PINE HILL RUN, ST. MARY'S COUNTY, MARYLAND WATERSHED AND STREAM ASSESSMENT PATUXENT RIVER NAVAL AIR STATION

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Stream Habitat Assessment and Restoration Program
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office

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EXECUTIVE SUMMARY

In 2001, the U.S. Fish and Wildlife Service (Service), Stream Habitat Assessment and Restoration Program, Chesapeake Bay Field Office and Patuxent River Naval Air Station (PRNAS) signed a 5-year Cooperative Agreement. In the agreement, PRNAS requested the assistance of the Service to conduct the following:

- Conduct watershed-based stream corridor assessments
- Identify and prioritize stream corridor problem areas
- Design and implement stream and habitat restoration projects
- Review PRNAS stream restoration and stabilization project designs
- Review PRNAS habitat enhancement initiatives

The first effort requested of the Service by PRNAS under this agreement was to conduct an assessment of the Pine Hill Run watershed. The purposes of the watershed assessment are to: 1) characterize physical conditions of stream habitat, 2) identify sources of runoff that contribute to the degradation of stream and riparian habitats, and 3) target and prioritize stream and riparian reaches for restoration.

The assessment area is on the Patuxent River Naval Air Station in St. Mary's County, Maryland. The Pine Hill Run watershed is in the western coastal plain and has a drainage area of 3.0 square miles. A total of 7.1 miles of stream channel exists in the Pine Hill Run watershed, consisting of the main stem and nine tributaries. The watershed has steep-sloped, narrow valleys and headwater tributaries that flow into a series of three man-made ponds – Calvert, Sewall, and Holton Ponds. The discharge from Holton Pond flows approximately 3,500 feet before entering the Chesapeake Bay.

The Service used a rapid stream assessment method developed as part of the West Cuddihy watershed assessment that was conducted earlier on another PRNAS watershed (Starr et al. 2001). The Service assessed the Pine Hill Run watershed in January through March of 2003. The rapid watershed assessment protocol involves walking all streams in the watershed to identify reach type and condition and problem areas. The Service walked each tributary and divided them into morphologically similar reaches based on the Rosgen classification system (Rosgen 1996). The Rosgen Stream Classification system uses specific bankfull channel characteristics such as width, depth, cross sectional area, entrenchment, sinuosity, water surface slope, and substrate composition to categorize streams into set groups which share similar fluvial geomorphic relationships.

This report contains five sections: 1) Methodology, 2) Watershed and Stream Characteristics and Stability Condition, 3) Problem Identification, 4) Prioritization, and 5) Recommendations. The watershed and stream characterization and stability section provides a historic overview of past land use activities within the watershed and describes current stream types and stability conditions. The problem identification and prioritization section uses information collected in the watershed characterization section and the stream characteristics and condition section to identify site-specific problems and rank them relative to one another in terms of problem severity and restoration priority. The recommendation section describes recommendations that minimize or reduce impacts to the stream systems and future studies in the Pine Hill Run watershed.

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A. Purpose

In 1997, the U.S. Fish and Wildlife Service (Service), Stream Habitat Assessment and Restoration Program, Chesapeake Bay Field Office and Patuxent River Naval Air Station (PRNAS) signed a 5-year Cooperative Agreement to conduct stream and riparian habitat assessment projects. The Service conducted one watershed assessment for the West Cuddihy Watershed under this agreement. The Service and PRNAS selected the West Cuddihy watershed as the pilot because it represented a variety of stream and riparian habitat conditions within PRNAS and can be used to develop a representative data base of conditions existing within PRNAS.

In 2001, the Service entered into a second 5-year Cooperative Agreement (1902-5008) with PRNAS. In the agreement, PRNAS requested the assistance of the Service to conduct the following:

- Conduct watershed-based stream corridor assessments
- Identify and prioritize stream corridor problem areas
- Design and implement stream and habitat restoration projects
- Review PRNAS stream restoration and stabilization project designs
- Review PRNAS habitat enhancement initiatives

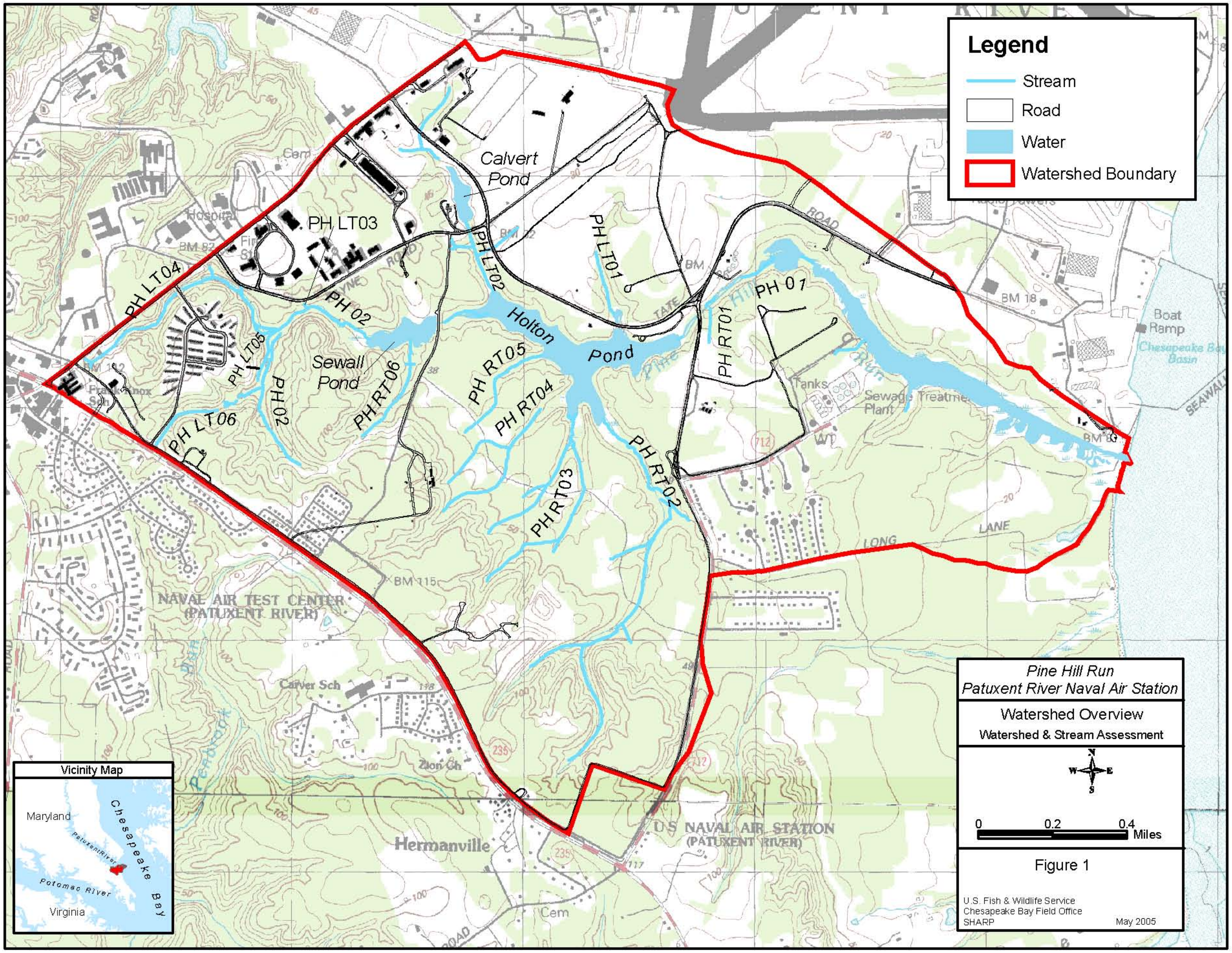
The first effort requested of the Service by PRNAS under this agreement was to conduct an assessment of the Pine Hill Run watershed. The purposes of the watershed assessment are to: 1) characterize physical conditions of stream habitat, 2) identify sources of runoff that contribute to the degradation of stream and riparian habitats, and 3) target and prioritize stream and riparian reaches for restoration.

B. Assessment Area

The assessment area is on the Patuxent River Naval Air Station in St. Mary's County, Maryland (Figure 1). The Pine Hill Run watershed is in the western coastal plain and has a drainage area of 3.0 square miles. A total of 7.1 miles of stream channel exists in the Pine Hill Run watershed, consisting of the main stem and nine tributaries. The watershed has steep-sloped, narrow valleys and headwater tributaries that flow into a series of three man-made ponds – Calvert, Sewall, and Holton Ponds. The discharge from Holton Pond flows approximately 3,500 feet before entering the Chesapeake Bay.

C. Report Outline

This report contains five sections: 1) Methodology, 2) Watershed and Stream Characteristics and Stability Condition, 3) Problem Identification, 4) Prioritization, and 5) Recommendations. The watershed and stream characterization and stability section provides a historic overview of past land use activities within the watershed and describes current stream types and stability conditions. The problem identification and prioritization section uses information collected in the watershed characterization section and the stream characteristics and condition section to identify site-specific problems and rank them relative to one another in terms of problem severity


Legend
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(PATUXENT RIVER)
U S NAVAL AIR STATION
(PATUXENT RIVER)
Hermanville
Boat Ramp
Chesapeake Bay Basin
Sewage Treatment Plant
Tanks
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Hospital
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and restoration priority. The recommendation section describes recommendations that minimize or reduce impacts to the stream systems and future studies in the Pine Hill Run watershed.

II. METHODOLOGY

A. Field Data Collection

The Service used a rapid stream assessment method developed as part of the West Cuddihy watershed assessment (Starr et al. 2001) to assess the Pine Hill Run watershed in January through March of 2003. If stream conditions are similar to those of the West Cuddihy, the rapid assessment method can be used to identify and prioritize problem areas within other PRNAS watersheds. The Service found conditions in the Pine Hill Run watershed similar to those in the West Cuddihy, so the rapid assessment method was applicable.

The rapid watershed assessment protocol involves walking all streams in the watershed to identify reach type and condition and problem areas. The Service walked each tributary and divided them into morphologically similar reaches based on the Rosgen classification system (Rosgen 1996). The Rosgen Stream Classification system uses specific bankfull channel characteristics such as width, depth, cross sectional area, entrenchment, sinuosity, water surface slope, and substrate composition to categorize streams into set groups which share similar fluvial geomorphic relationships. Bankfull is defined as the stream flow associated with the flow that moves the majority of the sediment most of the time and maintains the channel's dimension, profile, and pattern over time. Entrenchment is defined as the vertical containment of a stream and the degree to which it is incised in the valley floor. Incision is defined as the ratio of the bankfull height to the top of bank height.

The Service used standardized field data sheets to record two categories of information: 1) fluvial geomorphic stream conditions and 2) stream habitat and riparian conditions. The fluvial geomorphic stream conditions assessed the stream bed and bank stability. Bed stability is based on bank and bed materials, grade controls, depositional features, entrenchment, and incision. The bank stability condition is based on bed stability, width to depth ratio, debris channel obstructions, and potential sediment supply source. Road and storm water runoff, and utility, culvert, and bridge crossings are also identified in the characterization. The Service described the stream habitat riparian conditions based on length and width of riparian zone and bank protection capability. The Service recorded reach locations and site specific problems on maps during the watershed assessment. Photographs were also taken by the Service to document reach conditions and site specific problems.

In addition to the rapid assessment, the Service surveyed one monumented cross section in five separate reaches. The reaches were selected to document stream conditions, varying from stable to highly unstable, within the watershed. At each of these five locations, Service staff surveyed a monumented cross section, a bank profile, and a bank erosion hazard index (BEHI). At the selected stable reach, the Service also measured an average water surface slope and a riffle and reach substrate composition to estimate bankfull discharge.

Also, for the areas with a high percentage of development (*i.e.,* PH02, PH02 LT04, and PH02 LT06), the Service calculated BEHIs for all eroding banks. Stream channels in these areas are likely to have accelerated rates of bank erosion due to instability caused by development or disturbance in the watershed. The Service did not calculate BEHIs in the areas with a low percentage of development, since bank erosion rates are typically low. The Service used the monumented cross sections and BEHIs to establish a limited baseline to allow future prediction and validation of bank erosion rates.

B. Data Analysis

The Service identified and prioritized problem areas using the rapid assessment protocol within the Pine Hill Run watershed based on qualitative and semi-quantitative data. The data analysis consists of four main tasks: data reduction; stream classification, characterization, and stability conditions; identification of site specific problems; and rating of relative restoration priority.

The Service reduced the field data into Excel spreadsheets, and used the field data to generate a description of stream morphology. Such data included channel bankfull width, depth, cross-sectional area, width to depth ratio, entrenchment, incision, vertical stability and lateral stability.

The significant site-specific problem areas (*e.g*., headcut) identified during the field data collection were evaluated. The Service based the analysis on the current and potential impacts to the reach containing the problem as well as reaches upstream and downstream on the problem areas.

The Service employed several steps to develop a relative restoration priority for each reach. First, the Service conducted a stream sensitivity analysis based on the management interpretations of various stream types as presented in Rosgen (1996). The stream sensitivity analysis evaluated such parameters as sensitivity to disturbance, recovery potential, and sediment supply.

Sensitivity to disturbance refers to increases in streamflow volume and timing and/or sediment increases. Sediment supply predicts the relative amount of sediment that would be available if the stream system becomes unstable. It includes suspended and bedload from channel sources, as well as adjacent slopes. Recovery potential relates to the streams ability to become stable again if the destabilizing factors are removed. Stream types with excellent, very good, and good rates will likely recover on their own once the destabilizing factors are removed. However, streams with ratings of fair, poor, and very poor are not likely recover on their own in the near future. It may take decades for those systems to restabilze. Restoration of those areas would likely be needed to return those streams to a stable form. If the destabilizing factors cannot be removed, then restoration will be required to return the stream to a stable state.

Second, the Service used vertical and lateral stability, along with the other field data to determine overall stability and to predict stream evolution for the reach. Third and final, the Service used site specific problems identified during the field data collection effort to assist in developing a relative priority for the reach. The Service compiled all of these data into one table to conduct a qualitative evaluation of restoration priority for each reach relative to one another. Reaches that would receive a very high or high priority rating have widespread instability. Those reaches also have a majority of the assessment parameters that score poorly and they have site specific problems. Reaches that would receive a moderate rating would have several localized instability problems. They also have moderate scores on the majority of the assessment parameters. The Service would rate a reach low priority if it was stable with little or no localized erosion and if a majority of the assessment parameters had a good score.

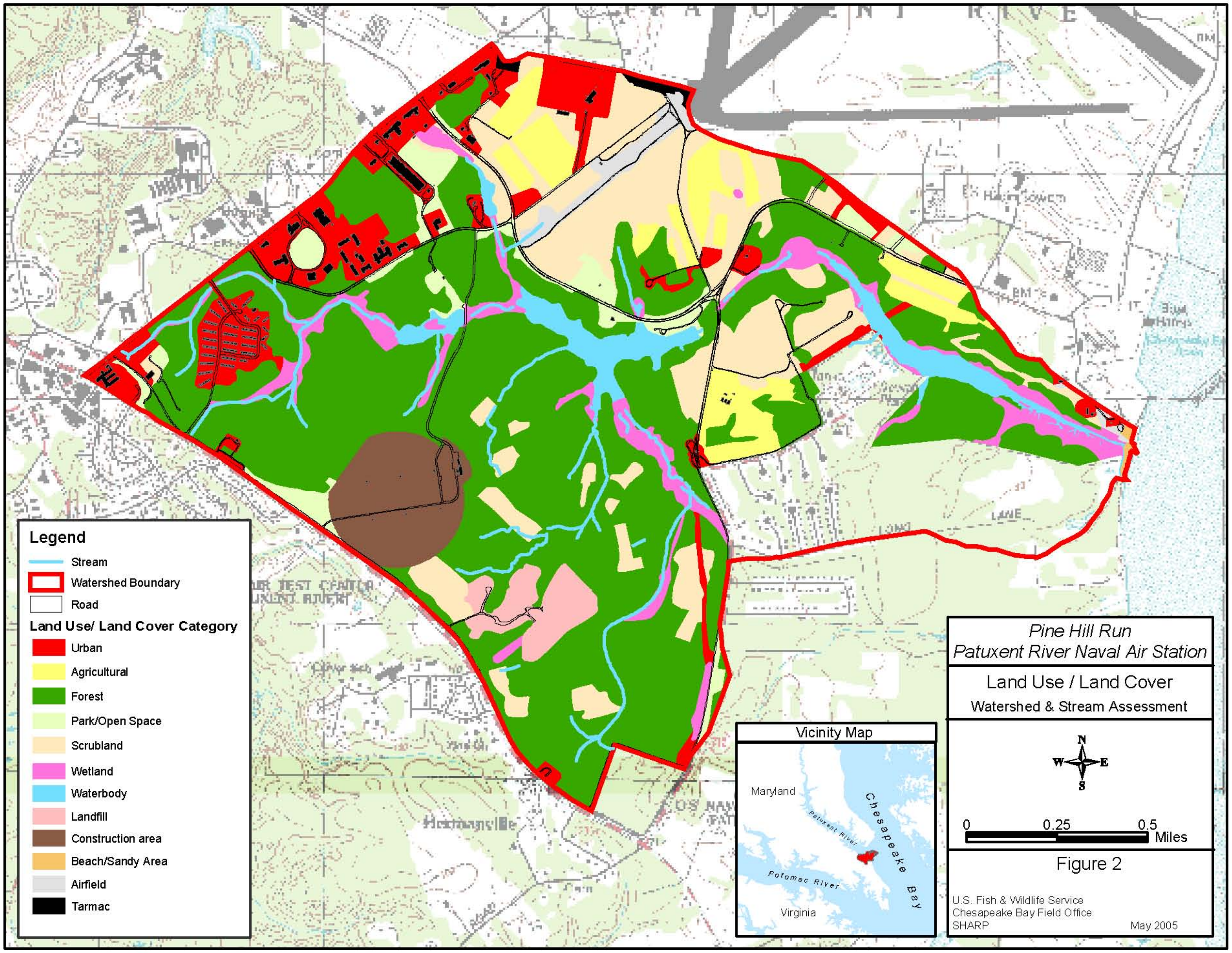
The Service developed an overall relative restoration priority for the major tributaries in the Pine Hill Run watershed. For each major tributary, the Service determined the percentage of stream length represented by the various restoration priorities (*i.e.*, low to very high). The tributary was assigned a relative restoration rank based on the major priority found in the tributary. For example, if the tributary had 65 percent of the length rated high, the Service assigned a restoration priority of high. If a tributary also had significant site specific problems, the Service assigned the tributary the next higher rating. For example, if a tributary had 60 percent of the length rated as high, but 30 percent was rated as very high because of large headcuts, the Service assigned a very high priority rating.

III. WATERSHED AND STREAM CHARACTERISTICS AND CONDITION

A. Watershed Characterization

PRNAS is an active naval research, development, test and evaluation, engineering, and fleet support center for air platforms. Established in 1942, PRNAS was created to centralize air testing facilities established prior to World War II. During the 1950's the station developed jet aircraft and improved conventional weapons. The U.S. Naval Test Pilot School was also established at the station during this time frame. In the 1960's, ordnance testing, as well as other programs at the station, were escalated as the Vietnam conflict intensified. In 1975, PRNAS became the Navy's principle site for development testing. The station continued to grow throughout the 1980's, and under the military's base realignment and closure program a large number of personnel and programs were relocated to PRNAS in the 1990's. Land use and land cover data from 1981 aerial photographs show the watershed mostly forested south of Payne and Tate Road. However, development had already taken place in portions of the watershed. Housing exists in the area around Fogerty Road and at the southern end of Priester Road. The landfill adjacent to Route 235 in the southern end of the watershed is evident on the photograph. The photographs show areas north of Payne Road had urban development in place, and the runways and associated infrastructure north of Tate Road were already constructed. Data from 1997, the latest available, shows the jet testing area (approximately 70 acres) at the southern end of Priester Road under construction and more urban development had occurred in the northern portion of the watershed adjacent to Cedar Point Road. The most recent available land use/land cover data from PRNAS (1997) shows the watershed was 58 percent forest, 17 percent urban, 13 percent agriculture, 9 percent wetlands, and 3 percent open space (Figure 2).

Currently PRNAS is planning several projects in the Pine Hill Run Watershed. A cleanup of Hermanville Landfill is underway and is scheduled to be completed within the next year. The landfill is located on Shaw Road between Gate 3 and Tate Road. A total of 19.9 acres will be disturbed in the cleanup. No impervious surface will be created during the cleanup and PRNAS


Legend
Stream
Watershed Boundary
Road
Land Use/ Land Cover Category
Urban
Agricultural
Forest
Park/Open Space
Scrubland
Wetland
Waterbody
Landfill
Construction area
Beach/Sandy Area
Airfield
Tarmac
Pine Hill Run
Patuxent River Naval Air Station
Land Use / Land Cover
Watershed & Stream Assessment
Vicinity Map
Maryland
Patuxent River
Chesapeake Bay
Potomac River
Virginia
N
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0.25
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Miles
Figure 2
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005

is constructing a 2.2-acre wetland as part of the cleanup. PRNAS is constructing a National Guard Readiness facility on the east side of Shaw Road at Gate 3. Construction is scheduled to begin in May of 2004. The facility covers 15.2 acres, with 11.9 acres of disturbance and 2.6 acres of impervious surface. Both project areas were mostly forested with some old pasture prior to the construction. Changes in the land use and land cover will increase flow to the surrounding tributaries and potentially cause instability.

Soils underlying the Pine Hill Run watershed were mapped as a Matapeake-Mattapex-Sassafras soil association in the St. Mary's County, Maryland Soil Survey (U.S. Department of Agriculture - Soil Conservation Service 1978). However, the soils and the steep V-shaped ravines within the project watershed are more characteristic of the Beltsville-Croom-Evesboro soil association. Soil surveys commonly have inclusions that allow for exceptions to its broad characterizations of soil associations and groups, as is the case in the project watershed.

The Beltsville soils within the project watershed are silty, very acidic, moderately well drained, moderately sloped and located in upland areas and hill slopes. There is a hard, dense fragipan in the lower part of the subsoil (approximately 22-28 inches below ground) which prevents root growth and downward movement of water. The water table is typically perched within a depth of one-half to two and one-half feet. The soil is moderately erodable and water runs off readily.

The Croom soils are gravelly sand loam, well drained, steeply sloped and located in uplands. The soils were formed on old fluvial deposits of gravel containing sand and clay. There is a thin soil layer underlain by a hard, compacted or cemented subsoil consisting of a gravelly sand clay loam. The soil is droughty and has a shallow root zone. Erosion can be severe if vegetation is cleared or the soil is disturbed, ultimately leading to the formation of gullies. There are some Chillum soils within the project watershed which have very similar characteristics of Croom soils, except they are generally located on ridge tops and were formed as silt or sand deposits over dense gravelly material.

The Evesboro soils are sandy, excessively drained, steeply sloped, very deep (5 feet) and have been cut by many deep V-shaped ravines in upland areas. They were formed in old marine deposits of sand that have been worked or partially reworked by wind and water. Their permeability is rapid and erosion is moderate to severe.

The stream valley floor soils are very sensitive to change in watershed land use activities due to the flashy runoff, steep V-shaped ravines, and the severe erosion potential of these loose sandy soils. Even though the soils are very deep and permeable, their severe erosion potential can result in active channel incision if there are rapid and sudden changes in land use activities within the watershed. Incision can go quite deep since the underlying subsoil/geology is made up of unconsolidated deposits of poorly sorted sands and gravel to poorly sorted to well sorted sand, silt, and clay which are also moderately to severely prone to erosion.

Parent materials to the Pine Hill Run soils consist of six primary formations. The primary geology formations within the watershed are: 1) Upland Gravel (upper pliocene), 2) Park Hall Formation (upper pliocene), 3) Omar Formation, Estuarine Facies (upper pleistocene), 4)

Maryland Point Formation (upper pleistocene), 5) Kent Island Formation (upper pleistocene), and 6) Holocene Deposits Undivided. The rise and fall of sea level over the centuries greatly influenced the geological formations, and as a result, both fluvial and marine processes formed the current geology. The Upland Gravel is located in the upper part of the Pine Hill Run watershed, with the other formations found in order moving downstream. The Holocene Deposits are located adjacent to the stream. The upper layer of the Upland Gravel formation has two distinct layers: a medium gravel (10-20 feet thick) layer underlain by a muddy coarse sand (15 to 20 feet thick) layer. Underlying these two layers are three depositional layers: the estuary shore and transgressive layers of fine gravel, an estuary center layer of muddy sand, and a regressive, prograding fluvial layer of medium to coarse gravel.

The Park Hall formation consists of silty fine-grained sand, and fine to medium sand and clay interbedded with medium coarse sand, gravel, cobble, and boulders. The Omar formation is predominantly sandy clay to clayey sand. The Maryland Point Formation consists of fine coarse sand on top, dark gray-green sandy clay in the middle, and medium to coarse sand at the base. The Kent Island formation is a fine-grained silty sand layer. The Holocene Deposits are unconsolidated deposits of poorly sorted sand and gravel to poorly sorted to well sorted sand, silt, and clay.

The watershed topography is characterized as steeply sloped hillsides surrounding the circumference of the watershed that have been cut by several deep, V-shaped ravines which drain into narrow, shallow sloped floodplains. Watershed elevations range from 115 feet above mean sea level in the southern portion of the watershed to sea level at the eastern portion of the watershed.

Land use activities, land cover, topography, and soils significantly influence the Pine Hill Run watershed's hydrology. A hydrologic analysis of the watershed was conducted by PRNAS in 1989 and 1999 as part of the Naval Air Station's regional stormwater management plan. The analyses identified stormwater runoff problem areas and provided solutions for the problem areas. The analyses evaluated several parameters, which included peak discharge. The peak discharge estimates provide information necessary to characterize the existing hydrologic regime. The estimates also provide a basis for evaluating the affects on watershed hydrology from land use changes and implementation of best management practices.

Land use activities and land cover changes associated with development have increased the amount of impervious surface in the Pine Hill Run watershed to a total of six percent, according to a 1999 Regional Stormwater Management Plan (URS Griener 1999). Increases of impervious surfaces resulted in increases of storm water runoff and thus a new flow regime of larger, flashy flows within stream systems. The watershed produced a 2-year 24-hour storm pre-development peak flow of 517 cubic feet per second (cfs), while the same storm with 1999 conditions produced 882 cfs. A 10-year 24-hour storm had a peak flow of 1597 cfs pre-development and 2353 cfs with 1999 conditions. Therefore, the 2-year storm flow increased 71 percent and the 10-year storm increased 47 percent.

In summary, development and changes in the watershed's land use and land cover have caused the stream channels to adjust. The shape and pattern of a stream is developed and maintained by the amount of water flowing within its channel. The channel forming, or bankfull, flow associated with a stream is typically somewhere between a 1- and 2-year storm event. With a larger, flashy flow, a stream must adjust its shape and pattern to accommodate the new flow regime. With these rapid changes in land use activities, streams will also adjust. Streams are typically unstable during rapid adjustment periods, which have occurred and are currently occurring to the stream systems within the Pine Hill Run watershed.

B. Stream Characteristics and Stability Condition

This section summarizes the results of the stream assessment conducted by the Service in the Pine Hill Run watershed. The Service identified and assessed eighty-five different reaches within the Pine Hill Run watershed. All Rosgen type streams of A, B, C, D, DA, E, F, and G are found in the watershed. Characterization descriptions in Section C of similar reaches are combined. Table 1 provides a summary of morphologic parameters of all reaches.

Rosgen A type streams represent approximately 0.8 percent of the total stream length within the watershed (Photograph 1). These are steep, entrenched and confined streams that are highly sensitive to disturbance and have a poor recovery potential. A stream that is entrenched has a small floodplain width (*i.e.*, a steep stream with a narrow valley) and a stream that is slightly entrenched has a large floodplain width. These stream types are found in the headwaters areas of this watershed.

Photograph 1. Example of Rosgen A type stream.

Pine Hill Run Watershed, PRNAS								
Table 1. Reach Characterization. A designation of swale indicates that a stream did not exist in this location prior to concentrated flow from development.								
Tributary	**Reach**	**Reach Length (ft)**	**Rosgen Stream Type**	**Bankfull Width (ft)**	**Bankfull Depth (ft)**	**Width/Depth Ratio**	**Entrenchment**	**Flow Regime**
PH 01	PH 01-A	1450	E4	10 - 20	1.25 - 2.0	8-10	3-6	Perennial
PH RT01	PH RT01-A	500	G5	1.5	0.3	5	1.1	Emphemeral
PH LT01	PH LT01-A	600	DA5	30	1.5	20	5	Perennial
	PH LT01-B	400	E5	9	1.5	6	5	Perennial
	PH LT01-C	250	C5	14	1.25	11.2	3	Perennial
	PH LT01-D	400	B4c	12	1	12	2	Perennial
PH RT02	PH RT02-A	1550	DA5	40	1	40	20	Perennial
	PH RT02-B	750	G5	4	0.75	5	1.1	Perennial
	PH RT02-C	1150	DA5	25	1	25	20	Perennial
	PH RT02-D	500	F5	4	0.35	11	1.2	Perennial
	PH RT02-E	1300	B4c	3	0.3	10	1.5	Perennial
	PH RT02-F	150	G5	3	0.3	10	1.1	Emphemeral
	PH RT02-G	500	E5	3	0.4	8	4	Emphemeral
	PH RT02 LT01-A	600	Swale/E5	2	0.3	7	5	Emphemeral
	PH RT02 RT01-A	150	B5/C5	3	0.2	15	3	Perennial
	PH RT02 RT01-B	125	DA5	15	0.2	75	5	Perennial
	PH RT02 LT02-A	325	G5	3.5	0.3	12	1.2	Perennial
	PH RT02 LT02-B	550	G5	3	0.3	10	1.1	Perennial
PH RT03	PH RT03-A	650	C5	4.75	0.4	12	40	Perennial
	PH RT03-B	575	E5	3.5	1.25	3	5	Perennial
	PH RT03-C	175	E5	6	0.75	8	4	Perennial
	PH RT03-D	75	G5	5	1	5	1.2	Perennial
	PH RT03-E	300	E5	3.5	0.75	5	40	Perennial
	PH RT03-F	300	D5	25	0.25	100	N/A	Perennial
	PH RT03-G	475	F5	6	0.4	15	1.2	Perennial
	PH RT03-H	400	F5	3.25	0.3	11	1.1	Emphemeral
	PH RT03-I	325	G5	3	0.4	8	1.1	Emphemeral
	PH RT03 RT01-A	175	Swale	N/A	N/A	N/A	N/A	N/A
	PH RT03 LT01-A	225	E5	3	0.6	5	40	Perennial
	PH RT03 LT01-B	450	G5	2.75	0.75	4	1.1	Perennial
	PH RT03 LT01-C	125	G5	2	0.7	3	1.2	Perennial
	PH RT03 LT01-D	750	G5	3	0.5	6	1.2	Perennial
	PH RT03 LT01-E	250	G5	3.75	0.5	8	1.1	Emphemeral
	PH RT03 LT01 LT01-A	275	B5	3	0.3	10	1.75	Emphemeral
PH RT04	PH RT04-A	250	D5	25	0.25	100	5	Perennial
	PH RT04-B	450	B5c	4	0.4	10	1.5	Perennial
	PH RT04-C	250	G5	3	0.3	10	1.2	Perennial
	PH RT04-D	400	G5	3-6	0.2-0.4	8-30	1.2	Perennial
	PH RT04-E	1000	G5	2.75	0.4	7	1.1	Intermittant
	PH RT04 LT01-A	400	B5	3	0.25	12	1.6	Emphemeral
	PH RT04 LT01-B	800	Swale/G6	1.5	0.2	8	1.5	Emphemeral
PH RT05	PH RT05-A	175	E5	4	0.5	8	6-10	Perennial
	PH RT05-B	1150	G5	2.5	0.5	5	1.4	Perennial
	PH RT05-C	300	B5	2	0.2	10	1.75	Emphemeral

Pine Hill Run Watershed, PRNAS								
Table 1. Reach Characterization Continued. A designation of swale indicates that a stream did not exist in this location prior to concentrated flow from development.								
Tributary	**Reach**	**Reach Length (ft)**	**Stream Type**	**Bankfull Width (ft)**	**Bankfull Depth (ft)**	**Width/Depth Ratio**	**Entrenchment**	**Flow Regime**
PH LT02	PH LT02-A	750	E5	2.5	0.5	5	5-40	Perennial
	PH LT02-B	475	E5	6	0.5	12	4-15	Perennial
	PH LT02-C	200	G5	1.75	0.2	8.75	1.2	Emphemeral
	PH LT02-D	1000	G5	1.5-4.0	0.3	5-13	1.1	Emphemeral
	PH LT02 LT01-A	250	B5	2.5	0.2	12.5	1.5	Perennial
	PH LT02 LT01-B	350	B5	3	0.3	10	2	Emphemeral
	PH LT02 RT01-A	200	E5	2.5	0.5	5	5-40	Perennial
	PH LT02 RT01-B	250	G5	1.25	0.2	6.25	1.2	Perennial
	PH LT02 RT02-A	200	G5	1.75	0.2	8.75	1.2	Emphemeral
PH RT06	PH RT06-A	350	D5	30	0.2	150	4	Perennial
	PH RT06-B	200	C5	5	0.2	25	3	Perennial
	PH RT06-C	750	G5	3-5	0.3	10-17	1.2	Perennial
	PH RT06-D	400	G5	2.5	0.3	8	1.1	Emphemeral
PH 02	PH 02-A	600	DA5	35	1.5	23	25	Perennial
	PH 02-B	300	E5	11	1.25	9	20	Perennial
	PH 02-C	650	F4	12	0.75	16	1.1	Perennial
	PH 02-D	400	E5	3	0.75	4	10	Perennial
	PH 02-E	150	C5	6	0.4	15	7	Perennial
	PH 02-F	275	G5	4.5	0.75	6	1.5	Perennial
	PH 02-G	1250	G5	3	0.75	4	1.3	Perennial
	PH 02-H	75	E4	3	1	3	5	Emphemeral
	PH 02-I	75	D5	20	0.2	100	10	Emphemeral
PH LT03	PH LT03-A	100	G5	5	1.25	4	1.2	Emphemeral
PH LT04	PH LT04-A	350	D5	50	1	50	1.1	Perennial
	PH LT04-B	450	D5	50	0.5	100	5	Perennial
	PH LT04-C	550	B5c	4	0.4	10	1.5	Perennial
	PH LT04-D	450	C5	6.5	0.5	13	4	Emphemeral
	PH LT04-E	300	G5	6	1	6	1.1	Perennial
	PH LT04-F	550	C5/G5	4-6	0.5	8-12	8-12	Emphemeral
	PH LT04-G	250	F5	7	0.5	14	1.2	Emphemeral
	PH LT04-H	375	G5	5	0.5	10	1.2	Emphemeral
	PH LT04-I	625	G5	2.5	0.5	5	1.2	Emphemeral
	PH LT04 LT01-A	150	B5	3	0.4	8	1.5	Emphemeral
PH LT05	PH LT05-A	300	G5	3	0.75	4	1	Perennial
	PH LT05-B	425	E5	3	0.6	5	10	Emphemeral
PH LT06	PH LT06-A	150	G5	3	0.5	6	1.4	Emphemeral
	PH LT06-B	50	B5	3	0.3	10	1.6	Emphemeral
	PH LT06-C	50	B5	5	0.4	13	1.5	Emphemeral
	PH LT06-D	75	G5	5	0.5	10	1.4	Emphemeral
	PH LT06-E	50	B5	4	0.3	13	1.75	Emphemeral
	PH LT06-F	200	G5	5	0.5	10	1.2	Emphemeral
	PH LT06-G	300	B5	9	0.8	11	1.5	Emphemeral
	PH LT06-H	275	A5	7	0.8	9	1.2	Emphemeral
	PH LT06-I	500	Ditch	4	0.7	6	1.75	Emphemeral

Rosgen B type streams represent approximately 13.3 percent of the total stream length within the watershed (Photograph 2). They are moderately entrenched, low sinuosity streams with a slope of two to four percent that are moderately sensitive to change and have an excellent recovery potential. Sinuosity is defined as the ratio of the stream length to valley length. A stream with high sinuosity has many meandering bends and a stream with low sinuosity is nearly straight. These stream types are also generally found in the tributary and headwater areas of this watershed.

Rosgen C type streams represent approximately 6.1 percent of the total stream length within the watershed (Photograph 3). They are slightly entrenched, low gradient, meandering riffle/pool channels with a well developed floodplain that are highly sensitive to disturbance but they have a good recovery potential. These stream types are generally found where there are low valley slopes and relatively large floodplain areas.

Rosgen D type streams represent approximately 3.9 percent of the total stream length within the watershed (Photograph 4). They are unstable, braided (multiple channels), high width/depth ratio channels found in well developed floodplains that are highly sensitive to disturbance and have a poor recovery potential. They are also typically considered unstable, transitional streams that were once a Rosgen C or E stream type.

Photograph 2. Example of Rosgen B type stream.

Photograph 3. Example of Rosgen C type stream.

Photograph 4. Example of Rosgen D type stream.

Rosgen DA type streams represent approximately 11.0 percent of the total stream length within the watershed (Photograph 5). They are stable braided (multiple channels), low width/depth ratio channels found in well-developed floodplains that are moderately sensitive to disturbance and have a good recovery potential.

Rosgen E type streams represent approximately 18.2 percent of the total stream length within the watershed (Photograph 6). They are slightly entrenched, low gradient, and meandering channels with low width/depth ratios and well developed floodplains that are highly sensitive to disturbance but have good recovery potential. Width/depth ratio is defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel. Streams with high width/depth ratios are wide and shallow and streams with low width/depth ratios are narrow and deep. These E type reaches are also generally found where there are low valley slopes and relatively large floodplain areas.

Rosgen F type streams represent approximately 7.3 percent of the total stream length within the watershed (Photograph 7). They are entrenched, incised channels that are highly sensitive to disturbance. Incision is defined as the ratio of the bankfull height to the top of the bank height. Streams with a large elevation difference between bankfull and top of bank height have a high incision ratio and streams with a small elevation distance between bankfull and top of bank height have a low incision ratio. Recovery potential for F streams is fair/poor.

Photograph 5. Example of Rosgen DA type stream. The photo only shows one channel of the DA, but many channels exist across the floodplain.

Photograph 6. Example of Rosgen E type stream.

Photograph 7. Example of Rosgen F type stream.

Rosgen G type streams represent approximately 39.3 percent of the total stream length within the watershed (Photograph 8). They are entrenched, moderately steep, incised channels that are highly sensitive to disturbance and have a very poor recovery potential. They are also typically considered unstable, transitional streams that were once a Rosgen A, B, C, or E stream type.

These stream types are generally found throughout the watershed where there has been some type of disturbance.

Photograph 8. Example of Rosgen G type stream.

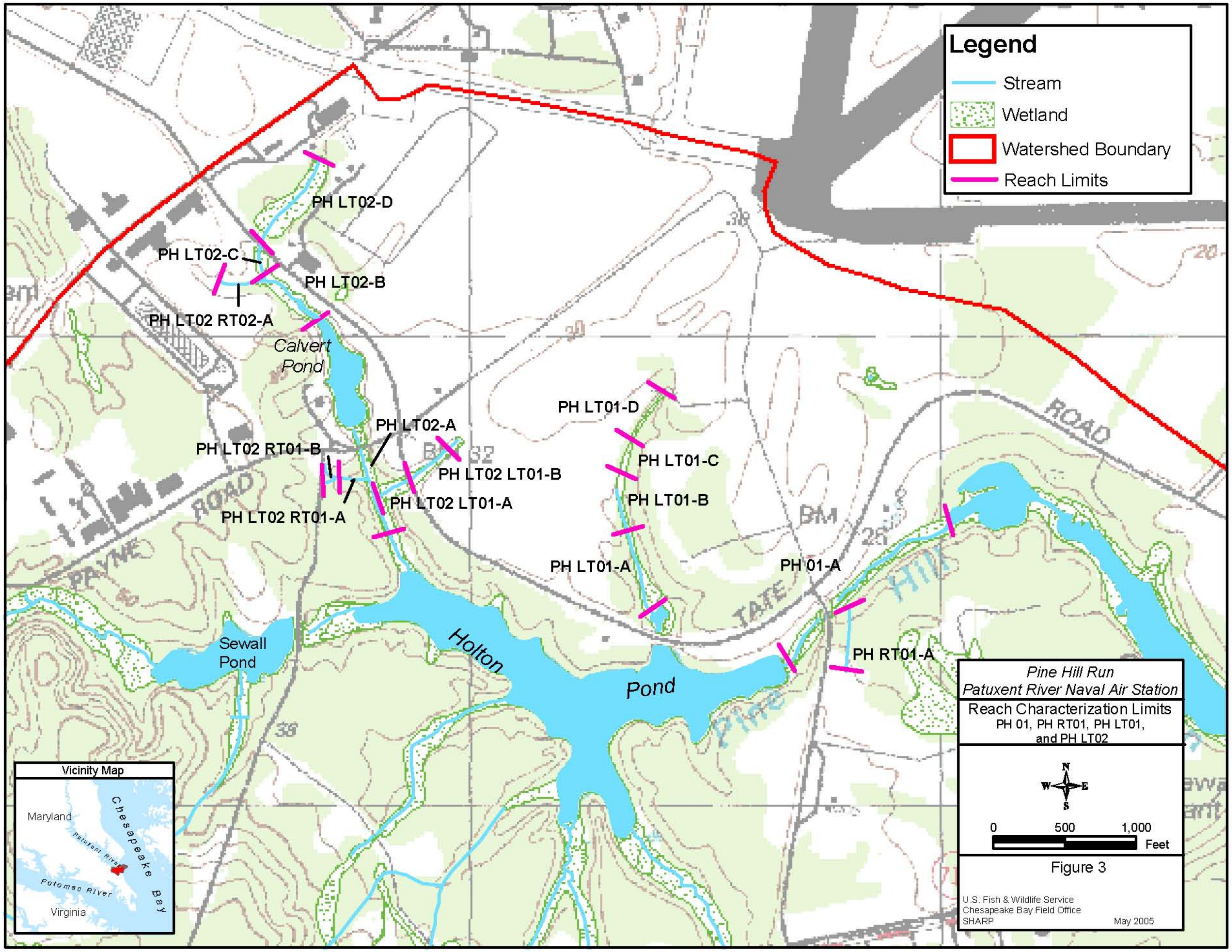
C. Reach Characterization and Stability Condition

This section gives the descriptions of the individual reaches in the Pine Hill Run Watershed. The description includes Rosgen stream type, reach length, site specific problems, stream stability, riparian buffer, and instream habitat.

The Service developed a system to label the reaches in the Pine Hill Run Watershed. The Service divided the main stem of Pine Hill Run into two sections. The section downstream of Holton Pond was designated as PH 01, and upstream of Sewell Pond is the section PH 02. The sections are further divided into reaches based on morphological conditions, in which a letter is added to the end of the section name (*e.g.*, PH 02-A). Reaches are labeled alphabetically starting with A at the downstream end of the section or tributary and proceeding upstream. The tributary labels include PH for Pine Hill, and are sequentially numbered starting with the downstream most tributary. A label of PH LT01, would mean that the tributary is the first one to enter the main stem Pine Hill Run from the downstream left. Tributaries to the main tributaries are labeled in a similar manner. A label of PH LT01 RT01, would mean that the tributary RT01 is the first to enter PH LT01 on the downstream right.

PH 01

The Service identified and assessed one reach in Reach PH 01 (Figure 3). Reach PH 01-A starts at the outfall of Holton Pond and ends approximately 1,450 feet downstream of Holton Pond at


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
PH LT02-D
PH LT02-C
PH LT02-B
PH LT02 RT02-A
Calvert Pond
PH LT02-A
PH LT02 RT01-B
PH LT02 LT01-B
PH LT02 LT01-A
PH LT02 RT01-A
PH LT01-D
PH LT01-C
PH LT01-B
PH LT01-A
PH 01-A
PH RT01-A
Sewall Pond
Holton Pond
PAYNE ROAD
TATE ROAD
Pine Hill
Vicinity Map
Maryland
Virginia
Chesapeake Bay
Patuxent River
Potomac River
Pine Hill Run
Patuxent River Naval Air Station
Reach Characterization Limits
PH 01, PH RT01, PH LT01, and PH LT02
0 500 1,000
Feet
Figure 3
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
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the upstream end of a beaver pond. Reach PH 01-A is a stable E4 that has a wide (200 to 500 feet) forested wetland floodplain. Moderate localized bank erosion is located at the outfall from Holton Pond. Some minor localized bed and bank erosion exists on the downstream end of a 60-inch culvert at Shaw Road. An elevated sewer line crosses the reach approximately 1,000 feet downstream of Shaw Road. The floodplain was filled with soil up to the stream banks beneath the line during construction. The floodplain fill is not causing any instability in the reach. Reach PH 01-A has good instream habitat and riparian buffer width.

PH RT01

The Service identified and assessed one reach in Reach PH RT01 (Figure 3). Reach PH RT01-A, a tributary to PH 01-A, originates from a wetland/pond complex adjacent to Shaw Road and Landfill Site 4. Reach PH RT01-A, 500 feet of unstable G5 stream type, is straight with numerous headcuts, and appears ditched. The swale containing Reach PH RT01-A did not have a stream channel prior to the ditching. The increase in flow caused the swale to become vertically and laterally unstable. A depositional fan, without a defined channel, has formed where Reach PH RT01-A outlets to the valley floor near PH 01-A. Reach PH RT01-A has poor instream habitat and a riparian buffer width of 200 feet. Recovery potential is very poor even if the destabilizing influences are corrected.

PH LT01

The Service identified and assessed four reaches in Reach PH LT01 (Figure 3). Reach PHLT01-A is located at the downstream end of the tributary, with Reaches B, C, and D located upstream of Reach A respectively.

Reach PH LT01-A, 600 feet in length, is a stable DA4/5 that flows into Holton Pond. The only unstable section of the reach is associated with a road crossing approximately 350 feet upstream from the reach start. The road crossing is a 48-inch culvert that is failing on the downstream end with a 2-foot drop in water surface. There is localized bank and bed erosion around the pipe on the downstream side with a large scour pool. Failure of the culvert under the road crossing would cause the upstream section of Reach PH LT01-A and Reach PH LT01-B to downcut and cause instability in the reaches. Reach PH LT01-A has good instream habitat and a riparian buffer width of 600 feet.

Reach PH LT01-B is 400 feet long and is a stable E5 that appears straightened. A concrete dam with a 4-foot drop in water surface exists at the upstream end of the reach. The dam does not currently appear to be causing erosion in the reach. Reach PH LT01-B instream habitat is good, while riparian buffer width is approximately 600 feet.

Reach PH LT01-C is 250 feet in length, starts at the upstream side of the dam in PH LT01-B, and is a stable C5. The reach has 2 sets of gabion baskets on the bed of the channel at the upstream end of the reach. Moderate to high localized bank erosion exists on the right bank, where the stream has eroded around the gabions. Two large grassed swales that drain the runway approaches at the northern portion of the watershed drain into the reach at the upstream end of the reach. The grass swales do not appear to be causing instability in the reach. Instream habitat is fair, while riparian buffer width is 0-100 feet.

Reach PH LT01-D, 400 feet in length, is a stable B4c that appears straightened. The reach starts with two 36-inch concrete culverts as the head waters for PH LT01. Just downstream of the pipes is series oil/water separators that were designed to treat airfield runoff. The separators do not appear to be causing any instability. Instream habitat is fair and riparian buffer width is approximately 50-100 feet.

PH RT02

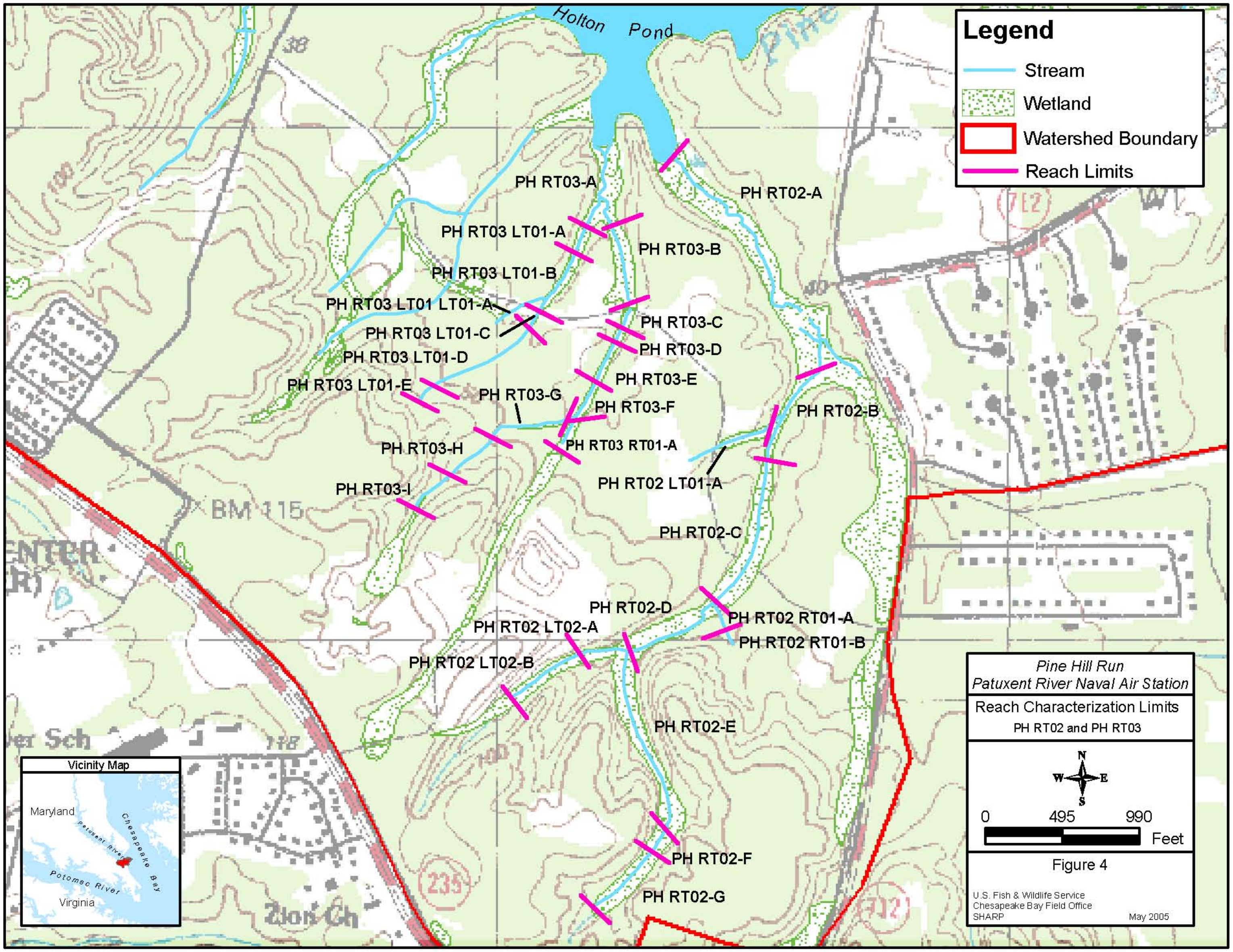
PH RT02 (Figure 4) is approximately 7,650 feet in length. The Service identified and assessed 12 reaches that comprise Rosgen stream types B5, C5, DA5, E5, F5, and G5. PH RT02 is located west of Forest Park Road and flows into the south side of Holton Pond. The increased flows and discharges from landfill Site 11 are likely causing the instability problems in PH RT02.

Both Reach PH RT02-A (1,550 feet) and Reach PH RT02-C (1,150 feet) are stable DA5 type streams. Reach PH RT02-A is the downstream most reach of PH RT02. Reach PH RT02-A flows through a 24-inch culvert under the dirt access road and an elevated 30-inch utility pipe crosses the reach just upstream of the access road. Fill was placed across the floodplain to construct the roadway. The floodplain fill is not causing any instability in the reach. Reach PH RT02-C also flows through a culvert under the upstream dirt access road and has minor localized erosion on the downstream end. Both reaches have a well developed forested wetland floodplain and good instream habitat. Riparian buffer widths are greater than 1,000 feet for both reaches.

Reach PH RT02-D is 500 feet of an unstable F5 that starts with a large active beaver dam across the stream. Bed erosion rates are low, but bank erosion is occurring at moderate/high rates. The channel has been straightened and possibly dredged in the past, leaving the existing channel at the toe of the slope on the right side of the valley. The outside meanders are eroding at a high to very high rate into the hillside and are producing a large amount of sediment. Riparian buffer width is greater than 1,000 feet for the reach. Instream habitat is poor. Two headcuts of 1 foot each are located at the top of Reach PH RT02-D and will likely move upstream if not corrected. Recovery potential is poor even if the destabilizing factors are corrected.

Reach PH RT02-E (1,300 feet) is a moderately stable B4c that is upstream of Reach PH RT02-D. The channel has formed inside an old F5 channel that has tried to restabilize. Bed erosion rates are low, and bank erosion is low except for the outside meanders which are eroding at a low to moderate rate. Instream habitat is good. The width of the riparian buffer is greater than 1,000 feet.

Reaches PH RT02-B (750 feet), PH RT02-F (150 feet), PH RT02 LT02-A (325 feet), and PH RT02 LT02-B (550 feet) are all unstable G5 reaches. Reach PH RT02-B contains three headcuts ranging in size from 0.5-2.5 feet. Four headcuts with a total drop of 5 feet are found in Reach PH RT02-F. It is likely that they will migrate upstream into Reach PH RT02-G if not fixed. Reaches RT02 LT02-A, and PH RT02 LT02-B are located on a small tributary (PH RT02 LT02) that is located south of landfill Site 11 and flow into the main stem at the upstream end of Reach PH RT02-D. Just upstream from the confluence of Reach PH RT02 LT02-A with the


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Holton Pond
PH RT03-A
PH RT03 LT01-A
PH RT03-B
PH RT03 LT01-B
PH RT03 LT01 LT01-A
PH RT03 LT01-C
PH RT03-C
PH RT03-D
PH RT03 LT01-D
PH RT03-E
PH RT03 LT01-E
PH RT03-G
PH RT03-F
PH RT03 RT01-A
PH RT03-H
PH RT03-I
PH RT02-A
PH RT02-B
PH RT02 LT01-A
PH RT02-C
PH RT02-D
PH RT02 LT02-A
PH RT02 RT01-A
PH RT02 RT01-B
PH RT02 LT02-B
PH RT02-E
PH RT02-F
PH RT02-G
BM 115
Zion Ch
Vicinity Map
Maryland
Virginia
Potomac River
Patuxent River
Chesapeake Bay
Pine Hill Run
Patuxent River Naval Air Station
Reach Characterization Limits
PH RT02 and PH RT03
N
W
E
S
0
495
990
Feet
Figure 4
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
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main stem, two 12-inch pipes discharge flow from landfill Site 11 down onto the adjacent hill slope. The discharges are cutting a new channel to Reach PH RT02 LT02-A causing a large amount of bed and bank erosion. At the top of the Reach PH RT02 LT02-A, are two headcuts that are 2.5 feet and 3 feet respectively. The headcuts will move upstream to Reach PH RT02 LT02-B if they are not corrected. Several headcuts occur in Reach PH RT02 LT02-B with a total drop of approximately 4 feet. Another 2-foot headcut is located at the top of Reach PH RT02 LT02-B, with a short section of dry channel/swale located upstream. Reach PH RT02 LT02-B also has two 12-inch pipes discharging into the stream from landfill Site 11. All reaches have moderate/high rates of bed and bank erosion. Instream habitat is poor in all reaches and they have a riparian buffer width that is greater than 1,000 feet. Recovery potential is very poor even if the destabilizing factors are corrected.

Reach PH RT02-G (500 feet) is a stable E5 at the headwaters of PH RT02. Bed and bank erosion rates are low. Numerous wetland seeps are found along the reach. Instream habitat is poor since the channel is ephemeral. The riparian buffer is greater than 1,000 feet. Upstream of Reach PH RT02-G is a short section of dry channel that transitions to a swale. If the headcuts in PH RT02-F are not fixed, they will move upstream into Reach PH RT02-G and cause widespread instability.

Reach PH RT02 LT01-A (600 feet) is located on a small tributary to the main channel of PH RT02 that flows into Reach PH RT02-B. The stream channel in Reach PH RT02 LT02-A is not well defined at the upstream end and appears to still be developing. An E5 currently exists in most of the reach, but several headcuts are located near the confluence with the main channel. The reach appears to be laterally stable, but downcutting. An old ditch or ditched channel runs along the toe of slope on the left side of the valley adjacent to Reach PH RT02-B. The stream in PH RT02 LT01-A flows through a portion of the old ditch, then flows into the main stem of PH RT02. As it flows into the old ditch, a series of headcuts totaling 3 feet are found on PH RT02 LT01-A. A 2.5-foot headcut is located on Reach PH RT02 LT01-A as it flows out of the ditch into the main stem. It is likely that the headcuts will move upstream through Reach PH RT02 LT01-A, causing widespread bed and bank erosion. The reach extends approximately 50 feet upstream of a dirt access road, then splits into two dry swales. A 30-inch culvert allows the stream to pass under the dirt road, but the culvert is starting to rust away and could cause road failure. Instream habitat is poor and the riparian buffer width is greater than 1,000 feet. Recovery potential for Reach PH RT02 LT01-A is good if the destabilizing factors are corrected. The trees in the area around the upstream end of Reach PH RT02 LT01-A are pines that are less than 20 years old. A large stump pile also exists in the same area. It is likely that forestry practices in the past have caused the channel to form in Reach PH RT02 LT01-A and that a channel did not exist there previous to the logging activities.

Reach PH RT02 RT01-A (150 feet) and PH RT02 RT01-B (125 feet) are both located on a small tributary that originates from a wetland seep. Reach PH RT02 RT01-A is on the downstream end of the tributary and is a stable B5/C5. Reach PH RT02 RT01-A is now receiving flow from Reach PH RT02-C because of the large beaver dam causing the stream flow to use several channels across the floodplain. Instream habitat is good in both reaches and the riparian buffer width is greater than 1,000 feet. The increase in flow could cause channel instability in the future. Since the beaver dam is part of a natural functioning system and increases habitat diversity, the dam should be left in place. Reach PH RT02 RT01-B is a stable DA5 that is upstream of Reach PH RT02 RT01-A and starts from a small wetland seep area.

PH RT03

PH RT03 (Figure 4) is approximately 5,525 feet in length. The Service identified and assessed 16 reaches that comprise Rosgen stream types B5, C5, D5, E5, F5, and G5. Reaches PH RT03 LT01-A through PH RT03 LT01-E and PH RT03 LT01 LT01-A are located on the western fork of the tributary. Reaches PH RT03-A through PH RT03-I and PH RT03 RT01-A are located on the eastern fork. Reach PH RT03 LT01-A is located on the downstream end of the tributary near the confluence of the two forks and flows into Holton Pond. The increased flows and discharges from landfill Site 11 are likely causing the wide spread instability in PH RT03. Past logging in some of the areas around PH RT03 may also have contributed to the instability.

Reach PH RT03-A (650 feet) is a stable C5. Reaches PH RTO3-C (175 feet), PH RT03-E (300 feet), and PH RTO3 LT01-A (225 feet) are stable E5 reaches. All four reaches have wide forested floodplains. Riparian buffer width ranges from 600-1,000 feet. Instream habitat is moderate-good for all reaches.

Reach PH RT03-B, 575 feet in length, is on the eastern fork and is a moderately stable E5 that has a debris jam 150 feet downstream (1.5-foot drop) of the access road. A small amount of localized bed and bank erosion exists in the area around the debris jam. Riparian buffer width ranges from 600-1,000 feet. Good instream habitat exists in the reach.

Reaches PH RT03-D (75 feet), PH RT03-I (325 feet), PH RT03 LT01-B (450 feet), PH RT03 LT01-C (125 feet), PH RT03 LT01-D (750 feet), and PH RT03 LT01-E (250 feet) are unstable G5 reaches. Widespread vertical and lateral instability, along with numerous headcuts, is found in the reaches. For example, at the top of Reach PH RT03 LT01-C is a series of three headcuts dropping a total of 6 feet. Riparian buffer width ranges from 600-1,000 feet. Poor instream habitat exists in the reaches. Recovery potential is very poor even if the destabilizing factors are corrected.

Reach PH RT03-F (300 feet) is a D5 reach that is aggrading, and does not have a well- defined channel. The source of sediment to Reach PH RT03-F is coming from the reaches upstream that are undergoing lateral and vertical adjustment. Riparian buffer width is greater than 1,000 feet and instream habitat is poor. Recovery potential is poor even if the destabilizing factors are corrected.

Reaches PH RT03-G (475 feet) and PH RT03-H (400 feet) are both unstable F5 reaches. Reach PH RT03-G has two swales that are unstable and have downcut to match the main channel. Swale 1 is 4 feet wide with 4-foot banks and is 75 feet long. Swale 2 has similar dimensions, but is only 40 feet long. Both swales have 4-foot headcuts at the top. The stream flows through an 18-inch culvert under the access road at the top of the Reach PH RT03-G. The culvert has a 2-foot drop to the downstream channel bed, and is causing some of the instability in Reach PH RT03-G.

Reach PH RT03-H has an unstable swale that enters the reach. The swale is 2.5 feet wide with 2.5-foot banks and is 30 feet long. A 2-foot headcut is located on the swale at the confluence with the main channel. Both reaches have poor instream habitat and a riparian buffer width of approximately 800 feet. Recovery potential is very poor even if the destabilizing factors are corrected.

Reach PH RT03 RT01-A (175 feet) is a stable swale that has several small wetlands on it. Riparian buffer width ranges from 500-1,000 feet. Instream habitat is poor because the swale is ephemeral.

Reach PH RT03 LT01 LT01-A, 275 feet in length, is a small tributary to the western fork that is a moderately stable B5 channel. A 2 foot headcut exists at the confluence of Reach RT03 LT01 LT01-A and Reach PH RT03 LT01-B which will likely move up into Reach PH RT03 LT01 LT01-A in the near future. The stream passes through a 24-inch culvert under the access road. A second culvert (12-inch concrete) is located 20 feet upstream of the dirt access road. The culverts are not causing any instability. Riparian buffer width is greater than 1,000 feet and instream habitat is poor.

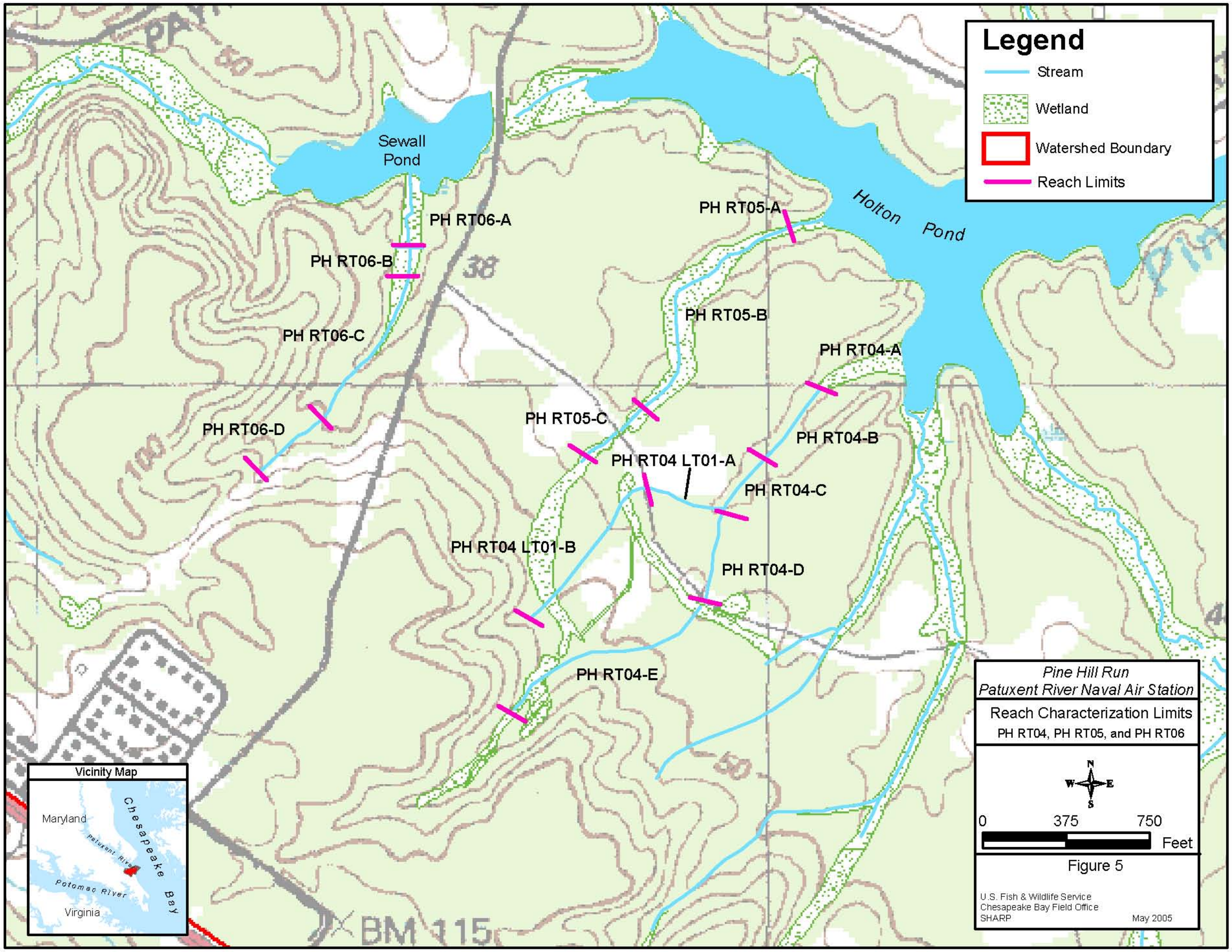
PH RT04

PH RT04 (Figure 5) is approximately 3,550 feet in length. The Service identified and assessed seven reaches that comprise Rosgen stream types B5, B5c, D5, F5, G5, and G6. The area in the headwaters of PH RT04 was developed in the mid 1990's with no stormwater management. Land use and land cover changes have resulted in a substantial increase in the amount of runoff and caused the instability in PH RT04. It is likely that a channel did not exist in the location of Reaches PH RT04 LT01-A, PH RT04 LT01-B, and PH RT04-E prior to the development at the southern end of Priester Road. The areas around the headwaters of PH RT04 also have evidence of logging in the recent past, which has also contributed to the instability in PH RT04.

Reach PH RT04-A (250 feet) is an unstable D5 that flows into the southern side of Holton Pond. Sediment from reaches upstream is causing the reach to aggrade and have multiple channels. The reach most likely was a stable E5 prior to the aggradation. Instream habitat is poor and the riparian buffer width is greater than 1,000 feet. Recovery potential is poor even if the destabilizing factors are corrected.

Reach PH RT04-B (450 feet) is an unstable B5c that is located directly upstream of Reach PH RT04-A. Excessive sediment from upstream is also causing Reach PH RT04-B to aggrade. Instream habitat is fair and the riparian buffer width is greater than 1,000 feet. Recovery potential is excellent if the destabilizing factors are corrected.

Reaches PH RT04-C (250 feet), PH RT04-D (400 feet), and PH RT04-E (1,000 feet) are unstable G5 channels. Bank erosion rates are moderate in Reach PH RT04-C. The large sediment supply from upstream is causing some aggradation in Reach PH RT04-C. Reach PH RT04-D has


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Sewall Pond
Holton Pond
PH RT06-A
PH RT06-B
PH RT06-C
PH RT06-D
PH RT05-A
PH RT05-B
PH RT05-C
PH RT04-A
PH RT04-B
PH RT04-C
PH RT04-D
PH RT04-E
PH RT04 LT01-A
PH RT04 LT01-B
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
BM 115
Pine Hill Run
Patuxent River Naval Air Station
Reach Characterization Limits
PH RT04, PH RT05, and PH RT06
0
375
750
Feet
Figure 5
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
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a moderate to high rate of bed and bank erosion. A 3-foot headcut is located 75 feet downstream of the dirt access road. The headcut is actively eroding and supplying a large volume of sediment downstream. Movement of the headcut upstream will compromise the integrity of the roadway and the 30-inch culvert which the stream flows through. Concentrated flow through the culvert is contributing to the instability in Reach PH RT04-D. Reach PH RT04-E is located in the headwaters of PH RT04 and receives runoff from FARM (Facility for Avionics and Radar Measurements) located at the southern end of Priester Road. Seven headcuts that range in size from 1-3 feet are located in Reach PH RT04-E. A dirt access road crosses near the top of Reach PH RT04-E. On the downstream side of the road, 5 feet of the metal culvert has rusted away and this has allowed the stream to erode the fill beneath the road. Failure of the roadway is likely if the problem is not corrected in the near future. Bank erosion rates for Reach PH RT04-E are low to moderate, but bed erosion is occurring at a moderate to high rate. Both reaches have poor instream habitat. The riparian buffer width is greater than 1,000 feet for Reaches PH RT04-C and PH RT04-D, but ranges from 50-150 feet for Reach PH RT04-E. Recovery potential is very poor even if the destabilizing factors are corrected.

Reach PH RT04 LT01-A (400 feet) is located on a tributary to the main stem of PH RT04. The reach is a moderately stable B5, but has a 4-foot headcut at the confluence to the main stem. Potential is high that the headcut will move upstream into Reach PH RT04 LT01-A and cause widespread bed and bank erosion. Instream habitat is poor and the riparian buffer width ranges from 200-1,000 feet.

Reach PH RT04 LT01-B (800 feet) is upstream of Reach PH RT04 LT01-A and is a poorly formed G6. The reach is receiving sheet flow, without the benefit of stormwater management, from FARM at the southern end of Priester Road and the channel is still in the process of developing. Bed and bank erosion is low to moderate. Instream habitat in the tributary is poor to fair because of the widespread instability and large amount of sediment in the channel. The riparian buffer is greater than 1,000 feet. Recovery potential is poor even if the destabilizing factors are corrected.

PH RT05

PH RT05 (Figure 5) is approximately 1,625 feet in length. The Service identified and assessed three reaches that comprise Rosgen stream types E5, B5, and G5. PH RT05- A is located on the downstream end of the tributary and Reaches PH RT05-B and C are located upstream of Reach PH RT05-A sequentially. The widespread instability in PH RT05 is likely caused by the construction of FARM at the southern end of Priester Road.

Reach PH RT05-A is a 175-foot section of stable E5 that flows into Holton Pond. The reach has a forested wetland floodplain. The riparian buffer width is greater than 1,000 feet and the reach has good instream habitat. Increased sediment from upstream will cause the reach to aggrade and cause instability.

Reach PH RT05-B is 1,150 feet in length and is an unstable G5 that has a moderate rate of bed and bank erosion. The reach was a B5 channel that downcut to its present elevation. Reach PH RT05-B has three major headcuts that range is size from 1-2 feet. Instream habitat is poor and the riparian buffer width is greater than 1,000 feet. The recovery potential for the reach is very poor even if the destabilizing influences are corrected.

Reach PH RT05-C, 300 feet in length, is a moderately stable B5 channel. The reach is the headwater of the tributary and therefore is small and poorly defined. The reach goes through a 12-inch culvert under the dirt access road, which is not causing instability in the immediate area. A 50-foot long dry swale exists upstream of the top of the reach. The ephemeral reach has poor instream habitat and a riparian buffer width of greater than 1,000 feet.

PH LT02

PH LT02 is approximately 3,675 feet long and includes two small tributaries (Figure 3). The Service identified and assessed seven reaches that comprise Rosgen stream types B5, G5, and E5. Reach PH LT02-A is located at the entrance of Holton Pond, with Reaches B, C, and D located on the tributary main stem upstream of Reach A respectively. PH LT02 LT01 is a small tributary that drains into PH LT02 from the left between Holton Pond and Calvert Pond and contains two reaches. PH LT02 RT02 is a tributary that drains into PH LT02 from the right, upstream of Calvert Pond.

Reach PH LT02 LT01-A is a 250-foot long reach of unstable B5 on a tributary to PH LT02 that receives runoff from a runway area. Reach PH LT02 LT01-A is downstream of Tate Road and has four headcuts that have a total drop of 3.5 feet. The culvert under Tate Road will provide grade control and stop the headcuts from moving into Reach PH LT02 LT01-B. Poor instream habitat exists in Reach PH LT02 LT01-A due to the instability and headcuts. Riparian buffer width is approximately 800 feet. Recovery potential is excellent if the destabilizing influences are corrected.

Reach PH LT02 LT01-B is a stable B5 and flows 350 feet from the headwaters of the tributary down to a culvert under Tate Road. Instream habitat is poor because the reach is ephemeral. Riparian buffer width is approximately 50 feet.

Reaches PH LT02-A (950 feet), PH LT02-B (475 feet), and PH LT02 RT01-A (300 feet) are all stable E5 stream types. Reach PH LT02-A has been dredged and straightened in the past. Reach PH LT02-A starts at the outfall from Calvert Pond and ends when it flows into Holton Pond. The reach has a wide, well developed floodplain. Two 30-inch culverts allow the stream to flow under Buse Road and the area on the downstream end of the culverts has minor localized bank and bed erosion. Reach PH LT02-B flows into the north end of Calvert Pond. There is an abandoned beaver dam near the upstream end of Reach PH LT02-B. A new 18-inch plastic pipe has been installed just upstream of the beaver dam and appears to be draining land west and southwest of the reach. Instream habitat is good in all reaches. Riparian buffer widths range from 50-500 feet. Although all three reaches are currently stable, the instability and excess sediment production in the upstream reaches could cause instability and aggradation in these reaches.

Reaches PH LT02-D, PH LT02 RT01-B, PH LTO2 RT02-A, and PH LT02-C are all unstable G5 Rosgen stream types. Each reach has a headcut that ranges in size from 1.5-3.0 feet. Reach PH

LT02-D, located at the top of PH LT02, receives runoff from the area near the intersection of Cedar Point Road and Tate Road without any storm water management. All four reaches have a low to moderate rate of bed and bank erosion with poor instream habitat. Recovery potential is very poor even if the destabilizing influences are corrected.

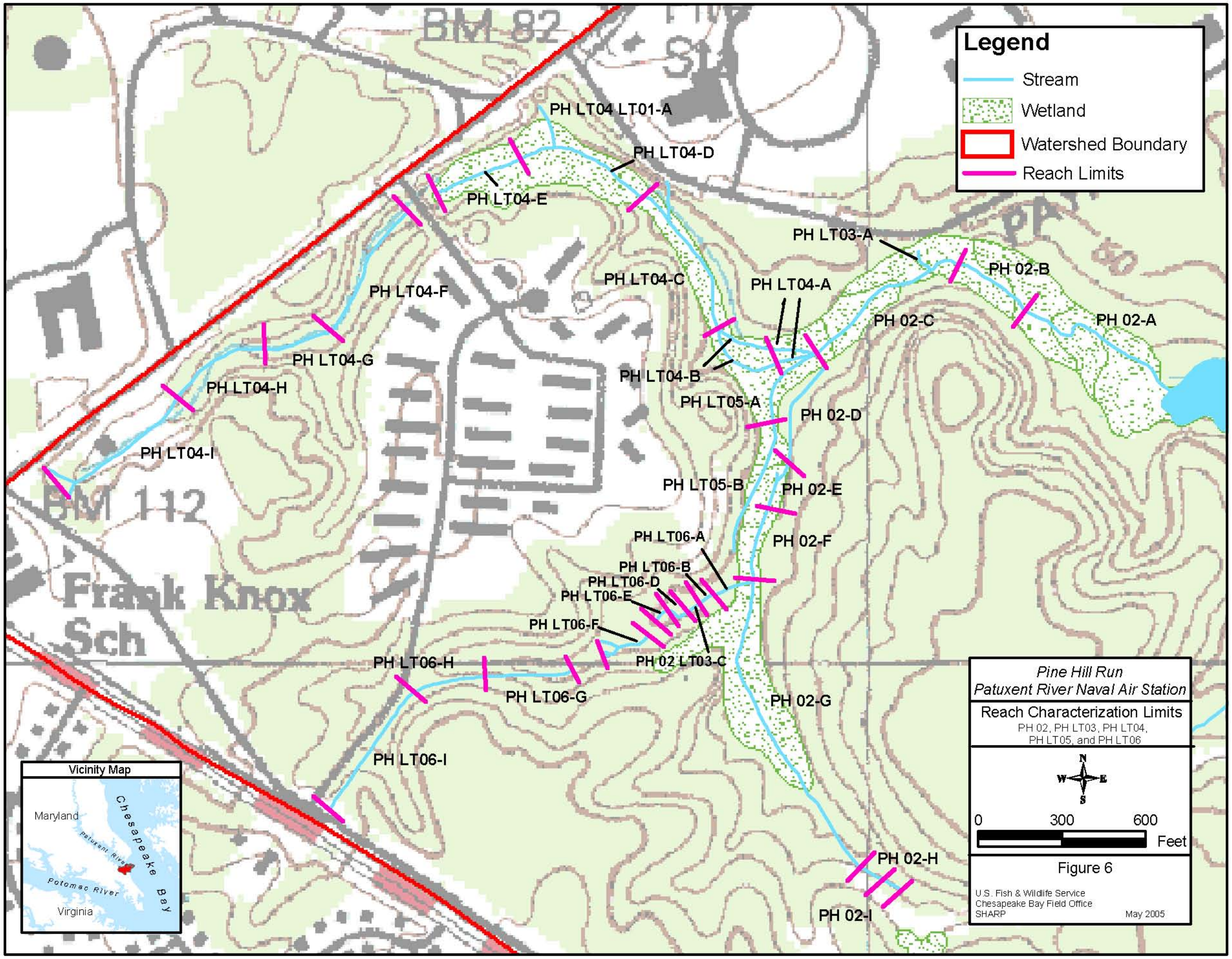
PH RT 06

PH RT 06 (Figure 6) is approximately 1,700 feet in length. The Service identified and assessed four reaches that comprise Rosgen stream types C5, D5, and G5. Reach PH RT06-A is located on the downstream end of the tributary and Reaches PH RT06-B through D are located upstream of Reach PH RT06-A sequentially. PH RT06 is receiving increased runoff due to impervious surface increases and deforestation at the FARM complex at the southern end of Preister Road. The area lacks any stormwater management and is responsible for the widespread instability in PH RT06. Reaches PH RT06-C and D probably did not exist as stream channels before development of the headwaters.

Reach PH RT06-A is 350 feet in length and flows into the south side of Sewall Pond. Reach PH RT06-A is an aggrading D5 stream. A forested wetland floodplain exists along the reach. The reach was probably an E5 prior to the large increase of sediment moving down from the reaches upstream. Instream habitat is poor and the riparian buffer width is approximately 1,000 feet. The reach will continue to aggrade unless the sediment from upstream is significantly reduced. Recovery potential for Reach PH RT06-A is poor even if the destabilizing influences are corrected.

Reach PH RT06-B, 200 feet in length, is a moderately stable aggrading C5. The upstream end of the reach starts at a 48-inch culvert in which the tributary flows under an access road. The culvert is not causing any instability in the reach. The stream was ditched and straightened in the past. Instream habitat is fair and the riparian buffer width is approximately 1,000 feet. The reach will continue to aggrade unless the sediment from upstream is significantly reduced. Recovery potential for Reach PH RT06-A is fair if the destabilizing influences are corrected.

Reach PH RT06-C is 750 feet of an extremely unstable G5 that is degrading to an F5 and is undergoing extensive lateral and vertical adjustment. Five eroding swales enter the main stem in the downstream end of the reach. Swales 1, 2, and 3 are 4 feet wide with 4-foot banks and 30-40 feet long with moderate to high rates of bed and bank erosion. Swales 4 and 5 are 4-6 feet wide with banks that are 5-6 feet tall and approximately 150 feet long with high rates of erosion. Approximately 450 feet upstream of the road crossing, the hillside on the right side of the stream has slumped down into Reach PH RT06-C. This has filled the channel in that area and caused a 3-foot rise in the bed of the stream channel. Two headcuts that are 1 and 2 feet high are located just upstream of the slope failure. Reach PH RT06-C is supplying an extremely large volume of sediment to the reaches downstream, and ultimately Sewell Pond. There is a 3-foot high headcut at the upstream end of the reach. The instream habitat is poor and the riparian buffer width is



Legend
Stream
Wetland
Watershed Boundary
Reach Limits
PH LT04 LT01-A
PH LT04-D
PH LT04-E
PH LT04-C
PH LT04-F
PH LT04-A
PH LT03-A
PH 02-B
PH 02-C
PH 02-A
PH LT04-G
PH LT04-H
PH LT04-B
PH LT05-A
PH 02-D
PH LT04-I
PH LT05-B
PH 02-E
PH 02-F
PH LT06-A
PH LT06-B
PH LT06-D
PH LT06-E
PH LT06-F
PH 02 LT03-C
PH LT06-H
PH LT06-G
PH 02-G
PH LT06-I
PH 02-H
PH 02-I
BM 82
BM 112
Frank Knox Sch
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
Pine Hill Run
Patuxent River Naval Air Station
Reach Characterization Limits
PH 02, PH LT03, PH LT04, PH LT05, and PH LT06
N
W
E
S
0
300
600
Feet
Figure 6
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005

approximately 1,000 feet. The reach has a poor to very poor recovery potential even if the destabilizing influences are corrected.

Reach PH RT06-D, 400 feet in length, is an unstable G5 with moderate rate of bed and bank erosion. Near the upstream end of the reach, a 12-inch culvert that is rusting away crosses under an access road. Overland flow concentrates on the upstream side of the road and is beginning to form a channel. Currently the culvert is providing grade control for the upstream end of Reach PH RT06-D. If the culvert fails, the channel on the upstream side of the road will downcut. The ephemeral channel has poor instream habitat and a riparian buffer width of approximately 1,000 feet. The reach has a very poor recovery potential even if the destabilizing influences are corrected.

PH 02

PH 02 is approximately 3,875 feet long and includes one small tributary (Figure 6). The Service identified and assessed ten reaches that comprise Rosgen stream types C5, D5, DA5, E4, E5, F4, and G5. Reach PH LT02-A is located on the downstream end of PH02 and flows into Sewell Pond, with Reaches PH 02-B through I located on the main stem upstream of Reach A respectively. Reach PH LT03-A is a small tributary that drains into PH LT02 from the left approximately 1,000 feet upstream of Sewell Pond. The instability throughout PH 02 appears to be the result of development in the watershed, which has greatly increased the amount of flow. The increased flow resulted in degradation and increased sediment moving from bed and bank erosion in PH 02.

Reach PH 02-A (600 feet) is a stable DA5 that flows into the western end of Sewall Pond. The reach has a forested wetland floodplain that is approximately 600 feet wide and has good instream habitat. The reach is currently stable, but could become unstable if the large amount of sediment from upstream reaches is not reduced.

Reach PH 02-B (300 feet) is a moderately stable E5 that most likely is aggrading due to the large amount of sediment coming from the upstream reaches. The reach is a short transition area from the F4 stream type upstream to the DA5 type downstream. Continuation of the large amount of sediment coming from upstream could cause the reach to change to an unstable D5 stream type. Instream habitat is fair and the riparian buffer width is approximately 1,000 feet.

Reach PH 02-C (650 feet) is an unstable F4 that is experiencing a moderate to high rate of bank erosion. The upstream end of the reach is located at the confluence of Reaches PH LT04 and PH LT05. Instream habitat for Reach PH 02-C is poor due to the high amount of sediment. Riparian buffer width is approximately 1,000 feet. The reach has a poor recovery potential even if the destabilizing factors are corrected.

Reach PH 02-D (400 feet) is a moderately stable E5 that ends with its flow spreading out on the valley floor at the upstream end of Reach PH 02-C**.** The reach was formed when aggradation at the downstream end of Reach PH 02-E caused the main channel to abandon its original channel and create a new channel. Instream habitat is good and riparian buffer width is greater than a 1,000 feet. The reach will cause a large headcut where the flow is dropping back into the channel at Reach PH 02-C. The headcut will migrate upstream and cause widespread instability in Reaches PH 02-D through PH 02-F.

Reach PH 02-E (150 feet) is an unstable C5 that was also formed when the main channel abandoned its original channel and created a new channel. Instream habitat is fair because of the large amount of sediment from upstream. Riparian buffer width is greater than 1,000 feet. The reach will continue to aggrade with sediment from upstream bed and bank erosion. The reach has a fair recovery potential if the destabilizing factors are corrected.

Reaches PH 02-F (275 feet) and PH 02-G (250 feet) are unstable G5 reaches that are undergoing widespread adjustment. Numerous headcuts, ranging in size from 2.5 feet to 4 feet, are moving through the reaches. Bed and bank erosion is taking place at moderate to high rates. Sediment produced by the headcuts causes further stability problems in the reaches downstream. The instability is caused by the increased runoff from the Carpenter Park housing area on Fogerty and Rassmussen Roads, and the FARM complex located at the southern end of Priester Road. Riparian buffer width is greater than 1,000 feet. Instream habitat is poor in both reaches. Recovery potential for the reaches is very poor even if the destabilizing factors are corrected.

Reaches PH 02-H (75 feet) and PH 02-I (75 feet) have formed from the increased runoff from the FARM complex at the southern end of Priester Road. Reach PH 02-H is a short reach of moderately stable E4 that appears to be downcutting. Overland flow from the FARM complex concentrates to form Reach PH 02-I. Reach PH 02-I is a D5 that is not well developed and is downcutting. Instream habitat for both reaches is poor because the channel is ephemeral. Riparian buffer width is greater than 1,000 feet. Reach PH 02-H has a good recovery potential, while Reach PH02-I has a poor recovery potential even if the destabilizing factors are corrected.

PH LT03

Reach PH LT03-A (100 feet) is a small tributary that receives overland flow from the upstream side of Buse Road through a culvert under the road. The reach is a highly unstable G5 that has a series of headcuts with an overall drop of approximately 9 feet before entering PH 02-C. Instream habitat is poor since the reach is ephemeral and the riparian buffer width is approximately 500 feet. The recovery potential is very poor even if the destabilizing factors are corrected.

PH LT04

PH LT04 (Figure 6) is approximately 4,050 feet in length. The Service identified and assessed ten reaches that comprise Rosgen stream types B5, C5, D5, F5, and G5. Reach PH LT04-A is located at the confluence of Reaches PH LT04 and PH LT05. Reaches PH LT04-B through I are located upstream from Reach A sequentially. Reach PH LT04 LT01-A is located on a small tributary that flows under Cedar Point Road near the intersection with Buse Road.

Reaches PH LT04-E (300 feet), H (375 feet), and I (625 feet) are all highly unstable G5 channels with widespread bed and bank erosion. The significant adjustments are the result of large headcuts (2-5 feet) that are moving through the reaches producing large volumes of sediment to the downstream reaches. The instability in Tributary PH LT04 appears to have occurred because of increased runoff volume during storm events from development in the watershed near Gate 2. The increased flows have caused the streams to adjust laterally and vertically. The reaches are deeply incised and a large event is required for the stream to flow out of bank. Therefore the erosive forces are extremely high and the stream will continue to adjust both laterally and vertically. Recovery potential for G5 stream types is very poor even if the destabilizing influences are removed. All four reaches have poor instream habitat and riparian buffer widths that range from 0-700 feet.

Reaches PH LT04-A (350 feet) and PH LT04-B (450 feet) are unstable D5 reaches. Reach PH LT04-A has downcut and now has 4-foot tall banks and a 4-foot headcut at the top of the reach. Reach PH LT04-B is aggrading from the large sediment supply from upstream. Localized bed and bank erosion is occurring at the downstream end of Reach PH LT04-B just upstream of the 4-foot headcut in Reach PH LT04-A. The headcut will likely continue to move upstream into Reach PH LT04-B in the near future. Recovery potential for PH LT04-A is very poor since the individual channels of the braid are essentially Rosgen G5 type channels. The recovery potential for PH LT04-B is good if the destabilizing influences are removed. Poor instream habitat exists in both of the ephemeral reaches, and riparian buffer width is approximately 700 feet.

Reach PH LT04-C, 550 feet in length, is a moderately stable B5c reach that formed inside an F5 channel. The reach has localized bank erosion in the main channel, but has two outfalls that are experiencing high bed and bank erosion. The first outfall into Reach PH LT04-C is a 24-inch metal culvert that receives flow from the north side of Buse Road and has a large amount of bank and bed erosion prior to entering the main channel. The second outfall is a 12-inch terra cotta pipe that has broken and caused a G5 to form for about 40 feet before entering the main channel. Before breaking, the terra cotta pipe discharged into the reach on the right bank. Near the top of Reach PH LT04-C, the stream flows through a 50-foot long, 40-inch diameter concrete culvert that is used for utility access and maintenance. The water surface drops approximately 0.5 feet when exiting the pipe, but the area around the pipe is stable. Instream habitat is fair with a riparian buffer width that ranges from 200-500 feet.

Reach PH LT04-D is 450 feet in length and is currently an unstable C5 that is downcutting due to localized bed erosion. A series of headcuts is located in the reach, with a total drop of 2 feet. At the bottom of Reach PH LT04-D is 4-foot headcut. The headcut has potential to move upstream through the reach and cause significant bed and bank erosion to the upstream reaches. If the problems are not addressed, the reach will continue to downcut to a G5, then widen to an F5 which would produce large volumes of sediment. Instream habitat is fair and riparian buffer width is 250-400 feet. The reach has a fair recovery potential if the destabilizing factors are corrected.

Reach PH LT04-F, 550 feet in length, is an unstable C5 and F5 upstream of Fogerty Road and is undergoing rapid adjustment. The reach has two headcuts with drops of 2.5 feet and 3.5 feet. The areas around the headcuts are F5, while the stream transitions to a C5 before the next headcut. Bed and bank erosion rates are high in the F5 sections, but are low to moderate in the C5 sections. Instream habitat is poor because the channel is ephemeral. Riparian buffer width ranges from 250-350 feet. The reach has a fair to poor recovery potential even if the destabilizing influences are corrected and will continue to degrade if the problems are not corrected.

Reach PH LT04-G is an unstable F5 reach. Severe downcutting occurred in the past and now the banks are 5-6 feet tall. The bed erosion appears to be at a low rate, but bank erosion is at a moderate to high rate. The upstream end of the reach is a 5 foot headcut moving into Reach H. Instream habitat is poor because the channel is ephemeral. Riparian buffer width ranges from 400-800 feet. The reach has a poor recovery potential even if the destabilizing influences are removed and will continue to degrade if the problems are not corrected.

Reach PH LT04 LT01-A is an unstable B5 that is degrading to a G5. The reach is located on a tributary to PH LT04 that flows under Cedar Point Road near the intersection of Buse Road. The tributary receives runoff from the area around the medical center and probably did not exist prior to development of that area. Instream habitat is poor because the channel is ephemeral. Riparian buffer width ranges from 100-500 feet. The Reach will continue to downcut and become an unstable G5 stream type with a very poor recovery potential even if the instability is corrected.

PH LT05
PH LT05 (Figure 6) is approximately 725 feet in length. The Service identified and assessed two reaches that comprise Rosgen stream types E5 and G5. Reach PH LT05-A was part of the original main stem of PH 02 until aggradation caused formation of a new channel consisting of Reaches PH 02-D and PH 02-E. Reach PH LT05-A now receives flow just from Reach PH LT05-B.

Reach PH LT05-A (300 feet) is an unstable G5 reach that is undergoing widespread adjustment. The reach has a 4-foot headcut at the upstream end of the reach. Bed and bank erosion is taking place at moderate to high rates. The instability was caused by the increased runoff from the Carpenter Park housing area on Fogerty and Rassmussen Roads, and the FARM complex located at the southern end of Priester Road. The reach has a very poor recovery potential even if the destabilizing influences are removed. Instream habitat is fair and riparian buffer width is greater than 1,000 feet.

Reach PH LT05-B (425 feet) is a stable E5 whose source is a wetland seep. Instream habitat is good and the riparian buffer width is greater than 1,000 feet. The headcut in Reach PH LT05-A will move upstream into this reach if the headcut is not addressed. Reach PH LT05-B will downcut to a G5 stream type with widespread instability and a very poor recovery potential.

PH LT06
PH LT06 (Figure 6) is approximately 1,650 feet in length. The Service identified and assessed nine reaches that comprise Rosgen stream types A5, B5, and G5.

Reaches PH LT06-A, PH LT06-D, and PH LT06-F are unstable G5 reaches that are undergoing widespread adjustment (Figure 6). Numerous headcuts ranging in size from 2.5-4 feet are moving through the reaches. Bed and bank erosion is taking place at moderate to high rates. Sediment produced by the headcuts causes further stability problems in the reaches downstream. Downstream of PH LT06-F is a short section of the valley without a defined channel. The channel reforms at the top of Reach PH LT06-E. The instability is caused by the increased runoff from the Carpenter Park housing area on Fogerty and Rassmussen Roads, and the FARM complex located at the southern end of Priester Road. Riparian buffer width ranges from approximately 800-1,000 feet. Instream habitat is poor in all of these reaches because the stream is ephemeral. Recovery potential for the reaches is very poor even with correction of the problems causing the instability.

Reach PH LT06-B is an unstable B5 that appears to be downcutting to match the level of the PH 02. Instream habitat is poor since the reach is ephemeral and the riparian buffer width is approximately 1,000 feet. The reach will continue to downcut to a G5, which has a very poor recovery potential even if the destabilizing factors are corrected.

Reaches PH LT06-C, PH LT06-E, and PH LT06-G are stable B5 channels that are located between sections of unstable G5 reaches. Instream habitat is poor because the channel is ephemeral. Riparian buffer width is approximately 500-1,000 feet. Downstream of Reach PH LT06-G is a short section of the valley without a defined channel. The channel reforms at the top of Reach PH LT06-F. The headcuts located in the G5 reaches will likely move upstream into these reaches and cause widespread instability. The reaches have a very poor recovery potential even if the destabilizing influences are removed

Reach PH LT06-H is a moderately stable A5 which was likely created by ditching. A 24-inch stormwater outfall is located at the upstream end of Reach PH LT06-H. The outfall receives runoff from Rassmussen Road and the Carpenter Park housing area on Fogerty Road. The outfall is responsible for much of the instability in PH LT06. Riparian buffer width is approximately 1,000 feet, although the width on the left bank is only 25 feet.

Reach PH LT06-I is a stable man-made ditch at the headwaters of Reach PH LT06 that is 500 feet long and runs along Rassmussen Road. Riparian buffer width is approximately 1,000 feet, although the width on the left bank is only 25 feet.

IV. PROBLEM IDENTIFICATION AND RATING

The Service used a priority rating of very high, high, moderate, and low to rate stream reaches relative to one another. The reach rating was based on specific data that would best indicate whether or not a stream was stable and if unstable, the relative severity of instability. The Service used semi-quantitative and qualitative data to determine stream stability. The Service used such semi-quantitative as bank erodibility, bed stability, entrenchment, and incision to determine if a stream is or has the potential to adjust laterally and vertically.

The qualitative data used by the Service is the management interpretations of the Rosgen stream types, as presented in Rosgen (1996). The management interpretations determine the sensitivity of each reach to disturbance, recovery potential, and potential source of sediment. The use of this method, based on this study's rating system, is mostly applicable for unstable reaches only. This is true because, on stable reaches, the assessment criteria have less influence than on unstable reaches. For example, a stable reach may have a high rating as a potential source of sediment because of its stream classification type. But since it is stable and not eroding, it is not considered a potential source of sediment. Therefore, it would not be rated as a high priority for restoration.

The Service assigned a very high restoration priority if most or all of the assessment parameters were rated as poor and the reach had significant specific problems. For example, a reach would receive a very high restoration priority rating if it was laterally unstable, vertically unstable, had a high sensitivity to disturbance, a low recovery potential, was a potential source of large sediment loads, and had large headcut(s) that could affect other reaches. The Service assigned a high restoration priority if most, but not all, of the assessment parameters were rated as poor and there were no significant site-specific problems. Conversely, a reach would have a low priority rating if it was stable; regardless if it was highly sensitive to disturbance, had a low recovery potential, and was a high potential source of sediment. A reach would receive a moderate priority rating for two reasons. First, if it was the same as the example provided for a low priority-rated reach, but had significant degradation occurring upstream or downstream of the reach, and second, if the overall reach was stable but had localized instability problem areas.

Site-specific problem areas were identified during the collection of field data. An example of a site-specific problem would be a severe headcut migrating upstream that would impact an otherwise stable, but sensitive reach. The Service also included site-specific problems in determining a reach's restoration priority rating, as described above.

A. Reach Problem Identification and Priority Rating

Table 2 summarizes the individual reach rating criteria and the overall restoration priority rating for each reach. Figures 7-10 show the location of all reaches and their restoration priority rating. Although much of the watershed is forested and the streams have good riparian buffers, many of the streams are unstable. Development in the headwaters of many of the tributaries has caused widespread vertical and lateral instability. Nine reaches were rated as very high priority, 44 reaches were rated as high priority, 14 reaches were rated as moderate priority, and 21 reaches were rated as low priority.

The Service rated reaches PH RT03 LT01-C, PH RT04-E, PH RT06-C, PH 02-G, PH LT04-A, PH LT04-D, PH LT04-G, PH LT04-H, and PH LT05-A a very high priority. These reaches have widespread instability with a series headcuts that range in height from 1-5 feet. The headcuts will move upstream and degrade other reaches.

The Service ranked the following reaches as a high priority for several reasons. High priority ratings include Reach PH LT04-C because it has two outfalls that are causing large erosion problems at their discharge sites, but the majority of the reach is moderately stable. Reaches PH RT02 LT01-A and PH RT04 LT01-A are rated high because 2.5- and 4-feet headcuts are located at the confluence of the main channel. The majority of the reach is moderately stable, but the headcuts will move upstream further into the reaches.

Pine Hill Run Watershed, PRNAS

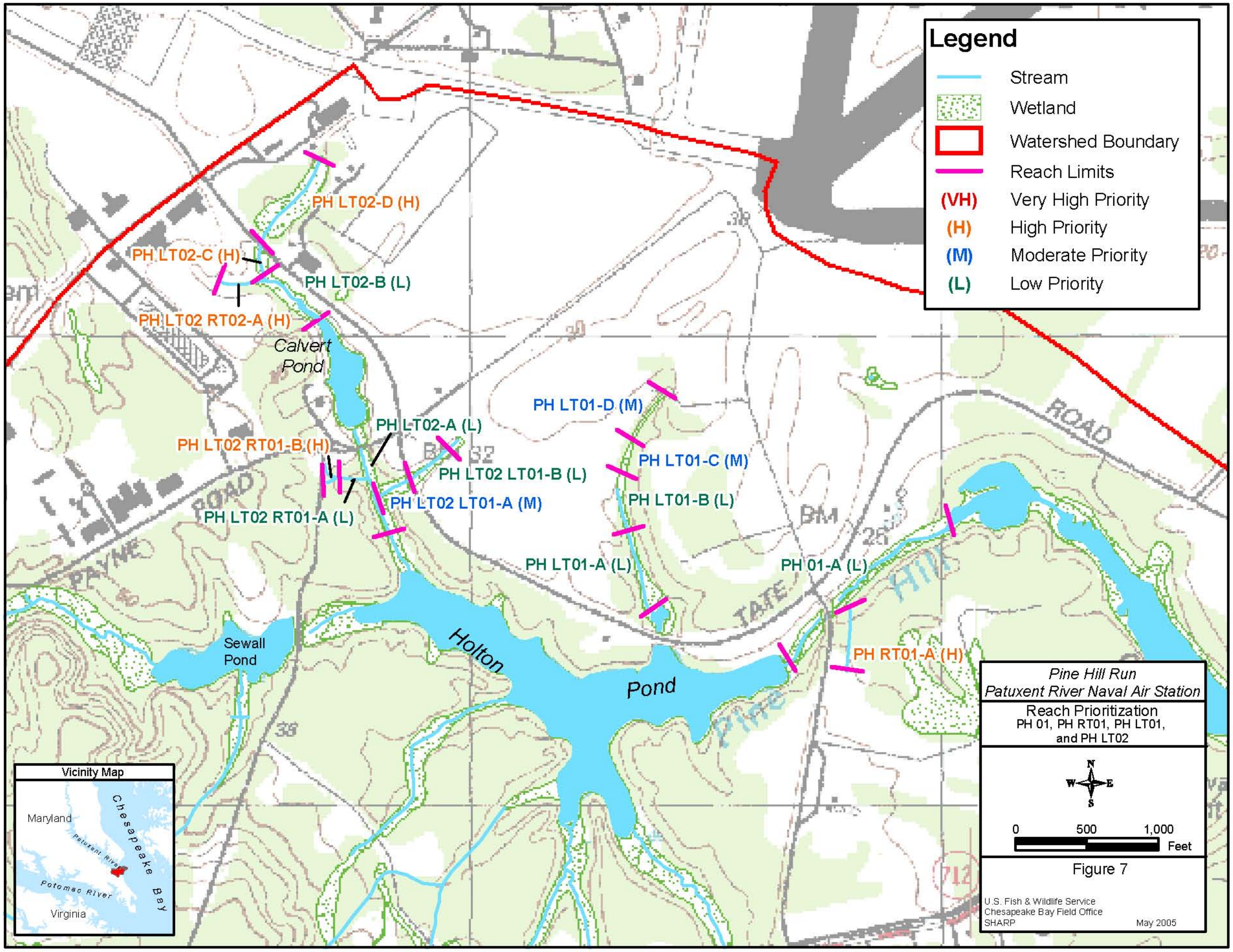
Table 2. Stream Stability Summary. [a] Includes increases in streamflow magnitude and timing and/or sediment increases. [b] Assumes natural recovery once cause of instability is removed or corrected.

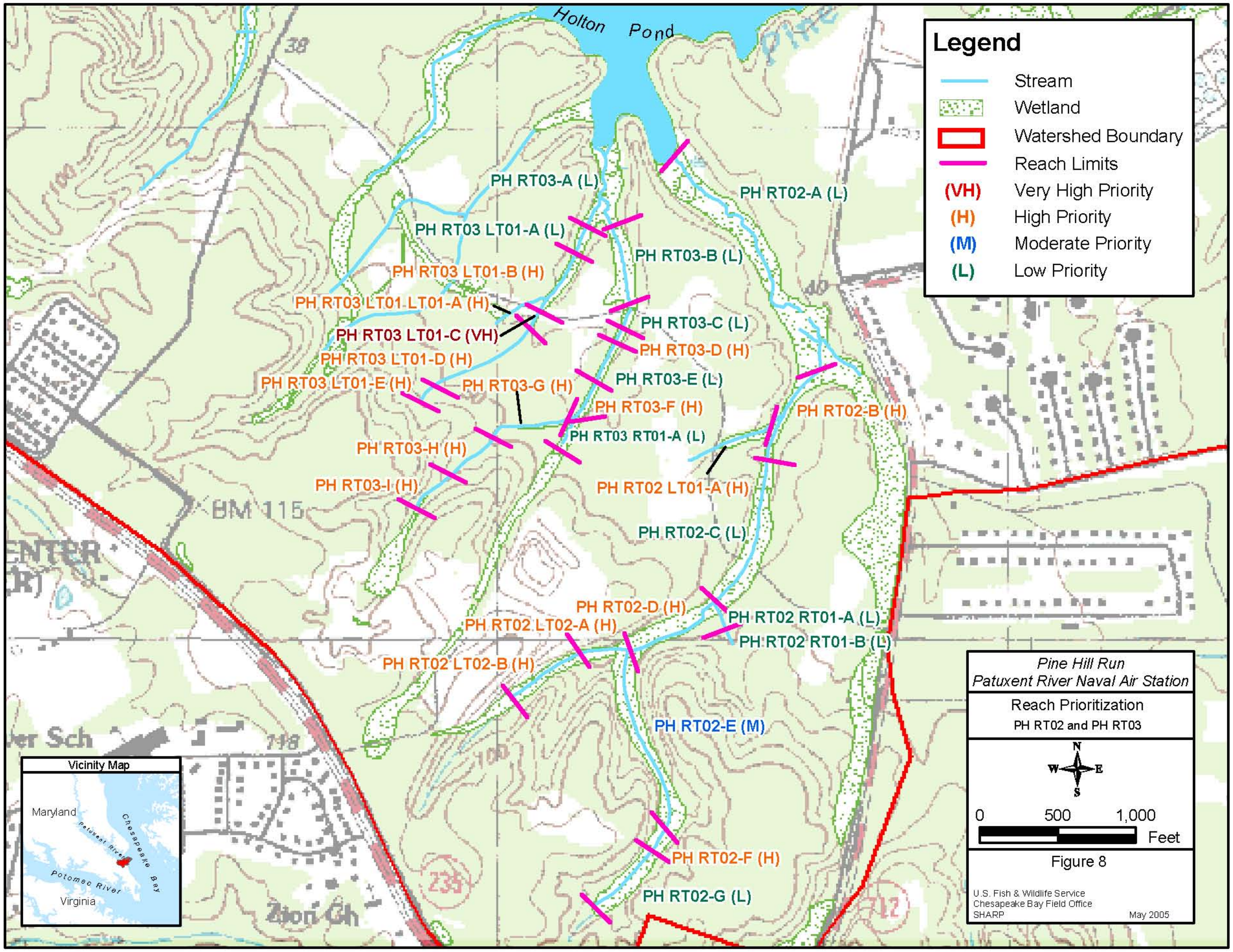
Tributary	Reach	Rosgen Stream Type	Bankfull Width (ft)	Bank Height (Range, ft)	Incision	Riparian Buffer Width (Range, ft) +/-	Instream Habitat	Vertical Stability	Lateral Stability	Stream Evolution	Sediment Supply	Disturbance Sensitivity [a]	Recovery Potential [b]	Relative Restoration Priority
PH 01	PH 01-A	E4	10 - 20	1.5-2.0	Low	200-500	Good	Stable	Stable	E4	Moderate	Very High	Good	Low
PH RT01-A	PH RT01-A	G5	2	4.0-5.0	High	200	Poor	Degrading	Unstable	G5→F5	Very High	Extreme	Very Poor	High
PH LT01	PH LT01-A	DA5	9	1.5	Low	600	Good	Stable	Stable	DA→C5→E5	Low	Moderate	Good	Low
	PH LT01-B	E5	9	1.5	Low	600	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH LT01-C	C5	14	1.5	Low	0-100	Fair	Stable	Mod Stable	C5	Very High	Very High	Fair	Moderate
	PH LT01-D	B4c	12	1.0-1.5	Moderate	50-100	Fair	Stable	Mod Stable	B4c	Moderate	Moderate	Excellent	Moderate
PH RT02	PH RT02-A	DA5	40	1.0	Low	>1000	Good	Stable	Stable	DA5	Low	Moderate	Good	Low
	PH RT02-B	G5	4	2.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT02-C	DA5	5	1.0	Low	>1000	Good	Stable	Stable	DA5	Low	Moderate	Good	Low
	PH RT02-D	F5	4	0.75-6.0	High	>1000	Poor	Degrading	Unstable	F5→C5	Very High	Very High	Poor	High
	PH RT02-E	B4c	3	0.7-5.0	Moderate	>1000	Good	Mod Stable	Unstable	B4/5c→G5→F5→C5	Moderate	Moderate	Excellent	Moderate
	PH RT02-F	G5	3	2.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT02-G	E5	3	0.4-0.5	Low	>1000	Poor/Dry	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH RT02 LT01-A	Swale/E5	2	0.4	Low	>1000	Poor/Dry	Degrading	Mod Stable	E5→G5→F5→C5	Moderate	Very High	Good	High
	PH RT02 RT01-A	B5/C5	3	0.2	Low/Mod	>1000	Good	Stable	Stable	B5/C5	Mod/Very High	Mod/Very High	Excellent/Fair	Low
	PH RT02 RT01-B	DA5	15	0.2	Low	>1000	Good	Stable	Stable	DA5	Low	Moderate	Good	Low
	PH RT02 LT02-A	G5	3.5	4.0-5.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT02 LT02-B	G5	3	2.0	High	>1000	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
PH RT03	PH RT03-A	C5	4.75	0.4	Low	>1000	Good	Stable	Stable	C5→E5	Very High	Very High	Fair	Low
	PH RT03-B	E5	3.5	1.3	Low	>1000	Good	Mod Stable	Stable	E5→G5→F5→C5	Moderate	Very High	Good	Low
	PH RT03-C	E5	6	1.0	Low	600	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH RT03-D	G5	5	1.5	Moderate	600	Fair	Unstable	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT03-E	E5	3.5	0.75-1.0	Low	>1000	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH RT03-F	D5	25	0.3	Low	>1000	Poor	Unstable	Unstable	D5→G5→F5→C5	Very High	Very High	Poor	High
	PH RT03-G	F5	6	5.0-6.0	High	800	Poor	Unstable	Unstable	F5→C5	Very High	Very High	Poor	High
	PH RT03-H	F5	3.25	4.0	High	800	Poor	Degrading	Unstable	F5→C5	Very High	Very High	Poor	High
	PH RT03-I	G5	3	1.0	High	600	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT03 RT01-A	Swale	N/A	N/A	N/A	500-1000	Poor	Stable	Stable	Swale	N/A	N/A	N/A	Low
	PH RT03 LT01-A	E5	3	0.6	Low	>1000	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH RT03 LT01-B	G5	2.75	1.75-3.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT03 LT01-C	G5	2	5.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH RT03 LT01-D	G5	3	1.5	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT03 LT01-E	G5	3.75	2.0-4.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT03 LT01 LT01-A	B5	3	0.9	Moderate	>1000	Poor/Dry	Stable	Stable	B5	Moderate	Moderate	Excellent	High
PH RT04	PH RT04-A	D5	25	0.3-0.4	Low	>1000	Poor	Aggrading	Unstable	D5→C5	Very High	Very High	Poor	High
	PH RT04-B	B5c	4	0.4-0.5	Moderate	>1000	Fair	Aggrading	Unstable	B5c→D5	Moderate	Moderate	Excellent	Moderate
	PH RT04-C	G5	3	4.0-5.0	High	>1000	Poor	Unstable	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT04-D	G5	3-6	4.0-5.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT04-E	G5	2.75	1.0-2.0	High	50-150	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH RT04 LT01-A	B5	3	0.5-1.0	Moderate	200-1000	Poor/Dry	Mod Stable	Mod Stable	B5→G5→F5	Moderate	Moderate	Excellent	High
	PH RT04 LT01-B	Swale/G6	1.5	0.5-1.0	High	>1000	Poor/Dry	Degrading	Mod Stable	G6→F6→C6	High	Very High	Poor	High
PH RT05	PH RT05-A	E5	4	0.5-0.7	Low	>1000	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH RT05-B	G5	2.5	1.5-2.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH RT05-C	B5	2	0.2-0.3	Moderate	>1000	Poor/Dry	Mod Stable	Stable	B5→G5→F5→C5	Moderate	Moderate	Excellent	Moderate

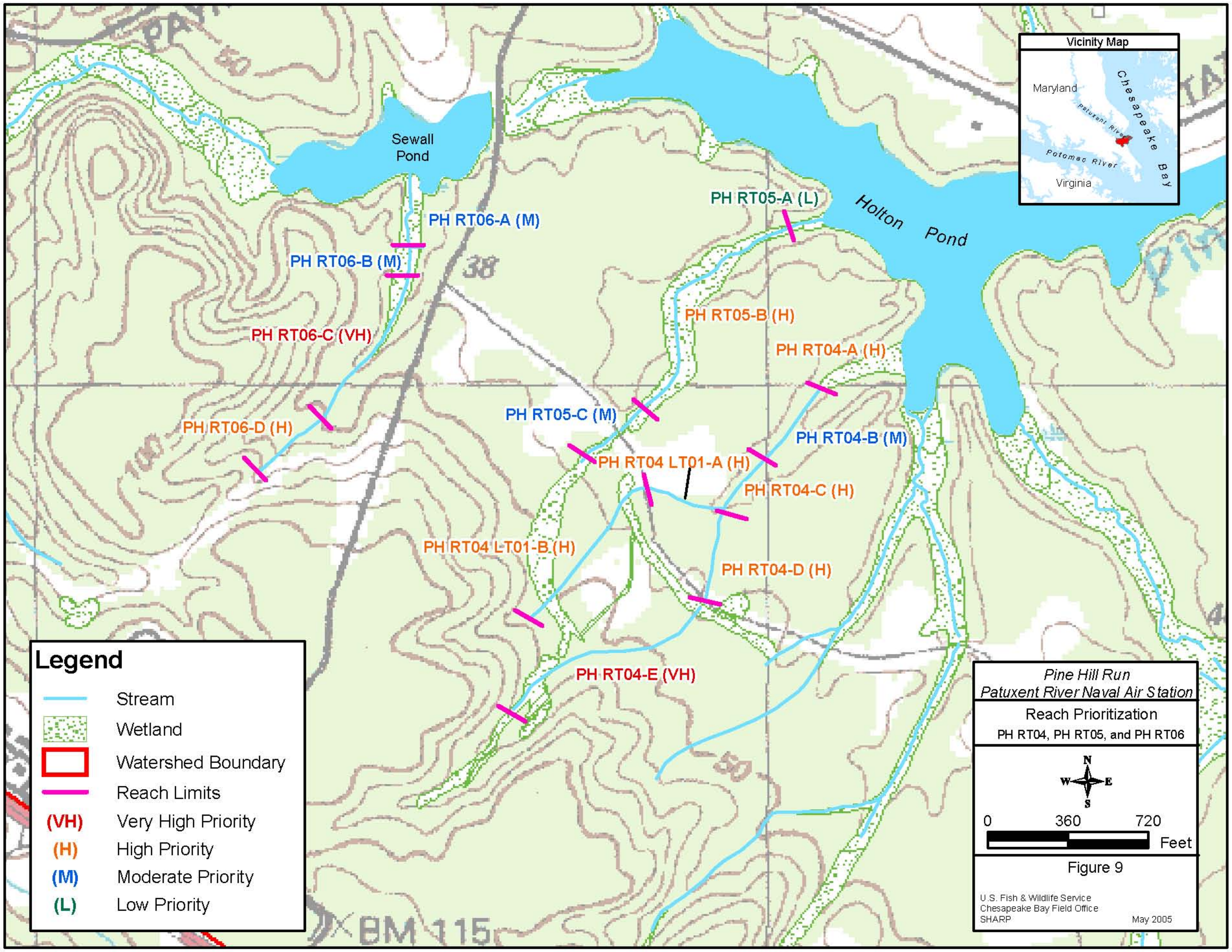
Pine Hill Run Watershed, PRNAS

Table 2. Stream Stability Summary Continued. [a] Includes increases in streamflow magnitude and timing and/or sediment increases. [b] Assumes natural recovery once cause of instability is removed or corrected.

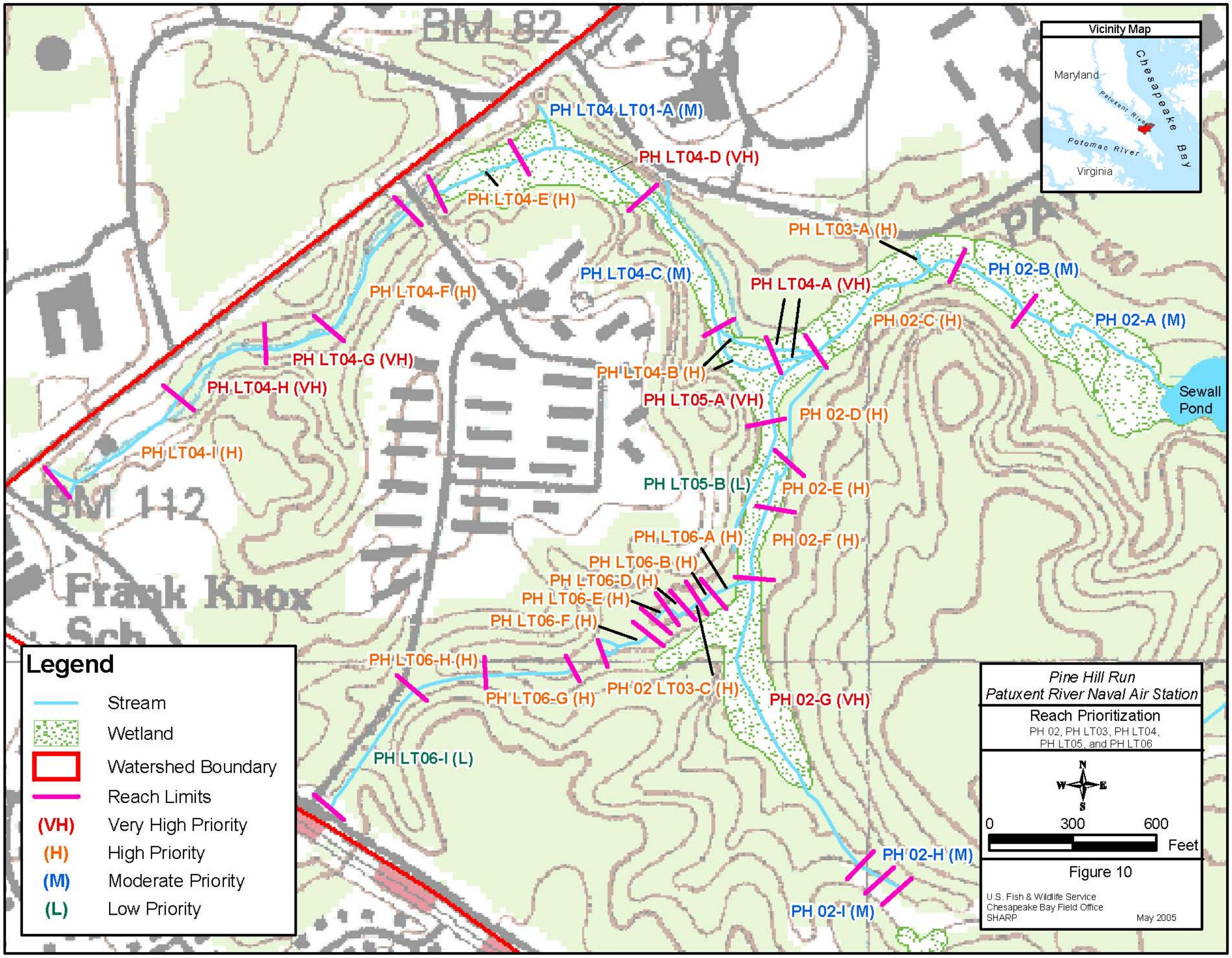
Tributary	Reach	Rosgen Stream Type	Bankfull Width (ft)	Bank Height (Range, ft)	Incision	Riparian Buffer Width (Range, ft) +/-	Instream Habitat	Vertical Stability	Lateral Stability	Stream Evolution	Sediment Supply	Disturbance Sensitivity [a]	Recovery Potential [b]	Relative Restoration Priority
PH LT02	PH LT02-A	E5	3	0.5	Low	50-500	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH LT02-B	E5	6	0.5-0.6	Low	200	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH LT02-C	G5	2	3.0	High	50	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT02-D	G5	1.5-4.0	2.0	High	100-300	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT02 LT01-A	B5	3	0.3	Moderate	800	Poor	Degrading	Unstable	B5→G5→F5→C5	Moderate	Moderate	Excellent	Moderate
	PH LT02 LT01-B	B5	3	0.4	Moderate	50	Poor/Dry	Stable	Stable	B5	Moderate	Moderate	Excellent	Low
	PH LT02 RT01-A	E5	3	0.5	Low	50-500	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
	PH LT02 RT01-B	G5	1	0.3	High	100	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT02 RT02-A	G5	2	3.0	High	50	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
PH RT06	PH RT06-A	D5	30	0.2-0.3	Low	>1000	Poor	Aggrading	Unstable	D5→C5	Very High	Very High	Poor	Moderate
	PH RT06-B	C5	5	0.2-0.3	Low	>1000	Fair	Aggrading	Stable	C5→D5	Very High	Very High	Fair	Moderate
	PH RT06-C	G5	3-5	5.0-6.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH RT06-D	G5	2.5	4.0-5.0	High	>1000	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
PH 02	PH 02-A	DA5	8	1.0	Low	>1000	Good	Stable	Stable	DA5	Low	Moderate	Good	Moderate
	PH 02-B	E5	11	0.8	Low	>1000	Fair	Aggrading	Stable	E5→D5	Moderate	Very High	Good	Moderate
	PH 02-C	F4	12	4.0	High	>1000	Poor	Degrading	Unstable	F4→C4	Very High	Extreme	Poor	High
	PH 02-D	E5	3	0.8	Low	>1000	Good	Mod Stable	Mod Stable	E5→G5→F5→C5	Moderate	Very High	Good	High
	PH 02-E	C5	6	0.4	Low	>1000	Fair	Aggrading	Unstable	C5→D5	Very High	Very High	Fair	High
	PH 02-F	G5	5	1.3	High	>1000	Poor	Unstable	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH 02-G	G5	3	1.8	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH 02-H	E4	3	1.0	Low	500	Poor/Dry	Degrading	Mod Stable	E4→G4/5	Moderate	Very High	Good	Moderate
	PH 02-I	D5	20	0.3	Low	500	Poor/Dry	Degrading	Unstable	D5→G5→F5→C5	Very High	Very High	Poor	Moderate
PH LT03	PH LT03-A	G5	5	3.0	High	>1000	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
PH LT04	PH LT04-A	D5	50	4.0	High	700	Poor	Degrading	Unstable	D5→G5→F5→C5	Very High	Very High	Poor	Very High
	PH LT04-B	D5	50	0.8	Low	700	Poor	Unstable	Unstable	D5→G5→F5→C5	Very High	Very High	Poor	High
	PH LT04-C	B5c	4	0.8	Moderate	200-500	Fair	Aggrading	Mod Stable	B5c→D5	Moderate	Moderate	Excellent	Moderate
	PH LT04-D	C5	7	0.6-0.75	Low	250-400	Fair	Degrading	Mod Stable	C5→G5→F5→C5	Very High	Very High	Fair	Very High
	PH LT04-E	G5	6	3.0	High	300	Poor	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT04-F	C5/G5	4-6	0.75-3.0	Low/High	250-350	Poor	Unstable	Unstable	C5→G5→F5→C5	Very High	V High/Extreme	Fair/Very Poor	High
	PH LT04-G	F5	7	5.0	High	400-800	Poor/Dry	Degrading	Unstable	F5→C5	Very High	Very High	Poor	Very High
	PH LT04-H	G5	5	2.0-5.0	High	300	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH LT04-I	G5	3	1.0	High	0-25	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT04 LT01-A	B5	3	0.5-1.0	Mod/High	100-500	Poor/Dry	Degrading	Unstable	B5→G5→F5	Moderate	Moderate	Excellent	Moderate
PH LT05	PH LT05-A	G5	3	4.0	High	>1000	Fair	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	Very High
	PH LT05-B	E5	3	0.6	Low	>1000	Good	Stable	Stable	E5	Moderate	Very High	Good	Low
PH LT06	PH LT06-A	G5	3	5.0	High	1000	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT06-B	B5	3	3.0	Moderate	1000	Poor/Dry	Degrading	Mod Stable	B5→G5→F5→C5	Moderate	Moderate	Excellent	High
	PH LT06-C	B5	5	1.5	Moderate	1000	Poor/Dry	Stable	Stable	B5	Moderate	Moderate	Excellent	High
	PH LT06-D	G5	5	5.0	High	800	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT06-E	B5	4	1.3	Moderate	800	Poor/Dry	Stable	Stable	B5	Moderate	Moderate	Excellent	High
	PH LT06-F	G5	5	4.0	High	800	Poor/Dry	Degrading	Unstable	G5→F5→C5	Very High	Extreme	Very Poor	High
	PH LT06-G	B5	9	2.0	Moderate	500	Poor/Dry	Stable	Stable	B5	Moderate	Moderate	Excellent	High
	PH LT06-H	A5	7	2.0-7.0	High	500-700	Poor/Dry	Stable	Unstable	A5	Very High	Extreme	Very Poor	High
	PH LT06-I	Ditch	4	2.0	High	0-400	Poor/Dry	Stable	Stable	Ditch	N/A	N/A	N/A	Low


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
(VH) Very High Priority
(H) High Priority
(M) Moderate Priority
(L) Low Priority
PH LT02-D (H)
PH LT02-C (H)
PH LT02-B (L)
PH LT02 RT02-A (H)
Calvert Pond
PH LT02-A (L)
PH LT02 RT01-B (H)
PH LT02 LT01-B (L)
PH LT02 LT01-A (M)
PH LT02 RT01-A (L)
PH LT01-D (M)
PH LT01-C (M)
PH LT01-B (L)
PH LT01-A (L)
PH 01-A (L)
PH RT01-A (H)
Sewall Pond
Holton Pond
PAYNE ROAD
TATE ROAD
Pine Hill
Vicinity Map
Maryland
Virginia
Chesapeake Bay
Patuxent River
Potomac River
Pine Hill Run
Patuxent River Naval Air Station
Reach Prioritization
PH 01, PH RT01, PH LT01, and PH LT02
N
W
E
S
0
500
1,000
Feet
Figure 7
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
(VH) Very High Priority
(H) High Priority
(M) Moderate Priority
(L) Low Priority
Holton Pond
PH RT03-A (L)
PH RT02-A (L)
PH RT03 LT01-A (L)
PH RT03-B (L)
PH RT03 LT01-B (H)
PH RT03 LT01 LT01-A (H)
PH RT03-C (L)
PH RT03 LT01-C (VH)
PH RT03-D (H)
PH RT03 LT01-D (H)
PH RT03-E (L)
PH RT03 LT01-E (H)
PH RT03-G (H)
PH RT03-F (H)
PH RT02-B (H)
PH RT03 RT01-A (L)
PH RT03-H (H)
PH RT03-I (H)
PH RT02 LT01-A (H)
PH RT02-C (L)
PH RT02-D (H)
PH RT02 LT02-A (H)
PH RT02 RT01-A (L)
PH RT02 RT01-B (L)
PH RT02 LT02-B (H)
PH RT02-E (M)
PH RT02-F (H)
PH RT02-G (L)
Pine Hill Run
Patuxent River Naval Air Station
Reach Prioritization
PH RT02 and PH RT03
0 500 1,000
Feet
Figure 8
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005
Vicinity Map
Maryland
Virginia
Chesapeake Bay
Patuxent River
Potomac River



Sewall Pond
Holton Pond
PH RT06-A (M)
PH RT06-B (M)
PH RT06-C (VH)
PH RT06-D (H)
PH RT05-A (L)
PH RT05-B (H)
PH RT05-C (M)
PH RT04-A (H)
PH RT04-B (M)
PH RT04 LT01-A (H)
PH RT04-C (H)
PH RT04 LT01-B (H)
PH RT04-D (H)
PH RT04-E (VH)
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
Legend
Stream
Wetland
Watershed Boundary
Reach Limits
(VH) Very High Priority
(H) High Priority
(M) Moderate Priority
(L) Low Priority
Pine Hill Run
Patuxent River Naval Air Station
Reach Prioritization
PH RT04, PH RT05, and PH RT06
N
W
E
S
0
360
720
Feet
Figure 9
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005



Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
PH LT04 LT01-A (M)
PH LT04-D (VH)
PH LT04-E (H)
PH LT03-A (H)
PH 02-B (M)
PH LT04-C (M)
PH LT04-A (VH)
PH LT04-F (H)
PH 02-C (H)
PH 02-A (M)
PH LT04-G (VH)
PH LT04-B (H)
PH LT04-H (VH)
PH LT05-A (VH)
PH 02-D (H)
Sewall Pond
PH LT04-I (H)
PH LT05-B (L)
PH 02-E (H)
PH LT06-A (H)
PH 02-F (H)
PH LT06-B (H)
PH LT06-D (H)
PH LT06-E (H)
PH LT06-F (H)
PH LT06-H (H)
PH LT06-G (H)
PH 02 LT03-C (H)
PH 02-G (VH)
PH LT06-I (L)
PH 02-H (M)
PH 02-I (M)
Legend
Stream
Wetland
Watershed Boundary
Reach Limits
(VH) Very High Priority
(H) High Priority
(M) Moderate Priority
(L) Low Priority
Pine Hill Run
Patuxent River Naval Air Station
Reach Prioritization
PH 02, PH LT03, PH LT04, PH LT05, and PH LT06
N
W
E
S
0
300
600
Feet
Figure 10
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005

The Service rated 14 reaches moderate priority and 20 reaches low priority. Reaches that were rated as moderate have localized instability. Low priority reaches are currently stable and do not need restoration.

Three instream ponds also exist in the Pine Hill Run watershed. After construction of the instream ponds, streams entering the pond aggrade quickly. The aggradation causes instability of the stream near the ponds, which can lead to instability farther up in the watershed. Concentrated flow discharging from ponds can cause localized bed and bank erosion and instability on the reaches downstream of the ponds. The channel immediately downstream of the discharges from Calvert and Holton Pond is experiencing localized bank erosion.

B. Tributary Priority Rating

The Service assigned a priority rating to each of the major tributaries (Table 3) using the same scale used on the reach priority rating. Five tributaries were rated as very high because of the widespread instability and large (1-5 foot) headcuts moving through the tributary. The Service rated six tributaries as high due to the lateral and vertical instability and headcuts located in the tributary. There were no tributaries rated as moderate. Two tributaries were rated as low priority.

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Table 3. Tributary Restoration Priority.

Tributary	% Low	% Moderate	% High	% Very High	Overall Rating	Tributary Length (ft)
PH 01	100	0	0	0	Low	1450
PH RT01	0	0	100	0	High	500
PH LT01	61	39	0	0	Low	1650
PH RT02	45	17	38	0	High	7650
PH RT03	38	0	60	2	High	5525
PH RT04	0	13	59	28	Very High	3550
PH RT05	11	19	71	0	High	1625
PH LT02	48	7	45	0	High	3675
PH RT06	0	32	24	44	Very High	1700
PH 02	0	27	41	32	Very High	3875
PH LT04	0	17	48	35	Very High	4050
PH LT05	59	0	0	41	Very High	725
PH LT06	30	0	70	0	High	1650

C. Site-Specific Problem Identification

Table 4 summarizes numerous site-specific problems (Photos 9-16) identified by the Service during the watershed assessment; the majority of these were headcuts. Thirty-nine reaches have headcuts and their locations are shown on Figures 11-14. Reach PH RT06-C has a hillside failure that has slumped into the reach. The slumped hillside added a large volume of sediment to PH RT06 and has caused more instability in the tributary. Reach PH LT01-A has a failing 48-inch culvert that is rusting away on the downstream end and also has a 2-foot drop in water surface. Reach PH RT06-D flows though a 12-inch culvert that is rusting away on the downstream side. Reach PH RT02 LT01-A has a rusting culvert that the reach flows through. Reach PH RT04-E has a failing 24-inch culvert under an access road. The downstream 5 feet of the culvert is rusting away, allowing road fill to be eroded. Failure of any of the culverts will cause the channel to downcut and cause instability in the reaches upstream. Reaches PH RT02 LT02-A and PH RT02 LT02-B both have two 12-inch pipes that are discharging runoff from landfill Site 11 directly in the stream without proper stormwater management. The flow from the landfill is causing the hillside to erode and is also causing instability in PH RT02.

D. Contaminants Problems

In 2002 and 2003, the U.S. Fish and Wildlife Service, Contaminants Branch, Chesapeake Bay Field Office conducted a chemical, toxicological, and ecological assessment on sections of PH 02 and PH LT01 in the Pine Hill Watershed (Pinkey, et al. 2004). The benthic communities were rated as poor, reflecting a lack of diversity and absence of pollution-sensitive species.

In PH LT01, the Contaminants Branch measured dissolved lead concentrations exceeding the state chronic ambient water quality standards and detected lead pellets in the stream and streambank. The Service also found levels of PAH that were nearly equal to the 22.8 mg/kg concentration, above which adverse effects to the benthic community are expected. Runoff from the airfield and surrounding roadways is the likely cause of the elevated levels of PAH. Those levels are much higher than what would be expected from background and require further investigation.

The Service found widespread instability in PH 02, which could be the cause of the poor rating of the benthic community. However, the Contaminants Branch did not rule out water column toxicity, perhaps due to episodic inputs. The instability throughout PH 02 appears to be the result of development in the watershed, which has greatly increased the amount of flow. The increased flow resulted in degradation and increased sediment moving from bed and bank erosion in PH 02. The increased sediment load in PH 02 will have a negative affect on the benthic community.

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Table 4. Site-Specific Problem Identification.

Category	Specific Problem	PH 01	PH RT01	PH LT01				PH RT02											
		PH 01-A	PH RT01-A	PH LT01-A	PH LT01-B	PH LT01-C	PH LT01-D	PH RT02-A	PH RT02-B	PH RT02-C	PH RT02-D	PH RT02-E	PH RT02-F	PH RT02-G	PH RT02 LT01-A	PH RT02 RT01-A	PH RT02 RT01-B	PH RT02 LT02-A	PH RT02 LT02-B
Watershed Processes	Stormwater outfalls	X			X	X	X											X	X
	Floodplain loss	X	X				X	X	X		X		X					X	X
	Stream confinement	X	X				X	X	X		X		X					X	X
Stream Processes	Channelization or alteration		X		X	X	X				X								
	Revetments-single bank					X													
	Revetments-entire stream																		
	Localized Vertical instability									X		X			X				
	Wide Spread Vertical instability		X						X		X		X					X	X
	Localized Lateral instability	X				X						X			X				
	Wide Spread Lateral instability		X						X		X		X					X	X
	Headcut(s) or Other Drops		X	X	X				X		X		X		X			X	X
	Mass wasting		X																
	Stream aggradation					X													
Sediment Processes	Localized Bank erosion	X		X		X	X					X			X				
	Wide Spread Bank erosion		X						X		X		X					X	X
	Localized Bed erosion	X										X			X				
	Wide Spread Bed erosion		X						X		X		X					X	X
Urban Infrastructure	Utility lines and crossings	X		X	X			X							X				
Water Quality	Poor water quality																		
	Contaminant input																		
Riparian Buffer	No buffer					X													
	Low-quality buffer					X													
Instream Habitat	Poorly developed bed features		X			X	X		X		X		X		X	X		X	X
	Insufficient cover					X	X												
	Obstacles to fish passage	X	X	X	X		X	X	X										

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Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH RT03															
		PH RT03-A	PH RT03-B	PH RT03-C	PH RT03-D	PH RT03-E	PH RT03-F	PH RT03-G	PH RT03-H	PH RT03-I	PH RT03 RT01-A	PH RT03 LT01-A	PH RT03 LT01-B	PH RT03 LT01-C	PH RT03 LT01-D	PH RT03 LT01-E	PH RT03 LT01 LT01-A
Watershed Processes	Stormwater outfalls																
	Floodplain loss							X	X	X			X	X	X	X	X
	Stream confinement							X	X	X			X	X	X	X	X
Stream Processes	Channelization or alteration												X		X		X
	Revetments-single bank																
	Revetments-entire stream																
	Localized Vertical instability		X		X												X
	Wide Spread Vertical instability						X	X	X	X			X	X	X	X	
	Localized Lateral instability														X		X
	Wide Spread Lateral instability							X	X	X			X	X		X	
	Headcut(s)							X	X	X			X	X	X	X	
	Mass wasting																
	Stream aggradation						X										
Sediment Processes	Localized Bank erosion														X		X
	Wide Spread Bank erosion							X	X	X			X	X		X	
	Localized Bed erosion		X														X
	Wide Spread Bed erosion							X	X	X			X	X	X	X	
Urban Infrastructure	Utility lines and crossings		X					X	X				X				X
Water Quality	Poor water quality																
	Contaminant input																
Riparian Buffer	No buffer																
	Low-quality buffer																
Instream Habitat	Poorly developed bed features						X	X	X	X			X	X	X	X	
	Insufficient cover																
	Obstacles to fish passage		X				X	X	X				X	X			

Pine Hill Run Watershed, PRNAS

Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH RT04							PH RT05		
		PH RT04-A	PH RT04-B	PH RT04-C	PH RT04-D	PH RT04-E	PH RT04 LT01-A	PH RT04 LT01-B	PH RT05-A	PH RT05-B	PH RT05-C
Watershed Processes	Stormwater outfalls										
	Floodplain loss			X	X	X				X	
	Stream confinement			X	X	X				X	
Stream Processes	Channelization or alteration										
	Revetments-single bank										
	Revetments-entire stream										
	Localized Vertical instability			X		X	X	X			
	Wide Spread Vertical instability	X			X					X	
	Localized Lateral instability		X	X		X	X	X			
	Wide Spread Lateral instability				X					X	
	Headcut(s)				X	X	X	X		X	
	Mass wasting										
	Stream aggradation	X	X	X							
Sediment Processes	Localized Bank erosion		X	X				X			
	Wide Spread Bank erosion				X	X				X	
	Localized Bed erosion							X			
	Wide Spread Bed erosion				X	X				X	
Urban Infrastructure	Utility lines and crossings				X	X					X
Water Quality	Poor water quality										
	Contaminant input										
Riparian Buffer	No buffer										
	Low-quality buffer										
Instream Habitat	Poorly developed bed features		X					X		X	
	Insufficient cover										
	Obstacles to fish passage				X	X				X	

Pine Hill Run Watershed, PRNAS

Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH LT02								
		PH LT02-A	PH LT02-B	PH LT02-C	PH LT02-D	PH LT02 LT01-B	PH LT02 LT01-A	PH LT02 RT01-A	PH LT02 RT01-B	PH LT02 RT02-A
Watershed Processes	Stormwater outfalls			X		X			X	X
	Floodplain loss			X	X				X	X
	Stream confinement			X	X				X	X
Stream Processes	Channelization or alteration			X		X	X			X
	Revetments-single bank					X				
	Revetments-entire stream									
	Localized Vertical instability		X			X				
	Wide Spread Vertical instability			X	X		X		X	X
	Localized Lateral instability				X					
	Wide Spread Lateral instability			X			X		X	X
	Headcut(s)		X	X	X		X		X	X
	Mass wasting									
	Stream aggradation		X							
Sediment Processes	Localized Bank erosion			X						X
	Wide Spread Bank erosion				X		X		X	
	Localized Bed erosion		X			X				
	Wide Spread Bed erosion			X	X		X		X	X
Urban Infrastructure	Utility lines and crossings	X	X	X	X	X	X	X	X	X
Water Quality	Poor water quality									
	Contaminant input									
Riparian Buffer	No buffer									
	Low-quality buffer					X				
Instream Habitat	Poorly developed bed features				X					
	Insufficient cover									
	Obstacles to fish passage	X	X	X	X	X	X	X	X	X

Pine Hill Run Watershed, PRNAS

Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH RT06				PH 02									PH LT03
		PH RT06-A	PH RT06-B	PH RT06-C	PH RT06-D	PH 02-A	PH 02-B	PH 02-C	PH 02-D	PH 02-E	PH 02-F	PH 02-G	PH 02-H	PH 02-I	PH LT03-A
Watershed Processes	Stormwater outfalls														X
	Floodplain loss		X	X	X			X			X	X			X
	Stream confinement		X	X	X			X			X	X			X
Stream Processes	Channelization or alteration		X												
	Revetments-single bank														
	Revetments-entire stream														
	Localized Vertical instability		X								X		X		
	Wide Spread Vertical instability	X		X	X		X	X		X		X		X	X
	Localized Lateral instability	X							X	X	X		X		
	Wide Spread Lateral instability			X	X			X				X		X	X
	Headcut(s)			X						X		X			X
	Mass wasting			X											
	Stream aggradation	X					X			X				X	
Sediment Processes	Localized Bank erosion		X						X	X	X		X		
	Wide Spread Bank erosion			X	X			X				X			X
	Localized Bed erosion										X		X		
	Wide Spread Bed erosion			X	X			X		X		X		X	X
Urban Infrastructure	Utility lines and crossings	X		X	X										X
Water Quality	Poor water quality														
	Contaminant input														
Riparian Buffer	No buffer														
	Low-quality buffer														
Instream Habitat	Poorly developed bed features			X	X					X	X	X	X	X	X
	Insufficient cover														
	Obstacles to fish passage	X		X					X	X		X			X

Pine Hill Run Watershed, PRNAS

Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH LT04									
		PH LT04-A	PH LT04-B	PH LT04-C	PH LT04-D	PH LT04-E	PH LT04-F	PH LT04-G	PH LT04-H	PH LT04-I	PH LT04 LT01-A
Watershed Processes	Stormwater outfalls			X		X				X	X
	Floodplain loss	X				X	X	X	X	X	X
	Stream confinement	X				X	X	X	X	X	X
Stream Processes	Channelization or alteration									X	
	Revetments-single bank									X	
	Revetments-entire stream										
	Localized Vertical instability			X		X				X	
	Wide Spread Vertical instability	X	X		X		X	X	X		X
	Localized Lateral instability			X	X					X	
	Wide Spread Lateral instability	X				X	X	X	X		X
	Headcut(s)	X		X	X	X	X		X		X
	Mass wasting										
	Stream aggradation		X				X				
Sediment Processes	Localized Bank erosion			X	X					X	
	Wide Spread Bank erosion	X				X	X	X	X		X
	Localized Bed erosion			X						X	
	Wide Spread Bed erosion	X			X	X	X	X	X		X
Urban Infrastructure	Utility lines and crossings			X		X					
Water Quality	Poor water quality										
	Contaminant input										
Riparian Buffer	No buffer									X	
	Low-quality buffer										
Instream Habitat	Poorly developed bed features	X	X	X	X	X	X	X	X	X	X
	Insufficient cover									X	
	Obstacles to fish passage	X		X	X	X					

Pine Hill Run Watershed, PRNAS

Table 4. Site-Specific Problem Identification Continued.

Category	Specific Problem	PH LT05		PH LT06								
		PH LT05-A	PH LT05-B	PH LT06-A	PH LT06-B	PH LT06-C	PH LT06-D	PH LT06-E	PH LT06-F	PH LT06-G	PH LT06-H	PH LT06-I
Watershed Processes	Stormwater outfalls											X
	Floodplain loss	X		X			X		X			
	Stream confinement	X		X			X		X			
Stream Processes	Channelization or alteration											X
	Revetments-single bank											
	Revetments-entire stream											
	Localized Vertical instability					X		X				
	Wide Spread Vertical instability	X		X			X		X			
	Localized Lateral instability										X	
	Wide Spread Lateral instability	X		X	X		X		X			
	Headcut(s)	X		X			X		X			
	Mass wasting											
	Stream aggradation										X	
Sediment Processes	Localized Bank erosion				X							
	Wide Spread Bank erosion	X		X			X		X			
	Localized Bed erosion				X	X						
	Wide Spread Bed erosion	X		X			X		X			
Urban Infrastructure	Utility lines and crossings											
Water Quality	Poor water quality											
	Contaminant input											
Riparian Buffer	No buffer											
	Low-quality buffer											X
Instream Habitat	Poorly developed bed features	X		X			X		X			X
	Insufficient cover											
	Obstacles to fish passage	X		X								

Photograph 9. This 4-foot headcut is located on PH LT04-D. This headcut is typical of many of the large headcuts located in the Pine Hill Run Watershed.

Photograph 10. The 3.5-foot Headcut is located in Reach PH RT03 LT01-E. This large headcut is typical of the rapid adjustment occurring in the watershed.

Photograph 11. An example of a failing culvert found in PH LT01-A.

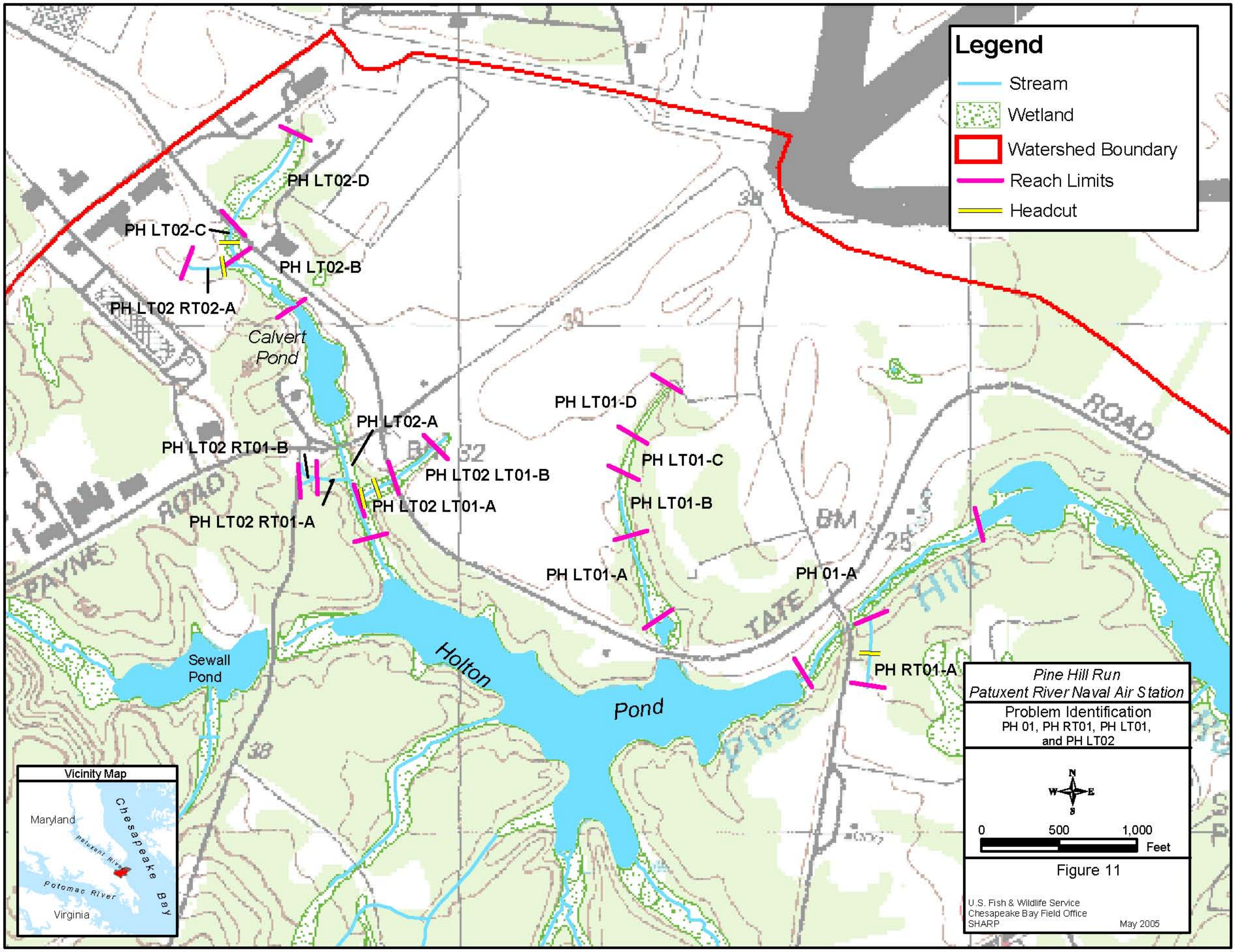
Photograph 12. A failing culvert located on PH RT03-I. The downstream end of the culvert is rusting away, allowing the road fill to erode.

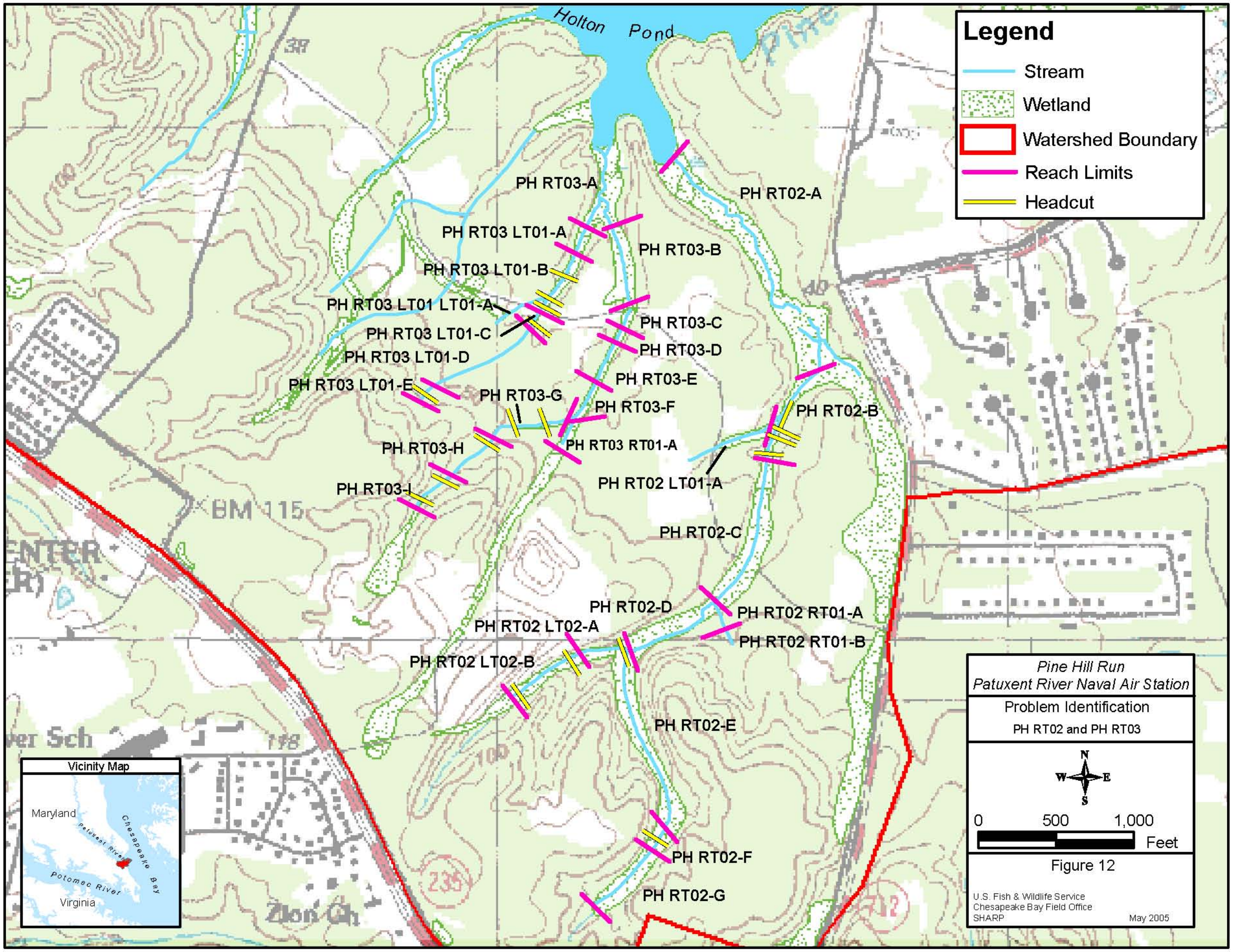
Photograph 13. High rate of bank erosion located on PH RT03 LT01-C. High bank erosion rates are typical of the Rosgen F and G stream types found in the watershed.

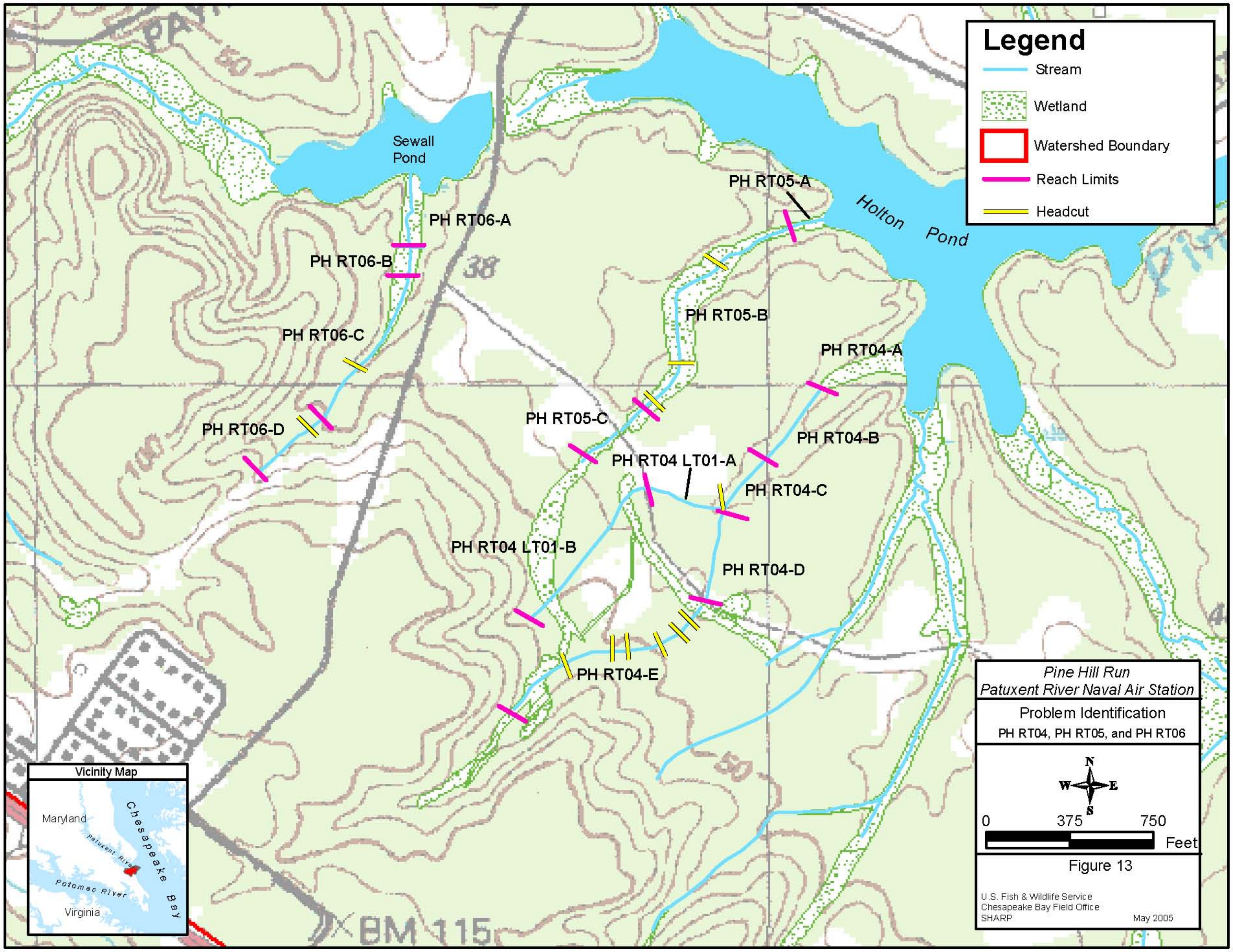
Photograph 14. Exposed roots in the channel of Reach PH RT05-B. The exposed roots are evidence that the channel has rapidly downcut and is typical of what is occurring in the watershed.

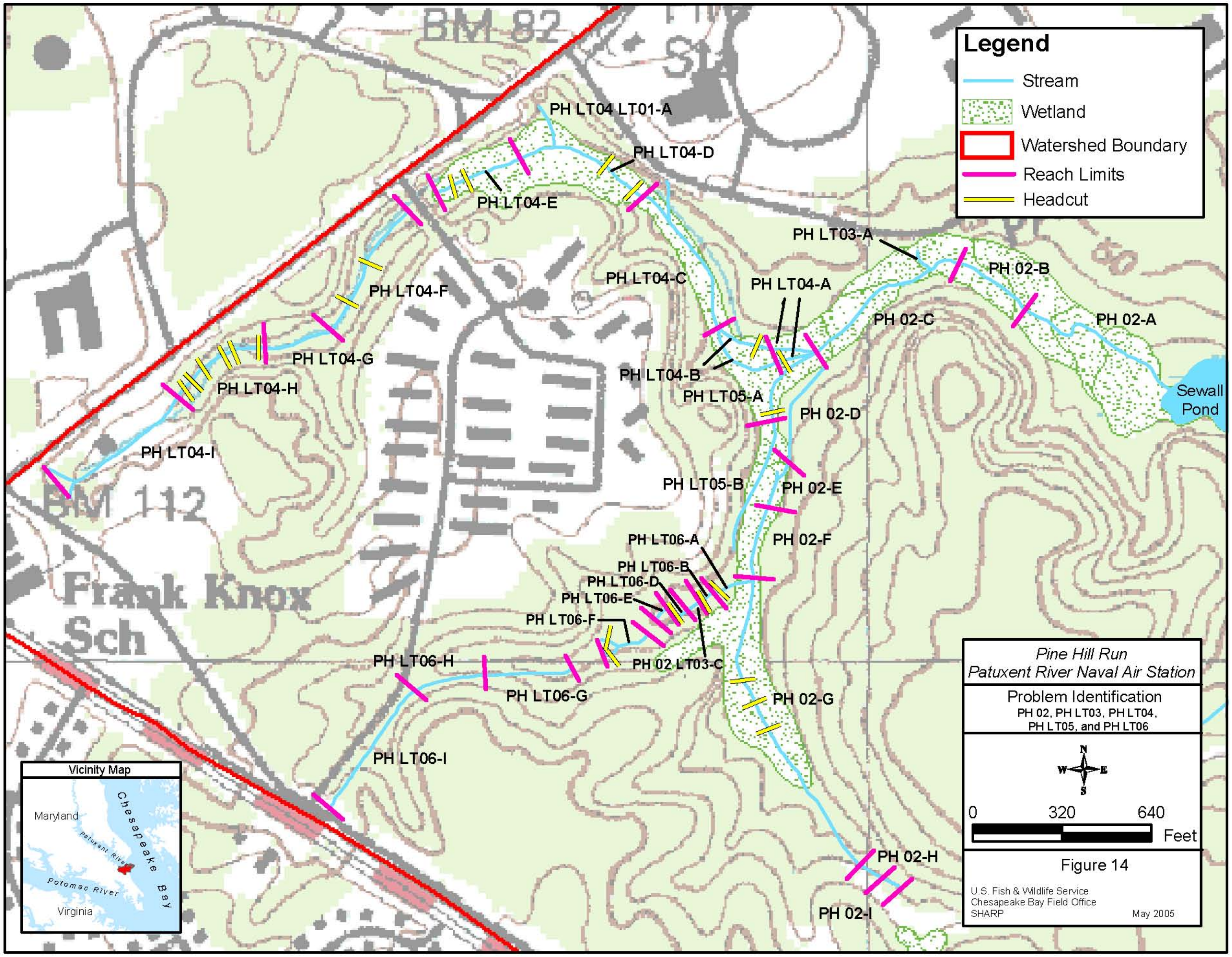
Photograph 15. Land use changes associated with Landfill Site 11 adjacent to PH RT03. Deforestation in the watershed with development has increased runoff and caused instability in many of the tributaries.

Photograph 16. Deforestation of the headwaters of PH RT06. This is typical of the land use changes that have caused much instability in the watershed.


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Headcut
PH LT02-D
PH LT02-C
PH LT02-B
PH LT02 RT02-A
Calvert Pond
PH LT02-A
PH LT02 RT01-B
PH LT02 LT01-B
PH LT02 LT01-A
PH LT02 RT01-A
PH LT01-D
PH LT01-C
PH LT01-B
PH LT01-A
PH 01-A
PH RT01-A
Sewall Pond
Holton Pond
PAYNE ROAD
TATE ROAD
Pine Hill Run
Pine Hill Run
Patuxent River Naval Air Station
Problem Identification
PH 01, PH RT01, PH LT01, and PH LT02
0 500 1,000 Feet
Figure 11
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Headcut
Holton Pond
PH RT03-A
PH RT03 LT01-A
PH RT03-B
PH RT03 LT01-B
PH RT03 LT01 LT01-A
PH RT03 LT01-C
PH RT03-C
PH RT03-D
PH RT03 LT01-D
PH RT03 LT01-E
PH RT03-G
PH RT03-E
PH RT03-F
PH RT03-H
PH RT03 RT01-A
PH RT03-I
PH RT02-A
PH RT02-B
PH RT02 LT01-A
PH RT02-C
PH RT02-D
PH RT02 RT01-A
PH RT02 LT02-A
PH RT02 RT01-B
PH RT02 LT02-B
PH RT02-E
PH RT02-F
PH RT02-G
BM 115
Vicinity Map
Maryland
Patuxent River
Chesapeake Bay
Potomac River
Virginia
Pine Hill Run
Patuxent River Naval Air Station
Problem Identification
PH RT02 and PH RT03
N
W
E
S
0
500
1,000
Feet
Figure 12
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005


Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Headcut
Sewall Pond
Holton Pond
PH RT05-A
PH RT06-A
PH RT06-B
PH RT05-B
PH RT06-C
PH RT04-A
PH RT06-D
PH RT05-C
PH RT04-B
PH RT04 LT01-A
PH RT04-C
PH RT04 LT01-B
PH RT04-D
PH RT04-E
BM 115
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
Pine Hill Run
Patuxent River Naval Air Station
Problem Identification
PH RT04, PH RT05, and PH RT06
0 375 750
Feet
Figure 13
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005


BM 82
BM 112
Frank Knox
Sch
Legend
Stream
Wetland
Watershed Boundary
Reach Limits
Headcut
PH LT04 LT01-A
PH LT04-D
PH LT04-E
PH LT04-C
PH LT03-A
PH 02-B
PH LT04-A
PH 02-C
PH 02-A
PH LT04-F
PH LT04-G
PH LT04-H
PH LT04-B
PH LT05-A
PH 02-D
Sewall
Pond
PH LT04-I
PH LT05-B
PH 02-E
PH LT06-A
PH 02-F
PH LT06-B
PH LT06-D
PH LT06-E
PH LT06-F
PH 02 LT03-C
PH LT06-H
PH LT06-G
PH 02-G
PH LT06-I
PH 02-H
PH 02-I
Vicinity Map
Maryland
Chesapeake Bay
Patuxent River
Potomac River
Virginia
Pine Hill Run
Patuxent River Naval Air Station
Problem Identification
PH 02, PH LT03, PH LT04,
PH LT05, and PH LT06
N
W
E
S
0
320
640
Feet
Figure 14
U.S. Fish & Wildlife Service
Chesapeake Bay Field Office
SHARP
May 2005

V. RECOMMENDATIONS

The Service recommends that land use changes be minimized for the Pine Hill Run watershed because the stream systems within the watershed are highly sensitive to change and disturbances. The Pine Hill Run watershed already has 6 percent of its total area in impervious surfaces. Research indicates that streams can begin to destabilize with an increase of just 5-10 percent impervious surface areas (Booth and Rienalt 1993; Galli 1994; Schueker and Claytor 1997). Additionally, Maryland Department of Natural Resources reported in their Maryland Biological Stream Survey study a change in macro-invertebrate diversity and abundance in watersheds with as little as 6 percent impervious surface areas (Roth, et al. 1999). Therefore, activities such as vegetation clearing, building and road development, and earth moving should be limited. Stormwater management should be used to reduce the volume of runoff from any areas that are developed.

The Service conducted a rapid assessment on the Pine Hill Run Watershed based on semi quantitative data, qualitative data, and visual observations. The rapid assessment characterizes conditions at the time of assessment and allows for the identification of problems, but does not provide a well documented cause and effect relationship between the watershed and stream process.

A detailed assessment provides data that supports visual observations and allows the validation of predictions.

The Service recommends that detailed surveys be conducted using the tributary restoration priority shown in Table 3. Those ratings took into account the individual reach ratings as well as any site specific problems that had the potential to affect the overall stability of the tributary. Detailed surveys need to be done first on the five tributaries with a very high overall rating. The six tributaries with a high rating would be surveyed next. No tributaries were rated as moderate, and the low priority tributaries were predominately stable.

The detailed assessment is needed to develop stream restoration designs and allow PRNAS to begin addressing the stream stability problems identified by the Service in this report. A detailed assessment will make it possible for PRNAS to make well informed decisions and prioritize funding for stream restoration projects.

VI. LITERATURE CITED

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