U.S. Army Corps
of Engineers
Philadelphia/Baltimore District's

Potential Bank Stabilization Methods

Wissahickon Creek, Tannery Run and Rose Valley Creek near the Bo-Rit Site
Ambler, Pennsylvania

Prepared for

United States Environmental Protection Agency
Region III

Prepared by

U.S. Army Corps of Engineers
Philadelphia/Baltimore District's

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I. INTRODUCTION

EPA requested USACE develop a Matrix of possible bank stabilization solutions for the Bo-Rit Site located in Ambler, PA. The project area extends approximately 2,440 ft along the Wissahickon Creek, 720 ft along Tannery Run and 775 ft along Rose Valley Creek. Tannery and Rose Valley are tributaries to the Wissahickon. The banks of all three creeks are eroding and contain Asbestos Containing Material (ACM). Both friable and bound ACM (pipes, rings and shingles) are visible along the banks of the three streams. Project location is shown in Figure 1.

II. SITE DESCRIPTION

Wissahickon Creek

The Wissahickon Creek has a bedrock channel that is approximately 30-40 ft wide within the project area. The left bank is stepped in places with a 2-5 ft high bank with a 10–20 ft wide bench and then another 10-15 ft rise. The left bank varies due to the random placement and grading of ACM fill. The right bank did not receive fill and is residential (single homes with large back-yards). The right bank is approximately 2-5 ft high. A sanitary sewer runs along the right bank.

The upstream portion of the Wissahickon has visible pipes and rings in the banks and sometimes in the channel. This material will be moved and disposed of either on- or off-site. All stabilization methods being considered consist of a hardened toe on the left bank and right bank. The right bank will be protected to prevent any erosion that may be induced by the required changes in the stream cross section to contain the ACM. Only the left bank will receive upland protection. Upland stabilization could be either hardened or "soft" methods since the upland area is expected to be dry under normal conditions and only be exposed to low velocities during storm events which will not be erosive enough to fail the protection

Tannery Run

Tannery Run's channel is approximately 5 ft wide and is lined with loose sediment. Both the left and right banks (and likely the channel) contain friable ACM and vary in height up to approximately 20 ft. There is a near-vertical 20 ft. scarp on the left bank near the confluence with the Wissahickon. This scarp is very close to a parking lot and the project area limits.

Hardened stabilization methods will be used at the toe. Due to the steep slopes (scarp) on the left bank, a different method may be used on each bank or a different method may be used only in the scarped area. For the purposes of the attached initial rough cost estimate, however, the evaluated methods will be assumed to be continuous along the left or right bank. Subsequent analyses performed after more data is collected may evaluate the use of more than one method on the left bank to better address the scarped and un-scarped areas.

Upland areas will also be protected to prevent exposure of ACM. "Green" solutions such as Willow plantings are not possible because of insufficient space for the "benches" required for the plantings.

Rose Valley Creek
Rose Valley Creek has a 10-15 ft wide bedrock channel. The banks are approximately 2-5 ft high and nearly vertical at the downstream end and 10-15 ft high at the upstream end. The banks are steep at the upstream end with slopes that are H:1V in places. Both banks contain ACM that is both friable and bound (pipes and rings).

Hardened stabilization methods will be used at the toe. Both hardened and soft methods were evaluated for the upland stabilization. For the purposes of the attached initial rough cost estimate, it was assumed that the same method will be used for both the upstream and downstream portions. However, subsequent analyses performed after more detailed data is collected may evaluate more than one method to better address the varying bank slopes along this creek.

III. CONSTRUCTION CONSIDERATIONS

Temporary access roads, staging areas for equipment and materials, and work areas/pads for equipment working from top of banks will be constructed as part of the mobilization effort on site. These actions will preclude any formal stabilization method work and will help to minimize impacts of equipment disturbance upon existing ACM. New fences may be constructed along with signage restricting access to anyone not signed in, properly briefed on the site hazards and receiving at least the minimum PPE required.

It is assumed for cost estimating purposes that all streams will be temporarily diverted using techniques such as water bladders/porta dams or pumped diversion, and that the construction work will proceed under de-watered conditions.

Along the Wissahickon the stream will be diverted to one side and work will be completed from the bank toe with construction equipment in the de-watered stream. Heavy equipment will need to work on the bank above the toe to properly compact the protective fill cover over asbestos containing material.

Due to the narrow channel width along Tannery and Rose Valley, construction may have to be performed from the tops of the existing banks. However, some options, such as soil nail with shotcrete and possibly the post and panel wall will require access from the bottom of the banks.
Along Tannery Run the top of the south bank contains existing parking lots that could provide a working area from which to construct the bank protection. Temporary construction/access easements will need to be acquired along the south bank. At Rose Valley, a temporary construction access road will most likely need to be built along the north bank to provide access for construction equipment and to stage construction.

IV. STABILIZATION METHODS

All methods assume minimal bank disturbance. Under normal circumstances some of these options would be placed into an excavated bank to minimize stream encroachment.

However, due to the nature of ACM, all methods assume no bank excavation and the hardened structures encroach the channel. This precluded several options for Tannery and Rose Valley due to their narrow channels. If some bank disturbance is allowed more options would be available for these streams such as eco-blocks. If some excavation is allowed, bank disturbance would be limited to excavating to the depth of the block so that the block face would be set at approximately the same location as the present earth bank.

Stabilization methods were organized into a matrix that is presented in Table 1. The matrix is divided into two main categories which are Toe Protection and Upland Protection:

Toe Protection. All Toe Protection methods considered are hardened to prevent any erosion and subsequent ACM exposure. Two types of Toe Protection were evaluated: Retaining Structures and Revetments. Retaining Structures are near-vertical and are a good solution where the existing bank is near vertical or scarped, especially if bank disturbance is to be kept to a minimum. Revetments work best when placed on an existing or constructed slope, so where bank disturbance is to be kept to a minimum, a fill slope will need to be constructed to place the revetment on. However, some revetment protection, such as Articulated Concrete Mat can be placed on nearly vertical slopes when properly anchored at the top and bottom of slope. The hardened toe (Retaining Structure or Revetment) will extend up to approximately 5 ft (the top of the lower bank) on Wissahickon and Rose Valley and up to approximately 6 ft on Tannery (100-yr flood elevation).

Upland Protection. Both hardened and "soft" Upland Protection methods were considered for aesthetics and eco-friendliness. All existing vegetation will be removed at ground level but roots will not be grubbed to minimize ground disturbance. All upland protection options include 1 foot of clean fill placed over existing ground. Asbestos-containing pipes will be crushed on-site and buried under the clean fill. The upland area is expected to be dry under normal conditions and only be exposed to low velocities during storm events which will not be erosive enough to fail the protection.

Evaluated stabilization methods are listed below along with a brief description of why it is or is not appropriate for further analysis (also see Table 1). A rough cost estimate for selected options is presented in Attachment 1. Sample photos of several methods are presented in Attachment 2.

V. ENVIRONMENTAL/SAFETY CONSIDERATIONS

The USACE is suggesting the USEPA provide a form of encapsulation on the surface of the site to restrict or minimize exposure to friable ACM before mobilization effort commences--at a minimum, constant wetting of the surfaces is assumed prudent. This engineered control will help minimize friable ACM exposure to the workers and the public and may influence minimum level of PPE required to do the work on site.

Continuous air monitoring is suggested before, during and after construction phase activities onsite (particularly at the residences and at the McDonalds locations). The

results of which will help determine the appropriate PPE to be used by workers on site. All contractors working for the USACE on behalf of USEPA will also be required to perform all work in accordance with EM 385-1-1.

VI. SOLUTION MATRIX WITH COST ESTIMATES

Bo Rit Site Bank Stabilization Matrix

GENERAL REQUIREMENTS COST			
	Wissahickon	**Tannery Run**	**Rose Valley**
See Note Below	**$1M**	**$500K**	**$700K**
TOE PROTECTION			
Retaining Structures (near vertical)			
	Wissahickon	**Tannery Run**	**Rose Valley**
Gabion Wall	x		
Confined Cellular System Wall	x		
Bin Wall			
Post & Panel	x	**$800K**	x
Pre-cast Concrete Block	**$1.4M**		
Soil Nailed Wall with Shotcrete Cover	x	**$700K**	x
Architectural Block Wall	x		**$500K**
Natural Stone Toe (large stone)	**$900K**		
Articulated Block Mat	**$900K**		
Revetment (sloped)			
Riprap	x	x**	x
Articulated Concrete Mat	**$1.7M**	**$950K**	**$1M**
Geoweb (Concrete Filled)	x	**$300K****	**$650K**
UPLAND PROTECTION			
Upland Protection (above Retaining Structure / Revetment)			
Erosion Control Mat	**$200K**	**$30K****	**$60K**
Geoweb (Concrete Filled)	x	x**	x
Geoweb (Gravel Filled)	**$500K**	**$100K****	**$200K**
Small Riprap	**$700K**	x**	**$250K**
Soil Nail & Shotcrete	x	**$600K*****	x
Willow Plantings (Coir Mat)	x		x

x Possible solution but not recommended. No cost estimate will be computed

** Right bank only
*** Left bank only

All options assume 1 ft of clean fill cover over existing banks
with asbestos containing material (ACM)

All costs rounded and include contingency, engineering, design, supervision, and inspection.

General requirements include mobilization, demobilization, care and diversion of water, clearing, erosion control, and typical field overhead items.

To compute total cost for bank protection for each stream, the general req. cost needs to be added to the toe and upland protection, except for Tannery Run where, depending on the option chosen, costs may need to be added seperately for left and right bank.
Example: Total cost = Blue Cost + Red Cost + Green Cost for each stream column

VII. TOE PROTECTION

Retaining Structures (near vertical):

Gabion Wall

Wissahickon – Possible. Not recommended due to potential basket failure and high O&M.
Tannery Run – Inappropriate due to narrow channel width
Rose Valley – Inappropriate due to narrow channel width

Confined Cellular System Wall (CCS)

Wissahickon – Possible. Not recommended due to relative cost.
Tannery Run – Inappropriate due to narrow channel width and bank disturbance
Rose Valley – Inappropriate due to narrow channel width and bank disturbance

Bin Wall

Wissahickon – Inappropriate due to relative cost
Tannery Run – Inappropriate due to narrow channel width, relative cost and bank disturbance
Rose Valley – Inappropriate due to narrow channel width, relative cost and bank disturbance

Post & Panel

Wissahickon – Possible. Not recommended due to relative cost
Tannery Run – Possible. Cost estimate will be computed.
Rose Valley – Possible. Not recommended due to relative cost

Pre-cast Concrete Blocks

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Inappropriate due to narrow channel width
Rose Valley – Inappropriate due to narrow channel width

Soil Nailed Wall with Shotcrete Cover

Wissahickon – Possible. Not recommended due to relative cost.
Tannery Run – Possible. Recommended due to limited possibilities for steep slopes. Cost estimate will be computed.
Rose Valley – Possible. Not recommended due to relative cost.

Architectural Block Wall

Wissahickon – Possible. Not recommended due to relative cost.
Tannery Run – Inappropriate due to bank height
Rose Valley – Possible. Cost estimate will be computed.

Natural Toe Stone (Large Stone)

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Inappropriate due to narrow channel width.
Rose Valley – Inappropriate due to narrow channel width.

Revetment (sloped):

Riprap

Wissahickon – Possible, but not recommended. Relative cost too high due to notching of riprap into the bedrock stream bottom.
Tannery Run – Possible on right bank only. Left bank is too steep in places and channel width is too narrow. Also will require notching into bedrock (high relative cost). Therefore, not recommended.
Rose Valley – Possible. Not recommended because requires notching into bedrock (high relative cost).

Articulated Concrete Mat

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Possible. Cost estimate will be computed.
Rose Valley – Possible. Cost estimate will be computed.

Geoweb (Concrete Filled)

Wissahickon – Possible. Not recommended due to relative cost.
Tannery Run – Possible on right bank only. Left bank is too steep in places. Cost will be computed for right bank.
Rose Valley – Possible. Cost will be computed.

VIII. UPLAND PROTECTION

Erosion Control Mat

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Possible on right bank only. Left bank is too steep in places. Cost estimate will be computed.
Rose Valley – Possible. Cost estimate will be computed.

Geoweb (Concrete Filled)

Wissahickon – Possible. Not recommended due to high relative cost.
Tannery Run – Possible on right bank only. Left bank is too steep in places. Not recommended due to high relative cost.
Rose Valley – Possible. Not recommended due to high relative cost.

Geoweb (Gravel Filled)

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Possible on right bank only. Left bank is too steep in places. Cost estimate will be computed.
Rose Valley – Possible. Cost estimate will be computed.

Small Riprap

Wissahickon – Possible. Cost estimate will be computed.
Tannery Run – Possible on right bank only. Left bank is too steep in places.
Rose Valley – Possible. Cost estimate will be computed.

Soil Nail & Shotcrete

Wissahickon – Possible. Not recommended due to high relative cost.
Tannery Run – Possible. Not recommended on right bank due to high relative cost. Recommended for left bank due to limited possibilities for steep slopes. Cost estimate will be computed.
Rose Valley – Possible. Not recommended due to high relative cost.

Willow Plantings (Coir Mat)

Wissahickon – Inappropriate since Willows will be planted above toe protection where soil will not be wet enough.
Tannery Run – Inappropriate due to steep banks with insufficient space for planting benches required for Willows.
Rose Valley – Inappropriate since Willows will be planted above toe protection where soil will not be wet enough.

IX.

SAMPLE PHOTOS

TOE PROTECTION

Retaining Wall Structures (near Vertical):

Gabion Wall

Stacked Geoweb Wall

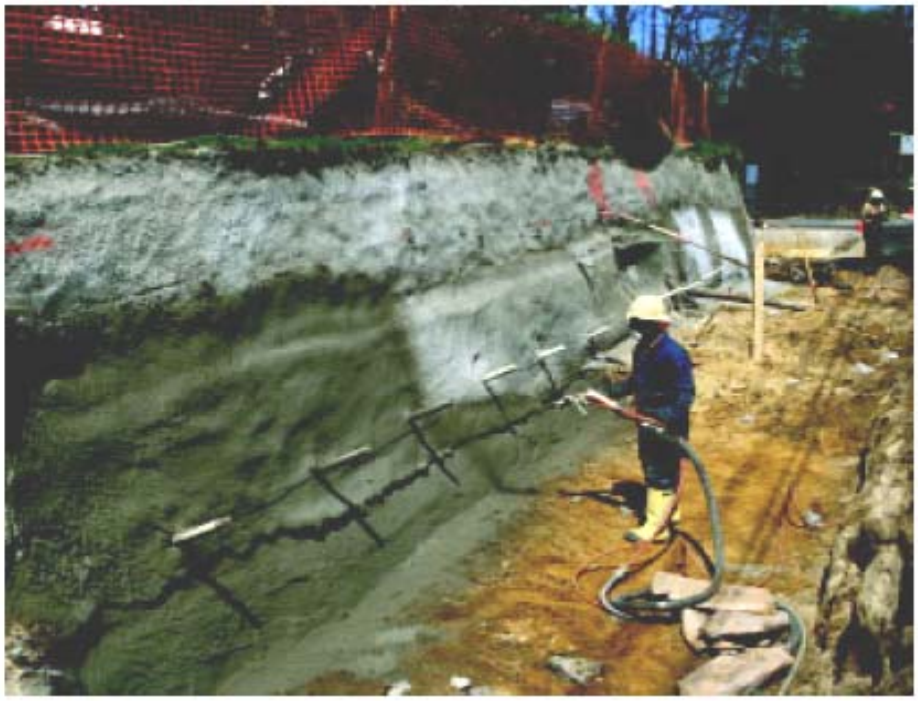
Bin Wall

Capital One Building, McLean, VA

Post and Panel Wall

Precast Concrete Block Wall

Precast Concrete Block Wall



Soil Nailed Wall with Shotcrete Cover

Soil Nailed Wall with Shotcrete Cover- Drilling for Nails

Architectural Block Wall (Smaller Size)

Natural Stone Toe (Large Stone)\

TOE PROTECTION

Revetment (sloped):

Riprap

Riprap

Articulated Concrete Mat

Articulated Concrete Mat

Concrete Filled Geoweb

UPLAND PROTECTION

Upland Protection (above Retaining Structure / Revetment):

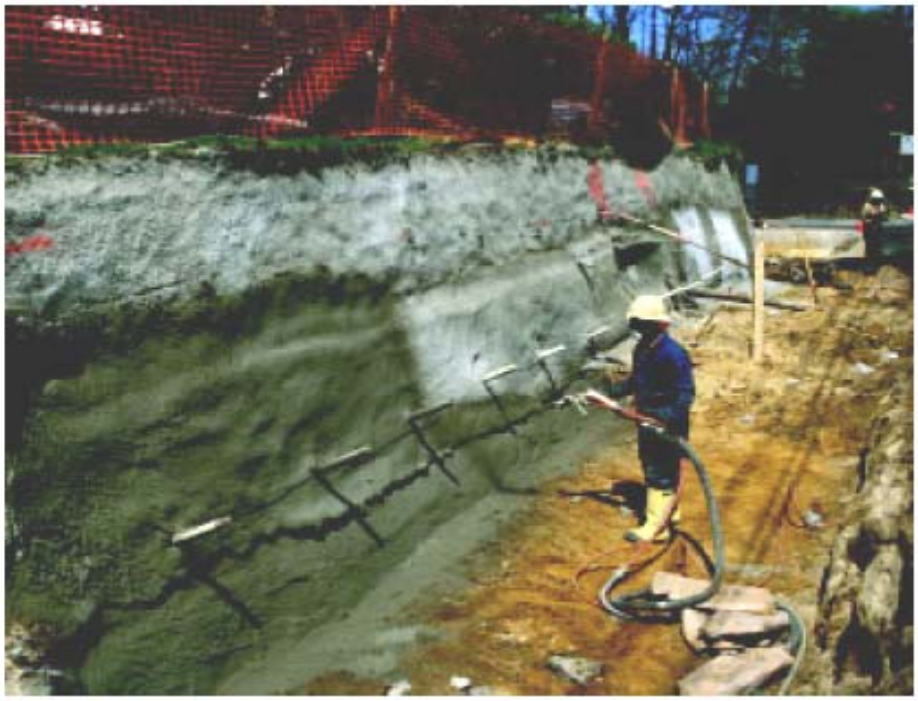
Erosion Control Mat

Erosion Control Mat

Geoweb (Gravel Filled)

Geoweb (Gravel Filled)

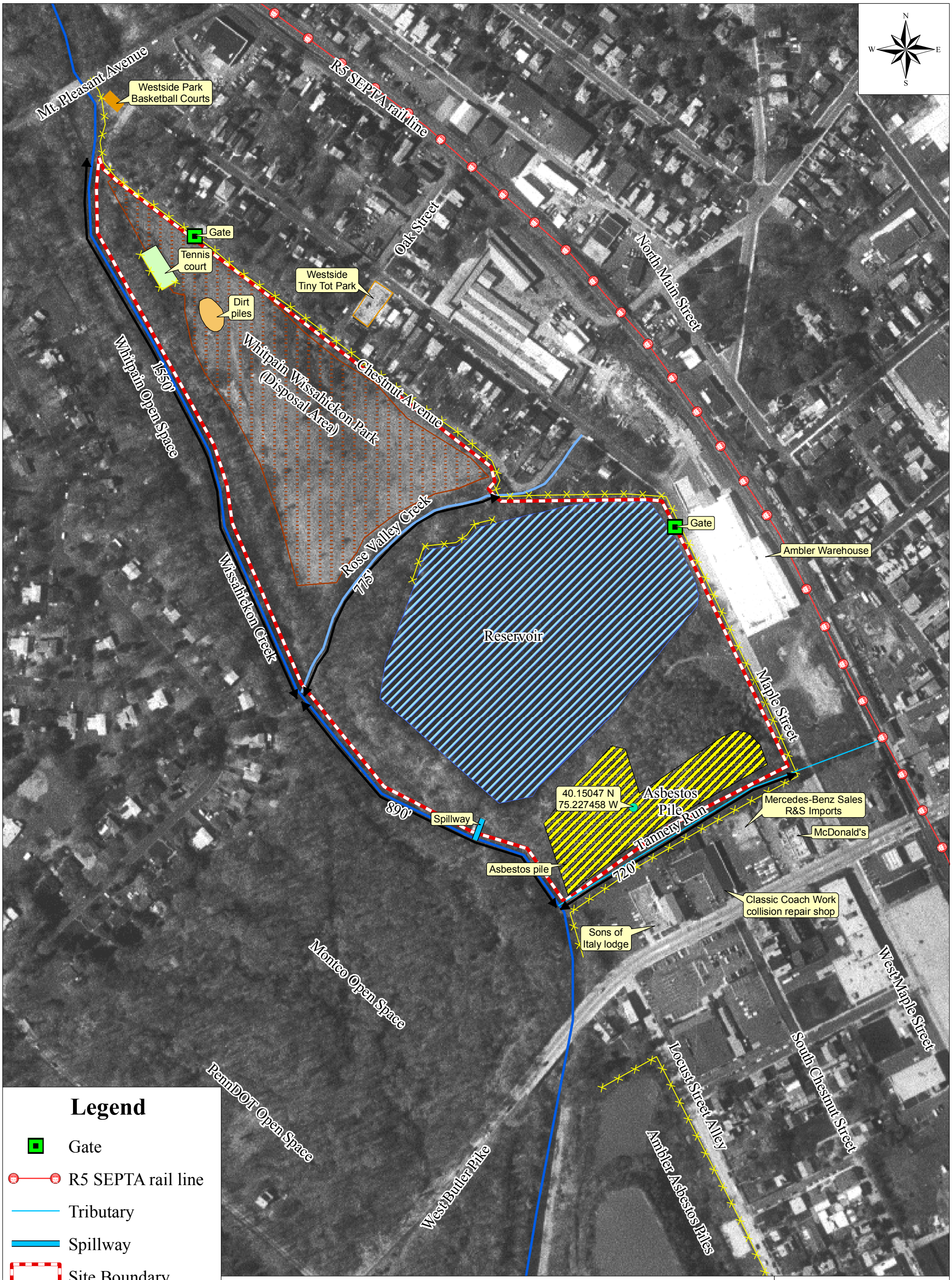
Small Riprap



Soil Nailed Wall with Shotcrete Cover

Willow Plantings (Coir Mat)

X. SITE MAP



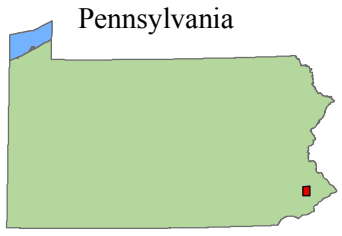
Legend

- Gate
- R5 SEPTA rail line
- Tributary
- Spillway
- Site Boundary
- Reservoir
- Fence
- Borit Asbestos Pile
- Dirt piles
- Tennis court

Source: Modified from U.S. Geological Survey Digital Orthophoto MrSID mosaic for Ambler Quadrangle, Pennsylvania (NAPP II, 1999)

0 100 200 300 Feet

Quadrangle Location = Pennsylvania



Borit Asbestos Tailing Pile Site
Ambler, Montgomery County, Pennsylvania

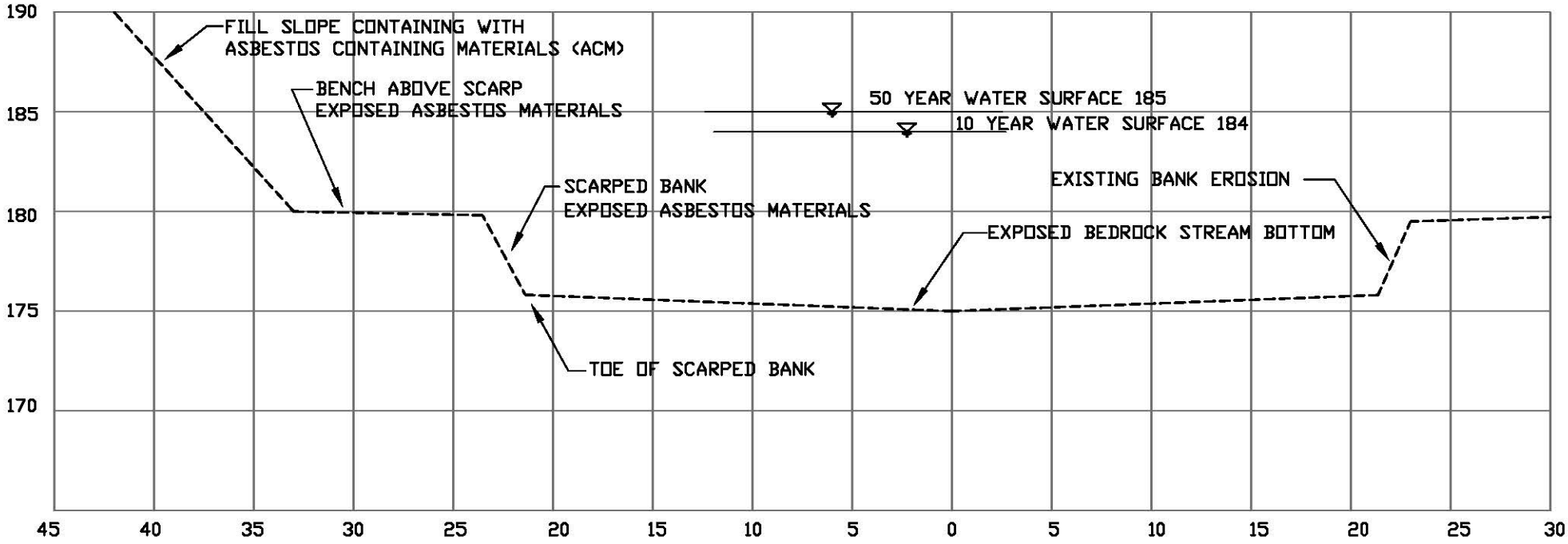
Figure 2
Site Layout Map

TDD No. E13-008-06-08-003
EPA Contract No. EP-S3-05-02

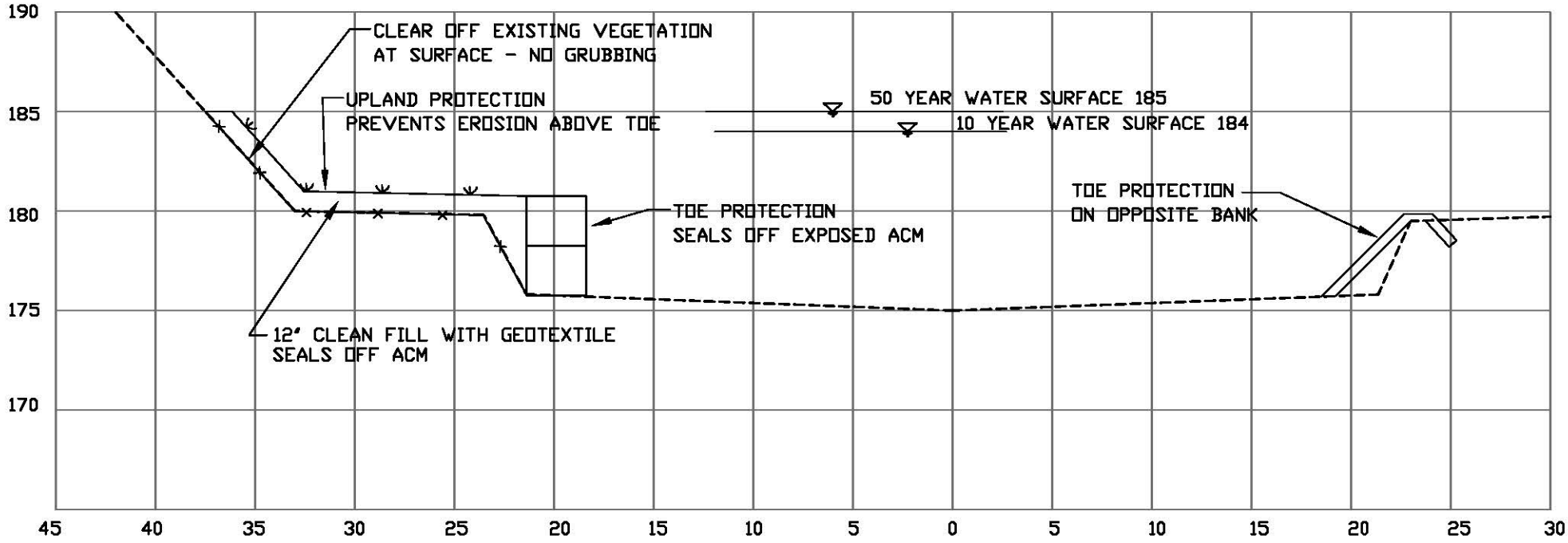
Map created on September 11, 2006
By D. Call, Tetra Tech EMI

TETRA TECH EM INC.

XI. SAMPLE SCHEMATIC CROSS SECTIONS



TYPICAL X-SECTION WISSAHICKON CREEK
EXISTING CONDITION



TYPICAL X-SECTION WISSAHICKON CREEK
WITH EROSION PROTECTION