APPENDIX O
STORMWATER MANAGEMENT PLAN

TECHNICAL MEMORANDUM

DATE: December 5, 2014

TO: Mark Peters, P.E.

FROM: Tony Donovan

SUBJECT: Appendix O – Stormwater Design
Callahan Mine Superfund Site
Brooksville, Maine

PROJECT: 3612-11-2201

INTRODUCTION

AMEC Environment & Infrastructure (AMEC), is completing the remedial design of Callahan Mine (Site) located approximately 15 miles west of the Town of Blue Hill and 35 miles west of the Town of Bar Harbor on the northwest side of the Cape Rosier peninsula on Penobscot Bay. The primary source of contamination at the Site is interpreted to be historical mine operations. In the absence of remedial actions, ongoing discharges from the Tailings Impoundment may result in dissolved-phase metals, including copper, lead, and zinc, reaching groundwater and surface water. Surface water may also erode friable material and transport suspended material to Goose Pond. Acid rock drainage from mineralized waste rock in upland areas may continue to contribute contaminants to groundwater. Transport by windblown dust, thought to have been significant during mine operations, is now expected to be minor. Because of the volume and exposed nature of mine waste material at the Site, these release and transport mechanisms are expected to persist.

The design objective for the Tailings Impoundment is to eliminate surface water contamination from runoff flows onto and infiltrating the Tailings Impoundment and the collection and treatment of the runoff flows in a wet pond.

This technical memorandum provides a summary of the drainage analysis performed to evaluate post remediation drainage conditions.

EXISTING CONDITIONS

The Tailings Impoundment is located at the southern end of the Site, adjacent to a Salt Marsh at the edge of South Goose Pond. The impoundment encompasses an approximately 17-acre trapezoidal-shaped footprint. The impoundment contains fine sand, silt, and clay-sized rock particles (i.e., tailings) from the Callahan-era mining operations.

The tailings are contained by a three-sided dam constructed against a sloping hillside. This dam configuration is commonly termed a side-hill impoundment (USEPA, 1994). Most of the dam is constructed with cobble and boulder-sized waste rock materials. The bottom part of the dam (i.e., the starter dike) is interpreted to either be constructed with waste rock and back-stopped with clay fill/re-work (from site) or constructed with clay fill/re-work and then faced extensively with waste rock. The

eastern side of the dam is about 60 feet tall and has an average slope of about 1.3H to 1V (horizontal to vertical).

The existing ground surface elevation is roughly +75 feet along the crest of the dam and about +70 feet in central portions of the impoundment. The impoundment surface is concave and surface water ponds in the middle. The pond covers about 2 to 2.5 acres of the impoundment and typically holds surface water throughout the summer months such that a cattail marsh has developed. The remainder of the impoundment surface is unvegetated.

It is our understanding that the Tailings Impoundment had an engineered structure (i.e., decant pipe) to remove water from inside the impoundment and discharge it under the berm. A drainage pipe was found at the western edge of the impoundment. Based on geophysical surveys and dye tracer testing the pipe was determined to discharge at a previously mapped seep at the base of the Tailings Impoundment berm. During the OU 1 remediation work the inlet pipe was extended above the stockpiled soils to allow access, if needed. Runoff from the Tailings Impoundment drains through a low area in the berm at the northwest corner of the Tailings Impoundment and into an overland drainage swale, which discharges to Goose Pond.

The existing ground surface elevation averages about +15 feet along the eastern toe. East of the toe, the existing ground surface slopes down gradually to the edge of the Salt Marsh/Goose Pond floodplain (at approximately elevation +7 feet). In some areas, the salt marsh/floodplain extends to the east on the order of 1500 feet.

The existing features and topography of the Tailings Impoundment are depicted in the Design Drawings. As previously noted topography and site features were altered in 2013 as part of the on-going OU 1 remediation, and the as-built topographic elevations for the stock-piled soils area were used to update the existing topographic information. In addition, MaineDOT provided supplemental survey topographic data for the toe of slope and perimeter areas.

POST REMEDIATION CONDITIONS

Post-remediation grading and drainage has been developed to minimize erosion and off-site sediment transport while providing grades to support positive drainage off of the tailings impoundment. All proposed drainage swales have been designed using the Army Corp of Engineers approved method to calculate the size of riprap lining the swales. A factor of safety of 1.5 was used to determine that a D50 riprap size of 4-inches would be more than adequate to provide channel stability and prevent channel erosion as shown on Table 3.

Using the Maine Stormwater BMP Manual, two Wet Ponds have been designed to remove sediment before reaching South Goose Pond. South Goose Pond, which is a tidal estuary, is the principal recipient of the stormwater runoff from the tailings impoundment. Since South Goose Pond is a tidal water way, the post-remediation peak flows are not required to be lower than pre-remediation peak flows.

Using the Maine Stormwater BMP Manual, the Wet Ponds have been designed to include a sediment forebay and a stormwater treatment bay. The sediment forebays have been designed using Maine DEP

standards to convey a 100-year storm event without overtopping the embankments. A riprap spillway connects the sediment forebays with the stormwater treatment bays.

The stormwater treatment bays have been designed to include a permanent pool volume and a channel protection volume. The permanent pool volume is designed to retain a runoff volume of 0.6 inches times the Wet Pond's non-impervious drainage area. The design of the Wet Pond assumes that the water retained in the Permanent Pool Volume will not drain out of the pond All stormwater above the permanent pool volume elevation is considered the channel protection volume. The channel protection volume has been designed to detain 0.4 inches times the Wet Pond's non-impervious drainage area above the permanent pool volume. This water will be released over a period of 24-36 hours through an underdrain gravel filter. The underdrain gravel filter is a 4-foot wide by 3.5-foot deep trench that contains a 6-inch diameter perforated pipe surrounded by crushed stone. This underdrain gravel filter allows for slow, extended release of stormwater above the permanent pool elevation while providing sediment filtration. The stormwater treatment bay has also been designed with a riprap emergency spillway to safely convey a 100-year storm event with a minimum freeboard of no less than 6-inches and a peak flow depth through the weir of less than 1-foot. All stormwater that is not released through the underdrain gravel filter will be released through the riprap emergency spillway to South Goose Pond.

METHODOLOGY

Peak runoff volumes for the 2-, 10-, 25-, and 100-year Type III 24-hour rainfall events were evaluated under existing and proposed conditions in accordance with the requirements of the Maine Stormwater Best Management Practices Manual.

Subcatchment boundaries were delineated under existing and proposed conditions to determine peak discharge rates at the Site. Rainfall data was obtained utilizing the latest published National Oceanic and Atmospheric Administration (NOAA) Atlas 14 information in the vicinity of the project site and summarized in Table 1.

Table 1. 24-Hour Rainfall Data

Rainfall Event	24 Hour Rainfall
2-Year	2.70 inches
10-Year	4.20 inches
25-Year	4.90 inches
100-Year	6.00 inches

Peak runoff volumes during various storm events were calculated using a stormwater model developed for the Site using commercially-available computer software based upon the United States Department of Agriculture Technical Release 20 (TR-20) methodologies. The TR-20 methodology is a standard engineering method used to evaluate runoff conditions and develop stormwater controls. HydroCAD® by Applied Microcomputer Systems, Inc, a stormwater modeling software which uses the TR-20 method, combined with the standard hydraulic equations, was used to develop the model for evaluation of the stormwater drainage system.

The approach to analyzing stormwater runoff was based on determining the post remediation peak flows to the two Wet Pond locations. The locations used are identified as Analysis Points (AP-1 thru AP-4) and are shown on attached Figure 1.

Hydrologic Soil Group (HSG) A, B, C and D have been selected for the Site based on soil data provided the USDA NCRS maps. Selected Curve Numbers (CNs) for post remediation cover conditions are summarized in Table 2.

Table 2. Curve Number Summary

Cover Condition	Curve Number (CN)
Bare Earth (HSG A)	72
Bare Earth (HSG C)	87
Gravel Surface (HSG A)	96
Gravel Surface (HSG C)	96
Newly Graded Areas HSG B)	86
Brush (HSG C)	70
Woods (HSG A)	30
Woods (HSG C)	70
Woods (HSG D)	77

CONCLUSION

Based on the above design evaluation, completion of remedial activities at the Site will not create any adverse impacts to South Goose Pond or surrounding properties. The proposed drainage design has incorporated Maine BMP practices to capture and treat stormwater across the Site through sediment forebays and wet ponds. Results presented herein are based on accepted and standard engineering practices for determining peak design flows and evaluating hydraulic characteristics.

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Table 3 Riprap Sizing - USCOE Method

Based on EM 1110-2-1601

$D_{30} = Sf \times Cs \times Cv \times Ct \times d[(\gamma\omega / (\gamma s - \gamma w)) \times V/(K_1 \times g \times d)^{1/2}]^{2.5}$

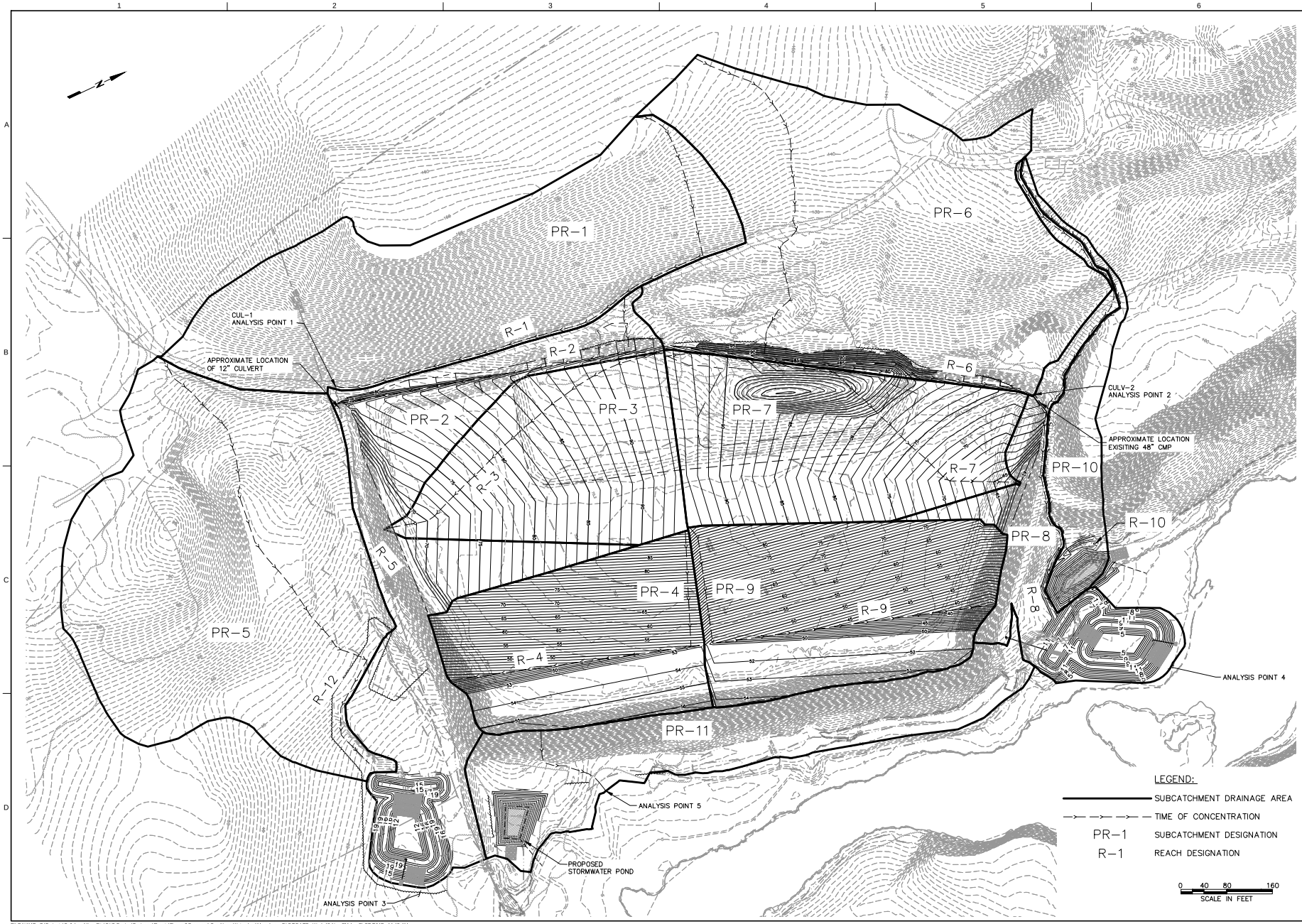
Where:

D_{30} = stone size (feet) at which 30 percent of the stones are smaller
Sf = safety factor (use 1.1 minimum)
Cs = stability coefficient for incipient failure; = 0.3 for angular rock
(rounded rock: use Cs = 0.38 minimum or increase safety factor to 1.55 x Sf minimum)
Cv = vertical velocity distribution coefficient
= 1.0 for straight channels
= 1.283 - 0.2log(R/W)
W = stream bank top width (top of bank to top of bank), feet
R = bend radius at centerline of channel, feet
Ct = 1.0 for thickness = $1xD_{100}$(max) or $1.5xD_{50}$(max)
d = local depth of flow at same location as V, feet
γs = unit weight of stone, lbs/ft^3
$\gamma\omega$ = unit weight of water, 62.43 lbs/ft^3
V = local depth averaged velocity, ft/s
g = gravitational constant, 32.174 ft/sec^2
K_1 = side slope correction factor
= 1.0 for bottom stone
= $[1 - \sin^2\Theta / \sin^2 ø]^{0.5}$
Θ = arctan(1/cotangent of sideslope), degrees
ø = riprap angle of repose = 40 degrees

Sf =	1.5		
Cs =	0.3		
Channel Bend Radius, R =	0	(enter 0 if straight)	
W =	6	feet	
Cv =	1.0		
Ct =	1.0		
d =	0.5	feet	Also:
V =	10	ft/s	$Wt = (D^3 \times \pi \times \gamma s)/6$
γs =	135	lbs/ft^3	Where:
Cotangent of sideslope, H =	3	(?H:1V)	Wt = weight of D stone size, lbs
Θ =	18.43	degrees	D = stone size, feet
K_1 =	0.87		

Calculated	D_{30} =	2.18	feet	Wt_{30} =	728	lbs
(Sideslopes) 1.45* D_{30}	D_{90} =	3.15	feet	Wt_{90} =	2219	lbs
Estimated	D_{50} =	2.50	feet	Wt_{50} =	1107	lbs
Estimated	D_{100} =	3.32	feet	Wt_{100} =	2582	lbs
Riprap Layer Thickness	T =	3.8	feet	min.		

	D_{30} =	1.83	feet	Wt_{30} =	433	lbs
(Bottom, K1 =1.0)	D_{90} =	2.65	feet	Wt_{90} =	1320	lbs
	D_{50} =	2.10	feet	Wt_{50} =	659	lbs
	D_{100} =	2.79	feet	Wt_{100} =	1536	lbs
Riprap Layer Thickness	T =	3.2	feet	min.		



NO	DATE	REVISION	BY	APVD
B	11/5/14	ISSUED FOR INTERNAL REVIEW	TDD	MAP
A	4/5/13	ISSUED FOR REGULATORY REVIEW	TDD	SHM

DSGN TDD DR BJB CHK MAP APVD PSB

ME PROFESSIONAL ENGINEER
LICENSE NUMBER

OU3 DRAFT FINAL REMEDIAL DESIGN
CALLAHAN MINE SUPERFUND SITE
BROOKSVILLE, MAINE

DRAWING STATUS
DRAFT FINAL DESIGN DRAWINGS

CIVIL

PROPOSED CONDITIONS
WATERSHED MAP

amec
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VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE
PROJ 3612-11-2201
DWG FIGURE 1
SHEET 1 OF 1

THIS DRAWING IS THE PROPERTY OF AMEC, INCLUDING ALL PATENTED AND PATENTABLE FEATURES, AND/OR CONFIDENTIAL INFORMATION AND ITS USE IS CONDITIONED UPON THE USERS AGREEMENT NOT TO REPRODUCE THE DRAWING, IN WHOLE OR PART, NOR THE MATERIAL DESCRIBED THEREON, NOR THE USE OF THE DRAWING FOR ANY PURPOSE OTHER THAN SPECIFICALLY PERMITTED IN WRITING BY AMEC.

FILE NAME: Z:\Projects\Callahan Mine Site\OU3 Design\Drainage\Sheets\Figure 2 Proposed Conditions Watershed Map.dwg PLOT DATE: Wed, 12 Nov 2014 PLOT TIME: 11:45 AM