APPENDIX D: CIVIL DESIGN

Contents

1 General

The selected plan, if implemented, consists of the construction of nine stormwater runoff detention facilities in the Tookany Creek Watershed. The mitigation facilities have been located in areas to improve flood risk management in the watershed by attenuating peak runoff flow throughout portions of Tookany Creek. These facilities consist of an upstream earthen embankment, an overflow spillway, downstream gabion walls and an engineered outlet structure that controls the flow through each embankment. The embankments are to be constructed across stream channels at locations that provide the maximum amount of potential storage volume while minimizing impacts to existing vegetation and or structures. Preliminary design and embankment footprints for the each of the stormwater detention facilities are attached at the end of this Appendix. Each embankment varies in height and length according to Table 1 below.

Table 1.

	Embankment	
	Length (LF)	Height (ft)
Doe Lane	135	11
West Waverly	268	9
Church Rd	436	11
Limekiln Pike	355	14
Grove Park	426	8
Washington Lane	299	15
Baeder Rd	234	12
Highland East	360	12
Highland West	264	16

2 Hydraulics and Hydrology

The earthen embankments have been designed with an outlet structure channeling flow to a concrete box culvert that conveys the water through the embankment and outfalls to the existing stream channel. The embankment dimensions and outlet structure configurations have been designed based on watershed runoff characteristics as determined in the Hydraulic and Hydrology portion of the study (See Appendix B).

3 Surveying and Mapping

The surveying and mapping data for the project were developed using LiDAR (Light Detection and Ranging), aerial photography, and computer modeling to combine and manipulate public domain geospatial data to engineering elevation models of the study areas. The following provides an in depth description of the LiDAR information and how it was processed to develop the elevation models.

LiDAR data is remotely sensed high-resolution elevation data collected by an airborne collection platform. The LiDAR data was sourced as Digital Elevation Models (DEM) with a horizontal

resolution of 1 meter. Elevations within the area of interest range from approximately 60 ft near the Cheltenham / Philadelphia County boundary to nearly 430 ft in the northwestern portions of the Tookany Creek watershed. These elevations were sourced from the Pennsylvania Department of Conservation and Natural Resources (DCNR) PAMAP LIDAR elevation coverages, which were representative of 2008 conditions. Digital Elevation Models were created in ArcGIS and exported into a TIFF file format readable in AutoCAD Civil 3D. This information was utilized in AutoCAD to layout, analyze, and compute quantities for the levee and floodwall structures.

More recent and comprehensive topographic surveys will be required in order to develop plans and specifications. It is recommended that an American Land Title Association (ALTA) Land Survey be performed in the next phase of design. This survey will provide existing physical features including topographic features, property boundary lines, easements, right-of-ways, structures, utilities, streets, etc.

4 Geotechnical Investigation

Soil information from the USDA's Web Soil Survey was utilized. No geotechnical investigation was performed onsite however one is recommended to determine if the soils on-site are consistent with our soil assumption taken from the USDA Web Soil Survey.

Table 2.

	Depth (in)	Type	K sat	Piping Potential
Doe Lane	0-44	Silty Loam	High	1
	0-19	Chanery Loam	High	1
Waverly Road	0-44	Silty Loam	High	1
Church Road	0-44	Silty Loam	High	1
	0-40	Silty clay Loam	Low- High	NR
Limekiln Pike	0-60	Clay Loam	Low-High	0.5
	0-40	Silty Clay Loam	Low-High	NR
Grove Park	0-40	Silty clay Loam	Low- High	NR
Washington Lane	0-60	Silt Loam	High	0.5
	0-60	Channery/sandy Loam	High	1
Highland West	0-44	Silty Loam	High	1
	0-72	Gravelly Sand Loam	High	Seepage 1
	0-60	Sandy Loam	High	NR
Highland East	0-44	Silty Loam	High	1
	0-72	Gravelly Sand Loam	High	Seepage 1
Baeder Creek	0-44	Silty Loam	High	1
	0-72	Gravelly Sand Loam	High	Seepage 1

At this stage of design the government assumes the soil on-site can be used as fill but an additional key trench is necessary to prevent seepage and piping underneath the structure. Other

design elements may be deemed necessary e.g. imported fill and anti-seep collars around the outlet pipe; however these elements are not included in this level of design. Upon geotechnical investigation, a failure analysis is recommended for hydraulic, structural and seepage failure modes. The ability of the wall to resist overturning, sliding and piping failures will guide the design when the in-situ soil information is provided.

5 Project Design

5.1 Description of Selected Plan

The proposed flood mitigation structures consist of an earthened embankment and rock filled gabion basket constructed across Tookany Creek. The typical structure section consists of an upstream earthen embankment having a slope of three horizontal to one vertical, a 15 foot top width, and a terraced gabion basket wall along the downstream face. See Sheet C-400 located at the end of this Appendix for the Typical Detail Section. An impervious key trench will be located within the embankment. The preliminary key trench dimensions consists of a six foot deep key with side slopes of one horizontal to two vertical. The key will have a width of five feet at the base, and an eleven foot width at its widest point. The depth of the key trench was assumed to be six feet, however the actual depth will vary from site to site and will be based on depths to rock or depths to suitable subbase material.

The earthen/gabion embankment is designed to be overtopped. For each site, the crest is proposed at a consistent elevation to allow the entire length of embankment to act as a spillway. This maximizes storage capacity within the area behind the embankment while keeping water velocities over the structure as low as possible.

5.2 Project Alternatives

Several alternatives were analyzed in the main report. The alternatives include the No Action alternative, as well as different combinations of a lesser number of basin areas. Because the selected plan contains all prospective sites, the civil portion of each alternative is similar except for excluding construction of certain sites.

5.3 Quantity Computations

The cut and fill quantities required to construct the embankments were developed using AutoCAD Civil 3D computer drafting and design software. The quantities are preliminary and are expected to change based on the optimization of the embankment locations and designs.

5.4 Design Assumptions

The quantity of earthen backfill required to construct the embankments was assumed to be generated from excavating on-site soils. Based on the preliminary geotechnical evaluation of the on-site soils, it is assumed that these soils can be used as fill material required to construct the embankment. Further testing of the on-site soils and engineering failure analysis of the embankment are required to determine suitability of these soils for fill material. In the event that the on-site soils are not suitable for use as fill material, then fill material must be imported to the site or an alternative embankment design shall be explored.

All excavation was assumed to be Bank Cubic Yards (BCY's). A fill factor of 1.41 was used to calculate the Loose Cubic Yard's (LCY's) of clay to be imported. A fill factor of 0.9 was used to convert the Bank Cubic Yard's to Compacted Cubic Yards (CCY's). The compacted fill specified in the detail is proposed to be excavated from the key trench and detention side of the embankment in part to increase the detention capacity.

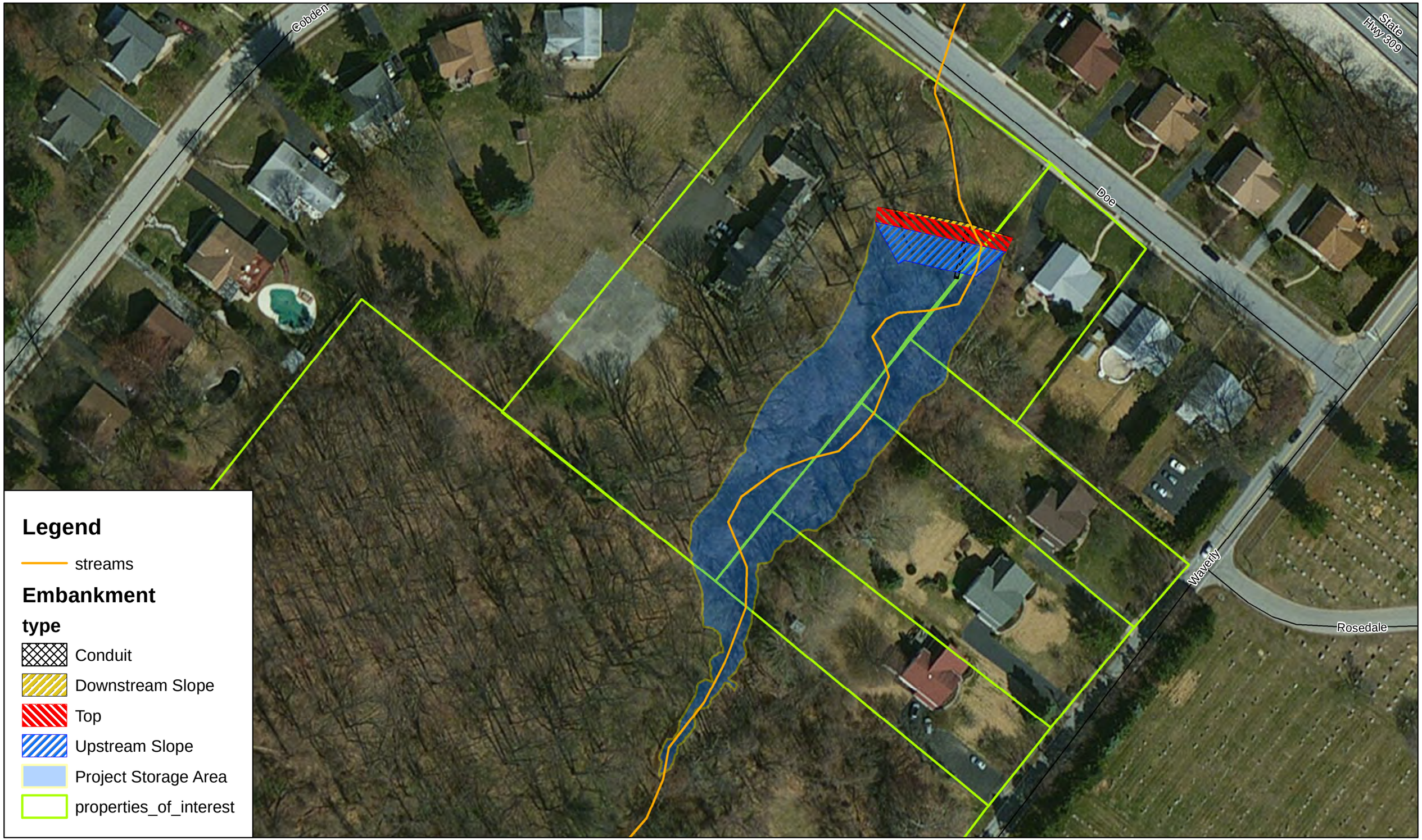
6 Access Roads

Access to the site and necessary easements will be required for maintenance. Comprehensive surveys are recommended to help determine access road placement and easement acquisitions. The project sites are located within Cheltenham Township, Montgomery County, PA and existing public city streets will be utilized for transportation of miscellaneous construction equipment and materials. The project site will require temporary construction easements within 15' of the earthen embankment/gabion structure. Permanent easements will be required for the sponsor to perform future maintenance as required.

7 Plan Views and Details

See Figures 1-9, and C-400.

DOE LANE DETENTION BASIN



WEST WAVERLY ROAD DETENTION BASIN

CHURCH ROAD DETENTION BASIN

LIMEKILN PIKE DETENTION BASIN

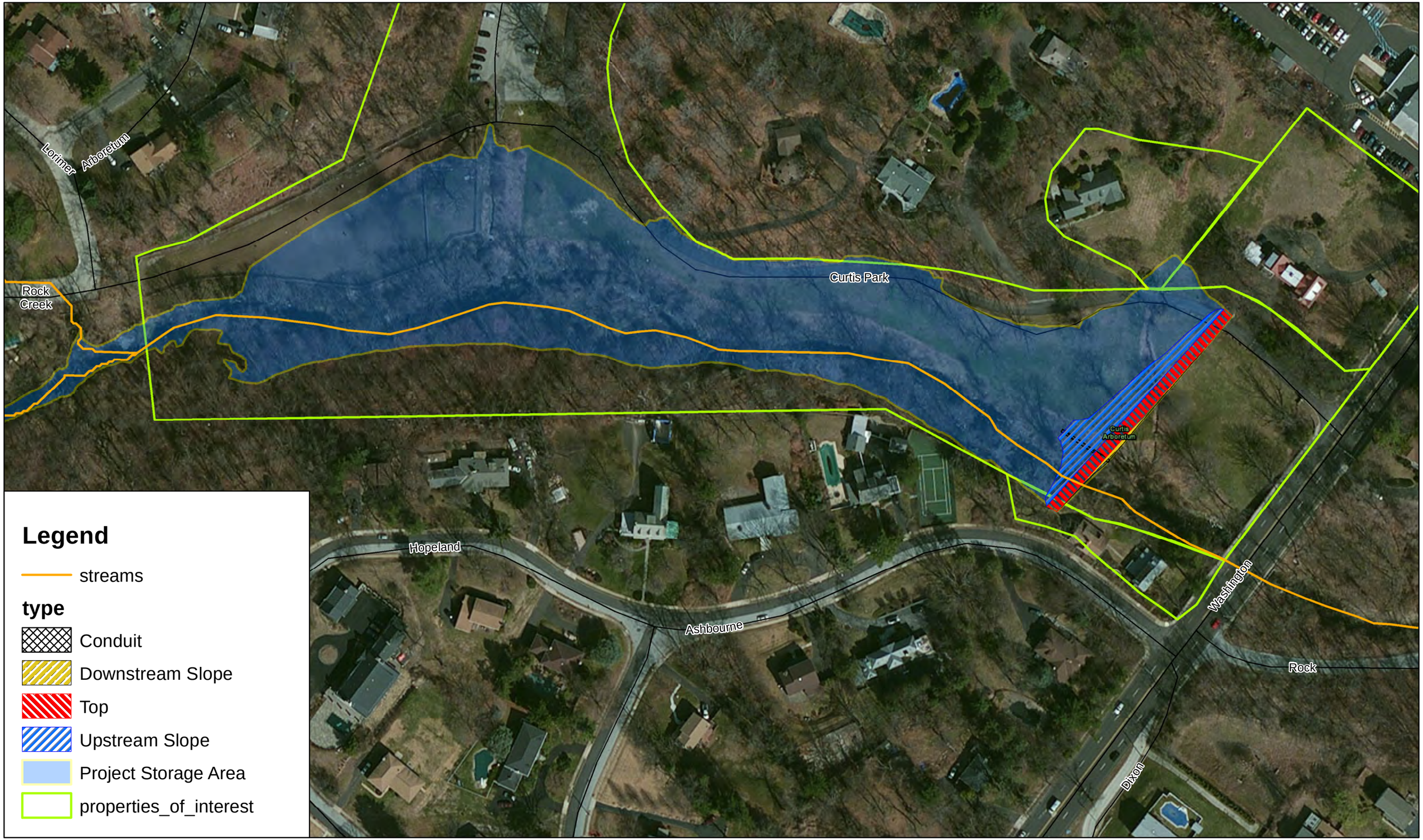
GROVE PARK DETENTION BASIN

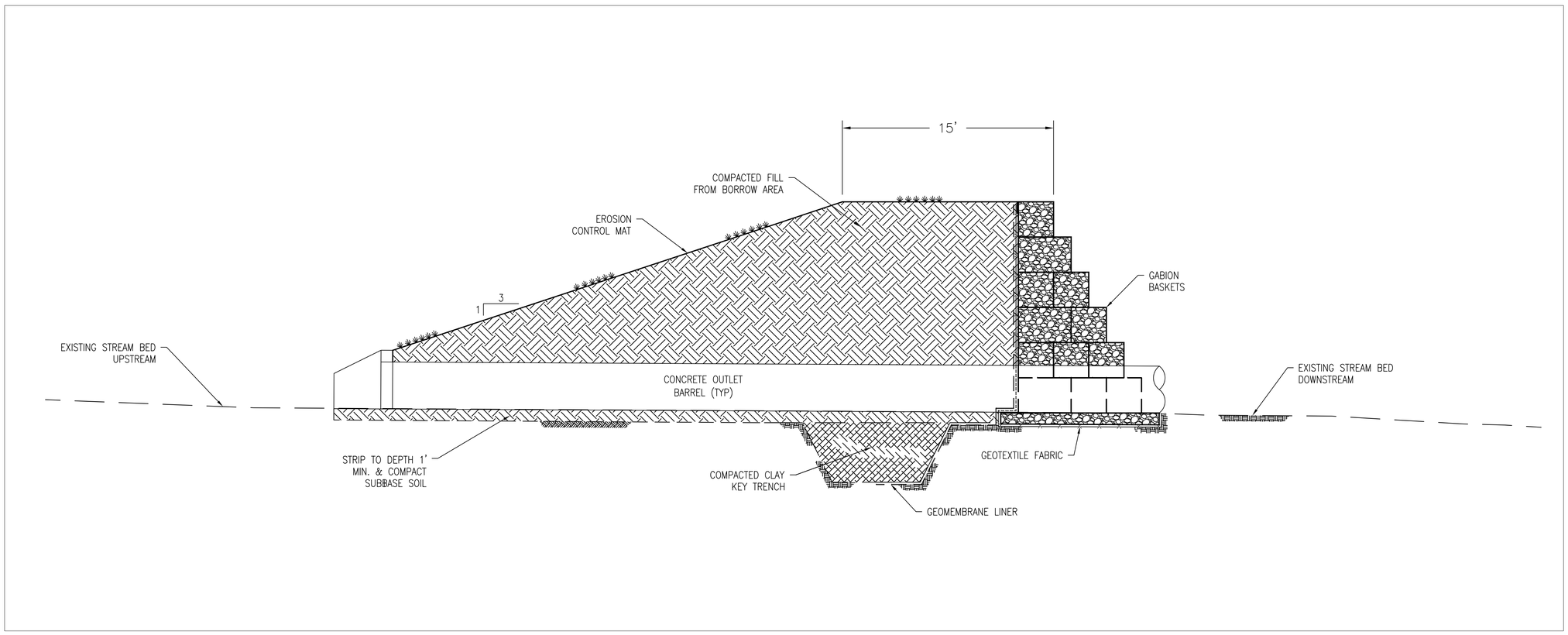
HIGHLAND WEST DETENTION BASIN


Lambert
Highland
Baederwood
Creek
Hilltop
Wooded
Winding
Glen
Legend
Stream
Embankment
type
Conduit
Downstream Slope
Top
Upstream Slope
Project Storage Area

BAEDER ROAD DETENTION BASIN

WASHINGTON LANE EMBANKMENT WITH FEMA FLOODPLAIN





1 TYPICAL EMBANKMENT SECTION

SCALE: 1"=5'

US Army Corps of Engineers
Philadelphia District

MARK	ACTION	DESCRIPTION	DATE	BY

MARK	ACTION	DESCRIPTION	DATE	BY

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
www.nap.usace.army.mil

DWN BY: DWK
CHD BY: -

DES BY: DWK
REVIEWED BY: -

ISSUE/RELEASE DATE: 1 JAN 2015
SOLICITATION NUMBER: ---
CONTRACT NUMBER: ---
PROJ. NUMBER: ---
PLOT SCALE:
DWG. SIZE: 22"x34" ANSI D
FILE NAME: C-400 TYPICAL SECTION.dwg

TOOKANY CREEK FLOOD DAMAGE REDUCTION STUDY
CHELTENHAM, PA
FEASABILITY STUDY

TYPICAL SECTION
-

SHEET NUMBER
C-400