatabase built on the City of Pittsburgh GIS infrastructure to archive natural resource inventory data, ensure uniform data management and allow for a centralized location to access natural resource information.

2. Assess the ecological significance of natural resources on parkland according to federal and state protection status, countywide occurrence, ecological function, ecosystem services and sensitivity to disturbance, and incorporate these

assessments into strategic and long-range planning, general management planning, and operational planning.

   a. Identify and protect species and ecosystems that are rare or significant on a local, regional or national scale.

3. Designate Resource Protection Zones and develop a map of parkland defining these areas in which land disturbance shall be limited and access regulated based on the needs of the resources present.

4. Assess the value of natural resources on parkland to include the ecosystem services it provides.
   a. Integrate ecological concepts to include biodiversity, habitat structure, and regeneration into economic valuation studies to develop a more complete picture of ecosystem function and value.
   b. Demonstrate differences in ecosystem and ecological service values between degraded and healthy natural communities.
   c. Develop cost estimates for restoring and managing natural resources.

5. Ensure that natural resource protection is integrated into all aspects of the City's practices to include land acquisition, park planning, development, management, maintenance, and interpretation.
   a. Ensure that natural resource planning takes place and accounts for vegetation, wildlife, water resources, air quality, human impacts and education.
   b. Ensure that park development, management, and interpretation does not conflict with site Natural Resource Management Plans.
   c. Ensure that natural resource specialists are consulted during project planning and prior to activities that impact natural resources.
   d. Base natural resource management decisions on science and best practices, including surveys, monitoring, and adaptive management.
   e. Include natural resource mitigation funding as a part of all projects that impact natural resources.
6. Create site-specific or resource-specific Natural Resource Management Plans and/or Natural Resource Action Plans as appropriate to guide natural resource management and protection and make these plans available to staff and the public.

7. Maintain expertise within park staff, adopt best practices, and seek innovative methods, technology and tools to proactively protect and manage natural resources.

PROTECTING NATURAL RESOURCES
Do no harm

Impacts to parkland degrade the quality and long-term health of the city's natural resources. Some impacts can be addressed locally and internally, such as limiting encroachments from adjoining property owners. Broader impacts, such as watershed degradation, browsing by overabundant white-tailed deer and non-native invasive plant infestation, are significant, large-scale problems with solutions that lie well beyond park boundaries. The actions within this management theme address some of the most significant impacts to natural resources, including impacts that are countywide in scope and will require the cooperation of citizens and partners to address.

8. Avoid adverse impacts to natural areas, mitigate unavoidable impacts from construction and maintenance projects and require restoration and rehabilitation of impacted natural resources.
    a. Minimize impacts to forests, meadows and other natural areas from human use.
    b. Protect significant natural communities and species.
    c. Require restoration of impacted natural resources when use of parkland causes damage to them.

9. Eliminate encroachments from park neighbors and illegal uses of parkland to prevent, remove or mitigate impacts to natural resources.

10. Protect water resources from impacts of urbanization and development such as stormwater runoff and excessive flows.
    a. Protect water quality by minimizing impacts from park development, as well as development outside of parkland.
    b. Support county, state and regional water quality efforts to include implementation of City of Pittsburgh Watershed Management Plans.
    c. Protect, enhance and restore riparian buffers.
    d. Protect wetlands to include springs, seeps and vernal pools and the buffers that surround them (e.g. the terrestrial habitat zone).
    e. Minimize negative impacts of stormwater facilities per the MS4 Stormwater Management.
    f. Work with partners to protect and restore streams on parkland.
    g. Utilize low impact development practices (such as stormwater management, green buildings and natural landscaping) to reduce impacts to water resources and other natural resources.

11. Prevent net loss of natural resources on or off parkland as a result of granting easements.
    a. Deny requests to place easements on parkland to offset losses elsewhere (except when required by interagency or other pre-existing agreement), when resources on parkland would not be restored to mitigate for those losses.

12. Protect park natural resources from threats of urbanization, development and park operations to include noise and light pollution, degradation of air quality and other sources of pollution.
    a. Prevent excessive light impacts on natural areas.
    b. Prevent or mitigate excessive noise impacts on wildlife.
    c. Reduce air pollution from park management by investing in cleaner equipment, reducing mowing, and incorporating other best practices.

13. Plant only locally common native plant species in natural areas, do not plant any invasive species, and use non-native non-invasive species in formal landscapes only when there are no suitable native plant alternatives.
    a. Use local ecotypes of native species when available.

14. Site trails to minimize natural resource impacts, utilize sustainable trail building principles and avoid placing trails in sensitive natural areas.
    a. Consult and follow the agency's Trail Development Strategy Plan.

15. Increase the City's ownership and buffering of ecologically valuable areas through acquisition of land, easements and other agreements that would serve to protect natural resources on or adjacent to parkland.

MANAGING WILD POPULATIONS AND RESTORING ECOSYSTEMS
Helping our waters heal

The City's natural resources must be adaptively managed to achieve positive ecological outcomes. Natural resource management should begin with clearly defined goals such as improving biodiversity, reducing overabundant or non-native invasive species, or promoting naturally regenerating native plant communities. Natural resource management should be adaptive and experimental. Management actions should include proven as well as novel practices, and staff should incorporate measurable feedback mechanisms, such as biological monitoring, to evaluate their effectiveness and adapt strategies accordingly. The City should embrace a hands-on approach to natural resource management based on the best available science and with clearly defined management goals.

16. Manage natural resources adaptively and holistically on a landscape scale with the goal of having naturally regenerating native plant systems and healthy native wildlife populations.
    a. Manage for landscape mosaics with diverse habitats, including non-forested ecosystems, to foster biodiversity and support different life-cycle stages for species.
    b. Focus on areas with the best, biggest and/or most connected resources.
    c. Protect intact soils with a rich ecological memory and restore degraded soils.
    d. Reintroduce disturbances necessary for system recovery such as fire and canopy gaps.
    e. Focus on removing stresses from systems to include human impacts, white-tailed deer, non-native invasive species, etc. to allow systems to recover.
    f. Restore natural communities to improve ecosystem resilience against large scale and long-term impacts such as climate change, severe weather events, and forest pests.
    g. Consider unique or important natural communities, species and ecological features when establishing management objectives and measuring

management outcomes.
h. Monitor results to determine change and measure success over time.

17. Control overabundant and invasive species that negatively impact natural resources to include, but not limited to, white-tailed deer, non-native invasive species, resident Canada geese, feral animals, and forest pests.
    a. Coordinate response amongst staff and with partner agencies.
    b. Maintain capacity for Early Detection and Rapid Response (EDRR).
    c. Be proactive in preventing new invasions.
    d. Mitigate wildlife conflict.

18. Ensure the health of existing forested areas. Where possible ensure native biodiversity and sustainable regeneration; elsewhere restore to the highest ecosystem function practicable.
    a. Ensure that forested areas are sustainable and promote regeneration.
    b. Expand tree cover and enhance forest health to protect ecosystem services, including improving local air and water quality and sequestering greenhouse gases.

19. Enhance connectivity of parkland to provide natural corridors that allow for the movement of populations over time and preserve ecosystem function and biodiversity.
    a. Focus on buffering sensitive natural resources.

FOSTERING STEWARDSHIP AND EXPANDING NATURAL RESOURCES
Spreading the word

The citizens of the City of Pittsburgh place a significant value on the community parks and greenspaces, with about 80% of the population using and visiting the parks each year. Many visitors participate in recreational activities that allow them to appreciate the parks natural resources, such as walking or biking on trails, birding, and nature study, visiting nature centers, and kayaking or canoeing in the rivers. It is clear, however, that many park visitors lack an understanding of the threats facing the long-term health of these natural resources and the important role that visitors play as stewards and advocates both on and off parkland. The natural resources provide the City with ecosystem services such as clean air and water and quality of life benefits for residents, requires active management and financial commitment to maintain. The actions under this management plan focuses on engaging citizens, staff and regional partners in resource management, with the goal of fostering support for programs and initiatives and raising awareness of the need for active stewardship.

20. Partner with diverse groups to engage and educate residents and staff about their role in natural resource stewardship and increase their awareness of conservation and resource management issues.

21. Maintain and/or enhance effective communication strategies with the public; explore new forms of outreach to engage citizens in natural resource conservation

and management and overcome socioeconomic, language and cultural challenges.

22. Provide high quality interpretive opportunities that enhance awareness of natural resources leading toward the appreciation and conservation of City of Pittsburgh's Natural Resources.
23. Work with adjacent landowners to expand natural areas beyond park boundaries through education, easements and cooperative agreements.
    a. Encourage habitat expansion through native landscaping practices.

24. Partner with diverse groups to conduct resource inventories, formulate plans and manage resources.
    a. Seek and develop partnerships to achieve resource management goals. Support citizen science where appropriate.
    b. Provide opportunities for volunteers to participate in natural resource management.

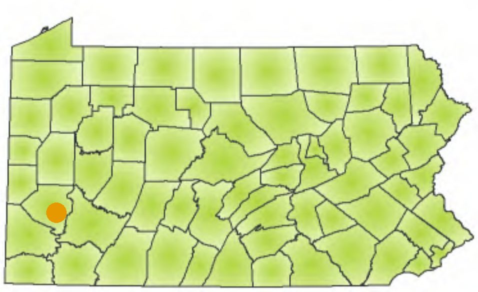
25. Leverage partnerships with all City agencies and entities having natural resource management responsibilities to optimize alignment of City and park policies as they relate to natural resource management.
    a. Identify and pursue opportunities for natural resource education, protection, restoration and management countywide.
    b. Extend natural resource management actions and benefits across property lines and jurisdictions.
    c. Collaborate with partners to maximize available resources.
    d. Broaden visions and align with regional efforts when possible and appropriate.

26. Participate in and support regional natural resource management planning and management efforts to better identify gaps and opportunities in natural resource protection and management.
    a. Protect and restore ecosystems on a regional and national scale.
    b. Encourage individuals and organizations to expand their vision beyond their own properties, neighborhoods, and counties.
    c. Collaborate and cooperate with partners in order to establish and achieve regional ecological goals.

APPENDIX A: City of Pittsburgh Properties

Figure 1
Project Location

Moore Park Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania



Project Location

N

0 750 1,500 3,000 Feet

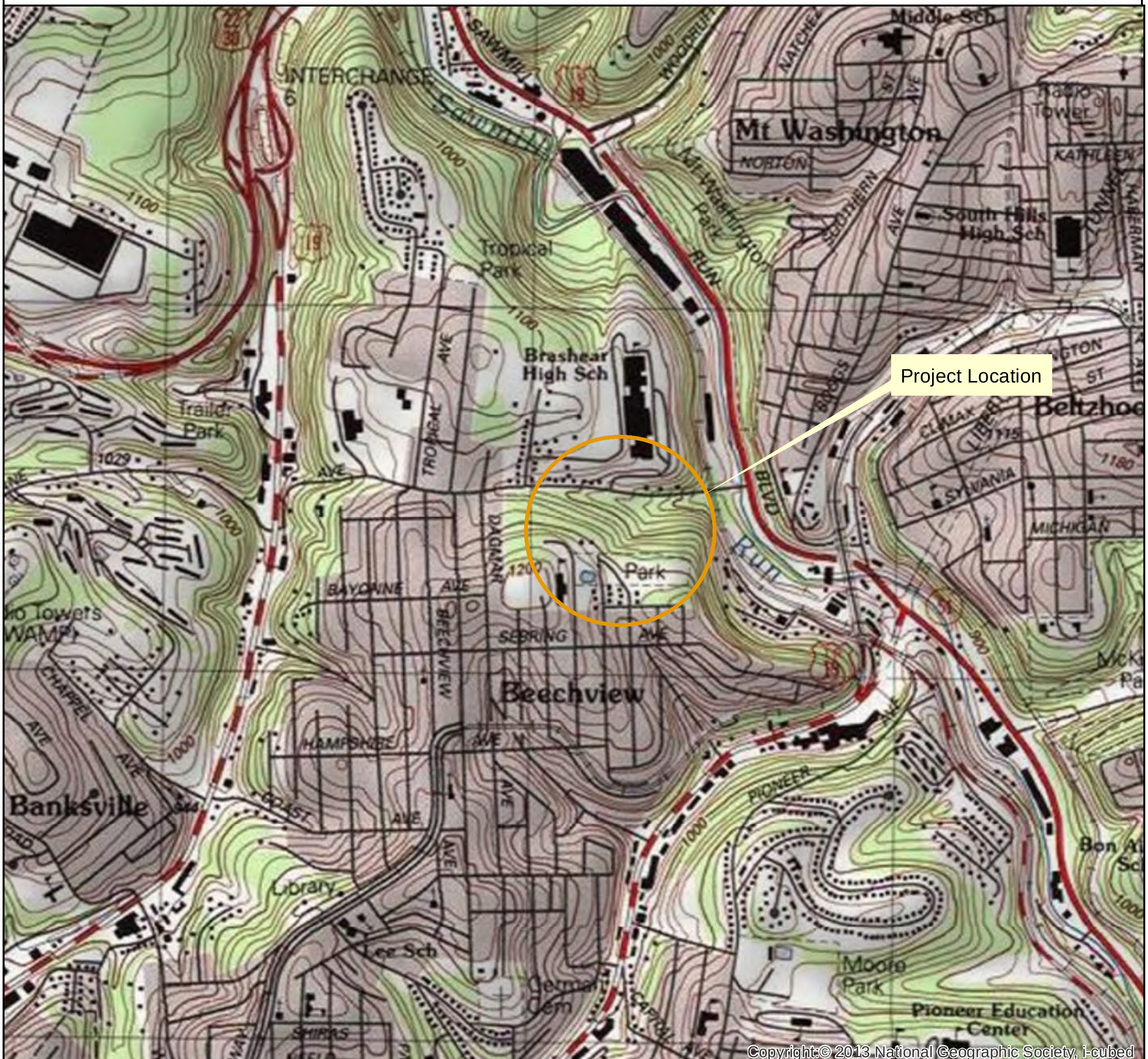
Scale: 1:24,000

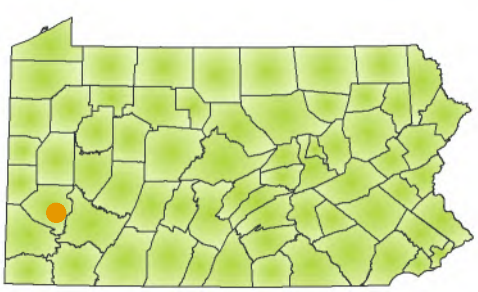
Map Source: USGS Quadrangle

Created by:
Hunt Valley Environmental, LLC

Figure 1
Project Location

Crane Avenue Stream Restoration Site
City of Pittsburgh, Allegheny County, Pennsylvania





Project Location

N

0 650 1,300 2,600 Feet

Scale: 1:24,000

Map Source: USGS Quadrangle

Created by:
Hunt Valley Environmental, LLC

APPENDIX B: Site Plans

Site Plans are included under Appendix C. The Resource Management Plan will include the same plans and details of the Moore Park and Crane Avenue- Beechview Greenway.

APPENDIX C: Operations and Maintenance

Operation, Maintenance, and Replacement Plans

The project proposes the use of stream and floodplain restoration to reduce the sediment loading rates at the selected sites at within the Sawmill Run Watershed (12-Digit HUC 050301010301). LRG has investigated several sites to determine the best possible options to provide sediment reduction mitigation.

The selected sites contain streams that are impaired due to urban runoff and sediment due to the impacts of stormwater runoff and land use. The selected restoration projects will be designed with sustainability in mind, along with increasing functionality to reduce sediment loads through the process of stabilizing stream banks and reconnecting the streams to the floodplain. LRG will utilize a method referred as regenerative stream conveyance in the unnamed tributaries to Sawmill Run. This will include channel restoration, floodplain grading and grade control structures to reestablish the stream channels and reconnect them with the floodplain. Woody debris will be used as the primary material for the stabilization of the channel in the form of log grade control structures and floodplain features. The reconstructed streams will be designed to have low bank heights that provide an opportunity for the stormwater to spread out over the floodplain.

Long term O&M is required for the project success. To minimize continual site management needs, Land Reclamation Group has designed Best Management Practices (BMP's) which will not require annual maintenance. The regenerative stream conveyance relies on the opportunities of the flood waters to access the flood plain that has vegetative cover minimizing the shear stress of the water. The Sponsor will need to inspect and monitor the channel. Vegetative success is important. The Sponsor will need to monitor, replace dead shrubs and reseed vegetation when plant success is not apparent. The grade controls need to be inspected. When scour is observed around the grad controls stone or products such as coir log should be used to prevent further scour.

For the Best Management practices proposed the Sponsor shall inspect the banks for further erosion. Vegetative cover is important. Plant success is essential for stabilization and minimization of erosion of sediment. The structures made of wood need to be inspected to make sure they are fixed firmly with no movement during high water events. If the structures are failing, they will require additional pinning or replacement. Where coir logs were utilized, the log must be securely staked/pinned to the streambed. The logs should be backed with material such as soil as presented in the plans. This area must be stabilized with vegetation to hold the material in place. Plugs must be planted in the coir log their success is important as the roots of the vegetation enhance the stability and strength of the log to minimize failure and soil erosion.

At all location success of vegetation is required. Where there are dead shrubs and less than 70% vegetative cover the areas will need to be seeded to prevent erosion and the shrubs will need to be replaced.

The stormwater retention facilities constructed at Moore Park and Beechview Greenway along Crane Avenue will require operations and maintenance for long term success.

Properly designed and installed Bioretention areas require some regular maintenance.

- While vegetation is being established, pruning and weeding may be required.
- Detritus may also need to be removed every year Perennial plantings may be cut down at the end of the growing season.
- Mulch should be re-spread when erosion is evident and be replenished as needed. Once every 2 to 3 years the entire area may require mulch replacement.
- Bioretention areas should be inspected at least two times per year for sediment buildup, erosion vegetative conditions, etc.
- During periods of extended drought, bioretention areas may require watering.
- Trees and shrubs should be inspected twice per year to evaluate health.

General Site Inspection

The reestablished streams shall be inspected for accelerated erosion and BMP failures every 6 months for the first two years. The reestablished streams will be inspected annually. Visual inspection of the grade controls and vegetation establishment will be required.

All sites shall be inspected for accelerated erosion and BMP failures every 6 months for the first two years. The stream bank BMP's will be inspected annually after the first two years.

All sites will be inspected after a significant event. This is a storm greater than a 5 year event.

GLOSSARY OF TERMS

Adaptive Resource Management – Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. It is not a 'trial and error' process, but rather emphasizes learning while doing.

Biodiversity – The variety of life in the world or in a particular habitat or ecosystem.

Citizen Science – A project that enables citizen volunteers to gather data that will be analyzed by professional researchers. Citizen volunteers may have no specific scientific training but can perform or manage research-related tasks such as observation, measurement, or computation.

Contributing Landscape – Ecological features which are critical to support species and their lifecycles or the proper functioning of natural systems. For example, field complexes which provide over-wintering habitat for short-eared owls and forested zones around vernal pools which protect hydrology and support breeding populations.

Early Detection and Rapid Response (EDRR) – An approach to preventing new invasive species infestations that requires regular monitoring of managed lands and a prompt and coordinated containment and eradication response. These actions result in lower cost and less resource damage than implementing a long-term control program after a species has become established.

Ecological Memory – The collective genetic biodiversity remaining in a given landscape locked up in living things and their roots, seeds, spores, and eggs. In terrestrial systems, the ecological memory cannot be separated from the soils.

Ecosystem Resilience – The capacity of an ecosystem to absorb disturbance without shifting to an alternative state and losing function and services.

Landscape Mosaic – A metaphor describing the intricate pattern of different habitats or land use types that comprise a geographic region.

Local Ecotype – Plant material and seeds that originate from a defined geographic area and carry genetic adaptations to the environmental conditions of the area.

Natural Resources – Includes living organisms; non-living components such as air, water and soil; the ecosystems they form; and the environmental services they provide, including cleaning air and water, supporting wildlife and contributing to the quality of life of our citizens. Natural resources is not self-sustaining, but requires deliberate care and investments to enhance, protect and preserve it.

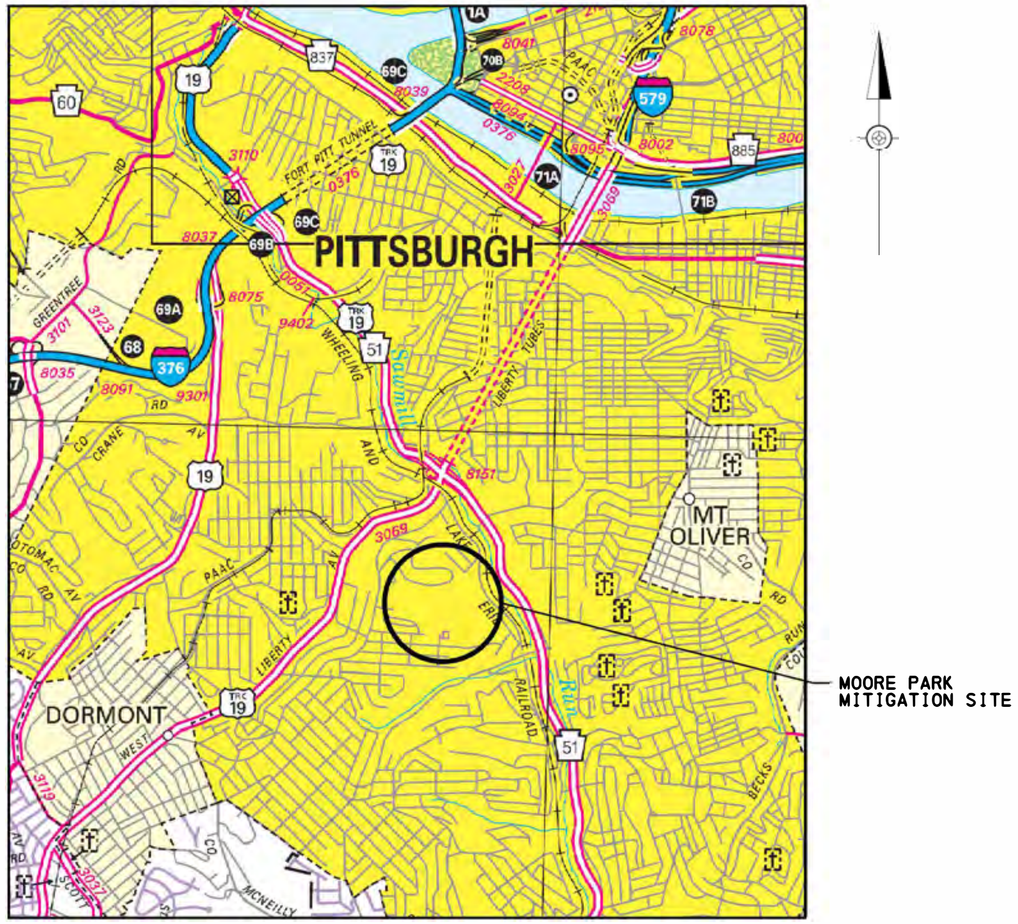
Natural Resource Management Plan(s) – A plan to identify, protect and manage natural resources that can be written to be agency-wide, site-specific, or resource- specific.

Natural Resource Action Plan(s) – An operations plan that summarizes the critical natural resources of a park and sets goals for their management based on available resources. These plans are intended to be brief.

Resource Protection Zone(s) – Areas of natural resource significance in which land disturbance shall be limited and access regulated based on the needs of the resources present. RPZs will generally be defined by the specific resources present.

Terrestrial Habitat Zone (for wetlands) – The terrestrial upland areas surrounding a wetland that influence the wetland's hydrology and contain the habitats necessary for various amphibian species to complete their life cycle.

Appendix C: Design Plans



LOCATION MAP

0 0.5 1.0 MILES

STREAM RESTORATION FOR MS4 CREDIT

IN THE SAW MILL RUN AND OHIO RIVER WATERSHED

FOR

PENNSYLVANIA DEPARTMENT OF TRANSPOTATION

AND

PITTSBURGH WATER AND SEWER AUTHORITY

POLLUANT REDUCTION PLAN

CALL BEFORE YOU DIG

PENNSYLVANIA LAW REQUIRES 3 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE AND 10 WORKING DAYS IN DESIGN STAGE - STOP CALL 1-800-242-1776

PA ONE CALL System Inc.

SHEET INDEX BLOCK

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
TITLE SHEET

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023

REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 065647

EROSION AND SEDIMENT POLLUTION CONTROL GENERAL NOTES

AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, INCLUDING CLEARING AND GRUBBING, THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE E&S PLAN PREPARER, THE PCSM PLAN PREPARER, THE LICENSED PROFESSIONAL RESPONSIBLE FOR OVERSIGHT OF CRITICAL STAGES OF IMPLEMENTATION OF THE PCSM PLAN, AND A REPRESENTATIVE FROM THE LOCAL CONSERVATION DISTRICT TO AN ON-SITE PRECONSTRUCTION MEETING.

AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS. DEVIATION FROM THAT SEQUENCE MUST BE APPROVED IN WRITING FROM THE LOCAL CONSERVATION DISTRICT OR BY THE DEPARTMENT PRIOR TO IMPLEMENTATION.

AREAS TO BE FILLED ARE TO BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS AND OTHER OBJECTIONABLE MATERIAL.

CLEARING, GRUBBING, AND TOPSOIL STRIPPING SHALL BE LIMITED TO THOSE AREAS DESCRIBED IN EACH STAGE OF THE CONSTRUCTION SEQUENCE. GENERAL SITE CLEARING, GRUBBING AND TOPSOIL STRIPPING MAY NOT COMMENCE IN ANY STAGE OR PHASE OF THE PROJECT UNTIL THE E&S BMPS SPECIFIED BY THE BMP SEQUENCE FOR THAT STAGE OR PHASE HAVE BEEN INSTALLED AND ARE FUNCTIONING AS DESCRIBED IN THIS E&S PLAN.

AT NO TIME SHALL CONSTRUCTION VEHICLES BE ALLOWED TO ENTER AREAS OUTSIDE THE LIMIT OF DISTURBANCE BOUNDARIES SHOWN ON THE PLAN MAPS. THESE AREAS MUST BE CLEARLY MARKED AND FENCED OFF BEFORE CLEARING AND GRUBBING OPERATIONS BEGIN.

TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED AT THE LOCATION(S) SHOWN ON THE PLAN MAPS(S) IN THE AMOUNT NECESSARY TO COMPLETE THE FINISH GRADING OF ALL EXPOSED AREAS THAT ARE TO BE STABILIZED BY VEGETATION. EACH STOCKPILE SHALL BE PROTECTED IN THE MANNER SHOWN ON THE PLAN DRAWINGS. STOCKPILE HEIGHTS SHALL NOT EXCEED 35 FEET. STOCKPILE SLOPES SHALL BE 2H:1V OR FLATTER.

IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, THE OPERATOR SHALL IMPLEMENT APPROPRIATE BEST MANAGEMENT PRACTICES TO MINIMIZE THE POTENTIAL FOR EROSION AND SEDIMENT POLLUTION AND NOTIFY THE LOCAL CONSERVATION DISTRICT AND/OR DISTRICT ENVIRONMENTAL UNIT.

ALL BUILDING MATERIALS AND WASTES SHALL BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED OF IN ACCORDANCE WITH THE DEPARTMENT'S SOLID WASTE MANAGEMENT REGULATIONS AT 25 PA. CODE 260.1 ET SEQ., 271.1, AND 287.1 ET. SEQ. NO BUILDING MATERIALS OR WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURNED, BURIED, DUMPED, OR DISCHARGED AT THE SITE.

EROSION AND SEDIMENTATION BEST MANAGEMENT PRACTICES (BMPS) THAT ARE PROPOSED FOR THE PROJECT SHALL BE INSTALLED AND FUNCTIONAL PRIOR TO ANY EARTH MOVING ACTIVITIES WITHIN THEIR CONTRIBUTING AREA.

CONDUCT ALL EARTH MOVING ACTIVITIES AS SPECIFIED IN THE EROSION AND SEDIMENTATION CONTROL PLAN AND IN ACCORDANCE WITH THE RULES AND REGULATION OF CHAPTER 102, TITLE 25 RELATED TO EROSION CONTROL, AND THE CLEAN STREAMS LAW OF PENNSYLVANIA.

UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENT BMPS SHALL BE MAINTAINED PROPERLY. MAINTENANCE SHALL INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENT BMPS AFTER EACH RUNOFF EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEAN OUT, REPAIR, REPLACEMENT, REGRADING, RESEEDING, REMULCHING AND RENETTING MUST BE PERFORMED IMMEDIATELY. IF THE E&S BMPS FAIL TO PERFORM AS EXPECTED, REPLACEMENT BMPS, OR MODIFICATIONS OF THOSE INSTALLED WILL BE REQUIRED IMMEDIATELY.

SEED AND MULCH ANY DISTURBED AREA THAT WILL REMAIN IDLE FOR MORE THAN 4 DAYS
STABILIZATION IS DEFINED AS A UNIFORM, 70%, PERENNIAL COVER ESTABLISHED OVER THE DISTURBED AREA.

ANY AND ALL ACCUMULATED SILT AND SEDIMENTS THAT ARE FOUND WITHIN AN EROSION CONTROL DEVICE SHALL BE REMOVED FROM THE CONTROL DEVICE AND SPREAD EVENLY ON THE FILL UPSLOPE OF THE EROSION AND SEDIMENTATION CONTROLS, AND THEN SEEDED AND MULCHED TO PROVIDE STABILIZATION.

ANY OFFSITE WASTE AND BORROW AREAS MUST HAVE AN E & S PLAN REVIEWED AND APPROVED BY THE LOCAL CONSERVATION DISTRICT AND THE DISTRICT ENVIRONMENTAL UNIT PRIOR TO BEING ACTIVATED.

CLEAN FILL IS DEFINED AS: UNCONTAMINATED, NON-WATER SOLUBLE, NON-DECOMPOSABLE, INERT, SOLID MATERIAL. THE TERM INCLUDES SOIL, ROCK, STONE, DREDGED MATERIAL, USED ASPHALT, AND BRICK, BLOCK OR CONCRETE, FROM CONSTRUCTION AND DEMOLITION ACTIVITIES THAT IS SEPARATE FROM OTHER WASTE AND IS RECOGNIZABLE AS SUCH. THE TERM DOES NOT INCLUDE MATERIALS PLACED IN OR ON THE WATERS OF THE COMMONWEALTH UNLESS OTHERWISE AUTHORIZED. (THE TERM USED ASPHALT DOES NOT INCLUDE MILLED ASPHALT OR ASPHALT THAT HAS BEEN PROCESSED FOR REUSE).

ENVIRONMENTAL DUE DILIGENCE MUST BE PERFORMED TO DETERMINE IF FILL MATERIALS ASSOCIATED WITH THE PROJECT QUALIFY AS CLEAN FILL. ENVIRONMENTAL DUE DILIGENCE IS DEFINED AS: INVESTIGATION TECHNIQUES, INCLUDING BUT NOT LIMITED TO, VISUAL PROPERTY INSPECTIONS, ELECTRONIC DATA BASE SEARCHES, REVIEW OF THE PROPERTY OWNERSHIP, REVIEW OF THE PROPERTY USE HISTORY, SANBORN MAPS, ENVIRONMENTAL QUESTIONNAIRES, TRANSACTION SCREEN, ANALYTICAL TESTING, ENVIRONMENTAL ASSESSMENTS OR AUDITS. ANALYTICAL TESTING IS NOT A REQUIRED PART OF DUE DILIGENCE UNLESS VISUAL INSPECTION AND/OR REVIEW OF THE PAST LAND USE OF THE PROPERTY INDICATES THAT THE FILL MAY HAVE BEEN COMPROMISED BY A RELEASE OF A REGULATED SUBSTANCE. IF THE FILL IS SUSPECTED TO HAVE BEEN COMPROMISED BY A RELEASE OF A REGULATED SUBSTANCE, IT MUST BE TESTED TO DETERMINE IF IT QUALIFIES AS A CLEAN FILL. TESTING SHOULD BE PERFORMED IN ACCORDANCE WITH APPENDIX A OF THE DEPARTMENT'S POLICY "MANAGEMENT OF CLEAN FILL".

THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ANY MATERIAL BROUGHT ON SITE IS CLEAN FILL. PADEP FORM FP-001 MUST BE RETAINED BY THE PROPERTY OWNER FOR ANY FILL MATERIAL AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE BUT QUALIFYING AS CLEAN FILL DUE TO ANALYTICAL TESTING.

ALL EARTH DISTURBANCES, INCLUDING CLEARING AND GRUBBING AS WELL AS CUTS AND FILLS SHALL BE DONE IN ACCORDANCE WITH THE APPROVED E&S PLAN. A COPY OF THE APPROVED DRAWINGS (STAMPED, SIGNED AND DATED BY THE REVIEWING AGENCY) MUST BE AVAILABLE AT THE PROJECT SITE AT ALL TIMES. THE REVIEWING AGENCY SHALL BE NOTIFIED OF ANY CHANGES TO THE APPROVED PLAN PRIOR TO IMPLEMENTATION OF THOSE CHANGES. THE REVIEWING AGENCY MAY REQUIRE A WRITTEN SUBMITTAL OF THOSE CHANGES FOR REVIEW AND APPROVAL AT ITS DISCRETION.

ALL PUMPING OF WATER FROM ANY WORK AREA SHALL BE DONE ACCORDING TO THE PROCEDURE DESCRIBED IN THIS PLAN, OVER UNDISTURBED VEGETATED AREAS.

A WRITTEN LOG MUST BE COMPLETED ON FORM 3800-FM-BCW0271D (MOST CURRENT FORM) SHOWING DATES THAT E&S BMPS WERE INSPECTED, DEFICIENCIES FOUND AND THE DATE THEY WERE CORRECTED SHALL BE MAINTAINED ON THE SITE AND BE MADE AVAILABLE TO REGULATORY AGENCY OFFICIALS AT THE TIME OF INSPECTION.

SEDIMENT TRACKED ONTO ANY PUBLIC ROADWAY OR SIDEWALK SHALL BE RETURNED TO THE CONSTRUCTION SITE BY THE END OF EACH WORK DAY AND DISPOSED IN THE MANNER DESCRIBED IN THIS PLAN. IN NO CASE SHALL THE SEDIMENT BE WASHED, SHOVELED, OR SWEPT INTO ANY ROADSIDE DITCH, STORM SEWER, OR SURFACE WATER.

AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 3 TO 5 INCHES 6 TO 12 INCHES ON COMPACTED SOILS PRIOR TO PLACEMENT OF TOPSOIL. AREAS TO BE VEGETATED SHALL HAVE A MINIMUM 4 INCHES OF TOPSOIL IN PLACE PRIOR TO SEEDING AND MULCHING. FILL OUTSLOPES SHALL HAVE A MINIMUM OF 2 INCHES OF TOPSOIL.

BMP INSPECTION, MAINTENANCE AND REPAIR SCHEDULE

BMP	INSPECTION	MAINTENANCE	REPAIR
ROCK CONSTRUCTION ENTRANCE	DAILY	REMOVE SEDIMENT	MAINTAIN THICKNESS AND DIMENSIONS BY ADDING ROCK
SEEDING AND MULCHING	WEEKLY AND AFTER EACH RAINFALL EVENT	N/A	EVALUATE CONDITIONS AND RE-SEED AND STABILIZE
PUMPED WATER FILTER BAG	DAILY	CEASE USE AND FIX PROBLEM	REPAIR IMMEDIATELY
TEMPORARY PUMP BYPASS	DAILY	CEASE USE AND FIX PROBLEM	REPAIR IMMEDIATELY

NOTES:

1. MAINTENANCE AND REPAIR ON BMP'S MUST BE COMPLETED IMMEDIATELY AFTER THE WEEKLY OR RAINFALL INSPECTION.
2. SEDIMENT REMOVED FROM BMP'S SHALL BE PLACED ON THE TOP SOIL STOCK PILE FOR USE LATER IN THE PROJECT.
3. A RUNOFF EVENT IS RAINFALL OR SNOW RUNOFF OF 0.25" OR MORE IN A 24 CONSECUTIVE HOUR PERIOD.
4. WEEKLY OR RAINFALL INSPECTIONS OVER MUST BE COMPLETED ON THE WRITTEN LOG FORM 3800-FM-BCW0271D (OR MOST CURRENT FORM).

ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES.

FILL MATERIALS SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS.

FROZEN MATERIALS OR SOFT, MUCKY, OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED INTO FILLS. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES.

SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD.

ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY UPON REACHING FINISHED GRADE. CUT SLOPES IN COMPETENT BEDROCK AND ROCK FILLS NEED NOT BE VEGETATED. SEEDED AREAS WITHIN 50 FEET OF A SURFACE WATER, OR AS OTHERWISE SHOWN ON THE PLAN DRAWINGS, SHALL BE BLANKETED ACCORDING TO THE STANDARDS OF THIS PLAN.

IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE IN ANY AREA OR SUBAREA OF THE PROJECT, THE OPERATOR SHALL STABILIZE ALL DISTURBED AREAS. DURING NON-GERMINATING MONTHS, MULCH OR PROTECTIVE BLANKETING SHALL BE APPLIED AS DESCRIBED IN THE PLAN. AREAS NOT AT FINISHED GRADE, WHICH WILL BE REACTIVATED WITHIN 1 YEAR, MAY BE STABILIZED IN ACCORDANCE WITH THE TEMPORARY STABILIZATION SPECIFICATIONS. THOSE AREAS WHICH WILL NOT BE REACTIVATED WITHIN 1 YEAR SHALL BE STABILIZED IN ACCORDANCE WITH THE PERMANENT STABILIZATION SPECIFICATIONS.

PERMANENT STABILIZATION IS DEFINED AS A MINIMUM UNIFORM, PERENNIAL 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED EROSION. CUT AND FILL SLOPES SHALL BE CAPABLE OF RESISTING FAILURE DUE TO SLUMPING, SLIDING, OR OTHER MOVEMENTS.

E&S BMPS SHALL REMAIN FUNCTIONAL AS SUCH UNTIL ALL AREAS TRIBUTARY TO THEM ARE PERMANENTLY STABILIZED OR UNTIL THEY ARE REPLACED BY ANOTHER BMP APPROVED BY THE LOCAL CONSERVATION DISTRICT OR DISTRICT ENVIRONMENTAL UNIT.

AFTER FINAL SITE STABILIZATION HAS BEEN ACHIEVED, TEMPORARY EROSION AND SEDIMENT BMPS MUST BE REMOVED OR CONVERTED TO PERMANENT POST CONSTRUCTION STORMWATER MANAGEMENT BMPS. AREAS DISTURBED DURING REMOVAL OR CONVERSION OF THE BMPS SHALL BE STABILIZED IMMEDIATELY. IN ORDER TO ENSURE RAPID REVEGETATION OF DISTURBED AREAS, SUCH REMOVAL/CONVERSIONS ARE TO BE DONE ONLY DURING THE GERMINATING SEASON.

UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE OWNER AND/OR OPERATOR SHALL CONTACT THE LOCAL CONSERVATION DISTRICT TO SCHEDULE A FINAL INSPECTION.

NOTIFY THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION AND THE ALLEGHENY COUNTY CONSERVATION DISTRICT 10 DAYS IN ADVANCE OF ANY LAND DISTURBANCE ACTIVITIES AT THE FOLLOWING ADDRESS:

PROCEDURES WHICH ENSURE THAT THE PROPER MEASURES FOR THE RECYCLING OR DISPOSAL OF MATERIALS ASSOCIATED WITH OR FROM THE PROJECT SITE WILL BE UNDERTAKEN IN ACCORDANCE WITH DEPARTMENT REGULATIONS. INDIVIDUALS RESPONSIBLE FOR EARTH DISTURBANCE ACTIVITIES MUST ENSURE THAT PROPER MECHANISMS ARE IN PLACE TO CONTROL WASTE MATERIALS. CONSTRUCTION WASTES INCLUDE, BUT ARE NOT LIMITED TO, EXCESS SOIL MATERIALS, BUILDING MATERIALS, CONCRETE WASH WATER, SANITARY WASTES, ETC. THAT COULD ADVERSELY IMPACT WATER QUALITY. MEASURES SHOULD BE PLANNED AND IMPLEMENTED FOR HOUSEKEEPING, MATERIALS MANAGEMENT, AND LITTER CONTROL. WHEREVER POSSIBLE, RECYCLING OF EXCESS MATERIALS IS PREFERRED, RATHER THAN DISPOSAL. A NOTE REQUIRING RECYCLING OF WASTE MATERIALS, WHERE FEASIBLE, SHOULD BE ADDED TO THE DRAWINGS.

MAUREEN COPELAND, SENIOR RESOURCE CONSERVATIONIST
ALLEGHENY COUNTY CONSERVATION DISTRICT
317 EAST CARSON STREET, SUITE 119
PITTSBURGH, PA 15219
PHONE: (412) 291-8005

PA DEP REGIONAL OFFICE CONTACT INFORMATION:

PA DEP SOUTHWEST REGIONAL OFFICE
WETLANDS AND WATERWAYS
400 WATERFRONT DRIVE
PITTSBURGH, PA 15222
OFFICE HOURS 8 A.M. - 4 P.M.
PHONE: (412) 422-4000

PLAN PREPARER CONTACT INFORMATION:

MR. JAMES FLYNN, P.E.
HUNT VALLEY ENVIROMENTAL, LLC
632 HUNT VALLEY CIRCLE
NEW KENSINGTON, PA 15068
PHONE: 724-594-0805

ALL CONSTRUCTION ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING CONSTRUCTION SEQUENCE. EACH STEP SHALL BE COMPLETED BEFORE A SUBSEQUENT STEP IS INITIATED. UPON COMPLETION OR TEMPORARY CESSATION OF THE EARTH DISTURBANCE ACTIVITY, OR ANY STAGE THEREOF, THE PROJECT SITE SHALL BE IMMEDIATELY STABILIZED. THE CONTRACTOR CAN PROCEED WITH THE REMAINDER OF CLEARING AND GRUBBING BETWEEN NOVEMBER 16 AND MARCH 31. INSTALL THE REMAINDER BMP'S AND CONTINUE WITH FILL ON THE SITE.

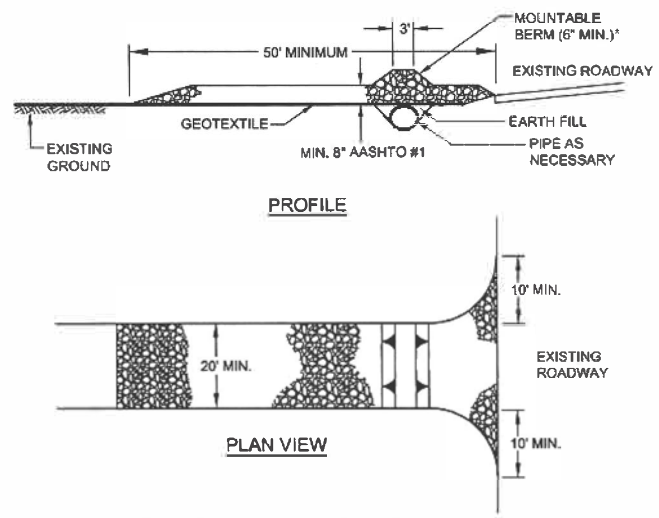
1. AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES (INCLUDING CLEARING AND GRUBBING), THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE EROSION AND SEDIMENT POLLUTION CONTROL PLAN PREPARER, A REPRESENTATIVE FROM THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION AND A REPRESENTATIVE FROM THE ALLEGHENY COUNTY CONSERVATION DISTRICT TO AN ON-SITE PRECONSTRUCTION MEETING.
2. AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.
3. ALL APPLICABLE PERMITS AND APPROVALS REQUIRED FOR THIS PROJECT SHALL BE SECURED PRIOR TO THE START OF CONSTRUCTION. COPIES OF PERMITS, PLANS AND APPROVALS SHALL BE KEPT ON-SITE AT ALL TIMES.
4. ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS.
5. THE SELECTED CONTRACTOR IS RESPONSIBLE FOR HAVING AN APPROVED EROSION AND SEDIMENTATION CONTROL PLAN FOR ALL OFF-SITE WASTE AND BORROW SITES.
6. CONTRACTOR SHOULD LIMIT STOCKPILING OF WASTE, CONSTRUCTION EQUIPMENT, FUEL TANKS, BORROWED EXCAVATION, ETC. NEAR THE STREAM IN THE EVENT A SIGNIFICANT STORM SHOULD OCCUR.
7. MOBILIZE FOR PROJECT CONSTRUCTION.

LRG WILL UTILIZE REGENERATIVE STREAM CONVEYANCE/FLOOD PLAIN RESTORATION FOR THE CONSTRUCTION METHOD OF THE REESTABLISHED UNNAMED TRIBUTARY CHANNELS IN SAWMILL RUN. LENGTH OF EACH CONSTRUCTION REACH IS BASED ON THE EXISTING FLOW OF THE CHANNEL.

1. PLACE A ROCK CONSTRUCTION ENTRANCE FOR ACCESS TO THE STREAM.
2. SET UP STREAM DIVERSION/PUMP AROUND APPROXIMATELY 200 FEET MAX IN LENGTH
3. ONLY DISTURB LENGTH OF CHANNEL THAT CAN BE RESTORED IN A DAY.
4. PLACE STONE FILTER IN THE CHANNEL 5-10 FEET UPSTREAM AT THE POINT WHERE THE PUMP DISCHARGES THE WATER INTO THE DOWN-STREAM CHANNEL. DISCHARGE THE WATER THROUGH A DIFFUSER 20 FEET DOWNSTREAM OF THE WORK AREA DO NOT CAUSE A SCOUR ISSUE IN THE CHANNEL OR WETLANDS.
5. GRADE THE CHANNEL CLOSED IN THE REACH.
6. EXCAVATE THE CHANNEL TO PROPOSED GRADE AND DEPTH BY USING THE BACK OF THE BUCKET. IT WILL BE 4" - 6" DEPTH BASED ON THE DETAIL.
7. EXCAVATE AND PLACE GRADE CONTROL STRUCTURES PERPENDICULAR TO CHANNEL SO TOP OF THE LOG STRUCTURE IS AT THE INVERT OF THE CHANNEL. THESE WILL BE SPACED ACCORDING TO CHART IN PLAN.
8. PLACE AASHTO-1 IN BED AS NEEDED
9. SEED FLOODWAY PER SEEDING SPECIFICATION ON DETAIL SHEET, MULCHING WITH A TEMPORARY MULCH BLANKET OR ECMB AS DETAIL RECOMENDS.
10. REMOVE BYPASS PUMP, PROCEED TO NEXT REACH, LEAVE STONE FILTER IN PLACE AT THE DOWNSTREAM END UNTIL THE CHANNEL RESTABLISHMENT PROJECT IS COMPLETED.

REPEAT THE SEQUENCE BASED UPON THE STATIONING OF THE REACH. EACH REACH CAN NOT EXCEED 200 FEET UNLESS THE CHANNEL IS DRY. THE SAME SEQUENCE WILL BE FOLLOWED FOR THE REESTBLISHEMNT OF EACH CHANNEL.

STANDARD CONSTRUCTION DETAIL # 3-1
Rock Construction Entrance



* MOUNTABLE BERM USED TO PROVIDE PROPER COVER FOR PIPE

Modified from Maryland DOE

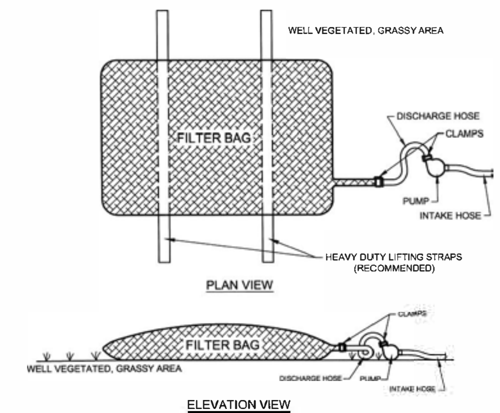
Remove topsoil prior to installation of rock construction entrance. Extend rock over full width of entrance.

Runoff shall be diverted from roadway to a suitable sediment removal BMP prior to entering rock construction entrance.

Mountable berm shall be installed wherever optional culvert pipe is used and proper pipe cover as specified by manufacturer is not otherwise provided. Pipe shall be sized appropriately for size of ditch being crossed.

MAINTENANCE: Rock construction entrance thickness shall be constantly maintained to the specified dimensions by adding rock. A stockpile shall be maintained on site for this purpose. All sediment deposited on paved roadways shall be removed and returned to the construction site immediately. If excessive amounts of sediment are being deposited on roadway, extend length of rock construction entrance by 50 foot increments until condition is alleviated or install wash rack. Washing the roadway or sweeping the deposits into roadway ditches, sewers, culverts, or other drainage courses is not acceptable.

STANDARD CONSTRUCTION DETAIL # 3-16
Pumped Water Filter Bag



PA DEP

Low volume filter bags shall be made from non-woven geotextile material sewn with high strength, double stitched "J" type seams. They shall be capable of trapping particles larger than 150 microns. High volume filter bags shall be made from woven geotextiles that meet the following standards:

Property	Test Method	Minimum Standard
Avg. Wide Width Strength	ASTM D-4884	60 lb/in
Grab Tensile	ASTM D-4632	205 lb
Puncture	ASTM D-4833	110 lb
Mullen Burst	ASTM D-3786	350 psi
UV Resistance	ASTM D-4355	70%
AOS % Retained	ASTM D-4751	80 Sieve

A suitable means of accessing the bag with machinery required for disposal purposes shall be provided. Filter bags shall be replaced when they become ½ full of sediment. Spare bags shall be kept available for replacement of those that have failed or are filled. Bags shall be placed on straps to facilitate removal unless bags come with lifting straps already attached.

Bags shall be located in well-vegetated (grassy) area, and discharge onto stable, erosion resistant areas. Where this is not possible, a geotextile underlayment and flow path shall be provided. Bags may be placed on filter stone to increase discharge capacity. Bags shall not be placed on slopes greater than 5%. For slopes exceeding 5%, clean rock or other non-erodible and non-polluting material may be placed under the bag to reduce slope steepness.

No downslope sediment barrier is required for most installations. Compost berm or compost filter sock shall be installed below bags located in HQ or EV watersheds, within 50 feet of any receiving surface water or where grassy area is not available.

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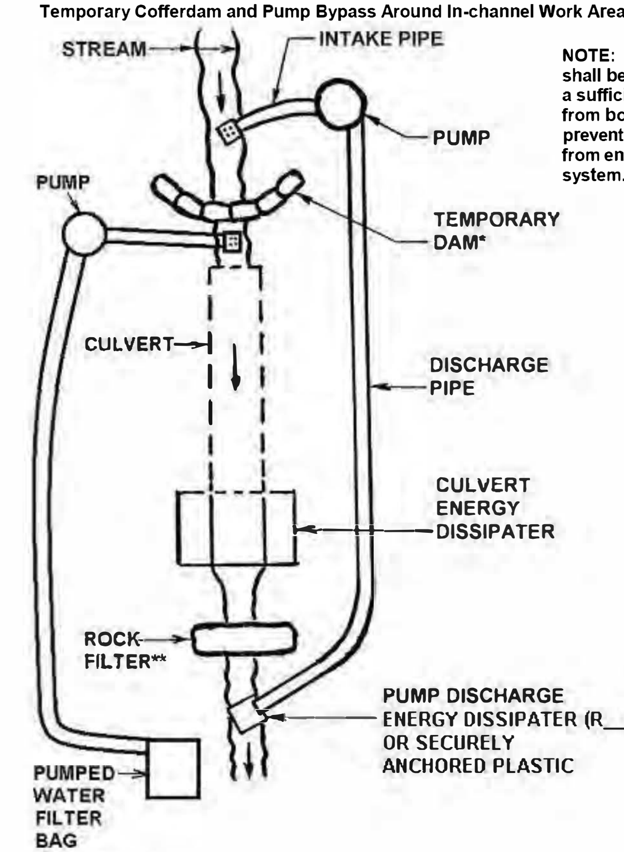
FIGURE 3.11
Temporary Cofferdam and Pump Bypass Around In-channel Work Areas



NOTE: Pump intake shall be maintained a sufficient distance from bottom to prevent sediment from entering the system.

PA DEP

* **Sandbags (Standard Construction Detail #3-15), Jersey barriers (Figure 3.13) or other non-erosive material, no earth fill. Do not excavate a sump for the pump intake.**

** **See Standard Construction Detail # 4-14. For low gradient channels, the rock filter may be replaced by an impervious cofferdam to prevent backflow into the work area.**

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(Additional Notes for Standard Construction Detail # 3-16)

The pump discharge hose shall be inserted into the bags in the manner specified by the manufacturer and securely clamped. A piece of PVC pipe is recommended for this purpose.

The pumping rate shall be no greater than 750 gpm or ½ the maximum specified by the manufacturer, whichever is less. Pump intakes shall be floating and screened.

Filter bags shall be inspected daily. If any problem is detected, pumping shall cease immediately and not resume until the problem is corrected.

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
EROSION AND SEDIMENT DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

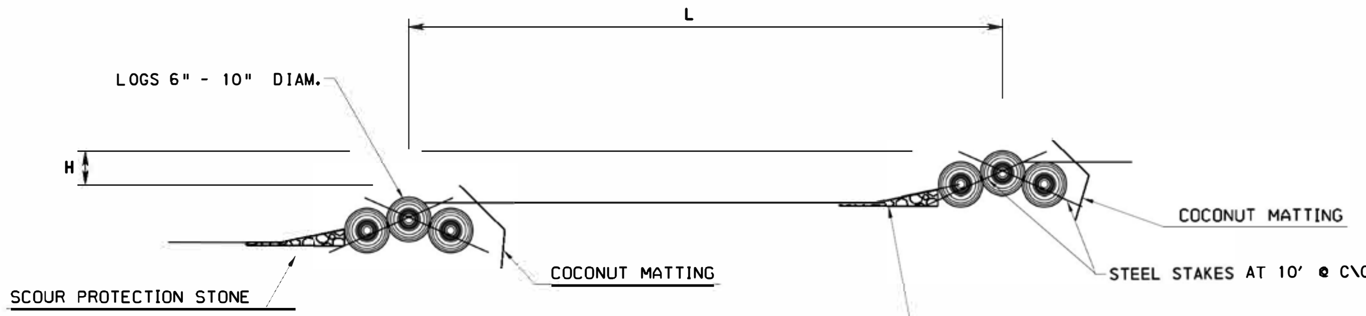
PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023
REVISED SUBMISSION DATE: 8-3-2023

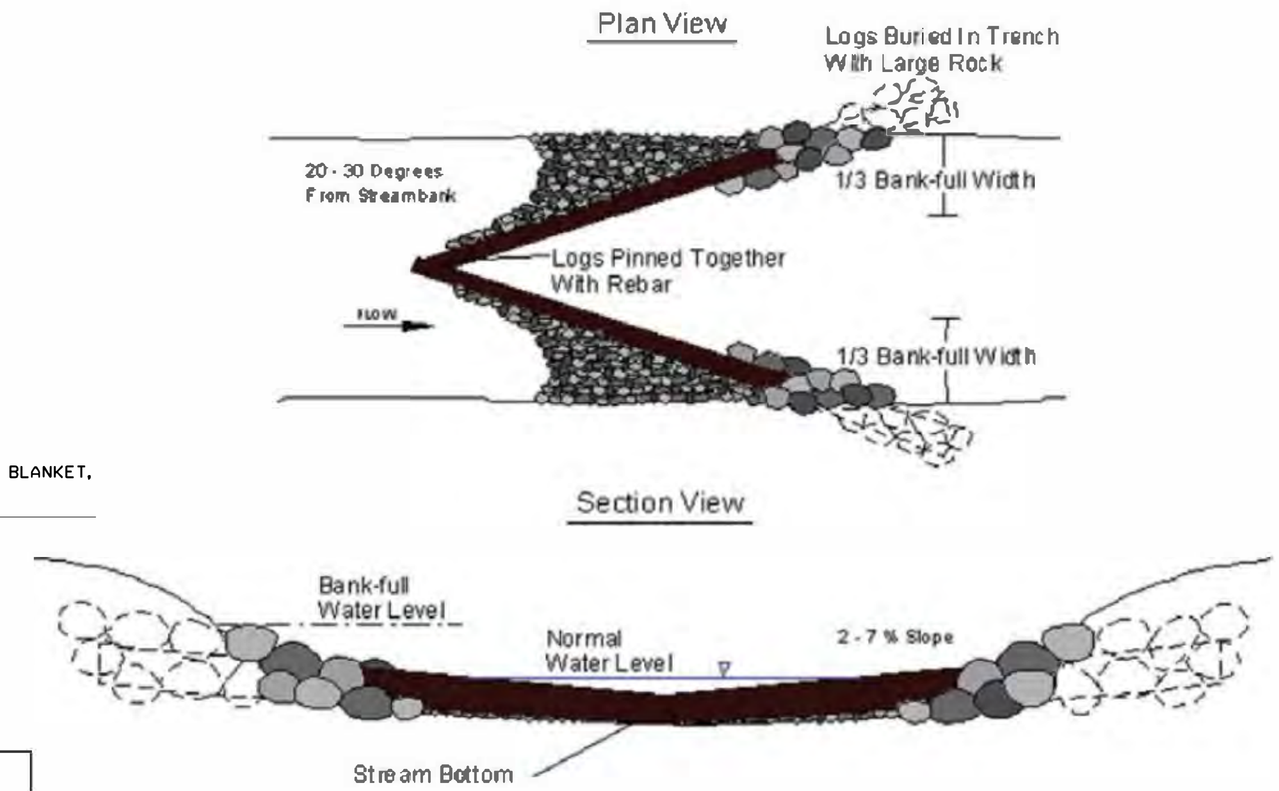
COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN PE 06647

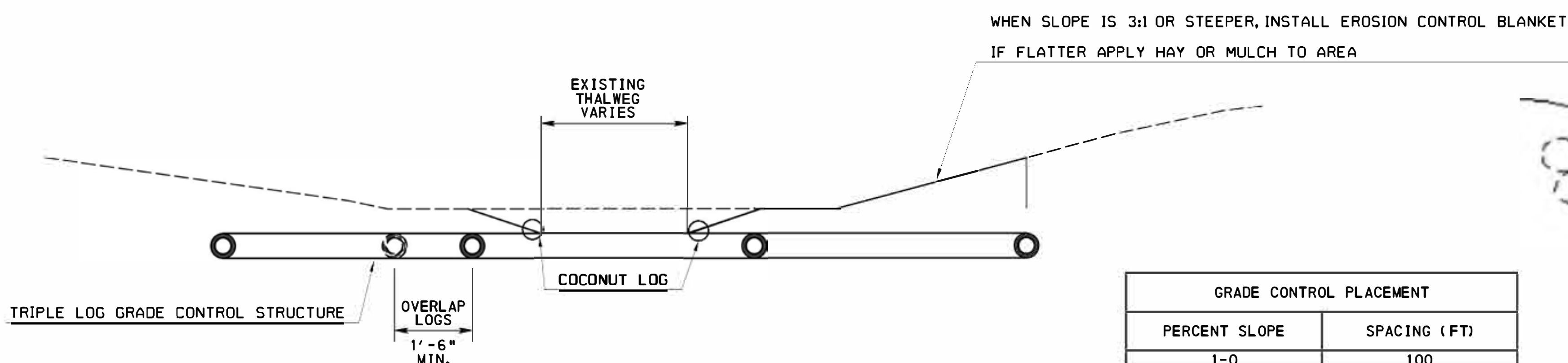


SECTION A-A

LOG CROSS VANE

(LOW FLOW CHANNEL STRUCTURE)





LOG GRADE CONTROL

GRADE CONTROL PLACEMENT	
PERCENT SLOPE	SPACING (FT)
1-0	100
3-1	75-100
5-3	60-75
7-5	45-60
9-7	30-45
11-9	20-30
13-11	15-20
15	9-15

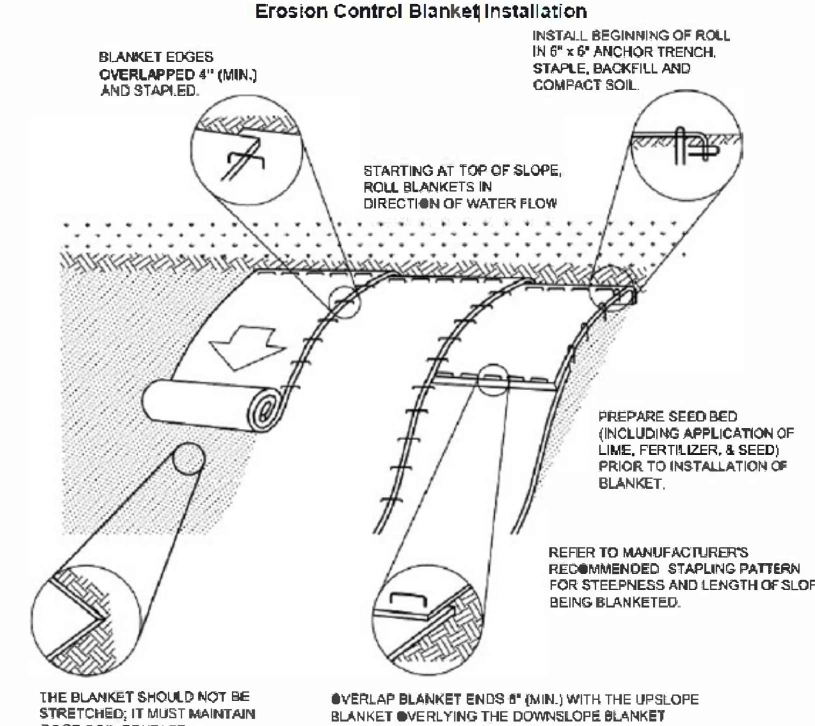
GRADE CONTROL NOTES:

1. GRADES GREATER THAN 20% WILL USE REESTABLISHMENT LOG AND ROCK STEP POOL. SEE DETAIL THIS SHEET.

GRADE CONTROL DETAIL

NTS

Erosion Control Blanket Installation



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STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
GRADE CONTROL DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

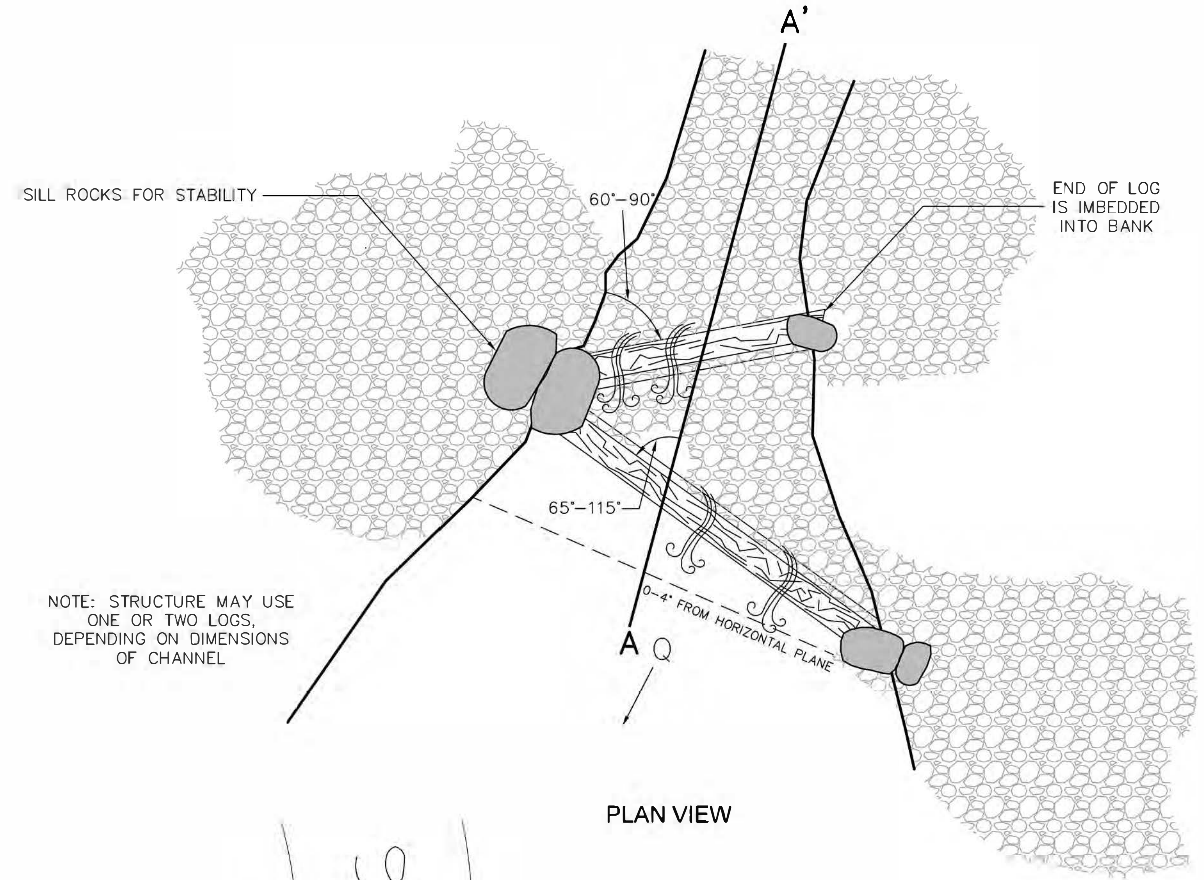
PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

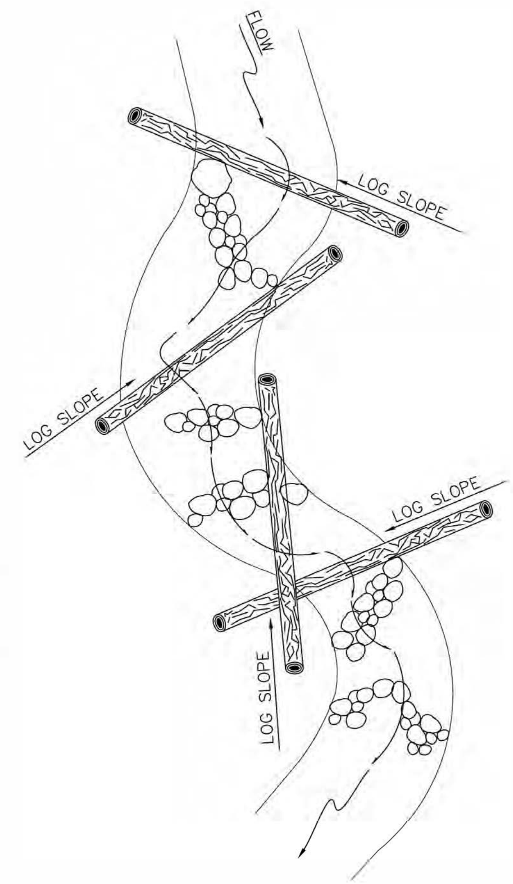
ORIGINAL SUBMISSION DATE: 3-8-2023

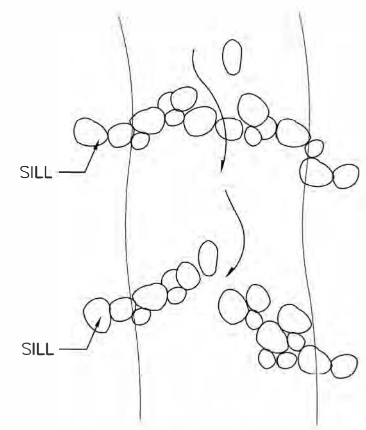
REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 06647



PLAN VIEW



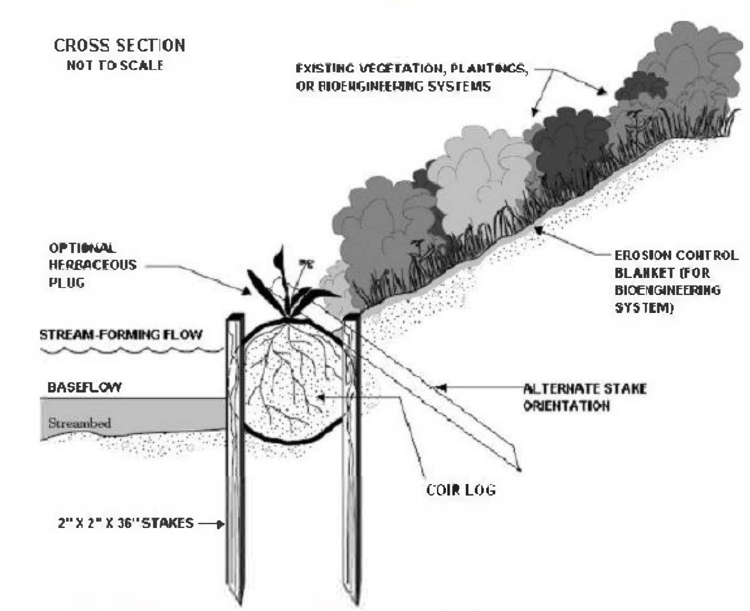


PLAN VIEW

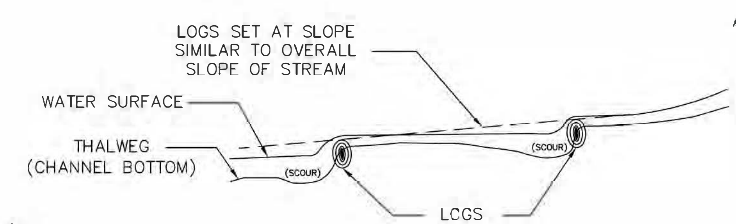
LOG AND ROCK STEP DETAIL

NOT TO SCALE

Fiber Rolls



Adapted from USDA, NRCS, *Engineering Field Handbook*, Chapter 16



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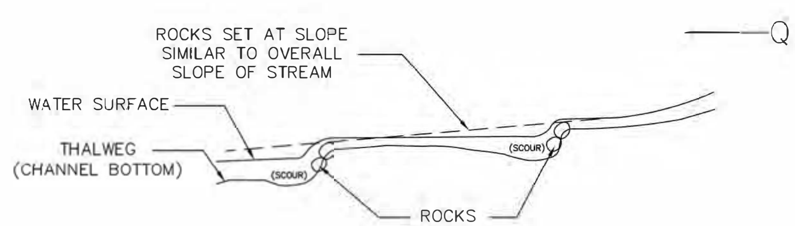

SECTION A - A'

CONSTRUCTION NOTES:

LOGS SHALL BE HEMLOCK, LOCUST, OR OTHER ONSITE AVAILALE SPECIES AND A MIN 8" IN DIAMETER.

LOG OR ROCK STEP POOL STRUCTURE

NOT TO SCALE

SHEET 6 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT GRADE CONTROL DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 06547

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4SawmillRunGradeControlDetails.dgn
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DETENTION BASIN FLOOR SEED MIXTURE

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
ALKALIGRASS (PUCCINELLIA DISTANS)	20	99	90	0.15	1.04

FORMULA L MIXTURE

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					48.0 TOTAL
HARD FESCUE MIXTURE (FESTUCA LONGIFOLIA) A COMBINATION OF IMPROVED CERTIFIED VARIETIES WITH NO ONE VARIETY EXCEEDING 50% OF THE TOTAL HARD FESCUE COMPONENT	55	97	85	0.10	26.0
CREEPING RED FESCUE (FESTUCA RUBRA) (IMPROVED AND CERTIFIED)	35	97	85	0.10	17.0
ANNUAL RYEGRASS (LOLIUM MULTIFLORUM)	10	95	90	0.10	5.0

LIMING RATES

AGRICULTURAL LIME (PERMANENT SEEDING) = 800 LBS / 1000 SY
AGRICULTURAL LIME (TEMPORARY SEEDING) = 800 LBS / 1000 SY

FERTILIZER RATES

APPLY SLOW RELEASE NITROGEN FERTILIZER TO THE SURFACE OF FORMULAS:

PULVERIZED AGRICULTURAL LIMESTONE = 800 LB/ 1000 SY

10-20-20 ANALYSIS COMMERCIAL FERTILIZER = 140 LBS / 1000 SY

38-0-0 UREAFORM FERTILIZER = 50 LBS / 1000 SY OR 32-0-0 TO 38-0-0 SULFUR COATED UREA FERTILIZER = 59 LBS / 1000 SY TO 50 LBS / 1000 SY, AS DIRECTED OR 31-0-0 IBDU FERTILIZER = 61 LBS / 1000 SY

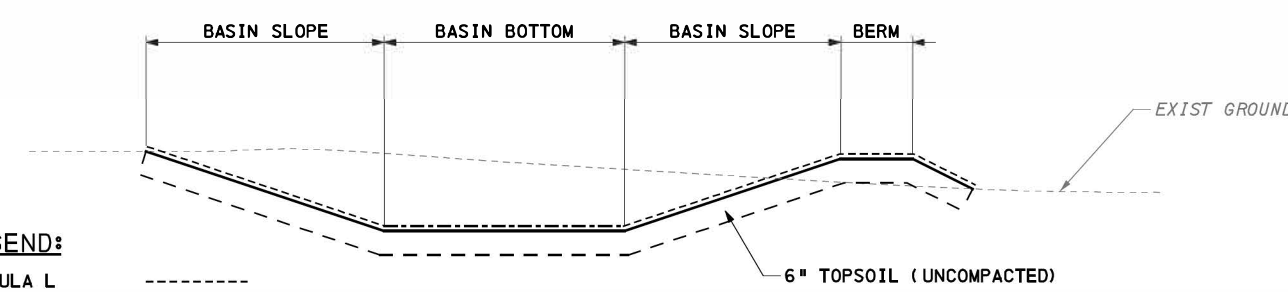
MULCHING RATES

APPLY STRAW AT A RATE OF 1200 LBS / 1000 SY TO THE SURFACE OF FORMULA E.

APPLY ROLLED EROSION CONTROL PRODUCT TO ALL NEWLY SEEDED AREAS ON SLOPES 3:1 OR GREATER.

SEEDING DATES

FORMULA L	
DETENTION BASIN FLOOR AND SEASONALLY FLOODED MIXTURE	MARCH 15 TO MAY 15 SEPTEMBER 1 TO OCTOBER 15



LEGEND:

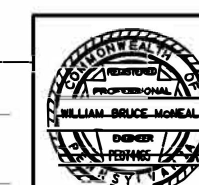
FORMULA L ---------

DETENTION BASIN FLOOR SEED MIX _._._._.

DRY DETENTION BASIN SEEDING TYPICAL SECTION

NOT TO SCALE

SHEET 7 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT DETENTION BASIN DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023



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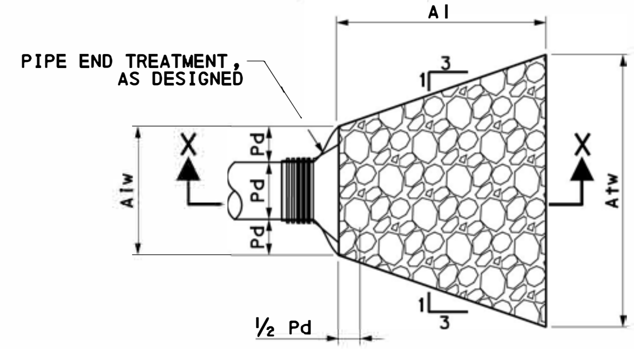
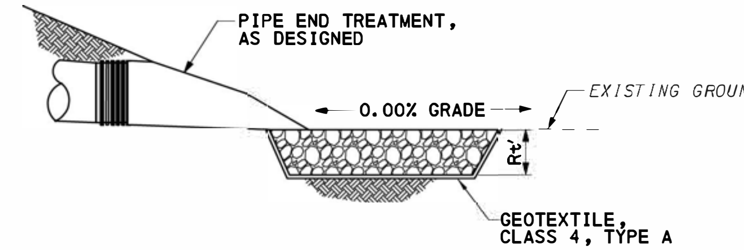


PLAN VIEW



SECTION X-X

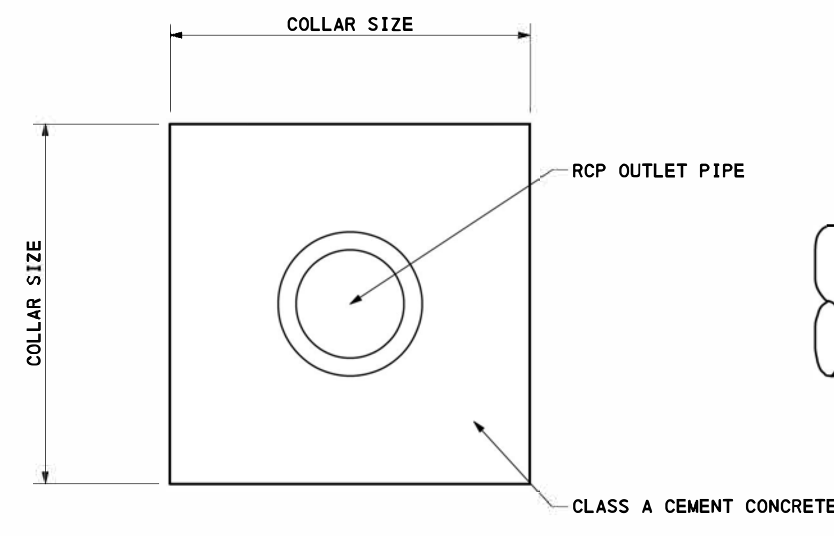
OUTLET PROTECTION NOTES:

1. ALL APRONS SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN. TERMINAL WIDTHS SHALL BE ADJUSTED AS NECESSARY TO MATCH RECEIVING CHANNELS.
2. PROVIDE GEOTEXTILE MATERIAL ALONG ALL INTERFACE AREAS WITH GROUND CONTACT.
3. EXTEND RIPRAP ON BACK SIDE OF APRON TO AT LEAST 1/2 DEPTH OF PIPE ON BOTH SIDES TO PREVENT SCOUR AROUND THE PIPE.

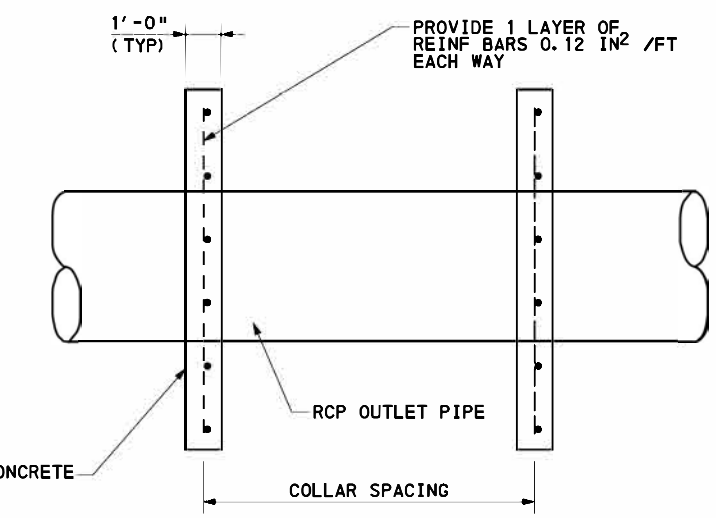
APRON NO.	LOCATION	PIPE DIA Pd (IN)	Q (CFS) 10-YR	Q * (CFS) 100-YR	VELOCITY (FPS) 10-YR	VELOCITY (FPS) * 100-YR	RIPRAP SIZE R-_	RIPRAP THICK Rt (IN)	APRON LENGTH AI (FT)	APRON INITIAL WIDTH AIw (FT)	APRON TERMINAL WIDTH Atw (FT)
OP-EW1	MOORE PARK	18	7.09	-	5.25	-	3	9	9	4.50	10.50
OP-EW2	MOORE PARK	18	2.96	9.15	5.29	7.26	4	18	9	4.50	10.50
OP-EW3	MOORE PARK	18	2.40	11.42	5.53	8.93	4	18	10	4.50	11.17
OP-EW4	CRANE AVE	15	10.76	-	10.13	-	5	27	12	3.75	11.75
OP-EW5	CRANE AVE	27	32.87	-	9.73	-	5	27	18	6.75	18.75
OP-EW6	CRANE AVE	18	8.52	14.60	9.17	10.53	5	27	12	4.50	12.50

ROCK APRON OUTLET PROTECTION DETAIL

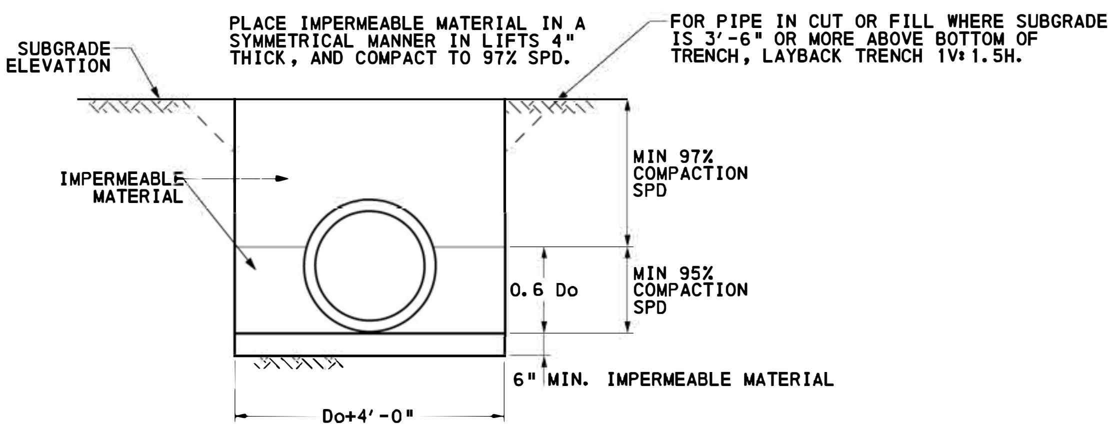
NOT TO SCALE



ELEVATION VIEW



END VIEW



DETENTION BASIN - OUTLET PIPE TRENCH DETAIL

NOT TO SCALE

BASIN NUMBER	NO. COLLARS	COLLAR SIZE (FT)	COLLAR SPACING (FT)	DIST TO 1ST COLAR (FT)	OUTLET PIPE DIA (IN)
SCM 001	2	5	7	7	18
SCM 002	3	5	7	7	18
SCM 003	3	5	8	12	18

DISTANCE TO 1ST COLLAR MEASURED FROM OUTSIDE FACE OF THE OUTET STRUCTURE.

REINFORCED CONCRETE ANTI-SEEP COLLAR

NOT TO SCALE

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4StrMooreResDetails.dgn
DATE: 4/6/2023 TIME: 3:09:21 PM

SHEET 8 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

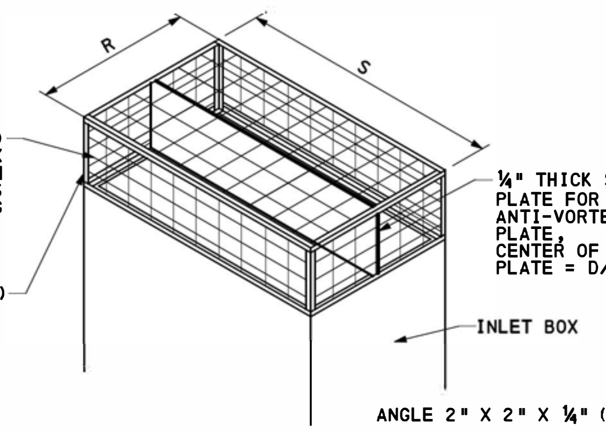
PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

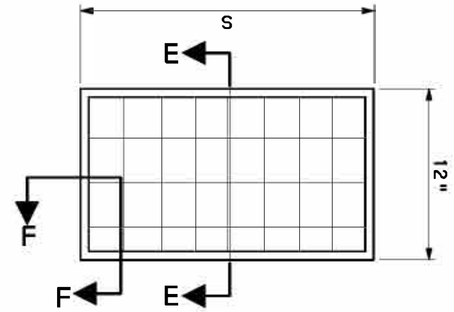
ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023
REVISED SUBMISSION DATE: 8-3-2023

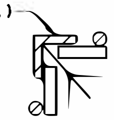
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER

HORIZONTAL TRASH RACK DIMENSIONS		
LOCATION	R	S
MOORE PARK OS-1	3'-0"	4'-9 1/4"
MOORE PARK OS-2	3'-0"	4'-9 1/4"
MOORE PARK OS-3	3'-0"	4'-9 1/4"
MOORE PARK OS-4	3'-0"	4'-9 1/4"
CRANE AVENUE OS-5	5'-0"	5'-0"
CRANE AVENUE OS-6	5'-0"	5'-0"

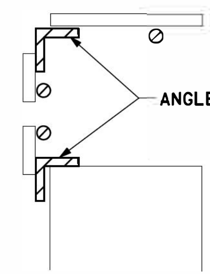




FRONT VIEW



SECTION F-F



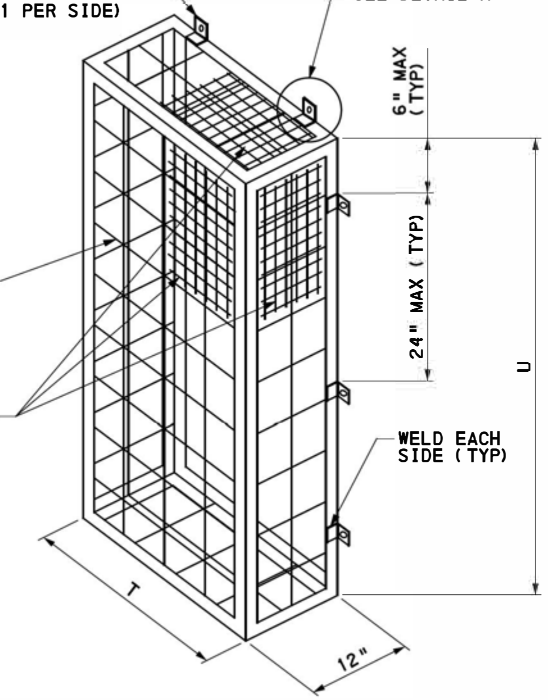
SECTION E-E

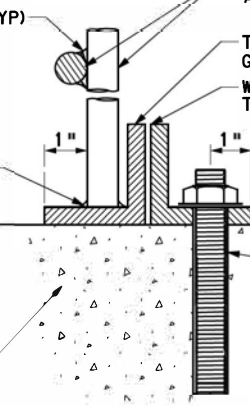
NOTES:

1. DIMENSIONS ARE APPROXIMATE, FABRICATE TO FIT OUTSIDE OF INLET BOX.

2. TRASH RACKS TO BE HOT DIPPED GALVANIZED ASSEMBLY PER ASTM A-123; TOUCH UP PER ASTM A-A780.

HORIZONTAL TRASH RACK WITH ANTI-VORTEX PLATE





DETAIL A

NOTES:

1. WELD #4 TRASH RACK SCREEN SUPPORT BARS TO THE ANGLES AND AT EACH INTERSECTION OF THE BARS.

2. WELD TRASH RACK SCREEN INSIDE OF ANGLE FRAMES ON FIVE SIDES OF RACK.

3. TRASH RACK ASSEMBLIES, BOLTS, AND ATTACHMENTS TO BE GALVANIZED IN ACCORDANCE WITH CS SECTION 1105.

4. REFER TO TABLE FOR OVERALL DIMENSIONS.

5. CENTER TRASH RACK OVER ORIFICES AND SET BOTTOM ELEVATION EQUAL TO BASIN INVERT.

TRASH RACK DIMENSIONS		
LOCATION	T	U
MOORE PARK OS-1	1'-3"	1'-3"
MOORE PARK OS-3	1'-4"	1'-4"
CRANE AVE OS-5	1'-6"	1'-6"

TRASH RACK

SHEET 9 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023

REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
WILLIAM BRUCE McNEAL
PE074465

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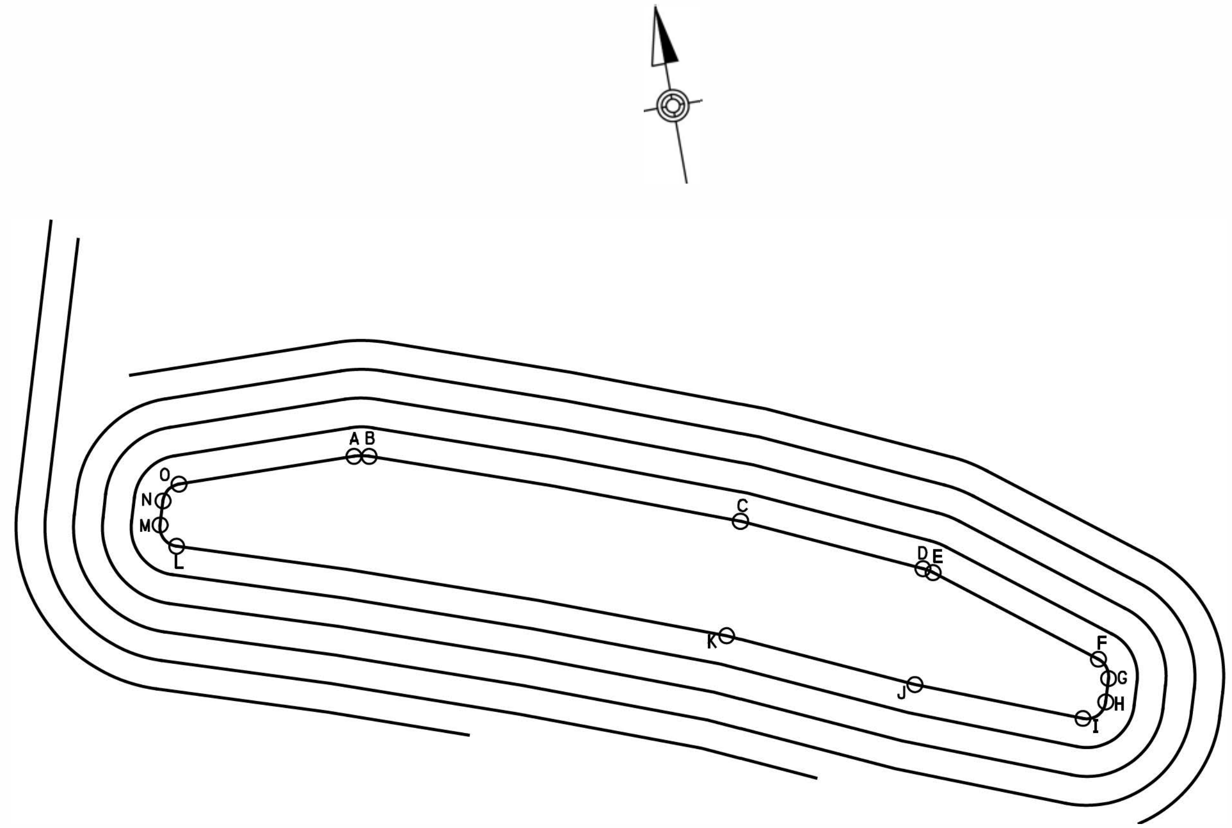

SCM 001 - CONTROL POINTS

POINT	COORDINATES NORTH	COORDINATES EAST	ELEVATION
A	398294.5689	1338656.7187	1095.00
B	398294.2885	1338658.3685	1095.00
C	398280.8454	1338695.1624	1095.00
D	398272.6560	1338712.9854	1095.00
E	398272.0667	1338713.9582	1095.00
F	398260.1605	1338729.3415	1095.00
G	398257.9982	1338730.0312	1095.00
H	398255.6506	1338729.3190	1095.00
I	398254.3705	1338726.6718	1095.00
J	398260.9240	1338710.0432	1095.00
K	398269.3623	1338691.6786	1095.00
L	398288.5997	1338636.8689	1095.00
M	398291.0840	1338635.5681	1095.00
N	398293.4966	1338636.3001	1095.00
O	398294.9156	1338638.2515	1095.00

FOUR PLACE COORDINATES ARE FOR COMPUTATIONAL PURPOSES ONLY AND DO NOT IMPLY A PRECISION BEYOND TWO DECIMAL PLACES

DRY EXTENDED DETENTION BASIN (SCM 001) GEOMETRIC LAYOUT

SCALE
0 10 20 FEET

0 10 20 FEET

SHEET 10 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

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ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023

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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465

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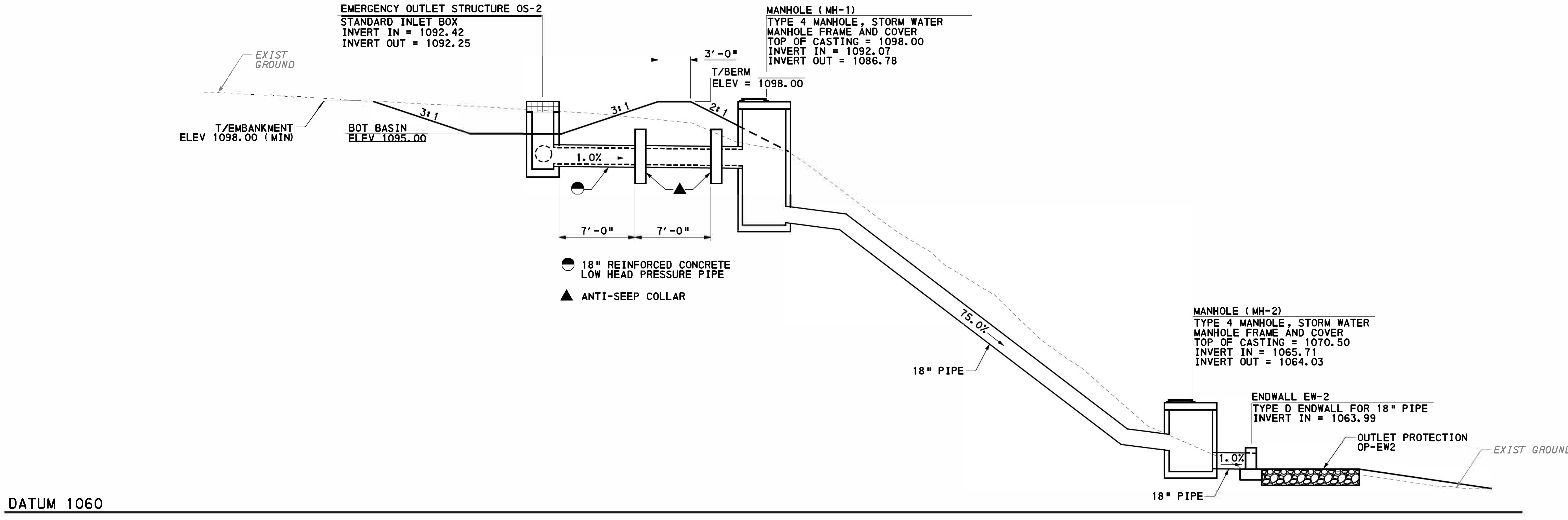
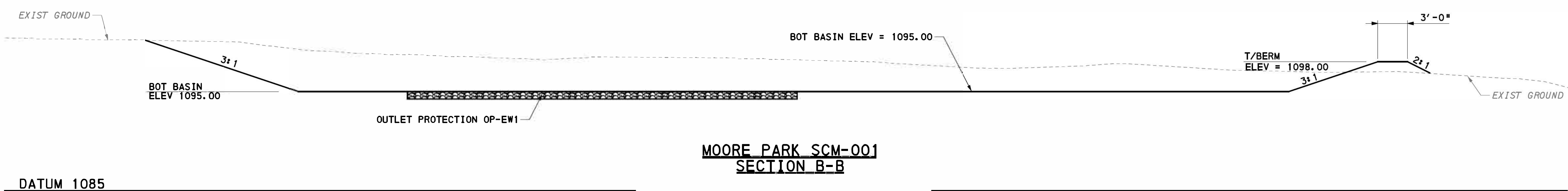


MOORE PARK SCM-001
SECTION A-A



MOORE PARK SCM-001
SECTION B-B

HORIZONTAL
VERTICAL
0 5 10 FEET

SHEET 11 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

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1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL
SUBMISSION DATE: 3-8-2023

REVISED
SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
WILLIAM BRUCE McNEAL
PE074465

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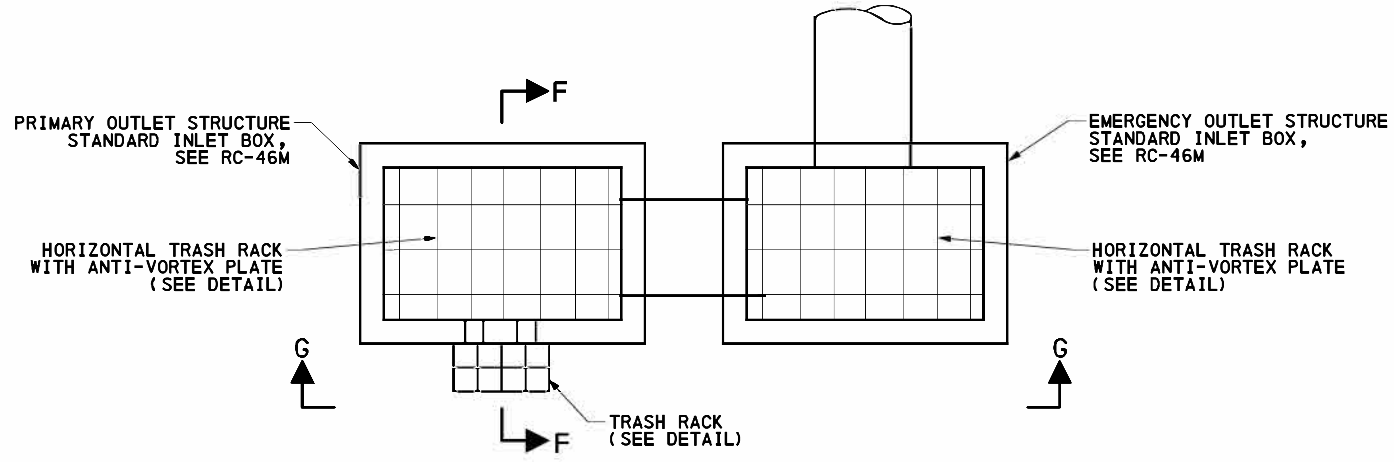
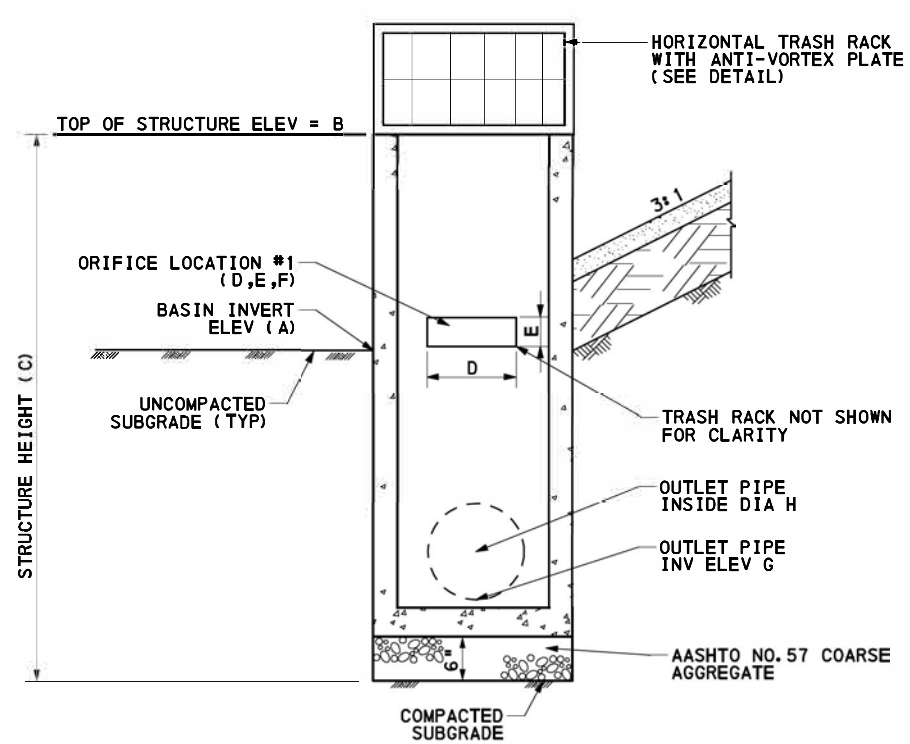


PLAN VIEW
NOT TO SCALE

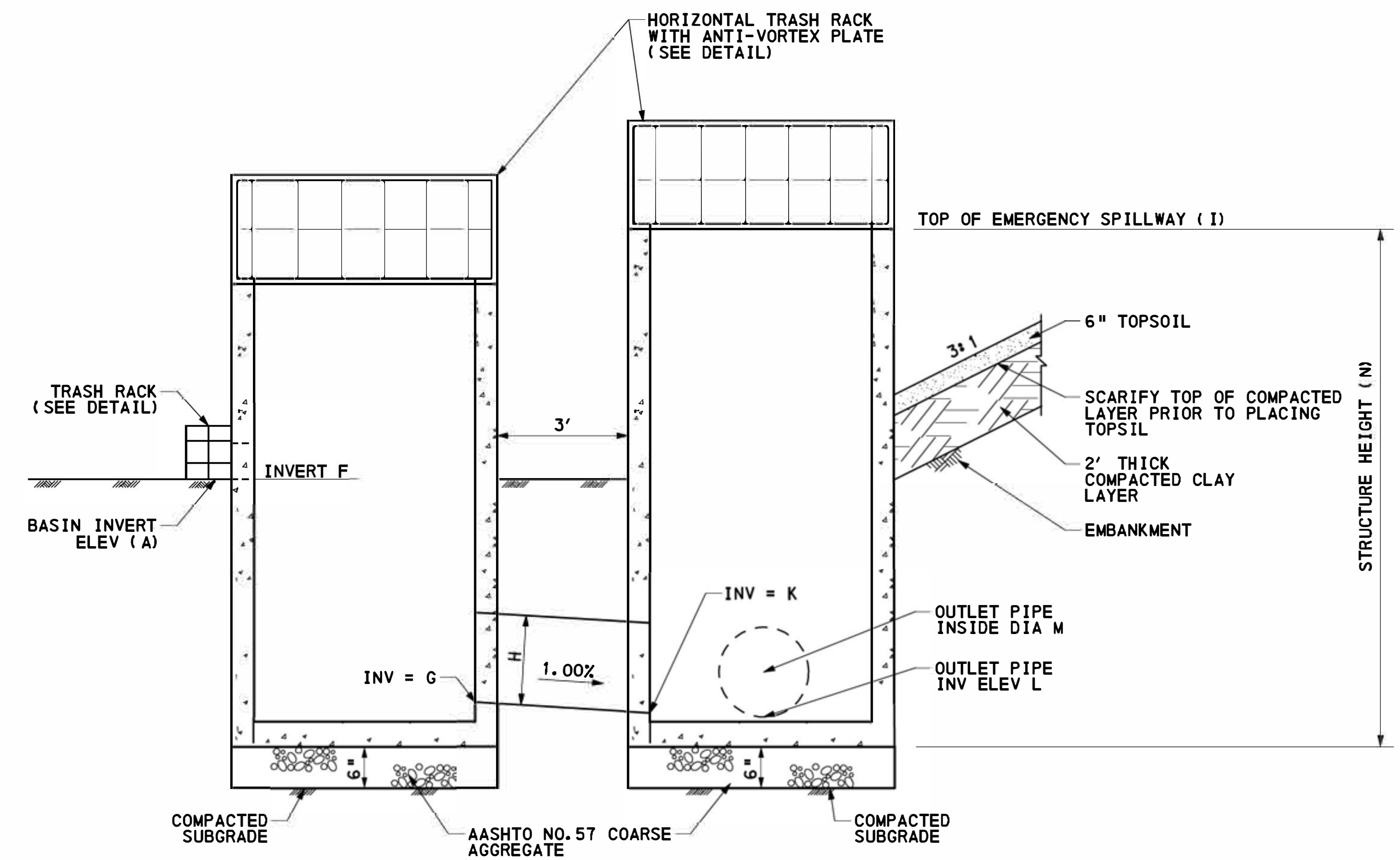
PRIMARY OUTLET STRUCTURE TABLE (OS-1)						
BASIN INVERT ELEV A	STRUCTURE TOP ELEV B	HEIGHT OF STRUCTURE C (FT)	ORIFICE #1 SIZE D X E (IN)	ORIFICE #1 INV F (FT)	OUTLET PIPE INVERT G (FT)	OUTLET PIPE INSIDE DIA H (IN)
1095.00	1096.70	5	9 X 9	1095.00	1092.45	18

EMERGENCY OUTLET STRUCTURE TABLE (OS-2)				
STRUCTURE TOP ELEV I	HEIGHT OF STRUCTURE J (FT)	OUTLET PIPE INVERT IN K (FT)	OUTLET PIPE INVERT OUT L (FT)	OUTLET PIPE INSIDE DIA M (IN)
1097.00	5.75	1092.41	1092.25	18



PRIMARY OUTLET STRUCTURE (OS-1)

SECTION F-F
NOT TO SCALE



PRIMARY OUTLET STRUCTURE (OS-1)

EMERGENCY OUTLET STRUCTURE (OS-2)

SECTION G-G
NOT TO SCALE

MOORE PARK SCM-001 OUTLET STRUCTURE DETAILS

SHEET 12 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT DETENTION BASIN DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 / PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL WILLIAM BRUCE McNEAL ENGINEER PE074465

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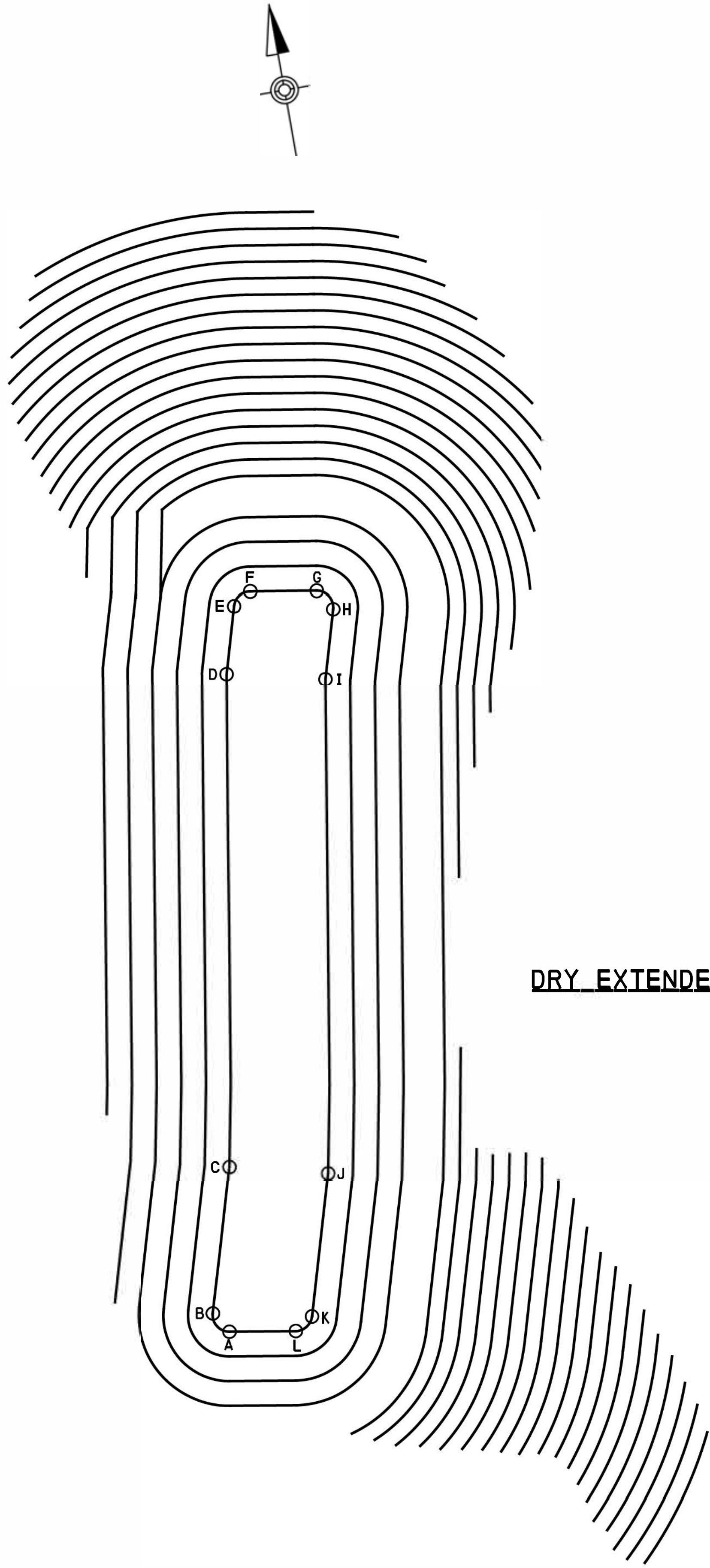

SCM 002 - CONTROL POINTS

POINT	COORDINATES		ELEVATION
	NORTH	EAST	
A	398434.2590	1338655.2380	1097.00
B	398436.7983	1338653.6510	1097.00
C	398453.9540	1338658.7217	1097.00
D	398513.0834	1338668.9091	1097.00
E	398521.0454	1338671.2615	1097.00
F	398522.4511	1338673.5106	1097.00
G	398521.1174	1338681.4584	1097.00
H	398518.5783	1338683.0454	1097.00
I	398510.3805	1338680.6233	1097.00
J	398451.0997	1338670.3912	1097.00
K	398434.3308	1338665.4349	1097.00
L	398432.9253	1338663.1859	1097.00

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DRY EXTENDED DETENTION BASIN (SCM 002) GEOMETRIC LAYOUT

SCALE

0 10 20 FEET

SHEET 13 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
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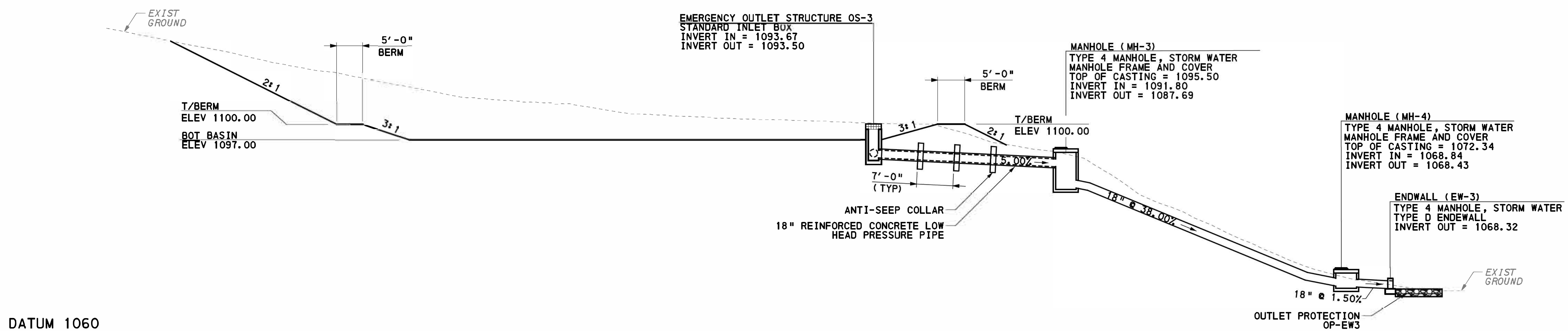
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

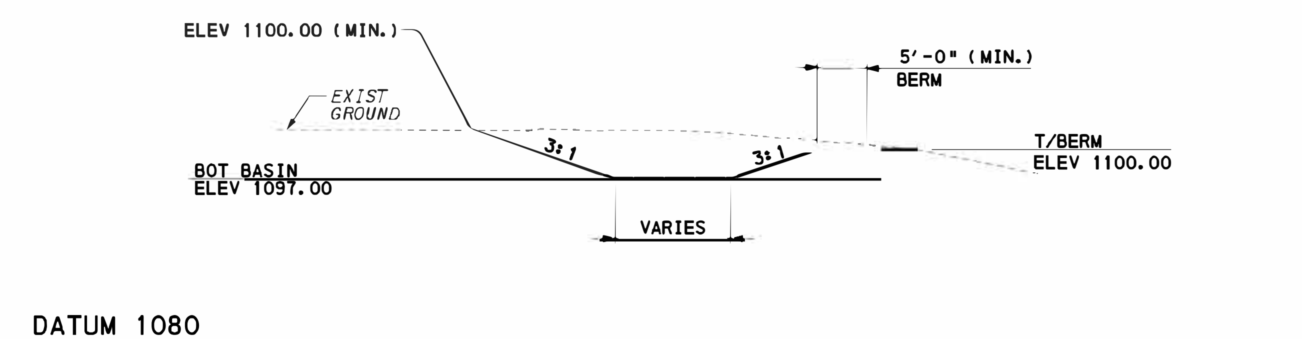
ORIGINAL SUBMISSION DATE: 3-8-2023

REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465



MOORE PARK SCM-002
SECTION C-C



MOORE PARK SCM-002
SECTION D-D

HORIZONTAL
VERTICAL
0 10 20 FEET

SHEET 14 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT DETENTION BASIN DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 — PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL WILLIAM BRUCE McNEAL ENGINEER PE074465

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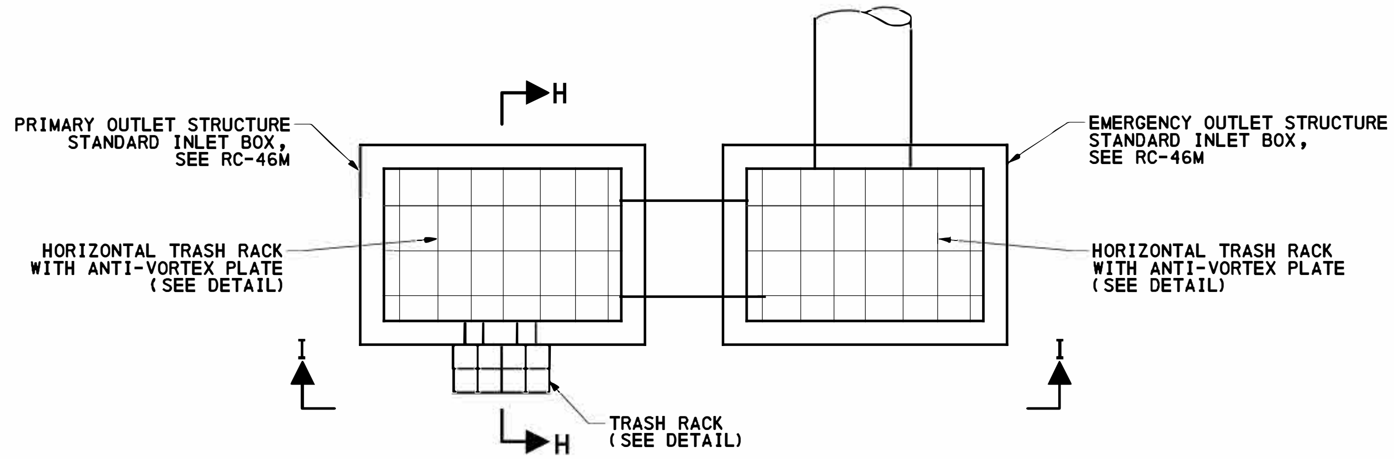
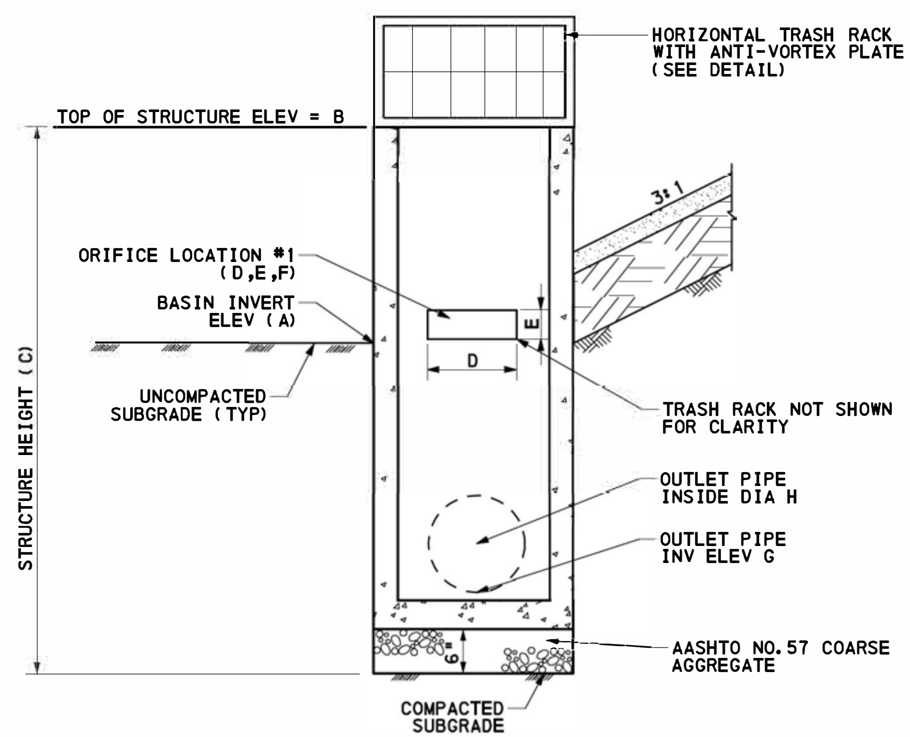


PLAN VIEW

NOT TO SCALE

PRIMARY OUTLET STRUCTURE TABLE (OS-3)						
BASIN INVERT ELEV A	STRUCTURE TOP ELEV B	HEIGHT OF STRUCTURE C (FT)	ORIFICE #1 SIZE D X E (IN)	ORIFICE #1 INV F (FT)	OUTLET PIPE INVERT G (FT)	OUTLET PIPE INSIDE DIA H (IN)
1097.00	1098.60	5.87	8 X 8	1097.00	1093.73	18

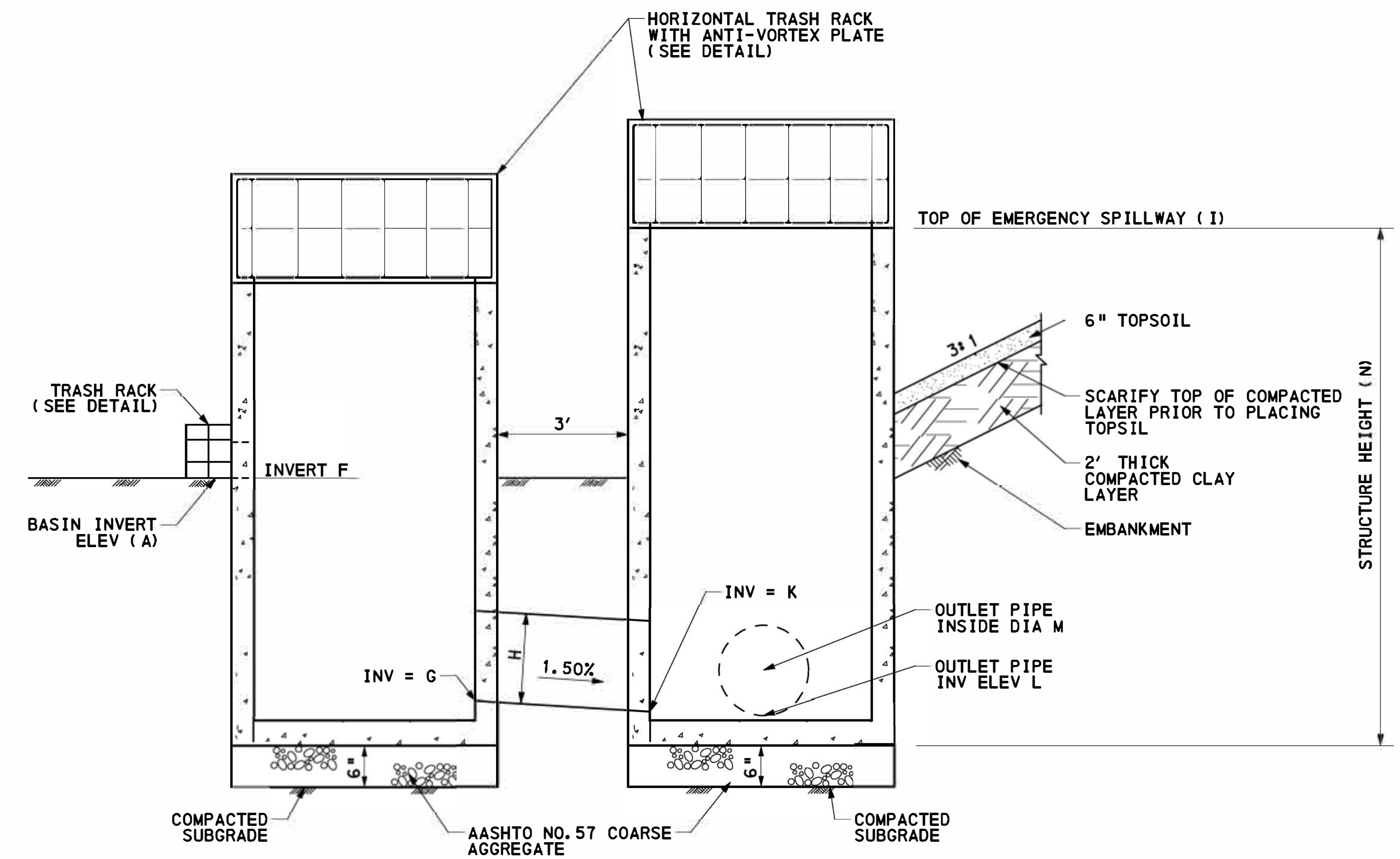
EMERGENCY OUTLET STRUCTURE TABLE (OS-4)				
STRUCTURE TOP ELEV I	HEIGHT OF STRUCTURE J (FT)	OUTLET PIPE INVERT IN K (FT)	OUTLET PIPE INVERT OUT L (FT)	OUTLET PIPE INSIDE DIA M (IN)
1099.00	6.50	1093.67	1093.50	18



PRIMARY OUTLET STRUCTURE (OS-3)

SECTION H-H

NOT TO SCALE



PRIMARY OUTLET STRUCTURE (OS-3)

EMERGENCY OUTLET STRUCTURE (OS-4)

SECTION I-I

NOT TO SCALE

MOORE PARK SCM-002 OUTLET STRUCTURE DETAILS

SHEET 15 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
DETENTION BASIN DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
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PREPARED FOR:

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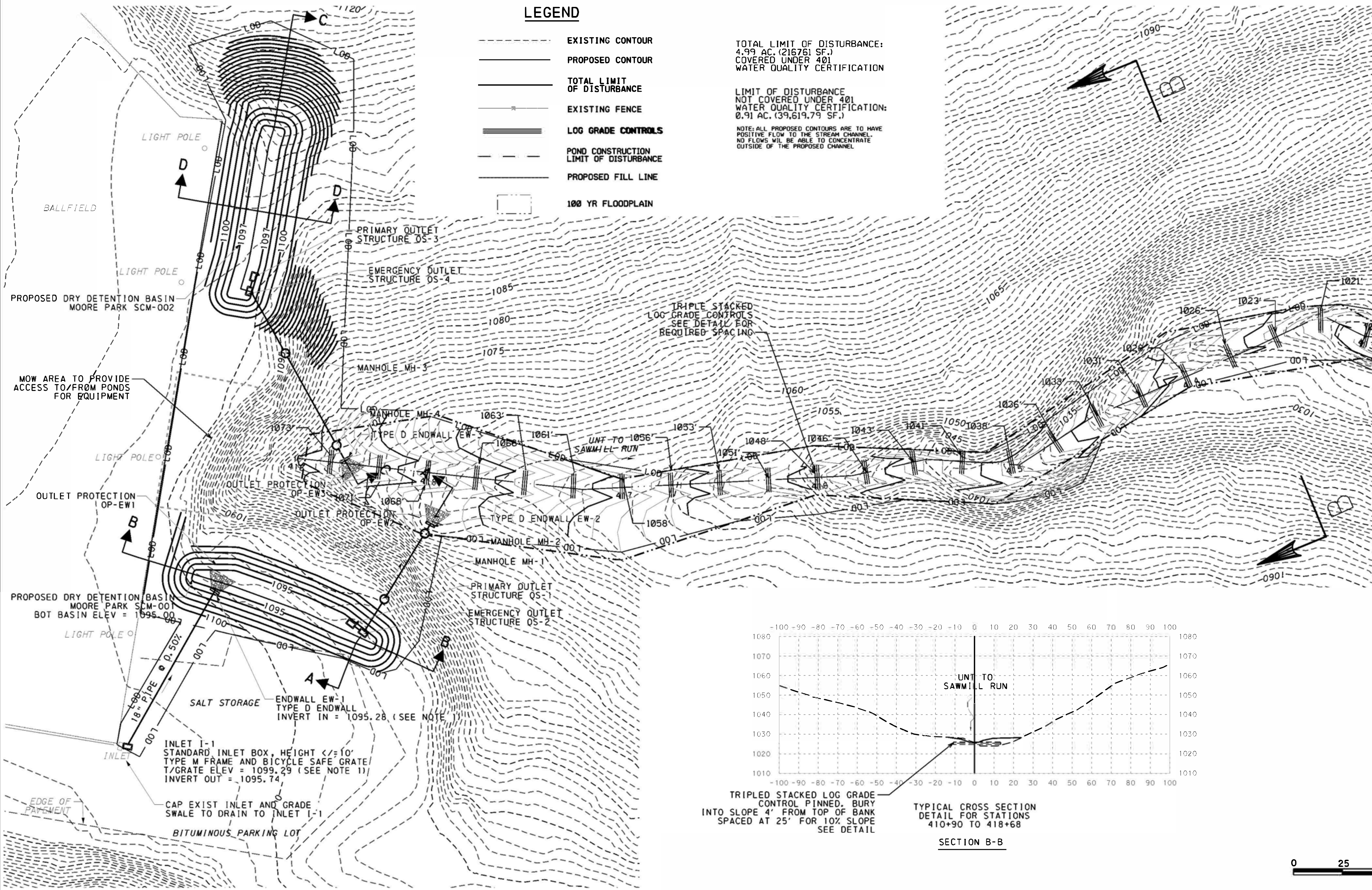
WILLIAM BRUCE McNEAL
PE074465



SHEET 16 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT PLAN SHEET	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 / PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023

REVISED SUBMISSION DATE: 8-3-2023

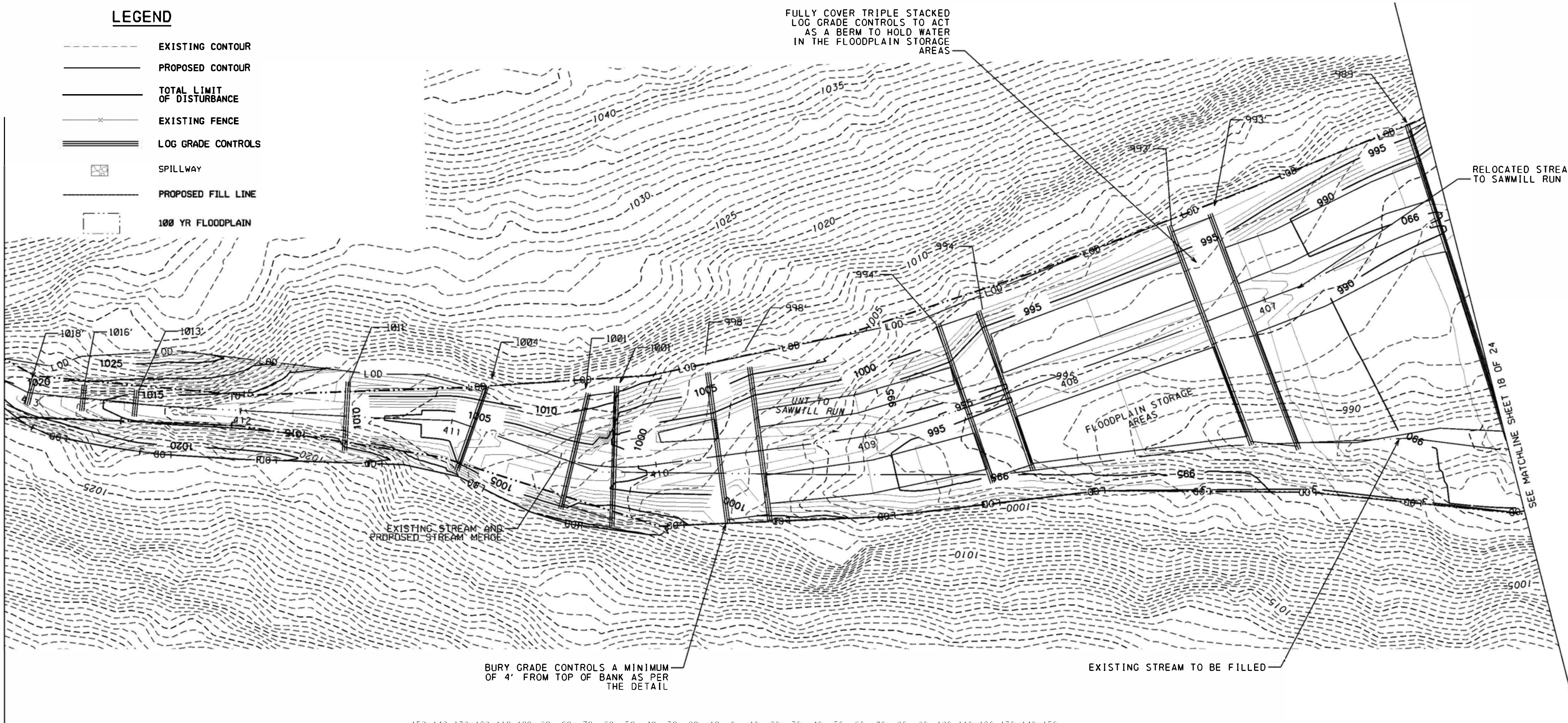
COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL WILLIAM BRUCE McNEAL ENGINEER PE074465

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL JAMES H. FLYNN ENGINEER PE 06647

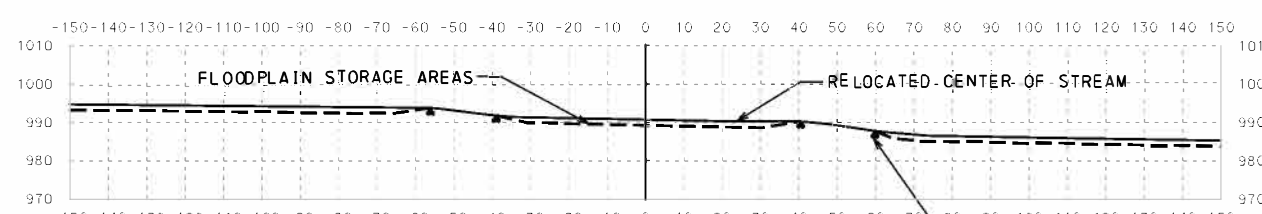
FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4MooreParkPlan1.dgn DATE: 4/6/2023 TIME: 4:05:09 PM

LEGEND

- EXISTING CONTOUR
- PROPOSED CONTOUR
- TOTAL LIMIT OF DISTURBANCE
- EXISTING FENCE
- LOG GRADE CONTROLS
- SPILLWAY
- PROPOSED FILL LINE
- 100 YR FLOODPLAIN



NOTE: ALL PROPOSED CONTOURS ARE TO HAVE POSITIVE FLOW TO THE STREAM CHANNEL. NO FLOWS WIL BE ABLE TO CONCENTRATE OUTSIDE OF THE PROPOSED CHANNEL



TYPICAL PROFILE
DETAIL FOR STATIONS
402+50 TO 410+90

0 25 50 FEET

SHEET 17 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT PLAN SHEET	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL JAMES H. FLYNN ENGINEER PE 06647

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4MooreParkPlan2-JHF.dgn
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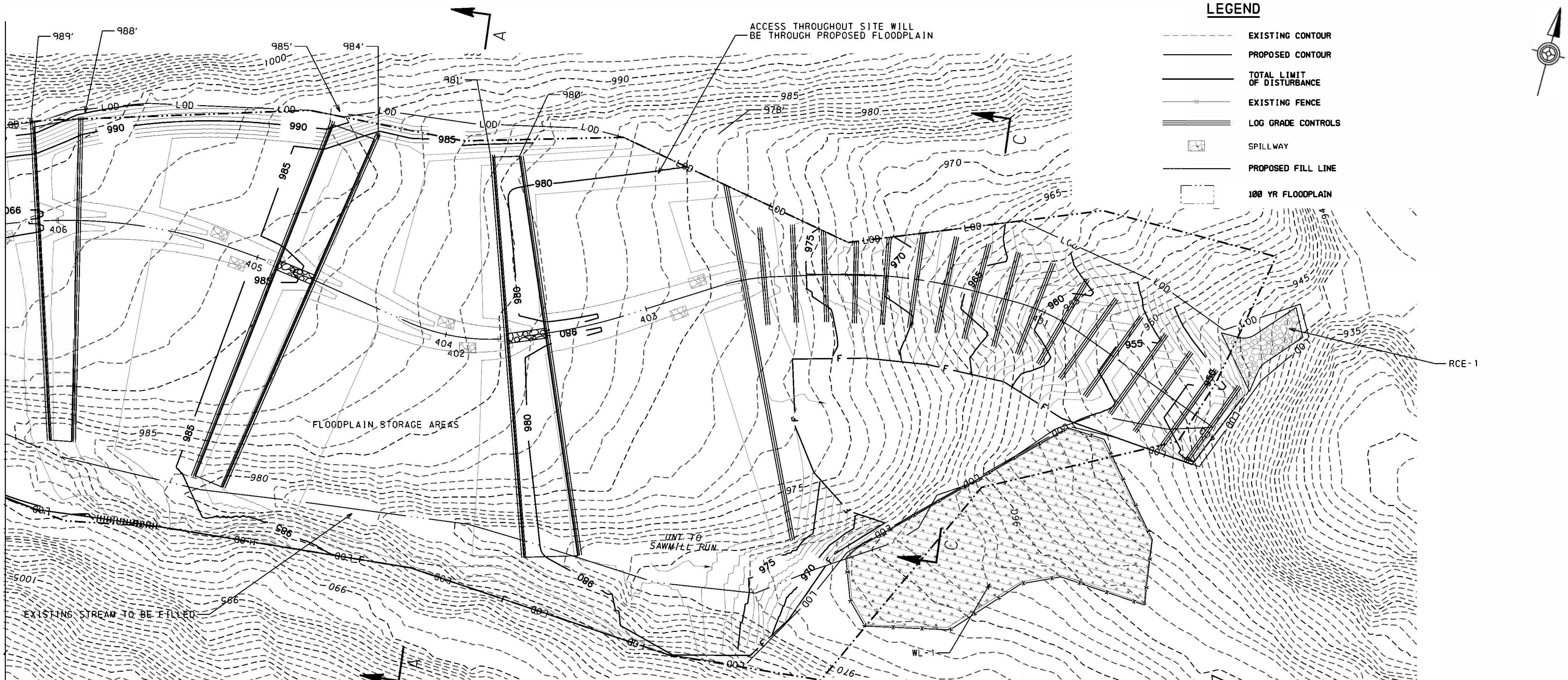
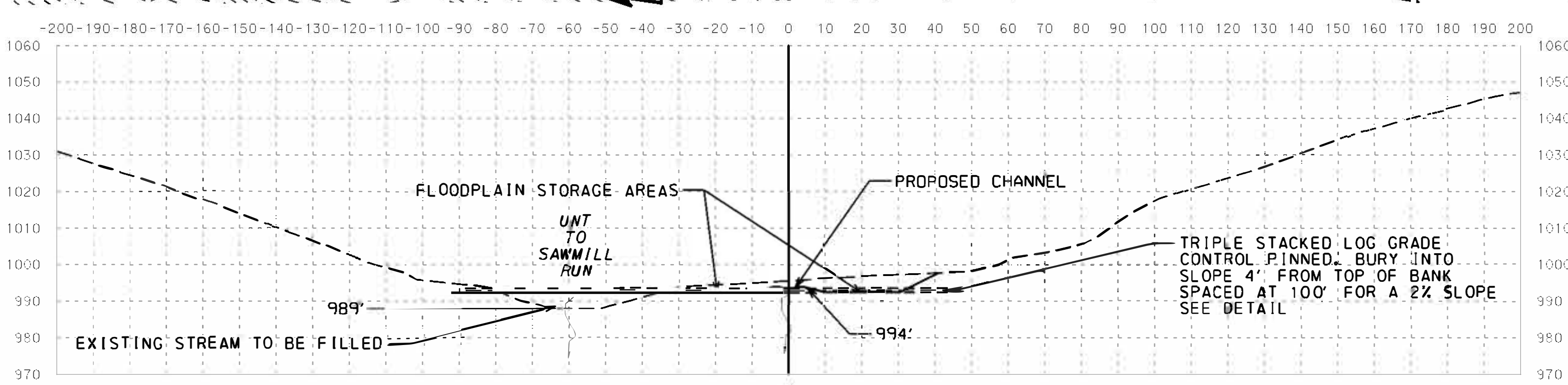


NOTE: ALL PROPOSED CONTOURS ARE TO HAVE POSITIVE FLOW TO THE STREAM CHANNEL. NO FLOWS WIL BE ABLE TO CONCENTRATE OUTSIDE OF THE PROPOSED CHANNEL



TYPICAL CROSS SECTION
DETAIL FOR STATIONS
402+50 TO 410+90

SECTION A-A

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4MooreParkPlan3.dgn
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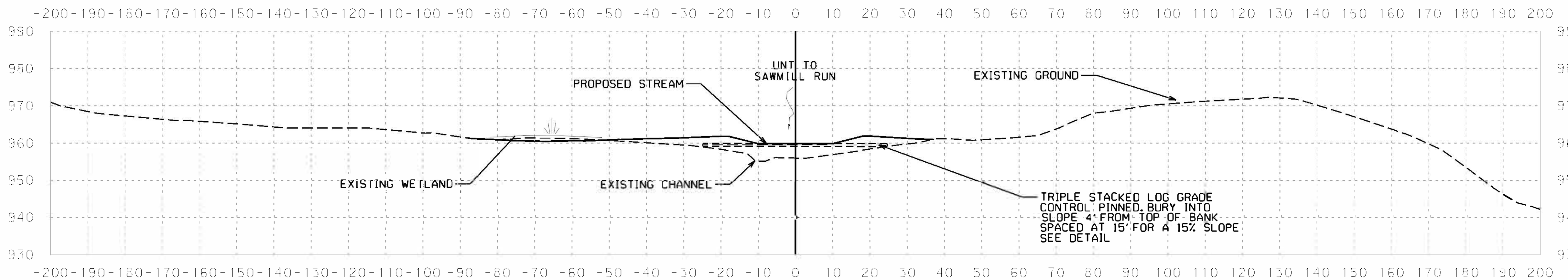
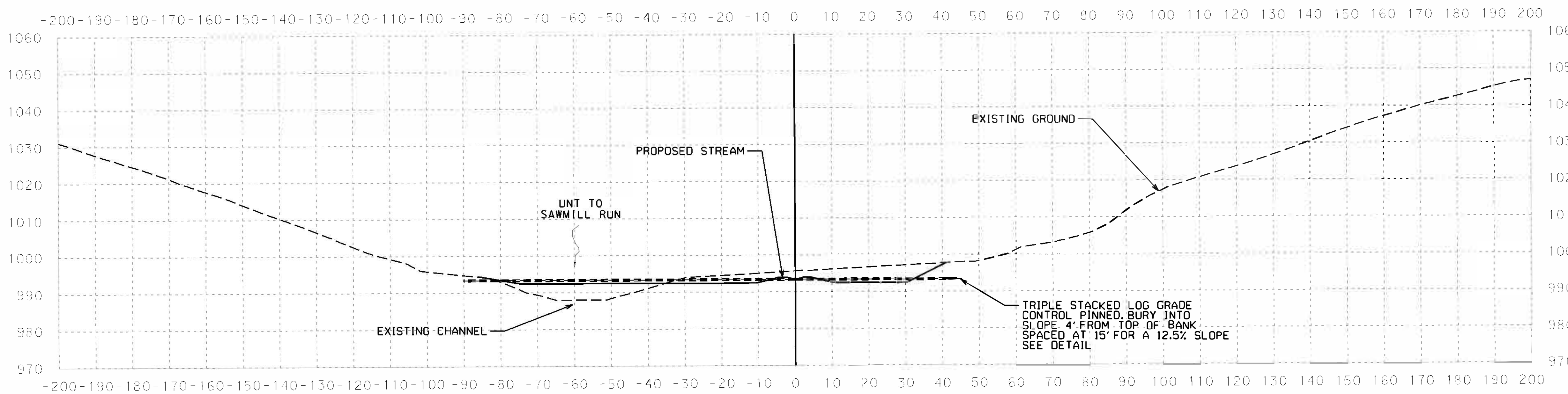
SHEET 18 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT PLAN SHEET	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 06647



TYPICAL CROSS SECTION
DETAIL FOR STATIONS
400+00 TO 402+50

SECTION C-C



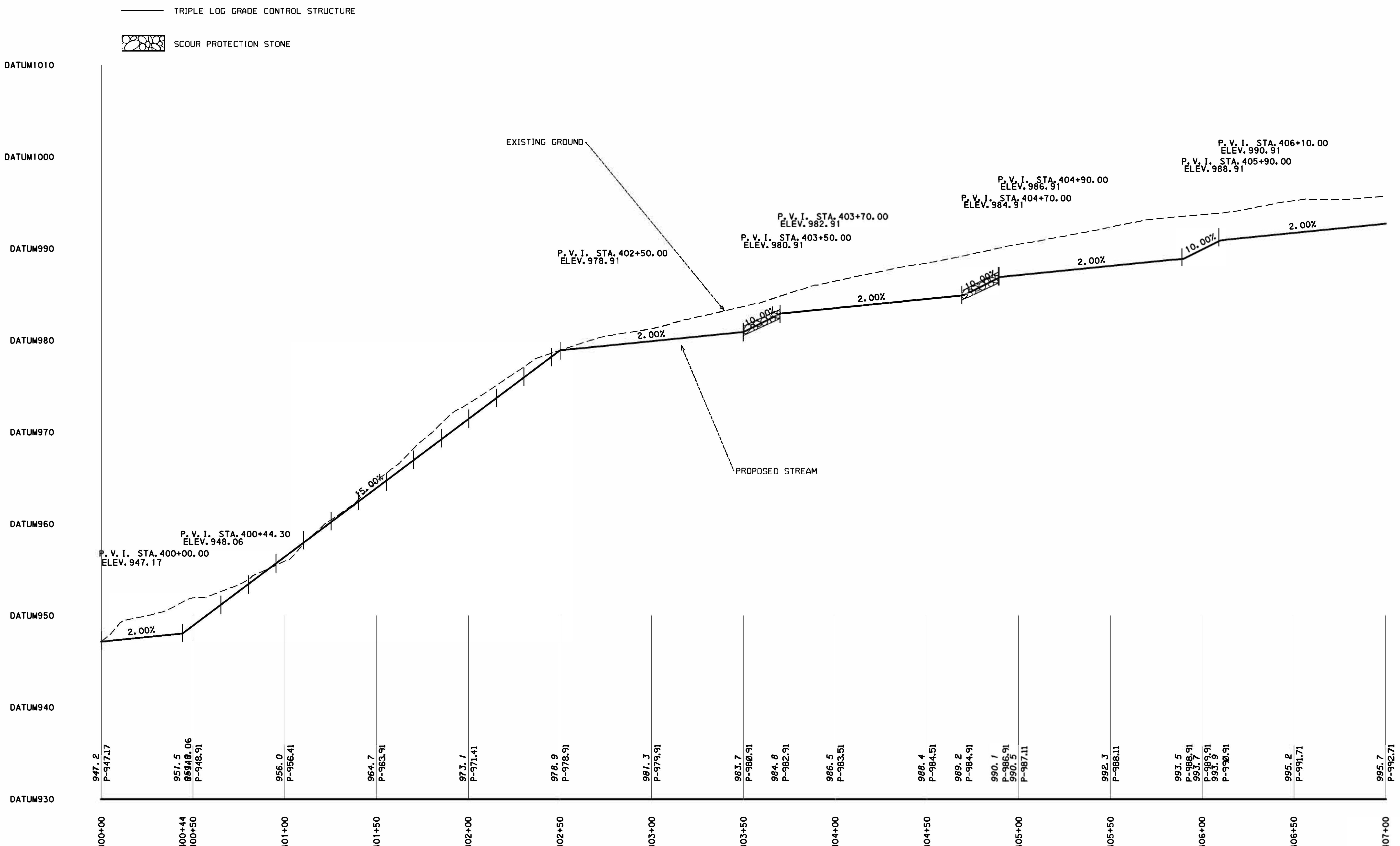
TYPICAL CROSS SECTION
DETAIL FOR STATIONS
402+50 TO 410+90

0 25 50 FEET

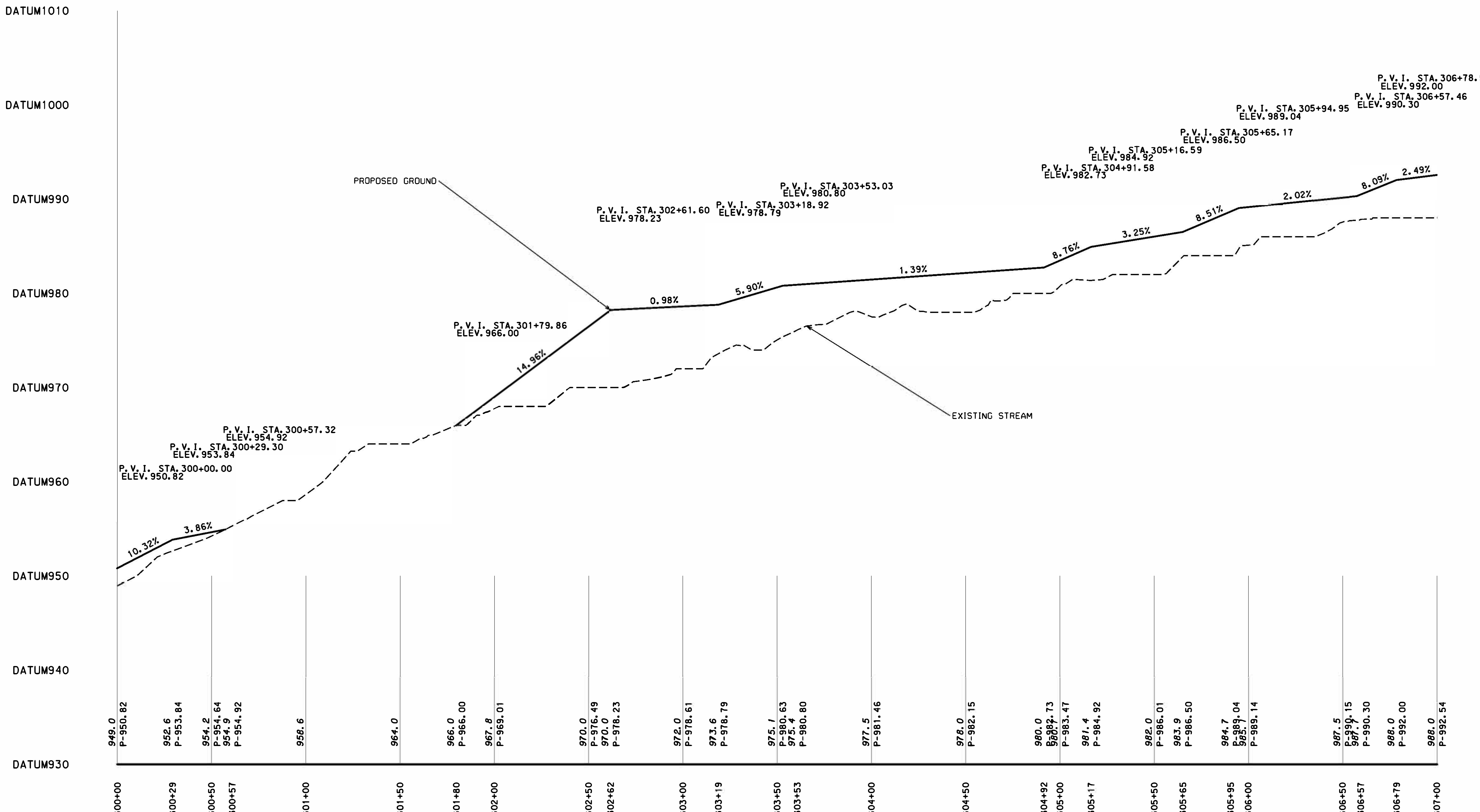
FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4MooreParkXSECPlans.dgn
DATE: 3/29/2023 TIME: 3:04:32 PM

SHEET 19 OF 26	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT CROSS SECTIONS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JAMES H. FLYNN
PE 06647



SHEET 20 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT PROPOSED STREAM PROFILE	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023



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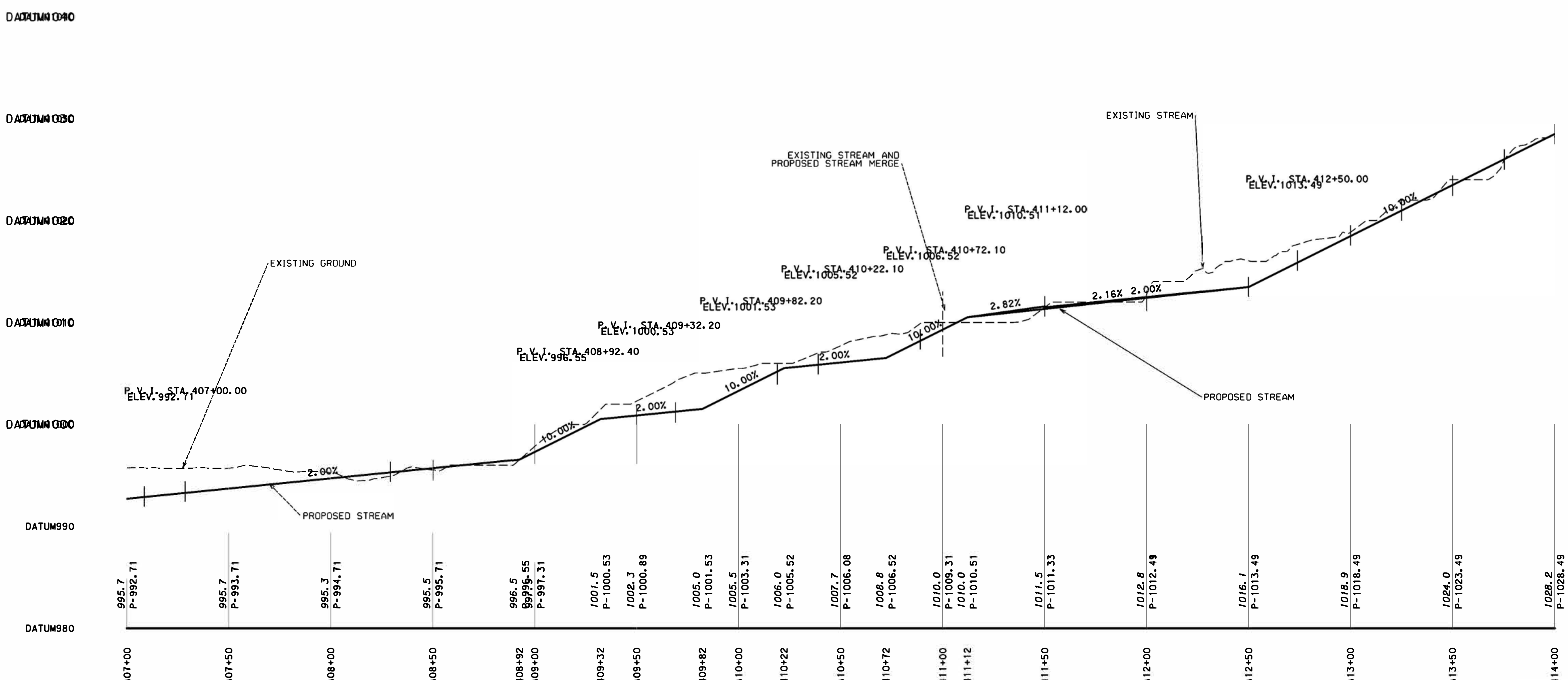
DATE: 4/4/2023 TIME: 3:03:04 PM

SHEET 21 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN PE 06647

TRIPLE LOG GRADE CONTROL STRUCTURE

SCOUR PROTECTION STONE



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DATE: 4/4/2023 TIME: 3:02:23 PM

SHEET 22 OF 25

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
PROPOSED STREAM PROFILE

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREET
HARRISBURG, PA 17120

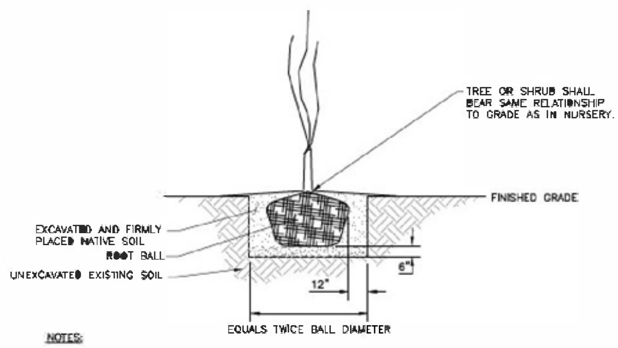
PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 3-8-2023

REVISED SUBMISSION DATE: 8-3-2023

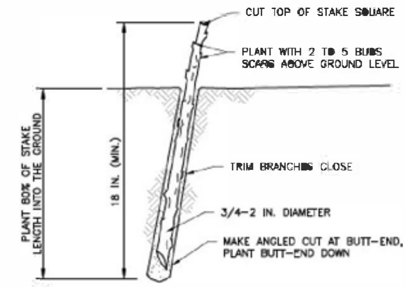
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JAMES H. FLYNN
PE 065647



NOTES:

1. UNLESS PLANTING WITHIN A WETLAND, PROVIDE POSITIVE DRAINAGE. DO NOT ALLOW PONDING AROUND ROOT BALL.
2. IF PLANT IS CONTAINER GROWN, REMOVE CONTAINER AND GENTLY LOOSEN SOIL AND OUTSIDE ROOTS OF ROOT BALL.
3. IF ROOTS ARE WRAPPED IN BURLAP, LEAVE THE BURLAP IN PLACE AND REMOVE ANY BINDINGS AROUND THE MAIN TRUNK.

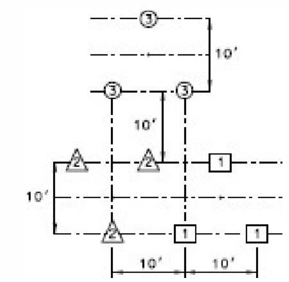
TREE AND SHRUB PLANTING (24)
NOT TO SCALE



PLANTING NOTES:

1. PLANT MATERIALS SHALL BE FROM PLANT STOCK NATIVE OR ADAPTED TO THE EASTERN BROADLEAF FOREST ECOREGIONS, AS DEFINED BY THE USDA FOREST SERVICE, AND USDA PLANT HARDINESS ZONES 5 AND 6.
2. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
3. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
4. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION; USE AN IRON BAR AND PILOT HOLE IN FIRM SOILS.
5. SOAK CUTTINGS FOR AT LEAST 24 HOURS PRIOR TO INSTALLATION. SOAK FOR 5-7 DAYS FOR BEST RESULTS.
6. TAMP THE SOIL AROUND THE STAKE.
7. DO NOT PLANT LIVE STAKES WITHIN 10 FEET OF PIPELINE.

LIVE STAKE PLANTING (1/24)
NOT TO SCALE



1 SHRUB-TREE SPECIES
2 SHRUB-TREE SPECIES
● SHRUB-TREE SPECIES

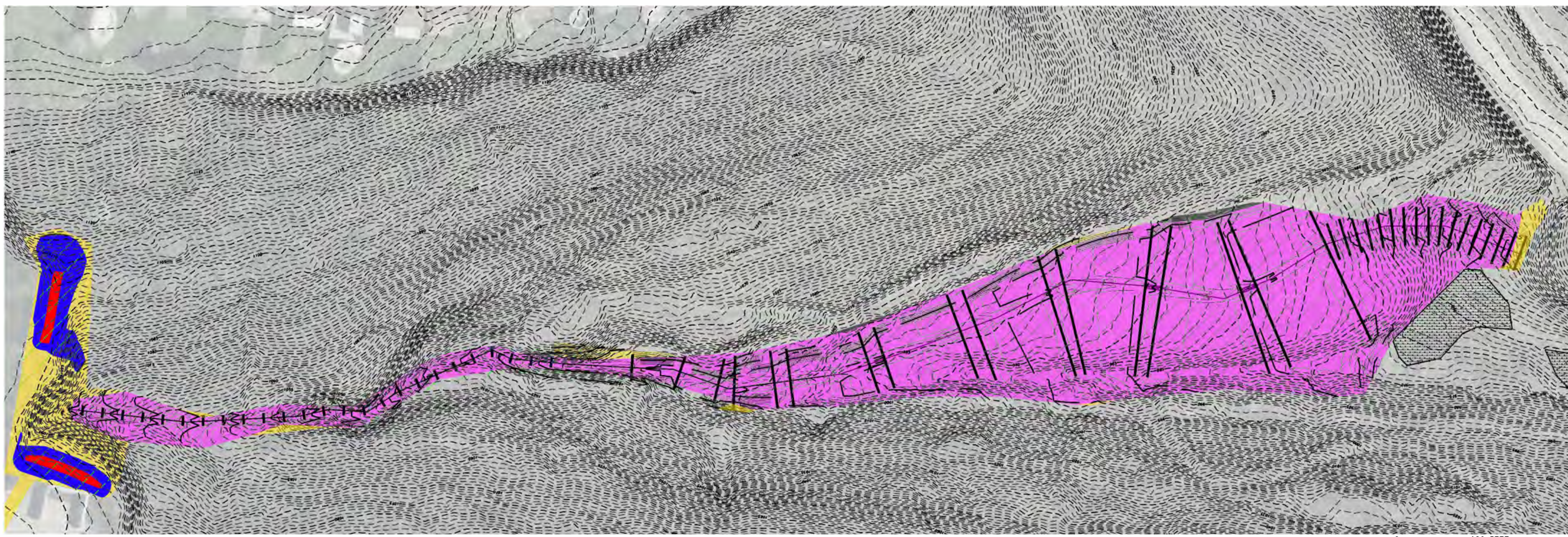
HOMOGENOUS CLUSTER OF SHRUB-TREE SPECIES

NOTE:
EVENLY DISTRIBUTE PLANT CLUSTER TO PROMOTE SPECIES DIVERSIFICATION

CLUSTER PLANTING PLAN
NOT TO SCALE

ERNMX-221 & ERNMX-223 SEED MIX
RAIN GARDEN BASIN SEED MIX
SEASONALY FLOODED AREA MIX/PENNSTATE MIX
UPLAND PLANTING
WETLAND PLANTINGS

RIPARIAN BUFFER OF THE STREAM IS TO BE A MINIMUM OF 35 FT WIDE ON EITHER SIDE OF THE STREAM.



0 50 100 FEET

SHEET 23 OF 25	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA MOORE PARK RESTORATION PROJECT PLANTING PLAN	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 3-8-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 066?47

PLANTING LIST

	FORMULA AND SPECIES	% BY WEIGHT	INDICATOR STATUS	APPLICATION RATE
ERNMX-221 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE FACW MIX	FOX SEDGE (CAREX VULPINOIDEA)	31	FACW	20.0 LBS/ACRE
	VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	FAC	
	LURID SEDGE (CAREX LURIDA)	8	OBL	
	HOP SEDGE (CAREX LUPULINA	7.8	OBL	
	BLUNT BROOM SEDGE (CAREX SCOPARIA)	7.8	FACW	
	BLUE VERVAIN (VERBENA HASTATA)	4	FAC	
	RIVER OATS (CHASMANTHIUM LATIFOLIUM)	3.3	FAC	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	STAR SEDGE (CAREX INTUMESCENS)	2	FACW	
	OXEYE SUNFLOWER (HELIPOSIS HELIANTHOIDES)	2	FACU	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.8	OBL	
	NODDING BUR MARIGOLD (BIDENS CERNUA)	1	OBL	
	AWL SEDGE (CAREX STIPATA)	1	OBL	
	NARROWLEAF BLUE EYED GRASS (SISYRINCHIUM ANGUSTIFOLIUM)	1	FACW	
	BONSET (EUPATORIUM PERFOLIATUM)	0.7	FACW	
	FOWL MANNAGRASS (GLYCERIA STRIATA)	0.5	OBL	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.5	FACW	
	PENNSYLVANIA SMARTWEED (POLYGONUM PENSYLVANICUM)	0.5	FACW	
	WOOLGRASS (SCIRPUS CYPERINUS)	0.5	OBL	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.5	OBL	
	GOLDEN ALEXANDERS (ZIZIA AUREA)	0.5	FAC	
	PUPLESTEM ASTER (ASTER PUNICEUS)	0.4	OBL	
	GREAT BLUE LOBELIA (LOBELIA SIPHILITICA)	0.4	OBL	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	SQUARE STEMMED MONKEYFLOWER (MIMULUS RINGENS)	0.3	OBL	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.3	FACW	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	SEPTEMBER-APRIL	-	
ERNMX-223 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE RIPARIAN MIX	LITTLE BLUESTEM (SCHIZACHYRIUM SCOPARIUM)	20	FACU	20.0 LBS/ACRE
	INDIANGRASS (SORGHASTRUM NUTANS)	20	FACU	
	VIRGINIA WILDRYE (ELYMUS VIRGINICUS)	18	FAC	
	BIG BLUESTEM (ANDROPOGON GERARDII)	12	FAC	
	RIVERBANK WILDRYE (ELYMUS RIPARIUS)	10.6	FACW	
	FOX SEOGE (CAREX VULPINOIDEA)	7	FACW	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	OXEYE SUNFLOWER (HELIOPSIS HELIANTHOIDES)	2	FACU	
	BLUE VERVAIN (VERBENA HASTATA)	2	FAC	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.6	OBL	
	WILD BERGAMOT (MONARDA FISTULOSA)	0.5	FACU	
	BONESET (EUPTORIUM PERFOLIATUM)	0.4	FACW	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.4	FACW	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.4	FACW	
	NEW ENGLANO ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	WRINKLELEAF GOLDENROD (SOLIDAGO RUGOSA)	0.3	FAC	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	CALICO ASTER (ASTER LATERIFLORUS)	0.2	FACW	
	AROMATIC ASTER (ASTER OBLONGIFOLIUS)	0.2	NI	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.2	OBL	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	JANUARY-JULY	-	

	FORMULA AND SPECIES	NUMBER PER ACRE	INDICATOR STATUS
WETLAND RESTORATION PLANTINGS	AMERICAN SYCAMORE (PLATANUS OCCIDENTALIS)	75	FACW
	SILVER MAPLE (ACER SACCHARINUM)	75	FACW
	PIN OAK (QUERCUS PALUSTRIS)	75	FACW
	COMMON BUTTON BUSH (CEPHALANTHUS OCCIDENTALIS)	50	OBL
	NORTHERN SPICEBUSH (LINDERA BEZOIN)	75	FACW
	SILKY DOGWOOD (CORNUS AMOMUM)	75	FACW
	SWAMP WHITE OAK (QUERCUS BICOLOR)	50	FACW
	RED CHOKEBERRY (ARONIA ARBUTIFOLIA)	75	FACW
	AMERICAN LARCH (LARIX LARICINA)	75	FACW
	RED OSHIER DOGWOOD (CORNUS SERICEA)	75	FACW
	PAWPAW (ASIMINA TRILOBA)	75	FACW
UPLAND RESTORATION PLANTINGS	SHAGBARK HICKORY (CARYA OVATA)	75	FACU
	CRANBERRY VIBURNUM (VIBURNUM TRILOBUM)	75	FACU
	BLACKHAW VIBURNUM (VIBURNUM PRUNIFOLIUM)	75	FACU
	NANNYBERRY VIBURNUM (VIBURNUM LENTAGO)	75	FACU
	WHITE OAK (QUERCUS ALBA)	75	FACU
	SUGAR MAPLE (ACER SACCHARUM)	75	UPL
	BLACK CHERRY (PRUNUS SEROTINA)	75	FACU
	DAWN REDWOOD (METASEQUOIA GLYPROSTROBOIDES)	75	NI
	EASTERN WHITE PINE (PINUS STROBUS)	75	FACU
	ALLEGHENY SERVICEBERRY (AMELANCHIER LAEVIS)	75	NI
	MOUNTAIN LAUREL (KALMIA LATIFOLIA)	75	FACU
	AMERICAN WITCH-HAZEL (HAMAMELIS VIRGINIANA)	75	FACU

A TREE SURVEY WAS CONDUCTED ON SITE BY AN ARBORIST TO DETERMINE THE SPECIES, DIAMETER AT BREAST HEIGHT AND GPS LOCATION OF ALL TREES LOCATED IN THE PROJECT'S LIMIT OF DISTURBANCE. THE ESTIMATED TREE LOSS WAS CALCULATED USING EXPERT JUDGMENT. A FINAL AUDIT OF ACTUAL TREE LOSS WILL BE CONDUCTED DURING CONSTRUCTION. TREE MITIGATION WILL BE CONDUCTED IN ACCORDANCE WITH THE CITY OF PITTSBURGH'S MITIGATION REQUIREMENTS. THE NUMBER OF PLANTINGS FOR EACH TREE CUT DOWN WILL BE DETERMINED BASED ON THE DIAMETER OF THE LOST TREE TO THE INCH. CREDIT FOR THE MAINTENANCE AND ELIMINATION OF INVASIVE SPECIES WILL BE DETERMINED AT A LATER DATE. SOME TREES LOST ON SITE ARE SPECIES ON THE CITY OF PITTSBURGH PROHIBITED SPECIES LIST. THESE TREES WILL BE REPLACED WITH SPECIES ON THE CITY OF PITTSBURGH APPROVED PARK SPECIES LIST. AS PER THE APPROVED TREE SPECIES FOR PITTSBURGH'S PARKS & OPEN SPACES DOCUMENT, 20% OF TREES PLANTED WILL BE CONIFERS AND 80% WILL BE DECIDUOUS. PLANT FAMILIES WILL TAKE UP NO MORE THAN 30% OF PLANTINGS. PLANT GENUSES WILL TAKE UP NO MORE THAT 20% OF PLANTINGS. PLANT SPECIES WILL TAKE UP NO MORE THAT 10% OF PLANTINGS. VEGETATIVE TRAILS WILL BE PLACED IN THE PARK FOR ACCESS.

PLANTING LIST

DETENTION BASIN FLOOR SEED MIXTURE (BOTTOM OF STORMWATER DETENTION BASIN)					
FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
ALKALIGRASS (PUCCINELLIA DISTANS)	20	99	90	0.15	1.04

SEASONALLY FLOODED AREA MIX (SLOPES OF STORMWATER DETENTION BASIN)					
FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					4.15 TOTAL
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75	0.15	0.83
SMARTWEED/BARNYARD MIX (POLYGONUM LAPATHIFOLIUM)	20	92	85	0.15	0.83
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	0.83
JAPANESE MILLET (ECHINOCHLOA CRUSGALLI FRUMENTA)	20	95	80	0.15	0.83
NODDING BUR-MARIGOLD (BIDENS CERNUA)	10	92	85	0.15	0.42
SWITCHGRASS (PANICUM VIRGATUM) (AN IMPROVED VARIETY MUST BE USED)	5	92	85	0.10	0.21
LURID SEDGE (CAREX LURIDA)	2.5	92	85	0.10	0.10
COSMOS SEDGE (CAREX COMOSA)	2.5	92	85	0.10	0.10

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
MOORE PARK RESTORATION PROJECT
PLANTING PLAN

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER
JAMES H. FLYNN

ORIGINAL SUBMISSION DATE: 3-8-2023
REVISED SUBMISSION DATE: 8-3-2023

WATERS OF THE COMMONWEALTH

SAWMILL RUN IS DESIGNATED AS WARM WATER FISHERIES PER THE PA CODE TITLE 25, ENVIRONMENTAL PROTECTION, CHAPTER 93, WATER QUALITY STANDARDS.

THE UNNAMED TRIBUTARY DOES NOT APPEAR IN CHAPTER 93, WATER QUALITY STANDARDS LIST AND ASSUMES THE SAME DESIGNATION AS SAWMILL RUN.

AREA OF DISTURBANCE

THE TOTAL AREA WITHIN LIMIT OF DISTURBANCE = 171,040 SF = 3.93 ACRES

THE TOTAL AREA OF APPLICABLE ROAD MAINTENANCE ACTIVITIES = 0 SF = 0.00 ACRES

THE TOTAL AREA WITHIN THE 100-YEAR FLOOD PLAIN BOUNDARY SUBJECT TO CHAPTER 105 & 410 WATER QUALITY CERTIFICATION = 171,040 SF = 3.93 ACRES

THE TOTAL PROJECT AREA SUBJECT TO CHAPTER 102 = 0 SF = 0.00 ACRES

AREAS OF WETLAND AND STREAM DISTURBANCE

TEMPORARY WETLAND IMPACTS = 0 SF

PERMANENT WETLAND IMPACTS = 0 SF

PERMANENT STREAM IMPACTS = 1,512 LF

PERMANENT STREAM IMPACTS = 8,624 SF

PLAN PREPARER (RATE CONTROL BMP DESIGN)
THE MARKOSKY ENGINEERING GROUP, INC.
3689 PA-711
LIGONIER, PA 15658
PHONE: (724) 238-4138

RESPONSIBLE ENGINEER
WILLIAM B. MCNEAL, P.E.
DESIGN ENGINEER

PLAN PREPARER (PRP AND E&S PLAN)
HUNT VALLEY ENVIRONMENTAL, LLC.
632 HUNT VALLEY CIRCLE
NEW KENSINGTON, PA 15068
PHONE: 724-594-0805

RESPONSIBLE ENGINEER
JAMES H. FLYNN, P.E.
PROJECT MANAGER

PROJECT CONTACTS
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HARRISBURG, PA 17120
DARYL T. CLARK
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PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVENUE
PITTSBURGH, PA 15222
ANA BENNETT, EIT
PROJECT MANAGER
412-255-8800

ALLEGHENY COUNTY CONSERVATION DISTRICT
THE HIGHLINE
317 EAST CARSON STREET, SUITE 119
PITTSBURGH, PA 15219
412-241-7645

THE DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHWEST REGIONAL OFFICE
400 WATERFRONT DRIVE
PITTSBURGH, PA 15222
412-442-4000

STREAM RESTORATION FOR MS4 CREDIT
IN THE SAW MILL RUN AND OHIO RIVER WATERSHED
FOR
PENNSYLVANIA DEPARTMENT OF TRANSPOTATION
AND
PITTSBURGH WATER AND SEWER AUTHORITY
POLLUANT REDUCTION PLAN

CRANE AVENUE
RESTORATION SITE

LOCATION MAP

0 0.5 1.0 MILES

CALL BEFORE YOU DIG
PENNSYLVANIA LAW REQUIRES 3 WORKING DAYS NOTICE
FOR CONSTRUCTION PHASE AND 10 WORKING DAYS
IN DESIGN STAGE - STOP CALL 1-800-242-1776

PA1 SYSTEM INC.

CITY OF PITTSBURGH PRELIMINARY DESIGN SERIAL NO. 20222372699

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COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER WILLIAM BRUCE McNEAL PE074465

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN PE 061647

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
TITLE SHEET

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\MS4CraneAve PRPTitle.dgn
DATE: 7/12/2023 TIME: 10:50:42 AM

EROSION AND SEDIMENT POLLUTION CONTROL GENERAL NOTES

IN ACCORDANCE WITH THE CURRENT POLICIES AND PRACTICES IN THE COMMONWEALTH OF PENNSYLVANIA TO CONTROL EROSION, IT IS REQUIRED THAT THE CONTRACTOR FOR THIS PROJECT CONFORM WITH THE FOLLOWING GUIDELINES AS THEY ARE APPLICABLE AND IN ACCORDANCE WITH THE INSTRUCTIONS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP) AND THE PENNDOT REPRESENTATIVE.

KEEP A COPY OF THE APPROVED PLAN DRAWINGS STAMPED, SIGNED AND DATED BY THE REVIEWING AGENCY AT THE PROJECT SITE AT ALL TIMES.

FAILURE TO CORRECTLY INSTALL ESPC BMPS, FAILURE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE CONSTRUCTION SITE, OR FAILURE TO TAKE IMMEDIATE CORRECTIVE ACTION TO RESOLVE FAILURE OF ESPC BMPS MAY RESULT IN ADMINISTRATIVE, CIVIL, AND/OR CRIMINAL PENALTIES BEING INSTITUTED BY PADEP AS DEFINED IN SECTION 602 OF THE PENNSYLVANIA CLEAN STREAMS LAW. THE CLEAN STREAMS LAW PROVIDES FOR UP TO $10,000 PER DAY IN CIVIL PENALTIES, UP TO $10,000 IN SUMMARY CRIMINAL PENALTIES, AND UP TO $25,000 IN MISDEMEANOR CRIMINAL PENALTIES FOR EACH VIOLATION.

CONSTRUCTION WASTES ANTICIPATED FOR THIS PROJECT ARE: UNSUITABLE AND EXCESS BUILDING MATERIALS, ASPHALT OR CONCRETE, EXCESS EXCAVATION, AND SEDIMENT MATERIAL ACCUMULATED BY THE ESPC BMPS (AND/OR OTHER WASTES AS DETERMINED BY THE PLAN OR THE DEPARTMENT'S REPRESENTATIVE).

ALL BUILDING MATERIALS AND WASTES SHALL BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED OF IN ACCORDANCE WITH THE PADEP'S SOLID WASTE MANAGEMENT REGULATIONS IN 25 PA. CODE SECTION 260.1, 271.1, AND 287.1. NO BUILDING MATERIALS OR WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURNED, BURIED, DUMPED, OR DISCHARGED AT THE SITE.

INSPECT ALL ESPC BMPS ACCORDING TO THE SCHEDULES OUTLINED IN THIS PLAN. PERFORM ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK IMMEDIATELY, INCLUDING CLEAN-OUT, REPAIR, REPLACEMENT, REGRADING, RESEEDING, RE-MULCHING, AND RE-NETTING.

MAINTAIN A LOG ON SITE SHOWING DATES THAT ESPC BMPS WERE INSPECTED AS WELL AS ANY DEFICIENCIES FOUND AND THE DATE THEY WERE CORRECTED.

IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, IMPLEMENT APPROPRIATE BMPS TO MINIMIZE THE POTENTIAL FOR EROSION AND SEDIMENT POLLUTION AND NOTIFY THE COUNTY CONSERVATION DISTRICT OR PADEP. ALSO, IMMEDIATELY NOTIFY THE DEPARTMENT IN ACCORDANCE WITH PUBLICATION 408, SPECIFICATIONS, SECTION 110.02.

CONDUCT ALL EARTH DISTURBANCES, INCLUDING CLEARING AND GRUBBING AS WELL AS CUTS AND FILLS, IN ACCORDANCE WITH THE APPROVED ESPC PLAN.

LIMIT CLEARING, GRUBBING, AND TOPSOIL STRIPPING TO THOSE AREAS DESCRIBED IN EACH STAGE OF THE CONSTRUCTION SEQUENCE. DO NOT COMMENCE WORK IN ANY STAGE OR PHASE OF THE PROJECT UNTIL THE ESPC BMPS SPECIFIED BY THE CONSTRUCTION SEQUENCE FOR THAT STAGE OR PHASE HAVE BEEN INSTALLED AND ARE FUNCTIONING AS DESCRIBED IN THIS DOCUMENT.

PUMP WATER FROM WORK AREA(S) TO UNDISTURBED VEGETATED AREAS AND ACCORDING TO THE PROCEDURE DESCRIBED IN THIS PLAN.

SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD.

RETURN SEDIMENT THAT IS TRACKED ONTO ANY PUBLIC ROADWAY OR SIDEWALK TO THE CONSTRUCTION SITE BY THE END OF EACH WORKDAY AND DISPOSE OF PROPERLY. DO NOT WASH, SHOVEL, OR SWEEP THE SEDIMENT INTO ANY ROADSIDE DITCH, STORM SEWER, OR SURFACE WATER.

SPRINKLE OR APPLY DUST SUPPRESSOR OR KEEP DUST WITHIN TOLERABLE LIMITS AT THE SITE.

HANDLE CONCRETE WASH WATER IN THE MANNER DESCRIBED IN THE PLAN. IN NO CASE SHALL IT BE ALLOWED TO ENTER SURFACE WATERS OR GROUNDWATER SYSTEMS.

KEEP ALL CHANNELS FREE OF OBSTRUCTIONS INCLUDING BUT NOT LIMITED TO FILL, ROCKS, LEAVES, WOODY DEBRIS, ACCUMULATED SEDIMENT, EXCESS VEGETATION, AND CONSTRUCTION MATERIAL/WASTES.

ENSURE THAT SUFFICIENT OVER-EXCAVATION IS PROVIDED FOR RIP-RAP CHANNELS SUCH THAT THE SPECIFIED CHANNEL DIMENSIONS ARE ACHIEVED AFTER PLACEMENT OF THE STONE.

PLACE TOPSOIL AS INDICATED ON THE PLAN AND IN ACCORDANCE WITH PUBLICATION 408 - SPECIFICATIONS.

PERMANENTLY STABILIZE ALL GRADED AREAS IMMEDIATELY UPON REACHING FINISHED GRADE. CUT SLOPES IN COMPETENT BEDROCK AND ROCK FILLS NEED NOT BE VEGETATED.

USE THE SPECIFIED ROLLED EROSION CONTROL PRODUCT(S) ON ALL SEEDED AREAS WITHIN 50 FT OF NON-SPECIAL PROTECTION SURFACE WATERS, WITHIN 100 FT OF SPECIAL PROTECTION SURFACE WATERS, AND WITH SLOPES 3H:1V AND STEEPER.

STABILIZE ALL DISTURBED AREAS IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE IN ANY AREA OF THE PROJECT. APPLY MULCH OR PROTECTIVE BLANKETING DURING NON-GERMINATING MONTHS. APPLY TEMPORARY STABILIZATION TO DISTURBED AREAS THAT WILL BE REACTIVATED WITHIN ONE YEAR; IF LONGER THAN ONE YEAR, APPLY PERMANENT STABILIZATION.

A DISTURBED AREA IS CONSIDERED PERMANENTLY STABILIZED WHEN IT IS COVERED WITH EITHER (1) A MINIMUM UNIFORM 70% PERENNIAL VEGETATIVE COVER WITH A DENSITY CAPABLE OF RESISTING ACCELERATED EROSION AND SEDIMENTATION; OR (2) AN ACCEPTABLE BMP WHICH PERMANENTLY MINIMIZES ACCELERATED EROSION AND SEDIMENTATION.

ENSURE THAT ESPC BMPS REMAIN FUNCTIONAL UNTIL ALL AREAS TRIBUTARY TO THEM ARE PERMANENTLY STABILIZED OR UNTIL THEY ARE REPLACED BY ANOTHER BMP.

OBTAIN ESPC PLAN APPROVAL FOR ALL OFF-SITE WASTE AND BORROW AREAS FROM THE CONSERVATION DISTRICT OR PADEP, AND FULLY IMPLEMENT THE PLAN PRIOR TO ACTIVATING THE SITE.

CLEAR, GRUB, AND STRIP TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS, AND OTHER OBJECTIONABLE MATERIAL FROM FILL AREAS.

KEEP ALL TOPSOIL STOCKPILED ONSITE IN THE LOCATION(S) SHOWN ON THE PLAN. PROVIDE THE AMOUNT OF TOPSOIL REQUIRED TO COMPLETE THE FINAL GRADING AND TO ESTABLISH VEGETATION. PROTECT STOCKPILE(S) AS SHOWN ON THE PLAN. PLACE STOCKPILES NO GREATER THAN 35 FT IN HEIGHT WITH SLOPES NO STEEPER THAN 2H:1V.

EROSION AND SEDIMENT POLLUTION CONTROL GENERAL NOTES (CONT)

COMPACT ALL FILLS TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE, OR OTHER RELATED PROBLEMS. COMPACT FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES, CONDUITS, ETC. IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES. PLACE ALL EARTHEN FILLS IN MAXIMUM 9-INCH THICK COMPACTED LAYERS.

DO NOT PLACE FILLS ON SATURATED OR FROZEN SURFACES. FILL MATERIALS SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH CONSTRUCTION OF SATISFACTORY FILLS. DO NOT INCORPORATE SOFT, MUCKY, OR HIGHLY COMPRESSIBLE MATERIALS INTO FILLS.

ENSURE THAT CUT AND FILL SLOPES ARE CAPABLE OF RESISTING FAILURE DUE TO SLUMPING, SLIDING, OR OTHER MOVEMENTS.

THE DEPARTMENT WILL PROVIDE TO THE CONTRACTOR A COMPLETED DUE DILIGENCE FORM FOR EXCESS MATERIAL THAT NEEDS TO BE EXPORTED TO AN OFF-SITE LOCATION. THE CONTRACTOR WILL PROVIDE TO THE DEPARTMENT A DUE DILIGENCE FORM FOR ALL MATERIAL THAT COMES ONTO THE SITE.

ENSURE THAT ANY MATERIAL BROUGHT ON SITE IS CLEAN FILL, DEFINED AS UNCONTAMINATED, NON-WATER SOLUBLE, NON-DECOMPOSABLE, INERT, SOLID MATERIAL. THE TERM INCLUDES SOILS, ROCK, STONE, DREDGED MATERIAL, USED ASPHALT (NOT INCLUDING MILLED OR PROCESSED FOR REUSE), BRICK, BLOCK OR CONCRETE FROM CONSTRUCTION AND DEMOLITION ACTIVITIES THAT IS SEPARATE FROM OTHER WASTE AND RECOGNIZABLE AS SUCH. THE TERM DOES NOT INCLUDE MATERIALS PLACED IN OR ON THE WATERS OF THE COMMONWEALTH UNLESS OTHERWISE AUTHORIZED.

ANY PLACEMENT OF CLEAN FILL THAT HAS BEEN AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE MUST USE FORM FP-001 TO CERTIFY THE ORIGIN OF THE FILL MATERIAL AND THE RESULTS OF THE ANALYTICAL TESTING TO QUALIFY THE MATERIAL AS CLEAN FILL. FORM FP-001 MUST BE RETAINED BY THE OWNER OF THE PROPERTY RECEIVING THE FILL.

ENVIRONMENTAL DUE DILIGENCE MUST BE PERFORMED TO DETERMINE IF THE FILL MATERIALS ASSOCIATED WITH THE PROJECT QUALIFY AS CLEAN FILL. ENVIRONMENTAL DUE DILIGENCE IS DEFINED AS: INVESTIGATIVE TECHNIQUES, INCLUDING BUT NOT LIMITED TO, VISUAL PROPERTY INSPECTIONS, ELECTRONIC DATA BASE SEARCHES, REVIEW OF PROPERTY OWNERSHIP, REVIEW OF PROPERTY USE HISTORY, SANBORN MAPS, ENVIRONMENTAL QUESTIONNAIRES, TRANSACTION SCREENS, ANALYTICAL TESTING, ENVIRONMENTAL ASSESSMENTS OR AUDITS. ANALYTICAL TESTING IS NOT A REQUIRED PART OF DUE DILIGENCE UNLESS VISUAL INSPECTION AND/OR REVIEW OF THE PAST LAND USE OF THE PROPERTY INDICATES THAT THE FILL MAY HAVE BEEN SUBJECTED TO A SPILL OR RELEASE OF A REGULATED SUBSTANCE. IF THE FILL MAY HAVE BEEN AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE, IT MUST BE TESTED TO DETERMINE IF IT QUALIFIES AS CLEAN FILL. TESTING SHOULD BE PERFORMED IN ACCORDANCE WITH APPENDIX A OF PADEP'S MANAGEMENT OF FILL POLICY.

GENERAL BMP INSTALLATION AND REMOVAL NOTES

AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, INCLUDING, CLEARING AND GRUBBING, INVITE ALL CONTRACTORS, THE DEPARTMENT'S REPRESENTATIVE, PWSA REPRESENTATIVE AND A REPRESENTATIVE FROM THE COUNTY CONSERVATION DISTRICT (CCD) OR PADEP TO AN ON-SITE PRE-CONSTRUCTION MEETING.

THE PERMITTEE OR CO-PERMITTEE SHALL NOTIFY THE CCD/PADEP UPON INSTALLATION OF ALL PERIMETER SEDIMENT CONTROL BMPS AT LEAST 3 BUSINESS DAYS PRIOR TO PROCEEDING WITH THE BULK EARTH DISTURBANCE ACTIVITIES.

THREE TO TEN WORKING DAYS PRIOR TO EXCAVATION BASED ON THE COMPLEXITY OF THE PROJECT, THE CONTRACTOR MUST CONTACT THE PA ONE CALL SYSTEM, INC., PHONE 1-800-242-1776, SERIAL NO: 20222372671 FOR CITY OF PITTSBURGH. ADDITIONAL INFORMATION IS AVAILABLE AT tt ://www. 1 ll.o /PA811/P li /.

THE CONTRACTOR IS REQUIRED TO NOTIFY THE DEPARTMENT AND SUBMIT AN ALLEGED VIOLATION REPORT (AVR) TO THE PA PUBLIC UTILITY COMMISSION THROUGH THE PA ONE CALL SYSTEM, WWW.PA1CALL.ORG, WITHIN TEN (10) BUSINESS DAYS AFTER A UTILITY LINE IS STRUCK, DAMAGED, OR PREVIOUS DAMAGE IS DISCOVERED AS REQUIRED BY PENNSYLVANIA'S UNDERGROUND UTILITY LINE PROTECTION LAW ACT 50 (P.L. 852, NO. 287 AMENDED OCT. 30, 2017).

PROCEED WITH ALL EARTH DISTURBANCE ACTIVITIES IN ACCORDANCE WITH THE BMP SEQUENCE. DEVIATION FROM THE SEQUENCE REQUIRES WRITTEN APPROVAL FROM THE CCD/PADEP PRIOR TO IMPLEMENTATION. COORDINATE ANY/ALL PROPOSED CHANGES TO THE APPROVED PLAN WITH THE PENNDOT REPRESENTATIVE. UPON REVIEW AND CONCURRENCE WITH THE PENNDOT REPRESENTATIVE, COMMUNICATE CHANGES AS FOLLOWS:

i. DISCUSS THE SEQUENCE DEVIATION WITH THE CCD/PADEP AND OBTAIN VERBAL APPROVAL.
ii. MODIFY THE ESPC PLAN (RED-LINE THE DRAWING) AND GET A SIGNATURE/INITIALS FROM THE CCD/PADEP AT THE SITE OR GET ACKNOWLEDGEMENT THROUGH AND ELECTRONIC PERMITTING SYSTEM. RETAIN THE EARTH DISTURBANCE INSPECTION REPORT ACKNOWLEDGING THE FIELD CHANGE.
iii. IF NEEDED, FAX OR EMAIL THE MODIFIED SEQUENCE TO THE CCD/PADEP.

PRE-CONSTRUCTION BMP NOTES

PERFORM A PRE-PROJECT SITE EVALUATION AND DETERMINE IF THERE ARE AREAS WITHIN THE LIMITS OF DISTURBANCE THAT SHOULD NOT BE DISTURBED DURING THE LIFE OF THE PROJECT.

CLEARLY MARK THE LIMITS OF DISTURBANCE AT THE LOCATIONS INDICATED ON THE PLAN. USE STAKES AND FLAGGING THAT ARE DURABLE ENOUGH TO LAST THE ENTIRE DURATION OF ACTIVE DISTURBANCE. INSTALL PROTECTIVE FENCING AROUND SENSITIVE AREAS SHOWN ON THE PLAN AND/OR IDENTIFIED DURING THE PRE-PROJECT EVALUATION. CONSTRUCTION VEHICLES ARE NOT PERMITTED TO ENTER AREAS OUTSIDE THE LIMIT OF DISTURBANCE BOUNDARIES SHOWN ON THE DRAWINGS.

CONSTRUCTION SEQUENCE

LRG WILL UTILIZE REGENERATIVE STREAM CONVEYANCE/FLOOD PLAIN RESTORATION FOR THE CONSTRUCTION METHOD OF THE REESTABLISHED UNNAMED TRIBUTARY CHANNELS IN SAWMILL RUN. LENGTH OF EACH CONSTRUCTION REACH IS BASED ON THE EXISTING FLOW OF THE CHANNEL.

1. PLACE ROCK CONSTRUCTION ENTRANCES RCE-1 WITH PIPE, RCE-2 AND RCE-3 FOR MOBILIZATION AND ACCESS TO THE STREAM.
2. PLACE COMPOST FILTER SOCK AT LAYDOWN/STAGING AREAS AS SHOWN ON THE PLANS.
3. SET UP STREAM DIVERSION/PUMP AND PUMP WATER FILTER BAG AROUND APPROXIMATELY 200 FEET MAX IN LENGTH.
4. ONLY DISTURB LENGTH OF CHANNEL THAT CAN BE RESTORED IN A DAY TO A MAX OF 200 FT.
5. PLACE ROCK FILTER IN THE CHANNEL 5-10 FEET UPSTREAM AT THE POINT WHERE THE PUMP DISCHARGES THE WATER INTO THE DOWN-STREAM CHANNEL. DISCHARGE THE WATER THROUGH A DIFFUSER 20 FEET DOWNSTREAM OF THE WORK AREA. DO NOT CAUSE A SCOUR ISSUE IN THE CHANNEL.
6. GRADE THE CHANNEL CLOSED IN THE REACH FROM STATION 213+84 TO 209+50.
7. EXCAVATE THE CHANNEL TO THE PROPOSED GRADE AND DEPTH BY USING THE BACK OF THE BUCKET.
8. EXCAVATE/FILL USING STREAM BED AND BANK MATERIAL AND PLACE GRADE CONTROL STRUCTURES PERPENDICULAR TO CHANNEL SO TOP OF THE LOG STRUCTURE IS AT THE INVERT OF THE CHANNEL. THESE WILL BE SPACED ACCORDING TO THE CHART ON THE PLANS.
9. PLACE AASHTO-1 IN BED AS NEEDED WHERE LOG GRADE CONTROLS MEET THE BANKS.
10. SEED FLOODWAY PER SEEDING SPECIFICATION ON DETAIL SHEETS, MULCHING WITH A TEMPORARY MULCH BLANKET OR ECMB AS DETAIL RECOMMENDS.
11. REMOVE BYPASS PUMP, PROCEED TO NEXT REACH, LEAVE ROCK FILTER IN PLACE AT THE DOWNSTREAM END UNTIL THE CHANNEL RESTABLISHMENT PROJECT IS COMPLETED.
12. CONSTRUCT OUTLET PROTECTION ROP-1 AND TP-01 AS PER THE DETAIL. INSTALL CLEAN WATER DIVERSION CHANNEL CW-DIV1D-A STARTING AT THE LOW END, CONNECT TO PIPE IN RCE AS PER THE DETAIL, UNTIL REACHING TEMPORARY SLOPE PIPE TP-02. INSTALL MANHOLE MH-4 AND PLUG THE SOUTH OUTLET HOLE FOR DIVERSION. CONNECT TP-02 TO MH-4 OUTFALL AS SHOWN ON THE PLANS TO DIVERT CLEAN WATER AROUND THE WORK AREA.
13. INSTALL COMPOST FILTER SOCK FOR CONSTRUCTION OF THE BIORETENTION RAIN GARDEN SCM-003.
14. INSTALL THE BIORETENTION RAIN GARDEN OUTLET PIPES, ENDWALL, AND ROCK OUTLET PROTECTION PRIOR TO REMOVING THE PUMP BYPASS SYSTEM. INSTALL OUTLET PIPE FROM THE HEADWALL.
15. EXCAVATE AND GRADE BIORETENTION RAIN GARDEN BASIN TO ELEVATIONS SHOWN ON THE PLANS AND CONSTRUCTION DETAILS.
16. INSTALL REMAINING OUTLET PIPE, REINFORCED CONCRETE ANTI-SEEP COLLARS AND OUTLET STRUCTURES. TEMPORARILY COVER ORIFICES TO PREVENT SEDIMENT LADEN RUNOFF FROM DISCHARGING THROUGH THE OUTLET STRUCTURE. USE PUMP WATER FILTER BAG TO DEWATER THE BASIN.
17. INSTALL BIORETENTION RAIN GARDEN SCM-003 INLET PIPE ROCK OUTLET PROTECTION, ENDWALL, AND SEGMENT OF PIPE. TEMPORARYLY BLOCK END OF PIPE.
18. PROVIDE PERMANENT SEEDING AND STABILIZATION TO AREAS DISTURBED DURING BASIN CONSTRUCTION IN ACCORDANCE WITH SEEDING AND MULCHING SPECIFICATIONS IN THIS PLAN.
19. ONCE THE BIORETENTION RAIN GARDEN BASIN IS STABILIZED, INSTALL THE REMAINING INLET PIPE, REMOVE TEMPORARY ORIFICE COVERS AND UNPLUG MH-4. REMOVE TEMPORARY SLOPE PIPE TP-02, CW-DIV1, TEMPORARY SLOPE PIPE TP-01 AND ROCK OUTLET PRORECTION ROP-1.
20. AFTER UNIFORM 70% PERENNIAL VEGETATIVE COVER IS ACHIEVED ON ALL AREAS, REMOVE ALL BMPS. SEED AND MULCH ANY REMAINING DISTURBED AREAS FROM BMP REMOVAL.

REPEAT THE SEQUENCE STEPS 3-11 BASED UPON THE STATIONING OF THE REACH. FOR STEP SEQUENCE STEP 6, GRADE CHANNEL CLOSED FROM STATIONS 209+50 TO 205+35, 301+58 TO 300+00, 205+23 TO 200+00. BYPASS PUMP IS TO BE INSTALLED AT STA 204+78 AT THE END OF ROP-1 UPON REACHING THAT LENGTH OF STREAMWORK. EACH REACH CAN NOT EXCEED 200 FEET. ONLY OPEN THE LENGTH OF CHANNEL THAT CAN BE COMPLETED IN THE WORKDAY. THE SAME SEQUENCE WILL BE FOLLOWED FOR THE REESTABLISHMENT OF EACH CHANNEL.

BMP INSPECTION, MAINTENANCE, AND REPAIR (IMR) SCHEDULE

BMP	INSPECTION	MAINTENANCE	REPAIR
COMPOST FILTER SOCK	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT WHEN IT REACHES 1/2 OF THE EXPOSED HEIGHT.	ANY SECTION OF THE FILTER SOCK THAT HAS BEEN DAMAGED, UNDERMINED OR WASHED OUT SHOULD BE IMMEDIATELY REPAIRED OR REPLACED WITH ADDITIONAL FILTER SOCK OR A ROCK FILTER OUTLET.
PUMPED WATER FILTER BAG	DAILY AND PRIOR TO THE START OF PUMPING	UPON DETECTION OF ANY PROBLEM WITH A PUMPED WATERFILTER BAG OR HOSE BETWEEN THE PUMP AND THE BAG, CEASE PUMPING IMMEDIATELY AND DO NOT RESUME UNTIL THE PROBLEM IS CORRECTED OR ANOTHER BAG OR HOSE IS PLACED INTO OPERATION.	REPLACE BAG WHEN IT IS 1/2 FULL OF SEDIMENT FOR VEGETATED AREAS. IF THE BAG IS PLACED ON No. 57 STONE (PER RC-75M DETAIL), REPLACE WHEN BAG IS FULL. IF LESS THAN 1/2 FULL AND DESIGN FLOW RATE IS REDUCED DUE TO SEDIMENT ACCUMULATION OR BAG IS DAMAGED, REPLACE BAG.
SEEDING AND MULCHING	WEEKLY AND AFTER EACH RUNOFF EVENT		IF WASHOUTS OCCUR, EVALUATE IF CONCENTRATED FLOW IS LIKELY TO HAPPEN AGAIN. IF SO, RE-SEED AND STABILIZE WITH A ROLLED EROSION CONTROL PRODUCT. IF CONCENTRATED FLOW IS NOT LIKELY TO HAPPEN AGAIN, RE-SEED AND APPLY MULCH.
TEMPORARY DIVERSION DIKE SYSTEM	DAILY AND AFTER EACH RUNOFF EVENT		REPLACE DAMAGED SANDBAGS AND PLASTIC SHEETING AS REQUIRED.
TEMPORARY COFFERDAM	DAILY AND AFTER EACH RUNOFF EVENT		
ROLLED EROSION CONTROL PRODUCTS	WEEKLY AND AFTER EACH RUNOFF EVENT		IF WASHOUTS OCCUR, EVALUATE IF CONCENTRATED FLOW IS LIKELY TO HAPPEN AGAIN. IF SO, RE-SEED AND STABILIZE WITH A ROLLED EROSION CONTROL PRODUCT UTILIZING HIGH SHEAR STRESS INSTALLATION AS RECOMMENDED BY MANUFACTURER.
ROCK FILTER	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT WHEN IT REACHES ½ OF THE ROCK HEIGHT AT THE CENTER OF THE DEPRESSION.	IF THE ROCK HAS BEEN ERODED OR CLOGGED, THE ROCK FILTER SHOULD BE IMMEDIATELY REPAIRED TO THE REQUIRED DIMENSIONS.
ROCK CONSTRUCTION ENTRANCE	DAILY AND AFTER EACH RUNOFF EVENT	RCE THICKNESS MUST BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK.	ADD CLEAN ROCK AS REQUIRED TO MAINTAIN ENTRANCE
TEMPORARY STREAM CROSSING	DAILY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT DEPOSITS ON THE CROSSING AND APPROACHES. ADD ROCK TO THE CROSSING AS NEEDED.	DAMAGED CROSSING SHALL BE REPAIRED WITHIN 24 HOURS OF THE INSPECTION AND BEFORE ANY SUBSEQUENT USE. SEDIMENT DEPOSITS ON THE CROSSING OR ITS APPROACHES SHALL BE REMOVED WITHIN 24 HOURS OF THE INSPECTION.
SEDIMENT FILTER TUBE	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT DEPOSITS WHEN IT REACHES HALF THE HEIGHT OF THE TUBE.	DAMAGED TUBES SHALL BE REPLACED WITHIN 24 HOURS OF INSPECTION. A SUPPLY OF TUBES SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE.
TEMPORARY DIVERSION CHANNELS	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT WHEN IT REACHES 25% DEPTH OF THE CHANNEL	REPAIR DAMAGED LININGS IMMEDIATELY
TEMPORARY SLOPE PIPE	WEEKLY AND AFTER EACH RUNOFF EVENT	REPAIR TO ORIGINAL DIMENSIONS	REPAIR IMMEDIATELY
INLET PROTECTION	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT DEPOSITS WHEN IT REACHES HALF THE HEIGHT OF THE TUBE.	REPLACE IMMEDIATELY

THE CONTRACTOR IS RESPONSIBLE FOR INSTALLATION, MAINTENANCE AND DISPOSAL OF EROSION AND SEDIMENT CONTROL DEVICES FOR THE CONSTRUCTION AREA AND SUBAREAS. PERFORM THESE ACTIVITIES IN ACCORDANCE WITH PENNDOT PUBLICATION 408 SPECIFICATIONS, THE PA DEP EROSION AND SEDIMENT CONTROL PROGRAM MANUAL, AND SPECIAL PROVISIONS AS APPLICABLE UNTIL THE SITE IS STABILIZED.

ON EXPOSED SOIL AREAS, THE SEEDING AND MULCH WILL BE MAINTAINED UNTIL COVER IS ESTABLISHED IN ACCORDANCE WITH PENNDOT PUBLICATION 408, SECTIONS 804 AND 805. IF A SLOPE FAILURE OCCURS ON A SLOPE PREVIOUSLY COMPLETED, REESTABLISH THE SLOPE AND REAPPLY THE SEEDING AND SOIL SUPPLEMENTS AND MULCH AS SPECIFIED FOR THE ORIGINAL SLOPE. PROMPTLY REAPPLY MULCH MATERIAL THAT BECOMES DISLODGED OR LOST DUE TO WIND, RAIN OR OTHER CAUSES. COMPOST FILTER SOCKS WILL REMAIN IN PLACE TO CONTROL DISTURBED AREAS UNTIL 70% VEGETATIVE COVER HAS BEEN ESTABLISHED ON THE DISTURBED AREAS.

ANY DAMAGED OR DETERIORATED PORTIONS OF THE BMPS WILL BE REPLACED OR REPAIRED IMMEDIATELY.

BMP FINAL INSPECTION NOTES

UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, CONTACT THE CCD/PADEP FOR AN INSPECTION PRIOR TO REMOVAL/CONVERSION OF ESPC BMPS. PERMANENTLY STABILIZED MEANS COVERED WITH EITHER (1) A MINIMUM UNIFORM 70% PERENNIAL VEGETATIVE COVER WITH A DENSITY CAPABLE OF RESISTING ACCELERATED EROSION AND SEDIMENTATION; OR (2) AN ACCEPTABLE BMP WHICH PERMANENTLY MINIMIZES ACCELERATED EROSION AND SEDIMENTATION.

UPON APPROVAL FROM THE CCD/PADEP, REMOVE TEMPORARY ESPC BMPS AND CONVERT DESIGNATED SEDIMENT TRAPS/ BASINS TO THEIR PERMANENT STORMWATER CONFIGURATIONS. IMMEDIATELY STABILIZE AREAS DISTURBED DURING REMOVAL OR CONVERSION OF BMPS. AVOID DOING REMOVAL OR CONVERSION DURING THE NON-GERMINATING SEASON.

CONTACT THE CCD/PADEP TO SCHEDULE A FINAL INSPECTION WHEN ALL ESPC BMPS ARE REMOVED AND/OR CONVERTED.

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SHEET 3 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
CONSTRUCTION SEQUENCE

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

STABILIZATION:

CUT AND FILL SLOPES WILL BE SEEDED AND MULCHED IN REGULAR VERTICAL INCREMENTS (15' MAX) AS THE SLOPE IS BEING CONSTRUCTED.

TOPSOIL IS REQUIRED FOR ANY AREA THAT SPECIFIES SEEDING. GRADED AREAS SHOULD BE SCARIFIED OR OTHERWISE LOOSENED PRIOR TO TOPSOIL DISTRIBUTION.

TOPSOIL SHOULD BE UNIFORMLY DISTRIBUTED ACROSS THE DISTURBED AREA AND COMPACTED AS INDICATED IN THE SPECIFICATIONS, TO A 4-INCH DEPTH OR AS INDICATED ON THE PLANS +/-1½ INCHES. SPREADING SHOULD BE DONE IN SUCH A MANNER THAT SODDING OR SEEDING CAN PROCEED WITH A MINIMUM OF ADDITIONAL PREPARATION OR TILLAGE. IRREGULARITIES IN THE SURFACE RESULTING FROM TOPSOIL PLACEMENT SHOULD BE CORRECTED IN ORDER TO PREVENT FORMATION OF DEPRESSIONS.

TEMPORARY STABILIZATION WILL BE UTILIZED AS NEEDED DURING PLANNED OR UNPLANNED PROJECT SUSPENSION OR IF THE DISTURBED AREA ACHIEVES FINAL GRADE DURING AN UNFAVORABLE GROWING SEASON.

SEED MIXTURES

SEASONALLY FLOODED AREA MIX (SLOPES OF STORMWATER DETENTION BASIN)

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					4.15 TOTAL
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75	0.15	0.83
SMARTWEED/BARNYARD MIX (POLYGONUM LAPATHIFOLIUM)	20	92	85	0.15	0.83
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	0.83
JAPANESE MILLET (ECHINOCHLOA CRUSGALLI FRUMENTA)	20	95	80	0.15	0.83
NODDING BUR-MARIGOLD (BIDENS CERNUA)	10	92	85	0.15	0.42
SWITCHGRASS (PANICUM VIRGATUM) (AN IMPROVED VARIETY MUST BE USED)	5	92	85	0.10	0.21
LURID SEDGE (CAREX LURIDA)	2.5	92	85	0.10	0.10
COSMOS SEDGE (CAREX COMOSA)	2.5	92	85	0.10	0.10

DETENTION BASIN FLOOR SEED MIXTURE (BOTTOM OF STORMWATER DETENTION BASIN)

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
ALKALIGRASS (PUCCINELLIA DISTANS)	20	99	90	0.15	1.04

FORMULA T (TEMPORARY STABILIZATION DURING CONSTRUCTION)

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					10.0 TOTAL
ANNUAL RYEGRASS (LOLIUM MULTIFLORUM)	100	95	90	0.10	10.0

SEED MIXTURES (CONT.)

HVE MIX (BASIN EXTERIOR SLOPES AND MISCELLANOUS RESTORATION)

FOPMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	APPLICATION RATE
					34.3 LBS/ACRE
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75		
PERENNIAL RYE GRASS	30	95	85		
KENTUCKY BLUEGRASS	30	95	80		
ANNUAL RYE GRASS	10	95	80		
FERTILIZED APPLICATION RATE	10-10-20				1000 LBS/ACRE
LIMING RATE	PULVERIZED AGRICULTURAL LIMESTONE				6 TONS/ACRE
MULCHING TYPE	STRAW				3.0 TONS/ACRE
SEEDING DATES	MARCH - NOVEMBER				-

SOIL SUPPLEMENTS

APPLY SOIL SUPPLEMENTS AS FOLLOWS TO SEASONALLY FLOODED AREA MIX AND DETENTION BASIN FLOOR SEED MIX:

- PULVERIZED AGRICULTURAL LIMESTONE: 800 LB / 1000 SY

MULCHING RATES

MULCH WITH CLEAN STRAW AT A RATE OF 3 TONS / ACRE

APPLY ROLLED EROSION CONTROL PRODUCT TO ALL NEWLY SEEDED AREAS ON SLOPES 3:1 OR GREATER AND/OR WITHIN 50 FEET OF STREAM CHANNEL.

SEEDING DATES

DETENTION BASIN FLOOR & SEASONALLY FLOODED MIX — MARCH 15 TO MAY 15 AND SEPTEMBER 1 TO OCTOBER 15

AMENDED SOILS:

AMENDED SOIL AREAS SHALL BE PREPARED AS FOLLOWS PRIOR TO PLANTING:
AMENDED SOIL SHALL BE USED AS SPECIFIED BELOW:
- * 50% WASHED SHARD SAND MEETING ASTM C-33 (BY VOLUME).
- * 35% TOPSOIL PER PENNDOT PUBLICATION 408, SECTION 802 (BY VOLUME).
  - * TOPSOIL SHALL CONTAIN LESS THAN 10% CLAY
- * 15% AGED LEAF COMPOST (BY VOLUME).

INSTALLATION OF AMENDED SOIL:
- * INSTALL AMENDED SOIL MIX TO SPECIFIED DIMENSIONS, RESTRICT EQUIPMENT MOVEMENT OVER FLOOR BEFORE, DURING, AND AFTER AMENDED SOIL PLACEMENT TO AVOID OVER-COMPACTION.
- * THOROUGHLY WATER ENTIRE RAIN GARDEN FLOOR AFTER AMENDED SOIL PLACEMENT AND PRIOR TO PLANTING TO AID SOIL SETTLEMENT.

	FORMULA AND SPECIES	% BY WEIGHT	APPLICATION RATE
ERNMX-221 (FLOODPLAIN AND STREAM RESTORATION)	FOX SEDGE (CAREX VULPINOIDEA)	31	20.0 LBS/ACRE
	VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	
	LURID SEDGE (CAREX LURIDA)	8	
	HOP SEDGE (CAREX LUPULINA	7.8	
	BLUNT BROOM SEDGE (CAREX SCOPARIA)	7.8	
	BLUE VERVAIN (VERBENA HASTATA)	4	
	RIVER OATS (CHASMANTHIUM LATIFOLIUM)	3.3	
	SOFT RUSH (JUNCUS EFFUSUS)	3	
	STAR SEDGE (CAREX INTUMESCENS)	2	
	OXEYE SUNFLOWER (HELIPOSIS HELIANTHOIDES)	2	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.8	
	NODDING BUR MARIGOLD (BIDENS CERNUA)	1	
	AWL SEDGE (CAREX STIPATA)	1	
	NARROWLEAF BLUE EYED GRASS (SISYRINCHIUM ANGUSTIFOLIUM)	1	
	BONSET (EUPATORIUM PERFOLIATUM)	0.7	
	FOWL MANNAGRASS (GLYCERIA STRIATA)	0.5	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.5	
	PENNSYLVANIA SMARTWEED (POLYGONUM PENSYLVANICUM)	0.5	
	WOOLGRASS (SCIRPUS CYPERINUS)	0.5	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.5	
	GOLDEN ALEXANDERS (ZIZIA AUREA)	0.5	
	PUPLESTEM ASTER (ASTER PUNICEUS)	0.4	
	GREAT BLUE LOBELIA (LOBELIA SIPHILITICA)	0.4	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	
	SQUARE STEMMED MONKEYFLOWER (MIMULUS RINGENS)	0.3	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.3	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE
	LIMING RATE	-	6.0 TONS/ACRE
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY
	SEASON SEEDING DATES	SEPTEMBER-APRIL	-

	FORMULA AND SPECIES	% BY WEIGHT	APPLICATION RATE
ERNMX-223 (FLOODPLAIN AND STREAM RESTORATION)	LITTLE BLUESTEM (SCHIZACHYRIUM SCOPARIUM)	20	20.0 LBS/ACRE
	INDIANGRASS (SORGHASTRUM NUTANS)	20	
	VIRGINIA WILDRYE (ELYMUS VIRGINICUS)	18	
	BIG BLUESTEM (ANDROPOGON GERARDII)	12	
	RIVERBANK WILDRYE (ELYMUS RIPARIUS)	10.6	
	FOX SEDGE (CAREX VULPINOIDEA)	7	
	SOFT RUSH (JUNCU EFFUSUS)	3	
	OXEYE SUNFLOWER (HELIOPSIS HELIANTHOIDES)	2	
	BLUE VERVAIN (VERBENA HASTATA)	2	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.6	
	WILD BERGAMOT (MONARDA FISTULOSA)	0.5	
	BONESET (EUPTORIUM PERFOLIATUM)	0.4	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.4	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.4	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	
	WRINKLELEAF GOLDENROD (SOLIDAGO RUGOSA)	0.3	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	
	CALICO ASTER (ASTER LATERIFLORUS)	0.2	
	AROMATIC ASTER (ASTER OBLONGIFOLIUS)	0.2	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.2	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE
	LIMING RATE	-	6.0 TONS/ACRE
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY
	SEASON SEEDING DATES	JANUARY-JULY	-

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
SEEDING DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
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PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
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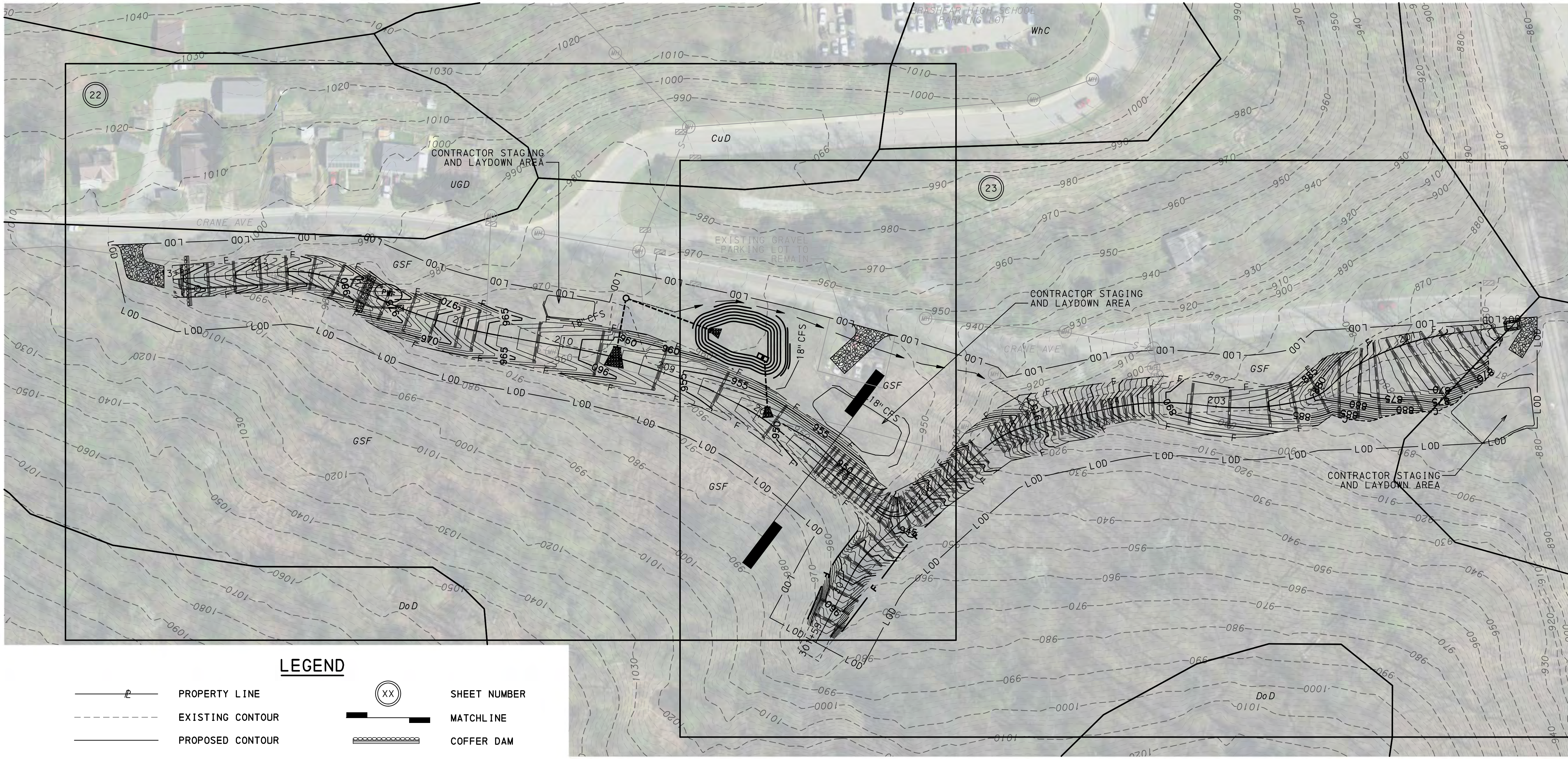
ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JAMES H. FLYNN
PE 061647



LEGEND

℄	PROPERTY LINE	XX	SHEET NUMBER
	EXISTING CONTOUR		MATCHLINE
	PROPOSED CONTOUR		COFFER DAM
LOD	LIMIT OF DISTURBANCE UNDER 401 CERT		ROCK FILTER
18" CFS	COMPOST FILTER SOCK		100 YR FLOODPLAIN BOUNDARY
	SOIL BOUNDARY LINE		
CdC	SOIL TYPE		
RCE	ROCK CONSTRUCTION ENTRANCE		
	DIVERSION CHANNEL		
	TEMPORARY PIPE		

0 50 100 FEET

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SHEET 6 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
INDEX MAP

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

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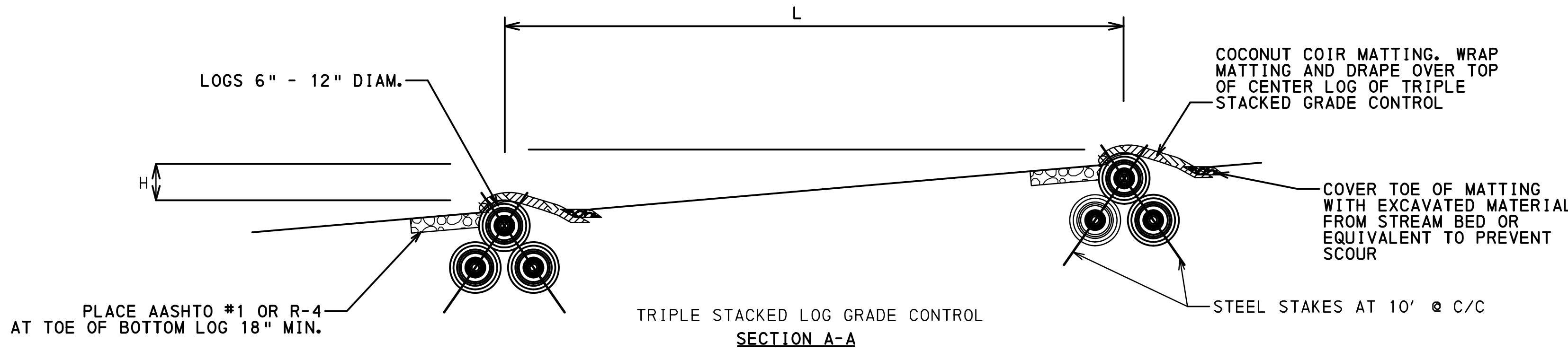
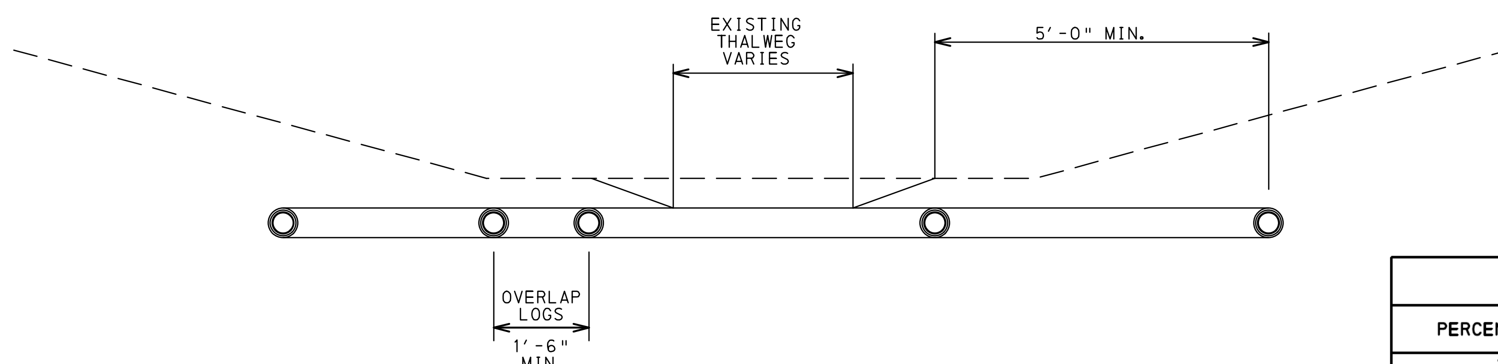


TRIPLE STACKED LOG GRADE CONTROL

SECTION A-A



LOG GRADE CONTROL

GRADE CONTROL PLACEMENT	
PERCENT SLOPE	SPACING (FT)
1-0	100
3-1	75-100
5-3	60-75
7-5	45-60
9-7	30-45
11-9	20-30
13-11	15-20
15	9-15

GRADE CONTROL NOTES:

1. GRADES GREATER THAN 20% WILL USE REESTABLISHMENT LOG AND ROCK STEP POOL. SEE DETAIL THIS SHEET.

GRADE CONTROL DETAIL

NTS

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
STREAM RESTORATION DETAILS

PREPARED BY:

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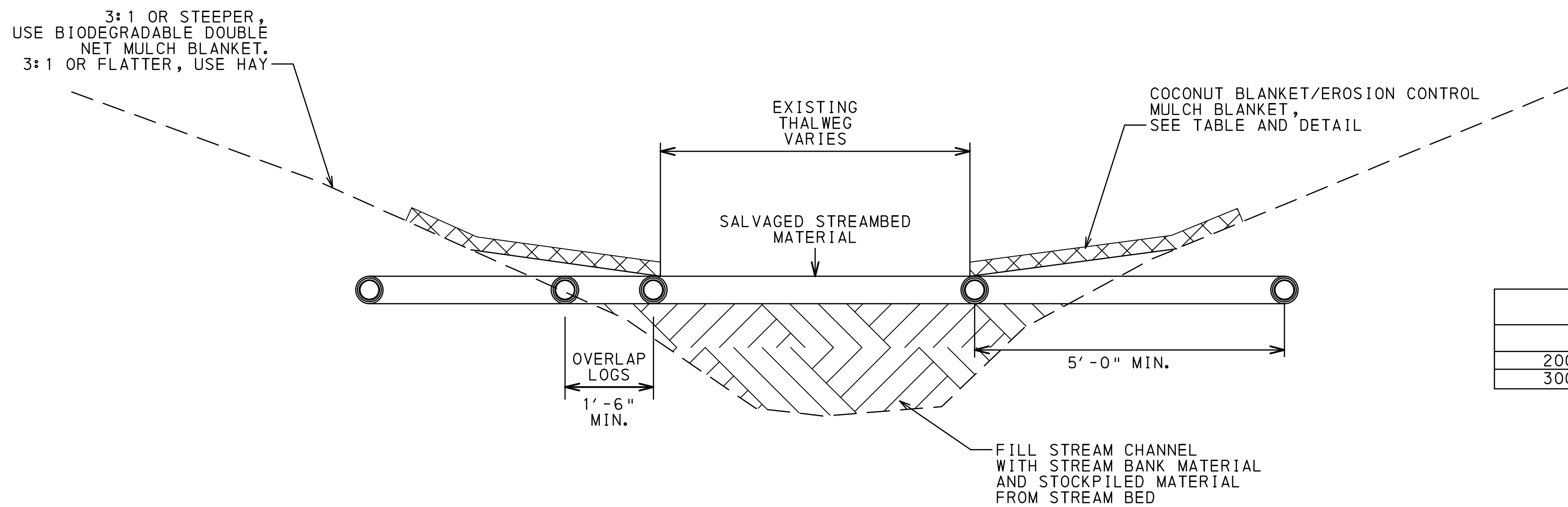
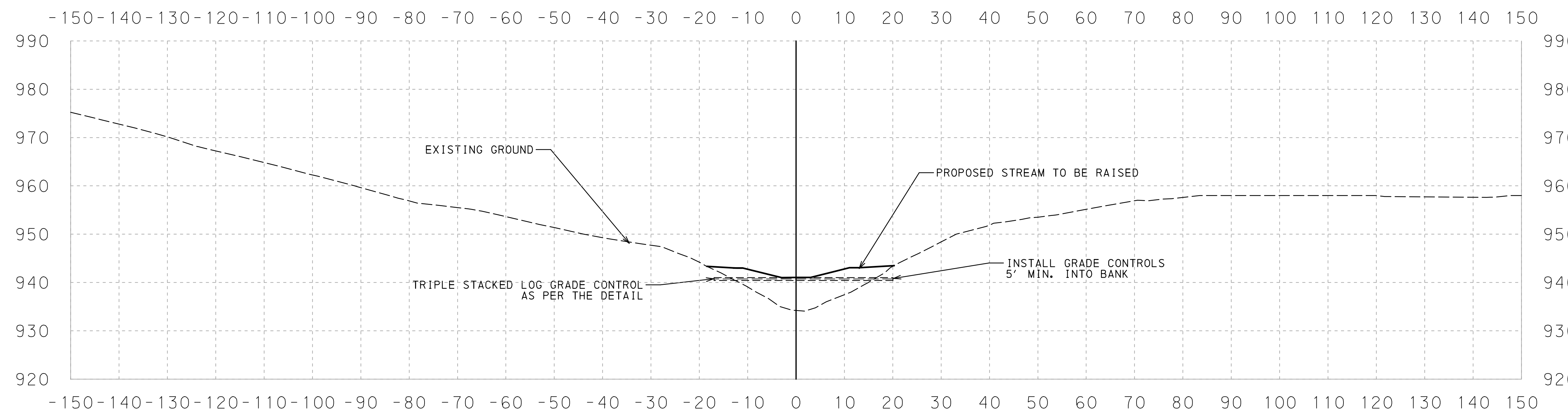


LOG GRADE CONTROL

EROSION CONTROL MULCH BLANKET	
STATION	LOCATION
200+15 TO 213+84	ALONG BANKS AS SHOWN
300+45 TO 301+47	ALONG BANKS AS SHOWN

SEE DETAIL SHEET
18 OF 28 FOR ECMB
INSTALLATION



TYPICAL CROSS SECTION
FOR ENTIRE REACH OF
MAIN STREAM ALIGNMENT

SHEET 8 OF 29	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT STREAM RESTORATION DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 03-08-2023 REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
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PE 061647

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DETENTION BASIN FLOOR SEED MIXTURE

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
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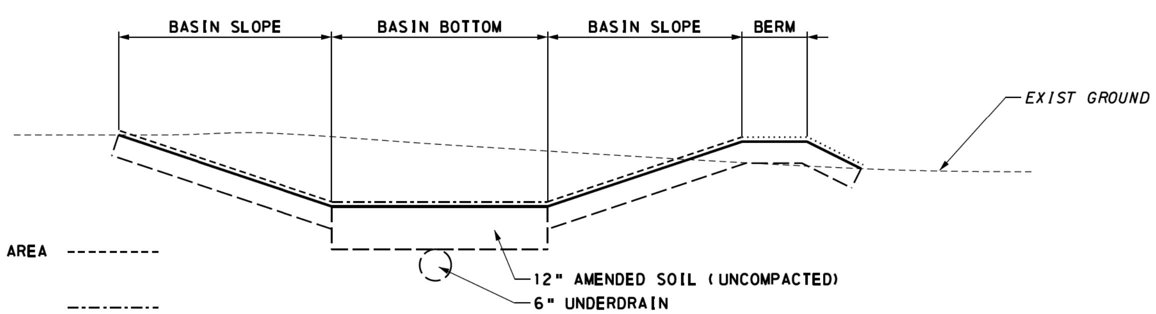

LEGEND:

SEASONLY FLOODED AREA MIX ---------

DETENTION BASIN FLOOR SEED MIX -·-·-·-·-

OTHER (SEE SEEDING DETAILS) ....

RAIN GARDEN TYPICAL SECTION

NOT TO SCALE

SEED MIXTURES (CONT.)

HVE MIX (BASIN EXTERIOR SLOPES AND MISCELLANOUS RESTORATION)					
FOPMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	APPLICATION RATE
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75		34.3 LBS/ACRE
PERENNIAL RYE GRASS	30	95	85		
KENTUCKY BLUEGRASS	30	95	80		
ANNUAL RYE GRASS	10	95	80		
FERTILIZED APPLICATION RATE	10-10-20				1000 LBS/ACRE
LIMING RATE	PULVERIZED AGRICULTURAL LIMESTONE				6 TONS/ACRE
MULCHING TYPE	STRAW				3.0 TONS/ACRE
SEEDING DATES	MARCH - NOVEMBER				-

SOIL SUPPLEMENTS

APPLY SOIL SUPPLEMENTS AS FOLLOWS TO SEASONALLY FLOODED AREA MIX AND DETENTION BASIN FLOOR SEED MIX:

- PULVERIZED AGRICULTURAL LIMESTONE: 800 LB / 1000 SY

MULCHING RATES

MULCH WITH CLEAN STRAW AT A RATE OF 3 TONS / ACRE

APPLY ROLLED EROSION CONTROL PRODUCT TO ALL NEWLY SEEDED AREAS ON SLOPES 3:1 OR GREATER AND/OR WITHIN 50 FEET OF STREAM CHANNEL.

SEEDING DATES

DETENTION BASIN FLOOR & SEASONALLY FLOODED MIX — MARCH 15 TO MAY 15 AND SEPTEMBER 1 TO OCTOBER 15

AMENDED SOILS:

AMENDED SOIL AREAS SHALL BE PREPARED AS FOLLOWS PRIOR TO PLANTING:
AMENDED SOIL SHALL BE USED AS SPECIFIED BELOW:

* 50% WASHED SHARD SAND MEETING ASTM C-33 (BY VOLUME).
* 35% TOPSOIL PER PENNDOT PUBLICATION 408, SECTION 802 (BY VOLUME).
  * TOPSOIL SHALL CONTAIN LESS THAN 10% CLAY
* 15% AGED LEAF COMPOST (BY VOLUME).

INSTALLATION OF AMENDED SOIL:

* INSTALL AMENDED SOIL MIX TO SPECIFIED DIMENSIONS, RESTRICT EQUIPMENT MOVEMENT OVER FLOOR BEFORE, DURING, AND AFTER AMENDED SOIL PLACEMENT TO AVOID OVER-COMPACTION.
* THOROUGHLY WATER ENTIRE RAIN GARDEN FLOOR AFTER AMENDED SOIL PLACEMENT AND PRIOR TO PLANTING TO AID SOIL SETTLEMENT.

STREAM RESTORATION FOR MS4 CREDITS
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CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
RAIN GARDEN DETAILS

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REVISED SUBMISSION DATE: 07-12-2023

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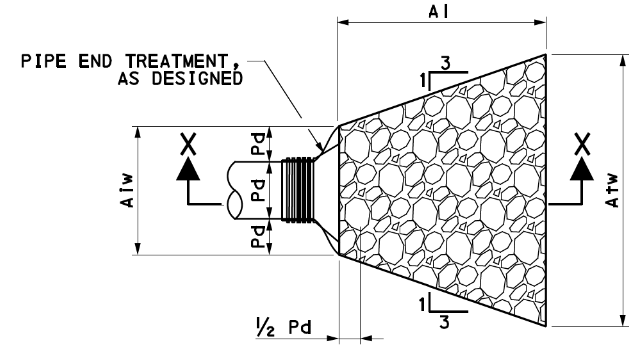
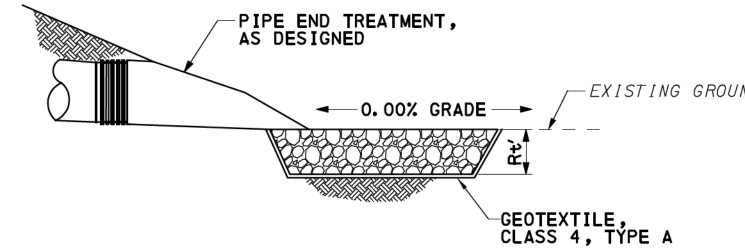
PE074465



PLAN VIEW



SECTION X-X

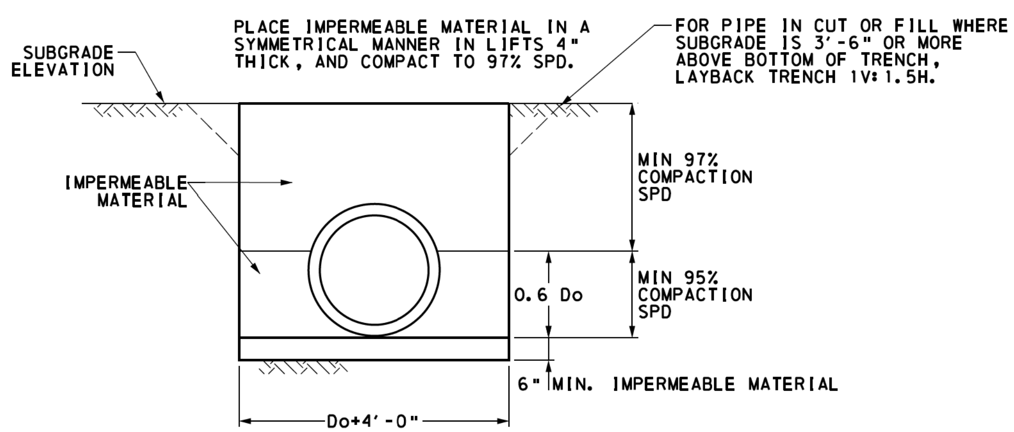
OUTLET PROTECTION NOTES:

1. ALL APRONS SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN. TERMINAL WIDTHS SHALL BE ADJUSTED AS NECESSARY TO MATCH RECEIVING CHANNELS.
2. PROVIDE GEOTEXTILE MATERIAL ALONG ALL INTERFACE AREAS WITH GROUND CONTACT.
3. EXTEND RIPRAP ON BACK SIDE OF APRON TO AT LEAST 1/2 DEPTH OF PIPE ON BOTH SIDES TO PREVENT SCOUR AROUND THE PIPE.

APRON NO.	LOCATION	PIPE DIA Pd (IN)	Q (CFS) 10-YR	Q * (CFS) 100-YR	VELOCITY (FPS) 10-YR	VELOCITY (FPS) * 100-YR	RIPRAP SIZE R-_	RIPRAP THICK Rt (IN)	APRON LENGTH Al (FT)	APRON INITIAL WIDTH Alw (FT)	APRON TERMINAL WIDTH Atw (FT)
OP-EW4	CRANE AVE	15	10.76	-	10.13	-	5	27	12	3.75	11.75
OP-EW5	CRANE AVE	27	32.87	-	9.73	-	5	27	18	6.75	18.75
OP-EW6	CRANE AVE	18	8.52	14.60	9.17	10.53	5	27	12	4.50	12.50

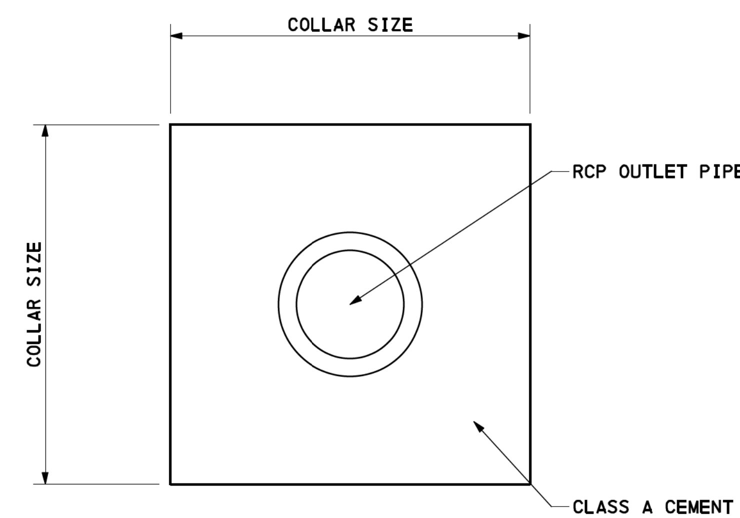
ROCK APRON OUTLET PROTECTION DETAIL

NOT TO SCALE

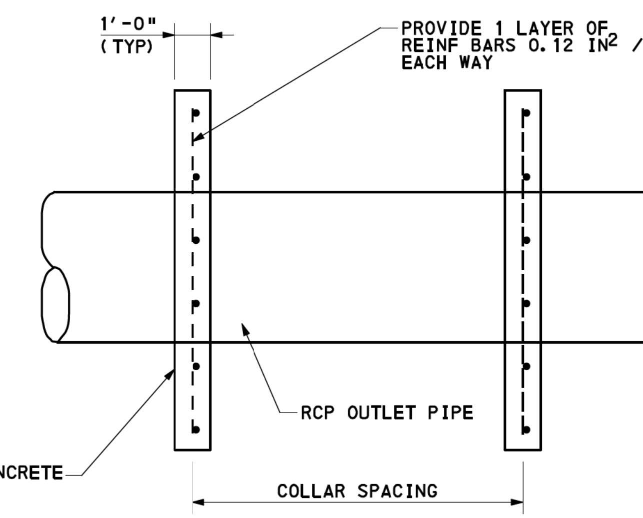


RAIN GARDEN - OUTLET PIPE TRENCH DETAIL

NOT TO SCALE



ELEVATION VIEW



END VIEW

BASIN NUMBER	NO. COLLARS	COLLAR SIZE (FT)	COLLAR SPACING (FT)	DIST TO 1ST COLAR (FT)	OUTLET PIPE DIA (IN)
SCM 003	3	5	8	12	18

DISTANCE TO 1ST COLLAR MEASURED FROM OUTSIDE FACE OF THE OUTET STRUCTURE.

REINFORCED CONCRETE ANTI-SEEP COLLAR

NOT TO SCALE

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\MS4StrResCrane PRPDetails.dgn
DATE: 7/12/2023 TIME: 11:26:03 AM

SHEET 10 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
RAIN GARDEN DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

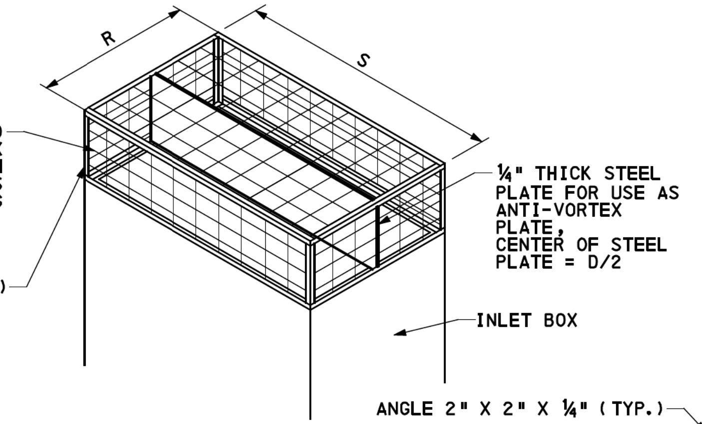
WILLIAM B. MCNEAL, P.E.
ENGINEER

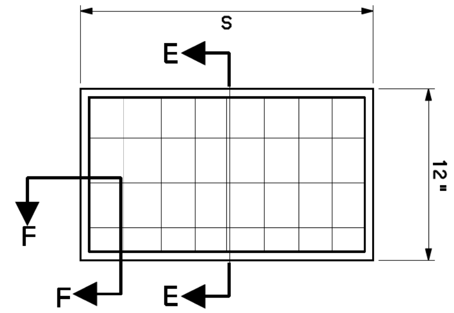
ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

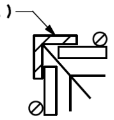
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465

HORIZONTAL TRASH RACK DIMENSIONS		
LOCATION	R	S
CRANE AVENUE OS-5	5'-0"	5'-0"
CRANE AVENUE OS-6	5'-0"	5'-0"

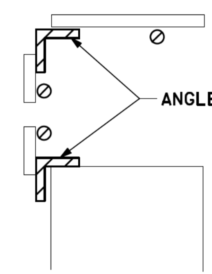




FRONT VIEW



SECTION F-F



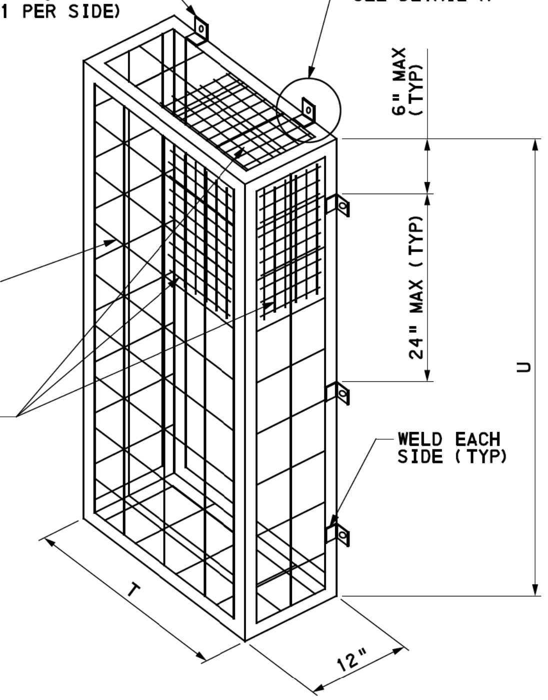
SECTION E-E

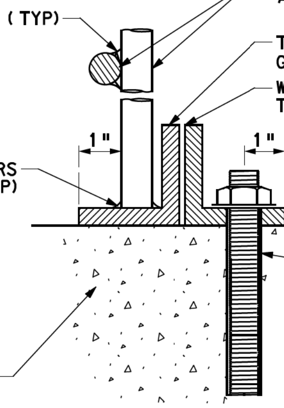
NOTES:

1. DIMENSIONS ARE APPROXIMATE, FABRICATE TO FIT OUTSIDE OF INLET BOX.

2. TRASH RACKS TO BE HOT DIPPED GALVANIZED ASSEMBLY PER ASTM A-123; TOUCH UP PER ASTM A-A780.

HORIZONTAL TRASH RACK WITH ANTI-VORTEX PLATE





DETAIL A

NOTES:

1. WELD #4 TRASH RACK SCREEN SUPPORT BARS TO THE ANGLES AND AT EACH INTERSECTION OF THE BARS.

2. WELD TRASH RACK SCREEN INSIDE OF ANGLE FRAMES ON FIVE SIDES OF RACK.

3. TRASH RACK ASSEMBLIES, BOLTS, AND ATTACHMENTS TO BE GALVANIZED IN ACCORDANCE WITH CS SECTION 1105.

4. REFER TO TABLE FOR OVERALL DIMENSIONS.

5. CENTER TRASH RACK OVER ORIFICES AND SET BOTTOM ELEVATION EQUAL TO BASIN INVERT.

TRASH RACK DIMENSIONS		
LOCATION	T	U
CRANE AVE OS-5	1'-6"	1'-6"

TRASH RACK

SHEET 11 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
RAIN GARDEN DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

WILLIAM B. MCNEAL, P.E.
ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465

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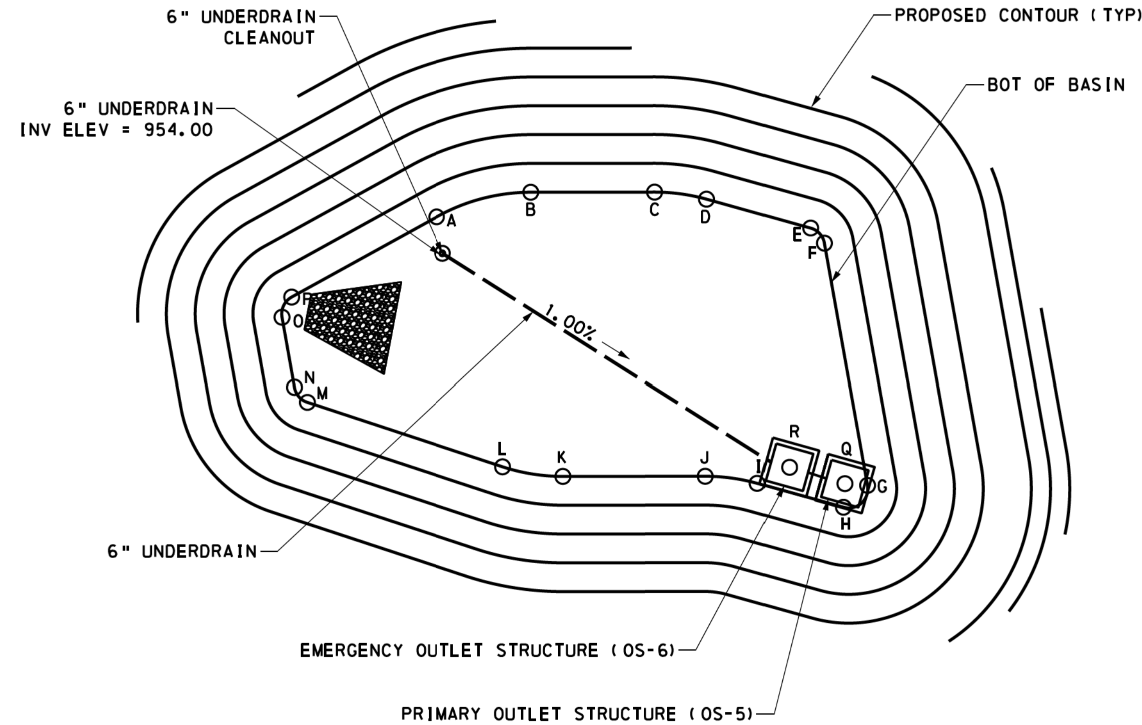

SCM 003 - CONTROL POINTS

POINT	COORDINATES		ELEVATION	LOCATION
	NORTH	EAST		
A	402824.3882	1336923.7286	956.00	BOT BASIN
B	402825.1894	1336933.8393	956.00	BOT BASIN
C	402822.9397	1336946.5299	956.00	BOT BASIN
D	402821.2681	1336951.7126	956.00	BOT BASIN
E	402816.4168	1336961.7922	956.00	BOT BASIN
F	402814.6146	1336962.9248	956.00	BOT BASIN
G	402789.0538	1336962.9248	956.00	BOT BASIN
H	402787.2517	1336960.0575	956.00	BOT BASIN
I	402791.2681	1336951.7126	956.00	BOT BASIN
J	402792.9397	1336946.5299	956.00	BOT BASIN
K	402795.5247	1336931.9476	956.00	BOT BASIN
L	402797.6146	1336925.9449	956.00	BOT BASIN
M	402807.7876	1336907.0823	956.00	BOT BASIN
N	402809.5479	1336906.0316	956.00	BOT BASIN
O	402816.9217	1336906.0316	956.00	BOT BASIN
P	402818.8153	1336907.3879	956.00	BOT BASIN
Q	402789.6459	1336960.6371	* 958.75	OS-5
R	402792.3319	1336955.2712	* 959.00	OS-6

FOUR PLACE COORDINATES ARE FOR COMPUTATIONAL PURPOSES ONLY AND DO NOT IMPLY A PRECISION BEYOND TWO DECIMAL PLACES

* TOP OF GRATE ELEVATION

RAIN GARDEN (SCM 003) GEOMETRIC LAYOUT

SCALE

0 10 20 FEET

SHEET 12 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
RAIN GARDEN DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

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WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

WILLIAM B. MCNEAL, P.E.
ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465

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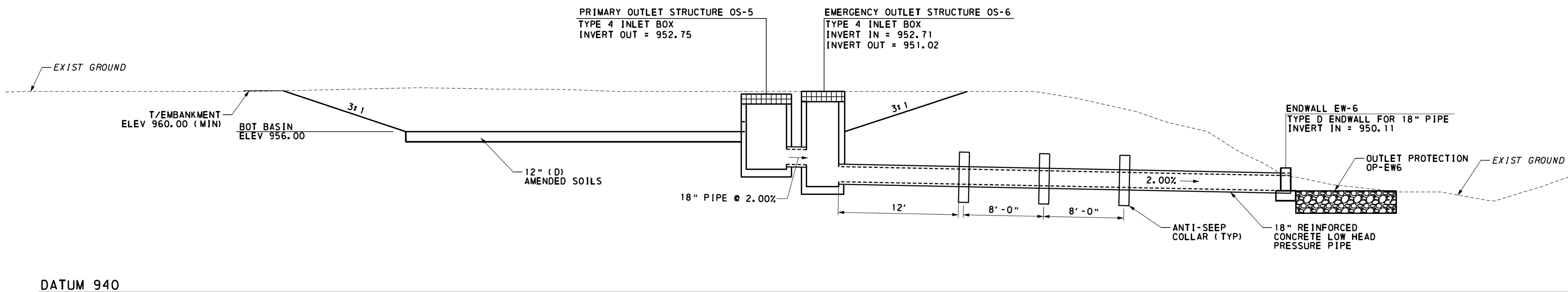

CRANE AVENUE SCM-003
SECTION E-E

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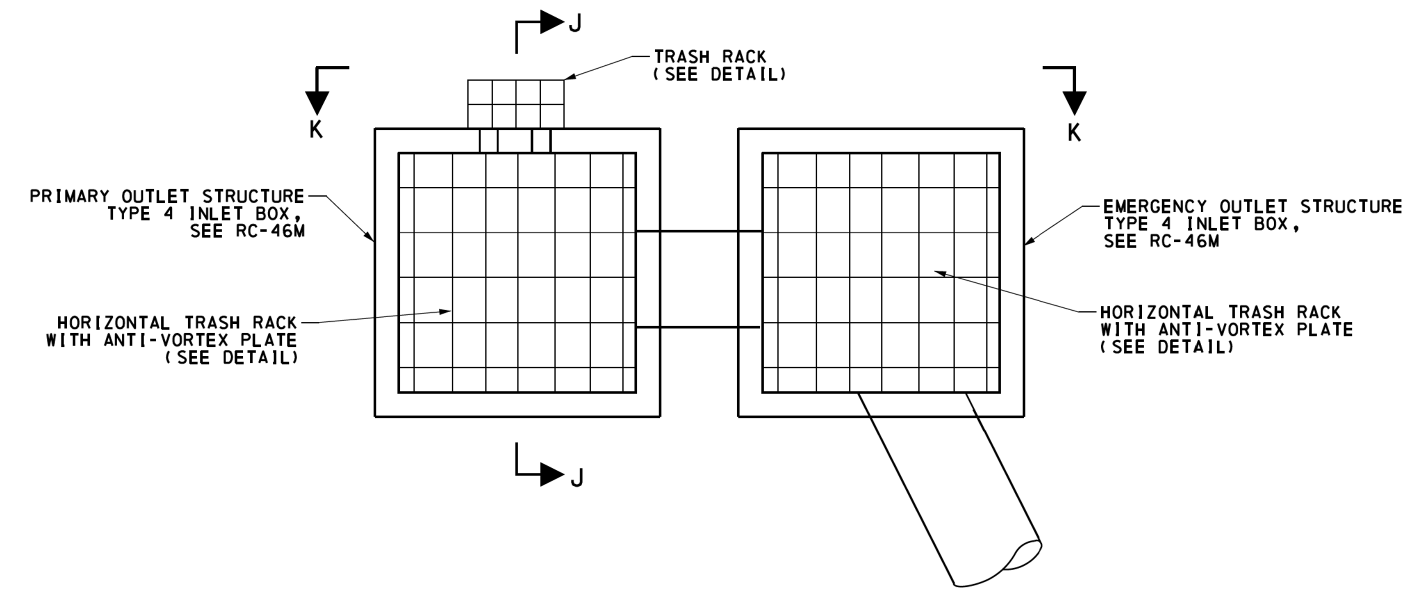
SHEET 13 OF 29	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT RAIN GARDEN DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	WILLIAM B. MCNEAL, P.E. ENGINEER ORIGINAL SUBMISSION DATE: 03-08-2023 REVISED SUBMISSION DATE: 07-12-2023

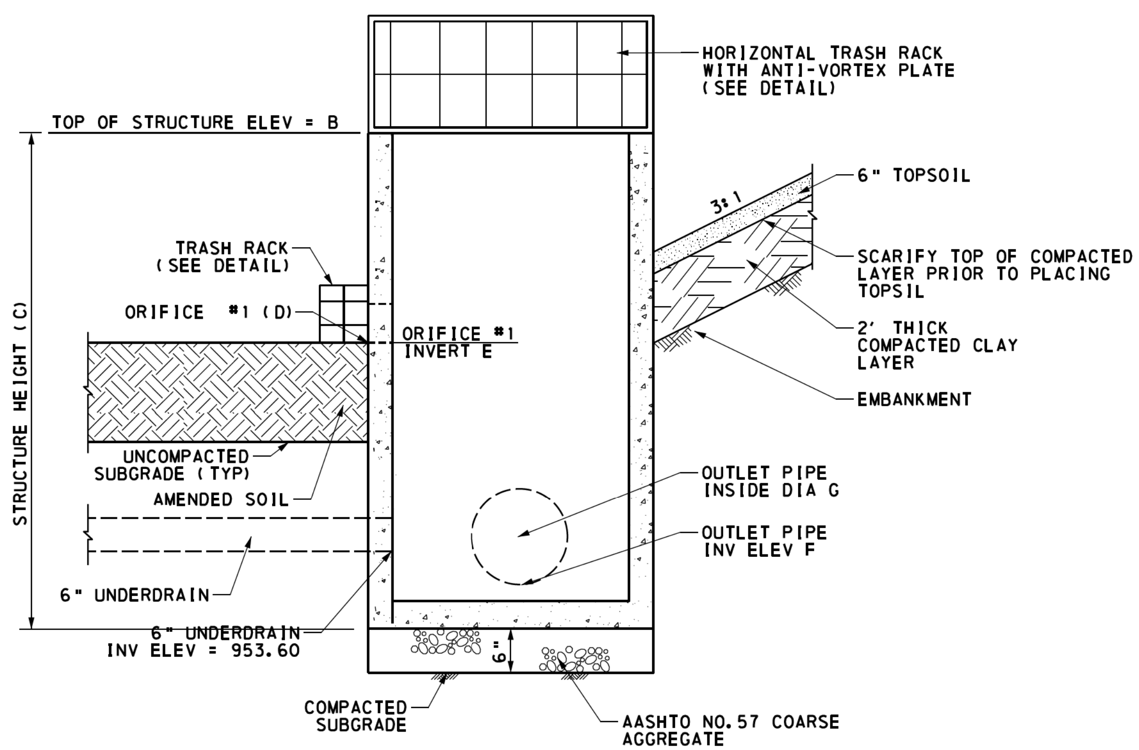
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
WILLIAM BRUCE McNEAL
ENGINEER
PE074465



PLAN VIEW
NOT TO SCALE

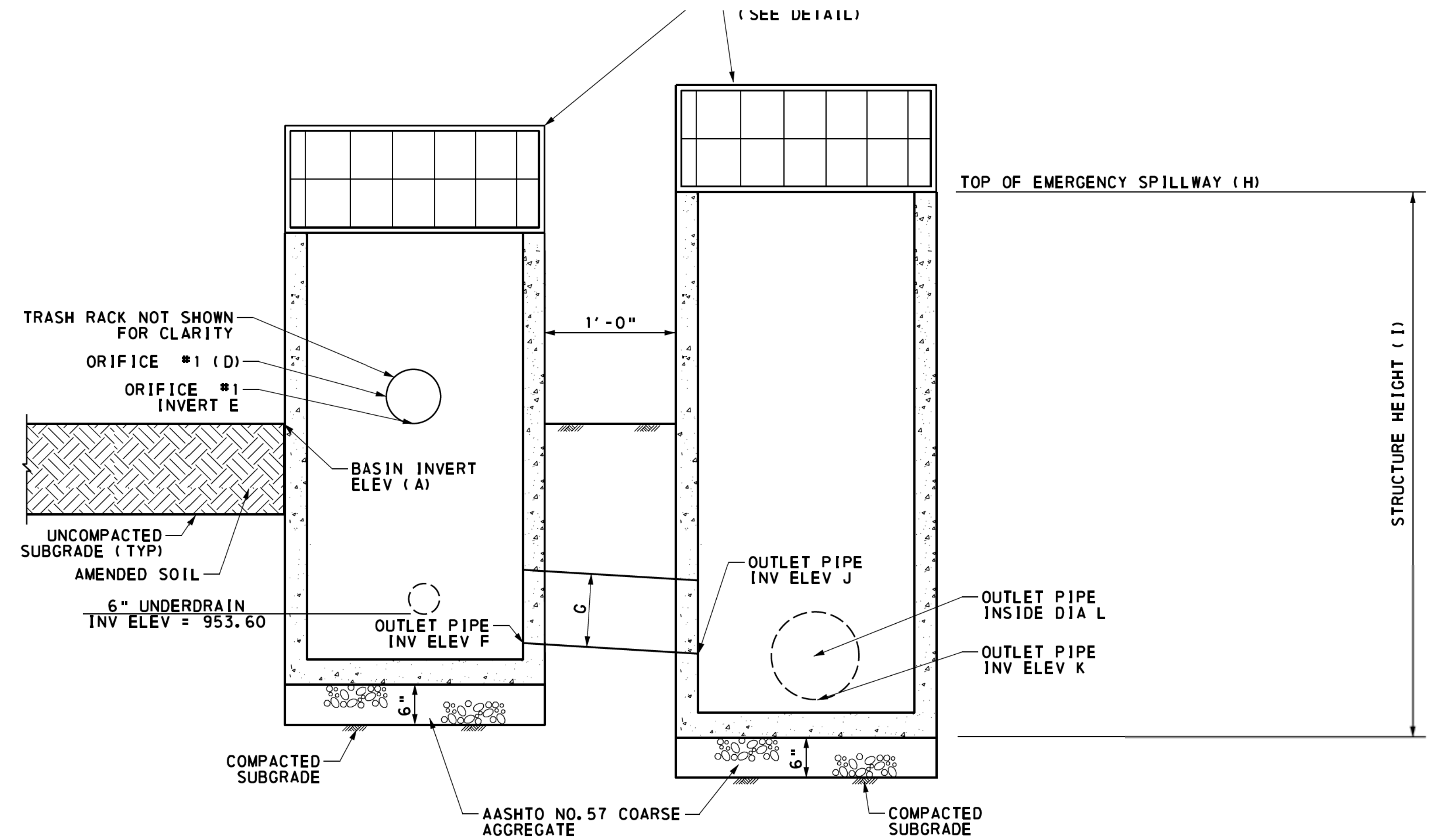
PRIMARY OUTLET STRUCTURE TABLE (OS-5)						
BASIN INVERT ELEV A	STRUCTURE TOP ELEV B	HEIGHT OF STRUCTURE C (FT)	ORIFICE #1 SIZE D (IN)	ORIFICE #1 INV E (FT)	OUTLET PIPE INVERT F (FT)	OUTLET PIPE INSIDE DIA G (IN)
956.00	958.75	7.00	12	956.00	952.75	18

EMERGENCY OUTLET STRUCTURE TABLE (OS-6)				
STRUCTURE TOP ELEV H	HEIGHT OF STRUCTURE I (FT)	OUTLET PIPE INVERT IN J (FT)	OUTLET PIPE INVERT OUT K (FT)	OUTLET PIPE INSIDE DIA L (IN)
959.00	9.00	952.71	951.02	18



PRIMARY OUTLET STRUCTURE (OS-5)

SECTION J-J
NOT TO SCALE



PRIMARY OUTLET STRUCTURE (OS-5)

EMERGENCY OUTLET STRUCTURE (OS-6)

SECTION K-K
NOT TO SCALE

CRANE AVENUE SCM-003 OUTLET STRUCTURE DETAILS

SHEET 14 OF 29	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT RAIN GARDEN DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120; PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	WILLIAM B. MCNEAL, P.E. ENGINEER; ORIGINAL SUBMISSION DATE: 03-08-2023; REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL WILLIAM BRUCE McNEAL ENGINEER PE074465

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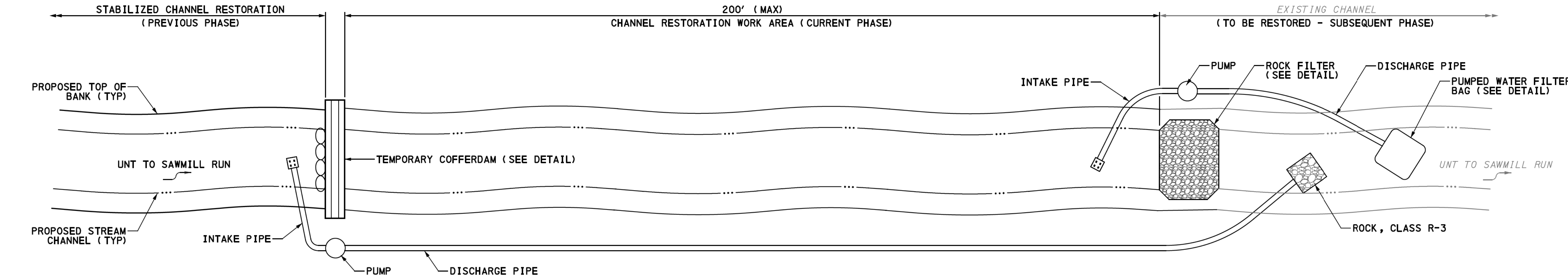
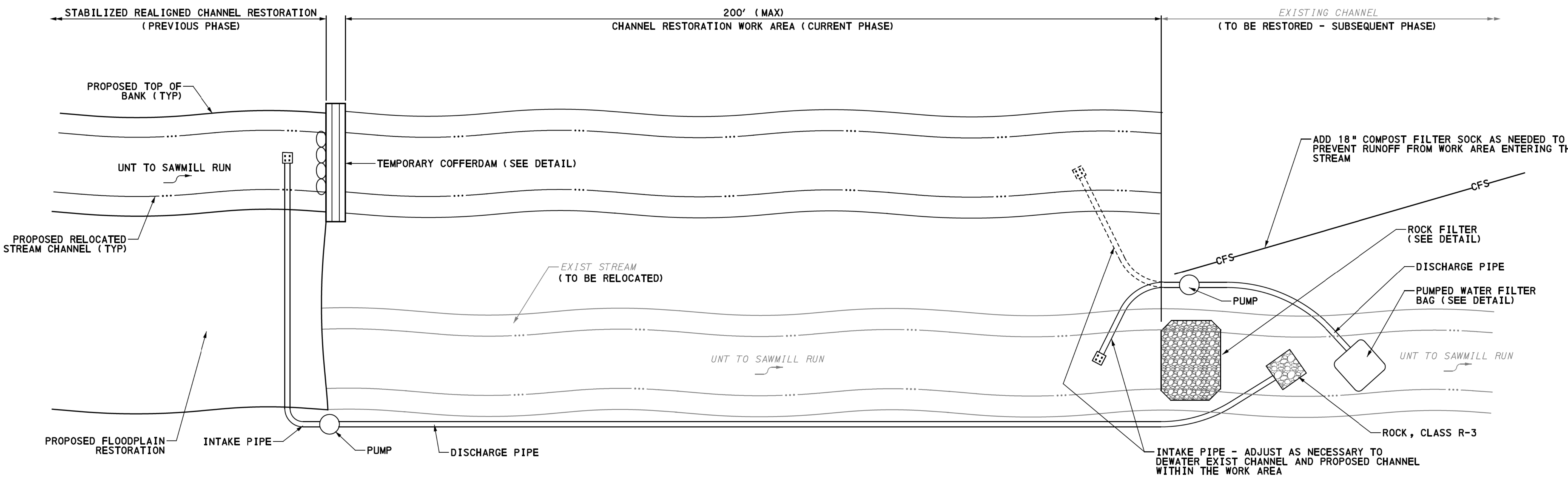


STREAM RESTORATION WITH NO RELOCATION

NOT TO SCALE



STREAM RESTORATION WITH RELOCATION

NOT TO SCALE

NOTES:

1. PUMP INTAKE SHALL BE MAINTAINED A SUFFICIENT DISTANCE FROM BOTTOM TO PREVENT SEDIMENT FROM ENTERING THE SYSTEM.
2. TEMPORARY DAM OF SANDBAGS, CONCRETE BARRIERS OR OTHER NON-EROSIVE MATERIAL. NO EARTH FILL. DO NOT EXCAVATE A SUMP FOR THE PUMP INTAKE.
3. FOR LOW GRADIENT CHANNELS, THE ROCK FILTER MAY BE REPLACED BY AN IMPERVIOUS COFFERDAM TO PREVENT BACKFLOW INTO THE WORK AREA.

TEMPORARY PUMP BYPASS SYSTEM

NOT TO SCALE

SHEET 15 OF 29	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT EROSION AND SEDIMENT CONTROL DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 / PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 03-08-2023 REVISED SUBMISSION DATE: 07-12-2023	COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL JAMES H. FLYNN ENGINEER PE 061647

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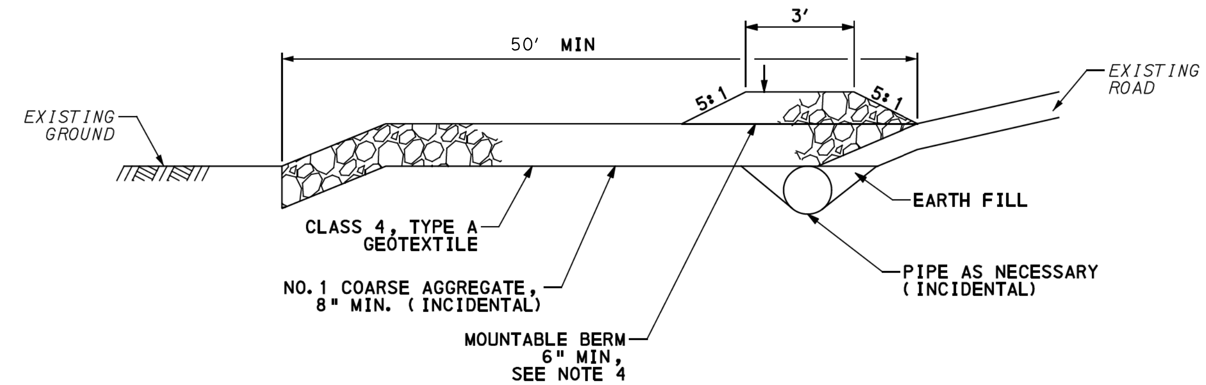
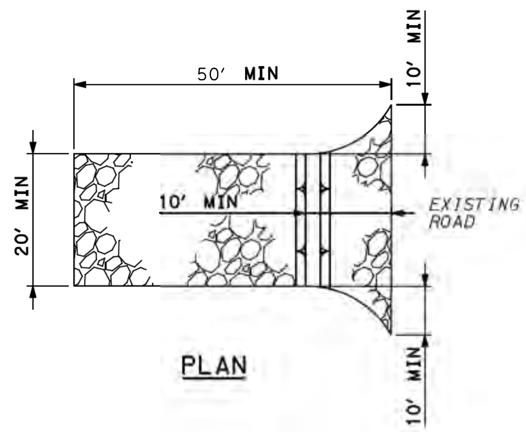


PROFILE



PLAN

ROCK CONSTRUCTION ENTRANCE ALTERNATIVE (ABACT)

NOT TO SCALE

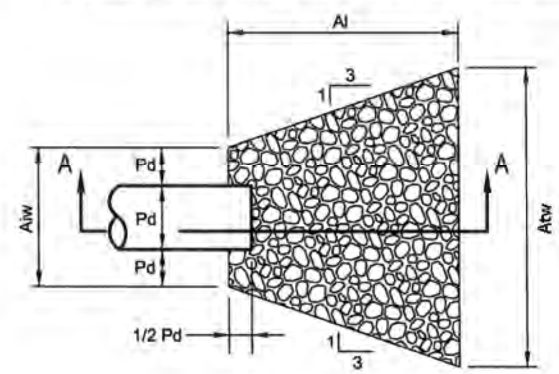
ROCK CONSTRUCTION ENTRANCE NOTES:

1. CONSTRUCT ROCK CONSTRUCTION ENTRANCE, AS SPECIFIED IN SECTION 849, WITHIN THE RIGHT-OF-WAY OR EASEMENT AREAS. ENTRANCE MAY BE CONSTRUCTED ON A SKEW IF ADEQUATE PULL OUT SIGHT DISTANCE IS AVAILABLE. EXCAVATE, AS SPECIFIED IN SECTION 203.3, AND FORM EMBANKMENT, AS SPECIFIED IN SECTION 206.3, AS NECESSARY TO CONSTRUCT THE ROCK CONSTRUCTION ENTRANCE.
2. PROVIDE GEOTEXTILE MATERIAL MEETING THE REQUIREMENTS OF SECTION 735. FURNISH AND INSTALL IN ACCORDANCE WITH SECTION 212. PROVIDE GEOTEXTILE ALONG ALL INTERFACE AREAS WITH GROUND CONTACT.
3. PROVIDE A STOCKPILE OF AASHTO NO. 1 COARSE AGGREGATE IN ORDER TO MAINTAIN THE SPECIFIED THICKNESS OF THE CONSTRUCTION ENTRANCE. PLACE ADDITIONAL ROCK WHENEVER ROCK BECOMES CLOGGED WITH SEDIMENT.
4. PROVIDE SATISFACTORY DRAINAGE THROUGH THE ROCK CONSTRUCTION ENTRANCE. CONSTRUCT A 6" MIN MOUNTABLE BERM TO PREVENT CRUSHING OF ANY PIPES NECESSARY TO CONVEY DRAINAGE.
5. INSPECT THE ENTRANCE DAILY AND MAINTAIN AS SPECIFIED IN THE INSPECTION, MAINTENANCE, AND REPAIR SCHEDULE.
6. ALL SEDIMENT DEPOSITED ON PAVED ROADWAYS SHALL BE REMOVED IMMEDIATELY AND RETURNED TO THE CONSTRUCTION SITE IMMEDIATELY. WASHING OF THE ROADWAY WILL NOT BE PERMITTED. A VACUUM TRUCK SWEEPER OR STREET SWEEPER WITH CATCH BIN SHALL BE USED AS NECESSARY TO REMOVE EXCESS SEDIMENT DEPOSITED ON PAVED ROADWAYS.
7. IF EXCESS AMOUNTS OF SEDIMENT ARE BEING DEPOSITED ON ROADWAY, EXTEND LENGTH OF ROCK CONSTRUCTION ENTRANCE BY 50 FOOT INCREMENTS UNTIL CONDITION IS ALLEVIATED OR INSTALL WASH RACK.
8. REASONABLE METHODS WHICH ARE SANCTIONED BY THE PADEP AS ALTERNATIVES TO INSTALLATION OF TIRE WASH STATIONS ON PUBLIC ROADS ACCESS POINTS FOR GATHERING PIPELINE PROJECTS IN EV/HQ OR SILTATION IMPAIRED WATERSHEDS INCLUDE:
   A. FOR PAVED SURFACE PUBLIC ROADS: USE OF A VACUUM TRUCK SWEEPER OR SWEEPER WITH CATCH BIN ATTACHMENT.
   B. FOR DIRT OR GRAVEL SURFACES PUBLIC ROADS: RIGOROUS MANUAL REMOVAL OF MUD/DIRT FROM VEHICLE/EQUIPMENT TIRES PRIOR TO EXITING CONSTRUCTION SITE, SUPPLEMENTED BY IMMEDIATE RECOVER, BY MANUAL OR MECHANICAL MEANS, OF SOIL WHICH MAY BECOME DISCHARGED ONTO PUBLIC ROADWAYS. DUST CONTROL AND/OR COMPACTION VIA ROLLING OF THE DIRT PUBLIC ROAD SURFACE WILL BE IMPLEMENTED AS NEEDED.

   A PREDICATE FOR UTILIZING ALTERNATIVE A AND B ABOVE IS THAT THE ROCK CONSTRUCTION ENTRANCE MUST BE EXTENDED TO A MINIMUM TOTAL LENGTH OF 100 FEET AND MUST BE CONSTANTLY MAINTAINED, INCLUDING STRUCTURE THICKNESS, TO ENSURE ITS EFFECTIVENESS REMAINS INTACT AT ALL TIMES.

   FREQUENCY OF MECHANICAL AND/OR MANUAL CONTROLS WILL BE DEPENDENT UPON CONSTRUCTION TRAFFIC INTENSITY, WEATHER AND SOIL MOISTURE CONDITIONS. AT A MINIMUM FOR PAVED ROADS-ANY DAY IN WHICH CONSTRUCTION TRAFFIC IS EXITING THE ROCK CONSTRUCTION ENTRANCE, THE VACUUM TRUCK SWEEPER OR SWEEPER WITH A CATCH BIN ATTACHMENT SHALL CLEAN THE ROADWAY AT THE END OF THE WORK DAY AND PRIOR TO ANY FORECASTED RAIN EVENT. THE REQUIREMENT IS TO NOT INTRODUCE SEDIMENT LOAD FROM CONSTRUCTION TRAFFIC ONTO PUBLIC ROAD SURFACE AND INTO ROAD DITCHES WHICH WILL FLOW INTO THE EV/HQ OR SILTATION IMPAIRED WATER RESOURCES, WHICH ARE THE SUBJECT OF THE INCREASED PROTECTION MEASURES.
9. SATISFACTORILY REMOVE MATERIALS AS PER SECTION 849 WHEN ROCK CONSTRUCTION ENTRANCE IS NO LONGER NEEDED.

STANDARD CONSTRUCTION DETAIL # 9-2
Riprap Apron at Pipe Outlet without Flared Endwall



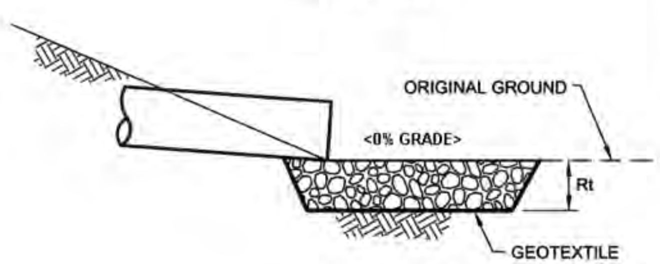
PLAN VIEW

OUTLET NO.	PIPE DIA Pd (IN)	RIPRAP SIZE (R-__)	RIPRAP THICK. Rt (IN)	APRON LENGTH Al (FT)	APRON INITIAL WIDTH Aiw (FT)	APRON TERMINAL WIDTH Atw (FT)
ROP-1	18"	R-4	18"	5'	4.5'	9.5' min

All aprons shall be constructed to the dimensions shown. Terminal widths shall be adjusted as necessary to match receiving channels.

All aprons shall be inspected at least weekly <u>and</u> after each runoff event. Displaced riprap within the apron shall be replaced immediately.

Extend riprap on back side of apron to at least ½ depth of pipe on both sides to prevent scour around the pipe.



SECTION A - A

SHEET 16 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
EROSION AND SEDIMENT CONTROL DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
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KEYSTONE BUILDING
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PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
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ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\MS4SawmillRun PRPESDetails.dgn
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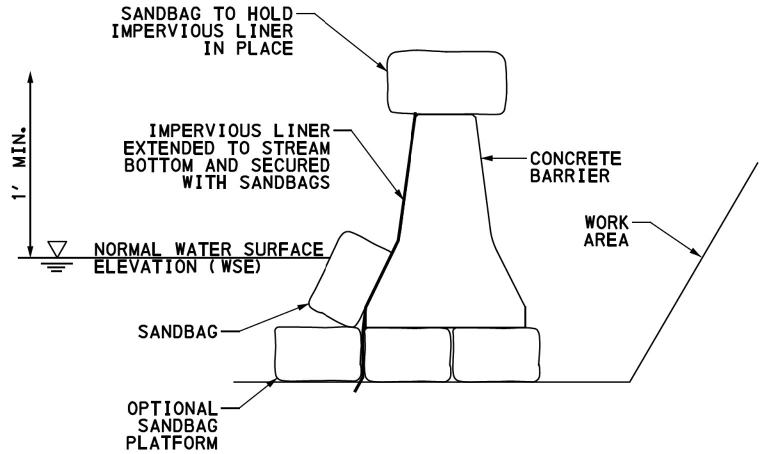
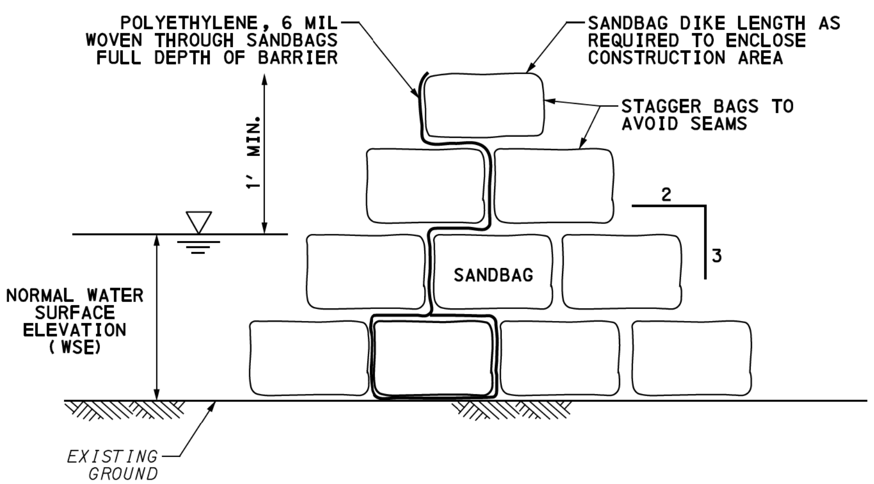


CONCRETE BARRIER COFFERDAM

NOT TO SCALE



SANDBAG COFFERDAM

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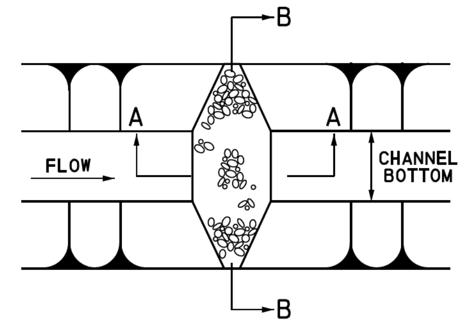
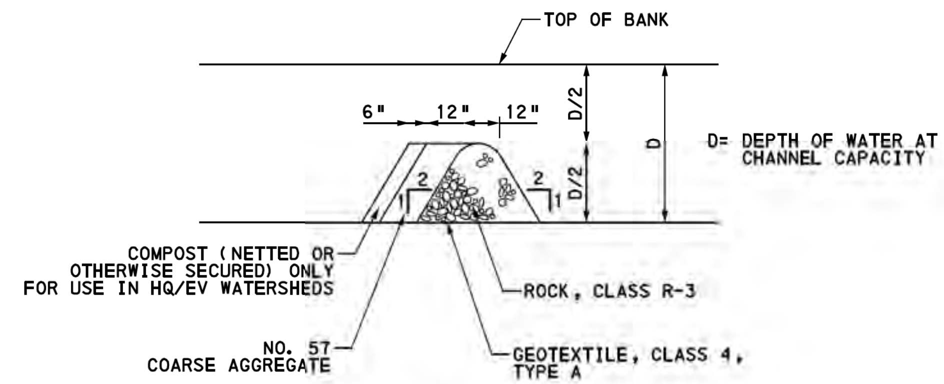
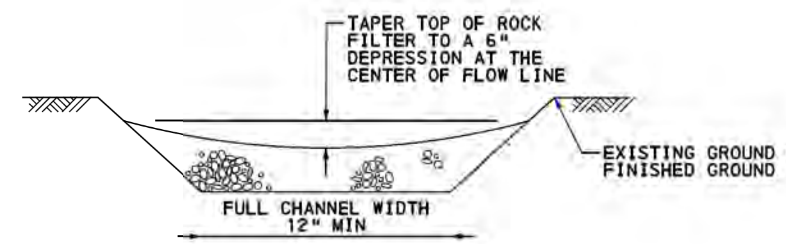


PLAN VIEW



SECTION A-A



SECTION B-B

ROCK FILTER

NOT TO SCALE

ROCK FILTER NOTES:

1. REMOVE ACCUMULATED SEDIMENT WHEN IT REACHES ONE HALF THE HEIGHT OF THE ROCK BARRIER. REPLACE CLOGGED FILTER STONE. REMOVE AND DISPOSE OF SEDIMENT IN AN APPROVED MANNER.
2. ROCK BARRIERS MAY NOT BE USED INSTEAD OF APPROPRIATE CHANNEL LININGS.
3. USE R-3 RIPRAP FOR CHANNEL DEPTH BETWEEN 2 AND 3 FEET. FOR CHANNEL DEPTHS EXCEEDING 3 FEET USE R-4 RIPRAP.
4. ROCK BARRIERS SHOULD NOT BE USED FOR CHANNEL DEPTH LESS THAN 2 FEET.

STREAM RESTORATION FOR MS4 CREDITS
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CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
EROSION AND SEDIMENT CONTROL DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
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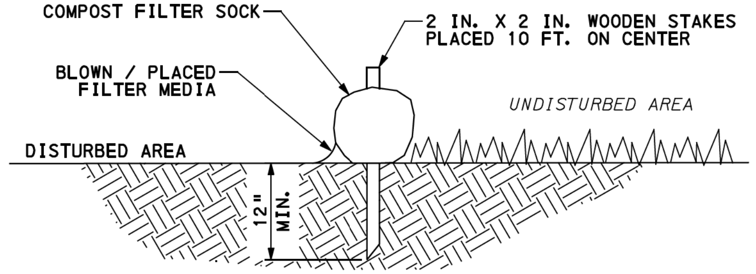
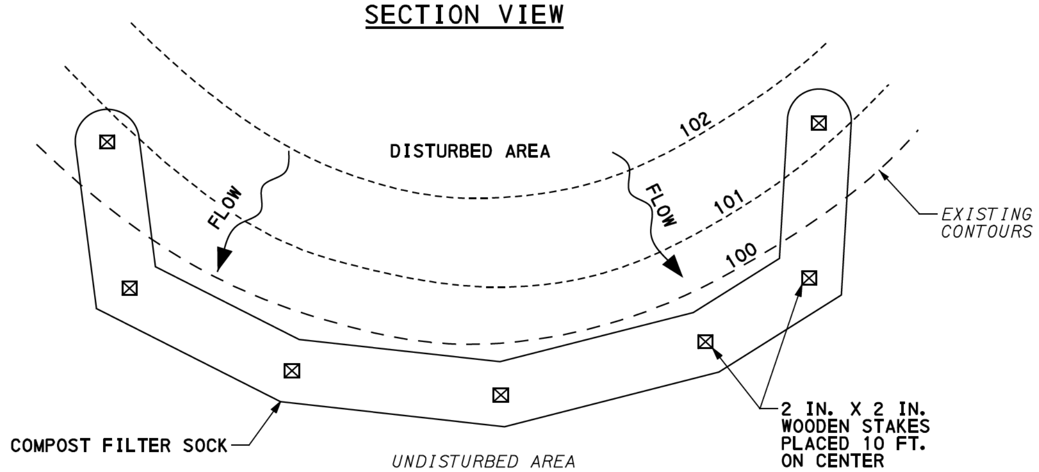
ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647



SECTION VIEW



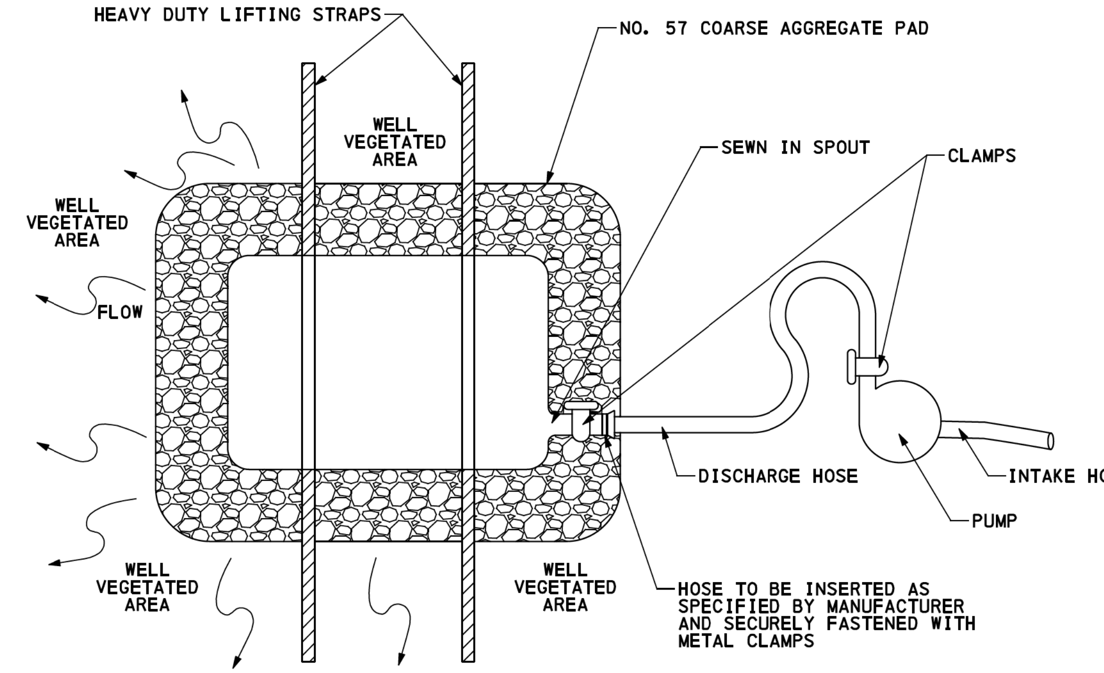
PLAN VIEW

COMPOST FILTER SOCK NOTES:

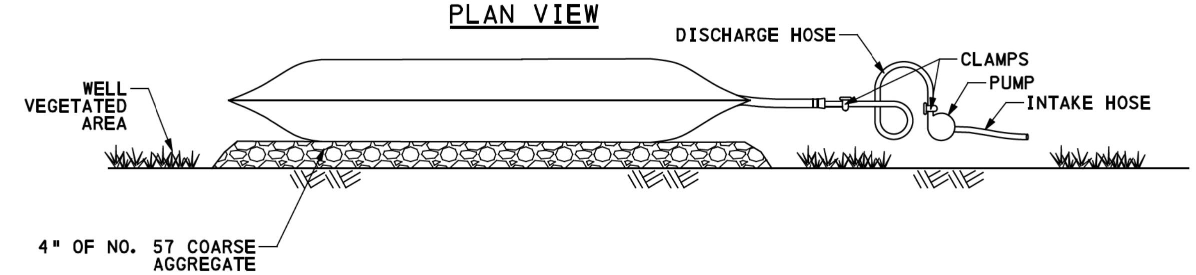
1. SOCK FABRIC SHALL MEET STANDARDS OF TABLE 4.1 OF THE PA DEP EROSION CONTROL MANUAL. COMPOST SHALL MEET THE STANDARDS OF TABLE 4.2 OF THE PA DEP EROSION CONTROL MANUAL.
2. COMPOST FILTER SOCK SHALL BE PLACED AT EXISTING LEVEL GRADE. BOTH ENDS OF THE BARRIER SHALL BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN BARRIER ALIGNMENT. MAXIMUM SLOPE LENGTH ABOVE ANY BARRIER SHALL NOT EXCEED THAT SPECIFIED FOR THE SIZE OF THE SOCK AND THE SLOPE OF ITS TRIBUTARY AREA ON FIGURE 4.2 OF THE PA DEP E&S MANUAL (2012).
3. TRAFFIC SHALL NOT BE PERMITTED TO CROSS COMPOST FILTER SOCKS.
4. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN IT REACHES 1/3 THE ABOVE GROUND HEIGHT OF THE BARRIER AND DISPOSED IN THE MANNER DESCRIBED ELSEWHERE IN THE PLAN.
5. COMPOST FILTER SOCKS SHALL BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF EACH RAINFALL. DAMAGED SOCKS SHALL BE REPAIRED ACCORDING TO MANUFACTURER'S SPECIFICATIONS OR REPLACED WITHIN 24 HOURS OF INSPECTION.
6. BIODEGRADABLE COMPOST FILTER SOCKS SHALL BE REPLACED AFTER 6 MONTHS; PHOTODEGRADABLE SOCKS AFTER 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
7. UPON STABILIZATION OF THE AREA TRIBUTARY TO THE SOCK, STAKES SHALL BE REMOVED. THE SOCK MAY BE LEFT IN PLACE AND VEGETATED OR REMOVED. IN THE LATTER CASE, THE MESH SHALL BE CUT OPEN AND THE MULCH SPREAD AS A SOIL SUPPLEMENT.

COMPOST FILTER SOCK

NOT TO SCALE



PLAN VIEW



ELEVATION VIEW

PUMPED WATER FILTER BAG

NOT TO SCALE

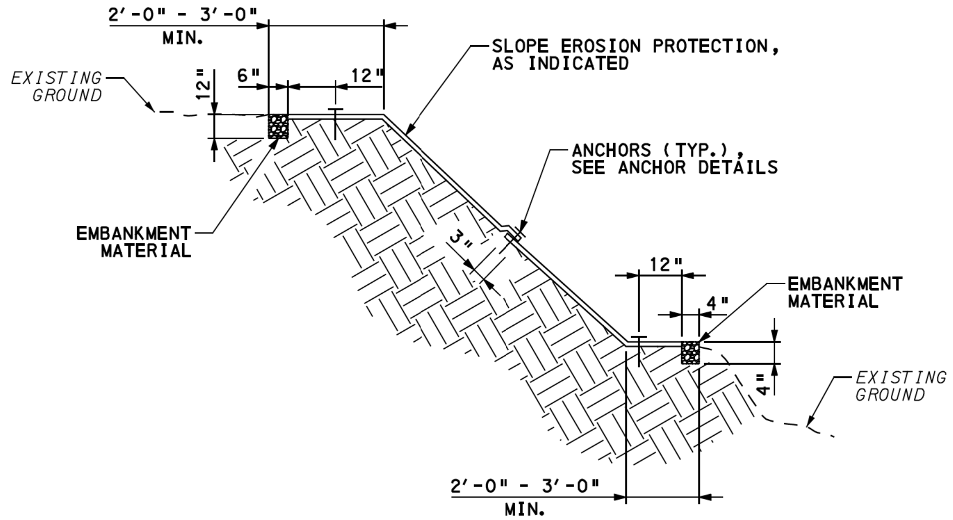
PUMPED WATER FILTER BAG NOTES:

1. LOCATE BAG IN LEVEL AREAS (LESS THAN 5% GRADE). PLACE NO. 57 COARSE AGGREGATE ON A STABILIZED AREA.
2. LOCATE BAG IN A WELL VEGETATED AREA. DISCHARGE ONTO A STABLE, EROSION RESISTANT AREA. WHEN VEGETATED AREA IS NOT AVAILABLE, PROVIDE A GEOTEXTILE (CLASS 4, TYPE A) LINED FLOW PATH TO A STABLE EROSION RESISTANT RECEIVING WATER COURSE OR A WELL VEGETATED AREA.
3. LOCATE BAG IN AN AREA ACCESSIBLE BY EQUIPMENT FOR MAINTENANCE AND REMOVAL PURPOSES.
4. DO NOT INSERT MORE THAN ONE HOSE INTO A BAG.
5. REPLACE THE BAG WHEN 50% OF THE SEDIMENT CAPACITY HAS BEEN FILLED AND/OR WHEN THERE IS A FAILURE. THE ADDITIONAL BAGS WILL BE PAID AS EACH.
6. REMOVE AND PROPERLY DISPOSE OF THE SEDIMENT FILTER BAG. RESTORE THE AREA AS SPECIFIED IN SECTION 105.14. DO NOT CUT FILTER BAG OR DISTRIBUTE AND SEED SEDIMENT.
7. DO NOT PERMIT DISCHARGE FROM THE BAG TO DRAIN BACK INTO WORK OR ACCESS AREAS OF THE PROJECT.

STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT EROSION AND SEDIMENT CONTROL DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 03-08-2023 REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

ROLLED EROSION CONTROL PRODUCT (RECP)



TYPICAL SLOPE CROSS-SECTION

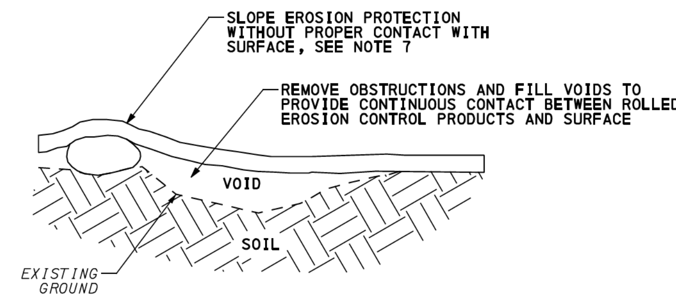


FIGURE 1

LACK OF CONTINUOUS CONTACT

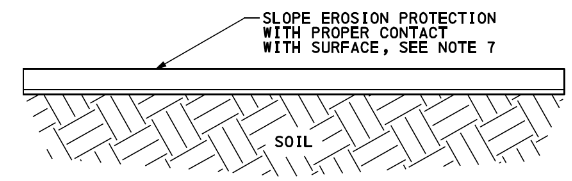
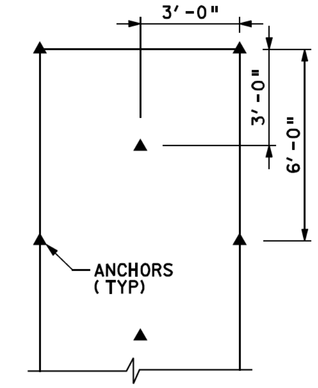


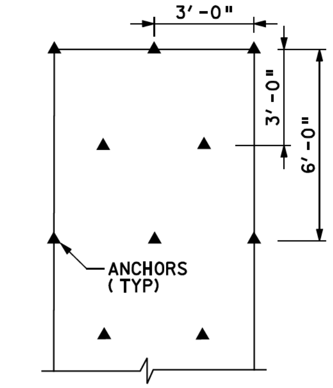
FIGURE 2

CONTINUOUS CONTACT



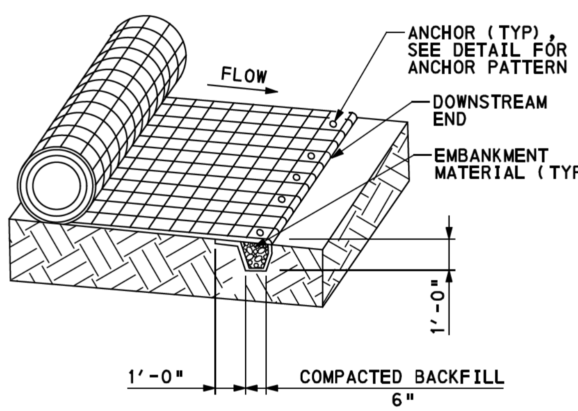
ANCHOR PATTERN FOR SLOPES FLATTER THAN 3:1

PLACE 1 ANCHOR/SY



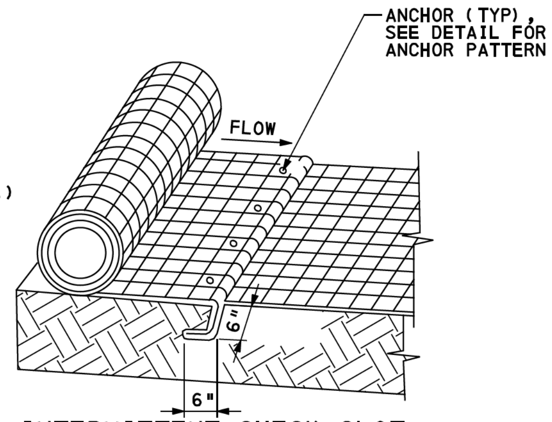
ANCHOR PATTERN FOR SLOPES BETWEEN 3:1 AND 2:1 (INCLUDING 3:1)

PLACE 1½ ANCHORS/SY



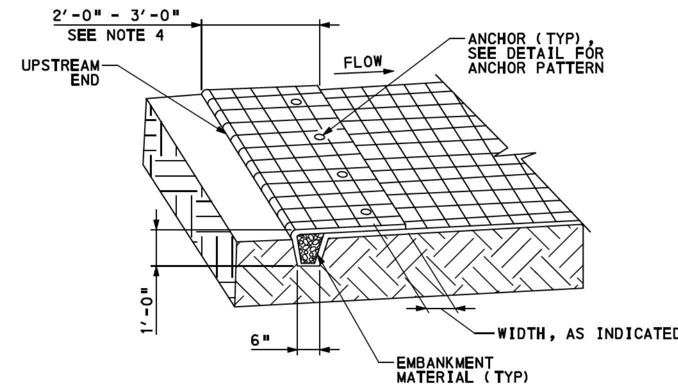
INITIAL ANCHOR TRENCH

SEE NOTE 1



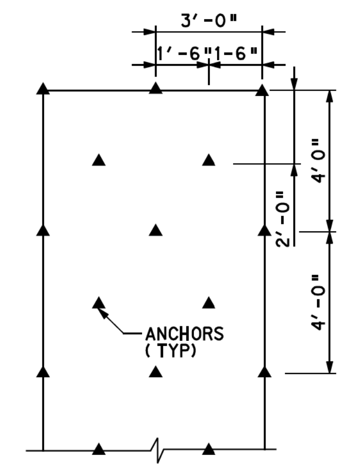
INTERMITTENT CHECK SLOT

SEE NOTE 2



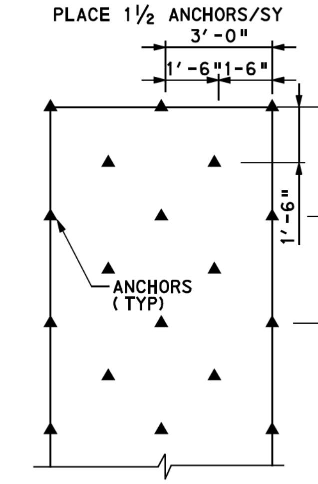
TERMINAL ANCHOR TRENCH

SEE NOTE 3



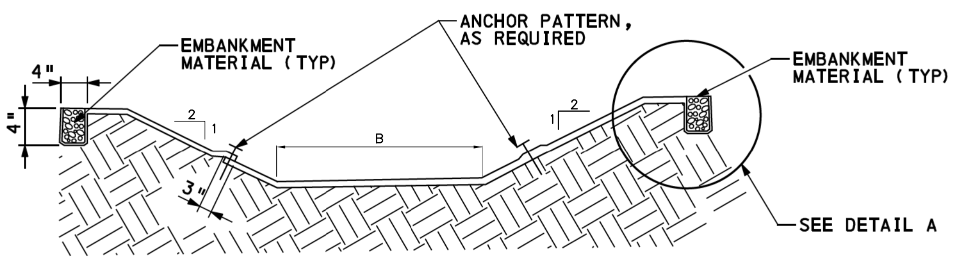
ANCHOR PATTERN FOR SLOPES BETWEEN 2:1 AND 1:1 (INCLUDING 2:1)

PLACE 2 ANCHORS/SY



ANCHOR PATTERN FOR 1:1 OR STEEPER

PLACE 2½ ANCHORS/SY



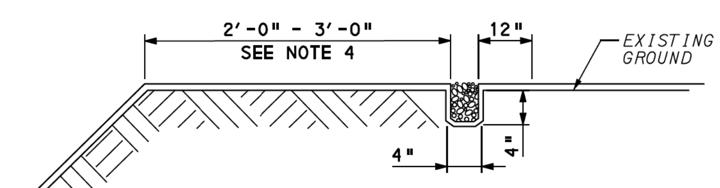
TYPICAL TRAPEZOIDAL CHANNEL CROSS-SECTION

CHANNEL OR CHANNEL SECTION	CW-DIV1A	CW-DIV1B	CW-DIV1C	CW-DIV1D
Temporary or Permanent	Temp	Temp	Temp	Temp
Design Storms	2 yr	2 yr	2 yr	2 yr
Acres	4.119	4.119	4.119	4.119
Multiplier (1.6, 2.55, or 2.75)[1]	1.60	1.60	1.60	1.60
Q_r (REQUIRED CAPCITY) CFS	6.59	6.59	6.59	6.59
Q (CALCULATED AT FLOW DEPTH d) CFS	6.59	6.59	6.59	6.59
PROTECTIVE LINING[2]	TP-02	S200	S200	TP-01
n (MANNING'S COEFFICIENT)[2]	0.034	0.034	0.034	0.034
V_a (ALLOWABLE VELOCITY) FPS	12.00	12.00	12.00	12.00
V (CALCULATED AT FLOW DEPTH d) FPS	4.09	5.84	5.84	10.35
t_a (MAX ALLOW STRESS AT FLOW DEPTH d) LB/FT^2	8.00	8.00	8.00	8.00
t_d (CALC'D SHEAR STRESS AT FLOW DEPTH d) LB/FT^2	1.09	2.26	2.26	7.45
CHANNEL BOTTOM WIDTH (FT)	2.00	2.00	2.00	2.00
CHANNEL SIDE SLOPES (H:V)	2:1	2:1	2:1	2:1
D (TOTAL DEPTH) FT	1.00	1.00	1.00	1.00
CHANNEL TOP WIDTH @ D (FT)	6.00	6.00	6.00	6.00
d (CACULATED FLOW DEPTH) FT	0.53	0.40	0.40	0.25
CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)	2.18	2.38	2.38	3.24
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)	3.79	4.97	4.97	7.88
D_{50} STONE SIZE (IN)	N/A	N/A	N/A	N/A
A (CROSS-SECTIONAL AREA IN SQ. FT.)	1.61	1.13	1.13	0.64
R (HYDRAULIC RADIUS)	0.37	0.30	0.30	0.20
S (BED SLOPE, FT/FT)[3]	0.033	0.090	0.090	0.470

ANCHOR NOTES:

1. HORIZONTAL ANCHOR SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW ANCHORS TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
2. IN LOOSE SOIL CONDITIONS, THE USE OF ANCHOR OR STAKE LENGTHS IN EXCESS OF 6 INCHES MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

ANCHOR PATTERNS FOR SLOPES



DETAIL A

ROLLED EROSION CONTROL PRODUCT NOTES:

1. EXCAVATE INITIAL ANCHOR TRENCH 1'-0" DEEP 6" WIDE ACROSS THE WIDTH OF THE CHANNEL TO PREVENT UNDERMINING OF THE SLOPE EROSION PROTECTION.
2. EXCAVATE INTERMITTENT CHECK SLOT 6" DEEP AND 6" WIDE ACROSS THE WIDTH OF THE CHANNEL AT 25'-0" TO 30'-0" ALONG THE LENGTH OF THE SLOPE EROSION PROTECTION TO PREVENT LOOSE SOIL FROM BEING TRANSPORTED DOWNSTREAM BENEATH THE SLOPE EROSION PROTECTION.
3. EXCAVATE TERMINAL ANCHOR TRENCH 1'-0" DEEP AND 6" WIDE ACROSS THE WIDTH OF THE CHANNEL TO ENSURE WATER FLOW TRANSITIONS SMOOTHLY ONTO THE SLOPE EROSION PROTECTION WITHOUT SEPARATION FROM THE SOIL.
4. EXTEND SLOPE EROSION PROTECTION 2'-0" - 3'-0" ABOVE THE CREST OF CHANNEL SIDE WHENEVER POSSIBLE.
5. PLACE ANCHORS IN ACCORDANCE WITH THE ANCHOR PATTERNS.
6. PROVIDE ANCHORING DEVICES IN ACCORDANCE WITH SECTION 806.2(d).
7. ESTABLISH AND MAINTAIN CONTINUOUS CONTACT BETWEEN THE SLOPE EROSION PROTECTION AND THE SOIL.

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JAMES H. FLYNN
PE 061647

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

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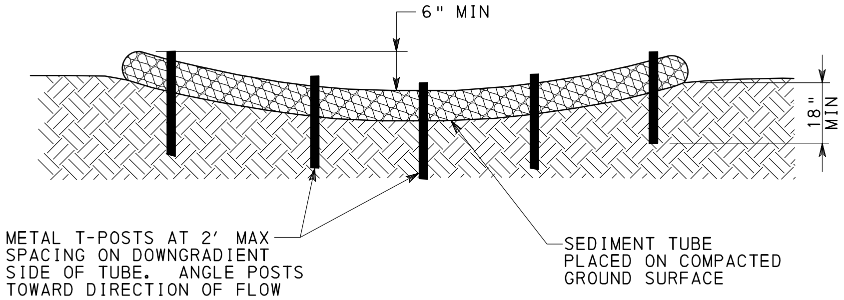
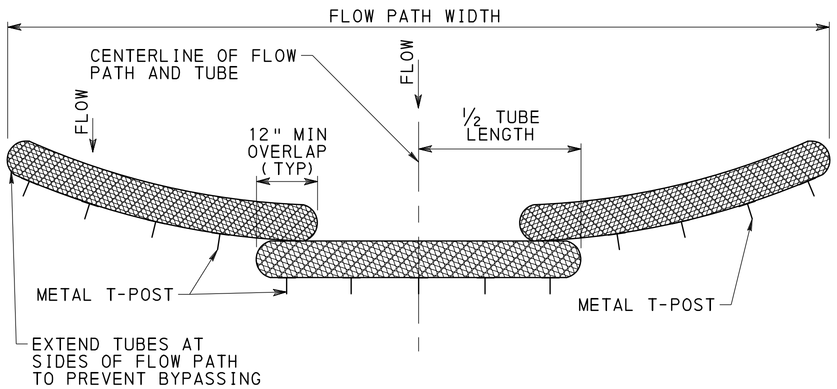
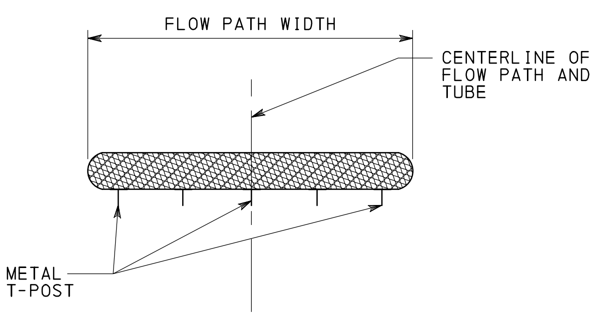


FRONT VIEW



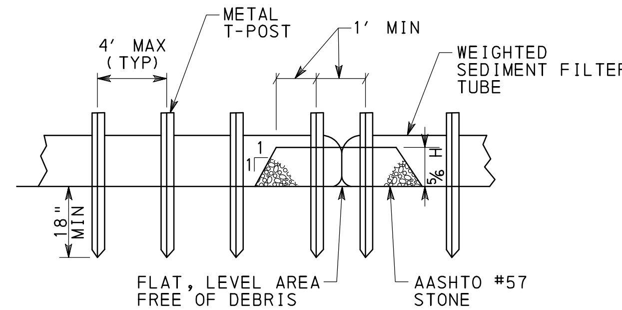
PLAN VIEW
(IN WIDE FLOW AREA)



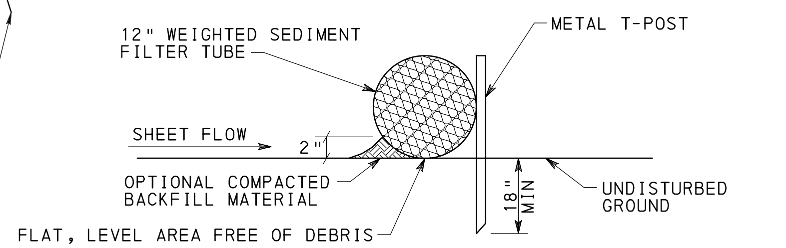
PLAN VIEW
(IN CONCENTRATED FLOW AREA)

WEIGHTED SEDIMENT FILTER TUBE

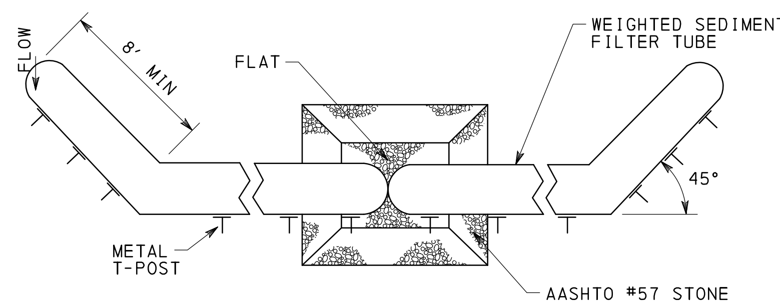
ITEM NO. 9000-0202



FRONT VIEW



ELEVATION VIEW

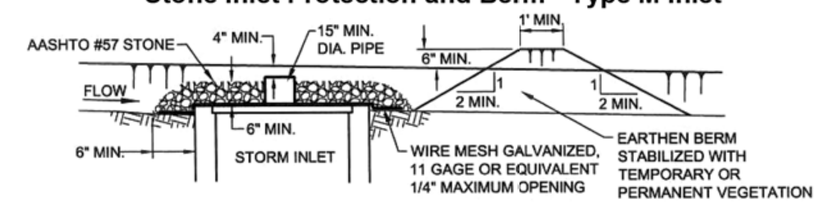


PLAN VIEW

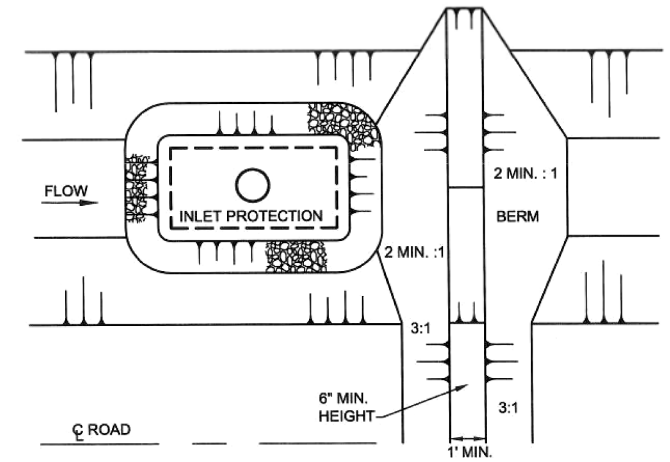
NOTES:

1. SEDIMENT TUBE PLACEMENT AREA SHALL BE PREPARED SO THAT IT IS FREE OF ALL DEBRIS, INCLUDING ROCKS, STICKS, ROOTS, ETC. A 2" LAYER OF AASHTO #57 STONE SHALL BE PLACED WHERE THE LOGS COME TOGETHER. ENDS OF TUBES MAY BE OVERLAPPED ACCORDING TO MANUFACTURER'S SPECIFICATIONS INSTEAD OF THE AASHTO #57 STONE.
2. SEDIMENT TUBES SHALL BE PLACED AT EXISTING LEVEL GRADE. ENDS SHALL BE EXTENDED UPSLOPE AT 45° TO THE MAIN FILTER LOG ALIGNMENT FOR A MINIMUM OF 8 FEET.
3. SEDIMENT TUBES SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT.
4. ACCUMULATED SEDIMENT DEPOSITS SHALL BE CLEANED FROM THE LOG WHEN IT REACHES HALF THE HEIGHT OF THE TUBE AND DISPOSED AS DIRECTED ELSEWHERE IN THE E&S PLAN.
5. DAMAGED TUBES SHALL BE REPLACED WITHIN 10 DAYS OF INSPECTION. A SUPPLY OF TUBES SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE.
6. METAL T-POSTS SHALL BE INSTALLED AT THE CENTER AND AT EACH END OF THE TUBE. ADDITIONAL T-POSTS AS NEEDED TO MEET THE MAXIMUM 2-FOOT SPACING.

STANDARD CONSTRUCTION DETAIL # 4-20
Stone Inlet Protection and Berm - Type M Inlet



ELEVATION VIEW



PLAN VIEW

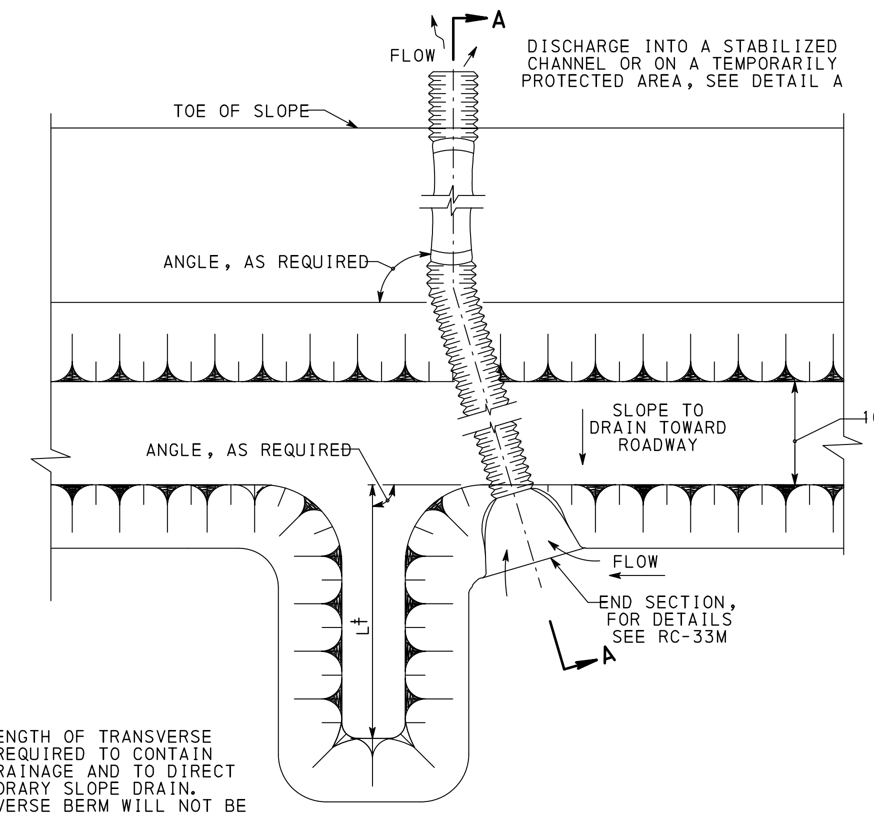
PA DEP

Inlet protection shall not be required for inlet tributary to sediment basin or trap. Berms shall be required for all installations not located at a low point.

Rolled earthen berm in roadway shall be provided and maintained immediately down gradient of the protected inlet until roadway is stoned. Road subbase berm on roadway shall be maintained until roadway is paved. Earthen berm in channel shall be maintained until permanent stabilization is completed or to remain permanently

Stone inlet protection and berm for a Type M Inlet can be used in one acre maximum drainage area with 15" overflow pipe and 4" head. A perforated plate welded to a metal riser may not be substituted for the wire mesh. A slotted plate welded to the riser may be used in conjunction with the wire mesh if calculations are provided to show sufficient capacity of the inlet to accept the peak runoff for a 2-year storm event from the tributary drainage area. Top of pipe shall be at least 6 inches below adjacent roadway if ponded water would pose a safety hazard to traffic. Earthen berm shall be rolled.

Sediment shall be removed when it reaches half the height of the stone. Damaged or clogged installations shall be repaired or replaced immediately. For systems discharging to HQ or EV surface water, a 6 inch thick compost layer shall be securely anchored on outside and over top of stone. Compost shall meet the standards in Table 4.2.



† PROVIDE LENGTH OF TRANSVERSE BERM (L) REQUIRED TO CONTAIN SURFACE DRAINAGE AND TO DIRECT INTO TEMPORARY SLOPE DRAIN. THE TRANSVERSE BERM WILL NOT BE REQUIRED WHERE THE DRAIN IS LOCATED AT A LOW POINT.

PLAN

NOT TO SCALE

TABLE A
SUGGESTED MINIMUM SIZES

DRAINAGE AREA (ACRES)	CORRUGATED PIPE SIZE DIAMETER (INCHES)	MINIMUM BERM HEIGHT (INCHES)
0 TO 2	12	24
2 TO 4	15	27
4 TO 5	18	30

TEMPORARY SLOPE PIPE GENERAL NOTES

1. ALL TEMPORARY SLOPE PIPES WILL HAVE AN APPROPRIATELY SIZED OUTLET PROTECTION.
2. THE SLOPE PIPE WILL BE SECURELY ANCHORED TO THE SLOPE.

INSTALLATION

1. CLEAR ONLY THE AREA THAT IS REQUIRED FOR THE TEMPORARY SLOPE PIPE INSTALLATION.
2. INSTALL THE TEMPORARY SLOPE PIPE AS DETAILED ON THE E&S PLAN. ENSURE THAT THE SLOPE PIPE HAS FULL CONTACT WITH THE SLOPES SURFACE.
3. CONSTRUCT THE TOP OF SLOPE BERM AND PIPE INLET, AS SHOWN ON THE DETAIL.
4. CONSTRUCT THE PIPE OUTLET AND DISCHARGE END TREATMENT.
5. STABILZE THE DISTURBED AREA WITH TEMPORARY SEEDING AND MULCHING.

INSPECTION

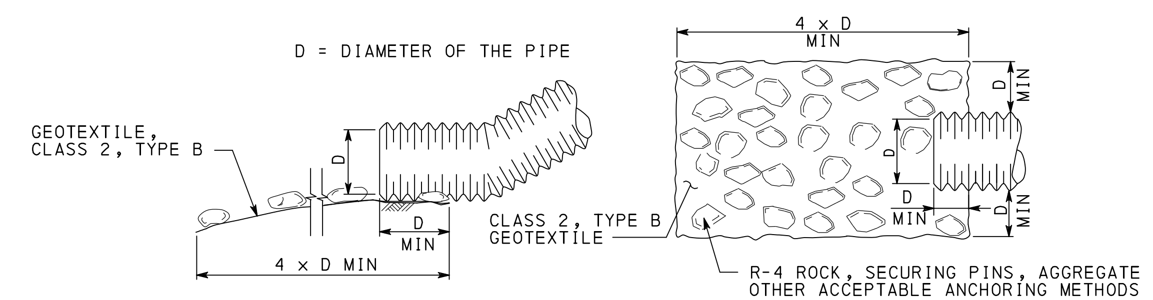
1. INSPECT THE TEMPORARY DIVERSION DEVICE WEEKLY AND AFTER EACH RUNOFF EVENT.

MAINTENANCE

1. REMOVE ALL ACCUMULATED SEDIMENT AND DEBRIS FROM THE INLET AND DISCHARGE WITHIN 24 HOURS AFTER THE COMPLETION OF THE INSPECTION.
2. ENSURE THAT THE TEMPORARY SLOPE PIPE IS FUNCTIONAL. IMMEDIATELY REPAIR OR REPLACE ANY PORTION OF THE TEMPORARY SLOPE PIPE THAT HAS FAILED OR IS NOT FUNCTIONING PROPERLY.
3. CLEAN OR REPAIR ALL CLOGGED OR LEAKING PIPES.

REMOVAL

1. REMOVE AND PROPERLY DISPOSE OF THE ACCUMULATED SEDIMENT, TEMPORARY SLOPE PIPE AND OUTLET PROTECTION.
2. GRADE THE AREA AS REQUIRED.
3. STABILIZE THE DISTURBED AREA WITH PERMANENT SEEDING AND MULCHING.



SECTION

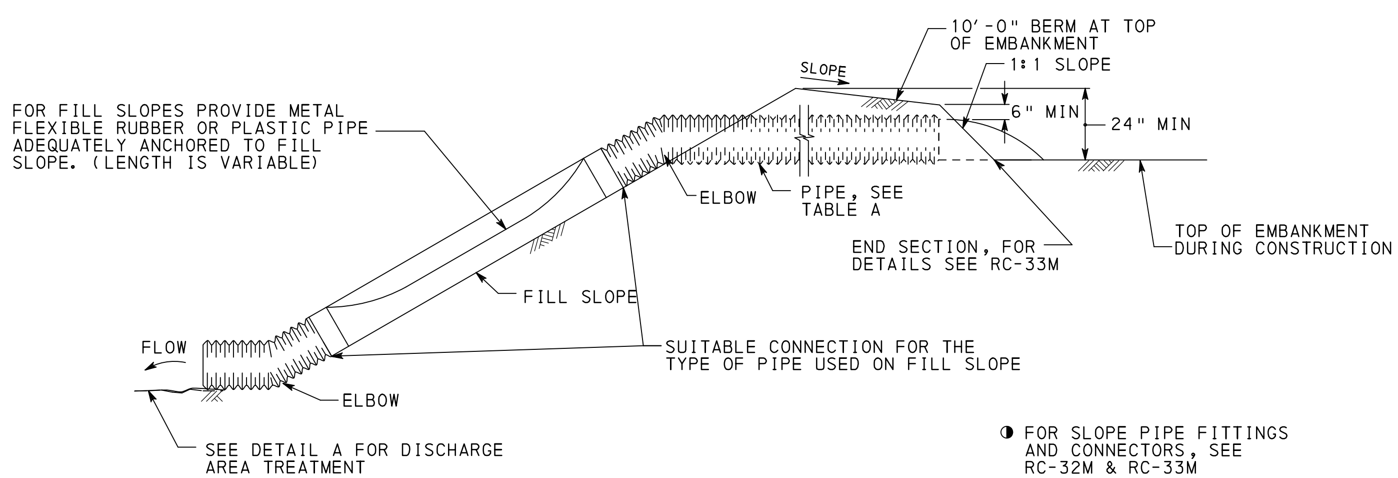
NOT TO SCALE

PLAN

NOT TO SCALE

DETAIL A

NOT TO SCALE



◑ FOR SLOPE PIPE FITTINGS AND CONNECTORS, SEE RC-32M & RC-33M

SECTION A-A

NOT TO SCALE

TEMPORARY SLOPE PIPE ◑

NOT TO SCALE

ITEM: TEMPORARY SLOPE PIPE

TEMPORARY PIPE\OUTLET PROTECTION TABLE

PIPE\DITCH NO.	PIPE SIZE INCHES	OUTLET PROTECTION TYPE	ROCK, R–	APRON LENGTH FT	APRON WIDTH FT
TP-01/ROP-1	18	ROCK	R-4	6	4.5
TP-02	18	-	-	-	-

NOTE:
SEE SHEET 16 OF 29 FOR ROCK OUTLET PROTECTION DETAIL #9-2 FOR FURTHER INFORMATION.

SHEET 21 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
SLOPE PIPE DETAIL

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

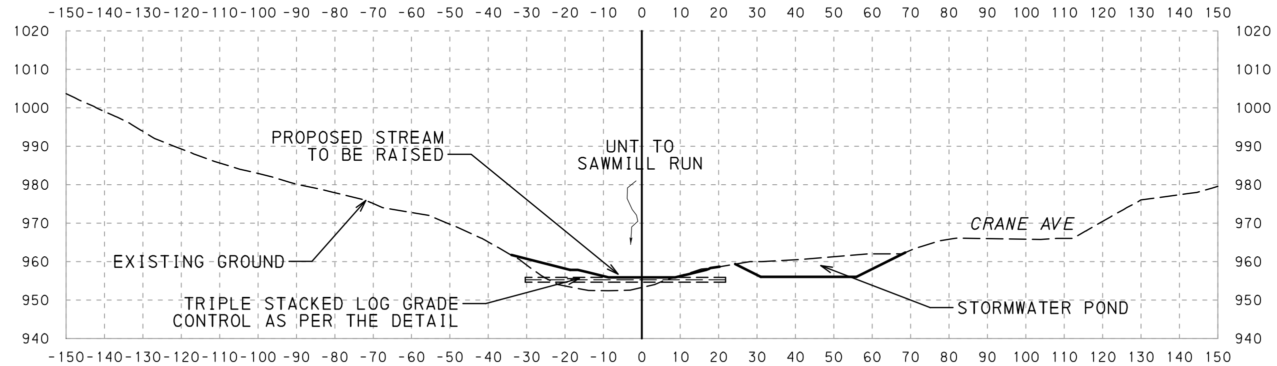
ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JAMES H. FLYNN
PE 061647

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\MS4SawmillRun PRPSlopePipeDetail.dgn
DATE: 7/12/2023 TIME: 11:34:53 AM

TOTAL LIMIT OF DISTURBANCE:
3.93 AC.(171,040 SF.)
COVERED UNDER 401
WATER QUALITY CERTIFICATION



TYPICAL CROSS SECTION
DETAIL FOR STATIONS
206+25 TO 213+84
SECTION C-C

ℓ	PROPERTY LINE
	EXISTING CONTOUR
	PROPOSED CONTOUR
LOD	LIMIT OF DISTURBANCE UNDER 401 CERT
18" CFS	COMPOST FILTER SOCK
	SOIL BOUNDARY LINE
GSF	SOIL TYPE
RCE	ROCK CONSTRUCTION ENTRANCE
	COFFER DAM
	ROCK FILTER
	100 YR FLOODPLAIN BOUNDARY

NOTE:
- WORK SHALL BEGIN AT STA 213+84. INSTALL PWFB, COFFER DAM, TEMPORARY PUMPAROUND AND ROCK FILTERS. A MAX OF 200' OF WORK AREA IS TO BE OPEN AT ANY TIME.
- TP-02 CONNECTS TO EXISTING PIPE OUTFALL TO ROUTE CLEAN WATER AROUND THE WORK AREA UNTIL BASIN IS CONSTRUCTED.

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\CraneAvePlan1.dgn
DATE: 8/4/2023 TIME: 2:17:15 PM

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PLAN SHEET

PREPARED BY:
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PREPARED FOR:
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HARRISBURG, PA 17120

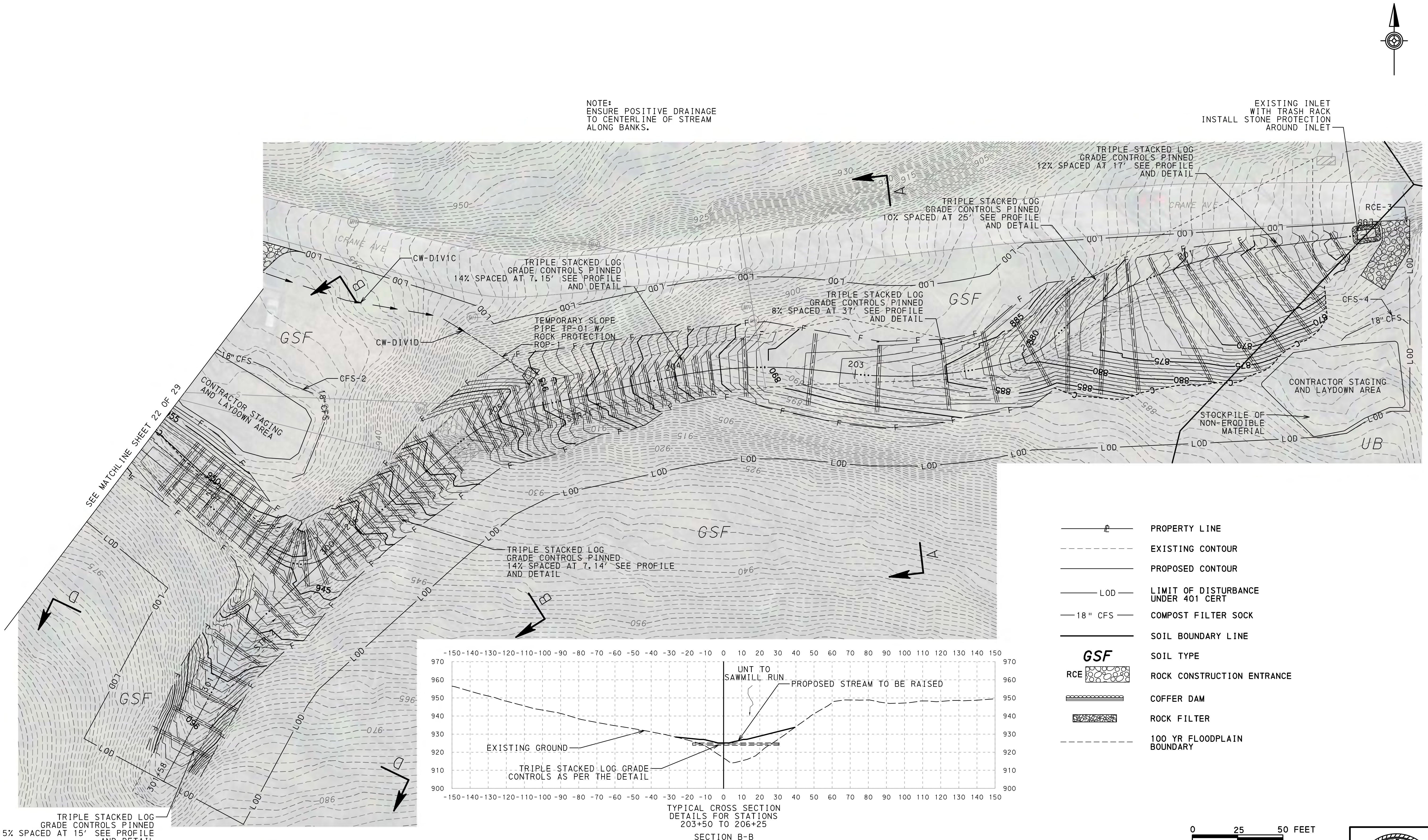
PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER WILLIAM BRUCE McNEAL PE074465

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN PE 061647



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DATE: 7/12/2023 TIME: 12:06:53 PM

SHEET 23 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PLAN SHEET

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
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NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

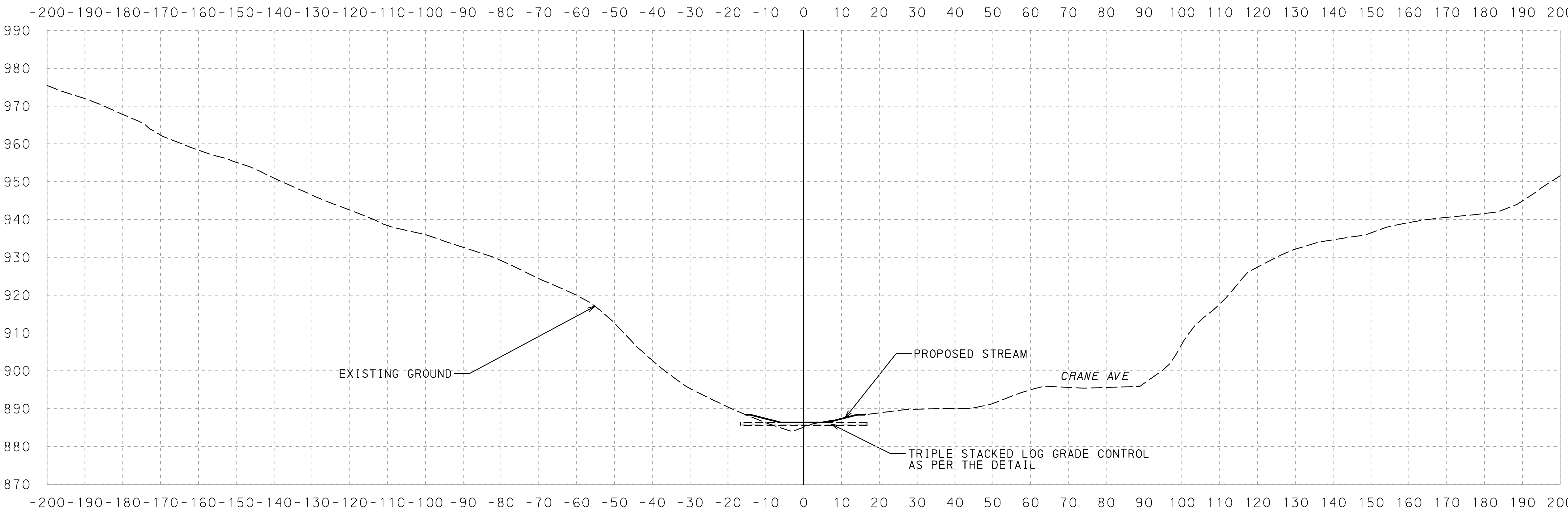
PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL
SUBMISSION DATE: 03-08-2023

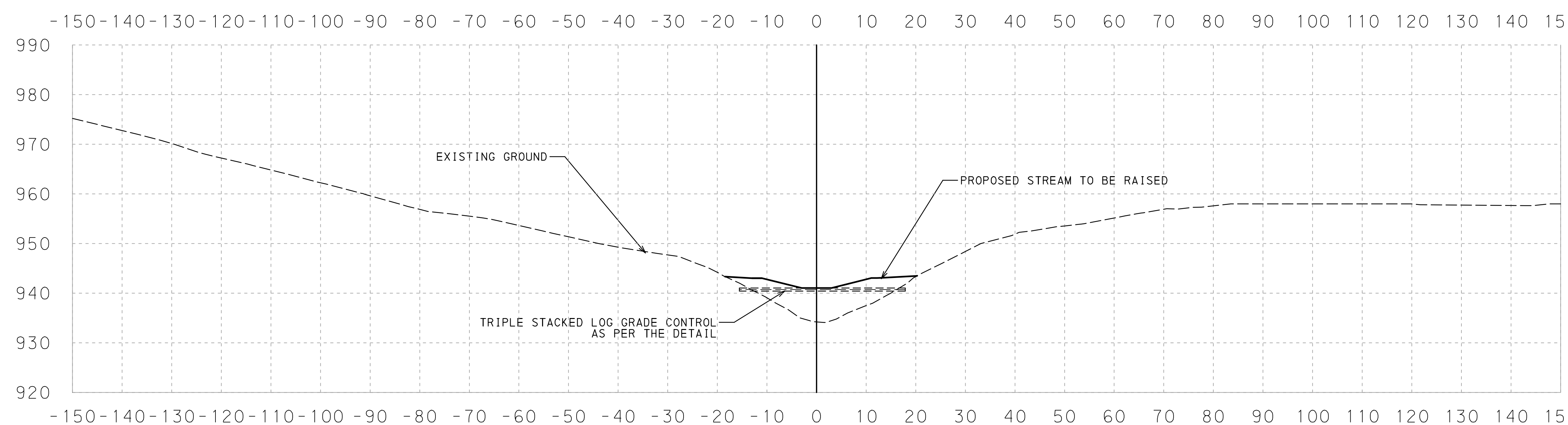
REVISED
SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647



TYPICAL CROSS SECTION
DETAIL FOR STATIONS
200+50 TO 203+50

SECTION A-A



TYPICAL CROSS SECTION
DETAIL FOR STATIONS
300+00 TO 301+47

SECTION D-D

SHEET 24 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
CROSS SECTIONS

PREPARED BY:

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NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
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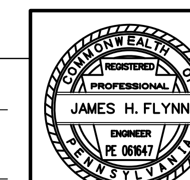
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

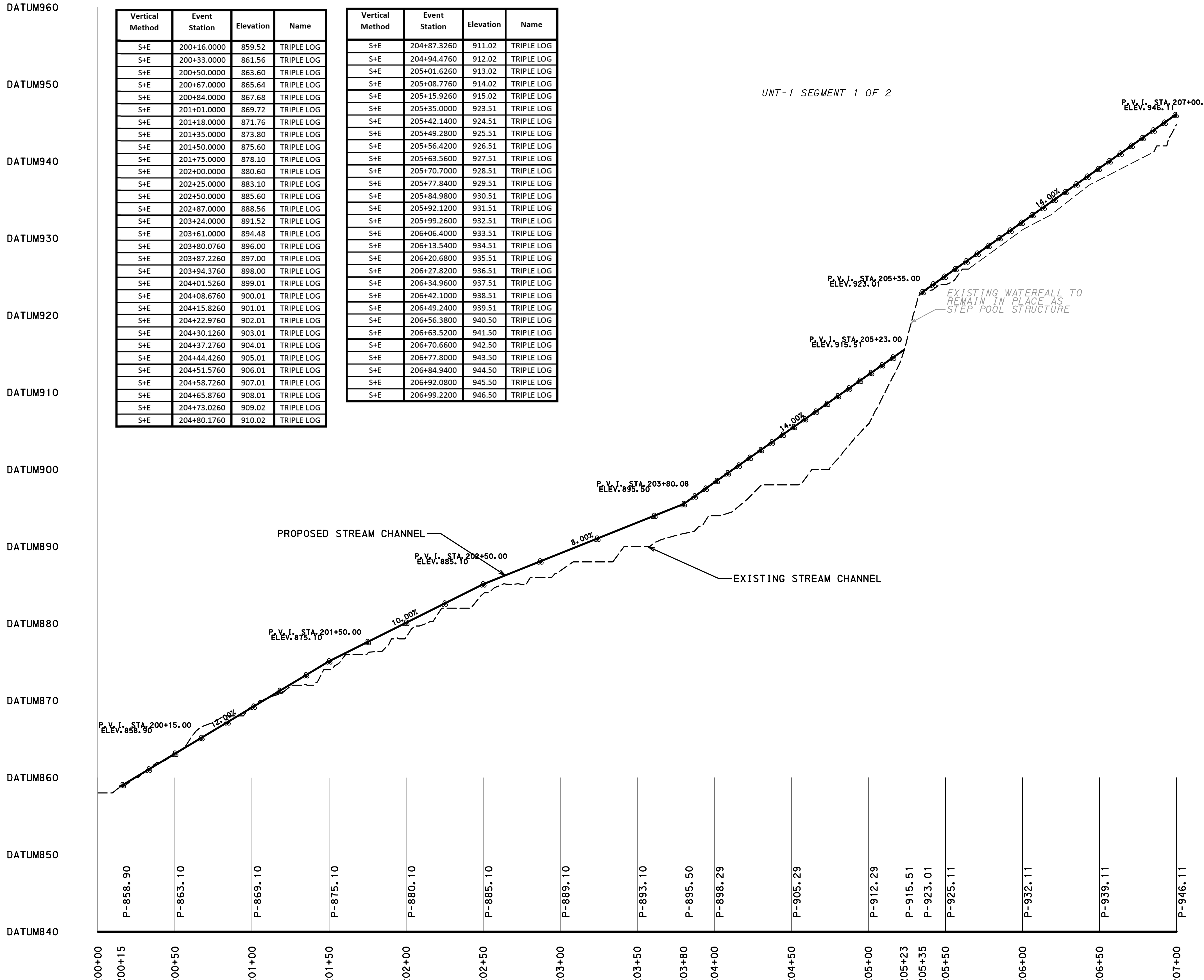
ORIGINAL
SUBMISSION DATE: 03-08-2023

REVISED
SUBMISSION DATE: 07-12-2023



Vertical Method	Event Station	Elevation	Name
S+E	200+16.0000	859.52	TRIPLE LOG
S+E	200+33.0000	861.56	TRIPLE LOG
S+E	200+50.0000	863.60	TRIPLE LOG
S+E	200+67.0000	865.64	TRIPLE LOG
S+E	200+84.0000	867.68	TRIPLE LOG
S+E	201+01.0000	869.72	TRIPLE LOG
S+E	201+18.0000	871.76	TRIPLE LOG
S+E	201+35.0000	873.80	TRIPLE LOG
S+E	201+50.0000	875.60	TRIPLE LOG
S+E	201+75.0000	878.10	TRIPLE LOG
S+E	202+00.0000	880.60	TRIPLE LOG
S+E	202+25.0000	883.10	TRIPLE LOG
S+E	202+50.0000	885.60	TRIPLE LOG
S+E	202+87.0000	888.56	TRIPLE LOG
S+E	203+24.0000	891.52	TRIPLE LOG
S+E	203+61.0000	894.48	TRIPLE LOG
S+E	203+80.0760	896.00	TRIPLE LOG
S+E	203+87.2260	897.00	TRIPLE LOG
S+E	203+94.3760	898.00	TRIPLE LOG
S+E	204+01.5260	899.01	TRIPLE LOG
S+E	204+08.6760	900.01	TRIPLE LOG
S+E	204+15.8260	901.01	TRIPLE LOG
S+E	204+22.9760	902.01	TRIPLE LOG
S+E	204+30.1260	903.01	TRIPLE LOG
S+E	204+37.2760	904.01	TRIPLE LOG
S+E	204+44.4260	905.01	TRIPLE LOG
S+E	204+51.5760	906.01	TRIPLE LOG
S+E	204+58.7260	907.01	TRIPLE LOG
S+E	204+65.8760	908.01	TRIPLE LOG
S+E	204+73.0260	909.02	TRIPLE LOG
S+E	204+80.1760	910.02	TRIPLE LOG

Vertical Method	Event Station	Elevation	Name
S+E	204+87.3260	911.02	TRIPLE LOG
S+E	204+94.4760	912.02	TRIPLE LOG
S+E	205+01.6260	913.02	TRIPLE LOG
S+E	205+08.7760	914.02	TRIPLE LOG
S+E	205+15.9260	915.02	TRIPLE LOG
S+E	205+35.0000	923.51	TRIPLE LOG
S+E	205+42.1400	924.51	TRIPLE LOG
S+E	205+49.2800	925.51	TRIPLE LOG
S+E	205+56.4200	926.51	TRIPLE LOG
S+E	205+63.5600	927.51	TRIPLE LOG
S+E	205+70.7000	928.51	TRIPLE LOG
S+E	205+77.8400	929.51	TRIPLE LOG
S+E	205+84.9800	930.51	TRIPLE LOG
S+E	205+92.1200	931.51	TRIPLE LOG
S+E	205+99.2600	932.51	TRIPLE LOG
S+E	206+06.4000	933.51	TRIPLE LOG
S+E	206+13.5400	934.51	TRIPLE LOG
S+E	206+20.6800	935.51	TRIPLE LOG
S+E	206+27.8200	936.51	TRIPLE LOG
S+E	206+34.9600	937.51	TRIPLE LOG
S+E	206+42.1000	938.51	TRIPLE LOG
S+E	206+49.2400	939.51	TRIPLE LOG
S+E	206+56.3800	940.50	TRIPLE LOG
S+E	206+63.5200	941.50	TRIPLE LOG
S+E	206+70.6600	942.50	TRIPLE LOG
S+E	206+77.8000	943.50	TRIPLE LOG
S+E	206+84.9400	944.50	TRIPLE LOG
S+E	206+92.0800	945.50	TRIPLE LOG
S+E	206+99.2200	946.50	TRIPLE LOG



HORIZONTAL
0 25 50 FEET

VERTICAL
0 25 50 FEET

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DATE: 7/12/2023 TIME: 12:09:13 PM

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PROFILES

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

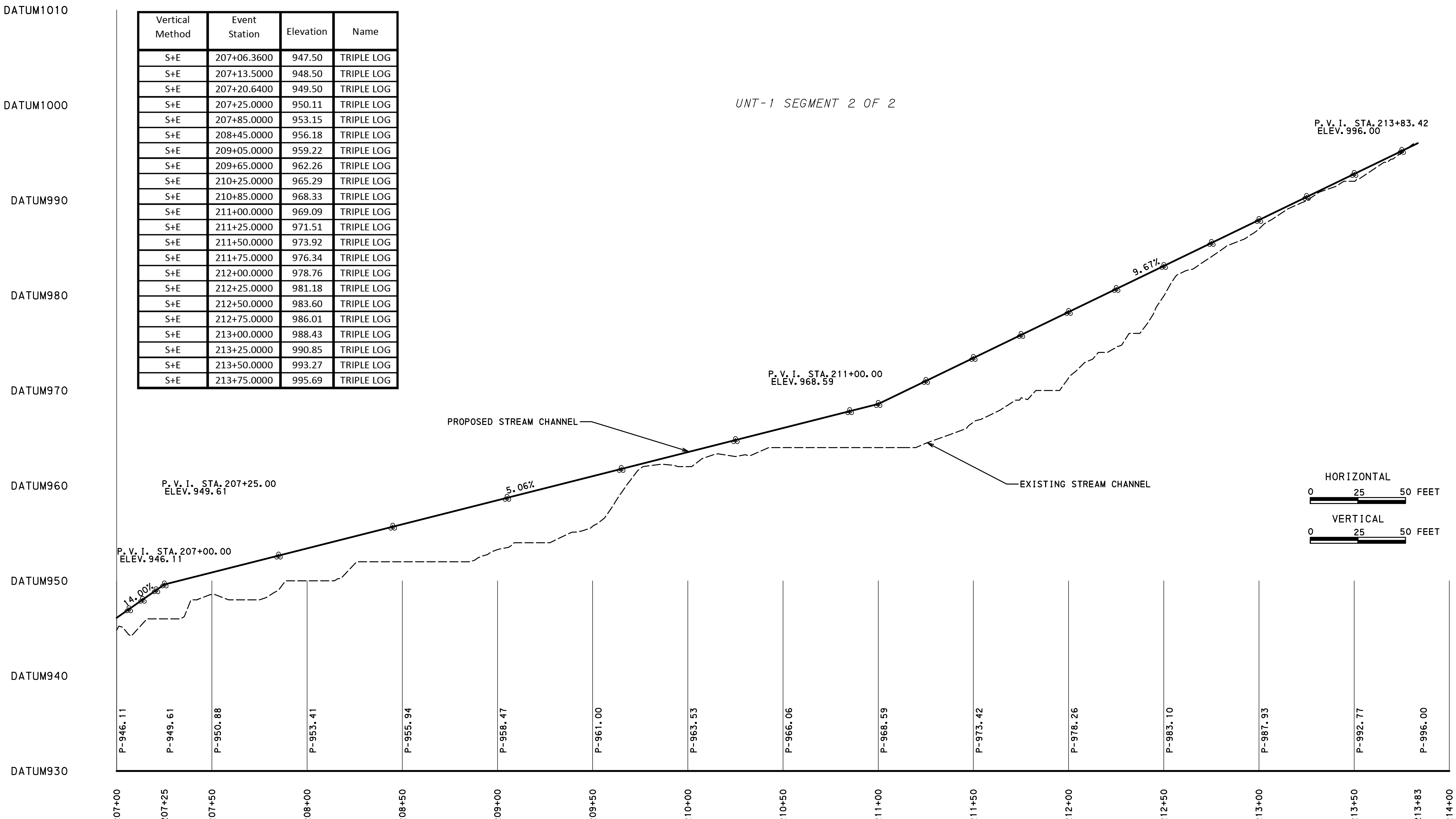
PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647



Vertical Method	Event Station	Elevation	Name
S+E	207+06.3600	947.50	TRIPLE LOG
S+E	207+13.5000	948.50	TRIPLE LOG
S+E	207+20.6400	949.50	TRIPLE LOG
S+E	207+25.0000	950.11	TRIPLE LOG
S+E	207+85.0000	953.15	TRIPLE LOG
S+E	208+45.0000	956.18	TRIPLE LOG
S+E	209+05.0000	959.22	TRIPLE LOG
S+E	209+65.0000	962.26	TRIPLE LOG
S+E	210+25.0000	965.29	TRIPLE LOG
S+E	210+85.0000	968.33	TRIPLE LOG
S+E	211+00.0000	969.09	TRIPLE LOG
S+E	211+25.0000	971.51	TRIPLE LOG
S+E	211+50.0000	973.92	TRIPLE LOG
S+E	211+75.0000	976.34	TRIPLE LOG
S+E	212+00.0000	978.76	TRIPLE LOG
S+E	212+25.0000	981.18	TRIPLE LOG
S+E	212+50.0000	983.60	TRIPLE LOG
S+E	212+75.0000	986.01	TRIPLE LOG
S+E	213+00.0000	988.43	TRIPLE LOG
S+E	213+25.0000	990.85	TRIPLE LOG
S+E	213+50.0000	993.27	TRIPLE LOG
S+E	213+75.0000	995.69	TRIPLE LOG

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\MS4CraneAveStreamProfile.dgn
DATE: 7/12/2023 TIME: 12:09:36 PM

SHEET 26 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PROFILES

PREPARED BY:

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NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

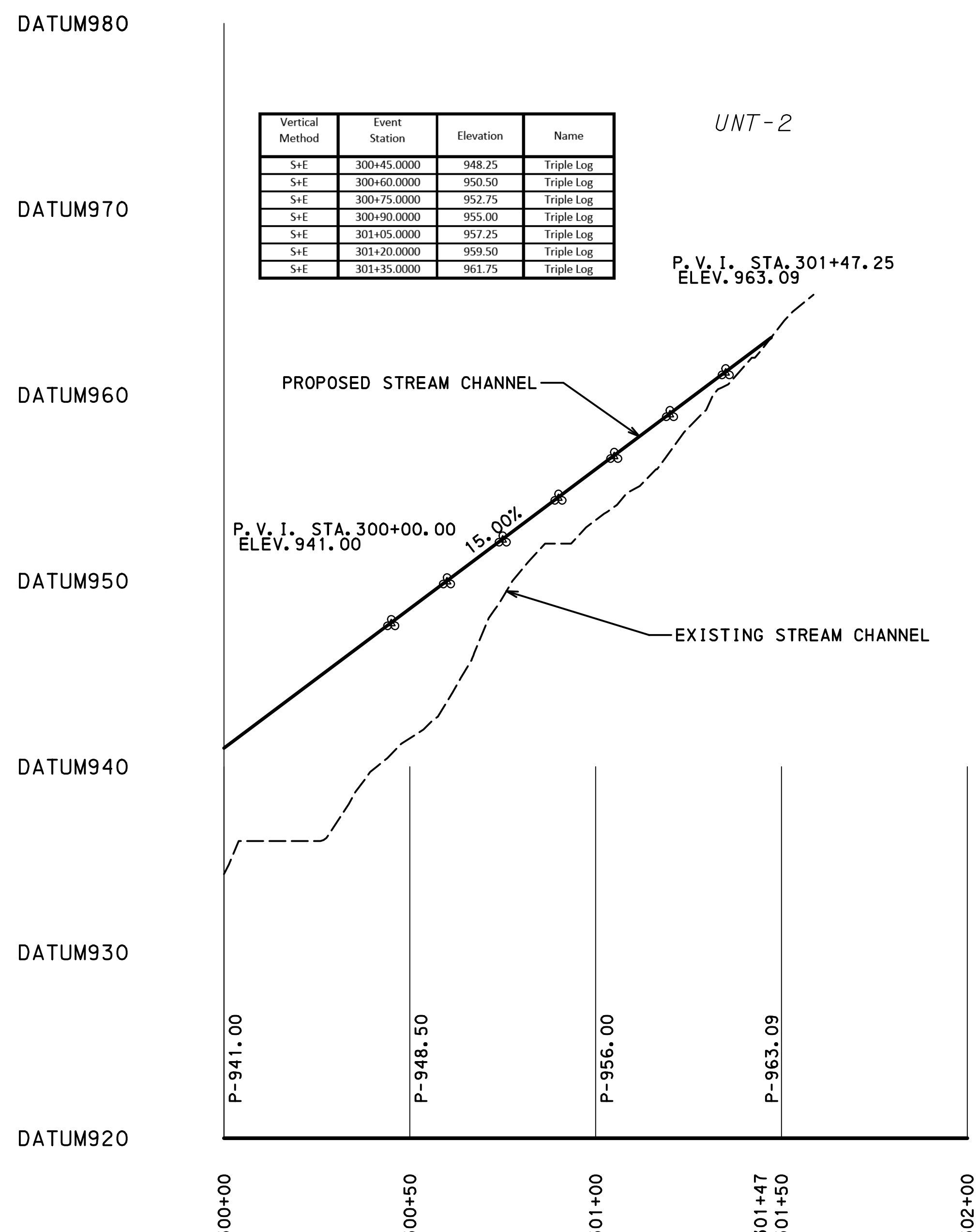
ENGINEER

ORIGINAL
SUBMISSION DATE: 03-08-2023

REVISED
SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

Vertical Method	Event Station	Elevation	Name
S+E	300+45.0000	948.25	Triple Log
S+E	300+60.0000	950.50	Triple Log
S+E	300+75.0000	952.75	Triple Log
S+E	300+90.0000	955.00	Triple Log
S+E	301+05.0000	957.25	Triple Log
S+E	301+20.0000	959.50	Triple Log
S+E	301+35.0000	961.75	Triple Log



HORIZONTAL
0 25 50 FEET

VERTICAL
0 25 50 FEET

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\MS4CraneAveStreamProfile.dgn
DATE: 7/12/2023 TIME: 12:09:47 PM

SHEET 27 OF 29

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PROFILES

PREPARED BY:

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NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
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ENGINEER

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SUBMISSION DATE: 03-08-2023

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SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
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JAMES H. FLYNN
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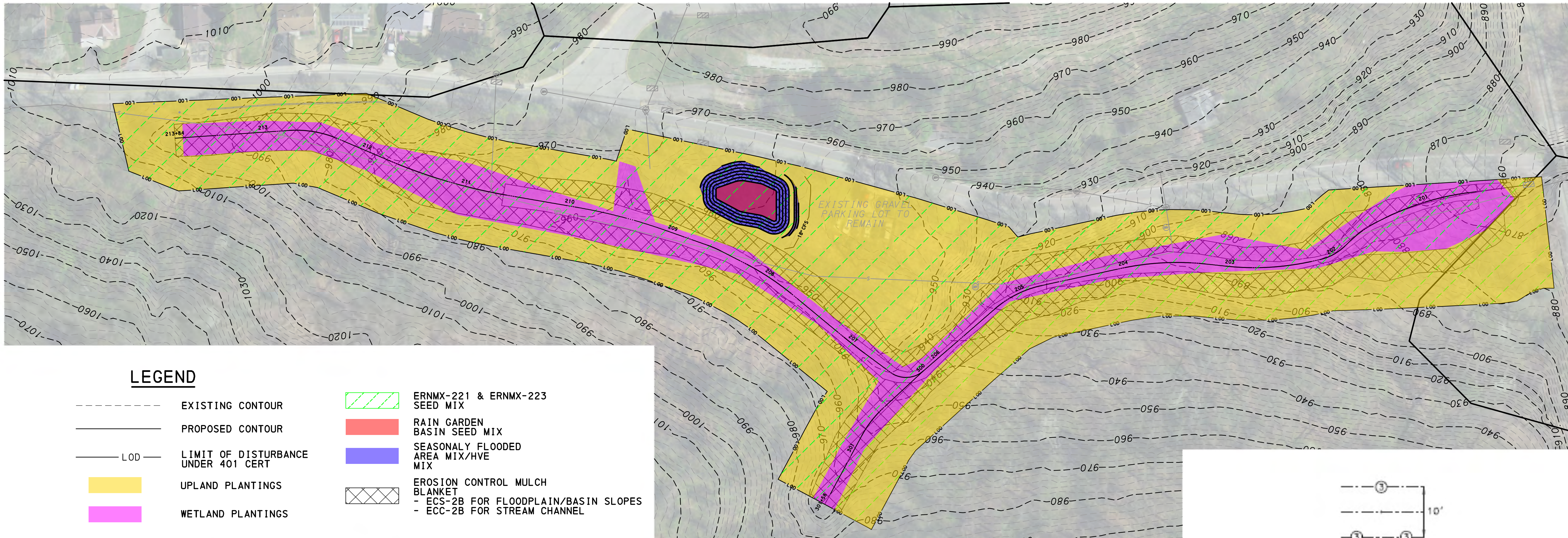
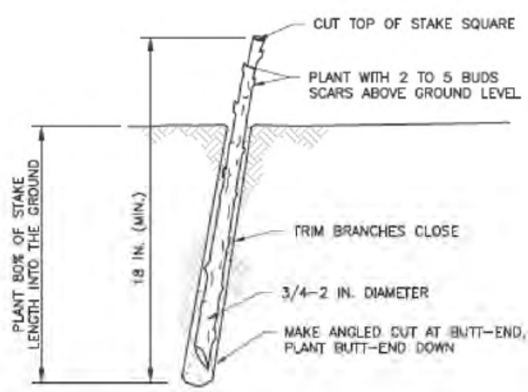


LEGEND

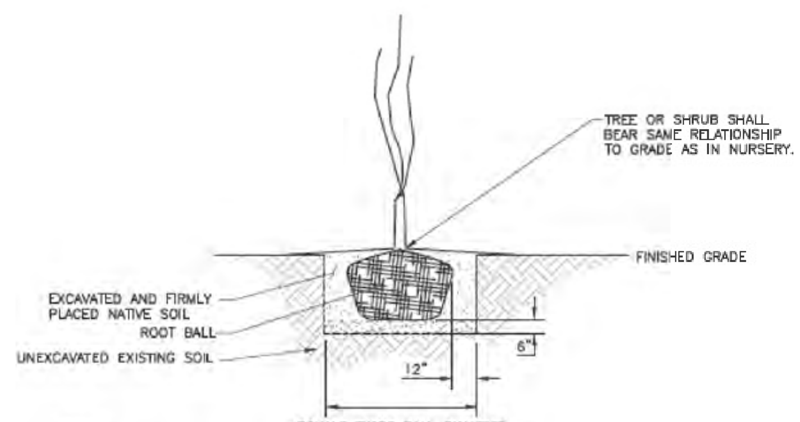
EXISTING CONTOUR	ERNMX-221 & ERNMX-223 SEED MIX
PROPOSED CONTOUR	RAIN GARDEN BASIN SEED MIX
LOD — LIMIT OF DISTURBANCE UNDER 401 CERT	SEASONALLY FLOODED AREA MIX/HVE MIX
UPLAND PLANTINGS	EROSION CONTROL MULCH BLANKET - ECS-2B FOR FLOODPLAIN/BASIN SLOPES - ECC-2B FOR STREAM CHANNEL
WETLAND PLANTINGS	



PLANTING NOTES:

1. PLANT MATERIALS SHALL BE FROM PLANT STOCK NATIVE OR ADAPTED TO THE EASTERN BROADLEAF FOREST ECOREGIONS, AS DEFINED BY THE USDA FOREST SERVICE, AND USDA PLANT HARDINESS ZONES 5 AND 6.
2. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
3. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
4. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION; USE AN IRON BAR AND PILOT HOLE IN FIRM SOILS.
5. SOAK CUTTINGS FOR AT LEAST 24 HOURS PRIOR TO INSTALLATION. SOAK FOR 5-7 DAYS FOR BEST RESULTS.
6. TAMP THE SOIL AROUND THE STAKE.
7. DO NOT PLANT LIVE STAKES WITHIN 10 FEET OF PIPELINE.

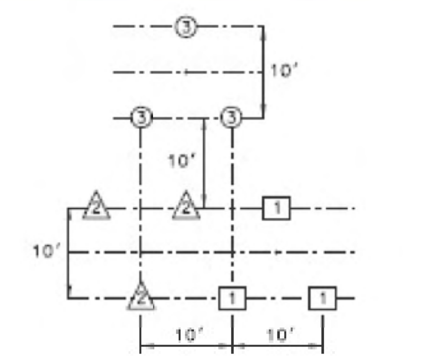
1/24 **LIVE STAKE PLANTING**
NOT TO SCALE



NOTES:

1. UNLESS PLANTING WITHIN A WETLAND, PROVIDE POSITIVE DRAINAGE. DO NOT ALLOW PONDING AROUND ROOT BALL.
2. IF PLANT IS CONTAINER GROWN, REMOVE CONTAINER AND GENTLY LOOSEN SOIL AND OUTSIDE ROOTS OF ROOT BALL.
3. IF ROOTS ARE WRAPPED IN BURLAP, LEAVE THE BURLAP IN PLACE AND REMOVE ANY BINDINGS AROUND THE MAIN TRUNK.

2/24 **TREE AND SHRUB PLANTING**
NOT TO SCALE



1 SHRUB-TREE SPECIES
2 SHRUB-TREE SPECIES
3 SHRUB-TREE SPECIES

1 1 1 HOMOGENOUS CLUSTER OF SHRUB-TREE SPECIES

NOTE:
EVENLY DISTRIBUTE PLANT CLUSTER TO PROMOTE SPECIES DIVERSIFICATION

CLUSTER PLANTING PLAN
NOT TO SCALE

0 50 100 FEET

SHEET 28 OF 29	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA CRANE AVE RESTORATION PROJECT PLANTING PLAN & DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 / PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: ____ REVISED SUBMISSION DATE: ____

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\Revised PlantingPlan\CraneAvePlantingPlan1.dgn
DATE: 8/4/2023 TIME: 2:20:05 PM

PLANTING LIST

	FORMULA AND SPECIES	% BY WEIGHT	INDICATOR STATUS	APPLICATION RATE
ERNMX-221 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE FACW MIX	FOX SEDGE (CAREX VULPINOIDEA)	31	FACW	20.0 LBS/ACRE
	VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	FAC	
	LURID SEDGE (CAREX LURIDA)	8	OBL	
	HOP SEDGE (CAREX LUPULINA	7.8	OBL	
	BLUNT BROOM SEDGE (CAREX SCOPARIA)	7.8	FACW	
	BLUE VERVAIN (VERBENA HASTATA)	4	FAC	
	RIVER OATS (CHASMANTHIUM LATIFOLIUM)	3.3	FAC	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	STAR SEDGE (CAREX INTUMESCENS)	2	FACW	
	OXEYE SUNFLOWER (HELIPOSIS HELIANTHOIDES)	2	FACU	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.8	OBL	
	NODDING BUR MARIGOLD (BIDENS CERNUA)	1	OBL	
	AWL SEDGE (CAREX STIPATA)	1	OBL	
	NARROWLEAF BLUE EYED GRASS (SISYRINCHIUM ANGUSTIFOLIUM)	1	FACW	
	BONSET (EUPATORIUM PERFOLIATUM)	0.7	FACW	
	FOWL MANNAGRASS (GLYCERIA STRIATA)	0.5	OBL	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.5	FACW	
	PENNSYLVANIA SMARTWEED (POLYGONUM PENSYLVANICUM)	0.5	FACW	
	WOOLGRASS (SCIRPUS CYPERINUS)	0.5	OBL	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.5	OBL	
	GOLDEN ALEXANDERS (ZIZIA AUREA)	0.5	FAC	
	PUPLESTEM ASTER (ASTER PUNICEUS)	0.4	OBL	
	GREAT BLUE LOBELIA (LOBELIA SIPHILITICA)	0.4	OBL	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	SQUARE STEMMED MONKEYFLOWER (MIMULUS RINGENS)	0.3	OBL	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.3	FACW	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	SEPTEMBER-APRIL	-	
ERNMX-223 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE RIPARIAN MIX	LITTLE BLUESTEM (SCHIZACHYRIUM SCOPARIUM)	20	FACU	20.0 LBS/ACRE
	INDIANGRASS (SORGHASTRUM NUTANS)	20	FACU	
	VIRGINIA WILDRYE (ELYMUS VIRGINICUS)	18	FAC	
	BIG BLUESTEM (ANDROPOGON GERARDII)	12	FAC	
	RIVERBANK WILDRYE (ELYMUS RIPARIUS)	10.6	FACW	
	FOX SEDGE (CAREX VULPINOIDEA)	7	FACW	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	OXEYE SUNFLOWER (HELIOPSIS HELIANTHOIDES)	2	FACU	
	BLUE VERVAIN (VERBENA HASTATA)	2	FAC	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.6	OBL	
	WILD BERGAMOT (MONARDA FISTULOSA)	0.5	FACU	
	BONESET (EUPTORIUM PERFOLIATUM)	0.4	FACW	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.4	FACW	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.4	FACW	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	WRINKLELEAF GOLDENROD (SOLIDAGO RUGOSA)	0.3	FAC	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	CALICO ASTER (ASTER LATERIFLORUS)	0.2	FACW	
	AROMATIC ASTER (ASTER OBLONGIFOLIUS)	0.2	NI	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.2	OBL	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	JANUARY-JULY	-	

	FORMULA AND SPECIES	NUMBER PER ACRE	INDICATOR STATUS
WETLAND RESTORATION PLANTINGS	AMERICAN SYCAMORE (PLATANUS OCCIDENTALIS)	75	FACW
	SILVER MAPLE (ACER SACCHARINUM)	75	FACW
	PIN OAK (QUERCUS PALUSTRIS)	75	FACW
	COMMON BUTTON BUSH (CEPHALANTHUS OCCIDENTALIS)	50	OBL
	NORTHERN SPICEBUSH (LINDERA BEZOIN)	75	FACW
	SILKY DOGWOOD (CORNUS AMOMUM)	75	FACW
	SWAMP WHITE OAK (QUERCUS BICOLOR)	50	FACW
	RED CHOKEBERRY (ARONIA ARBUTIFOLIA)	75	FACW
	AMERICAN LARCH (LARIX LARICINA)	75	FACW
	RED OSHIER DOGWOOD (CORNUS SERICEA)	75	FACW
	PAWPAW (ASIMINA TRILOBA)	75	FACW
UPLAND RESTORATION PLANTINGS	SHAGBARK HICKORY (CARYA OVATA)	75	FACU
	CRANBERRY VIBURNUM (VIBURNUM TRILOBUM)	75	FACU
	BLACKHAW VIBURNUM (VIBURNUM PRUNIFOLIUM)	75	FACU
	NANNYBERRY VIBURNUM (VIBURNUM LENTAGO)	75	FACU
	WHITE OAK (QUERCUS ALBA)	75	FACU
	SUGAR MAPLE (ACER SACCHARUM)	75	UPL
	BLACK CHERRY (PRUNUS SEROTINA)	75	FACU
	DAWN REDWOOD (METASEQUOIA GLYPROSTROBOIDES)	75	NI
	EASTERN WHITE PINE (PINUS STROBUS)	75	FACU
	ALLEGHENY SERVICEBERRY (AMELANCHIER LAEVIS)	75	NI
	MOUNTAIN LAUREL (KALMIA LATIFOLIA)	75	FACU
	AMERICAN WITCH-HAZEL (HAMAMELIS VIRGINIANA	75	FACU

SEED MIXTURES

SEASONALLY FLOODED AREA MIX (SLOPES OF STORMWATER DETENTION BASIN)

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					4.15 TOTAL
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75	0.15	0.83
SMARTWEED/BARNYARD MIX (POLYGONUM LAPATHIFOLIUM)	20	92	85	0.15	0.83
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	0.83
JAPANESE MILLET (ECHINOCHLOA CRUSGALLI FRUMENTA)	20	95	80	0.15	0.83
NODDING BUR-MARIGOLD (BIDENS CERNUA)	10	92	85	0.15	0.42
SWITCHGRASS (PANICUM VIRGATUM) (AN IMPROVED VARIETY MUST BE USED)	5	92	85	0.10	0.21
LURID SEDGE (CAREX LURIDA)	2.5	92	85	0.10	0.10
COSMOS SEDGE (CAREX COMOSA)	2.5	92	85	0.10	0.10

DETENTION BASIN FLOOR SEED MIXTURE (BOTTOM OF STORMWATER DETENTION BASIN)

FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
ALKALIGRASS (PUCCINELLIA DISTANS)	20	99	90	0.15	1.04

A TREE SURVEY WAS CONDUCTED ON SITE BY AN ARBORIST TO DETERMINE THE SPECIES, DIAMETER AT BREAST HEIGHT AND GPS LOCATION OF ALL TREES LOCATED IN THE PROJECT'S LIMIT OF DISTURBANCE. THE ESTIMATED TREE LOSS WAS CALCULATED USING EXPERT JUDGMENT. A FINAL AUDIT OF ACTUAL TREE LOSS WILL BE CONDUCTED DURING CONSTRUCTION. TREE MITIGATION WILL BE CONDUCTED IN ACCORDANCE WITH THE CITY OF PITTSBURGH'S MITIGATION REQUIREMENTS. THE NUMBER OF PLANTINGS FOR EACH TREE CUT DOWN WILL BE DETERMINED BASED ON THE DIAMETER OF THE LOST TREE TO THE INCH. CREDIT FOR THE MAINTENANCE AND ELIMINATION OF INVASIVE SPECIES WILL BE DETERMINED AT A LATER DATE. SOME TREES LOST ON SITE ARE SPECIES ON THE CITY OF PITTSBURGH PROHIBITED SPECIES LIST. THESE TREES WILL BE REPLACED WITH SPECIES ON THE CITY OF PITTSBURGH APPROVED PARK SPECIES LIST. AS PER THE APPROVED TREE SPECIES FOR PITTSBURGH'S PARKS & OPEN SPACES DOCUMENT, 20% OF TREES PLANTED WILL BE CONIFERS AND 80% WILL BE DECIDUOUS. PLANT FAMILIES WILL TAKE UP NO MORE THAN 30% OF PLANTINGS. PLANT GENUSES WILL TAKE UP NO MORE THAT 20% OF PLANTINGS. PLANT SPECIES WILL TAKE UP NO MORE THAT 10% OF PLANTINGS. VEGETATIVE TRAILS WILL BE PLACED IN THE PARK FOR ACCESS.

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
CRANE AVE RESTORATION PROJECT
PLANTING MIX DETAILS

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREET
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

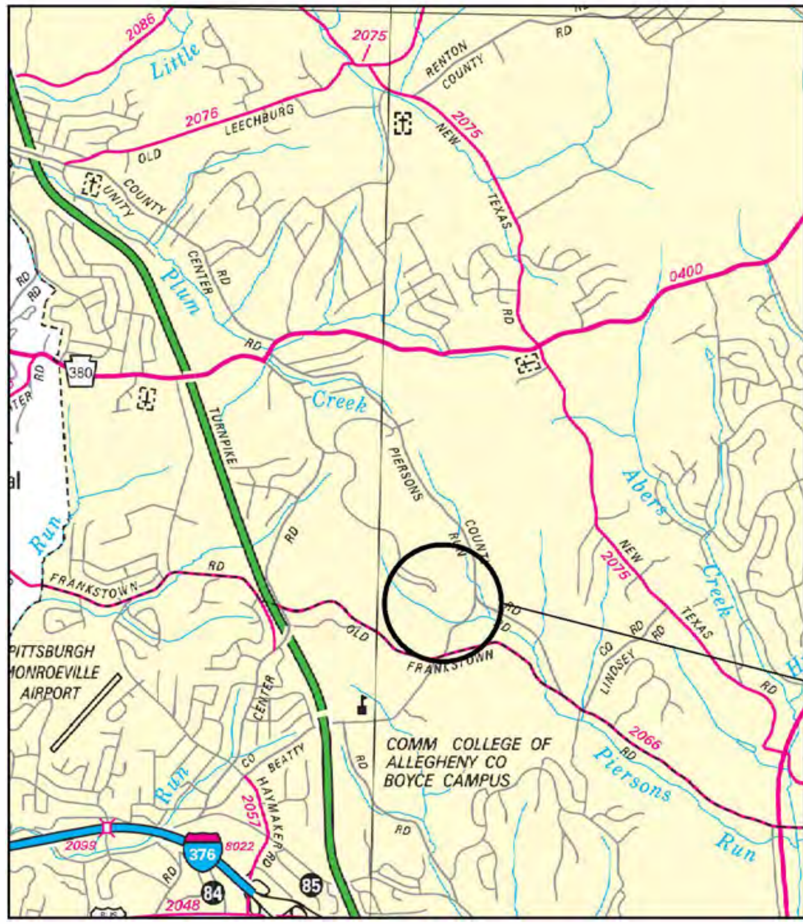
ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\Crane\CraneAvePlantingPlan1.dgn
DATE: 8/4/2023 TIME: 2:15:16 PM

STREAM RESTORATION FOR MS4 CREDIT
IN THE SAW MILL RUN AND OHIO RIVER WATERSHED
FOR
PENNSYLVANIA TURNPIKE COMMISSION
POLLUTANT REDUCTION PLAN



LOCATION MAP

0 0.5 1.0 MILES

CALL BEFORE YOU DIG

PENNSYLVANIA LAW REQUIRES 3 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE AND 10 WORKING DAYS IN DESIGN STAGE - STOP CALL 1-800-242-1776

PA ONE CALL System Inc.

PENNSYLVANIA ONE CALL SYSTEM, INC. 1-800-242-1776 STOP-CALL BEFORE YOU DIG!

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STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
BOYCE PARK RESTORATION PROJECT
TITLE SHEET

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ORIGINAL SUBMISSION DATE: 5-11-2023

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COMMONWEALTH OF PENNSYLVANIA
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FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4BoyceParkTitle.dgn
DATE: 5/18/2023 TIME: 2:38:40 PM

EROSION AND SEDIMENT POLLUTION CONTROL GENERAL NOTES

AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, INCLUDING CLEARING AND GRUBBING, THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE E&S PLAN PREPARER, THE PCSM PLAN PREPARER, THE LICENSED PROFESSIONAL RESPONSIBLE FOR OVERSIGHT OF CRITICAL STAGES OF IMPLEMENTATION OF THE PCSM PLAN, AND A REPRESENTATIVE FROM THE LOCAL CONSERVATION DISTRICT TO AN ON-SITE PRECONSTRUCTION MEETING.

AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS. DEVIATION FROM THAT SEQUENCE MUST BE APPROVED IN WRITING FROM THE LOCAL CONSERVATION DISTRICT OR BY THE DEPARTMENT PRIOR TO IMPLEMENTATION.

AREAS TO BE FILLED ARE TO BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS AND OTHER OBJECTIONABLE MATERIAL.

CLEARING, GRUBBING, AND TOPSOIL STRIPPING SHALL BE LIMITED TO THOSE AREAS DESCRIBED IN EACH STAGE OF THE CONSTRUCTION SEQUENCE. GENERAL SITE CLEARING, GRUBBING AND TOPSOIL STRIPPING MAY NOT COMMENCE IN ANY STAGE OR PHASE OF THE PROJECT UNTIL THE E&S BMPS SPECIFIED BY THE BMP SEQUENCE FOR THAT STAGE OR PHASE HAVE BEEN INSTALLED AND ARE FUNCTIONING AS DESCRIBED IN THIS E&S PLAN.

AT NO TIME SHALL CONSTRUCTION VEHICLES BE ALLOWED TO ENTER AREAS OUTSIDE THE LIMIT OF DISTURBANCE BOUNDARIES SHOWN ON THE PLAN MAPS. THESE AREAS MUST BE CLEARLY MARKED AND FENCED OFF BEFORE CLEARING AND GRUBBING OPERATIONS BEGIN.

TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED AT THE LOCATION(S) SHOWN ON THE PLAN MAPS(S) IN THE AMOUNT NECESSARY TO COMPLETE THE FINISH GRADING OF ALL EXPOSED AREAS THAT ARE TO BE STABILIZED BY VEGETATION. EACH STOCKPILE SHALL BE PROTECTED IN THE MANNER SHOWN ON THE PLAN DRAWINGS. STOCKPILE HEIGHTS SHALL NOT EXCEED 35 FEET. STOCKPILE SLOPES SHALL BE 2H:1V OR FLATTER.

IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, THE OPERATOR SHALL IMPLEMENT APPROPRIATE BEST MANAGEMENT PRACTICES TO MINIMIZE THE POTENTIAL FOR EROSION AND SEDIMENT POLLUTION AND NOTIFY THE LOCAL CONSERVATION DISTRICT AND/OR DISTRICT ENVIRONMENTAL UNIT.

ALL BUILDING MATERIALS AND WASTES SHALL BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED OF IN ACCORDANCE WITH THE DEPARTMENT'S SOLID WASTE MANAGEMENT REGULATIONS AT 25 PA. CODE 260.1 ET SEQ., 271.1, AND 287.1 ET. SEQ. NO BUILDING MATERIALS OR WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURNED, BURIED, DUMPED, OR DISCHARGED AT THE SITE.

EROSION AND SEDIMENTATION BEST MANAGEMENT PRACTICES (BMPS) THAT ARE PROPOSED FOR THE PROJECT SHALL BE INSTALLED AND FUNCTIONAL PRIOR TO ANY EARTH MOVING ACTIVITIES WITHIN THEIR CONTRIBUTING AREA.

CONDUCT ALL EARTH MOVING ACTIVITIES AS SPECIFIED IN THE EROSION AND SEDIMENTATION CONTROL PLAN AND IN ACCORDANCE WITH THE RULES AND REGULATION OF CHAPTER 102, TITLE 25 RELATED TO EROSION CONTROL, AND THE CLEAN STREAMS LAW OF PENNSYLVANIA.

UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENT BMPS SHALL BE MAINTAINED PROPERLY. MAINTENANCE SHALL INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENT BMPS AFTER EACH RUNOFF EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEAN OUT, REPAIR, REPLACEMENT, REGRADING, RESEEDING, REMULCHING AND RENETTING MUST BE PERFORMED IMMEDIATELY. IF THE E&S BMPS FAIL TO PERFORM AS EXPECTED, REPLACEMENT BMPS, OR MODIFICATIONS OF THOSE INSTALLED WILL BE REQUIRED IMMEDIATELY.

SEED AND MULCH ANY DISTURBED AREA THAT WILL REMAIN IDLE FOR MORE THAN 4 DAYS
STABILIZATION IS DEFINED AS A UNIFORM, 70%, PERENNIAL COVER ESTABLISHED OVER THE DISTURBED AREA.

ANY AND ALL ACCUMULATED SILT AND SEDIMENTS THAT ARE FOUND WITHIN AN EROSION CONTROL DEVICE SHALL BE REMOVED FROM THE CONTROL DEVICE AND SPREAD EVENLY ON THE FILL UPSLOPE OF THE EROSION AND SEDIMENTATION CONTROLS, AND THEN SEEDED AND MULCHED TO PROVIDE STABILIZATION.

ANY OFFSITE WASTE AND BORROW AREAS MUST HAVE AN E & S PLAN REVIEWED AND APPROVED BY THE LOCAL CONSERVATION DISTRICT AND THE DISTRICT ENVIRONMENTAL UNIT PRIOR TO BEING ACTIVATED.

CLEAN FILL IS DEFINED AS: UNCONTAMINATED, NON-WATER SOLUBLE, NON-DECOMPOSABLE, INERT, SOLID MATERIAL. THE TERM INCLUDES SOIL, ROCK, STONE, DREDGED MATERIAL, USED ASPHALT, AND BRICK, BLOCK OR CONCRETE, FROM CONSTRUCTION AND DEMOLITION ACTIVITIES THAT IS SEPARATE FROM OTHER WASTE AND IS RECOGNIZABLE AS SUCH. THE TERM DOES NOT INCLUDE MATERIALS PLACED IN OR ON THE WATERS OF THE COMMONWEALTH UNLESS OTHERWISE AUTHORIZED. (THE TERM USED ASPHALT DOES NOT INCLUDE MILLED ASPHALT OR ASPHALT THAT HAS BEEN PROCESSED FOR REUSE).

ENVIRONMENTAL DUE DILIGENCE MUST BE PERFORMED TO DETERMINE IF FILL MATERIALS ASSOCIATED WITH THE PROJECT QUALIFY AS CLEAN FILL. ENVIRONMENTAL DUE DILIGENCE IS DEFINED AS: INVESTIGATION TECHNIQUES, INCLUDING BUT NOT LIMITED TO, VISUAL PROPERTY INSPECTIONS, ELECTRONIC DATA BASE SEARCHES, REVIEW OF THE PROPERTY OWNERSHIP, REVIEW OF THE PROPERTY USE HISTORY, SANBORN MAPS, ENVIRONMENTAL QUESTIONNAIRES, TRANSACTION SCREEN, ANALYTICAL TESTING, ENVIRONMENTAL ASSESSMENTS OR AUDITS. ANALYTICAL TESTING IS NOT A REQUIRED PART OF DUE DILIGENCE UNLESS VISUAL INSPECTION AND/OR REVIEW OF THE PAST LAND USE OF THE PROPERTY INDICATES THAT THE FILL MAY HAVE BEEN COMPROMISED BY A RELEASE OF A REGULATED SUBSTANCE. IF THE FILL IS SUSPECTED TO HAVE BEEN COMPROMISED BY A RELEASE OF A REGULATED SUBSTANCE, IT MUST BE TESTED TO DETERMINE IF IT QUALIFIES AS A CLEAN FILL. TESTING SHOULD BE PERFORMED IN ACCORDANCE WITH APPENDIX A OF THE DEPARTMENT'S POLICY "MANAGEMENT OF CLEAN FILL".

THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ANY MATERIAL BROUGHT ON SITE IS CLEAN FILL. PADEP FORM FP-001 MUST BE RETAINED BY THE PROPERTY OWNER FOR ANY FILL MATERIAL AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE BUT QUALIFYING AS CLEAN FILL DUE TO ANALYTICAL TESTING.

ALL EARTH DISTURBANCES, INCLUDING CLEARING AND GRUBBING AS WELL AS CUTS AND FILLS SHALL BE DONE IN ACCORDANCE WITH THE APPROVED E&S PLAN. A COPY OF THE APPROVED DRAWINGS (STAMPED, SIGNED AND DATED BY THE REVIEWING AGENCY) MUST BE AVAILABLE AT THE PROJECT SITE AT ALL TIMES. THE REVIEWING AGENCY SHALL BE NOTIFIED OF ANY CHANGES TO THE APPROVED PLAN PRIOR TO IMPLEMENTATION OF THOSE CHANGES. THE REVIEWING AGENCY MAY REQUIRE A WRITTEN SUBMITTAL OF THOSE CHANGES FOR REVIEW AND APPROVAL AT ITS DISCRETION.

ALL PUMPING OF WATER FROM ANY WORK AREA SHALL BE DONE ACCORDING TO THE PROCEDURE DESCRIBED IN THIS PLAN, OVER UNDISTURBED VEGETATED AREAS.

A WRITTEN LOG MUST BE COMPLETED ON FORM 3800-FM-BCW0271D (MOST CURRENT FORM) SHOWING DATES THAT E&S BMPS WERE INSPECTED, DEFICIENCIES FOUND AND THE DATE THEY WERE CORRECTED SHALL BE MAINTAINED ON THE SITE AND BE MADE AVAILABLE TO REGULATORY AGENCY OFFICIALS AT THE TIME OF INSPECTION.

SEDIMENT TRACKED ONTO ANY PUBLIC ROADWAY OR SIDEWALK SHALL BE RETURNED TO THE CONSTRUCTION SITE BY THE END OF EACH WORK DAY AND DISPOSED IN THE MANNER DESCRIBED IN THIS PLAN. IN NO CASE SHALL THE SEDIMENT BE WASHED, SHOVELED, OR SWEPT INTO ANY ROADSIDE DITCH, STORM SEWER, OR SURFACE WATER.

AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 3 TO 5 INCHES 6 TO 12 INCHES ON COMPACTED SOILS PRIOR TO PLACEMENT OF TOPSOIL. AREAS TO BE VEGETATED SHALL HAVE A MINIMUM 4 INCHES OF TOPSOIL IN PLACE PRIOR TO SEEDING AND MULCHING. FILL OUTSLOPES SHALL HAVE A MINIMUM OF 2 INCHES OF TOPSOIL.

BMP INSPECTION, MAINTENANCE, AND REPAIR (IMR) SCHEDULE

COMPOST FILTER SOCK	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT WHEN IT REACHES 1/2 OF THE EXPOSED HEIGHT.	ANY SECTION OF THE FILTER SOCK THAT HAS BEEN DAMAGED, UNDERMINED OR WASHED OUT SHOULD BE IMMEDIATELY REPAIRED OR REPLACED WITH ADDITIONAL FILTER SOCK OR A ROCK FILTER OUTLET.
PUMPED WATER FILTER BAG	DAILY AND PRIOR TO THE START OF PUMPING	UPON DETECTION OF ANY PROBLEM WITH A PUMPED WATERFILTER BAG OR HOSE BETWEEN THE PUMP AND THE BAG, CEASE PUMPING IMMEDIATELY AND DO NOT RESUME UNTIL THE PROBLEM IS CORRECTED OR ANOTHER BAG OR HOSE IS PLACED INTO OPERATION.	REPLACE BAG WHEN IT IS 1/2 FULL OF SEDIMENT FOR VEGETATED AREAS. IF THE BAG IS PLACED ON NO. 57 STONE (PER RC-75M DETAIL), REPLACE WHEN BAG IS FULL. IF LESS THAN 1/2 FULL AND DESIGN FLOW RATE IS REDUCED DUE TO SEDIMENT ACCUMULATION OR BAG IS DAMAGED, REPLACE BAG.
SEEDING AND MULCHING	WEEKLY AND AFTER EACH RUNOFF EVENT		IF WASHOUTS OCCUR, EVALUATE IF CONCENTRATED FLOW IS LIKELY TO HAPPEN AGAIN. IF SO, RE-SEED AND STABILIZE WITH A ROLLED EROSION CONTROL PRODUCT. IF CONCENTRATED FLOW IS NOT LIKELY TO HAPPEN AGAIN, RE-SEED AND APPLY MULCH.
TEMPORARY DIVERSION DIKE SYSTEM	DAILY AND AFTER EACH RUNOFF EVENT		REPLACE DAMAGED SANDBAGS AND PLASTIC SHEETING AS REQUIRED.
TEMPORARY COFFERDAM	DAILY AND AFTER EACH RUNOFF EVENT		
ROLLED EROSION CONTROL PRODUCTS	WEEKLY AND AFTER EACH RUNOFF EVENT		IF WASHOUTS OCCUR, EVALUATE IF CONCENTRATED FLOW IS LIKELY TO HAPPEN AGAIN. IF SO, RE-SEED AND STABILIZE WITH A ROLLED EROSION CONTROL PRODUCT UTILIZING HIGH SHEAR STRESS INSTALLATION AS RECOMMENDED BY MANUFACTURER.
ROCK FILTER	WEEKLY AND AFTER EACH RUNOFF EVENT	REMOVE SEDIMENT WHEN IT REACHES ½ OF THE ROCK HEIGHT AT THE CENTER OF THE DEPRESSION.	IF THE ROCK HAS BEEN ERODED OR CLOGGED, THE ROCK FILTER SHOULD BE IMMEDIATELY REPAIRED TO THE REQUIRED DIMENSIONS.
ROCK CONSTRUCTION ENTRANCE	DAILY AND AFTER EACH RAINFALL EVENT	RCE THICKNESS MUST BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK.	ADD CLEAN ROCK AS REQUIRED TO MAINTAIN ENTRANCE
TEMPORARY STREAM CROSSING	DAILY AND AFTER EACH RAINFALL EVENT	REMOVE SEDIMENT DEPOSITS ON THE CROSSING AND APPROACHES. ADD ROCK TO THE CROSSING AS NEEDED.	DAMAGED CROSSING SHALL BE REPAIRED WITHIN 24 HOURS OF THE INSPECTION AND BEFORE ANY SUBSEQUENT USE. SEDIMENT DEPOSITS ON THE CROSSING OR ITS APPROACHES SHALL BE REMOVED WITHIN 24 HOURS OF THE INSPECTION.
SEDIMENT FILTER TUBE	WEEKLY AND AFTER EACH RAINFALL EVENT	REMOVE SEDIMENT DEPOSITS WHEN IT REACHES HALF THE HEIGHT OF THE TUBE.	DAMAGED TUBES SHALL BE REPLACED WITHIN 24 HOURS OF INSPECTION. A SUPPLY OF TUBES SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE.

NOTES:

1. MAINTENANCE AND REPAIR ON BMP'S MUST BE COMPLETED IMMEDIATELY AFTER THE WEEKLY OR RAINFALL INSPECTION.
2. SEDIMENT REMOVED FROM BMP'S SHALL BE PLACED ON THE TOP SOIL STOCK PILE FOR USE LATER IN THE PROJECT.
3. A RUNOFF EVENT IS RAINFALL OR SNOW RUNOFF OF 0.25" OR MORE IN A 24 CONSECUTIVE HOUR PERIOD.
4. WEEKLY OR RAINFALL INSPECTIONS OVER MUST BE COMPLETED ON THE WRITTEN LOG FORM 3800-FM-BCW0271D (OR MOST CURRENT FORM).

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
BOYCE PARK RESTORATION PROJECT
GENERAL NOTES

PREPARED BY:

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PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
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PE 06647

ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES.

FILL MATERIALS SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS.

FROZEN MATERIALS OR SOFT, MUCKY, OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED INTO FILLS. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES.

SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD.

ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY UPON REACHING FINISHED GRADE. CUT SLOPES IN COMPETENT BEDROCK AND ROCK FILLS NEED NOT BE VEGETATED. SEEDED AREAS WITHIN 50 FEET OF A SURFACE WATER, OR AS OTHERWISE SHOWN ON THE PLAN DRAWINGS, SHALL BE BLANKETED ACCORDING TO THE STANDARDS OF THIS PLAN.

IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE IN ANY AREA OR SUBAREA OF THE PROJECT, THE OPERATOR SHALL STABILIZE ALL DISTURBED AREAS. DURING NON-GERMINATING MONTHS, MULCH OR PROTECTIVE BLANKETING SHALL BE APPLIED AS DESCRIBED IN THE PLAN. AREAS NOT AT FINISHED GRADE, WHICH WILL BE REACTIVATED WITHIN 1 YEAR, MAY BE STABILIZED IN ACCORDANCE WITH THE TEMPORARY STABILIZATION SPECIFICATIONS. THOSE AREAS WHICH WILL NOT BE REACTIVATED WITHIN 1 YEAR SHALL BE STABILIZED IN ACCORDANCE WITH THE PERMANENT STABILIZATION SPECIFICATIONS.

PERMANENT STABILIZATION IS DEFINED AS A MINIMUM UNIFORM, PERENNIAL 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED EROSION. CUT AND FILL SLOPES SHALL BE CAPABLE OF RESISTING FAILURE DUE TO SLUMPING, SLIDING, OR OTHER MOVEMENTS.

E&S BMPS SHALL REMAIN FUNCTIONAL AS SUCH UNTIL ALL AREAS TRIBUTARY TO THEM ARE PERMANENTLY STABILIZED OR UNTIL THEY ARE REPLACED BY ANOTHER BMP APPROVED BY THE LOCAL CONSERVATION DISTRICT OR DISTRICT ENVIRONMENTAL UNIT.

AFTER FINAL SITE STABILIZATION HAS BEEN ACHIEVED, TEMPORARY EROSION AND SEDIMENT BMPS MUST BE REMOVED OR CONVERTED TO PERMANENT POST CONSTRUCTION STORMWATER MANAGEMENT BMPS. AREAS DISTURBED DURING REMOVAL OR CONVERSION OF THE BMPS SHALL BE STABILIZED IMMEDIATELY. IN ORDER TO ENSURE RAPID REVEGETATION OF DISTURBED AREAS, SUCH REMOVAL/CONVERSIONS ARE TO BE DONE ONLY DURING THE GERMINATING SEASON.

UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE OWNER AND/OR OPERATOR SHALL CONTACT THE LOCAL CONSERVATION DISTRICT TO SCHEDULE A FINAL INSPECTION.

NOTIFY THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION AND THE ALLEGHENY COUNTY CONSERVATION DISTRICT 10 DAYS IN ADVANCE OF ANY LAND DISTURBANCE ACTIVITIES AT THE FOLLOWING ADDRESS:

PROCEDURES WHICH ENSURE THAT THE PROPER MEASURES FOR THE RECYCLING OR DISPOSAL OF MATERIALS ASSOCIATED WITH OR FROM THE PROJECT SITE WILL BE UNDERTAKEN IN ACCORDANCE WITH DEPARTMENT REGULATIONS. INDIVIDUALS RESPONSIBLE FOR EARTH DISTURBANCE ACTIVITIES MUST ENSURE THAT PROPER MECHANISMS ARE IN PLACE TO CONTROL WASTE MATERIALS. CONSTRUCTION WASTES INCLUDE, BUT ARE NOT LIMITED TO, EXCESS SOIL MATERIALS, BUILDING MATERIALS, CONCRETE WASH WATER, SANITARY WASTES, ETC. THAT COULD ADVERSELY IMPACT WATER QUALITY. MEASURES SHOULD BE PLANNED AND IMPLEMENTED FOR HOUSEKEEPING, MATERIALS MANAGEMENT, AND LITTER CONTROL. WHEREVER POSSIBLE, RECYCLING OF EXCESS MATERIALS IS PREFERRED, RATHER THAN DISPOSAL. A NOTE REQUIRING RECYCLING OF WASTE MATERIALS, WHERE FEASIBLE, SHOULD BE ADDED TO THE DRAWINGS.

MAUREEN COPELAND, SENIOR RESOURCE CONSERVATIONIST
ALLEGHENY COUNTY CONSERVATION DISTRICT
317 EAST CARSON STREET, SUITE 119
PITTSBURGH, PA 15219
PHONE: (412) 291-8005

PLAN PREPARER CONTACT INFORMATION:

MR. JAMES FLYNN, P.E.
HUNT VALLEY ENVIROMENTAL, LLC
632 HUNT VALLEY CIRCLE
NEW KENSINGTON, PA 15068
PHONE: 724-594-0805

ALL CONSTRUCTION ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING CONSTRUCTION SEQUENCE. EACH STEP SHALL BE COMPLETED BEFORE A SUBSEQUENT STEP IS INITIATED. UPON COMPLETION OR TEMPORARY CESSATION OF THE EARTH DISTURBANCE ACTIVITY, OR ANY STAGE THEREOF, THE PROJECT SITE SHALL BE IMMEDIATELY STABILIZED. THE CONTRACTOR CAN PROCEED WITH THE REMAINDER OF CLEARING AND GRUBBING BETWEEN NOVEMBER 16 AND MARCH 31. INSTALL THE REMAINDER BMP'S AND CONTINUE WITH FILL ON THE SITE.

1. AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES (INCLUDING CLEARING AND GRUBBING), THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE EROSION AND SEDIMENT POLLUTION CONTROL PLAN PREPARER, A REPRESENTATIVE FROM THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION AND A REPRESENTATIVE FROM THE ALLEGHENY COUNTY CONSERVATION DISTRICT TO AN ON-SITE PRECONSTRUCTION MEETING.

2. AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

3. ALL APPLICABLE PERMITS AND APPROVALS REQUIRED FOR THIS PROJECT SHALL BE SECURED PRIOR TO THE START OF CONSTRUCTION. COPIES OF PERMITS, PLANS AND APPROVALS SHALL BE KEPT ON-SITE AT ALL TIMES.

4. ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS.

5. THE SELECTED CONTRACTOR IS RESPONSIBLE FOR HAVING AN APPROVED EROSION AND SEDIMENTATION CONTROL PLAN FOR ALL OFF-SITE WASTE AND BORROW SITES.

6. CONTRACTOR SHOULD LIMIT STOCKPILING OF WASTE, CONSTRUCTION EQUIPMENT, FUEL TANKS, BORROWED EXCAVATION, ETC. NEAR THE STREAM IN THE EVENT A SIGNIFICANT STORM SHOULD OCCUR.

7. MOBILIZE FOR PROJECT CONSTRUCTION.

LRG WILL UTILIZE REGENERATIVE STREAM CONVEYANCE/FLOOD PLAIN RESTORATION FOR THE CONSTRUCTION METHOD OF THE REESTABLISHED UNNAMED TRIBUTARY CHANNELS IN SAWMILL RUN. LENGTH OF EACH CONSTRUCTION REACH IS BASED ON THE EXISTING FLOW OF THE CHANNEL.

1. PLACE ROCK CONSTRUCTION ENTRANCES RCE-1 AND RCE-2 FOR MOBILIZATION AND ACCESS TO THE STREAM.

2. PLACE COMPOST FILTER SOCK AT LAYDOWN/STAGING AREAS AS SHOWN ON THE PLANS.

3. SET UP STREAM DIVERSION/PUMP AND PUMP WATER FILTER BAG AROUND APPROXIMATELY 200 FEET MAX IN LENGTH.

4. ONLY DISTURB LENGTH OF CHANNEL THAT CAN BE RESTORED IN A DAY.

5. PLACE ROCK FILTER IN THE CHANNEL 5-10 FEET UPSTREAM AT THE POINT WHERE THE PUMP DISCHARGES THE WATER INTO THE DOWN-STREAM CHANNEL. DISCHARGE THE WATER THROUGH A DIFFUSER 20 FEET DOWNSTREAM OF THE WORK AREA DO NOT CAUSE A SCOUR ISSUE IN THE CHANNEL.

6. SALVAGE STREAM BED MATERIAL AND STOCKPILE AT LOCATIONS ON THE PLANS. GRADE THE CHANNEL CLOSED IN THE REACH.

7. EXCAVATE THE CHANNEL TO THE PROPOSED GRADE AND DEPTH BY USING THE BACK OF THE BUCKET.

8. EXCAVATE/FILL USING STREAM BANK MATERIAL AND PLACE GRADE CONTROL STRUCTURES PERPENDICULAR TO CHANNEL SO TOP OF THE LOG STRUCTURE IS AT THE INVERT OF THE CHANNEL. THESE WILL BE SPACED ACCORDING TO THE CHART ON THE PLANS.

9. PLACE AASHTO-1 IN BED AS NEEDED.

10. SEED FLOODWAY PER SEEDING SPECIFICATION ON DETAIL SHEET, MULCHING WITH A TEMPORARY MULCH BLANKET OR ECMB AS DETAIL RECOMENDS.

11. REMOVE BYPASS PUMP, PROCEED TO NEXT REACH, LEAVE ROCK FILTER IN PLACE AT THE DOWNSTREAM END UNTIL THE CHANNEL RESTABLISHMENT PROJECT IS COMPLETED.

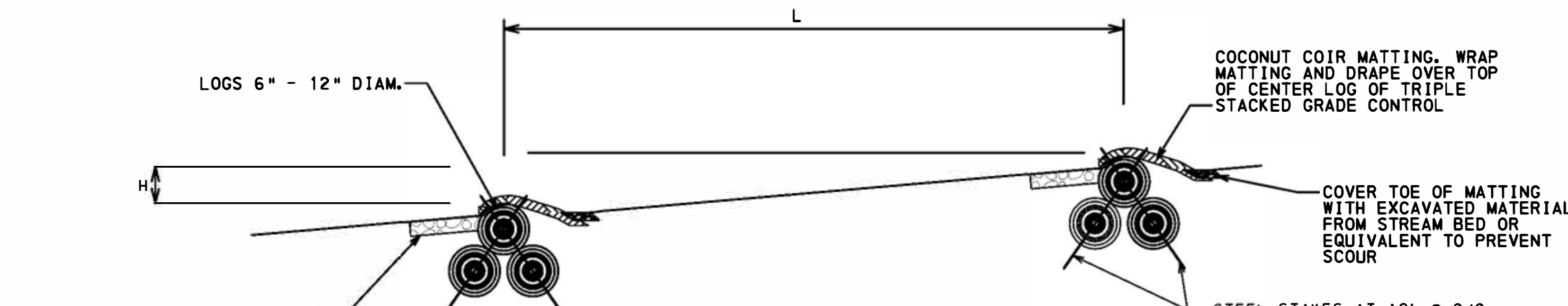
12. INSTALL CLEAN WATER DIVERSION CHANNEL CW-DIV1, TEMPORARY SLOPE PIPE TP-01 AND OUTLET PROTECTION OF PIPE TO DIVERT CLEAN WATER AROUND THE WORK AREA.

10. SEED FLOODWAY PER SEEDING SPECIFICATION ON DETAIL SHEET, MULCHING WITH A TEMPORARY MULCH BLANKET OR ECMB AS DETAIL RECOMENDS.

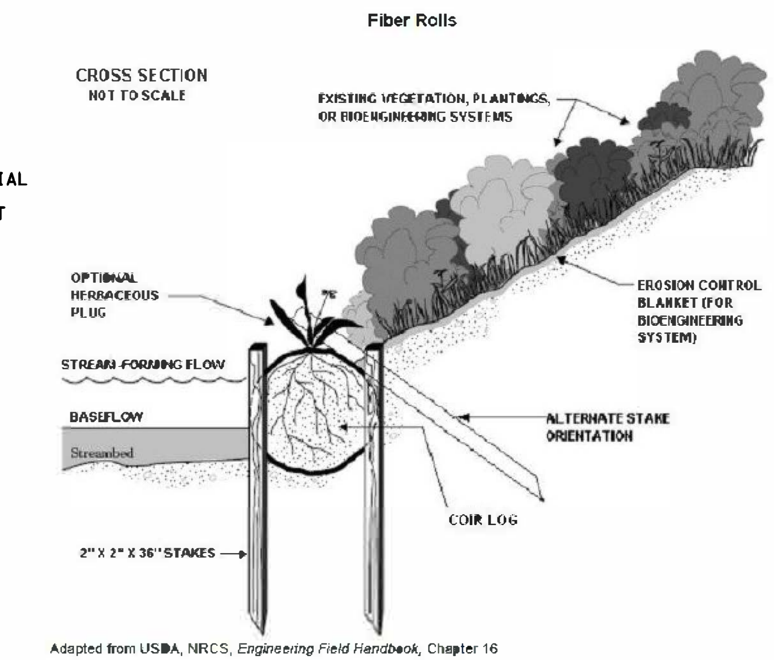
11. REMOVE BYPASS PUMP, PROCEED TO NEXT REACH, LEAVE STONE FILTER IN PLACE AT THE DOWNSTREAM END UNTIL THE CHANNEL RESTABLISHMENT PROJECT IS COMPLETED.

12. AFTER 70% UNIFORM VEGETATIVE COVER IS ACHIEVED ON ALL AREAS, REMOVE ALL BMPS. SEED AND MULCH ANY REMAINING DISTRUBED AREAS FROM BMP REMOVAL.

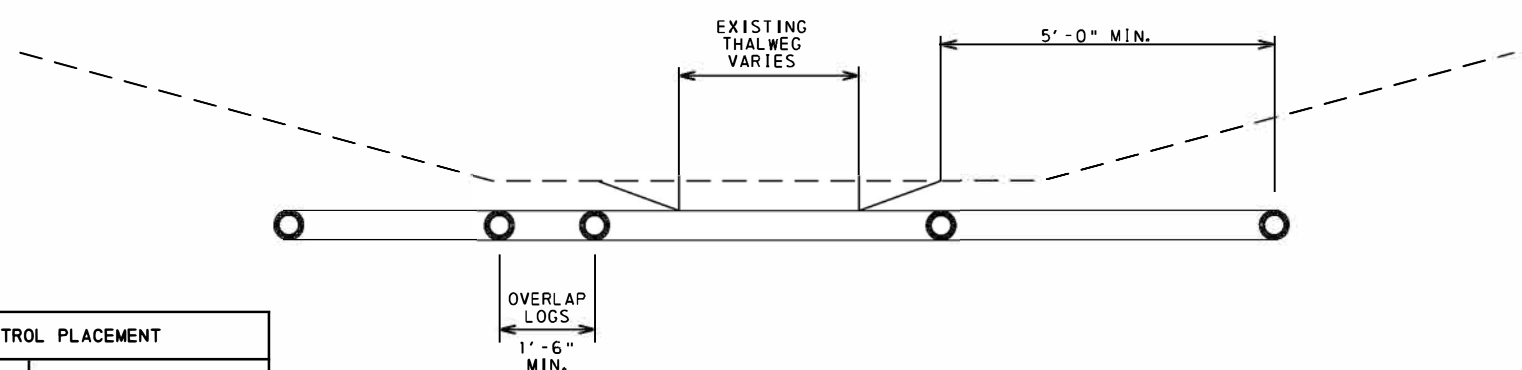
REPEAT THE SEQUENCE STEPS 2-10 BASED UPON THE STATIONING OF THE REACH. EACH REACH CAN NOT EXCEED 200 FEET UNLESS THE CHANNEL IS DRY. THE SAME SEQUENCE WILL BE FOLLOWED FOR THE REESTBLISHEMNT OF EACH CHANNEL.



TRIPLE STACKED LOG GRADE CONTROL
SECTION A-A

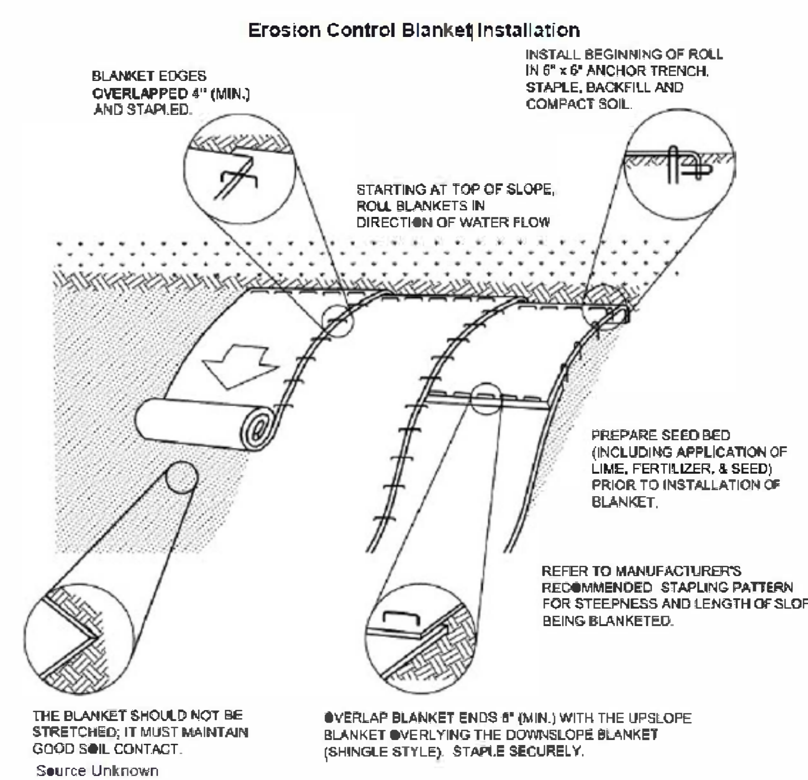


Adapted from USDA, NRCS, *Engineering Field Handbook*, Chapter 16



LOG GRADE CONTROL

GRADE CONTROL PLACEMENT	
PERCENT SLOPE	SPACING (FT)
1-0	100
3-1	75-100
5-3	60-75
7-5	45-60
9-7	30-45
11-9	20-30
13-11	15-20
15	9-15



Source Unknown

GRADE CONTROL NOTES:

1. GRADES GREATER THAN 20% WILL USE REESTABLISHMENT LOG AND ROCK STEP POOL. SEE DETAIL THIS SHEET.

GRADE CONTROL DETAIL

NTS

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4SawmillRunGradeControlDetailsBoyce.dgn
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SHEET 4 OF 10

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
BOYCE PARK RESTORATION PROJECT
GRADE CONTROL DETAILS

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREET
HARRISBURG, PA 17120

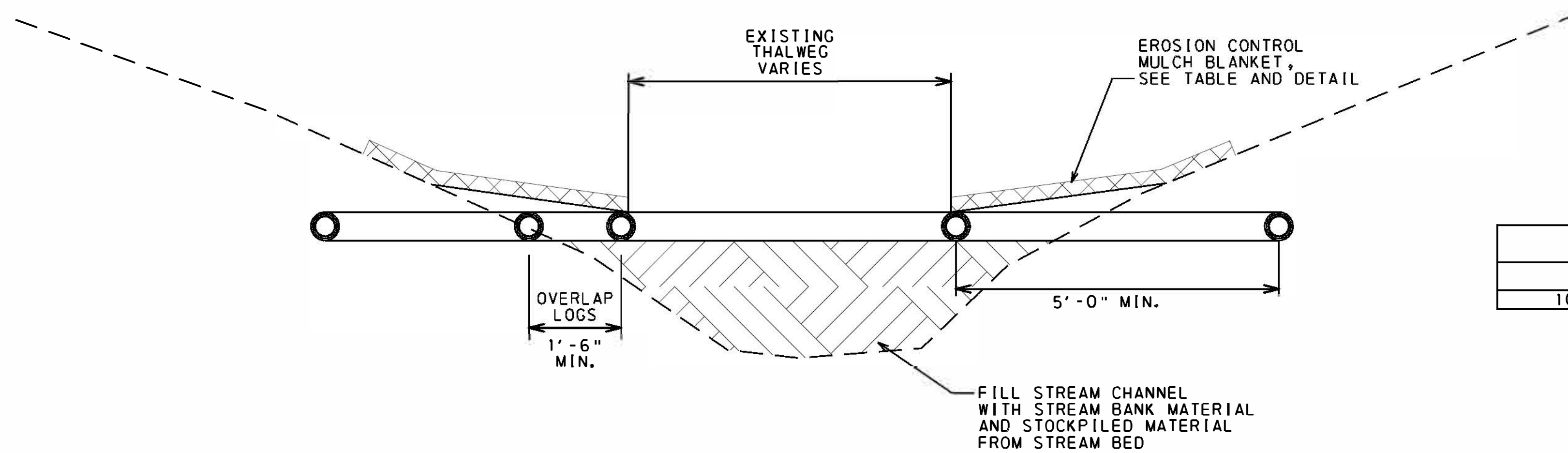
PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 5-11-2023

REVISED SUBMISSION DATE: 8-3-2023

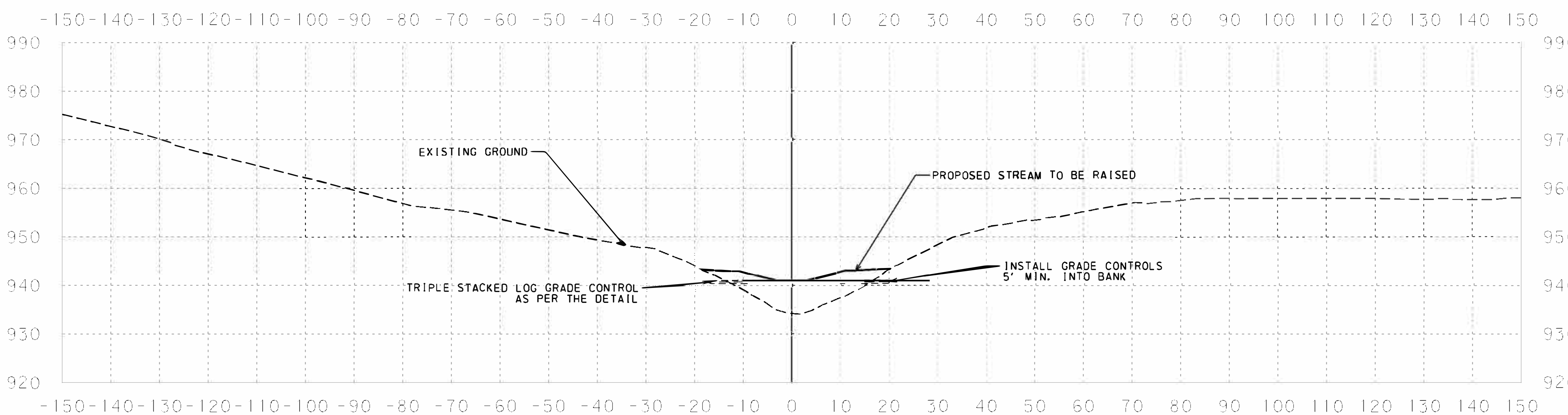
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER



LOG GRADE CONTROL

EROSION CONTROL MULCH BLANKET	
STATION	LOCATION
106+60 TO 115+4	ALONG BANKS AS SHOWN

SEE DETAIL SHEET
6 OF 9 FOR ECMB
INSTALLATION



TYPICAL CROSS SECTION
FOR ENTIRE REACH OF
MAIN STREAM ALIGNMENT

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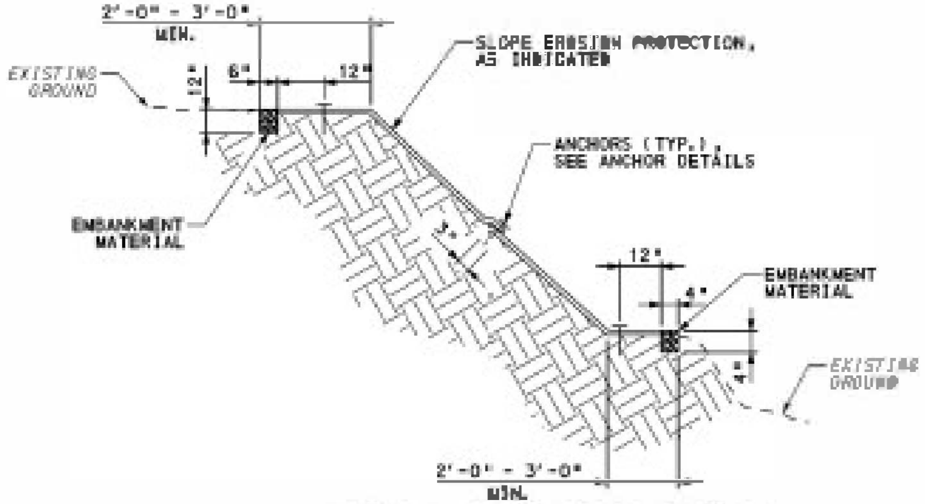
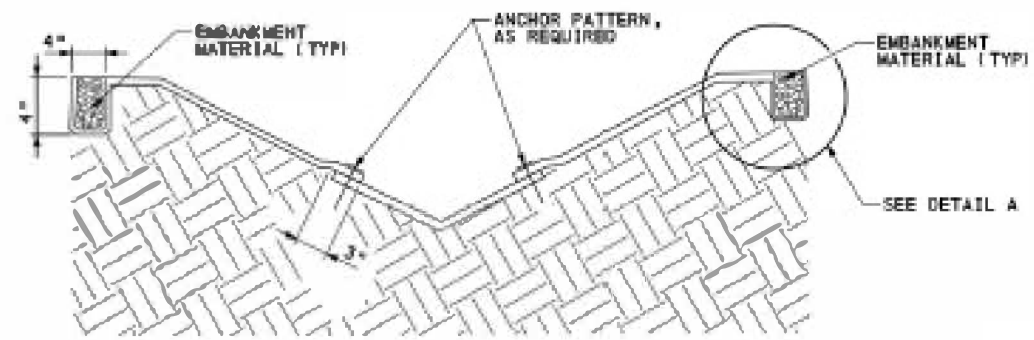
SHEET 5 OF 10	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA BOYCE PARK RESTORATION PROJECT GRADE CONTROL DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 5-11-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 065647

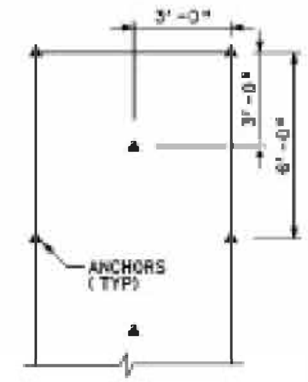
ROLLED EROSION CONTROL PRODUCT (RECP)



TYPICAL SLOPE CROSS-SECTION

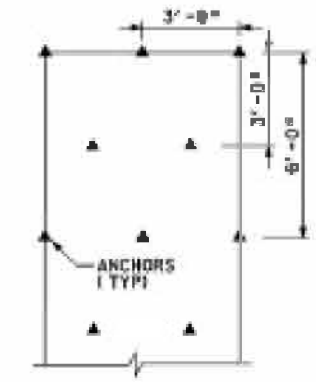


TYPICAL V-DITCH CROSS-SECTION



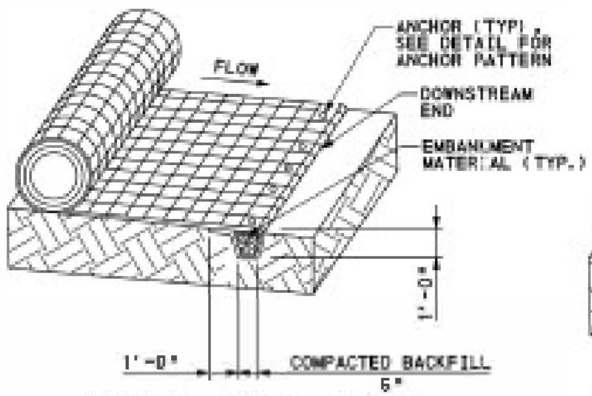
ANCHOR PATTERN FOR SLOPES FLATTER THAN 3:1

PLACE 1 ANCHOR/SY



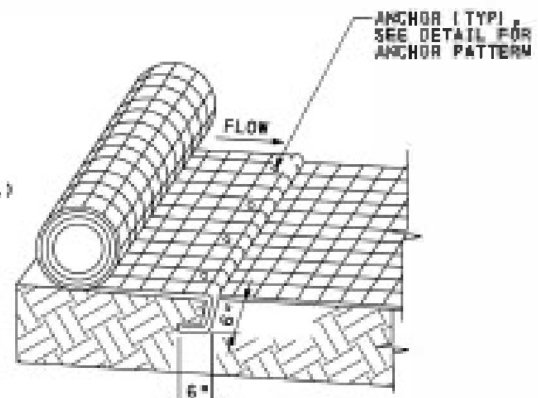
ANCHOR PATTERN FOR SLOPES BETWEEN 3:1 AND 2:1 (INCLUDING 3:1)

PLACE 1½ ANCHORS/SY



INITIAL ANCHOR TRENCH

SEE NOTE 1



INTERMITTENT CHECK SLOT

SEE NOTE 2

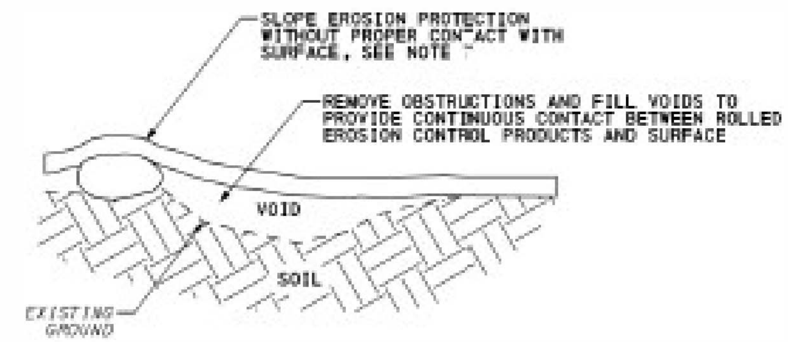
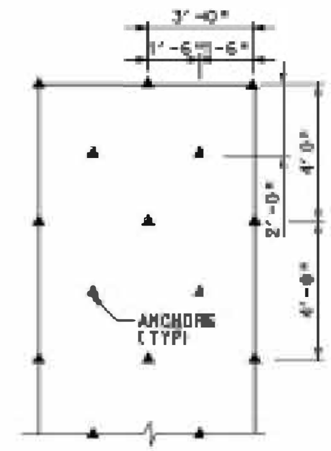


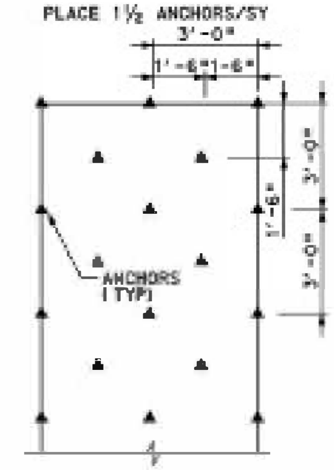
FIGURE 1

LACK OF CONTINUOUS CONTACT



ANCHOR PATTERN FOR SLOPES BETWEEN 2:1 AND 1:1 (INCLUDING 2:1)

PLACE 2 ANCHORS/SY



ANCHOR PATTERN FOR 1:1 OR STEEPER

PLACE 2½ ANCHORS/SY

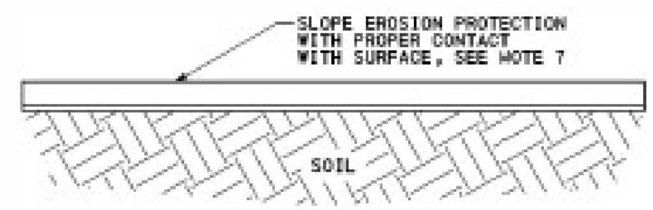


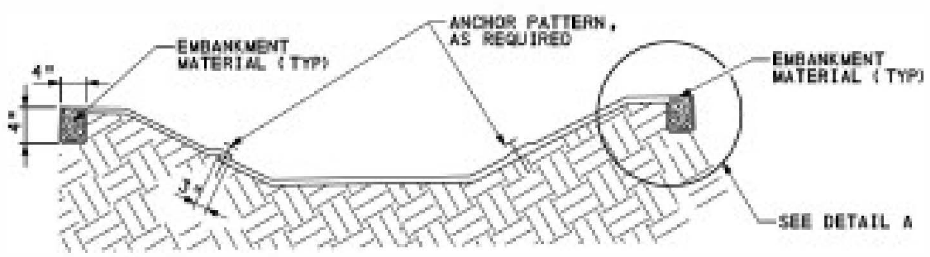
FIGURE 2

CONTINUOUS CONTACT

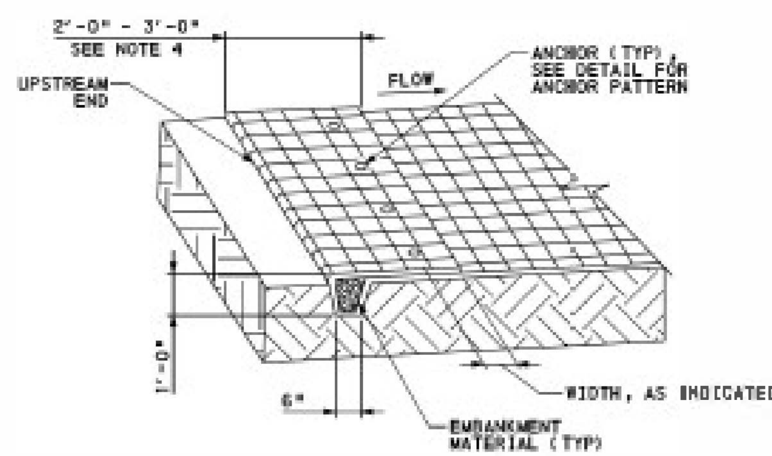
ANCHOR NOTES:

1. HORIZONTAL ANCHOR SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW ANCHORS TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.
2. IN LOOSE SOIL CONDITIONS, THE USE OF ANCHOR OR STAKE LENGTHS IN EXCESS OF 6 INCHES MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

ANCHOR PATTERNS FOR SLOPES

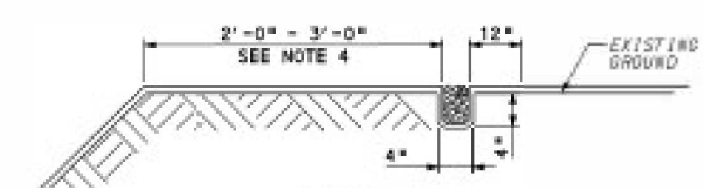


TYPICAL TRAPEZOIDAL CHANNEL CROSS-SECTION



TERMINAL ANCHOR TRENCH

SEE NOTE 3



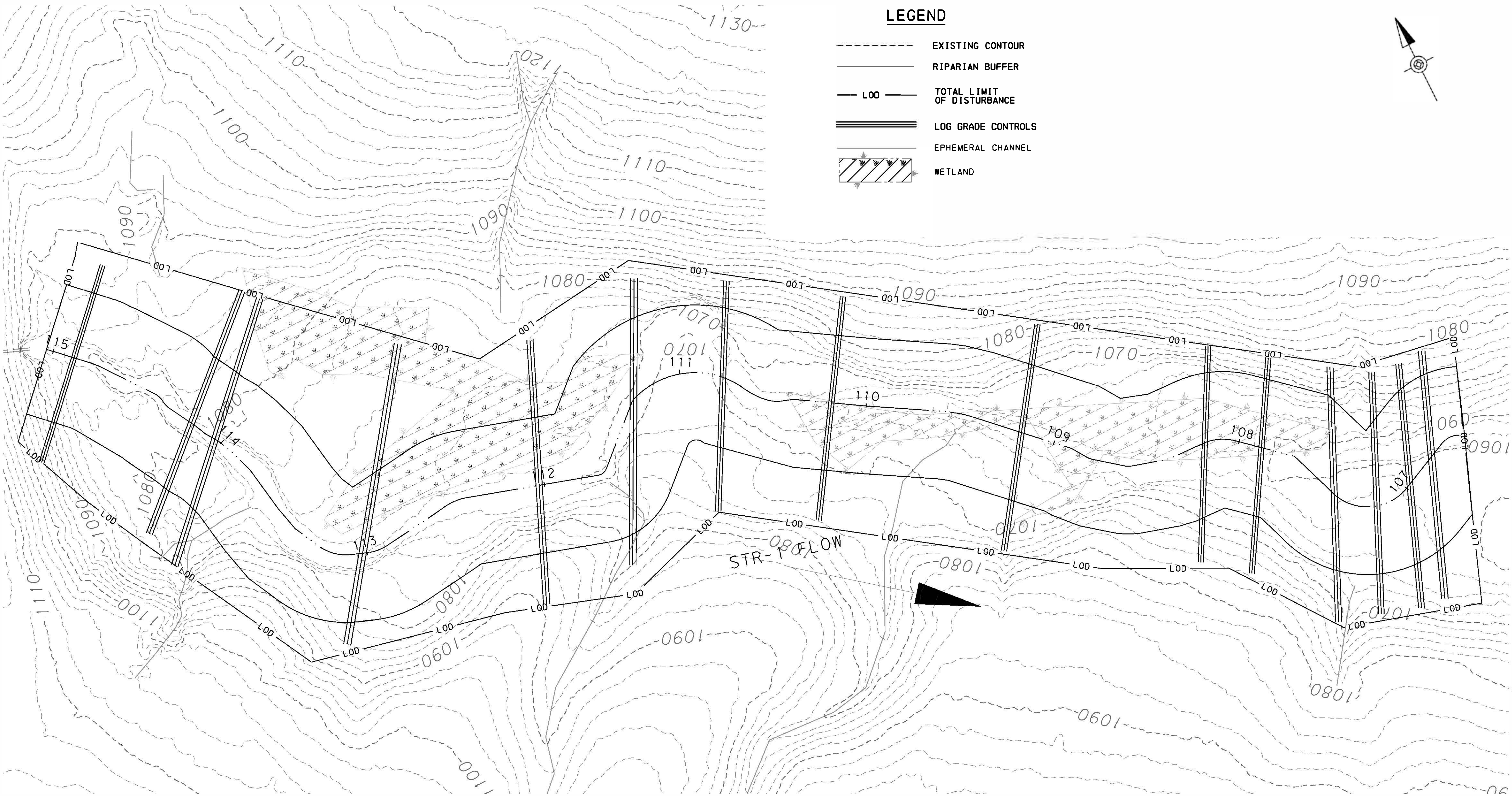
DETAIL A

ROLLED EROSION CONTROL PRODUCT NOTES:

1. EXCAVATE INITIAL ANCHOR TRENCH 1'-0" DEEP 6" WIDE ACROSS THE WIDTH OF THE CHANNEL TO PREVENT UNDERMINING OF THE SLOPE EROSION PROTECTION.
2. EXCAVATE INTERMITTENT CHECK SLOT 6" DEEP AND 6" WIDE ACROSS THE WIDTH OF THE CHANNEL AT 25'-0" TO 30'-0" ALONG THE LENGTH OF THE SLOPE EROSION PROTECTION TO PREVENT LOOSE SOIL FROM BEING TRANSPORTED DOWNSTREAM BENEATH THE SLOPE EROSION PROTECTION.
3. EXCAVATE TERMINAL ANCHOR TRENCH 1'-0" DEEP AND 6" WIDE ACROSS THE WIDTH OF THE CHANNEL TO ENSURE WATER FLOW TRANSITIONS SMOOTHLY ONTO THE SLOPE EROSION PROTECTION WITHOUT SEPARATION FROM THE SOIL.
4. EXTEND SLOPE EROSION PROTECTION 2'-0" - 3'-0" ABOVE THE CREST OF CHANNEL SIDE WHENEVER POSSIBLE.
5. PLACE ANCHORS IN ACCORDANCE WITH THE ANCHOR PATTERNS.
6. PROVIDE ANCHORING DEVICES IN ACCORDANCE WITH SECTION 806.2(d).
7. ESTABLISH AND MAINTAIN CONTINUOUS CONTACT BETWEEN THE SLOPE EROSION PROTECTION AND THE SOIL.

SHEET 6 OF 10	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA BOYCE PARK RESTORATION PROJECT EROSION AND SEDIMENT CONTROL DETAILS	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 5-11-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER JAMES H. FLYNN PE 065647



0 25 50 FEET

SHEET 7 OF 10	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA BOYCE PARK RESTORATION PROJECT	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 5-11-2023 REVISED SUBMISSION DATE: 8-3-2023

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JAMES H. FLYNN
ENGINEER
PE 065647

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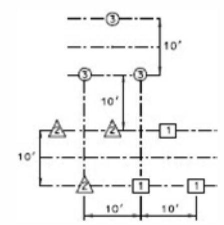
LEGEND

ERNMX-221 & ERNMX-223 SEED MIX

WETLAND PLANTING

UPLAND PLANTINGS



1 SHRUB-TREE SPECIES

2 SHRUB-TREE SPECIES

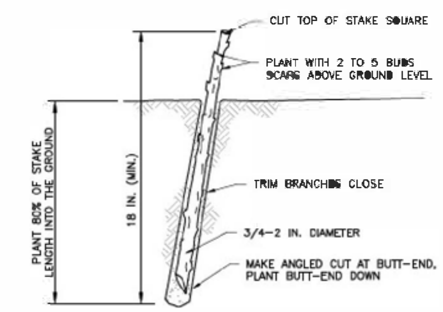
3 SHRUB-TREE SPECIES

1 1 1 HOMOGENOUS CLUSTER OF SHRUB-TREE SPECIES

NOTE:
EVENLY DISTRIBUTE PLANT CLUSTER TO PROMOTE SPECIES DIVERSIFICATION

CLUSTER PLANTING PLAN

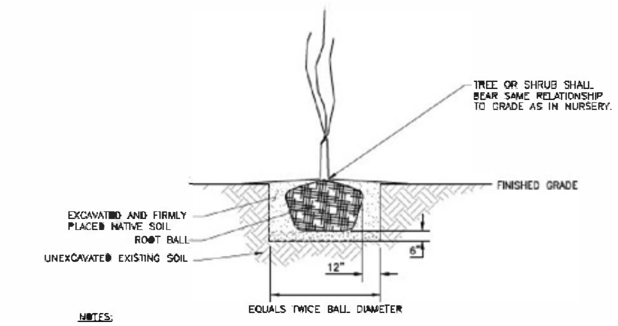
NOT TO SCALE



PLANTING NOTES:

1. PLANT MATERIALS SHALL BE FROM PLANT STOCK NATIVE OR ADAPTED TO THE EASTERN BROADLEAF FOREST ECOREGIONS, AS DEFINED BY THE USDA FOREST SERVICE, AND USDA PLANT HARDINESS ZONES 5 AND 6.
2. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
3. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
4. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION; USE AN IRON BAR AND PILOT HOLE IN FIRM SOILS.
5. SOAK CUTTINGS FOR AT LEAST 24 HOURS PRIOR TO INSTALLATION. SOAK FOR 5-7 DAYS FOR BEST RESULTS.
6. TAMP THE SOIL AROUND THE STAKE.
7. DO NOT PLANT LIVE STAKES WITHIN 10 FEET OF PIPELINE.

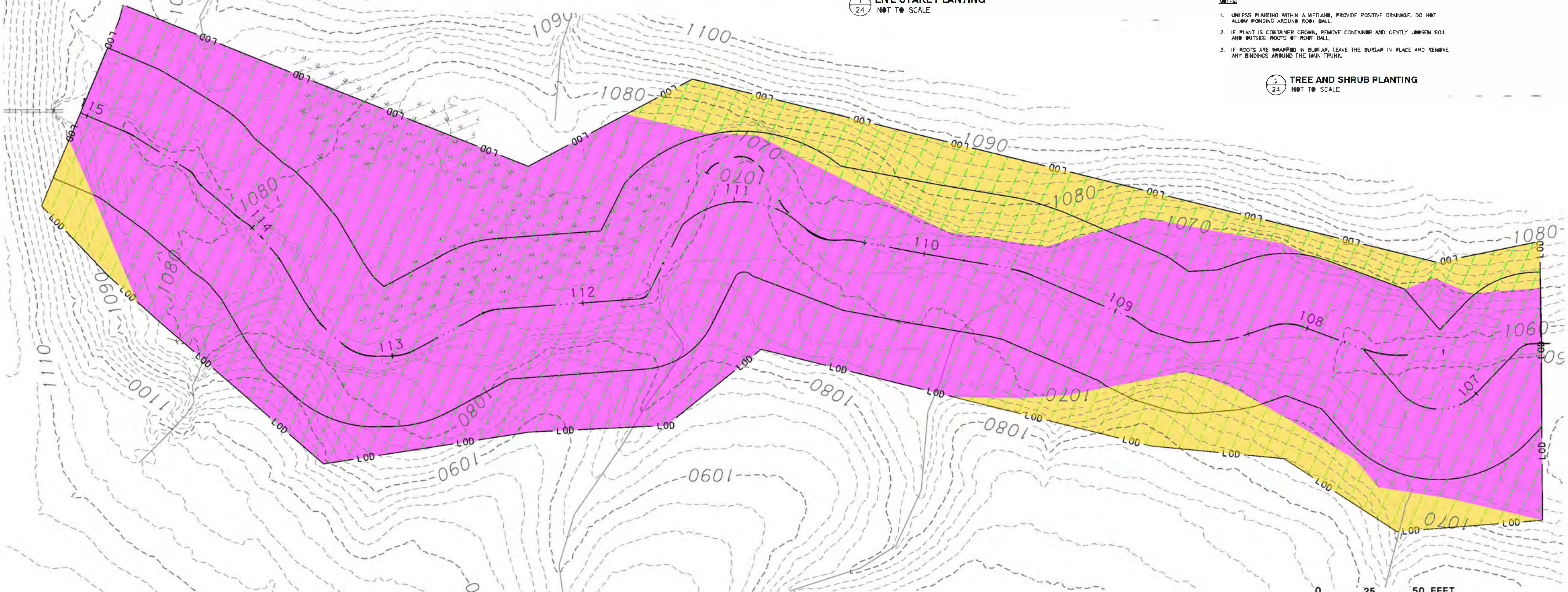
1/24 **LIVE STAKE PLANTING**
NOT TO SCALE



NOTES:

1. UNLESS PLANTING WITHIN A WETLAND, PROVIDE POSITIVE DRAINAGE. DO NOT ALLOW PONDING AROUND ROOT BALL.
2. IF PLANT IS CONTAINER GROWN, REMOVE CONTAINER AND GENTLY LOOSEN SOIL AND OUTSIDE ROOTS OF ROOT BALL.
3. IF ROOTS ARE WRAPPED IN BURLAP, LEAVE THE BURLAP IN PLACE AND REMOVE ANY BINDINGS AROUND THE MAIN TRUNK.

2/24 **TREE AND SHRUB PLANTING**
NOT TO SCALE



SHEET 8 OF 10	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA BOYCE PARK RESTORATION PROJECT PLANTING PLAN	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREET HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER ORIGINAL SUBMISSION DATE: 5-11-2023 REVISED SUBMISSION DATE: 8-3-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 065647

File: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4BoyceParkPlantingPlan.dgn
DATE: 8/3/2023 TIME: 2:59:25 PM

PLANTING LIST

	FORMULA AND SPECIES	% BY WEIGHT	INDICATOR STATUS	APPLICATION RATE
ERNMX-221 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE FACW MIX	FOX SEDGE (CAREX VULPINOIDEA)	31	FACW	20.0 LBS/ACRE
	VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	FAC	
	LURID SEDGE (CAREX LURIDA)	8	OBL	
	HOP SEDGE (CAREX LUPULINA	7.8	OBL	
	BLUNT BROOM SEDGE (CAREX SCOPARIA)	7.8	FACW	
	BLUE VERVAIN (VERBENA HASTATA)	4	FAC	
	RIVER OATS (CHASMANTHIUM LATIFOLIUM)	3.3	FAC	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	STAR SEDGE (CAREX INTUMESCENS)	2	FACW	
	OXEYE SUNFLOWER (HELIPOSIS HELIANTHOIDES)	2	FACU	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.8	OBL	
	NODDING BUR MARIGOLD (BIDENS CERNUA)	1	OBL	
	AWL SEDGE (CAREX STIPATA)	1	OBL	
	NARROWLEAF BLUE EYED GRASS (SISYRINCHIUM ANGUSTIFOLIUM)	1	FACW	
	BONSET (EUPATORIUM PERFOLIATUM)	0.7	FACW	
	FOWL MANNAGRASS (GLYCERIA STRIATA)	0.5	OBL	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.5	FACW	
	PENNSYLVANIA SMARTWEED (POLYGONUM PENSYLVANICUM)	0.5	FACW	
	WOOLGRASS (SCIRPUS CYPERINUS)	0.5	OBL	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.5	OBL	
	GOLDEN ALEXANDERS (ZIZIA AUREA)	0.5	FAC	
	PUPLESTEM ASTER (ASTER PUNICEUS)	0.4	OBL	
	GREAT BLUE LOBELIA (LOBELIA SIPHILITICA)	0.4	OBL	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	SQUARE STEMMED MONKEYFLOWER (MIMULUS RINGENS)	0.3	OBL	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.3	FACW	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	SEPTEMBER-APRIL	-	
ERNMX-223 PA SOUTHERN ALLEGHENY PLATEAU PROVINCE RIPARIAN MIX	LITTLE BLUESTEM (SCHIZACHYRIUM SCOPARIUM)	20	FACU	20.0 LBS/ACRE
	INDIANGRASS (SORGHASTRUM NUTANS)	20	FACU	
	VIRGINIA WILDRYE (ELYMUS VIRGINICUS)	18	FAC	
	BIG BLUESTEM (ANDROPOGON GERARDII)	12	FAC	
	RIVERBANK WILDRYE (ELYMUS RIPARIUS)	10.6	FACW	
	FOX SEDGE (CAREX VULPINOIDEA)	7	FACW	
	SOFT RUSH (JUNCUS EFFUSUS)	3	OBL	
	OXEYE SUNFLOWER (HELIOPSIS HELIANTHOIDES)	2	FACU	
	BLUE VERVAIN (VERBENA HASTATA)	2	FAC	
	SWAMP MILKWEED (ASCLEPIAS INCARNATA)	1.6	OBL	
	WILD BERGAMOT (MONARDA FISTULOSA)	0.5	FACU	
	BONESET (EUPTORIUM PERFOLIATUM)	0.4	FACW	
	COMMON SNEEZEWEED (HELENIUM AUTUMNALE)	0.4	FACW	
	NEW YORK IRONWEED (VERNONIA NOVEBORACENSIS)	0.4	FACW	
	NEW ENGLAND ASTER (ASTER NOVAE-ANGLIAE)	0.3	FACW	
	ZIGZAG ASTER (ASTER PRENANTHOIDES)	0.3	FAC	
	JOE PYE WEED (EUPATORIUM FISTULOSUM)	0.3	FACW	
	WRINKLELEAF GOLDENROD (SOLIDAGO RUGOSA)	0.3	FAC	
	GIANT IRONWEED (VERNONIA GIGANTEA)	0.3	FAC	
	CALICO ASTER (ASTER LATERIFLORUS)	0.2	FACW	
	AROMATIC ASTER (ASTER OBLONGIFOLIUS)	0.2	NI	
	ROUGHLEAF GOLDENROD (SOLIDAGO PATULA)	0.2	OBL	
	FERTILIZER APPL. RATE	10-20-20	1000.0 LBS/ACRE	
	LIMING RATE	-	6.0 TONS/ACRE	
	MULCHING TYPE	HAY	1,200 LBS/1,000 SY	
	SEASON SEEDING DATES	JANUARY-JULY	-	

	FORMULA AND SPECIES	NUMBER PER ACRE	INDICATOR STATUS
WETLAND RESTORATION PLANTINGS	AMERICAN SYCAMORE (PLATANUS OCCIDENTALIS)	75	FACW
	SILVER MAPLE (ACER SACCHARINUM)	75	FACW
	PIN OAK (QUERCUS PALUSTRIS)	75	FACW
	COMMON BUTTON BUSH (CEPHALANTHUS OCCIDENTALIS)	50	OBL
	NORTHERN SPICEBUSH (LINDERA BEZOIN)	75	FACW
	SILKY DOGWOOD (CORNUS AMOMUM)	75	FACW
	SWAMP WHITE OAK (QUERCUS BICOLOR)	50	FACW
	RED CHOKEBERRY (ARONIA ARBUTIFOLIA)	75	FACW
	AMERICAN LARCH (LARIX LARICINA)	75	FACW
	RED OSHIER DOGWOOD (CORNUS SERICEA)	75	FACW
	PAWPAW (ASIMINA TRILOBA)	75	FACW
UPLAND RESTORATION PLANTINGS	SHAGBARK HICKORY (CARYA OVATA)	75	FACU
	CRANBERRY VIBURNUM (VIBURNUM TRILOBUM)	75	FACU
	BLACKHAW VIBURNUM (VIBURNUM PRUNIFOLIUM)	75	FACU
	NANNYBERRY VIBURNUM (VIBURNUM LENTAGO)	75	FACU
	WHITE OAK (QUERCUS ALBA)	75	FACU
	SUGAR MAPLE (ACER SACCHARUM)	75	UPL
	BLACK CHERRY (PRUNUS SEROTINA)	75	FACU
	DAWN REDWOOD (METASEQUOIA GLYPROSTROBOIDES)	75	NI
	EASTERN WHITE PINE (PINUS STROBUS)	75	FACU
	ALLEGHENY SERVICEBERRY (AMELANCHIER LAEVIS)	75	NI
	MOUNTAIN LAUREL (KALMIA LATIFOLIA)	75	FACU
	AMERICAN WITCH-HAZEL (HAMAMELIS VIRGINIANA)	75	FACU

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
BOYCE PARK RESTORATION PROJECT
PLANTING PLAN

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 5-11-2023

REVISED SUBMISSION DATE: 8-3-2023

JAMES H. FLYNN

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MS4SawmillRunPlantingList.dgn
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PLANTING LIST

DETENTION BASIN FLOOR SEED MIXTURE (BOTTOM OF STORMWATER DETENTION BASIN)					
FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					5.2 TOTAL
RED TOP (AGROSTIS ALBA)	20	92	85	0.15	1.04
CREEPING BENTGRASS (AGROSTIS STOLONIFERA)	20	92	85	0.15	1.04
RIVERBANK WILD RYE (ELYMUS RIPARIUS)	20	95	85	0.15	1.04
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	1.04
ALKALIGRASS (PUCCINELLIA DISTANS)	20	99	90	0.15	1.04

SEASONALLY FLOODED AREA MIX (SLOPES OF STORMWATER DETENTION BASIN)					
FORMULA AND SPECIES	% BY WEIGHT	MIN. % PURITY	MIN. % GERMINATION	MAX. % WEED SEED	SEEDING RATE LB PER 1000 SY
					4.15 TOTAL
VIRGINIA WILD RYE (ELYMUS VIRGINICUS)	20	95	75	0.15	0.83
SMARTWEED/BARNYARD MIX (POLYGONUM LAPATHIFOLIUM)	20	92	85	0.15	0.83
FOX SEDGE (CAREX VULPINOIDES)	20	94	85	0.10	0.83
JAPANESE MILLET (ECHINOCHLOA CRUSGALLI FRUMENTA)	20	95	80	0.15	0.83
NODDING BUR-MARIGOLD (BIDENS CERNUA)	10	92	85	0.15	0.42
SWITCHGRASS (PANICUM VIRGATUM) (AN IMPROVED VARIETY MUST BE USED)	5	92	85	0.10	0.21
LURID SEDGE (CAREX LURIDA)	2.5	92	85	0.10	0.10
COSMOS SEDGE (CAREX COMOSA)	2.5	92	85	0.10	0.10

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DATE: 8/3/2023 TIME: 2:47:38 PM

SHEET 10 OF 10

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
BOYCE PARK RESTORATION PROJECT
PLANTING PLAN

PREPARED BY:

HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:

PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

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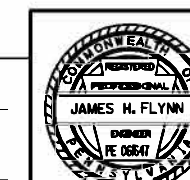

Appendix D1: Supporting Sediment Data

MARKOSKY
3689 Route 711 • Ligonier, PA 15658
724.238.4138 • www.markosky.com
COLLABORATIVE ENGINEERING

Subject:	Sawmill Run - MS4	Calc By:	WBM
	BMP Load Calcs	Date:	10/18/2022
		Chk'd By	
		Date:	

MOORE PARK (SCM 001) - PROPOSED BMP LOAD CALCULATIONS

Source	Area (Ac)	Sediment		Nitrogen		Phosphorus	
		Total Load (lb)	Loading Rate (lb/ac)	Total Load (lb)	Loading Rate (lb/ac)	Total Load (lb)	Loading Rate (lb/ac)
Forest	0.66	16.50	25	0.059	0.09	0.007	0.01
Open Land	1.25	402.13	321.7	1.363	1.09	0.088	0.07
HD Residential	0.53	74.73	141	1.622	3.06	0.186	0.35
TOTALS	**2.44**	**493.36**		**3.0437**		**0.280**	

Note: Loading Rates obtained from MapShed Modeling

MARKOSKY
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COLLABORATIVE ENGINEERING

Subject:	Sawmill Run - MS4	Calc By:	WBM
	BMP Load Calcs	Date:	10/18/2022
		Chk'd By	
		Date:	

MOORE PARK (SCM 002) - PROPOSED BMP LOAD CALCULATIONS

Source	Area (Ac)	Sediment		Nitrogen		Phosphorus	
		Total Load (lb)	Loading Rate (lb/ac)	Total Load (lb)	Loading Rate (lb/ac)	Total Load (lb)	Loading Rate (lb/ac)
Forest	2.45	61.25	25.00	0.221	0.090	0.025	0.010
Open Land	0.71	229.37	321.70	0.777	1.090	0.050	0.070
HD Residential	0.00	0.00	141.00	0.000	3.060	0.000	0.350
TOTALS	**3.163**	**290.62**		**0.998**		**0.074**	

Note: Loading Rates obtained from MapShed Modeling

MARKOSKY
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COLLABORATIVE ENGINEERING

Subject: Sawmill Run - MS4
BMP Load Calcs

Calc By: WBM
Date: 10/18/2022

Chk'd By
Date:

CRANE AVENUE (SCM 003) - PROPOSED BMP LOAD CALCULATIONS

Source	Area (Ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Forest	0.00	0.00	25.00	0.000	0.090	0.000	0.010
Open Land	0.00	0.00	321.70	0.000	1.090	0.000	0.070
HD Residential	2.22	313.02	141.00	6.793	3.060	0.777	0.350
TOTALS	**2.22**	**313.02**		**6.793**		**0.777**	

1. Loading Rates obtained from MapShed Modeling.
2. Drainage Area to the existing outfall is 11.66 acres. The computed flow from the drainage area exceeds the overall capacity of the proposed detention basin. Flow is split at a proposed manhole sending Q_{10} = 9.71 cfs to the basin and 31.27 cfs to UNT to Sawmill Run. The equivalent impervious area (Q_{10} = 9.71 cfs) is 2.22 acres which will be used to compute proposed BMP Load Calculations.

MARKOSKY
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COLLABORATIVE ENGINEERING

Subject: Sawmill Run - MS4
BMP Load Reduction

Calc By: WBM
Date: 10/18/2022

Chk'd By
Date:

PROPOSED BMP LOAD REDUCTION TABLE

BMP ID	BMP Type	Removal Efficiency Determination Method	Existing Sediment Load (lb/yr)	Existing TP Load (lb/yr)	Sediment Removal Efficiency	TP Removal Efficiency	Sediment Load Reduction (lb/yr)	TP Load Reduction (lb/yr)
Moore Park-SCM 001	Dry Extended Detention Basin	PADEP Effectiveness	493.36	0.28	60.00%	20.00%	296.01	0.056
Moore Park - SCM 002	Dry Extended Detention Basin	PADEP Effectiveness	290.62	0.07	60.00%	20.00%	174.37	0.015
Crane Ave - SCM 003	Dry Extended Detention Basin	PADEP Effectiveness	313.02	0.78	60.00%	20.00%	187.81	0.155
TOTALS							**296.01**	**0.056**

Moore Park SCM 001 Sediment Reduction Using Simplified Method					
Land Coverage	Area (m²)	Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)	Sediment Loading (lbs/yr)
Developed, Low Intensity	3890.25	0.961	0.471	0.490	996.137
Deciduous Forest	2093.44	0.517	0.000	0.517	137.064
Pasture/Hay	3890.65	0.961	0.000	0.961	254.733
Total	9874.34	2.440	0.471	1.969	1387.933
Sediment Reductions (lbs/yr) with 55% BMP Efficiency Value					763.363

D1-6

Moore Park SCM 002 Sediment Reduction Using Simplified Method					
Land Coverage	Area (m^2)	Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)	Sediment Loading (lbs/yr)
Developed, Open Space	4547.62	1.12	0.225	0.899	651.508
Developed, Low Intensity	958.09	0.24	0.116	0.121	245.330
Mixed Forest	6340.42	1.57	0.000	1.567	415.126
Pasture/Hay	3890.65	0.961	0.000	0.961	62.729
Total	11189.16	2.765	0.116	2.649	1374.693
Sediment Reductions (lbs/yr) with 55% BMP Efficiency Value					756.081

D1-7

Crane Avenue SCM 003 Sediment Reduction Using Simplified Method					
Land Coverage	Area (m²)	Area (Acres)	Impervious Area (Acres)	Pervious Area (Acres)	Sediment Loading (lbs/yr)
Developed, Open Space	12,909.48	3.19	0.64	2.55	1,849.46
Developed, Low Intensity	8,417.47	2.08	1.02	1.06	2,155.38
Developed, Medium Intensity	10,238.56	2.53	2	0.53	3,816.38
Developed, High Intensity	15,620.88	3.86	3.86	-	7,098.54
Total	47,186.39	11.66	7.52	4.14	14,919.76
Sediment Reductions (lbs/yr) with 55% BMP Efficiency Value*					1,559.11

*Due to the Rain Garden only treating 19% of the basins drainage area due to the inclusion of a splitter, a multiplier of 0.19 was applied after the total was calculated used to account for the splitter.

D1-8

Project Name	Moore Park								
Feature Feature I.D. (Bank., Headcut or Deposition I.D.)	Length, ft (Bank or deposition)	Height, ft (Bank or Headcut)	BEHI Rating	NBS Rating	Predicted Rate of Bank Erosion (ft/year)	Predicted Erosion Amount (ft^3/year)	Predicted Erosion Amount (tons/year)	Predicted Erosion Rate (tons/year/ft)	Comments
1	32.0	2.5	Very High	Extreme	2.50	200.00	8.91	0.30	Right Bank
2 R	12.0	1.5	High	Moderate	0.64	11.52	0.51	0.05	Right Bank
2 L	12.0	3.3	Very High	Moderate	0.64	25.60	1.14	0.10	Left Bank
3 (Right and Left Banks)	32.0	3.2	Very High	Extreme	2.50	253.33	11.28	0.38	Right and Left Bank
4 (Right and Left Banks)	34.0	1.5	Very High	Moderate	0.64	32.64	1.45	0.05	Right and Left Bank
5 (Right and Left Banks)	42.0	2.5	Very High	Extreme	2.50	262.50	11.69	0.30	Right and Left Bank
6 R	46.0	3.7	Very High	Low	0.40	67.47	3.00	0.07	Right Bank
6 L	46.0	2.0	High	Low	0.40	36.80	1.64	0.04	Left Bank
7 (Right and Left Banks)	42.0	2.7	High	Low	0.40	44.80	2.00	0.05	Right and Left Bank
8 (Right and Left Banks)	34.0	3.3	High	Low	0.40	45.33	2.02	0.06	Right and Left Bank
9 (Right and Left Banks)	44.0	3.6	High	High	1.00	157.67	7.02	0.17	Right and Left Bank
10 (Right and Left Banks)	24.0	4.1	Extreme	High	2.50	245.00	10.91	0.49	Right and Left Bank
11 (Right and Left Banks)	24.0	1.7	High	Low	0.40	16.00	0.71	0.03	Right and Left Bank
12 (Right and Left Banks)	224.0	1.3	High	Extreme	2.50	700.00	31.18	0.15	Right and Left Bank
13 (Right and Left Banks)	68.0	1.2	Very High	Low	0.40	31.73	1.41	0.02	Right and Left Bank
14 (Right and Left Banks)	168.0	2.6	Very High	Extreme	2.50	1085.00	48.33	0.31	Right and Left Bank
15 (Right and Left Banks)	76.0	3.1	High	Extreme	2.50	585.83	26.09	0.37	Right and Left Bank
16 R	90.0	2.4	Extreme	Low	1.30	282.75	12.59	0.15	Right Bank
16 L	90.0	2.4	High	Low	0.40	87.00	3.87	0.05	Left Bank
17 (Right and Left Banks)	66.0	3.6	Very High	Low	0.25	59.13	2.63	0.04	Right and Left Bank
18 (Right and Left Banks)	98.0	2.5	High	Very High	1.75	428.75	19.10	0.21	Right and Left Bank
19 (Right and Left Banks)	206.0	2.0	Extreme	Extreme	4.50	1854.00	82.58	0.43	Right and Left Bank
20 (Right and Left Bank)	22.0	0.9	Very High	Moderate	0.64	12.91	0.57	0.03	Right Bank
21 (Right and Left Banks)	164.0	2.5	Very High	Moderate	0.64	262.40	11.69	0.08	Right and Left Bank
22 (Right and Left Banks)	160.0	0.8	High	Moderate	0.64	76.80	3.42	0.02	Right and Left Bank
23 (Right and Left Banks)	328.0	3.0	High	High	1.00	984.00	43.83	0.14	Right and Left Bank
24 (Right and Left Banks)	194.0	0.9	High	High	1.00	169.75	7.56	0.04	Right and Left Bank
25 (Right and Left Banks)	342.0	4.0	Moderate	Very High	0.70	957.60	42.65	0.13	Right and Left Bank
26 (Right and Left Banks)	292.0	3.0	High	Low	0.40	350.40	15.61	0.06	Right and Left Bank
27 (Right and Left Banks)	428.0	6.0	Moderate	High	0.80	2054.40	91.50	0.23	Right and Left Bank
28 (Right and Left Banks)	210.0	2.5	High	Moderate	0.64	336.00	14.97	0.08	Right and Left Bank
29 (Right and Left Banks)	134.0	1.8	Moderate	Low	0.13	29.31	1.31	0.01	Right and Left Bank
TOTAL OF ALL GRIDS	**3784.0**	**N/A**	**N/A**	**N/A**	**37.6**	**11,746.42**	**523.2**	**4.7**	

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	44.08				
Reach:		**Comments:**							Very High				
Location:	1	**Bank Length**	32					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.29	8.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	2.50	0.13	8.07	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.13	4.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification			5.00		undercutting
		TOTAL SCORE	**44.08**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow………………….… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating	**Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	36.69				
Reach:		**Comments:**							High				
Location:	2 R	**Bank Length**	12					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.50	0.29	5.14	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	1.50	0.33	5.57	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.33	5.00	9.00	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**36.69**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….……NBS = High / Very High
Extensive deposition (continuous, cross-channel)………….…………..……. ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.1666667	**0.7**	**1.6666667**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.02				
Reach:		**Comments:**							Very High				
Location:	2 L	**Bank Length**	12					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.33	0.29	11.43	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	3.33	0.15	7.90	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.15	2.25	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.02**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: | Location: **Moore Park**

Station: | Stream Type: | Valley Type: **Confined**

Observers: **AT, AD** | Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………….…...…… ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………….……. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.1666667	**0.7**	**1.6666667**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	43.64				
Reach:		**Comments:**							Very High				
Location:	3 (Right and Left Banks)	**Bank Length**	32					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.17	0.29	10.86	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	3.17	0.32	5.74	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.32	1.58	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
2.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**43.64**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — **(1)**

Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……………..……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… …………..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	41.33				
Reach:		**Comments:**							Very High				
Location:	4 (Right and Left Banks)	**Bank Length**	34					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.50	0.29	5.14	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.21	1.50	0.14	8.01	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.14	1.39	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
48.00			3.32	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.33**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I **(1)**

Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..…………..…….. ……………...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Moderate	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.03				
Reach:		**Comments:**							Very High				
Location:	5 (Right and Left Banks)	**Bank Length**	42					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.29	8.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	2.50	0.13	8.07	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.13	4.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.03**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……………..…… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.97				
Reach:		**Comments:**							Very High				
Location:	6 R	**Bank Length**	46					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.67	0.29	12.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	3.67	0.14	8.04	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	0.14	4.77	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
40.00			2.93	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.97**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Adjustments								
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
Stratification								
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………….NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**1.75**	**1.2833333**	**1.3636364**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	38.05				
Reach:		**Comments:**							High				
Location:	6 L	**Bank Length**	46					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.29	6.86	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	2.00	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	0.25	8.75	8.58	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
40.00			2.93	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.05**		

Bank Erosion Potential								
Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Material	**Adjustments**							
	Bedrock	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.75	**1.2833333**	**1.3636364**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	38.37			
Reach:		**Comments:**							High			
Location:	7 (Right and Left Banks)	**Bank Length**	42					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/12/2022								5-10	10-20	20-30	30-40

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.67	0.29	9.14	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.25	2.67	0.47	4.21	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
25.00	0.47	11.72	8.25	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
2.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.37**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**1.75**	**1.2833333**	**1.3636364**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**39.21**					
Reach:		**Comments:**							**High**					
Location:	8 (Right and Left Banks)	**Bank Length**	34					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.33	0.29	11.43	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	3.33	0.60	3.41	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
25.00	0.60	15.00	7.90	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**39.21**		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)………….………...……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.75	**1.2833333**	**1.3636364**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**		39.44			
Reach:		**Comments:**								High			
Location:	9 (Right and Left Banks)	**Bank Length**	44					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.58	0.29	12.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.17	3.58	0.33	5.64	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.33	3.26	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**39.44**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)………….…………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………...NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	Ratio R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	Ratio S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	Ratio S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
High	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	Ratio d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	50.62				
Reach:		**Comments:**							Extreme				
Location:	10 (Right and Left Banks)	**Bank Length**	24					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45

Extreme	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.08	0.29	14.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	4.08	0.16	7.72	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.16	1.63	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification			5.00		Undercutting
		TOTAL SCORE	**50.62**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow………………….…. …………….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: **High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	35.50				
Reach:		**Comments:**							High				
Location:	11 (Right and Left Banks)	**Bank Length**	24					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.67	0.29	5.71	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	1.67	0.20	7.22	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.20	3.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	35.50		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………....…………...…… ……….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………………….NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**1.75**	**1.2833333**	**1.3636364**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	34.98			
Reach:		**Comments:**							High			
Location:	12 (Right and Left Banks)	**Bank Length**	224					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.25	0.29	4.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	1.25	0.13	8.07	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.13	1.33	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
25.00			2.19	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
45.00			4.71	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**34.98**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous…………. ……………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………….NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**		41.87			
Reach:		**Comments:**								Very High			
Location:	13 (Right and Left Banks)	**Bank Length**	68					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.17	0.29	4.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.46	1.17	0.39	4.97	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.39	1.96	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.87**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...……. ……….…...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………….…… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**1.75**	**1.2833333**	**1.3636364**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	41.00				
Reach:		**Comments:**							Very High				
Location:	14 (Right and Left Banks)	**Bank Length**	168					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.58	0.29	8.86	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.08	2.58	0.42	4.71	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
25.00	0.42	10.48	8.39	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
1.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.00**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………………… ……………NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	38.92					
Reach:		**Comments:**							High					
Location:	15 (Right and Left Banks)	**Bank Length**	76					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.08	0.29	10.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	3.08	0.27	6.27	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.27	4.05	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
55.00			3.66	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.92**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………...……. ……………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	52.11					
Reach:		**Comments:**							Extreme					
Location:	16 R	**Bank Length**	90					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.42	0.29	8.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	2.42	0.28	6.19	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.28	13.79	8.02	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
2.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification			10.00		
		TOTAL SCORE	**52.11**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………......……………...…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**1.4583333**	**0.9916667**	**1.4705882**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**33.87**				
Reach:		**Comments:**							**High**				
Location:	16 L	**Bank Length**	90					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.42	0.29	8.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	2.42	0.28	6.19	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.28	13.79	8.02	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
30.00			2.44	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**33.87**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous…………. ………………...NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..…………..……. ……………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.4583333	**0.9916667**	**1.4705882**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	43.35				
Reach:		**Comments:**							Very High				
Location:	17 (Right and Left Banks)	**Bank Length**	66					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.58	0.29	12.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.92	3.58	0.26	6.46	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.26	5.12	8.99	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
2.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**43.35**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Bank Material

Adjustments

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
Low	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	1.4583333	**0.9916667**	**1.4705882**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Low**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	39.30				
Reach:		**Comments:**							High				
Location:	18 (Right and Left Banks)	**Bank Length**	98					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.29	8.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.75	2.50	0.30	5.90	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.30	4.50	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
65.00			4.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**39.30**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………… ………………...NBS = High / Very High
- Extensive deposition (continuous, cross-channel)…………...……………...…… …………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Very High	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	46.04			
Reach:		**Comments:**							Extreme			
Location:	19 (Right and Left Banks)	**Bank Length**	206					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/12/2022								5-10	10-20	20-30	30-40

Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.29	6.86	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	2.00	0.08	8.63	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.08	0.42	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials			6.00		red dog
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**46.04**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I **(1)**
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..…… ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.15			
Reach:		**Comments:**							Very High			
Location:	20 (Right and Left Bank)	**Bank Length**	22					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/12/2022								5-10	10-20	20-30	30-40

Total Score Values:	**Very High**	**Extreme**
	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
0.92	0.29	3.14	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.17	0.92	0.18	7.47	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.18	2.73	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
35.00			2.68	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.15**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….......NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………....……….....……. ……….…...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………….….. …………...NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.9166667**	**0.5166667**	**1.7741935**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	41.61			
Reach:		**Comments:**							Very High			
Location:	21 (Right and Left Banks)	**Bank Length**	164					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.29	8.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.25	2.50	0.10	8.44	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.10	4.00	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.61**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.9166667**	**0.5166667**	**1.7741935**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	31.15			
Reach:		**Comments:**							High			
Location:	22 (Right and Left Banks)	**Bank Length**	160					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
0.75	0.33	2.25	8.21	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	0.75	0.56	3.63	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.56	8.33	8.63	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
15.00			1.68	Very Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**31.15**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Bank Material	Adjustments	
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

	Method	Level	Prediction
(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	5
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.9166667**	**0.5166667**	**1.7741935**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	32.70				
Reach:		**Comments:**							High				
Location:	23 (Right and Left Banks)	**Bank Length**	328					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	0.29	10.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.67	3.00	0.89	2.01	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.89	17.78	7.52	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**32.70**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)	Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High Extensive deposition (continuous, cross-channel)……………..…………..……… ……………..NBS = Extreme Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**5**
Dominant Near-Bank Stress	
High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.3166667**	**2.3684211**	**High**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	35.69				
Reach:		**Comments:**							High				
Location:	24 (Right and Left Banks)	**Bank Length**	194					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
0.88	0.29	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	0.88	0.48	4.14	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.48	23.81	6.70	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.69**		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………….....……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	5
Dominant Near-Bank Stress	
High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.3166667**	**2.3684211**	**High**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	23.99				
Reach:		**Comments:**							Moderate				
Location:	25 (Right and Left Banks)	**Bank Length**	342					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.00	0.29	13.71	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
6.00	4.00	1.50	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	1.50	45.00	4.71	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**23.99**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments		
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Very High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40
	Overall Near-Bank Stress (NBS) rating					**Very High**	

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	38.54				
Reach:		**Comments:**							High				
Location:	26 (Right and Left Banks)	**Bank Length**	292					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High** / **Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45 / 45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	0.29	10.29	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.75	3.00	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	0.25	8.75	8.58	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.54**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous……………………………NBS = High / Very High
- Extensive deposition (continuous, cross-channel)…………………………………NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow………………………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**5**
Dominant Near-Bank Stress	
Low	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.4166667**	**0.3888889**	**1.0714286**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	25.18				
Reach:		**Comments:**							Moderate				
Location:	27 (Right and Left Banks)	**Bank Length**	428					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45

Extreme	45-50				

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	0.29	20.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
6.00	6.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	1.00	35.00	5.50	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
35.00			5.50	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**25.18**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: | Location: **Moore Park**

Station: | Stream Type: | Valley Type: **Confined**

Observers: **AT, AD** | Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….......NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………...…………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **High**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	35.71				
Reach:		**Comments:**							High				
Location:	28 (Right and Left Banks)	**Bank Length**	210					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.29	8.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	2.50	0.33	5.57	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	0.33	0.28	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
40.00			2.93	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.71**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream:	Location: **Moore Park**	
Station:	Stream Type:	Valley Type: **Confined**
Observers: **AT, AD**		Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — **(1)**

Transverse and/or central bars-short and/or discontinuous……………………..…NBS = High / Very High

Extensive deposition (continuous, cross-channel)…………………………………………...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………………...NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**1**
Dominant Near-Bank Stress	
Moderate	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Moore Park	**Observer(s):**	AT, JR, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	24.30				
Reach:		**Comments:**							Moderate				
Location:	29 (Right and Left Banks)	**Bank Length**	134					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/12/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.75	0.29	6.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.75	1.75	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
80.00	1.00	80.00	1.90	Very Low	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**24.30**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: Location: **Moore Park**

Station: Stream Type: Valley Type: **Confined**

Observers: **AT, AD** Date: **5-25-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……….…..……. ……….…...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.4166667	**0.35**	**1.1904762**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BEHI	NBS	Rate
low	very low	0.017
low	low	0.020
low	moderate	0.090
low	high	0.160
low	very high	0.325
low	extreme	0.6
moderate	very low	0.09
moderate	low	0.125
moderate	moderate	0.300
moderate	high	0.800
moderate	very high	0.700
moderate	extreme	1.200
high	very low	0.250
high	low	0.400
high	moderate	0.640
high	high	1.000
high	very high	1.750
high	extreme	2.500
very high	very low	0.250
very high	low	0.400
very high	moderate	0.640
very high	high	1.000
very high	very high	1.750
very high	extreme	2.500
extreme	very low	0.15
extreme	low	1.300
extreme	moderate	1.750
extreme	high	2.500
extreme	very high	3.500
extreme	extreme	4.500

Non-highlighted rates from USFWS Bank Erosion Rate Curve Yellow Highlighted rates from Rosgen Colorado Bank Erosion Rate Blue Highlighted rates are interpolated from Rosgen Colorado Bank Erosion Rate

Photo location 1 facing Northeast.

Photo Location 2 facing Northeast.

Photo location 3 facing Northeast.

Photo location 4 facing South.

Photo location 5 facing South.

Photo Location 6 facing South.

Photo Location 7 Facing South.

Photo location 8 facing Southeast.

Photo Location 9 Facing South.

Photo Location 10 facing North.

Photo location 11 facing Northeast.

Photo location 12 facing Southwest.

Photo location 13 facing Northeast.

Photo location 14 facing West.

Photo Location 15 Facing East.

Photo Location 16 facing Northeast.

Photo Location 17 facing Southwest.

Photo location 18 facing Southwest.

Photo location 19 facing Southwest.

Photo location 20 facing South.

Photo location 21 facing Southwest.

Photo location 22 facing South.

Photo location 23 facing South.

Photo Location 24 facing North.

Photo Location 25 facing Northeast.

Photo location 26 facing Southwest.

Photo location 27 facing Northeast.

Photo location 28 facing Southwest.

Photo location 29 facing Southwest.

Photo location 30 facing Northeast.

Photo location 31 facing South.

Photo location 32 facing Northeast.

Photo location 33 facing Southwest.

Photo location 34 Facing Southeast.

Photo location 35 facing Southwest.

Photo location 36 facing Southeast.

Photo location 37 facing Northeast.

Project Name	Crane Avenue								
Feature Feature I.D. (Bank., Headcut or Deposition I.D.)	Length, ft (Bank or deposition)	Height, ft (Bank or Headcut)	BEHI Rating	NBS Rating	Predicted Rate of Bank Erosion (ft/year)	Predicted Erosion Amount (ft^3/year)	Predicted Erosion Amount (tons/year)	Predicted Erosion Rate (tons/year/ft)	Comments
1 L	85.0	2.0	High	Moderate	0.64	108.80	5.40	0.06	Left Bank
1 R	85.0	1.3	High	Moderate	0.64	72.53	3.60	0.04	Right Bank
2 R	34.0	6.0	High	Low	0.40	81.60	4.05	0.12	Right Bank
2 L	34.0	4.8	High	Low	0.40	65.73	3.26	0.09	Left Bank
3	54.0	5.0	Moderate	Low	0.13	33.75	1.67	0.03	Left and Right Bank
4	56.0	7.0	High	Extreme	2.50	980.00	48.63	0.84	Left and Right Bank
5	74.0	6.0	High	Moderate	0.64	284.16	14.10	0.18	Left and Right Bank
6	38.0	5.0	High	Extreme	2.50	475.00	23.57	0.60	Left and Right Bank
7 R	14.0	7.0	Very High	Extreme	2.50	245.00	12.16	0.84	Right Bank
7 L	14.0	2.0	Moderate	Extreme	1.20	33.60	1.67	0.12	Left Bank
8	50.0	2.2	High	Moderate	0.64	69.33	3.44	0.07	Left and Right Bank
9	24.0	3.2	High	Low	0.40	30.40	1.51	0.06	Left and Right Bank
10	64.0	2.2	High	Low	0.40	55.47	2.75	0.04	Left and Right Bank
11	32.0	2.7	High	Extreme	2.50	213.33	10.59	0.32	Left and Right Bank
12	66.0	2.5	Very High	Moderate	0.64	105.60	5.24	0.08	Left and Right Bank
13	158.0	2.0	High	Moderate	0.64	202.24	10.04	0.06	Left and Right Bank
14	366.0	8.0	High	Extreme	2.50	7320.00	363.26	0.96	Left and Right Bank
15	142.0	6.0	High	Moderate	0.64	545.28	27.06	0.18	Left and Right Bank
16	72.0	8.0	Very High	Low	0.25	144.00	7.15	0.10	Left and Right Bank
17	56.0	4.5	Very High	Low	0.25	63.00	3.13	0.05	Left and Right Bank
18	72.0	7.0	High	Low	0.40	201.60	10.00	0.13	Left and Right Bank
19	14.0	7.0	High	Moderate	0.64	62.72	3.11	0.22	Left and Right Bank
20	24.0	4.0	Low	Low	0.02	1.92	0.10	0.00	Left and Right Bank
21	44.0	2.0	Low	Low	0.02	1.76	0.09	0.00	Left and Right Bank
22	172.0	3.3	High	High	1.00	573.33	28.45	0.16	Left and Right Bank
23	76.0	2.7	High	Moderate	0.64	129.71	6.44	0.08	Left and Right Bank
24	130.0	2.3	High	Moderate	0.64	194.13	9.63	0.07	Left and Right Bank
25	76.0	1.0	High	Moderate	0.64	48.64	2.41	0.03	Left and Right Bank
26	50.0	6.4	High	Low	0.40	128.33	6.37	0.12	Left and Right Bank
27	40.0	2.0	Very High	Low	0.25	20.00	0.99	0.02	Left and Right Bank
28	76.0	4.0	Moderate	Very High	0.70	212.80	10.56	0.13	Left and Right Bank
29	132.0	1.7	High	Low	0.40	88.00	4.37	0.03	Left and Right Bank
TOTAL OF ALL GRIDS	**1628.0**	**N/A**	**N/A**	**N/A**	**21.5**	**11,395.07**	**565.5**	**5.2**	

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**39.01**				
Reach:		**Comments:**	left bank						**High**				
Location:	1 L	**Bank Length**	85					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45

Total Score Values	Very Low	Low	Moderate	High	Very High	Extreme
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.25	8.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	2.00	0.21	7.11	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.21	4.17	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
60.00			3.90	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**39.01**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**		Location: **Vanucci Park**
Station:	Stream Type:	Valley Type:
Observers: **AT, AD ,MB**		Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………..……… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.4583333**	**1.6363636**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	32.85					
Reach:		**Comments:**	right bank						High					
Location:	1 R	**Bank Length**	85					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.33	0.25	5.33	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	1.33	0.38	5.15	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.38	7.50	8.72	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
30.00			2.44	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
25.00			6.54	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**32.85**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**	Location: **Vanucci Park**	
Station:	Stream Type:	Valley Type:
Observers: **AT, AD ,MB**		Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — **(1)**

Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..………….....……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… …………..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.75**	**0.4583333**	**1.6363636**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**33.18**					
Reach:		**Comments:**							**High**					
Location:	2 R	**Bank Length**	34					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	0.46	13.09	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
6.00	6.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	1.00	35.00	5.50	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
110.00			8.68	Very High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**33.18**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.5833333**	**0.4583333**	**1.2727273**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	30.30					
Reach:		**Comments:**							High					
Location:	2 L	**Bank Length**	34					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.83	0.46	10.55	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
4.83	4.83	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	1.00	35.00	5.50	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**30.30**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous…………. …………….......NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………...NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.5833333	**0.4583333**	**1.2727273**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	24.63			
Reach:		**Comments:**							Moderate			
Location:	3	**Bank Length**	54					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40

Total Score Values:	**Very High**	**Extreme**
	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.83	6.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
5.00	5.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	1.00	40.00	5.11	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
40.00			5.11	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**24.63**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — **(1)**

Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..…………...……. …………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.6666667	**0.4583333**	**1.4545455**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**34.89**				
Reach:		**Comments:**							**High**				
Location:	4	**Bank Length**	56					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
7.00	1.83	3.82	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
6.00	7.00	0.86	2.16	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.86	17.14	7.61	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**34.89**		

Bank Erosion Potential							
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments		
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.
	Stratification	
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.	

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………………………… ……………NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………………………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	33.49				
Reach:		**Comments:**							High				
Location:	5	**Bank Length**	74					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	1.67	3.60	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
5.00	6.00	0.83	2.28	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
60.00	0.83	50.00	4.32	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**33.49**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………...……………...…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.4583333**	**1.6363636**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	Observer(s):	AT,MM	Data:	AT	QA/QC:		Total Score:	38.43				
Reach:		Comments:							High				
Location:	6	Bank Length	38					Total Score	Very Low	Low	Moderate	High	Very High	Extreme
Date:	5/11/2022							Values:	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	1.33	3.75	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
3.50	5.00	0.70	2.93	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.70	35.00	5.50	Moderate	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
160.00			10.00	Extreme	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.43**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...…… ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**41.40**				
Reach:		**Comments:**							**Very High**				
Location:	7 R	**Bank Length**	14					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
7.00	1.83	3.82	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	7.00	0.29	6.06	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	0.29	10.00	8.44	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.40**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**	Location: **Vanucci Park**	
Station:	Stream Type:	Valley Type:
Observers: **AT, AD ,MB**		Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
4.5	**6.5**	**0.6923077**	**Extreme**

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating	**Extreme**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	24.79				
Reach:		**Comments:**							Moderate				
Location:	7 L	**Bank Length**	14					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	1.83	1.09	1.82	Very Low	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	2.00	0.50	3.90	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	0.50	0.25	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
45.00			3.17	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**24.79**		

Bank Erosion Potential							
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Erodibility Variables

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….. ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)	**4.5**	**6.5**	**0.6923077**	**Extreme**

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	30.42				
Reach:		**Comments:**							High				
Location:	8	**Bank Length**	50					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.17	0.67	3.25	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.67	2.17	0.77	2.59	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.77	23.08	6.80	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
58.00			3.80	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**30.42**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………….….…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.7083333	**0.4583333**	**1.5454545**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**		35.30			
Reach:		**Comments:**								High			
Location:	9	**Bank Length**	24					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.17	1.00	3.17	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.50	3.17	0.47	4.16	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
25.00	0.47	11.84	8.24	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
60.00			3.90	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.30**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.6666667	**0.4583333**	**1.4545455**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**32.19**				
Reach:		**Comments:**							**High**				
Location:	10	**Bank Length**	64					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.17	0.67	3.25	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.67	2.17	0.77	2.59	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.77	23.08	6.80	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
58.00			3.80	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**32.19**		

Bank Erosion Potential							
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Erodibility Variables

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.5833333	**0.4583333**	**1.2727273**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**35.11**				
Reach:		**Comments:**							**High**				
Location:	11	**Bank Length**	32					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.67	1.00	2.67	8.81	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.67	2.67	0.63	3.29	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.63	12.50	8.17	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.11**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments		
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.
Stratification		
		Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….......NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………….…… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	44.92				
Reach:		**Comments:**							Very High				
Location:	12	**Bank Length**	66					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45

Extreme
45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.50	0.46	5.45	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	2.50	0.13	8.07	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.13	1.33	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**44.92**		

Bank Erosion Potential							
		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Erodibility Variables

Adjustments	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Bank Material

Stratification
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.75	**0.4583333**	**1.6363636**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**35.04**				
Reach:		**Comments:**							**High**				
Location:	13	**Bank Length**	158					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.67	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.67	2.00	0.33	5.57	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.33	13.33	8.07	Very High	
Bank Angle					
Bank Angle ($^{\circ}$)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.04**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments		
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.
Stratification		
		Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………….…..……. ……………..NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.4166667**	**1.8**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**38.35**				
Reach:		**Comments:**							**High**				
Location:	14	**Bank Length**	366					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
8.00	1.08	7.38	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.67	8.00	0.21	7.11	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.21	8.33	8.63	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
45.00			4.71	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.35**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………….…….. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.8333333**	**0.4583333**	**1.8181818**	**High**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**31.17**				
Reach:		**Comments:**							**High**				
Location:	15	**Bank Length**	142					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.00	0.75	8.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.08	6.00	0.35	5.43	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
80.00	0.35	27.78	6.17	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
85.00			1.68	Very Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**31.17**		

Bank Erosion Potential								
Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Bank Material	Adjustments	
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification
Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**	Location: **Vanucci Park**	
Station:	Stream Type:	Valley Type:
Observers: **AT, AD ,MB**		Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………...…………...…… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.75**	**0.4583333**	**1.6363636**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating: Moderate

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**42.00**				
Reach:		**Comments:**							**Very High**				
Location:	16	**Bank Length**	72					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
8.00	1.00	8.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	8.00	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
70.00	0.25	17.50	7.56	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**42.00**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………………………………… ……………NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.6666667**	**0.4583333**	**1.4545455**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**41.32**				
Reach:		**Comments:**							**Very High**				
Location:	17	**Bank Length**	56					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.50	1.00	4.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	4.50	0.22	6.92	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
15.00	0.22	3.33	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
65.00			4.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.32**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………...………...……… ……………..NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………………….NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.58	**0.4583333**	**1.2727273**	**Low**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**36.62**				
Reach:		**Comments:**							**High**				
Location:	18	**Bank Length**	72					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
7.00	0.50	14.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
4.00	7.00	0.57	3.55	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
21.00	0.57	12.00	8.22	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**36.62**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………...…………...……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.5833333	**0.5**	**1.1666667**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	35.06				
Reach:		**Comments:**							High				
Location:	19	**Bank Length**	14					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
7.00	1.00	7.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
4.50	7.00	0.64	3.20	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
45.00	0.64	28.93	6.01	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**35.06**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………………………… ……………NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.75**	**0.4583333**	**1.6363636**	**Moderate**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	17.76					
Reach:		**Comments:**							Low					
Location:	20	**Bank Length**	24					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.00	0.83	4.80	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
4.00	4.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
85.00	1.00	85.00	1.68	Very Low	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
85.00			1.68	Very Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**17.76**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**	Location: **Vanucci Park**	
Station:	Stream Type:	Valley Type:
Observers: **AT, AD ,MB**		Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………………NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………………………… …………….NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow………………………………NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.5833333	**0.4583333**	**1.2727273**	**Low**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**16.19**				
Reach:		**Comments:**							**Low**				
Location:	21	**Bank Length**	44					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.83	2.40	8.43	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	2.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
85.00	1.00	85.00	1.68	Very Low	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
50.00			3.41	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
85.00			1.68	Very Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**16.19**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I — **(1)**
Transverse and/or central bars-short and/or discontinuous………… ……………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………..……. ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.5833333**	**0.4583333**	**1.2727273**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	38.04				
Reach:		**Comments:**							High				
Location:	22	**Bank Length**	172					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.33	0.67	5.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	3.33	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.25	5.00	9.00	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
66.00			4.50	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.04**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……….. ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.8333333	**0.4583333**	**1.8181818**	**High**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **High**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	31.35				
Reach:		**Comments:**							High				
Location:	23	**Bank Length**	76					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.67	0.58	4.57	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.67	2.67	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
60.00	1.00	60.00	3.50	Low	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**31.35**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………...…………...……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
	0.75	**0.4583333**	**1.6363636**	**Moderate**

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**37.02**				
Reach:		**Comments:**							**High**				
Location:	24	**Bank Length**	130					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.33	0.50	4.67	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.67	2.33	0.71	2.86	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.71	7.14	8.76	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
75.00			5.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
1.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**37.02**		

Bank Erosion Potential		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....…NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………….....…… ……….…...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……….…………. ……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
0.75	**0.4583333**	**1.6363636**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	33.54				
Reach:		**Comments:**							High				
Location:	25	**Bank Length**	76					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.46	2.18	8.12	Very High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	1.00	0.33	5.57	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.33	3.33	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
34.00			2.63	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**33.54**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue**	Location: **Vanucci Park**
Station:	Stream Type: / Valley Type:
Observers: **AT, AD ,MB**	Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………...……………..…… …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………….……… ……………NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
17.5	8	2.1875	**Moderate**

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	
Dominant Near-Bank Stress	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
2	0.33	6.0606061	**Extreme**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	36.74				
Reach:		**Comments:**							High				
Location:	26	**Bank Length**	50					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
6.42	0.50	12.83	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
3.00	6.42	0.47	4.22	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.47	18.70	7.40	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
20.00			7.22	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**36.74**		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………...……………..……. ………….....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.5833333**	**0.4583333**	**1.2727273**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	42.44				
Reach:		**Comments:**							Very High				
Location:	27	**Bank Length**	40					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.50	4.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.01	2.00	0.01	10.00	Extreme	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.01	0.01	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
30.00			2.44	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
1.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**42.44**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..…………..……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.5**	**0.4583333**	**1.0909091**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Low**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	27.47					
Reach:		**Comments:**							Moderate					
Location:	28	**Bank Length**	76					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.00	0.50	8.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
3.00	4.00	0.75	2.68	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.75	22.50	6.88	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
65.00			4.40	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
60.00			3.50	Low	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**27.47**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….......NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………...…… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………… ……………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Very High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

BANK EROSION HAZARD INDEX

Stream:	Crane Avenue	**Observer(s):**	AT,MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**32.59**					
Reach:		**Comments:**							**High**					
Location:	29	**Bank Length**	132					**Total Score**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	5/11/2022							**Values:**	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.67	0.83	2.00	7.90	High	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	1.67	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
10.00	0.25	2.50	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
26.00			2.24	Low	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**32.59**		

Bank Erosion Potential

			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **Crane Avenue** Location: **Vanucci Park**

Station: Stream Type: Valley Type:

Observers: **AT, AD ,MB** Date: **6-2-22**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..……………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………. …………...NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	
Dominant Near-Bank Stress	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)	**0.5**	**0.4583333**	**1.0909091**	**Low**

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Low**

BEHI	NBS	Rate
low	very low	0.017
low	low	0.020
low	moderate	0.090
low	high	0.160
low	very high	0.325
low	extreme	0.6
moderate	very low	0.09
moderate	low	0.125
moderate	moderate	0.300
moderate	high	0.800
moderate	very high	0.700
moderate	extreme	1.200
high	very low	0.250
high	low	0.400
high	moderate	0.640
high	high	1.000
high	very high	1.750
high	extreme	2.500
very high	very low	0.250
very high	low	0.400
very high	moderate	0.640
very high	high	1.000
very high	very high	1.750
very high	extreme	2.500
extreme	very low	0.15
extreme	low	1.300
extreme	moderate	1.750
extreme	high	2.500
extreme	very high	3.500
extreme	extreme	4.500

Non-highlighted rates from USFWS Bank Erosion Rate Curve Yellow Highlighted rates from Rosgen Colorado Bank Erosion Rate Blue Highlighted rates are interpolated from Rosgen Colorado Bank Erosion Rate

Photo location 3 facing west

Photo location 4 facing Northeast

Photo location 5 facing Southwest

Photo location 6 facing Southeast

Photo location 7 facing North

Photo location 8 facing West

Photo location 9 facing West

Photo location 10 facing North

Photo location 11 facing Northwest

Photo location 12 facing East

Photo location 13 facing Southwest

Photo location 14 facing West

Photo location 15 facing North

Photo location 16 facing South

Photo location 17 facing Northwest

Photo location 18 facing Southwest

Photo location 19 facing Northwest

Photo location 20 facing Northeast

Photo location 21 facing Northeast

Photo Location 22 facing East

Photo location 25 facing Southwest

Photo location 27 facing Northwest

Photo location 28 facing South

Photo location 30 facing Northeast

Photo location 31 facing North

Photo location 32 facing South

Boyce Park BANCS Evaluation/Pictures of UNT to Pierson Run

Project Name	Boyce Park							
Feature Feature I.D. (Bank., Headcut or Deposition I.D.)	Length, ft (Bank or deposition)	Height, ft (Bank or Headcut)	BEHI Rating	NBS Rating	Predicted Rate of Bank Erosion (ft/year)	Predicted Erosion Amount (ft^3/year)	Predicted Erosion Amount (tons/year)	Predicted Erosion Rate (tons/year/ft)
1 L	54.0	5.5	Very High	Extreme	2.50	742.50	27.45	0.66
1 R	54.0	5.0	Very High	Extreme	2.50	675.00	24.95	0.60
2 L	74.0	4.5	Very High	Extreme	2.50	832.50	30.77	0.54
2 R	74.0	4.0	Very High	Extreme	2.50	740.00	27.35	0.48
3 L	28.0	5.5	Very High	Extreme	2.50	385.00	14.23	0.66
3 R	28.0	5.0	Very High	Extreme	2.50	350.00	12.94	0.60
4 L	55.0	3.5	Extreme	Extreme	4.50	866.25	32.02	0.76
4 R	55.0	5.0	Very High	Extreme	2.50	687.50	25.41	0.60
5 L	110.0	2.0	High	Extreme	2.50	550.00	20.33	0.24
5 R	110.0	2.0	Very High	Extreme	2.50	550.00	20.33	0.24
6 L	92.0	1.0	Moderate	Extreme	1.20	110.40	4.08	0.06
6 R	92.0	1.0	High	Extreme	2.50	230.00	8.50	0.12
7 L	45.0	9.0	Very High	Extreme	2.50	1012.50	37.43	1.08
7 R	45.0	1.0	High	Extreme	2.50	112.50	4.16	0.12
8 L	348.0	2.0	High	Extreme	2.50	1740.00	64.32	0.24
8 R	348.0	1.0	High	Extreme	2.50	870.00	32.16	0.12
9 L	147.0	3.0	Very High	Extreme	2.50	1102.50	40.75	0.36
9 R	147.0	3.0	High	Extreme	2.50	1102.50	40.75	0.36
TOTAL OF ALL GRIDS	**1906.0**	**N/A**	**N/A**	**N/A**	**45.7**	**12,659.15**	**467.9**	**7.9**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	44.72			
Reach:		**Comments:**							Very High			
Location:	1 L	**Bank Length**	54					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.50	0.67	8.25	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	5.50	0.15	7.88	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.15	3.03	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**44.72**		

Bank Erosion Potential

Erodibility Variables

		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….…………….NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.44				
Reach:		**Comments:**							Very High				
Location:	1 R	**Bank Length**	54					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.67	7.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	5.00	0.40	4.90	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.40	20.00	7.22	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
100.00			8.32	Very High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.44**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………..…NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**44.27**				
Reach:		**Comments:**							**Very High**				
Location:	2 L	**Bank Length**	74					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.50	0.67	6.75	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	4.50	0.19	7.42	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.19	3.70	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**44.27**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run**	Location: **Boyce Patk**	
Station:	Stream Type:	Valley Type:
Observers: **AT, MM**		Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….…………...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating — **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**42.03**
Reach:		**Comments:**							**Very High**
Location:	2 R	**Bank Length**	74						
Date:	1/10/2023								

Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
4.00	0.67	6.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	4.00	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
35.00	0.25	8.75	8.58	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**42.03**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous…………. ………………..…NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..………………..……… …………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow……………………..…………..…NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Very High	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Very High**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	44.72				
Reach:		**Comments:**							Very High				
Location:	3 L	**Bank Length**	28					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.50	0.67	8.25	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.83	5.50	0.15	7.88	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.15	3.03	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**44.72**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...……. ……………..NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..……….......NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	40.02				
Reach:		**Comments:**							Very High				
Location:	3 R	**Bank Length**	28					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.67	7.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
2.00	5.00	0.40	4.90	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
50.00	0.40	20.00	7.22	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.02**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous…………. ………………......NBS = High / Very High
- Extensive deposition (continuous, cross-channel)…………….…………….....……. …………....NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow……………………..…………...NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	46.13				
Reach:		**Comments:**							Extreme				
Location:	4 L	**Bank Length**	55					**Total Score Values:**		**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023									5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.50	0.67	5.25	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.42	3.50	0.12	8.23	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.12	3.57	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
8.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**46.13**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………..…NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**		41.36			
Reach:		**Comments:**								Very High			
Location:	4 R	**Bank Length**	55					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
5.00	0.67	7.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.50	5.00	0.30	5.90	Moderate	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.30	9.00	8.56	Very High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
10.00			9.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**41.36**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Adjustments								
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
Stratification								
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………..………….....……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..……….…..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	37.70			
Reach:		**Comments:**							High			
Location:	5 L	**Bank Length**	110					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.67	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	2.00	0.50	3.90	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.50	15.00	7.90	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
80.00			5.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**37.70**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……… ……………..NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..……….…..NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**		40.24			
Reach:		**Comments:**								Very High			
Location:	5 R	**Bank Length**	110					**Total Score Values:**	Very Low	Low	Moderate	High	Very High	Extreme
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.67	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	2.00	0.50	3.90	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.50	10.00	8.44	Very High	
Bank Angle					
Bank Angle (^{o})			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**40.24**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)
- Transverse and/or central bars-short and/or discontinuous…………. ………………..…..NBS = High / Very High
- Extensive deposition (continuous, cross-channel)……………..……………..……… ……………...NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow……………………..…………..…NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	Observer(s):	AT, MM	Data:	AT	QA/QC:		Total Score:	29.91				
Reach:		Comments:							Moderate				
Location:	6 L	Bank Length	92					Total Score Values:	Very Low	Low	Moderate	High	Very High	Extreme
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.67	1.50	5.90	Moderate	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	1.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	1.00	40.00	5.11	Moderate	
Bank Angle					
Bank Angle (^{o})			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**29.91**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments (Bank Material)

Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run**	Location: **Boyce Patk**	
Station:	Stream Type:	Valley Type:
Observers: **AT, MM**		Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………..…NBS = High / Very High
Extensive deposition (continuous, cross-channel)………………..………………..……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………...NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	32.02			
Reach:		**Comments:**							High			
Location:	6 R	**Bank Length**	92					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High** / **Very High** / **Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40 / 40-45 / 45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.67	1.50	5.90	Moderate	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.00	1.00	1.00	1.00	Very Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	1.00	20.00	7.22	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**32.02**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………..…..NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..…………...……. …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….……….…..NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**		45.04				
Reach:		**Comments:**								Very High				
Location:	7 L	**Bank Length**	45					**Total Score Values:**		**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023									5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
9.00	0.67	13.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
1.10	9.00	0.12	8.20	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.12	2.44	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**45.04**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I (1)

Transverse and/or central bars-short and/or discontinuous……….. ………………...NBS = High / Very High

Extensive deposition (continuous, cross-channel)…………..………………..……. …………...NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow…………………….…………...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	30.60				
Reach:		**Comments:**							High				
Location:	7 R	**Bank Length**	45					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.67	1.50	5.90	Moderate	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	1.00	0.50	3.90	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.50	15.00	7.90	High	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**30.60**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Adjustments							
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
	Stratification							
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ………………...NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………………..……. ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………...NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	**38.01**				
Reach:		**Comments:**							**High**				
Location:	8 L	**Bank Length**	348					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45

Extreme	45-50												

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
2.00	0.67	3.00	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	2.00	0.25	6.54	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.25	7.50	8.72	Very High	
Bank Angle					
Bank Angle (^{o})			Index	Bank Erosion Potental	Notes
85.00			6.84	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
30.00			5.90	Moderate	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**38.01**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run**	Location: **Boyce Patk**	
Station:	Stream Type:	Valley Type:
Observers: **AT, MM**		Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….....NBS = High / Very High
Extensive deposition (continuous, cross-channel)…………….………….....…… …………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………..NBS = Extreme

Level II

(2)	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	**1**
Dominant Near-Bank Stress	
Extreme	

Level III

(5)	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	30.60				
Reach:		**Comments:**							High				
Location:	8 R	**Bank Length**	348					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
1.00	0.67	1.50	5.90	Moderate	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	1.00	0.50	3.90	Low	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
30.00	0.50	15.00	7.90	High	
Bank Angle					
Bank Angle (^{o})			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
15.00			8.00	Very High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**30.60**		

Bank Erosion Potential

Erodibility Variables			Very Low	Low	Moderate	High	Very High	Extreme
	Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material		
	Bedrock	Bedrock banks have a very low erosion potential.
	Boulders	Boulder banks have a low erosion potential.
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
	Clay/Silt Loam	Add 5 points.
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
	Sand	Add 10 points.
	Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… ……………...….NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..……………..……… ……………...NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow……………………..…………...NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

USFWS - SHARP
STREAM NAME - REACH IDENTIFICATION

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**		**Total Score:**	45.57				
Reach:		**Comments:**							Very High				
Location:	9 L	**Bank Length**	147					**Total Score Values:**	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Date:	1/10/2023								5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables					
Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	0.67	4.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.50	3.00	0.17	7.67	High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
20.00	0.17	3.33	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
90.00			7.90	High	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
5.00			10.00	Extreme	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**45.57**		

Bank Erosion Potential								
			Very Low	Low	Moderate	High	Very High	Extreme
Erodibility Variables	**Bank Height / Bankfull Height**	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
	Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
		Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Adjustments								
Bank Material	**Bedrock**	Bedrock banks have a very low erosion potential.						
	Boulders	Boulder banks have a low erosion potential.						
	Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.						
	Clay/Silt Loam	Add 5 points.						
	Gravel	Add 5-10 points depending on percentage of bank material composed of sand.						
	Sand	Add 10 points.						
	Silt / Clay	No adjustment.						
Stratification								
	Add 5-10 points depending on position of unstable layers in relation to bankfull stage.							

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1) Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2) Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3) Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4) Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5) Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6) Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7) Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
Transverse and/or central bars-short and/or discontinuous………… …………….……NBS = High / Very High
Extensive deposition (continuous, cross-channel)……………..………….…..……. …………....NBS = Extreme
Chute cutoffs, down-valley meander migration, converging flow…………………….……….……NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Extreme**

BANK EROSION HAZARD INDEX

Stream:	UNT to Pierson Run	**Observer(s):**	AT, MM	**Data:**	AT	**QA/QC:**	
Reach:		**Comments:**					
Location:	9 R	**Bank Length**	147				
Date:	1/10/2023						

Total Score:	39.76					
	High					
Total Score Values:	**Very Low**	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
	5-10	10-20	20-30	30-40	40-45	45-50

Erodibility Variables

Bank Height / Bankfull Height Ratio					
Bank Height	Bankfull Height	Value	Index	Bank Erosion Potental	Notes
3.00	0.67	4.50	10.00	Extreme	
Root Depth / Bank Height Ratio					
Root Depth	Bank Height	Value	Index	Bank Erosion Potental	Notes
0.33	3.00	0.11	8.32	Very High	
Weighted Root Density					
Root Density (%)	Root Depth / Bank Height	Value	Index	Bank Erosion Potental	Notes
40.00	0.11	4.44	10.00	Extreme	
Bank Angle					
Bank Angle (°)			Index	Bank Erosion Potental	Notes
70.00			4.90	Moderate	
Surface Protection					
Surface Protection (%)			Index	Bank Erosion Potental	Notes
25.00			6.54	High	
			Adjustment		Notes
Bank Materials					
			Adjustment		Notes
Bank Stratification					
		TOTAL SCORE	**39.76**		

Bank Erosion Potential

Erodibility Variables		Very Low	Low	Moderate	High	Very High	Extreme
Bank Height / Bankfull Height	Value	1.00-1.10	1.11-1.19	1.20-1.50	1.60-2.00	2.10-2.80	>2.80
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Root Depth / Bank Height	Value	1.00-0.90	0.89-0.50	0.49-0.30	0.29-0.15	0.14-0.05	<0.05
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Weighted Root Density	Value	100-80	79-55	54-30	29-15	14-5	<5
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Bank Angle	Value	0-20	21-60	61-80	81-90	91-119	>119
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10
Surface Protection	Value	100-80	79-55	54-30	29-15	14-10	<10
	Index	1.0-1.9	2.0-3.9	4.0-5.9	6.0-7.9	8.0-9.0	10

Adjustments

Bank Material	
Bedrock	Bedrock banks have a very low erosion potential.
Boulders	Boulder banks have a low erosion potential.
Cobble	Substract 10 points. No adjustment if sand/gravel compose greater than 50% of bank.
Clay/Silt Loam	Add 5 points.
Gravel	Add 5-10 points depending on percentage of bank material composed of sand.
Sand	Add 10 points.
Silt / Clay	No adjustment.

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage.

Worksheet 3-12. Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate erosion rate.

Estimating Near-Bank Stress (NBS)

Stream: **UNT to Pierson Run** Location: **Boyce Patk**

Station: Stream Type: Valley Type:

Observers: **AT, MM** Date: **1/10/23**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)
- Transverse and/or central bars-short and/or discontinuous………………………....NBS = High / Very High
- Extensive deposition (continuous, cross-channel)………………………………………..NBS = Extreme
- Chute cutoffs, down-valley meander migration, converging flow………………………………NBS = Extreme

Level II

	Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)
(2)				

	Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)
(3)				

	Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)
(4)				

Method	1
Dominant Near-Bank Stress	
Extreme	

Level III

	Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
(5)				

	Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)
(6)								

Level IV

	Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
(7)		

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	Method number						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Very Low	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating | **Extreme**

Photo Location 1

Photo Location 2

Photo Location 3

Photo Location 4

Photo Location 5

Photo Location 6

Photo Location 7

Photo Location 8

Appendix D2: Supporting Stormwater Data

PCSM SUPORTING CALCULATIONS - BMP DESIGN

1. BASIN SUMMARY
2. DRAINAGE AREA / LAND COVER MAPS
3. LAND COVER AREA CALCULATIONS
4. BASIN CALCULATIONS
5. ANTI-SEEP COLLAR CALCULATIONS
6. PIPE CAPACITY CALCULATIONS
7. RIPRAP APRONG OUTLET PROTECTION CALCULATIONS
8. PA RAINFALL INTENSITY CHARTS (PENNDOT PUB 584)

Purpose:

Install BMP's throughout the Sawmill Run Watershed to reduce 10-year storm event peak flows to maximum extent feasible.

Existing Conditions:

SCM 001 and SCM 002

SCM 001 and SCM 002 are proposed to be placed at the low end of Moore Park and at the headwaters of UNT to Sawmill Run. Each location are flat wood/brush areas that sit directly above the deep valley that carries UNT to Sawmill run. SCM 001 is to be placed adjacent to an existing paved parking area along the Southwest corner of the park. SCM 002 will be located to the north of SCM 001 adjacent to an existing ball field perimeter fence. Moore Park runoff is mostly collected by inlets and conveyed by means of storm sewer system. The discharge points of the existing system could not be located.

SCM 003

SCM 003 will be located adjacent to Crane Avenue across from the entrance to Brashear Public School. The location of the basin is a flat area consisting mostly of brush and trees and located near UNT to Sawmill Run channel banks. The basin will be placed adjacent to an existing pipe outfall. The source of the outfall is primarilly runoff from the Brashear Public School Property. A portion of the flow from this outfall will be directed to SCM 003.

Proposed Conditions;

Each SCM will be Dry Detention type BMP consisting of a Primary Outlet Structure, Emergency Outlet Structure, and associated piping with Anti-Seep Collars. Each Primary Outlet Structure will be a PennDOT inlet box that includes a low flow vertical orifice that controls 10-year storm event. The top of the box will remain open and will serve as a horizontal orifice/weir controlling the 100-year storm event. The Primary Outlet Structure has been designed to provide a minimum of 1' of freeboard. The Emergency Outlet Structure will be a PennDOT inlet box with the top of box serving as an emergency spillway in the event the Primary Outlet Structure is clogged or not functioning as designed. The Emergency Spillway is designed to convey the 100-year storm event without overtopping of the basin.

Capacity calculations have been computed for proposed inflow and outflow pipes. Inflow pipes entering the basin have been designed to convey 10-year storm event. Outflow pipes from the Primary and Emergency Outlet structures have been designed to convey 100-year storm event. Outflow pipes for each basin will discharge to UNT's to Sawmill Run.

SCM 001 will collect runoff from approximately 2.44 acres of Moore Park. The drainage area currently drains to an existing brick lined swale which is then collected by an existing inlet and pipe with an unknow discharge point. It is assumed that the existing inlet/pipe is part of a larger conveyance system that drains the uper reaches of Moore Park. It is proposed that the existing conveyance system will remain in-place and the inlet that currently collects 2.44 acre drainage area be capped and and runoff be directed to a new separate system that conveys flow to proposed SCM-001.

SCM 002 will collect sheet flow runoff from the existing ball field and adjacent wooded hillside/ and residential grass area located above Moore Park. Runoff is currently collected along the perimeter of the ball field and conveyed overland to UNT to Sawmill Run.

SCM 003 will collect a portion of runoff that originates from the Brashear school property located above the proposed basin location. Currently, Brashear School runoff is collected and discharged to an existing outfall located adjacent to the proposed basin which Calculated flow from the drainage area exceeds the capacity of the proposed basin. The existing endwall at the outfall will be replaced with a manhole that is designed to split flow sending a portion of flow to the proposed basin and remaining flow to UNT to Sawmill Run.

Basin Calculations:

Basin calculations were computed using HydroCAD Software (See attached output). Input for HydroCAD model includes the following:

Drainage Area:

Drainage areas delineated using Lidar Contours, existing storm sewer mapping, and field visits.

Land Cover:

Land Cover areas were computed using aerial imagery and verified during field views.

Time of Concentration:

Time of Concentration segments were determined using Lidar Contours, Aerial Imagery, and field views. Total Tc value was computed in HydroCAD.

Rainfall Data:

Rainfall data for the 10-year and 100-year events was obtained from Publication 584, Chapter 7, Appendix A 'Field manual for Pennsylvania

Pre to Post Comparison

SCM-001		
Design Year Storm	Pre-Constr (cfs)	Post-Constr (cfs)
10	5.31	2.96
100	10.2	9.02

SCM-002		
Design Year Storm	Pre-Constr (cfs)	Post-Constr (cfs)
10	5.32	3.33
100	11.57	11.42

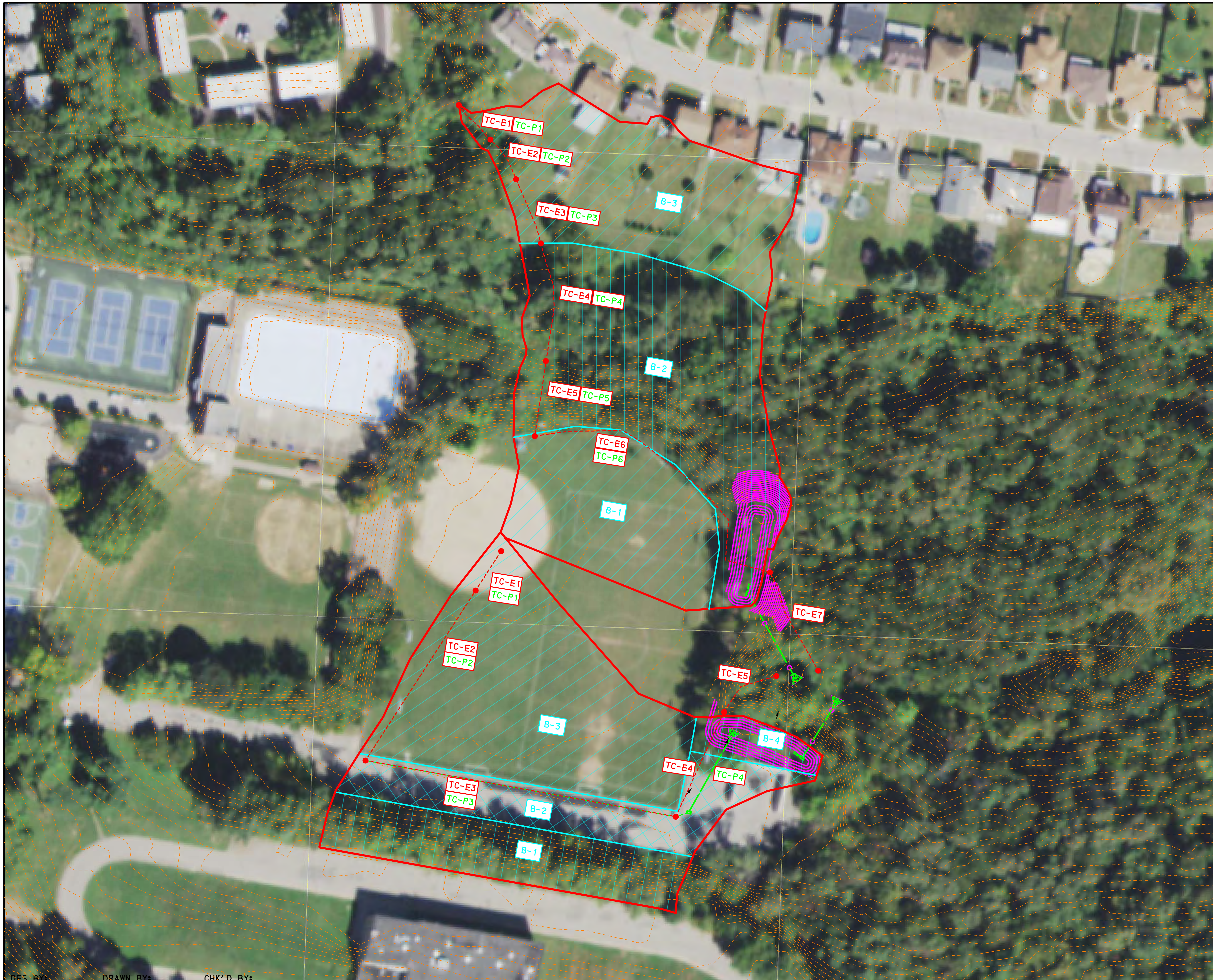
SCM-003		
Design Year Storm	Pre-Constr (cfs)	Post-Constr (cfs)
10	43.29	38.05
100	72.96	72.45

DRAINAGE AREA / LAND COVER MAPS

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
11-0	ALLEGHENY	SAWMILL RUN		OF 15

CITY OF PITTSBURGH

REV NO	REVISIONS	DATE	BY	APPD



LEGEND:

- LIDAR EXISTING CONTOUR
- PROPOSED DRAINAGE AREA
- PROPOSED PIPE
- PROPOSED CONTOUR
- TC-E1 EXIST Tc PATH / SEGMENT
- TC-P1 PROPOSED Tc PATH / SEGMENT
- PAVED PARKING, HSG C
- WOODS, FAIR, HSG C
- 50-75% GRASS COVER, FAIR, HSG C
- B-1 LAND USE AREA LABEL

MOORE PARK
SCM 001 & SCM 002
DRAINAGE AREA / LAND COVER MAP

0 50 100 FEET

D2-6

DES BY: ________ DRAWN BY: ________ CHK'D BY: ______

PLOTTED: 10/19/2022 10:57:51 PM

FILE NAME: G:\21-068 Stream Restoration MS4 Sawmill Run_Ohio Watershed\CADD\Env\Exhibits\Moore Park_SCM 001 Drainage Areas.dgn

PLOTTED: 10/19/2022 11:05:02 PM

FILE NAME: G:\21-068 Stream Restoration MS4 Sawmill Run_Ohio Watershed\CADD\Env\Exhibits\Crane Avenue_SCM 003 Drainage Areas.dgn

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
11-0	ALLEGHENY	SAWMILL RUN		OF 15

CITY OF PITTSBURGH

REV NO	REVISIONS	DATE	BY	APPD

LEGEND:

- LIDAR EXISTING CONTOUR
- DRAINAGE AREA
- PROPOSED CONTOUR
- TC-E1 EXIST/PROP Tc PATH / SEGMENT
- PAVED ROADS WITH CURBS, HSG C
- OPEN SPACE, FAIR CONDITION, HSG C
- WOODS, FAIR, HSG-C
- 1/2 ACRE RESIDENTIAL LOTS, HSG-C
- B-1 LAND USE AREA LABEL

CRANE AVE
SCM 003
DRAINAGE AREA/LAND COVER MAP

0 50 100 FEET

D2-7

DES BY: ________ DRAWN BY: ________ CHK'D BY: ______

LAND COVER AREA CALCULATIONS

MARKOSKY
3689 Route 711 • Ligonier, PA 15658
724.238.4138 • www.markosky.com
COLLABORATIVE ENGINEERING

Subjext: Sawmill Run - MS4
Land Cover Calcs - SCM 001

Area	Woods, Fair, HSG C		50-75% Grass cover, Fair, HSG C		Paved parking, HSG C	
	SF	Acre	SF	Acre	SF	Acre
B-1	23393.0106	0.537029628				
B-2					23010.4272	0.528
B-3			54637.4905	1.25430419		
B-4	5470	0.125573921				
Totals	28863.0106	0.663	54637.4905	1.254	23010.4272	0.528

TOTAL AREA **2.445 ACRES**

MARKOSKY
3689 Route 711 • Ligonier, PA 15658
724.238.4138 • www.markosky.com
COLLABORATIVE ENGINEERING

Subjext: Sawmill Run - MS4
Land Cover Calcs - SCM 002

Area	Woods, Fair, HSG C		50-75% Grass cover, Fair, HSG C		Paved parking, HSG C	
	SF	Acre	SF	Acre	SF	Acre
B-1			31036.9126	0.71		
B-2	61925.7392	1.42				
B-3			44905.3018	1.03		
Totals	61925.7392	1.422	75942.2144	1.743	0	0.000

TOTAL AREA **3.165 ACRES**

MARKOSKY
3689 Route 711 • Ligonier, PA 15658
724.238.4138 • www.markosky.com
COLLABORATIVE ENGINEERING

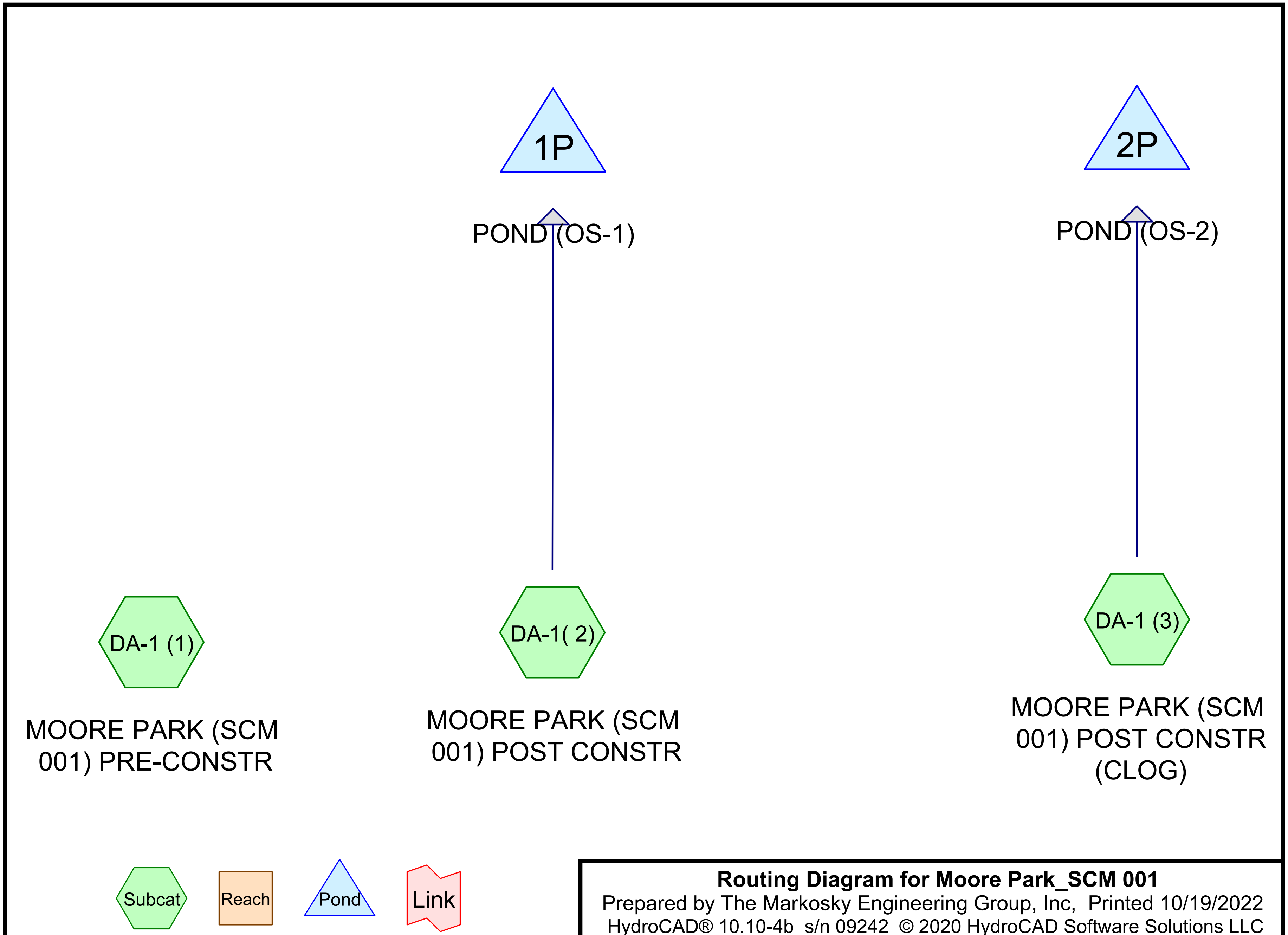
Subjext: Sawmill Run - MS4
Land Cover Calcs - SCM 003

Area	Impervious Areas, HSG C		1/2 Acre Residential Lot, HSG C		Open Space, Fair Condtion, HSG C		Woods , Fair Condtion, HSG C	
	SF	Acre	SF	Acre	SF	Acre	SF	Acre
B-1	292864.9724	6.72						
B-2					108110.7478	2.48		
B-3							25766.9792	0.59
B-4			4260.0728	0.10				
B-5							68933.3266	1.58
B-6							8056.4819	0.18
Totals	292864.9724	6.723	4260.0728	0.098	108110.7478	2.482	102756.7877	2.359

TOTAL AREA **11.662 ACRES**

BASIN CALCULATIONS

SCM-001 (10-YEAR)



Routing Diagram for Moore Park_SCM 001
Prepared by The Markosky Engineering Group, Inc, Printed 10/19/2022

Summary for Subcatchment DA-1 (1): MOORE PARK (SCM 001) PRE-CONSTR

Runoff = 5.31 cfs @ 12.07 hrs, Volume= 14,734 cf, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.44"

Area (ac)	CN	Description
0.663	73	Woods, Fair, HSG C
1.254	79	50-75% Grass cover, Fair, HSG C
0.528	98	Paved parking, HSG C
2.445	81	Weighted Average
1.917		78.40% Pervious Area
0.528		21.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0100	0.10		**Sheet Flow, TC-E1**
					Grass: Short n= 0.150 P2= 2.40"
5.1	215	0.0100	0.70		**Shallow Concentrated Flow, TC-E2**
					Short Grass Pasture Kv= 7.0 fps
0.2	336	0.0050	22.90	297.65	**Channel Flow, TC-E3**
					Area= 13.0 sf Perim= 2.2' r= 5.91'
					n= 0.015 Brickwork
0.5	124	0.0100	4.56	5.60	**Pipe Channel, TC-E4**
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.015 Concrete sewer w/manholes & inlets
0.0	40	0.5000	51.55	5,155.34	**Channel Flow, TC-E5**
					Area= 100.0 sf Perim= 56.0' r= 1.79'
					n= 0.030 Stream, clean & straight
14.4	765	Total			

Summary for Subcatchment DA-1(2): MOORE PARK (SCM 001) POST CONSTR

[47] Hint: Peak is 121% of capacity of segment #4

Runoff = 4.79 cfs @ 12.10 hrs, Volume= 14,734 cf, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.44"

Area (ac)	CN	Description
0.663	73	Woods, Fair, HSG C
1.254	79	50-75% Grass cover, Fair, HSG C
0.528	98	Paved parking, HSG C
2.445	81	Weighted Average
1.917		78.40% Pervious Area
0.528		21.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0100	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
5.1	215	0.0100	0.70		**Shallow Concentrated Flow, TC-P2** Short Grass Pasture Kv= 7.0 fps
3.4	336	0.0050	1.64	6.55	**Channel Flow, TC-P3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.030
0.6	110	0.0050	3.23	3.96	**Pipe Channel, TC-E4** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
17.7	711	Total			

Summary for Pond 1P: POND (OS-1)

Inflow Area = 106,504 sf, 21.60% Impervious, Inflow Depth = 1.66" for 10 year event
Inflow = 4.79 cfs @ 12.10 hrs, Volume= 14,734 cf
Outflow = 2.96 cfs @ 12.26 hrs, Volume= 14,734 cf, Atten= 38%, Lag= 9.1 min
Primary = 2.96 cfs @ 12.26 hrs, Volume= 14,734 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,096.58' @ 12.26 hrs Surf.Area= 2,174 sf Storage= 2,541 cf

Plug-Flow detention time= 15.7 min calculated for 14,724 cf (100% of inflow)
Center-of-Mass det. time= 15.9 min (859.5 - 843.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,095.00'	6,429 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,095.00	1,080	213.0	0	0	1,080
1,096.00	1,758	235.0	1,405	1,405	1,896
1,097.00	2,505	258.0	2,121	3,526	2,831
1,098.00	3,320	280.0	2,903	6,429	3,811

Device	Routing	Invert	Outlet Devices
#1	Primary	1,092.45'	**18.0" Round Culvert** L= 4.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,092.45' / 1,092.41' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,095.00'	**9.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,096.70'	**45.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.96 cfs @ 12.26 hrs HW=1,096.58' (Free Discharge)
└─**1=Culvert** (Passes 2.96 cfs of 19.54 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.96 cfs @ 5.25 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

SCM-001 (100-YEAR)

Summary for Subcatchment DA-1 (1): MOORE PARK (SCM 001) PRE-CONSTR

[47] Hint: Peak is 182% of capacity of segment #4

Runoff = 10.20 cfs @ 12.06 hrs, Volume= 28,386 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
0.663	73	Woods, Fair, HSG C
1.254	79	50-75% Grass cover, Fair, HSG C
0.528	98	Paved parking, HSG C
2.445	81	Weighted Average
1.917		78.40% Pervious Area
0.528		21.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0100	0.10		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
5.1	215	0.0100	0.70		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
0.2	336	0.0050	22.90	297.65	**Channel Flow, TC-E3** Area= 13.0 sf Perim= 2.2' r= 5.91' n= 0.015 Brickwork
0.5	124	0.0100	4.56	5.60	**Pipe Channel, TC-E4** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
0.0	40	0.5000	51.55	5,155.34	**Channel Flow, TC-E5** Area= 100.0 sf Perim= 56.0' r= 1.79' n= 0.030 Stream, clean & straight
14.4	765	Total			

Summary for Subcatchment DA-1(2): MOORE PARK (SCM 001) POST CONSTR

[47] Hint: Peak is 141% of capacity of segment #3
[47] Hint: Peak is 233% of capacity of segment #4

Runoff = 9.23 cfs @ 12.10 hrs, Volume= 28,386 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
0.663	73	Woods, Fair, HSG C
1.254	79	50-75% Grass cover, Fair, HSG C
0.528	98	Paved parking, HSG C
2.445	81	Weighted Average
1.917		78.40% Pervious Area
0.528		21.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0100	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
5.1	215	0.0100	0.70		**Shallow Concentrated Flow, TC-P2** Short Grass Pasture Kv= 7.0 fps
3.4	336	0.0050	1.64	6.55	**Channel Flow, TC-P3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.030
0.6	110	0.0050	3.23	3.96	**Pipe Channel, TC-E4** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
17.7	711	Total			

Summary for Pond 1P: POND (OS-1)

Inflow Area = 106,504 sf, 21.60% Impervious, Inflow Depth = 3.20" for 100 year event
Inflow = 9.23 cfs @ 12.10 hrs, Volume= 28,386 cf
Outflow = 9.02 cfs @ 12.13 hrs, Volume= 28,386 cf, Atten= 2%, Lag= 1.9 min
Primary = 9.02 cfs @ 12.13 hrs, Volume= 28,386 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,096.98' @ 12.13 hrs Surf.Area= 2,489 sf Storage= 3,478 cf

Plug-Flow detention time= 13.2 min calculated for 28,367 cf (100% of inflow)
Center-of-Mass det. time= 13.3 min (838.2 - 824.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,095.00'	6,429 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,095.00	1,080	213.0	0	0	1,080
1,096.00	1,758	235.0	1,405	1,405	1,896
1,097.00	2,505	258.0	2,121	3,526	2,831
1,098.00	3,320	280.0	2,903	6,429	3,811

Device	Routing	Invert	Outlet Devices
#1	Primary	1,092.45'	**18.0" Round Culvert** L= 4.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,092.45' / 1,092.41' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,095.00'	**9.0" W x 9.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,096.70'	**45.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.87 cfs @ 12.13 hrs HW=1,096.98' (Free Discharge)
└─**1=Culvert** (Passes 8.87 cfs of 20.67 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.42 cfs @ 6.08 fps)
  └─**3=Orifice/Grate** (Weir Controls 5.46 cfs @ 1.72 fps)

SCM-001 (100-YEAR)
CLOGGED CONDITION

Summary for Subcatchment DA-1 (3): MOORE PARK (SCM 001) POST CONSTR (CLOG)

[47] Hint: Peak is 142% of capacity of segment #3
[47] Hint: Peak is 166% of capacity of segment #4

Runoff = 9.28 cfs @ 12.10 hrs, Volume= 28,386 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
0.663	73	Woods, Fair, HSG C
1.254	79	50-75% Grass cover, Fair, HSG C
0.528	98	Paved parking, HSG C
2.445	81	Weighted Average
1.917		78.40% Pervious Area
0.528		21.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	50	0.0100	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.40"
5.1	215	0.0100	0.70		**Shallow Concentrated Flow, TC-P2** Short Grass Pasture Kv= 7.0 fps
3.4	336	0.0050	1.64	6.55	**Channel Flow, TC-P3** Area= 4.0 sf Perim= 12.5' r= 0.32' n= 0.030
0.4	110	0.0100	4.56	5.60	**Pipe Channel, TC-P4** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
17.5	711	Total			

Summary for Pond 2P: POND (OS-2)

Inflow Area = 106,504 sf, 21.60% Impervious, Inflow Depth = 3.20" for 100 year event
Inflow = 9.28 cfs @ 12.10 hrs, Volume= 28,386 cf
Outflow = 9.15 cfs @ 12.12 hrs, Volume= 24,861 cf, Atten= 1%, Lag= 1.3 min
Primary = 9.15 cfs @ 12.12 hrs, Volume= 24,861 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 1,097.39' @ 12.12 hrs Surf.Area= 2,809 sf Storage= 4,561 cf

Plug-Flow detention time= 87.4 min calculated for 24,843 cf (88% of inflow)
Center-of-Mass det. time= 27.6 min (852.3 - 824.7)

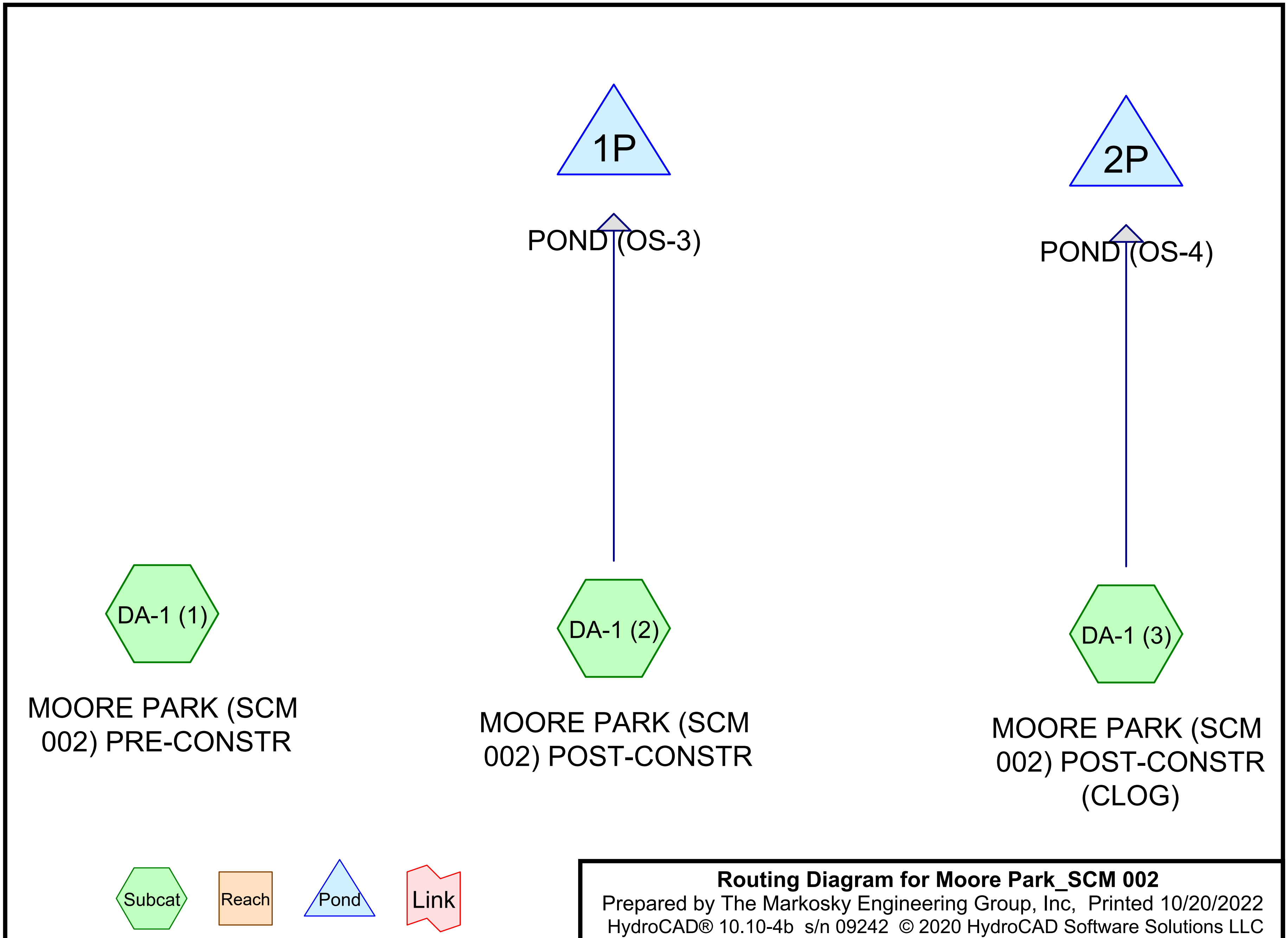
Volume	Invert	Avail.Storage	Storage Description
#1	1,095.00'	6,429 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,095.00	1,080	213.0	0	0	1,080
1,096.00	1,758	235.0	1,405	1,405	1,896
1,097.00	2,505	258.0	2,121	3,526	2,831
1,098.00	3,320	280.0	2,903	6,429	3,811

Device	Routing	Invert	Outlet Devices
#1	Primary	1,086.78'	**18.0" Round Culvert** L= 28.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,086.78' / 1,065.71' S= 0.7525 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,097.00'	**45.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.00 cfs @ 12.12 hrs HW=1,097.39' (Free Discharge)
└─**1=Culvert** (Passes 9.00 cfs of 33.39 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 9.00 cfs @ 2.03 fps)

SCM-002 (10-YEAR)



Routing Diagram for Moore Park_SCM 002
Prepared by The Markosky Engineering Group, Inc, Printed 10/20/2022
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Summary for Subcatchment DA-1 (1): MOORE PARK (SCM 002) PRE-CONSTR

Runoff = 4.87 cfs @ 12.05 hrs, Volume= 12,687 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.30"

Area (ac)	CN	Description
2.453	73	Woods, Fair, HSG C
0.713	79	50-75% Grass cover, Fair, HSG C
0.000	98	Paved parking, HSG C
3.166	74	Weighted Average
3.166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1700	0.30		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.3	52	0.2000	3.13		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
0.5	74	0.1351	2.57		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
1.4	128	0.0900	1.50		**Shallow Concentrated Flow, TC-E4** Woodland Kv= 5.0 fps
0.4	80	0.4000	3.16		**Shallow Concentrated Flow, TC-E5** Woodland Kv= 5.0 fps
5.6	334	0.0200	0.99		**Shallow Concentrated Flow, TC-E6** Short Grass Pasture Kv= 7.0 fps
0.8	117	0.2700	2.60		**Shallow Concentrated Flow, TC-E7** Woodland Kv= 5.0 fps
11.8	835	Total			

Summary for Subcatchment DA-1 (2): MOORE PARK (SCM 002) POST-CONSTR

Runoff = 4.87 cfs @ 12.05 hrs, Volume= 12,687 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.30"

Area (ac)	CN	Description
2.453	73	Woods, Fair, HSG C
0.713	79	50-75% Grass cover, Fair, HSG C
0.000	98	Paved parking, HSG C
3.166	74	Weighted Average
3.166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1700	0.30		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.3	52	0.2000	3.13		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
0.5	74	0.1351	2.57		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
1.4	128	0.0900	1.50		**Shallow Concentrated Flow, TC-E4** Woodland Kv= 5.0 fps
0.4	80	0.4000	3.16		**Shallow Concentrated Flow, TC-E5** Woodland Kv= 5.0 fps
5.6	334	0.0200	0.99		**Shallow Concentrated Flow, TC-E6** Short Grass Pasture Kv= 7.0 fps
0.8	117	0.2700	2.60		**Shallow Concentrated Flow, TC-E7** Woodland Kv= 5.0 fps
11.8	835	Total			

Summary for Pond 1P: POND (OS-3)

Inflow Area = 137,911 sf, 0.00% Impervious, Inflow Depth = 1.10" for 10 year event
Inflow = 4.87 cfs @ 12.05 hrs, Volume= 12,687 cf
Outflow = 2.40 cfs @ 12.19 hrs, Volume= 12,687 cf, Atten= 51%, Lag= 8.5 min
Primary = 2.40 cfs @ 12.19 hrs, Volume= 12,687 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 1,098.59' @ 12.19 hrs Surf.Area= 2,106 sf Storage= 2,514 cf

Plug-Flow detention time= 18.3 min calculated for 12,687 cf (100% of inflow)
Center-of-Mass det. time= 18.0 min (880.2 - 862.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,097.00'	6,192 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,097.00	1,079	200.0	0	0	1,079
1,098.00	1,711	219.0	1,383	1,383	1,746
1,099.00	2,400	238.0	2,046	3,429	2,474
1,100.00	3,143	256.0	2,763	6,192	3,224

Device	Routing	Invert	Outlet Devices
#1	Primary	1,093.73'	**18.0" Round Culvert** L= 4.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,093.73' / 1,093.67' S= 0.0150 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,097.00'	**8.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,098.60'	**45.2" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.39 cfs @ 12.19 hrs HW=1,098.59' (Free Discharge)
└─**1=Culvert** (Passes 2.39 cfs of 21.56 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.39 cfs @ 5.38 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

SCM-002 (100-YEAR)

Summary for Subcatchment DA-1 (1): MOORE PARK (SCM 002) PRE-CONSTR

Runoff = 11.57 cfs @ 12.04 hrs, Volume= 29,388 cf, Depth= 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
2.453	73	Woods, Fair, HSG C
0.713	79	50-75% Grass cover, Fair, HSG C
0.000	98	Paved parking, HSG C
3.166	74	Weighted Average
3.166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1700	0.30		**Sheet Flow, TC-E1**
					Grass: Short n= 0.150 P2= 2.40"
0.3	52	0.2000	3.13		**Shallow Concentrated Flow, TC-E2**
					Short Grass Pasture Kv= 7.0 fps
0.5	74	0.1351	2.57		**Shallow Concentrated Flow, TC-E3**
					Short Grass Pasture Kv= 7.0 fps
1.4	128	0.0900	1.50		**Shallow Concentrated Flow, TC-E4**
					Woodland Kv= 5.0 fps
0.4	80	0.4000	3.16		**Shallow Concentrated Flow, TC-E5**
					Woodland Kv= 5.0 fps
5.6	334	0.0200	0.99		**Shallow Concentrated Flow, TC-E6**
					Short Grass Pasture Kv= 7.0 fps
0.8	117	0.2700	2.60		**Shallow Concentrated Flow, TC-E7**
					Woodland Kv= 5.0 fps
11.8	835	Total			

Summary for Subcatchment DA-1 (2): MOORE PARK (SCM 002) POST-CONSTR

Runoff = 11.57 cfs @ 12.04 hrs, Volume= 29,388 cf, Depth= 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
2.453	73	Woods, Fair, HSG C
0.713	79	50-75% Grass cover, Fair, HSG C
0.000	98	Paved parking, HSG C
3.166	74	Weighted Average
3.166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1700	0.30		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.3	52	0.2000	3.13		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
0.5	74	0.1351	2.57		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
1.4	128	0.0900	1.50		**Shallow Concentrated Flow, TC-E4** Woodland Kv= 5.0 fps
0.4	80	0.4000	3.16		**Shallow Concentrated Flow, TC-E5** Woodland Kv= 5.0 fps
5.6	334	0.0200	0.99		**Shallow Concentrated Flow, TC-E6** Short Grass Pasture Kv= 7.0 fps
0.8	117	0.2700	2.60		**Shallow Concentrated Flow, TC-E7** Woodland Kv= 5.0 fps
11.8	835	Total			

Summary for Pond 1P: POND (OS-3)

Inflow Area = 137,911 sf, 0.00% Impervious, Inflow Depth = 2.56" for 100 year event
Inflow = 11.57 cfs @ 12.04 hrs, Volume= 29,388 cf
Outflow = 11.42 cfs @ 12.06 hrs, Volume= 29,388 cf, Atten= 1%, Lag= 1.2 min
Primary = 11.42 cfs @ 12.06 hrs, Volume= 29,388 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 1,098.98' @ 12.06 hrs Surf.Area= 2,382 sf Storage= 3,370 cf

Plug-Flow detention time= 13.8 min calculated for 29,388 cf (100% of inflow)
Center-of-Mass det. time= 13.5 min (850.8 - 837.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,097.00'	6,192 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,097.00	1,079	200.0	0	0	1,079
1,098.00	1,711	219.0	1,383	1,383	1,746
1,099.00	2,400	238.0	2,046	3,429	2,474
1,100.00	3,143	256.0	2,763	6,192	3,224

Device	Routing	Invert	Outlet Devices
#1	Primary	1,093.73'	**18.0" Round Culvert** L= 4.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,093.73' / 1,093.67' S= 0.0150 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,097.00'	**8.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,098.60'	**45.2" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.21 cfs @ 12.06 hrs HW=1,098.97' (Free Discharge)
└─**1=Culvert** (Passes 11.21 cfs of 22.54 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.73 cfs @ 6.15 fps)
  └─**3=Orifice/Grate** (Weir Controls 8.48 cfs @ 1.99 fps)

SCM-002 (100-YEAR)
CLOGGED CONDITION

Summary for Subcatchment DA-1 (3): MOORE PARK (SCM 002) POST-CONSTR (CLOG)

Runoff = 11.57 cfs @ 12.04 hrs, Volume= 29,388 cf, Depth= 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
2.453	73	Woods, Fair, HSG C
0.713	79	50-75% Grass cover, Fair, HSG C
0.000	98	Paved parking, HSG C
3.166	74	Weighted Average
3.166		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	50	0.1700	0.30		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.3	52	0.2000	3.13		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
0.5	74	0.1351	2.57		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
1.4	128	0.0900	1.50		**Shallow Concentrated Flow, TC-E4** Woodland Kv= 5.0 fps
0.4	80	0.4000	3.16		**Shallow Concentrated Flow, TC-E5** Woodland Kv= 5.0 fps
5.6	334	0.0200	0.99		**Shallow Concentrated Flow, TC-E6** Short Grass Pasture Kv= 7.0 fps
0.8	117	0.2700	2.60		**Shallow Concentrated Flow, TC-E7** Woodland Kv= 5.0 fps
11.8	835	Total			

Summary for Pond 2P: POND (OS-4)

Inflow Area = 137,911 sf, 0.00% Impervious, Inflow Depth = 2.56" for 100 year event
Inflow = 11.57 cfs @ 12.04 hrs, Volume= 29,388 cf
Outflow = 11.34 cfs @ 12.06 hrs, Volume= 25,959 cf, Atten= 2%, Lag= 1.2 min
Primary = 11.34 cfs @ 12.06 hrs, Volume= 25,959 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 1,099.45' @ 12.06 hrs Surf.Area= 2,721 sf Storage= 4,577 cf

Plug-Flow detention time= 81.8 min calculated for 25,959 cf (88% of inflow)
Center-of-Mass det. time= 23.7 min (861.0 - 837.3)

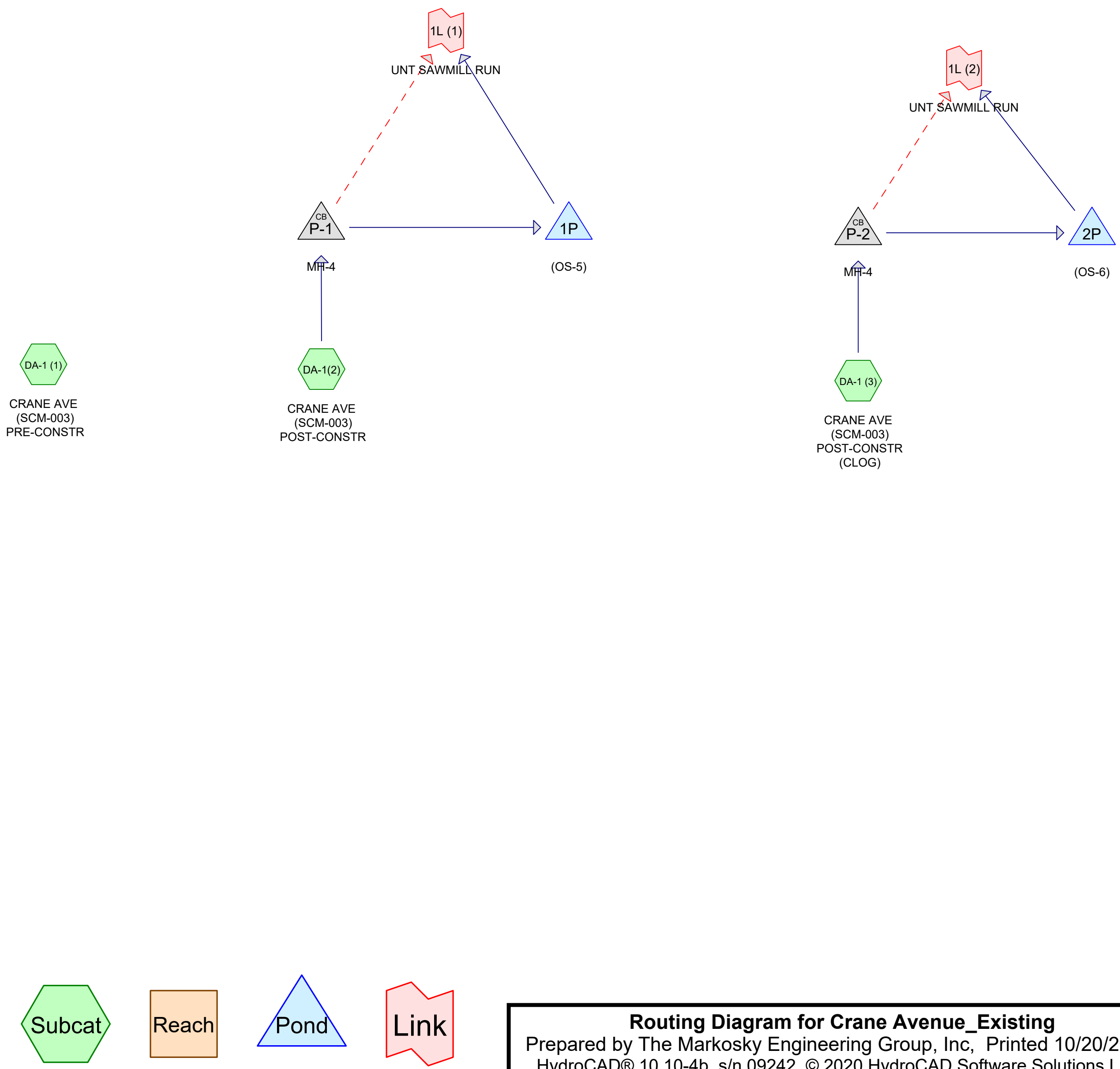
Volume	Invert	Avail.Storage	Storage Description
#1	1,097.00'	6,192 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
1,097.00	1,079	200.0	0	0	1,079
1,098.00	1,711	219.0	1,383	1,383	1,746
1,099.00	2,400	238.0	2,046	3,429	2,474
1,100.00	3,143	256.0	2,763	6,192	3,224

Device	Routing	Invert	Outlet Devices
#1	Primary	1,093.50'	**18.0" Round Culvert** L= 34.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 1,093.50' / 1,091.80' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	1,099.00'	**45.2" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.17 cfs @ 12.06 hrs HW=1,099.44' (Free Discharge)
└**1=Culvert** (Passes 11.17 cfs of 24.24 cfs potential flow)
  └**2=Orifice/Grate** (Weir Controls 11.17 cfs @ 2.18 fps)

SCM-003 (10-YEAR)



Routing Diagram for Crane Avenue_Existing
Prepared by The Markosky Engineering Group, Inc, Printed 10/20/2022
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Summary for Subcatchment DA-1 (1): CRANE AVE (SCM-003) PRE-CONSTR

Runoff = 43.29 cfs @ 11.99 hrs, Volume= 97,433 cf, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.44"

Area (ac)	CN	Description
6.723	98	Paved roads w/curbs & sewers, HSG C
0.098	80	1/2 acre lots, 25% imp, HSG C
2.480	79	50-75% Grass cover, Fair, HSG C
2.360	73	Woods, Fair, HSG C
11.661	89	Weighted Average
4.913		42.14% Pervious Area
6.747		57.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	50	0.1000	0.24		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.5	60	0.0700	1.85		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
1.4	212	0.1300	2.52		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.5000	4.95		**Shallow Concentrated Flow, TC-E4** Short Grass Pasture Kv= 7.0 fps
1.7	174	0.0600	1.71		**Shallow Concentrated Flow, TC-E5** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.0300	11.15	19.71	**Pipe Channel, TC-E6** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	190	0.3100	35.85	63.36	**Pipe Channel, TC-E7** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	132	0.0740	17.52	30.96	**Pipe Channel, TC-E8** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.0	55	0.1500	24.94	44.07	**Pipe Channel, TC-E9** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
7.6	1,095	Total			

Summary for Subcatchment DA-1(2): CRANE AVE (SCM-003) POST-CONSTR

Runoff = 43.29 cfs @ 11.99 hrs, Volume= 97,433 cf, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 year Rainfall=3.44"

Area (ac)	CN	Description
6.723	98	Paved roads w/curbs & sewers, HSG C
0.098	80	1/2 acre lots, 25% imp, HSG C
2.480	79	50-75% Grass cover, Fair, HSG C
2.360	73	Woods, Fair, HSG C
11.661	89	Weighted Average
4.913		42.14% Pervious Area
6.747		57.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	50	0.1000	0.24		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.5	60	0.0700	1.85		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
1.4	212	0.1300	2.52		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.5000	4.95		**Shallow Concentrated Flow, TC-E4** Short Grass Pasture Kv= 7.0 fps
1.7	174	0.0600	1.71		**Shallow Concentrated Flow, TC-E5** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.0300	11.15	19.71	**Pipe Channel, TC-E6** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	190	0.3100	35.85	63.36	**Pipe Channel, TC-E7** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	132	0.0740	17.52	30.96	**Pipe Channel, TC-E8** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.0	55	0.1500	24.94	44.07	**Pipe Channel, TC-E9** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
7.6	1,095	Total			

Summary for Pond 1P: (OS-5)

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 1.38" for 10 year event
Inflow = 10.76 cfs @ 11.97 hrs, Volume= 58,217 cf
Outflow = 8.52 cfs @ 12.06 hrs, Volume= 58,205 cf, Atten= 21%, Lag= 5.2 min
Primary = 8.52 cfs @ 12.06 hrs, Volume= 58,205 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 958.84' @ 12.06 hrs Surf.Area= 3,048 sf Storage= 6,306 cf

Plug-Flow detention time= 15.5 min calculated for 58,205 cf (100% of inflow)
Center-of-Mass det. time= 15.1 min (870.5 - 855.3)

Volume	Invert	Avail.Storage	Storage Description
#1	956.00'	10,290 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
956.00	1,473	157.0	0	0	1,473
957.00	1,976	177.0	1,718	1,718	2,030
958.00	2,536	195.0	2,250	3,969	2,595
959.00	3,152	215.0	2,838	6,807	3,279
960.00	3,825	233.0	3,483	10,290	3,958

Device	Routing	Invert	Outlet Devices
#1	Primary	952.75'	**18.0" Round Culvert** L= 2.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 952.75' / 952.71' S= 0.0200 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	956.00'	**12.2" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	958.70'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.19 cfs @ 12.06 hrs HW=958.82' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 8.19 cfs of 24.54 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 5.95 cfs @ 7.32 fps)
  └─**3=Orifice/Grate** (Weir Controls 2.25 cfs @ 1.15 fps)

Summary for Pond P-1: MH-4

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 2.30" for 10 year event
Inflow = 43.29 cfs @ 11.99 hrs, Volume= 97,433 cf
Outflow = 43.29 cfs @ 11.99 hrs, Volume= 97,433 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.76 cfs @ 11.97 hrs, Volume= 58,217 cf
Secondary = 32.48 cfs @ 11.99 hrs, Volume= 39,216 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 961.73' @ 11.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	958.00'	**15.0" Round Culvert** L= 84.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.00' / 956.00' S= 0.0238 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	958.25'	**27.0" Round Culvert** L= 46.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.25' / 957.79' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.98 sf

Primary OutFlow Max=10.08 cfs @ 11.97 hrs HW=961.52' TW=958.52' (Dynamic Tailwater)
1=Culvert (Outlet Controls 10.08 cfs @ 8.21 fps)

Secondary OutFlow Max=31.61 cfs @ 11.99 hrs HW=961.63' TW=0.00' (Dynamic Tailwater)
2=Culvert (Barrel Controls 31.61 cfs @ 7.95 fps)

Summary for Link 1L (1): UNT SAWMILL RUN

Inflow Area =	507,953 sf, 57.86% Impervious,	Inflow Depth = 2.30"	for 10 year event
Inflow =	38.05 cfs @ 12.00 hrs, Volume=	97,422 cf	
Primary =	38.05 cfs @ 12.00 hrs, Volume=	97,422 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

SCM-003 (100-YEAR)

Summary for Subcatchment DA-1 (1): CRANE AVE (SCM-003) PRE-CONSTR

Runoff = 72.96 cfs @ 11.99 hrs, Volume= 169,407 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
6.723	98	Paved roads w/curbs & sewers, HSG C
0.098	80	1/2 acre lots, 25% imp, HSG C
2.480	79	50-75% Grass cover, Fair, HSG C
2.360	73	Woods, Fair, HSG C
11.661	89	Weighted Average
4.913		42.14% Pervious Area
6.747		57.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	50	0.1000	0.24		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.5	60	0.0700	1.85		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
1.4	212	0.1300	2.52		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.5000	4.95		**Shallow Concentrated Flow, TC-E4** Short Grass Pasture Kv= 7.0 fps
1.7	174	0.0600	1.71		**Shallow Concentrated Flow, TC-E5** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.0300	11.15	19.71	**Pipe Channel, TC-E6** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	190	0.3100	35.85	63.36	**Pipe Channel, TC-E7** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	132	0.0740	17.52	30.96	**Pipe Channel, TC-E8** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.0	55	0.1500	24.94	44.07	**Pipe Channel, TC-E9** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
7.6	1,095	Total			

Summary for Subcatchment DA-1(2): CRANE AVE (SCM-003) POST-CONSTR

Runoff = 72.96 cfs @ 11.99 hrs, Volume= 169,407 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
6.723	98	Paved roads w/curbs & sewers, HSG C
0.098	80	1/2 acre lots, 25% imp, HSG C
2.480	79	50-75% Grass cover, Fair, HSG C
2.360	73	Woods, Fair, HSG C
11.661	89	Weighted Average
4.913		42.14% Pervious Area
6.747		57.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	50	0.1000	0.24		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.5	60	0.0700	1.85		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
1.4	212	0.1300	2.52		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.5000	4.95		**Shallow Concentrated Flow, TC-E4** Short Grass Pasture Kv= 7.0 fps
1.7	174	0.0600	1.71		**Shallow Concentrated Flow, TC-E5** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.0300	11.15	19.71	**Pipe Channel, TC-E6** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	190	0.3100	35.85	63.36	**Pipe Channel, TC-E7** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	132	0.0740	17.52	30.96	**Pipe Channel, TC-E8** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.0	55	0.1500	24.94	44.07	**Pipe Channel, TC-E9** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
7.6	1,095	Total			

Summary for Pond P-1: MH-4

Inflow Area =	507,953 sf,	57.86% Impervious,	Inflow Depth = 4.00"	for 100 year event
Inflow =	72.96 cfs @	11.99 hrs, Volume=	169,407 cf	
Outflow =	72.96 cfs @	11.99 hrs, Volume=	169,407 cf,	Atten= 0%, Lag= 0.0 min
Primary =	14.85 cfs @	11.98 hrs, Volume=	89,411 cf	
Secondary =	58.11 cfs @	11.99 hrs, Volume=	79,995 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 965.38' @ 11.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	958.00'	**15.0" Round Culvert** L= 84.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.00' / 956.00' S= 0.0238 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	958.25'	**27.0" Round Culvert** L= 46.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.25' / 957.79' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.98 sf

Primary OutFlow Max=14.31 cfs @ 11.98 hrs HW=965.03' TW=958.97' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 14.31 cfs @ 11.66 fps)

Secondary OutFlow Max=56.30 cfs @ 11.99 hrs HW=965.08' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Barrel Controls 56.30 cfs @ 14.16 fps)

Summary for Pond 1P: (OS-5)

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 2.11" for 100 year event
Inflow = 14.85 cfs @ 11.98 hrs, Volume= 89,411 cf
Outflow = 14.60 cfs @ 12.01 hrs, Volume= 89,400 cf, Atten= 2%, Lag= 1.4 min
Primary = 14.60 cfs @ 12.01 hrs, Volume= 89,400 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 959.00' @ 12.01 hrs Surf.Area= 3,150 sf Storage= 6,795 cf

Plug-Flow detention time= 13.8 min calculated for 89,400 cf (100% of inflow)
Center-of-Mass det. time= 13.4 min (848.8 - 835.3)

Volume	Invert	Avail.Storage	Storage Description
#1	956.00'	10,290 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
956.00	1,473	157.0	0	0	1,473
957.00	1,976	177.0	1,718	1,718	2,030
958.00	2,536	195.0	2,250	3,969	2,595
959.00	3,152	215.0	2,838	6,807	3,279
960.00	3,825	233.0	3,483	10,290	3,958

Device	Routing	Invert	Outlet Devices
#1	Primary	952.75'	**18.0" Round Culvert** L= 2.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 952.75' / 952.71' S= 0.0200 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	956.00'	**12.2" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	958.70'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=14.39 cfs @ 12.01 hrs HW=958.99' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 14.39 cfs of 24.92 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 6.16 cfs @ 7.59 fps)
  └─**3=Orifice/Grate** (Weir Controls 8.23 cfs @ 1.77 fps)

Summary for Link 1L (1): UNT SAWMILL RUN

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 4.00" for 100 year event
Inflow = 72.45 cfs @ 11.99 hrs, Volume= 169,396 cf
Primary = 72.45 cfs @ 11.99 hrs, Volume= 169,396 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

SCM-003 (100-YEAR)
CLOGGED CONDITION

Summary for Subcatchment DA-1 (3): CRANE AVE (SCM-003) POST-CONSTR (CLOG)

Runoff = 72.96 cfs @ 11.99 hrs, Volume= 169,407 cf, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=5.24"

Area (ac)	CN	Description
6.723	98	Paved roads w/curbs & sewers, HSG C
0.098	80	1/2 acre lots, 25% imp, HSG C
2.480	79	50-75% Grass cover, Fair, HSG C
2.360	73	Woods, Fair, HSG C
11.661	89	Weighted Average
4.913		42.14% Pervious Area
6.747		57.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	50	0.1000	0.24		**Sheet Flow, TC-E1** Grass: Short n= 0.150 P2= 2.40"
0.5	60	0.0700	1.85		**Shallow Concentrated Flow, TC-E2** Short Grass Pasture Kv= 7.0 fps
1.4	212	0.1300	2.52		**Shallow Concentrated Flow, TC-E3** Short Grass Pasture Kv= 7.0 fps
0.1	22	0.5000	4.95		**Shallow Concentrated Flow, TC-E4** Short Grass Pasture Kv= 7.0 fps
1.7	174	0.0600	1.71		**Shallow Concentrated Flow, TC-E5** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.0300	11.15	19.71	**Pipe Channel, TC-E6** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	190	0.3100	35.85	63.36	**Pipe Channel, TC-E7** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.1	132	0.0740	17.52	30.96	**Pipe Channel, TC-E8** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
0.0	55	0.1500	24.94	44.07	**Pipe Channel, TC-E9** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
7.6	1,095	Total			

Summary for Pond P-2: MH-4

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 4.00" for 100 year event
Inflow = 72.96 cfs @ 11.99 hrs, Volume= 169,407 cf
Outflow = 72.96 cfs @ 11.99 hrs, Volume= 169,407 cf, Atten= 0%, Lag= 0.0 min
Primary = 14.38 cfs @ 11.98 hrs, Volume= 27,678 cf
Secondary = 58.57 cfs @ 11.99 hrs, Volume= 141,729 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 965.46' @ 11.99 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	958.00'	**15.0" Round Culvert** L= 84.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.00' / 956.00' S= 0.0238 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	958.25'	**27.0" Round Culvert** L= 46.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 958.25' / 957.79' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.98 sf

Primary OutFlow Max=13.93 cfs @ 11.98 hrs HW=965.15' TW=959.41' (Dynamic Tailwater)
└—**1=Culvert** (Outlet Controls 13.93 cfs @ 11.35 fps)

Secondary OutFlow Max=56.75 cfs @ 11.99 hrs HW=965.16' TW=0.00' (Dynamic Tailwater)
└—**2=Culvert** (Barrel Controls 56.75 cfs @ 14.27 fps)

Summary for Pond 2P: (OS-6)

Inflow Area = 507,953 sf, 57.86% Impervious, Inflow Depth = 0.65" for 100 year event
Inflow = 14.38 cfs @ 11.98 hrs, Volume= 27,678 cf
Outflow = 14.03 cfs @ 12.00 hrs, Volume= 20,871 cf, Atten= 2%, Lag= 1.0 min
Primary = 14.03 cfs @ 12.00 hrs, Volume= 20,871 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 959.42' @ 12.00 hrs Surf.Area= 3,424 sf Storage= 8,174 cf

Plug-Flow detention time= 86.0 min calculated for 20,842 cf (75% of inflow)
Center-of-Mass det. time= 61.5 min (722.1 - 660.6)

Volume	Invert	Avail.Storage	Storage Description
#1	956.00'	10,290 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
956.00	1,473	157.0	0	0	1,473
957.00	1,976	177.0	1,718	1,718	2,030
958.00	2,536	195.0	2,250	3,969	2,595
959.00	3,152	215.0	2,838	6,807	3,279
960.00	3,825	233.0	3,483	10,290	3,958

Device	Routing	Invert	Outlet Devices
#1	Primary	951.02'	**18.0" Round Culvert** L= 45.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 951.02' / 950.11' S= 0.0202 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#2	Device 1	959.00'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=13.99 cfs @ 12.00 hrs HW=959.42' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 13.99 cfs of 28.73 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 13.99 cfs @ 2.11 fps)

Summary for Link 1L (2): UNT SAWMILL RUN

Inflow Area =	507,953 sf,	57.86% Impervious,	Inflow Depth = 3.84"	for 100 year event	
Inflow =	72.47 cfs @	11.99 hrs,	Volume=	162,600 cf	
Primary =	72.47 cfs @	11.99 hrs,	Volume=	162,600 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

ANTI-SEEP COLLAR CALCULATIONS

MARKOSKY 3689 Route 711 • Ligonier, PA 15658 724.238.4138 • www.markosky.com COLLABORATIVE ENGINEERING	Subject : Subject : Sawmill Run - MS4	Calculated By:	WBM	Date:	10/13/2022
	Crane Avenue SCM-003	Checked By:		Date:	

DRY EXTENDED DETENTION BASIN (SCM 001) - ANTI-SEEP COLLAR

Length of Pipe in Saturated Zone (Ls)

Ls = y(z+4) [1+(Pipe Slope / 0.25-pipe slope)

y = Distance from upstream invert of principal spillway riser to top of dewatering volume

T/ Dewatering Volume Elev =	959.31	FT	(Top of WSE under Clogged Conditions)
Invert Elev. =	951.02	FT	(Invert Out - Emergency Spillway)
y =	8.29	FT	

z = Horizontal component of upstream embankment slope

z = 3.00

Pipe Slope = 0.0200 FT/FT

Ls = **63.08** **FT**

Required Increase in Flow Path (Lf)

Lf = 1.15Ls (FT)

Lf = **72.54** **FT**

Minimum Collar Project (Vmin)

Vmin = (Lf - Ls) / 2 x N

Lf - Ls = 9.46 FT

N = Number of Collars

N = 3.00 EA

Vmin = **1.58** **FT** USE **2** **FT**

Maximum Collar Spacing (Smax)

Smax = Ls (N-1)

Smax = **31.54** **FT** USE **32** **FT**

Minimum Collar Spacing (Smin)

Smin = 5 x V

Smin = **7.88** **FT** USE **8** **FT**

SUMMARY

Collar Height and Width = PIPE OD + (V x 2)

Pipe OD = 24.00 IN

Colllar Height & Width = **5** **FT**

MARKOSKY
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COLLABORATIVE ENGINEERING

Subject : Subject : Sawmill Run - MS4	Calculated By:	WBM	Date:	10/10/2022
Moore Park SCM 002	Checked By:		Date:	

DRY EXTENDED DETENTION BASIN (SCM 002) - ANTI-SEEP COLLAR

Length of Pipe in Saturated Zone (Ls)

Ls = y(z+4) [1+(Pipe Slope / 0.25-pipe slope)

y = Distance from upstream invert of principal spillway riser to top of dewatering volume

T/ Dewatering Volume Elev =	1099.45	FT	(Top of WSE under Clogged Conditions)
Invert Elev. =	1093.50	FT	(Invert Out - Emergency Spillway)
y =	5.95	FT	

z = Horizontal component of upstream embankment slope

z = 3.00

Pipe Slope = 0.0500 FT/FT

Ls = **52.06** **FT**

Required Increase in Flow Path (Lf)

Lf = 1.15Ls (FT)

Lf = **59.87** **FT**

Minimum Collar Project (Vmin)

Vmin = (Lf - Ls) / 2 x N

Lf - Ls = 7.81 FT

N = Number of Collars

N = 3.00 EA

Vmin = **1.30** **FT** USE **1** **FT**

Maximum Collar Spacing (Smax)

Smax = Ls (N-1)

Smax = **26.03** **FT** USE **26** **FT**

Minimum Collar Spacing (Smin)

Smin = 5 x V

Smin = **6.51** **FT** USE **7** **FT**

SUMMARY

Collar Height and Width = PIPE OD + (V x 2)

Pipe OD = 24.00 IN

Colllar Height & Width = **5** **FT**

DRY EXTENDED DETENTION BASIN (SCM 003) - ANTI-SEEP COLLAR

Length of Pipe in Saturated Zone (Ls)

Ls = y(z+4) [1+(Pipe Slope / 0.25-pipe slope)

y = Distance from upstream invert of principal spillway riser to top of dewatering volume

T/ Dewatering Volume Elev =	959.31	FT	(Top of WSE under Clogged Conditions)
Invert Elev. =	951.02	FT	(Invert Out - Emergency Spillway)
y =	8.29	FT	

z = Horizontal component of upstream embankment slope

z = 3.00

Pipe Slope = 0.0200 FT/FT

Ls = **63.08** **FT**

Required Increase in Flow Path (Lf)

Lf = 1.15Ls (FT)

Lf = **72.54** **FT**

Minimum Collar Project (Vmin)

Vmin = (Lf - Ls) / 2 x N

Lf - Ls = 9.46 FT

N = Number of Collars

N = 3.00 EA

Vmin = **1.58** **FT** USE **2** **FT**

Maximum Collar Spacing (Smax)

Smax = Ls (N-1)

Smax = **31.54** **FT** USE **32** **FT**

Minimum Collar Spacing (Smin)

Smin = 5 x V

Smin = **7.88** **FT** USE **8** **FT**

SUMMARY

Collar Height and Width = PIPE OD + (V x 2)

Pipe OD = 24.00 IN

Colllar Height & Width = **5** **FT**

PIPE CAPACITY CALCULATIONS

DRAINAGE COMPUTATION FORM
STORM SEWER, HYDRAULIC DESIGN

PROJECT NAME MS4 Sawmill Run
PROJECT NUMBER

DESIGNER WBM
REVIEWER

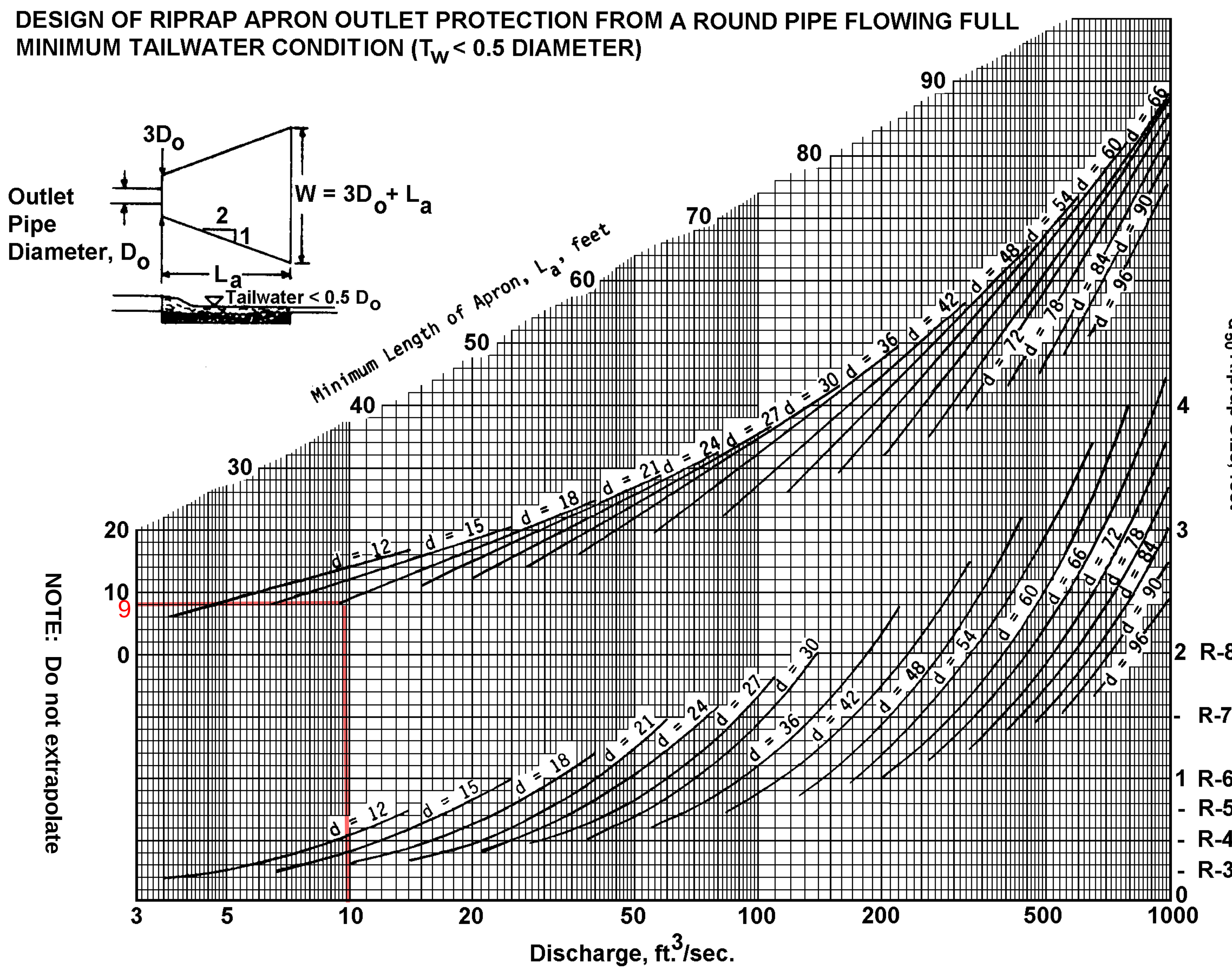
DATE 10/18/2022
DATE

SHEET 1 **OF** 1

						GRATE		PIPE DEPTH ANALYSIS				HYDRAULIC DESIGN														
FROM INLET	TO INLET	ROUTE	STATION OF INLET	SIDE OFFSET	INCREMENTAL RUNOFF (cfs)	BYPASS FROM UPSTREAM INLET (cfs)	GRATE CAPACITY (cfs)	DISTANCE FROM TOP RIM TO INSIDE TOP PIPE (ft)	FILL ABOVE TOP OF PIPE (ft)	MIN REQ'D FILL BASED ON PIPE STRENGTH AND LOCATION (ft)	MIN REQ'D FILL BASED ON INLET BOX CONFIGURATION (ft)	FLOW IN PIPE (cfs)	TOP OF RIM (GROUND) (ft)	PIPE INVERT OUT (ft)	PIPE INVERT IN (ft)	LENGTH OF PIPE (ft)	SLOPE OF PIPE (ft/ft)	TYPE OF PIPE	MANNING'S n VALUE	SIZE OF PIPE (in)	phi (assumed) (Degree)	AREA OF PARTIALLY FULL PIPE (ft^2)	DESIGN FLOW (cfs)	MEAN VELOCITY (fps)	PIPE CAPACITY FLOWING FULL (cfs)	REMARKS
SCM-001																										
I-1	EW-1	Moore	-	-	-	0.00	16.00	1.52	1.50	1.50	1.42	7.09	1099.29	1095.74	1095.28	91.00	0.0051	TP	0.012	18			7.09	5.25	8.09	10-YR STORM EVENT
OS-1	OS-2	Moore	-	-	-	0.00	-	-	-	-	-	9.02	-	1092.45	1092.41	4.00	0.0100	RCP	0.012	18			9.02	7.23	11.38	100-YR STORM EVENT - SCM 001 OS-1
OS-2	MH-1	Moore	-	-	-	0.00	-	-	-	-	-	9.15	-	1092.25	1092.07	17.50	0.0103	TP	0.012	18			9.15	7.33	11.54	100-YR STORM EVENT - SCM 001 OS-2 Governs
MH-1	MH-2	Moore	-	-	-	0.00	-	-	-	-	-	9.15	-	1086.78	1065.71	28.00	0.7525	TP	0.012	18			9.15	31.06	98.68	100-YR STORM EVENT - SCM 001 OS-2 Governs
MH-2	EW-2	Moore	-	-	-	0.00	-	-	-	-	-	2.96	-	1064.03	1063.99	4.00	0.0100	TP	0.012	18			2.96	5.29	11.38	10-YR STORM EVENT - SCM 001 OS-1
MH-2	EW-2	Moore	-	-	-	0.00	-	-	-	-	-	9.15	-	1064.03	1063.99	4.00	0.0100	TP	0.012	18			9.15	7.26	11.38	100-YR STORM EVENT - SCM 001 OS-2 Governs
SCM-002																										
OS-3	OS-4	Moore				0.00	-	-	-	-	-	11.42	-	1093.73	1093.67	4.00	0.0150	TP	0.012	18			11.42	8.93	13.93	100-YR STORM EVENT - SCM 002 OS-3 Normal Function
OS-4	MH-3	Moore				0.00						11.42		1093.50	1091.80	34.00	0.0500	TP	0.012	18			11.42	13.78	25.44	100-YR STORM EVENT - SCM 002 OS-3 Governs
MH-3	MH-4	Moore				0.00						11.42		1087.69	1068.84	50.00	0.3770	TP	0.012	18			11.42	27.33	69.85	100-YR STORM EVENT - SCM 002 OS-3 Governs
MH-4	EW-3	Moore				0.00						2.40		1068.43	1068.32	7.00	0.0150	TP	0.012	18			2.40	5.53	13.93	10-YR STORM EVENT - SCM 002 OS-3
MH-4	EW-3	Moore				0.00						11.42		1068.43	1068.32	7.00	0.0150	TP	0.012	18			11.42	8.93	13.93	100-YR STORM EVENT - SCM 002 OS-3 Governs
SCM-003																										
MH-4	EW-4	Crane				0.00						10.76		958.00	956.00	84.00	0.0238	TP	0.012	15			10.76	10.13	10.79	10-YR STORM EVENT - SCM 003
MH-4	EW-5	Crane				0.00						32.87		958.25	957.79	46.00	0.0100	TP	0.012	27			32.87	9.73	33.54	10-YR STORM EVENT - SCM 003
OS-5	OS-6	Crane				0.00						14.60		952.75	952.71	2.00	0.0200	TP	0.012	18			14.60	10.47	16.09	100-YR STORM EVENT - SCM 003 OS-5 Governs
OS-6	EW-6	Crane				0.00						8.52		951.02	950.11	45.00	0.0202	TP	0.012	18			8.52	9.17	16.18	100-YR STORM EVENT - SCM 003 OS-5 Normal Function
OS-6	EW-6	Crane				0.00						14.60		951.02	950.11	45.00	0.0202	TP	0.012	18			14.60	10.53	16.18	100-YR STORM EVENT - SCM 003 OS-5 Normal Function

RIPRAP APRON OUTLET PROTECTION

Moore Park
OP - EW1



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

Adapted from USDA - NRCS

NOTE: Do not extrapolate

Not to be used for Box Culverts

Moore Park
OP - EW1

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / **Rock Size (Inches)**	**R-8**	**R-7**	**R-6**	**R-5**	**R-4**	**R-3**
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	11.5	9.0	$\boxed{6.5}$

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-1 = 5.25 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

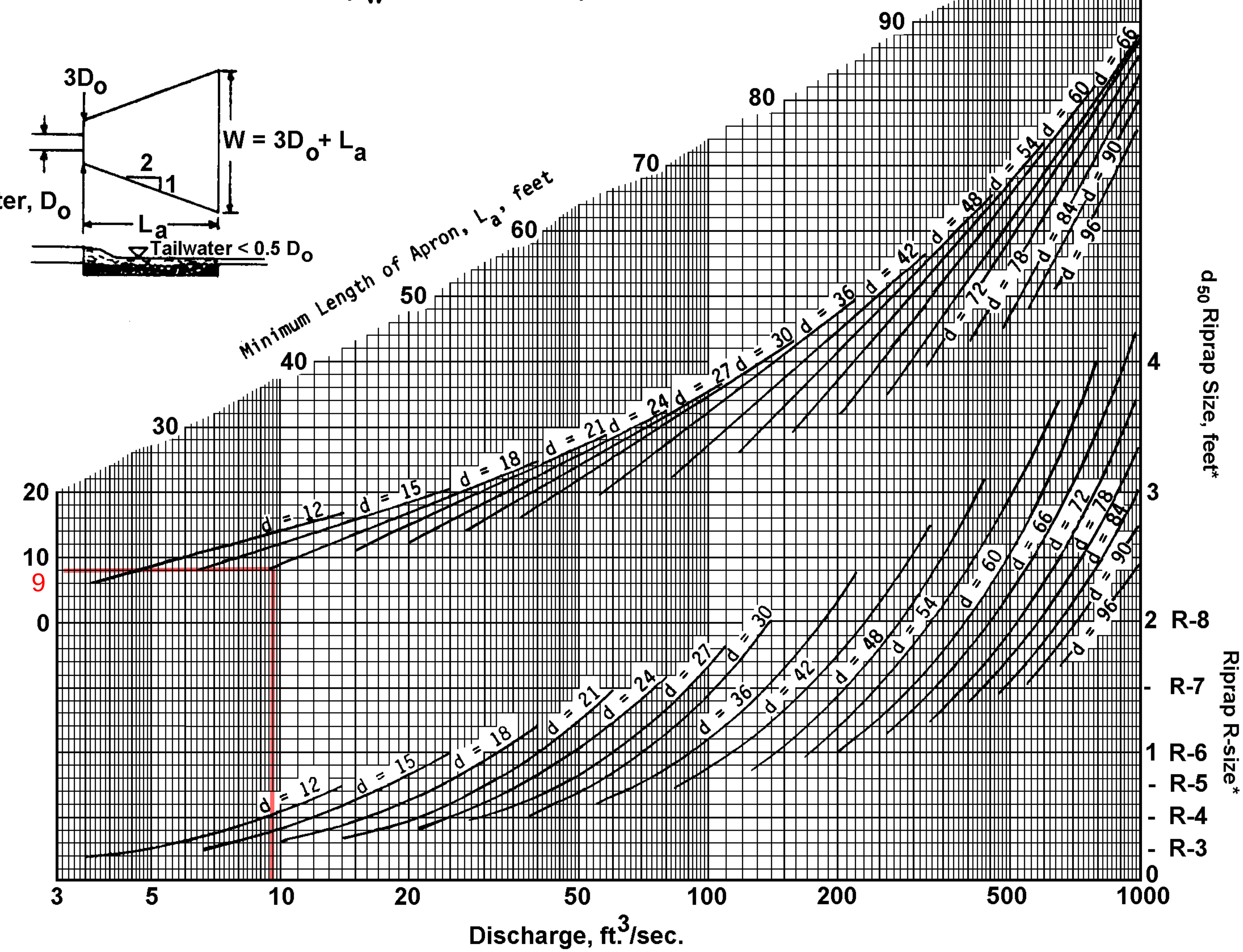
PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

Moore Park
OP - EW2

Adapted from USDA - NRCS

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

NOTE: Do not extrapolate

Not to be used for Box Culverts

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

Moore Park
OP - EW2

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / **Rock Size (Inches)**	**R-8**	**R-7**	**R-6**	**R-5**	**R-4**	**R-3**
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	11.5	$\boxed{9.0}$	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-2 = 7.26 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

Moore Park
OP - EW3

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / **Rock Size (Inches)**	**R-8**	**R-7**	**R-6**	**R-5**	**R-4**	**R-3**
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	11.5	$\boxed{9.0}$	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-3 = 8.93 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

Moore Park
OP - EW3

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)

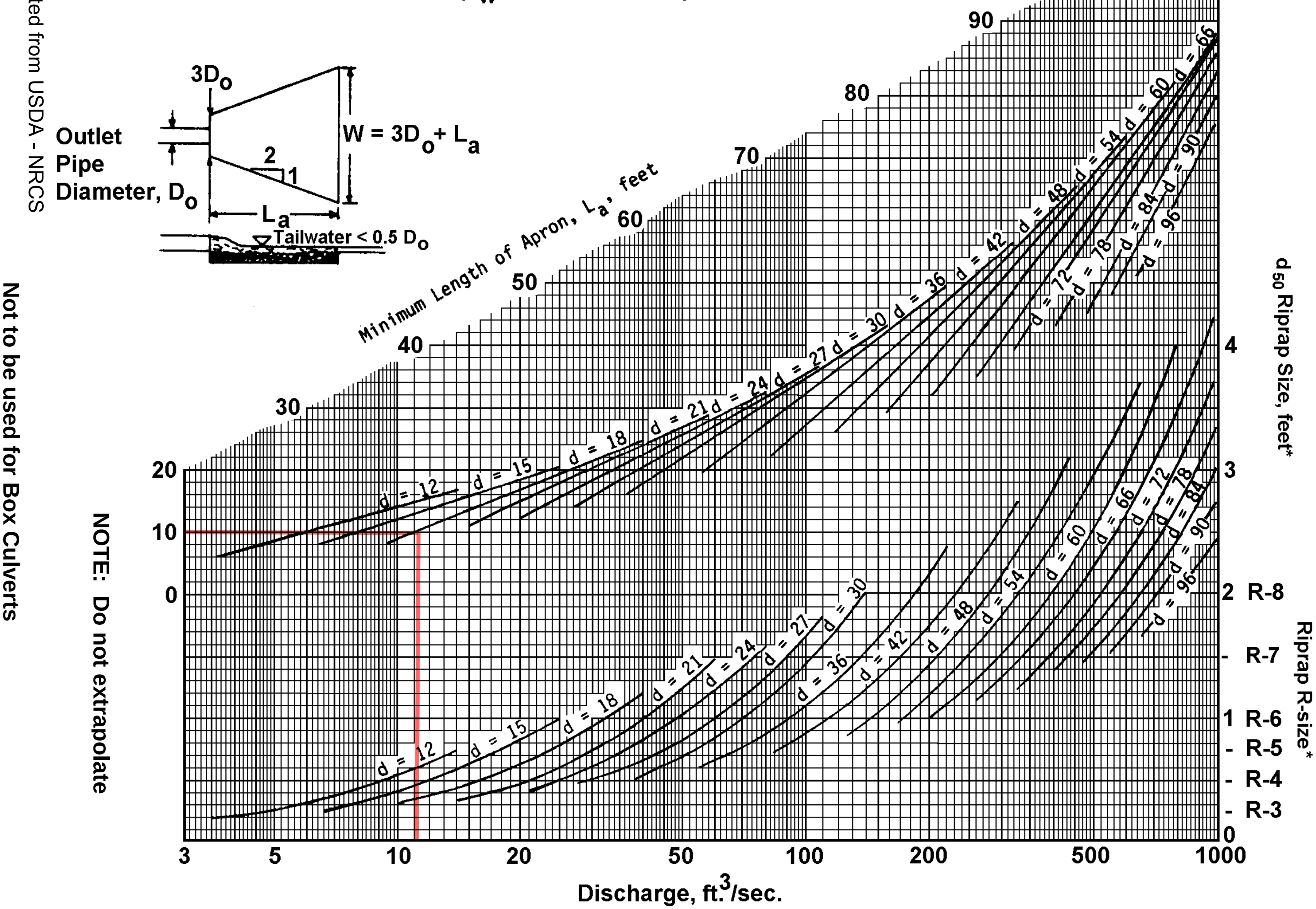


FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Moore Park
OP - EW4

Adapted from USDA - NRCS

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)

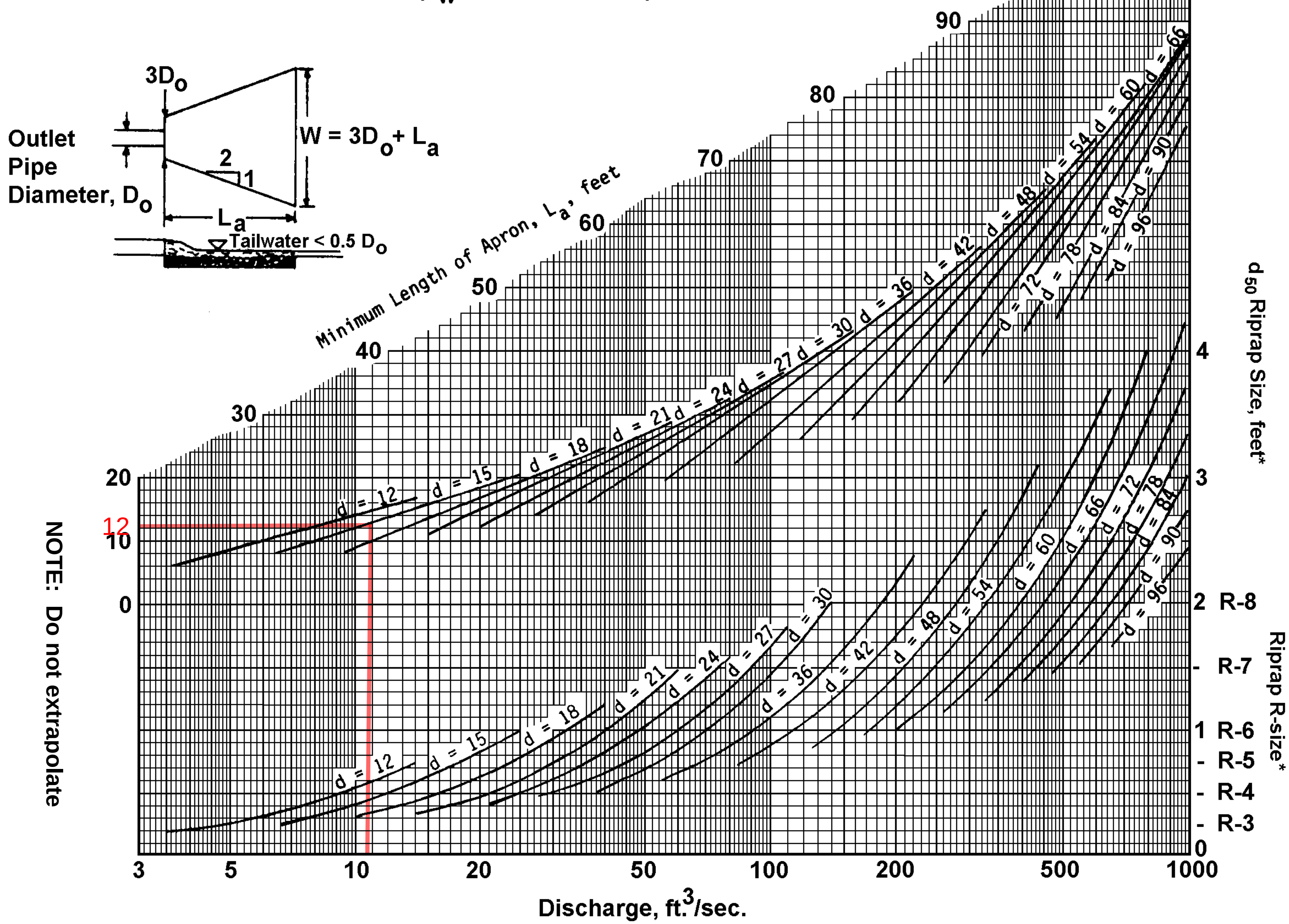


FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

Moore Park
OP - EW4

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / Rock Size (Inches)	R-8	R-7	R-6	R-5	R-4	R-3
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	$\boxed{11.5}$	9.0	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-4 = 10.13 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

Moore Park
OP - EW5

Not to be used for Box Culverts

Adapted from USDA - NRCS

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)

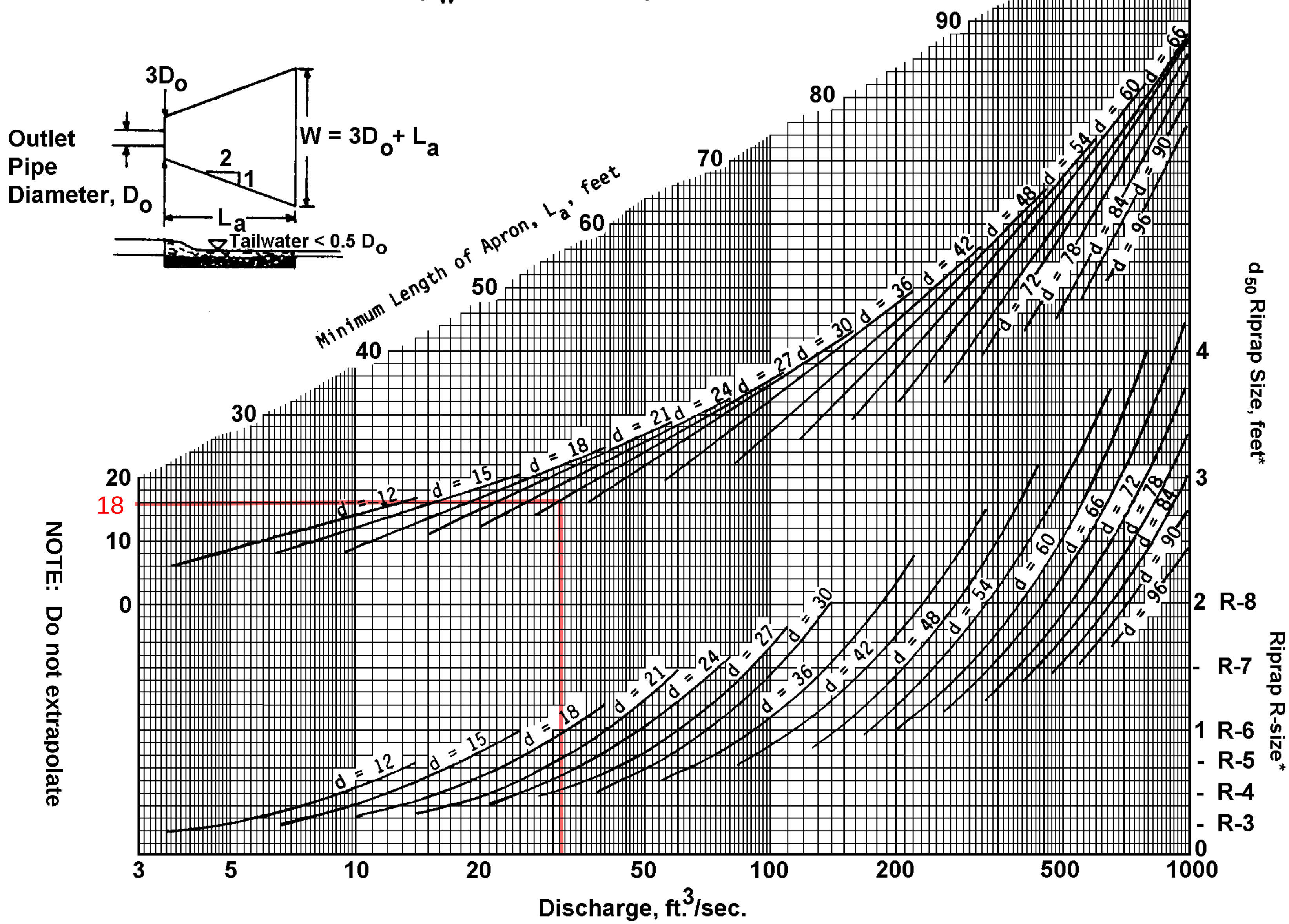


FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Moore Park
OP - EW5

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / **Rock Size (Inches)**	**R-8**	**R-7**	**R-6**	**R-5**	**R-4**	**R-3**
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	11.5	9.0	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-5 = 9.73 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

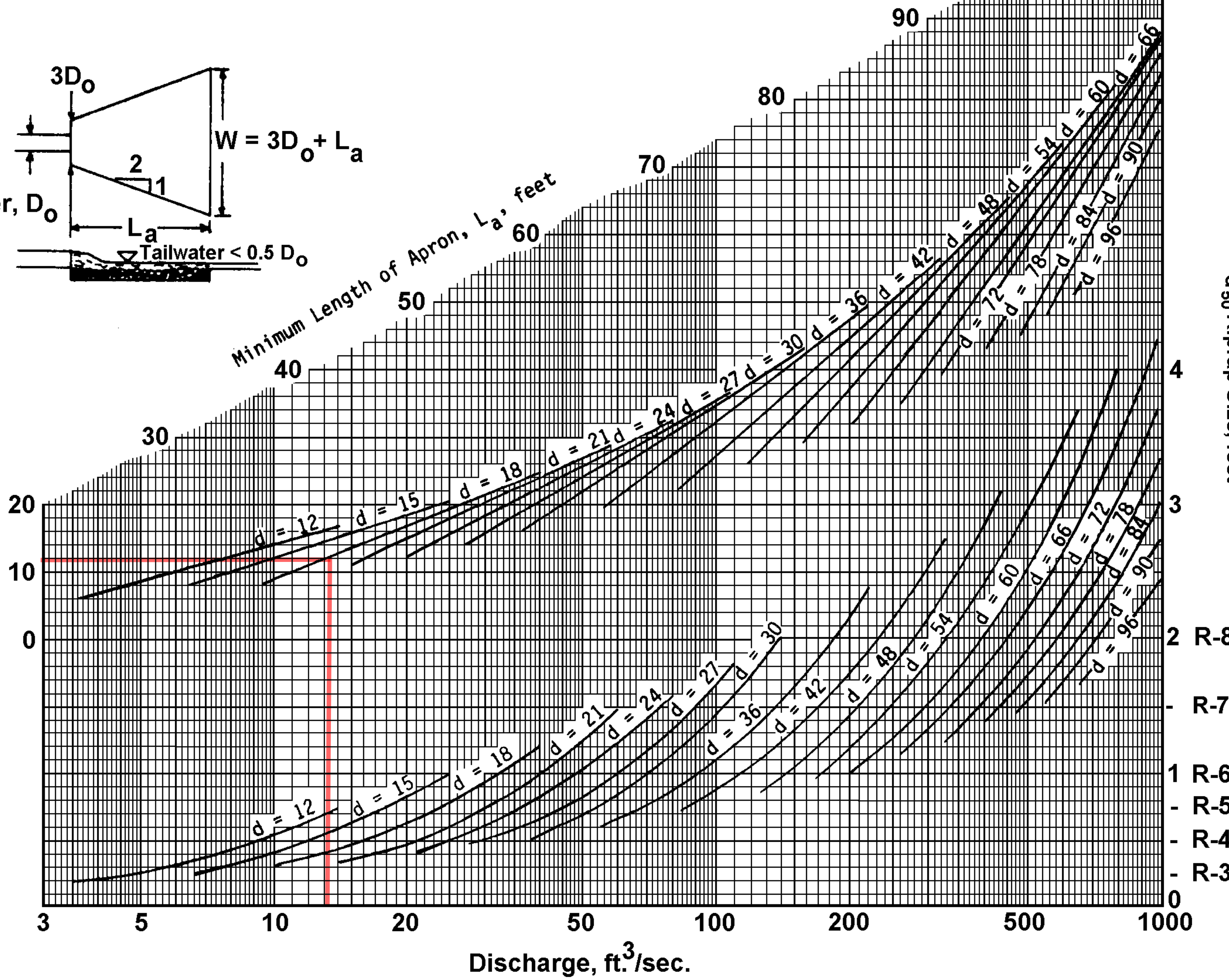
PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

FIGURE 9.3

Riprap Apron Design, Minimum Tailwater Condition

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)



Adapted from USDA - NRCS

NOTE: Do not extrapolate

Not to be used for Box Culverts

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Moore Park
OP - EW3

TABLE 6.6
Riprap Gradation, Filter Blanket Requirements, Maximum Velocities

Percent Passing (Square Openings)						
Class, Size NO. / **Rock Size (Inches)**	**R-8**	**R-7**	**R-6**	**R-5**	**R-4**	**R-3**
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone[1]	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V_{max} (ft/sec)	17.0	14.5	13.0	$\boxed{11.5}$	9.0	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

V @ EW-6 = 10.53 fps

1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

TABLE 6.7
Comparison of Various Gradations of Coarse Aggregates

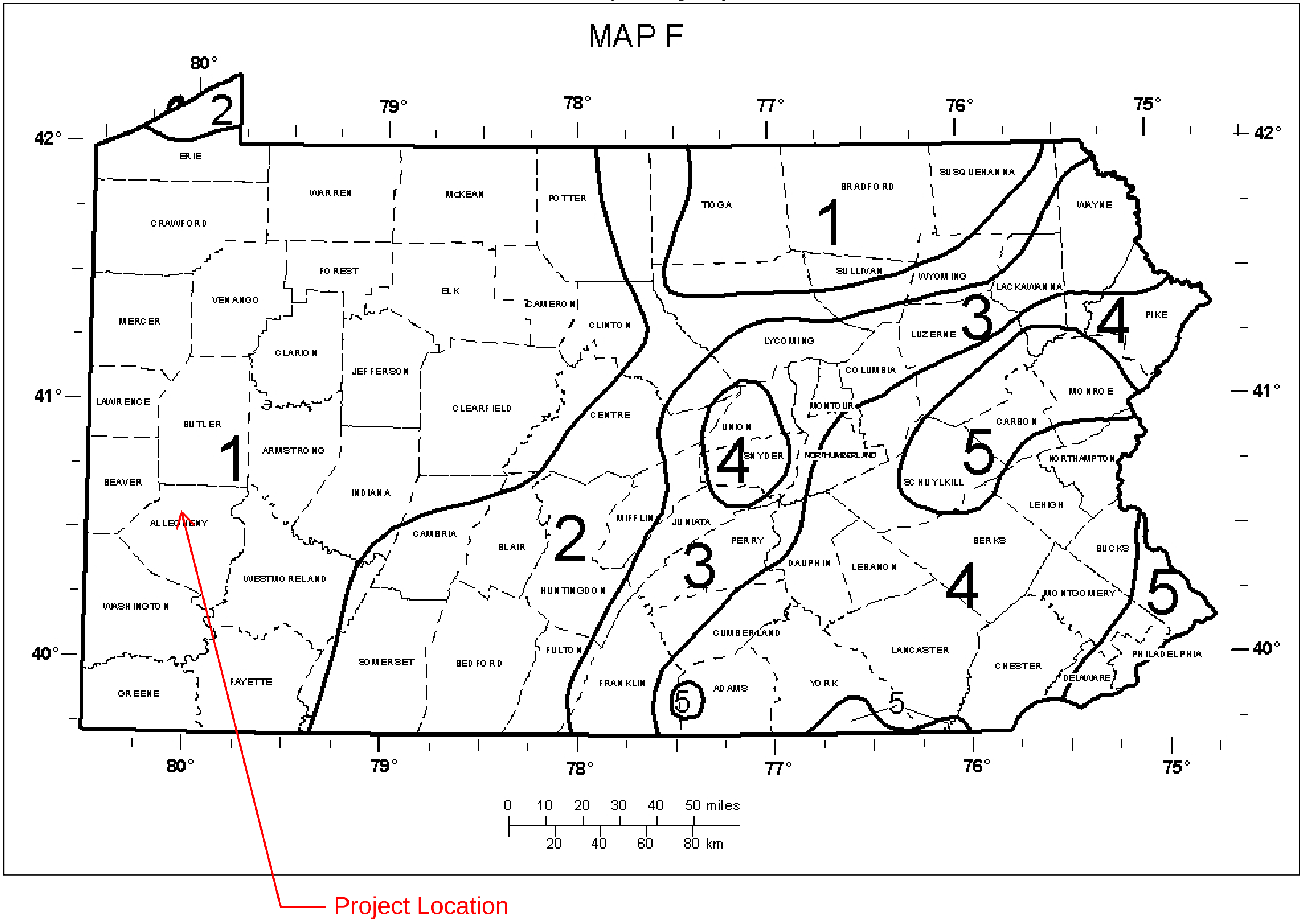
Total Percent Passing															
AASHTO NUMBER	**6 ½**	**4"**	**3 ½"**	**2 ½**	**2"**	**1 ½ "**	**1"**	**3/4 "**	**1/2"**	**3/8"**	**#4**	**#8**	**#16**	**#30**	**#100**
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.

PA DESIGN RAINFALL INTENSITY

Figure 7A.6 Map F. 12- and 24-hour durations for storms occurring with an average recurrence interval (ARI) of 1-, 2-, 5-, 10-, 25-, 50-, and 100-years and the 24-hour duration for the 500-year frequency storm.



If a basin should be found to lie on the boundary between two regions, the intensities should be obtained from the two corresponding regional graphs and averaged. In the case that the basin is large enough to be divided into areas A_i and A_j of measurable size in the adjacent regions i and j, a weighted average intensity may be used.

$$I = \frac{I_i A_i + I_j A_j}{A_i + A_j}$$

Step 4 From the PDT-IDF curves for that region, determine the rainfall intensity.

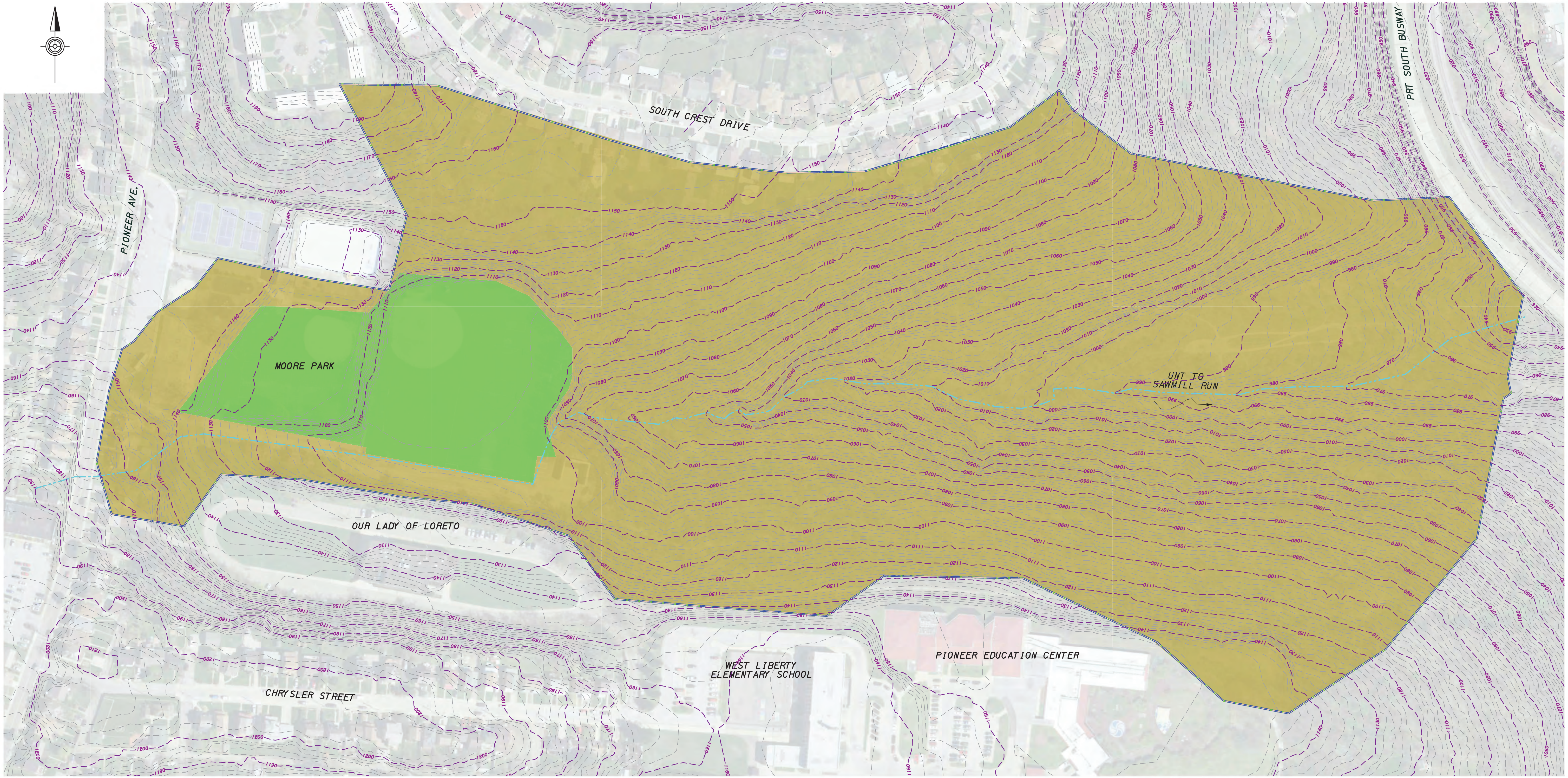
The rainfall values for the five-minute through six (6) hour storms can be obtained directly from Tables 7A.2(a/b) through 7A.6(a/b) for each of the five regions or from interpolation from the PDT-IDF curves, Figures 7A.7(a/b) through 7A.16(a/b). For the twelve (12) and twenty-four (24) hour storms, the rainfall values can only be obtained directly from Tables 7A.2(a/b) through 7A.6(a/b) for each of the five regions.

Table 7A.2(a) Five (5) minute through twenty-four (24) hour storm totals for Region 1 (Metric).

Region 1								
Rainfall Total								
	1-Yr Storm	2-Yr Storm	5-Yr Storm	10-Yr Storm	25-Yr Storm	50-Yr Storm	100-Yr Storm	500-Yr Storm
Duration (Min)	cm	cm	cm	cm	cm	cm	cm	cm
5	0.70	0.83	1.00	1.13	1.29	1.39	1.47	
10	1.09	1.30	1.56	1.75	1.97	2.11	2.22	
15	1.34	1.59	1.91	2.15	2.44	2.61	2.76	
30	1.77	2.13	2.63	2.99	3.45	3.73	3.99	
60	2.16	2.62	3.30	3.81	4.48	4.92	5.33	
120	2.52	3.03	3.79	4.41	5.28	5.98	6.64	
180	2.77	3.32	4.15	4.82	5.80	6.55	7.34	
360	3.49	4.17	5.17	6.02	7.22	8.11	9.04	
720	4.30	5.14	6.33	7.38	8.93	10.09	11.32	
1440	5.18	6.19	7.59	8.74	10.40	11.80	13.30	17.11

Table 7A.2(b) Five (5) minute through twenty-four (24) hour storm totals for Region 1 (U.S. Customary).

Region 1								
Rainfall Total								
	1-Yr Storm	2-Yr Storm	5-Yr Storm	10-Yr Storm	25-Yr Storm	50-Yr Storm	100-Yr Storm	500-Yr Storm
Duration (Min)	in	in	in	in	in	in	in	in
5	0.28	0.33	0.39	0.45	0.51	0.55	0.58	
10	0.43	0.51	0.61	0.69	0.78	0.83	0.87	
15	0.53	0.63	0.75	0.85	0.96	1.03	1.09	
30	0.70	0.84	1.03	1.18	1.36	1.47	1.57	
60	0.85	1.03	1.30	1.50	1.76	1.94	2.10	
120	0.99	1.19	1.49	1.74	2.08	2.35	2.62	
180	1.09	1.31	1.63	1.90	2.28	2.58	2.89	
360	1.37	1.64	2.04	2.37	2.84	3.19	3.56	
720	1.69	2.02	2.49	2.91	3.52	3.97	4.46	
1440	2.04	2.44	2.99	3.44	4.09	4.65	5.24	6.74



LEGEND

WOODS

OPEN SPACE - PARKS

TIME OF CONCENTRATION

DRAINAGE AREA

TOTAL DRAINAGE AREA - 51.00 AC (2,221,569.00 SF)

D2-77

0 100 200 FEET

SHEET 1 OF 1	STREAM RESTORATION FOR MS4 CREDITS IN THE THE SAW MILL RUN AND THE OHIO WATERSHED CITY OF PITTSBURGH ALLEGHENY COUNTY, PENNSYLVANIA RESTORATION PROJECT DRAINAGE AREA MAP	PREPARED BY: HUNT VALLEY ENVIRONMENTAL, LLC 632 HUNT VALLEY ROAD NEW KENSINGTON, PA 15068	PREPARED FOR: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION KEYSTONE BUILDING 400 NORTHSTREER HARRISBURG, PA 17120 PITTSBURGH WATER AND SEWER AUTHORITY 1200 PENN AVE PITTSBURGH, PA 15222	ENGINEER	ORIGINAL SUBMISSION DATE: 10-13-2022 REVISED SUBMISSION DATE:

FILE: S:\Shared Folders\Projects\21-XXX Sawmill Run MS4\CADD\MooreParkDrainageAreaMapRev.dgn
DATE: 10/13/2022 TIME: 11:04:36 AM

SAWMILL RUN MS-4 - MOORE PARK

Outlet Areas and Flows

Work Sheet 10

Done By: JHF Date: 9/28/2022

Checked By: Date:

Inlet	Total Inlet Drainage Area		Residential 1\8 ac or less					Urban District - Commercial			Open Space - Parks			Woods - Fair						Weighted C Value	Rainfall Intensity	Q Design
			C Value	Area #1	Area #2	Area #3	Area	C Value	Area	Area	C Value	Area	Area	C Value	Area	Area	C Value	Area	Area			
	(SF)	(AC)		(SF)	(SF)	(SF)	(Ac)		(SF)	(Ac)		(SF)	(Ac)		(SF)	(Ac)		(SF)	(Ac)		(in/hr)	(CFS)
UNT to Sawmill Run Base Flow	2,221,569.00	51.000	0.92				0.000	0.80	601,122.00	13.800	0.80	215,056.00	4.937	0.55	1,405,391.00	32.263				0.64	1.47	0.54
UNT to Sawmill Run 1-yr	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	1.47	48.12
UNT to Sawmill Run 1-yr Post	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	1.21	39.61
UNT to Sawmill Run 10-yr	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	2.63	86.09
UNT to Sawmill Run 10-yr Post	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	2.17	71.03
UNT to Sawmill Run 25-yr	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	3.12	102.13
UNT to Sawmill Run 25-yr Post	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	2.57	84.13
UNT to Sawmill Run 100-yr	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	4.17	136.50
UNT to Sawmill Run 100-yr Post	2,221,569.00	51.000	0.92				0.000	0.80	601,123.00	13.800	0.80	215,057.00	4.937	0.55	1,405,389.00	32.263				0.64	3.48	113.92
3																						
Total Drainage Area																						
Total	24437259.00	561.002		0.00	0.00	0.00	0.000		6612352.000	151.799		2365626.00	54.307		15459281.000	354.896		0.00	0.000			

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SAWMILL RUN MS-4 - MOORE PARK
Time of Concentration (T_c) Calculation Summary

Done By: JHF Date: 7/19/2022
Checked By: Date:

I Rainfall Intensity (1 yr/Tc Min. Duration)

Map / Region	Duration (min.)	Rainfall (in.)
NOAA	5	0.315
NOAA	10	0.490
NOAA	15	0.600
NOAA	30	0.794
NOAA	60	0.970
NOAA	120	1.110
NOAA	180	1.180
NOAA	360	1.420

T_c Drainage Area Name	Associated Drainage Area For Maps in Appendix B	Duration (min.)	Rainfall Total (in.)	Rainfall Intensity (in/hr)
Pre Condition POI	Pre Condition	33.5	0.82	1.47
Post Condition POI	Post Condition	43.9	0.88	1.21

SAWMILL RUN MS-4 - MOORE PARK
Time of Concentration (T_c) Calculation Summary

Done By: JHF Date: 7/19/2022
Checked By: Date:

I Rainfall Intensity (10 yr/Tc Min. Duration)

Map / Region	Duration (min.)	Rainfall (in.)
NOAA	5	0.516
NOAA	10	0.797
NOAA	15	0.981
NOAA	30	1.360
NOAA	60	1.730
NOAA	120	1.980
NOAA	180	2.090
NOAA	360	2.460

T_c Drainage Area Name	Associated Drainage Area For Maps in Appendix B	Duration (min.)	Rainfall Total (in.)	Rainfall Intensity (in/hr)
Pre Condition POI 2	Pre Condition	31.5	1.38	2.63
Post Condition POI 2	Post Condition	41.9	1.51	2.17

SAWMILL RUN MS-4 - MOORE PARK
Time of Concentration (T_c) Calculation Summary

Done By: JHF Date: 7/19/2022
Checked By: Date:

I Rainfall Intensity (25 yr/Tc Min. Duration)

Map / Region	Duration (min.)	Rainfall (in.)
NOAA	5	0.594
NOAA	10	0.909
NOAA	15	1.120
NOAA	30	1.590
NOAA	60	2.060
NOAA	120	2.360
NOAA	180	2.490
NOAA	360	2.940

T_c Drainage Area Name	Associated Drainage Area For Maps in Appendix B	Duration (min.)	Rainfall Total (in.)	Rainfall Intensity (in/hr)
Pre Condition POI 2	Pre Condition	31.0	1.61	3.12
Post Condition POI 2	Post Condition	41.4	1.77	2.57

Moore Park TOC
UNT to Sawmill Run

Done By: JHF 04-16-22
Checked By:

Hunt Valley Environmental, LLC

Calculation of Overland Sheet Flow Travel Time [A]

Inputs

Manning roughness, **n** = 0.15
Length of Flow Path, **L** = 82 ft
1 yr, 24 hr rainfall, **P** = 1.97 in
Ground Slope, **S** = 0.033 ft/ft

Calculations

Overland Flow Time
Travel, t_A = 8.72 min

Calculation of Shallow Concentrated Flow Travel Time [B]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 40 ft
Ground Slope, **S** = 0.025 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 3.20 ft/sec

Travel time, t_B = 0.21 min

Calculation of Shallow Concentrated Flow Travel Time [C]

Inputs

Surface Type = Unpaved
Length of Flow Path, **L** = 245 ft
Ground Slope, **S** = 0.150 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.30 ft/sec

Travel time, t_C = 0.65 min

Calculation of Shallow Concentrated Flow Travel Time [D]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 330 ft
Ground Slope, **S** = 0.100 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.50 ft/sec

Travel time, t_D = 0.85 min

Moore Park TOC
UNT to Sawmill Run

Done By: JHF 04-16-22
Checked By:

Calculation of Shallow Concentrated Flow Travel Time [E]

Inputs

Cross Section Flow Area, **a**	2.00	ft^2
Wetted Permimeter, p_w	5.24	ft^2
Ground Slope, **S** =	0.010	ft/ft
Manning Roug Coeff, **n** =	0.010	
Length of Flow Path, **L** =	335	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.38	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	0.39	ft/sec
Travel time, t_E =	14.24	min

Calculation of Shallow Concentrated Flow Travel Time [F]

Inputs

Surface Type =	Paved	
Length of Flow Path, **L** =	50	ft
Ground Slope, **S** =	0.010	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.00	ft/sec
Travel time, t_F =	0.42	min

Calculation of Shallow Concentrated Flow Travel Time [G]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	55	ft
Ground Slope, **S** =	0.020	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.20	ft/sec
Travel time, t_G =	0.42	min

Calculation of Channel Flow Travel Time [H]

Inputs

Surface Type = Unpaved
Length of Flow Path, **L** = 75 ft
Ground Slope, **S** = 0.400 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 10.00 ft/sec

Travel time, $\mathbf{t}_H$ = 0.13 min

Calculation of Channel Flow Travel Time [I]

Inputs

Surface Type = Unpaved
Length of Flow Path, **L** = 300 ft
Ground Slope, **S** = 0.120 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 5.50 ft/sec

Travel time, $\mathbf{t}_I$ = 0.91 min

Calculation of Channel Flow Travel Time [J]

Inputs

Cross Section Flow Area, **a** 5.78 ft^2
Wetted Permimeter, p_w 7.78 ft^2
Ground Slope, **S** = 0.700 ft/ft
Manning Roug Coeff, **n** = 0.200
Length of Flow Path, **L** = 390 ft

Calculations

Hydraulic Radius, r=a\pw
Compute, **r** = 0.74 ft/sec

Compute V
$V=1.49r^{2/3}s^{1/2}/n$ 5.11 ft/sec

Travel time, $\mathbf{t}_J$ = 1.27 min

Calculation of Channel Flow Travel Time [K]

Inputs			**Calculations**		
Cross Section Flow Area, **a**	5.78	ft^2	**Hydraulic Radius, r=a\pw**		
Wetted Permimeter, p_w	7.78	ft^2	Compute, **r** =	0.74	ft/sec
Ground Slope, **S** =	0.050	ft/ft	**Compute V**		
Manning Roug Coeff, **n** =	0.200		$V=1.49r^{2/3}s^{1/2}/n$	1.37	ft/sec
Length of Flow Path, **L** =	1320	ft			
			Travel time, t_K =	16.10	min

Calculation of Time of Concentration

Inputs (values from above)

t_A =	8.72	min	t_H =	0.13	min
t_B =	0.21	min	t_I =	0.91	min
t_C =	0.65	min	t_J =	1.27	min
t_D =	0.85	min	t_K =	16.10	min
t_E =	14.24	min	t_L =		min
t_F =	0.42	min	t_M =		min
t_G =	0.42	min	t_N =		min
			$t_{c\ TOTAL}$ =	43.9	min

Moore Park TOC
UNT to Sawmill Run

Done By: JHF 4-16-22
Checked By:

Calculation of Overland Sheet Flow Travel Time [A]

Inputs

Manning roughness, **n** = 0.15
Length of Flow Path, **L** = 82 ft
10 yr, 24 hr rainfall, **P** = 3.30 in
Ground Slope, **S** = 0.033 ft/ft

Calculations

Overland Flow Time
Travel, $\mathbf{t_A}$ = 6.74 min

Calculation of Shallow Concentrated Flow Travel Time [B]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 40 ft
Ground Slope, **S** = 0.025 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 3.20 ft/sec

Travel time, $\mathbf{t_B}$ = 0.21 min

Calculation of Shallow Concentrated Flow Travel Time [C]

Inputs

Surface Type = Unpaved
Length of Flow Path, **L** = 245 ft
Ground Slope, **S** = 0.150 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.30 ft/sec

Travel time, $\mathbf{t_C}$ = 0.65 min

Calculation of Shallow Concentrated Flow Travel Time [D]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 330 ft
Ground Slope, **S** = 0.100 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.50 ft/sec

Travel time, $\mathbf{t_D}$ = 0.85 min

Calculation of Shallow Concentrated Flow Travel Time [E]

Inputs

Cross Section Flow Area, **a**	2.00	ft^2
Wetted Permimeter, p_w	5.24	ft^2
Ground Slope, **S** =	0.010	ft/ft
Manning Roug Coeff, **n** =	0.010	
Length of Flow Path, **L** =	335	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.38	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	0.39	ft/sec
Travel time, t_E =	14.24	min

Calculation of Shallow Concentrated Flow Travel Time [F]

Inputs

Surface Type =	Paved	
Length of Flow Path, **L** =	50	ft
Ground Slope, **S** =	0.010	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.00	ft/sec
Travel time, t_F =	0.42	min

Calculation of Shallow Concentrated Flow Travel Time [G]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	55	ft
Ground Slope, **S** =	0.020	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.20	ft/sec
Travel time, t_G =	0.42	min

Calculation of Channel Flow Travel Time [H]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	75	ft
Ground Slope, **S** =	0.400	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:

Flow Velocity, **V** = ______ ft/sec

For Slopes <0.5% on Paved surfaces:

Flow Velocity, **V** = ______ ft/sec

For Slopes >0.5% (TR-55 Figure 3-1):

Flow Velocity, **V** = 10.00 ft/sec

Travel time, t_H = 0.13 min

Calculation of Channel Flow Travel Time [I]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	300	ft
Ground Slope, **S** =	0.120	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:

Flow Velocity, **V** = ______ ft/sec

For Slopes <0.5% on Paved surfaces:

Flow Velocity, **V** = ______ ft/sec

For Slopes >0.5% (TR-55 Figure 3-1):

Flow Velocity, **V** = 5.50 ft/sec

Travel time, t_I = 0.91 min

Calculation of Channel Flow Travel Time [J]

Inputs

Cross Section Flow Area, **a**	5.78	ft^2
Wetted Permimeter, p_w	7.78	ft^2
Ground Slope, **S** =	0.700	ft/ft
Manning Roug Coeff, **n** =	0.200	
Length of Flow Path, **L** =	390	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** = 0.74 ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$ 5.11 ft/sec

Travel time, t_J = 1.27 min

Calculation of Channel Flow Travel Time [K]

Inputs

Cross Section Flow Area, **a**	5.78	ft^2
Wetted Permimeter, p_w	7.78	ft^2
Ground Slope, **S** =	0.050	ft/ft
Manning Roug Coeff, **n** =	0.200	
Length of Flow Path, **L** =	1320	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.74	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	1.37	ft/sec

Travel time, t_K =	16.10	min

Calculation of Time of Concentration

Inputs (values from above)

t_A =	6.74	min	t_H =	0.13	min
t_B =	0.21	min	t_I =	0.91	min
t_C =	0.65	min	t_J =	1.27	min
t_D =	0.85	min	t_K =	16.10	min
t_E =	14.24	min	t_L =		min
t_F =	0.42	min	t_M =		min
t_G =	0.42	min	t_N =		min

$t_{c\ TOTAL}$ =	41.9	min

Moore Park - TOC
UNT Sawmill Run

Done By: JHF 4-16-22
Checked By:

Calculation of Overland Sheet Flow Travel Time [A]

Inputs

Manning roughness, **n** = 0.15
Length of Flow Path, **L** = 82 ft
25 yr, 24 hr rainfall, **P** = 3.90 in
Ground Slope, **S** = 0.033 ft/ft

Calculations

Overland Flow Time
Travel, t_A = 6.20 min

Calculation of Shallow Concentrated Flow Travel Time [B]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 40 ft
Ground Slope, **S** = 0.025 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 3.20 ft/sec

Travel time, t_B = 0.21 min

Calculation of Shallow Concentrated Flow Travel Time [C]

Inputs

Surface Type = Unpaved
Length of Flow Path, **L** = 245 ft
Ground Slope, **S** = 0.150 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.30 ft/sec

Travel time, t_C = 0.65 min

Calculation of Shallow Concentrated Flow Travel Time [D]

Inputs

Surface Type = Paved
Length of Flow Path, **L** = 330 ft
Ground Slope, **S** = 0.100 ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes <0.5% on Paved surfaces:
Flow Velocity, **V** = ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):
Flow Velocity, **V** = 6.50 ft/sec

Travel time, t_D = 0.85 min

Calculation of Shallow Concentrated Flow Travel Time [E]

Inputs

Cross Section Flow Area, **a**	2.00	ft^2
Wetted Permimeter, p_w	5.24	ft^2
Ground Slope, **S** =	0.010	ft/ft
Manning Roug Coeff, **n** =	0.010	
Length of Flow Path, **L** =	335	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.38	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	0.39	ft/sec
Travel time, t_E =	14.24	min

Calculation of Shallow Concentrated Flow Travel Time [F]

Inputs

Surface Type =	Paved	
Length of Flow Path, **L** =	50	ft
Ground Slope, **S** =	0.010	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.00	ft/sec
Travel time, t_F =	0.42	min

Calculation of Shallow Concentrated Flow Travel Time [G]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	55	ft
Ground Slope, **S** =	0.020	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes <0.5% on Paved surfaces:		
Flow Velocity, **V** =		ft/sec
For Slopes >0.5% (TR-55 Figure 3-1):		
Flow Velocity, **V** =	2.20	ft/sec
Travel time, t_G =	0.42	min

Moore Park - TOC
UNT Sawmill Run

Done By: JHF 4-16-22
Checked By:

HUNT VALLEY ENVIRONMENTAL, LLC

Calculation of Channel Flow Travel Time [H]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	75	ft
Ground Slope, **S** =	0.400	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:

Flow Velocity, **V** =		ft/sec

For Slopes <0.5% on Paved surfaces:

Flow Velocity, **V** =		ft/sec

For Slopes >0.5% (TR-55 Figure 3-1):

Flow Velocity, **V** =	10.00	ft/sec
Travel time, t_H =	0.13	min

Calculation of Channel Flow Travel Time [I]

Inputs

Surface Type =	Unpaved	
Length of Flow Path, **L** =	300	ft
Ground Slope, **S** =	0.120	ft/ft

Calculations

For Slopes <0.5% on Unpaved surfaces:

Flow Velocity, **V** =		ft/sec

For Slopes <0.5% on Paved surfaces:

Flow Velocity, **V** =		ft/sec

For Slopes >0.5% (TR-55 Figure 3-1):

Flow Velocity, **V** =	5.50	ft/sec
Travel time, t_I =	0.91	min

Calculation of Channel Flow Travel Time [J]

Inputs

Cross Section Flow Area, **a**	5.78	ft^2
Wetted Permimeter, p_w	7.78	ft^2
Ground Slope, **S** =	0.700	ft/ft
Manning Roug Coeff, **n** =	0.200	
Length of Flow Path, **L** =	390	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.74	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	5.11	ft/sec
Travel time, t_J =	1.27	min

Calculation of Channel Flow Travel Time [K]

Inputs

Cross Section Flow Area, **a**	5.78	ft^2
Wetted Permimeter, p_w	7.78	ft^2
Ground Slope, **S** =	0.050	ft/ft
Manning Roug Coeff, **n** =	0.200	
Length of Flow Path, **L** =	1320	ft

Calculations

Hydraulic Radius, r=a\pw

Compute, **r** =	0.74	ft/sec

Compute V

$V=1.49r^{2/3}s^{1/2}/n$	1.37	ft/sec

Travel time, t_K =	16.10	min

Calculation of Time of Concentration

Inputs (values from above)

t_A =	6.20	min	t_H =	0.13	min
t_B =	0.21	min	t_I =	0.91	min
t_C =	0.65	min	t_J =	1.27	min
t_D =	0.85	min	t_K =	16.10	min
t_E =	14.24	min	t_L =		min
t_F =	0.42	min	t_M =		min
t_G =	0.42	min	t_N =		min

$t_{c\ TOTAL}$ =	41.4	min

Volume Management

Project: Moore Park MS4

Instructions | General | *Volume* | Rate | Quality

2-Year / 24-Hour Storm Event (NOAA Atlas 14): **1.97** inches

Alternative 2-Year / 24-Hour Storm Event: inches

Alternative Source:

Pre-Construction Conditions: *No. Rows:* **2**

Exempt from Meadow in Good Condition

Automatically Calculate CN, Ia, Runoff and Volume

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Good Condition (Grass Cover > 75%)	4.94	D	80	0.500	0.54	9,761
Woods (Good Condition)	46.06	B	55	1.636	0.01	2,186
TOTAL (ACRES):	**51.00**				**TOTAL (CF):**	**11,946**

Post-Construction Conditions: *No. Rows:* **1**

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
TOTAL (ACRES):	**0.00**				**TOTAL (CF):**	**0**

NET CHANGE IN VOLUME TO MANAGE (CF): -11,946

Non-Structural BMP Volume Credits:

- Tree Planting Credit
- Other (attach calculations):

Structural BMP Volume Credits: *No. Structural BMPs:* | | *Start BMP Numbering at:* | |

DP No.	BMP No.	BMP Name	MRC?	Discharge	Incremental BMP DA (acres)	Volume Routed to BMP (CF)	Infiltration / Vegetated Area (SF)	Infiltration Rate (in/hr)	Infiltration Period (hrs)	Vegeta-ted?	Media Depth (ft)	Storage Volume (CF)	Infiltration Credit (CF)	ET Credit (CF)
												Totals:		

INFILTRATION & ET CREDITS (CF):

NET CHANGE IN VOLUME TO MANAGE (CF): **-11,946**

TOTAL CREDITS (CF):

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Volume Management

Project: Moore Park MS4

Instructions | General | *Volume* | Rate | Quality

2-Year / 24-Hour Storm Event (NOAA Atlas 14): **3.3** inches

Alternative 2-Year / 24-Hour Storm Event: inches

Alternative Source:

Pre-Construction Conditions: *No. Rows:* **2**

Exempt from Meadow in Good Condition

Automatically Calculate CN, Ia, Runoff and Volume

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Good Condition (Grass Cover > 75%)	4.94	D	80	0.500	1.48	26,526
Woods (Good Condition)	46.06	B	55	1.636	0.28	47,001
TOTAL (ACRES):	**51.00**				**TOTAL (CF):**	**73,528**

Post-Construction Conditions: *No. Rows:*

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
TOTAL (ACRES):	**0.00**				**TOTAL (CF):**	**0**

NET CHANGE IN VOLUME TO MANAGE (CF): **-73,528**

Non-Structural BMP Volume Credits:

- Tree Planting Credit
- Other (attach calculations):

D2-96

Structural BMP Volume Credits: *No. Structural BMPs:* *Start BMP Numbering at:*

DP No.	BMP No.	BMP Name	MRC?	Discharge	Incremental BMP DA (acres)	Volume Routed to BMP (CF)	Infiltration / Vegetated Area (SF)	Infiltration Rate (in/hr)	Infiltration Period (hrs)	Vegeta-ted?	Media Depth (ft)	Storage Volume (CF)	Infiltration Credit (CF)	ET Credit (CF)
												Totals:		

INFILTRATION & ET CREDITS (CF):

NET CHANGE IN VOLUME TO MANAGE (CF): **-73,528**

TOTAL CREDITS (CF):

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Volume Management

Project: Moore Park MS4

Instructions | General | *Volume* | Rate | Quality

2-Year / 24-Hour Storm Event (NOAA Atlas 14): **3.9** inches   Alternative 2-Year / 24-Hour Storm Event: inches

Alternative Source:

Pre-Construction Conditions: *No. Rows:* **2**   *Exempt from Meadow in Good Condition*   *Automatically Calculate CN, Ia, Runoff and Volume*

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Open Space (Lawns, Parks, Golf Courses, Cemeteries, Etc.) - Good Condition (Grass Cover > 75%)	4.94	D	80	0.500	1.96	35,135
Woods (Good Condition)	46.06	B	55	1.636	0.49	82,019
TOTAL (ACRES):	**51.00**				**TOTAL (CF):**	**117,154**

Post-Construction Conditions: *No. Rows:*

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
TOTAL (ACRES):	**0.00**				**TOTAL (CF):**	**0**

NET CHANGE IN VOLUME TO MANAGE (CF): **-117,154**

Non-Structural BMP Volume Credits:

- Tree Planting Credit
- Other (attach calculations):

Structural BMP Volume Credits: *No. Structural BMPs:* *Start BMP Numbering at:*

DP No.	BMP No.	BMP Name	MRC?	Discharge	Incremental BMP DA (acres)	Volume Routed to BMP (CF)	Infiltration / Vegetated Area (SF)	Infiltration Rate (in/hr)	Infiltration Period (hrs)	Vegeta-ted?	Media Depth (ft)	Storage Volume (CF)	Infiltration Credit (CF)	ET Credit (CF)
												Totals:		

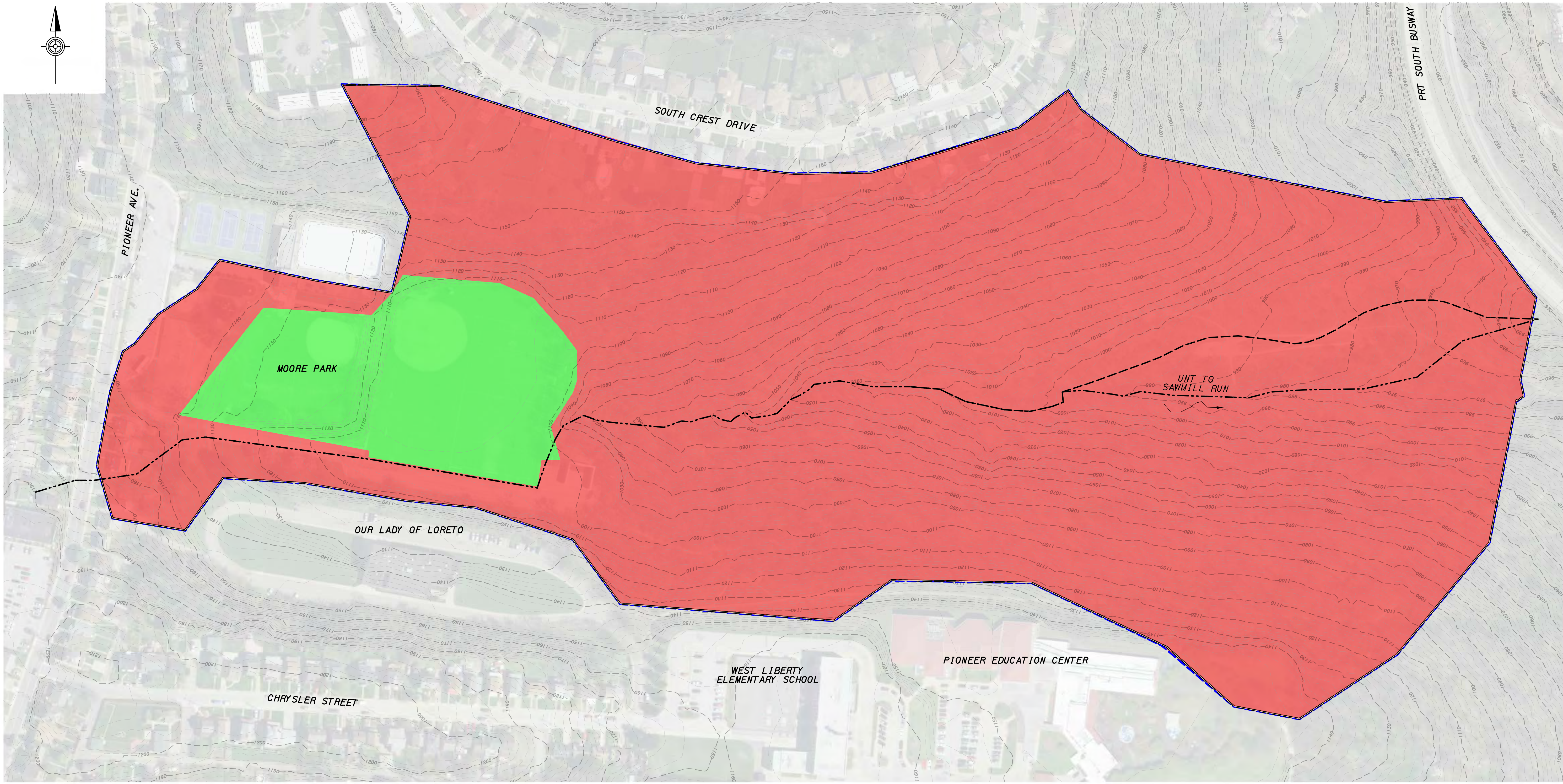
INFILTRATION & ET CREDITS (CF):

NET CHANGE IN VOLUME TO MANAGE (CF): **-117,154**

TOTAL CREDITS (CF):

Proposed Flood Plain Stoage at Moore Park

Area	SqFt	Depth Ft	CF
1	193	1.5	290
2	790	1.5	1,185
3	1,608	1.5	2,412
4	1,854	1.5	2,781
5	3,414	1.5	5,121
6	1,728	1.5	2,592
7	6,914	1.5	10,371
8	3,845	1.5	5,768
9	7,390	1.5	11,085
10	5,238	1.5	7,857
11	11,672	1.5	17,508
12	6,325	1.5	9,488
13	10434	1.5	15,651
		Total	**92,108**



LEGEND

WOODS

OPEN SPACE - PARKS

PRE TIME OF CONCENTRATION FLOW PATH

POST TIME OF CONCENTRATION FLOW PATH

DRAINAGE AREA

TOTAL DRAINAGE AREA - 51.00 AC (2,221,569.00 SF)

D2-101

0 100 200 FEET

SHEET 1 OF 2

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
RESTORATION PROJECT
PRE-DRAINAGE AREA MAP

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

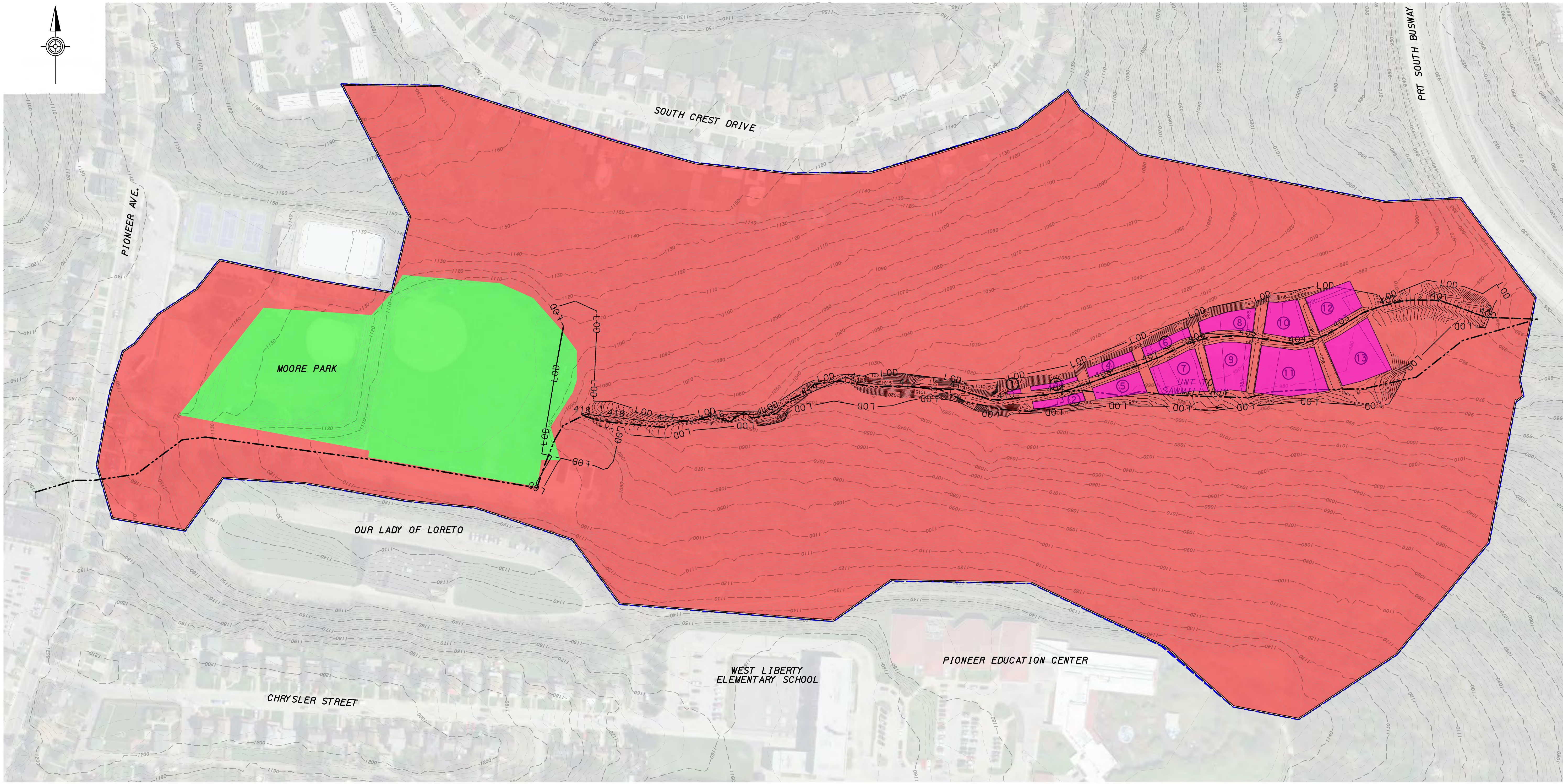
ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023

REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JAMES H. FLYNN
ENGINEER
PE 061647

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\MooreParkDrainageAreaMapRev.dgn
DATE: 7/13/2023 TIME: 9:19:30 AM



LEGEND

WOODS	PRE TIME OF CONCENTRATION FLOW PATH
OPEN SPACE - PARKS	POST TIME OF CONCENTRATION FLOW PATH
FLOODPLAIN STORAGE AREAS	DRAINAGE AREA

TOTAL DRAINAGE AREA - 51.00 AC (2,221,569.00 SF)

FLOODPLAIN STORAGE AREAS

1 - 290 CF	7 - 10,371 CF
2 - 1185 CF	8 - 5768 CF
3 - 2412 CF	9 - 11,085 CF
4 - 2781 CF	10 - 7857 CF
5 - 5121 CF	11 - 17,508 CF
6 - 2592 CF	12 - 9488 CF
	13 - 15,651 CF

TOTAL STORAGE = 92,108 CF

D2-102

0 100 200 FEET

SHEET 2 OF 2

STREAM RESTORATION FOR MS4 CREDITS
IN THE THE SAW MILL RUN AND THE OHIO WATERSHED
CITY OF PITTSBURGH
ALLEGHENY COUNTY, PENNSYLVANIA
RESTORATION PROJECT
PRE-DRAINAGE AREA MAP

PREPARED BY:
HUNT VALLEY ENVIRONMENTAL, LLC
632 HUNT VALLEY ROAD
NEW KENSINGTON, PA 15068

PREPARED FOR:
PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
KEYSTONE BUILDING
400 NORTHSTREER
HARRISBURG, PA 17120

PITTSBURGH
WATER AND SEWER AUTHORITY
1200 PENN AVE
PITTSBURGH, PA 15222

ENGINEER

ORIGINAL SUBMISSION DATE: 03-08-2023
REVISED SUBMISSION DATE: 07-12-2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JAMES H. FLYNN
PE 061647

FILE: W:\Projects\21-XXX Sawmill Run MS4\CADD\MooreParkDrainageAreaMapPostRev.dgn
DATE: 7/13/2023 TIME: 11:31:50 AM

Appendix E: Anticipated Project Schedule

Sawmill Run/ Boyce Park MS4 Schedule:

	Milestone Activity Boyce Park	**Milestone Date (on or before)**
1.	Conceptual PRP submitted to Turnpike	May 2023
2.	Final PRP submitted to PennDOT	May 2023
3.	Federal, State, and Local permits submission	July/August 2023
4.	Begin BMP construction	May 2024
5.	25% construction complete	June 2024
6.	50% construction complete	July 2024
7.	100% construction complete	December 2024
8.	As-built Plans	January 2025
9.	Post-Construction monitoring begins	January 2025
10.	Post-Construction Monitoring	Summer 2025
11.	Required Sediment Reduction Approval	Summer 2025
12.	Post-Construction Monitoring	Summer, 2025
13.	Post-Construction Monitoring	Summer, 2026
14.	Post-Construction Monitoring	Summer, 2027
15.	Post-Construction Monitoring	Summer, 2028
16.	Post-Construction Monitoring Ends	Winter, 2028
17.	End of Post-Construction	January 2029

Appendix F: Soil Bulk Density Lab Results

ACKENHEIL ENGINEERS, INC.
GEOTECHNICAL · CIVIL · INSPECTION · TESTING
1000 Banksville Road, Pittsburgh, Pennsylvania 15216
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Unit Weight of Density

ASTM D 7263 (Method B)

Project: Moore Park **Date:** 5/16/2022

AE Client: Hunt Valley Environmental **Project No.:** 22501

Boring	Sample Number	Depth	USCS	Moisture Content	Average Length (in)	Average Diameter (in)	Volume (ft^3)	Weight (lb)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)
SP-1	S-1	16"		39.8%	6.025	2.050	0.0115	1.158	100.7	72.0
SP-2	S-1	24"		19.1%	6.025	2.050	0.0115	1.404	122.1	102.5
SP-3	S-1	50"		22.2%	6.025	2.050	0.0115	1.160	100.8	82.5
SP-4	S-1	48"		20.6%	6.025	2.050	0.0115	1.370	119.1	98.8
SP-5	S-1	20"		27.6%	6.025	2.050	0.0115	1.322	114.9	90.1

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Unit Weight of Density

ASTM D 7263 (Method B)

Project: Crane Avenue **Date:** 5/16/2022

AE Client: Hunt Valley Environmental **Project No.:** 22501

Boring	Sample Number	Depth	USCS	Moisture Content	Average Length (in)	Average Diameter (in)	Volume (ft^3)	Weight (lb)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)
CA-Sp1	S-1			22.2%	6.025	2.050	0.0115	1.514	131.6	107.7
CA-Sp2	S-1			29.8%	6.025	2.050	0.0115	1.222	106.2	81.8
CA-Sp3	S-1			13.7%	6.025	2.050	0.0115	1.530	133.0	117.0
CA-Sp4	S-1			30.1%	6.025	2.050	0.0115	1.354	117.7	90.5

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Project: Boyce Park **Date:** 4/14/2023

Client: Hunt Valley Environmental **Project No.:** 22501

Sample Number	Moisture Content	Average Length (in)	Average Diameter (in)	Volume (ft^3)	Weight (lb)	Wet Unit Weight (pcf)	Unit Weight (pcf)
1	53.1%	6.130	2.053	0.0117	1.190	101.4	66.2
2	34.3%	6.084	2.056	0.0117	1.390	119.0	88.6
3	41.1%	6.019	2.058	0.0116	1.110	95.8	67.9
4	47.3%	6.079	2.047	0.0116	1.220	105.4	71.6
5	22.2%	6.055	2.053	0.0116	1.020	88.0	72.0
6	45.0%	6.125	2.049	0.0117	1.310	112.1	77.3

Appendix G: Summary Credit Sheet

PennDOT Sediment Reduction Credit Summary

Moore Park Water Quality Credit Attained (per DEP input and guidance)	
Ave. Bank Height (ft)	2.89
Ave. BEHI	38.39
Ave. NBS	3.55 Mod-High
Ave. Erosion Rate (ft/yr)	1.21
Stream Length (ft)	1,981.00
Estimated Erosion (cf/yr)	11,814.89
Pounds of Sediment Removed (lbs/yr	189,393.18
50% Reduction Based Upon Expert Panel (lbs/yr)	94,696.59
Stormwater Basin Reductions	
Sediment (lbs/yr)	1,427.82
Flow Rate (CFS)	33.14
Volume Reduction (CF)	117,154

Crane Avenue Water Quality Credit Attained (per DEP input and guidance)	
Ave. Bank Height (ft)	4.81
Ave. BEHI	32.84
Ave. NBS	3.75, Mod-High
Ave. Erosion Rate (ft/yr)	0.82
Stream Length (ft)	1,722.00
Estimated Erosion (cf/yr)	28,952.59
Pounds of Sediment Removed (lbs/yr	520,111.11
50% Reduction Based Upon Expert Panel (lbs/yr)	260,055.78
Stormwater Basin Reductions	
Sediment (lbs/yr)	1,559.11
Flow Rate (CFS)	5.24

Sediment Reduction from Stream Restorations = 94,696.59 + 260,055.78 = 354,752.37 lbs/yr

Sediment Reduction Stormwater Basins = 1,427.82 + 1,559.11 = 2,986.93lbs/yr

Total Reduction for BMPS = 354,752.37 + 2986.93 = 357,739.30 lbs/yr

PWSA Sediment Reduction Credit Summary

Moore Park Water Quality Credit Attained (per DEP input and guidance)	
Ave. Bank Height (ft)	2.89
Ave. BEHI	38.39
Ave. NBS	3.55 Mod-High
Ave. Erosion Rate (ft/yr)	1.21
Stream Length (ft)	1,981.00
Estimated Erosion (cf/yr)	11,814.89
Pounds of Sediment Removed (lbs/yr	189,393.18
50% Reduction Based Upon Expert Panel (lbs/yr)	95,166.97
115 lbs/ft Default Rate	228,285.38
Stormwater Basin Reductions	
Sediment (lbs/yr)	470.38
Flow Rate (CFS)	33.14
Volume Reduction (CF)	117,154

Crane Avenue Water Quality Credit Attained (per DEP input and guidance)	
Ave. Bank Height (ft)	4.81
Ave. BEHI	32.84
Ave. NBS	3.75, Mod-High
Ave. Erosion Rate (ft/yr)	0.82
Stream Length (ft)	1,722.00
Estimated Erosion (cf/yr)	28,952.59
Pounds of Sediment Removed (lbs/yr	520,111.11
50% Reduction Based Upon Expert Panel (lbs/yr)	260,055.78
Stormwater Basin Reductions	
Sediment (lbs/yr)	187.81
Flow Rate (CFS)	5.24

Sediment Reduction from Stream Restorations = 228,285.38 + 260,055.78 = 488,341.16 lbs/yr

Sediment Reduction Stormwater Basins = 470.38 + 187.81 = 658.19 lbs/yr

Total Reduction for BMPS = 488,341.16 + 658.19 = 488,999.35 lbs/yr

PTC Sediment Reduction Credit Summary

Boyce Park Water Quality Credit Attained (per DEP input and guidance)	
Ave. Bank Height (ft)	2.60
Stream Length (ft)	850
115 lbs/ft Default Rate	97,750

Sediment Reduction from Stream Restoration= 97,750 lbs/yr

Total Reduction for BMPS = 97,750 lbs/yr

Appendix H: Sample Monitoring Plan

Unnamed Tributary to Sawmill Run Pollutant Reduction Project

Beechview Greenway Crane Avenue /Moore Park Restoration Sites
City of Pittsburgh, Allegheny County, Pennsylvania

Boyce Park Restoration Site
Plum Borough, Allegheny County, Pennsylvania

Year X 20XX Monitoring Report

Prepared For: Commonwealth of Pennsylvania
Department of Transportation,
Pittsburgh Water Sewage Authority
Pennsylvania Turnpike

Prepared By:
Land Reclamation Group, LLC
632 Hunt Valley Circle
New Kensington, PA 15068

DATE

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Appendix B: Validated Sediment Reduction Data and Calculations

Appendix C: Monitoring Data and Photographs

1.0 Goals and Objectives

Include a summary of the project, The restoration efforts utilized a combination of channel relocation, floodplain restoration, and riparian corridor enhancement to reduce pollutant loadings by stabilizing eroding streambanks and connecting the stream with its newly established floodplain. The resulting system promotes the spread of high flow storm events to a reconnected floodplain, reducing excessive shear stress values that would otherwise frequently mobilize bed substrate and cause severe bank erosion. Subsurface log and rock structures established grade control throughout the system and improved vertical bed stability. The resulting stream complex has low bank heights and expected low streambank erosion rates. The installed structures will promote the reestablishment of bed sediment and provide improved habitat for both fish and macroinvertebrate communities.

Directions to the site

2.0 Monitoring Methods

Overview

To accurately monitor the overall performance of the Project, three permanent monitoring stations were installed on the restored stream reach to assess and monitor bank stability, water quality, hydrology, vegetation, and fish/macroinvertebrate communities. One permanent cross section was installed to assess cross-sectional stability. Three wetland monitoring locations were installed within the wetland reestablishment areas to monitor herbaceous/woody vegetation and wetland hydrology, and three upland monitoring locations were installed to monitor herbaceous/woody vegetation outside of the reestablished wetlands. Five monitoring photo location markers were installed throughout the Project to provide an overall visual perspective of the monitoring reach in both upstream and downstream orientations. Visual assessments were completed to document invasive species coverage and aid in the development of adaptive management procedures if deemed necessary. Please see the Monitoring Location Map series in Appendix A: Figure 2. Monitoring Location Map for a detailed view of monitoring locations.

Permanent Monitoring Stations

The performance standard for the stream requires that monitoring results demonstrate an ecological uplift from preconstruction conditions. At permanent monitoring stations, bank stability was monitored using Rosgen's Bank Erosion Hazard Index (BEHI) evaluation on the bank within the cross-section that was receiving the most direct amount of flow. The BEHI procedure evaluates five main categories (Bank Height/Bank full Ratio, Root Depth/Bank Height Ratio, Root Density Percentage, Bank Angle Degrees, and Surface Protection Percentage) that factor into bank erosive potential, which are summed to generate an overall hazard or risk rating ranging from very low to extreme.

Rosgen's Near Bank Stress (NBS) assessments were also performed to monitor bank stability. Level II – General Prediction estimations described in Method 1: Rapid Visual Assessment outlined by Rosgen were used. NBS ratings were determined in the field by evaluating the position of the thalweg relative to the study bank concurrent with the BEHI evaluations.

Instream photos were captured in upstream, downstream, left bank, and right bank-oriented viewpoints to document changes that may occur throughout the monitoring lifecycle.

Sediment Reduction Validation Assessment

An assessment will be performed to validate the post-construction sediment loads and erosion rates following protocols established in "*Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects.*" During the As-built data collection, a topographic and longitudinal profile survey was conducted for the restored stream. The surveyed stream data were used in the field and the entire project was walked to identify unique reaches based on bank conditions, as well as erosion severity/frequency if observed. One BEHI Assessment and NBS Assessment was completed at a representative bank in each of the assessment reaches as described above. Upon the completion of the evaluations, each reach was walked again to verify the assessment results, record the average height of each bank, and determine the start and endpoints of every eroding bank using a Trimble Handheld GPS Unit.

Bank erosion rates were then calculated following procedures outlined in Rosgen's Bank and Nonpoint Source Consequences of Sediment (BANCS) Method with the incorporation of Bank Erosion Curves created by the U.S. Fish & Wildlife Service Chesapeake Bay Field Office Coastal Program. For a more accurate calculation of erosion rate, values were plotted in Excel on a scatter plot where linear equations were later developed.

Using the resulting data, the post-construction annual total suspended sediment (TSS) loads were calculated for comparison to pre-construction sediment loads summarized in the BMP Design Plan. The default concentrations of Total Phosphorus (TP) and Total Nitrogen (TN), as described in the *Expert Panel*, were also used to estimate TP and TN contributions.

3.0 Monitoring Results

Tracking the progression of the site, a monitoring visit will be performed to collect vegetative plot data and to collect photographs post construction, and again 12 and 24 months later to validate the post-construction sediment reduction results and hydrology.

BEHI & NBS Scores

BEHI evaluations were performed at each of the monitoring stations, as well as components of the sediment loading assessment to evaluate results 2-years post-construction. The results for individual monitoring stations are presented in Table 3: BEHI & NBS Summary. The results of the BEHI and NBS assessment for the reach-long assessment of sediment reduction are shown as Figures 3 and 4 (Appendix A. Figures).

TABLE 1: BEHI and NBS summary

BEHI and NBS scores ranged from low to moderate with an average BEHI score of Low and an average NBS of Low-Moderate. This data is evidence of substantial uplift with regard to streambank and channel stability.

Sediment Reduction Validation

Using the stream bank condition data (BEHI, NBS, and bank heights) summarized above, the Protocol 1 data was revisited and updated, if needed, based upon field conditions. The calculations were re-run in order to compare them to the baseline data summarized in the BMP Design Plan. The results of both analyses are summarized in Table X below and in Appendix B. Validated Sediment Reduction Data and Calculations.

Table 2: Post-Construction Sediment Load Reduction & Efficiency Summary

Cross-sectional and Longitudinal Stability

Cross-sectional and longitudinal profiles are provided in the As-built drawings in **Appendix D**. The surveyed cross-sectional profile was plotted showing horizontal stationing from left to right bank facing upstream versus elevation for the pre and post construction stream. Longitudinal profiles….. pre and post-construction with the longitudinal station from upstream to downstream versus elevation.

Overall, channel geometry…

4.0 Monitoring Discussion

Overall, the 2-year monitoring results show that restoration efforts have succeeded in creating a stable, holistic, and systematically functioning floodplain system. The resulting stream has low banks consistent with stream/floodplain connectivity, as well as low erosion rates which have contributed to the observed geomorphic stability of the Project. This is evident within the in the photos and the BEHI/NBS results. The water level loggers indicate a high level of hydrologic interaction between the stream and floodplain, which has resulted in the reestablishment of wetland hydrology and the promotion of additional sediment capture and retention during even minor flooding events.

5.0 Maintenance Activities

Appendix A: Figures

Figure 1 Location Map
Figure 2 Plan View of the site with Sample Locations and Picture locations
Figure 3 BANCS Mapping Results

Appendix B: Validated Sediment Reduction Data and Calculations

Appendix C: Monitoring Data and Photographs

APPENDIX F –
PUBLIC REVIEW COMMENTS

Notice of the initial draft Ohio River PRP was published in the Pennsylvania Bulletin on September 24, 2022. The announcement directed the public to its website to review the PRP, and a 30-day comment period was provided. The public-comment period ended on October 24, 2022.

No comments were received during the Public Comment Period.