APPENDIX I:
Stream Assessment for Paint Branch and Associated Tributaries on ALC

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US Army Corps
of Engineers
Baltimore District

Stream Assessment for Paint Branch and Associated Tributaries on Adelphi Laboratory Center

U.S. Army Garrison Adelphi Laboratory Center,
Montgomery and Prince Georges County, Maryland

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1 INTRODUCTION

The U.S. Army Garrison Adelphi Laboratory Center (ALC) Environmental Division requested the U.S. Army Corps of Engineers (USACE), Baltimore District to conduct fish and macroinvertebrate sampling and stream corridor assessments at ALC. The study assessed the physical, biological and water quality health of Paint Branch and its tributaries on ALC to identify and document fish and macroinvertebrate populations, impaired stream conditions and potential pollution sources. Paint Branch is designated as a Use III stream and supports native brown trout north of the Capital Beltway.

This report covers the lengths of Paint Branch, Hillandale Run, and an unnamed tributary to Paint Branch that are located within the ALC boundaries and presents the findings of current conditions and recommendations for improvements, which may include stream restoration efforts, retrofit of best management practices, or enhancements to the existing forested riparian buffer.

1.1 General Watershed Description

The Paint Branch Watershed is a sub-watershed of the Anacostia River Watershed. Paint Branch drains to the Anacostia River, which drains to the Potomac River then to the Chesapeake Bay. The Paint Branch Watershed encompasses 19.5 square miles (12,466 acres) in south central Maryland. The Paint Branch Watershed is one of the least developed sub-watersheds of the Anacostia Watershed. Approximately 18 percent of Paint Branch Watershed is impervious surfaces; whereas, 25 percent of the Anacostia Watershed, which is 176 square miles in size, is impervious surfaces. Land use within the Paint Branch watershed is shown in Table 1.

ALC covers approximately 207 acres, within the Paint Branch Watershed, split between eastern Montgomery County and western Prince Georges County, Maryland. The line between the two counties roughly parallels the fall line, which is the division between the Piedmont Plateau and the Coastal Plain Physiographic Provinces. Paint Branch begins in the Piedmont Plateau and flows into the Coastal Plain, where it has its confluence with the Northeast Branch of the Anacostia River (See Figure 1 in Appendix A).

There are three main surface water streams within ALC; Paint Branch, Hillandale Run, and an unnamed tributary to Paint Branch. Paint Branch enters ALC from the north and flows southeast for approximately 1,800 feet before exiting ALC. Hillandale Run enters ALC via a concrete culvert, from the residential neighbor to the west, and flows northeast for approximately 1,900 feet to its confluence with Paint Branch. The unnamed tributary to Paint Branch roughly parallels Paint Branch, flowing from north to south, just east of Paint Branch. Its confluence with Paint Branch is just south of ALC's southern boundary.

The Paint Branch Sub Watershed Action Plan (SWAP) is provided in Appendix D. The plan was developed as a vision statement with targets for restoration within the sub watershed by the year 2020, to identify and describe specific problems within the sub watershed, discuss methodologies used to evaluate potential restoration opportunities, and present a prioritized list of restoration opportunities for implementation.

TABLE 1. MAPPED LAND USE IN THE PAINT BRANCH WATERSHED

Land Use	Acres	Percent of Watershed
Residential	5,511	42
Forest	3,412	26
Agricultural	1,575	12
Institutional	1,312	10
Parkland	656	5

Data Source: Maryland Department of Planning (MDP), 2010

1.2 Anacostia Watershed Water Quality

The Northeast Branch (NEB) and Northwest Branch (NWB) are tributaries of the Anacostia River, which in turn flows into the Potomac River, a tributary of the Chesapeake Bay. Approximately 70% of the Anacostia River watershed is drained by the NEB and NWB. The Anacostia River watershed is located in two physiographic provinces, the Piedmont Plateau and the Atlantic Coastal Plain, and drains about 176 square miles of land from Washington, DC (30.2 miles, 17.2%), Montgomery County, MD (60.8 miles, 34.4%), and Prince George's County, MD (85.2 miles, 48.4%). The NEB and NWB watersheds combined are approximately 127 square miles and are home to approximately 519,000 residents.

The Maryland Department of the Environment (MDE) established Total Maximum Daily Loads (TMDLs) for polychlorinated biphenyls (PCBs) in the Northeast and Northwest Branches of the Anacostia River (basin code 02140205). MDE has identified various portions of the Anacostia River watershed on the State's 2008 Integrated Report as impaired by the following (listing years in parentheses): nutrients (1996), sediments (1996), fecal bacteria (2002), trash/debris (2006), impacts to biological communities (2002), PCBs (2002), and heptachlor epoxide (2002). The 2002 PCB listing for the Anacostia River watershed refers solely to the Northeast Branch and Northwest Branch, where the water column samples were collected. Similarly, the 2002 heptachlor epoxide listing refers solely to the Northwest Branch. Maryland water quality standards state that all surface waters of the State shall be protected for water contact recreation, fishing, and protection of aquatic life and wildlife. All waters of the Anacostia River have been designated as Use I – Water Contact Recreation, and Protection of Aquatic Life. Additionally, Paint Branch and its tributaries upstream of the Capital Beltway have been designated as Use III – Cold Water, and the Northwest Branch and its tributaries upstream of Route 410 as Use IV – Recreational Trout Waters.

The U.S. Environmental Protection Agency (USEPA) established a TMDL for nutrients and sediment in the entire Chesapeake Bay watershed. In addition, the EPA required the Chesapeake Bay watershed jurisdictions to develop statewide Watershed Implementation Plans (WIPs). WIPs provide the state's strategy for how it intends to meet the TMDLs. The Phase I WIP identifies strategies for reducing the levels of nitrogen, phosphorus, and sediments that are impairing the Chesapeake Bay. The Phase II WIP addresses how federal property owners can achieve reductions. According to the State of Maryland's Phase II WIP, for federal facilities, Maryland plans to revise the Municipal Separate Storm Sewer System (MS4) permit program and apply a 20% reduction requirement for untreated impervious surfaces. This strategy will be used to meet the required overall load reductions established by the EPA. The Paint Branch Sub-Watershed Action Plan (Anacostia Watershed Restoration Partnership, 2017) is included in Appendix D of this report.

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2 METHODS

2.1 Fish, Macroinvertebrate and Water Quality Sampling

To characterize the aquatic resources on the ALC property, two rounds of stream surveys were completed, one in the fall of 2016 and a second in the spring of 2017. The same protocols, sample reaches, and sampling techniques were used in each survey. Two surveys were completed to assess potential seasonal differences in the waterbodies during both low-flow (fall) and high-flow (spring) events. Following the Maryland Biological Stream Survey (MBSS) protocol, 75-meter sample reaches were established; one in Hillandale Run and two in Paint Branch. A single surface water sampling location was also established on the unnamed tributary to Paint Branch. After discussions with the project team, it was decided to perform fish and invertebrate community sampling at two locations in Paint Branch and only conduct surface water sampling at the unnamed tributary as aquatic habitat was limited in the unnamed tributary during the initial reconnaissance and site selection. Sample locations are presented on Appendix A, Figure 2. Before sampling, reaches were demarcated at the upstream and downstream ends with block nets to prevent fish escape.

In each survey event, the field team recorded water quality measurements from all locations and collected surface water samples from the unnamed tributary to Paint Branch, Hillandale Run, and the downstream Paint Branch locations (Appendix A, Figure 2). Surface water samples were preserved on ice and sent to Eurofins Lancaster Laboratory in Lancaster, Pennsylvania for analysis of total nitrogen, total phosphorus, and total suspended solids (TSS). The results of the surface water sampling and water quality measurements are presented in Appendix B, Table 4.

Following completion of the surface water sampling, the field team conducted a benthic macroinvertebrate community survey using D-framed kick net and sweep netting techniques as described in the Work Plan and based on the MBSS protocol. In total, a 20 square foot area was sampled for each of the benthic macroinvertebrate surveys with the sampling area divided proportionally amongst the various habitat types present in each 75-meter reach. All the material collected in the D-frame net was strained through a No. 30 sieve and the resulting invertebrate/sediment matrix was containerized and preserved with 91% isopropyl alcohol. The preserved samples were shipped to Normandeua Associates Inc. in Stowe, Pennsylvania for taxonomic identification and enumeration. Macroinvertebrate samples were processed and analyzed following the MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy Protocols. Specifically, at the lab the sample matrices were rinsed through a 500-micron sieve and individual aliquots were distributed into a gridded pan partially filled with water. Invertebrate specimens were removed under magnification from randomly selected grids and sorted by type into glass vials until a random count of 100 (+/- 10%) was obtained. Specimens were identified typically to genus level and then assigned a pollution tolerance value ranging from 0.0 to 10.0; where low values indicate pollution sensitivity. Metrics were then calculated to compare the invertebrate community at each location.

Metrics are a characteristic of biota that changes in some predictable way with increased human influence (Barbour et al. 1999) and are commonly used to assess the health of aquatic communities.

Many states, including Maryland, use metrics to calculate an Index of Biotic Integrity (IBI). Multi-metric IBIs are the most commonly used indicators of stream condition as they provide a regionally appropriate framework for assessing and comparing stream health to reference waterbodies (Southerland et al. 2005). Since the ALC property is located on the border between the Coastal Plain and Piedmont ecoregions, metrics were calculated for both ecoregions. Following the MBSS protocol seven metrics were calculated for the Coastal Plain: 1) Number of taxa, 2) Number of EPT taxa (mayflies, stoneflies and caddisflies), 3) Percent Ephemeroptera Specimens 4) Number of scraper taxa, 5) Number of Ephemeroptera (mayfly) taxa, 6) Percent climber specimens, and 7) Percent intolerant urban specimens and six metrics were calculated for the Piedmont: 1) Number of taxa, 2) Number of EPT taxa (mayflies, stoneflies and caddisflies), 3) Number of Ephemeroptera (mayfly) taxa, 4) Percent intolerant urban specimens, 5) Percent Chironomidae and 6) Percent Clingers. The protocol provides criteria used to assign scores of 1, 3, or 5 to each metric. These metric scores are then averaged to produce a Benthic Index of Biotic Integrity (BIBI) and Stream Condition Rating for each location. BIBI scores can range from 1.0 to 5.0; and are interpreted as follows: 1.0 – 1.9 = very poor, 2.0 - 2.9 = poor, 3.0 – 3.9 = fair, 4.0 – 5.0 = good. The results of the invertebrate sampling including species and numbers collected are presented in Appendix B, Table 5 and summary metrics and the Stream Condition Rating in Appendix B, Table 6.

Following completion of the macroinvertebrate sampling, the field team set up and tested Smith-Root model LR-20b backpack electrofishing units to determine the proper settings. Based on the stream width measurements recommended in the MBSS protocol, between one and three backpack electrofishing units were used for each reach. Once the proper settings and numbers of units were determined, the crew began shocking at the downstream end of the 75-meter reach and shocked all available habitats working upstream and collecting all fish encountered. Collected fish were held in an aerated holding tank to keep the fish alive until processing. Once the first pass of the survey was complete, all fish were identified, counted, weighed and checked for anomalies before being released outside of the blocked off sample reach. A second pass of the 75-meter reach was then conducted following the same procedures as the first pass, and fish were similarly processed and released.

Similarly to the invertebrate data, the fish field data was used to calculate metrics following the procedures for freshwater Coastal Plain and Piedmont streams found in the New Biological Indicators to Better Assess the Condition of Maryland Streams (Southerland et al. 2005). Specifically, six metrics were calculated for the Coastal Plain: 1) Abundance per square meter, 2) Number of benthic species, 3) Percent tolerant, 4) Percent generalist, omnivores, invertivores, 5) Percent round-bodied suckers, and 6) Percent abundance dominant taxa and 6 metrics for the Piedmont (1) Abundance per square meter, 2) Number of benthic species, 3) Percent tolerant, 4) Percent generalist, omnivores, invertivores, 5) Biomass per square meter and 6) Percent lithophilic spawners. The protocol provides criteria used to assign scores of 1, 3 or 5 to each metric. These metric scores are then averaged to produce a Fish Index of Biotic Integrity (FIBI) for each location. FIBI scores can range between 1.0 to 5.0; and are interpreted as follows:1.0 – 1.9 = very poor, 2.0 - 2.9 = poor, 3.0 – 3.9 = fair, 4.0 – 5.0 = good. The results of the fish community surveys and a summary of the fish collected are presented in Appendix B, Table 7 and summary metrics and the Stream Condition Rating are presented in Appendix B, Table 8.

2.2 Physical Stream Assessment

Physical stream assessments were conducted in December 2016 in order to identify potential sources of sediment and nutrients and other issues potentially degrading water quality at ALC. Stream corridors along Paint Branch, Hillandale Run, and the unnamed tributary to Paint Branch were evaluated to determine impacted reaches using methods adapted from Stream Corridor Assessment (SCA) Survey Protocols (Yetman 2001) developed by the Maryland Department of Natural Resources (MDDNR). The objectives of these survey protocols are to provide:

1. A list of observable environmental problems within a stream and along its riparian corridor.

2. Sufficient data on each problem to make a preliminary determination of the severity and correctability.

3. Sufficient data to prioritize restoration efforts; and

4. A rapid assessment of both in- and near- stream habitat conditions to make comparisons among the conditions of different stream segments.

2.3 Stream Corridor Assessment

The method used in this study was consistent with the SCA survey protocol and consisted of walking the entire length of streams within the boundaries of ALC to identify and evaluate environmental problems that have the ability to impact streams. Potential environmental problems identified during the stream assessment included: channelized stream sections, inadequate stream buffers, fish migration blockages, excessive bank erosion, trash dumping sites, and pipe outfalls. In addition, information on the location of problems sites, general condition of in-stream and riparian habitats, and estimates of the extent of impact (e.g. linear feet of bank erosion) were recorded on data sheets. A description of the types of problem sites evaluated during the physical stream assessment is provided below.

2.3.1 Inadequate Buffers

Forested stream buffers maintain stream health by providing shade to prevent excessive heating of the stream and stabilizing the stream bank. Buffers reduce nutrients, sediment and other pollutants carried in runoff; slow water flow into the stream; mitigate floods; and, provide food and habitat for wildlife and aquatic animals. While there is no single minimum standard for stream buffer width, MDDNR generally considers a buffer inadequate if it is less than 50 feet wide from the edge of the stream (Yetman 2001). For this stream assessment, inadequate buffers were considered to be forested buffers less than 50 feet wide on either side of the stream corridor.

2.3.2 Erosion Sites

Erosion is a natural process necessary to maintain aquatic habitats in streams; however, excessive erosion can lead to destabilization of banks, destruction of in-stream habitat, and increase sediment loads to the stream. Erosion problems can result from alterations of the stream's hydrology or sediment supply associated with watershed changes or road crossings. Using MDDNR guidance (Yetman 2001), erosion sites were defined as areas where stream bank erosion was at least minor (heights over 1 foot) and/or vegetative roots along the stream bank were unable to hold the soil onto the banks for this stream assessment.

2.3.3 Channel Alteration

Channel alteration sites are stream sections that have been altered by dredging, straightening, or widening streams in an attempt to reduce flooding impacts on stream banks and property or to lower the groundwater table. Often rocks, gabion baskets, or concrete are used in these areas. Road crossings were identified as channel alteration sites if the alteration seemed to significantly impact the stream flow, habitat, or banks. Stream channelization can reduce in-stream habitat for aquatic organisms, act as barriers to migratory fish, and may increase flooding in downstream channels. Since water moves more quickly out of the system, infiltration is reduced, thereby reducing base flow conditions.

2.3.4 Fish Barriers

Fish barriers include obstructions in the stream channel that can interfere with the upstream or downstream movement of fish. Unobstructed stream channels are important for migratory and resident fish that travel upstream and downstream during different stages of their life cycle. Fish barriers can isolate stream sections, endangering trapped fish and reducing biological diversity. Note that this assessment does not consider fish barriers outside of the project limits which may affect fish communities within the project area.

2.3.5 Pipe Outfalls

Pipe outfalls refer to any pipe or small manmade channel discharging into a stream through a stream corridor. Pipes can carry uncontrolled runoff and pollutants such as oil, heavy metals, and nutrients into streams.

2.3.6 Exposed Pipes

Exposed pipes include pipes in the stream or along the stream's immediate banks that could be damaged by a high flow event. In urban areas, pipelines and other utilities are commonly placed along stream corridors. As streams erode and migrate, exposed pipes become vulnerable to puncture and can result in water quality problems and negative impacts on habitat. In addition, stream water can be lost to the cracked and aged pipes resulting in reduced base flow or even loss of the stream entirely.

2.3.7 Trash Dumping

Trash dumping refers to any site where large amounts of trash are inside the stream corridors; either as a site of deliberate dumping or a place where trash tends to accumulate.

2.4 Environmental Problem Rating

During the physical stream assessment, each identified problem site was evaluated and rated for severity, correctability, and accessibility. The severity rating was used to identify problems and determine the overall impact on the stream's aquatic resources. The correctability rating was used to determine the effort required to minimize or alleviate the problem through maintenance, repair, restoration or best management practices. The accessibility rating was used to provide a relative measure of how difficult it is to reach a specific problem site in order to correct the problem. The ratings for each problem site were recorded on field data sheets.

Although the ratings are subjective, they can be effective in providing a starting point for more detailed follow-up evaluations. A general description of the rating system used during the physical stream assessment at ALC is provided in Table 2.

TABLE 2. PROBLEM SITE RATING CRITERIA

	Rating				
Measure	**1**	**2**	**3**	**4**	**5**
Severity	Very Severe	Severe	Moderate	Low	Minor
Correctability	Best	Easy	Moderate	Difficult	Worst
Access	Best	Easy	Moderate	Difficult	Worst

Note: Rating criteria based on MDNR's Stream Corridor Assessment Survey Protocols (Yetman, 2001)

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3 STREAM ASSESSMENT RESULTS

3.1 Water Quality

During each sampling event water quality parameters were measured and surface water samples were taken from Hillandale Run, Paint Branch and the unnamed tributary to Paint Branch. The results of the water sampling are presented in Appendix B, Table 4 and compared to applicable water quality criteria in Appendix B, Table 9. All waterbodies onsite are designated as Use Class III (Non-tidal Cold Water), which must support the following individual designated uses:

- Growth and propagation of fish (not trout), other aquatic life and wildlife
- Water contact sports
- Leisure activities involving direct contact with surface water
- Fishing
- Agricultural water supply
- Industrial water supply
- Growth and propagation

Per the Code of Maryland Regulations (COMAR), water quality standards specific to designated uses, the water quality criteria for Class III Waters are as follows:

1. Bacteriological — same as Class I waters.
2. Dissolved Oxygen. The dissolved oxygen concentration may not be less than 5 milligrams/liter at any time, with a minimum daily average of not less than 6 milligrams/liter.
3. Temperature.
   a. The maximum temperature outside the mixing may not exceed 68°F (20°C) or the ambient temperature of the surface waters, whichever is greater.
   b. Ambient temperature — same as Class I.
   c. A thermal barrier that adversely affects salmonid fish may not be established.
   d. It is the policy of the State that riparian forest buffer adjacent to Class III waters shall be retained whenever possible to maintain the temperatures essential to meeting this criterion.

4. pH — same as Class I waters. Normal pH values may not be less than 6.5 or greater than 8.5.

5. Turbidity — same as Class I waters. Turbidity in the surface water resulting from any discharge may not exceed 150 units at any time or 50 units as a monthly average. Units shall be measured in Nephelometer Turbidity Units.

6. Color — Same as Class I-P waters.

As shown in Appendix B, Table 9, turbidity, dissolved oxygen, pH and temperature in Paint Branch, Hillandale Run and the unnamed tributary to Paint Branch were all well within the water quality standards for a Class III stream. During the ALC stream assessment waterbodies were not monitored for bacteria and color; therefore, a comparison to these water quality standards cannot be made.

Comparison of the analytical results for onsite streams is not as straight-forward, as several of the parameters do not have regulated surface water limits, including total suspended solids (TSS), total nitrite and nitrate, and total Kjeldahl nitrogen (TKN). The Adelphi site is within the Chesapeake Bay watershed, which has an approved Total Maximum Daily Load (TMDL) for nitrogen, phosphorus and TSS. In addition, the site is within the Anacostia River watershed, which has an approved sediment TMDL. However, both TMDLs do not have waste load allocations for the pollutants of concern. According to COMAR §26.08.02.03-2.H(1), the total nitrogen limit based on acute water quality criteria for freshwater aquatic life is between 1.04 mg/L (for a pH of 6.7) and 29.8 mg/L (for a pH of 8.9). Looking at the measured pH in the streams, all total nitrogen levels are well within the acute water quality criteria for freshwater aquatic life. Maryland does not have phosphorus limits for surface waters, however, to prevent eutrophication, the EPA recommends that total phosphorus levels do not exceed 0.1 mg/L in streams that do not enter a lake or reservoir. In the Fall 2016, the Hillandale Run slightly exceeded this recommended phosphorus level with a measured concentration of 0.17 mg/L but all other locations and sample events met this recommended level. All measured total nitrate and nitrite levels are well below the drinking water standard for nitrates, which is set at 10 mg/L. Although a direct comparison to water quality standards is not applicable for all constituents and measurements, in general, the waterbodies of the ALC appear to meet applicable criteria and are capable of supporting aquatic life.

3.2 Macroinvertebrates

For each of the two sample events, a BIBI was calculated following MBSS protocols. Since the boundary between ecoregions runs through the ALC property both the Coastal Plain and Piedmont metrics are shown on the tables for comparison. However, since most of the ALC property is located in the Piedmont ecoregion; the Piedmont results are discussed in the text. The results of the metrics and BIBI scores are presented in Appendix B, Table 6. At the Paint Branch upstream location, there were 29 total taxa in 2016 and 32 total taxa in 2017. In both sampling events, the most abundant taxa were midges (Dicrotendipes and Polypedilum, respectively). In 2016 and 2017, the Paint Branch upstream location had a BIBI of 2.3 (poor) and 2.7 (poor), respectively.

At the Paint Branch downstream location, there were 24 total taxa in 2016 and 21 total taxa in 2017. In both sampling events, the most abundant taxon was a midge species (Dicrotendipes and Orthocladius, respectively). In both the 2016 and 2017 sampling events the Paint Branch downstream location had a BIBI of 2.0 (poor).

At the Hillandale Run location, there were 28 total taxa in 2016 and 23 total taxa in 2017. In the 2016 assessment the most abundant taxon was the bladder snail, while in 2017 it was the naiad worm. In 2016 Hillandale Run had a BIBI of 2.3 (poor), and in 2017 a BIBI of 1.7 (very poor). The MBSS protocol calls for sampling invertebrates during the spring sampling period (March 1 to April 30). However, as previously discussed, invertebrate samples were collected in both the spring and fall sampling events at the ALC property to compare seasonal differences. The BIBI scores were similar between the fall and the spring, with the upstream Paint Branch location scoring slightly higher and Hillandale Run scoring slightly lower in the spring. Scores were relatively similar between locations for each event, each location scored "poor" in the fall and "poor or very poor" in the spring (Appendix B, Table 5). At both Paint Branch locations, dipterans (midges) were the most abundant type of organism in the fall and spring. In Hillandale Run snails were the most abundant organism type in the fall and midges in the spring. Of the three sample locations on the ALC property, the Paint Branch upstream location and Hillandale Run scored the highest in the fall and the Paint Branch upstream location had the highest score in the spring.

The results of the ALC invertebrate sampling show a community typical of an urban stream in that area of Maryland. Data collected by the State as part of MBSS monitoring from Paint Branch downstream of the ALC property in 2004 and 2008 show a similar invertebrate community to the Paint Branch sections sampled in 2016 and 2017, and had BIBI scores of 3.0 and 2.7 (Appendix B, Table 10). Other Paint Branch sampling sections shown on the state's interactive stream mapper did not have the raw data listed but reported BIBI scores ranged from very poor to fair (1.57, 1.86, 2.43, 2.70, 3.00, and 3.29) (MDNR 2017).

3.3 Fish

Fish community data were also collected at each of the three locations in both the fall and spring. For each of the two sample events, a Fish Index of Biotic Integrity (FIBI) was calculated following MBSS protocols. The summary metrics and FIBI scores are presented in Appendix B, Table 8. In 2016, the Paint Branch upstream location had a total of 224 individuals from 21 species, and in 2017 had 271 individuals from 20 species. In 2016, the most abundant species at the Paint Branch upstream location was the redbreast sunfish (Lepomis auritus) with 34 individuals, while in 2017 it was the blacknose dace (Rhinichthys atratulus) with 40 individuals. In both the 2016 and 2017 sampling, the upstream Paint Branch location had a FIBI of 3.3 (fair).

At the downstream Paint Branch location in 2016 there was a total of 1,310 individuals from 22 species, and in 2017 1,134 individuals from 21 species. In both stream assessments, the most abundant species was the blacknose dace. In both 2016 and 2017 the Paint Branch downstream location scored as "good" with a FIBI score of 4.0.

At the Hillandale Run location, in 2016 there was a total of 155 individuals from 6 species, and in 2017 there was a total of 395 individuals from 5 species. The most abundant fish species in both sample events was the blacknose dace. In both 2016 and 2017 the Hillandale Run location scored as poor with a FIBI of 2.0 and 2.3 respectively.

The MBSS protocol calls for sampling fish during the summer sampling period (June - September) to assess the fish community during low flow conditions. However, as previously discussed, fish surveys were conducted in both high flow (spring) and low flow (fall) conditions to evaluate potential seasonal differences. The fish community IBI scores were similar in the fall and the spring, with only the Hillandale Run location scoring slightly higher in the spring than fall (2.3 compared to 2.0). The Stream Condition Ratings were the same for both events at all three of the locations (fair for the upstream Paint Branch location, good for the downstream Paint Branch location, and poor for Hillandale Run). Both Paint Branch locations scored higher than Hillandale Run, but this is likely due to habitat constraints and not necessarily water quality issues. Hillandale Run is much smaller and shallower than Paint Branch, so there is less physical habitat to support a diverse fish species assemblage there.

The results of the ALC fish and macroinvertebrate sampling show a community typical of an urban stream in that area of Maryland. Both locations on Paint Branch had a diverse fish community with "fair" and "good" scores on the Maryland Stream Condition Rating. Hillandale Run had fewer species and fewer individuals, and scored poor on the Stream Condition Rating. However, the poor Stream Condition Rating is likely due to its smaller size. The MBSS data collected by the state is similar, and the Little Paint Branch location (which is closer in size to Hillandale Run) had fewer species and was classified as poor, similar to Hillandale Run (Appendix B, Table 11). When compared to the State's locations on Paint Branch, the ALC Paint Branch locations scored slightly lower than one (FIBI of 4.7 and "good") and higher than the other (FIBI of 2 and "poor" (Appendix B, Table 11)).

A photographic record of the fish, macroinvertebrate and water quality sampling is included in Appendix C.

3.4 Stream Corridor Assessment

The physical stream corridor assessment conducted at ALC in December 2016 identified a total of 23 problem sites within Paint Branch, Hillandale Run, and the unnamed tributaries to Paint Branch (Appendix B, Figure 3). A summary of the results of each of the problems sites identified during the physical stream assessment are provided below and a photographic record documenting representative problem sites is provided in Appendix C.

3.4.1 Inadequate Buffers

No areas of inadequate buffers were identified during the physical stream assessment at ALC. The narrowest stream buffers located on ALC were in the 200 Area, along Hillendale Run, at the northwestern extent of development. These buffers were approximately 60 feet in width, 10 feet above the 50 foot requirement. All stream buffers within ALC were forested with mature deciduous forest.

3.4.2 Erosion Sites

A total of seven erosion sites totaling approximately 2,600 linear feet in length and ranging 2 to 6 feet in height were identified during the physical stream assessment at ALC (Figure 3). Land use surrounding erosion sites was forested. The most common potential causes for excessive erosion included stream reaches situated below channelization and road crossings, stream bends at steep slopes, and pipe outfalls.

Three of the erosion sites, one on Hillandale Run and two on Paint Branch, were a result of pipe outfalls from stormwater management facilities. All three sites outfall onto steep wooded hillsides and have reached bedrock through down-cutting; therefore, making the sites relatively stable. Due to the grade of these three sites and apparent stability, no remedial action is recommended at this time. Only one of the sites, on the unnamed tributary to Paint Branch, had erosion that is a threat to infrastructure. Erosion at this site has exposed a sewer manhole along a sharp bend in the stream. This site is identified on Figure 3, in Appendix A, as EP1

Two erosion sites on unnamed tributaries to Paint Branch, one uncovering a sewer manhole (ES3) and one eroding a highly rare wetland (ES6), are ranked as *severe* or *very severe*; the remaining 5 sites were ranked as *moderate to moderately severe* (Figure 3). These sites were located in areas dominated by forests and steep terrain. The correctability and accessibility for all erosion sites varied, ranging from *moderate to difficult*.

3.4.3 Channel Alteration

Three sites of channel alteration were identified during the assessment, which totaled 250 linear feet. One site on each of the three streams (see Figure 3). The concrete swale below the outfall which conveys Hillandale Run onto ALC, a sewer crossing of the unnamed tributary and a stream restoration on Paint Branch near the southern boundary. The restoration site is not counted in the total for problem areas, since it has improved conditions for that section of stream.

The two sites other than the restoration site were ranked as *low* severity. The correctability of both sites is ranked as *difficult* with *difficult* access. The culvert on Hillandale Run acts as a security feature, which must remain and the sewer crossing of the unnamed tributary has riprap in place which is considered a best management practice for that type of crossing.

3.4.4 Fish Barriers

A total of four fish barrier sites were identified during the physical stream assessment at ALC. One at the southern boundary of ALC and one at the northern boundary of ALC on Paint Branch, one at the confluence of the unnamed tributary and Paint Branch and one at the outfall of Hillandale Run at it enters ALC (Figure 3).

The Hillandale Run and Unnamed tributary sites were ranked *severe* or *very severe*; the Paint Branch security fence site was ranked *low*. Paint Branch security fence was ranked *best* correctability, and the other two sites as low correctability. All sites were ranked *moderate to best* accessibility.

3.4.5 Pipe Outfalls

Any pipes or manmade channels designed to discharge into the streams were considered pipe outfalls and included in the survey. A total of eight pipes were identified during the physical stream assessment at ALC (Figure 3). The majority of identified pipe outfalls were constructed of concrete; two of the identified pipe outfalls included constructed channels.

All of the pipe outfalls are from known sources, either storm flow from roadside swales, stormwater management facility outfalls or stream culverts. Only one of the pipe outfalls, other than the Hillandale Run culvert, was observed to have discharge during the survey; however, the flow from pipe was observed to be clear water from a storm water management pond.

The eight pipe outfalls were ranked as *minor* due to the know origins of the pipes and lack of illicit discharge. Accessibility was ranked *moderate to best* for all pipe outfall sites. Correctability was ranked as *best*.

3.4.6 Exposed Pipes

Exposed pipes include one sewer manhole stack in or along the edge of the unnamed tributary to Paint Branch (Appendix C, Photo 47). The erosion downstream of the exposed sewer manhole stack is a threat to exposing and undermining the sewer line.

Severity of the exposed sewer manhole stack is *severe to very severe*. Correctability is ranked as *moderate* and access to the site is ranked as *moderate to difficult*.

3.4.7 Trash Dumping

No direct trash dumping sites were observed during the assessment. Overall, the stream corridors on ALC were relatively free of trash, likely due to the lack of development surrounding the site. The one area that trash was observed occurred on Hillandale Run, at the outfall of the culvert that conveys Hillandale Run onto ALC from the residential neighborhood to the west. The trash appears to be carried onto ALC from the neighborhood during storm events.

The outfall site is ranked as *low to moderate* severity and *moderate to difficult* correctibility. The volume of trash is relatively low and the fact that it originates off-site makes it more difficult to correct. Accessibility of the site is *easy to moderate*.

4 SAMPLING AND CORRIDOR ASSESSMENT SUMMARY

Overall, the waterbodies of the ALC support a relatively diverse community of invertebrates and fish considering their location in a highly developed area of the state. In total, 3,489 fish from 23 species were collected with several size classes present, indicating a diverse and naturally reproducing fish community in the waterbodies of the ALC. Many species of invertebrates were collected, including several taxa considered by Maryland to be intolerant to pollution. Although formal wildlife surveys were not conducted as part of the stream assessments, many species of herptiles, birds and mammals were observed incidentally during the stream assessment activities, including northern two-lined salamanders (Eurycea bislineata), green frogs (Lithobates clamitans melanota), bull frogs (Lithobates catesbeianus), a worm snake (Carphophis amoenus amoenus), northern water snakes (Nerodia sipedon sipedon), and a snapping turtle (Chelydra serpentina). No threatened or endangered species of fish or invertebrates were observed during the sampling, but several fish species and invertebrate taxa classified as intolerant to pollution were collected indicating good water quality.

- The streams in ALC were generally non-typical of urbanized environments, due to the lack of extensive development immediately surrounding the site. The most common issues encountered include pipe outfalls, erosion sites, and fish passage barriers.
- The most severe environmental issues encountered included erosion sites, on the unnamed tributary to Paint Branch, and the exposed sewer manhole stack. Erosion sites and inadequate buffer sites were generally ranked moderate correctability and accessibility. Channel alteration sites were ranked mostly moderate to difficult correctability since the concrete channelized site also acted as a security feature on the perimeter of the property.
- Fish passage barrier sites were mostly temporary barriers caused by debris blockages that are too high for fish to overcome. Generally these sites were ranked easy to moderate correctability and accessibility.
- Trash dumping in streams was not issue in the streams at ALC.
- Except for channel alteration, accessibility and correctability of most problem sites ranged from easy to moderate.

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5 POTENTIAL BEST MANAGEMENT PRACTICES

A best management practice (BMP) is a technique, process, activity, or structure used to reduce the amount of pollutants (e.g. nitrogen, phosphorus, and sediment) in stormwater discharge. BMPs may include simple non-structural methods, such as good housekeeping as well as preventive maintenance. BMPs may also include structural modifications that require installation and construction. BMPs are most effective when used in combination with each other, customized for a specific location, and when they consider the existing conditions at the site.

It is recommended that BMPs are inspected and maintained regularly to ensure correct treatment of stormwater and to attain desired pollutant removal efficiencies. It should be determined if these BMPs can possibly be expanded or retrofitted with new technologies and/or if these BMPs are undersized or oversized.

In addition to the BMPs that currently exist at the site, recommendations for potential non-structural and structural BMPs at ALC are discussed below. See Table 3 in Section 5.1.11 for a summary of efficiencies for the following recommended structural BMPs.

5.1 Recommended Structural BMPs

5.1.1 Removal of Impervious Surfaces or Porous Pavement

Impervious pavement can be removed and planted or can be replaced with pervious pavement or permeable pavers, where appropriate, allowing stormwater to infiltrate directly and receive water quality treatment. Options include porous asphalt, pervious concrete, and grass pavers. Potential locations for porous pavement at ALC include parking lots that are generally not used on a daily basis but are still required or needed for either overflow parking or special event parking. Impervious surface could be removed in areas where buildings have been vacant or where the parking lot size could be downgraded.

5.1.2 Wet Retention Ponds

Wet retention ponds provide highly effective stormwater control structures that provide retention and treatment of stormwater runoff by plant uptake and removal. Runoff from each rain event is retained and treated in the pond (that may be planted with native plant material) until it is displaced by runoff from the next storm. Sedimentation processes remove particulates, organic matter, and metals, while dissolved metals and nutrients are biologically removed. Wet retention ponds could be utilized at ALC adjacent to parking lots where impervious surface requires water quality treatment prior to entering the stormdrain system or in underutilized open grassy areas.

5.1.3 Stormwater Wetland Systems

Stormwater wetland systems are wetlands that allow stormwater runoff to flow through a soil-lined basin at shallow depths. Stormwater wetland systems can include a shallow marsh, an extended detention wetland, a pond/wetland system, and a pocket wetland. Each area can be planted with native vegetation. This type of BMP controls runoff volume, removes pollutants from runoff, and is adaptable to many locations. Locations for potential stormwater wetlands at ALC include areas located adjacent to existing streams and wetlands.

5.1.4 Vegetated Swales

Vegetated swales are broad, shallow channels with vegetation covering the side slopes and the channel bottom. Swales are designed to trap particulate pollutants such as suspended solids and trace metals, promote infiltration, and reduce the flow velocity of stormwater runoff. A fine, close-growing, water-resistant grass is most beneficial for use in vegetated swales to increase the surface area of the vegetation. If possible, vegetated swales should not be mowed. Vegetated swales are commonly utilized along small roadways.

5.1.5 Vegetated Filter Strips

Vegetated filter strips are similar to rain gardens in that they are landscaping features that provide on-site treatment of stormwater runoff through infiltration. Vegetated filter strips are normally located within or adjacent to existing parking lots or roadways. They are generally gently sloping, vegetated areas adjacent to impervious surfaces that reduce impacts of sheet flow and velocity of stormwater and improve water quality by removal of sediments and associated contaminants from runoff as well as recharging the water table. Vegetated filter strips filter water through a mixture of highly permeable soils (sand, mulch, compost), then store water in an underlying gravel layer from which the water percolates into groundwater. This BMP incorporates a visually appealing green effect to otherwise impervious parking lots.

5.1.6 Bioretention Systems

Bioretention systems, such as rain gardens, are shallow planted depressions designed to retain or detain stormwater before it is infiltrated or discharged. These areas are landscaping features that provide on-site treatment of stormwater runoff and may be small or large in size and can be located in parking lots or residential areas. Bioretention systems are a combination of native grasses, shrubs, and trees planted in constructed depressions with soil media that collect and retain rainwater. Bioretention improves water quality by allowing rainwater to slowly penetrate and filter through soil layers. Locations for potential bioretention include areas adjacent to large or small buildings that have a source of runoff (from downspouts particularly), parking lots or within landscaped areas, and in small or large pervious areas that could be graded and replanted. Curb cuts, which are cut out sections of curb, allow runoff to enter the bioretention cell from a parking lot or roadway. Bioretention cells can also be used within the road right-of-way (ROW) between the curb and the sidewalk.

5.1.7 Stormwater Retrofits

This BMP includes stormwater pipe outfall retrofits and older stormwater pond retrofits. Stormwater pipe outfall retrofit includes retrofitting major outfalls from stormwater pipe conveyance systems and zero order ephemeral channels with Step Pool Storm Conveyance filtering systems (SPSC, described in more detail under stream restoration) to achieve water quality improvement. The pre-2002 stormwater management pond retrofits involve retrofitting stormwater management ponds constructed before 2002 that drain more than 10 acres. An assessment and inspection of stormwater management ponds is recommended to determine if such a retrofit is appropriate.

5.1.8 Green Roofs

Green roofs are vegetated roof covers consisting of three primary layers: foliage, growth media and principal root zone, and drain layer. Green roofs do not require irrigation, mowing, of fertilizing if the primary layers are chosen carefully. Normally, low-maintenance sedum species are good options for green roofs. These roofs reduce surface runoff that is absorbed by the green roof and improves the aesthetic value of the roof and surrounding area. It is estimated that 75% reduction of rainfall runoff quantity can be attained with a green roof (USEPA 2008). In addition, they improve water quality, decrease runoff temperature, and increase the health of adjacent biota; as well as improve efficiency of roof insulation, minimize the heat island effect, and reduce sound reflection. Green roofs can be retrofitted on existing roofs at the installation. Buildings with a large footprint and flat roof are good options for green roofs; facilities at ALC that meet these requirements should be considered for green roof retrofits. New buildings could also be designed to include a full or partial green roof. Anti-Terrorism/Force Protection standards should be consulted before considering a green roof.

5.1.9 Tree Box Filters

Tree box filters are enclosed boxes that use a plant/soil complex to filter out pollutants from stormwater runoff and then discharge to storm sewers. These filters can be constructed along sidewalks to treat stormwater flowing through street inlets or as vegetation strips to filter out pollutants. This BMP is normally constructed or retrofitted in ultra-urban areas and are aesthetically pleasing to the surrounding community. Tree box filters should be considered at ALC along areas of sidewalks that have little to no existing plantings and can be constructed in rows along main streets.

5.1.10 Modular Treatments

Modular treatments are systems that are installed to remove pollutants from stormwater runoff. The capacity of these systems is typically small for the “off-the-shelf” products; however, if conditions permit, several may be implemented throughout a larger area. They are often utilized in urban areas from residential settings to parking lots. Depending on the system, these treatments consist of a series of sedimentation chambers and constructed wetlands. Since modular systems are small in size, they can be placed in ROW areas such as between the sidewalk and the curb, or between the sidewalks and parking lots.

5.1.11 Summary of Structural BMPs

As discussed, there are many types of structural BMPs recommended for ALC. Their water quality benefits are summarized in Table 3, which provides removal efficiencies from the Chesapeake Bay Watershed Model Phase 5 (Simpson and Weammert 2009). Some of the recommended BMPs are not identified in the Bay model (e.g. tree box filters, modular treatments); therefore, performance metrics for these BMPs are not provided. In general, BMP effectiveness tends to vary widely in real-world conditions depending on site-specific factors such as hydrology and vegetation. The published efficiencies from the Bay model are based on average operational conditions representative of the entire Bay watershed (Simpson and Weammert 2009).

TABLE 3. BMP REMOVAL EFFICIENCIES (%) FROM THE CHESAPEAKE BAY WATERSHED MODEL

Recommended BMP [1]	Bay Model BMP [2]	Phase 5 BMP Efficiency [2]		
		Nitrogen	Phosphorus	Sediment
Riparian Buffers	Forest Buffer (Inner Coastal Plain)	65	42	56
Sand Filters	Filters All (sand, organic, peat)	60	40	80
Removal of Impervious Surfaces or Porous Pavement	Permeable Pavement (no sand/veg):			
	C/D soils, underdrain	20	10	55
	A/B soils, underdrain	50	45	70
	A/B soils, no underdrain	80	75	85
	Permeable Pavement (with sand, veg):			
	C/D soils, underdrain	20	20	55
	A/B soils, underdrain	50	50	70
	A/B soils, no underdrain	80	80	85
Wet Retention Ponds	Urban Wetlands and Wet Ponds	20	45	60
Stormwater Wetland Systems	Urban Wetlands and Wet Ponds	20	45	60
Vegetated Swales	Vegetated Open Channels:			
	C/D soils, no underdrain	10	10	50
	A/B soil, no underdrain	45	45	70
Bioretention Systems	Bioretention:			
	C/D soils, underdrain	45	25	55
	A/B soils, underdrain	75	70	80
	A/B soils, no underdrain	85	80	90

[1] Recommended BMPs are those listed in Section 5.1 of the text. Not all of the recommended BMPs are included in this table because they are not directly identified in the Bay watershed model.

[2] From Simpson and Weammert (2009)

5.2 Recommended Non-Structural BMPs

5.2.1 Maintenance, Pollution Prevention and Good Housekeeping Techniques

Activities including maintenance, pollution prevention, and good housekeeping are considered important BMPs that can also reduce pollutants that enter waterbodies. These activities can include winter road maintenance (salt application and storage), minor road repairs and other infrastructure work, vehicle fleet maintenance, landscaping and park maintenance, and building maintenance. Other activities that remove pollutants when performed properly include parking lot and street sweeping and storm drain system cleaning (includes cleaning of curb opening inlets). Sweeping utilizes mechanical or vacuum sweepers to remove sediment and debris from streets/parking lots that would otherwise enter the stormwater conveyance system. This practice is most effective when the main arteries adjacent to waterbodies are swept on a weekly basis, although frequency varies. Altering other maintenance activities such as mowing can also be considered a BMP. Allowing grass to become a meadow (not mowing regularly) or planting a riparian buffer adjacent to streams is a BMP that was described previously. As stated above, pollutants such as suspended solids and trace metals can be trapped in the vegetation, infiltration can be promoted, and the flow velocity of stormwater runoff can be reduced. Army facilities such as ALC can be sources of stormwater pollutants if BMPs are not in place to contain spills, manage trash, and handle non-stormwater discharges (USEPA 2006). In addition, the National Defense Center for Energy and Environment (2011) generated a list of activities observed at Army facilities applicable to the TMDL and pollution prevention that include the following: semi-permanent stockpiles of soils and sands; air emissions with deposition potential; construction projects; and fertilizer applications. If these situations can be avoided or minimized at ALC, fewer pollutants would run off during storm events. Contractor erosion and sediment control training could also be considered with the techniques above to reduce sediment in stormwater.

A total of four fish passage blockage sites were identified during the physical stream assessment. A summary of the findings is described in Section 3. These fish barriers are recommended for removal. The site at the southern boundary of ALC on Paint Branch is caused by debris build up on the security fence. This site is accessible and should be cleared on a regular basis. The site at the northern boundary of ALC on Paint Branch has been caused by the collapse of the security fence. The site at the confluence of the unnamed tributary and Paint Branch is a culvert under Floral Drive. The culvert is too high to allow fish passage and one side of the culvert is completely blocked. The site at which Hillandale Run enters ALC through a culvert is also too high to allow fish passage and continues off-site as an underground pipe through the Hillandale neighborhood for approximately 3,200 feet.

A total of eight pipe outfalls were identified during the physical stream assessment at ALC. Findings are described in Section 3.4.5 and mapped locations are shown Figure 3. It is recommended that the unusual discharges be investigated for potential sources of pollution or sedimentation.

One exposed pipe was identified during the physical stream assessment at ALC. A summary of the findings is described in Section 3.4.6 and mapped location is shown in Figure 3. The exposed pipe should be investigated for potential contaminants and is recommended for repair.

5.2.2 Rain Barrels

Rain barrels, also called cisterns, are aboveground water storage vessels that collect rain runoff from a building's roof using the gutter and downspout system. Rain barrels with a drainage valve can store water for use between rain events; the valve is opened when water is need and empties out slowly, thus reducing runoff and increasing infiltration. Rain barrels reduce pollutants and the velocity of water entering local rivers and streams. Water collected in rain barrels can be used for irrigating landscaping, or even for reuse in buildings as greywater.

5.2.3 Downspout Disconnection

A downspout can be disconnected (by cutting) from existing standpipes so the water flows over landscaped areas or lawns. Disconnection can be a low-maintenance option to help move water away from building foundations and allow it to soak into the ground, providing infiltration.

6 REFERENCES

Anacostia Watershed Restoration Partnership. 2017. Paint Branch Subwatershed Action Plan. Accessed online August 2016 at: http://www.anacostia.net/Restoration_Plan.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Eyes of Paint Branch. 1999. Restoring Paint Branch. Accessed online July 6, 2017 at: http://www.eopb.org/publications/restoringpb.pdf.

Maryland Department of the Environment. Title 26 Department of the Environment. Subtitle 08 Water Pollution. 2008. Accessed on-line July 19, 2017 at: http://mde.maryland.gov/programs/Land/RecyclingandOperationsprogram/Documents/Notice_of_Final_Action.pdf.

Maryland Department of Natural Resources (MDNR). 2000. MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy Protocols. *Maryland Department of Natural Resources Monitoring and Non-tidal Assessment Division Ecological Assessment Program, Annapolis, November.*

MDNR. 2017. Interactive Stream Health Mapper. Accessed online July 11, 2017 at http://geodata.md.gov/sggatlas/index.html

Roth et al. 1998. Maryland Biological Stream Survey: Development of an Index of Biotic Integrity for Fishes in Maryland Streams. *Environmental Monitoring and Assessment* 51:89-106.

Southerland, MT et al. 2005. New biological indicators to better assess the condition of Maryland streams. Maryland Department of Natural Resources. Annapolis, Maryland. October.

Stranko et al. Maryland Biological Stream Survey (MBSS): Round Four Field Sampling Manual. Maryland Department of Natural Resources. Annapolis, Maryland. January.

United States Environmental Protection Agency (USEPA). 2006. Mid-Atlantic Integrated Assessment (MAIA) State of Flowing Waters Report. Office of Research and Development. Washington, DC. February

Kazyak, Paul F. 2001. *Maryland Biological Stream Survey Sampling Manual.* Maryland Department of Natural Resources. February

Maryland Department of the Environment (MDE). 2010. *2010 Integrated Report*. Accessed from:http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/Final_approved_2010_ir.aspx

Maryland Department of Environment (MDE). 2012. *Maryland's Phase II Watershed Implementation Plan for the Chesapeake Bay TMDL.* 26 October.

National Defense Center for Energy and Environment (NDCEE).2011.*Army Chesapeake Bay Total Maximum Daily Load Pilots*. Environment, Energy, Security, and Sustainability (E2S2) Symposium and Exhibition. May.

Rantz, S.E., and others. 1982. *Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge*. U.S. Geological Survey, Water Supply Paper 2175.

Simpson, T.W, Weammert, S.E. 2009. *Developing Nitrogen, Phosphorus and Sediment Reduction Efficiencies for Tributary Strategy Practices*. BMP Assessment: Final Report. University of Maryland/Mid-Atlantic Water Program. March

U.S. Environmental Protection Agency (USEPA). 1997. *Volunteer Stream Monitoring: A Methods Manual*. EPA-841-B-97-003. November.

U.S. Environmental Protection Agency (USEPA). 1999. *Preliminary Data Summary of Urban Stormwater Best Management Practices.* EPA-821-R-99-012. August.

U.S. Environmental Protection Agency (USEPA). 2000. *Ambient Water Quality Criteria Recommendations, Information Supporting the Development of State and Tribal Nutrient Criteria, Rivers and Streams in Ecoregion IX*. EPA 822-B-00-019. December.

U.S. Environmental Protection Agency (USEPA). 2005. *Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations.* EPA/600/R-05/118.October.

U.S. Environmental Protection Agency (USEPA). 2006. *Fact Sheet on Pollution Prevention/Good Housekeeping for Municipal Operations*. National Pollutant Discharge Elimination System (NPDES). May.

U.S. Environmental Protection Agency (USEPA). 2008. *Reducing Urban Heat Islands: Compendium of Strategies.* Accessed from: http://www.epa.gov/heatisld/resources/pdf/GreenRoofsCompendium.pdf

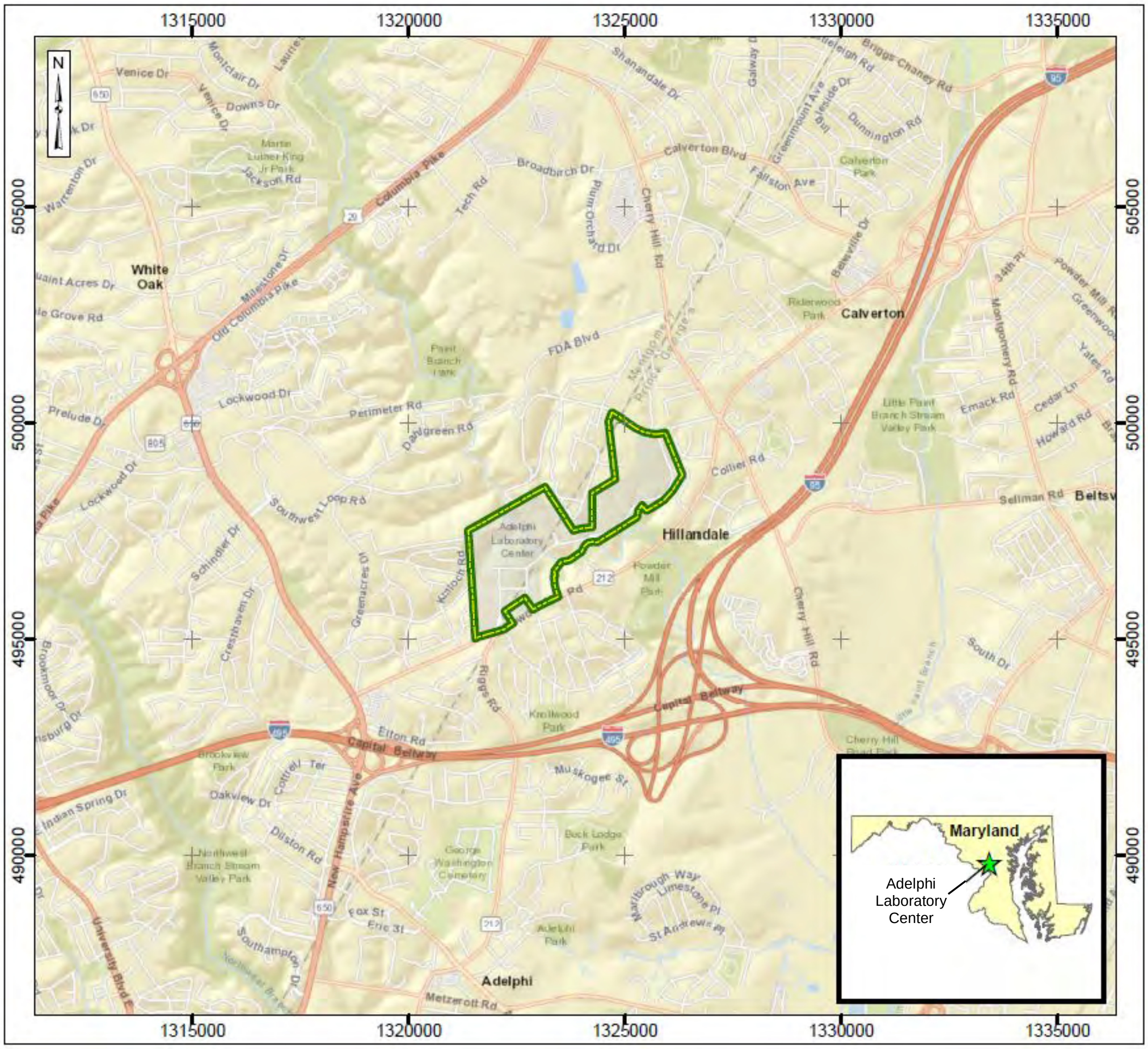
U.S. Geological Survey. 2012. *The National Map Viewer and Download Platform*. Accessed from: http://nationalmap.gov/viewer.html

Yetman, K.T. 2001. *Stream Corridor Assessment Survey Protocols*. Maryland Department of Natural Resources, Watershed Restoration Division, Annapolis, Maryland.

APPENDIX A

Figures

Figure 1
Adelphi Laboratory Center Location



Legend

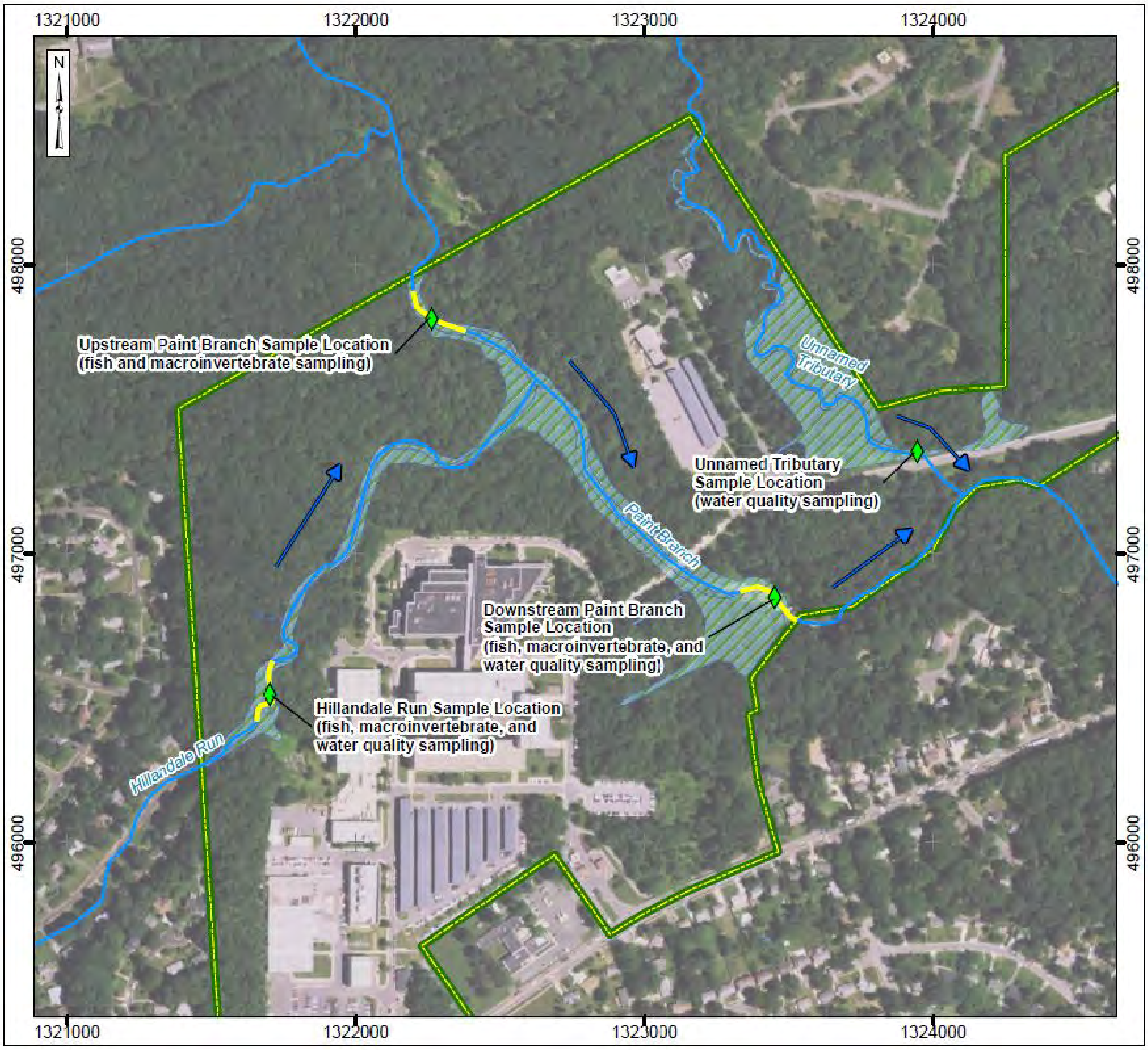
Installation Boundary

0 2,000 4,000
Feet

Data Sources: ESRI, ArcGIS Online, Street Map Data

Coordinate System: MD, State Plane
Datum: NAD83
Units: Feet

Figure 2
Fish, Macroinvertebrate and Water Quality Sampling Locations



Legend

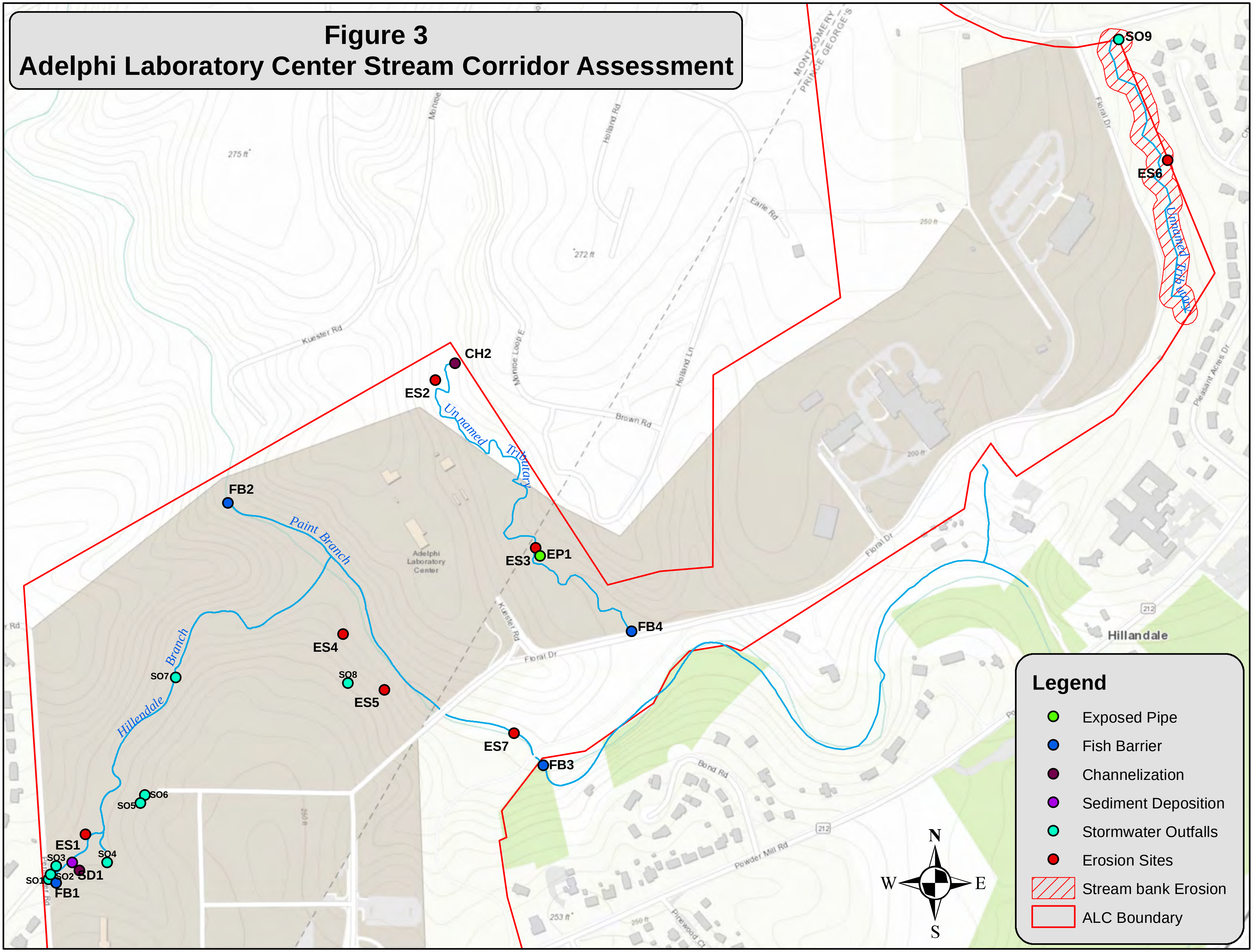
- Installation Boundary
- Stream
- Wetland Area
- Surface Water Sample Location
- Fish and Invertebrate Sample Location
- Surface Water Flow Direction

0 250 500
Feet

Data Sources: ESRI, ArcGIS Online, Aerial Imagery

Coordinate System: MD, State Plane
Datum: NAD83
Units: Feet

Figure 3
Adelphi Laboratory Center Stream Corridor Assessment



Appendix B

Tables

Table 4: Water Quality Parameters

Water Quality Parameters	Fall 2016 Paint Branch Upstream	Fall 2016 Paint Branch Downstream	Fall 2016 Hillandale Run	Fall 2016 Unnamed Tributary	Spring 2017 Paint Branch Upstream	Spring 2017 Paint Branch Downstream	Spring 2017 Hillandale Run	Spring 2017 Unnamed Tributary
Pool Depth (ft)	3.9	4.0	2.2	0.4	3.5	4.73	2.44	0.64
Flow (ft/sec)	-0.11	-0.03	0.06	0.08	-0.04	0.02	0.02	0.5
Riffle Depth (ft)	2.0	1.3	1.5	N/A[1]	0.5	1.8	0.25	NA[1]
Riffle Flow (ft/sec)	0.26	0.56	0.05	N/A[1]	1.42	1.16	0.3	NA[1]
Conductivity (ms/cm)	0.326	0.339	1.477	0.459	0.358	0.365	0.469	0.635
Turbidity (NTU)	N/A[2]	0.4	N/A[2]	1.5	2.6	3.5	5.2	2.8
Dissolved Oxygen (mg/L)	10.17	10.61	10.76	7.90	10.35	10.56	10.86	8.55
pH	8.42	8.85	6.89	7.60	7.81	8.07	6.72	7.73
Temperature (°C)	12.94	11.98	17.09	15.81	17.42	18.43	13.66	18.49
Analytical Results								
Kjeldahl Nitrogen (mg/L)	NS	ND	ND	0.50 J	NS	ND	ND	ND
Total Nitrite/Nitrate Nitrogen (mg/L)	NS	0.92	1.2	0.62	NS	0.73	1.2	0.24
Total Phosphorus (mg/L)	NS	ND	0.17	ND	NS	ND	0.068 J	ND
Total NO2/NO3/TKN (mg/L)	NS	0.92 J	1.2	1.1	NS	0.73 J	1.2	ND
Total Suspended Solids (mg/l)	NS	ND	1.50 J	1.50 J	NS	1.60 J	3.43	2.00 J

Notes:

1. Unnamed tributary did not have riffle habitat at the sample location.
2. YSI Water Quality Meter malfunction.

°C = Degrees Celsius
ft = feet
ft/sec = feet per second
J = estimated value greater than or equal to the Method Detection Limit and less than the Limit of Quantitation
mg/l = milligrams per liter
ms/cm = microsiemens per centimeter
ND = non-detect
NS = not sampled
NTU = Nephelometric Turbidity Unit
N/A = Not applicable

Table 5: Benthic Macroinvertebrate Community Data

Taxon	Common Name	Fall 2016			Spring 2017		
		Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run
Nemertea							
Tetrastemmatidae							
Prostoma	proboscis worm	8	3	16	-	-	-
Tricladida							
Planariidae							
Dugesia	flat worm	1	-	-	-	-	-
Nematoda	round worms	-	-	-	1	1	-
Oligochaeta							
Enchytraeidae	earth worm	1	-	3	3	1	
Lumbricina	earth worm	1	2	4	1	1	1
Lumbriculidae	earth worm	-	-	-	-	-	-
Naididae	naiad worm	7	7	2	6	29	22
Tubificidae	tube worm	-	-	2	6	-	6
Limnodrilus	tube worm	11	-	5	-	-	-
Basommatophora							
Ancylidae							
Ferrissia	limpet snail	3	8	8	1	-	-
Lymnaeidae							
Galba	pond snail	1	-	-	2	-	-
Physidae							
Physella	bladder snail	7	-	17	4	-	1
Planorbidae							
Menetus	ramshorn snail	1	-	1	1	-	-
Veneroidea							
Sphaeriidae							
Pisidium	pill clam	4	-	3	2	-	-
Amphipoda							
Crangonyx	side swimmer	9	-	-	2	2	-
Hydracarina							
Lebertia	water mite	2	4	-	-	-	-
Odonata							
Coenagrionidae							
Argia	damselfly	-	-	2	-	-	-
Enallagma	damselfly	8	-	5	1	-	-
Ephemeroptera							
Baetidae							
Baetis	mayfly	-	-	-	-	1	-
Heptageniidae							
Stenacron	mayfly	1	-	-	-	-	-
Hempitera							
Belastoma	giant water bug	-	-	1	-	-	-
Trichoptera							
Hydropsychidae							
Cheumatopsyche	caddisfly	-	10	1	-	1	-
Hydropsyche	caddisfly	-	9	-	-	1	-
Hydroptilidae							
Hydroptila	caddisfly	1	10	-	-	-	-
Leptoceridae							
Mystacides	caddisfly	-	1	-	-		
Philopotamidae							
Chimarra	caddisfly	-	-	2	-	-	-
Polycentropodidae							
Polycentropus	caddisfly	1	-	4	-	1	-
Decapoda							
Cambaridae							
Cambarus	crayfish	-	-	-	-	-	2
Plecoptera							
Nemouridae							
Amphinemura	stonefly	-	-	-	1	-	-

Table 5: Benthic Macroinvertebrate Community Data (cont.)

Taxon	Common Name	Fall 2016			Spring 2017		
		Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run
Coleoptera							
Elmidae							
Ancyronyx	riffle beetle	3	2	-	1	-	3
Dubiraphia	riffle beetle	1	-	-	-	-	2
Macronychus	riffle beetle	-	-	2	2	-	-
Optioservus	riffle beetle	-	1	-	-	-	-
Stenelmis	riffle beetle	-	-	4	-	-	-
Hydrophilidae	scavenger beetle	-	-	1	-	-	-
Psephenidae							
Ectopria	water penny	1	-	2	-	-	-
Diptera							
Ceratopogonidae							
Atrichopogon	sand fly	-	-	-	1	-	-
Ceratopogon	sand fly	-	-	-	-	-	2
Culicoides	sand fly	1	-	-	-	-	1
Chironomidae							
Ablabesmyia	midge	-	-	-	3	2	2
Chironomus	midge	-	3	3	1	-	-
Cladopelma	midge	-	-	-	1	-	-
Cladotanytarsus	midge	-	-	-	4	4	-
Corynoneura	midge	-	4	-	1	2	2
Cricotopus	midge	10	6	-	-	3	-
Cryptochironomus	midge	-	3	-	-	-	1
Diamesa	midge	-	-	-	-	-	4
Dicrotendipes	midge	14	11	2	5	2	-
Diplocladius	midge	1	-	-	-	-	2
Eukiefferiella	midge	-	-	-	-	-	1
Microtendipes	midge	-	3	-	-	-	-
Orthocladius	midge	-	6	1	10	28	13
Parametriocnemus	midge	-	-	-	-	-	12
Paratanytarsus	midge	-	7	-	2	4	-
Phaenopsectra	midge	3	3	1	2	-	-
Polypedilum	midge	-	-	5	11	10	2
Psectrocladius	midge	-	-	-	-	3	-
Rheotanytarsus	midge	3	-	-	2	-	2
Stenochironomus	midge	1	1	-	-	6	1
Stictochironomus	midge	-	-	-	4	-	-
Tanytarsus	midge	9	2	-	7	-	-
Thienemannella	midge	1	-	-	1	-	-
Thienemannimyia gr.	midge	-	-	6	-	-	4
Tvetenia	midge	-	-	-	2	-	6
Xylotopus	midge	-	-	1	-	-	-
Empididae							
Hemerodromia	dance fly	-	1	-	1	1	-
Tipulidae							
Antocha	crane fly	-	-	-	-	3	-
Tipula	crane fly	-	1	1	-	-	1
Total Specimens		115	108	105	92	106	93

Table 6: Benthic Macroinvertebrate Metrics

	Metric	Fall 2016						Spring 2017					
		Paint Branch Upstream		Paint Branch Downstream		Hillandale Run		Paint Branch Upstream		Paint Branch Downstream		Hillandale Run	
		Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Piedmont	Number of Taxa	29	5	24	3	28	5	32	5	21	3	23	3
Piedmont	EPT Taxa	3	1	4	1	3	1	1	1	4	1	0	1
Piedmont	Ephemeroptera Taxa	1	1	0	1	0	1	0	1	1	1	0	1
Piedmont	Percent Intolerant Urban Taxa	2.6%	1	0.0%	1	5.7%	1	1.1%	1	0.9%	1	4.3%	1
Piedmont	Percent Chironomidae	36.5%	3	45.4%	3	18.1%	5	17.4%	5	21.7%	5	55.9%	3
Piedmont	Percent Clingers	38.3%	3	43.5%	3	26.7%	1	34.8%	3	18.9%	1	14.0%	1
Piedmont	Index of Biotic Integrity (IBI)	2.3		2.0		2.3		2.7		2.0		1.7	
Piedmont	Stream Condition Rating	Poor		Poor		Poor		Poor		Poor		Very Poor	
Coastal Plain	Number of Taxa	29	5	24	5	28	5	32	5	21	3	23	5
Coastal Plain	EPT Taxa	3	3	4	3	3	3	1	1	4	3	0	1
Coastal Plain	Ephemeroptera Taxa	1	3	0	1	0	1	0	1	1	3	0	1
Coastal Plain	Percent Intolerant Urban Taxa	2.6%	1	0.0%	1	5.7%	1	1.1%	1	0.9%	1	4.3%	1
Coastal Plain	Percent Ephemeroptera	0.9%	3	0.0%	1	0.0%	1	0.0%	1	0.9%	3	0.0%	1
Coastal Plain	Scraper Taxa	8	5	4	5	6	5	6	5	0	1	3	5
Coastal Plain	Percent Climbers	25.2%	5	10.2%	5	37.1%	5	29.3%	5	10.4%	5	3.2%	3
Coastal Plain	Index of Biotic Integrity (IBI)	3.6		3.0		3.0		2.7		2.7		2.4	
Coastal Plain	Stream Condition Rating	Fair		Fair		Fair		Poor		Poor		Poor	

Piedmont IBI Metrics and Thresholds			
Metric	5	3	1
Number of Taxa	>=25	15-24	<15
Number of EPT Taxa	>=11	5-10	<5
Number of Ephemeroptera Taxa	>=4	2-3	<2
Percent Intolerant Urban (Tol = 0-3)	>=51	12-50	<12
Percent Chironomidae	<24	24-63	>63
Percent Clingers	>=74	31-73	<31

Coastal Plain IBI Metrics and Thresholds			
Metric	5	3	1
Number of Taxa	>=22	14-21	<14
Number of EPT Taxa	>=5	2-4	<2
Number of Ephemeroptera Taxa	>=2	1	<1
Percent Intolerant Urban (Tol = 0-3)	>=28	10-27	<10
Percent Ephemeroptera	>=11	0.8-10.9	<0.8
Number of Scraper Taxa	>=2	1	<1
Percent Climbers	>=8	0.9-7.9	<0.9

Note:
Metrics shown are those recommended for the Coastal Plain and Piedmont ecoregions in Maryland protocol (Southerland et al 2005).

Table 7: Fish Community Survey Data

Location	Paint Branch Upstream						Paint Branch Downstream						Hillandale Run					
Pass #	Pass #1			Pass #2			Pass #1			Pass #2			Pass #1			Pass #2		
Sample Date	10/12/2016						10/13/2016						10/13/2016					
	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies
American eel	5	782	-	1	25	-	20	3628	-	11	464	-	25	334	-	10	242	-
Blacknose dace	14	20	-	5	12	-	420	682	D	292	404	-	56	102	-	12	20	-
Blue ridge sculpin	2	7	-	-	-	-	6	21	-	2	6	-	-	-	-	-	-	-
Bluegill	7	18	-	5	18	BS	15	52	-	13	53	-	-	-	-	-	-	-
Common shiner	23	65	P	6	16	-	27	192	-	29	200	-	-	-	-	-	-	-
Creek chub	2	2	-	1	2	-	4	6	-	-	-	-	22	190	-	7	22	-
Cutlips minnow	7	30	-	2	5	-	12	119	-	12	90	-	-	-	-	-	-	-
Fall fish	-	-	-	5	4	-	23	552	-	7	9	-	-	-	-	-	-	-
Northern hog sucker	17	272	-	8	55	-	49	1081	-	27	409	-	-	-	-	-	-	-
Longnose dace	10	27	-	5	17	-	30	80	-	15	34	-	1	1	-	1	2	-
Margined madtom	3	28	-	1	8	-	17	118	-	16	71	-	-	-	-	-	-	-
Pumpkinseed	2	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redbreast sunfish	20	565	-	14	589	-	16	368	-	10	164	-	-	-	-	-	-	-
Redear sunfish	1	4	-	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-
Rosyside dace	16	37	-	9	16	-	54	89	-	33	57	-	2	8	-	1	3	-
Satinfin shiner	3	10	-	1	3	-	8	15	-	7	16	-	-	-	-	-	-	-
Sea lamprey	-	-	-	1	7	-	2	10	-	3	30	-	-	-	-	-	-	-
Spotfin shiner	7	11	-	3	4	-	15	28	-	11	23	-	-	-	-	-	-	-
Spottail shiner	-	-	-	-	-	-	2	26	-	4	40	-	-	-	-	-	-	-
Striped shiner	-	-	-	-	-	-	1	11	-	-	-	-	-	-	-	-	-	-
Swallowtail shiner	3	4	-	-	-	-	14	32	-	4	7	-	-	-	-	-	-	-
Tesselated darter	2	5	-	1	2	-	20	37	-	8	15	-	-	-	-	-	-	-
White sucker	7	345	-	5	196	-	29	1441	D	21	645	-	11	54	-	7	34	-
Total Specimens	151			73			785			525			117			38		

Location	Paint Branch Upstream						Paint Branch Downstream						Hillandale Run					
Pass #	Pass #1			Pass #2			Pass #1			Pass #2			Pass #1			Pass #2		
Sample Date	4/19/2017						4/19/2017						4/18/2017					
	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies	Number of Individuals	Total Weight (g)	Delt Anomalies
American eel	10	1184		5	64		50	1167		21	620		14	321		4	86	
Blacknose dace	18	18		22	22		276	379		174	246		263	372		49	80	
Blue ridge sculpin	1	6					3	9		2	4							
Bluegill	4	20	D	2	9		23	65	BS (3), P	5	19							
Common shiner	8	21		11	120		41	444	E, P, D	25	136	D						
Creek chub	3	8					6	12		4	7		33	509	D	9	70	D
Cutlips minnow	10	38		4	2		9	80		9	43							
Fall fish	6	96		3	67		18	371		8	107							
Northern hog sucker	3	17		3	12		26	243		16	83							
Longnose dace	7	23		3	2		33	82		24	42	P						
Margined madtom	14	138		15	132		46	134		21	134							
Pumpkinseed																		
Redbreast sunfish	8	52		10	115		28	524	BS (2)	20	262							
Redear sunfish							3	18	P									
Rosyside dace	20	37		7	18		58	116		18	33		4	27		2	22	
Satinfin shiner	7	19		9	15		30	25		12	19							
Sea lamprey	3	17		5	33		3	29		3	25							
Spotfin shiner	7	12		6	8		9	10										
Spottail shiner				1	1					10	17							
Striped shiner																		
Swallowtail shiner	5	4		7	6		18	41		7	21							
Tesselated darter	10	25		9	15		31	61		19	35							
White sucker	4	27		1	4		24	962		1	222		14	181		3	49	
Total Specimens	148			123			735			399			328			67		

Notes:
BS = Black spot
D = Delt (deformity, erosion, lesion, tumor)
g = gram
P = popeye

Table 8: Fish Metrics

	Metric	Fall 2016						Spring 2017					
		Paint Branch Upstream		Paint Branch Downstream		Hillandale Run		Paint Branch Upstream		Paint Branch Downstream		Hillandale Run	
		Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Piedmont	Abundance per square meter	0.33	1	2.20	5	0.52	3	0.40	1	1.89	5	1.32	5
Piedmont	Number of Benthic Species[1]	0.36	5	0.36	5	0.00	1	0.36	5	0.36	5	0.00	1
Piedmont	Percent Tolerant	22.8%	5	62.7%	5	74.2%	3	26.9%	5	49.6%	5	93.9%	3
Piedmont	Percent Generalist, Omnivores, Invertivores	98.2%	3	98.9%	3	100%	1	96.7%	3	98.8%	3	100%	1
Piedmont	Biomass per square meter	5.4	3	16.8	5	3.4	1	4	3	10.1	5	5.7	3
Piedmont	Percent Lithophilic Spawners	50.4%	3	27.5%	1	32.3%	3	35.8%	3	26.7%	1	16.5%	1
Piedmont	Fish Index of Biotic Integrity (FIBI)	3.3		4.0		2.0		3.3		4.0		2.3	
Piedmont	Stream Condition Rating	Fair		Good		Poor		Fair		Good		Poor	
Coastal Plain	Abundance per square meter	0.33	1	2.20	5	0.52	3	0.40	1	1.89	5	1.32	5
Coastal Plain	Number of Benthic Species[1]	0.36	5	0.36	5	0.00	1	0.36	5	0.36	5	0.00	1
Coastal Plain	Percent Tolerant	22.8%	5	62.7%	5	74.2%	3	26.9%	5	49.6%	5	93.9%	3
Coastal Plain	Percent Generalist, Omnivores, Invertivores	98.2%	3	98.9%	3	100%	1	96.7%	3	98.8%	3	100%	1
Coastal Plain	Percent Round-bodied Suckers	11.2%	5	5.8%	5	0.0%	1	2.2%	5	3.7%	5	0.0%	1
Coastal Plain	Percent Abundance Dominant Taxa	15.2%	5	54.4%	3	43.9%	3	14.8%	5	39.7%	5	80.0%	1
Coastal Plain	Fish Index of Biotic Integrity (FIBI)	4.0		4.3		2.0		4.0		4.7		2.0	
Coastal Plain	Stream Condition Rating	Good		Good		Poor		Good		Good		Poor	

Piedmont FIBI Metrics and Thresholds			
Metric	5	3	1
Abundance per square meter	≥ 1.25	0.25 – 1.24	< 0.25
Number of Benthic species *	≥ 0.26	0.09 – 0.25	<0.09
Percent Tolerant	≤ 45	46-68	>68
Percent Generalist, Omnivores, Invertivores	≤ 80	81-99	100
Biomass per square meter	≥ 8.6	4.0-8.5	<4.0
Percent Lithophilic Spawners	≥ 61	32-60	<32

Coastal Plain FIBI Metrics and Thresholds			
Metric	5	3	1
Abundance per square meter	≥ 0.72	0.45 – 0.71	< 0.45
Number of Benthic species *	≥ 0.22	0.01 – 0.21	0
Percent Tolerant	≤ 68	69 - 97	> 97
Percent Generalist, Omnivores, Invertivores	≤ 92	93 - 99	100
Percent Round-bodied Suckers	≥ 2	1	0
Percent Abundance Dominant Taxa	≤ 40	41 - 69	> 69

Notes:
1. Metric adjusted for catchment size per Roth et al. 1998.
2. Metrics shown are those recommended for the Coastal Plain and Piedmont ecoregions in Maryland protocol (Southerland et al 2005).

Table 9: Water Quality Measurements vs Maryland State Criteria

Water Quality Parameters	Fall 2016				Spring 2017				Water Quality Criteria	
	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Unnamed Tributary	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Unnamed Tributary	Criteria	Source
Pool Depth (ft)	3.9	4	2.2	0.4	3.5	4.73	2.44	0.64	-	-
Flow (ft/sec)	-0.11	-0.03	0.06	0.08	-0.04	0.02	0.02	0.5	-	-
Riffle Depth (ft)	2	1.3	1.5	N/A[1]	0.5	1.8	0.25	N/A[1]	-	-
Riffle Flow (ft/sec)	0.26	0.56	0.05	N/A[1]	1.42	1.16	0.3	N/A[1]	-	-
Conductivity (ms/cm)	0.326	0.339	1.477	0.459	0.358	0.365	0.469	0.635		
Turbidity (NTU)	N/A[2]	0.4	N/A[2]	1.5	2.6	3.5	5.2	2.8	<150 NTU	1
Dissolved Oxygen (mg/L)	10.17	10.61	10.76	7.9	10.35	10.56	10.86	8.55	> 5 mg/L	1
pH	8.42	8.85	6.89	7.6	7.81	8.07	6.72	7.73	6.5 - 8.5	1
Temperature (°C)	12.94	11.98	17.09	15.81	17.42	18.43	13.66	18.49	< 20°C	1
Kjeldahl Nitrogen (mg/L)	--	ND	ND	0.50 J	--	ND	ND	ND	N/A	-
Total Nitrite/Nitrate Nitrogen (mg/L)	--	0.92	1.2	0.62	--	0.73	1.2	0.24	10 mg/L	3
Total Phosphorus (mg/L)	--	ND	**0.17**	ND	--	ND	0.068 J	ND	0.1	4
Total NO2/NO3/TKN (mg/L)	--	0.92 J	1.2	1.1	--	0.73 J	1.2	ND	29.8 - 1.04 mg/L	2
Total Suspended Solids (mg/l)	--	ND	1.50 J	1.50 J	--	1.60 J	3.43	2.00 J	N/A	5

Notes:

-- = not sampled.

J = estimated concentration.

N/A[1] = not applicable, no riffle present. ND = non-detect.

(1) Maryland Water Quality Standards for Class III Designated Use waterbody (26.08.02.03-3 Water Quality Criteria Specific to Designated Uses).

(2) Total Nitrogen based on Acute Water Quality Criteria for freshwater aquatic life (based on pH between 6.7 and 8.9, salmonids present), COMAR §26.08.02.03-2.H(1).

(3) Drinking water standard for nitrates are set at 10 mg/L, nitrite standard is set at 1 mg/L. However, drinking water standards are not applicable for these streams.

(4) Maryland does not have phosphorus limits for surface waters, however, the EPA recommends TP levels to not exceed 0.1 mg/L in streams that do not enter a lake or reservoir.

(5) There is an approved Sediment TMDL for the Anacostia River watershed; however, there are no waste load allocations for sediment that apply to the Adelphi site.

Table 10: Macroinvertebrate Counts vs Background Data

Taxon	Location and Date	Site Locations						Reference Locations	
		Fall 2016			Spring 2017			2004	2008
	Common Name	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch[1]	Paint Branch[2]
Nemertea									
Tetrastemmatidae									
Prostoma	proboscis worm	8	3	16	-	-	-	-	2
Tricladida									
Planariidae									
Dugesia	flat worm	1	-	-	-	-	-	-	-
Nematoda	round worms	-	-	-	1	1	-	-	-
Oligochaeta									
Enchytraeidae	earth worm	1	-	3	3	1	-	-	-
Lumbricina	earth worm	1	2	4	1	1	1	-	-
Lumbriculidae	earth worm	-	-	-	-	-	-	1	-
Naididae	naiad worm	7	7	2	6	29	22	-	-
Tubificidae	tube worm	-	-	2	6	-	6	-	9
Limnodrilus	tube worm	11	-	5	-	-	-	-	-
Basommatophora									
Ancylidae									
Ferrissia	limpet snail	3	8	8	1	-	-	-	-
Lymnaeidae									
Galba	pond snail	1	-	-	2	-	-	-	-
Physidae									
Physella	bladder snail	7	-	17	4	-	1	-	-
Planorbidae									
Menetus	ramshorn snail	1	-	1	1	-	-	-	-
Veneroidea									
Sphaeriidae									
Pisidium	pill clam	4	-	3	2	-	-	-	-
Amphipoda									
Crangonyx	side swimmer	9	-	-	2	2	-	10	-
Hydracarina									
Lebertia	water mite	2	4	-	-	-	-	-	-
Odonata									
Boyeria		-	-	-	-	-	-	2	-
Gomphidae		-	-	-	-	-	-	2	-
Calopterygidae									
Calopteryx	damselfly	-	-	-	-	-	-	5	-
Coenagrionidae		-	-	-	-	-	-	3	-
Argia	damselfly	-	-	2	-	-	-	-	-
Enallagma	damselfly	8	-	5	1	-	-	-	-

Table 10: Macroinvertebrate Counts vs Background Data (cont.)

Taxon	Location and Date / Common Name	Site Locations – Fall 2016 – Paint Branch Upstream	Fall 2016 – Paint Branch Downstream	Fall 2016 – Hillandale Run	Spring 2017 – Paint Branch Upstream	Spring 2017 – Paint Branch Downstream	Spring 2017 – Hillandale Run	Reference Locations – 2004 – Paint Branch[1]	Reference Locations – 2008 – Paint Branch[2]
Ephemeroptera									
Baetidae									
Baetis	mayfly	-	-	-	-	1	-	-	-
Ephemerella	mayfly	-	-	-	-	-	-	-	1
Heptageniidae									
Stenacron	mayfly	1	-	-	-	-	-	-	-
Hempitera									
Belastoma	giant water bug	-	-	1	-	-	-	-	-
Trichoptera									
Hydropsychidae									
Cheumatopsyche	caddisfly	-	10	1	-	1	-	13	7
Hydropsyche	caddisfly	-	9	-	-	1	-	4	1
Hydroptilidae									
Hydroptila	caddisfly	1	10	-	-	-	-	-	-
Leptoceridae									
Mystacides	caddisfly	-	1	-	-				
Philopotamidae									
Chimarra	caddisfly	-	-	2	-	-	-	-	-
Polycentropodidae									
Polycentropus	caddisfly	1	-	4	-	1	-	-	-
Decapoda									
Cambaridae									
Cambarus	crayfish	-	-	-	-	-	2	-	-
Plecoptera									
Nemouridae									
Amphinemura	stonefly	-	-	-	1	-	-	-	-
Coleoptera									
Elmidae									
Ancyronyx	riffle beetle	3	2	-	1	-	3	-	-
Dubiraphia	riffle beetle	1	-	-	-	-	2	-	-
Macronychus	riffle beetle	-	-	2	2	-	-	1	-
Optioservus	riffle beetle	-	1	-	-	-	-	-	-
Stenelmis	riffle beetle	-	-	4	-	-	-	-	-
Hydrophilidae	scavenger beetle	-	-	1	-	-	-	-	-
Psephenidae									
Ectopria	water penny	1	-	2	-	-	-	-	-

Table 10: Macroinvertebrate Count vs Background Data (cont.)

	Location and Date	Site Locations						Reference Locations	
		Fall 2016			Spring 2017			2004	2008
Taxon	Common Name	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch[1]	Paint Branch[2]
Diptera									
Ceratopogonidae									
Atrichopogon	sand fly	-	-	-	1	-	-	-	-
Ceratopogon	sand fly	-	-	-	-	-	2	-	-
Culicoides	sand fly	1	-	-	-	-	1	-	-
Chironomidae									
Ablabesmyia	midge	-	-	-	3	2	2	-	-
Brillia	midge							2	-
Chironomus	midge	-	3	3	1	-	-	-	-
Cladopelma	midge	-	-	-	1	-	-	-	-
Cladotanytarsus	midge	-	-	-	4	4	-	-	-
Corynoneura	midge	-	4	-	1	2	2	-	-
Cricotopus	midge	10	6	-	-	3	-	-	19
Cryptochironomus	midge	-	3	-	-	-	1	-	1
Diamesa	midge	-	-	-	-	-	4	-	-
Dicrotendipes	midge	14	11	2	5	2	-	-	-
Diplocladius	midge	1	-	-	-	-	2	-	-
Eukiefferiella	midge	-	-	-	-	-	1	1	-
Hydrobaenus	midge							1	39
Microtendipes	midge	-	3	-	-	-	-	-	-
Micropsectra	midge	-	-	-	-	-	-	-	1
Nanocladius	midge	-	-	-	-	-	-	-	2
Orthocladius	midge	-	6	1	10	28	13	10	14
Parametriocnemus	midge	-	-	-	-	-	12	2	-
Paratanytarsus	midge	-	7	-	2	4	-	1	-
Phaenopsectra	midge	3	3	1	2	-	-	2	-
Polypedilum	midge	-	-	5	11	10	2	-	2
Potthastia	midge	-	-	-	-	-	-	1	-
Psectrocladius	midge	-	-	-	-	3	-	-	-
Rheocricotopus	midge	-	-	-	-	-	-	-	1
Rheosmittia	midge	-	-	-	-	-	-	4	-
Rheotanytarsus	midge	3	-	-	2	-	2	-	1
Stenochironomus	midge	1	1	-	-	6	1	-	-
Stictochironomus	midge	-	-	-	4	-	-	-	-
Tanytarsus	midge	9	2	-	7	-	-	-	3
Thienemannella	midge	1	-	-	1	-	-	-	2
Thienemannimyia gr.	midge	-	-	6	-	-	4	14	7
Tvetenia	midge	-	-	-	2	-	6	11	-
Xylotopus	midge	-	-	1	-	-	-	-	-
Zavrelimyia	midge	-	-	-	-	-	-	9	-

Table 10: Macroinvertebrate Count vs Background Data (cont.)

Taxon	Location and Date / Common Name	Site Locations: Fall 2016: Paint Branch Upstream	Fall 2016: Paint Branch Downstream	Fall 2016: Hillandale Run	Spring 2017: Paint Branch Upstream	Spring 2017: Paint Branch Downstream	Spring 2017: Hillandale Run	Reference Locations: 2004: Paint Branch[1]	2008: Paint Branch[2]
Empididae									
Hemerodromia	dance fly	-	1	-	1	1	-	1	-
Tipulidae									
Antocha	crane fly	-	-	-	-	3	-	2	1
Tipula	crane fly	-	1	1	-	-	1	6	-
Total Specimens		115	108	105	92	106	93	108	113
Piedmont Metrics									
Index of Biotic Integrity (IBI)		2.3	2.0	2.3	2.7	2.0	1.7		
Stream Condition Rating		Poor	Poor	Poor	Poor	Poor	Very Poor		
Coastal Plain Metrics									
Index of Biotic Integrity (IBI)		3.6	3.0	3.0	2.7	2.7	2.4	3.0	2.7
Stream Condition Rating		Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor

Notes:
1. Data from MBSS site summary for ANAC-208-R-2004 as part of the Maryland DNR Maryland Biological Stream Survey.
2. Data from MBSS site summary for ANAC-401-R-2008 as part of the Maryland DNR Maryland Biological Stream Survey.

Table 11: Fish Count vs Background Data

Location	Site Locations						Reference Locations		
	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch Upstream	Paint Branch Downstream	Hillandale Run	Paint Branch[1]	Paint Branch[2]	Little Paint Branch[3]
Sample Date	10/12/2016	10/13/2016	10/13/2016	4/19/2017	4/19/2017	4/18/2017	2004	2008	1997
Fish Species	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals	Number of Individuals
American eel	6	31	35	15	71	18	18	2	11
Blacknose dace	19	712	68	40	450	312	277	83	29
Blue ridge sculpin	2	8	0	1	5	0	59	-	-
Bluegill	12	28	0	6	28	0	1	1	-
Common shiner	29	56	0	19	66	0	-	-	-
Creek chub	3	4	29	3	10	42	6	-	7
Cutlips minnow	9	24	0	14	18	0	-	-	-
Fall fish	5	30	0	9	26	0	49	-	4
Green sunfish	-	-	-	-	-	-	2	-	-
Northern hog sucker	25	76	0	6	42	0	3	-	-
Largemouth bass	-	-	-	-	-	-	6	-	-
Longnose dace	15	45	2	10	57	0	74	4	50
Margined madtom	4	33	0	29	67	0	8	-	-
Pumpkinseed	2	0	0	0	0	0	-	-	-
Redbreast sunfish	34	26	0	18	48	0	30	-	-
Redear sunfish	1	1	0	0	3	0	-	-	-
Rosyside dace	25	87	3	27	76	6	2	-	16
Satinfin shiner	4	15	0	16	42	0	58	-	-
Sea lamprey	1	5	0	8	6	0	25	-	-
Spotfin shiner	10	26	0	13	9	0	-	36	-
Spottail shiner	0	6	0	1	10	0	2	2	-
Striped shiner	0	1	0	0	0	0	-	-	-
Swallowtail shiner	3	18	0	12	25	0	-	-	-
Tesselated darter	3	28	0	19	50	0	151	-	-
White sucker	12	50	18	5	25	17	12	-	1
Total Specimens	224	1310	155	271	1134	395	783	128	118
Piedmont Metrics									
Fish Index of Biotic Integrity	3.3	4.0	2.0	3.3	4.0	2.3			
Stream Condition Rating	Fair	Good	Poor	Fair	Good	Poor			
Coastal Plain Metrics									
Fish Index of Biotic Integrity	4.0	4.3	2.0	4.0	4.7	2.0	4.7	2	2.3
Stream Condition Rating	Good	Good	Poor	Good	Good	Poor	Good	Poor	Poor

Notes:
1. Data from MBSS site summary for ANAC-208-R-2004 as part of the Maryland DNR Maryland Biological Stream Survey.
2. Data from MBSS site summary for ANAC-401-R-2008 as part of the Maryland DNR Maryland Biological Stream Survey.
3. Data from MBSS site summary for MO-P-258-213-97 as part of the Maryland DNR Maryland Biological Stream Survey.

APPENDIX C

Photolog


Photo 1: Paint Branch downstream reach, looking upstream


Photo 2: Paint Branch downstream reach, looking downstream


Photo 3: Paint Branch upstream reach, looking downstream


Photo 4: Paint Branch upstream reach, looking upstream


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Photo 6: Hillendale Run reach, looking downstream

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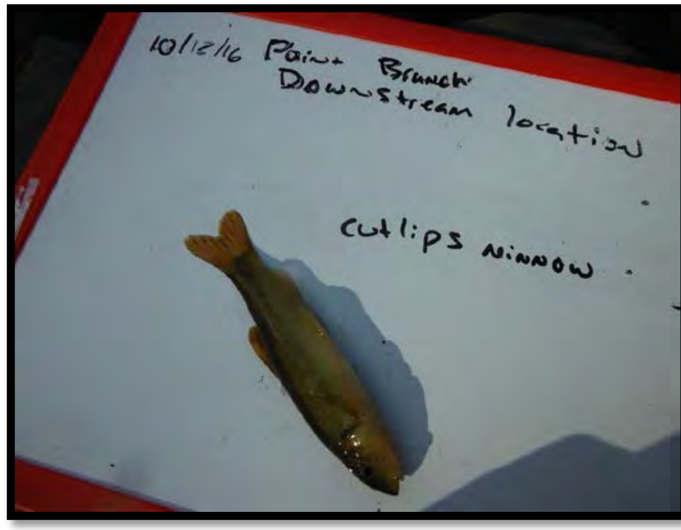

Photo 20: Cutlip minnow

Photo 21: Spotfin shiner

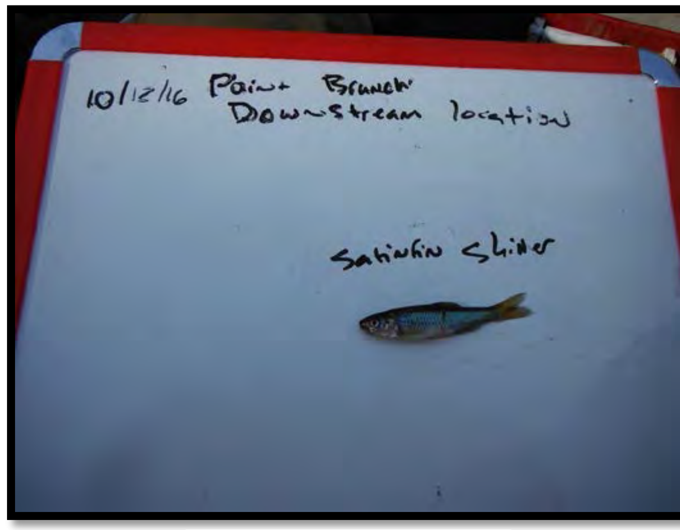

Photo 22: Satinfin shiner

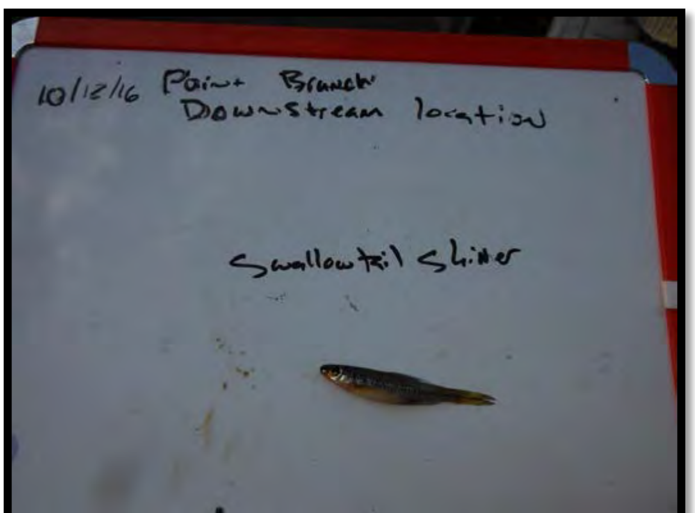

Photo 23: Swallowtail shiner

Photo 24: Spottail shiner

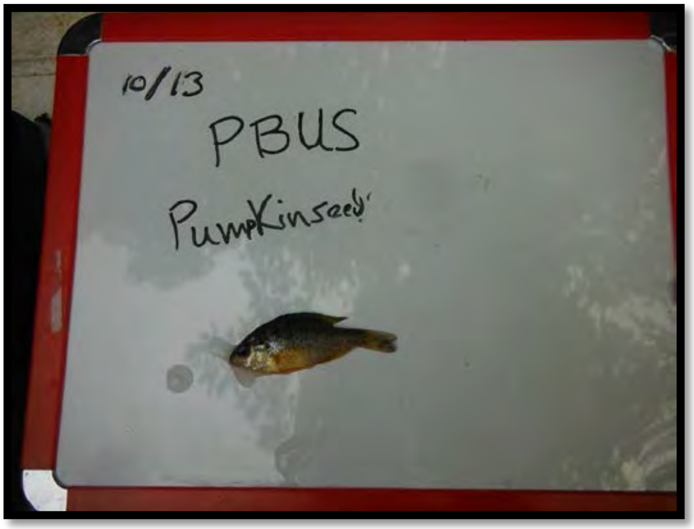

Photo 25: Pumpkinseed sunfish

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Photo 27: Rosyside dace

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Photo 29: Striped shiner

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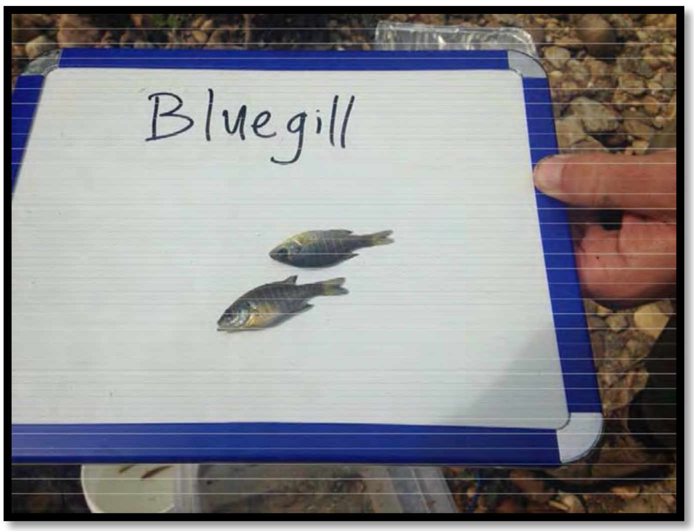

Photo 33: Bluegill

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Photo 36: Northern water snake

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Photo 43: Hillendale Run stable center section, bedrock in both banks

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APPENDIX D

Paint Branch Sub-Watershed Action Plan

Paint Branch Subwatershed Action Plan

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Section 1
Vision and Existing Conditions

The Paint Branch Subwatershed Action Plan (SWAP) is intended to be an integrated summary document for the Paint Branch Subwatershed Environmental Baseline Conditions Report and the Paint Branch Subwatershed Provisional Restoration Projects Inventory. Based on a planning level analysis and evaluations, various activities or actions have been identified as part of a 10-year comprehensive restoration plan for the Anacostia River watershed. In addition, the layout of the report is intended to follow as closely as possible the EPA nine key elements to develop a watershed plan to improve water quality impairments, and are the minimal requirements to be eligible to receive incremental Clean Water Act Section 319 funding (EPA, 2008).

Need and Purpose

The Anacostia River watershed lies in a heavily populated urban landscape substantially altered from natural conditions. Urbanization causes many environmental changes. Among these, impervious surfaces cause excessive runoff, a reduction in groundwater recharge, a reduction in water quality through the transport of pollutants, a loss of riparian areas, and ultimately a degradation of the watershed's ecological habitat. The increase in impervious areas has disrupted the natural hydrologic cycle and ultimately affected the environmental health of the Anacostia River and its tributaries.

While urbanization and impervious surfaces are the primary stressors for the overall Anacostia River watershed, there is regional variation throughout the watershed and as such, the extent and source of the environmental stressors as well as potential restoration actions will be evaluated on a subwatershed basis. As part of the Anacostia Restoration Plan (ARP) study, each of the 14 primary subwatersheds and the Tidal Anacostia River reach were evaluated in order to determine problems and opportunities at the subwatershed scale for environmental or ecological restoration, and present this information in such a way that would be beneficial to several different audiences. In addition, for each of the 14 primary subwatersheds and the Tidal Anacostia River reach, a SWAP, an environmental baseline conditions report, and a subwatershed provisional restoration project inventory was generated.

The purpose of the Paint Branch SWAP is to provide a vision statement and targets for restoration within the subwatershed by the year 2020, identify and describe specific problems within the subwatershed, discuss methodologies used to evaluate potential restoration opportunities, and present a prioritized list of restoration opportunities for implementation.

The identification of restoration opportunities and potential projects were based on the following selected strategies:

1. Stormwater Management Retrofits
2. Stream Restoration
3. Wetland Creation and Restoration
4. Fish Blockage Removal/Modification
5. Riparian Reforestation, Meadow Creation, Street Tree, and Invasive Species Management
6. Trash Reduction
7. Toxic Remediation
8. Parkland Acquisition

Building upon the preceding eight restoration strategies, the following 2020 restoration objectives align with and expand upon the existing Anacostia River watershed restoration goals and requirements established by the Anacostia Watershed Restoration Partnership (AWRP):

1. **Stormwater Management:** Implement stormwater retrofits or Best Management Practices (BMPs) to reduce pollutant loading and increase flow regime stability. Increase use of homeowner BMPs throughout the subwatershed.
2. **Wetland Creation and Restoration:** Increase wetland habitat throughout the subwatershed.
3. **Riparian Corridors:** Increase the health of riparian corridors so as to both improve wildlife habitat connectivity and reduce the number of invasive plant problem sites. Also, increase overall tree canopy coverage throughout the subwatershed.
4. **Aquatic Community**: Increase the health of the aquatic community; specifically increase the number of resident fish species and providing for a healthier macroinvertebrate community food base. Restore migratory fish usage of Paint Branch.
5. **Trash Reduction**: Dramatically reduce trash loads in Paint Branch.
6. **Outreach:** Increase participation of residents, businesses, and school-age children in activities that are beneficial to the watershed.
7. **Parkland Acquisition:** Increase parkland and habitat connectivity

10-Year Vision

The Paint Branch subwatershed vision is to create, by the year 2020, a more environmentally healthy and sustainable watershed by dramatically reducing stormwater runoff volumes, stream channel erosion problems, trash levels and pollutant loadings; protecting and restoring aquatic and terrestrial habitats and associated biological communities; enhancing watershed recreational opportunities; and fully engaging both public and private sectors through expanded environmental education and incentive-based initiatives. The preceding objectives are a continuation of and expansion on the AWRP's existing Anacostia River watershed goals, leading to the achievement of realistic and attainable restoration targets within the next decade.

Paint Branch 2020 Restoration Targets

The Paint Branch 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Paint Branch subwatershed as part of the ARP, along with realistic expectations of what could be accomplished in ten years to meet the 2020 restoration objectives. These targets are established to ensure that restoration of the subwatershed is proceeding in the right direction and at a continuous, reasonable pace. The analysis presented in this SWAP will help to establish specific target levels of restoration for the subwatershed. Quantitative targets established such as stormwater management, aquatic community, trash reduction, wetland creation/restoration, riparian corridor restoration, and land acquisition, will be based on the potential restoration project inventory and recommend acreages or mileages to be restored, whereas the qualitative targets including environmental programs and public outreach will recommend programmatic actions that will serve to increase public awareness and interest in restoring the Anacostia watershed. The 2020 Restoration Targets are presented in Section 4 of this SWAP.

Existing Conditions in the Paint Branch Subwatershed

The Paint Branch subwatershed, which has a drainage area of 20.5 square miles (or approximately 13,121 acres), is located in the northwestern vicinity of the Anacostia River watershed (Figures 1-2 and 1-3). The Paint Branch subwatershed is located within Montgomery and Prince George's Counties, Maryland. The three largest land uses of the area in the Paint Branch subwatershed are forest cover/open space/parkland/institutional, medium density single family residential, and low density single family residential. There are approximately 10,380 single-family homes. The subwatershed includes three major Federal facilities and one major State facility; the General Services Administration's 787-acre Federal Research Center, the U.S. Army's 23-acre Harry Diamond Laboratory, USDA's 365-acre Beltsville Agricultural Research Center-'South Farm', and the 1,500-acre University of Maryland, College Park Campus. Impervious surfaces make up about 17-percent of the subwatershed. Elevations range from 560 feet at the Paint Branch/Patuxent River watershed divide to 35 feet at the Northeast Branch, with an average gradient of 0.60-percent over 11.4 miles of the main stem. Paint Branch flows from its headwaters in the Piedmont physiographic province, through the Fall Line, into the Coastal Plain. Table 1-1 and Figure 1-1 present a summary of the impervious surfaces within the Paint Branch subwatershed. There are approximately 329 storm drain outfalls in the Paint Branch and only about 19-percent of the impervious surfaces in the subwatershed have stormwater controls (Figure 1-4). Table 1-1 summarizes the current level of stormwater control of impervious areas (by acre) within the Paint Branch subwatershed.

The area located in the northern portion of the watershed north of Randolph Road has been designated a Special Protection Area (SPA) by the Montgomery County Council in order to protect the naturally reproducing brown trout fisheries. The SPA designation includes strict restrictions and conditions for new development, and was followed by an aggressive stream valley conservation park initiative by the Maryland-National Capital Park and Planning Commission (M-NCPPC). It should also be noted that the six-lane Inter County Connector (ICC) is presently under construction and the road's alignment takes it across the most environmentally sensitive portions of the SPA.

Figure 1-1: Impervious Surfaces in the Paint Branch Subwatershed

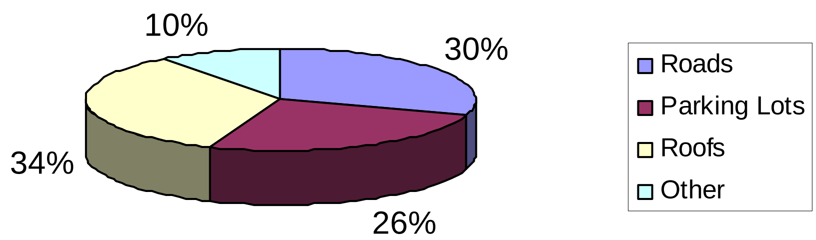


Table 1-1: Impervious Surfaces in the Paint Branch Watershed and Existing Level of Control

	Miles	Acres
Roads	194.0	**663.9**
State/Federal	20.1	165.0
Local	173.9	498.9
Parking Lots	…	**587.8**
Public/Institutional	…	183.0
Private	…	404.7
Roofs	…	**755.3**
Public/Institutional	…	137.6
Private	…	185.1
Single Family	…	432.6
Other	…	**229.6**
Sidewalks	…	84.3
Single Family Driveways	…	145.3
Total Impervious Acres	388.0	2,239.9
Total Subwatershed Acres		13,121
Avg. % Imperviousness		17.0%
Current Impervious Acreage Controlled		435.1
Current-percent Impervious Acreage Controlled		19.4%
Number of existing BMPs		283

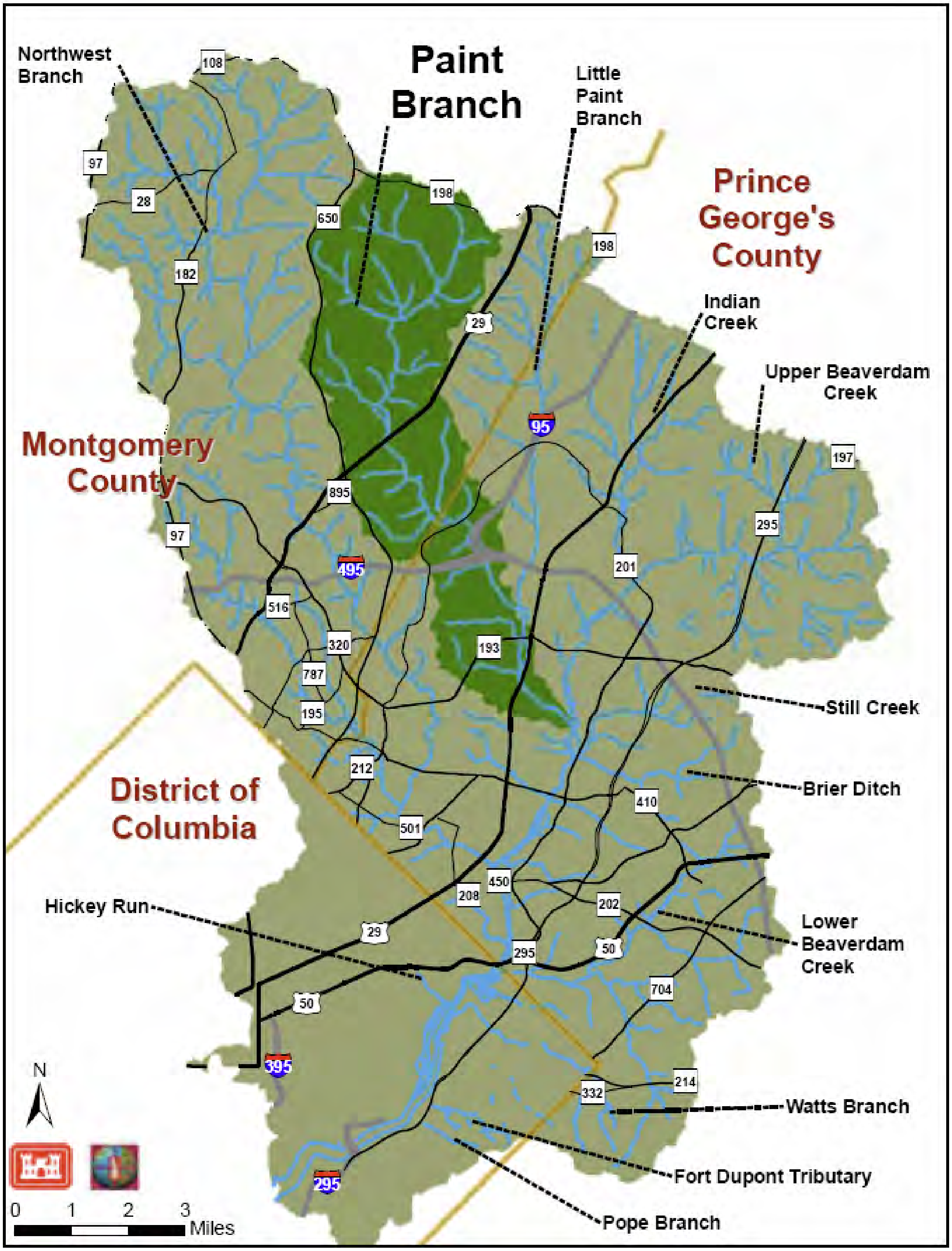


Figure 1-2: Paint Branch Subwatershed

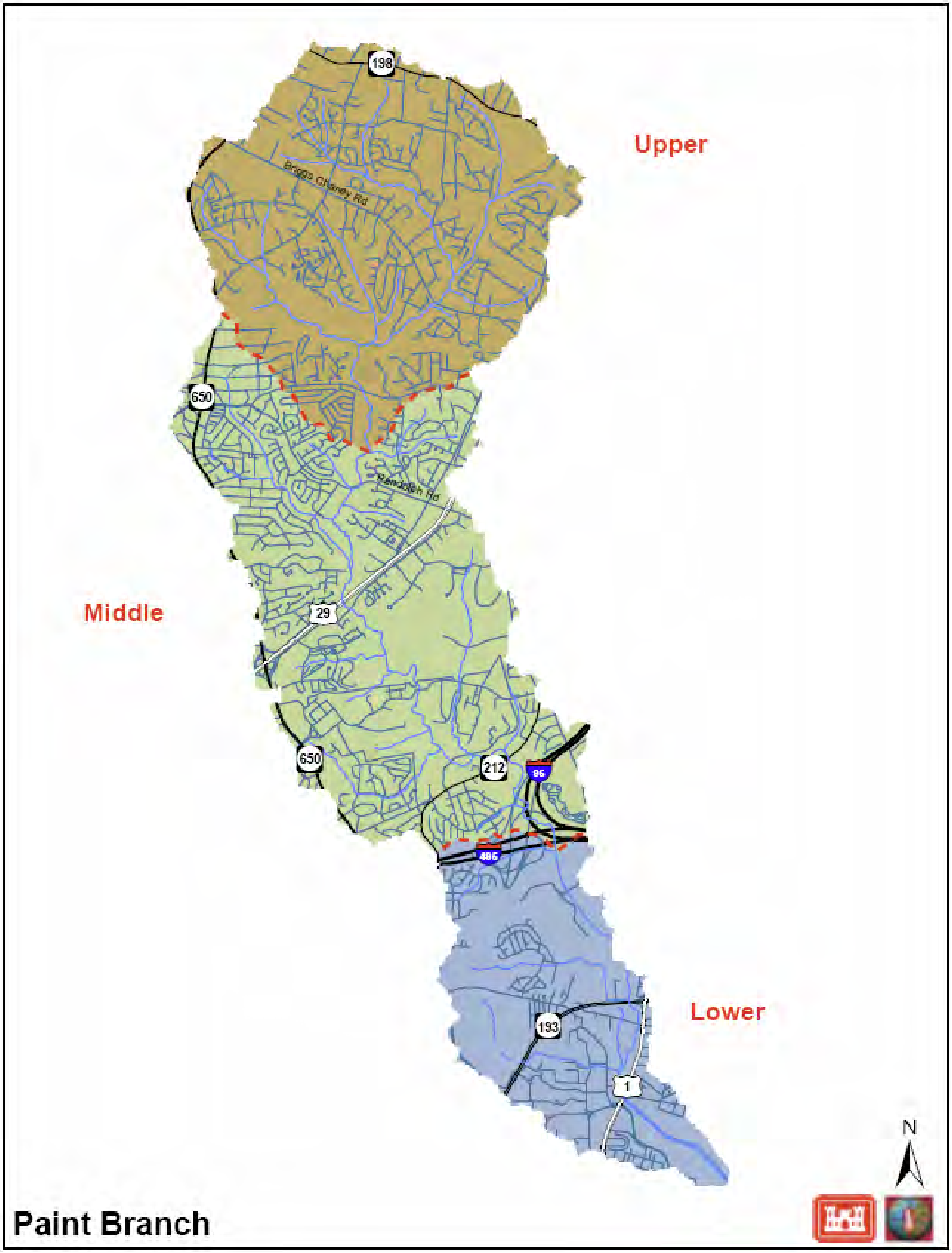


Figure 1-3: Paint Branch Planning Units

In February 2006, the Lower Paint Branch Watershed Restoration Study was completed for Montgomery County Department of Environmental Protection for portions of the subwatershed within Montgomery County only. The objective of this study was to identify and prioritize stormwater management opportunities, including Low Impact Development (LID) opportunities and stream restoration projects. Information from this report was reviewed as part of the Anacostia Restoration Project (ARP) effort to identify restoration opportunities within Paint Branch subwatershed. A separate, complimentary study is currently underway for portions of the Little Paint Branch and Paint Branch subwatersheds in Prince George's County. A separate Paint Branch study is being conducted by the M-NCPPC, Anacostia Watershed Society (AWS), the University of Maryland, and the City of College Park, Maryland. The objective of the study is to identify and prioritize restoration opportunities for mitigation purposes in greater detail than the ARP effort as the lower reach redevelops. A coordination meeting between the stakeholders involved in the study occurred on July 8, 2009.

A U.S. Army Corps of Engineers (USACE) feasibility study for fish passage and ecosystem restoration was completed in September 2006 under Section 206 of the Continuing Authorities Program. The stream restoration project study area extends from U.S. Route 1 upstream to University Boulevard, and is bounded by U.S. Route 1 to the south and east, and Paint Branch Drive to the west. The anticipated construction start is summer 2010 with Prince George's County signing a cost-sharing agreement. Additional stakeholders involved in the study include the University of Maryland and M-NCPPC, which owns the parkland within the stream valley.

In May 2007, the University of Maryland completed the University of Maryland Potential Water Quality Improvement Study. The objective of the study was to identify potential water quality improvement opportunities for the College Park Campus and surrounding campus facilities, including the University of Maryland College Park Golf Course. Information from this report was reviewed as part of the ARP effort to identify restoration opportunities within the Paint Branch subwatershed.

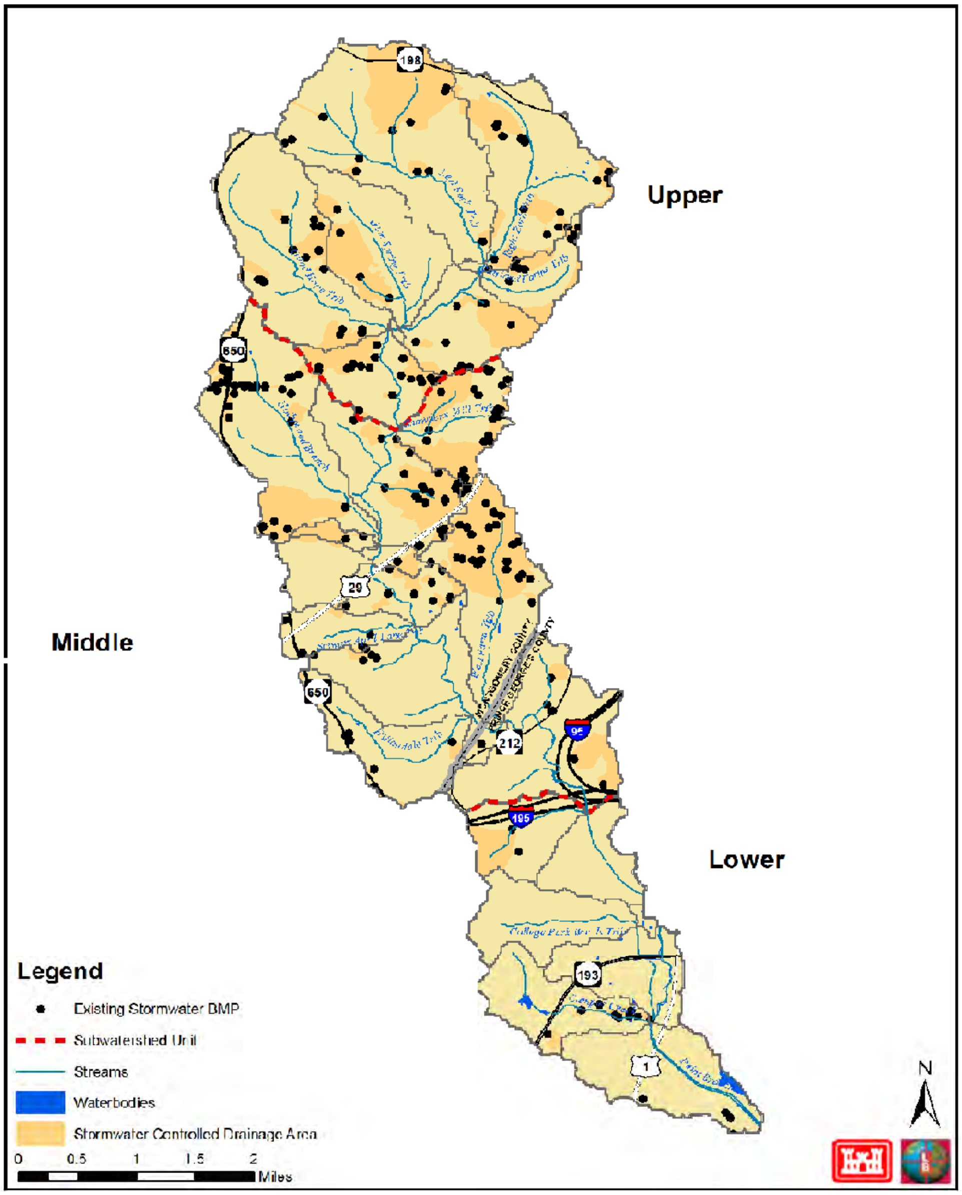


Figure 1-4: Paint Branch Existing BMPs

Problems Facing the Paint Branch Subwatershed

Changes to Hydrology

The development of the Paint Branch subwatershed has altered the hydrology and flow regime, and is a major cause for other problems facing the subwatershed. The change in land cover from forest or agriculture to impervious surfaces (such as roofs, roads, and parking lots) has set up a dynamic in which stormwater runoff increases and infiltration of precipitation into soils decreases. An increase in stormwater runoff increases peak discharge that provides energy necessary to erode stream banks as well as discharging pollutants from overland sources into receiving streams. Moderate to severe stream channel erosion was documented in all three sections of the Paint Branch subwatershed, with the far more extensive erosion areas being located in the lower section, south of the Capital Beltway (Route 495).

Poor Aquatic Habitats

Since the late 1980's many natural resources professionals working in the Anacostia watershed have monitored these communities using an *Index of Biotic Integrity* or IBI approach. The IBI compares the fish and macroinvertebrate communities of urban streams with those of healthy reference streams, incorporating geographical, ecosystem, community, and population, as well as distribution and abundance variables that account for differences in water body size, type, and region of occurrence. While there are still many gaps in the Anacostia macroinvertebrate and fish community IBI databases, available data have proven extremely valuable in the restoration effort. In general, the overall health of the aquatic community in Paint Branch can be characterized as ranging from Poor to Good in the middle and lower basins, and from Good to Excellent in the Upper, less developed basin. Currently about 53-percent of the stream miles have adequate riparian buffers (300 feet total width). There are multiple physical barriers to fish movement in the subwatershed. Many of these blockages are a result of channelization, perched culverts, and exposed utility lines. A total of 35 blockages were field verified. There have been 3 major main stem and two major tributary fish passage projects completed since 1990. The Paint Branch Environmental Baseline Conditions and Restoration Report appendix contains additional information on the locations of the fish barriers and IBI data for the subwatershed.

Poor Water Quality

Water quality also plays a major role in the problems facing the Paint Branch subwatershed. This area was developed prior to the era of mandatory stormwater controls; as such there are 329 storm drain outfalls and only about 20-percent of the subwatershed has stormwater controls. The high level of imperviousness, inadequate numbers of stormwater management controls, old sewer systems, as well as high levels of stream channel erosion have all contributed to the Paint Branch subwatershed total suspended solids (TSS) load. The TSS load is estimated to be approximately 72 tons/square mile/year. The nutrient loading rates associated with this are presented in Table 1-2. The sediment Total Maximum Daily Load (TMDL) analysis for the Anacostia River estimates that approximately 70-percent of the sediment loaded into the tidal estuary originates from the stream banks and channels. Further discussion of Best Management Practices (BMPs) and TMDLs for the Anacostia River watershed can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Toxics, which include trace metals, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), pesticides, herbicides, enter the surface waters of the subwatershed via runoff (non-point source) and industrial/municipal discharge. There has been minimal data collected to determine the amount and source of the toxics that are present in the Paint Branch subwatershed, as such, the extent of the problem is unknown at this time. There are a total of 119 National Pollutant Discharge Elimination System (NPDES) related discharges in the Anacostia watershed and 13 of them are located within the Paint Branch subwatershed. Figure 1-5 shows the location of NPDES sites in the Anacostia watershed. There are three Resource Conservation and Recovery Act (RCRA) sites located in the Paint Branch subwatershed (2 in the middle basin and one in the lower basin). These sites are shown on Figure 1-6. There are no Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund) sites are located within this subwatershed.

Figure 1-5: NPDES Sites in Anacostia Watershed

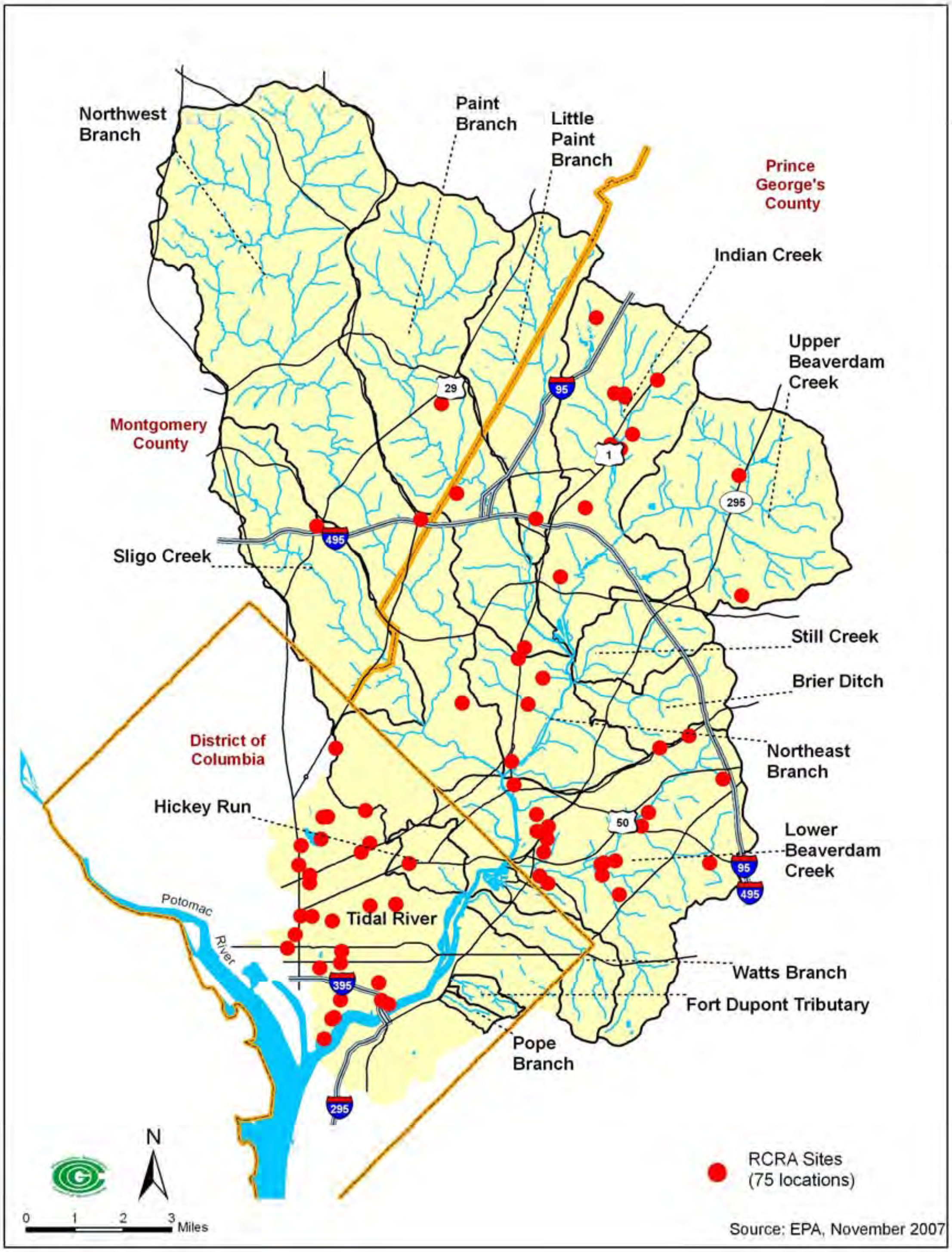


Figure 1-6: RCRA Sites in Anacostia Watershed

The available fecal coliform sampling for Anacostia River watershed suggests that streams in the watershed do not meet established bacterial water quality standards. While this data is not specifically available for Paint Branch, studies done in other subwatersheds of the Anacostia River have shown that bacterial contamination is contributed to the subwatershed by the following sources; Human (9 to 55-percent), domestic animals (24 to 28-percent), livestock (6 t 28-percent), wildlife (12 to 38-percent). As a result of the requirement for Washington Sanitary Sewer Commission (WSSC) to rehabilitate its sewer line system in Maryland and develop a water quality management plan, there are now 17 monitoring stations located in Paint Branch subwatershed

Trash
Trash is another non-point source contaminant entering the system. Trash surveys have indicated that the middle and lower main stem of Paint Branch have one of the highest trash levels in the Anacostia watershed. This is not surprising given the high population density of the subwatershed.

Flooding
Flooding has been a long-standing problem throughout the Anacostia River watershed, particularly in Prince George’s County, though areas of Montgomery County and the District of Columbia experience episodic flooding as well. Prince George’s County is prone to flooding because the county is located within the Coastal Plain physiographic province, which is generally wider and flatter, and due to development of floodplains prior to the development of stormwater management regulations and controls. Periodic flooding within Paint Branch can occur throughout the watershed in all three sections, but the most frequently flooded areas are in the main stem in the lower section, downstream of the confluence of Little Paint Branch.
Further data and discussion regarding the current conditions of the Paint Branch subwatershed can be found in the Anacostia Watershed Environmental Baseline Conditions and Restoration Report prepared by MWCOG.

Existing Pollutant Loads

Existing pollutant loadings for sediment, nitrogen (N), and phosphorous (P) was calculated for the Anacostia River watershed TMDL by MDE. As part of the ARP, the sediment, N, and P loadings were calculated for the Paint Branch subwatershed using the same loading rates per land use for the TMDL in order to estimate the Paint Branch subwatershed’s contribution of pollutant load to the overall Anacostia River load (Kim et al, 2007; Mandel et al, 2008). The Anacostia River watershed TMDL identifies a reduction goal for sediment, N, and P as 85-, 79-, and 80-percent, respectively. By knowing the percent reduction necessary for the entire Anacostia River watershed and applying the percent reduction to the Paint Branch subwatershed pollutant loading estimate, the subwatershed loading reduction for Paint Branch necessary to achieve the overall Anacostia River watershed TMDL can be estimated. Additional information is available on the existing pollutant loading calculations is available in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Identifying the existing magnitude of loadings on a subwatershed basis allows for the ability to geographically target and evaluate the scale of restoration needed to reduce N, P, and sediment inputs within each subwatershed to attain goals. A summary table of Paint Branch subwatershed current loadings and how they compare to the rest of the Anacostia River watershed is found in Table 1-2. The efforts to attain TMDLs are being led by the U. S. Environmental Protection Agency (EPA) and MDE, and as such neither this SWAP nor the ARP are intended to serve as TMDL implementation plans, although data presented here may contribute to that effort. The Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report provides more details regarding the methodology used to obtain the current loading estimates and presents the results of those analyses. It must be noted that the analyses conducted for the ARP in regards to pollutant reduction only considered overland flow, and does not account for pollutant contribution from the stream channel itself, namely sediment from erosion. Additional detailed modeling would be required to determine sediment transport change associated with reduced runoff volumes from implementation of the stormwater management retrofit projects identified in the ARP.

Table 1-2: Nutrient Loading Estimates for Paint Branch Subwatershed and Comparison Values

	Nitrogen lbs/sq mi/year	Phosphorus lbs/sq mi/year	TSS tons/sq mi/year
Paint Branch	4,532	336	72
Average Anacostia Subwatershed	5,255	500	99
Completely Forested Watershed	42	8	Value not calculated

Table 1-3: TMDL Reduction Goals

	Nitrogen lbs/sq mi/year	Phosphorus lbs/sq mi/year	TSS tons/sq mi/year
Anacostia River Watershed TMDL Reduction Goals	79%	80%	85%
Estimated Paint Branch TMDL Loadings	4,532	336	72
Estimated Paint Branch Reduction Goal	3,580	269	61

Section 2
Inventory of the Provisional Restoration Candidates

Inventory of the Provisional Restoration Candidates

As part of the ARP study, a systematic process was developed to identify, catalog, and evaluate each restoration opportunity. In addition, the evaluation of restoration projects was completed by using a detailed system to score the various projects and ultimately determine a ranking of projects. The opportunities presented were identified through the compilation of existing data, input from local jurisdictions, GIS analyses, and field observations. The existing data provided by the local municipalities included land use data, public/private ownership information, impervious surfaces data, planning department classifications, digital elevation models, stormwater management data, and aerial photographs. A detailed explanation of the methodology utilized to identify the opportunities can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

In addition to the restoration strategies discussed in Section 1, the potential projects identified as part of this analysis are intended to achieve one or more of the following 2020 restoration objectives:

1. Stormwater Management
2. Wetland Creation and Restoration
3. Riparian Corridors
4. Aquatic Community
5. Trash Reduction
6. Outreach
7. Parkland Acquisition

Table 2-1 identifies potential project types per objective, gives a brief description, and states the metric that will be used.

Table 2-1: 2020 Paint Branch Restoration Objectives		
Objectives	**Description of Objective**	**Metric**
Stormwater Management		
Retrofits, ESD, LID	Retrofit current stormwater controls, utilize bioretention, filters, bioswales, wet ponds, wetlands to add controlled acreage to the subwatershed	Acres Controlled and Pounds of N, P, TSS loading reduced
Homeowner BMPs	Include use of Green roofs, disconnects, rain barrels, permeable pavement, and rain gardens	Acres Controlled and Pounds of N, P, TSS loading reduced
Trash		
Implement reduction projects	Reduce trash through use of netting, catching, and grates	Number of Projects Implemented / MWCOG Trash Index Rating
Street Sweeping	Increase street sweeping programs	Acres Swept and Pounds of N, P, TSS loading reduced
Aquatic Community		
IBI Rating for Fish	Restore fish habitat through improved water quality and flow management	Index of Biotic Integrity Rating
IBI Rating for Macroinvertebrate	Restore macroinvertebrate habitat through improved water quality and flow management	Index of Biotic Integrity Rating
Fish Passage	Remove barriers to fish migration	Miles of Stream
Wetland Creation and Restoration		
Create and Restore Acreage	Create new wetlands and vernal pools and restore/expand existing ones	Acreage created or restored
Riparian Corridors		
Invasive Species Management	Removal of invasive species from the corridor	Acres managed
Reforestation	Replanting of the riparian corridor	Acres reforested
Increase Tree Canopy	Tree planting in both urban and non-urban areas	Acres / % increase
Outreach / Public Involvement		
Increase participation of residents and businesses	Educate the public about BMPs and encourage their use of them	Qualitative
Establish Friends of Paint Branch Organization	Establish a subwatershed group to facilitate public involvement	Yes or No
Incentive Programs	Expand current programs and encourage businesses to offer incentives. Assist private owners with measures such as rain barrels.	Expanded or Maintained

A total of 369 potential restoration candidate projects within the Paint Branch subwatershed have been identified as part of the ARP investigation. The complete inventory and description of the 369 proposed projects are included in Project Inventory section of this appendix. The potential restoration projects address five of six restoration strategies identified for the Paint Branch 2020 restoration objectives (does not include projects for increasing participation). The presence of toxic contaminants has been identified in Paint Branch; however, detailed studies have not been completed to identify the exact sources and extent of the problem, and thus there are no provisional restoration candidate projects that address toxics in the report. It is recommended that further studies regarding the source and extent of toxic contamination should be undertaken by the appropriate authorities. In addition to illicit discharges, historic dump sites may be sources of toxic contaminants in the system. A diagram of these sites and current NPDES sites can be found in Section 1 of this subwatershed action plan on Figures 1-3 and 1-4.

Tables 2-2, 2-3, and 2-4 provide a summary of the proposed restoration project types, quantity, and the estimated cost of implementation. It should be noted that the development of the NPDES MS4 permit by the three local jurisdictions may or may not include provisional restoration projects presented in the SWAP or Subwatershed Provisional Restoration Projects Inventory.

Table 2-2: Inventory of Restoration Projects in the Paint Branch Subwatershed

Candidate Project Type	Number of Projects	Estimated Cost ($)	Impervious Acreage Newly Controlled (ac)	Length (mi)	Acreage (Ac)
Stormwater Retrofit	239	122,006,000	885.5	-	-
Stream Restoration	58	15,169,700	-	9.2	
Wetland Creation / Restoration	17	360,500	-	-	7.5
Fish Blockage Removal / Modification	14	5,120,000	-	5.9	-
Riparian Reforestation/Buffer/Meadow/ Invasive Management	20	286,500	-	-	49.6
Trash Reduction	8	43,700	-	-	-
Sediment Remediation	-	-	-	-	-
Parkland Acquisition	13	5,350,000	-	-	53.5
Total	**369**	**148,336,400**	**885.5**	**15.1**	**110.6**

Table 2-3: Proposed Restoration by Type in the Paint Branch Subwatershed					
Project Type	Watershed Area				
	Upper	Middle	Lower	Total	Total New
Wetland and Wet Pond Stormwater (acres)*	68.4	80.5	7.1	155.6	10.5
Bioretention (acres)*	150.8	330.7	152.1	633.5	629.3
Bioswales (acres)*	35.6	37.5	1.0	74.0	73.4
Swale Mod (acres)*	1.4	0.0	0.0	1.4	0.0
Permeable Pavement (acres)*	3.4	6.3	6.8	16.5	16.5
Filter (acres)*	12.2	51.9	13.4	77.5	42.6
Green Roof (acres)*	2.8	8.1	23.3	34.2	34.2
Downspout Disconnects (acres)*	6.8	22.0	0.9	29.8	29.8
Rain Barrels (acres)*	2.2	8.8	1.0	11.9	11.9
Rain Garden (acres)*	5.4	23.1	2.9	31.4	31.4
Dry Pond (acres)*	4.6	0.0	0.0	4.6	0.0
Infiltration Practices (acres)*	0.0	4.5	0.0	4.5	4.5
Invasive Species Management (acres)	0.1	39.7	0.1	39.9	NA
Wetland Restoration (acres)	0.4	2.7	2.5	5.6	NA
Vernal Pools Restoration/Creation (acres)	1.5	0.3	2.5	4.3	NA
Reforestation (acres)	3.5	3.5	0.2	7.2	NA
Land Acquisition (acres)	0.0	42.7	10.8	53.5	NA
Meadow Creation (acres)	0.0	2.5	0.0	2.5	NA
Stream Restoration (miles)	2.6	4.0	2.6	9.2	NA
Fish Passage (miles)	0.8	3.5	1.6	5.9	NA
Trash Reduction (number of projects)	4	2	2	8	NA
*Note: Acreage shown represents the total acreage controlled by the project. A portion of these are retrofits and upgrades, therefore the acreage is not representative of 'new' acreage controlled but represents new and current acreage controlled by the proposed project. The newly controlled acreage is in the last column.					

Table 2-4: Provisional Restoration Project Estimated Unit Costs		
No.	**Practice**	**Approximate Unit Cost ($)**
	Stormwater Retrofit	
1	Existing Stormwater Management Pond/Wetland Retrofitting	$1,000-$3,000/acre of drainage
2	New Stormwater Management Pond/Wetland Construction	$3,000-$5,000/acre of drainage
3	LID-Bioretention with Under Drain System	$100,000/impervious acre
4	LID-Curbside/Street Planter	$100,000/impervious acre
5	LID tree box filter	$54,450-$65,340/impervious acre
6	LID-Green Roof	$42/square foot
7	LID-Single Family Home Rain Garden	$5,000 per individual garden
8	LID-Single Family Home Rain Barrel	$200/barrel (typically two per house)
9	Sand Filter	$20,000 to $25,000 per impervious acre
10	Underground Pipe Storage	$15,000/impervious acre
11	Permeable Pavement	$4.0/square foot
	Stream Restoration/Fish Passage Blockage Removal or Modification	
12	Stream Restoration	$300/linear foot
13	Concrete Stream Channel Removal	$1,000/linear foot
14	Stream Day Lighting	$2,000/linear foot
15	Fish Passage/Riffle Grade Control Structure	$150,000/one foot barrier height
16	Wetland Creation	$50,000/acre
	Trash Reduction/Water Quality	
17	Fresh Creek Trash Netting System	$1,000/acre of drainage
18	End-of-Pipe Trash Catching System	$4,000/acre of drainage
19	Street Sweeping	$50/curb mile
20	Storm Drain Trash Grate	$500/inlet

Results of the Evaluation and Scoring of Restoration Actions in Paint Branch Subwatershed

To recommend restoration action and to determine the sequence for implementation, the quantitative scoring scheme was used to evaluate the 369 provisional restoration candidate projects. This common scoring system allowed for comparison of candidates across as well as within the restoration strategies. The scores for all 369 projects ranged from 88 to 49 points out of a possible 100. To prioritize among projects based on benefits, the scores were divided into three tiers based on the distribution of the scores, with Tier I projects being those anticipated to provide the greatest potential benefits. Tier I includes projects that scored an 80 or above, Tier II includes projects that scored anywhere from 79 to 65, and Tier III includes those that scored 64 or below. Further discussion on the scoring system for the proposed projects can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

The scoring scheme for the provisional stormwater management candidate projects was subsequently further adjusted. The tier system was retained, but the tier boundaries were refined based on distribution of the adjusted score as described in the stormwater management subsection below.

The following tables present the scores and overall rank of the provisional restoration actions for the Paint Branch subwatershed separated by restoration strategy.

Stormwater Management

To provide for better differentiation for potential benefits that would be produced by the 239 potential stormwater management candidate projects and aid the local communities in prioritization for implementation, the scoring system used for project candidates in this restoration strategy were adjusted from the common scoring system. Variables representing two additional factors unique to stormwater management were incorporated into the scoring system: unit imperviousness and existing stormwater control. Data for these variables was obtained from MWCOG and is presented in the Paint Branch Environmental Baseline Conditions and Restoration Report. In the adjusted scoring system for the stormwater projects, Tier I includes projects above 100, Tier II includes projects that are between 89 and 99, Tier III are those scored 88 and below, and Tier IV are those projects that did not meet the minimum requirements to be included in the adjusted scoring system but could still be considered as restoration opportunities in the future. Further explanation of the basis for the adjusted scoring can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report. The top 20 stormwater retrofit candidate projects (Tiers I, II, and III) are listed in Table 2-5. Additional information and project descriptions can be in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-5: Top 20 Potential Stormwater Retrofit Projects within the Paint Branch Subwatershed					
Project ID	**Jurisdiction***	**Project Name**	**Adjusted Score**	**Overall Rank based on Original Scoring**	**Estimated Cost ($)**
PB-M-01-S-9	PG	Stormwater outfall approximately 200 feet from the end of Deakins Hall Drive, Hyattsville, MD	107.6	15	1,890,000
PB-M-01-S-52	MC	Outfall at the northern end of Montclair Drive, Silver Spring, MD	106.6	23	1,500,000
PB-L-01-S-52	PG	Parking areas 2a, 2g, SS2, and SS3, University of Maryland, College Park, MD	106.1	15	403,000
PB-L-01-S-62	PG	Research greenhouses, University of Maryland, College Park, MD	106.1	15	840,000
PB-L-01-S-63	PG	North side of the Comcast Center, University of Maryland, College Park, MD	106.1	15	980,000
PB-M-01-S-12	MC	White Oak Garden Apartments, 11600 Lockwood Drive, Silver Spring, MD	105.1	7	67,000
PB-M-01-S-48	MC	Oak Hill Apartments, Silver Spring, MD	104.8	23	640,000
PB-M-01-S-43	MC	Renick Lane between Jackson Road and Nora Drive, Silver Spring, MD	104.6	42	1,700,000
PB-L-01-S-54	PG	Clarence Smith Performing Arts Center, University of Maryland, College Park, MD	104.0	42	6,694,000
PB-M-01-S-4	MC	Seventh Day Adventist Church World Headquarters, 12501 Old Columbia Pike, Silver Spring, MD	103.6	56	300,000
PB-M-01-S-77	MC	Jackson Road Elementary School and athletic fields, 900 Jackson Road, Silver Spring, MD	102.8	42	1,370,000
PB-M-01-S-45	MC	White Oak Middle School and athletics fields, 12201 New Hampshire Avenue, Silver Spring, MD	102.7	56	2,100,000
PB-L-01-S-44	PG	Cherokee Lane Elementary School, 9000 25th Avenue, Hyattsville, MD	102.4	23	472,000
PB-U-01-S-1	MC	Langside Street neighborhood, Silver Spring, MD	102.2	32	630,000
PB-U-01-S-7	MC	Neighborhood of Holly Spring Drive and Kaywood Lane, Silver Spring, MD	102.2	32	974,000
PB-U-01-S-9	MC	Neighborhood bounded by Seibel Drive, Timberlake Drive, Redmiles Drive, and Donna Drive, Silver Spring, MD	102.2	32	960,000
PB-M-01-S-53	MC	Outfall at the corner of Eastbourne Place and Montclair Drive, Silver Spring, MD	102.1	23	803,000
PB-M-01-S-5	MC	Meadows II Commercial Center, 12520 Prosperity Drive, Silver Spring, MD	101.8	56	794,000
PB-M-01-S-40	MC	January Drive, Silver Spring, MD	101.8	56	600,000
PB-U-01-S-27	MC	Fairland Road between Paint Branch and Hobart Drive, and the residential neighborhood on Castle Cliff Way .	101.6	8	578,000
TOTAL					**24,295,000**
*PG=Prince George's County, Maryland MC=Montgomery County Scoring Tier = **Tier I**, **Tier II**, **Tier III**					

In order to allow for more regional prioritization, the top five stormwater projects for each of the planning units in the subwatershed (Upper, Middle, Lower) are in Tables 2-6, 2-7, and 2-8.

Table 2-6: Top 5 Potential Stormwater Retrofit Projects within the Upper Paint Branch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
PB-U-01-S-1	MC	Langside Street neighborhood, Silver Spring, MD	102.2	32	630,000
PB-U-01-S-7	MC	Neighborhood of Holly Spring Drive and Kaywood Lane, Silver Spring, MD	102.2	32	974,000
PB-U-01-S-9	MC	Neighborhood bounded by Seibel Drive, Timberlake Drive, Redmiles Drive, and Donna Drive, Silver Spring, MD	102.2	32	960,000
PB-U-01-S-27	MC	Fairland Road between Paint Branch and Hobart Drive, and the residential neighborhood on Castle Cliff Way south of Castle Cliff Place, Silver Spring, MD	101.6	8	578,000
PB-U-01-S-62	MC	Tamarack Road, Lemontree Lane, Crestline Road, and Northcrest Drive, Colesville, MD 20904	99.3	56	620,000
TOTAL					**3,762,000**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Table 2-7: Top 5 Potential Stormwater Retrofit Projects within the Middle Paint Branch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
PB-M-01-S-9	PG	Stormwater outfall approximately 200 feet from the end of Deakins Hall Drive, Hyattsville, MD	107.6	15	1,890,000
PB-M-01-S-52	MC	Outfall at the northern end of Montclair Drive, Silver Spring, MD	106.6	23	1,500,000
PB-M-01-S-12	MC	White Oak Garden Apartments, 11600 Lockwood Drive, Silver Spring, MD	105.1	7	67,000
PB-M-01-S-48	MC	Oak Hill Apartments, Silver Spring, MD	104.8	23	640,000
PB-M-01-S-43	MC	Renick Lane between Jackson Road and Nora Drive, Silver Spring, MD	104.6	42	1,700,000
TOTAL					**5,797,000**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Table 2-8: Top 5 Potential Stormwater Retrofit Projects within the Lower Paint Branch Subwatershed					
Project ID	**Jurisdiction***	**Project Name**	**Adjusted Score**	**Overall Rank based on Original Scoring**	**Estimated Cost ($)**
PB-L-01-S-52	PG	Parking areas 2a, 2g, SS2, and SS3, University of Maryland, College Park, MD	106.1	15	403,000
PB-L-01-S-62	PG	Research greenhouses, University of Maryland, College Park, MD	106.1	15	840,000
PB-L-01-S-63	PG	North side of the Comcast Center, University of Maryland, College Park, MD	106.1	15	980,000
PB-L-01-S-54	PG	Clarence Smith Performing Arts Center, University of Maryland, College Park, MD	104.0	42	6,694,000
PB-L-01-S-44	PG	Cherokee Lane Elementary School, 9000 25th Avenue, Hyattsville, MD	102.4	23	472,000
TOTAL					**9,389,000**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Stream Restoration
The top 5 out of 58 potential stream restoration candidate projects are presented in Table 2-9. The projects range in length from 150 feet to 2,700 feet and include projects addressing stream channel morphology, in-stream habitat, and regenerative stormwater conveyance. Additional project description information can be found the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-9: Top 5 Potential Stream Restoration Projects within the Paint Branch Subwatershed

Project ID	Jurisdiction*	Project Name	Score	Overall Rank	Estimated Cost ($)
PB-M-02-SR-8	MC	Paint Branch Park directly east of January Drive, Silver Spring, MD	76	42	74,000
PB-L-02-SR-2	PG	Northeast of Moon River Court and Muskogee Street, approximately 240 feet southwest of culvert under I-495, Hyattsville, MD	76	42	45,000
PB-L-02-SR-13	PG	Stormwater outfall, south of Marlborough Way and St. Andrews Place, College Park, MD	76	42	74,000
PB-L-02-SR-14	PG	Dead end of Marlborough Way near intersection with Bridgewater Street, College Park, MD	76	42	55,500
PB-U-02-SR-5	MC	At end of Fireside Drive, Silver Spring, MD	74	72	810,000
TOTAL					**1,058,500**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Wetland and Vernal Pool Creation and Restoration
The potential wetland restoration candidate projects are presented in Table 2-10. These projects include wetland creations/restorations that range from 0.1 acres to 3.5 acres in size and vernal pool creations from 0.03 acres to 0.5 acres in size. Additional project description information can be found in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-10: Potential Wetland Creation or Restoration Projects within the Paint Branch Subwatershed					
Project ID	**Jurisdiction**	**Project Name**	**Score**	**Overall Rank**	**Estimated Cost ($)**
PB-U-03-W-2	MC	Approximately 400 feet northwest of the terminus of Williston Road, Silver Spring, MD	80	8	25,000
PB-U-03-W-3	MC	Approximately 300 feet north of the intersection of Rainbow Drive and Tindlay Street, Silver Spring, MD	80	8	25,000
PB-U-03-W-4	MC	Approximately 420 feet north-northeast of intersection of Peach Orchard Road and Banbury Ridings Drive, Silver Spring, MD	77	32	5,000
PB-M-03-W-6	MC	Approximately 60 feet west of I-95, and approximately 950 feet southeast of Powder Mill Community Park baseball diamond, Hyattsville, MD	76	42	13,000
PB-M-03-W-3	MC	South floodplain of perennial tributary at 1302-1304 Downs Drive, Silver Spring, MD	74	72	50,000
PB-M-03-W-5	MC	Approximately 300 feet west of I-95, and approximately 700 feet southeast of Powder Mill Community Park baseball diamond, Hyattsville, MD	73	91	5,000
PB-L-03-W-1	PG	South of Campus Creek, north of the parking lot at University of Maryland Outdoor and Recreation Center, Ellicott Drive, College Park, MD	72	111	75,000
PB-U-03-W-5	MC	Approximately 400 feet west-southwest of the intersection of Route 198 and Oursler Road, Burtonsville, MD	70	153	2,000
PB-U-03-W-6	MC	Approximately 350 feet northwest of the intersection of Rainbow Drive and Tindlay Street, Silver Spring, MD	66	275	5,000
PB-U-03-W-7	MC	Approximately 350 feet east-northeast of the intersection of Rainbow Drive and Tindlay Street, Silver Spring, MD	66	275	5,000
PB-U-03-W-1	MC	Approximately 700 feet east-northeast of the intersection of Old Barn Court and Piping Rock Drive, Silver Spring, MD	64	315	10,000
PB-M-03-W-4	MC	Floodplain of intermittent tributary on the east bank of Paint Branch, approximately 550 feet south of Randolph Road, Silver Spring, MD	61	345	45,000
PB-M-03-W-1	MC	Forested area approximately 700 feet southeast of Collingwood Terrace and Collingwood Lane, directly northeast of PDWT # 2392, Silver Spring, MD	60	355	22,000
PB-M-03-W-2	MC	Valley north of the northern dead end of Caplinger Road and south of the Tanley Drive and Sarah Road intersection, Silver Spring, MD	60	355	5,000
PB-M-03-W-7	MC	Approximately 500 feet west of I-95, and approximately 650 feet southeast of Powder Mill Community Park baseball diamond, Hyattsville, MD	58	358	16,000
PB-M-03-W-8	MC	Riparian forest located south of Hidden Valley Lane and west of Falling Creek Road, Silver Spring, MD	55	366	2,500
PB-L-03-W-2	PG	Paint Branch mainstem, approximately 1000 feet upstream from Paint Branch Parkway Railroad Crossing, north of bike path, College Park, MD	49	369	50,000
TOTAL					**360,500**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Fish Blockage and Removal or Modification

The 14 potential fish blockage removal or modification candidate projects are presented in Table 2-11. These fish blockage removals range from 300 feet to 1.5 miles in length. Additional information regarding the project descriptions is available in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-11: Potential Fish Blockage Removal or Modification Projects within Paint Branch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
PB-M-04-F-4	MC	Stream reach approximately 535 feet northeast of MD-212 and Bond Road, Hyattsville, MD	70	153	20,000
PB-U-04-F-1	MC	Paint Branch tributary on Rainbow Drive, west of Langside Street, Silver Spring, MD	65	293	75,000
PB-M-04-F-3	MC	Perennial stream crossed at Laurie Drive culvert, Silver Spring, MD	65	293	750,000
PB-M-04-F-7	PG	Approximately 300 feet upstream from exit 25B of I-95 North to I-495 East, College Park, MD	65	293	150,000
PB-L-04-F-1	PG	Prince George's County Site 758110, approximately 500 feet northwest of the intersection of Route 1 and Lakeland Road, College Park, MD	64	315	300,000
PB-L-04-F-2	PG	Campus Creek area north of the parking lot at University of Maryland Outdoor and Recreation Center, Ellicott Road, College Park, MD	64	315	75,000
PB-M-04-F-1	MC	Perennial tributary at the Serpentine Way crossing immediately upstream of the culvert, approximately 420 feet south of Serpentine Way and Aquamarine Terrace, Silver Spring, MD	61	345	600,000
PB-M-04-F-6	PG	Under exit 25B from I-95 North to I-495 East, College Park, MD	61	345	150,000
PB-U-04-F-2	MC	Paint Branch tributary bisected by Rainbow Drive, east of Valencia Street, Silver Spring, MD	59	357	600,000
PB-M-04-F-9	PG	Approximately 1,520 feet east, southeast of the intersection of Deakin Hall Road and Tullymore Road at culvert that goes under I-95, Silver Spring, MD	58	358	750,000
PB-M-04-F-5	PG	Approximately 235 feet east from where the on ramp of I-95 North connects to I-495 East, College Park, MD	57	361	300,000
PB-M-04-F-8	PG	Approximately 930 feet northeast of the intersection of Deakin Hall Road and Tullymore Road east of the I-95 and I-495 ramp, Silver Spring, MD	57	361	750,000
PB-M-04-F-2	MC	Approximately 900 feet north-northwest of the intersection of Powder Mill Road and Bond Road, Hyattsville, MD	56	364	150,000
PB-L-04-F-3	PG	Approximately 380 feet southwest of De Pauw Place and St. Andrews Place, College Park, MD	54	367	450,000
TOTAL					**5,120,000**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Riparian Reforestation, Meadow Creation, and Invasive Species Management

All of the 20 potential riparian reforestation, meadow creation, and invasive species management candidate projects are presented in Table 2-12. The reforestation projects range from 0.1 to 1.8 acres, the invasive species management projects from 0.1 to 15.4 acres, and the meadow creation project is for 2.5 acres. Additional information regarding the project descriptions is available in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-12 Potential Riparian Reforestation, Meadow Creation, Street Tree, and Invasive Species Management Candidate Projects within the Paint Branch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
PB-M-05-R-12	MC	Across the street from 2320 Broadbirch Drive, Silver Spring, MD	88	1	7,500
PB-M-05-R-1	MC	Forested area near the baseball fields in Fairland Park, 2201 Fairland Road, Silver Spring, MD	83	3	23,000
PB-M-05-R-3	MC	Riparian area located between Carters Grove Drive and Staley Manor Drive, Silver Spring, MD	83	3	77,000
PB-M-05-R-4	MC	Riparian area of the tributary located between Priscilla Drive and Featherwood Street, Silver Spring, MD	83	3	43,000
PB-U-05-R-3	MC	Approximately 300 feet southeast of intersection of Good Hope Road and Hopefield Road, Silver Spring, MD	80	8	5,400
PB-U-05-R-5	MC	West of Veitch Lane, approximately 160 feet north of intersection with Spencerville Road, Spencerville, MD	80	8	13,000
PB-M-05-R-6	MC	2001 East Randolph Road, southeast of the Southern Asian Seventh Day Adventist Church, Silver Spring, MD	80	8	22,500
PB-U-05-R-2	MC	Existing wet detention pond PDWT #888, approximately 600 feet south of Cradock Street.	78	23	500
PB-M-05-R-2	MC	Approximately 450 feet east of the Laurie Drive / Montclair Drive intersection, Silver Spring, MD	78	23	2,000
PB-M-05-R-9	MC	Riparian forest located east of Falling Creek Road, Silver Spring, MD	78	23	38,000
PB-L-05-R-2	PG	Approximately 100 feet southwest of intersection of Route 1 and Lakeland Road on north side of bridge, College Park, MD	78	23	500
PB-U-05-R-1	MC	PB-TIC-27, across street from Wembrough Park, 15400 Wembrough Street, Silver Spring, MD	75	56	4,500
PB-U-05-R-4	MC	PB-MC-41 (T41), in Paint Branch Park approximately 475 feet east of intersection of Collingwood Terrace and Lemontree Lane, Silver Spring, MD	75	56	9,000
PB-M-05-R-5	MC	Residential neighborhood on Angelwing Drive, Statford Garden Drive, and Withan Drive, Silver Spring, MD	75	56	16,000
PB-M-05-R-10	MC	Tributary located south of Parallel Lane, Silver Spring, MD	73	91	6,300
PB-M-05-R-7	MC	Riparian forest located south of Hidden Valley Lane and west of Falling Creek Road, Silver Spring, MD	71	137	7,000
PB-M-05-R-8	MC	South riparian area of stream located at 2400-2412 Falling Creek Road, Silver Spring, MD	70	153	4,000
PB-M-05-R-11	MC	Riparian area approximately 875 feet northwest of intersection of Plum Orchard Drive and Broadbirch Drive, Silver Spring, MD	70	153	4,500
PB-M-05-R-13	MC	U.S. Army laboratory complex, Adelphi, MD	68	216	1,000
PB-L-05-R-1	PG	Campus Creek north bank, west of Regents Drive, College Park, MD	68	216	1,800
TOTAL					**286,500**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = Tier I, Tier II, Tier III

Land Acquisition
The provisional land acquisition candidate projects are presented in Table 2-13. The size of the acquisition sites range from 0.4 acres to 19.8 acres. Additional information regarding the project descriptions can be found in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-13: Potential Land Acquisition Projects within the Paint Branch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
PB-L-08-L-1	PG	0000 Tulsa Drive	74	72	1,083,000
PB-M-08-L-6	PG	3118 Powder Mill Road	73	91	74,000
PB-M-08-L-7	PG	3030 Powder Mill Road	72	111	500,000
PB-M-08-L-8	PG	3120 Powder Mill Road	72	111	347,000
PB-M-08-L-11	PG	10020 Riggs Road	72	111	486,000
PB-M-08-L-10	PG	00000 Powder Mill Road	69	179	1,982,000
PB-M-08-L-1	PG	2924 Powder Mill Road	68	216	39,000
PB-M-08-L-2	PG	10921 Bond Road	67	239	146,000
PB-M-08-L-3	PG	3010 Powder Mill Road	67	239	155,000
PB-M-08-L-4	PG	3108 Powder Mill Road	67	239	139,000
PB-M-08-L-5	PG	3112 Powder Mill Road	67	239	139,000
PB-M-08-L-9	PG	3202 Powder Mill Road	67	239	123,000
PB-M-08-L-12	PG	3207 Cherry Mill Road	67	239	137,000
TOTAL					**5,350,000**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Trash Reduction

The provisional trash reduction candidate projects are presented in Table 2-14. The projects include trash removal, inlet grates, signage, trash trap, and outreach. Additional information regarding the project descriptions can be found in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-14: Potential Trash Reduction Projects within the Paint Branch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
PB-U-06-T-2	MC	Dead end of Kaywood Lane, Silver Spring, MD	74	72	5,000
PB-L-06-T-1	PG	Approximately 450 feet northwest of culvert under Falling Brook Terrace and Silver Lake Court, Hyattsville, MD	74	72	3,700
PB-L-06-T-2	PG	Approximately 500 feet north of Ellicott Road and Valley Drive, directly north of parking lot, College Park, MD	74	72	2,000
PB-U-06-T-4	MC	Approximately 500 feet northeast of the eastern terminus of Kaywood Lane, Silver Spring, MD	72	111	20,000
PB-U-06-T-3	MC	Dead end of Apple Tree Lane, Silver Spring, MD	71	137	2,000
PB-U-06-T-1	MC	Approximately 900 feet southeast of the intersection of Route 198 and Peach Orchard Road, Silver Spring, MD	67	239	7,000
PB-M-06-T-1	MC	Outfall located approximately 250 feet north of Carters Grove Drive, Silver Spring, MD	66	275	1,000
PB-M-06-T-2	MC	North riparian area of the tributary located approximately 300 feet south of Loft Lane, Silver Spring, MD	64	315	3,000
TOTAL					**43,700**

*PG=Prince George's County, Maryland
MC=Montgomery County
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Summary of Recommended Restoration Actions

The Recommended Restoration Actions are those that could potentially be implemented and a roll-up of these projects is presented in Table 2-15. Additional information on the descriptions and details of the potential actions can be found in the Paint Branch Subwatershed Provisional Restoration Projects Inventory.

Table 2-15: Summary of Recommended Potential Restoration Actions		
Candidate Project Type	**Number of Projects**	**Estimated Cost**
Stormwater Retrofits		
Tier I	25	32,891,000
Tier II	71	57,439,000
Tier III	6	1,540,000
Tier IV	137	30,136,000
Stream Restoration		
Tier I	0	0
Tier II	42	10,534,700
Tier III	16	4,635,000
Wetland Creation / Restoration		
Tier I	2	50,000
Tier II	8	160,000
Tier III	7	150,500
Fish Blockage Removal / Modification		
Tier I	0	0
Tier II	4	995,000
Tier III	10	4,125,000
Riparian Reforestation, Meadow Creation, and Invasive Management		
Tier I	7	191,400
Tier II	13	95,100
Tier III	0	0
Trash Reduction		
Tier I	0	0
Tier II	7	40,700
Tier III	1	3,000
Parkland Acquisition		
Tier I	0	0
Tier II	13	5,350,000
Tier III	0	0
TOTAL	**369**	**148,336,400**
***Tiers for the Stormwater Projects Reflect the Adjusted Scoring System**		

Implementation Type of Potential Restoration Actions

Restoration opportunities identified as part of the ARP require additional study, design, or policy change prior to implementation. Table 2-16 provides a summary of the number of projects that fall under each of the four implementation types. The 2007 Water Resources Development Act provides authority for USACE to complete design/build projects in the Anacostia Watershed. However, design/build projects could also be implemented by local jurisdictions, state agencies, or non-profit organizations. Feasibility Study projects would require additional detailed studies prior to the design phase. The projects requiring feasibility studies like stream restoration or wetland creation likely would be projects USACE could implement following the appropriate Civil Works authority, budgeting cycle, and protocol. Projects requiring a programmatic element prior to implementation may require governmental policy changes, or authority to purchase land. Finally, stewardship projects are likely those potential projects to be completed by volunteers from local churches, schools, or community watershed groups.

Additional information regarding specific projects can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report

Table 2-16: Summary of Potential Restoration Actions.

Implementation Type	Number of Projects	Estimated Cost ($)
Design/Build	239	122,006,000
Feasibility Study	89	20,650,200
Stewardship	28	330,200
Programmatic	13	5,350,000
TOTAL	**369**	**148,336,400**

Section 3
Evaluation of the Restoration Strategies

Evaluation of Proposed Restoration Strategies

The proposed restoration projects were evaluated using the approach described in the main report of the ARP. The first step in the evaluation consisted of assessing the potential of the restoration actions to control pollutant loads. As described in the Anacostia Watershed Environmental Baseline Conditions and Restoration Report, the TMDL modeling efforts of Interstate Commission on the Potomac River Basin (ICPRB) and MDE were used to provide the existing pollutant loads, and the Watershed Treatment Model (WTM) was used to estimate the potential pollution reduction achieved by the proposed restoration strategies. The Plan Formulation Appendix lists the efficiencies of the various BMPs included in the WTM. It should be noted that the list of stormwater management practices listed in the WTM was expanded to include LID practices. The LID practices included green roofs, rooftop disconnection, rain barrels and cisterns, soil amendments, sheet flow to open space, bioretention, and rain gardens.

The potential restoration strategies were individually evaluated using the WTM to estimate the pollutant reduction benefit the project could provide. The full WTM user guide is available online from the Center for Watershed Protection (CWP) at www.cwp.org.

There are several large federally owned tracts of property located in this subwatershed. It is imperative that these tracts remain as undeveloped and open as possible. The areas located along stream corridors are essential for habitat connectivity throughout the area.

Potential to Reduce Stormwater Pollutant Loads

The proposed restoration projects would provide additional stormwater controls to 884 impervious acres in the Paint Branch subwatershed. This represents a 40-percent increase in the acres of impervious surfaces controlled by stormwater management, bringing the total impervious acres controlled by stormwater management up to approximately 1,319 or 59-percent of the total impervious acres. Table 3-1 summarizes the improvements in stormwater controls after implementation of the proposed projects.

Table 3-1: Level of Stormwater Control in Paint Branch Subwatershed After Implementation of All Proposed Stormwater Projects

Total Impervious Acres	Existing Stormwater Controls		Potential Future Stormwater Controls		Increase in Impervious Acreage Controlled by Stormwater Projects
	Acres	% of Impervious Total	Acres	% of Impervious Total	
2,239	435	19%	1,319	59%	40%

Table 3-2: Evaluation of Stormwater Control Levels and Potential in Pollutants Load Reduction					
Impervious Acreage Controlled	**Pollutants Load Reduction Potential**				**Increase in Impervious Acreage Controlled by Stormwater Projects**
	N	**P**	**TSS**	**Bacteria**	
	(lbs/yr)	(lbs/yr)	(tonsyr)	(billons cfu/yr)	
59% (proposed projects)	11,887	1,605	333	197,367	40%

* Current Stormwater Control Levels are at 19%

Using the distribution of projects included in the provisional inventory, several future control levels were evaluated using the WTM to estimate potential pollution reduction. Table 3-2 identifies the maximum control level evaluated (as percent impervious acres controlled) as well as the associated pollution reduction potential. The Plan Formulation appendix of the Anacostia Restoration Plan and Report provides the characteristics of each BMP type included in the provisional inventory.

To fully evaluate the benefits of providing different levels of stormwater control, the existing pollutant load and the pollution reduction potential in the watershed must be considered in terms of the existing Anacostia River TMDLs for nutrients and TSS (Kim et al., 2007; Mandel et al., 2008). The TSS TMDL calls for an 85-percent reduction in existing TSS loading to the Anacostia River watershed. The nutrient TMDL established a necessary reduction of 79-percent for nitrogen and 80-percent for phosphorus. Table 3-3 summarizes the overall Anacostia River TMDL reduction goals, the Paint Branch existing pollutant loadings, and the ability of the various stormwater control levels to address the pollution reduction in the Paint Branch subwatershed to help meet the Anacostia River TMDLs. The implementation of all of the proposed stormwater projects reduces the pollutant load between 14 and 25-percent. Given that the TMDL goals for the Anacostia River are between 79 and 85-percent reduction, stormwater controls alone will not be able to address the contribution from Paint Branch.

Table 3-3: Ability of Stormwater Control Levels to Address TMDL Goals in Paint Branch Subwatershed			
Impervious Control Level	**Pollutant Reduction Achieved**		
	N	**P**	**TSS**
Reduction Goal for Paint Branch as Pro-Rated Share of Anacostia TMDL	69,528 lbs/yr (79%)	5,222 lbs/yr (80%)	1,191 tons/yr (85%)
Estimate of Existing Pollutant Loads in Paint Branch	88,010 lbs/yr	6,527 lbs/yr	1,401 tons/yr
Maximum Reduction Potential from Proposed Projects	11,887 lbs/yr (14%)	1,605 lbs/yr (25%)	333 tons/yr (24%)

It should be noted that the load reduction estimates of Table 3-3 do not account for reductions in stream channel erosion, which is another benefit of stormwater management. The following section addresses the potential reduction in stream channel erosion following the implementation of the proposed restoration actions.

Potential to Reduce Peak Flow Discharge

The TSS TMDL for the Anacostia River estimates that about 70 to 75-percent of the sediment delivered from the watershed to the tidal estuary comes from stream bank and channel erosion. Estimating the reduction of stream channel sediment loads that would result from controlling urban stormwater runoff is very challenging. A peak flow reduction analysis is used as a surrogate measure to give insight into the potential for reducing in-stream channel erosion loads. In fact, erosion of the stream channel is directly related to the increase in stream energy associated with the peak flow. Reducing the peak flow at the outlet of the watershed will lead to the reduction in erosive shear stress on the stream banks. Therefore, it is logical to assume potential reduction in stream bank erosion by quantifying the reduction in peak flows associated with the levels of stormwater control. Table 3-4 contains the results of that quantification. The CWP has an Impervious Cover Model (ICM) which classifies the ability of watersheds to support aquatic life based on the percentage of their surface covered with manmade impervious materials. The ICM describes watersheds having an impervious surface cover between 0 to 10-percent as ‘sensitive’, 10 to 25-percent as being ‘impaired’, those having 25 to 60-percent impervious cover as ‘non-supporting’, and those with 60 to 100-percent impervious cover as ‘urban drainage’. With its 17-percent impervious cover, Paint Branch, with would be classified as ‘impaired’ by the ICM. The watersheds analyzed in preparation of the ICM were not segregated based on stormwater management, and a substantial number of those analyzed had minimal stormwater management. Recent studies of watersheds in nearby Montgomery County, Maryland, where stormwater management and other watershed restoration measures have been implemented strongly indicate that such watersheds can support much higher aquatic organism health than can watersheds lacking these management practices.

Accordingly, the expectation for the Paint Branch subwatershed is generally that if stormwater management is improved and other watershed restoration measures implemented aquatic ecosystem health will also improve. This is an area of active ongoing investigation by scientists and engineers, and the relationship between watershed restoration and stream aquatic ecosystem health is impacted by many factors as was discussed earlier in this document. Although it is not possible to confidently predict the magnitude of aquatic ecosystem improvement that can be generated by watershed restoration measures, the effective resultant impervious cover that a combination of watershed restoration features installed within a given watershed would provide would be the maximum likely response.

The peak discharges are estimated using regression equations developed by the Maryland Hydrology Panel in support of the Maryland State Highway Administration (MSHA). The equations are used in the estimate of flood discharges for the design of culverts and bridges (Molgen, 2007). Details on the peak flow reduction potential analysis are given in the Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report.

Table 3-4: Peak Flow Analysis Results for Paint Branch Subwatershed**

	No Treatment	**Current Treatment**	**Impervious Area Treated with Storm Water Controls**					
	0% Treated	22.4% Treated	25% Treated	30% Treated	40% Treated	50% Treated	70% Treated	100% Treated
Effective Percent Impervious	17.7	14.5	14.1	13.4	12.0	10.6	7.8	3.5
Peak Flow (cfs)	914	830	820	800	758	715	619	443
Peak Flow per square mile (cfs)	29	27	26	26	24	23	20	14
Peak Flow in gpd per square mile	18,992,809	17,243,620	17,033,414	16,617,136	15,755,340	14,849,119	12,867,050	9,202,799
(cfs) = cubic feet per second			(gpd) = gallons per day			Conversion: 1 cfs = 646,316.883 gpd		
**Flow rate includes Little Paint Branch with flows into Paint Branch								

The Paint Branch subwatershed spans both the piedmont and coastal plan geographic provinces, as such the peak discharges were estimated using a weighted average of the following two regression equations:

(Equation 1 – Coastal) $$Q1.25 = 18.62 * DA^{0.611} * (IA+1)^{0.419} * (SD+1)^{0.165}$$

(Equation 2 – Piedmont Urban) $$Q1.25 = 17.85\ DA^{0.652} * (IA+1)^{0.635}$$

The Q1.25 indicates that the peak discharges are associated with a rainfall event that has the likelihood of occurring once every 1.25 years. In addition, DA represents drainage area in square miles, IA represents-percentage of impervious area, and SD represents-percentage of group D soils, which are soils with a high runoff potential and slow infiltration rate. Although these regression equations have limitations, which are discussed in the Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report, they provide a reasonable initial measure of the potential for reducing peak discharges as a function of different amounts of stormwater management.

Among the limitations of this analysis, one is of particular importance. The peak discharge analysis should be interpreted with caution. Although the peak flow at the outlet of a watershed is used as a simple yardstick, reducing the peak flow is not a guarantee of reduced stream channel erosion throughout the watershed. Detailed hydrologic and hydraulic analyses are necessary to determine hydrograph timing to avoid inadvertently increasing channel erosion.

Potential to Reduce Pollutant Loads Using Street Sweeping

Street sweeping is included in the provisional project inventory as a trash control, but street sweeping can also serve as an effective pollutant removal technique if the right equipment and the right techniques are employed (Montgomery County 2002). Particles that accumulate on road surfaces such as road grit, sand, and dirt; heavy metals including copper, lead, and zinc; and nitrogen and phosphorus can all be removed to some extent by street sweeping. The highest concentration of pollutants is associated with the smallest particles of road grit (EPA, 1983). Of the three technologies available for street sweeping, regenerative air sweepers and vacuum assisted sweepers provide the greatest pollutant removal. Mechanical broom sweepers do the least to remove the small particles associated with most pollutants.

Decisions such as frequency of sweeping, type of road swept (residential or mixed use, etc.), whether cars are permitted to be parked in the roadway, and training of personnel performing the street sweeping affects the efficiency of the practice. Ideally, street sweeping is most effective when pollutants are permitted to accumulate and then the area is swept prior to a rain event. However, this situation is logistically difficult. The WTM is capable of estimating removal of N, P, and TSS by street sweeping. Evaluations with the WTM identify that weekly sweeping can remove 67-percent more N, P, and TSS than monthly sweeping.

The benefit of street sweeping was evaluated for the roads within the Paint Branch subwatershed. (Table 3-5). Information regarding the methodology and assumptions made in the analysis can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Table 3-5: Pollutant Reduction Estimate of Weekly Street Sweeping (Streets Only)							
Other Roads		**Annual Pollutant Reduction**			**Percent Reduction**		
Percent of Roadway Treated	**Miles**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	3.4	189	15	3	0.2%	0.2%	0.2%
10	6.8	378	31	6	0.4%	0.5%	0.4%
15	10.3	568	46	9	0.6%	0.7%	0.6%
20	13.7	757	61	11	0.9%	0.9%	0.8%
25	17.1	946	76	14	1.1%	1.2%	1.0%
50	34.2	1,892	153	28	2.1%	2.3%	2.0%
75	51.3	2,838	229	43	3.2%	3.5%	3.0%
100	68.4	3,784	306	57	4.3%	4.7%	4.1%
Residential Roads		**Annual Pollutant Reduction**			**Percent Reduction**		
Percent of Roadway Treated	**Miles**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	6.3	655	55	6	0.7%	0.8%	0.4%
10	12.6	1,310	111	12	1.5%	1.7%	0.9%
15	18.8	1,964	166	18	2.2%	2.5%	1.3%
20	25.1	2,619	222	24	3.0%	3.4%	1.7%
25	31.4	3,274	277	30	3.7%	4.2%	2.1%
50	62.8	6,548	554	60	7.4%	8.5%	4.3%
75	94.2	9,822	831	90	11.2%	12.7%	6.4%
100	125.6	13,096	1108	120	14.9%	17.0%	8.5%

The benefits of street sweeping on pollutant removal can also be considered for parking lots. Parking lots accumulate trash and pollutants that eventually wash into the stormwater system during rain events. The results of the parking lot analysis are displayed in the Table 3-6. The benefit of sweeping parking lots does not appear to be great, but once accumulated over the entire watershed this practice has the potential to not only contribute to reaching trash reduction goals, but also pollutant removal goals if implemented on a large scale.

Table 3-6: Pollutant Reduction Estimate of Weekly Sweeping of Parking Lots							
Parking Lots		Annual Pollutant Reduction			Percent Reduction		
Percent of Parking Lots Swept	Acres	N (lbs/yr)	P (lbs/yr)	TSS (tons/yr)	N	P	TSS
5	29.4	51	3	1	0.06%	0.05%	0.06%
10	58.8	101	7	2	0.1%	0.1%	0.1%
15	88.2	152	10	2	0.2%	0.2%	0.2%
20	117.6	203	13	3	0.2%	0.2%	0.2%
25	146.9	254	17	4	0.3%	0.3%	0.3%
50	293.9	507	34	8	0.6%	0.5%	0.6%
75	440.8	761	51	12	0.9%	0.8%	0.8%
100	587.8	1,015	67	16	1.2%	1.0%	1.1%

The full benefit of an enlarged street sweeping program would reflect the pollution reduction gained from sweeping residential and 'other' roads, as well as parking lots. Table 3-7 contains the totals for sweep all three types of areas swept. The data indicates that fairly substantial reductions can be realized once the percentage of roads swept weekly get above 50-percent.

Table 3-7: Total Pollutant Reduction Estimate of Weekly Sweeping of All Streets and Parking Lots							
Streets and Parking Lots		Total Annual Pollutant Reduction			Total-percent Reduction		
Percent Swept	Acres	N (lbs/yr)	P (lbs/yr)	TSS (tons/yr)	N	P	TSS
5	62.6	895	74	10	1.0%	1.1%	0.7%
10	125.2	1,789	148	19	2.0%	2.3%	1.4%
15	187.8	2,684	222	29	3.0%	3.4%	2.1%
20	250.3	3,579	296	38	4.1%	4.5%	2.7%
25	312.9	4,474	370	48	5.1%	5.7%	3.4%
50	625.8	8,947	741	96	10.2%	11.3%	6.9%
75	938.8	13,421	1,111	144	15.2%	17.0%	10.3%
100	1,251.7	17,895	1,482	192	20.3%	22.7%	13.7%
Paint Branch Subwatershed Reduction Goals as Pro-Rated Share of Anacostia TMDL		69,528	5,222	1,191	79%	80%	85%

As discussed previously, sweeping may be logistically difficult. Stormwater retrofits to the road network within the Paint Branch subwatershed, including green streets, bioswales, or pervious pavement, in conjunction with street sweeping would increase the amount of pollutants removed from the system. These green streets initiatives would require programmatic or policy changes to local ordinances. These road network stormwater retrofits are further described in the Anacostia Watershed Restoration Plan and Report and associated Plan Formulation appendix.

Pollutant Reduction of Homeowner Stormwater Management

Provisional stormwater restoration projects implemented by governmental agencies alone are only one piece of the strategy needed to control stormwater and the pollutants carried into the Anacostia River watershed. Implementing every stormwater project outlined in this inventory will account for an approximate 40-percent increase in the impervious acres controlled by stormwater management within the Paint Branch subwatershed. However, with approximately 10,400 residential homes in the subwatershed, there is also the need to involve private homeowners in the stormwater control effort. Homeowner efforts would target stormwater from the roofs, driveways, and sidewalks. A number of stormwater control treatments, or homeowner BMPs, are available for application: green roofs, rain gardens, rain barrels, permeable pavement, and downspout disconnects. Additional information on homeowner BMPs can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Table 3-8 summarizes the number of residential homes throughout Paint Branch subwatershed and the related impervious acreage. The impervious acreage that is occupied by single family homes, on-single family homes, single family driveways, and sidewalks equals approximately 847 acres of the 2,239 total impervious acres, or 38-percent within the subwatershed. Stormwater management controls ion this acreage could contribute significantly to reducing pollutant and stormwater inputs throughout the watershed.

Table 3-8 : Paint Branch Subwatershed Impervious Acres Analysis of Residential Homes

		Impervious acres			
Watershed Area	**Number of Residential Homes**	**Single Family Homes**	**Private (non-single family)**	**Single Family Driveway**	**Sidewalks**
Upper Watts	4,354	172.6	13.4	61.0	28.1
Middle Watts	4,807	215.7	142.9	67.3	44.4
Lower Watts	1,219	44.4	28.8	17.1	11.8
TOTAL	10,380	432.6	185.1	145.3	84.3

An evaluation was performed, using the WTM, to investigate the potential of the homeowner BMPs to control the stormwater inputs produced by residential homes within the subwatershed. Four of the practices are focused on rooftop runoff: green roofs, rain barrels, rain gardens, and downspout disconnects. The fifth practice directly applies to sidewalks and driveways. Six scenarios of various combinations of the five BMPs were evaluated.

1. Control 1-percent of the impervious acreage with green roofs, 1-percent with downspout disconnections, 1-percent with rain barrels and 1-percent with rain gardens. Control 1-percent of the sidewalk and drive way impervious acreage with permeable pavement.

2. Control 5-percent of the impervious acreage with green roofs, 5-percent with downspout disconnections, 5-percent with rain barrels, and 5-percent with rain gardens. Control 5-percent of the sidewalk and drive way impervious acreage with permeable pavement.

3. Control 10-percent of the impervious acreage with green roofs, 10-percent with downspout disconnections, 10-percent with rain barrels, and 10-percent with rain gardens. Control 10-percent of the sidewalk and driveway impervious acreage with permeable pavement.

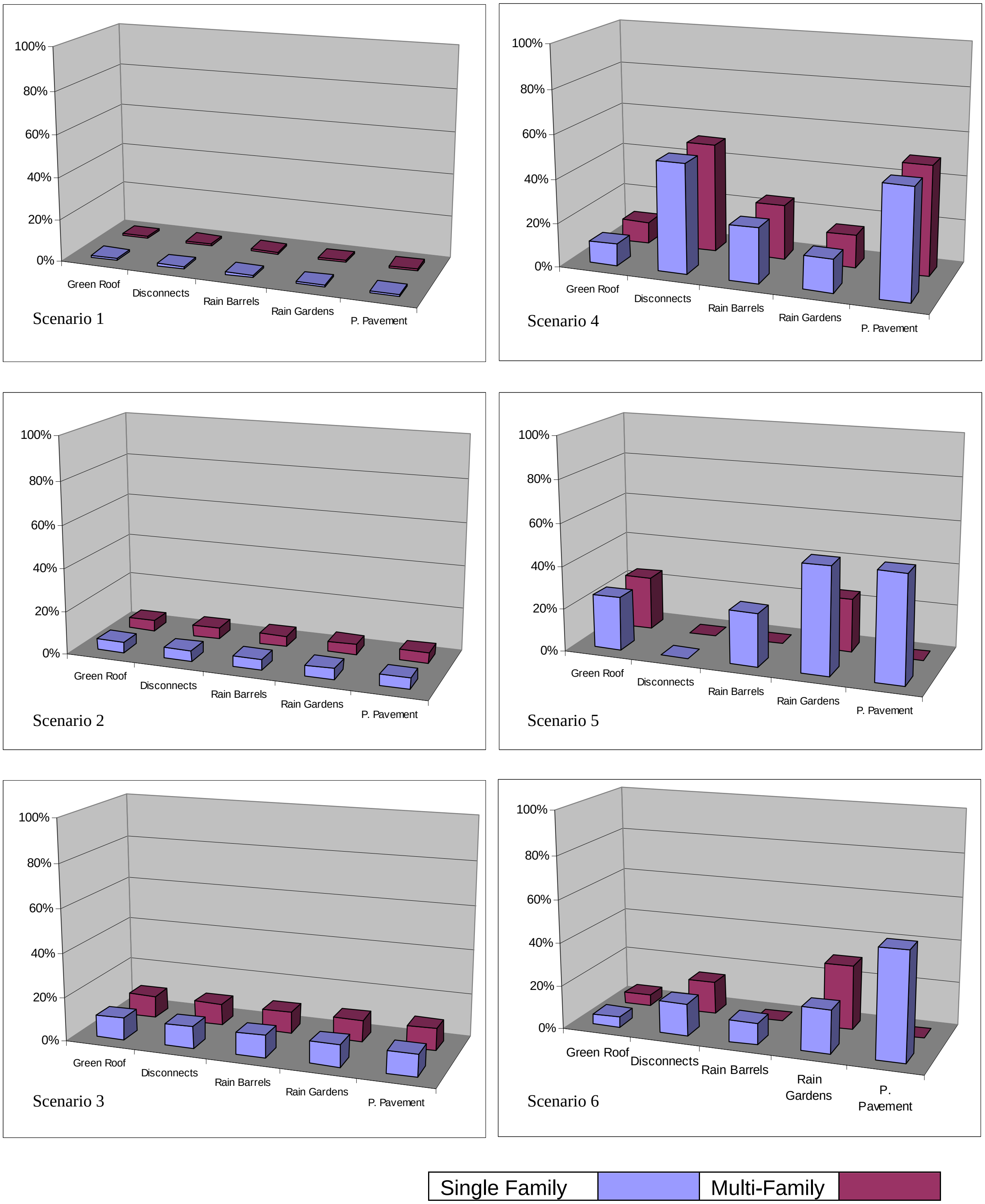
4. Control 10-percent of the impervious acres with green roofs, 50-percent with downspout disconnections, 25-percent with rain barrels, and 15-percent with rain gardens. Control 50-percent of the sidewalk and driveway impervious acreage with permeable pavement.

5. Control half of the acreage of private, multi-family residences by treating 25-percent of the impervious acreage with rain gardens and 25-percent with green roofs. Control half of the single-family driveways and sidewalks with permeable pavement, and control all of the single-family home impervious roof acreage by treating 25-percent with rain barrels, 25-percent with green roofs, and 50-percent with rain gardens.

6. Control half of the acreage of private, multi-family residences by treating 30-percent of the impervious acreage with rain gardens, 15-percent with downspout disconnections, and 5-percent with green roofs. Control half of the single-family driveways and sidewalks with permeable pavement, and control all of the single-family home impervious roof acreage by treating 10-percent with rain barrels, 5-percent with green roofs, 15-percent with downspout disconnections and 20-percent with rain gardens.

Figure 3-1 illustrates the 6 scenarios of homeowner BMPs were analyzed.

Figure 3-1: Homeowner BMP Scenarios



The efficiencies used by the WTM for pollutant reduction estimates when evaluating the first four scenarios of homeowner BMPs are presented in Table 3-9

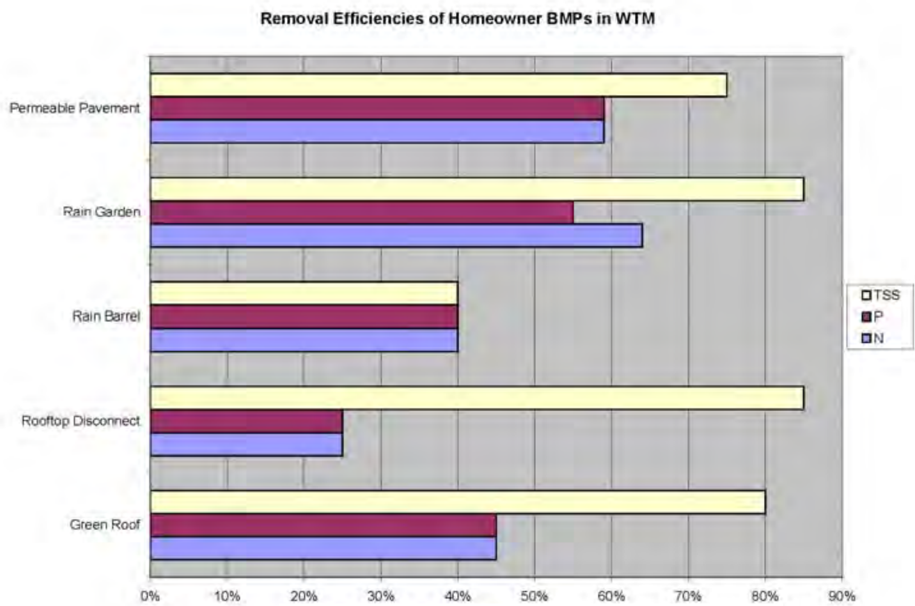


Figure 3-2: Removal Efficiencies

Table 3-9: Removal Efficiencies of Homeowner BMPs in WTM				
	Pollutant Removal Efficiencies of WTM			
	N	**P**	**TSS**	**Bacteria**
Green Roof	45%	45%	80%	0%
Rooftop Disconnect	25%	25%	85%	0%
Rain Barrel	40%	40%	40%	0%
Rain Garden	64%	55%	85%	90%
Permeable Pavement	59%	59%	75%	0%

Based on the removal efficiencies, rain gardens provide the greatest pollutant removal capability for treating rooftop run-off; however, implementation of this may be problematic in areas where there are large numbers of apartments or townhouses rather than single homes. For treating sidewalks and driveways, permeable pavement provides similar capabilities to rain gardens, except there is no reduction for bacteria. Plans that incorporate these two practices on residential properties would make the greatest pollutant removal contributions.

These scenarios evaluate potential plans that could be set as targets for homeowner participation in stormwater control programs. Tables 3-10 and 3-11 provide an estimate of the potential for each of these scenarios to reduce the current pollutant loadings to Paint Branch.

Table 3-10: Pollutant Reduction of Homeowner Stormwater Control Scenarios (Estimates made using WTM)

Scenario	N (lbs/yr)	P (lbs/yr)	TSS (tons/yr)	Bacteria (billions cfu/yr)
1	485	38	10	4,560
2	2,424	191	48	22,800
3	4,847	382	96	45,600
4	11,768	945	263	68,400
5	13,959	1,076	232	193,835
6	8,532	663	160	104,865

Table 3-11:-percent Reduction of Pollutants Estimated for Homeowner Scenarios and Acreage Controlled

Scenario	N	P	TSS	Impervious Acreage Controlled	Percent of Residential Impervious Acreage Controlled
1	1%	1%	1%	44.3	5.2%
2	3%	3%	3%	135.0	15.9%
3	6%	6%	7%	270.1	31.9%
4	13%	14%	19%	732.6	86.5%
5	16%	16%	17%	640.0	75.5%
6	10%	10%	11%	423.7	50.0%

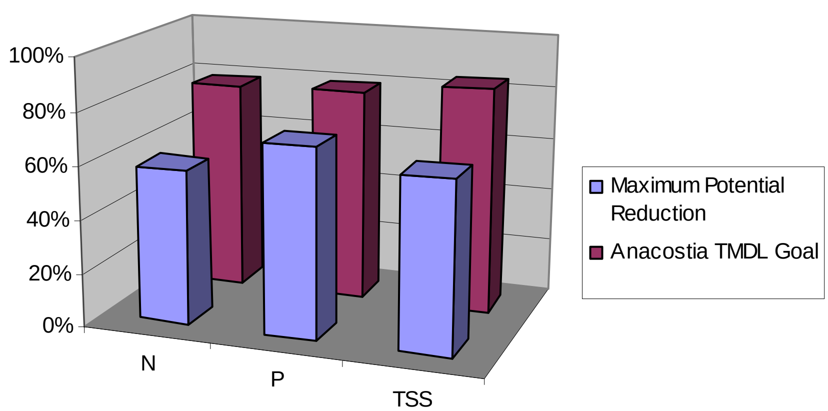
A significant fraction of pollutants could be controlled if homeowner stormwater controls were implemented over a large portion of the subwatershed. In order to achieve this, an effort needs to be put forth to increase public awareness and participation, so that all the citizens of the subwatershed are working together toward the common goal. Local governments can encourage this through significant outreach, coordination, technical assistance, and funding to extensively apply a homeowner’s stormwater management control program. If implemented, such programs have the potential to greatly reduce the pollutant loads to the subwatershed, particularly when implemented alongside provisional stormwater management projects implemented by local governments.

Table 3-12 and Figure 3-3 presents a summary of the potential pollutant load reductions that could be achievable by implementing the aforementioned projects, and compares them to the TMDL reductions goals that were established for the Anacostia River. The numbers presented here, however, do not necessarily account for the interactions of the projects with one another and are clearly subject to some double-counting of reductions. Therefore the numbers in Table 3-12 should not be considered in any further calculations, but rather taken in more relative terms of what is achievable. This double counting of reductions is likely attributed to double coverage of residential acreage through homeowner BMPs, green streets in residential areas, and sweeping of residential streets, because all three of these potential project types were considered independently when in reality they would affect the same physical acreage on a map. Likewise, the combining of stormwater retrofit projects with other practices would lead to same reductions being accounted for in multiple projects. The Plan Formulation appendix of the main document addresses this occurrence in more detail.

Therefore, when considering the results of this analysis, it should be viewed not from the standpoint of whether or not a certain level of reductions can be achieved in 10 years, but rather what significant contributions can be made toward creating a healthier Anacostia River watershed. The data presented in this report is an encouraging indicator that it is not too late to take the steps necessary to improve the environmental conditions in the Anacostia River. The projects recommended in this report are a great start down that path, but they need to be supplemented with increased community involvement, a strong education effort, and more environmentally friendly policies. The goal should be to look back in 10 years and see the progress that has been made in restoring the Anacostia River and its subwatersheds.

Table 3-12: Maximum Potential Pollutant Reduction for Stormwater Controls, Homeowner BMPs, and Street Sweeping			
	N (lbs/yr)	**P (lbs/yr)**	**TSS (tons/yr)**
Current Paint Branch Loading	**88,010**	**6,527**	**1,401**
Paint Branch Reduction Goals as Pro-Rates Share of Anacostia TMDL	**69,528 (79%)**	**5,222 (80%)**	**1,191 (85%)**
Maximum Possible Reduction			
Stormwater Controls (59% of Impervious Acreage Controlled)	11,887	1,605	333
LID Green Streets	10,082	716	163
Homeowner BMPs (Scenario 5)	13,959	1,076	232
Street Sweeping (75% of roads and 50% of lots)	15,344	1,215	169
Total Maximum Possible Reduction	51,272	4,612	897
% Total Reduction in Paint Branch Loading	**58%**	**71%**	**64%**

Figure 3-3: Maximum Potential Percent Reduction verus Anacostia TMDL Goals



Section 4
Targets and Milestones

Paint Branch 10-Year Targets and Milestones

The Paint Branch 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Paint Branch subwatershed as part of the ARP, along with realistic expectations of what could be accomplished in ten years to meet the 2020 restoration objectives, and as such the target numbers do not necessarily represent the implementation of every project in the potential inventory. These targets are established to ensure that restoration of the subwatershed is proceeding in the right direction and at a continuous, reasonable pace.

Stormwater Management

Using LID, ESD and other stormwater management techniques, stormwater retrofit projects should be implemented to increase control to a total of approximately 1,300 acres of existing impervious surfaces. This represents a 40-percent increase of controlled impervious surfaces.

Operate and maintain existing stormwater management facilities, stormwater drainage systems, and water and wastewater systems.

Aquatic Community

Increase the general Index of Biotic Integrity (IBI) scores to "Fair Range" for both fish and macroinvertebrate communities in the middle basin, and to "Good" for the upper and lower basin. This represents an improvement of one tier in each basin.

Remove or modify fish passage barriers to open approximately 6 miles of Paint Branch and tributaries for the movement of both residents and migratory fish.

Trash Reduction

Using the MWCOG Trash Index for reference, reduce trash levels one tier from High to Moderate near Route 29 in the middle basin and Moderate to Light in the lower basin near Route 1. Implement all 8 of the trash reduction projects from the recommended list by 2020.

Increase existing street sweeping programs to sweep approximately 20 to 25 additional curb miles weekly of residential and other roads. Additionally, increase sweeping of parking lots up to approximately 130-140 acres.

Wetland Creation and Restoration

Create or restore approximately 5.6 acres of permanent wetlands, and approximately 1.8 acres of vernal pools.

Riparian Corridors, Meadow Planting and Invasive Species Management
Reforest approximately 7 acres riparian buffer and upland forest, manage invasive species for approximately 40 acres, and create approximately 2.5 acres of meadow.

Based on the Anacostia Watershed Forest Management and Protection Strategy and the Center for Watershed Protection recommended tree canopy cover as a-percentage of land area, increase the overall tree canopy over 40-percent.

Land Acquisition and Management
Acquire approximately 25 acres of land to increase parkland and improve habitat connectivity.

Work to ensure that large federally owned tracts remain as open and undeveloped as possible. Areas adjacent to stream corridors should especially be maintained as undisturbed as is practical.

Environmental Restoration Programs
Consider the implementation or expansion of programs designed to assist private property owners in controlling impervious surfaces with measures such as rain barrels and rain gardens.

Outreach and Public Participation
Increase both the outreach and education programs for schools and private businesses on the restoration and protection of Paint Branch subwatershed.

Launch a new membership drive for Friends of Paint Branch.

Promote homeowners and private business restoration incentives, such as reusable grocery bags, rain gardens, rain barrels, and tree planting.

Expand existing programs to provide homeowners with access to BMPs such as rain barrels.

Promote passive uses of exiting parkland and employ more eco-friendly techniques in areas designated for high usage such as unpaved walking paths and higher grass mowing height.

APPENDIX J:
Shoreline Survey and Management Plan

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U.S. Army Garrison Adelphi Laboratory Center
Blossom Point Research Facility
Shoreline Management Plan
for
Potomac River and Nanjemoy Creek

Shoreline Studies Program
Virginia Institute of Marine Science
College of William & Mary

September 2016

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U.S. Army Garrison Adelphi Laboratory Center
Blossom Point Research Facility
Shoreline Management Plan
For
Potomac River and Nanjemoy Creek

By

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September 2016

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Executive Summary

In order to develop a comprehensive shoreline management plan for the U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research facility, Charles County, Maryland, the shore zone around the Facility's at Cedar Point Neck on the Potomac River and Nanjemoy Creek was assessed. The total shoreline considered for the study was about five miles.

This study developed recommendations that address shoreline erosion on a reach basis. Recommendations include shoreline protection strategies that are relatively non-intrusive to natural surroundings yet effective within the context of long-term shoreline erosion control. This can be accomplished with a combination of stone structures, particularly sills and/or breakwaters along with sand nourishment which create a stable substrate for establishing wetland vegetation. This "Living Shoreline" approach of utilizing stable marshes and beaches for shore protection are the preferred alternatives for shore protection.

Site parameters such as existing shore conditions, shore change, underlying geology, geomorphology, wave climate, and water levels due to storm surge and sea level rise were considered in the development of shore protection recommendations. Shore protection structures were recommended along 18,500 ft of shoreline along Nanjemoy Creek and the Potomac River as shown in the table below.

		Structures Recommended		
Reach	**Subreach**	**Type**	**Number**	**Designation**
I	A	Gapped Sill	4	A1-A5
	C	Gapped Sill	9	C1-C9
	D	Gapped Sill	4	D2, D3, D5, D6
		Spur	1	D1
		Revetment	1	D4
II	A	Gapped Sill	6	A1-A6
	B	Gapped Sill	5	B1-B5
	D	Gapped Sill	3	D1-D3
III	A	Gapped Brill	4	A1-A4
	B	Gapped Brill	8	B1-B8
	C	Gapped Brill	4	C1-C4
		Sill	1	C5

Acknowledgements

The authors would like to acknowledge Glenn G. Gass, PE for his assistance with the development of conceptual shore protection structures and structure planning so that they are compliant with engineering standards.

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1 INTRODUCTION

1.1 Background and Purpose

1.1.1 General Statements

In order to develop a comprehensive shoreline management plan for the U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility, Charles County, Maryland (Figure 1-1), the shore zone around the Facility at Cedar Point Neck on the Potomac River and Nanjemoy Creek was assessed. In this report, the study area is referred to as the Facility or Blossom Point. The total shoreline considered for the study was about five miles.

Generally, the Facility's shorelines on the open Potomac River are subject to wind-driven wave-forces that cause low to moderate to severe shoreline erosion. Shorelines along Nanjemoy Creek are somewhat less exposed to wind wave action. Hydrodynamic forcing and the way it relates to shoreline change is an important component of this study. This Plan will attempt to put the natural process of shoreline erosion into perspective as to potential long-term impacts to upland infrastructure and land loss.

This study developed recommendations that address shoreline erosion on a reach basis. The impacts of "doing nothing" to the shoreline also were assessed. Recommendations include shoreline protection strategies that are relatively non-intrusive to natural surroundings yet effective within the context of long-term shoreline erosion control. This can be accomplished with a combination of stone structures, particularly sills and/or breakwaters along with sand nourishment which create a stable substrate for establishing wetland vegetation. This "Living

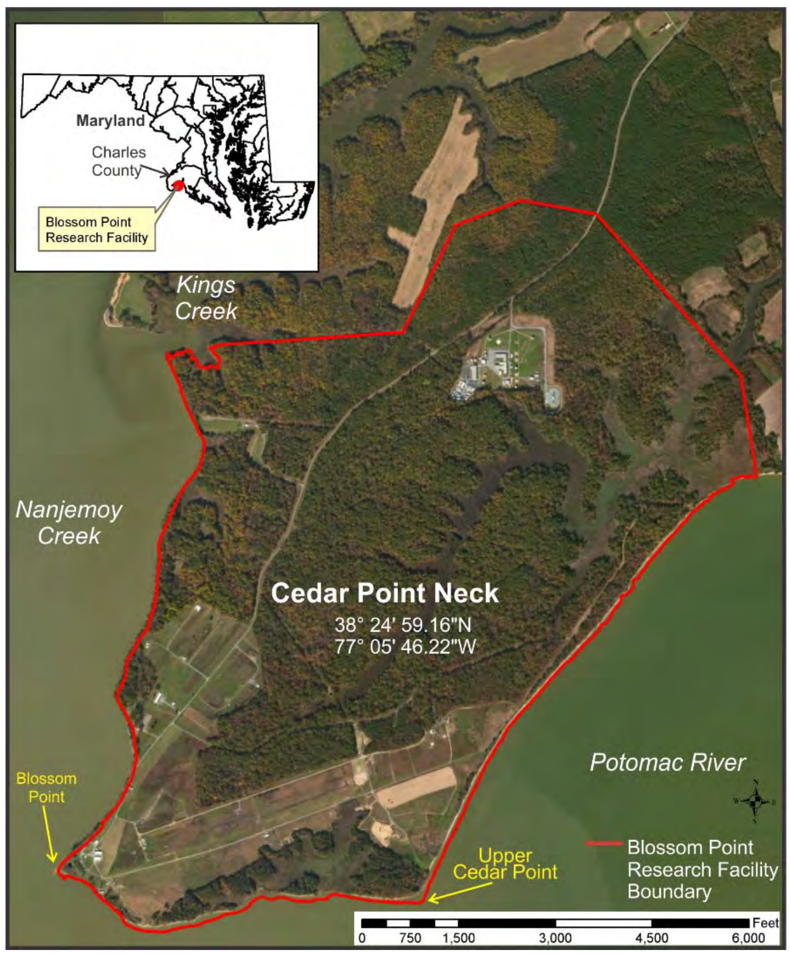


Figure 1-1. Location of U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research facility within the Chesapeake Bay estuarine system.

Shoreline" approach of utilizing stable marshes and beaches for shore protection are the preferred alternatives for shore protection.

High priority is given to eroding shorelines where infrastructure is threatened. Eroding upland banks and shoreline morphology are addressed holistically in the context of the overall shoreline management plan.

1.1.2 Site Description

Blossom Point Research Facility is located on Cedar Point Neck. The shorelines along the Facility are generally moderate upland banks ranging from 10 ft to 20 ft above mean low water (MLW). These banks are in various states of instability from relatively stable uplands with beach along the Potomac River to vertically exposed in situ strata. Shore erosion and bank failure is an evolutionary process where banks with little or no beach are directly impacted during even modest storm events. The bank height and bank composition are a function of the underlying geology. Typically, along Potomac River high banks, a basal clay or silt strata is overlain by various layers of sand and gravel. However, no significant basal clay occurs along the Blossom Point coast and groundwater does not occur as seeps or springs in the study area.

Most of the Potomac River shorelines have a narrow beach along the coast composed of fine to coarse sands from the adjacent eroding banks. The backshore (base of bank to mean high water (MHW)), where present, is littered with fallen trees and drift logs which interface between the beach and base of bank and often trap littoral sands increasing beach width at those locations. Several areas of marsh shorelines exist and generally consist of brackish water species ranging from *Spartina alterniflora* (smooth cordgrass), Spartina *cynosuroides* (big cordgrass), *Scirpus* (bulrush), and *Phragmites australis* (common reed).

1.2 Components of the Shoreline Management Plan

1.2.1 Existing Shoreline Conditions

Documentation of the existing condition of the upland bank, beach, intertidal and nearshore areas is essential to management of the shore zone. In addition to determining the type of shore and intertidal area (i.e. beach or marsh, sand or clay), nearshore water depths and bottom stability must be assessed as well as the condition of the base of bank (BOB) and bank face. The bank face is an important factor in long-term shoreline management. The degree of instability and potential for erosion must be weighed against threatened infrastructure, land loss, and costs for shore/bank protection and structure relocation.

1.2.2 Shore Change, Geology, and Geomorphology

Understanding long-term change within the study area is important in assessing specific shoreline reaches. Upland features are assessed in terms of coincidence with areas of shoreline erosion and flooding to determine priority of action and what shoreline strategies should be employed. Shoreline morphology and erosion patterns are evaluated in order to determine the long-term shore response to the hydrodynamic processes.

The geologic underpinnings relative to shore morphology also should be assessed. The geology of an area can cause shorelines to erode unevenly. Adjacent shore types, such as uplands and marsh and even unprotected shore segments that border protected shores, result in the development of different morphologic expressions along the shore. The net effect is that beaches and shorelines tend to orient themselves into or parallel with the dominant direction of wave approach. The morphologic expressions were compared with the wave climate assessments to see if a correlation exists. Generally, beach and shoreline planforms will reflect the net impact of the impinging wave climate. When the wave climate assessment agrees with the morphologic expression, then the impacts of proposed shoreline management strategies can be assessed with more confidence.

1.2.3 Wave Climatology and Water Levels

Shoreline change (erosion and accretion) is a function of upland geology, shore orientation and the impinging wave climate (Hardaway and Byrne, 1999). Wave climate refers to averaged wave conditions as they change throughout the year. It is a function of seasonal winds as well as extreme storms. Seasonal wind patterns vary. In Chesapeake Bay region, from late fall to spring, the dominant winds are from the north and northwest. During the late spring through the fall, the dominant wind shifts to the south and southwest. Northeast storms occur from late fall to early spring (Hardaway and Byrne, 1999) while infrequent occurrence of hurricanes annually peaks in late August to mid-September.

The wave climate of a particular site depends not only on the wind but also the fetch, shore orientation, shore type, and nearshore bathymetry. Fetch is defined as the distance over open water that wind can generate waves. Fetch can be used as a simple measure of relative wave energy acting on shorelines (Hardaway and Byrne, 1999).

Increased water levels regardless of wind conditions pose a threat to coastal resources. For this reason, another component of the wave climate assessment was the determination of the frequency of storm surges and flooding. This assessment is based, in part, on long-term tidal data from the National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (Corps), and Flood studies conducted by Federal Emergency Management Agency (FEMA) for nearby King George, Virginia. Analyses such as these are critical when determining the potential impact of the local wave climate and storm surge on the shoreline. Consideration of these impacts is an important element in the design of a shoreline management strategy particularly the dimensions of structural options.

When developing a management plan to protect upland infrastructure, sea-level rise is an important long-term consideration. Projected sea-level rise rates tend to be higher than those measured over the recent past based on climate change and global warming. Whatever the rate, the recommended shoreline strategies have the ability to adjust by being built upon and added to in order to address the impacts of sea-level rise over the long-term.

1.2.4 Reach Assessment and Recommendations

With the aforementioned analyses are complete, shore reach assessment was performed. This assessment incorporates the Army’s land use goals as well as existing shoreline conditions and their potential for change. The purpose of assessment is to determine the "immediate" need for any specific shoreline management strategy and how the strategies fit into the long-term plan.

A variety of shoreline management strategies may be recommended for each shore reach. The strategies may include any of the following:

1. Do nothing and/or move infrastructure
2. Defensive approach (stone revetments)
3. Offensive approach (stone sills with wetlands plantings, stone breakwaters and beach fill with wetlands planting)
4. Headland control (stone breakwaters strategically placed)

One or a combination of the above strategies may be appropriate for a given reach depending on the availability of funds and project goals. Phasing shoreline management strategies through time also is addressed because it is usually the more prudent and cost-effective approach. All strategies integrate upland management as part of the plan. Bank grading may be recommended in a few instances along the Blossom Point coast, but generally will be limited due to potential archeological resources and/or unexploded ordinances (UXOs).

2 METHODS

2.1 Reach Boundaries, Geology/geomorphology, and Historic Shore Change

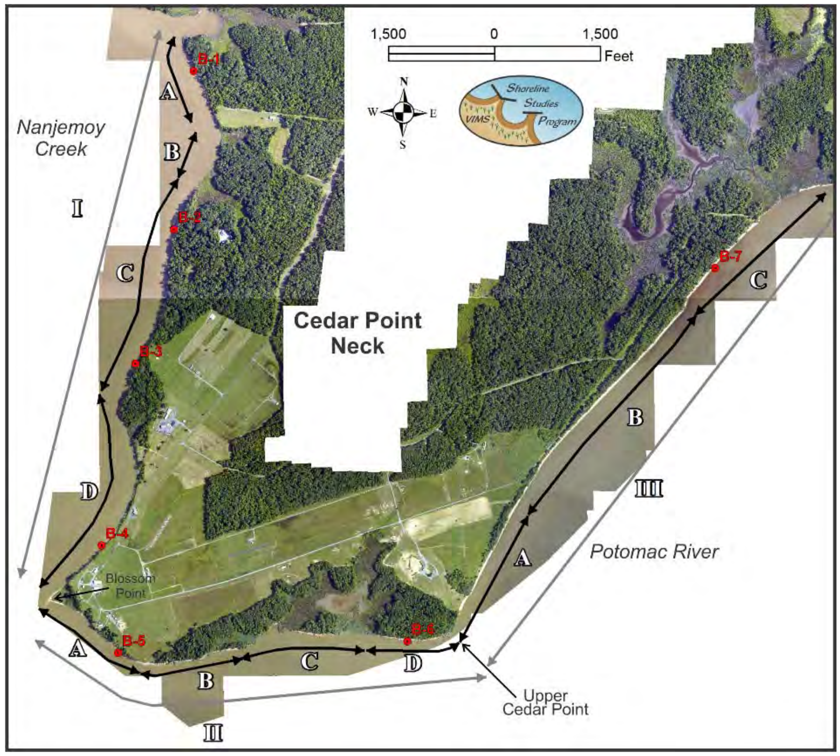


Figure 2-1. Location of Reaches and subreaches along Blossom Point. Also shown are the locations of the short cores taken in the nearshore as well as the location of wave climate modeling.

The Facility's shorelines are described by Reach based, in part, on fetch exposure, shore orientation, and geology. Cedar Point Neck consists of three reaches, Reach I on Nanjemoy Creek and Reach II and III on the Potomac River coast (Figure 2-1). A combination of field observations, maps, charts, and aerial imagery were used to develop these reach designations.

Within each Reach, several subreaches are defined (Figure 2-1), in part, by land use (threatened infrastructure) and shore zone geomorphology. A site visit was performed during the summer of 2016 to assess the upland bank, beach, intertidal and nearshore areas. Field notes were taken on aerial photo base maps which were created from an aerial imagery of Blossom Point taken on 30 June 2016. The land use (infrastructure) and shore zone geomorphology of each subreach determined, in part, the detail of the shoreline management recommendations.

The geomorphology of the study area was assessed using topographic maps and verified through field observations. Other information, particularly upland topography was obtained from a 2014 LIDAR survey of Charles County available online from the Salisbury University LIDAR server (http://esrgc1.salisbury.edu/LiDAR/portal). The 2014 imagery was downloaded from Maryland iMap, Maryland's mapping and GIS data portal (http://imap.maryland.gov/Pages/data.aspx). Additional aerial imagery taken in 2016 by the Virginia Institute of Marine Science, Shoreline Studies Program (VIMS, SSP) and Google Earth was used to further assess geomorphology.

The historic shore change analysis used existing shorelines from the Maryland Department of Natural Resources Geopatial Data Center (http://dnrweb.dnr.state.md.us/gis/data/). These shorelines, 1852, 1904, 1961, and 1993, were plotted with the 2014 and 2016 digitized shorelines and analyzed in the Digital Shoreline Analysis System (DSAS) (Himmelstoss, 2009). DSAS was used to determine the end point rate (EPR) of change for Blossom Point's shorelines between 1904 and 2016, except for one area along Nanjemoy Creek where the 1904 shoreline was missing. This section has a shore change rate calculated between 1961 and 2016. The EPR is calculated by determining the distance between the oldest and most recent shoreline in the data and dividing it by the number of years between them. This method provides an accurate net rate of change over the long term and is relatively easy to apply to most shorelines because it only requires two dates.

2.2 Upland Bank Characteristics

The condition of the upland banks and shore zone were qualitatively ascertained from alongshore boat observations as well as from land side reconnaissance. To simplify the field data for graphic display, a coding system was developed to display the condition of the base of the bank (BOB) and the bank slope. The BOB and bank slope were characterized as 1) stable, 2) transitional or 3) erosive or failing. Stable BOBs are not undercut and often will have a beach or vegetation along the base. Stable bank slopes are vegetated with relatively gentle slopes. The higher banks may be complicated by stable slumps but exposed upper bank faces. A transitional BOB may be slightly undercut possibly indicating a trend toward either more erosion or stability. Transitional bank slopes are partially vegetated banks with steeper slopes. Erosive BOBs are significantly eroding often with vertically exposed banks or slump face. Erosive bank slopes are steep, often vertically exposed, and have little or no stabilizing vegetation.

2.3 Nearshore Characteristics

In order to determine the type of sediment in the nearshore, seven short cores were taken by auger (Figure 2-1). The cores were 2 ft long and were sampled for sediment analysis. The percent gravel, sand, silt, and clay were determined. This information is important to determine any factors that might influence stability of structures constructed in the nearshore.

Additionally, an extensive nearshore survey was conducted on July 26 and 27, 2016 by Waterway Surveys & Engineering, Ltd. This survey consisted of transects from the shoreline varying distances into the nearshore region spaced approximately 400 ft apart (Figure 2-2). The data was delivered with a vertical datum of NAVD88 in feet. A baseline and cross-sections were created along the Blossom Point shoreline. Data points from the LIDAR data and from the nearshore survey were exported along the cross-sections to create a complete coastal cross-section of the bank and the nearshore. Select cross-sections were plotted as the base for structure design. The difference between NAVD88 and MLW at Blossom Point is approximately 0.7 ft based on SSP's database calculated using the National Oceanic and Atmospheric Administration VDATUM grids (Hardaway *et al*., 2010).

2.4 Wave Climate

To assess the wave climate at the Blossom Point, wave hindcasting was conducted using the US Army Corps of Engineers Coastal Engineer program, ACES. Longest and effective fetch was calculated at two stations on the Potomac River, one located along Reach II and the other along Reach III. Fetch is the distance over which wind can blow and generate waves. Due to limited fetch along Nanjemoy Creek, the wave climate was not assessed for Reach I. Wind/waves from the southwest and south have the most impact on Reach II and from the southeast along Reach III. Longest fetch is the longest distance from the wave modeling point while effective fetch is calculated using six degree radials offset on either side of the main fetch direction (southwest, south, and southeast). Average fetch is calculated using fewer radials and is used more generally to understand the wave climate at a site.

Along Reach II, the longest fetch is 9.5 miles toward the southwest. The effective fetches for the southwest and south directions for Reach II were 3.8 miles and 2.7, respectively. The effective fetch for the southeast condition along Reach III was 3.2 miles. Reach III, the longest fetch was 5.6 miles toward the east-southeast. Once fetch was calculated, the ACES model was used to develop predicted wave heights and periods for specific conditions. Wind/waves were calculated for the 25, 35, 45, and 55 mph winds with +3, +4, +5, and +6 ft MLW surge levels, respectively. Additional wave climate assessment information is located in Appendix B.

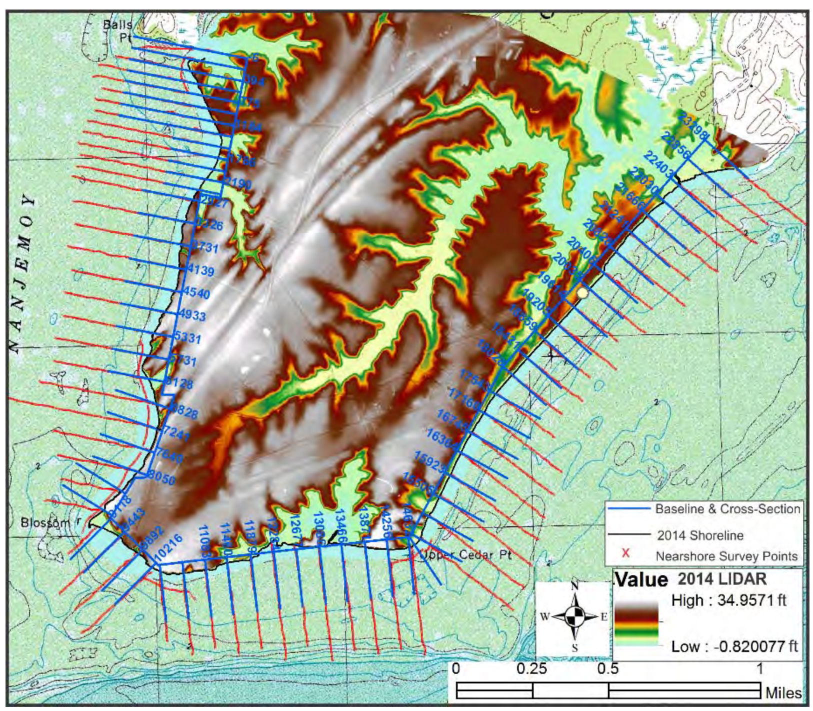


Figure 2-2. 2014 LIDAR data plotted with the 2016 nearshore survey. Also shown are the cross-sections created from the combined data. The data is plotted on a USGS topographic map. The topographic elevations and water depths are shown in meters.

3 CEDAR NECK PHYSICAL and ENVIRONMENTAL SETTING

3.1 Geology/Geomorphic Setting and Sea-Level Rise

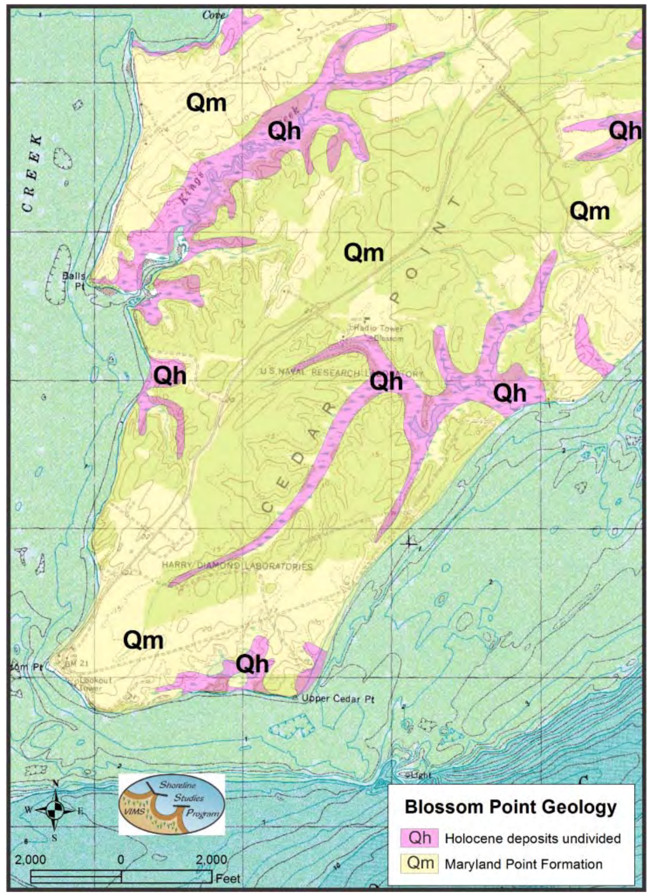


Figure 3-1. Geology of Blossom Point overlain on the USGS topographic map. Surface layers are Quaternary in origin although deeper layers may be Tertiary and exposed along eroding banks.

During the Tertiary (65 million to 1.8 million years ago) and Quaternary (1.8 million years ago to present) Periods, the Coastal Plain was both covered by shallow seas and exposed for long periods of time through several cycles of high and low sea levels producing thick sequences of marine and estuarine formations that were deposited when the Coastal Plain was under water. Each sediment formation is separated by bounding unconformities that formed when sea level was low and the land eroded. These preserved Tertiary and Quaternary formations were deposited under different circumstances. The Tertiary formations typically were formed during a shallow, continental shelf state while the Quaternary formations typically were deposited in rivers, estuaries, bays, barrier islands and nearshore marine conditions that are comparable to the present lower (Figure 3-1).

Cedar Point Neck is composed of sedimentary strata. The coastal uplands consist of Maryland Point Formation, Qm, (Upper Pleistocene- 1.8 million to 11,500 years ago) with intermittent Holocene (11,500 years ago to present) tidal marsh sediments (Qh). The geomorphology of the Blossom Point coast, like most tidal Chesapeake Bay areas, is shaped by geologic history. During a protracted low stand in sea level during the Late Pliocene (3.6 to 1.8 million years ago), the present day drainage of the Susquehanna and major estuaries including the Potomac were entrenched into the underlying strata. Sea level has risen and fallen numerous times which resulted in deposition and erosion, respectively, of material during the Pliestocene. The last low stand in sea level was about 15,000 years ago. Since then, sea level has been rising. The effect has been a transgressing ocean over a low coastal plain with consequent flooding of meandering fluvial systems that were set in place as the sea was retreating. The result is shoreline recession or shoreline erosion across the mostly dendritic drainage pattern of the Chesapeake Bay watershed. Cedar Point Neck is an interfluve feature set between the Nanjemoy Creek and the Port Tobacco River.

Since the last low sea level 15,000 years ago, sea level has been rising and over the past several thousand years at a rate of about 1 foot per 100 years. However, analysis of tide gauge data just downriver at Colonial Beach, Virginia indicates that since 1970, sea level has risen at 4.9 mm/yr or 1.6 ft/100 years (NOAA, 2016) in this region of the Potomac River.

3.2 Upland Bank and Shore Change

Erosion rates along estuarine shorelines are a function of two unrelated factors – wave climate and the site-specific character of the sediments. The different amount of energy required to suspend and re-suspend, hence erode, individual types of sediment determines the variations in erosion rates between sections of shore exposed to equal amounts of impinging energy. More energy, in terms of waves and currents, is required to re-suspend silts, clays, coarse sands, and larger-sized sediments than medium- and fine-grained sands. Thus, given equal exposure to waves and currents, shores consisting of medium- and fine-grained sands will erode more rapidly than deposits of clays or silts.

Sediments from eroding upland banks supply the beach/backshore and nearshore zones found in front. Beaches and upland banks tend to orient themselves into the direction of dominant wave approach, especially if there is a “hard” point, such as an erosion resistant feature, upon which sand will accumulate on one side and the bank will cut on the other in the alongshore direction. The nature of the beach/backshore is a function of the adjacent bank geology. Sand, silts and clays are deposited differently as the bank erodes over time. The finer fraction, fine sands, silts, and clays, are readily carried offshore and deposited. The coarser sands and gravels generally occur as the beach and backshore deposits. Because much of the Cedar Point Neck bank material contains muddy fine sands to coarse sand and clay, the beach/backshore occur as fine to medium sand and nearshore regions have a soft muddy fine sand layer over more stiff/dense clays and sand layers.

Blossom Point’s upland banks are mostly silty medium fine sands that, when eroded, are transported both alongshore and offshore. The net movement of sediment transport is driven by the impinging wind/ wave climate over time as determined by fetch exposure to the dominate wind direction for a given reach. Shoreline features such as downed trees can indicate the net movement of beach sands either up or downriver.

There are four important bank/shore types in the scheme of shoreline erosion around Blossom Point: beaches/spits, upland banks, marsh fringe, and protected shorelines. The geomorphic evolution of estuarine shorelines is an interplay among these four features. They create differentially eroding shorelines which allow us to better ascertain the impinging wave climate by identifying the tangential bank and/or beach features. Tangential features, which are a function of wave climate, shore change analysis, and the description of offsets in bank and marsh shores created by differential erosion allow us to develop a fairly accurate picture of how the shoreline has evolved through time (Figure 3-2). Lack of these offset features is also important and may indicate a more balanced system of littoral movement.

Figure 3-2. Photo of Blossom Point showing how natural and man-made headlands impact the shoreline morphology by creating offsets along the shore. These headlands impact sediment transport along the reach as well.

Historic shore erosion rates generally are higher along Reach II than Reach III or Reach I (Figure 3-3). The increased fetch exposure allows more wind/wave energy to impact the base of the banks which causes chronic bank face instability, shore erosion, and sediment transport. However, Reach III has very low erosion/accretion on its southern half and low to medium erosion on its northern half. It has a wider beach and backshore because sediments for these beaches come from bank erosion updrift and upriver including Reach II. Historic rates along the Potomac River Reach II and III vary from no change to erosion over -3.0 ft/yr.

Along the Blossom Point coast, the primary forces of shore retreat are the undermining action of waves against the base of the upland banks (Figure 3-4). The upland banks become too steep to support the load and fail by sloughing/slumping. For a period of time, the bank is stable where the sloughed material sits along the shore. However, the sloughed material is continually acted upon by the ongoing wave action and, with time, will erode back to the in situ bank, and the process begins again. Other factors such as upland runoff, freeze/thaw, and groundwater can add to bank instability but are not major factors along Blossom Pt coast.

The beach and intertidal areas vary around the Blossom Point coast. Most of the Potomac River shorelines have some type of beach feature. These beaches are composed of varying mixtures of sand and gravel. A relatively wide backshore region (from MHW to the BOB) can provide a natural buffer to wave action which often translates to a stable BOB and bank slope such as along Reach IIIB. A narrow or non-existent backshore allows wave action to act upon the BOB on a frequent basis and offers no buffer during storm events as occurs along Reach I and II.

3.3 Nearshore and Channel Characteristics

The nearshore region within the project area varies in extent and bathymetry. The width and depth of the nearshore can have an impact on wave climate because wider nearshores better attenuate the impinging waves. Along the Potomac River shoreline, the nearshore "shelf" from the shoreline to about the -6 ft MLW isobath varies in width from a 300 to maximum of about 2000 feet (Figure 3-1). The Nanjemoy Creek nearshore varies from 500 to 1000 ft.

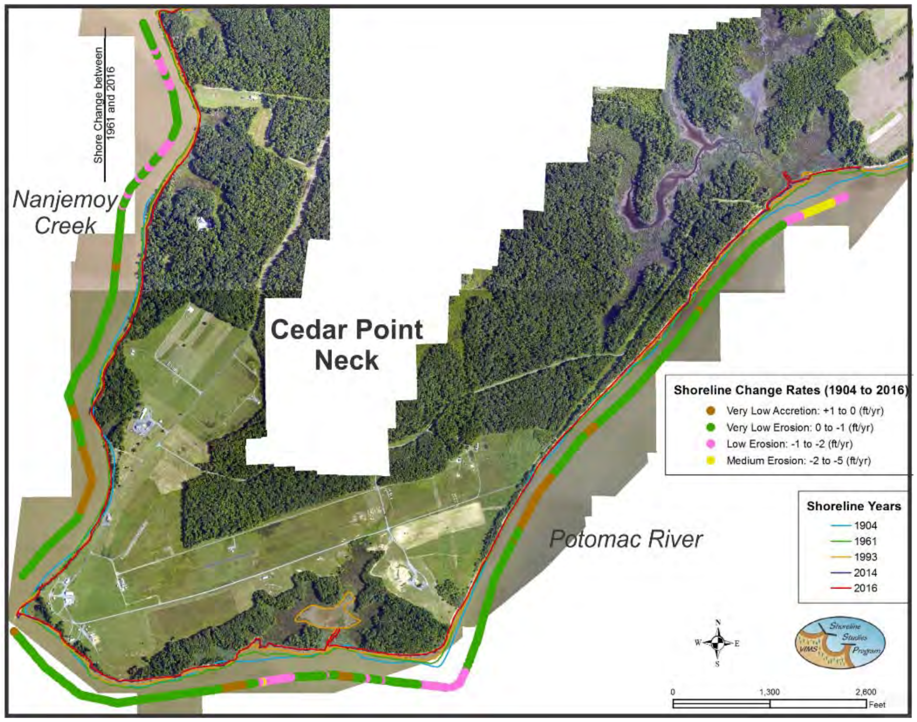


Figure 3-3. Shorelines and shoreline rate of change along Blossom Point Facility.

From MLW, potential structures, such as sills and breakwaters, may be situated from MLW out 50 ft to 100 ft. Along the Potomac River, the nearshore bottom, which is important for structure stability, is relatively firm due to underlying medium stiff clays. The nearshore regions along the creek shores can vary from soft to hard. The results of the sediments sampled from the cores are shown in Table 3-1. Core 7 in Reach III is the only core that shows a significant amount of silt and clay. The nearshore should be sampled in more detail along this reach before construction.

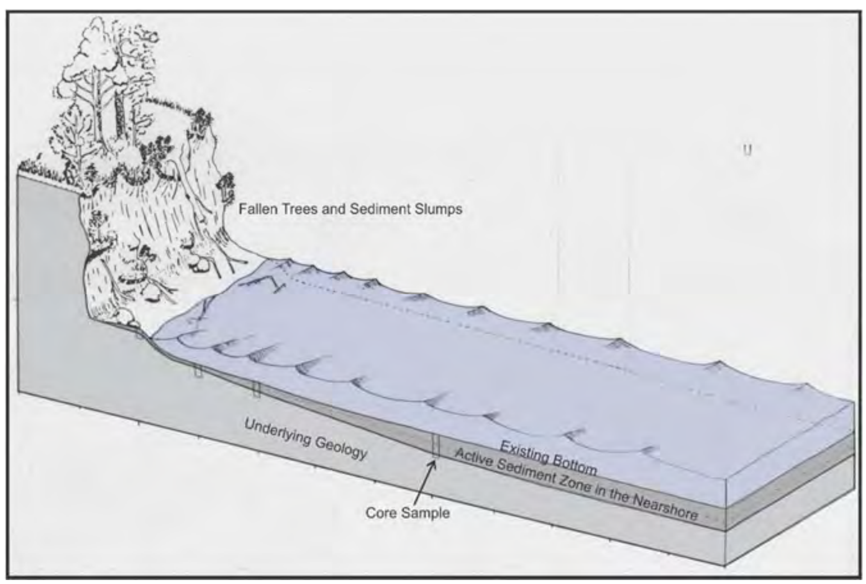


Figure 3-4. Diagram showing an unstable bank with fallen trees and sediment slumps along the shoreline. Also shown is the nearshore which has an active sediment transport layer over the underlying geology. Core samples are taken from the bottom through the active sediment zone and possibly into the underlying geology. From Hardaway (1980).

Table 3-1. Sediment sample results from cores.

Core	Depth (ft)	% Gravel	% Sand	% Silt	% Clay	Stability
B-1	1	0	83.9	10.9	5.2	Firm
B-1	2	0	92.8	4.5	2.7	
B-2	2	20.1	68.2	9.1	2.6	Firm
B-3	1	0.5	84.1	11.8	3.6	Firm
B-3	2	22.8	66.8	7.0	3.4	Firm
B-4	2	14.5	69.9	11.5	4.1	Firm
B-5	2	0	90.2	5.3	4.5	Firm
B-6	2	0	89.9	7.6	2.5	Firm
B-7	2	0	45.0	31.6	23.4	Soft

3.4 Wind and Water Level Assessment

Hourly wind data from Quantico taken between 1973 and 2001 (Table 3-2) shows the highest overall percentage of frequency of occurrence coming from the north direction (28%) which does not directly affect Blossom Point shorelines. The other 7 directions from highest to lowest are 2) northwest (19%), 3) south (18%), 4) west (10%), 5) northeast (7%), 6) southwest (7%), 7) southeast (7%), and finally 8) east (5%). In terms of wind speed, most winds fall in the 5-10 mph range with only few sustained winds above 30 mph.

The wind/wave climate is important to erosional processes when elevated water levels occur with wind speeds of about 20 mph. Above 20 mph, most occurrences were from northwest, north, and west. However, the Blossom Point Potomac River, Reaches II and III are mostly impacted by wind driven waves from the southwest, south, and southeast.

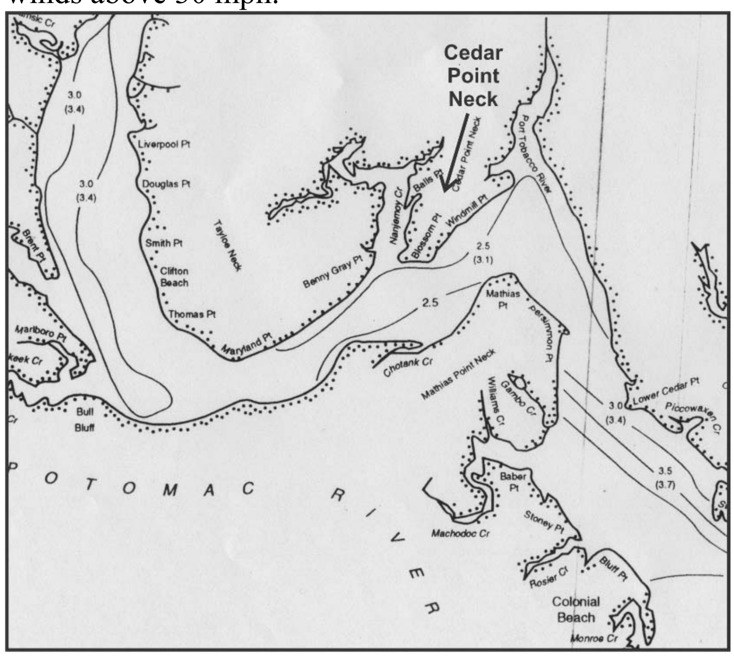


Figure 3-5. Wave modeling results along the Potomac River near Blossom Point from Basco and Shin (1993).

Basco and Shin (1993) described the wave climate in the Potomac River for use in planning and designing structures. Their analysis utilized winds of 35 miles per hour to generate waves with characteristics that could be expected to impact the coast about once every two years. The storm surge for this event is about 2.5 feet above MHW. Wave heights and wave periods near Blossom Point were modeled to be 2.5 ft with a 3.1 second period before nearshore shoaling (Figure 3-5).

Table 3-2. Summary wind conditions at Quantico from 1973-2001.

# Occurrences									
Wind Speed									
mph	S	SW	W	NW	N	NE	E	SE	Total
0_5	12120	4194	6813	15305	35670	3282	3798	4725	76489
5_10	18480	6720	10506	13811	12522	7785	5461	6772	102844
10_20	4400	2175	2151	7434	6790	2984	1050	1287	63453
20_30	93	79	109	439	293	95	47	35	3620
30_40	3	3	7	9	15	3	3	2	45
40_60	2	0	1	2	1	0	1	1	8
Total	35098	13171	19587	37000	55291	14149	10360	12822	197478
Percentage									
	S	SW	W	NW	N	NE	E	SE	Total
0_5	6.1	2.1	3.5	7.8	18.1	1.7	1.9	2.4	31.0
5_10	9.4	3.4	5.3	7.0	6.3	3.9	2.8	3.4	41.7
10_20	2.2	1.1	1.1	3.8	3.4	1.5	0.5	0.7	25.7
20_30	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	1.5
30_40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40_60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	17.8	6.7	9.9	18.7	28.0	7.2	5.2	6.5	100.0

Storms are a large part of the force of change along Potomac River shorelines. Two types of storms can impact the shore -- hurricanes and northeasters. During a hurricane, storm surges, which can exceed 6 feet along the Potomac River, and high winds can generate 4 ft breaking waves capable of transporting significant amounts of sediments. Northeasters have weaker wind fields and generally have surges less than 5 feet. However, these extratropical northeasters usually have longer durations and can span several tidal cycles significantly elevating water level during times of high tide. For Blossom Point Head, storm surge frequency is shown in Table 3-3 based on FEMA study for King George County, Virginia across the Potomac River.

Tides and tidal currents can have an impact on wind/waves and sediment movement along the project shorelines. The mean tide range at Blossom Point 1.2 ft with a spring tide range of 1.3 ft. Tidal currents off Maryland Point, about 6 mile upriver, are 1.8 knots for maximum ebb and 1.4 knots for maximum flood. Tidal currents were considered but are not a direct parameter in the wave climate analysis.

Table 3-3. Potomac River at King George across the Potomac River from Blossom Point (FEMA, 2009).

Event Frequency (years)	Storm Surge Level (ft MLW)
10	4.4
25	5.0
50	6.1
100	7.2
500	9.1

3.5 Wave Climate Analysis

Utilizing the wind speed adjustment wave growth function in ACES, the imping wave at a point offshore at about the -6ft contour was performed. Several surge levels (3 ft, 4 ft, 5 ft, and 6 ft) were applied on wind speeds of 25 mph, 35 mph, 45mph, and 55 mph, respectively. Due to fetch restrictions of Reach I only Reach II and Reach III were assessed. Reach II included wind waves from the south and southwest while Reach III from the southeast. As waves proceed landward, they will break when the water depth is about 0.78 the wave height. Breaking waves, in turn, provide the energy for bank erosion and alongshore sediment transport. The long-term net direction of sediment transport is often best ascertained by shoreline features, such as fallen trees trapping sand on morphologic offsets. The net direction, shown for each subreach in Appendix A, is a combination of these elements. Additional information is found in Appendix B.

Since MHW in many areas is at or just above BOB along much of Reach I and Reach II, the storm waves with surges of +3 to +4 will directly impact the BOB causing erosion and sloughing. Concurrent sediment transport carries eroded sediments in the opposite direction of the imping storm waves. Storm surges of +5 and + 6 impact higher on the bank face and typically have larger waves causing an increased volume of littoral transport. Reach IIIA and IIIB generally have a wide enough beach and backshore to accommodate storm surges between +3 and +5 ft MLW as well as the associated breaking waves and subsequent run up. However, along Reach IIIC, wave run up can impact the BOB. Wave run up generally impacts directly on the vertically exposed banks of Reach I and Reach II.

3.6 Environmental Setting

Locally, marine resources of concern are primarily submerged aquatic vegetation (SAV) because sea grasses offer habitat to various fish species. Historically SAV beds were located along the project shoreline, no significant SAV has been mapped in the nearshore along the

Potomac River or Nanjemoy Creek coasts since 2007 (SAV, 2016). Anthropogenic impacts to the nearshore region have been minimal.

The salinity of this section of the Potomac River varies from 0-10 ppt (parts per thousand salinity) in the spring to 10-20 ppt in the summer (Chesapeake Bay Foundation, 2016). No oyster leases occur in this part of the Potomac River. The National Wetland Inventory defines the wetlands up Kings Creek and the other small tidal creeks as E2EM1P which is estuarine, intertidal, emergent, persistent, as well as irregularly flooded. Dominate marsh grass species found include *Spartina alterniflora* (smooth cordgrass), *Spartina cynasuroides* (big cordgrass) and *Scirpus americanus* (American threesquare).

Archeological resources were searched online, and no sites on the National Register occur along the project shoreline. In addition, Blossom Point does not have any reported UXO reported along the shoreline, thus simplifying construction activities.

4 SHORELINE MANAGEMENT ELEMENTS

4.1 Objectives

The first step in developing a framework for shoreline management is establishing clear objectives toward which erosion control strategies can be directed. In developing the Blossom Point Shoreline Management Plan, the following objectives have been given consideration:

- Prevention of loss of land and protection of upland improvement.
- Protection, maintenance, enhancement and/or creation of wetlands habitat both vegetated and non-vegetated.
- Management of upland runoff and groundwater flow which may exacerbate bank erosion.
- For a proposed shoreline strategy, addressing potential secondary impacts within the reach which may include impacts to downdrift shores through a reduction in the sand supply or the encroachment of structures onto subaqueous land and wetlands.

These objectives must be assessed in the context of a shoreline reach. While all objectives should be considered, each one will not carry equal weight. In fact, satisfaction of all objectives for any given reach is not likely as some may be mutually exclusive. These areas of concern could then be addressed specifically in the shore change and hydrodynamic analysis.

Living Shorelines are a best management practice that addresses erosion and enhance ecosystem services by providing long-term protection, restoration, or enhancement of vegetated shoreline habitats through strategic placement of plants, stone, sand fill and other structural or organic materials. Living Shorelines is the overarching guide for the recommended protection strategies in the Plan because both sills and breakwaters are considered living shorelines. However, all erosion problems cannot be solved with a Living Shoreline design, and in some cases, a revetment is more practical. Most likely, a combination of these practices will be required at a given site. Living shoreline strategies provide the suitable gradient to address sea-level rise and enhance the coastal resiliency of the Blossom Point coast.

4.2 Protection Strategies and Coastal Structures

Four general types of shore protection strategies were considered in the discussion of each shore reach within the study area. These strategies are discussed below.

4.2.1 No Action

Essentially, this strategy allows the natural processes of shoreline erosion and evolution to continue as they have for the past 15,000 years as part of the latest sea-level transgression. However, threatened infrastructure, such as roads and buildings, may force the implementation of shore protection strategies. Moving the buildings and roads will delay the problem, but it also might allow more room to initiate a lesser degree of bank work and a reduction in size and scope of shore structures.

No action can include low cost measures to address bank stability problems at the top of the bank by reducing the amount of storm water runoff and infiltration that reaches the bank slopes.

4.2.2 Defensive Approach

The Defensive Approach refers to the use of shore protection structures that commonly are placed along the base of an eroding bank as a "last line of defense" against the erosive forces of wave action, storm surge, and currents. For the purposes of this study, stone revetments are the strategy employed.

Revetments are shoreline armoring systems that protect the base of eroding upland banks and usually are built across a graded slope (Figure 4-1). The dimensions of the revetment are dependent on bank conditions and design parameters such as storm surge and wave height. These parameters also determine the size of the rock required for long-term structural integrity. Generally, two layers of armor stone are laid over a bedding stone layer with filter cloth between the earth subgrade and bedding layer.

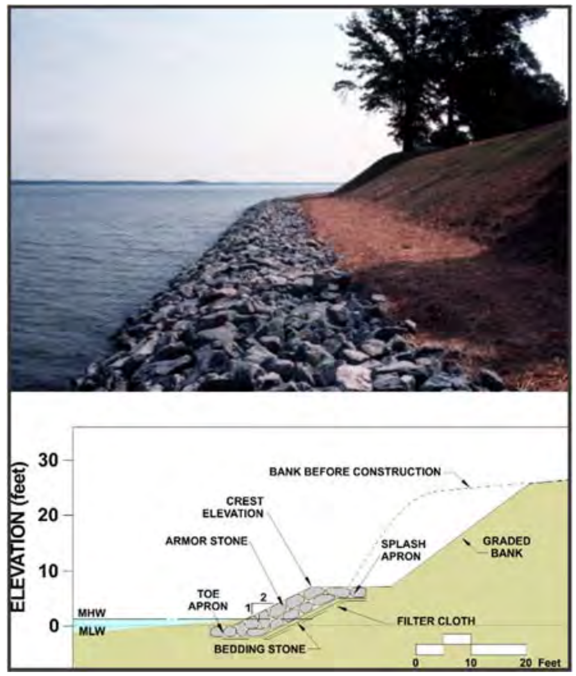


Figure 4-1. Stone revetment (top) and cross-section of elements necessary for proper stone revetment design (bottom). From Hardaway and Byrne (1999).

4.2.3 Offensive Approach

The Offensive Approach to shoreline protection refers to structures that are built in the region of sand transport to address impinging waves before they reach upland areas. These structures traditionally have been groins, but over the past decade, the use of breakwaters and sills have become important elements for shoreline protection. Spurs are installed on breakwaters and sills to move the wave diffraction point further offshore to assist in attaining local equilibrium of the shore planform. The use of offensive structures requires a thorough understanding of littoral processes acting within a given shore reach.

Breakwaters and sills are "free standing" structures designed to reduce wave action by attenuation, refraction, and diffraction before it reaches the upland region. A sill (Figure 4-2) has a lower crest, is usually closer to shore, and more continuous than larger breakwater units that the sill can be used in combination with. Sills are installed with beach fill to create a substrate for establishing a marsh fringe.

Attached or headland breakwaters usually require beach fill in order to acquire long-term shoreline erosion control (Figure 4-3) because they are generally constructed in areas that are subject to more energetic conditions. Headland breakwaters can be used to accentuate existing shore features and are the primary component for Headland Control. The dimensions of a breakwater system are dependent on the desired degree of protection and potential impacts on littoral processes.

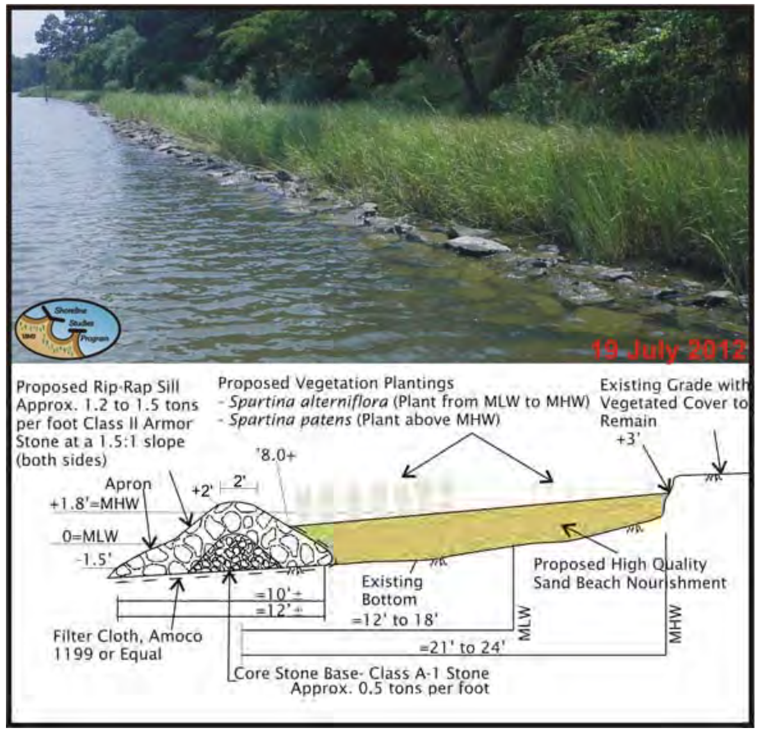


Figure 4-2. Longwood University's Hull Springs Farm four years after construction (top) and the cross-section used for construction (bottom). From Hardaway et al. *(2010).*

A brill system is a combination of a sill and breakwater and consists of relatively long sill structures with wide gaps similar to a breakwater system. This allows for both extensive marsh and beach habitats to be exist along the same cost because it is closer to the shoreline than a breakwater system. Marsh is planted behind the structures while the embayments between the structures allow for a wide beach.

Spurs are similar to breakwaters and sills in that they are "free standing" structures. The distinction is that spurs are attached to the shoreline or another structure; the unattached end of the spur acts as a breakwater by diffracting incoming waves. Spurs often are used as interfacing structures between other strategies and/or adjacent unprotected coasts.

Figure 4-3. Image from Google Earth showing a breakwater installation (top) and a typical breakwater cross-section (bottom).

4.2.4 Headland Control

Headland control is an innovative approach to shoreline erosion protection because it addresses long stretches of shoreline and can be phased over time. The basic premise is that by controlling existing points of land (i.e. headlands) or strategically creating new points of land, the shape of the adjacent embayments can be predicted (Hardaway and Byrne, 1999). A thorough understanding of the littoral processes operating within the reach is necessary to create a stable planform. Headland control can utilize elements of the three previous strategies.

Headland Control can be accomplished with the aforementioned structures and usually involves protecting a point or shore headland (Figure 4-4). This strategy partially protects long reaches of shoreline because littoral sands are encapsulated to create a beach, and impinging waves are redirected so that they have less impact alongshore. By providing a strategic hard point, adjacent shorelines are allowed to erode into equilibrium planforms. Predicted, stable shore planforms between proposed headland structures are provided for recommended shoreline strategies of each reach. These planforms are estimates based on general wave climatology and shoreline composition (*i.e.* marsh, upland).

Figure 4-4. Examples of headland breakwaters spaced widely apart to allow adjacent shoreline to erode toward a dynamic equilibrium. This is a cost-effective shoreline management strategy when infrastructure is not threatened by the upland erosion between the structures. From Hardaway and Byrne (1999).

Even though all of these strategies are considered in terms of the management plan, the preferred method for each reach of shoreline is shown on plates in Appendix A.

4.3 Structure Design and Sea-Level Rise

Designing shore protection structures for specific return storm surge frequencies provides a metric by which the proposed system can expect to perform during that event. Costs, what's being protected, and durability are factors to consider. The shore protection system is designed for a particular storm condition, in this case, the 25 year event which could have a + 5 ft MLW storm surge. However, a system does not necessarily fail at higher water levels and wave energies. The 50 year and 100 year events are predicted to have +6 ft and +7 ft MLW, respectively, storm surges. For proposed sill systems, this means that bank erosion may occur when the system is overtopped, but the sediment from the bank will slump onto the fronting protective marsh, perhaps covering some. This process can actually create a more stable bank condition as it evolves to a more equilibrium slope. Typical eroding banks are at a 1:1 slope, but as they move toward a 1.3:1 slope, they become more stable.

Durability of these systems composed of properly placed rock, sand, and plants have been shown very successful in numerous projects around Chesapeake Bay that have been in for 10, 20 and 30 years (Hardaway and Gunn, 2010). Looking to 2050 (34 years), with sea level rising at a rate of about 0.016 ft/yr (Colonial Beach), water levels will be about 0.5 ft higher somewhat submerging the sand and rock structures. Adaptive management considers if or when the system may need to be raised with additional rock and sand or require bank grading. This is a consideration when the conceptual structures in this plan enter the design, permitting, and construction phase.

4.4 Structures for Blossom Point Shoreline Management Plan

The following plan utilizes Living Shorelines consisting of stable beaches and marshes for long-term shore protection that address hydrodynamic forcing along the coast by systematic wave attenuation before storm waves can impact the upland banks. The design storm is the 25 year event at + 5 ft MLW, except for Critical area 1 and 2 where buildings are within 50 ft of the eroding bank. There, the elevation should be +6 ft MLW.

The optimum plan will achieve a balance between long-term, predictable shore protection and cost. Two specific shoreline strategies, breakwaters and sills, are recommended for the project shorelines and the typical cross-sections for these structures are shown in Appendix A. Although fairly accurate in terms of the proposed over the existing topography, these typical cross-sections and shore plan are part of a Conceptual Plan and are good for developing rough costs. Final design will require more detailed bank and bottom surveys and more extensive geotechnical investigations. Project permitting and final cost can be developed in the Design Phase.

Each Reach section chapter will discuss the use of the four basic methods of shore management. In addition, recommendations will be made regarding which type of structure is suitable for that particular reach. A summary of site conditions and recommended strategies is listed in Table 4-1. Figure 4-5 is an index of the plates used to show existing conditions and proposed structures along the Potomac River. Individual plates are shown in Appendix A.

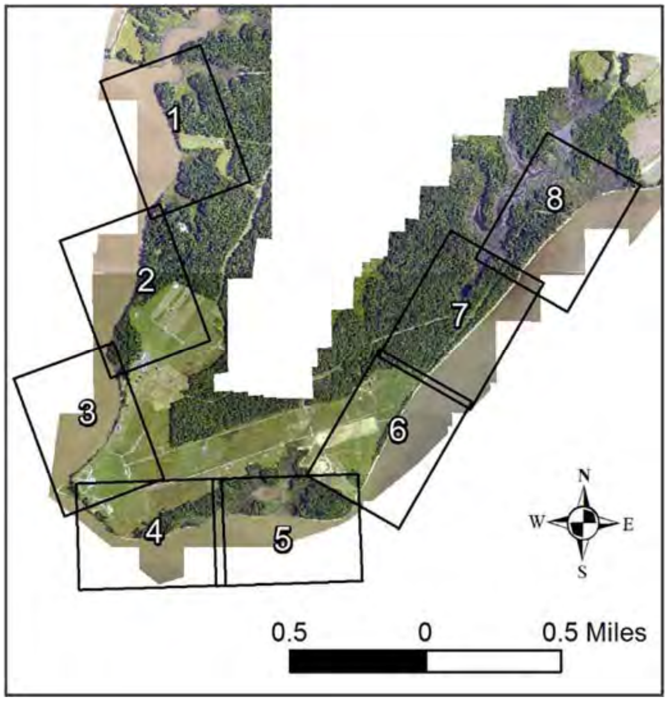


Figure 4-5. Index of plates shown in Appendix A with the Reach specific information and typical cross-sections.

Table 4-1A. Reach description information for each section of shore.

Reach	Subreach	Length (ft)	Geology (McCartan, 1989)	Historical Erosion Rate - Avg (ft/yr)	Upland Soil within 100 ft of shore*
I	A	1,800	Qh/Qm	-0.8	Ek
	B	900	Qh/Tm	-0.9	Tm/Ek
	C	3,900	Qm	-0.5	mt/B2
	D	3,000	Qm	-0.5	mt/B2
II	A	1,800	Qm	-0.5	Os
	B	1,500	Qm	-0.4	mt/B2/Tm
	C	2,700	Qh/Tm	-1.0	Ek/mta
	D	1,100	Qh/Qm	-1.2	mt/B2/Tm
III	A	2,400	Qh/Qm	-0.3	mta
	B	3,500	Qm	-0.3	mta/Ek
	C	3,400	Qm	-0.6	Ek
	Total	**26,000**			

Geology: **Qh**-Holocene deposits; **Qm**-Maryland Point formation Upper Pleistocene. Soil Types: **Ek**: Elkton silt loam; **Tm**: Tidal Marsh; **mt/B2:** Mattapex fine sandy loam; Slope > 2%; **mta:** Mattapex fine sandy loam; Slope <2%; **Os:** Othello fine sandy loam

Table 4-1B. Reach description information for each section of shore.

Reach	Subreach	Averge Height (ft)	Gross Slope	Upland Bank Face Condition	Upland Bank Base Condition
I	A	10	1:1	Actively Eroding	Actively Eroding
	B	3		Actively Eroding	Actively Eroding
	C	15	1:1	Actively Eroding	Actively Eroding
	D	20	1:1	Actively Eroding	Actively Eroding
II	A	12	1:1	Actively Eroding	Actively Eroding
	B	15	1:1	Actively Eroding	Actively Eroding
	C	18	1:1	Actively Eroding	Actively Eroding
	D	20	1:1	Actively Eroding	Actively Eroding
III	A	10	2:1	Stable	Stable
	B	10	1.5:1	Stable to Intermediate	Stable to Eroding
	C	12	1.3:1	Actively Eroding	Intermediate to Eroding

Table 4-1C. Reach description information for each section of shore.

Reach	Subreach	Beach /Backshore Width	Intertidal Shore Type	Intertidal Shore Sediment	Nearshore Width Distance MLW to -6 ft	Fetch Average (nm)	Direction of Face
I	A	<5 ft	Beach	Sand	1,100	1.9	WSW
	B		Marsh	Marsh	500	1.1	WSW
	C	<5 ft	Beach	Sand	700	1	WSW
	D	<5 ft	Beach	Rock/Sand	800	1	WNW
II	A	<5 ft	Beach	Sand	600	5.8	SW
	B	<5 ft	Beach	Marsh	1,000	2.4	SSE
	C	<5 ft	Beach	Sand	1,200	2.4	S
	D	<5 ft	Beach	Sand	1,200	2.4	S
III	A	>15 ft	Beach & Marsh	Sand	2,000	1.8	SE
	B	>15 ft	Beach	Sand	700	2	SE
	C	5-15 ft	Beach	Sand	1,200	5.4	SE

Table 4-1D. Reach description information for each section of shore.

Reach	Subreach	Existing Shore Structures	Upland infrastructure within 50 ft Top of Bank	Management Priority	Recommended Strategies Shore	Recommended Strategies Bank
I	A			Low	Sill System	
	B			Low	No Action	
	C			Low	Sill System	
	D	Revetment	Building	Moderate	Sill System/Spur	
II	A			Low	Sill System	
	B	Small broken Concrete/BW	Tower	High	Sill System	
	C			Low	No Action	
	D			Low	Sill System	Fill
III	A			Low	Spur/Brill System	
	B		Roads	Moderate	Brill System	
	C			Low	Brill System	

5 CEDAR POINT NECK, NANJEMOY CREEK: REACH I

5.1 Physical Setting

5.1.1 Reach Boundaries, Geology/Geomorphology/Soils, and Historic Shore Change

Reach I begins at the mouth of Kings Creek and extends downriver approximately 9,600 ft to Blossom Point. Reach I coast trends generally north-south and can be divided into four subreaches, A thru D (Figure 5-1). Reach IA extends from the mouth of Kings Creek downriver for about 1,800 feet and is an actively eroding upland bank 10 to 15 feet in elevation. Reach IB is about 900 feet long and mostly tidal marsh coast with a short upland segment separating two tidal pocket marshes. Reach IC is about 3,900 feet long consisting of actively eroding upland bank 15 to 20 feet high, and Reach ID is about 3,000 feet long with a continuing eroding upland bank 15 to 20 high.

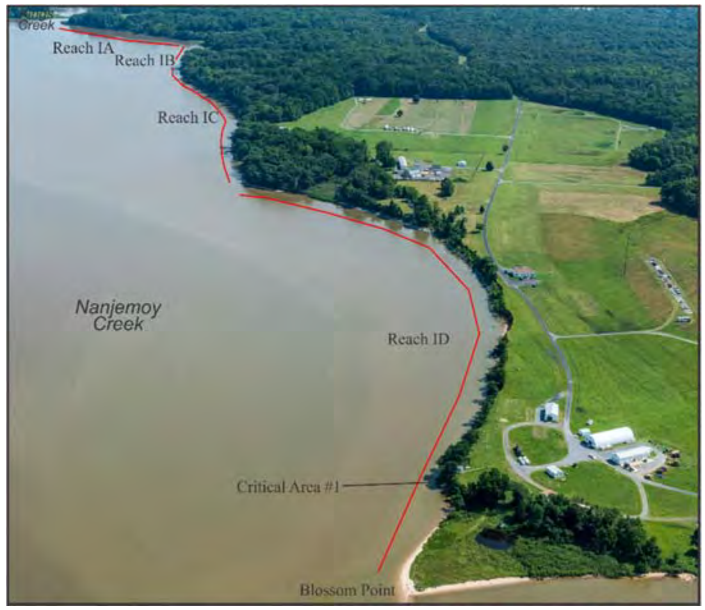


Figure 5-1. Photo showing the four subreaches of Reach I along Nanjemoy Creek.

The geology of the Reach I coast consists of the Maryland Formation, Qm, (Upper Pleistocene) (Figure 3-1). The statra is mostly consists of fine to coarse grained sands. The soil designation for most of the Reach I upland is Ek to MtB2. Reach IA is designated as Ek soils which indicates Elkston silt loam. Reach IB is Tm tidal marsh. Reach IC and ID are MtB2, Mattapex fine sandy loam.

Historic erosion rates vary along Reach I from very low erosion (0 to -1 ft/yr) to low erosion (1 to -2 ft/yr) along Reach IA, IB, and IC with some very low accretion (0 to +1 ft/yr) along Reach ID (Figure 3-3). Accretionary trends along Reach ID are the result of upland land disturbance activities including farming and military impacts. Blossom Point proper is an accretionary feature feed by littoral transport of eroding bank sediment southward along Reach I and westward from eroding banks sediments from Reach II.

5.1.2 Upland Bank and Shore Zone Characteristics

The eroding upland banks along the Reach I coast rise from 10 to 20 feet above MLW (Table 4-1). Reach IA is a short straight coast where the base of bank (BOB) and bank face generally exists as vertically exposed and actively eroding sandy sediment strata with many downed trees along the wooded sections (Figure 5-2). The base of the bank (BOB) is easily impacted by modest storm events and is in a constant state of instability. Reach IB is low eroding tidal marsh shoreline with about 120 feet of low eroding upland about mid-way (Figure 5-3).

The Reach IC shore segment is a curvilinear coast with two headland points and a long embayment that is vertically exposed and actively eroding with numerous fallen trees (Figure 5-4). The trees are in essence acting like groins, trapping eroded bank sediments and in some sections creating a backshore feature that can act to abate moderate wave energy storm events (Figure 5-5). They also act as geomorphic indicators of net alongshore sediment transport with accretion on the north side and an offset on the south side, indicating southward sediment transport of beach sands.

Figure 5-2. Photo of Reach IA showing vertical eroding bank, fallen trees and slumped material.

Figure 5-3. Photo of Reach OB showing a low eroding tidal marsh shoreline.

Figure 5-4. Photo showing Reach IC showing a long embayment that has a vertically-exposed bank.

Figure 5-5. Photo showing how fallen trees can act like groins along the shoreline impacting alongshore sediment transport.

Reach ID is mostly vertically exposed and actively eroding upland bank, except for about 200 ft of tidal marsh shore at the north end of the reach and about 1,300 feet of stone revetment with little or no bank grading. Beyond that there are few trees and an end effect on the south end of the revetment (Figure 5-6). A section of this reach has been designated Critical Area #1 because of a building close to the eroding bank. Along this shore, broken concrete has been placed along the shoreline (Figure 5-7). The upland continues to be erosive as it transitions to the low sandy spit that marks Blossom Point and the boundary between Reach I and Reach II. The spit has evolved over time as eroding bank sediment are transported from Reach I and Reach II and accumulate. Wetlands vegetation and a semi-tidal pond occupies the bulk of spit (Figure 5-7).

Figure 5-6. Photo showing vertical, eroding banks along Reach ID.

Figure 5-7. Photos showing Critical Area #1 along Reach ID and the Blossom Point spit.

5.1.3 Nearshore Characteristics

The nearshore region is relatively shallow along Reach I with the 6 ft contour occurring about 1000 ft offshore of Reach 1A then drawing in to about 500 feet off Reach IB possibly a reflection of antecedent upland drainage (Figure 3-1). The 6 ft contour continues along Reach 1C averaging about 700 feet offshore increasing to about 800 ft off Reach 1D before converging to about 300 feet right off Blossom Point proper.

5.2 Hydrodynamic Setting

The Reach I coast is exposed to wind and wave action from the northwest, west and southwest. Average effective fetches for Reach IA, IB, IC, and ID are 1.9 miles, 1.1 miles, 1.0 miles, and 1.0 miles, respectively. The northwest appears to dominate the littoral process operating along Reach I with an overall resultant southerly movement of beach and nearshore sediments.

5.3 Shoreline Management Strategies

The general strategy for the Reach I coast would be to address specific areas of concern and then provide an overall plan for long-term shoreline management along other upland areas (Appendix A, pages 1-6).

No action: This is probably acceptable along much of the Reach I due to lack of threatened upland infrastructure. Other than Reach IB and ID, most of Reach I coast is either very low eroding or low accretion.

Defensive: This approach has been employed along the Reach ID with stone revetments and broken concrete. Unprotected areas occur within Reach ID where revetments could be installed and tied to the existing structure.

The use of revetments along Reach IA, IC, and ID is not the preferred method because it would require extensive base of bank disturbance and tree clearing unless placed on a subgrade foundation along the beach and in front of the eroding bank face.

Offensive: This involves the use of "freestanding" sills and/or breakwater units that sit offshore with beach fill and in the lee, the establishment of securing vegetation of grasses, shrubs, and "wet" trees such as sycamore. Sills and breakwaters with sand fill and vegetative plantings are most appropriate here due to the "softer" environmental edge this system provides without compromising shore protection. The key is to protect the BOB from ongoing wave attack. The preferred shore protection strategy is a semi-continuous sill along Reach I with a spur off the existing revetment (Appendix A, pages 1-3). The sill elevations would range from 3 to 3.5 ft MLW with sand placed along the backshore to an elevation of +5 ft MLW. The sand will be planted with *Spartina patens*, *Spartina alterniflora*, and *Scirpus* (Appendix A, pages 4-5). Consideration must be given to construction access which, due to the shallow nearshore, would be from the upland. Material could be stockpiled near open areas that are relatively close to base roads.

Headland Control: This strategy is most applicable along Reach 1D which is already a curvilinear embayment where a large headland structure could be placed at Blossom Point to work in concert with a large stone spur coming off the existing revetment. In addition, beach fill would be placed along the shore. The adjacent coast would be allowed to erode/evolve toward an equilibrium shore planform (Hardaway and Gunn, 2010).

6 CEDAR POINT NECK, POTOMAC RIVER: REACH II

6.1 Physical Setting

6.1.1 Reach Boundaries, Geology/Geomorphology/Soils, Historical Shore Change

Reach II begins at Blossom Point and extends generally eastward to Upper Cedar Point, about 7,100 feet. It can be divided into four subreaches, Reach IIA, IIB, IIC, and IID, with shore lengths of 1,800ft, 1,500ft, 2,700 ft and 1,100 ft, respectively. Reach IIA (Figure 6-1) begins at the low spit of Blossom Point and transitions to the exposed and actively eroding upland bank down to a point where a low short breakwater occurs at the Reach IIA/IIB boundary and concurrent with the shore turning orientation from a northwest-southeast strike to a more east-west strike along Reach IIB (Figure 6-2). Reach IIB is mostly an exposed eroding upland bank becoming more wooded downriver and transitioning to a low upland fronting a small tidal marsh complex. Reach IIC is mostly tidal marsh shoreline with about a 500 ft segment of low eroding upland. Reach IID is a return to eroding wooded upland banks down to Upper Cedar Point.

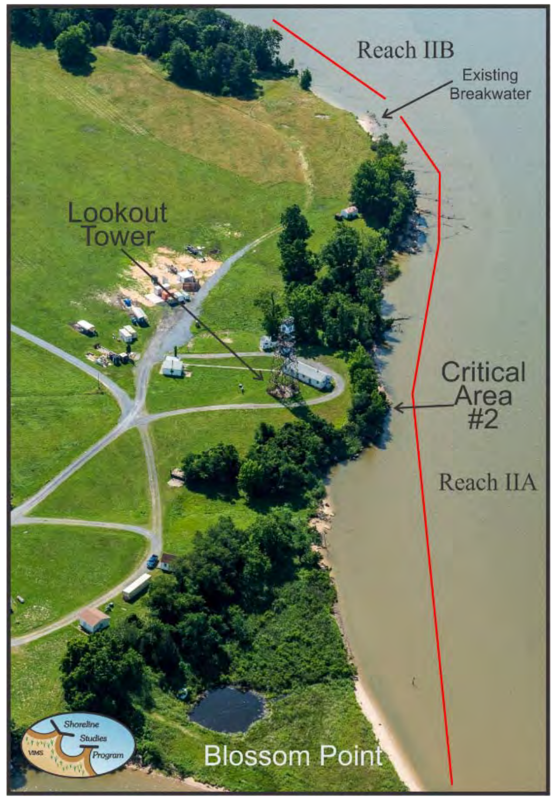


Figure 6-1. Photo showing Reach IIA which includes Critical Area #2 at the Lookout Tower.

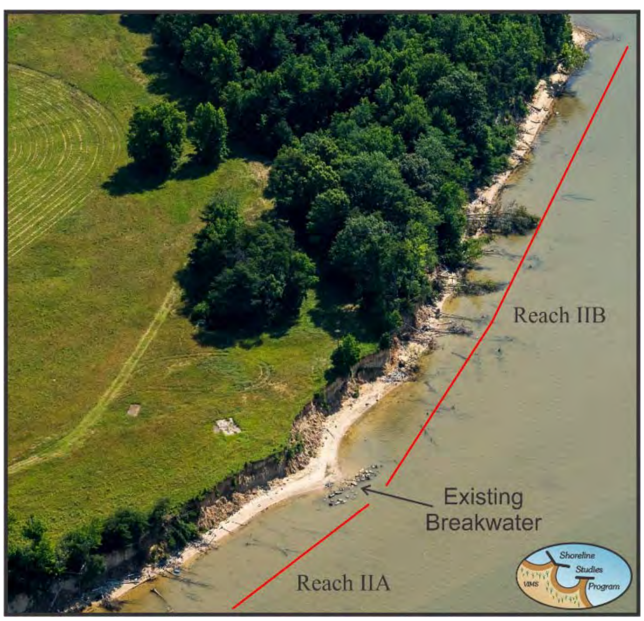


Figure 6-2. Photo showing Reach IIA and IIB.

The coast of Reach II is exposed Maryland Point Formation (Qm) with Holocene sediments and tidal marsh designated Qh (Figure 3-1). Soils are mostly Os, Othelo fine sandy loam along Reach IIA and MtB2,Mattapex fine sandy loam transitioning into Reach IIB which is mostly tidal marsh. Reach IIC begins as Ek, Elkton Loam to MtA, Mattapex fine sandy loam to Upper Cedar Point and Reach IID.

Historic erosion along Reach II varies from very low accretion at Blossom Point to low erosion along most of the reach ranging from -1 to -2 ft/yr. Several areas, including Upper Cedar Point, are eroding faster at -2 to -5 ft/yr (Figure 3-3). Unlike Blossom Point, an accretionary feature, Upper Cedar Point is a very erosive feature.

6.1.2 Upland Bank and Shore Zone Characteristics

The upland banks along Reach IIA that extend landward and behind the Blossom Point spit are stable because they are protected by the spit feature, but the banks quickly become vertically exposed and erosive downriver beyond the “lee” of the Blossom Point spit feature (Figure 6.1). The upland banks have a narrow band of trees in front of an open field. Bank heights vary between 12 and 20 ft becoming slightly higher toward Upper Cedar Point which is the boundary between Reach II and III. A Lookout Tower occurs about mid-reach and is very close to the bank edge (Figure 6-2), about 30 feet with the access road even closer, about 20 feet. This shore segment is designated Critical Area #2 (Figure 6-3).

Figure 6-3. Photo of the Lookout Tower along Reach IIA.

The shore zone from where the Blossom Point spit meets the exposed upland banks has a narrow beach and few trees, but an open area in the trees has numerous concrete slabs alongshore which have trapped some sand and widened the beach. Farther downriver under the Lookout Tower, numerous types of concrete debris was placed along the shoreline for about 150 ft in an effort to abate erosion. Fallen trees intermittently trap sand and slightly widening the beach to the Reach boundary. Here there is a break in the tree line where more concrete debris was placed as a low breakwater which has formed a salient in its lee.

Reach IIB begins as an open field with an eroding upland bank, but most of the shoreline is wooded which contributes fallen trees to the shoreline (Figure 6-2). The bank heights drop down from about 20 feet to about 6 feet at the downriver end of the subreach. A narrow beach occurs, helped by the fallen trees and the groin effect as well as a small section with the concrete debris breakwater creating a small point with a downriver offset (Figure 6-4).

Figure 6-4. Photo of the Reach IIB shoreline with exposed banks, fallen trees and an existing broken concrete breakwater.

Reach IIC is mostly low, eroding tidal marsh peat shoreline with no beach. The eroding low, upland segment with trees about mid-reach is basically an island surrounded by marsh (Figure 6-5). The shoreline consists of fallen trees and a narrow beach along this section. A small tidal creek occurs near the boundary with Reach IID and connects to a small tidal pond. Reach IIC ends where the marsh shoreline intersects the next segment, Reach IID, of eroding upland banks (Figure 6.5).

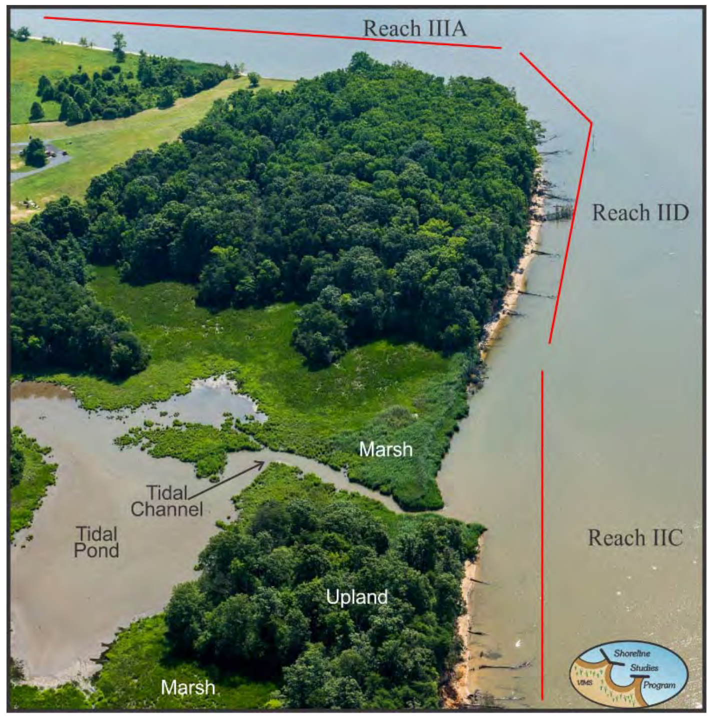


Figure 6-5. Aerial photo showing Reach IIC, IID, and IIIA.

Reach IID is vertically exposed upland banks about 18 to 20 feet in elevation before dropping down to about 5 feet at the Reach II/Reach III boundary, Upper Cedar Point (Figure 6-6). Again, numerous fallen trees occur along shore, trapping sand and widening and partially stabilizing the beach.

6.1.3 Nearshore Characteristics

The +6 foot contour averages about 500 feet offshore along Reach IIA. Farther east along Reaches IIB, IIC, and IID it is more than 1,000 ft offshore (Figure 3-1). Offshore of Upper Cedar Point the 6 ft contour is almost 2,000 feet from the shoreline, and a navigation light is required adjacent to the main channel of the Potomac River.

Figure 6-6. Low, eroding banks with a thickly wooded upland along Reach IID.

6.2 Hydrodynamic Setting

Reach II begins as the coast turns and becomes oriented more to the north-northeast/south-southwest. The shoreline is more exposed to the southwest, south, and southeast across the Potomac River. Average effective fetches for Reach IIA, IIB, IIC, and IID are 5.8 miles, 2.4 miles, 2.4 miles, and 2.4 miles, respectively. The southerly wind/wave exposure causes sediment movement both west and eastward as well as offshore and northward from Upper Cedar Point into Reach III.

6.3 Shoreline Management Strategies

The general strategy for the Reach II coast is to address specific areas of concern and then provide an overall plan for long-term shoreline management along other upland areas. The preferred management strategies are shown in Appendix A (pages 6-9). All upland runoff should be forced away from eroding bank faces.

No Action: The no action alternative is appropriate to much of the shoreline along Reach II. However, threatened infrastructure in Reach IIA warrants immediate consideration. Reach IIC not accessible by land or water (too shallow), and therefore a No Action is recommended.

Defensive: The use of revetments along Reach II would require extensive base of bank disturbance and tree clearing unless placed on a subgrade foundation along the beach and in front of the eroding bank face. However, this is appropriate in Critical Area #2 due to the close proximity of the Lookout Tower. A stone revetment (structure IIA3) is proposed.

Offensive: Sills are the preferred method of shore protection along most of Reach II (Appendix A, pages 6-7). However, breakwaters are viable and could offer more wave attenuation per structure length, but more beach fill is required, raising costs. Reach II has relatively high wave exposure and modest erosion. Sill heights and sand terrace widths can vary depending on the upland use, but the elevation of the structures should be +4 ft MLW (Appendix A, pages 8-9).

Headland Control: This strategy may not be appropriate due to the lack of geomorphic features along Reach II and the proximity of some infrastructure.

7 CEDAR POINT NECK, POTOMAC RIVER: REACH III

7.1 Physical Setting

7.1.1 Reach Boundaries, Geology/Geomorphology/Soils, and Historic Shore Change

Figure 7-1. Reach III mainly consists of eroding forested upland banks except along Reach IIIA.

Reach III begins on the downriver side of Upper Cedar Point where there are two short sections of marsh fringe which have an eroding upland bank with no trees between them. Reach III is divided into three subreaches Reach IIIA, IIIB, and IIIC with shore lengths of 2,400 ft, 3,500 ft, and 3,400 ft, respectively (Figure 7.1). Reach IIIA begins at Upper Cedar Point as short marsh fringe, it becomes an exposed eroding bank, and then extends alongshore to approximately where the Facility's access road turns away from the coast. Here Reach IIIB begins not as a geomorphic feature, but where the road runs relatively close (about 70 ft from pavement to MLW) to shore for about 900 ft. Reach IIIB ends where a marsh fringe occurs with a consequent downriver/downdrift offset at the Reach IIIB/IIIC boundary which indicates net sediment transport is downriver. Reach IIIC extends to where a small tidal creek enters the Potomac River near the Facility's boundary.

The coast of Reach III is exposed Maryland Point Formation (Qm) with Holocene sediments and tidal marsh designated Qh (Figure 3-1). Soils are mostly MtA, Mattapex fine sandy loam along Reach IIIA and Ek, Elkton silt loam along Reach IIIB and IIIC.

Shore change rates along Reach III vary from medium erosion to very low accretion (Figure 3-3). The larger erosion rates occur on the northern section of the reach while the southern section of the reach has smaller erosion rates. Sandy material for the protective beach zone most likely came from erosion of the eroding uplands of Reach II and from eroding banks within the reach; the shore morphology indicates net sediment transport is downriver.

7.1.2 Upland Bank and Shore Zone Characteristics

Downriver of the actively eroding upland bank segment the Reach IIIA coast is a low stable vegetated upland bank with a wide sand beach coast intermittently occupied by three sections of upper marsh fringe. These marsh fringes are mostly composed of *Phragmites australis* and act as narrow headland features (Figure 7-2). The sandy beach sections between these grass headlands have a 20-25 ft beach/backshore moderately vegetated with high marsh grasses then a thick zone of shrubs and small trees protecting BOB.

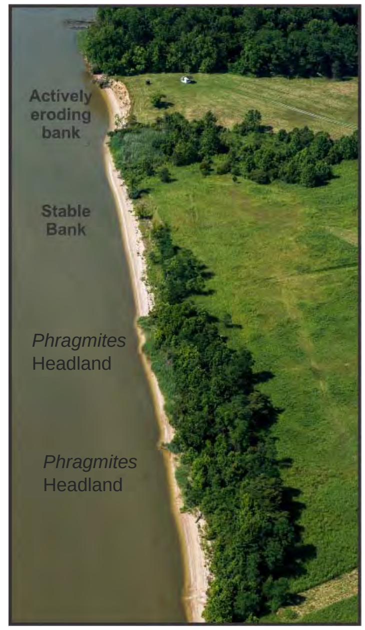


Figure 7-2. Reach IIIA showing the actively eroding bank and the more stable bank to the north.

Reach IIIB begins with a short *Phragmites* fringe but quickly becomes mostly sand beach downriver toward the boundary. The first 900 feet where the road is closest has a low upland bank (5-7 ft) with stable BOB but transitional bank face with some exposed strata. Broken concrete is intermittently strewn along the backshore (Figure 7-3). Farther, downriver the upland bank rises slightly in elevation and becomes more exposed and erosive with both the bank face and BOB becoming transitional and erosional. More fallen trees can be seen along the coast. The sand beach continues along this shore segment and the beach/backshore becomes greater than 15 ft wide. Reach IIIB ends with a 200 foot *Phragmites* marsh fringe, acting like a small headland creating a shoreline offset downriver of about 90 ft. Here, the adjacent upriver upland bank is stable (Figure 7-4).

Reach IIIC begins at the *Phragmites* marsh fringe. The low upland bank is vertically exposed and erosive for several hundred feet and has a 10 and 20 ft wide beach backshore intermittently vegetated with grasses (Figure 7-4). More fallen trees are noted. This condition continues to another headland feature about 1,600 ft from the Reach IIIB/IIIC boundary and where a Facility road comes down the shoreline. This headland is composed of a combination of broken concrete and rock. A shoreline offset occurs downriver as the shoreline transitions from

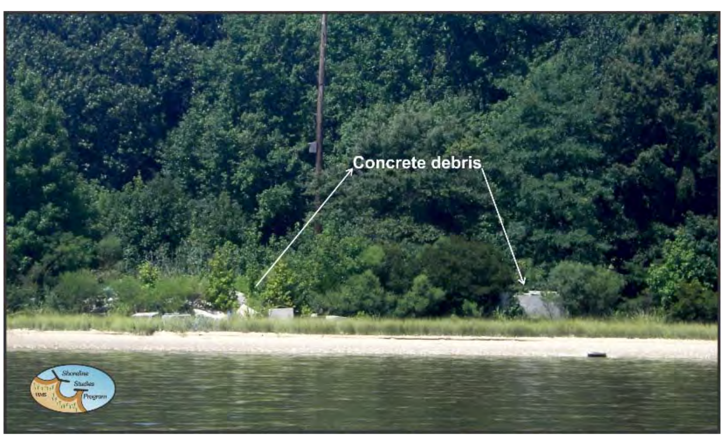


Figure 7-3. Low beach and marsh fronting a wooded upland along Reach IIIB with concrete debris along the shoreline.

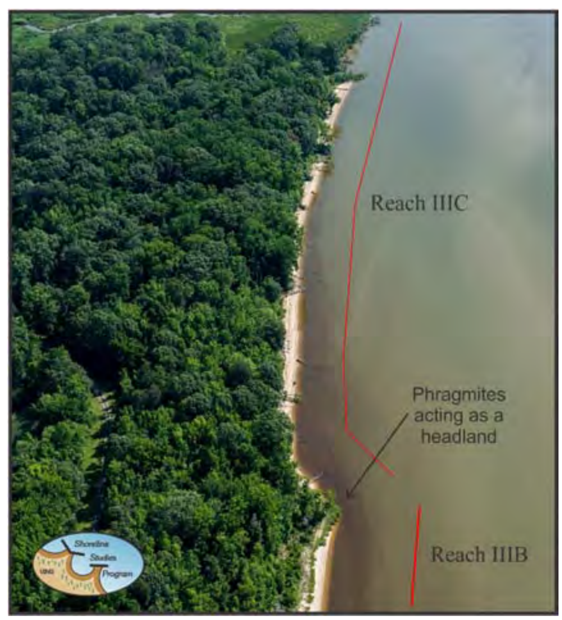


Figure 7-4. Photo of Reach IIIB and IIIC showing the Phragmites acting as a headland along the shore.

low eroding upland to eroding tidal marsh for about 300 ft to the tidal channel and the Facility property line and the end of Reach IIIC and the project coast.

Figure 7-5. Low bank with beach and intermittent marsh vegetation along Reach IIIC.

7.1.3 Nearshore Characteristics

The nearshore region along Reach III is very narrow just north of Upper Cedar Point where the 6 ft contour comes within 200 ft of the shoreline. It then goes out to about 500 ft off the Reach IIIA/IIIB boundary and continues in an undulating fashion between 500 and 600 ft off to the end of the Facility. However, a broad shoal occurs beyond the nearshore along Reach III with depths not increasing significantly for several thousand feet. The 9 ft contour is nearly 5,000 ft from the shoreline. This wide, shallow shoal, no doubt, attenuates the impinging wave climate for Reach III.

7.2 Hydrodynamic Setting

Reach III is exposed to the southeasterly fetch across the Potomac River. Average effective fetch exposures for Reach IIIA, IIIB and IIIC are 1.8 miles, 2.0 miles and 5.4 miles, respectively. Due to persistent southerly wind wave climate, the net movement of beach sand is northward or downriver.

7.3 Shoreline Management Strategies

The general strategy for the Reach III coast would be to address specific areas of concern and then provide an overall plan for long-term shoreline management along other upland areas (Appendix A, pages 10-14). All upland runoff should be forced away from eroding bank faces.

No Action: The no action alternative is always a consideration, but the Facility's shoreline road is only about 40 ft from BOB and about 70 ft from MLW along sections of Reach IIIB. However, the shore rate of change is very low. Therefore, this reach maybe a low priority for shoreline structures at this time.

Defensive: Revetments could be considered along eroding upland at the beginning of Reach IIIA but would require extensive tree clearing for access. This strategy is not recommended.

Offensive: For long-term shore protection and sea level, a brill system is suggested. The structures are larger than a typical sill, but not as large, widely spaced, or as far offshore as a breakwater system (Appendix A, pages 10-12).

Headland Control: Headland control strategy can be employed using long breakwaters strategically placed along with beach nourishment.

From a shoreline management perspective Reach III is relatively stable with erosion of the upland eroding banks only occurring during significant storm events. The access road along Reach IIIB is the only infrastructure that is moderately threatened.

8 SUMMARY of SHORELINE MANAGEMENT PLAN

8.1 Summary of Results

The Potomac River and Nanjemoy Creek shoreline plan for Reaches I, II, and III (Appendix A) will provide long-term shore protection for Blossom Point's shoreline. Many shorelines will require little or no bank modifications. However, the two Critical Areas, will need more detailed bank analysis to properly ascertain the nature of the bank instability and the proper management strategy. Phasing is an appropriate approach for this shoreline reach. Phasing components of each Reach, in terms of costs and priorities, will be the long-term challenge of the Army. After the Critical Areas are addressed, Reach II should be the priority followed by Reach I and then Reach III. From a process-response perspective, protecting Reach II will reduce sediment supply to the littoral system and ultimately Reach III. Therefore, strategic placement of some structures and phased through time would allow for adaptive shoreline management

The base of bank and bank face conditions for the Blossom Point Shoreline are summarized in Table 8-1. Most of the upland banks are in a state of erosion along Reach I and Reach II. Reach IIIA and IIIB have sections of stable upland banks due, in part, to the wide beach/backshore feature helping to abate the impinging storm wind/wave climate.

Table 8-2 summarized the recommended structures along the shoreline. The materials needed for proposed shoreline protection strategies are summarized in Table 8-3. The estimated installed cost for the recommended strategies are summarized in Table 8-4. These costs also include 20% for Mobilization and Demobilization costs as well as site work. The unit cost used for the cost estimate are based on projects at Indian Head and Swan Point from water and land-based operations, respectively, and should be used with caution as material and labor costs continue to rise.

8.2 Construction

Access to the shoreline is a critical element. It appears the nearshore is simply too shallow to allow construction access by barge, and all materials and equipment must come by land. However, the water may be deep enough at Blossom Point to place a barge port and allow material to unload onto site trucks that can be delivered to each reach over base roads and open fields. Logging mats maybe required, but they can be costly and are not included in the estimated cost. These access points are denoted on the proposed conceptual plan sheets in Appendix A.

Through initial geotechnical investigations, the nearshore substrate appears suitable for supporting the weight of the proposed rock structures. A more thorough assessment should be undertaken during the preliminary design phase to insure substrate stability. Preliminary material specifications are provided in Appendix B including rock, filter fabric, sand, and plants.

8.3 Monitoring

Ongoing monitoring needs to be part of the long-range adaptive management plan for construction. After the phasing options are agreed upon, a reasonable cost-effective monitoring plan can be developed. Aerial photography supporting a shore change database will be the primary tool to monitor shoreline change. In addition, selected sites should be monitored through bank/beach profiling efforts to document cross-sectional changes in the upland bank and beach profile as well as possible changes in structures elevation due to settlement.

Table 8-1. Summary of shoreline, base of bank, and bank face conditions.

				Base of Bank			Bank Face		
Reach	Sub-reach	Existing Structures	Marsh	Stable	Transitional	Erosional	Stable	Transitional	Erosional
I	A					1,770			1,770
	B		782			161			161
	C					3,868			3,868
	D	1,257	153			1,567			1,567
Reach Total (ft)		**1,257**	**935**			**7,366**			**7,366**
II	A					1,817			1,817
	B					1,518			1,518
	C		2,023			645			645
	D					1,135			1,135
Reach Total (ft)			**2,023**			**5,115**			**5,115**
III	A			1,850		514	1,850		514
	B			2,114	603	792	382	1,732	1,395
	C		1,618		950	838		340	1,448
Reach Total (ft)			**1,618**	**3,964**	**1,553**	**2,144**	**2,232**	**2,072**	**3,357**
TOTAL (ft)		**1,257**	**4,576**	**3,964**	**1,553**	**14,625**	**2,232**	**2,072**	**15,838**

Table 8-2. Summary of recommended structures by reach.

		Structures Recommended		
Reach	**Subreach**	**Type**	**Number**	**Designation**
I	A	Gapped Sill	4	A1-A5
	C	Gapped Sill	9	C1-C9
	D	Gapped Sill	4	D2, D3, D5, D6
		Spur	1	D1
		Revetment	1	D4
II	A	Gapped Sill	6	A1-A6
	B	Gapped Sill	5	B1-B5
	D	Gapped Sill	3	D1-D3
III	A	Gapped Brill	4	A1-A4
	B	Gapped Brill	8	B1-B8
	C	Gapped Brill	4	C1-C4
		Sill	1	C5

Table 8-2. Summary of structure length and materials recommended in this plan.

Reach	SubReach	Length (ft)	Rock (Tons)	Sand (cy)	Cobble (cy)	Plants #
I	A	1,570	4,430	4,430	90	20,265
I	C	4,210	10,290	14,520	420	75,774
I	D	1,340	4,630	5,370	40	23,952
Reach Total		**7,120**	**19,350**	**24,320**	**550**	**119,991**
II	A	1,450	5,100	6,450	140	25,953
II	B	1,590	5,520	6,790	120	35,331
II	D	1,160	4,480	5,600	80	29,866
Reach Total		**4,200**	**15,100**	**18,840**	**340**	**91,150**
III	A	2,190	4,650	4,380	0	32,756
III	B	3,390	8,070	6,780	0	62,044
III	C	1,740	4,000	4,760	0	32,933
Reach Total		**7,320**	**16,720**	**15,920**	**0**	**127,733**
Total		**18,640**	**51,170**	**59,080**	**890**	**338,874**

Table 8-3. Approximate cost of materials for the recommended shore protection structures.

	Amount	**Cost/unit**	**Total**
Rock (Tons)	51,170	$90	$4,605,300
Sand (cy)	59,080	$50	$2,954,000
Cobble (cy)	890	$90	$80,100
Plants (#)	338,874	$1.50	$508,312
Mob/Demob		20%	$1,629,542
& Site Work			
Plan Total			**$9,777,254**

9 REFERENCES

Basco, D.R. and C.S. Shin, 1993. Design Wave Information for Chesapeake Bay and Major Tributaries in Virginia. Coastal Engineering Program, Civil and Environmental Engineering Department, Old Dominion University, Norfolk, Virginia. Report No. 93-1.

Chesapeake Bay Foundation website, 2016. http://www.cbf.org/about-the-bay/maps/seasonal-salinity-changes

FEMA, 2009. Flood Insurance Study, King George, Virginia and Incorporated Areas. Federal Emergency Management Agency, FIS number 51099CV000A.

Hardaway, C.S., Jr., 1980. Shoreline Erosion and its Relationship to the Geology of the Pamilico River Estuary. Master's Thesis. East Carolina University.

Hardaway, C.S., Jr. and R.J. Byrne, 1999. Shoreline Management in Chesapeake Bay. Special Report in Applied Marine Science and Ocean Engineering No. 356. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

Hardaway, Jr., C.S. and J.R. Gunn, 2010. Design and performance of headland bays in Chesapeake Bay, USA. *Coastal Engineering* 57: 203-212.

Hardaway, Jr., C.S., D.A. Milligan, and K. Duhring, 2010. Living Shoreline Design Guidelines for Shore Protectin in Virginia's Estuarine Environments. Special Report in Applied Marine Science and Ocean Engineering No. 421. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.

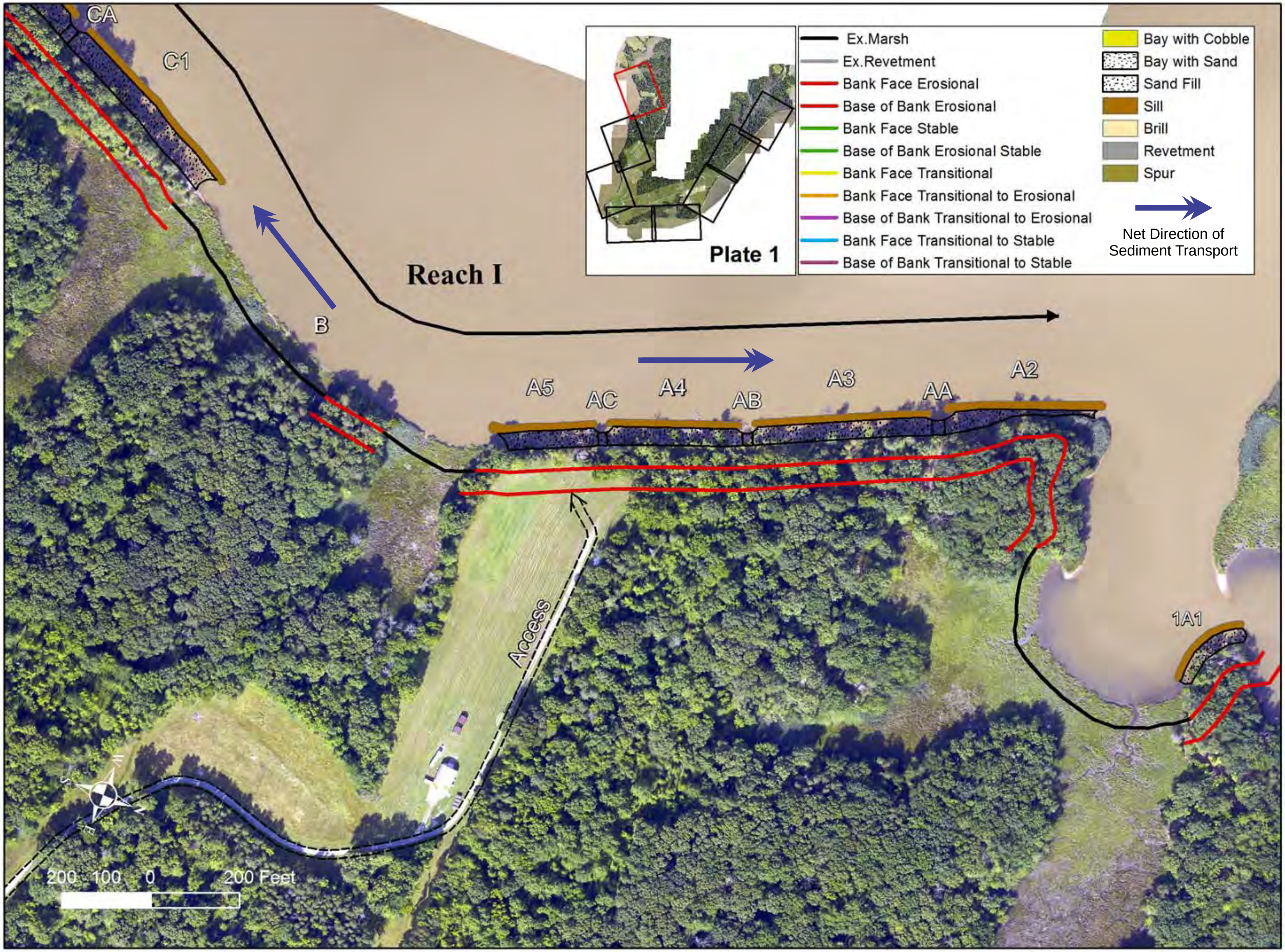
Himmelstoss, E.A., 2009. "DSAS 4.0 Installation Instructions and User Guide" in: Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan. 2009 Digital Shoreline Analysis System (DSAS) version 4.0 — An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-1278.

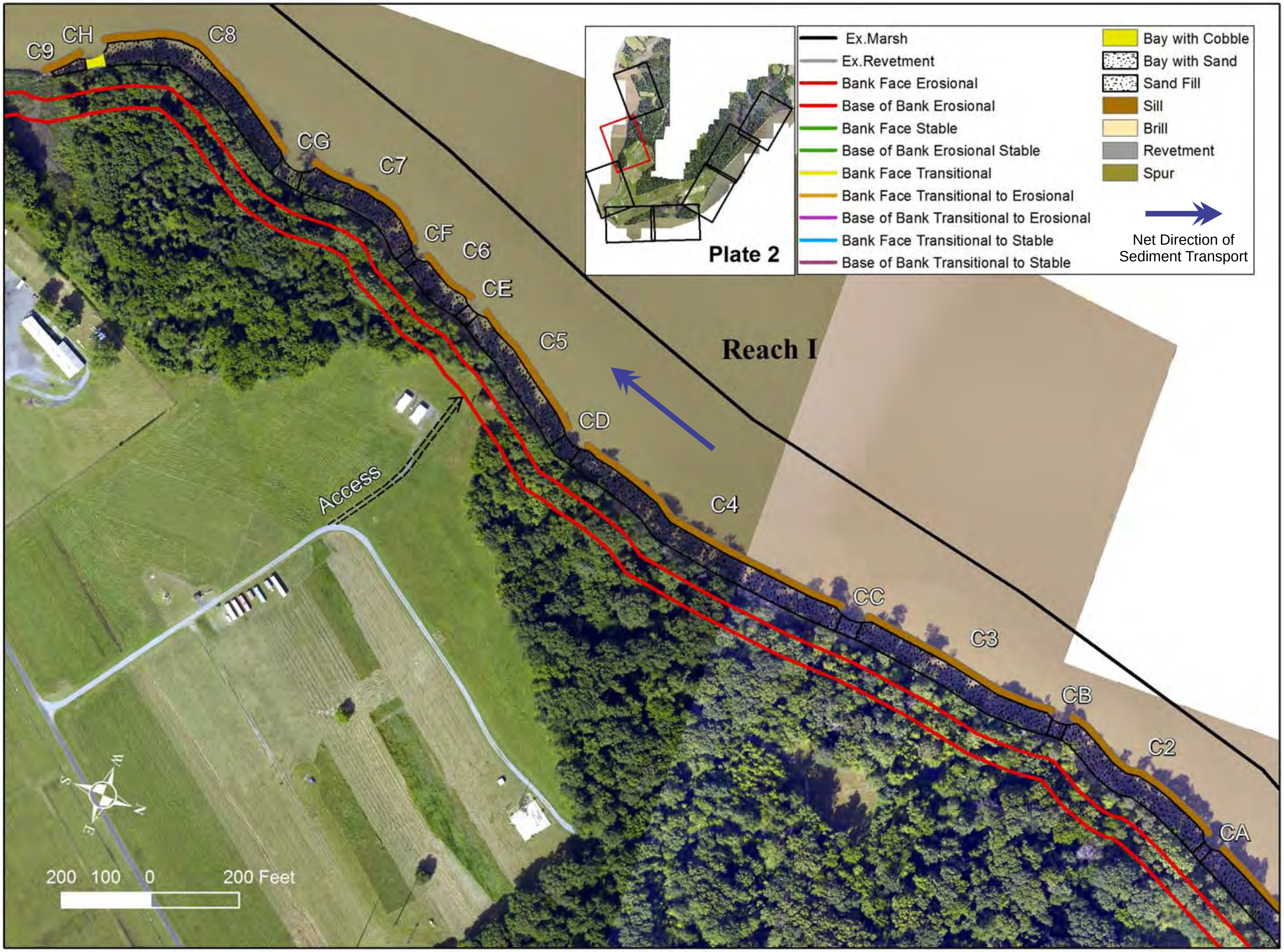
NOAA, 2016. Mean Sea Level Trend, Colonial Beach, Virginia. Retrieved from tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8635150

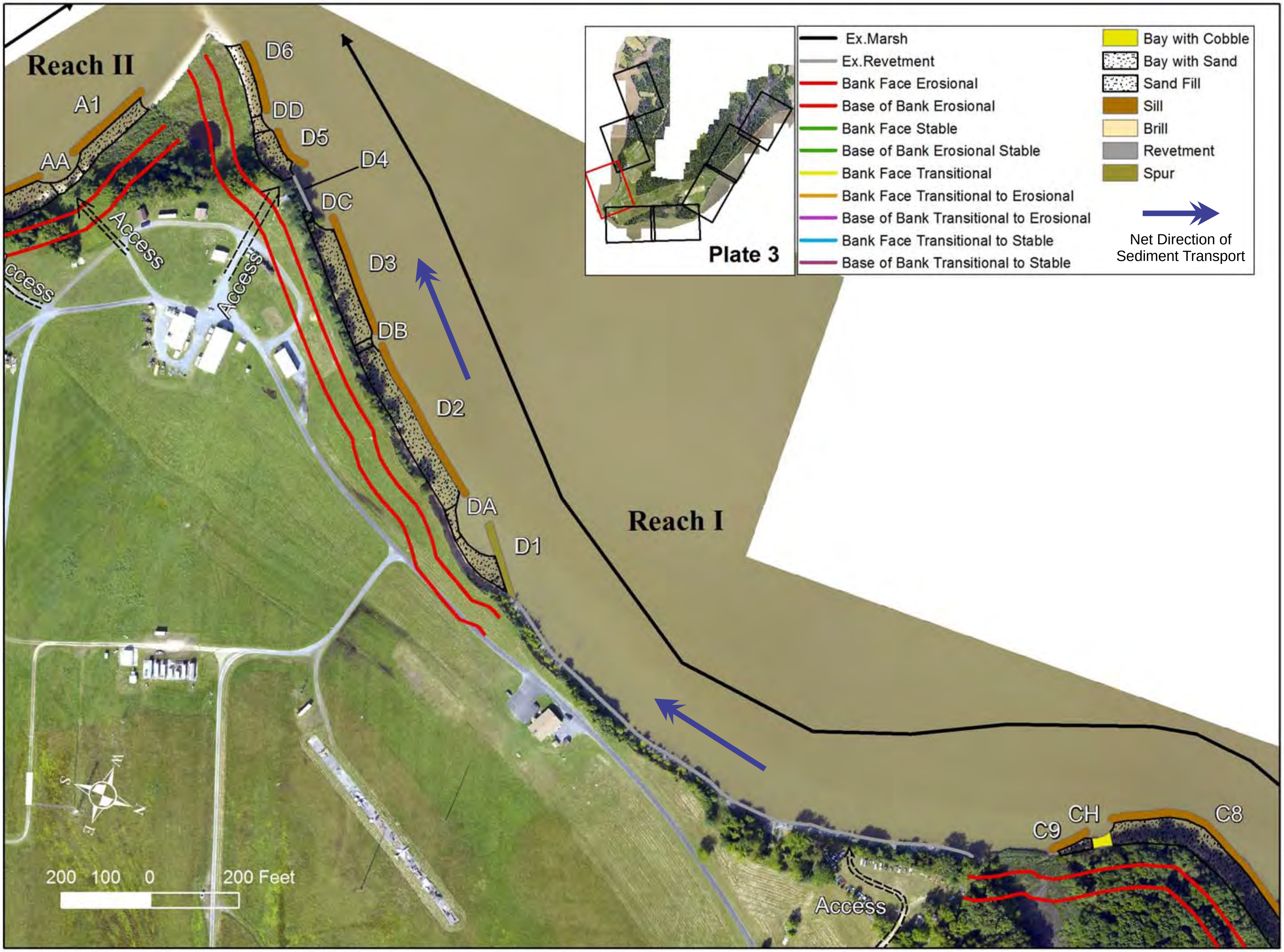
SAV, 2016. Submerged Aquatic Vegetation website. Virginia Institute of Marine Science, Gloucester Point, Virginia.

Appendix A

Shoreline Management Plan with typical cross-sections


CA
C1
B
Reach I
A5
AC
A4
AB
A3
AA
A2
1A1
Access
200 100 0 200 Feet
Plate 1
Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport


C9
CH
C8
CG
C7
CF
C6
CE
C5
CD
C4
CC
C3
CB
C2
CA
Reach I
Access
Plate 2
Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport
200 100 0 200 Feet


Reach II
A1
AA
D6
DD
D5
D4
DC
D3
DB
D2
DA
D1
Access
Access
ccess
Access
Reach I
C9
CH
C8
200 100 0 200 Feet
Plate 3
Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
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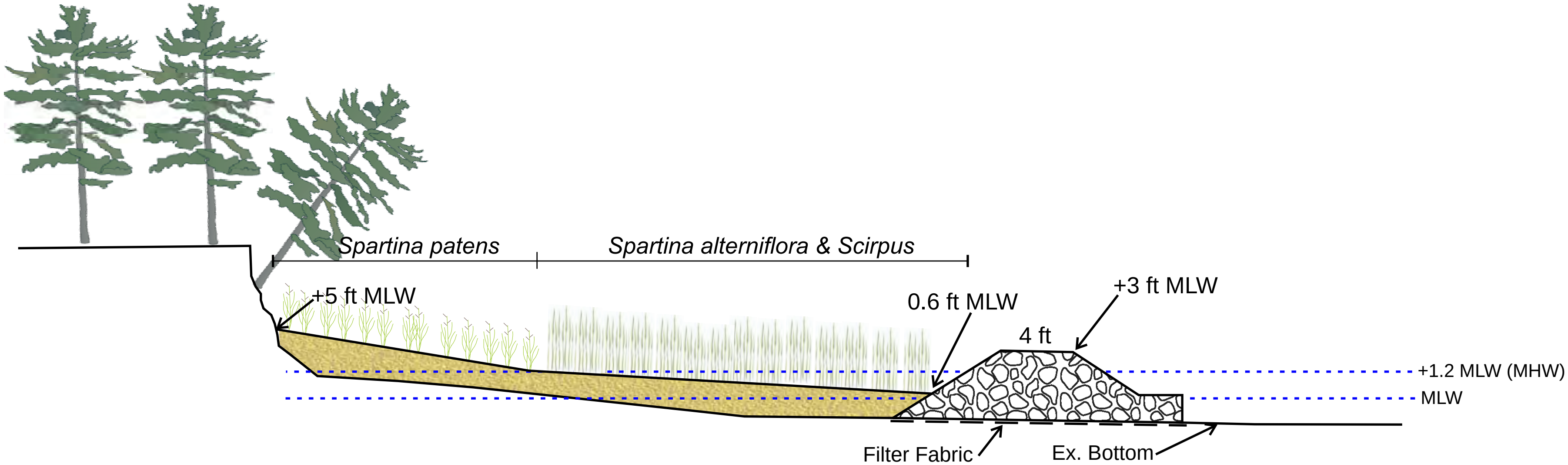
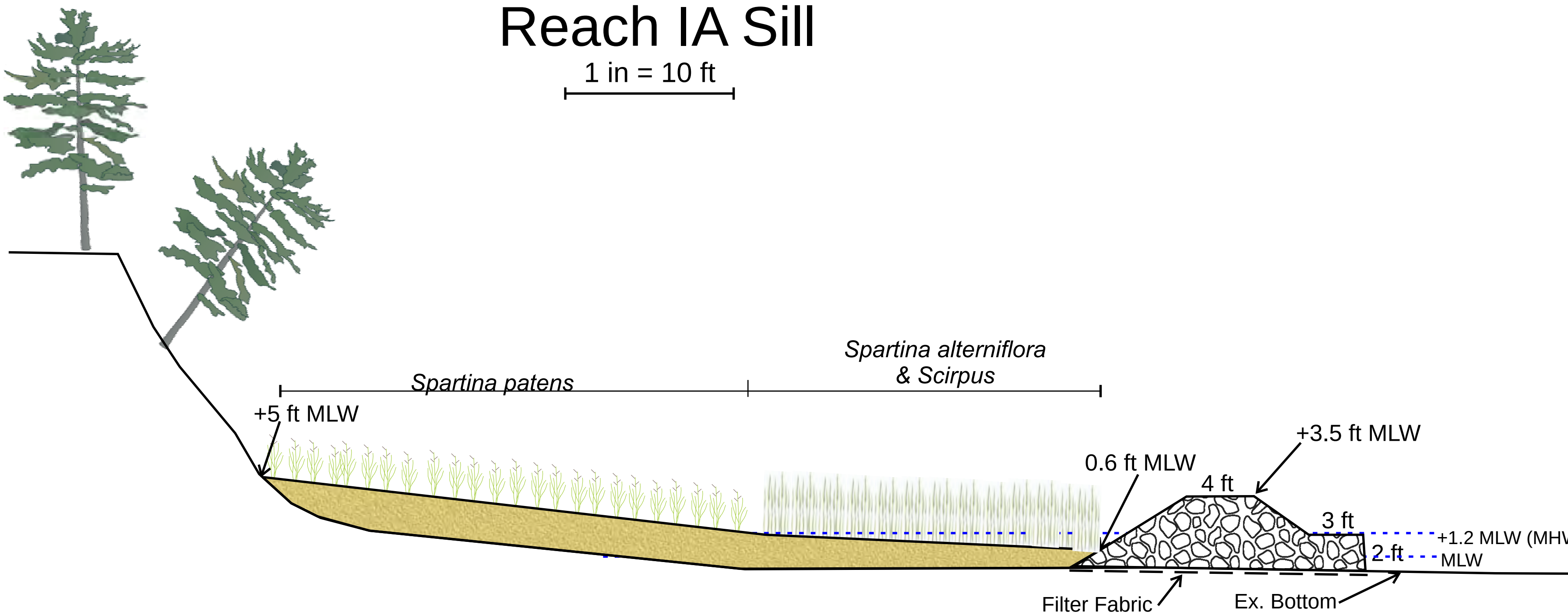
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport



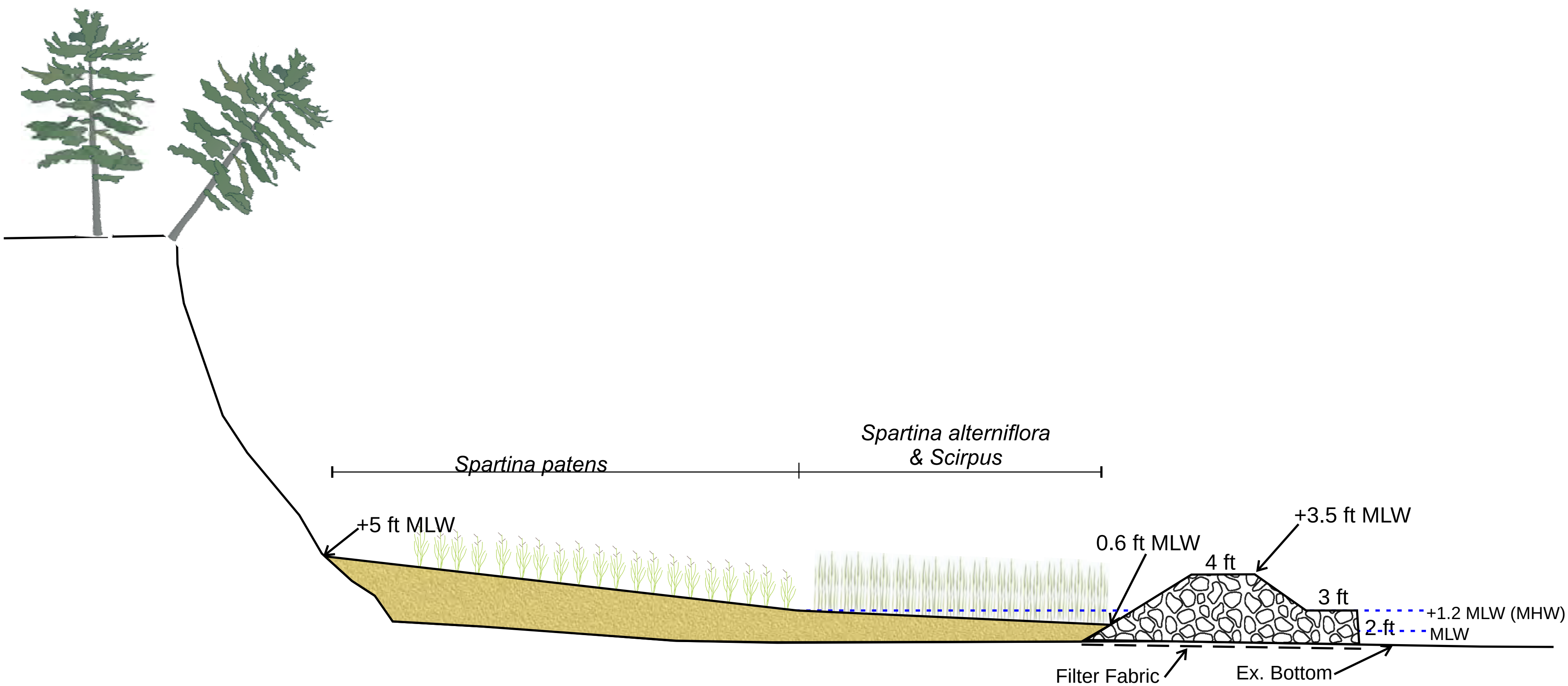
Reach IA Sill

1 in = 10 ft



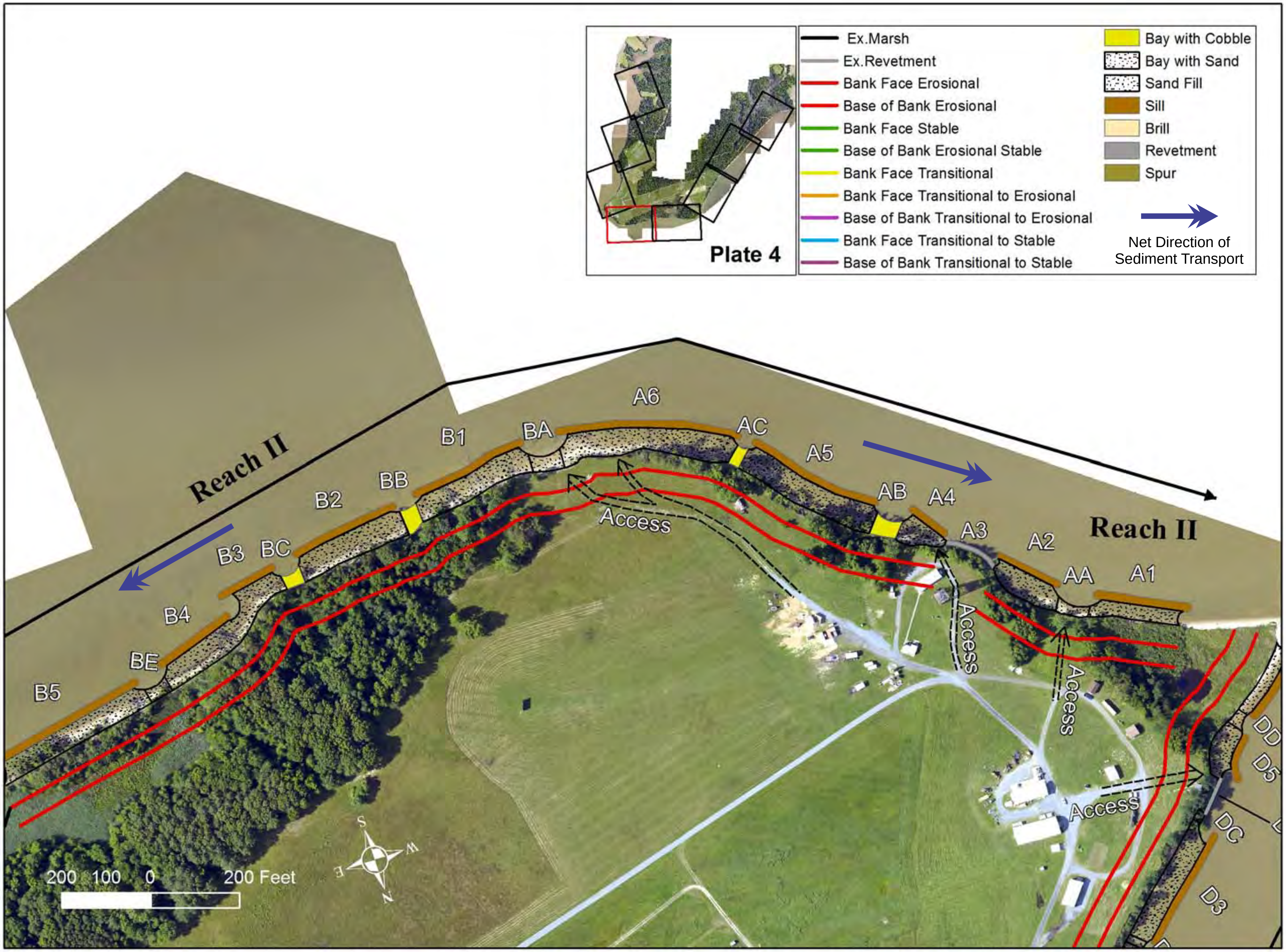
Reach IC Sill

1 in = 10 ft



Reach ID Sill/Spur

1 in = 10 ft


Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of
Sediment Transport
Plate 4
Reach II
Reach II
A6
AC
A5
AB
A4
A3
A2
AA
A1
BA
B1
BB
B2
BC
B3
B4
BE
B5
DD
D5
DC
D3
Access
Access
Access
Access
200 100 0 200 Feet

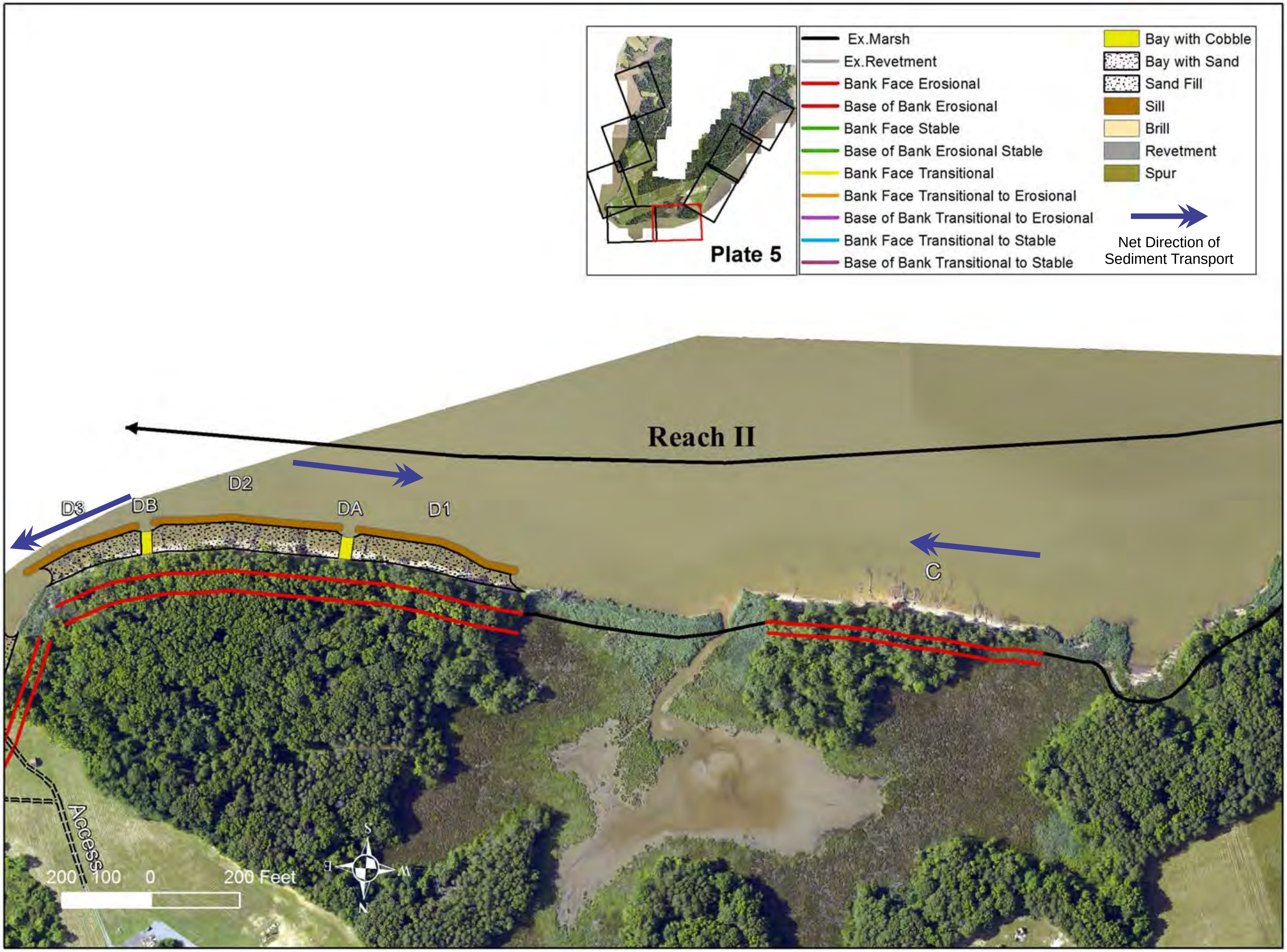
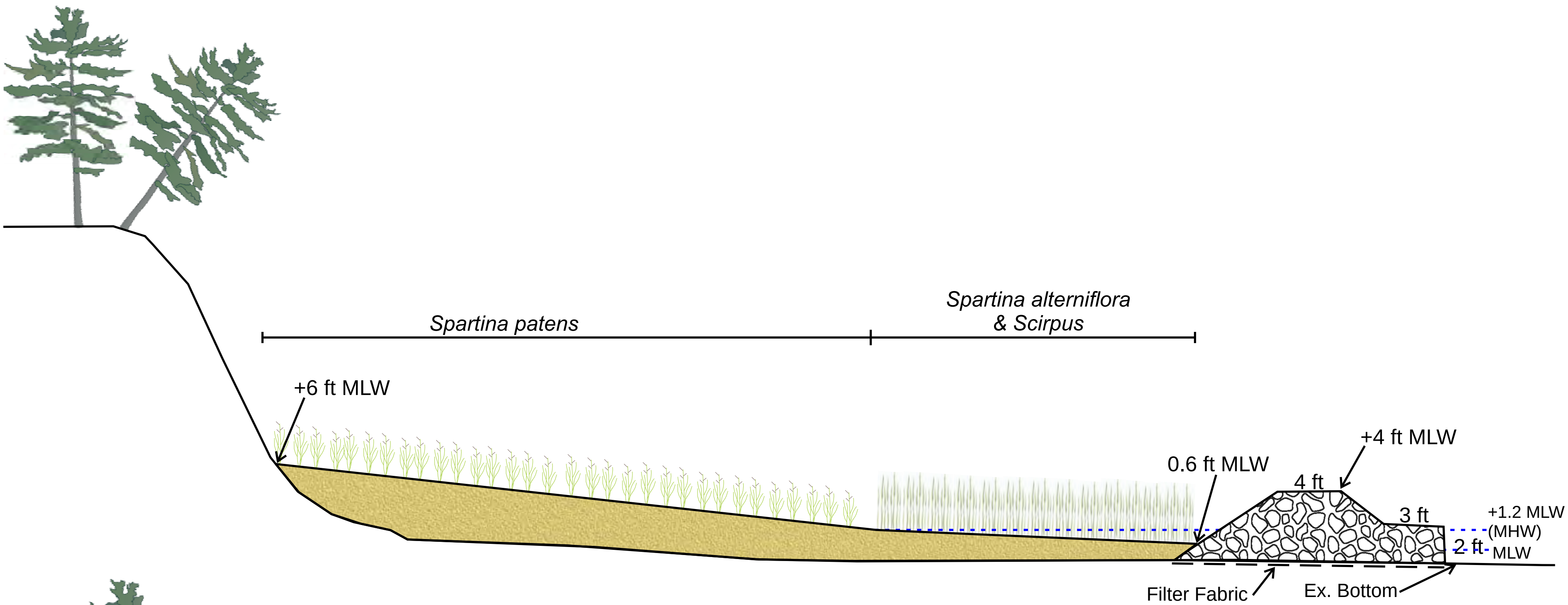
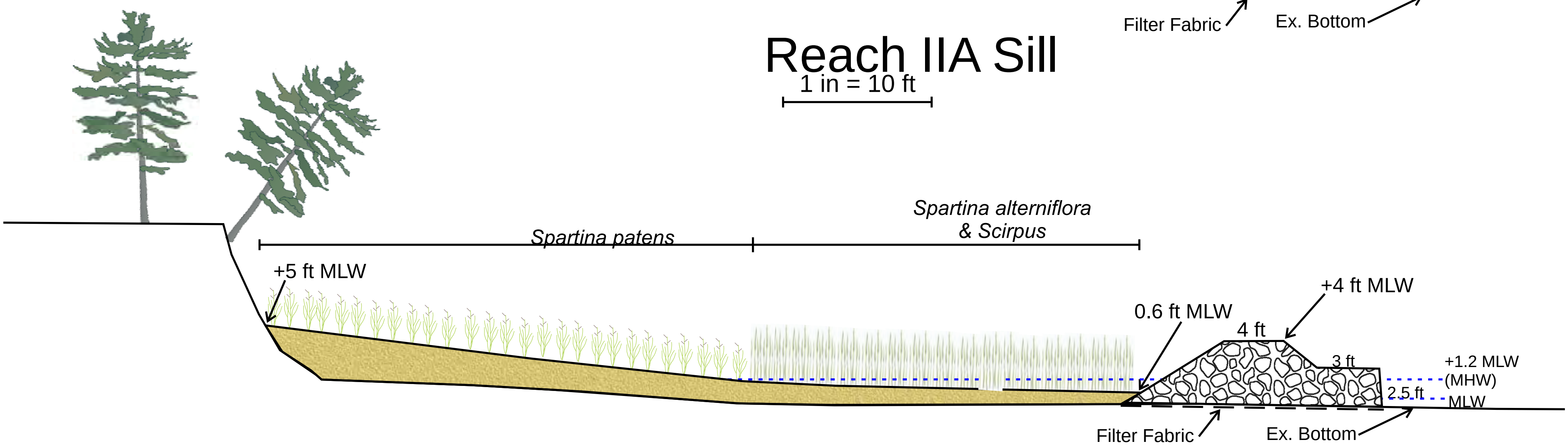


Plate 5
Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport
Reach II
D3
DB
D2
DA
D1
C
Access
200 100 0 200 Feet



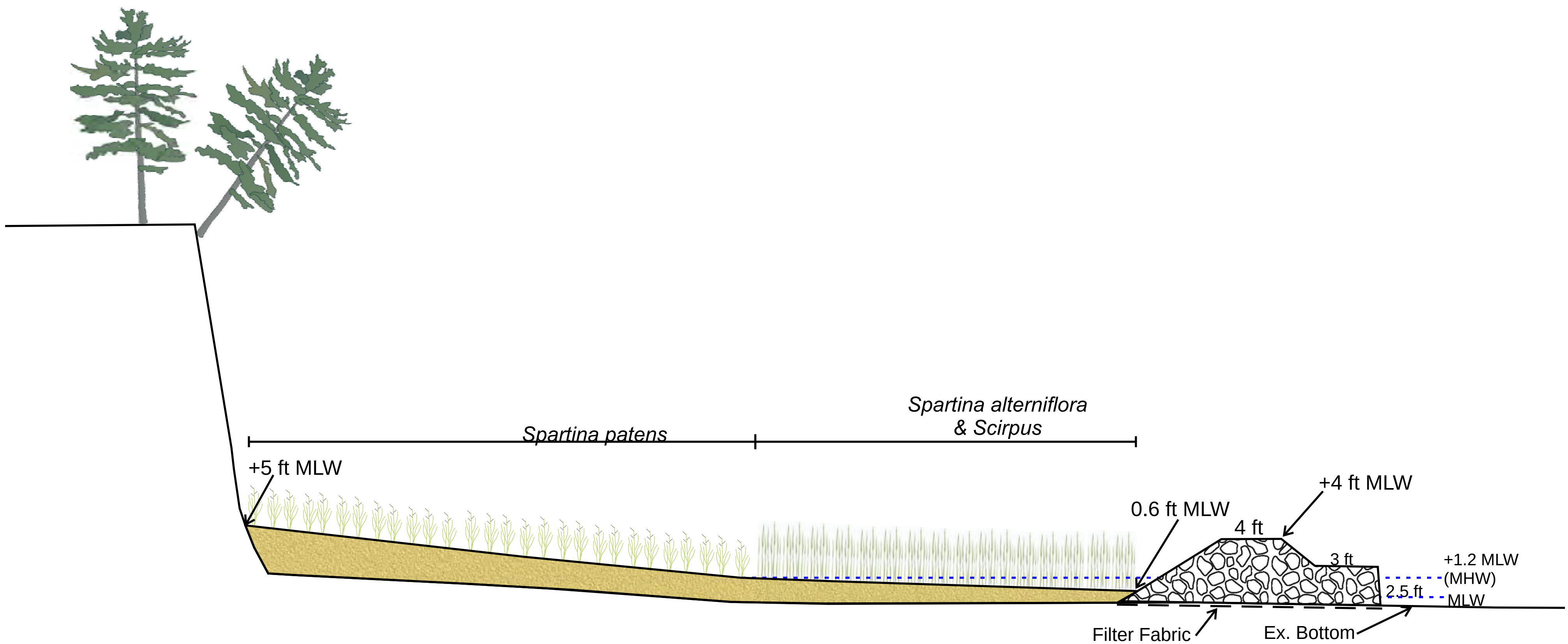
Reach IIA Sill

1 in = 10 ft



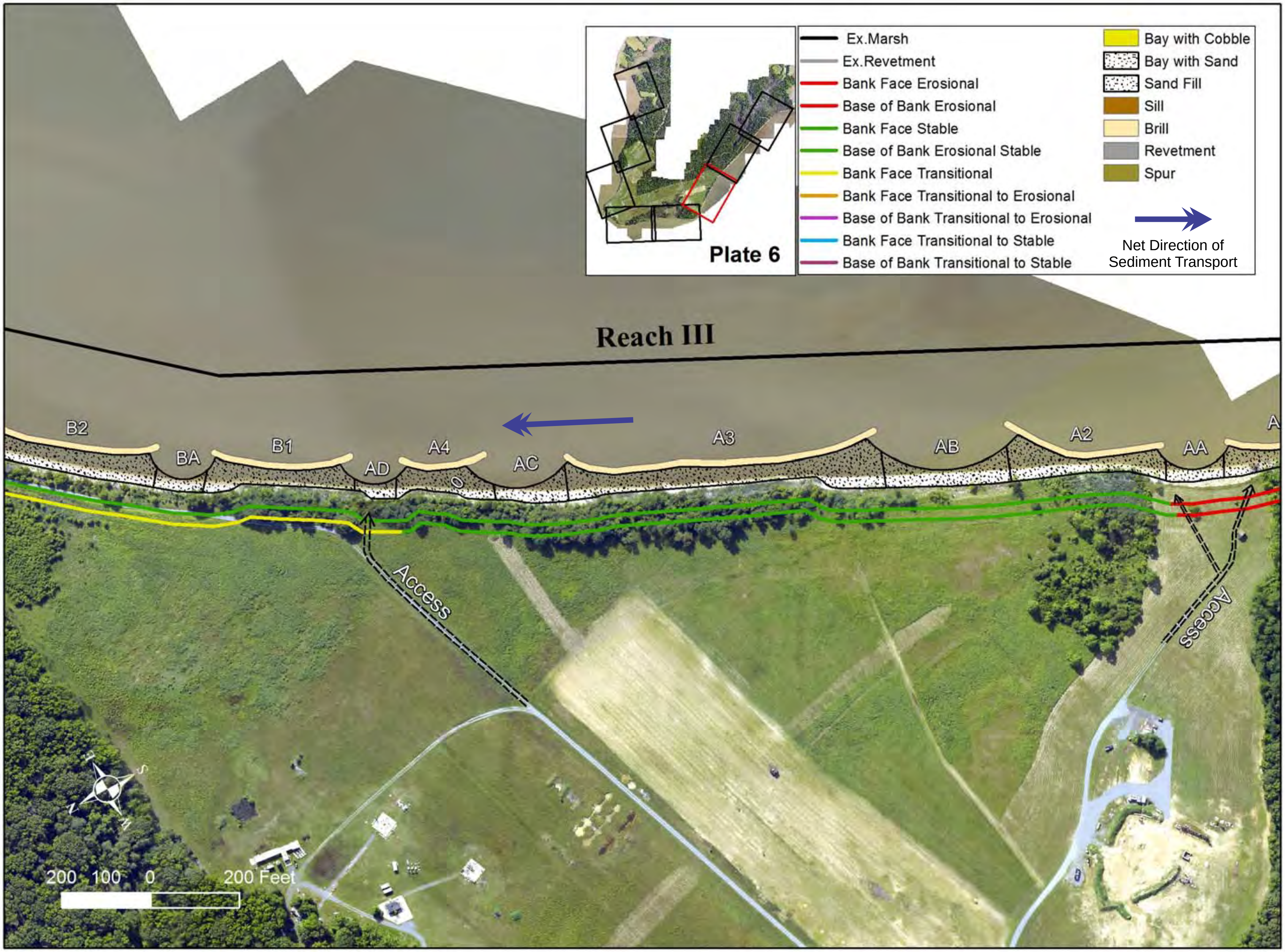
Reach IIB Sill

1 in = 10 ft



Reach IID Sill

1 in = 10 ft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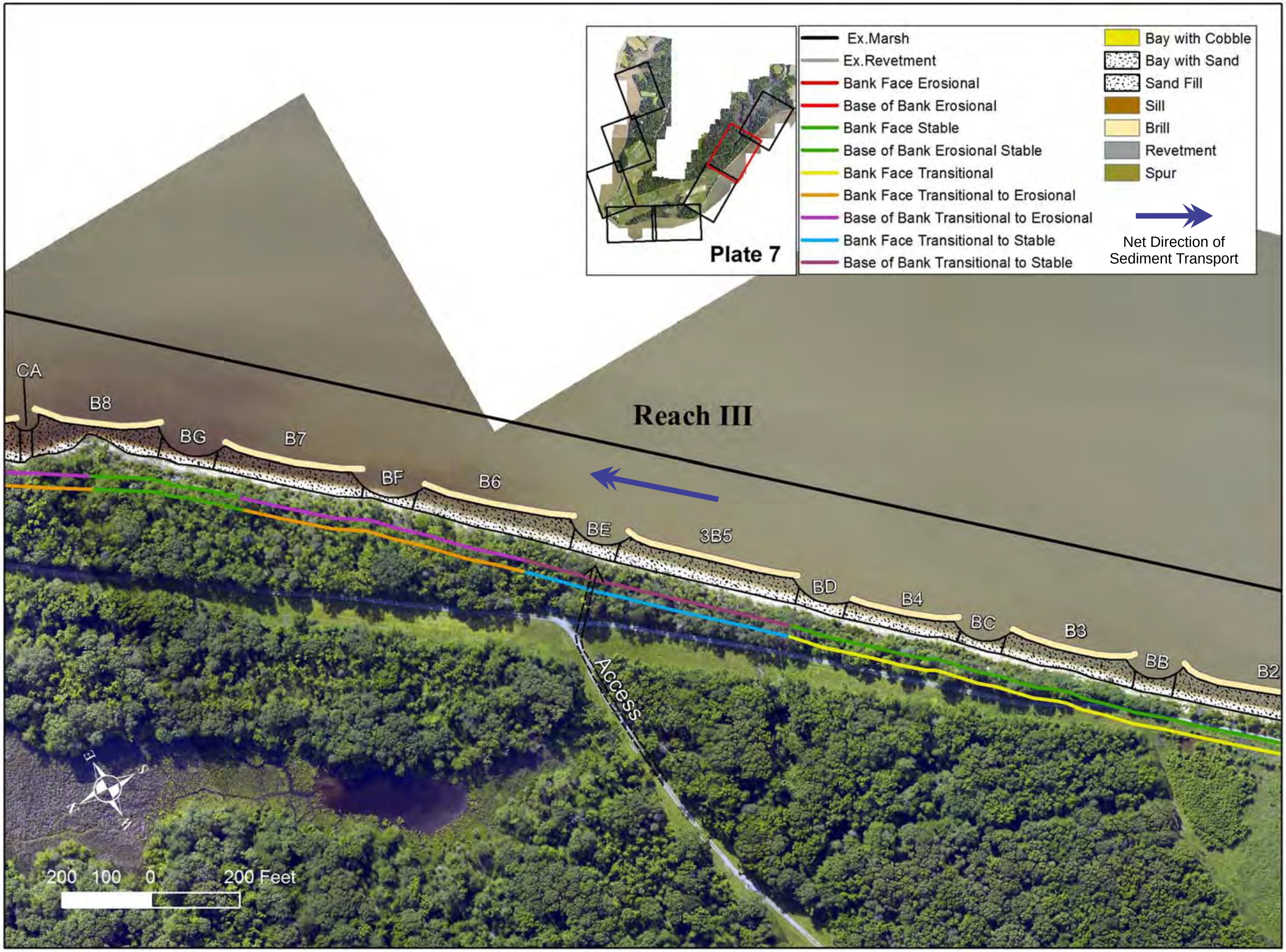
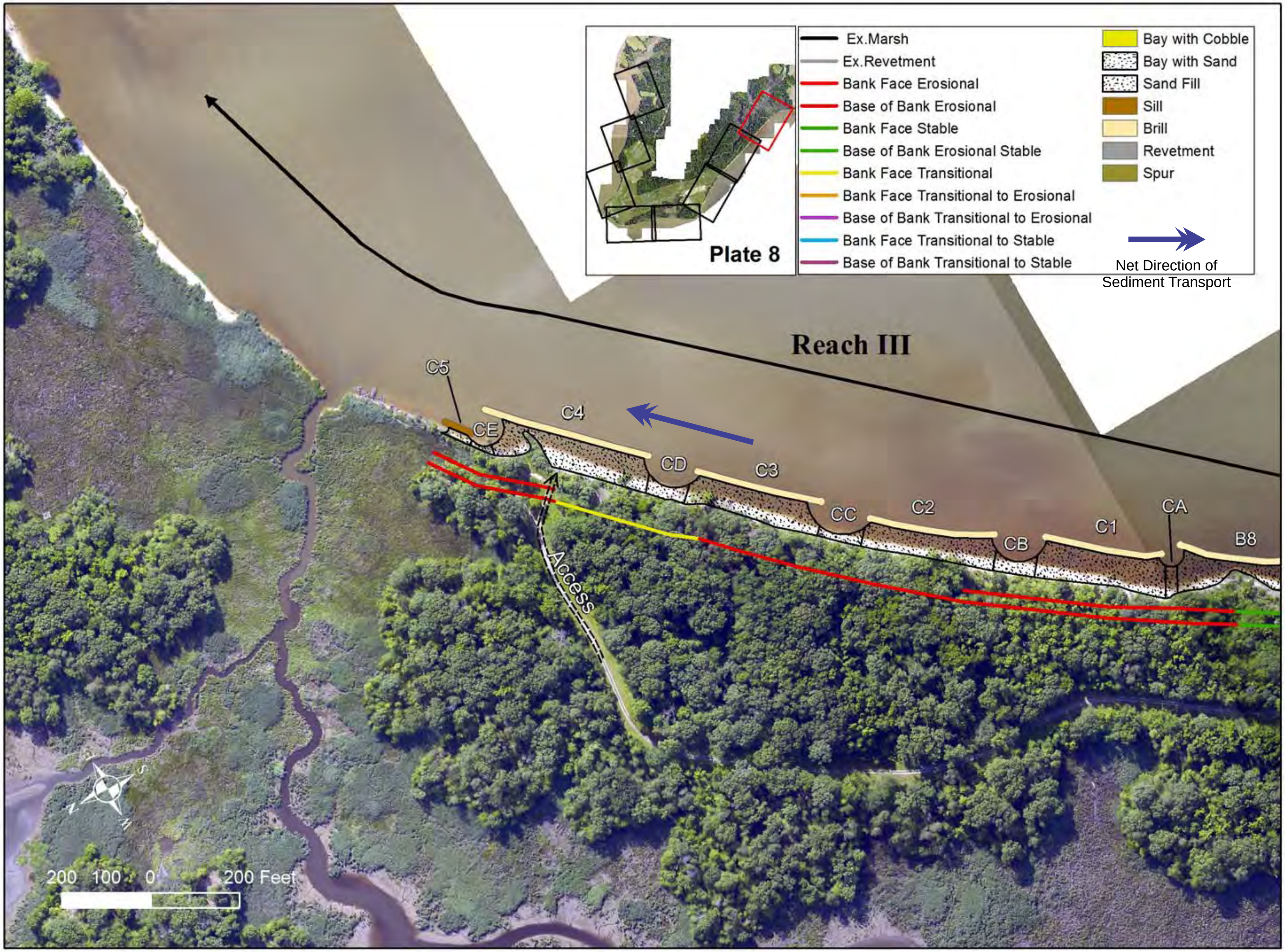
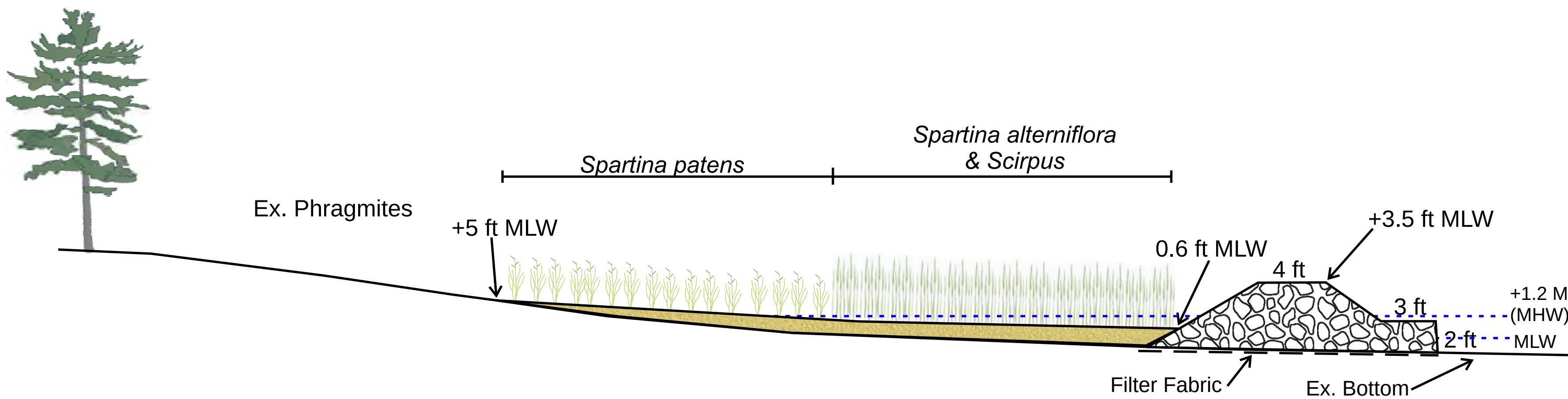
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport
Plate 6
Reach III
B2
BA
B1
AD
A4
AC
A3
AB
A2
AA
A
Access
Access
200 100 0 200 Feet

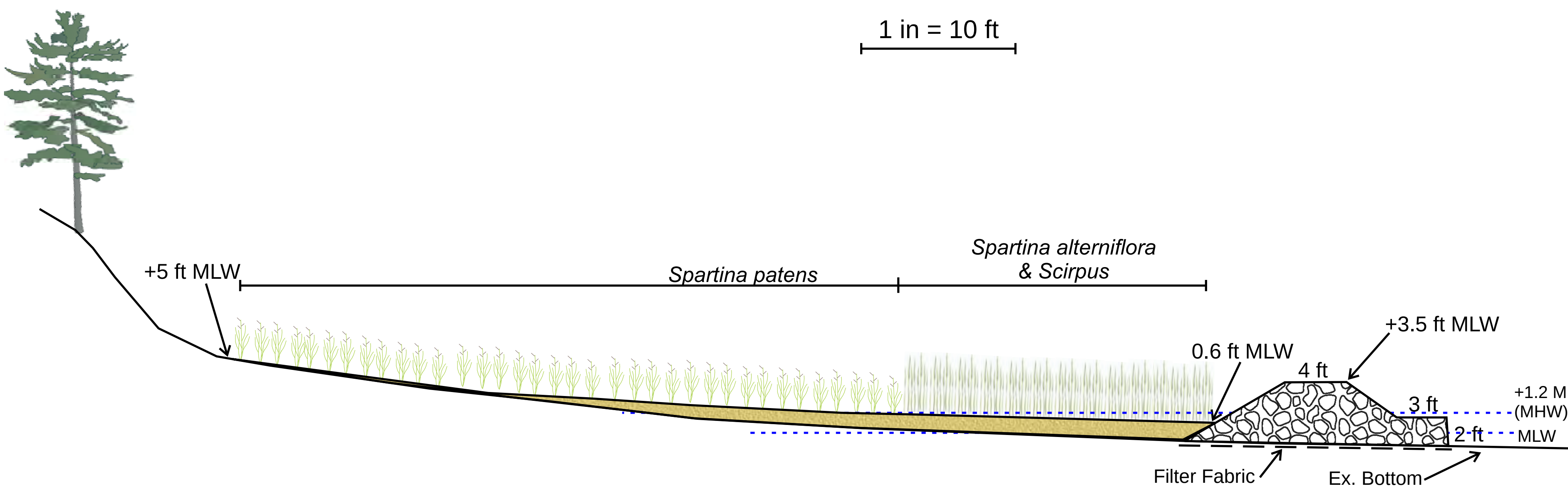

Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport
Plate 7
Reach III
CA
B8
BG
B7
BF
B6
BE
3B5
BD
B4
BC
B3
BB
B2
Access
200 100 0 200 Feet


Ex.Marsh
Ex.Revetment
Bank Face Erosional
Base of Bank Erosional
Bank Face Stable
Base of Bank Erosional Stable
Bank Face Transitional
Bank Face Transitional to Erosional
Base of Bank Transitional to Erosional
Bank Face Transitional to Stable
Base of Bank Transitional to Stable
Bay with Cobble
Bay with Sand
Sand Fill
Sill
Brill
Revetment
Spur
Net Direction of Sediment Transport
Plate 8
Reach III
C5
CE
C4
CD
C3
CC
C2
CB
C1
CA
B8
Access
200 100 0 200 Feet



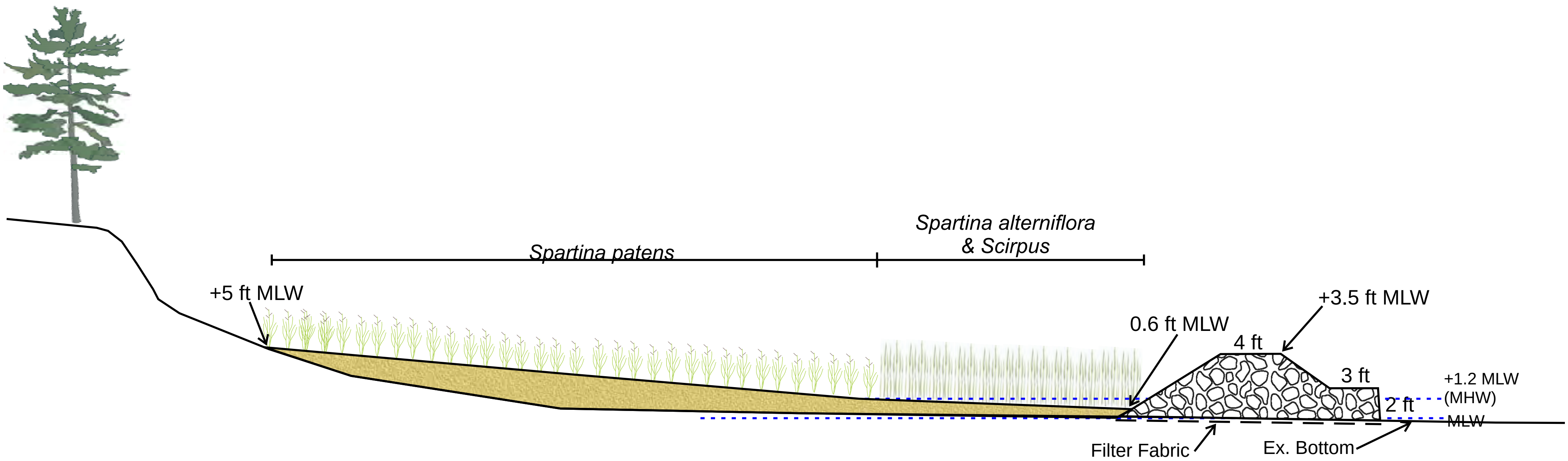
Reach IIIA Sill

1 in = 10 ft



Reach IIIB Sill

1 in = 10 ft



Reach IIIC Sill

1 in = 10 ft

Appendix B

Wave climate analysis

Utilizing the wind speed adjustment wave growth function in ACES, the imping wave at a point offshore at about the -6ft contour was performed. Several surge levels (3 ft, 4 ft, 5 ft, and 6 ft) were applied on wind speeds of 25 mph, 35 mph, 45mph, and 55 mph, respectively. Due to fetch restrictions of Reach I only Reach II and Reach III were assessed. Reach II included wind waves from the south and southwest while Reach III from the southeast.

For the southwest condition, the effective fetch was 3.8 miles and the average depth along a southwest axial from the -6 ft water depth to the opposite shore was 18 ft. The surge levels were applied on top of this average depth.

For the south condition, the effective fetch was 2.7 miles and the average depth along a south axial from the -6 ft water depth to the opposite shore was 15 ft. The surge levels were applied on top of this average depth.

For the southeast condition, the effective fetch was 3.2 miles and the average depth along a southeast axial from the -6 ft water depth to the opposite shore was 18 ft. The surge levels were applied on top of this average depth.

The results of the ACES analysis are shown below. These waves would impact the shoreline along with the increased water level during a storm.

	Reach II				**Reach III**	
	Southwest		South		Southeast	
	Wave Height	Wave Period	Wave Height	Wave Period	Wave Height	Wave Period
	(ft)	(seconds)	(ft)	(seconds)	(ft)	(seconds)
25 mph, 3 ft surge	1.5	2.4	1.3	2.9	1.4	2.3
35 mph, 4 ft surge	2.3	2.8	2.0	2.5	2.1	2.7
45 mph, 5 ft surge	3.1	3.1	2.7	2.8	2.9	3.0
55 mph, 6 ft surge	4.0	3.4	3.4	3.1	3.8	3.3

Appendix C

List of structures
and
preliminary material specifications for rock, filter fabric, sand, and plants recommended for the shore protection structures

List of recommended shore protection structures by reach with approximate length.

Reach	SubReach	StrucNum	Feature	Length_ft	Reach	SubReach	StrucNum	Feature	Length_ft	Reach	SubReach	StrucNum	Feature	Length_ft
1	A	1	Sill	210	2	A	1	Sill	220	3	A	1	Brill	270
1	A	2	Sill	360	2	A	A	Bay	80	3	A	A	Bay	140
1	A	A	Bay	30	2	A	2	Sill	160	3	A	2	Brill	380
1	A	3	Sill	410	2	A	3	Revetment	130	3	A	B	Bay	290
1	A	B	Bay	20	2	A	4	Spur	110	3	A	3	Brill	730
1	A	4	Sill	310	2	A	B	Bay	70	3	A	C	Bay	170
1	A	C	Bay	20	2	A	5	Sill	320	3	A	4	Brill	210
1	A	5	Sill	240	2	A	C	Bay	30	3	A	D	Bay	100
1	C	1	Sill	470	2	A	6	Sill	420	3	B	1	Brill	330
1	C	A	Bay	30	2	B	A	Bay	70	3	B	A	Bay	120
1	C	2	Sill	420	2	B	1	Sill	280	3	B	2	Brill	400
1	C	B	Bay	40	2	B	B	Bay	40	3	B	B	Bay	100
1	C	3	Sill	480	2	B	2	Sill	260	3	B	3	Brill	300
1	C	C	Bay	50	2	B	C	Bay	50	3	B	C	Bay	110
1	C	4	Sill	700	2	B	3	Sill	150	3	B	4	Brill	260
1	C	D	Bay	40	2	B	4	Sill	200	3	B	D	Bay	120
1	C	5	Sill	340	2	B	E	Bay	50	3	B	5	Brill	410
1	C	E	Bay	30	2	B	5	Sill	380	3	B	E	Bay	110
1	C	6	Sill	150	2	D	1	Sill	380	3	B	6	Brill	360
1	C	F	Bay	30	2	D	A	Bay	30	3	B	F	Bay	130
1	C	7	Sill	310	2	D	2	Sill	440	3	B	7	Brill	330
1	C	G	Bay	70	2	D	B	Bay	30	3	B	G	Bay	140
1	C	8	Sill	510	2	D	3	Sill	290	3	B	8	Brill	310
1	C	H	Bay	60						3	C	A	Bay	30
1	C	9	Sill	100						3	C	1	Brill	280
1	D	1	Spur	160						3	C	B	Bay	100
1	D	A	Bay	70						3	C	2	Brill	300
1	D	2	Sill	400						3	C	C	Bay	100
1	D	B	Bay	20						3	C	3	Brill	300
1	D	3	Sill	290						3	C	D	Bay	100
1	D	4	Revetment	120						3	C	4	Brill	400
1	D	5	Sill	120						3	C	5	Sill	80
1	D	D	Bay	40										
1	D	6	Sill	170										

DIVISION II

STONE PROTECTION

2.1 **Scope**

The work covered by this section consists of furnishing all labor, plant, equipment, and materials, and performing all operations in connection with the hauling and placement of stone as shown on the Drawings, and in strict accordance with this Specification.

2.2 **Materials**

All stone for the protection work shall be durable quarried stone. The stone shall be hard and angular, free from either laminations, weak cleavages or undesirable weathering, and of such character that it will not disintegrate from the action of air, salt water, or handling. Sedimentary stone will generally be unacceptable. Individual stones will be approximately rectangular in cross-section and free from thin slabby pieces having a maximum dimension of more than three and one-half times the least dimension.

Existing rock may be reused as fill or armor if it meets size and material specifications.

Existing broken concrete maybe reused as fill material if it meets size specifications.

2.3 **Size And Weight:** Stone shall meet the following requirements:

2.3.1. **Stone:** Sizes for the following structures:

Sills/Brills: Armor stone sizes shall be such that a minimum of 90% of the individual stones shall weigh from 800 lbs. to 1,800 lbs. and shall have a well graded distribution of these sizes through these limits. Not more than 10% of the individual stones shall weigh more than 1,800 lbs. No armor stones shall weigh less than 800 lbs. Core stone shall be approximately 3" up to 15" in size with an even distribution between these limits.

2.3.2. **Unit weight:** The stone shall have a minimum unit weight of 165 lbs. per cubic foot.

2.4 **Field Samples**

The Contractor shall supply samples of stone to be displayed at the site with appropriate weights marked for the minimum, maximum and one-half (50%) weight range specified. These samples of stone shall be from the same quarry and of the same type of stone as that to be supplied for the job, and shall be delivered to the site in advance of the time when placing the stone is expected to begin. The Contractor will not be granted an extension of time or extra compensation due to delay caused by sampling, testing, approval, or disapproval of stone protection material to complete the requirements of the Specifications.

2.5 **Certification**

The Contractor shall obtain from the quarry and submit to the Agent for the Owner a certificate indicating the following:

i. stone classification

ii. stone weight per cubic foot

iii. the stone furnished will meet the requirement of Sections 2.2 and 2.3 of these Specifications

2.6 **Placement**

Stone shall be placed in such a manner as to produce a well-graded mass of rock with a minimum percentage of voids, and shall be constructed to the specified lines and grades shown on the Drawings. Stones shall be placed such that there is a well-graded distribution of the various sizes throughout the structure. Any oversized stones shall be placed at the toe of the structure. The finished structure shall be free from pockets of small stones and clusters of large stones. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a well-graded distribution of stone size, to obtain contact between adjacent armor stones, and to achieve the lines and grades shown on the Drawings. The Contractor shall maintain the structure until it is accepted and any material displaced by any cause shall be replaced at the Contractor's expense to the lines and grades shown on the Drawings. A tolerance of +/- 0.30 feet measured normal to the faces will be allowed. No negative or positive tolerance will be allowed over an area greater than fifty (50) square feet.

2.7 **Sample Section**

At the start of construction the Contractor shall construct a thirty (30) foot sample section for each type of structure at a location in the field agreed on by the Agent for the Owner and the Contractor. This sample section must be approved by the Agent for the Owner prior to the start of any additional stone construction. Once the sample section is approved by the Agent for the Owner, it shall serve as a standard for further stone work.

2.8 **Measurement**

No measurement for payment for this item of work will be made, since the cost shall be included in the Base bid on the Special Form of Proposal.

DIVISION III

FILTER CLOTH

3.1 Scope

The work covered by this section consists of furnishing all labor, plant, equipment, and materials and performing all operations required to complete the installation of filter cloth as shown on the Drawings and in strict accordance with this Specification.

3.2 Materials

3.2.1. **Filter Cloth:** The plastic filter fabric shall be porous, plastic sheets woven, calendared and palmered filament yarn. The plastic yarn shall consist of a long-chain synthetic polymer composed of at least 85% by weight of propylene, ethylene, ester, amide or vinylidene chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure. The fabric shall conform to the following minimum requirements:

Property	Test Method	Criteria
Seam Breaking Strength	ASTM D-4884	>90%
Tensile Strength	ASTM D-4632	400 x 315 lbs
Burst Strength	ASTM D-3786	800 psi
Puncture Strength	ASTM D-4833	150 lbs.
Elongation@Break	ASTM D-4632	15%.
Wide Width Tensile	ASTM D-4595	250 x 230 lbs.
Trapezoidal Tear	ASTM D-4533	150 x 200 lbs
AOS	ASTM D-4751	40 U.S. Sieve
Permittivity	ASTM D-4491	.90 Sec^{-1}
Flow Rate	ASTM D-4491-85	70gal/min/ft
U.V. Resistance % Retained (500hrs)	ASTM D-4355	>90%

3.2.2. **Seams:** Seams of fabric shall be sewn with thread meeting or exceeding specifications given for plastic yarn, and shall be bonded by cementing or calendaring. Seams shall be tested in accordance with method ASTM D-1683, and the seam strength shall meet the strength specified herein but shall not be less than 90% of the tensile strength of the imaged fabric in any principal direction.

3.2.3. **Securing pins:** Securing pins shall be 3/16 inch in diameter, of steel pointed on one end, and fabricated such that the head retains a steel washer 1.5 inches in diameter or more. Pins shall be no less than 18 inches in length. In cases where stone protection will be placed adjacent to timber bulkheads, galvanized staples or roofing nails placed at 24 inch o.c.e.w. shall be used to fasten the filer cloth to the bulkhead. Alternate anchoring methods may be used, subject to approval by the Agent for the Owner.

3.2.4. **Certification of fabric:** All plastic filter fabrics to be used shall be tested for compliance with the above Specifications. Before installing the filter cloth, the Contractor shall submit to the Agent for the Owner a certificate or affidavit signed by a legally-authorized representative of the company manufacturing the fabric. The certificate shall state that the chemical, physical, and manufacturing requirements of this Specification are met. In addition, a manufacturer's statement showing evidence of a service record of the filter cloth shall be submitted proving successful performance in projects of similar scope.

3.3 Installation

3.3.1. **Placement of filter cloth:** The strips of plastic filter cloth shall be spread parallel to the major axis of the structure on the prepared foundation as shown on the Drawings. The cloth shall be loosely laid (not stretched). Rolls of as great a length as it economical for the Contractor to handle shall be used whenever possible in order to minimize the number of overlaps perpendicular to the major axis of the structure. The cloth shall be securely fastened in place to prevent slippage during construction with securing pins placed thirty (30) inches apart each way. Existing stones greater than one (1) inch in the largest dimension shall be removed prior to placement of filter cloth to prevent damage to the filter cloth.

3.3.2. **Placement of stones on filter cloth:** Adequate precaution shall be taken to prevent damage to the plastic filter cloth from placement of overlaying materials. No stone will be dropped onto the filter cloth. Care shall be taken in placing plastic filter cloth onto prepared subgrade of rock or broken concrete. This subgrade shall be prepared to prevent cloth damage from below. Any filter cloth damaged or displaced before or during placement of overlaying materials or improper subgrade preparations shall be replaced or repaired to the satisfaction of the Agent for the Owner at the Contractor's expense.

3.4 **Measurement**

No measurement for payment of this item of work will be made, since the cost shall be included in the Base bid on the Special Form of Proposal.

DIVISION IV

WETLANDS PLANTING TERRACE

4.1 **Scope**

The work covered in this section consists of furnishing all labor, plant, equipment, and materials, and performing all operations required to obtain, transport, place, and grade the beach fill material as shown on the Drawings and in strict accordance with this Specification.

4.2 **Satisfactory Fill Material for Wetlands/ Dune Planting Terrace**

Medium-to-coarse-grained gravelly to sandy soils classified as SW, SP, GW, and GP in "ANSI/ASTM D-247-69, Classification of Soils for Engineering Purposes" are satisfactory. Crushed sone or slag will not be acceptable. The beach nourishment and wetlands/dune planting terrace material must contain no more than five percent (5%) passing the number 200 sieve and no more than ten percent (10%) passing the number 100 sieve. The material shall consist of rounded or semi-rounded grains having a median diameter of 0.60 mm (+/-.25mm).

4.3 **Inspection and Testing**

4.3.1. Prior to constructing the wetlands planting terrace, the Contractor will furnish samples of the proposed fill material to the Agent for the Owner. The Contractor will also obtain from an inspection firm acceptable to the Agent for the Owner, and submit to the Agent for the Owner, a certificate indicating the following:

i. sand classification and gradation curves of the proposed fill material;

ii. weight per cubic yard of the proposed fill material;

iii. the fill materials furnished will meet the requirements of Section 4.2 of these Specifications.

The cost for obtaining certifications and test results shall be included in the Lump Sum Price Bid for beach fill material on the Special Form of Proposal.

Sand will be tested every 1,000 cubic yards by Contractor to confirm compliance.

Test results will be supplied to the Agent for the Owner for approval.

4.4 **Placement of Wetlands Terrace**

The proposed wetland planting terrace shall be constructed uniformly to the lines and grades indicated on the Drawings. The final surface shall be reasonably smooth graded, and free of irregular areas which can collect water or other debris. The Contractor shall remove, and properly dispose of, all excess waste materials, rubbish, construction debris, etc., from the area within the Limit of Contract prior to the placement of the fill.

4.5 **Acceptance**

The final graded surface shall not vary from the lines and grades indicated on the Drawings by more than +0.2 feet or -0.2 feet (plus or minus two-tenths feet).

4.6 **Measurement**

No measurement for payment for this item of work will be made, since the cost shall be included in the Lump Sum Price bid shown on the Special Form of Proposal.

DIVISION V

FILL AND GRADING

5.1 Scope

The work covered in this section consists of furnishing all labor, plant, equipment, and materials, and performing all operations required to perform the upland fill and grading to the lines and grades shown on the Drawings, and in strict accordance with this Specification. Unsuitable or excess material shall be disposed of off-site at an Owner furnished stockpile area within one mile of the construction site.

5.2 Fill

Where the depth of fill behind or above the proposed breakwater or sill substrate may exceed 3" the Contractor shall bring the area to 3" undergrade with sand fill. Sand fill shall consist of earth materials, free from perceptible amounts of wood and debris. It shall be free of frost at the time of placement and shall not contain marl or other elements which tend to keep it in a plastic state. All backfill shall be placed from the bottom up in successive 8" horizontal layers and compacted to the approval of the Agent for the Owner. Upland berm fill shall contain enough silt or clay so as to be impervious.

5.3 Grading

A. The Contractor shall grade all areas shown on the Drawings and all areas disturbed by construction activities, uniformly to the lines and grades shown on the Drawings. The finish surface shall be smooth, compacted, and free of irregular surface changes and areas which collect water.

B. The Contractor shall remove all excess stone and construction debris from the construction site prior to final grading to an approved disposal area. This shall include all waste larger than one inch in its largest dimension which may be embedded in the soil.

5.4 Measurement

No measurement for payment of this item of work shall be made, since the cost shall be included in the Base bid shown on the Special Form of Proposal.

DIVISION VI

RESTORATION OF GRADED AND DISTURBED AREAS

6.1 Scope

The work covered in this section consists of furnishing all labor, plant, equipment, and materials, and performing all operations required to: (i) furnish, spread, and rake topsoil for seeding; and (ii) complete the restoration of all graded and disturbed areas within the Limit of Contract, as shown on the Drawings and in strict accordance with this Specification.

6.2 Contractor's Responsibility

6.2.1. The Contractor will accomplish the upland seeding and mulching operation:

i. within seven (7) calendar days after completion of the fill and grading work for all slopes greater than 3:1;

ii. within fourteen (14) calendar days for all other disturbed areas within the Limit of Contract at the Project Site.

6.2.2. The Contractor shall submit to the Agent for the Owner evidence of the type of seed used.

6.2.3. Once the finished project has been accepted, the Contractor shall be required to re-seed any areas which do not show the proper density of grass.

6.3 Topsoiling (if necessary)

6.3.1. **General:** Upon completion and compaction of fill to subgrade (three inches below finished grade), three (3) inches of topsoil shall be placed, spread to a uniform thickness, graded, and raked to remove large stones (fist size or larger), root mat, and other foreign materials, and left ready for seeding.

6.3.2. **Material:** Topsoil shall consist of natural surface soil from well-drained areas from which no topsoil has previously been stripped. The topsoil shall be homogeneous in nature, free from any material harmful to plant growth, and have an organic content of not less than 1.5% by weight. Testing results shall be supplied to the Agent for the Owner for approval. The Contractor strip and shall stockpile all existing topsoil in areas to be graded. The Contractor shall be responsible for supplying additional topsoil if needed.

6.4 **Seeding (if necessary)**

6.4.1. **Temporary Upland Seeding:** The Contractor shall undertake temporary upland seeding to minimize soil loss when it is expected that the area within the Limit of Contract will be disturbed again before completion of construction.

Site preparation: The Contractor shall grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, and mulch application.

Seedbed preparation: The Contractor shall apply 4,000 pounds per acre of pulverized dolomitic limestone, and 1,000 pounds per acre of 10-10-10 or equivalent fertilizer. The lime and fertilizer shall be worked into the top three inches of topsoil by raking or use of other conventional equipment.

Seeding: The contractor shall apply forty-three (43) pounds per acre of annual rye. The seed shall be worked into the top ½ inch of topsoil by raking.

Planting season: Temporary seedbed preparation and seeding shall be accomplished between February 1 and April 30, and between August 15 and November 30, within fourteen (14) days after the completion of the fill, grading, and topsoiling operations, except when the ground is frozen. Between Fall and Spring seeding, the Contractor will only apply mulch in accordance with Section 6.5 of these Specifications.

6.4.2. **Permanent Upland Seeding:** The Contractor shall undertake permanent upland seeding of any area within the Limit of Contract once all work has been completed according to the Drawings and Specifications and the area will not be disturbed again before the completion of construction activities.

Site preparation: The Contractor shall grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding and mulch application.

Seedbed preparation: The Contractor shall apply 4,000 pounds per acre of pulverized dolomitic limestone, and 1,000 pounds per acre of 10-10-10 or equivalent fertilizer. The lime and fertilizer shall be worked into the top three (3) inches of topsoil by raking or use of conventional equipment.

Seeding: The Contractor shall apply sixty (60) pounds per acre of Kentucky 31 tall fescue. The seed will be applied uniformly with cyclone seeder, drill, cultipacker seeder or hydro-seeder (slurry includes seed, fertilizer, lime, cellulose fibers with binder and water) preferably on a firm, moist seedbed. Normal coverage is 1/4 to ½ inch. Where feasible (except when a cultipacker seeder is used), the seedbed shall be firmed following seeding operations with a light roller.

Planting season: Permanent upland seedbed preparation and seeding shall be accomplished between February 1, and April 30, or between August 15 and November 30, within fourteen (14) days after completion of fill, grading, and topsoiling operations, except when the ground is frozen. Between Fall and Spring seeding, the Contractor will only apply mulch in accordance with Section 6.5 of these Specifications.

6.5 Mulching

A. Mulch materials shall be unweathered, unchopped small grain straw (preferably wheat straw) applied at the rate of 1-1/2 to 2 tons per acre. Oat straw is less desirable, since it may contain viable seed which may provide serious competition for grass and legum seedlings unless clipped.

B. Mulch shall be spread uniformly by hand or mechanically so that approximately 85% of the soil will be covered.

C. Mulch anchoring shall be accomplished immediately after placement of mulch to minimize loss by wind or water. Liquid mulch binders, including synthetic mulch binders, may be used provided they receive advance approval by the Agent for the Owner. No asphalt shall be used for mulch anchoring. If synthetic mulch binders are used, the mixing procedures and method of application shall be in accordance with the manufacturer's latest technical bulletins. In lieu of liquid mulch binders, ground stabilization netts may be used provided they receive advance approval by the Agent of the Owner.

6.6 Soil Stabilization Blanket

For slopes 3 ft horizontal to 1 ft vertical or steeper:

Material: Soil stabilization blanket material shall be a dense mate of curled and seasoned Aspen wood excelsior of which at least 80% shall be six inches or longer in fiber length with a consistent thickness. The fiber shall be evenly distributed over the entire area of the blanket. The top side of each blanket shall be covered with a photodegradable extruded plastic mesh. The blanket shall be made smolder resistant without the use of chemical additives.

One material equal to the above requirements is “Curlex Blankets” as manufactured by American Excelsior Company, P.O. Box 25, Annapolis Junction, Maryland 20701.

6.7 Measurement

No measurement for payment for this item of work will be made, since the cost shall be included in the Base bid on the Special Form of Proposal.

DIVISION VII

WETLANDS VEGETATION

7.1 **Scope**

The work covered in this section will include furnishing all labor, plant, equipment and materials, and performing all operations required to complete the installation of the wetlands vegetation as shown on the Drawings and in strict accordance with this Specification.

7.2 **Contractor's Responsibilities**

The Contractor will be responsible for replanting any areas which do not show the proper density of wetland vegetation for a period of one (1) year from the date of acceptance of the finished project. The minimum acceptable density of surviving wetland species vegetation will be 80% for every 25 linear feet measured along the shoreline.

7.3 **Wetlands Planting**

7.3.1. **Spartina alterniflora (Smooth Cordgrass)**

A. **Materials:**

i. Fertilizer: Each transplant site will be fertilized with one ounce of "Osmocote 3-4 Month 19-6-21" (or equivalent slow-release) fertilizer placed in the planting hole at the time of planting.

ii. Plant Stock: Plant stock will be Spartina alterniflora (Smooth Cordgrass) grown in peat pots. Prior to installing plants at the project site, the Contractor will be required to show proof of a valid Maryland Nursery Inspection Certificate or Plant Dealers License (or comparable certification for out-of-state installers). All shipments of nursery stock into Maryland must be accompanied by a valid certificate of inspection issued at the state of origin, and acceptable to the Maryland Department of Agriculture Office of Plant Industries and Resource Conservation. Plants will be three to six months old and approximately 12 inches high. Individual pots will contain three or more plants.

iii. It will be the responsibility of the Contractor to maintain the vigor of the plants held at the site during site preparation work and construction. Plants held at the site will be watered by sprinkling with fresh water at least once a day.

iv. Planting will be done with moist, but not saturated, root masses. Plants will not be removed from the peat pots.

B. **Soil Preparation and Planting:**

i. Grass, weeds and debris will be cleaned from all areas to be planted, and the ground surface will be smoothed.

ii. After grading, the Mid-tide and Mean High Water (MHW) lines will be marked on the ground, and plantings made in rows generally parallel to and between these lines, or according to the elevations as specified on the Drawings. Rows will be 1.5 feet apart, and plants will be 1.5 feet apart in the rows.

iii. Plantings will be made by hand with dibble, spade or shovel by opening a hole at the planting site, placing the fertilizer and then the plant in the hole, closing the hole and firming the soil around the plant so that the surface soil is three to four inches above the top of the root mass.

7.3.2. **Spartina patens (Saltmeadow Cordgrass)**

A. **Materials:**

i. Fertilizer: Each transplant site will be fertilized with one ounce of "Osmocote 3-4 Month 19-6-21" (or equivalent slow-release) fertilizer placed in the planting hole at the time of planting.

ii. Plant Stock: Plant stock will be Spartina patens (Saltmeadow Cordgrass) grown in peat pots. Prior to installing plants at the project site, the Contractor will be required to show proof of a valid Maryland Nursery Inspection Certificate or Plant Dealers License (or comparable certification for out-of-state installers). All shipments of nursery stock into Maryland must be accompanied by a valid certificate of inspection issued at the state of origin, and acceptable to the Maryland Department of Agriculture Office of Plant Industries and Resource Conservation. Plants will be three to six months old and approximately 12 inches high. Individual pots will contain three or more plants.

iii. It will be the responsibility of the Contractor to maintain the vigor of the plants held at the site during site preparation work and construction. Plants held at the site will be watered by sprinkling with fresh water at least once a day.

iv. Plants will not be removed from the peat pots. Planting will be done with moist, but not saturated, root masses.

B. **Soil Preparation and Planting:**

i. Grass, weeds, and debris will be cleaned from all areas to be planted, and the ground surface will be smoothed.

ii. After grading the Spartina patens will be planted between the Mean High Water (MHW) Line and the toe of the bank, or according to the elevations as specified on the Drawings. Plants will be placed in rows that are generally parallel to lines of equal elevation. Rows will be 1.5 feet apart. Plants will be 1.5 feet apart in the rows.

iii. Plantings will be made by hand with dibble, spade or shovel by opening a hole at the planting site, placing the fertilizer and then the plant in the hole, closing the hole and firming the soil around the plant so that the surface soil is three to four inches above the top of the root mass. If the soil at the planting site is not wet or damp, the plants will be well- watered, with fresh water, within four hours after planting.

7.4 Planting Season

7.4.1. **Spartina patens:** Sprigging will be accomplished between August 15 and October 15 or between April 1 and June 30.

7.4.2. **Spartina alterniflora:** Sprigging will be accomplished between August 15 and

October 15 or between April 1 and June 30 during periods of low tide.

7.5 Measurement

No measurement for payment for this item of work will be made, since the cost shall be included in the Lump Sum Price bid on the Special Form of Proposal.

U.S. Army Garrison Aberdeen Proving Ground

Adelphi Laboratory Center

Environmental Assessment for Shoreline Improvements at the Blossom Point Research Facility

Potomac River and Nanjemoy Creek

October 2019

FINAL ENVIRONMENTAL ASSESSMENT

SHORELINE IMPROVEMENTS AT THE ADELPHI LABORATORY CENTER BLOSSOM POINT RESEARCH FACILITY

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EXECUTIVE SUMMARY

In this Environmental Assessment (EA), the United States Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) identifies, analyzes, and documents the potential physical, environmental, cultural, and socioeconomic impacts associated with the Proposed Action to implement the 2016 *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* ("SMP") (VIMS, 2016) at the ALC Blossom Point Research Facility (BPRF) located in Welcome, southern Charles County, Maryland.

The ALC BPRF serves the ALC as a primary test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems. The ALC BPRF is located on a peninsula situated between the Potomac River and its tidal tributary Nanjemoy Creek. The shoreline of the property extends approximately 3.5 miles and is subject to erosive wind-driven wave forces.

Due to extensive erosion of the shoreline, ALC has determined that if shoreline management strategies are not implemented the longevity of the ALC BPRF at its current location will be jeopardized and land and critical infrastructure may be lost.

Purpose and Need

Accordingly, the ***purpose*** of the Proposed Action is to improve the stability and resiliency of the ALC BPRF shoreline and prevent further loss of land so that ALC can continue to operate the ALC BPRF as a testing facility at its current location.

Due to extensive shoreline erosion, the Proposed Action is ***needed*** to prevent further erosive damage of the ALC BPRF shoreline, and to allow the ALC to continue meeting its goal of developing and managing ALC BPRF in an efficient, effective, and environmentally sensitive manner, which responds to its inventory of cultural resources, its natural setting, and the natural environment.

Alternatives

ALC has prepared this EA to evaluate the potential impacts of implementing the Proposed Action. This EA also evaluates the potential impact of a "No Action" alternative, defined as not implementing the Proposed Action and maintaining conditions at ALC BPRF as they currently exist. These two alternatives are summarized below:

- The ***Proposed Action*** is to implement the 2016 SMP by constructing and operating shoreline improvements at the ALC BPRF. The Proposed Action would include constructing shoreline protection structures including sills, brills, spurs, and revetments along approximately 3.5 miles of shoreline, and associated sand nourishment and marsh vegetation planting. The shoreline improvements would prevent further erosion of the Potomac River shoreline, provide coastal resiliency, and extend the longevity of the ALC BPRF at its present location.
- The ***No Action*** alternative is to maintain the shorelines at ALC BPRF as they currently exist and not implement the proposed 2016 SMP. Under the No Action alternative, the shorelines of the ALC BPRF would continue eroding, threatening critical infrastructure, and compromising the longevity of the ALC BPRF at its current location. Accordingly, the No Action alternative does not meet the purpose and need for action.

Affected Environment and Environmental Consequences

The following table summarizes the potential environmental impacts of the Proposed Action and the No Action alternative.

Resource / Issue	Proposed Action	No Action
Aesthetics	Short-term, direct, less-than-significant adverse impacts during construction due to the use and presence of heavy construction equipment on the ALC BPRF property. Direct, long-term beneficial aesthetic impact from the reduction in shoreline erosion and the installation of marsh vegetation.	Long-term, direct, significant adverse impact from continued erosion of the shoreline.
Air Quality	Short-term, direct, negligible, adverse impact from construction vehicle emissions and dust generation. Long-term, direct, moderately beneficial impact from stabilization of the shoreline and decreased soil exposure.	Long-term, direct adverse impact from continued dust generation form exposed soils.
Cultural Resources	Short-term, direct, less-than-significant adverse levels due to inadvertently encountering previously unknown cultural resources during construction activities.	Long-term, direct, significant adverse impacts if cultural resources are damaged or lost due to erosion.
Geology, Topography, and Soils	No impact to geology. Long-term, less-than-significant adverse impacts on topography due to grading for sand nourishment. Short-term, direct, less-than-significant adverse impact on soils due to potential erosion during construction. Long-term, direct, beneficial impact during operation from reduced erosion.	Long-term, direct, significant adverse impact to topography and soils from allowing continued erosion of the shoreline. No impact to geology.
Hydrology and Water Quality	Short-term, direct, less-than-significant adverse impact on surface water during construction from potential sedimentation of run-off. Long-term, direct, beneficial impact on water quality during operation from reduced sedimentation of surface waters.	Long-term, direct, significant adverse impact to water quality from continued sedimentation of surface waters.
Wildlife and Habitat	Short-term, less-than-significant adverse impacts on wildlife species and on the quality of the habitat at the site due to disturbance during construction. No impact to listed species due to their unlikely presence and avoidance measures. No impact to SAV as none is present along the ALC BPRF shorelines. Long-term, direct and indirect, beneficial impacts from operation due to improved water quality and stabilized shorelines.	Long-term, significant, adverse impacts to aquatic wildlife and habitat from increased sedimentation and turbidity of surface waters. Potential loss of terrestrial habitat from loss of land due to erosion.
Noise	Short-term, direct, less-than-significant adverse impact from construction noise on staff and off-site receptors. No impact during operation.	None.
Land Use	Potential short-term, direct, less-than-significant impact from interruption to Land Use Controls for construction. .	None.

Resource / Issue	Proposed Action	No Action
Floodplains and Wetlands	Construction of the shoreline improvements avoids wetlands and would have no impact. Operation would have long-term, direct, beneficial impacts due to creation of new tidal marsh. ALC BPRF is within the 100-year floodplain; beneficial impact due to flood protection by shoreline protection structures.	None.
Socioeconomics	Short-term, direct, less-than-significant beneficial impact on the local economy from construction employment and material purchases. No impact during operation.	None.
Community Services	Long-term beneficial impact from increased longevity of the ALC BPRF as a testing facility at its present location.	Long-term, significant adverse impact due to threatened longevity of the ALC BPRF at its current location.
Solid and Hazardous Materials	Short-term, direct, negligible adverse impacts from generation of construction debris. No impact during operation.	None.
Transportation and Parking	Short-term, direct, negligible adverse impact on transportation and parking during the construction phase. No impact during operation.	None.
Utilities	No impact to any utilities.	None.
Environmental Justice	No impact; no environmental justice issues or communities within area.	None.
Potential for Generating Substantial Controversy	The community is anticipated to support the shoreline improvements due to beneficial environmental outcomes. No substantial controversy is anticipated.	Not implementing the Proposed Action would be viewed negatively in the community due to continuing erosion of the shorelines and subsequent negative environmental outcomes.

The impacts from the Proposed Action, when considered on a cumulative basis with impacts from past projects and probable future projects at and in vicinity of the ALC BPRF, still remain at less-than-significant adverse levels for all of the environmental resources analyzed in this EA. The No Action alternative would have potential significant adverse cumulative impacts to soil and surface water resources in the region due to the unmitigated erosion of the Potomac River and Nanjemoy Creek shorelines. Therefore, ALC has selected the Proposed Action as the preferred action alternative.

Agency and Public Involvement

As part of the public involvement process, ALC invited regulatory stakeholders and the public to review and provide comments on the Draft EA. Comments received during the 30-day comment period on the Draft EA are documented and addressed in this Final EA.

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2016 Shoreline Management Plan for Shoreline Improvements
Potomac River and Nanjemoy Creek
U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center
Blossom Point Research Facility, Charles County, Maryland

Introduction

The United States Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) has prepared an Environmental Assessment (EA), included in its entirety herein by reference, to evaluate the potential environmental impacts from implementing the 2016 *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* ("SMP") at the ALC Blossom Point Research Facility (BPRF), located in the unincorporated town of Welcome, Charles County, Maryland. The ALC BPRF is operated as a satellite facility and serves the ALC as a primary test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems. The ALC BPRF is located on an approximately 1,600-acre peninsula between the Potomac River and Nanjemoy Creek. The shorelines of the peninsula are subject to extensive erosive wind-driven wave forces. The shorelines of the ALC BPRF are eroding at a rate of approximately 1- to 3-feet per year, and faster in some areas.

ALC has determined that if shoreline management strategies are not implemented, then the longevity of the ALC BPRF at its current location will be jeopardized, and land and critical infrastructure may be lost.

Purpose and Need

The ***purpose*** of the Proposed Action is to improve the stability and resiliency of the ALC BPRF shoreline and prevent further loss of land so that ALC can continue to operate the ALC BPRF as a testing facility at its current location.

Due to extensive shoreline erosion, the Proposed Action is ***needed*** to prevent further erosive damage of the ALC BPRF shoreline and to allow the ALC to continue meeting its goal of developing and managing ALC BPRF in an efficient, effective, and environmentally-sensitive manner, which responds to its inventory of cultural resources, its natural setting, and the natural environment.

Proposed Action and Alternatives

The **Proposed Action** is to implement the 2016 SMP by constructing and operating shoreline improvements at the ALC BPRF in a phased approach, contingent on the availability of funding, with critical areas given priority. The Proposed Action includes constructing stone shoreline protection structures such as sills, brills, spurs, and revetments, along with associated sand nourishment and marsh vegetation planting along approximately 3.5 miles of shoreline. The shoreline improvements would prevent further shoreline erosion, provide coastal resiliency, and extend the longevity of the ALC BPRF at its present location.

The **No Action alternative** is to maintain the shorelines at ALC BPRF as they currently exist and not implement the 2016 SMP. Under the No Action alternative, the shorelines of the ALC BPRF would continue eroding, threatening critical infrastructure, and compromising the longevity of the ALC BPRF at its current location. Accordingly, the No Action alternative does not meet the purpose and need for action.

Summary of Findings

Based on the EA findings, no significant adverse impacts to any of the environmental resources analyzed would occur during construction or operation of the Proposed Action. No or negligible adverse impacts are anticipated to occur to air quality, geology, groundwater, wetlands and floodplains, socioeconomics, solid and hazardous materials, transportation and parking, utilities, and environmental justice. Minor, less-than-significant adverse impacts are anticipated to occur to the aesthetics, soil and water quality, wildlife and habitat, cultural resources, noise, and land use.

Current aesthetic conditions would incur short-term, direct, less-than-significant adverse impacts due to the temporary presence of heavy construction equipment, vehicles, and associated materials on the ALC BPRF shorelines and roads. Impacts would be minimized by implementing standard Best Management Practices (BMPs), including consolidated staging areas and dust control.

Construction grading and nourishment activities could adversely impact soil and water quality through erosion and sedimentation of surface water. Impacts would be minimized by implementing a Maryland Department of the Environment-approved stormwater management and erosion/sediment control plan to capture sediment on-site, minimize on-site soil erosion, and protect against downstream erosion and sedimentation of surface waters.

Terrestrial wildlife and habitat would incur short-term, direct, less-than-significant adverse impacts during creation of temporary construction access lanes through existing vegetation between the interior ALC BPRF and the shoreline. Impacts would be minimized due to the presence of other suitable habitat at and surrounding ALC BPRF, limiting construction activities to relatively small areas where construction is required, replanting following construction, and following recommended avoidance measures for special status species such as bald eagles and migratory birds to include clearing time of year restrictions and establishment of buffers. In-water construction would temporarily disturb bottom sediments and increase turbidity, which could interfere with foraging and shelter behaviors of aquatic wildlife. Impacts would be minimized by implementing BMPs, such as installing silt curtains and turbidity barriers.

Cultural resources could potentially be impacted should previously unknown cultural resources be inadvertently encountered and disturbed during construction activities. Impacts to unknown resources would be minimized by implementing an inadvertent discovery plan. Ground-disturbing construction activities would entirely avoid areas with known cultural resources.

Construction noise could have a temporary, direct, short-term adverse impact on receptors including ALC BPRF staff and residents living in the immediate vicinity of the ALC BPRF shoreline. Impacts would be minimized by scheduling construction activities to normal weekday hours and utilizing equipment mufflers and noise shields.

Constructing shoreline improvements along Nanjemoy Creek and the southern portion of the peninsula on the Potomac River would require contractors to access Munitions Response Sites (MRS) with land use controls (LUCs). However, all LUCs would be reimplemented following each phase of construction, and MRS long-term management and annual inspections would continue following construction activities.

Operation of the Proposed Action is anticipated to result in beneficial impacts to aesthetics, cultural resources, air quality, topography and soils, hydrology and water quality, wildlife and habitat, floodplains and wetlands, and community services.

Cumulative Impacts

When considered with other past, present, and reasonably foreseeable future projects, no significant cumulative adverse impacts to any resources analyzed in the EA are anticipated from implementing the Proposed Action.

Agency Coordination and Public Involvement

During preparation of the EA, ALC notified relevant federal and state agencies to allow them sufficient time to make known their environmental concerns that are specific to this Proposed Action. Comments submitted by agencies and the public have been considered during the impact assessment and incorporated into the EA.

A Notice of Availability announcing the release of the Draft EA and Draft Finding of No Significant Impact (FONSI) for a 30-day review and comment period was published in the *Maryland Independent* on August 28, 2019. The Draft EA and Draft FONSI were available for review at the Charles County Public Library; 2 Garrett Avenue, La Plata, MD 20646. Comments from regulatory agencies received during the 30-day public review period are documented in the Final EA. No comments from the public were received during the Draft EA 30-day review period.

Finding of No Significant Impact

Implementing the Proposed Action would not result in significant, direct, indirect, or cumulative adverse impacts on the natural or human environment. Therefore, the EA supports a FONSI. Accordingly, the requirements of the National Environmental Policy Act of 1969 (NEPA) (42 United States Code 4321 *et seq.*), the Council on Environmental Quality regulations for implementing the procedural provisions of the NEPA (40 CFR Section 1500-1508), and Environmental Analysis of Army Actions (32 CFR 651) have been fulfilled, and an Environmental Impact Statement (EIS) is not required.

15 Jan 2020

Date

Timothy E. Druell
Colonel, U.S. Army
Commander, U.S. Army Garrison
Aberdeen Proving Ground, MD

ACRONYMS AND ABBREVIATIONS

ACS	American Community Survey
ALC	Adelphi Laboratory Center
amsl	above mean sea level
ARPA	Archaeological Resources Protection Act
BMP	Best Management Practice
BPRF	Blossom Point Research Facility
BPTF	Blossom Point Tracking Facility
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
dBA	A-weighted decibel
DO	Dissolved Oxygen
DoD	Department of Defense
DDT	Dichlorodiphenyltrichloroethane
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EOD	Explosive Ordnance Detonation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FID	Forest Interior Dwelling
FONPA	Finding of No Practical Alternative
FONSI	Finding of No Significant Impact
FPMO	Maryland Model Floodplain Management Ordinance
GCR	General Conformity Rule
GHG	Greenhouse Gas
HAPC	Habitat Areas of Particular Concern
IAP	Installation Action Plan
JLUS	Joint Land Use Study
kW	Kilowatt
LUC	Land Use Control
MBTA	Migratory Bird Treaty Act
MD	Maryland
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MLW	Mean Low Water
MPRWA	Middle Potomac River Watershed Assessment

NASA	National Aeronautics and Space Administration
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NMFS	National Marine Fisheries Service
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NRL	Naval Research Laboratory
O_3	Ozone
OSHA	Occupational Safety and Health Administration
Pb	Lead
PM	Particulate Matter
ppt	parts per thousand
RCRA	Resource Conservation and Recovery Act
ROG	Reactive Organic Gas
RONA	Record of Non-Applicability
SAV	Submerged Aquatic Vegetation
SHPO	State Historic Preservation Office
SMP	Shoreline Management Plan
SNEGS-E	Space Network Expansion Ground System-East
SR	State Route
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
T&E	Threatened and Endangered
TMDL	Total Maximum Daily Loads
TSS	Total Suspended Sediment
U.S.	United States
USAG	United States Army Garrison
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UXO	Unexploded ordnance
VIMS	Virginia Institute of Marine Science
VOC	Volatile Organic Compound

1 INTRODUCTION

The United States Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) supports the mission to execute fundamental and applied research to provide the United States Army (Army) with the key technologies and the analytical support necessary to assure supremacy in future land warfare. The Blossom Point Research Facility (BPRF), located in the unincorporated community of Welcome, in southern Charles County, Maryland (MD), is operated as a satellite facility and serves the ALC as a primary test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems. ALC manages and operates ALC BPRF in an equitable, effective manner to support on-going research, enable the well-being of soldiers and civilians, improve infrastructure, and preserve the environment.

The ALC BPRF is located on an approximately 1,600-acre peninsula between the Potomac River and Nanjemoy Creek. This peninsula is subject to extensive erosive forces that threaten the long-term function and stability of infrastructure at the ALC BPRF. Accordingly, the USAG, in conjunction with the Virginia Institute of Marine Science (VIMS), have prepared the *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* (“SMP”) (VIMS, 2016). Under the SMP, physical shoreline improvements would be constructed and operated at the ALC BPRF to reduce erosion of the peninsula and extend the longevity of the ALC BPRF.

This Environmental Assessment (EA) has been prepared to evaluate the environmental impacts associated with a Proposed Action to implement the SMP.

1.1 Background and Existing Site Details

1.1.1 Location

The ALC BPRF is located approximately 45-miles south of Washington, D.C. and approximately 75-miles southwest of Baltimore, MD. The ALC BPRF is located in the unincorporated community of Welcome, 9-miles south of the town of La Plata.

The ALC BPRF is located on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck (Figure 1).

The ALC BPRF is bordered by the Potomac River to the east and south, and by Nanjemoy Creek to the west (). Nanjemoy Creek is an approximately 13.1-mile long tidal tributary of the Potomac River and drains smaller tributaries located to the north and west of the ALC BPRF.

As depicted on Figure 2 the shoreline of Cedar Point Neck consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical or biological conditions. The reaches of Cedar Point Neck are defined by fetch exposure (the length of water over which a given wind has blown), shore orientation, and geology. The three reaches are further divided into several subreaches according to land use and shore zone geomorphology as designated in the following list (VIMS, 2016):

- Reach I on the western shore of the peninsula on Nanjemoy Creek. Reach I consists of subreaches A, B, C and D, from upstream to downstream.
- Reach II at the southern edge of the peninsula on the Potomac River. Reach II consists of subreaches A, B, C and D, from west to east.
- Reach III on the eastern shore of the peninsula on the Potomac River. Reach III consists of subreaches A, B and C, from downriver to upriver.

Figure 1. Blossom Point Research Facility Site Location Map

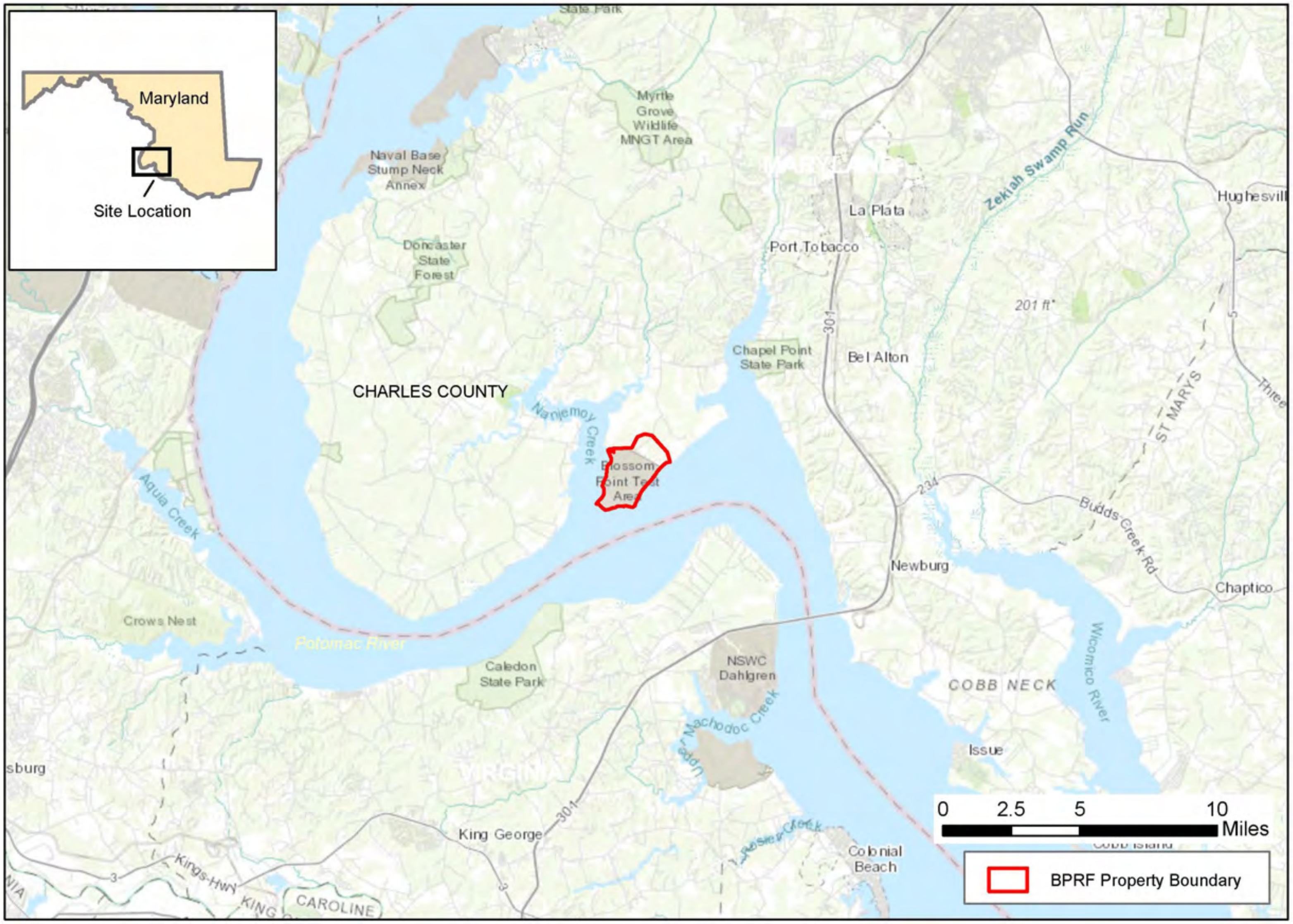
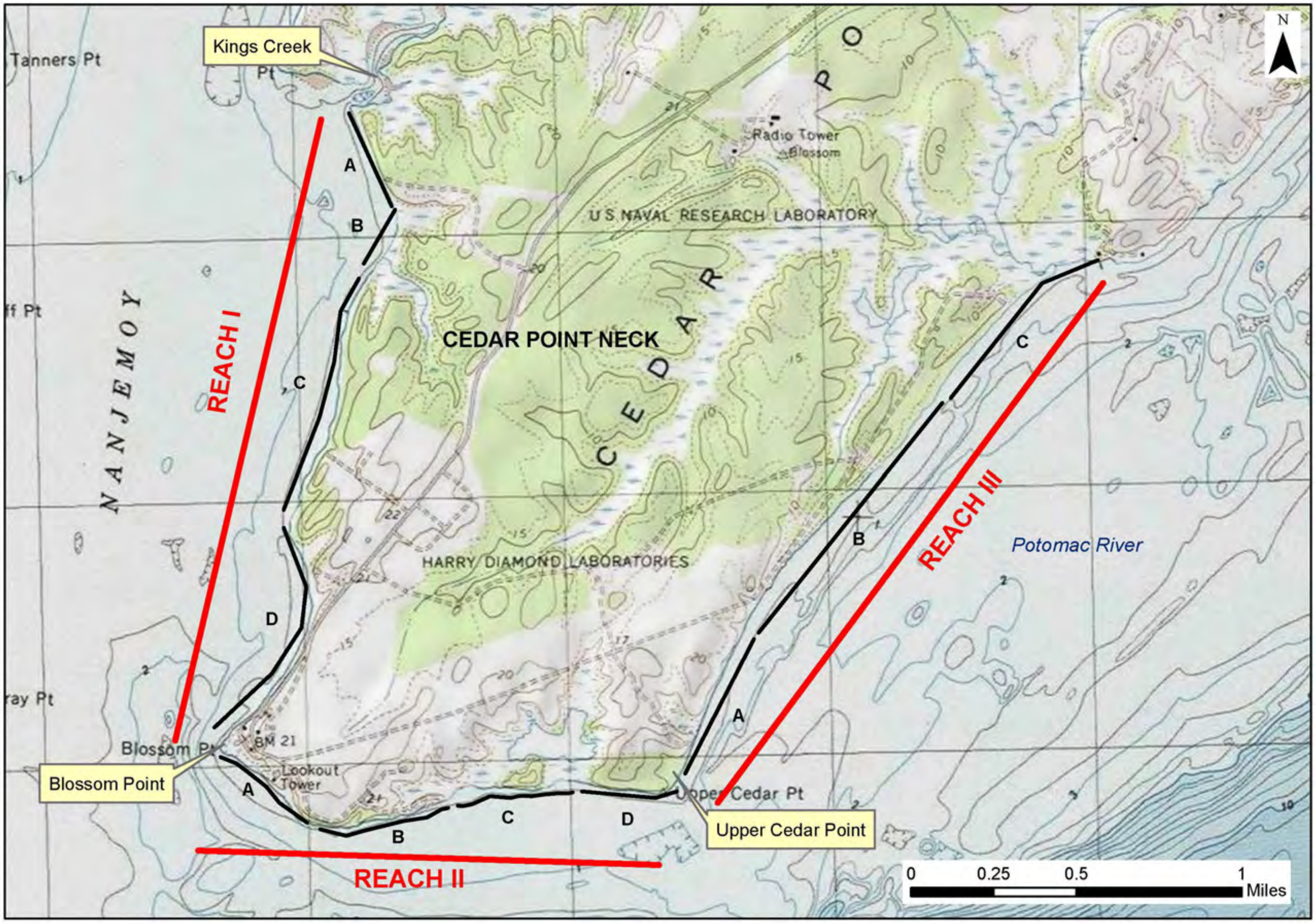


Figure 2. Reaches and Subreaches of the ALC BPRF Shoreline



1.1.2 Operational History

The ALC BPRF property has been used as a proving ground and firing range since 1942, when the land was leased to the National Bureau of Standards Ordnance Development Division by the Jesuit Order in Maryland, who owned the lands encompassing Cedar Point Neck since the mid-1600s (CENAB, 2016). Beginning in the mid-1940s, a variety of test sites were built on the property including instrumentation ranges for aerial drops and sites for nonexplosive rocket, mortar and projectile aerial firings. Testing occurred on the property until the majority of activities were transferred off-site in 1976. The Army purchased the property in 1980, resumed testing, and reactivated it for use as a satellite facility of ALC (CENAB, 2016).

Currently, the ALC BPRF serves as a test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems. The ALC BPRF is also home to the Naval Research Laboratory (NRL) Blossom Point Tracking Facility (BPTF). This facility was established in 1956 as a communications tracking station for satellites for the Vanguard Missile Program. The National Aeronautics and Space Administration (NASA) operated this facility from 1958 until 1967, when the Navy took control of its operation. The NRL BPTF currently covers approximately 41 acres within the northern portion of the ALC BPRF property and is surrounded by a 265-acre buffer zone to provide protection from outside signal or noise interference (CENAB, 2016).

1.2 Problem Statement

The shorelines of the ALC BPRF are eroding at an average rate of 1-to 3-feet per year (VIMS, 2016). The erosion is primarily caused by wind-driven wave-forces. Erosion threatens the stability of the shorelines at the ALC BPRF and endangers the long-term coastal resilience of the property and its critical infrastructure. In some areas there is infrastructure within 15 feet of the shoreline. In one location 20 feet of shoreline has been lost in less than three years and a building has recently needed to be demolished due to erosion reaching the structure.

In addition to wind driven-wave forces, large storms such as nor’easters and hurricanes are a driving force of the erosive action (VIMS, 2016). Storms are particularly harmful to the Potomac River shorelines where hurricanes can produce storm surges exceeding six feet above mean sea level (amsl). These storm surges combine with strong winds to generate four-foot high breaking waves, which can transport large amounts of sediment and quickly remove shoreline substrate. Sea-level rise further threatens the ALC BPRF; sea levels have risen at a rate of 1.6-feet per 100 years in this region of the Potomac River (VIMS, 2016).

Erosion also damages water quality by releasing large amounts of sediments and associated pollutants, including agricultural fertilizers, into the adjacent water bodies and which can be harmful to important aquatic and terrestrial habitat and wildlife. Polluted runoff is the fastest growing source of pollution in the Potomac River. In 2010 the USEPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) to restore clean water to the Chesapeake Bay and the regions streams, creeks, and rivers. USEPA set the TMDL reduction goal for sedimentation loads in the Maryland Potomac River at 680.29 million pounds per year by 2025 (USEPA, 2010).

Additionally, Cedar Point Neck has a long cultural history; as a result has a number of documented cultural resources that could be damaged or lost due to shoreline erosion (CENAB, 2016).

If shoreline management strategies are not implemented, then the shorelines of the ALC BPRF will continue to erode at a rapid rate leading to the potential loss of land and critical infrastructure, threatening the longevity of the ALC BPRF at its current location.

Therefore, ALC has concluded that an action is needed to address this problem.

1.3 Purpose and Need for the Proposed Action

The **purpose** of the Proposed Action is to improve the stability and resiliency of the ALC BPRF shoreline and prevent further loss of land so that ALC can continue to operate the ALC BPRF as a testing facility at its current location.

The Proposed Action is **needed** to prevent further erosive damage of the ALC BPRF shoreline, and to allow the ALC to continue meeting its goal of developing and managing the BPRF in an efficient, effective, and environmentally sensitive manner, which responds to its inventory of cultural resources, its natural setting, and the natural environment.

Under a No Action alternative, whereby the Proposed Action would not be implemented, the shorelines of the ALC BPRF would continue to erode, sedimentation of the Potomac River and Nanjemoy creek would continue, and the longevity of the ALC BPRF at its current location would be jeopardized.

1.4 Regulatory Requirements

The *National Environmental Policy Act* (NEPA) of 1969 requires that any major federal actions take into consideration the environmental consequences of proposed actions during the decision-making process. The Council on Environmental Quality (CEQ) was established under NEPA to implement and oversee Federal policy in this process. To this end, the CEQ issued regulations for implementing the Procedural Provisions of NEPA (40 CFR 1500-1508). The Army has supplemented the CEQ NEPA regulations by promulgating its own NEPA implementation procedures, which are found at 79 Federal Register 153, Friday August 8, 2014, page 46410-46419 and 32 CFR Part 651, *Environmental Analysis of Army Actions*.

These regulations establish the Army policies and responsibilities for the early integration of environmental considerations into planning and decision-making. These regulations require the Army to conduct an environmental analysis of actions affecting human health and the environment. The regulations also provide criteria and guidance on actions normally requiring Environmental Assessments (EAs) or Environmental Impact Statements (EISs) and list Army actions that are categorically excluded from such requirements provided specific criteria are met. These regulations must be read in conjunction with CEQ's regulations.

Applicable Federal, state and local regulations will be considered during the analysis of the impacts to individual environmental and social resources evaluated as a part of the EA. The following legislation will be given particular consideration:

- Clean Air Act (CAA) (42 USC 7401)
- Clean Water Act (CWA) (33 USC 1251)
- Endangered Species Act (ESA) (16 USC 1531-1543)
- Archaeological Resources Protection Act (ARPA) (16 USC 470aa et.seq.)
- National Historic Preservation Act of 1966 (16 USC 470 et seq., as amended)
- Resource Conservation and Recovery Act (RCRA) (42 USC 6901)

1.5 Decision Making

The ALC, as a component of a federal agency (the Department of the Army), is required to incorporate environmental considerations into its decision-making process for the actions it proposes to undertake. This is done according to the regulations and guidance identified in Section 1.4 of this document.

As such, this EA provides ALC with the necessary analysis to address and support decision making for the Proposed Action and serves to:

- Inform the public of the possible environmental impacts of the Proposed Action and its considered alternatives, as well as methods to reduce these impacts,
- Provide for public, state, inter-agency, and tribal input into ALC's planning and evaluation,
- Document the NEPA process, and
- Support informed decision-making by the federal government.

As the decision document for this proposed federal undertaking, this EA also identifies the actions to which ALC would commit to minimize environmental effects, as required under NEPA, its implementing regulations from CEQ (40 CFR Part 1500-1508) and the Army (32 CFR Part 165). The decision to be made is whether—having considered the potential physical, environmental, cultural, and socioeconomic effects—ALC should implement the Proposed Action including, as appropriate, measures to reduce potential adverse effects.

An EA provides a sufficient level of analysis and evidence to evaluate whether or not an action would cause a significant environmental impact. When the EA concludes there is no significant impact, the agency may issue a Finding of No Significant Impact (FONSI) (40 CFR Part 1508.9). A FONSI is a decision document that briefly presents the reasons why an action would not have a significant effect on the human environment (40 CFR Part 1508.13). Conversely, when an action may have a significant adverse impact on the environment, the agency may consider issuing a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS).

1.6 Scope of Analysis

This EA has been prepared to analyze and evaluate the potential environmental impacts of the Proposed Action to implement the 2016 SMP for the ALC BPRF. Further details of the Proposed Action are provided in Section 2.0.

This EA incorporates information and protection strategies presented in the 2016 SMP (VIMS, 2016). The SMP was developed from management suggestions presented in the 2014 Integrated Natural Resources Management Plan (INRMP) update for the ALC and ALC BPRF (CENAB, 2014). The purpose of the INRMP update was to guide the conservation and management of natural resources at the ALC and the ALC BPRF through 2018 and beyond. The INRMP included research project recommendations to further implement the INRMP, including a BPRF Shoreline Study. Subsequently, ALC coordinated with VIMS to develop the 2016 SMP, which determined the extent and rate of erosion of the ALC BPRF shoreline and provided management recommendations.

The evaluation of the potential environmental impacts of the Proposed Action includes direct, indirect, and cumulative effects, as well as a qualitative and quantitative (where possible) assessment of the level of significance of these effects. Additionally, as required by NEPA and the implementing regulations from CEQ and the Army, the alternative of taking no action is also evaluated, providing a baseline for comparison of potential impacts from the action alternative.

Resource areas that are evaluated in further detail in this EA include: aesthetics; air quality; cultural resources; geology, topography, and soils; hydrology and water quality; wildlife and habitat; noise; floodplains and wetlands; socioeconomics; community services; solid and hazardous materials; transportation and parking; utilities; environmental justice; land use and zoning; and cumulative effects.

1.7 Public Participation

The Army invites and strongly encourages public participation in the NEPA process. Consideration of the views and information of all interested persons and entities promotes open communication and enables better decision making. All agencies, organizations, and members of the public having a potential interest in the Proposed Action are urged to participate in the decision-making process.

1.8 Interagency and Intergovernmental Coordination and Consultations

Federal, state, and local agencies, and Native American Tribes with jurisdiction that could be affected by the proposed and alternative actions were notified and consulted during the development of this EA, and copies of correspondence with agencies are included in Appendix A.

Public and governmental participation opportunities with respect to this EA and decision making on the Proposed Action are guided by the Army Regulation 200-1 (Department of the Army, 2007). Upon completion, the draft EA, along with a draft FONSI, was made available to the public, agencies, and Tribes for comment during a 30-day review period. A Notice of Availability (NOA) of the EA was published in The Maryland Independent, a local newspaper with coverage that includes the ALC BPRF, while a copy of the NOA was mailed to agencies and Tribes. Comments received during the review period are documented and addressed in the Final EA.

If it is determined that implementing the Proposed Action would result in significant adverse impacts, the Army would either publish a NOI to prepare an EIS, commit to mitigation actions to reduce impacts to below significant levels, or not take the action.

2 Description of the Proposed Action and Alternatives

The CEQ regulations require federal agencies to use the NEPA process to identify and assess reasonable alternatives to proposed actions that would avoid or minimize adverse effects of the actions upon the quality of the human environment. This chapter describes the alternatives development process, alternatives considered but eliminated from further review, and alternatives selected for analysis in this EA.

2.1 Development of Alternatives

When developing alternatives for the Proposed Action, ALC determined that shoreline erosion should be addressed on a reach-specific basis and that protection strategies should be relatively non-intrusive to the natural surroundings—yet effective within the context of long-term shoreline erosion control. Based on the analysis conducted as part of the SMP, ALC determined that the recommendations made for shoreline improvements in the SMP best met the purpose and need for action while adhering to the determinations described above. The Proposed Action is described in detail in the following Section 2.2.

The No Action alternative serves as the baseline for determining the significance of potential effects of the Proposed Action in relation to existing conditions. A description of the No Action alternative is provided in Section 2.3.

2.2 Proposed Action

2.2.1 Development Background

In 2016 ALC developed the SMP in collaboration with the Shoreline Studies Program of the Virginia Institute of Marine Science at the College of William and Mary (VIMS, 2016). The shoreline of the ALC BPRF was assessed for existing shoreline conditions, shore change, geology, geomorphology, and wave climatology and water levels in order to develop recommendations to address shoreline erosion on a reach basis. The goal of the SMP was to develop shoreline protection recommendations that are relatively non-intrusive to natural surroundings yet effective in the context of long-term shoreline erosion control.

The 2016 SMP utilizes the state of Maryland’s preferred shoreline management strategy of Living Shorelines for long-term shore protection. Living Shorelines are a best management practice (BMP) that addresses erosion and enhances ecosystem function by providing long-term protection, restoration, or enhancement of vegetated shoreline habitats through strategic placement of plants, stone, sand fill, and other structural or organic materials (VIMS, 2016).

By building protective structures parallel to the shoreline and increasing marsh habitat along this section of the river, the Proposed Action would help prevent further erosion of the bank face and subsequently reduce sedimentation, improving water quality in both the Potomac River and its tributary, Nanjemoy Creek. In doing so, the Proposed Action could help reach the USEPA reduction goal for sedimentation loads in the Potomac River.

Prior to adoption of Living Shorelines, shoreline stabilization measures typically involved “hardening” the shoreline by building stone revetments or wood bulkheads. While effective at stabilizing the shore, this hardening approach creates a disconnect between the upland and the water and does not enhance natural coastline habitats. Living Shorelines use natural features of the shoreline to create marsh habitat, improve water quality, and reduce sedimentation. Therefore, the preferred approach is to use Living Shoreline strategies to stabilize the shoreline of the ALC BPRF.

The proposed ALC BPRF Living Shorelines would consist of stable beaches and marshes protected by built shoreline structures such as sills and brills (VIMS, 2016).

2.2.2 Phasing

Under the Proposed Action, the SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority (VIMS, 2016).

To date, two critical areas have been identified, Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Reach ID also contains underground power and phone lines 15 feet from the bank edge and Building 511 (the main office for ALC BPRF personnel) is within 50 feet of the bank edge in this Reach.

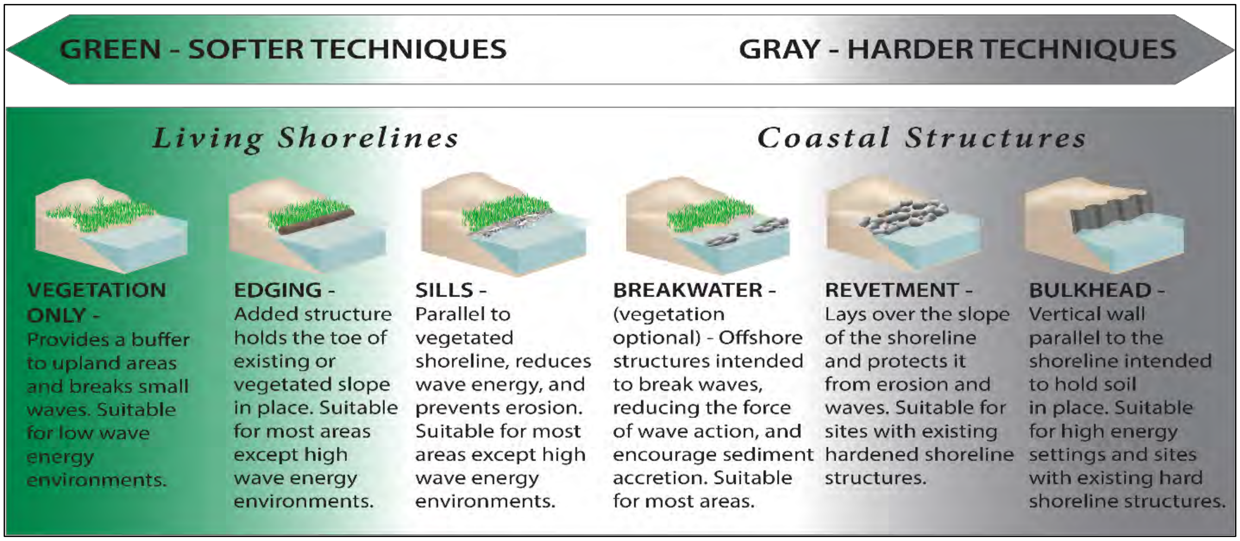
Critical Area 2 is located within Reach IIA, where erosion threatens the existing lookout tower and the Building 504. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

2.2.3 Proposed Action Elements

The shoreline improvements detailed in the SMP would include the construction of shoreline protection structures including sills, gapped sills, gapped brills, spurs and revetments, along approximately 18,500 feet (3.5 miles) of total shoreline along Nanjemoy Creek and the Potomac River (VIMS, 2016). Sand nourishment measures to create stable substrate for establishing wetland vegetation would occur in areas where sills, brills, and spurs are the preferred structures. These improvements will be designed to protect against a 25-year storm event and a storm surge that is 5-feet above mean low water (MLW) (VIMS, 2016). Explanations of each type of proposed shoreline improvement structure are provided in the following list. A depiction of these and other shoreline improvement structures is provided in Figure 3.

- **Sills** consist of a line of rock placed directly offshore and parallel to the eroding shoreline. Sand is filled between the stone and the eroding bank and marsh grasses are planted on the sand fill to create a protective marsh fringe.
- **Gapped sills** are a series of sill structures with strategic gaps between them to allow ingress and egress of marine fauna.
- **Brills** are a combination of sills and breakwaters. Breakwaters are a series of rock structures placed strategically offshore to dissipate wave energy before it reaches the shoreline.
- **Gapped brills** consist of long brill structures with wide gaps between them.
- **Revetments** are structures, typically constructed from stone, with sloped and rough faces that decrease wave reflection. They are built directly parallel to the shoreline and are often a last line of defense in high impact environments, where the nearshore is too deep for other structures, or where infrastructure is very close to the shoreline.
- **Spurs** are transitional structures that minimize impacts of other structures on adjacent properties. They are often built off existing structures such as revetments.

Figure 3. Common Shoreline Stabilization Techniques



(NOAA, 2018)

The SMP recommends shoreline management strategies and improvement structures specific to subreach. Improvements are only recommended for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable and therefore improvements are not recommended for these areas. A detailed description of the shoreline management strategies for each reach and subreach is provided in the following subsections. Specifically, the Proposed Action includes the following elements:

- Stone Shoreline Improvement Structures, including
  - Thirty-two (32) gapped sills
  - Sixteen (16) gapped brills
  - One (1) standalone sill
  - One (1) spur
  - One (1) revetment
- Shore Stabilization through Sand Nourishment, including
  - Establishment of sand fill between the structures and the bank at a slope of approximately 10:1 from the base of the bank to the back of the stone structure.
  - Strategic planting of wetland vegetation including *Spartina alterniflora*, *Spartina patens*, and *Scirpus cyperinus* in order to stabilize the new sand substrate and create permanent marsh habitat.

Construction of shoreline improvement structures at the ALC BPRF will involve the anchoring of filter fabric on the existing bottom of the nearshore and the placement of stones on the filter fabric base to the desired width and height. The area behind the sill and brill structures will be graded and backfilled with clean sand and planted with native, non-invasive marsh grasses. Stone, sand fill, and construction equipment will be transported to the construction areas by a combination of barge and truck, depending on the depth of the nearshore and the capability of equipment to reach the proposed construction locations.

Table 1. Proposed Shoreline Structures by Reach and Subreach

Reach	Subreach	Structures Recommended	
		Type	Number
I	A	Gapped Sill	5
	C	Gapped Sill	9
	D (Critical Area 1 is within this subreach)	Gapped Sill	4
		Spur	1
		Revetment	1
II	A (Critical Area 2 is within this subreach)	Gapped Sill	6
	B	Gapped Sill	5
	D	Gapped Sill	3
III	A	Gapped Brill	4
	B	Gapped Brill	8
	C	Gapped Brill	4
		Sill	1

2.2.3.1 *Reach I*

Reach I on Nanjemoy Creek originates at the mouth of Kings Creek and extends downriver approximately 9,600 feet to Blossom Point. Reach IA extends approximately 1,800 feet from the mouth of Kings Creek downriver to a small inlet. It is an actively eroding upland bank that ranges in elevation from 10 to 15 feet. Reach IB extends approximately 900 feet and consists mainly of tidal marshland. There is a short upland segment which separates two pockets of tidal marsh. Reach IC extends approximately 3,900 feet and consists of actively eroding upland bank that ranges in elevation from 15 to 20 feet. Reach ID extends approximately 3,000 feet to Blossom Point and includes Critical Area 1. It is defined by the continuous eroding upland bank that ranges from 15- to 20-feet high (VIMS, 2016).

The proposed shoreline improvements for Reach I involve construction of an approximately 7,100-foot-long gapped sill structure and a spur off the existing revetment. Sand nourishment strategies within Reach I would involve the strategic placement of sand behind the sill structures to an elevation of 5-feet above MLW. Native, non-invasive marsh vegetation (*Spartina patens*, *Spartina alterniflora and Scirpus cyperinus*) will be planted on the new sand filled areas to stabilize the shore and provide marsh habitat (VIMS, 2016).

Specific proposed improvements for each subreach within Reach I are presented in the following outline:

<u>Reach IA (refer to Figure 4)</u>

- Five (5) gapped sill structures
    - Sills in this subreach will reach a height of 3-feet above MLW.
    - The base of the sills will be approximately 15-feet wide.

    - The top ledge of the sills will be approximately 4-feet wide.
- Sand Nourishment
    - The area directly up shore of the sills will be backfilled with sand to 5-feet above MLW.
    - New sand filled areas will extend approximately 35 feet from the base of the sills up to the base of the existing bank.
    - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

<u>Reach IB</u>

Reach IB has an existing marsh and a bank face that is generally stable, and therefore no shoreline improvements are planned at this reach.

<u>Reach IC (refer to Figure 4)</u>

- Nine (9) gapped sill structures
    - Sills in this subreach will reach a height of 3.5-feet above MLW.
    - The base of the sills will be approximately 15-feet wide
    - The top ledge of the sills will be approximately 4-feet wide.
- Sand Nourishment
    - The area directly up shore of the sills will be backfilled with sand to 5-feet above MLW.
    - New sand filled areas will extend approximately 45 feet from the base of the sills up to the base of the existing bank.
    - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

<u>Reach ID (refer to)</u>

- Four (4) gapped sill structures
    - Sills in this subreach will reach a height of 3.5-feet above MLW.
    - The base of the sills will be approximately 15-feet wide
    - The top ledge of the sills will be approximately 4-feet wide.
- One (1) spur structure
    - This spur will be built off the existing stone revetment, which stretches approximately 3000-feet between subreaches IC and ID.
    - Similar to the sills, this spur will be constructed with stone set upon filter fabric, the base will be approximately 15-feet wide, and reach a height of 3.5-feet above MLW.

- One (1) revetment
  - This revetment will be built directly parallel to the shoreline in order to protect Critical Area 1 from further erosion.
- Sand nourishment
  - The area directly up shore of the sills will be backfilled with sand to 5-feet above MLW.
  - New sand filled areas will extend approximately 45 feet from the base of the sills and spur up to the base of the existing bank.
  - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

2.2.3.2 ***Reach II***

Reach II on the Potomac River originates at Blossom Point and extends approximately 7,100-feet eastward along the southern tip of Cedar Point. Reach IIA extends approximately 1,800 feet and includes Critical Area 2. It is defined by an exposed and actively eroding upland bank. A short existing breakwater constructed from broken rubble is located between Reach IIA and Reach IIB. Reach IIB extends approximately 1,500 feet and includes an eroding upland bank, more wooded areas downriver, and a small area of tidal marsh. Reach IIC extends 2,700 feet and consists mainly of tidal marshland. This reach includes an approximately 500-foot segment of low eroding upland. Reach IID extends for 1,100 feet and is defined by eroding wooded upland banks (VIMS, 2016).

The proposed shoreline improvements for Reach II involve construction of an approximately 4,200-foot long gapped sill structure. The sills in this Reach would be 4 feet above MLW. Sand nourishment strategies within Reach II would involve the strategic placement of sand behind the sill structures at elevations dependent upon shore morphology. Native, non-invasive marsh vegetation (*Spartina patens, Spartina alterniflora* and *Scirpus cyperinus*) will be planted on the new sand filled areas to stabilize the shore and provide marsh habitat (VIMS, 2016).

Specific proposed improvements for each subreach within Reach II are outlined in the following subheadings.

Reach IIA (refer to Figure 6)

- Six (6) gapped sill structures
  - Sills in this subreach will reach a height of 4-feet above MLW.
  - The base of the sills will be approximately 15-feet wide.
  - The top ledge of the sills will be approximately 4-feet wide.
- Sand nourishment
  - The areas directly up shore of the sills will be backfilled with sand to 6-feet above MLW.
  - New sand filled areas will extend approximately 55 feet from the base of the sills up to the base of the existing bank.
  - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

Figure 4. Proposed Shoreline Improvements for Reaches IA and IC

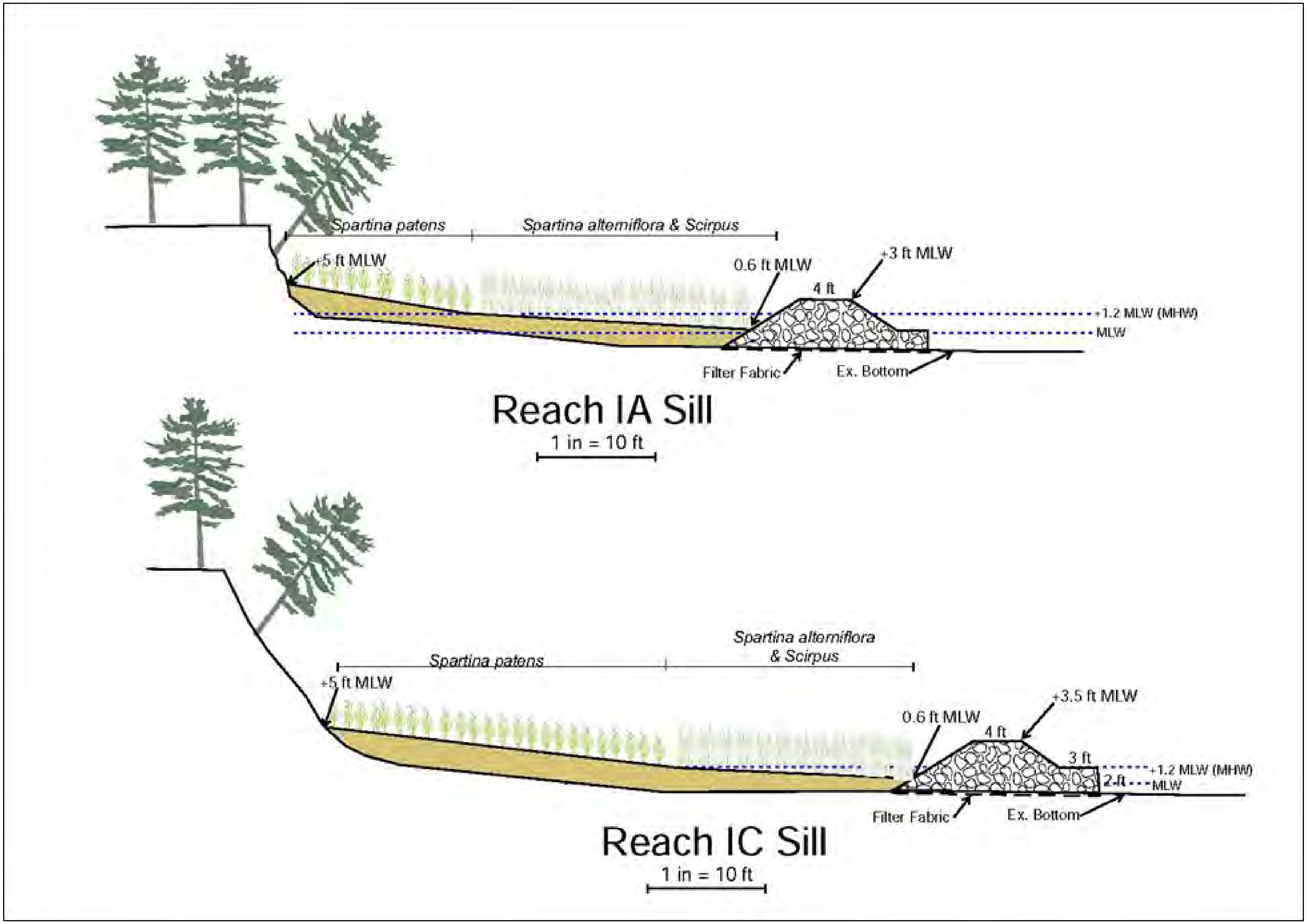
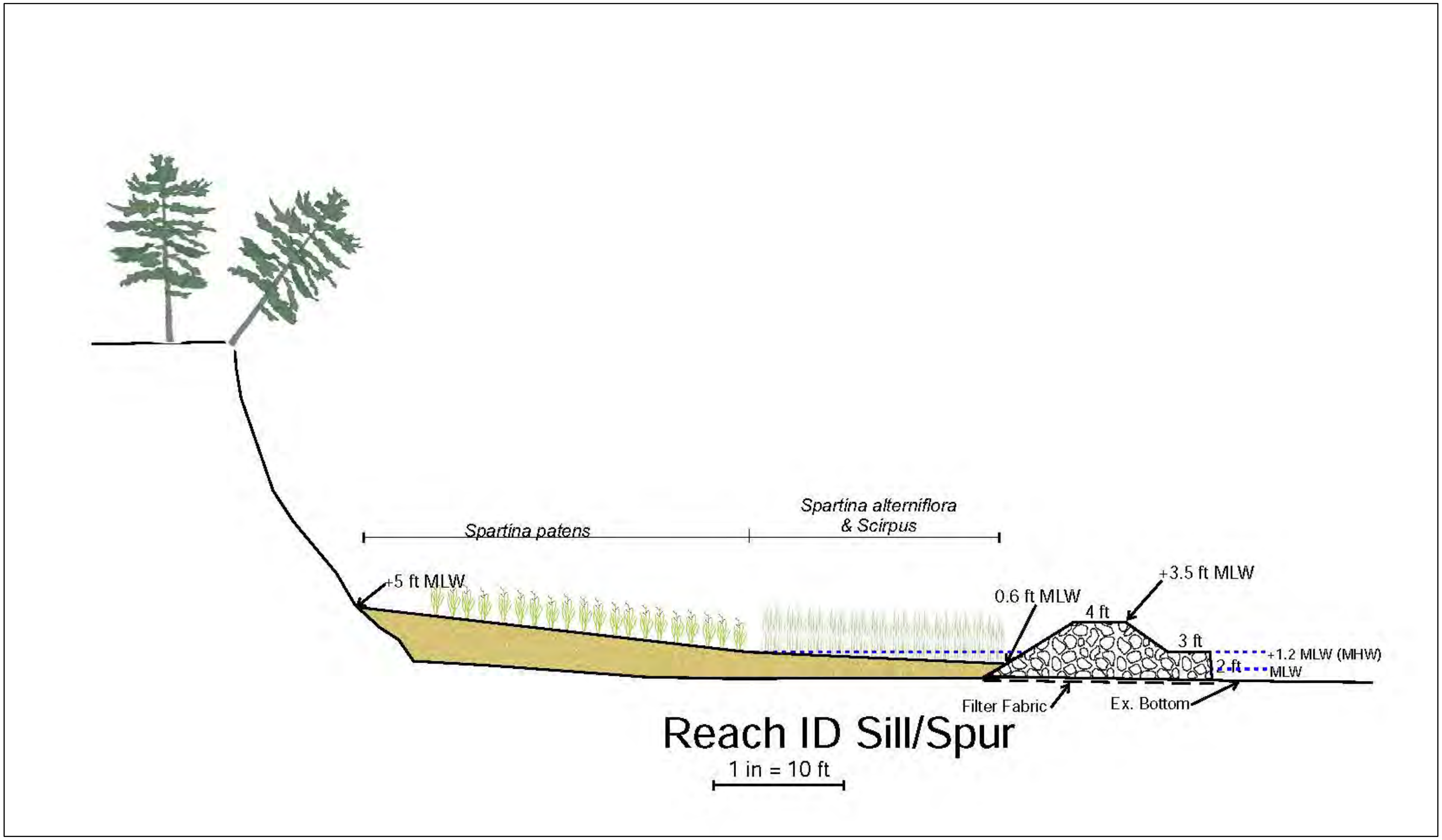


Figure 5. Proposed Shoreline Improvements for Reach ID



Reach IIB (refer to Figure 6)

- Five (5) gapped sill structures
  - Sills in this subreach will reach a height of 4-feet above MLW.
  - The base of the sills will be approximately 15-feet wide.
  - The top ledge of the sills will be approximately 4-feet wide.
- Sand nourishment
  - Areas directly up shore of the sills to be backfilled with sand to 5-feet above MLW.
  - The new sand filled areas will extend approximately 55 feet from the base of the sills up to the base of the existing bank.
  - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at the higher elevations to establish high marsh vegetation.

Reach IIC

Reach IIC has an existing marsh and a bank face that is generally stable, and therefore no shoreline improvements are planned at this reach.

Reach IID (refer to Figure 7)

- Three (3) gapped sill structures
  - Sills in this subreach will reach a height of 4-feet above MLW.
  - The base of the sills will be approximately 15-feet wide.
  - The top ledge of the sills will be approximately 4-feet wide.
- Sand nourishment
  - The areas directly up shore of the sills will be backfilled with sand to 5-feet above MLW.
  - New sand filled areas will extend approximately 55 feet from the base of the sills up to the base of the existing bank.
  - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

2.2.3.3 ***Reach III***

Reach III on the Potomac River originates on the eastern tip of Upper Cedar Point and extends approximately 9,300 feet northward, as depicted on Figure 1. Reach IIIA extends 2,400 feet to where the adjacent access road turns inland. This reach consists of a short marsh fringe and an exposed eroding bank. Reach IIIB extends 3,500 feet and is defined by the access road which runs within 70 feet of the shoreline for approximately 900 feet. The end of this reach consists of a small marsh fringe. Reach IIIC extends for 3,400 feet to the output of a small tidal creek that enters the Potomac at the ALC BPRF northern boundary (VIMS, 2016).

Figure 6. Proposed Shoreline Improvements for Reaches IIA and IIB

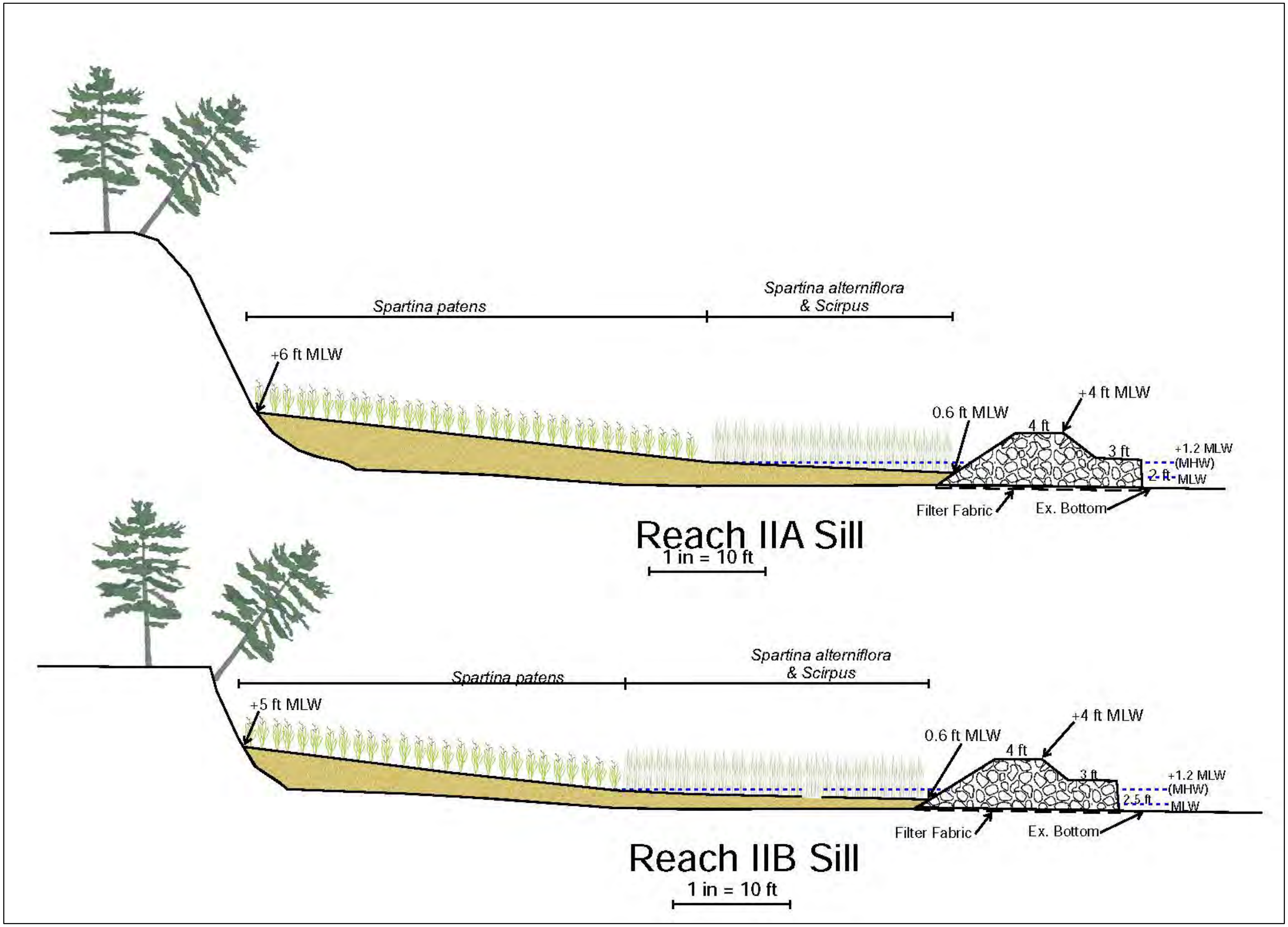
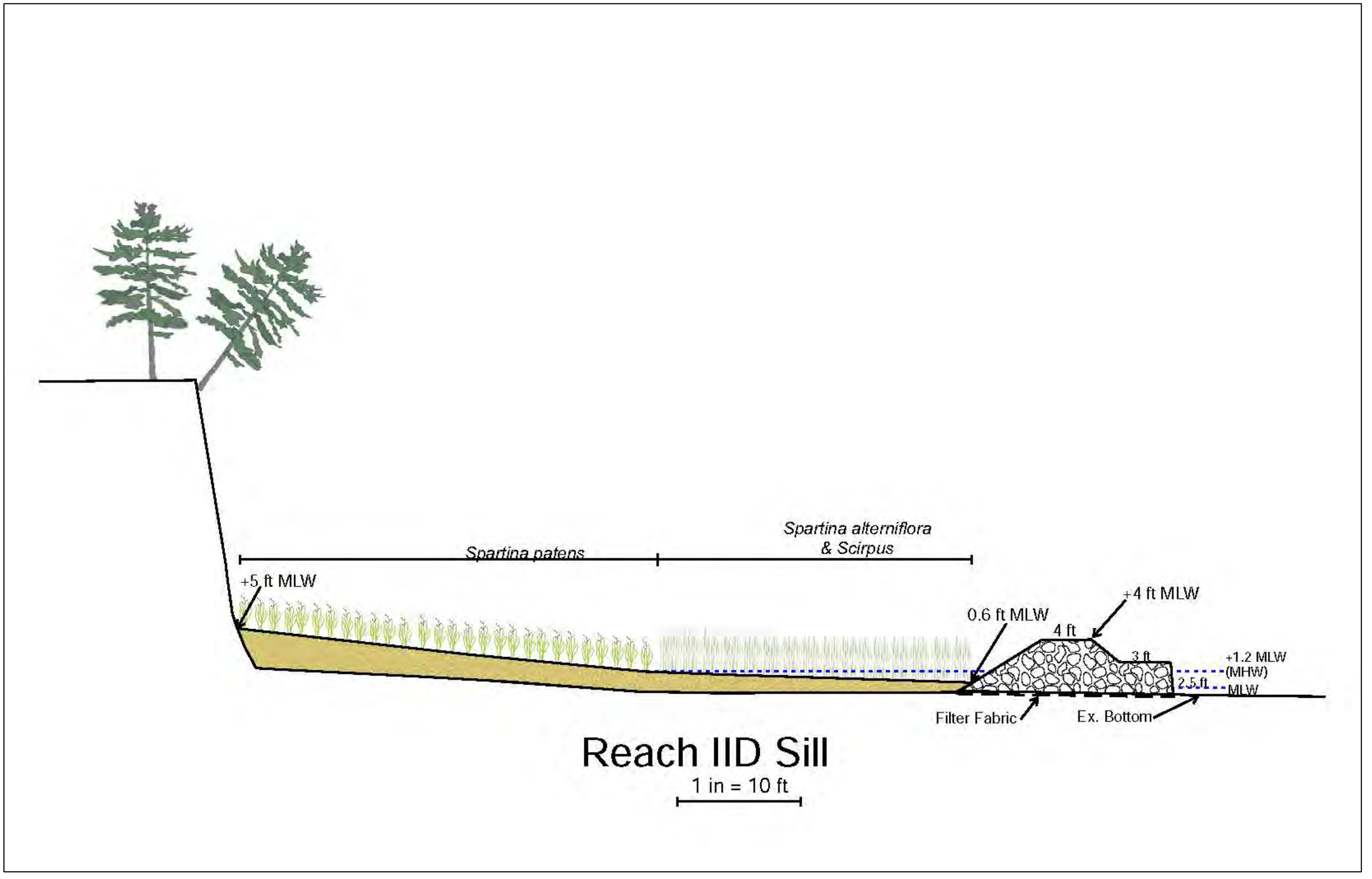


Figure 7. Proposed Shoreline Improvements for Reach IID



The proposed shoreline improvements for Reach III involve construction of an approximately 7,300-foot-long gapped brill structure. The brills in this reach would be 3.5-feet above MLW. Sand nourishment strategies within Reach III would involve the strategic placement of sand behind the sill structures to an elevation of 5-feet above MLW. Native, non-invasive marsh vegetation (*Spartina patens*, *Spartina alterniflora* and *Scirpus cyperinus*) will be planted on the new sand filled areas to stabilize the shore and provide marsh habitat (VIMS, 2016).

Reach IIIA (refer to Figure 8)

- Four (4) gapped brill structures
    - Brills in this subreach will reach a height of 3.5-feet above MLW.
    - The base of the sills will be approximately 15-feet wide.
    - The top ledge of the brills will be approximately 4-feet wide.
- Sand nourishment
    - The areas directly up shore of the brills will be backfilled with sand to 5-feet above MLW.
    - New sand filled areas will extend approximately 40 feet from the base of the brills up to the base of the existing bank.
    - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

Reach IIIB (refer to Figure 8)

- Eight (8) gapped brill structures
    - Brills in this subreach will reach a height of 3.5-feet above MLW.
    - The base of the sills will be approximately 15-feet wide.
    - The top ledge of the brills will be approximately 4-feet wide.
- Sand nourishment
    - The areas directly up shore of the sills will be backfilled with sand to 5-feet above MLW.
    - New sand filled areas will extend approximately 60 feet from the base of the brills up to the base of the existing bank.
    - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

Reach IIIC (refer to Figure 9)

- Four (4) gapped brill structures
    - Brills in this subreach will reach a height of 3.5-feet above MLW.
    - The base of the sills will be approximately 15-feet wide.
    - The top ledge of the brills will be approximately 4-feet wide.

- One (1) sill
  - This sill will reach a height of 3.5-feet above MLW.
  - The base of the sills will be approximately 15-feet wide.
  - The top ledge of the sill will be approximately 4-feet wide.
- Sand nourishment
  - The areas directly up shore of the brills and sill will be backfilled with sand to 5-feet above MLW.
  - New sand filled areas will extend approximately 55 feet from the base of the brills and sill up to the base of the existing bank.
  - *Spartina alterniflora* and *Scirpus cyperinus* will be planted at lower elevations to establish low marsh vegetation and *Spartina patens* will be planted at higher elevations to establish high marsh vegetation.

2.3 No Action Alternative

CEQ regulations require analysis of a No Action Alternative in order to provide a benchmark enabling decision makers to compare the magnitude of the potential environmental effects caused by the proposed action and other alternative actions. The No Action Alternative is not required to be reasonable, nor does it need to meet the purpose and need described in this EA.

The No Action Alternative presumes conditions at the ALC BPRF will remain as they currently exist for the foreseeable future. The No Action Alternative would allow the natural processes of erosion to continue on the ALC BPRF shorelines of Nanjemoy Creek and the Potomac River. Continued erosion would result in loss of land and potentially of critical infrastructure including installation roads that come within 70 feet of the shoreline and the lookout tower at Critical Area 2, as well as threaten cultural resources present on or in the proximity of the shoreline. Erosion will continue unabated, leading to increased sedimentation of the Potomac River and Nanjemoy Creek. Both waterways provide important habitat to wildlife including populations of bottlenose dolphins, federally endangered Atlantic and Shortnose sturgeon, and migratory birds. Sedimentation decreases water quality and can have adverse impacts on wildlife in these waterways. Although the No Action Alternative would not meet the purpose of and need for action, it is carried forward in the EA as prescribed by CEQ and provides a baseline for analysis of the action alternative.

2.4 Alternatives Eliminated from Further Consideration

During development of the Proposed Action, a non-Living Shoreline restoration plan was considered by ALC. This plan would use structures such as stone breakwaters and revetments instead of green Living Shoreline strategies and would not involve any sand nourishment. This alternative would potentially result in adverse impacts to wildlife and habitat caused by the separation of riparian habitat from the Potomac River and Nanjemoy Creek, as well as to aesthetics due to the constructed hardening of the shoreline without being balanced by the establishment of marsh habitat. Additionally, a non-Living Shoreline does not meet the preferred strategy for shoreline improvements in Maryland. Therefore, this alternative was eliminated from further consideration and is not analyzed in this EA.

No other reasonable action alternatives were identified that adequately met the purpose and need for the Proposed Action. Thus, ALC chose to limit the consideration of action alternatives to the Proposed Action alone.

Figure 8. Proposed Shoreline Improvements for Reaches IIIA and IIIB

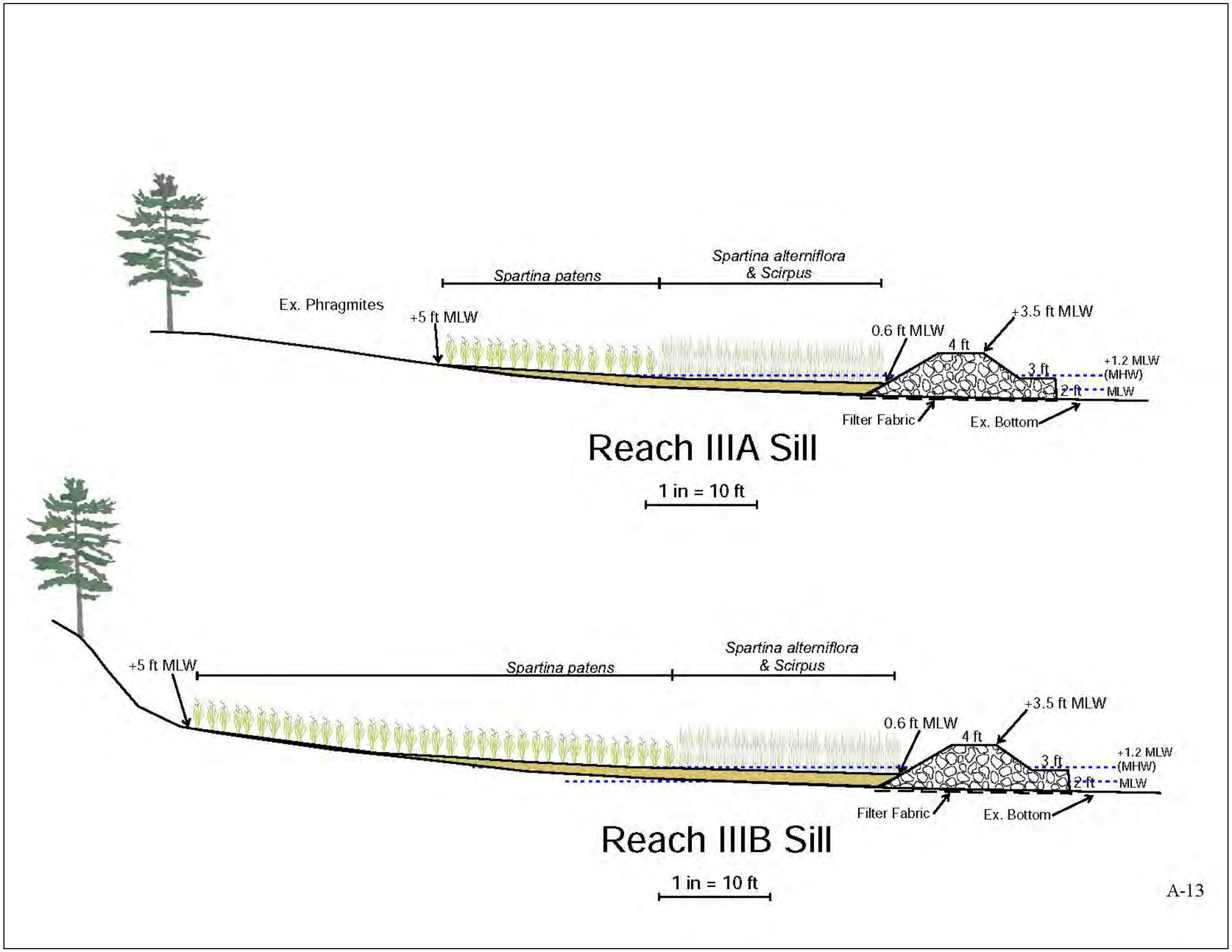
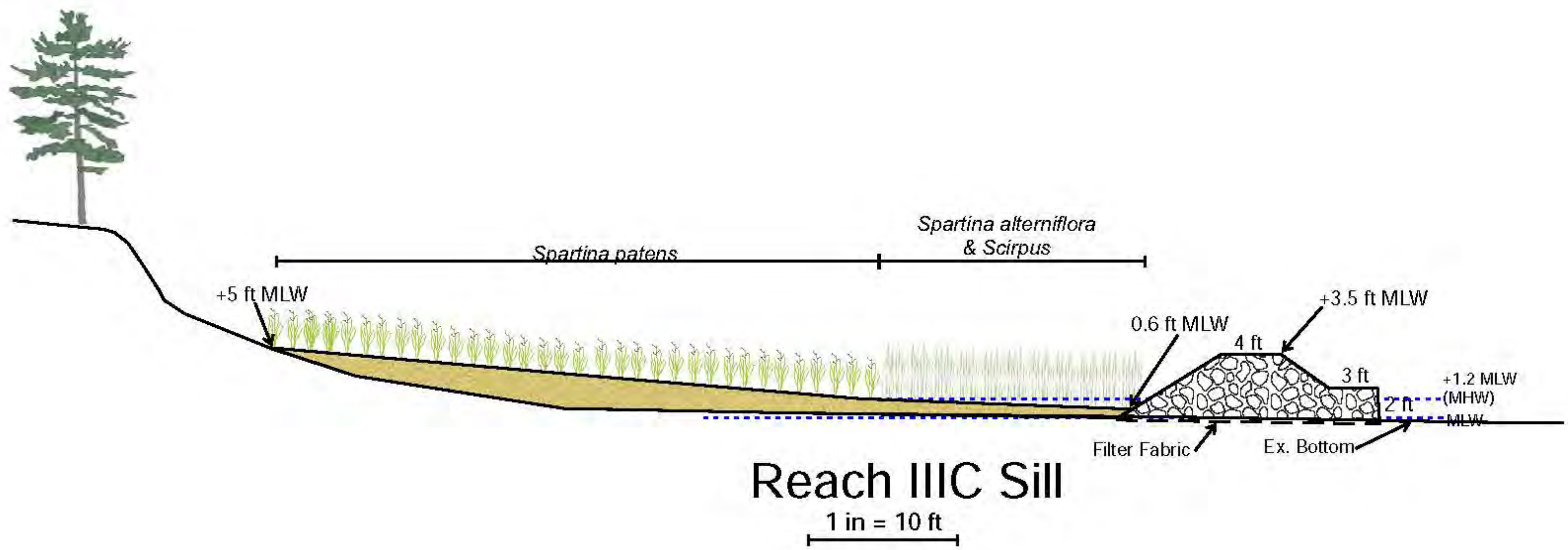


Figure 9. Proposed Shoreline Improvements for Reach IIIC



3 Affected Environment and Environmental Consequences

3.1 Criteria for Analysis of Impacts

This chapter describes the affected environment and evaluates the potential direct, indirect, short-term, and long-term impacts for each relevant human and natural environmental resource potentially affected by the Proposed Action or the No Action Alternative, in accordance with CEQ guidelines at 40 CFR Part 1508.8. An evaluation of the potential cumulative impacts resulting from the Proposed Action or the No Action Alternative, when added to other past, present, and reasonably foreseeable future actions, is presented in Chapter 4 (Cumulative Impacts).

The specific criteria for evaluating the potential environmental impacts of the Proposed Action and the No Action alternative are described in the following sections. The significance of an action is also measured in terms of its context and intensity. The context and intensity of potential environmental impacts are described in terms of duration, whether they are direct or indirect, the magnitude of the impact, and whether they are adverse or beneficial, as summarized in the following paragraphs:

Short-term or long-term. In general, short-term impacts are those that would occur only with respect to a particular activity, for a finite period, or only during the time required for construction or installation activities. Long-term impacts are those that are more likely to be persistent and chronic.

Direct or indirect. A direct impact is caused by an action and occurs around the same time at or near the location of the action. An indirect impact is caused by an action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action.

Less-than-significant (negligible, minor, moderate), or significant. These relative terms are used to characterize the magnitude or intensity of an impact. Negligible impacts are generally those that might be perceptible but are at the lower level of detection. A minor impact is slight, but detectable. A moderate impact is readily apparent. Significant impacts are those that, in their context and due to their magnitude (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR Part 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the policies set forth in NEPA. Significance criteria by resource area are presented in the following sections.

Adverse or beneficial. An adverse impact is one having unfavorable or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment.

3.2 Aesthetics

3.2.1 Existing Environment

A combination of natural and built features influences and contribute to the aesthetic environment of an area. Natural features may include topography, vegetation, and water features which themselves may have been altered over time by human action, while built features can include buildings and other constructed elements. Beneficial or adverse impacts may occur depending on how changes to the existing aesthetic environment are perceived by human receptors, which can include staff and visitors to ALC BPRF, and residents in vicinity of the area.

ALC BPRF is located on an approximately 1,600-acre peninsula between the Potomac River and Nanjemoy Creek (Figure 1). The ALC BPRF is accessible by Blossom Point Road, a paved road that serves as the only entrance and exit route. A chain-link fence along the northern border of the property restricts access to the ALC BPRF. Two gates on Blossom Point Road restrict vehicle access to the ALC BPRF. No testing ranges or facility buildings are visible from the entrance. Viewsheds from directly outside the ALC BPRF consist of dense forest and Blossom Point Road.

The area immediately surrounding the ALC BPRF is characterized by rural farmland and forested areas. There are some low-density residences along the upper portion of Blossom Point Road and on the rest of Cedar Point Neck. The area immediately northeast of the ALC BPRF property is a state wildlife management area, the Cedar Point Wildlife Management Area (WMA). A 300-foot buffer zone exists at the boundary of the Cedar Point WMA and the ALC BPRF to maintain the safety and security of the Army's operations at the ALC BPRF.

Within the ALC BPRF, viewsheds consist of dense forested areas interrupted by flat grass fields which serve as testing ranges. Forested areas are most common in the northern and central portions of the ALC BPRF, with some areas directly along the shorelines. Built features at the ALC BPRF include the chain-link fence and 46 buildings. Additionally, the NRL BPTF antenna yard is visible to staff and visitors entering and exiting the installation.

3.2.1.1 *Shoreline Aesthetics*

The shoreline at ALC BPRF is characterized by sandy beaches, eroding upland banks with an average height of 20 feet, exposed tree roots, and fallen trees

Environmental Consequences

3.2.1.2 *Construction*

Materials for construction such as stone and sand would be transported to the construction areas via a combination of barge and truck. The use of barges would depend on nearshore depth and feasibility of shoreline access at each reach. Delivery barges would access the ALC BPRF on the Potomac River from the east. These barges would be visible to boaters or fishermen offshore, and to residences along adjacent portions of the Potomac River shoreline.

). The width of the beach along the shoreline ranges from no beach (areas where banks directly abut the water) to approximately 30 feet of sandy beach depending on the location, level of erosion, and tide. In many areas along the shoreline the beaches abruptly give way to actively eroding upland banks with exposed sandy soil. The eastern shoreline along the Potomac River is more vegetated and less steep than the western shoreline along Nanjemoy Creek. Fallen trees are common along both shorelines, due to the instability of the actively eroding bank faces.

The shorelines of the ALC BPRF are visible to recreational boaters or fishermen offshore in the Potomac River or Nanjemoy Creek as well as residents of nearby waterfront properties. The shoreline is not visible from much of the interior portions of the ALC BPRF due to forested areas that naturally obstruct views and the steep bluffs (average of 20 feet high).

3.2.1.3 *Water Aesthetics*

Turbidity is a measure of the degree to which water becomes less transparent due to the presence of suspended particulates. Turbidity is an indicator of water quality and contributes to the aesthetic quality of waterbodies. The turbidity of the waters of the Potomac River vary depending on the season but can reach high levels that contribute to a murky appearance of the river. Turbidity in the Potomac River measured at the nearest turbidity gage to the ALC BPRF, the Little Falls Pump Station, approximately 50 miles upriver from the ALC BPRF, reached approximately 200 formazin nephelometric units (FNU) in January 2019 (USGS, 2019).

3.2.2 Environmental Consequences

3.2.2.1 *Construction*

Materials for construction such as stone and sand would be transported to the construction areas via a combination of barge and truck. The use of barges would depend on nearshore depth and feasibility of shoreline access at each reach. Delivery barges would access the ALC BPRF on the Potomac River from the east. These barges would be visible to boaters or fishermen offshore, and to residences along adjacent portions of the Potomac River shoreline.

Figure 10. Typical ALC BPRF Shoreline Aesthetic Conditions

When ground transportation is used for transport of materials and equipment, trucks traveling to and from the ALC BPRF via Blossom Point Road would be visible to residents along Blossom Point Road.

As previously mentioned in Section 2.0, the construction of these improvements would be completed in a phased approach and contingent upon funding. The frequency of material deliveries and volume of materials stockpiled at the ALC BPRF would be limited to what is needed for each funded phase of the project. Once each phase of construction is completed, the stockpiled materials and any transport vessels would no longer be present on or near the ALC BPRF. Thus, the degradation of the visual quality and character of the site caused by construction activities would be short-term.

To further minimize potential adverse impacts to the visual quality of the site, construction activities would be confined to only those areas undergoing improvements. Blossom Point Road would be kept clear of standing construction vehicles, equipment, and materials and debris, to maintain its rural setting. Sand or stone delivered to the site would be covered with haul tarps to minimize the release of dust, which can lead to nuisance concerns if the dust accumulates on nearby surfaces or is visible in the air for prolonged periods. Fugitive dust emissions would also be minimized by implementing industry-standard construction BMPs including using water trucks for dust suppression, brushing loose soil and debris off construction vehicle tires before leaving the construction site, and installation of gravel pads at the construction exits to further prevent the tracking of soil and debris onto roadways.

Therefore, construction of the proposed shoreline improvements would have a short-term, direct, less-than-significant, adverse impact on aesthetics.

3.2.2.2 *Operation*

Once the shoreline improvements are completed there would be new stone structures and planted marsh fringe along approximately 3.5 miles (based on completion of all phases) of the ALC BPRF shoreline. These improvements would change the current aesthetics of the shoreline from beach and eroding bank face to a Living Shoreline with built structures and a stable marsh. Living Shorelines provide an aesthetically pleasing green space that attracts wildlife and improves water quality. Over time, the newly planted marsh grasses would grow, and the shoreline would develop a marsh-like appearance. The proposed shoreline improvements would prevent further erosion of the upland banks and prevent trees from falling onto the beach. Preventing erosion would also decrease sedimentation and turbidity of the Potomac River and Nanjemoy Creek, resulting in an incremental improvement to the clarity of these water bodies. This would provide a minor improvement to the visual quality of the water in the immediate area of the ALC BPRF and Cedar Point Neck.

Therefore, the Proposed Action would have long-term, direct, beneficial impacts on aesthetics of the ALC BPRF shoreline.

3.2.2.3 *No Action*

Under the No Action alternative, the Proposed Action would not be implemented and shoreline conditions would continue to deteriorate. Erosion would continue to impact the aesthetics of the ALC BPRF shoreline by increasing sedimentation and the turbidity of the Potomac River and Nanjemoy Creek, and increasing the number of fallen trees. Therefore, the No Action alternative would result in long-term, significant adverse impacts to aesthetics of the ALC BPRF shoreline.

3.3 Air Quality

3.3.1 Regional Climate

Weather and climate are important influences on air resources. Eastern Maryland has a humid subtropical climate strongly influenced by the Chesapeake Bay and the Atlantic Ocean, characterized by moderately cold winters, warm humid summers, and year-round precipitation (NOAA, 2018). In Charles County, temperature averages range from a high of approximately 77.6 degrees Fahrenheit (°F) in July to a low of approximately 33.6 °F in January. January is the driest month with an average precipitation of 2.69 inches and July is the wettest month with an average precipitation of 5.16 inches. The average annual total precipitation is approximately 44.77 inches and the average seasonal snowfall is 15.8 inches. Wind information recorded at Washington-Reagan National Airport indicated the prevailing wind direction is from the south (NOAA, 2018).

3.3.2 Air Quality Standards

3.3.2.1 *National Ambient Air Quality Standards*

The *Clean Air Act* (CAA) and its subsequent amendments require the USEPA to establish the National Ambient Air Quality Standards (NAAQS) for pollutants that may endanger public health or welfare. The USEPA has promulgated primary and secondary NAAQS for six criteria pollutants including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), particulate matter

(PM); particulate matter sized 10 microns or less (PM_{10}) and particulate matter sized 2.5 microns or less ($PM_{2.5}$), and sulfur dioxide (SO_2). Primary standards set limits to protect public health, and secondary standards set limits to protect public welfare. The CAA also gives the authority to states to establish air quality rules and regulations stricter than the federal standards. Federal ambient air quality standards are shown in Table 2; these standards have been accepted in MD.

Table 2. Federal and State Ambient Air Quality Standards

NAAQS Pollutant	Primary/ Secondary	Averaging Time	Level(1)	Form
Carbon Monoxide	Primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Nitrogen Dioxide	Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	Primary and secondary	Annual	53 ppb	Annual Mean
Ozone	Primary and secondary	8-hour	70 ppb	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particular Matter ($PM_{2.5}$)	Primary	Annual	12 $\mu g/m^3$	Annual mean, averaged over 3 years
	Secondary	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
	Primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
Particular Matter (PM_{10})	Primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Lead	Primary and secondary	Rolling 3-month average	0.15 $\mu g/m^3$	Not to be exceeded
Sulfur Dioxide	Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

1 - Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu g/m^3$) (USEPA, 2018).

The CAA, as amended in 1990, mandates that state agencies adopt State Implementation Plans (SIP) that target the elimination or reduction of the severity and number of violations of the NAAQS. SIPs set forth policies to expeditiously achieve and maintain attainment of the NAAQS. Maryland has developed an Air Quality State Implementation Plan (SIP) that outline regulations, control measures, and strategies to achieve compliance with NAAQS (MDE, 2014).

3.3.2.2 *Attainment Status*

The determination of whether a region's air quality is healthful or unhealthful is made by comparing contaminant levels in ambient air samples to the Federal and state standards. Both the USEPA and Maryland use ambient air quality monitoring data to designate areas according to their attainment status for criteria pollutants.

Federal regulations designate Air Quality Control Regions (AQCR) that have concentrations of one or more of the criteria pollutants that exceed the NAAQS as nonattainment areas, while

AQCRs with levels below the NAAQS are designated as attainment areas. Further, maintenance areas are AQCRs that have previously been designated nonattainment and have been redesignated to attainment for a probationary period through implementation of maintenance plans. According to the severity of the pollution problem, O_3 and PM_{10} nonattainment areas can be categorized as marginal, moderate, serious, severe, or extreme. Where insufficient data exist to determine an area's attainment status, it is designated unclassifiable or in attainment.

Charles County, MD is under the jurisdiction of the MD DEP Southern Maryland Intrastate Air Quality Control Region (AQCR 116), and USEPA Region 3.

Charles County is designated as in attainment for all criteria pollutants, with the exception of 8-hour O_3 (marginal nonattainment).

3.3.2.3 *General Conformity Requirements*

The General Conformity Rule (GCR) (CAA Part 176(c)(4)) applies to all federal actions in nonattainment or maintenance areas. This rule requires that any federal action meet the requirements of a SIP or Federal Implementation Plan. More specifically, CAA conformity is ensured when a federal action would not cause a new violation of the NAAQS; contribute to an increase in the frequency or severity of violations of NAAQS; or delay the timely attainment of any NAAQS, interim progress milestones, or other milestones toward achieving compliance with the NAAQS. AQCRs that comply with the NAAQS are designated "attainment" areas by the USEPA, while areas where the standards are not met are designated as "non-attainment" areas. In addition, the conformity determination requirements apply to emissions of volatile organic compounds (VOCs) and oxides of nitrogen (NOx), which are chemical precursors involved in the production of O_3.

Charles County is designated as in attainment for all criteria pollutants, with the exception of 8-hour O_3 (marginal nonattainment). Therefore, a conformity determination with the GCR is applicable to the Proposed Action for emissions of the O_3 precursors: VOCs and NOx. The applicable GCR *de minimis* thresholds are shown in Table 3.

The potential emissions associated with the Proposed Action are required to be compared to the GCR *de minimis* thresholds. If the Proposed Action emissions are below the *de minimis* thresholds, then a full Conformity Determination is not required.

Table 3. General Conformity d*e minimis* Levels

Pollutant	Emission Threshold (tons/year)
CO	100 [(a)]
O_3 (as VOC or NOx precursors)	50 [(b)]
SO_2 or NO_2	100 [(b)]
PM_{10}	100 [(c)]
Pb	25

Source: 40 CFR 93.153(b)(1) (USEPA, 2018)
(a) Applicable emissions threshold in maintenance areas.
(b) Applicable emissions threshold in non-attainment areas.
(c) Applicable emission threshold for PM10. There is currently no threshold for PM2.5.

3.3.2.4 *Emission Sources*

Current emission sources at the ALC BPRF are limited to staff and visitor vehicles and gas-powered maintenance equipment and mowers. According to the Maryland Department of the Environment (MDE) Issued Part 70 Operating Permits database, ALC BPRF does not have any existing Title V permits. ALC BPRF does have MDE permits (017-0247-9-0171 and 017-0247-9-0172) for two Mitsubshi Model Stemford 1207 900-kilowatt (kW) emergency generators. These generators were permitted in August 2015. Additionally, NRL has separate permits (017-0247-9-0144 and 017-0247-9-0145) for their two Detroit model (MTU Detroit Diesel) 1500-kW emergency generators. These generators were permitted March 2010.

3.3.2.5 *Sensitive Receptors*

CEQ NEPA regulations require evaluation of the degree to which the proposed action affects public health (40 CFR 1508.27). Children, elderly people, and people with illnesses are especially sensitive to the effects of air pollutants; therefore, hospitals, schools, convalescent facilities, and residential areas are considered to be sensitive receptors for air quality impacts, particularly when located within one mile from the emissions source.

There are no hospitals, schools, or convalescent facilities within one mile of the ALC BPRF. The nearest hospital to the ALC BPRF is the Physicians Memorial Hospital in La Plata, MD approximately 10-miles northeast. The nearest schools to the ALC BPRF are the Cedar Point Neck School located approximately 3-miles north on Blossom Point Road and the Nanjemoy Creek Environmental Education Center located approximately 2.5-miles west, across Nanjemoy Creek. The nearest residences to the ALC BPRF are the low-density farm residences on Cedar Point Neck.

3.3.3 Environmental Consequences

3.3.3.1 *Construction*

Construction of the shoreline protection structures and associated Living Shorelines would require approximately 51,170 tons of rock, 87,260 tons of sand, 1,314 tons of cobble, and 338,847 plants (VIMS, 2016). Construction would involve the use of heavy construction equipment including graders, loaders used for grading of the eroding bank face, placement of filter fabric and stone, and transportation and placement of aggregate (rock, sand, cobble) and plants. This equipment would generate emissions of criteria pollutants from the operation of gas and/or diesel-fuel-powered combustion engines.

Construction would also temporarily expose soils of the upland bank and generate particulate matter associated with grading and vehicles traveling on paved and unpaved surfaces. However, due to the extensive erosion that exists along the ALC BPRF shorelines, much of the existing upland bank soils are already exposed. Additionally, excavation of the nearshore river bottom would not be required to install shoreline protective features.

As previously described, Charles County is in nonattainment for O3. Therefore, since construction associated with the Proposed Action would result in the emission of the precursor nonattainment air pollutants (VOC and NOx), a review has been conducted to determine if the Proposed Action is subject to a full conformity determination.

A federal action is exempt from the GCR requirements if the action’s total net emissions are below the de minimis threshold or are otherwise exempt per 40 CFR 51.153. If net emissions exceed the de minimis value, or if a project is regionally significant, a formal conformity determination process must be followed.

3.3.3.1.1 *Particulate Emissions*

To assess whether the Proposed Action construction emissions would exceed the GCR de minimis levels, the estimated total suspended particulate emissions from the anticipated construction activities were calculated using the emission factors for heavy construction operations from “AP-42, Compilation for Air Pollutant Emission Factors” (USEPA, 1995).

Construction will occur along approximately 3.5 miles of shoreline. Anticipating that construction will occur within 200 feet of the shoreline, the total exposed area is estimated to be approximately 85 acres. These estimates are summarized in Table 4.

Table 4. Total Suspended Particulates

Total Area (acres)	Exposed Area (acres)	Construction Duration (months)	Emission Factor (tons/acre/month)(1)	Control Efficiency (%)	Total Suspended Particulate Emissions (tons/year)
85	85	24	1.2	80	244.8

Non-Road Construction Equipment Emissions

Non-road construction vehicles would emit criteria pollutants during construction of the shoreline protection structures and sand nourishment. Based on knowledge of construction of shoreline protection structures similar to the ones proposed, criteria pollution emissions from construction equipment were calculated assuming the use of two backhoes and two graders operating for approximately eight hours per day for a total of approximately 24 months. It should be noted that the 24 months is an estimate for implementation of the entire SMP. The SMP would be implemented in phases, contingent upon funding, with critical areas given priority. Thus, the 24-month construction schedule would not likely be continuous.

Emissions were estimated using "Off-Road – Model Mobile Source Emission Factors" from the California South Coast Air Quality Management District (SCAQMD, 2019) because MDE has not issued individual emission factors.

Table 5 Table 6 presents the estimated average composite emission factor for each type of equipment previously listed in Table 5.

Table 5. Estimated Total Operational Hours for Construction Equipment

Equipment Type	Number	Operating Hours/Day	Total Operating Days	Total Operating Hours
Graders	2	8	730	11,680
Tractors/Loaders/Backhoes	2	8	730	11,680

Table 6. SCAB Fleet Average Emission Factors (Diesel)

Equipment Type	Emission Factors(1)						
	ROG(2) (lb/hr)	CO (lb/hr)	NO_x (lb/hr)	SO_x (lb/hr)	PM(3) (lb/hr)	CO_2(4) (lb/hr)	CH_4(4) (lb/hr)
Graders	0.0982	0.5787	0.6490	0.0015	0.0316	133.0000	0.0108
Tractors/Loaders/Backhoes	0.0472	0.3630	0.3019	0.0008	0.0160	66.8000	0.0055

1 – Emissions factors for year 2019 (SCAQMD, 2019). Lead (Pb) is not estimated, as it is no longer used as a common fuel additive.
2 - Reactive Organic Gases (ROG) are assumed to be equivalent to VOCs for estimated non-road construction equipment emissions.
3 – Combined $PM_{2.5}$ and PM_{10}
4 – Presented for informative purposes; not a NAAQS criteria pollutant

By multiplying the operating hours in Table 5 by the emissions factors in Table 6, the estimated emissions were calculated for non-road construction equipment, as shown in Table 7.

Table 7. Total Criteria Pollutant Emissions from Non-Road Construction Vehicles

Equipment Type	Total Hours	ROG	CO	NO_x	SO_x	PM	CO_2(1)	CH_4(1)
Graders (lbs)	11,680	1,146.9	6,759.22	7,580.3	17.47	369.41	1,553,44	126.14
Tractors/Loader/Backhoes (lbs)	11,680	551.30	4,239.84	3,526.1	9.05	186.62	780,224	64.3
Total, lbs	--	1,698.3	10,999.1	11,106	26.53	556.04	2,333,66	190.44
Total, tons	--	0.85	5.50	5.55	0.01	0.28	1,167	0.0952
Annual Emissions (tons/year)	--	0.4246	2.7498	2.7766	0.0066	0.1390	583.4160	0.0476
de minimis level(2) (tons/year)	--	50/100	100	100	100	100	N/A	N/A

1 – Presented for informative purposes; not a NAAQS criteria pollutant
2 –General Conformity de minimis levels (USEPA, 2018)

As shown in Table 7, non-road construction vehicle emissions associated with the construction of the shoreline improvements would be below the GCR *de minimis* thresholds for all criteria pollutants.

3.3.3.1.2 *On-Road Haul Truck Emissions*

As previously described, construction of the shoreline improvements could require importing stone and sand fill by overland truck. This would occur if barges alone are not able to deliver this material directly to the shoreline where improvements are planned.

At this time, ALC is not currently able to precisely confirm how aggregate material deliveries would be distributed between overland truck and water-based barge. Thus, as a conservative approach, emissions were estimated for a scenario where all aggregate needed for all phases of the project would be transported by overland haul trucks. However, it is noted that this is not anticipated to be the case, as some phases of the project would likely involve material transport via barge (depending on the depth and accessibility of the shoreline from the water).

Approximately 130,928 tons (approximately equivalent to 87,285 cubic yards) of aggregate would be transported to the site under the Proposed Action (VIMS, 2016). The total number of overland truck trips was calculated based on a typical 15-ton capacity of a tri-axle haul truck and a borrow source approximately 20 miles from the site (40 miles round trip) (Table 8). Estimated emissions associated with this transportation scenario is provided in Table 9.

Table 8. Total Materials and Truck Trips Required

Category	Unit
Total Material (Stone and Sand), tons	130,928(1)
Total Number of Truck Trips required(2)	8,729
Miles Per Trip (round trip)(3)	40

1 - 130,928 tons equivalent to approximately 87,285 cubic yards (at 1.48 tons/cubic yard).
2 - Values based on an average tri-axle dump truck haul capacity of 15 tons.
3 - 40 miles round trip based on distance to aggregate supplier located near the Interstate 95 corridor.

Table 9. Estimated Emissions from On-Road Haul Truck Transport

On-Road Haul Trucks	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2[(1)]
Emission factor lbs/mile[(2)]	0.000884	0.003673	0.010831	0.000029	0.000412	0.000379	3.267549
Emissions, lbs/total miles traveled[(3)]	309	1,282	3,782	10	144	132	1,140,832
Emissions, tons/total miles traveled	0.154	0.641	1.891	0.005	0.072	0.066	570.416
Emissions tons/total miles traveled/year	0.077	0.321	0.945	0.003	0.036	0.033	285.208
GCR *de minimis* level[(4)] (tons/year)	100	100	50/100	100	100	100	N/A

1 – Presented for informative purposes; not a NAAQS criteria pollutant
2 – On-road emissions factors for heavy duty diesel-fueled vehicle, greater than 8,500 lbs gross vehicle weight, for Maryland, year 2019 (USEPA, 2014)
3 – 349,140 total miles, based on 8,728 total trips at 40 miles per round trip.
4 – GCR de minimis thresholds (USEPA, 2018)

As shown in Table 9, construction emissions associated with the land transport of material for shoreline protection structures and sand nourishment would be below the General Conformity Rule *de minimis* thresholds for all criteria pollutants.

3.3.3.1.3 *Barge Emissions*

The Proposed Action could involve transporting aggregate by dry bulk cargo barges (powered by tugboats) if the depth of the nearshore and accessibility to the shoreline from the water are conducive (e.g. there is sufficient depth) to sourcing construction materials by water. If practical, the use of barges may limit the number of overland haul trucks transporting aggregate to ALC BPRF. However, ALC is not currently able to precisely confirm how material deliveries would be distributed between overland truck or in-water barge.

Thus, as a conservative approach, emissions were estimated for a scenario where all aggregate needed for all phases of the Proposed Action would be transported by in-water barge. As noted above, this is not anticipated to be the case, as overland haul trucks are also likely to be used to transport aggregate, due to the potential for insufficient water depths and associated water-based accessibility constraints along shallower reaches of the ALC BPRF shoreline.

Under the complete in-water barge scenario, emissions were estimated based on the assumptions provided in Table 10. A conservative estimate of 300 miles for a round trip (assuming aggregate is transported from a supplier in Easton, Maryland, to BPRF; the round trip is approximately 300 miles) using a towboat/pushboat moving a barge with a 1,500 ton capacity and traveling at a typical average speed of approximately 7 miles per hour. Estimated emissions based on these assumptions for in-water transport is provided in Table 11. It is noted that the in-water travel distance may decrease if a closer supplier of aggregate is ultimately selected for actual construction the Proposed Action. Likewise, the trip frequency may vary if a smaller or larger capacity barge is used.

Table 10. Total Materials and Barge Loads Required

Total Aggregate (tons)(1)	130,928
Total Number of Barge Loads (or Trips) Required(2)	88
Miles per Round Trip(3)	300
Travel Time per Round Trip (hours)(4)	43

1 – From VIMS, 2016
2 – Values based on a barge (200 x 35 feet) with capacity of 1,500 tons per load (Heartland Barge Co., 2019)
3 – Based on an aggregate supplier located within 150 miles in-water of ALC BPRF in Easton, MD.
4 – Based on average speed of a tugboat and barge at 7 miles/hour; does not account for in port or landing time.

Table 11. Estimated Emissions from In-Water Tugboat and Barge Transport

Towboat/push boat emissions	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2(1)	CH_4(1)
Emission Rates (lbs/hour)(2)	1.346	4.833	16.115	0.01	0.875	0.783	1151.779	0.047
Emissions per round trip (lbs)(3)	57.69	207.13	690.64	0.43	37.50	33.56	49361.96	2.01
Emissions, total for project (lbs)(4)	5,076.34	18,227.3	60,776.5	37.71	3,300.00	2,953.03	4,343,852	177.26
Emissions, total for project (tons)(4)	2.54	9.11	30.39	0.02	1.65	1.48	2,171.93	0.09
Emissions, 12-month period (tons/year)	1.27	4.56	15.19	0.01	0.83	0.74	1,085.96	0.04
GCR *de minimis* level(5) (tons/year)	50/100	100	100	100	100	N/A	N/A	N/A

1 – Presented for informative purposes; not a NAAQS criteria pollutant
2 – Based on combined emission factors for a typical towboat/pushboat with a single 1,250-hp rated engine, model year 2000, and a 79 hp auxiliary generator (SCAQMD, 2017)
3 – Based on a 43-hour round trip (see Table 10).
4 – Based on 88 round trips over 24 months
5 – GCR de minimis thresholds (USEPA, 2018)

As shown in Table 11, construction emissions associated with aggregate transport via towboat/pushboat and barge would be below the General Conformity *de minimis* thresholds for all criteria pollutants. Therefore, a full conformity determination is not required. Accordingly, a Record of Non-Applicability (RONA) concerning the GCR is provided in Appendix B.

To further minimize any potential adverse impacts to air quality from the construction phase, the construction contractor would implement the following BMPs:

- Utilize appropriate construction scheduling (avoid earthwork during extremely windy and dry periods).
- Construction vehicles traveling on paved roads within and outside of the ALC BPRF would follow posted speed limits. This would minimize dust generated by vehicles and equipment on paved surfaces.
- On unpaved surfaces at the site, vehicle speeds will be maintained at or below 5 miles per hour to prevent dust generation of any exposed soil. Additionally, should any vehicles transport soil from one area of the property to another, soil will be covered with haul tarps.

- Visually monitor construction activities on a daily basis, and particularly during extended periods of dry weather; implement additional dust control measures as needed.
- Limit the idling of mobile emission sources to three minutes; after three minutes turn engines off.
- Cover beds of all incoming and outgoing haul trucks and barges with tarps.

Therefore, construction of the Proposed Action would have short-term, direct, negligible, adverse impacts on air quality.

3.3.3.2 *Operation*

Erosive wind forces currently carry fugitive dust from the exposed soils of the eroding banks into the air. Operation of the Proposed Action is anticipated to reduce erosion of the shoreline, therefore decreasing the amount of exposed soils of the upland banks. Additionally, the Proposed Action would include vegetating approximately 3.5 miles of currently exposed shoreline with marsh vegetation. These plants would help anchor the sandy soils of the shoreline, preventing erosion and the release of exposed soils to the air. Marshes are also known to have an indirect benefit to air quality globally by sequestering carbon. Therefore, operation of the proposed action would have a long-term, direct and indirect, minor beneficial impact to air quality.

3.3.3.3 *No Action*

Under the No Action alternative, no impacts to air quality would occur and baseline conditions would remain, as described above. However, the minor beneficial impacts to air quality due to the reduction in erosion, stabilization of soils, and establishment of marsh vegetation along the shoreline would not occur.

3.4 Topography, Geology and Soils

3.4.1 Topography

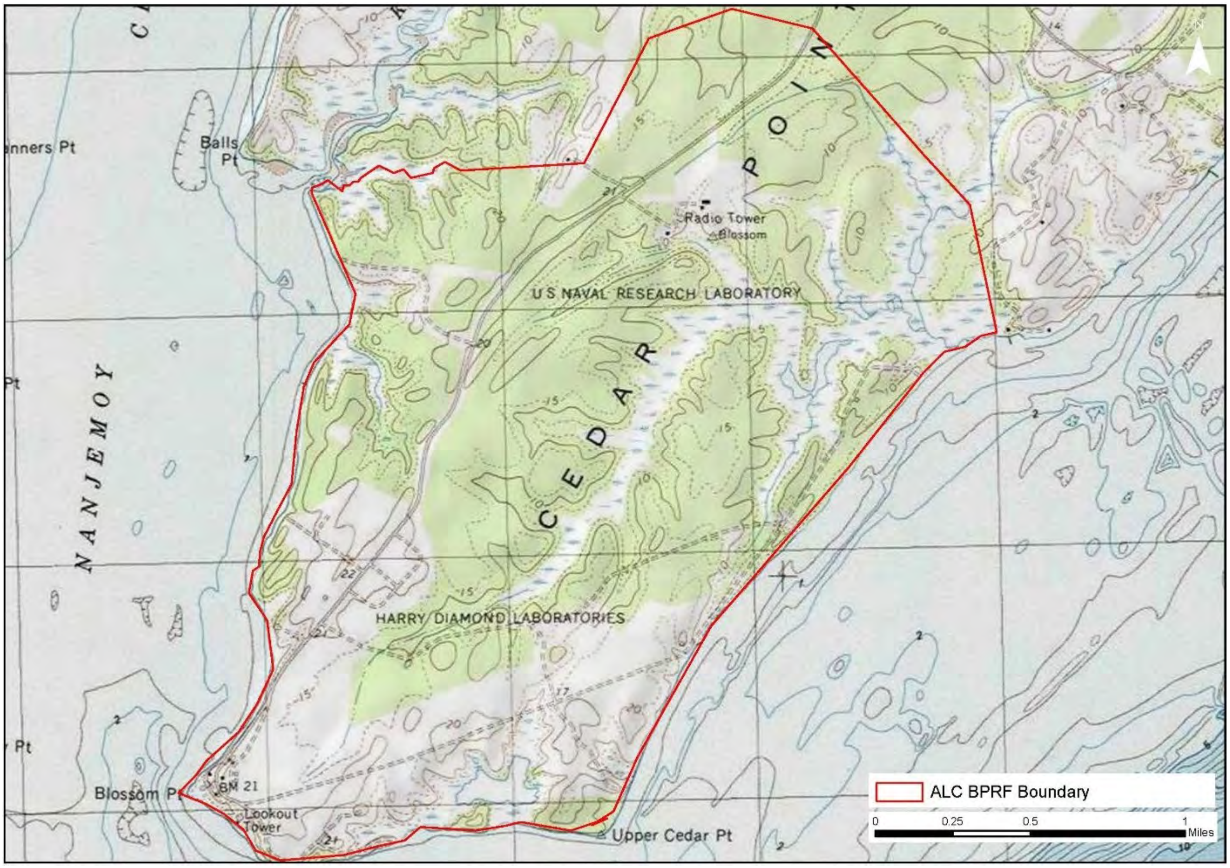
The ALC BPRF is located on the generally flat Cedar Point Neck peninsula. According to the available U.S. Geological Survey (USGS) 7.5-minute topographical map (Mathias Point VA 38077D1, effective 2016) elevations range from mean sea level to 25-feet amsl. The property gently slopes toward the Potomac River to the east and Nanjemoy Creek to the west, with slopes ranging from two to five percent. The shoreline is composed of steep bluffs with an average height of 20 feet (VIMS, 2016). A topographic map of the ALC BPRF is provided in Figure 11.

3.4.2 Geology

Cedar Point Neck is an interfluve feature between Nanjemoy Creek and the Port Tobacco River (VIMS, 2016). The geology of Cedar Point Neck is composed of sedimentary strata. The coastal uplands consist of Maryland Point Formation (Qm) with intermittent Holocene tidal marsh sediments (Qh) (VIMS, 2016). Approximately 1,300 feet of sediment cover the bedrock on the ALC BPRF.

Like most of the Chesapeake Bay shoreline, the shoreline along the ALC BPRF has been shaped by cycles of sea level fluctuations. The last low stand of sea level was approximately 15,000 years ago. Since then, sea level has consistently been rising, ultimately resulting in shoreline recession and erosion along the dendritic drainage pattern of the Chesapeake Bay watershed (VIMS, 2016). This has resulted in the erosional shoreline present at the ALC BPRF today.

Figure 11. Topography of the ALC BPRF



3.4.3 Soils

According to the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS, 2018) soils at the ALC BPRF consist primarily of the Annemessex and Lenni and Quindocqua soil complexes. The majority of soil units on the ALC BPRF meet hydric criteria. As previously described under the Topography heading, existing soils are relatively flat with soil slopes generally ranging from 0 to 5 percent. All soil units present on the ALC BPRF are listed in Table 12 and soil unit locations within the ALC BPRF are provided in **Error! Reference source not found.**. Detailed descriptions of the main soil units at the ALC BPRF are provided in the following list:

Annemessex silt loam (AsA, AsB): These soils account for 38.6% of the ALC BPRF. The Annemessex silt loam soils consist of very deep, somewhat poorly drained soils formed in loamy fluviomarine deposits. They are nearly level soils on stream terraces and fluviomarine terraces. Slopes range from 0 to 5 percent. These soils do not meet hydric criteria.

Lenni and Quindocqua soils, 0 to 2 percent slopes (LQA): These soils account for 20.7% of the ALC BPRF. The Lenni and Quindocqua soils are very deep, poorly drained soils formed in clayey fluviomarine deposits. They are nearly level soils on depressions on broad interstream divides and fluviomarine terraces. Slopes range from 0 to 2 percent. These soils meet hydric criteria.

Liverpool-Piccowaxen complex 5 to 15% slopes (LxD): These soils account for 15.9% of the ALC BPRF. The Liverpool-piccowaxen complex consists of very deep, moderately well drained soils formed in silty and loamy fluviomarine deposits. They are moderately sloping soils on fluviomarine terraces. Slopes range from 5 to 15 percent. These soils do not meet hydric criteria.

Liverpool silt loam (LsA, LsB): These soils account for 5.6% of the ALC BPRF. The Liverpool silt loam soils consist of very deep, moderately well drained soils formed in silty and loamy fluviomarine deposits. They are nearly level soils on terraces. Slopes range from 0 to 5 percent. These soils do not meet hydric criteria.

Nanticoke and Mannington soils, frequently flooded (NG): These soils account for 5.5% of the ALC BPRF. The Nanticoke and Mannington soils consist of very deep, very poorly drained soils. They are nearly level soils on tidal marshes. Slopes range from 0 to 1 percent. These soils meet hydric criteria.

Mispillion and Transquaking soils, tidally flooded (MT): These soils account for 4.8% of the BPRF. The Mispillion and Transquaking soils consist of very deep, very poorly drained soils formed in herbaceous organic material over silty estuarine sediments. They are nearly level soils on tidal marshes. Slopes range from 0 to 1 percent. These soils meet hydric criteria.

Elkton silt loam, 0 to 2 percent slopes, frequently ponded (EkA): These soils account for 3.6% of the BPRF. The Elkton silt loam soils consist of very deep, poorly drained soils formed in silty eolian deposits over loamy fluviomarine deposits. They are nearly level soils on depressions on fluviomarine terraces. Slopes range from 0 to 2 percent. These soils meet hydric criteria.

Piccowaxen loam (PcA, PcB): These soils account for 2.9% of the ALC BPRF. The Piccowaxen loam soils consist of very deep, somewhat poorly drained soils formed in silty and loamy fluviomarine deposits. They are nearly level soils on terraces. Slopes range from 0 to 5 percent. These soils do not meet hydric criteria.

Dodon fine sandy loam, 2 to 5 percent slopes (DfB): These soils account for 0.3% of the ALC BPRF. The Dodon fine sandy loam soils consist of very deep, moderately well drained soils. They are nearly level soils on stream terraces. Slopes range from 2 to 5 percent. These soils do not meet hydric criteria.

The soils at the ALC BPRF are subject to large erosive wind-driven wave forces. Approximately 15,838 feet of the existing bank face of the ALC BPRF shoreline is erosional and approximately 14,625 feet of the base of the bank is erosional (VIMS, 2016). Currently, the shorelines of the ALC BPRF are eroding at a rate of 1-3 feet per year. In some areas erosion is occurring at a much faster rate, including Critical Area 1 where 20 feet of shoreline has been lost in under three years. High erosion rates lead to unstable soils and sedimentation of the Potomac River and Nanjemoy Creek.

Table 12. Soil Units at the ALC BPRF

Soil Map Unit	Soil Map Unit Name	Drainage Class	Hydric (Y/N)	Acres (percentage) within ALC BPRF Property
AsA	Annemessex silt loam, 0 to 2 percent slopes	Somewhat poorly drained	N	563.8 (35.3)
LQA	Lenni and Quindocqua soils, 0 to 2 percent slopes	Poorly drained	Y	330.9 (20.7)
LxD	Liverpool-Piccowaxen complex, 5 to 15 percent slopes	Moderately well drained	N	253.5 (15.9)
NG	Nanticoke and Mannington soils, frequently flooded	Very poorly drained	Y	87.4 (5.5)
MT	Mispillion and Transquaking soils, tidally flooded	Very poorly drained	Y	77.4 (4.8)

Soil Map Unit	Soil Map Unit Name	Drainage Class	Hydric (Y/N)	Acres (percentage) within ALC BPRF Property
EkA	Elkton silt loam, 0 to 2 percent slopes, frequently ponded	Poorly drained	Y	57.0 (3.6)
AsB	Annemessex silt loam, 2 to 5 percent slopes	Somewhat poorly drained	N	52.5 (3.3)
LsA	Liverpool silt loam, 0 to 2 percent slopes	Moderately well drained	N	46.5 (2.9)
LsB	Liverpool silt loam, 2 to 5 percent slopes	Moderately well drained	N	43.7 (2.7)
W	Water	-----------	--	34.8 (2.2)
PcA	Piccowaxen loam, 0 to 2 percent slopes	Somewhat poorly drained	N	28.0 (1.8)
PcB	Piccowaxen loam, 2 to 5 percent slopes	Somewhat poorly drained	N	17.9 (1.1)
DfB	Dodon fine sandy loam, 2 to 5 percent slopes	Moderately well drained	N	5.4 (0.3)
Total 1,598.7 (100)				

3.4.4 Environmental Consequences

3.4.4.1 *Geology*

3.4.4.1.1 *Construction and Operation*

Construction of the Proposed Action would not require contacting or exposing the bedrock at the ALC BPRF. Stone and sand would be placed on top of the shoreline or riverine sediment. Additionally, construction activities have no mechanisms, such as bedrock fracturing, fluid injections, or blasting, to directly or indirectly impact bedrock. Therefore, no impacts to geology are anticipated.

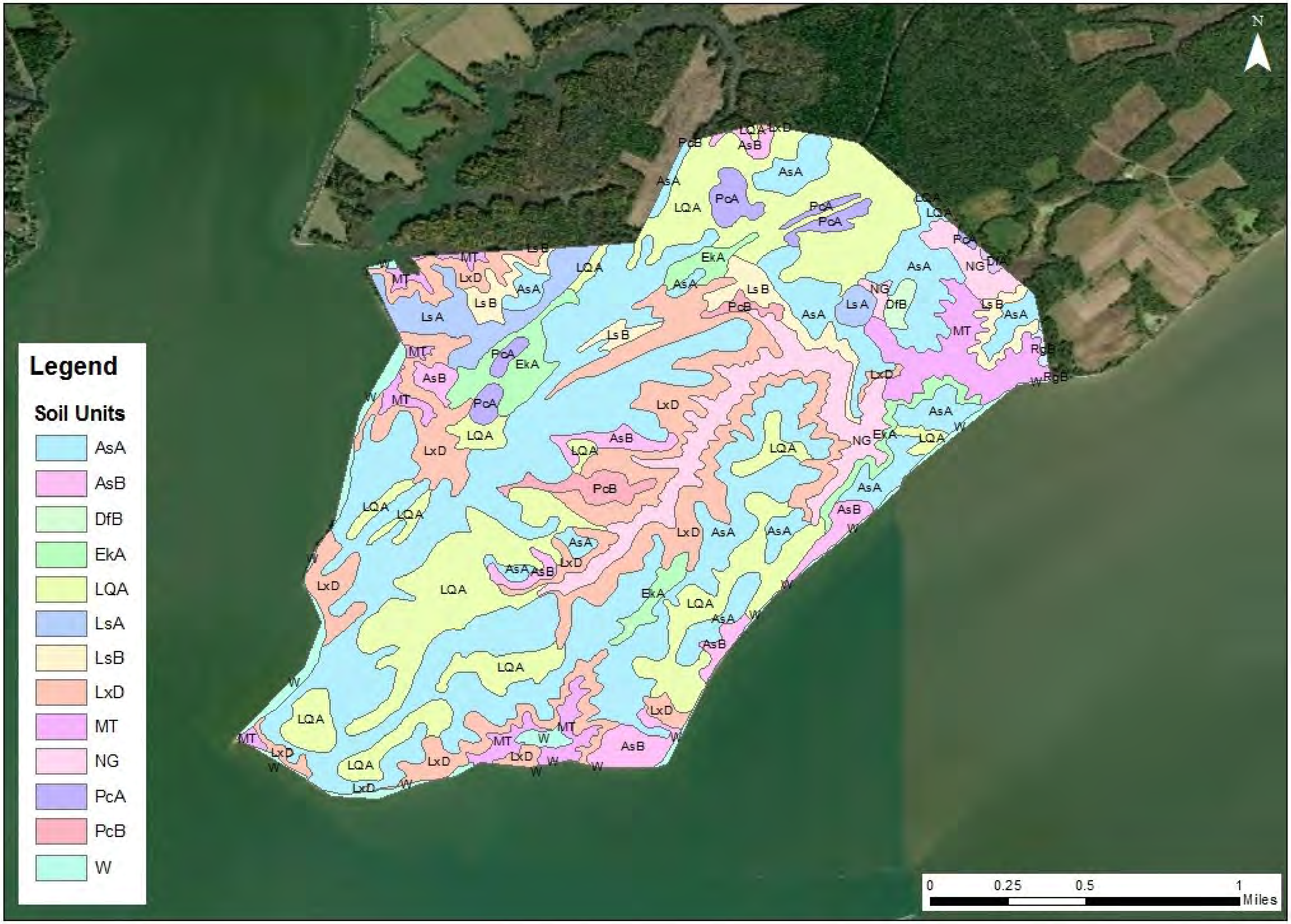
3.4.4.2 *Topography*

3.4.4.2.1 *Construction and Operation*

During construction of the shoreline improvements, the bank face of the existing shoreline would be graded at an approximately 10:1 slope to allow for the backfilling of clean sand for plantings of new marsh grasses. Although the Proposed Action would therefore permanently change the topography of approximately 3.5 miles of shoreline at the ALC BPRF, steep eroding bank faces will be converted to gently sloping sandy shoreline with marsh vegetation plantings. This action will allow for the establishment of a tidal marsh and decrease exposed bank faces. No changes to topography of the interior ALC BPRF property will occur as part of the Proposed Action.

Therefore, by restoring the shoreline to pre-erosional conditions, the Proposed Action will have a long-term, direct, beneficial impact to topography.

Figure 12. Soil Units at the ALC BPRF



3.4.4.3 ***Soils***

3.4.4.3.1 *Construction*

The Proposed Action would require grading of the eroding upland banks to a slope of approximately 10:1 to establish areas for sand nourishment. Grading would occur in areas where soils are currently exposed or minimally vegetated. Following grading and nourishment, exposed soil would be stabilized with native vegetation to permanently establish a marsh environment. To minimize potential generation of fugitive dust and sedimentation of surface water during grading and nourishment, the following BMPs would be implemented throughout the construction process.

- Install and maintain sedimentation and erosion control measures, including silt fences and water breaks, detention basins, filter fences, sediment berms, interceptor ditches, synthetic hay bales, rip-rap, and/or similar physical control structures.
- Maintain construction equipment in good working order and ensure the construction contractor has an emergency spill kit and is prepared to respond to a release of petroleum-based fluids (diesel, hydraulic fluid) to the soil.
- Refuel construction equipment in designated impervious areas and away from exposed soil surfaces.

The scope of the Proposed Action would also require ALC to develop and implement an MDE-approved stormwater management and erosion/sediment control plan. This plan is required to identify the measures to be used to capture sediment on-site, mitigate on-site soil erosion, and protect against downstream erosion by preventing increases in runoff from the construction area (MDE, 2015). ALC would submit their plan to the MDE Water Management Administration Sediment and Stormwater Plan Review Division for approval during the design process, and prior to construction.

No excavation of the nearshore will be necessary for construction of the shoreline protections structures. Prior to any stone being placed in the waters of the Potomac River or Nanjemoy Creek, filter fabric will be placed on the nearshore bottom. This will prevent disturbance of the sediment and minimize its release into the overlying water. Additionally, stone will be carefully placed on the filter fabric, rather than dropped from above the water surface. This BMP will further protect against sediment disturbance.

Therefore, construction of the Proposed Action would have short-term, direct, less-than-significant adverse impacts to soil at the ALC BPRF.

3.4.4.3.2 *Operation*

During operation of the Proposed Action, routine maintenance of the shoreline stabilization elements would be performed to ensure their proper function over time. As needed, unhealthy vegetation would be replanted and erosional ruts would be filled with additional sand.

The shoreline protection structures would reduce erosion of the ALC BPRF shorelines. Additionally, marsh plants would help anchor the sandy soils of the shoreline, further protecting the shoreline from erosion and subsequent sedimentation of the Potomac River and Nanjemoy Creek.

Therefore, operation of the Proposed Action would have long-term, direct, beneficial impact to soil resources at the ALC BPRF.

3.4.4.4 ***No Action***

No impacts to geology would be anticipated from the No Action alternative, baseline conditions would remain, as described above. Topography would continue to be altered as shoreline erosion progresses inland. Shorelines would continue to be exposed to wind-driven wave forces. This would have a significant adverse impact on the soils of the ALC BPRF due to the continued erosion of the exposed bank face soils.

3.5 Hydrology and Water Quality

3.5.1 Existing Conditions

3.5.1.1 ***Surface water***

3.5.1.1.1 *Regional Surface Water Conditions*

The Potomac River Basin is the second largest basin that drains into the Chesapeake Bay, draining surface waters from the District of Columbia, parts of Maryland, Pennsylvania, Virginia and West Virginia. The Potomac River extends approximately 283 miles and is tidally influenced for its last 113 miles, including the area that abuts the ALC BPRF. The average tidal variation of the Potomac River at the ALC BPRF is 20- to 40-inches daily and high tide is one-foot amsl. Average discharge to the Chesapeake Bay at the Potomac River mouth is approximately 14,300 cubic feet per second (cfs) (USACE, TNC, ICPRB, 2014).

Average daily flows for the Potomac River have been measured continuously since February 1895 at the Point of Rocks gage (01638500). The observed river flow characteristics of the Potomac River are primarily a result of weather, climate, and land use factors rather than a result of human flow regulation (USACE, TNC, ICPRB, 2014).

3.5.1.1.2 *ALC BPRF Surface Water Conditions*

The ALC BPRF is located between the lower Potomac River, or Potomac River estuary, and its tributary Nanjemoy Creek within the larger Chesapeake Bay region. In addition to these two waterbodies, there are two additional stream features at the ALC BPRF. Kings Creek originates approximately two miles northeast of the ALC BPRF and flows southwest, entering Nanjemoy Creek directly above the northwestern border of the ALC BPRF. An unnamed stream originates between Blossom Point Road and the NRL BPTF in the northern central portion of the ALC BPRF and flows north, then southeast, entering the Potomac River approximately 200 feet from the northeastern border of the ALC BPRF.

3.5.1.1.3 *Stormwater Conditions*

There are no point source discharges on the installation, therefore the ALC BPRF is not required to obtain a National Pollutant Discharge Elimination System (NPDES) permit. There are several drainage ditches, a retention pond, and an outfall constructed for the Space Network Expansion Ground System-East (SNEGS-E) antenna at the NRL. There are no separate stormwater management systems present at the ALC BPRF because there are few impervious surfaces. Stormwater run-off from inland impervious surfaces infiltrates into the ground before it can enter the Potomac River or Nanjemoy Creek.

3.5.1.1.4 *Hydrologic Conditions*

In the tidally-influenced portion of the Potomac River (where the ALC BPRF is located), poor water quality is a greater stressor on biological communities than flow alteration due to human impediments such as dams, as eutrophication and sedimentation have changed estuarine flow relationships (USACE, TNC, ICPRB, 2014). Portions of the river with low to moderate flow rates currently have higher nutrient levels and poor light penetration. This is believed to be due to excessive urban runoff and increased sedimentation of these river segments (USACE, TNC, ICPRB, 2014). Because the ALC BRPF shoreline is unprotected, its erosion is considered to make an incremental contribution to the overall eutrophication and sedimentation of the lower Potomac River.

3.5.1.2 ***Wind and wave action***

Wind impacts the height and strength of waves. The longer the fetch (the distance traveled by wind or waves across open water), the larger the resulting wave, and the more potential erosive damage on impacted shorelines.

Erosion is most likely when waves combine with winds above 20 miles per hour (mph). Winds above 20 mph at Blossom Point typically come from the northwest, north, and west (VIMS, 2016). Reach II and Reach III along the Potomac River are most impacted from wind-driven waves from the southwest, south, and southeast (VIMS, 2016).

Wave climate analysis performed on Reaches II and III showed the following (VIMS, 2016):

- 25 mph winds combined with a 3-foot storm surge could generate waves up to 1.5 feet for Reach II and 1.4 feet for Reach III.
- 35-mph wind combined with a 4-foot storm surge could generate waves up to 2.3 feet for Reach II and 2.1 feet for Reach III.
- 45-mph wind combined with a 5-foot storm surge could generate waves up to 3.1 feet for Reach II and 2.9 feet for Reach III.
- 55-mph wind combined with a 6-foot storm surge could generate waves up to 4 feet for Reach II and 3.8 feet for Reach III.

These wind and wave interactions cause extensive erosion to the ALC BPRF shoreline.

3.5.2 Environmental Consequences

3.5.2.1 ***Construction***

Grading activities during construction of the Proposed Action would temporarily expose soils, leading to potential sedimentation of the Potomac River and Nanjemoy Creek. To minimize these impacts the construction contractor would adhere to the BMPs described in section 3.4.4.2 for Soils.

Construction of the Proposed Action is not anticipated to have any impacts on wind or wave forces.

Therefore, construction of the Proposed Action would have short-term, direct, less-than-significant adverse impacts on hydrology and water quality.

3.5.2.2 ***Operation***

3.5.2.2.1 *Surface Water*

Since dams have not been found to cause significant disturbances in hydrology (USACE, TNC, ICPRB, 2014), it is unlikely that the addition of shoreline protection structures such as sills would have significant adverse impacts. Shoreline protections would contribute to maintaining flows by preventing erosion and upholding stable land masses that direct flows (USACE, TNC, ICPRB, 2014). Shoreline protection structures would also help improve water quality by preventing sedimentation from eroding bank faces. No new impervious surfaces would be created; therefore, no additional runoff would result from the Proposed Action.

Additionally, as part of the Proposed Action, tidal marsh would be established along approximately 3.5 miles of the ALC BPRF shoreline. Marshes temporarily store and slowly release stormwater and improve water quality by reducing stormwater flows and removing sediments and associated pollutants. Therefore, the Proposed Action would have long-term, direct and indirect, beneficial impacts to surface water quality.

3.5.2.2.2 *Wind and Wave Action*

Shoreline protection structures such as sills can alter tidal exchange, wave height, and wave direction. In order to minimize these alterations while still attenuating erosive wave forces, the Proposed Action would be implemented in accordance with the 2016 SMP. Specifically, the SMP recommends using gapped sills along the majority of the ALC BPRF shoreline. Gapped sills provide spaces between sill structures that allow tidal exchange while still dissipating wave energy. This will help maintain current tidal exchanges while protecting the shoreline from further erosion from wind-driven waves.

The Proposed Action also includes sand nourishment and the planting of native marsh grasses along previously eroding shoreline. Typical marsh plants are shown to slow wind speeds and attenuate waves, thereby decreasing the energy of these forces and reducing the potential for erosion.

Therefore, the Proposed Action would have long-term, direct, beneficial impacts on wind and wave action at the ALC BPRF.

3.5.2.3 ***No Action***

Under the No Action alternative shoreline protection structures would not be built and sand nourishment and associated marsh plantings would not occur. This would leave the shorelines of the ALC BPRF vulnerable to wind-driven wave forces. Erosion of the shoreline would continue, leading to increased sedimentation and eutrophication of the Potomac River and Nanjemoy Creek.

Therefore, the No Action alternative would have long-term, direct, significant adverse impacts on hydrology and water quality resources at the ALC BPRF.

3.6 Habitat and Wildlife

This section describes the biological resources potentially present at or near the ALC BPRF, including terrestrial and aquatic habitats, wildlife, and special status species.

3.6.1 Vegetation Communities

Historically, the ALC BPRF was classified as an oak-hickory-pine forest habitat. Medium to tall forested areas of broadleaf deciduous and needle leaf evergreen trees were characteristic of the area. Parts of the installation were cleared for development and agriculture, lending to its current state. Vegetation types include maintained lawn, forestland, grassland, and wetlands. Tree cover consists of natural stands of mixed maples (*Acer* spp.), oaks (*Quercus* spp.), black locust (*Robinia pseudoacacia*), black walnut (*Juglans nigra*), sweetgum (*Liquidambar styraciflua*), blackgum (*Nyssa sylvatica*), ash (*Fraxinus spp*.), willow (*Salix spp*.), tulip poplar (*Liriodendron tulipifera*), Virginia pine (*Pinus virginiana*), red cedar (*Juniperus virginiana*), and American holly (*Ilex opaca*). Scattered sumac (*Rhus spp*.), tulip poplar, and sycamore (*Platanus occidentalis*) are found along the streams and swamps. Shrubs and small trees include elderberry (*Sambucus canadensis*), bayberry (*Myrica heterophylla*), autumn olive (*Elaeagnus spp*.), dogwood (*Cornus florida*), sweetbay (*Magnolia virginiana spp*.), and redbud (*Cercis canadensis*) (USACE, 2014).

Wetlands are extensive at the ALC BPRF. There are 25 wetlands identified on ALC BPRF totaling approximately 264 acres (USACE, 2014). Most of these wetlands are estuarine emergent wetlands, palustrine forested, estuarine scrub-shrub and palustrine scrub-shrub wetlands. Dominant wetland vegetation includes common cattail (*Typha latifolia*), sedges (*Carex spp.* and *Cyperus spp*.), and common reed (*Phragmites australis*) in marshes, while high bush blueberry (*Vaccinium corymbosum*), red maple (*Acer rubrum*), American holly, and sweetgum are dominant in forested wetlands. The estuarine emergent wetlands represent important feeding, resting, and cover areas for migratory and resident birds and waterfowl. Further discussion of wetlands is provided in Section 3.9.

Submerged aquatic vegetation (SAV) has been historically documented to occur adjacent to the ALC BPRF shoreline. SAV is important in providing erosion control, water quality benefits, and fish habitat. SAV is also an important source of primary production. However, no significant SAV has been mapped in the nearshore along the Potomac River or Nanjemoy Creek coasts since 2007 (Virginia Institute of Marine Science , 2016). A query of the Maryland Environmental Resource & Land Information Network's (MERLIN) database yielded no SAV presence in Nanjemoy Creek and the Potomac River along the ALC BPRF shorelines or within a mile of the ALC BPRF (Maryland DNR, 2018a).

In a letter dated March 06, 2019 ALC solicited input from NOAA National Marine Fisheries Service (NMFS) on the Proposed Action. NMFS Habitat Conservation Division responded in a letter dated April 04, 2019 and provided information about SAV in proximity to the ALC BPRF. SAV is present in Kings Creek, the surface water feature that enters Nanjemoy Creek just north of the ALC BPRF boundary. Construction plans will avoid placing stones or sand fill in any area where SAV has been mapped in the last five years and ALC will minimize impacts to SAV from wave refraction. Additionally, time of year restriction to protect spawning fish are incorporated into the Proposed Action. During review of the Draft EA, NOAA expressed appreciation for commitments to include these minimization practices and time of year restrictions (a copy of this correspondence is included in Appendix B).

3.6.2 Invasive Species

Invasive species at the ALC BPRF are managed through an Invasive Species Management Plan. Methods of control vary depending on the species and generally involve biological, chemical, manual, and mechanical treatment. In addition, ALC monitors and protects the headwaters of wetlands and intermittent streams from unnecessary disturbance in order to prevent invasive species from being transported downstream.

Common invasive species at the ALC BPRF include tree of heaven (*Ailanthus altissima*), garlic mustard (*Alliaria officinalis*), wild garlic (*Allium vineale*), Japanese barberry (*Berberis thunbergii*), bull thistle (*Cirsium vulgare*), autumn olive, English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*), princess tree (*Paulownia tomentosa*), common reed (*Phragmites australis*), mutiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), and Johnson grass (*Sorghum halepense*).

3.6.3 Terrestrial Wildlife

The ALC BPRF is suitable for many species of terrestrial wildlife because of the diversity of habitats. Common mammal species include the white-tailed deer (*Odocoileus virginianus*), gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), woodchuck (*Marmota monax*), opossum (*Didelphis virginiana*), mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and gray fox (*Urocyon cinereoargenteus*).

The ALC BPRF also provides suitable habitat for forest interior dwelling (FID) birds, species that require large forest tracts to breed successfully; while the waterfront area provides suitable waterfowl concentration and staging areas. During 2018 avian surveys, a total of 94 species were observed. Of these 94 species, 16 were identified as FID species (Table 13) (USACE, 2019).

Table 13. Forest Interior Dwelling Species in the Proposed Action Area

Common Name	Scientific Name
Acadian flycatcher	*Empidonax virescens*
American redstart	*Setophaga ruticilla*
Barred owl	*Strix varia*
Black-throated green warbler	*Setophaga virens*
Black-and-white warbler	*Mniotilta varia*
Brown creeper	*Certhia Americana*
Hairy woodpecker	*Leuconotopicus villosus*
Northern parula	*Setophaga Americana*
Ovenbird	*Seiurus aurocapilla*
Pileated woodpecker	*Dryocopus pileatus*
Prothonotary warbler	*Protonotaria citrea*
Red-eyed vireo	*Vireo olivaceus*
Red-shouldered hawk	*Buteo lineatus*
Scarlet tanager	*Piranga olivacea*
Wood thrush	*Hylocichla mustelina*
Yellow-throated vireo	*Vireo flavifrons*

3.6.4 Aquatic Wildlife

The nearshore and intertidal areas bordering the ALC BPRF provide suitable habitat for aquatic wildlife. Terrapin and horseshoe crab spawning habitat is likely present at the beaches along the shoreline. The waters bordering the ALC BPRF provide habitat for anadromous fish such as Yellow perch (*Perca flavescens*) and largemouth bass (*Micropterus salmoides*). Finfish surveys from 2003 to 2017 reveal a total of 44 species occurring at ALC BPRF (Maryland DNR, 2017). The most common species are white perch (*Morone Americana*), Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), striped bass (*Morone saxatilis)*, and bay anchovy (*Anchoa mitchilli*). Farther upstream, Nanjemoy Creek provides spawning habitat for alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and white perch. Natural oyster bars are also found near the ALC BPRF, typically a short distance downstream within the mainstem of the Potomac River. None are within the construction area of the Proposed Action (Maryland DNR, 2018a).

While present in the vicinity of the ALC BPRF shoreline, the benthic macroinvertebrate community is characterized as poor, according to the Maryland Department of Natural Resources (MDNR) Biological Stream Survey. Only seven different benthic families were collected during previous surveys, indicating low diversity and poor stream quality (Maryland DNR, 2018b).

3.6.5 Special Status Species

3.6.5.1 *Federally-Listed Species*

The U.S. Fish & Wildlife Service (USFWS) and NMFS administer the Federal Endangered Species Act (ESA) of 1973, which protects listed species against killing, harming, harassing, or any action that may damage their habitat. The USFWS has primary responsibility for terrestrial and freshwater organisms, while NMFS has jurisdiction over marine wildlife. An official species list was obtained from the USFWS Information for Planning and Consultation project planning tool on 20 December 2018 to identify potential threatened and endangered (T&E) species that may occur in the proposed project location, and/or may be affected by the Proposed Action. Based on this consultation, no federally listed T&E species or critical habitat under the jurisdiction of USFWS has the potential to occur in the vicinity of the Proposed Action. Based on a search of the NOAA NMFS database, the federally endangered Atlantic sturgeon (*Acipenser brevirostrum*) and shortnose sturgeon (*Acipenser oxyrinchus oxyrinchus*) have the potential to occur in the construction area of the Proposed Action (NOAA, 2018a). In addition, critical habitat has been designated in the construction area for Atlantic sturgeon. Copies of the USFWS ESA Section 7 consultation package and NMFS Section 7 early consultation letter are included in Appendix A.

3.6.5.1.1 *Atlantic Sturgeon*

Atlantic sturgeons are anadromous and spend most of their lives in nearshore marine and estuarine waters, migrating to freshwater rivers and tributaries to spawn. Observations of Atlantic sturgeons in the Potomac River, including along the shoreline of the ALC BPRF, are limited. While the Potomac River has been confirmed to have had a historical spawning population, current spawning populations are absent. Although existing spawning habitat in the Potomac River seems to be intact, water quality is a major concern in this system due to low dissolved oxygen (DO) during the summer and poor sediment quality (Atlantic Sturgeon Status Review Team, 2007). In addition, clean, hard substrate for attachment of demersal adhesive eggs is limited within the Chesapeake Bay Distinct Population Segment (Atlantic Sturgeon Status Review Team, 2007). No individuals were observed in Nanjemoy Creek.

The poor benthic macroinvertebrate community may limit Atlantic sturgeon foraging. For this reason, as well as the poor water and sediment quality in the Potomac River, lack of confirmed and documented current spawning populations, and infrequent captures and observations of individuals, Atlantic sturgeons are not anticipated to be present along the shorelines of the ALC BPRF.

3.6.5.1.2 *Shortnose Sturgeon*

Shortnose sturgeons hatch in freshwater of rivers and spend most of their time in the estuaries of these rivers. Unlike Atlantic sturgeons, shortnose sturgeons tend to spend relatively little time in the ocean. There is little evidence of spawning populations in any river within the Chesapeake Bay, and no early life stages or young shortnose sturgeon have been observed in the Potomac River (Kynard et al., 2016). Adult individuals have been documented in the Potomac River, although in low abundance. No individuals were observed in Nanjemoy Creek.

The Potomac River has low DO levels and numerous water quality impairments affecting its potential for suitable habitat. The benthic community at the ALC BPRF shoreline is poor as well. For these reasons and due to the lack of confirmed and documented current populations, shortnose sturgeons are not anticipated to be present along the shorelines of the ALC BPRF.

3.6.5.2 ***State-Listed Species***

The MDNR administers the Nongame and Endangered Species Conservation Act, which is the primary Maryland law that governs the legal state listing of T&E species. A total of 54 state-listed T&E species, including 11 animals and 43 plants, have the potential to occur in Charles County (Maryland DNR, 2018c). In addition to state-listed T&E species, MDNR also designates state-listed rare and watchlist species, which are species that have a moderate to high risk of extinction or extirpation.

Rare, threatened, and endangered species surveys were conducted at the ALC BPRF in June and August 2015 to assess the presence of state-listed species (USACE, 2016). No federally listed species were observed. Habitat for the federally endangered small-whorled pogonia (*Isotria medeoloides*) was observed throughout the site. Although surveys were timed to occur during the flowering period, no individuals were observed. Habitat for the state-endangered rainbow snake (*Farancia erytrogramma*) was also noted throughout the site; however, no individuals were observed. In addition, one state rare/watchlist species was identified: American chestnut (*Castanea dentata*).

Avian surveys conducted at the ALC BPRF in 2018 found eight state-listed rare/watchlist species: bald eagle (*Haliaeetus leucocephalus*), least flycatcher (*Empidonax minimus*), brown creeper (*Certhia americana*), red-breasted nuthatch (*Sitta canadensis*), golden-crowned kinglet (*Regulus satrapa*), Swainson's thrush (*Catharus ustulatus*), golden-winged warbler (*Vermivora chrysoptera*), and dark-eyed junco (*Junco hyemalis*) (USACE, 2019). No T&E avian species were observed.

As no federal or state-listed threatened, or endangered species were observed during survey efforts, none are anticipated to occur within the ALC BPRF. During review of the Draft EA, MDNR confirmed this finding, but added that open waters surrounding BPRF are known historic waterfowl concentration areas, and that MDNR should be consulted in the future should water-dependent facilities be constructed. A copy of the MDNR consultation is included in Appendix A.

3.6.5.3 *Essential Fish Habitat*

NMFS regulates Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Based on a query of the NOAA EFH Mapper, designated EFH has been mapped for eight species along the ALC BPRF shorelines, as listed in Table 14. No Habitat Areas of Particular Concern (HAPCs) and no EFH Areas Protected from Fishing (EFHA) were identified in the construction area.

Table 14. EFH Species and Life Stages Potentially Found at the ALC BPRF Shorelines

Species	Egg	Larvae	Juvenile	Adult
Atlantic Herring	--	--	✓	✓
Bluefish	--	--	✓	✓
Clearnose Skate	--	--	✓	✓
Little Skate	--	--	--	✓
Red Hake	✓	✓	✓	✓
Summer Flounder	--	--	✓	✓
Windowpane Flounder	--	--	✓	✓
Winter Skate	--	--	--	✓

Mean salinity in this section of the Potomac River ranges from approximately one to four parts per thousand (ppt) throughout the year, with higher salinity during the late summer and fall seasons (Maryland DNR, 2018d). Mean water temperatures range from 38°F to 44°F during winter months and 55°F to 81°F during spring and summer months (Maryland DNR, 2018d). Given the low salinity, the Potomac River along the ALC BPRF shoreline is not expected to support suitable habitat for adult and juvenile EFH species. Adult and juvenile individuals are not likely to occur or would occur in low densities, as these species prefer high salinity zones (greater than 10 ppt) of the Chesapeake Bay (New England Fishery Management Council &

NMFS, 2017). These species also generally avoid water temperatures above 50°F. EFH for red hake eggs and larvae are not anticipated to be present as preferred habitat includes pelagic habitats within the middle to outer continental shelf of the Mid-Atlantic Bight (New England Fishery Management Council & NMFS, 2017). The ALC BPRF is not within this region. Therefore, EFH is not anticipated to be present along the ALC BPRF shoreline. A copy of the NMFS EFH consultation is included in Appendix A.

3.6.5.4 *Bald and Golden Eagle Protection Act*

Bald eagles (*Haliaeetus leucocephalus*) are known to nest at the ALC BPRF. Historically, the species experienced a severe population decline due to habitat loss and DDT contamination in fish (DDT, or dichlorodiphenyltrichloroethane, is an organochlorine pesticide). With ESA protection and the banning of DDT, bald eagle populations recovered, leading to the delisting of the species from the ESA in 2007. The species was subsequently delisted by the State of Maryland in 2010.

Bald eagles remain protected under the Bald and Golden Eagle Protection Act of 1940, which prohibits the take, possession, transport, or sale of live or dead eagles and their parts, nests, or eggs unless authorized by permit. Since 2013, annual fly over surveys conducted by the Center for Conservation Biology, have confirmed the presence of active bald eagle nests and chicks at the ALC BPRF. Most recently during March 2019 surveys, three active nests were observed. No active nests were identified along the ALC BPRF shoreline.

3.6.5.5 *Migratory Bird Treaty Act*

The Migratory Bird Treaty Act (MBTA) is an international agreement among the United States, Canada, and Mexico that protects designated migratory species. More than 1,000 species are protected under this act. The MBTA controls the take of these birds, their nests, eggs, parts, or products. Under EO 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds*, the Department of Defense (DoD) and USFWS established a memorandum of understanding to promote the conservation of migratory bird populations during DoD activities.

The ALC BPRF is located within the Atlantic Flyway, a main migratory route generally following the Atlantic Coast of North America. Approximately 500 species utilize the Atlantic Flyway. The 16 FID species (Table 13) observed during 2018 avian surveys are protected under MBTA, as well as the eight observed state-listed rare/watchlist species (Section 3.6.5.2).

3.6.6 Environmental Consequences

3.6.6.1 *Vegetation Communities*

3.6.6.1.1 *Construction*

Construction of the Proposed Action would result in minimal disruption to vegetation communities, particularly forested and grassland areas, for site access. Limited clearing would be required to establish temporary access points to the shoreline. All disturbed areas would be replanted with grass, shrubs, and trees, in accordance with the installation's *Forest Management Plan* and vegetation management guidance in the INRMP (USACE, 2014). In accordance with the ALC BPRF's *Invasive Species Management Plan*, native, non-invasive species would be planted where ground disturbing activities occur to restore any disturbed areas and prevent invasive species from spreading (USACE, 2014). Disturbed areas and areas where invasive species are likely to originate would be monitored for introduction or growth. In addition, ALC would monitor headwaters of wetlands and streams following any disturbance to prevent invasive species from being transported downstream by flowing water.

Therefore, construction of, the Proposed Action would have short-term, less-than-significant adverse impacts on vegetation communities.

3.6.6.1.2 *Operation*

The shoreline protection structures would stabilize the shoreline along Nanjemoy Creek and the Potomac River. Improved stability and resiliency of the ALC BPRF shoreline would contribute toward healthy soils and improved drainage, which would indirectly benefit plant growth and reproduction in the long run. Through strategic planting of wetland vegetation (e.g., *Spartina alterniflora*, *Spartina patens*, and *Scirpus cyperinus*) to stabilize the sand substrate from sand nourishment activities, the Proposed Action would also create new permanent marsh habitat. The Proposed Action would prevent further loss of land, and subsequently, minimize the loss and degradation of vegetation communities.

Therefore, operation of the Proposed Action would have long-term, beneficial impacts on vegetation communities.

3.6.6.2 ***No Action***

Under the No Action alternative, the SMP would not be implemented and shoreline conditions at ALC BPRF would remain as they currently exist for the foreseeable future. Continued erosion would result in nutrient loss in soils, adversely affecting the health of vegetation communities at the ALC BPRF shoreline. Erosion would also lead to the physical loss of soils, preventing plants from laying down extensive root systems. Changes in vegetation root depth and stability would weaken vegetation communities as a whole and leave plants vulnerable to uprooting during storm, flood, and wind events. Since riparian vegetation along the ALC BPRF shoreline can help combat erosion events, the weakening of plant life would lead to continued and increased erosion. Therefore, the No Action alternative would result in long-term, significant adverse impacts on terrestrial and aquatic vegetation communities.

3.6.6.3 ***Terrestrial Wildlife***

3.6.6.3.1 *Construction*

Construction of the Proposed Action would result in the disturbance and displacement of terrestrial wildlife and their habitats. Limited clearing for access points to the shoreline would occur and the transport of construction equipment may cause minimal disturbance to open fields. Additionally, use of construction equipment would generate disruptive noise and vibrations. Construction activities would occur over a small area relative to the amount of suitable habitat available for wildlife. Mobile terrestrial species would be able to avoid construction areas and utilize more favorable habitats nearby. However, construction of the Proposed Action may potentially cause loss of life to less mobile species during clearing activities. Overall, physical disturbance would be temporary and localized in nature.

To minimize potential adverse impacts to terrestrial species, the construction contractor would implement standard construction BMPs, such as using construction equipment with mufflers to minimize noise impacts and installing exclusionary fencing around construction sites. In a letter dated March 06, 2019 ALC requested early consultation from MDNR Environmental Review Program on the Proposed Action. The MDNR Environmental Review Program responded in a letter dated March 15, 2019 stating that the project site falls within a Waterfowl Concentration Area. Accordingly, ALC would adhere to time of year restrictions for clearing from 15 November through 1 March in order to protect overwintering waterfowl. As previously described, all disturbed areas would be replanted with native, non-invasive plant varieties after construction activities have been completed to provide suitable habitat for terrestrial species.

Therefore, the Proposed Action would have short-term, less-than-significant adverse impacts to terrestrial wildlife.

3.6.6.3.2 *Operation*

The shoreline protection structures would stabilize riparian habitat along Nanjemoy Creek and the Potomac River. The placement of plants, stone, and sand fill would provide long-term protection, restoration, and enhancement of vegetated shoreline habitats that would result in the protection of available foraging, shelter, and breeding opportunities for terrestrial species. Therefore, the Proposed Action would have long-term, moderate, beneficial impacts on terrestrial wildlife.

3.6.6.4 ***No Action***

Under the No Action alternative, the SMP would not be implemented and shoreline conditions at ALC BPRF would remain as they currently exist for the foreseeable future. As previously discussed, continued erosion would result in vegetation decline**.** A loss in vegetation would reduce foraging resources and opportunities to shelter for terrestrial wildlife. Many of the terrestrial species commonly found at the ALC BPRF rely on dense vegetation for protection and habitat. The loss of forest cover, wetland communities, and riparian vegetation due to erosion and shoreline degradation would adversely affect breeding and foraging behaviors of terrestrial wildlife. Therefore, the No Action alternative could result in long-term, direct, significant adverse impacts on terrestrial wildlife due to substantial loss or degradation of these shoreline habitats.

3.6.6.5 ***Aquatic Wildlife***

3.6.6.5.1 *Construction*

In-water construction work, such as barge operation and the placement of filter fabric and stone, would temporarily increase underwater noise and vibrations. There would also be potential disturbance to bottom sediments that would cause a temporary increase in suspended sediments and turbidity in the Potomac River and Nanjemoy Creek. An increase in turbidity could interfere with foraging and shelter behaviors, as well as affect fish respiration. Mobile species would be able to move to more suitable areas to avoid localized construction sites, while less mobile species, such as benthic invertebrates and larvae, may experience loss of life.

Total suspended sediment (TSS) concentrations created by beach nourishment operations along an open coastline are expected to be between 34.0-64.0 mg/L, lower than levels shown to have adverse effect on fish (580.0 mg/L for the most sensitive species), and benthic communities (390.0 mg/L) (NOAA, 2018). Considering beach nourishment materials consist primarily of coarse sands, plumes from the discharge should settle rapidly and not affect large areas.

Any adverse impacts would be temporary and further minimized through BMPs, such as silt curtains and turbidity barriers. ALC would also implement seasonal restrictions to in-water work during construction activities in efforts to minimize potential impacts to specified fish species. As previously mentioned, the MDNR Environmental Review Program responded to ALC's request for early consultation in a letter dated March 15, 2019. This letter stated that both the Potomac River and Nanjemoy Creek are classified as Use II streams with records of yellow perch. Generally, no in-stream work is permitted in Use II streams with yellow perch from 15 February through 15 June of any given year in order to protect spawning fish. Accordingly, ALC would adhere to time of year restrictions for instream work such that no work would be performed in the Potomac River or Nanjemoy Creek from 15 February through 15 June in order to protect spawning fish.

Therefore, construction of the Proposed Action would result in short-term, direct, less-than-significant adverse impacts to aquatic wildlife.

3.6.6.5.2 *Operation*

The Proposed Action would enhance existing aquatic habitat by planting wetland vegetation. The new vegetation would provide shade and shelter for aquatic species, while increasing DO levels and stabilizing water temperatures. The Proposed Action would minimize erosion events along the ALC BPRF shoreline, decreasing sedimentation and reducing turbidity, resulting in an incremental improvement to water quality. Improved water quality would benefit aquatic habitats and species.

Therefore, the Proposed Action would have long-term, direct and indirect, beneficial impacts on aquatic wildlife.

3.6.6.6 ***No Action***

Under the No Action alternative, the SMP would not be implemented and shoreline conditions at ALC BPRF would remain as they currently exist for the foreseeable future. Increased or prolonged erosion from the No Action alternative would contribute adverse effects on water quality, and consequently, aquatic wildlife. Resulting effects, such as increased water temperatures, decreased levels of DO, and increased turbidity from sedimentation, would impact aquatic wildlife dependent on healthy water habitats. Polluted waterways could cause algal blooms which are toxic to fish, contributing to a loss of life as well as an impact to predator food sources.

Therefore, the No Action alternative would result in long-term, direct and indirect, significant adverse impacts on aquatic wildlife at the ALC BPRF shoreline and downstream of it due to an increase in turbidity and sedimentation from ongoing bank erosion.

3.6.6.7 ***Special Status Species***

3.6.6.7.1 *Construction*

No impacts to federal- or state-listed T&E species would occur as these species are not anticipated to be present at the ALC BPRF. In a letter dated March 25, 2019 the MDNR Wildlife and Heritage Service confirmed that there are no state or federally listed species within the project site. While no active bald eagle nests occur along the ALC BPRF shoreline, active nests are within one mile of the shoreline, with the closest nest less than 1,500 feet from Subreach IIA. Construction of the Proposed Action may result in noise and vibration disturbance to bald eagles. However, construction activities would be temporary and adhere to appropriate BMPs. To minimize potential impacts to bald eagles, in accordance with the *National Bald Eagle Management Guidelines* as well as the Army's *Endangered Species Management Plan for the Chesapeake Region Bald Eagle*, a minimum 330-foot buffer would be maintained around the nests and construction activities would only take place outside of the bald eagle breeding season (15 December through 15 June) (USFWS, 2007; US Army, 1996). Therefore, potential adverse impacts to bald eagles from construction of the Proposed Action would be short-term, and less-than-significant.

The Proposed Action would result in short-term, less-than-significant adverse impacts on EFH and migratory birds. Shoreline activities would cause construction-related disturbances, such as minor vegetation clearing and disruptive noise/vibrations, while activities in-water would increase turbidity and potentially cause physical disturbance to aquatic species and habitats. Construction activities would be temporary and localized to a small area for each reach. Additionally, mobile species would be able to avoid construction areas and move to more suitable areas during construction of the Proposed Action.

To minimize potential adverse impacts to EFH and migratory birds, construction of the Proposed Action would follow appropriate BMPs including installing silt curtains and turbidity barriers and adhere to any applicable permit conditions. As a general measure to protect avian species, any minor clearing would be planned to occur outside the primary nesting season to avoid potential impacts to migratory birds.

3.6.6.7.2 *Operation*

Implementation of the Proposed Action would reduce erosion and minimize sedimentation in the Potomac River and Nanjemoy Creek. As a result, water quality would improve and contribute toward healthier habitats for EFH. Shoreline improvements would also stabilize shoreline vegetation and incorporate strategic planting of wetland vegetation to create permanent marsh habitat, benefitting wildlife utilizing these areas. Enhanced aquatic and terrestrial habitats would provide increased shelter, foraging, and reproductive opportunities for EFH and migratory birds in the long term. Therefore, operation of the Proposed Action would result in long-term, direct, beneficial impacts to EFH and migratory birds.

3.6.6.8 ***No Action***

Under the No Action alternative, the SMP would not be implemented and shoreline conditions at ALC BPRF would remain as they currently exist for the foreseeable future. EFH species would experience habitat degradation from increased turbidity and sedimentation resulting from erosion and destabilization of the shoreline. Continued erosion would also result in vegetation decline and reduce foraging resources and opportunities to shelter for migratory birds. Therefore, the No Action alternative would result in long-term, direct, significant adverse impacts on EFH and migratory birds.

As no federal- or state-listed species are anticipated to occur at the ALC BPRF, no impacts to these species would occur under the No Action alternative. In addition, no active bald eagle nests were sighted along the ALC BPRF shoreline in 2013 surveys that could be affected by shoreline erosion; thus no impacts would occur to this species (USACE, 2014).

3.7 Cultural Resources

3.7.1 Existing Environment

Section 106 and Section 110 of the *National Historic Preservation Act of 1966*, as amended (NHPA) (Pub. L. 89-655, 16 USC 470 et seq.), ensures that federal agencies consider cultural resources, defined as any prehistoric or historic district, site, building, structure, or object eligible for inclusion on the National Register of Historic Places (NRHP), in their proposed programs, projects, and actions prior to initiation.

Cultural Resources are managed at ALC BPRF through the implementation of the Integrated Cultural Resources Management Plan (ICRMP) (CENAB, 2016). The ICRMP outlines specific procedures for consultation with the Maryland State Historic Preservation Office (MD SHPO), the Advisory Council on Historic Preservation (ACHP), the National Park Service, federally-recognized Native American tribes, and other potential partners in cultural resource management. The ICRMP was developed to protect resources significant to American history and prehistory. The ICRMP also provides an internal compliance and management tool that integrates the entirety of the cultural resources program with ongoing mission activities.

3.7.1.1 ***Cultural History***

The ALC BPRF property has a long history of human presence that extends to the prehistoric era. In Maryland, the three major periods of the prehistoric era are the Paleoindian (12,000-9,500 BC), the Archaic (9,500-1000 BC), and the Woodland (1000 BC-1600 AD). These periods are defined by different material cultures, settlement patterns, and strategies for obtaining sustenance. The Paleoindian period was characterized by nomadic hunters and gatherers. The Archaic period was characterized by smaller game hunting and wider spread gathering. The Woodland period was characterized by an increase in material culture and advances in food processing and storage techniques (CENAB, 2016).

The Historic Period in the Middle Atlantic region began with the first contact between Europeans and Native Americans in 1607. Settlement along the Potomac River occurred in the mid-17th century and Charles County was established in 1658. Cedar Point Neck was part of a large landholding called St. Thomas which was acquired by the Jesuit Order of Maryland in the mid-1600s. The Jesuit Order leased much of their land holdings at Cedar Point Neck to local farmers and the area remained mainly agricultural until the Jesuit Order leased much of the property to the Army for use as a field test facility in 1942 (CENAB, 2016).

3.7.1.2 *Archaeological Surveys and Sites*

A total of 14 archaeological surveys have identified 33 archaeological sites at the ALC BPRF. Historical records suggest that there is one and possibly two cemeteries located on the ALC BPRF. One of these is a possible prehistoric cemetery that is thought to be located on the western perimeter of Blossom Point. The other is a confirmed historic period cemetery that is located along the eastern side of Blossom Point, at Site 18CH162. There are no archaeological sites on the ALC BPRF that have been formally nominated to or included in the NRHP. However, there are multiple archaeological sites which are on the shorelines of the ALC BPRF and are threatened by erosion.

3.7.1.3 *Section 106 Consultation*

As part of the Section 106 consultation process ALC sent a letter to the Maryland Historical Trust (MHT) State Historic Preservation Officer (SHPO) on March 08, 2019 describing the Proposed Action and seeking concurrence that the proposed project would have No Effect on above-ground historic properties.

The Section 106 Criteria for Adverse Effect (36 CFR 800.5) defines an undertaking (action) as having an adverse effect on historic properties if the undertaking would alter, directly or indirectly, any of the characteristics that qualify a property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. The analysis considers potential effects to cultural resources located in and within view of the project area.

3.7.1.4 *Native American Resources and Consultation*

For all federally proposed actions, federal agencies are required to consult with federally-recognized Native American Tribes in accordance with NEPA, the NHPA, the *Native American Graves Protection and Repatriation Act* (NAGPRA), and Executive Order (EO) 13175. Based on a review of the U.S. Department of the Interior Bureau of Indian Affairs database, there are no federally-recognized Native American Tribes in Maryland (BIA, 2019). The ALC BPRF is within the known historical range of the Piscataway Indians who are not federally recognized. No Native American sacred places are currently known to exist on the ALC BPRF.

3.7.2 Environmental Consequences

3.7.2.1 *Construction*

Construction of the shoreline protection structures will not require any excavating work. Additionally, the construction of temporary access lanes from the interior of the ALC BPRF to the shoreline, if required, would be positioned to avoid all known cultural resources at the ALC BPRF.

There is the potential for adverse impacts to cultural resources should any unknown cultural resources be discovered during grading work or other construction activities. To minimize the potential impact on previously unknown resources during construction, ALC would comply with the NHPA, *Archaeological Resources Protection Act of 1979* (ARPA), NAGPRA, *American Indian Religious Freedom Act* (AIRFA), 36 CFR Part 79, and EO 13007.

Additionally, ALC would implement an "Inadvertent Discovery" plan. Under this plan, if prehistoric or historic artifacts that could be associated with Native American, early European, or American settlement are encountered at any time during construction, ALC would cease all activities involving subsurface disturbance in the vicinity of the discovery. Should human remain or other cultural items, as defined by NAGPRA, be discovered during project construction, the construction contractor would immediately cease work and notify ALC to properly identify and appropriately treat discovered items in accordance with applicable state and federal law(s).

Implementation of these measures would ensure that potential impacts on cultural resources are maintained at long-term, direct, less-than-significant adverse levels.

Accordingly, ALC anticipates that construction of the Proposed Action would have no adverse effect on historic properties or archaeological resources. As previously described, ALC initiated Section 106 consultation with the MHT SHPO. MHT concurred with ALC's determination that the Proposed Action would have No Effect on any historic structures in a letter dated March 28, 2019. ALC will continue coordinating with MHT as shoreline improvement design and construction plans develop in order to determine the Proposed Actions effects on archaeological resources. Copies of MHT communications are provided in Appendix A.

3.7.2.2 *Operation*

Operation of the Proposed Action would have a long-term beneficial impact on cultural resources at the ALC BPRF by stabilizing the shoreline and preventing the potential loss of known or undiscovered archaeological sites or cultural resources from being washed away through shoreline erosion.

3.7.2.3 *No Action*

Under the No Action alternative, the Proposed Action would not be implemented and baseline conditions would remain, as described above. Potentially significant adverse impacts could occur under the No Action alternative, should erosion lead to loss of known or yet to be discovered archaeological sites or cultural resources present within the shorelines of the ALC BPRF.

3.8 Noise

3.8.1 Existing Environment

Sound occurs when vibrations that travel through a medium are interpreted by the biological elements of the ear. Noise occurs when sounds become undesirable, unpleasant, or damaging.

Sound pressure levels are quantified in decibels (dB), which is dependent on both frequency and intensity, and is given a level on a logarithmic scale. The way the human ear hears sound intensity is quantified in A-weighted decibel (dBA), which are level "A" weights according to weighting curves. Sound levels for common activities and construction work are presented in Table 15. Noise levels and durations from these activities would vary depending on the specific equipment being used, and the impact from this noise on a receptor would depend on the distance between the receptor and the source of the noise. Generally, noise levels decrease by approximately 6 dBA for every doubling of distance for point sources (such as a single piece of construction equipment), and approximately 3 dBA for every doubling of distance for line sources (such as a stream of motor vehicles on a busy road at a distance).

The National Institute for Occupational Safety and Health (NIOSH) recommends that individuals working in an environment of 85 dBA or louder for an eight-hour work day limit their exposure to this noise level and wear protective earwear to help manage and prevent hearing loss due to noise exposure.

Table 15. Common Household, Industrial, and Construction Sound Levels

Sound Level (dBA)	Common Sounds	Effect
140	Jet engine	Painful
130	Near air-raid siren	Painful
120	Jet plane takeoff, siren	Painful
110	Chain saw, Thunder, Garbage Truck	Extremely Loud
100	Hand drill	Extremely Loud
90	Subway, passing motorcycle	Extremely Loud
85	Backhoe, Paver	Very Loud
80	Blow-dryer, kitchen blender, food processor, cement mixer, power saw	Very Loud
70	Busy traffic, vacuum cleaner, alarm clock	Loud
60	Typical conversation, dishwasher, clothes dryer	Moderate
50	Moderate rainfall	Moderate
40	Quiet room	Moderate
30	Whisper, quiet library	Faint

3.8.1.1 *Noise Receptors*

Noise sensitive receptors are defined as properties where frequent human use occurs and where a lowered noise level would be of benefit. These noise sensitive receptors are residences, hospitals, libraries, recreation areas, churches, and other similar uses.

There are no hospitals, churches, schools, or other similar areas within one mile of the ALC BPRF. The closest noise receptors to the ALC BPRF are ALC BPRF employees, contractors using the property for testing, individual farm residences located on Cedar Point Neck, residences along Blossom Point Road, and residences across the Potomac River and Nanjemoy Creek from the ALC BPRF.

3.8.1.2 *Current Noise Conditions*

Currently, the largest source of potential noise to receptors generated at the ALC BPRF is the explosives testing and firing operations. These operations occur between eight AM and four PM and testing is voluntarily limited to 15 pounds per explosion (CCC, 2012). Testing is mainly contained to the southern portion of the peninsula. Other operational noises are generated from routine maintenance equipment (mowers) and staff vehicle traffic.

Occasional acoustical testing occurs at the ALC BPRF. Acoustic testing is performed using a mounted acoustic source which can produce 20,000 acoustic watts of power (CCC, 2012). In response to environmental concerns ALC BPRF has limited the scope and duration of acoustic testing and it is no longer performed at high levels that would create unacceptable noise for nearby receptors (CCC, 2012).

According to the 2012 Joint Land Use Study (JLUS) for the ALC BPRF and Charles County, there have been noise complaints associated with operations at the ALC BPRF, mainly from residents on nearby farms. Some of these concerns were voiced at a public meeting held on December 10, 2009. However, noise testing conducted on April 12, 1990, showed that actual noise heard at four nearby locations was below levels of concern. The type of testing at the ALC BPRF has remained relatively similar since 1990, however the frequency of testing has increased, averaging 20 days of testing per month in 2012 (CCC, 2012).

As part of the 1990 noise study, noise contours were developed for the detonation operations at the ALC BPRF. These contours are divided into three zones, Zone I, Zone II, and Zone III. The area encompassing Zone I is entirely outside of the ALC BPRF boundary. All non-facility associated noise sensitive receptors are located within this zone and noise generated from the ALC BPRF is considered at acceptable levels. Zone II extends slightly beyond the ALC BPRF boundary and noise levels within this zone would typically be considered unacceptable to receptors. Zone III is entirely confined to the testing area of the ALC BPRF and contains the majority of unacceptable noise levels (CCC, 2012).

3.8.2 Environmental Consequences

3.8.2.1 *Construction*

During construction of the proposed shoreline improvements noise would be generated from the operation of heavy construction equipment used for grading, stone placement, and placement of sand fill.

Noise levels from these activities would vary depending on the duration and type of specific equipment being used, while the impact from this noise on a receptor would depend on how far the receptor is from the noise source. Noise from construction activities varies depending on the type of equipment being used, the area that the action would occur in, and the distance from the noise source. To predict how these activities impact adjacent populations, noise from probable equipment was estimated. For example, construction usually involves several pieces of equipment (e.g., bulldozers and trucks) that can be used simultaneously. Under the Proposed Action, the cumulative noise from the equipment, during a typical day, was estimated to determine the total impact of noise from construction activities at a given distance. Examples of expected cumulative construction noise during daytime hours at specified distances are shown in Table 16.

Table 16. Estimated Noise Levels from Construction Activities

Distance from Noise Source in feet (meters)	Estimated Noise Level in dBA
50 (15.2)	90–94
100 (30.5)	84–88
150 (45.7)	81–85
200 (61.0)	78–82
400 (121.9)	72–76
800 (243.8)	66–70
1,200 (365.8)	< 64

Construction noise may be perceived by receptors including ALC BPRF staff and residents living in the vicinity of the ALC BPRF shoreline. As previously described, the Proposed Action would occur in phases, contingent upon funding. Each phase of the Proposed Action is anticipated to generate a similar degree and amount of noise; but may be perceived differently and by different receptors depending on which Reach is undergoing construction at that time. Noise associated with these activities would cease once each phase of construction is complete. The nearest receptors to

Reaches I and II are residences along the western shoreline of Nanjemoy Creek, approximately one mile away. The nearest receptors to Reach III are residences on the upper portions or Cedar Point Neck and residences across the Potomac River on Mathias Point, VA, located approximately 1.5 and 2.5 miles away, respectively. These potential receptors are all more than 1,200 feet away from the ALC BPRF shorelines, where construction noise would be generated. Therefore, construction noises at these receptors would be anticipated to be less than 64 dbA.

To further minimize potential adverse impacts from construction noise, construction activities would be scheduled to occur outside of normal testing operation to the greatest extent practicable. Additionally, the following BMPs would be implemented:

- Schedule construction activities during daylight hours during the weekday unless extenuating circumstances require activities to be completed outside the normal construction schedule.
- Maintain mufflers and sound shielding on construction equipment and shut down construction equipment when not in use for more than three minutes.
- Schedule notably loud construction work to avoid impacts during testing operations to minimize cumulative impacts to receptors and to prevent interference to normal operations, particularly at the NRL.
- Provide hearing protection to workers for activities that exceed the OSHA permissible noise exposure level.

Therefore, noise associated with constructing the proposed shoreline improvements would have a short-term, direct, less-than-significant adverse impacts on sensitive receptors.

3.8.2.2 *Operation*

Normal testing operations at the ALC BPRF would not be affected by the operation of the Proposed Action. Additionally, no changes to the noise profile generated from routine maintenance activities would occur during operation of the Proposed Action.

Therefore, operation of the Proposed Action would have no impact on sensitive noise receptors.

3.8.2.3 *No Action*

Under the No Action alternative construction would not occur and there would be no additional noise generated from construction operations. Noise levels from normal testing operations of the ALC BPRF would remain unchanged. Therefore, no impacts to noise receptors would occur and baseline conditions would remain, as described above.

3.9 Wetlands

3.9.1 Existing Environment

3.9.1.1 *Wetland Regulations*

The USACE has regulatory jurisdiction over Waters of the United States, including wetlands pursuant to Section 404 of the *Clean Water Act* (CWA) and Navigable Waters of the United States pursuant to Section 10 of the 1899 Rivers and Harbors Act. Jurisdictional wetlands are delineated based upon the presence of hydric soils, hydrologic indicators, and hydrophytic vegetation in accordance with the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual for the Atlantic and Gulf Coastal Plain Region (USACE, 2012) and Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979). In Maryland, activities impacting wetlands must be determined for consistency with the Maryland Tidal Wetland Act and the Non-tidal Wetlands Protection Act.

Construction activities associated with the Proposed Action would be subject to the Chesapeake Bay Critical Areas Act. The Critical Areas Act is implemented by the Critical Area Commission. The Critical Area includes all land within 1,000 feet of Maryland's tidal waters and tidal wetlands, as well as the waters of the Chesapeake Bay, the Atlantic Coastal Bays, their tidal tributaries, and the lands underneath these tidal areas. The Critical Area Buffer is the land area immediately adjacent to tidal waters, tidal wetlands, and tributary streams. The minimum buffer width is 100 feet and it is measured from the mean high-water line, or from the edge of tidal wetlands and streams. Development activities that result in disturbance to land or natural vegetation or that involve the construction of a structure or result in new lot coverage are generally not permitted within the 100-foot buffer, and it is suggested that the buffer be naturally vegetated. Activities within 25 feet of non-tidal wetlands must be coordinated with the MDE Wetlands and Waterways Program.

3.9.1.2 *Wetlands within the ALC BPRF*

There are 25 known wetlands identified on ALC BPRF totaling approximately 264 acres (CENAB, 2014). Most of these are classified as estuarine emergent, palustrine forested, estuarine scrub-shrub and palustrine scrub-shrub wetlands. Dominant wetland vegetation includes common cattail (*Typha latifolia*), sedges (*Carex* spp. and *Cyperus* spp.), and common reed (*Phragmites australis*) in marshes, while high bush blueberry (*Vaccinium corymbosum*), red maple (*Acer rubrum*), American holly (*Ilex opaca*) and sweet gum (*Liquidambar styraciflua*) are dominant in forested wetlands (CENAB, 2014). The estuarine emergent wetlands represent important feeding, resting, and cover areas for migratory and resident birds and waterfowl. Along the shoreline of the ALC BPRF there are approximately 4,576 feet of existing marsh (VIMS, 2016). Figure 13 depicts delineated wetlands on the ALC BPRF by wetland class.

3.9.2 Environmental Consequences

3.9.2.1 *Construction*

Construction of the shoreline protection structures would require creation of temporary construction access points leading to the shoreline. Access points would avoid all known wetland features at the ALC BPRF. Additionally, areas of established marsh along the shoreline will be avoided. These areas, including Reaches IB and IIC, are considered stable and do not require shoreline protection under this Proposed Action.

Grading activities have the potential to expose soils which could lead to sedimentation of tidal wetlands. To minimize potential adverse impacts the construction contractor would implement the management measures specified for Soils and Hydrology and Water Quality to prevent sedimentation of run-off and its potential migration to wetlands.

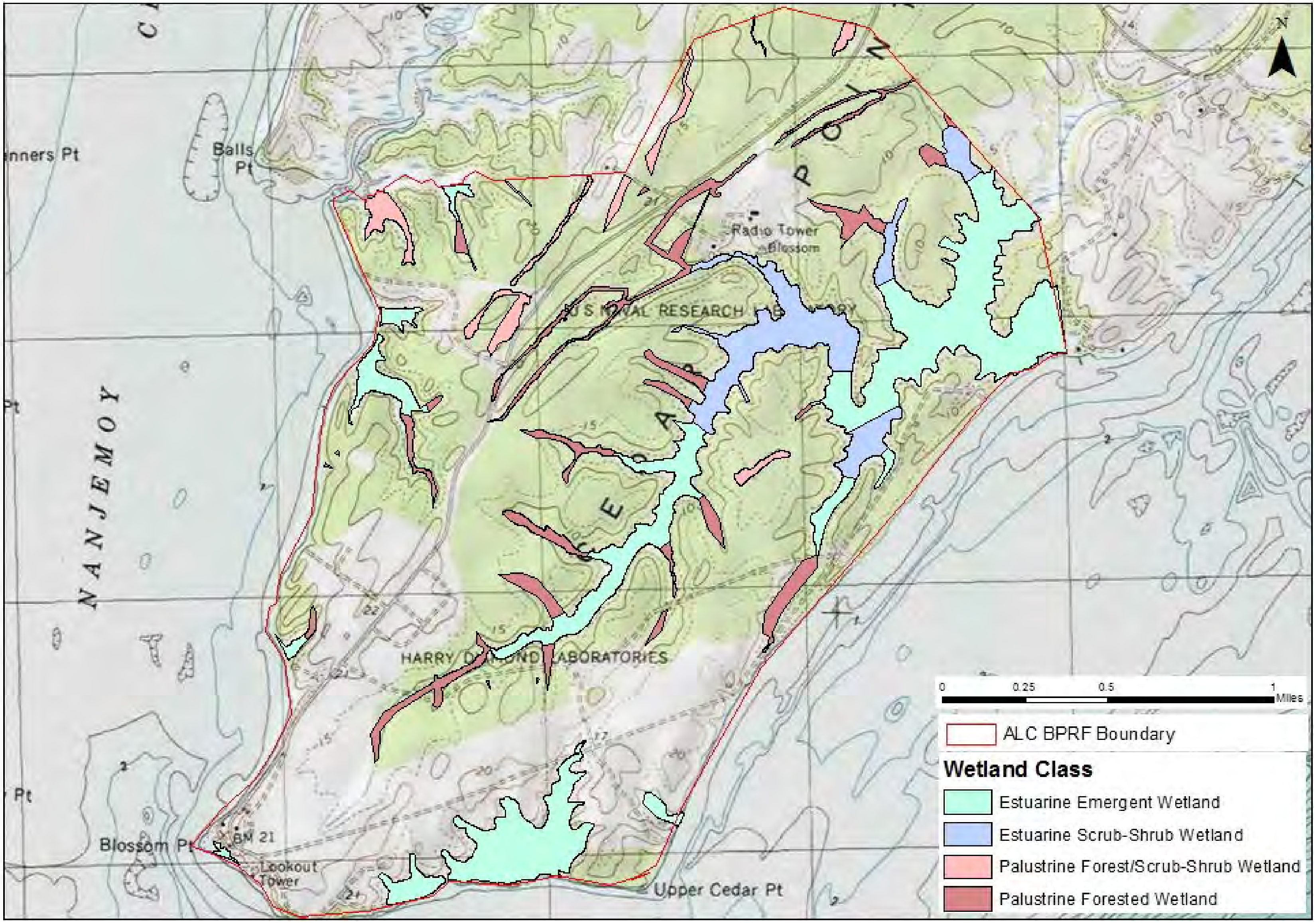
Therefore, construction of the Proposed Action would have no impacts to wetland resources.

3.9.2.2 *Operation*

As part of the Proposed Action approximately 340,000 new marsh grass plants including *Spartina alterniflora*, *Spartina patens*, and *Scirpus cyperinus* species would be planted along approximately 3.5 miles of the ALC BPRF shoreline to create new tidal marsh wetland areas. These new tidal marsh fringes would provide numerous ecosystem benefits including habitat for migratory and resident birds and waterfowl and improvements to water quality.

Therefore, operation of the Proposed Action would have long-term, direct, beneficial impacts by creating new tidal marsh wetlands at the ALC BPRF.

Figure 13. Wetlands at the ALC BPRF



3.9.2.3 *No Action*

Under the No Action alternative, no new wetlands would be created, and baseline conditions would remain, as described above. The beneficial impacts from implementing the Proposed Action would not occur.

3.10 Floodplains

3.10.1 Existing Environment

A floodplain is any lowland or relatively flat area adjoining inland and coastal waters that are subject to a one percent or greater chance of flooding in any given year. Floodplains perform important natural functions including temporary storage of floodwaters, moderation of peak flows, maintenance of water quality, and the prevention of erosion.

The ALC BPRF is identified on the Federal Emergency Management Agency (FEMA) floodplain map Charles County Unincorporated Areas 24017C0315D effective May 4, 2015. According to this map approximately one third of the ALC BPRF property, including the majority of the eastern shoreline along the Potomac River and the western shoreline along Nanjemoy Creek is located within the 100-year floodplain (Zones AE and VE). VE zones are designated coastal hazard areas and are subject to high velocity wind and wave action in addition to tidal flooding. A map depicting these flood hazard areas is provided in Figure 14.

In Maryland, construction activities that occur within the floodplain require a state permit from the Wetlands and Waterways Program, Water and Science Administration at MDE. The Maryland Model Floodplain Management Ordinance (FPMO) integrates National Flood Insurance Program and the state permit requirements.

3.10.2 Environmental Consequences

3.10.2.1 *Construction and Operation*

The Proposed Action would occur within the 100-year floodplain. However, construction would not alter floodplains or contribute to increased flooding of adjacent areas, because water would still be able to flow freely in Nanjemoy Creek and the Potomac River during the construction process. Additionally, construction activities would not alter water levels and thus not alter floodplain boundaries. ALC will conduct construction activities, including grading, in compliance with the FPMO and obtain all required permits and approvals (refer to Table 21) prior to starting construction.

Operation of the proposed shoreline improvements would help to reduce the intensity of coastal flood events at the ALC BPRF shoreline. Sand nourishment and planting native, non-invasive marsh vegetation will enhance the floodplain by storing floodwaters, as tidal marshes are known to act like sponges by temporarily storing flood waters. Additionally, using a living shoreline as a flood prevention tool can drastically decrease the costs associated with other types of flood control measures (e.g. structural modifications to buildings, barriers) and those associated with repairing environmental and infrastructure damage after a flood event (USEPA, 2006).

Additionally, Executive Order (EO) 11988 *Floodplain Management* directs all federal agencies to "take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities," and to "avoid direct or indirect support of floodplain development wherever there is a practicable alternative." No practical alternative to the shoreline stabilization measures has been identified by USAG for the ALC BPRF. Further, the

Figure 14. Floodplain Map

Proposed Action would be consistent with E.O. 13690, *Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*, issued January 30, 2015. E.O. 13690 amended E.O. 11988 and established the Federal Flood Risk Management Standard (FFRMS) to improve the Nation's resilience to current and future flood risks, which are anticipated to increase over time due to the effects of climate change and other threats. In accordance with E.O. 13690, the Proposed Action design considers a higher vertical flood elevation and corresponding horizontal floodplain than the base flood to address current and future flood risk to ensure its resiliency and lasts as long as intended. Accordingly, a Finding of No Practical Alternative (FONPA) has been prepared and included with this EA; a copy of the FONPA is provided in Appendix B.

Therefore, operation of the Proposed Action would have long-term, direct and indirect, moderate, beneficial impacts to floodplains at the ALC BPRF.

3.10.2.2 *No Action*

Under the No Action alternative shoreline protection structures would not be built and flood attenuating marsh vegetation would not be established. As sea levels continue to rise and large storms increase in frequency the ALC BPRF would be vulnerable to increased flooding without any shoreline protections in place. Therefore, the No Action alternative would result in long-term significant adverse flood impacts.

3.11 Coastal Zone Management

3.11.1 Existing Conditions

The *Coastal Zone Management Act* (CZMA) was enacted in 1972 to preserve, protect, develop, and where possible, to restore and enhance the resources of the nation's coastal zone. Coastal states are encouraged to develop state coastal management programs, and comprehensively manage and balance competing uses of and impacts to coastal resources.

The U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA) approves coastal management programs. The Maryland Coastal Management Program (CZMP) was approved by NOAA in 1978. The Maryland Department of Natural Resources (DNR) is the lead agency for the CZMP and implements the program. Section 307 of the CZMA mandates the federal consistency review process to ensure that any federal actions which are reasonably likely to affect any land or water use, or natural resource of a state's coastal zone be conducted in a manner that is consistent with a state's federally approved CZMP. In Maryland, the federal consistency review process is carried out by the Coastal Zone Consistency Division in the Wetlands and Waterways Program of the Water Management Administration (WMA) in the MDE.

The Maryland coastal zone extends from three miles out in the Atlantic Ocean to the inland boundaries of the 16 counties and Baltimore City that border the Atlantic Ocean, Chesapeake Bay, and the Potomac River up to the District of Columbia. The ALC BPRF is completely within the Maryland coastal zone and is anticipated to impact coastal resources to some degree. Therefore, the Proposed Action is subject to a federal consistency review under the CZMA and ALC will complete a federal consistency review as part of the NEPA process. A map of the Maryland coastal zone is provided as Figure 15.

Figure 15. Maryland Coastal Zone

3.11.2 Environmental Consequences

3.11.2.1 *Construction*

Construction of the Proposed Action would temporarily impact resources of the Maryland coastal zone due to construction activities and the presence of heavy construction equipment on the shorelines of the ALC BPRF. Some clearing of coastal zone vegetation would be required to gain access to the shoreline for the transport of equipment and materials to the construction site. However, these clearing lanes would avoid all wetland resources. Construction of shoreline protection structures would require some minor disturbance to the bottom of the nearshore due to the placement of filter fabric and stone. This could temporarily disturb benthic aquatic wildlife and increase sedimentation of the surface waters in the construction zone short-term. To minimize potential impacts from this process, stones would be carefully placed onto the filter fabric, and not dropped into the water.

To maintain the security of the ALC BPRF there is no recreational or commercial fishing allowed directly offshore of the ALC BPRF property and no aquaculture leases exist within the construction zone. Additionally, there are no recreational uses on the narrow beaches of the ALC BPRF shoreline. Therefore, there are no anticipated impacts to recreational or commercial coastal zone resources.

ALC, as part of the DoD, would submit a Negative Determination to the MDE in accordance with Maryland CZMP guidelines and the 2013 Memorandum of Understanding (MOU) between the State of Maryland and the DoD concerning federal consistency requirements of the CZMA (Maryland and DoD 2013), before initiating any phase of the Proposed Action. This would ensure that construction of the Proposed Action is consistent with the Maryland CZMP.

Therefore, construction of the Proposed Action would have short-term, direct, negligible adverse impacts to coastal zone resources.

3.11.2.2 *Operation*

The purpose of the CZMA is to preserve, protect, develop, and where possible, to restore and enhance the resources of the nation's coastal zone. By implementing the state of Maryland's preferred shoreline management strategy of Living Shorelines, the Proposed Action aligns with the goals of the CZMA by protecting and restoring the shorelines of the ALC BPRF and increasing their resiliency from erosion and large storm events. As stated in previous sections of this EA, the Proposed Action would have beneficial impacts to coastal zone resources including wetlands, floodplains, water quality, and shoreline aesthetics. Therefore, operation of the Proposed Action would have long-term, direct, beneficial impacts on coastal zone resources.

3.12 Socioeconomics

3.12.1 Existing Conditions

The ALC BPRF is located in the unincorporated community of Welcome in southern Charles County, MD. The socioeconomics of the area are influenced by the range of economic industries present in the county, including public admin, healthcare and social assistance, and retail trade. The population of Charles County grew approximately 21.5 percent between 2000 and 2010 and was the fastest growing county in Southern Maryland. This is more than double the population increase for the state of Maryland, 9 percent, over the same time period. This increase is due to natural growth and an increase in all minority populations within the county. The median household income of Charles County is $91,373, with 7.65 percent of the population living below the poverty level.

Relevant population and demographic data for Charles County and the state of Maryland are presented in Table 17, and economic data are presented in Table 18. The relevant economic and demographic data show that socioeconomic factors are relatively similar between Charles County and the State of Maryland, however Charles County has a higher minority population than the state of Maryland and lower poverty and unemployment rates.

Table 17. Demographic Data for Charles County and the State of Maryland

Location	Total Population(1)	Median Age	% Population under age 18(1)	% Minority Population(2)	% High School Graduates(1)
Charles County	154,357	37.9	24.2%	61.5%	92.8%
State of Maryland	6,052,177	38.5	22.3%	51.1%	89.6%

1 – U.S. Census Bureau 2018a
2 –includes all race/ethnicity categories except non-Hispanic White persons

Table 18. Economic Data for Charles County and the State of Maryland

Location	Number of Households(1)	% Population in Poverty(2)	% Unemployment Rate(2)
Charles County	54,105	7.65%	3.8%
State of Maryland	2,177,492	9.7%	4.3%

1 – U.S. Census Bureau, 2018b
2 – NOTE: Estimates are not comparable to other geographic levels due to methodology differences that may exist between different data sources.

3.12.2 Environmental Consequences

3.12.2.1 *Construction and Operation*

Construction of the Proposed Action would require the temporary employment of skilled laborers and the purchase of stone, sand fill, and other materials from local and regional vendors. The estimated total cost for construction of the shoreline improvements, including materials and labor, is approximately $9,777,254. As previously stated, construction would occur in phases, contingent on funding. The temporary increase in employment and spending on materials for each phase of the project would have a short-term, direct, beneficial but less-than-significant impact on the local economy. These construction-related beneficial impacts would end once each construction phase is completed.

Operation of the Proposed Action would require some occasional maintenance of the shoreline structures, however the materials and labor required for this maintenance would not be anticipated to impact the local economy beyond a negligible amount. However, operation of the shoreline improvements would increase the longevity of the ALC BPRF at its current location. This would avoid the high costs required to move the facility elsewhere.

3.12.2.2 *No Action*

No impacts to socioeconomics would occur under the No Action alternative, baseline conditions would remain, as described above. However, if erosion is allowed to continue unabated, ALC BPRF may be required to initiate a costly move to a new location.

3.13 Community Services

Community services addressed in this section include fire protection services, emergency [medical] services, law enforcement services, schools, and park facilities. Solid waste disposal is discussed in Section 3.14 and other community services including water, sewage, electricity, and stormwater drainage are discussed in Section 3.13.

3.13.1 Existing Conditions

The ALC BPRF has provided the USAG with a primary testing facility for fuzes, explosive and pyrotechnic devices, and telemetry systems since 1980. Other community services are provided off site of the ALC BPRF.

The nearest emergency medical center is the Civista Medical Center in La Plata, MD approximately 12 miles from the ALC BPRF. Fire and emergency response are provided by the Nanjemoy Volunteer Fire Department and emergency ambulance service is provided by the Ironsides Volunteer Rescue Squad located in Port Tobacco, MD. The Charles County Sherriff's Department, the Maryland State Police, and the La Plata Police all provide law enforcement support to the area. Other community services provided in Charles County include schools and parks and recreation.

3.13.2 Environmental Consequences

3.13.2.1 *Construction and Operation*

Construction activities are not anticipated to adversely affect established service ratios for fire protection, emergency services, law enforcement or schools. Potential incidents requiring fire protection or emergency services could occur during construction. However, the potential temporary increase in incidents would not exceed the capacity of services provided compared to the existing overall population and service area. Any increase in incidents as a result of construction activities at the project site is anticipated to be negligible and could be accommodated by existing service providers.

Although construction sites can be sources of attractive nuisances (e.g., providing hazards, potential for theft, or vandalism), no substantial increase in security or law enforcement demand would be anticipated given that the ALC BPRF is a secure facility and not generally accessible to the public. The Proposed Action would not influence school enrollment or use of parks as construction activities would be temporary and likely supported by workers from the local labor pool.

Therefore, construction of the projects under the Proposed Action would not result in significant construction-related effects on community services.

There are no anticipated impacts to any of the above-mentioned community services during operation of the Proposed Action. However, by stabilizing the shorelines and preventing further erosion the Proposed Action would protect the ALC BPRF from losing any land or critical infrastructure. This would allow the ALC to continue providing important testing facilities to USAG.

3.13.2.2 *No Action*

Under the No Action alternative, the shorelines of the ALC BPRF would continue to erode, potentially resulting in loss of land or critical infrastructure. This would negatively impact the long-term use of the property as an ALC testing facility. Therefore, the No Action alternative would cause long-term, direct, significant, adverse impacts to the community service related to providing the USAG with a primary testing facility for fuzes, explosive and pyrotechnic devices, and telemetry systems.

3.14 Transportation and Parking

3.14.1 Existing Conditions

Blossom Point Road serves as the sole entrance and exit route to the ACL BPRF. Blossom Point Road is a rural minor connector road. Average Annual Daily Traffic (AADT) for the segment of Blossom Point Road between Maryland State Route (SR) 6 to the entrance of the ALC BPRF is 1,062 (MDOT, 2018). SR 6, also known as Port Tobacco Road, is a rural major collector and the AADT for the segment of SR 6 closest to Blossom Point Road is 3,481.

There are several paved and unpaved access roads throughout the ALC BPRF. All paved roads within the ALC BPRF are undivided one or two-land roads. There is a small parking lot located in front (on the south side) of the range control building. This parking area provides space for approximately ten vehicles. Heavy construction vehicles frequently access the ALC BPRF via Blossom Point Road through the main entrance gate, therefore there are no anticipated road improvements needed to accommodate construction vehicles associated with the Proposed Action.

3.14.2 Environmental Consequences

3.14.2.1 *Construction and Operation*

Construction of the Proposed Action in its entirety would potentially require thousands of truck trips to provide stone and sand fill material to the construction site, if transport overwater by barge is not possible. However, it is anticipated that at least some phases of the project would be supplied materials by barge, depending on the depth of the nearshore and accessibility to the shoreline along each reach. If necessary, haul trucks and heavy construction equipment would travel on the existing roads of the ALC BPRF and local roads. Any equipment or material staging would not occur in the range control parking area.

As previously described, construction would be phased and contingent upon funding. Therefore, traffic increases associated with the Proposed Action would also be phased. The existing area roadway infrastructure is adequate for handling this temporary increase in roadway use, and no modifications to these roadways or traffic patterns would be required. These temporary traffic increases would cease once each phase of construction is completed. Therefore, the amount of traffic on ALC BPRF roads and adjacent roadways is not anticipated to decrease the level of service of Blossom Point Road and adjacent local roads.

To ensure that construction vehicles do not degrade the quality of the existing roadways within the ALC BPRF, gravel pads would be established at the exit of each construction area to ensure dirt is removed from construction vehicle tires before traveling on ALC BPRF roadways. Additionally, contractors would consult with ALC BPRF staff about roadway usage to ensure that construction activities do not interfere with normal testing operations.

Operation of the Proposed Action would not result in an increase in traffic or use of ALC BPRF roadways.

Therefore, the Proposed Action would have short-term, direct, negligible adverse impacts to transportation and parking resources at the ALC BPRF.

3.14.2.2 *No Action*

Under the No Action alternative, no construction equipment, vehicles, or materials would be transported to the ALC BPRF. Therefore, there would be no impacts to transportation or parking resources. Baseline conditions would remain, as described above.

3.15 Utilities

3.15.1 Existing Conditions

3.15.1.1 Water

Potable water at the ALC BPRF is supplied to the facility from offsite. There are no on-site wells that provide potable water to the ALC BPRF. The NRL has separate wells that supply their facilities with potable water. None of this water is used by the Army facilities at the ALC BPRF.

3.15.1.2 *Wastewater*

Sanitation is provided by onsite sewage disposal systems. Wastewater from the ALC BPRF latrine is treated by a mound system that uses evaporation rather than a filtration system, with an existing capacity for about 65 people. Solids are collected in a tank and removed every year by a private contractor. The solid tank is 1,500 gallons and the gray water tank is 2,500 gallons. The NRL facility operates and maintains a septic tank with tile field disposal and several aboveground sand mound disposal systems. The existing system adequately serves the existing flow (DOA, 2014).

3.15.1.3 *Electric*

Electric service is provided by Southern Maryland Electric Cooperative (SMECO). Overhead power lines enter the ALC BPRF from Blossom Point Road and run adjacent to the road throughout the property. The 19 active transformers are served by the overhead lines, and two pad mounted transformers are provided power by underground lines (DOA, 2014).

3.15.2 Environmental Consequences

3.15.2.1 *Construction and Operation*

Construction and operation of the Proposed Action would not require use of any of the above-mentioned utilities. Additionally, no utilities are located within the construction area. Therefore, there are no anticipated impacts to utilities from either construction or operation of the Proposed Action.

3.15.2.2 *No Action*

There are no anticipated impacts to utilities from the No Action alternative. Baseline conditions would remain, as described above.

3.16 Solid and Hazardous Materials/Exposure

3.16.1 Existing Conditions

3.16.1.1 *Solid Wastes*

Solid waste is collected by facilities personnel and transported and disposed of offsite by licensed private contractors. Any reusable solid waste is handled by the Defense Reutilization Marketing Officer (DOA, 2014).

Hazardous materials are typically not used, generated, or stored at the ALC BPTF. Used motor oil from site utility and operations vehicles and diesel generator fuel are stored in onsite storage tanks. Used oil is transported from the site by licensed contractors. The ALC BPRF has a Spill Prevention Control and Countermeasure Plan (SPCCP) in place to prevent and respond to any hazardous spills (DOA, 2014).

Weapons are not generally stored or stockpiled at the ALC BPRF. Minimal amounts of ammunition are occasionally stored on site in bunkers within designated explosive storage buildings. A 900-foot fragment distance designation around the storage area allows for the storage of high explosives when necessary.

3.16.1.2 *Installation Restoration Program*

ALC BPRF participates in the U.S. DOD Installation Restoration Program (IRP), which was established in 1978 to identify and evaluate past DOD hazardous waste sites and to control the migration of hazardous contaminants from these sites.

Under the IRP, an Installation Action Plan (IAP) has been prepared for the ALC BPRF (US Army, 2016). The IAP identifies environmental cleanup requirements at each operable unit, solid waste management unit, or area of concern, and proposes a comprehensive, installation-wide approach, along with the costs and schedules associated with conducting investigations and taking the necessary remedial actions.

As stated in the IAP, soil and groundwater contamination has been identified at the ALC BPRF. Remedial actions have and/or will include excavation of contaminated soil that is believed to be the source of groundwater contamination, followed by long-term groundwater monitoring until remedial goals are met (US Army, 2016).

Additionally, under the Military Munitions Response Program (MMRP), non-time critical removal actions were completed in August 2011 to address munitions and explosives of concern (MEC) in Nanjemoy Creek (site "BPF-002-R-01") and Potomac River South (site "BPF-002-R-03"). Completed removal actions included:

> (1) Installation of a 600-foot erosion control barrier along a portion of the Nanjemoy Creek shoreline to prevent potential MEC and munitions debris from eroding out of the slope above the shoreline
>
> (2) Distribution of public education pamphlets and posters at 14 different marinas within a 15-mile radius of the BPRF,
>
> (3) Updating of the navigation charts for BPRF water courses,
>
> (4) Annual surface sweeps of approximately 9.5 acres of shoreline along the Nanjemoy Creek and Potomac River South MRSs, and,
>
> (5) Posting of signage along the two MRS shorelines depicting, "DANGER," "EXPLOSIVE HAZARD" and "KEEP OUT."

3.16.1.3 *Unexploded Ordinance*

The DOD developed the Military Munitions Response Program (MMRP) to address munitions-related concerns, including explosive safety, environmental, and health hazards from releases of unexploded ordnance (UXO), discarded military munitions (DDM), and munitions constituents (MC) found at locations other than operational ranges on active and Base Realignment and Closure (BRAC) installations and Formerly Used Defense Sites (FUDS) properties. The MMRP addresses non-operational range lands with suspected or known hazards from munitions and explosives of concern (MEC) that occurred prior to September 2002 but are not already included in an Installation Response Program (IRP) site cleanup activity.

UXO is any munitions, weapons delivery system, or ordnance item that contains explosives, propellants, and chemical agents. UXO consists of munitions that are armed or otherwise prepared for action; are launched, placed, fired, or released in a way that they cause hazards; or remain unexploded either through malfunction or design. UXO presents an immediate safety danger (from explosion) and a long-term health threat (from toxic contamination).

Ordinance testing operations at the ALC BPRF over several decades has resulted in explosives contamination on the property. UXO is present across much of the ALC BPRF, with the highest levels of contamination existing in the southern portion of the property where most of the testing occurs. Although testing of explosive devices and projectiles over adjacent waterways is no longer conducted at the ALC BPRF, UXO contamination in Nanjemoy Creek and the Potomac River remains from previous decades of testing. Erosion and frost heaves have occasionally exposed UXO buried at depths up to 20 feet (CCC, 2012).

3.16.2 Environmental Consequences

3.16.2.1 *Construction and Operation*

Construction of the Proposed Action would generate solid wastes including cleared vegetation, excess stone and sand fill, and construction packaging. This waste would be typical of other similarly scaled construction projects and would not increase the amount of waste generated in Charles County to any noticeable degree. Excess construction materials would be reused to the maximum extent practicable. Cleared vegetation would be composted on or off-site. and other solid wastes would be collected and transported offsite for recycling or disposal.

To ensure the safety of all construction workers and ALC staff an explosive ordnance detonation (EOD) team would clear the construction area prior to the start of each construction phase. Additionally, a pre-construction safety briefing would be provided to the construction contractors outlining how to recognize UXO and the steps to follow. Should construction contractors encounter any UXO they would immediately cease all activities and report the finding to ALC BPRF personnel. The discovery would then be evaluated and handled appropriately by a UXO expert.

MRS areas BPF-002-R-01 and BPF-002-R-03 are located in Reaches I and II, respectively, where construction activities would occur. Construction activities would require construction contractors to access these sites which have Land Use Controls (LUCs) implemented for long-term management of the sites. Land use restrictions in these areas include restricted access to the site, and activities that result in contact with contaminated sediments on the shoreline and in surface water are prohibited (US Army, 2016). Exposure of sediments during grading activities would be minimized to the greatest extent possible, and no excavations of the nearshore are anticipated for the Proposed Action. Additionally, long-term management and annual inspections would continue at all MRS areas following construction activities.

Operation of the Proposed Action would not generate any solid or hazardous waste.

Therefore, the Proposed Action would have short-term, direct, negligible adverse impacts regarding the generation of solid and hazardous materials and exposure to such materials.

3.16.2.2 *No Action*

No additional waste would be created from the No Action alternative. Baseline conditions would remain, as described above.

3.17 Land Use and Zoning

3.17.1 Existing Conditions

According to the 2016 Charles County Comprehensive Plan Land Use Plan Map, the ALC BPRF is designated as Military or Federally Owned Lands. According to the accompanying Comprehensive Plan, the ALC BPRF property will remain Military or Federally Owned Land for the foreseeable future (CCC, 2016).

According to the Charles County Department of Planning and Growth Management Zoning Map number 71, effective December 11, 2000, the lands encompassing the ALC BPRF property are zoned as Agricultural Conservation (AC) with some overlay zones of Resource Protection. Particularly, parts of the shorelines of the ALC BPRF and its neighboring properties are designated as a Resource Conservation Zone as part of the Maryland Chesapeake Bay Critical Area law and the Critical Area provisions in the Charles County Zoning Ordinance.

The shoreline along Nanjemoy Creek at site BPF-002-R-01 and the shoreline along the southern portion of the peninsula on the Potomac River at site BPF-002-R-03 are MRS under the MMRP program. These areas have LUCs implemented for long-term management of the sites. Land use restrictions in these areas include restricted access to the site and activities that result in contact with contaminated sediments on the shoreline and in surface water are prohibited (US Army, 2016).

3.17.2 Environmental Consequences

3.17.2.1 *Construction and Operation*

Construction of the shoreline improvements along Nanjemoy Creek and the southern portion of the peninsula on the Potomac River would require construction contractors to have access to land use restricted sites. This could potentially result in short-term, direct, less-than-significant impacts to the existing LUCs. All LUCs would be reimplemented following each phase of construction and long-term management and annual inspections would continue at all MRS following construction activities.

There are no anticipated impacts to zoning from the Proposed Action.

3.17.2.2 *No Action*

There would be no impacts to land use or zoning from the No Action alternative. Baseline conditions would remain, as described above.

3.18 Environmental Justice

3.18.1 Existing Conditions

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, issued on February 11, 1994, mandates Federal agencies to assess whether their actions have disproportionate environmental and human health impacts on minority and low-income populations. The intent of this order is to ensure all communities, including minority, low-income, or federally recognized tribes, live in a safe and healthful environment.

Each Federal department or agency is to accomplish this by conducting programs, policies, and activities that substantially affect human health or the environment in a manner that does not exclude communities from participation in, deny communities the benefits of, nor subject communities to discrimination under such actions because of their race, color, or national origin.

Population data are important in determining the presence of Environmental Justice populations. CEQ provides guidance on EO 12898 by stating that "minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis" (CEQ, 1997)

This EA considered a radius of 2.5-miles from the approximate center of the ALC BPRF for the identification and analysis of environmental justice populations. These data were compared to population data for all of Charles County and the State of Maryland (Table 19). This area was selected because it was reasonably anticipated to experience potential impacts associated with activities at the ALC BPRF. According to these data, the area within a 2.5-mile radius of the ALC BPRF has a lower minority population than Charles County and the State of Maryland, and a higher percentage of low-income population (household income less than $25,000/year) than either the surrounding county or state.

Table 19. Environmental Justice Factors

Location	Total Population[1]	% Minority Population[1,2]	Percentage of Population below Poverty Level[1]
5-mile radius of ALC BPRF	2,942	37.0%	10.0%
Charles County	154,357	61.5%	7.65%
State of Maryland	6,052,177	51.1%	9.7%

3.18.2 Environmental Consequences

3.18.2.1 *Construction and Operation*

There is little potential for the Proposed Action to have a disproportionately high adverse human health or environmental effect on low-income and minority populations within a 2.5-mile radius of the ALC BPRF because construction will be contained to the property and occur over a relatively short period of time.

Operation of the Proposed Action would require minimal maintenance and would not be anticipated to result in any adverse environmental impacts that could potentially disproportionately impact these populations. Therefore, there are no environmental justice impacts anticipated from either construction or operation of the Proposed Action.

3.18.2.2 *No Action*

There are no anticipated environmental justice impacts from the No Action alternative. Baseline conditions would remain, as described above.

4 CUMULATIVE IMPACTS

The CEQ regulations for implementing NEPA define cumulative effects as "the impact on the environment which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR Part 1508.7). This EA considers past, present, and reasonably foreseeable short-term and long-term future effects from implementing the Proposed Action and other projects that share a temporal and spatial scale with the Proposed Action. Reasonably foreseeable projects are projects for which plans have been approved, projects for which funding has been identified, recently completed projects, and projects in progress.

4.1 Proposed Action

As determined through the analysis provided in Section 3, the Proposed Action would not result in appreciable (i.e., more than negligible) adverse impacts in context with existing baseline conditions for Air Quality, Topography and Geology, Socioeconomics, Community Services, Transportation, Utilities, Solid and Hazardous Materials, and Environmental Justice. Therefore, these resources were not evaluated for potential cumulative impacts. Resources that have the potential to be adversely cumulatively affected by the Proposed Action, when combined with other past, present, and reasonably foreseeable future projects at and in the vicinity of the ALC BPRF, include Aesthetics (construction), Cultural Resources (construction), Soils (construction), Hydrology and Water Quality (construction) Wildlife and Habitat (construction), and Noise (construction). Therefore, past, present and reasonably foreseeable future projects that could result in effects on these resource areas were considered for analysis.

4.2 Projects Considered for Potential Cumulative Impacts

Other past, present, and future actions with the same spatial and temporal scale as construction and operation of the ALC BPRF shoreline improvements that may have cumulative impacts on the environment include:

- Past, present and future construction and operation of shoreline protection structures along the Potomac River, Nanjemoy Creek, and other tributaries and shorelines of the Chesapeake Bay including;
  - Shoreline protections consisting of four sill structures along approximately 800 feet of shoreline at Leesylvania State Park on the Potomac River.
  - Shoreline protections consisting of breakwaters and sills along approximately 3,500 feet of shoreline at the Naval Support Facility in Indian Head, Maryland on the east shore of the Potomac River.
  - Shoreline improvements at the Naval Support Facility at Dahlgren, Virginia consisting of 11,730 linear feet of shoreline stabilization.
  - Other reasonably foreseeable future shoreline improvements in the region.

4.3 Effects of Cumulative Actions on the Proposed Action

No significant, cumulative adverse impacts to any of the resources analyzed in the EA are anticipated from the implementation of the Proposed Action. The following is analysis of cumulative impacts on Aesthetics, Cultural Resources, Soils, Hydrology and Water Quality, Wildlife and Habitat, and Noise.

Aesthetics. Living Shorelines are the preferred shoreline management strategy of the state of Maryland, as stated in the 2008 Maryland Living Shorelines Protection Act. Consequently, the presence of Living Shorelines and associated protection structures in the Chesapeake Bay region have increased in the past decade. As erosion continues to threaten Maryland and Virginia shorelines it is reasonably anticipated that more shoreline protection structures will be built along the shorelines of the Potomac River and the Chesapeake Bay. Construction of some of these shoreline protections are likely to coincide in part with phased construction of the shoreline improvements at the ALC BPRF. Should construction coincide, a minor, direct, short-term adverse cumulative impact to aesthetics would be anticipated due to the presence of construction equipment and associated materials and transportation (barges) along the visible shoreline. Operation of the Proposed Action and other similar shoreline protection projects, however, would provide a cumulative beneficial impact to aesthetics since less erosion would occur and the presence of vegetated tidal marshes would increase along the visible shorelines.

Cultural Resources. There is potential for adverse impacts to these resources during construction of the Proposed Action should any be inadvertently discovered and disturbed by construction activities. The Chesapeake Bay region has a rich cultural history and many known and unknown culturally significant resources are likely present along the shorelines of the Chesapeake Bay and its tributaries. Should construction of other shoreline protection projects inadvertently disturb any cultural resources there would be the potential for moderate, direct, short- and long-term adverse cumulative impacts to cultural resources from the Proposed Action and similar past, present and reasonably foreseeable future projects. However, operation of the Proposed Action and similar projects would potentially have beneficial cumulative impacts on cultural resources should the shoreline protections prevent the damage or loss of archaeological sites by erosive action.

Soils. The construction of the shoreline improvements at the ALC BPRF would involve grading which would permanently change the topography of the ALC BPRF shoreline and expose soils, which could lead to potential sedimentation of adjacent surface waters. Should similar shoreline protection projects coincide with the phased construction of the Proposed Action, minor, direct, short-term adverse cumulative impacts to soils of the Chesapeake Bay shorelines would be anticipated. However, operation of the Proposed Action and similar projects would stabilize the shoreline and decrease erosion, leading to lower sedimentation levels of adjacent surface waters. This would provide direct, long-term beneficial impacts to soils.

Hydrology and Water Quality. Construction activities associated with the Proposed Action would expose soils, potentially leading to sedimentation of the Potomac River and Nanjemoy Creek. Additionally, in-water work would cause increased turbidity. Increased sedimentation could lead to eutrophication and poor water quality. Should similar shoreline protection projects coincide with the phased construction of the Proposed Action, minor, direct, short-term adverse cumulative impacts to water quality could occur from large amounts of sediment entering surface waters of the region. However, construction disturbances would be localized to construction sites. Sedimentation due to construction activities would be temporary and cease once construction stopped. Therefore, any adverse cumulative impacts would be less-than-significant. Additionally, operation of the Proposed Action and similar projects would potentially have beneficial cumulative impacts to water quality by reducing shoreline erosion. Water quality would be expected to improve in response to decreased sedimentation and associated pollutant loads.

Wildlife and Habitat. Construction of the Proposed Action would result in less-than-significant adverse impacts to wildlife and habitat on and in the vicinity of the ALC BPRF due to disturbances to vegetation from site access and underwater disturbances from shoreline protection structure construction. Additionally, use of construction equipment would generate disruptive noise and vibrations. But construction activities would occur over a small area relative to the amount of suitable habitat available for wildlife. Mobile terrestrial species would be able to avoid construction areas and utilize more favorable habitats nearby, while less mobile species may experience loss of life. There would also be potential disturbance to bottom sediments that would cause a temporary increase in suspended sediments and turbidity in the Potomac River and Nanjemoy Creek. An increase in turbidity could interfere with foraging and shelter behaviors, as well as affect fish respiration. Should the phased construction of the Proposed Action coincide with other similar construction projects along the region's shorelines, there could be a cumulative increase in sedimentation and turbidity of the Potomac River and Nanjemoy Creek. This could adversely impact wildlife's foraging and shelter behavior. However, these potential cumulative adverse impacts would be temporary and unlikely to reach a significant level due to the wide range of suitable habitat available to species in the region. Additionally, operation of the Proposed Action and similar projects would have long-term, beneficial impacts to wildlife and habitat by preventing erosion and decreasing sedimentation levels in the region's surface waters; thereby improving water quality.

Noise (construction). Construction of the Proposed Action is anticipated to generate less-than-significant adverse noise impacts from construction activities, primarily associated with over-land truck deliveries of stone and sand fill along rural roads leading to the ALC BPRF, and to a lesser degree from noises generated during placement of aggregate materials along the shoreline. Should the phased construction of the Proposed Action coincide with other similar construction projects along the shorelines, there would be the potential for less-than-significant direct, short-term cumulative noise impacts. Additionally, should construction of the Proposed Action coincide with normal testing operations at the ALC BPRF, noise impacts may cumulatively rise above minor levels to some nearby receptors. These potential cumulative impacts would be minimized by implementing construction BMPs, including scheduling construction activities for daytime hours on weekdays and outside of normal testing operations, to the greatest extent practicable. Additionally, noise levels dissipate with distance. Similar reasonably foreseeable future construction projects are likely to be located far enough away from the ALC BPRF that noise generated from each individual project will not be perceived by the same sensitive receptors.

5 CONCLUSION

This EA analyzes potential environmental, cultural, and socioeconomic effects associated with the Proposed Action to implement the 2016 SMP for shoreline improvements at the ALC BPRF. The Proposed Action is comprised on a number of stone shoreline protection structures and associated sand nourishments activities. The Proposed Action would be implemented in a phased approach and contingent upon funding, with critical areas given priority.

The EA was prepared in accordance with the NEPA and implementing regulations issued by CEQ and 32 CFR Part 651.

The purpose of the Proposed Action is to improve the stability and resiliency of the ALC BPRF shoreline and prevent further loss of land so that ALC can continue to operate the ALC BPRF as a testing facility at its current location.

Due to extensive shoreline erosion, the Proposed Action is needed to prevent further erosive damage of the ALC BPRF shoreline, and to allow the ALC to continue meeting its goal of developing and managing ALC BPRF in an efficient, effective, and environmentally sensitive manner, which responds to its inventory of cultural resources, its natural setting, and the natural environment.

The Proposed Action would not result in any impacts or negligible impacts to air quality (construction), geology (construction and operation), groundwater (construction and operation), wetlands and floodplains (construction), socioeconomics (operation), solid and hazardous materials (construction and operation), transportation and parking (construction and operation), utilities (construction and operation), and environmental justice (construction and operation).

All minor and less-than-significant adverse impacts anticipated to occur due to the Proposed Action are summarized in the following paragraphs.

Aesthetics (construction). Construction of the Proposed Action would result in short-term, direct, less-than-significant adverse impacts on aesthetics due to the temporary presence of construction vehicles, heavy construction equipment, and associated materials on the shorelines and roads within the ALC BPRF property. Materials such as stone and sand would be transported to construction areas via a combination of barge and truck, depending on the nearshore depth and feasibility of shoreline access. Barges would be visible to boaters, fishermen offshore, and nearby Potomac River shoreline residences. Construction vehicles would be visible to residents along Blossom Point Road. These negative impacts would last only as long as each funded phase of construction and would be further minimized by BMPs including controlling fugitive dust generation, covering material stockpiles when not in use, and keeping Blossom Point Road clear of standing construction vehicles, equipment and materials.

Soils (construction). Construction of the Proposed Action would require grading the eroding upland banks to a slope of approximately 10:1 to establish areas for sand nourishment. Grading would occur in areas where soils are currently exposed or minimally vegetated. Following grading and nourishment, exposed soil would be stabilized with native vegetation to permanently establish a marsh environment. Grading and nourishment activities could potentially generate fugitive dust and lead to sedimentation of surface water. The implementation of BMPs including installing and maintaining sedimentation and erosion controls, maintaining construction equipment in good working order, and refueling construction equipment in designated impervious areas and away from exposed soils, would maintain adverse impacts at short-term, direct, less-than-significant levels. Additionally, ALC would develop and implement a Maryland Department of the Environment-approved stormwater management and erosion/sediment control plan to capture sediment on-site, minimize on-site soil erosion, and protect against downstream erosion.

Hydrology and Water Quality (construction). Construction of the Proposed Action would result in short-term, direct, less-than-significant adverse impacts due to potential sedimentation of runoff from grading activities. These adverse impacts would be further minimized by implementing the BMPs described above for Soils.

Wildlife and Habitat (construction).

Vegetative Communities and Terrestrial Wildlife. Construction of the Proposed Action may require limited clearing to provide temporary access lanes from the interior ALC BPRF to the shoreline. Limiting the clearing to these selected lanes would result in minimal disruption to vegetation communities and terrestrial wildlife. Further, all disturbed areas would be replanted with native, non-invasive species following construction activities. Temporary disruptive noise and vibrations could also potentially impact terrestrial species; however, construction activities would occur over a small area relative to the amount of available suitable habitat. The ALC BPRF is located within a Waterfowl Concentration Area. Accordingly, ALC would adhere to time of year restriction for clearing from 15 November through 1 March to protect overwintering waterfowl.

Aquatic Wildlife. In water construction work would temporarily disturb bottom sediments resulting in a temporary increase in turbidity which could interfere with foraging and shelter behaviors of aquatic wildlife. Construction activities including stone placement may result in minimal loss of life to less mobile species. Impacts would be minimized by implementing BMPs such as installing silt curtains and turbidity barriers. The MDNR identified the Potomac River and Nanjemoy Creek as Use II streams with records of yellow perch. Accordingly, ALC would adhere to time of year restrictions for in-stream work, such that no work would be performed in the Potomac River or Nanjemoy Creek from 15 February through 15 June in order to protect spawning fish.

Special Status Species. There are no anticipated impacts to any federal- or state-listed species due to their unlikely presence in the area of impact. U.S. Fish and Wildlife Service and the MDNR Wildlife and Heritage Service confirmed that no state or federally listed species occur within the project site. Additionally, the National Marine Fisheries Service concurred that the Proposed Action is not likely to have a significant adverse impact on Essential Fish Habitat. Any impacts to other special status species, such as bald eagles and migratory birds, would be minimized by implementing BMPs and avoidance measures. Active bald eagle nests are located within one mile of the ALC BPRF shoreline. In accordance with the *National Bald Eagle Management Guidelines* as well as the Army's *Endangered Species Management Plan for the Chesapeake Region Bald Eagle*, a minimum 330-foot buffer would be maintained around the nests and construction activities would only take place outside of the bald eagle breeding season (15 December through 15 June).

Cultural Resources (construction). Construction of the Proposed Action could potentially result in long-term, direct, less-than-significant adverse impacts should previously unknown cultural resources be inadvertently encountered and disturbed. There are many known archaeological sites on the ALC BPRF property including along the shorelines of the Potomac River and Nanjemoy Creek. The Proposed Action does not involve any excavating work and any temporary construction access lanes cleared from the interior of the ALC BPRF to the shoreline would avoid all known cultural resources and archaeological sites. Additionally, to further minimize any potential adverse impacts to these resources, an "Inadvertent Discovery" plan would be implemented. Under this plan, if prehistoric or historic artifacts that could be associated with Native American, early

European, or American settlement are encountered at any time during construction, ALC would cease all activities involving subsurface disturbance in the vicinity of the discovery. Should human remains or other cultural items, as defined by the Native American Graves Protection and Repatriation Act, be discovered during project construction, the construction contractor would immediately cease work and notify ALC to properly identify and appropriately treat discovered items in accordance with applicable state and federal law(s). Implementing these BMPs would ensure potential impacts are maintained at less-than-significant adverse levels. Additionally, the Maryland Historical Trust has concurred with ALC's determination that the Proposed Action would have no effect on any historic structures.

Noise (construction). Construction would generate noise from the operation of heavy construction equipment used for grading, stone placement and the placement of sand fill. Noise associated with these activities would potentially be perceived by receptors including ALC BPRF staff and residents living in the vicinity of the ALC BPRF shoreline. Noise would last only as long as each phase of construction and would be perceived differently and by different receptors depending on which Reach is undergoing construction at that time. All residences are located 1,200 feet or further from the shorelines of the ALC BPRF; therefore, noise at these receptors would be anticipated to be less than 64 A-weighted decibels. BMPs including scheduling construction activities during daylight hours and weekdays, maintaining mufflers and sound shielding on construction equipment in good working order, providing hearing protection to workers for activities that exceed Occupational Safety and Health Administration permissible noise exposure levels, and scheduling notably loud construction work to avoid impacts during testing operations, would maintain adverse impacts at short-term, less-than-significant levels.

Land Use (construction). Under the Military Munitions Response Program, there are two Munitions Response Sites (MRS) along the shoreline along Nanjemoy Creek (site BP-002-R-01) and along the southern portion of the peninsula on the Potomac River (site BPF-002-R-03). These sites have land use controls (LUCs) implemented for long-term management of the sites. LUCs in these areas include restricted access to the site and prohibit activities that result in contact with contaminated sediments on the shoreline and in surface water. Construction of the shoreline improvements along Nanjemoy Creek and the southern portion of the peninsula on the Potomac River would require construction contractors to access these LUC sites. However, all LUCs would be reimplemented following each phase of construction and long-term management and annual inspections would continue at all MRS following construction activities. This would maintain impacts to existing LUC sites at short-term, direct, less-than-significant levels.

Operation of the shoreline improvements is anticipated to result in beneficial impacts to aesthetics, cultural resources, air quality, topography and soils, hydrology and water quality, wildlife and habitat, floodplains and wetlands, and community services due to decreased erosion and sedimentation, installation of new marsh habitat, and the extended longevity of the ALC BPRF at its present location.

Cumulative Impacts

When considered with other past, present, and reasonably foreseeable future projects, no significant cumulative adverse impacts to any resources analyzed in this EA are anticipated from implementation of the Proposed Action. Any potential cumulative impacts would be maintained at less-than-significant levels due to the distance between project sites and the implementation of BMPs during construction of each project. Operation of the Proposed Action and other similar past, present, and reasonably foreseeable future projects would result in significant beneficial cumulative impacts on a number of resources analyzed in this EA.

Based on the evaluation of environmental impacts provided in Chapter 3, the Proposed Action will not result in a significant impact to the environment. Therefore, an EIS will not be necessary for this Proposed Action. This conclusion is documented in the FONSI found at the beginning of this EA.

6 Agency Coordination and Public Involvement

ALC invites public participation in decision-making on new proposals through the NEPA process. Public participation with respect to decision-making on the Proposed Action is guided by Army Regulation 200-1. Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. Agencies, organizations, and members of the public with a potential interest in the Proposed Action, such as minority, low-income, and disadvantaged persons, are urged to participate. The following sections describe agency coordination and public involvement efforts associated with the EA.

6.1 Federal, State, and Local Agency Coordination

ALC notified relevant federal, state, and local agencies and allow them sufficient time to make known their environmental concerns that are specific to this Proposed Action. Comments and concerns submitted by these agencies have been subsequently incorporated into the analysis of potential environmental effects conducted as part of this EA. These agencies are listed in the following table. Copies of agency correspondence are provided in Appendix A.

Agency	Contact Information
Maryland Department of Natural Resources Environmental Review Program	Ms. Jennifer Petrisko, Management Associate 580 Taylor Avenue Annapolis, MD 21401
Maryland Department of Natural Resources Wildlife and Heritage Service	Ms. Lori Byrne, Environmental Review Coordinator 580 Taylor Avenue Annapolis, MD 21401
Maryland Historical Trust State Historic Preservation Office	Elizabeth Hughes, State Historic Preservation Officer 100 Community Place Crownsville, MD 21032
NOAA Fisheries Service	Ms. Karen Green, Mid-Atlantic Field Office Supervisor/EFH Coordinator 55 Great Republic Drive Gloucester, MA 01930
NOAA National Marine Fisheries Service Protected Resources Division	Mrs. Kimberly Damon-Randall 55 Great Republic Drive Gloucester, MA 01930
U.S. Fish and Wildlife Service Chesapeake Bay Field Office	Genevieve LaRouche, Field Supervisor 177 Admiral Cochrane Drive Annapolis, MD 21401

6.2 Native American Tribal Coordination

For federal proposed actions, federal agencies are required to consult with federally-recognized Native American tribes in accordance with NEPA, NHPA, NAGPRA, and EO 13175. Based on a review of the U.S. Department of the Interior Bureau of Indian Affairs, there are no federally recognized tribes that may have ancestral ties to the Proposed Action's Region of Interest; Charles County, MD.

6.3 Public Involvement

6.3.1 Public Review of the Draft Environmental Assessment

ALC, as the federal proponent of this Proposed Action, made the Draft EA and Draft FONSI available for a 30-day public review and comment period. The start of the review period and the process to obtain a copy of the EA was announced in a Notice of Availability (NOA) published in The Maryland *Independent* on August 28, 2019. The Draft EA and Draft FONSI were published and available for review at the Charles County Public Library; 2 Garrett Avenue, La Plata, MD 20646. An affidavit of publication of the NOA is included in Appendix C.

No comments from the public were received during the 30-day public review period.

7 Environmental Management Measures

This chapter summarizes the environmental avoidance, minimization, and management measures (identified in Chapter 3) that have been incorporated into the Proposed Action to ensure that potential adverse impacts remain at or below minor, less-than-significant levels. "Management measures" are defined as routine BMPs and/or regulatory environmental compliance and protection measures that are regularly implemented as part of ALC projects. Per established protocols, procedures, and requirements, ALC (and ALC's design and construction contractors) would implement these management measures and satisfy all applicable regulatory requirements associated with the design, construction, and operation of the Proposed Action. These management measures are summarized in Table 20. Additionally, environmental permits and approvals potentially required for construction and operation of the Proposed Action are provided in Table 21.

Table 20. Environmental Protection Measures Incorporated into the Proposed Action

AESTHETICS
Construction
▪ Construct the Living Shorelines and associated shoreline protection structures according the 2016 Shoreline Management Plan.
▪ Control fugitive dust emissions by implementing industry-standard construction BMPs, including using water trucks for dust suppression, brushing dirt off construction vehicle tires before leaving the construction site, and installation of gravel pads at the construction exits to further prevent the tracking of dirt onto roadways.
AIR QUALITY
Construction
▪ Implement the dust control BMPs described for aesthetics.
▪ Utilize appropriate construction scheduling (avoid earthwork during extremely windy and dry periods).
▪ Construction vehicles traveling on paved roads within and outside of the ALC BPRF would follow posted speed limits. This would minimize dust generated by vehicles and equipment on paved surfaces.
▪ On unpaved surfaces at the site, vehicle speeds will be maintained at or below five miles per hour to prevent dust generation of any exposed soil. Additionally, should any vehicles transport soil from one area of the property to another, the soil will be covered with haul tarps.
▪ Visually monitor construction activities on a daily basis, and particularly during extended periods of dry weather; implement additional dust control measures as needed.
▪ Limit the idling of mobile emission sources to three minutes; after three minutes turn engines off.
▪ Cover beds of all incoming and outgoing haul trucks with tarps

CULTURAL RESOURCES
Construction
▪ Implement the "Inadvertent Discovery" plan as follows. Should human remains or other cultural items as defined by the Native American Graves Protection and Repatriation Act (NAGPRA) be discovered during project construction, the construction contractor shall immediately cease work until ALC, a qualified archaeologist, and the SHPO are contacted to properly identify and appropriately treat discovered items in accordance with applicable federal and state regulations
GEOLOGY, SOILS, AND TOPOGRAPHY
Construction
▪ Install and maintain sedimentation and erosion control measures, including silt fences and water breaks, detention basins, filter fences, sediment berms, interceptor ditches, synthetic hay bales, rip-rap, and/or similar physical control structures.
▪ Maintain construction equipment in good working order and ensure the construction contractor has an emergency spill kit and is prepared to respond to a release of petroleum-based fluids (diesel, hydraulic fluid) to the soil.
▪ Refuel construction equipment in designated impervious areas and away from exposed soil surfaces.
HYDROLOGY AND WATER QUALITY
Construction
▪ Implement the soil erosion and stormwater management system BMPs listed above for Geology, Soils, and Topography.
HABITAT AND WILDLIFE
Construction and Operation
▪ Plant native, non-invasive vegetation after ground disturbance activities to restore disrupted areas and prevent the spread of invasive species.
▪ Monitor headwaters of wetlands and streams following any disturbance to prevent invasive species from being transported downstream by flowing water.
▪ Use construction equipment with mufflers to minimize noise impacts and install exclusionary fencing around construction sites.
▪ Install silt curtains and turbidity barriers in construction areas.
▪ If required by any permit conditions, implement seasonal restrictions to in-water work to minimize potential impacts to specified fish species.
▪ Adhere to the *National Bald Eagle Management Guidelines* as well as the Army's *Endangered Species Management Plan for the Chesapeake Region Bald Eagle's* minimum 330-foot buffer around the nests. Construction activities would only take place outside of the bald eagle breeding season (15 December through 15 June).
▪ Adhere to time of year restrictions such that no work would be performed in the Potomac River or Nanjemoy Creek from 15 February through 15 June in order to protect spawning fish.
▪ Adhere to time of year restrictions for clearing from 15 November through 1 March in order to protect overwintering waterfowl.

NOISE
Construction
▪ Schedule construction activities for daylight hours during the weekday to minimize potential impacts to nearby residential areas during otherwise quieter evening and weekend periods.
▪ Maintain mufflers and sound shielding on construction equipment and shut down construction equipment when not in use for more than 5 minutes.
▪ Schedule notably loud construction work to avoid impacts during testing operations.
▪ Provide hearing protection to workers for activities that will exceed the OSHA permissible noise exposure level.
WETLANDS
Construction
▪ Implement the management measures specified above for Soils and Hydrology and Water Quality to prevent sedimentation of run-off and potential migration to wetlands.
SOLID WASTE AND HAZARDOUS MATERIALS
Construction
▪ Reuse excess construction materials to the maximum extent practicable. Recycle materials that cannot be reused. Properly dispose of all other materials.
▪ Provide a pre-construction safety brief to the construction contractors outlining how to recognize UXO and the steps to follow. In the case that UXO is encountered, immediately cease all activities and report the finding to ALC BPRF personnel.
TRANSPORTATION AND PARKING
Construction
▪ Schedule and route construction vehicle traffic away from roadways potentially needed for testing operations.
▪ Utilize BMPs specified for Soils to avoid tracking dirt onto area roadways.

Table 21. Permits, Approvals, and Determinations Potentially Required

Permit, Approval, or Certification	Responsible Agency	Contact Information	Applicable Criteria
Federal or State Environmental			
Coastal Zone Management Act Federal Consistency Review	Coastal Zone Consistency Division Wetlands and Waterways Program of the Water Management Administration (WMA) Maryland Department of the Environment (MDE)	Federal Consistency Coordinator Wetlands and Waterways Program Maryland Department of the Environment 1800 Washington Boulevard Baltimore, MD 21230	Federal actions that have reasonably foreseeable coastal effects
Section 7 Consultation	United States Fish and Wildlife Service National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)	Genevieve LaRouche, Field Supervisor USFWS Chesapeake Bay Field Office 177 Admiral Cochrane Drive Annapolis, MD 21401 Mrs. Kimberly Damon-Randall 55 Great Republic Drive Gloucester, MA 01930	Required for all federal projects that *may affect* listed endangered or threatened species.
Section 106 Consultation	Maryland Historical Trust State Historic Preservation Office (MHT SHPO)	Elizabeth Hughes, State Historic Preservation Officer 100 Community Place Crownsville, MD 21032	Required for all federal actions.
Sediment Control/Stormwater Management Plan Review	MDE	Water Management Administration (WSA) Sediment & Stormwater Plan Review Division 1800 Washington Boulevard, 4th Floor Baltimore, MD 21230	State and federal projects that disturb over 5,000 square feet of land area.
Wetland and Floodplain Permitting	USACE MDE	USACE Permitting Branch MDE, Water Management Administration	Construction activities in floodplains require permit from MD Wetlands and Waterways Program, Water and Science Administration.

8 References

Atlantic Sturgeon Status Review Team. (2007). *Status Reivew of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus). Prepared for NOAA NMFS.* Retrieved from https://www.greateratlantic.fisheries.noaa.gov/protected/atlsturgeon/docs/AtlSturgeonStatusReviewReport.pdf

BIA. (2019). *Federal and State Recognized Tribes* . Retrieved from National Conference of State Legislatures : http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#federal

CCC. (2012). *Blossom Point Research Facility Charles County, Maryland Joint Land Use Study.*

CCC. (2016). *Charles County Comprehensive Plan.*

CENAB. (2014). *Integrated Natural Resources Management Plan Update.*

CENAB. (2016). *Integrated Cultural Resources Management Plan for the U.S. Army Garrison Adelphi Laboratory Center Adelphi, Maryland Including the Blossom Point Reasearch Facility, Charles County, Maryland.*

CEQ. (1997December). Environmental Justice, Guidance Under the National Environmental Policy Act.

Department of the Army. (2007). *Environmental Protection and Enhancement* .

DOA. (2014). *Expansion of Satellite Ground Communications Terminal Faclities and Operations Blossom Point Research Facility Final Environmental Assessment.*

Heartland Barge Co. (2019, July 29). *Barge weight capacity*. Retrieved from Heartland Barge Management website: http://heartlandbarge.com/barge-weight-capacities-chart/

Kynard et al. (2016). *Life History and Status of Shortnose Sturgeon (Acipenser brevirostrum).*

Maryland DNR. (2017). *Species List and Catch Composition at Blossom Point, 2003-2017.*

Maryland DNR. (2018a). *MERLIN Online*. Retrieved from Maryland Department of Natural Resources: https://gisapps.dnr.state.md.us/MERLIN/index.html

Maryland DNR. (2018b). *Stream Health*. Retrieved December 31, 2018, from Maryland Biological Stream Survey: geodata.md.gov/streamhealth

Maryland DNR. (2018c). *List of Rare, Threatened, and Endnagered Species of Charles County.* Maryland Wildlife and Heritage Service, Natural Heritage Program.

Maryland DNR. (2018d). *Fixed Station Monthly Monitoring*. Retrieved December 21, 2018, from Eyes on the Bay: http://eyesonthebay.dnr.maryland.gov/bay_cond/bay_cond.cfm?station=RET22&param=sal

MDE. (2015). *Maryalnd Stormwater Management and Erosion & Sediment Control Guidelines for State and Federal Projects* .

New England Fishery Management Council & NMFS. (2017). *Omnibus Essential Fish Habitat Admendment 2. Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts*. Retrieved from https://www.habitat.noaa.gov/application/efhmapper/oa2_efh_hapc.pdf#page=36

NOAA. (2018, August). *Climate at a Glance: County Mapping.* Retrieved from National Centers for Environmental information: https://www.ncdc.noaa.gov/cag/

NOAA. (2018). *Habitat Blueprint*. Retrieved from Living Shorelines: https://www.habitatblueprint.noaa.gov/living-shorelines/

NOAA. (2018). *Turbidity Table*. Retrieved from NOAA Fisheries Greater Atlantic Region: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/turbiditytablenew.html

NOAA. (2018a). *Section 7 Mapper*. Retrieved November 20, 2018, from NOAA Fisheries Greater Atlantic Region: http://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=1bc332edc5204e03b250ac11f9914a27

SCAQMD. (2017). *Harborcraft, Dredge and Barge Emission Factor Calculator.* South Coast Air Quality Management District.

SCAQMD. (2019). *Off-road Mobile Source Emission Factors (Scenario Years 2007 – 2025).* South Coast Air Quality Management District.

US Army. (1996). *Endangered Species Management Plan for Chesapeake Region Bald Eagle, Haliaeetus leucocephalus.* W.T. Reynolds Company.

US Army. (2016). FY2016 Blossom Point Research Facility. Army Defense Environmental Restoration Program, Installation Action Plan.

USACE. (2012). *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual for the Atlantic and Gulf Coastal Plain Region.*

USACE. (2012). *Upper Mississippi River Restoration Enviornmental Management Program Environmental Design Handbook.*

USACE. (2014). *Integrated Natural Resources Management Plan Update, US Army Garrison Adelphi Laboratory Center.*

USACE. (2016). *Rare, Threatened, and Endangered Species Surveys, U.S. Army Garrison Adelphi Laboratory Center and Blossom Point Research Facility Prince Georges and Charles Counties, Maryland.*

USACE. (2019). *Draft Avian Surveys, U.S. Army Garrison Adelphi Laboratory Center and Blossom Point Research Facility Prince Georges and Charles Counties, Maryland.*

USACE, TNC, ICPRB. (2014). *Middle Potomac River Watershed Assessment: Potomac River Sustainability Flow and Water Resources Analysis.*

USAF. (2018). *Air Emissions Guide for Air Force Mobile Sources, Methods for Estimating Emissions of Air Pollutants for Mobile Sources at United States Air Force Installations.* Air Force Civil Engineer Center.

USEPA. (1995). *Compilation fo Air Pollutant Emission Factors, AP-42, Fifth Edition, January.* USEPA.

USEPA. (2006). *Economic Benefits of Wetlands .*

USEPA. (2010). *Chesapeake Bay TMDL Executive Summary.*

USEPA. (2014). *Motor Vehicle Emissions Simulator (MOVES2014a). Accessed November 2018 <https://www.epa.gov/moves/moves2014a-latest-version-motor-vehicle-emission-simulator-moves>*. U.S. Environmental Protection Agency.

USEPA. (2018). *General Conformity de minimis Tables.*

USFWS. (2007, May). *National Bald Eagle Management Guidelines*. Retrieved from U.S. Fish and Wildlife Service: https://www.fws.gov/southdakotafieldoffice/NationalBaldEagleManagementGuidelines.pdf

USGS. (2019, February 08). *National Water Information System: Web Interface* . Retrieved from https://waterdata.usgs.gov/nwis/uv?cb_00010=on&cb_00010=on&cb_00010=on&cb_00010=on&cb_00060=on&cb_00065=on&cb_00095=on&cb_00095=on&cb_00300=on&cb_00400=on&cb_63680=on&cb_99133=on&format=gif_default&site_no=01646500&period=&begin_date=2019-01-01&end_date=2

VIMS. (2016). *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek.* Shoreline Studies Program, Virginia Institute of Marine Science, College of William and Mary.

Virginia Institute of Marine Science . (2016). *Shoreline Management Plan for Potomac River and Nanjemoy Creek, US Army Garrison Adelphi Laboratory Center, Blossom Point Research Facility*.

Appendices

Appendix A – Regulatory Communications

Appendix B – Federal Consistency Determination, FONPA, RONA

Appendix C – Public Involvement Documentation and Comments

Appendix A – Regulatory Communications

October 22, 2019

Mr. Philip Jones, Chief, Public Affairs
Adelphi Laboratory Center
U.S. Army Garrison Aberdeen Proving Ground
2800 Powder Mill Road, IMAL-PWE
Adelphi, MD 20783

Mr. Andrew Glucksman, LEED AP, Sr. Environmental Scientist/Project Manager
Mabbett & Associates, Inc.
40 Old Louisquisset Pike, Suite 200
North Smithfield, RI 02896

STATE CLEARINGHOUSE RECOMMENDATION

State Application Identifier: MD20190822-0717
Applicant: U.S. Army Garrison Aberdeen Proving Ground **and** Mabbett & Associates, Inc.
Project Description: Draft Environmental Assessment and Finding of No Significant Impact: To Evaluate Potential Environmental Impacts of Proposed Implementation of the 2016 Shoreline Management Plan for Potomac River and Nanjemoy Creek at Blossom Point Research Facility, U.S.A.G. Aberdeen Proving Ground, Adelphi Lab.
Project Address: Blossom Point Research Facility—Adelphi Laboratory Center, Blossom Point Road, Welcome, MD 20653
Project Location: Charles County
Recommendation: **Consistent with Qualifying Comments and Contingent Upon Certain Actions**

Dear Mr. Jones and Mr. Glucksman:

In accordance with Presidential Executive Order 12372 and Code of Maryland Regulation 34.02.02.04-.07, the State Clearinghouse has coordinated the intergovernmental review of the referenced project. This letter constitutes the State process review and recommendation. This recommendation is valid for a period of three years from the date of this letter.

Review comments were requested from the Maryland Departments of General Services, Natural Resources, Transportation, and the Environment; the Maryland Military Department; Charles County; the Tri-County Council for Southern Maryland; and the Maryland Department of Planning, including the Maryland Historical Trust. The Maryland Department of Transportation, the Maryland Military Department, and the Tri-County Council for Southern Maryland did not provide comments.

The Maryland Departments of General Services, and Natural Resources; Charles County; and the Maryland Department of Planning found this project to be consistent with their plans, programs, and objectives.

The Maryland Department of Planning provided the following comments, "Planning has no comment for the EA. Planning will review the next phase of clearinghouse review for funding requests with more specificity, depending on action plan choice; and consistency with approved [Environmental Assessment]."

The Maryland Historical Trust stated that their finding of consistency is contingent upon the applicant's completion of the review process required under Section 106 of the National Historic Preservation Act, as follows: "The Army needs to complete its consultation with the Maryland Historical Trust as project planning proceeds, to fulfill compliance with Section 106 of the National Historic Preservation Act of 1966, and consider the project's effects on historic and archeological resources."

The Maryland Department of the Environment (MDE) found this project to be generally consistent with their plans, programs, and objectives, but included certain qualifying comments summarized below.

1. "Any solid waste including construction, demolition and land clearing debris, generated from the subject project, must be properly disposed of at a permitted solid waste acceptance facility, or recycled if possible. Contact the Solid Waste Program at (410) 537-3315 for additional information regarding solid waste activities and contact the Resource Management Program at (410) 537-3314 for additional information regarding recycling activities.

2. The Waste Diversion and Utilization Program should be contacted directly at (410) 537-3314 by those facilities which generate or propose to generate or handle hazardous wastes to ensure these activities are being conducted in compliance with applicable State and federal laws and regulations. The Program should also be contacted prior to construction activities to ensure that the treatment, storage or disposal of hazardous wastes and low-level radioactive wastes at the facility will be conducted in compliance with applicable State and federal laws and regulations.

3. The proposed project may involve rehabilitation, redevelopment, revitalization, or property acquisition of commercial, industrial property. Accordingly, MDE's Brownfields Site Assessment and Voluntary Cleanup Programs (VCP) may provide valuable assistance to you in this project. These programs involve environmental site assessment in accordance with accepted industry and financial institution standards for property transfer. For specific information about these programs and eligibility, please contact the Land Restoration Program at (410) 537-3437.

4. Borrow areas used to provide clean earth back fill material may require a surface mine permit. Disposal of excess cut material at a surface mine may require site approval. Contact the Mining Program at (410) 537-3557 for further details."

The State Application Identifier Number <u>must</u> be placed on any correspondence pertaining to this project.

Please remember, you must comply with all applicable state and local laws and regulations. If you need assistance or have questions, contact the State Clearinghouse staff person noted above at 410-767-4490 or through e-mail at sylvia.mosser@maryland.gov.

Thank you for your cooperation with the MIRC process.

Sincerely,

Myra A. Barnes

Myra Barnes, Lead Clearinghouse Coordinator

MB:SM

cc: Elizabeth A. Shipley (elizabeth.a.shipley@usace.army.mil)

Tina Quinichette - MDOT
Amanda Redmiles - MDE
Tony Redman - DNR
Wendy Scott-Napier - DGS
Daniel Pyle - MILT
Jason Groth - CHAS
Wayne E. Clark - TCCSMD
Joseph Griffiths - MDPL
Beth Cole - MHT

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Larry Hogan, Governor
Boyd Rutherford, Lt. Governor

Robert S. McCord, Secretary
Sandy Schrader, Deputy Secretary

Maryland
DEPARTMENT OF PLANNING

August 22, 2019

Mr. Philip Jones, Chief, Public Affairs
Adelphi Laboratory Center
U.S. Army Garrison Aberdeen Proving Ground
2800 Powder Mill Road, IMAL-PWE
Adelphi, MD 20783

Mr. Andrew Glucksman, LEED AP, Sr. Environmental Scientist/Project Manager
Mabbett & Associates, Inc.
40 Old Louisquisset Pike, Suite 200
North Smithfield, RI 02896

STATE CLEARINGHOUSE REVIEW PROCESS

State Application Identifier: **MD20190822-0717**
Reviewer Comments Due By: September 23, 2019
Project Description: Draft Environmental Assessment and Finding of No Significant Impact: To Evaluate Potential Environmental Impacts of Proposed Implementation of the 2016 Shoreline Management Plan for Potomac River and Nanjemoy Creek at Blossom Point Research Facility, United States Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center
Project Address: Blossom Point Research Facility—Adelphi Laboratory Center, Blossom Point Road, Welcome, MD 20653
Project Location: Charles County
Clearinghouse Contact: Sylvia Mosser

Dear Mr. Jones:

Thank you for submitting your project for intergovernmental review. Participation in the Maryland Intergovernmental Review and Coordination (MIRC) process helps ensure project consistency with plans, programs, and objectives of State agencies and local governments. MIRC enhances opportunities for approval and/or funding and minimizes delays by resolving issues before project implementation.

Maryland Gubernatorial Executive Order 01.01.1998.04, Smart Growth and Neighborhood Conservation Policy, encourages federal agencies to adopt flexible standards that support "Smart Growth." In addition, Federal Executive Order 12072, Federal Space Management, directs federal agencies to locate facilities in urban areas. Consideration of these two Orders should be taken prior to making final site selections. A copy of Maryland

Gubernatorial Executive Order 01.01.1998.04, Smart Growth and Neighborhood Conservation Policy is available upon request.

We have forwarded your project to the following agencies and/or jurisdictions for their review and comments: the Maryland Departments of Transportation, the Environment, Natural Resources, and General Services; the Maryland Military Department; Charles County; the Tri-County Council for Southern Maryland; and the Maryland Department of Planning, including the Maryland Historical Trust. A composite review and recommendation letter will be sent to you by the reply due date. Your project has been assigned a unique State Application Identifier that you should use on all documents and correspondence. Please be assured that we will expeditiously process your project.

If you need assistance or have questions, contact the State Clearinghouse staff noted above at 410-767-4490 or through e-mail at sylvia.mosser@maryland.gov. Thank you for your cooperation with the MIRC process.

Sincerely,

Jason Dubow, Manager
Resource Conservation and Management

JD:SM
cc: Elizabeth A. Shipley (elizabeth.a.shipley@usace.army.mil)

19-0717_NFP.NEW.doc

Glucksman Andrew

Subject: FW: Blossom Point Shoreline EA Comment

Mr. Jones,

Thank you for providing us the Draft EA for U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center Implementation of the 2016 Shoreline Management Plan at Blossom Point Research Facility, Charles County, Maryland. The Proposed Action is to implement the 2016 shoreline management plan by constructing and operating shoreline improvements at the ALC BPRF. The Proposed Action would include constructing shoreline protection structures including sills, brills, spurs, and revetments along approximately 3.5 miles of shoreline, and associated sand nourishment and marsh vegetation planting. The shoreline improvements would prevent further erosion of the Potomac River shoreline, provide coastal resiliency, and extend the longevity of the ALC BPRF at its present location.

We appreciate that you have incorporated measures to minimize impacts to habitat into your EA, including those we recommended in our April 4, 2019 letter, and will be installing silt curtains and turbidity barriers in construction areas and adhering to time of year restrictions such that no work would be performed in the Potomac River or Nanjemoy Creek from 15 February through 15 June in order to protect spawning fish.

Shoreline protection would include:

Stone Shoreline Improvement Structures, including

o Thirty-two (32) gapped sills

o Sixteen (16) gapped brills

o One (1) standalone sill

o One (1) spur

o One (1) revetment

Shore Stabilization through Sand Nourishment, including

o Establishment of sand fill between the structures and the bank at a slope of

approximately 10:1 from the base of the bank to the back of the stone structure.

o Strategic planting of wetland vegetation including Spartina alterniflora, Spartina

patens, and Scirpus cyperinus in order to stabilize the new sand substrate and create permanent marsh habitat.

For each reach, the EA describes the height of sills, brills, and spur above mean low water, the width at the base and top of the sills, and the approximate distance from the base of the existing bank to the base of the sills. The length of each structure and of the gaps between them is not provided. This information is important in determining if the design will allow fish to access and exit the created marsh. If necessary, we will provide our comments on this portion of the project during the Corps permitting process once we review the design plans.

Thank you again for the opportunity to comment. If you have questions, please let me know.

Kristy

Kristy Beard
Marine Habitat Resource Specialist
Habitat Conservation Division
NOAA Fisheries
200 Harry S. Truman Parkway
Annapolis, MD 21401

September 16, 2019

Mr. Philip H. Jones Chief, Public Affairs
US Army APG ALC
2800 Powder Mill Road
IMAL-PWE
Adelphi, MD 20783

RE: Environmental Review for US Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center, Blossom Point Research Facility Implementation of 2016 Shoreline Management Plan, Charles County, Maryland.

Dear Mr. Jones:

The Wildlife and Heritage Service has determined that there are no State or Federal records for rare, threatened or endangered species within the boundaries of the project site as delineated. However, we would like to point out that the open waters that are adjacent to or part of the site are known historic waterfowl concentration areas. If there is to be any construction of water-dependent facilities please contact Josh Homyack of the Wildlife and Heritage Service at (410) 827-8612 x100 or josh.homyack@maryland.gov for further technical assistance regarding waterfowl.

Thank you for allowing us the opportunity to review this project. If you should have any further questions regarding this information, please contact me at (410) 260-8573.

Sincerely,

Lori A. Byrne

Lori A. Byrne,
Environmental Review Coordinator
Wildlife and Heritage Service
MD Dept. of Natural Resources

ER# 2019.1456.ch
Cc: J. Homyack, DNR
C. Shearin, CAC

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
ADELPHI LABORATORY CENTER
2800 POWDER MILL ROAD
ADELPHI, MD 20783-1138

March 6, 2019

Elizabeth Hughes
State Historic Preservation Officer
Maryland Historical Trust
State Historic Preservation Office
100 Community Place
Crownsville, MD 21032-2023

Subject: Blossom Point Research Facility Environmental Assessment for the Potomac River and Nanjemoy Creek, Charles County, Maryland

Dear Ms. Hughes:

The U.S. Army Corps of Engineers, Baltimore (USACE-Baltimore), is supporting the U.S. Army Garrison (USAG) Adelphi Laboratory Center (ALC) in the preparation of an Environmental Assessment (EA) to evaluate the environmental impacts associated with implementation of the *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* ("SMP") (VIMS 2016) at the Blossom Point Research Facility (BPRF), located in Welcome, Charles County, Maryland.

ALC is preparing the EA in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et. seq.) (NEPA) and the Council on Environmental Quality NEPA regulations (40 CFR parts 1500–1508) and are coordinating the EA process with consultation pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations (36 CFR Part 800; Section 106) (NHPA), as amended. The purpose of this letter is for ALC to formally initiate Section 106 consultation with the Maryland State Historic Preservation Office (MD SHPO) for this project.

Background

The ALC BPRF property has been used as a proving ground and firing range since 1942, when the land was leased to the National Bureau of Standards Ordnance Development Division by the Jesuit Order in Maryland, which owned the lands encompassing Cedar Point Neck since the mid-1600s (USACE-Baltimore 2016). Starting in the mid-1940s, a variety of test sites were built on the property including instrumentation ranges for aerial drops and sites for nonexplosive rocket, mortar, and projectile aerial firings. Testing occurred on the property until most activities were transferred to another off-site facility in 1976. The Army purchased the property in 1980, resumed testing, and reactivated it for use as a satellite facility of ALC (USACE-Baltimore 2016).

Currently, the ALC BPRF serves as a test facility for fuses, explosive and pyrotechnic devices, and telemetry systems. The ALC BPRF is also home to the Naval Research Laboratory (NRL) Blossom Point Tracking Facility (BPTF). This facility was established in 1956 as part of the Vanguard Missile Program as a communications tracking station for satellites. The National Aeronautics and Space Administration (NASA) operated this facility from 1958 until 1967, when the Navy took over control of its operation. The NRL BPTF currently covers approximately 41 acres of the northern portion of the ALC BPRF property and is surrounded by a 265-acre buffer zone to provide protection from outside signal or noise interference (USACE-Baltimore 2016).

Description of the Undertaking

The ALC BPRF is located on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck (Figure 1). The ALC BPRF is bordered by the Potomac River to the east and south, while the western border of the ALC BPRF, which is approximately 1.5 miles long, is bordered by Nanjemoy Creek (Figure 2). Nanjemoy Creek is an approximately 13.1-mile long tidal tributary of the Potomac River and drains smaller tributaries located to the north and west of the ALC BPRF.

The shorelines of the ALC BPRF are subject to wind-driven wave-forces that cause varying degrees of erosion. Erosion threatens the stability of the shorelines at the ALC BPRF and endangers the long-term coastal resilience of the property and its critical infrastructure, which in some areas is within 50 feet of the shoreline. Erosion also damages water quality by releasing large amounts of sediments and associated pollutants into adjacent water bodies, which can prove harmful to important habitat and wildlife. Additionally, Cedar Point Neck has a long cultural history and there are a number of documented cultural resources present on the site that could be damaged or lost due to the erosive action (USACE-Baltimore 2016).

The shoreline is eroding at an average rate of 1 to 3 feet per year, and large storms such as nor'easters and hurricanes are a driving force of the erosive action (VIMS 2016). Storms are particularly harmful to the Potomac River shorelines where hurricanes can produce storm surges exceeding 6 feet above mean sea level (amsl). These storm surges combine with strong winds to generate 4-foot breaking waves that can transport large amounts of sediment and quickly remove shoreline substrate. Sea level rise further threatens coastal resources at the ALC BPRF, with sea level rising at a rate of 1.6 feet per 100 years in this region of the Potomac River (VIMS 2016). If shoreline management strategies are not implemented, then the shorelines of the ALC BPRF will continue to erode, and land and critical infrastructure may be lost.

Therefore, ALC has concluded that implementation of the SMP is necessary to improve the stability and resiliency of the ALC BPRF shoreline and prevent further loss of land so that ALC can continue to operate the ALC BPRF as a testing facility at its current location. This is necessary to prevent further erosive damage of the ALC BPRF shoreline, and to allow the ALC to continue meeting its goal of developing and managing ALC BPRF in an efficient, effective, and environmentally sensitive manner that responds to its inventory of cultural resources, its natural setting, and the natural environment. Without the implementation of the Proposed Action, the coastal resiliency of the ALC BPRF shorelines would not be improved, and the longevity of the ALC BPRF at its current location would be jeopardized.

As depicted on Figure 2, the shoreline of Cedar Point Neck consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical, or biological conditions. The reaches of Cedar Point Neck are defined by fetch exposure (the length of water over which a given wind has blown), shore orientation, and geology. These reaches are designated as Reach I on the western shore of the peninsula on Nanjemoy Creek, Reach II at the southern edge of the peninsula on the Potomac River, and Reach III on the eastern shore of the peninsula on the Potomac River (VIMS 2016). These reaches are further divided into several subreaches according to land use and shore zone geomorphology. Reach I consists of subreaches A, B, C and D, from upstream to downstream. Reach II consists of subreaches A, B, C and D, from west to east, and Reach III consists of subreaches A, B and C, from downriver to upriver (VIMS 2016).

The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority (VIMS 2016). Specifically, two critical areas have been identified: Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA where erosion threatens the existing lookout tower. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

The shoreline improvements detailed in the SMP would include the construction of shoreline protection structures including sills, gapped sills, gapped brills, spurs, and revetments along approximately 18,500-feet (3.5 miles) of total shoreline along Nanjemoy Creek and the Potomac River (VIMS 2016). Sand nourishment measures to create stable substrate for establishing wetland vegetation would occur in areas where sills, brills, and spurs are the preferred structures. These improvements will be designed to protect against a 25-year storm event and a 5-feet above mean low water (MLW) storm surge (VIMS 2016). An explanation of each type of proposed shoreline improvement structure is provided below; and a depiction of these and other shoreline improvement structures is provided in Figure 3.

- **Sills** consist of a line of rock placed directly offshore and parallel to the eroding shoreline. Sand is filled between the stone and the eroding bank and marsh grasses are planted on the sand fill to create a protective marsh fringe.
- **Gapped sills** are a series of sill structures with strategic gaps between them to allow ingress and egress of marine fauna.
- **Brills** are a combination of sills and breakwaters. Breakwaters are a series of rock structures placed strategically offshore to dissipate wave energy before it reaches the shoreline.

- **Gapped brills** consist of long brill structures with wide gaps between them.
- **Revetments** are structures, typically constructed from stone, with sloped and rough faces that decrease wave reflection. They are built directly parallel to the shoreline and are often a last line of defense in high impact environments, where the nearshore is too deep for other structures, or where infrastructure is very close to the shoreline.
- **Spurs** are transitional structures that minimize impacts of other structures on adjacent properties. They are often built off existing structures such as revetments.

The SMP recommends shoreline management strategies and improvement structures specific to each subreach. Improvements are only recommended for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable, and therefore improvements are not recommended for these areas. Table 1 summarizes the recommended type, number, and location of shoreline improvement structures by reach and subreach, while Figures 4 to 9 provide summary cross-sections.

Table 1. Proposed Shoreline Structures by Reach and Subreach

Reach	**Subreach**	**Structures Recommended**	
		Type	Number
I	A	Gapped Sill	5
	C	Gapped Sill	9
	D	Gapped Sill	4
		Spur	1
		Revetment	1
II	A	Gapped Sill	6
	B	Gapped Sill	5
	D	Gapped Sill	3
III	A	Gapped Brill	4
	B	Gapped Brill	8
	C	Gapped Brill	4
		Sill	1

Specifically, the undertaking includes the following elements:

- Stone Shoreline Improvement Structures, including:
  - Thirty-two (32) gapped sills
  - Sixteen (16) gapped brills
  - One (1) standalone sill
  - One (1) spur
  - One (1) revetment

- Shore Stabilization through Sand Nourishment, including:
  - Establishment of sand fill between the structures and the bank at a slope of

approximately 10:1 from the base of the bank to the back of the stone structure.
  - Strategic planting of wetland vegetation including *Spartina alterniflora*, *Spartina patens*, and *Scirpus cyperinus* in order to stabilize the new sand substrate and create permanent marsh habitat.

Construction of shoreline improvement structures at the ALC BPRF will involve the anchoring of filter fabric on the existing bottom of the nearshore and the placement of stones on the filter fabric base to the desired width and height. The area behind the sill and brill structures will be graded and backfilled with clean sand and planted with native, non-invasive marsh grasses. Stone, sand fill, and construction equipment will be transported to the construction areas by a combination of barge and truck, depending on the depth of the nearshore and the capability of equipment to reach the proposed construction locations.

Area of Potential Effects

The APE as defined in 36 CFR 800.16(d), is "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if such properties exist. The APE is influenced by the scale of the undertaking and may be different for different kinds of effect caused by the undertaking."

The direct APE consists of areas of ground disturbance, including the entire shoreline above and below mean sea level along Reaches I-III as depicted on Figure 2, extending into the water up to 100 feet and extending inland up to 200 feet. The direct APE also includes construction staging areas, access roads, and areas for the acquisition of sand for beach renourishment as well as areas within the waters of the Potomac River and Nanjemoy Creek for barge anchoring, if necessary. Locations and/or need for these latter elements have not been determined to date. The potential for visual and other indirect impacts to above-ground historic properties is low, and as such, it is assumed that the indirect APE for above-ground resources will be contiguous with the direct APE.

As engineering planning and design continues, if necessary, the APE may be refined. The locations of previously identified archaeological sites will be avoided, and areas previously subjected to archaeological survey will be taken into consideration to avoid impacts to archaeological historic properties.

Research

Background research was conducted using MEDUSA, the Maryland Historical Trust's (MHT) online cultural resources database, and ALC's most recent Integrated Cultural Resource Management Plan (ICRMP) (USACE-Baltimore 2016) to review previously identified archaeological sites, cultural resources, and cultural resources surveys at BPRF. Table 2 lists the cultural resource investigations that have occurred in some form or fashion at Cedar Point Neck and the BPRF since the late 1800s. While much of the BPRF has been subjected to formal archaeological survey, as of 2016, approximately 800 acres of the BPRF have not been surveyed

(USACE-Baltimore 2016), and the BPRF has not been subject to an architectural assessment since a 1984 investigation (BTI 1984).

Known archaeological sites at the BPRF are listed in Table 3; three have been determined eligible for listing in the National Register of Historic Places (NRHP). Site 18CH162 contains an historic period cemetery, and a possible prehistoric cemetery may be located somewhere along the western edge of the BPRF (USACE-Baltimore 2016). While the BPRF once contained the Ballast House (CH-337), this property was demolished in the 1990s, and the BPRF currently contains no above-ground resources that are listed in or have been determined eligible for listing in the NRHP.

Table 2. Cultural Resources Surveys at BPRF

Number	Title	Date	Reference
n/a	Notes and Correspondence.	1890	Holmes, W.H., G. Fawke, and W. Dinwiddie
n/a	The Indians of Port Tobacco River, Maryland, and Their Burial Places	1935	Graham, W.J.
n/a	Travel memorandum.	1973	Ward, Dr. F. Prescott
CH8	Cultural Resources Survey of Harry Diamond Labs Field Test Facility, Blossom Point, Maryland.	1980	Wilke, Steve, R. Dolan, L. Walsh, and R. Stuckenrath
n/a	Historic Properties Report. Harry Diamond Laboratories, Maryland and Satellite Installations, Woodbridge Research Facility, Virginia and Blossom Point Field Test Facility, Maryland.	1984	Building Technology, Inc.
CH33	Architectural, Historical, and Archaeological Investigations at Blossom Point Farm, Blossom Point Testing Facility, Charles County, Maryland.	1990	Kise, Franks, and Straw, Inc.
CH47	Phase II Archaeological Investigations, Blossom Point Farmhouse, Blossom Point, Charles County, Maryland.	1993	Custer, Jay F.
CH59	Phase I Archaeological Survey of Twelve Areas at the Blossom Point Field Test Facility (BPFTF), Charles County, Maryland.	1996	Thomas, Ronald A., and Martin Reinbold
CH96/ CH117	Phase II Archaeological Studies, Sites 18CH155, 18CH156, 18CH161, 18CH162, 18CH218, 18CH222 and 18CH227.	2001	Leininger, Hope, and Paula Bienenfeld
CH175/ CH175ADD	Phase I Archaeological Survey for the Expansion of Satellite Ground Communications Terminal Facilities and Operations at Blossom Point Research Facility, Charles County, Maryland.	2014	Parker, J., et al.

Table 3. Archaeological Sites within BPRF

Number	Name	NRHP Status
18CH155	W-T, CH-J1	Not Eligible
18CH156	W-T, CH-J2	Eligible
18CH157	W-T, CH-J3	Unassessed
18CH158	W-T, CH-K13	Unassessed
18CH159	W-T, CH-K12	Unassessed
18CH160	W-T, CH-K11	Unassessed
18CH161	W-T, CH-K2	Not Eligible
18CH162	W-T, CH-K1	Eligible
18CH163	W-T, CH-K4	Unassessed
18CH213	T1	Unassessed
18CH214	T2	Unassessed
18CH215	T3	Unassessed
18CH216	T4	Not Eligible
18CH217	T5	Unassessed
18CH218	T6	Not Eligible
18CH219	T7	Unassessed
18CH220	T8	Unassessed
18CH221	T9	Unassessed
18CH222	T10	Not Eligible
18CH223	T11	Unassessed
18CH224	T12	Unassessed
18CH225	T13	Unassessed
18CH226	T14	Unassessed
18CH227	T15	Eligible
18CH228	T16	Unassessed
18CH229	T17	Unassessed
18CH479	Locus 4-A	Unassessed
18CH480	Locus 4-B	Unassessed
18CH481	Locus 4-C	Unassessed
18CH482	Locus 5-A	Unassessed
18CH483	Locus 6-A	Unassessed
18CH484	Locus 9-C	Unassessed
18CH485	Locus 9-D	Unassessed

Summary

The BPRF contains 33 known archaeological sites, three of which have been determined eligible for the NRHP and most have not had their NRHP eligibility status assessed. Additionally, approximately half of the BPRF has not been subjected to Phase I archaeological survey.

As preliminary engineering information becomes available, ALC, in consultation with other consulting parties, will develop and refine the direct APE and continue to identify and assess effects of the undertaking on historic properties. ALC will ensure that avoidance of adverse effects on identified historic properties is the preferred alternative and will utilize all practicable measures to avoid adverse effects. If avoidance is not possible, and an adverse effect will result, ALC will develop a Memorandum of Agreement (MOA), in consultation with consulting parties, to define any measures needed to mitigate project-related adverse effects on historic properties as described in the MOA. The MOA will be submitted to the consulting parties for review and concurrence. ALC will initiate and complete the stipulations, including mitigation measures, in accordance with the project phasing and the deadlines established therein.

ALC has evaluated this project pursuant to the regulations adopted by the ACHP (36 CFR Part 800, “Protection of Historic Properties”) and has determined that the proposed project would have No Effect on above-ground historic properties. In the event your office disagrees with ALC’s finding with regards to above-ground historic properties, please notify us within 30 days via overnight or private delivery service or email to ensure timely receipt of your communications

ALC looks forward to consulting with MHT regarding this project and to receiving a response regarding the information presented in this letter. We have enclosed an MHT Project Review Form for your information. ALC also requests that MHT provide a list of potential consulting parties that may have an interest in this project. If you have questions or wish to discuss this project, please contact Bridget Kelly Butcher, U.S. Army Garrison Adelphi Laboratory, at 301-394-1062 or bridget.c.kellybutcher.civ@mail.mil.

Sincerely,

James Krake

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory Center

Please note that all included Figures are For Official Use Only (FOUO).

Encl. -Figures
-MHT Project Review Form
-Recorded Archaeological Sites List

References Cited

U.S. Army Corps of Engineers, Baltimore District (USACE-Baltimore)
2016 Integrated Cultural Resources Management Plan for the U.S. Army Garrison Adelphi Laboratory Center Adelphi, Maryland Including the Blossom Point Research Facility, Charles County, Maryland.

MEDUSA
2018 Maryland's Cultural Resource Information System. Electronic document, https://mht.maryland.gov/secure/medusa/, accessed December 19, 2018.

National Oceanic and Atmospheric Administration (NOAA)
2018 Habitat Blueprint. Retrieved from Living Shorelines. Electronic document, https://www.habitatblueprint.noaa.gov/living-shorelines/, accessed 2018.

Virginia Institute of Marine Science (VIMS)
2016 *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek.* Shoreline Studies Program, Virginia Institute of Marine Science, College of William and Mary.

Figure 1. Blossom Point Research Facility Site Location Map

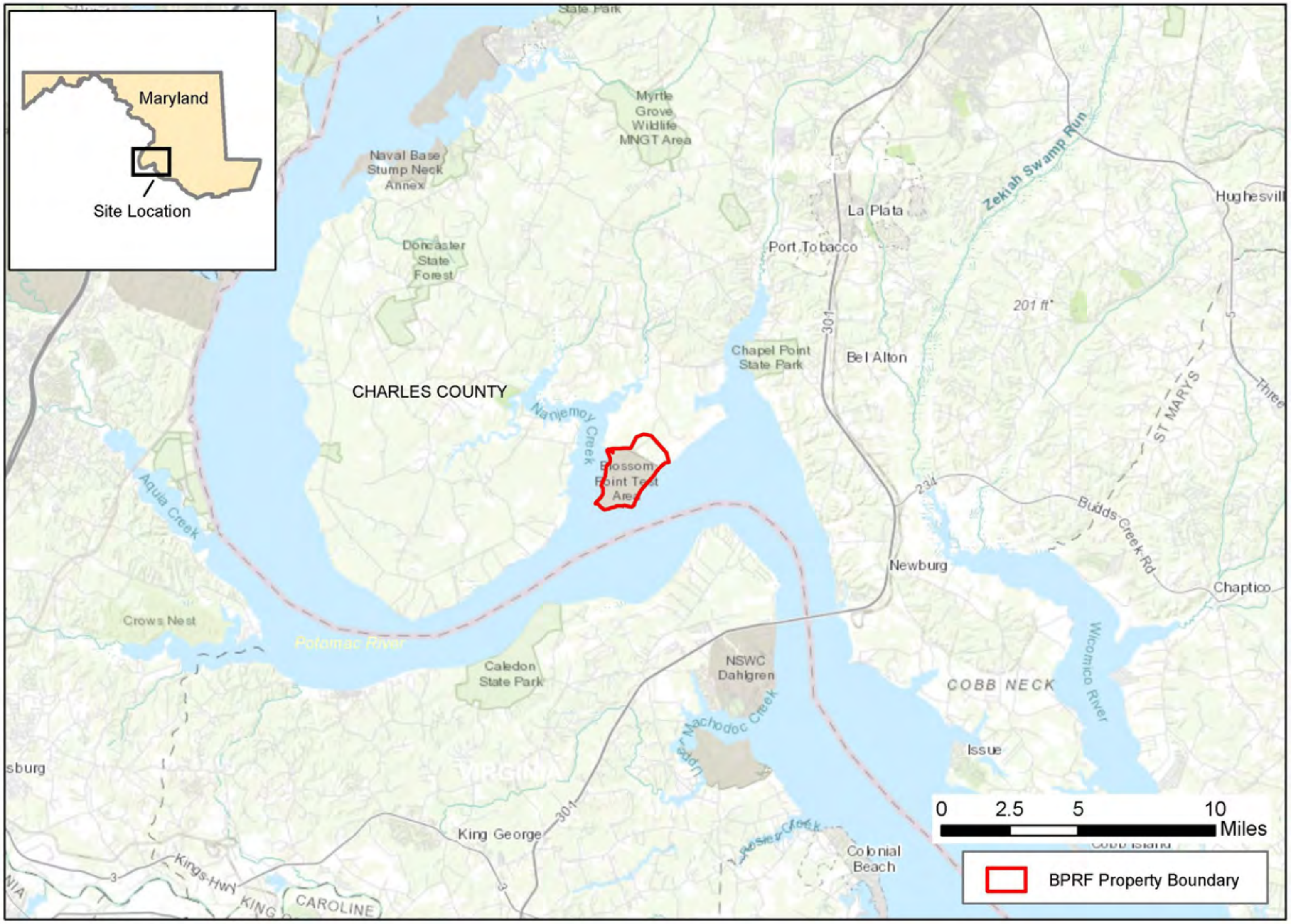
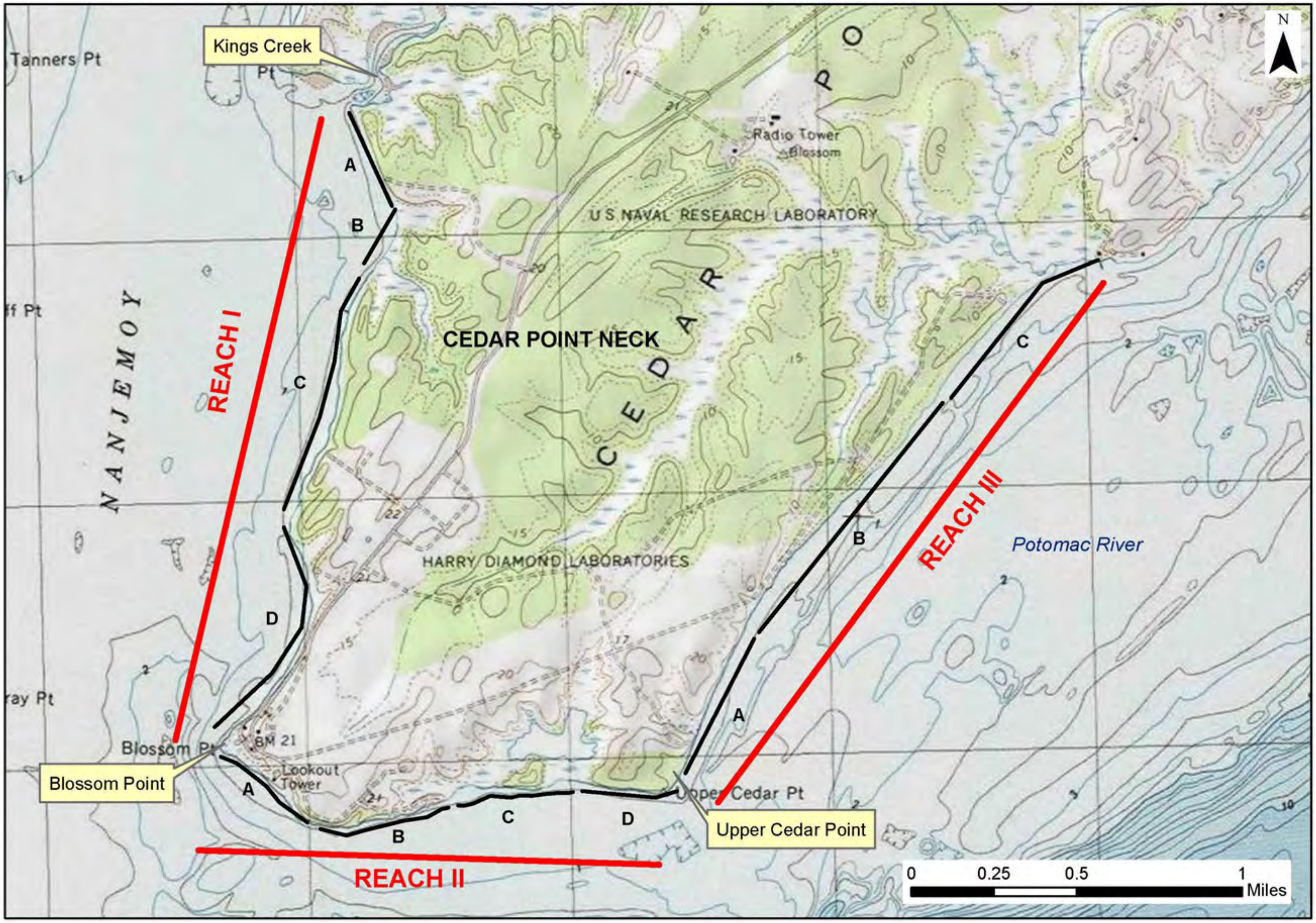


Figure 2. Reaches and Subreaches of the BPRF Shoreline



DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
ADELPHI LABORATORY CENTER
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ADELPHI, MD 20783-1138

March 6, 2019

Ms. Lori Byrne
Environmental Review Coordinator
Wildlife and Heritage Service
Maryland Department of Natural Resources
580 Taylor Avenue
Annapolis, MD 21401

Subject: Early Scoping and Coordination
Environmental Assessment for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek
Charles County, Maryland

Dear Ms. Byrne,

The purpose of this letter is to solicit comments regarding the United States Army Garrison (USAG) Adelphi Laboratory Center's (ALC's) intent to implement the ALC Blossom Point Research Facility (BPRF) Shoreline Management Plan (SMP) for Potomac River and Nanjemoy Creek. Under the SMP, physical shoreline improvements would be constructed at the ALC BPRF to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek. ALC is preparing an Environmental Assessment (EA) to evaluate the potential environmental effects associated with the Proposed Action pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. Code §4321 et seq.), the Council on Environmental Quality Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508), and 32 CFR Part 651, *Environmental Analysis of Army Actions.*

The ALC BPRF is located approximately 45 miles south of Washington, D.C. and approximately 75 miles southwest of Baltimore, MD. The ALC BPRF is located approximately 9 miles south of La Plata, and within the unincorporated community of Welcome, MD. The ALC BPRF is situated on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck (**Figure 1**). The ALC BPRF is bordered by the Potomac River to the east and south, while the approximately 1.5-mile long western boundary is bordered by Nanjemoy Creek (**Figure 2**). Nanjemoy Creek is an approximately 13.1-mile long tidal tributary of the Potomac River and drains smaller tributaries located to the north and west of the ALC BPRF. Currently, the ALC BPRF serves as a test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems.

As depicted on **Figure 2**, the shoreline of Cedar Point Neck consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical or biological conditions. These reaches are designated as Reach I on the western shore of the peninsula on

Nanjemoy Creek, Reach II at the southern edge of the peninsula on the Potomac River, and Reach III on the eastern shore of the peninsula on the Potomac River. These reaches are further divided into several subreaches according to land use and shore zone geomorphology. Reach I consists of subreaches A, B, C and D, from upstream to downstream. Reach II consists of subreaches A, B, C and D, from west to east, and Reach III consists of subreaches A, B and C, from downriver to upriver.

The Proposed Action involves the implementation of a Living Shoreline, a best management practice that provides long-term protection, restoration, or enhancement of vegetated shoreline habitats through strategic placement of organic materials. During development of the SMP, a non-Living Shoreline alternative was considered but determined to not meet the preferred strategy for shoreline improvements for the state of Maryland, as it would use structures such as stone breakwaters instead of green strategies. Under the Proposed Action, the Living Shoreline would incorporate two types of shoreline improvements as detailed in the SMP and described below. These improvements would be designed to protect against a 25-year storm event and a 5-feet above mean low water storm surge.

The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority. Specifically, two critical areas have been identified: Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA where erosion threatens the existing lookout tower. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

1) Shoreline improvement structures – Construction of stone structures for shoreline protection would occur along approximately 18,500 feet (3.5 miles) of total shoreline along Nanjemoy Creek and the Potomac River. Such structures include the following:

    a. **Sills** consist of a line of rock placed directly offshore and parallel to the eroding shoreline. Sand is filled between the stone and the eroding bank and marsh grasses are planted on the sand fill to create a protective marsh fringe.
    b. **Gapped sills** are a series of sill structures with strategic gaps between them to allow ingress and egress of marine fauna.
    c. **Brills** are a combination of sills and breakwaters. Breakwaters are a series of rock structures placed strategically offshore to dissipate wave energy before it reaches the shoreline.
    d. **Gapped brills** consist of long brill structures with wide gaps between them.
    e. **Revetments** are structures, typically constructed from stone, with sloped and rough faces that decrease wave reflection. They are built directly parallel to the shoreline and are often a last line of defense in high impact

environments, where the nearshore is too deep for other structures, or where infrastructure is very close to the shoreline.

f. **Spurs** are transitional structures that minimize impacts of other structures on adjacent properties. They are often built off existing structures such as revetments.

2) Sand nourishment – Shore stabilization through sand nourishment involves the fill of sand (approximately 59,000 cubic yards) between the stone structures and the bank. Sand nourishment would also include the strategic planting of wetland vegetation to stabilize the new sand substrate and create permanent marsh habitat. Wetland vegetation would include *Spartina alterniflora, Spartina patens,* and *Scirpus cyperinus.*

Construction activities would involve the anchoring of filter fabric on the existing bottom of the nearshore and the placement of stones on the filter fabric base to the desired width and height. The area behind the sill and brill structures would be graded and backfilled with clean sand and planted with native, non-invasive marsh grasses. Stone, sand fill, and construction equipment would be transported to the construction areas by a combination of barge and truck, depending on the depth of the nearshore and the capability of equipment to reach the proposed construction locations.

The SMP recommends shoreline management strategies and improvement structures specific to subreach, as improvements are only needed for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable and therefore improvements are not recommended for these areas.

We look forward to and welcome your participation in this analysis. Please provide any comments, concerns, information, studies, or other data you may have regarding the Proposed Action within **thirty (30) days** of receipt of this letter to enable us to complete this phase of the project within the scheduled timeframe. All responses will be considered for incorporation in the EA.

If you have information relevant to the development of the EA, please direct your correspondence to Bridget Kelly Butcher, U.S. Army Garrison Adelphi Laboratory Center, at 301-394-1062 or bridget.c.kellybutcher.civ@mail.mil.

Sincerely,

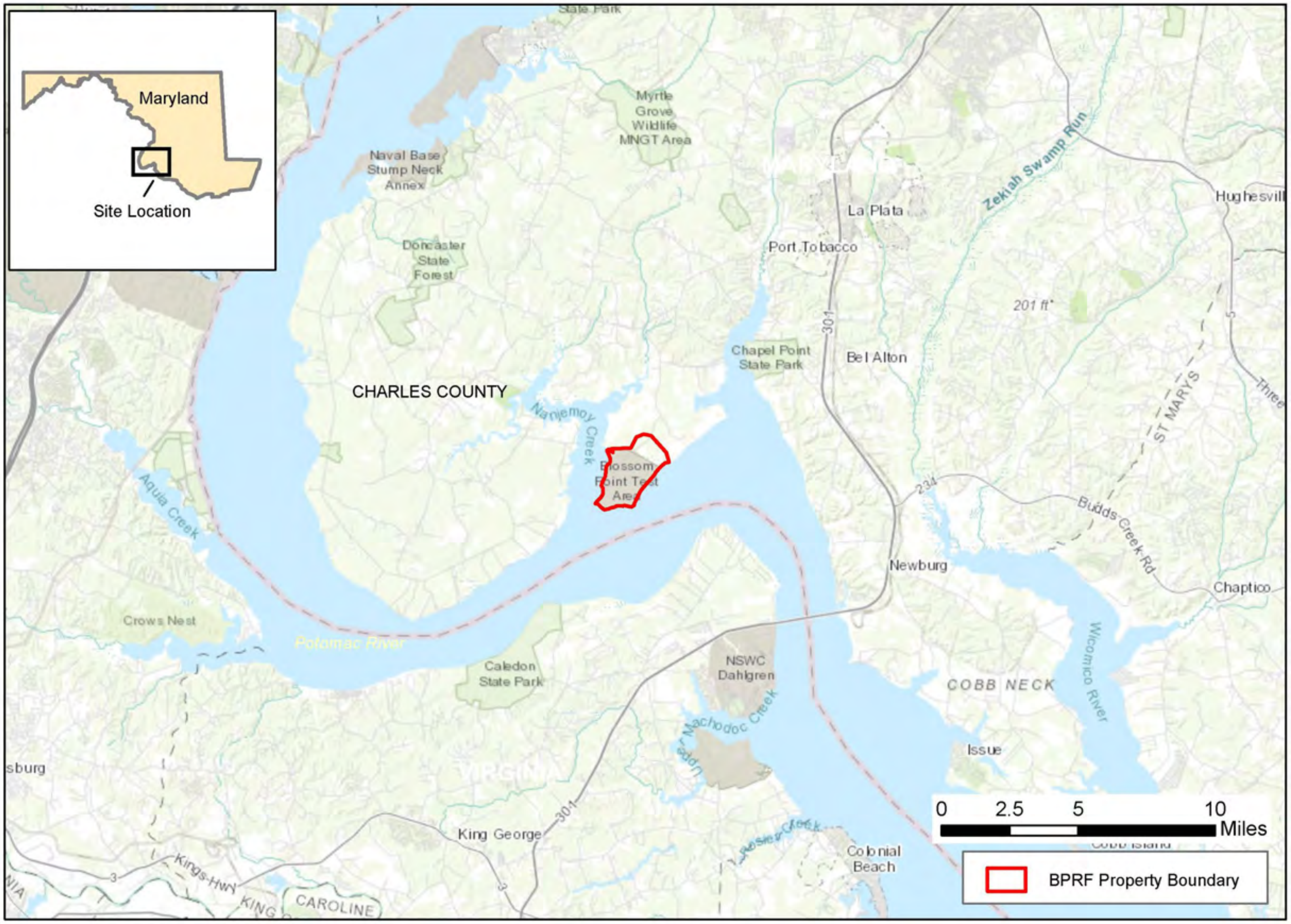
James Krake

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory Center

Please note that all included Figures are For Official Use Only (FOUO).

Enclosures: Figure 1: Blossom Point Research Facility Site Location Map
Figure 2: Reaches and Subreaches of the BPRF Shoreline

Figure 1. Blossom Point Research Facility Site Location Map



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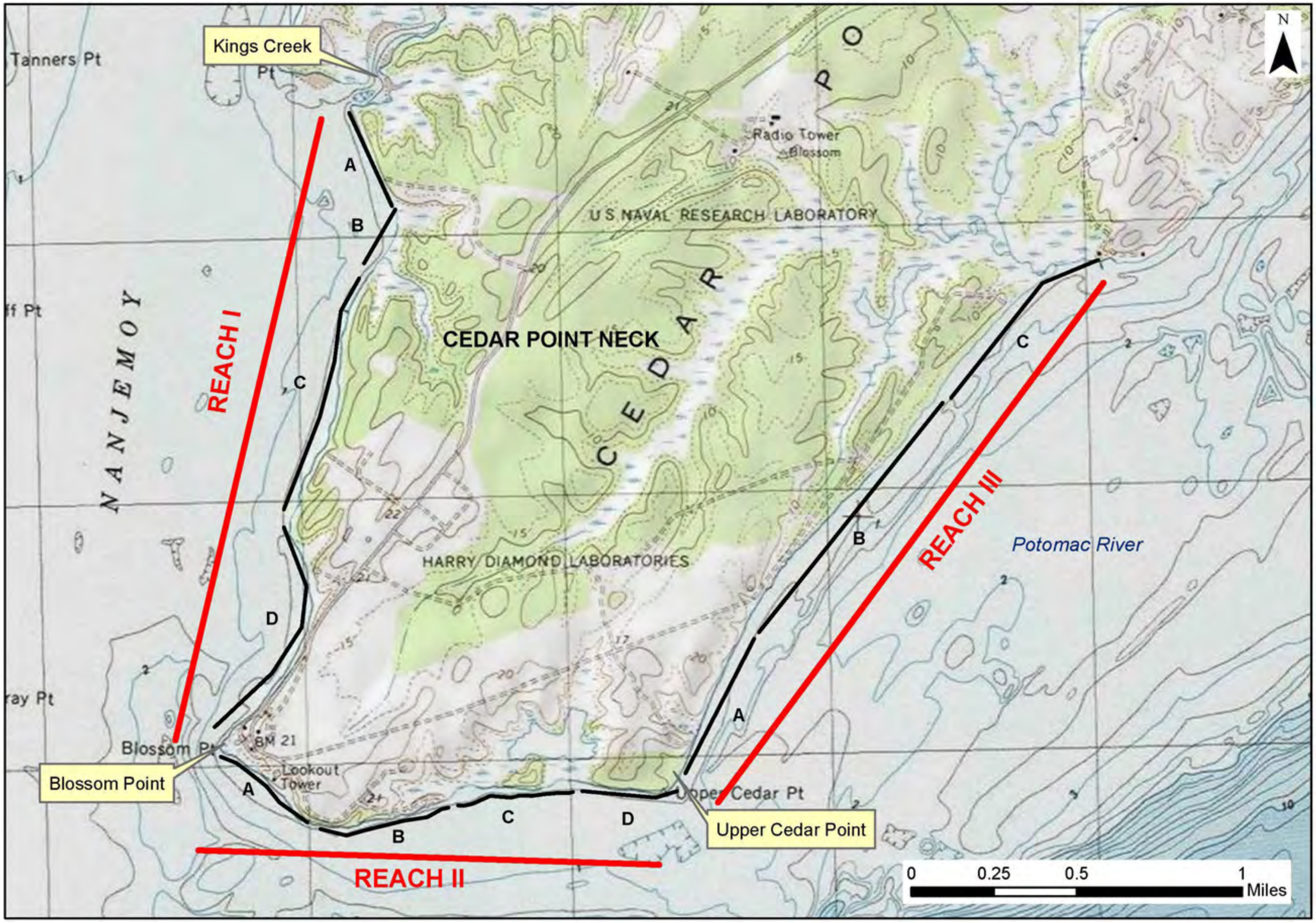

DEPARTMENT OF THE ARMY
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March 6, 2019

Ms. Karen Green
Mid-Atlantic Field Office Supervisor/EFH Coordinator
55 Great Republic Drive
NOAA Fisheries Service
Gloucester, MA 01930
Karen.Greene@noaa.gov

Subject: Magnuson-Stevens Fishery Conservation and Management Act Consultation Environmental Assessment for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek Charles County, Maryland

Dear Ms. Greene,

The purpose of this letter is to solicit comments regarding the United States Army Garrison (USAG) Adelphi Laboratory Center's (ALC's) intent to implement the ALC Blossom Point Research Facility (BPRF) Shoreline Management Plan (SMP) for Potomac River and Nanjemoy Creek. Under the SMP, physical shoreline improvements would be constructed at the ALC BPRF to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek. ALC is preparing an Environmental Assessment (EA) to evaluate the potential environmental effects associated with the Proposed Action pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. Code §4321 et seq.), the Council on Environmental Quality Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508), and 32 CFR Part 651, *Environmental Analysis of Army Actions.*

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<u>Proposed Action</u>

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The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority. Specifically, two critical areas have been identified: Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA where erosion threatens the existing lookout tower. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

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The SMP recommends shoreline management strategies and improvement structures specific to subreach, as improvements are only needed for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable and therefore improvements are not recommended for these areas.

Essential Fish Habitat

Construction of the shoreline improvements would have the potential to affect resources under the jurisdiction of the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). The Magnuson-Stevens Fishery Conservation and Management Act requires Federal agencies to consult with NOAA NMFS to address activities that may adversely affect Essential Fish Habitat (EFH), which is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Based on a query of the NOAA EFH Mapper, designated EFH has been mapped for eight species as listed in the table below. No Habitat Areas of Particular Concern (HAPCs) and no EFH Areas Protected from Fishing (EFHA) were identified in the Proposed Action area.

EFH Species and Life Stages Potentially Found in the Project Area

Species	Egg	Larvae	Juvenile	Adult
Atlantic Herring	--	--	✓	✓
Bluefish	--	--	✓	✓
Clearnose Skate	--	--	✓	✓
Little Skate	--	--	--	✓
Red Hake	✓	✓	✓	✓
Summer Flounder	--	--	✓	✓
Windowpane Flounder	--	--	✓	
Winter Skate	--	--	--	✓

Mean salinity in this section of the Potomac River ranges from approximately 1 to 4 ppt throughout the year, with higher salinity during the late summer and fall seasons (Maryland DNR, 2018). Mean water temperatures range from 38°F to 44°F during winter months and 55 °F to 81°F during spring and summer months (Maryland DNR, 2018). Given the low salinity, adult and juvenile EFH species are not expected to occur in the Proposed Action area, or would occur in low densities, as these species prefer high salinity zones (greater than 10 ppt) of the Chesapeake Bay (New England Fishery Management Council & NMFS, 2017). These species also generally avoid water temperatures above 50 °F. EFH for red hake eggs and larvae are not anticipated to be present as preferred habitat includes pelagic habitats within the middle to outer continental shelf of the Mid-Atlantic Bight (New England Fishery Management Council & NMFS, 2017). The Proposed Action area is not within this region.

In-water activities associated with the development of shoreline improvement structures would result in construction-related disturbances (including increased turbidity, physical disturbance, and noise/vibration) that may cause short-term adverse impacts to aquatic species and habitats. No dredging or pile driving would be required. Construction activities would be temporary and localized to a small area, allowing adult and juvenile individuals to move out of affected areas. Additionally, after construction of the shoreline improvement structures, turbidity and sedimentation would decrease due to the decrease in shoreline erosion. More information can be found in the *NOAA Fisheries EFH Assessment Worksheet* (see **Attachment 2**).

Conclusion

Because EFH species are unlikely to be present in the Proposed Action area, any potential adverse impacts would be insignificant. Thus, ALC anticipates that the Proposed Action ***may affect, but is unlikely to adversely affect*** EFH, particularly with the implementation of best management practices (BMPs) during construction. ALC would implement BMPs, such as the use of silt curtains, turbidity barriers, noise-reducing measures, and seasonal restrictions, as appropriate, in accordance with permit conditions to further avoid or minimize impacts to aquatic species and habitat.

ALC requests NMFS review and concur with the effects determination stated in this letter. Please advise if there are any further actions needed to facilitate the implementation of the Proposed Action in a manner that avoids or minimizes adverse effects to EFH species or habitat.

If you have information relevant to the development of the EA, please direct your correspondence to Bridget Kelly Butcher, U.S. Army Garrison Adelphi Laboratory Center at 301-394-1062 or bridget.c.kellybutcher.civ@mail.mil.

Sincerely,

James Krake

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory Center

Please note that all included Figures are For Official Use Only (FOUO).

Enclosures: Attachment 1: Figures 1 and 2
Attachment 2: EFH Assessment Worksheet

References

Maryland DNR. (2018). *Fixed Station Monthly Monitoring*. Retrieved December 21, 2018, from Eyes on the Bay: http://eyesonthebay.dnr.maryland.gov/bay_cond/bay_cond.cfm?station=RET22&param=sal

New England Fishery Management Council & NMFS. (2017). *Omnibus Essential Fish Habitat Admendment 2. Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts*. Retrieved from https://www.habitat.noaa.gov/application/efhmapper/oa2_efh_hapc.pdf#page=36

U.S. Army Garrison. (2016). *Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek.*

Figure 1. Blossom Point Research Facility Site Location Map

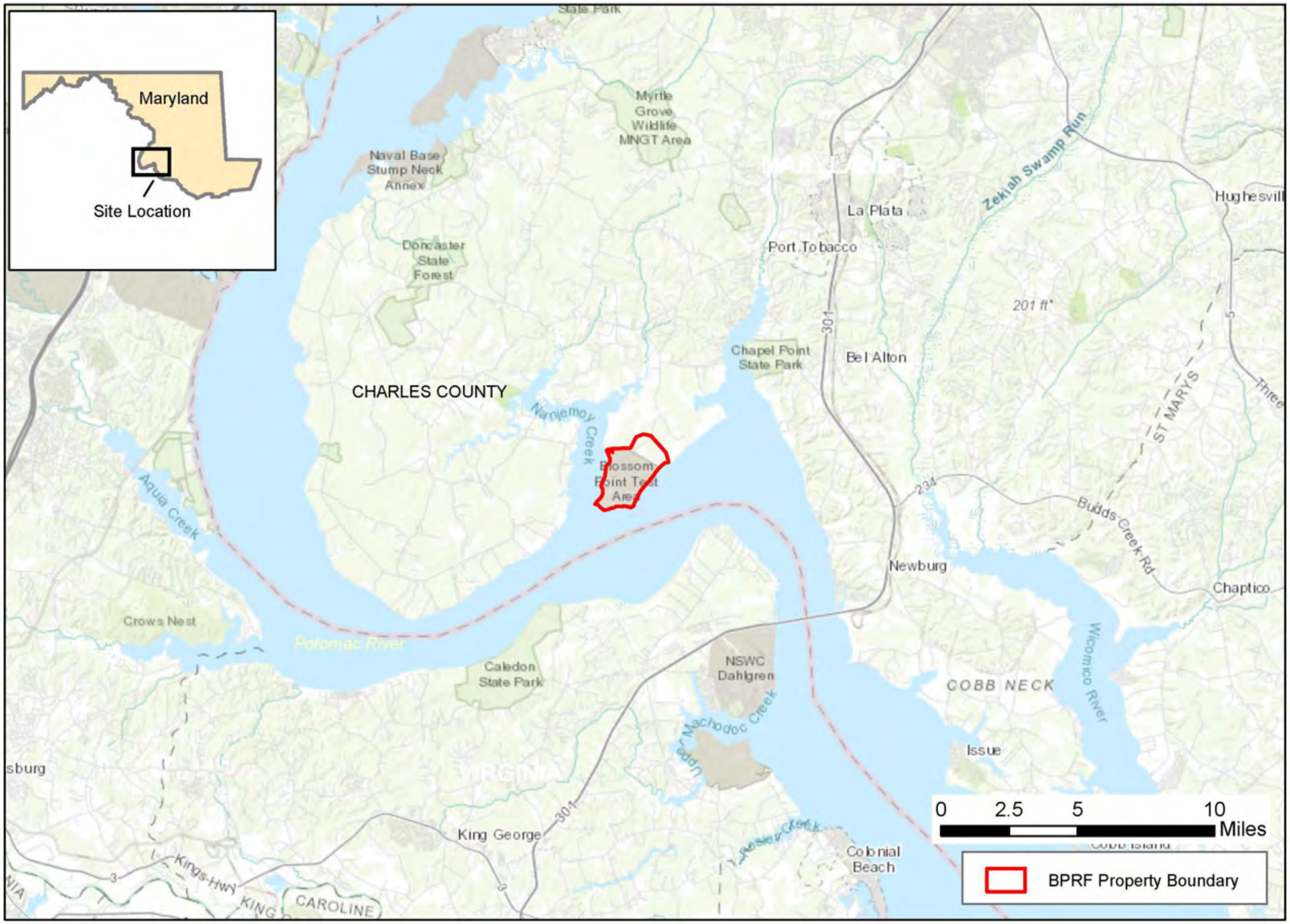
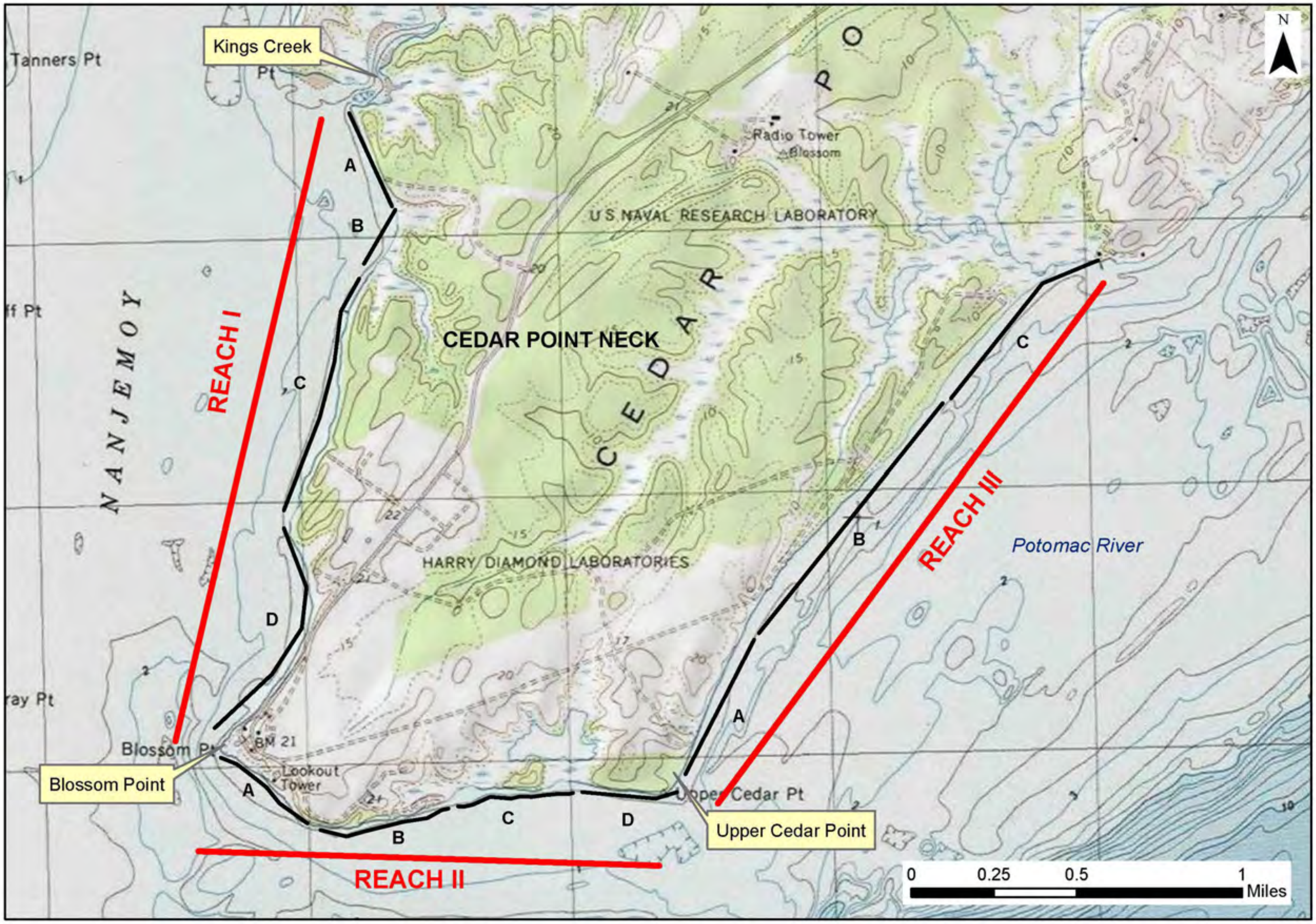


Figure 2. Reaches and Subreaches of the ALC BPRF Shoreline



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ADELPHI, MD 20783-1138

March 6, 2019

Mrs. Kimberly Damon-Randall
NOAA National Marine Fisheries Service
Protected Resources Division
55 Great Republic Drive
Gloucester, MA 01930

Subject: Endangered Species Act Section 7 – Early Consultation
Environmental Assessment for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek, Charles County, Maryland

Dear Mrs. Damon-Randall,

The United States Army Garrison (USAG) Adelphi Laboratory Center (ALC) supports the mission to execute fundamental and applied research to provide the Army with the key technologies and the analytical support necessary to assure supremacy in future land warfare. The Blossom Point Research Facility (BPRF), located in Welcome, Charles County, Maryland, is operated as a satellite facility and serves the ALC as a primary test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems.

The ALC BPRF is located on a peninsula along the Potomac River and is subject to extensive erosive forces. Accordingly, ALC is preparing an Environmental Assessment (EA) to evaluate the environmental impacts associated with a Proposed Action to implement the U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek (SMP). Under the SMP, physical shoreline improvements would be constructed and operated at the ALC BPRF to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek.

This letter is to request Endangered Species Act (ESA) concurrence from your office for the EA for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek. We have made the determination that the proposed activity ***may affect, but is not likely to adversely affect***, any species listed as threatened or endangered by NMFS under the ESA of 1973, as amended, and critical habitat. Our supporting analysis is provided below.

1. Proposed Action

The Proposed Action involves the implementation of a Living Shoreline, a best management practice that provides long-term protection, restoration, or enhancement of vegetated shoreline habitats through strategic placement of organic materials. During development of the SMP, a non-Living Shoreline alternative was considered but determined to not meet the preferred strategy for shoreline improvements for the state of Maryland, as it would use structures such as stone breakwaters instead of green strategies. Under the Proposed Action, the Living Shoreline would incorporate two types of shoreline improvements as detailed in the SMP and described below. These improvements would be designed to protect against a 25-year storm event and a 5-feet above mean low water storm surge.

The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority. Specifically, two critical areas have been identified: Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA where erosion threatens the existing lookout tower. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

1) Shoreline improvement structures – Construction of stone structures for shoreline protection would occur along approximately 18,500 feet (3.5 miles) of total shoreline along Nanjemoy Creek and the Potomac River. Such structures include the following:

    a. **Sills** consist of a line of rock placed directly offshore and parallel to the eroding shoreline. Sand is filled between the stone and the eroding bank and marsh grasses are planted on the sand fill to create a protective marsh fringe.

    b. **Gapped sills** are a series of sill structures with strategic gaps between them to allow ingress and egress of marine fauna.

    c. **Brills** are a combination of sills and breakwaters. Breakwaters are a series of rock structures placed strategically offshore to dissipate wave energy before it reaches the shoreline.

    d. **Gapped brills** consist of long brill structures with wide gaps between them.

    e. **Revetments** are structures, typically constructed from stone, with sloped and rough faces that decrease wave reflection. They are built directly parallel to the shoreline and are often a last line of defense in high impact environments, where the nearshore is too deep for other structures, or where infrastructure is very close to the shoreline.

    f. **Spurs** are transitional structures that minimize impacts of other structures on adjacent properties. They are often built off existing structures such as revetments.

2) Sand nourishment – Shore stabilization through sand nourishment involves the fill of sand (approximately 59,000 cubic yards) between the stone structures and the bank. Sand nourishment would also include the strategic planting of wetland vegetation to stabilize the new sand substrate and create permanent marsh habitat. Wetland vegetation would include *Spartina alterniflora*, *Spartina patens*, and

Scirpus cyperinus.

Construction activities would involve the anchoring of filter fabric on the existing bottom of the nearshore and the placement of stones on the filter fabric base to the desired width and height. The area behind the sill and brill structures would be graded and backfilled with clean sand and planted with native, non-invasive marsh grasses. Stone, sand fill, and construction equipment would be transported to the construction areas by a combination of barge and truck, depending on the depth of the nearshore and the capability of equipment to reach the proposed construction locations. No dredging or pile driving activities would be required.

The SMP recommends shoreline management strategies and improvement structures specific to subreach, as improvements are only needed for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable and therefore improvements are not recommended for these areas.

2. **Description of the Proposed Action Area**

The ALC BPRF is located approximately 45 miles south of Washington, D.C. and approximately 75 miles southwest of Baltimore, MD. The ALC BPRF is situated on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck (Figure 1). The ALC BPRF is bordered by the Potomac River to the east and south, while the approximately 1.5-mile long western boundary is bordered by Nanjemoy Creek (Figure 2). Nanjemoy Creek is an approximately 13.1-mile long tidal tributary of the Potomac River and drains smaller tributaries located to the north and west of the ALC BPRF.

As depicted on Figure 2, the shoreline of ALC BPRF consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical or biological conditions. These reaches are designated as Reach I on the western shore of the peninsula on Nanjemoy Creek, Reach II at the southern edge of the peninsula on the Potomac River, and Reach III on the eastern shore of the peninsula on the Potomac River. These reaches are further divided into several subreaches according to land use and shore zone geomorphology.

The Proposed Action area includes the three reaches along the ALC BPRF shoreline, which include portions of Nanjemoy Creek and the Potomac River.

3. **NMFS Listed Species (and Critical Habitat) in the Action Area**

The federally listed endangered or threatened species (and/or their critical habitat) that occur or have the potential to occur in or near the Proposed Action area include the following:

<u>Fish</u>

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) (77 FR 5880 and 77 FR 5914)

Shortnose Sturgeon (*Acipenser brevirostrum*) (32 FR 4001; Recovery plan: NMFS 1998)

<u>Critical Habitat</u>

Atlantic Sturgeon Critical Habitat (82 FR 39160)

These species and critical habitat are described in further detail below.

Atlantic Sturgeon

Atlantic sturgeons are anadromous and spend most of their lives in nearshore marine and estuarine waters, migrating to freshwater rivers and tributaries to spawn. Most juveniles remain in their river of birth (natal river) for at least several months before migrating out to the ocean. Atlantic sturgeons prefer deep waterways and spend most of their time foraging in the benthic environment (NOAA Fisheries, 2017; NOAA Fisheries, 2015).

There are five Distinct Population Segments (DPS) of Atlantic sturgeon listed as threatened or endangered. Atlantic sturgeon originating from the New York Bight, Chesapeake Bay, South Atlantic, and Carolina DPSs are listed as endangered; the Gulf of Maine DPS is listed as threatened. Atlantic sturgeons in the Potomac River are a part of the Chesapeake Bay DPS and may occur in or near the Proposed Action area. Based on a query of the NOAA NMFS Section 7 Mapper, juvenile, subadult, and adult individuals may occur in or near the Proposed Action area. Juveniles and subadults may occur year-round, while adults may be present from late March through late November.

The presence of Atlantic sturgeon in the Potomac River, including the Proposed Action area, is limited. Recent captures in the Potomac River include three small juveniles in 2006 and a large mature female in 1970. Two of the three juveniles were captured near river kilometer (rkm) 99, approximately 10 nautical miles (nm) west of the Proposed Action area, and one was captured near rkm 115, approximately 16 nm northwest of the Proposed Action area. During a 2013-2014 Chesapeake Bay finfish investigation, the Atlantic sturgeon was not documented (Maryland DNR, 2014).

While the Potomac River has been confirmed to have had a historical spawning population, current spawning populations are absent. Further, although existing spawning habitat in the Potomac River seems to be intact, water quality is a major concern in this system due to low dissolved oxygen (DO) during the summer and poor sediment quality (Atlantic Sturgeon Status Review Team, 2007). In addition, clean, hard substrate for attachment of demersal adhesive eggs is limited within the Chesapeake Bay DPS (Atlantic Sturgeon Status Review Team, 2007). Young rearing and foraging may also potentially occur as evidenced by the previously captured three small juveniles (Kynard et al. , 2007). However, it is unknown if the juveniles were non-natal coastal migrants from another river or if they were a result of undiscovered spawning in the Potomac River. No individuals have been observed in Nanjemoy Creek.

The benthic macroinvertebrate community is poor in the Proposed Action area, which may limit Atlantic sturgeon foraging (Maryland DNR, 2018). During 2004 stream surveys, only seven different benthic families were collected, revealing low diversity and indicating poor stream quality. For this reason, as well as the poor water and sediment quality in the Potomac River, lack of confirmed and documented current spawning populations, and infrequent captures and observations of individuals, we expect the presence of Atlantic sturgeon in the vicinity of the Proposed Action area to be limited.

Shortnose Sturgeon

The shortnose sturgeon is federally listed as endangered throughout its range, occurring in rivers and coastal waters from Canada to Florida (NOAA Fisheries, 2018). They hatch in the freshwater of rivers and spend most of their time in the estuaries of these rivers. Unlike Atlantic sturgeon, shortnose sturgeon tend to spend relatively little time in the ocean. When they do enter marine waters, they generally stay close to shore. In the spring, adults move far upstream and away from saltwater to spawn. After spawning, the adults move rapidly back downstream to the estuaries, where they feed, rest, and spend most of their time.

Based on a query of the NOAA NMFS Section 7 Mapper, juvenile and adult individuals may occur in or near the Proposed Action area and engage in foraging, migrating, and overwintering behaviors. Overwintering occurs from November through March, while foraging and migrating activities would occur year-round.

There is little evidence of spawning populations in any river within the Chesapeake Bay and no early life stages or young shortnose sturgeon have been observed in the Potomac River (Kynard et al., 2016). Adult individuals have been documented in the Potomac River. Between 1996 and 2008, 11 captures were documented via a reward program sponsored by the US Fish and Wildlife Service to compensate commercial fishermen who report captures of sturgeon (Shortnose Sturgeon Status Review Team, 2010). During a 2004 to 2007 telemetry study of shortnose sturgeon in the Potomac River, only two female adults were captured (Kynard et al. , 2007). One individual was captured near rkm 139, approximately 30 nm northwest of the Proposed Action area, while the other was captured near rkm 63, approximately 18 nm south of the Proposed Action area. The lack of captures, as well as the fact that one of the tagged individuals was recaptured three times, indicated low abundance, potentially less than in any river known with a sustaining population of the species. No individuals have been observed in Nanjemoy Creek.

As previously discussed, the Potomac River has low DO levels and numerous water quality impairments affecting its potential for suitable habitat. Additionally, the benthic community surrounding the Proposed Action area is poor. For these reasons and due to the lack of confirmed and documented current populations, we expect the presence of shortnose sturgeon in the Proposed Action area to be limited.

Atlantic Sturgeon Critical Habitat

The Proposed Action area is located within designated Atlantic sturgeon critical habitat; specifically, the Potomac River of the Chesapeake Bay DPS. The final rule (82 FR 39160) identifies four physical and biological features (PBFs) of Atlantic sturgeon critical habitat:

1) Hard bottom substrate in low salinity waters (0.0 to 0.5 parts per thousand [ppt]) for settlement of fertilized eggs, refuge, growth, and development of early life stages;

2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate between the river mouth and spawning sites for juvenile foraging and physiological development;

3) Water of appropriate depth and absent of physical barriers to passage between the river mouth and spawning sites necessary to support unimpeded movements of adults to and from spawning sites. Water depths in main river channels must also be deep enough (at least 1.2 meters [4 feet]) to ensure continuous flow in the main channel; and,

4) Water, between the river mouth and spawning sites with the temperature, salinity, and oxygen values that, combined, support spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment (e.g., 13° C [55^{0}F] to 26° C [78.8 ^{0}F] for spawning habitat and no more than 30° C (86^{0}F) for juvenile rearing habitat, and 6 mg/L or greater dissolved oxygen for juvenile rearing habitat).

Of these four PBFs, two may occur in the Proposed Action area: PBF 2 and PBF 4. Mean salinity in this section of the Potomac River ranges from approximately 1 to 4 ppt throughout the year, with higher salinity during the late summer and fall seasons (Maryland DNR, 2018). Mean water temperatures range from 38^{0}F to 44^{0}F during winter months and 55 ^{0}F to 81^{0}F during spring and summer months (Maryland DNR, 2018). These temperatures are within the range suitable for spawning habitat and juvenile rearing, and a gradual downstream salinity gradient is present. While two PBFs are observed in the Proposed Action area, current spawning populations are absent and Atlantic sturgeon have not been observed in the Potomac River in recent decades. Given the poor water and sediment quality of the Potomac River, the Proposed Action area is not likely to support Atlantic sturgeon populations.

4. **Effects Determination**

Habitat Modification

Approximately 59,000 cubic yards of sand would be used as fill for shoreline nourishment purposes. Some benthic habitat could be permanently filled which may impact any sturgeon opportunistically foraging in the Proposed Action area. However, as previously mentioned, the existing benthic community is anticipated to be poor and the area of effect would be small relative to the size of the ALC BPRF shoreline and the greater Potomac River habitat. Any potential sturgeon in the area would be juveniles and adults, capable of moving to other more suitable areas to forage. The new shoreline structures would not add any detectable obstruction to migrating sturgeon and thus would not alter the habitat in any way that prevents sturgeon from using the Proposed Action area as a migratory or movement corridor to other more suitable areas for foraging, overwintering, and spawning. Therefore, the effects of habitat modification on sturgeon resulting from the Proposed Action would be insignificant.

Water Quality

Beach nourishment activities and placement of stone structures along the shoreline would potentially disturb bottom sediments and cause a temporary increase in suspended sediment in the Proposed Action area. Considering beach nourishment materials consist primarily of coarse sands, plumes from the discharge should settle rapidly and not affect large areas. Total suspended solids (TSS) concentrations created by beach nourishment operations along an open coastline are expected to be between 34.0-64.0 mg/L and would settle within several hours after discharge cessation. These TSS levels are below those shown to have adverse effect on fish (580.0 mg/L for the most sensitive species) and benthic communities (390.0 mg/L) (NOAA Fisheries, 2017). Therefore, the effects of suspended sediment on sturgeon resulting from the Proposed Action would be insignificant. Additionally, shoreline protections and beach nourishment are expected to decrease erosion of the ALC BPRF shorelines, therefore providing long-term, beneficial effects on water quality.

Vessel Traffic

Barges would potentially be used to transport and stockpile materials and construction equipment. These barges would be placed in an area of sufficient depth and would be consistent with vessel use and operations in the Potomac River/Nanjemoy Creek area. Transportation of the barges to and from the Proposed Action area during construction would not significantly increase vessel traffic above existing levels for the limited period of time during construction. Further, there would be no measurable or detectable increase in the risk of vessel strike; therefore, effects to sturgeon and critical habitat are insignificant.

Conclusions

Based on the analysis that all effects of the Proposed Action would be insignificant and/or discountable, we have determined that implementation of the *Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* (Proposed Action) ***may affect but is not likely to adversely affect*** any listed species or critical habitat under NMFS' jurisdiction. ALC would implement BMPs, such as the use of silt curtains, turbidity barriers, noise-reducing measures, and seasonal restrictions, as appropriate, in accordance with permit conditions to further avoid or minimize impacts to aquatic species and habitat. We certify that we have used the best scientific and commercial data available to complete this analysis. We request your concurrence with this determination.

If you have information relevant to the development of the EA, please direct your correspondence to Bridget Kelly Butcher, U.S. Army Garrison Adelphi Laboratory Center at 301-394-1062 or bridget.c.kellybutcher.civ@mail.mil.

Sincerely,

James Krake

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory
Center

Please note that all included Figures are For Official Use Only (FOUO).

Attachments:

Figure 1 **–** Blossom Point Research Facility Site Location Map

Figure 2 **–** Reaches and Subreaches of the BPRF Shoreline

References

Atlantic Sturgeon Status Review Team. (2007). *Status Reivew of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus). Prepared for NOAA NMFS.*

Kynard et al. . (2007). *Status of Shortnose Sturgeon in the Potomac River, Part I - Field Studies.*

Kynard et al. (2016). *Life History and Status of Shortnose Sturgeon (Acipenser brevirostrum).*

Maryland DNR. (2014). *Chesapeake Bay Finfish Investigations* .

Maryland DNR. (2018). *Fixed Station Monthly Monitoring*. Retrieved December 21, 2018, from Eyes on the Bay: http://eyesonthebay.dnr.maryland.gov/bay_cond/bay_cond.cfm?station=RET22&param=sal

Maryland DNR. (2018). *Stream Health*. Retrieved December 31, 2018, from Maryland Biological Stream Survey: geodata.md.gov/streamhealth

NOAA Fisheries. (2015, October 26). *Shortnose Sturgeon (Acipenser brevirostrum)*. Retrieved July 5, 2018, from http://www.nmfs.noaa.gov/pr/species/fish/shortnose-sturgeon.html

NOAA Fisheries. (2017, August 17). *Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus)*. Retrieved July 5, 2018, from http://www.nmfs.noaa.gov/pr/species/fish/atlantic-sturgeon.html

NOAA Fisheries. (2017). *Turbidity Table*. Retrieved from Section 7 Program: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/turbiditytablenew.html

NOAA Fisheries. (2018). *Shortnose Sturgeon*. Retrieved December 26, 2018, from National Oceanic and Atmospheric Administration: https://www.fisheries.noaa.gov/species/shortnose-sturgeon

Shortnose Sturgeon Status Review Team. (2010). *Biological Assessment of Shortnose Sturgeon. Prepared for NOAA NMFS.*

Figure 1. Blossom Point Research Facility Site Location Map

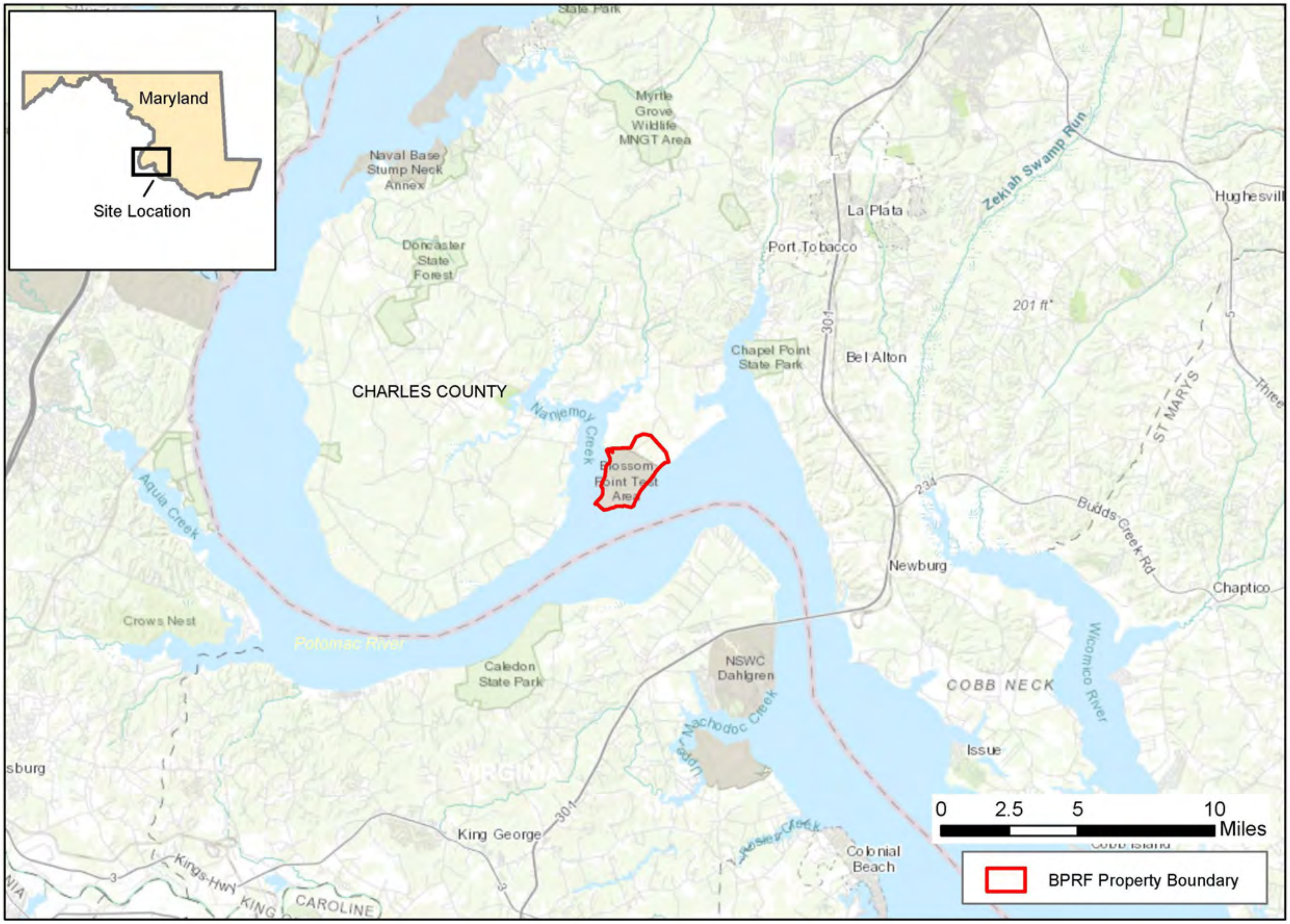
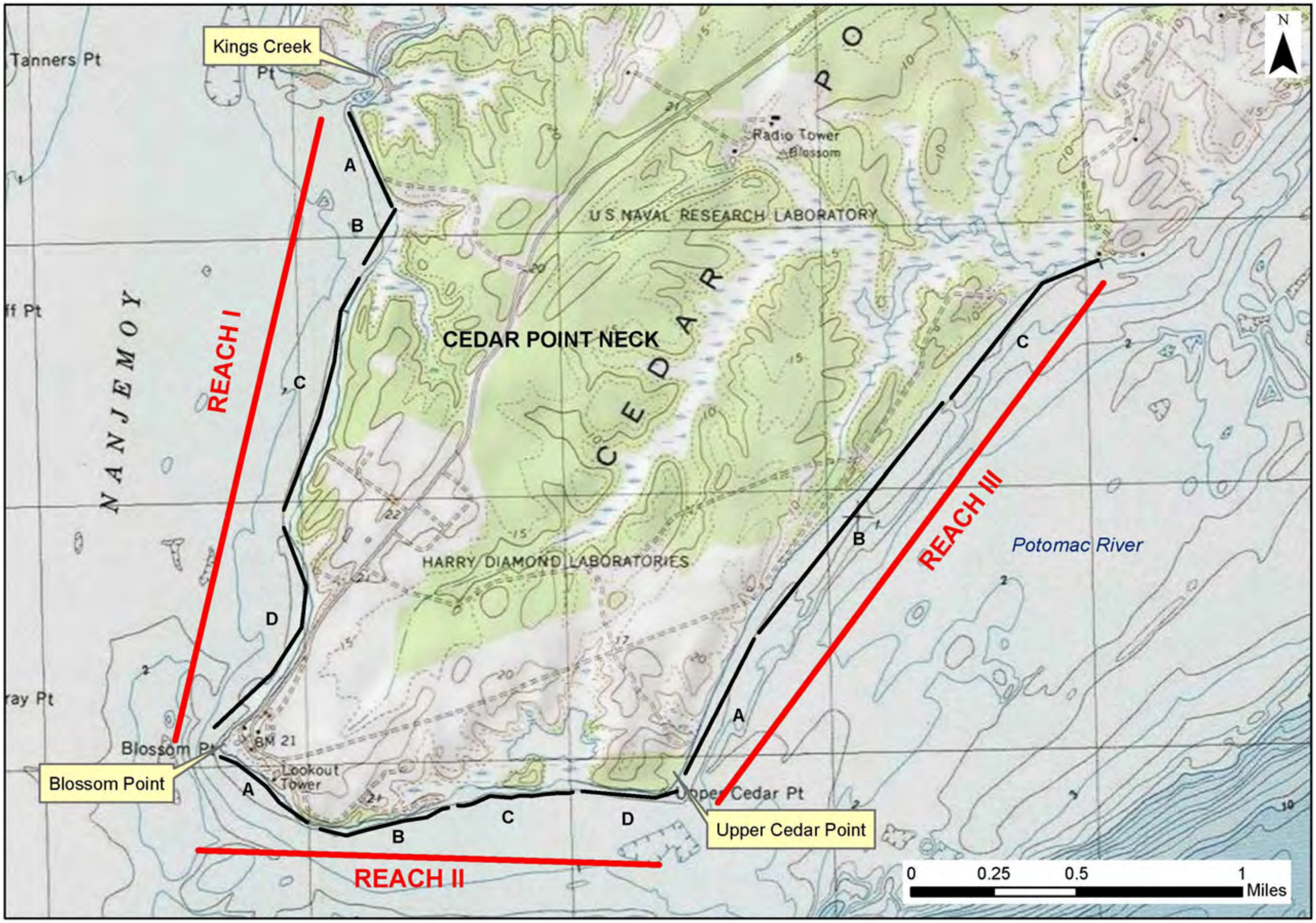


Figure 2. Reaches and Subreaches of the ALC BPRF Shoreline



DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
ADELPHI LABORATORY CENTER
2800 POWDER MILL ROAD
ADELPHI, MD 20783-1138

March 6, 2019

Ms. Jennifer Petrisko
Management Associate
Environmental Review Program
Maryland Department of Natural Resources
580 Taylor Avenue
Annapolis, MD 21401

Subject: Early Scoping and Coordination
Environmental Assessment for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek
Charles County, Maryland

Dear Ms. Petrisko,

The purpose of this letter is to solicit comments regarding the United States Army Garrison (USAG) Adelphi Laboratory Center's (ALC's) intent to implement the ALC Blossom Point Research Facility (BPRF) Shoreline Management Plan (SMP) for Potomac River and Nanjemoy Creek. Under the SMP, physical shoreline improvements would be constructed at the ALC BPRF to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek. ALC is preparing an Environmental Assessment (EA) to evaluate the potential environmental effects associated with the Proposed Action pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. Code §4321 et seq.), the Council on Environmental Quality Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508), and 32 CFR Part 651, *Environmental Analysis of Army Actions.*

The ALC BPRF is located approximately 45 miles south of Washington, D.C. and approximately 75 miles southwest of Baltimore, MD. The ALC BPRF is located approximately 9 miles south of La Plata, and within the unincorporated community of Welcome, MD. The ALC BPRF is situated on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck (**Figure 1**). The ALC BPRF is bordered by the Potomac River to the east and south, while the approximately 1.5-mile long western boundary is bordered by Nanjemoy Creek (**Figure 2**). Nanjemoy Creek is an approximately 13.1-mile long tidal tributary of the Potomac River and drains smaller tributaries located to the north and west of the ALC BPRF. Currently, the ALC BPRF serves as a test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems.

As depicted on **Figure 2**, the shoreline of Cedar Point Neck consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical or biological conditions. These reaches are designated as Reach I on the western shore of the peninsula on Nanjemoy Creek, Reach II at the southern edge of the peninsula on the Potomac River, and

Reach III on the eastern shore of the peninsula on the Potomac River. These reaches are further divided into several subreaches according to land use and shore zone geomorphology. Reach I consists of subreaches A, B, C and D, from upstream to downstream. Reach II consists of subreaches A, B, C and D, from west to east, and Reach III consists of subreaches A, B and C, from downriver to upriver.

The Proposed Action involves the implementation of a Living Shoreline, a best management practice that provides long-term protection, restoration, or enhancement of vegetated shoreline habitats through strategic placement of organic materials. During development of the SMP, a non-Living Shoreline alternative was considered but determined to not meet the preferred strategy for shoreline improvements for the state of Maryland, as it would use structures such as stone breakwaters instead of green strategies. Under the Proposed Action, the Living Shoreline would incorporate two types of shoreline improvements as detailed in the SMP and described below. These improvements would be designed to protect against a 25-year storm event and a 5-feet above mean low water storm surge.

The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority. Specifically, two critical areas have been identified: Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA where erosion threatens the existing lookout tower. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

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The SMP recommends shoreline management strategies and improvement structures specific to subreach, as improvements are only needed for parts of the ALC BPRF shoreline. Certain areas of the shoreline are stable and therefore improvements are not recommended for these areas.

We look forward to and welcome your participation in this analysis. The Environmental Review Unit form on fisheries resources is attached to assist you with your involvement (Attachment A). Please provide any comments, concerns, information, studies, or other data you may have regarding the Proposed Action within **thirty (30) days** of receipt of this letter to enable us to complete this phase of the project within the scheduled timeframe. All responses will be considered for incorporation in the EA.

If you have information relevant to the development of the EA, please direct your correspondence to Bridget Kelly Butcher, U.S. Army Garrison Adelphi Laboratory Center, at 301-394-1062 or bridget.c.kellybutcher.civ@mail.mil.

Sincerely,

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory Center

Please note that all included Figures are For Official Use Only (FOUO).

Enclosures: Figure 1: Site Location Map
Figure 2: Proposed Action Area
Attachment A: Environmental Review Unit Form

Figure 1. Blossom Point Research Facility Site Location Map

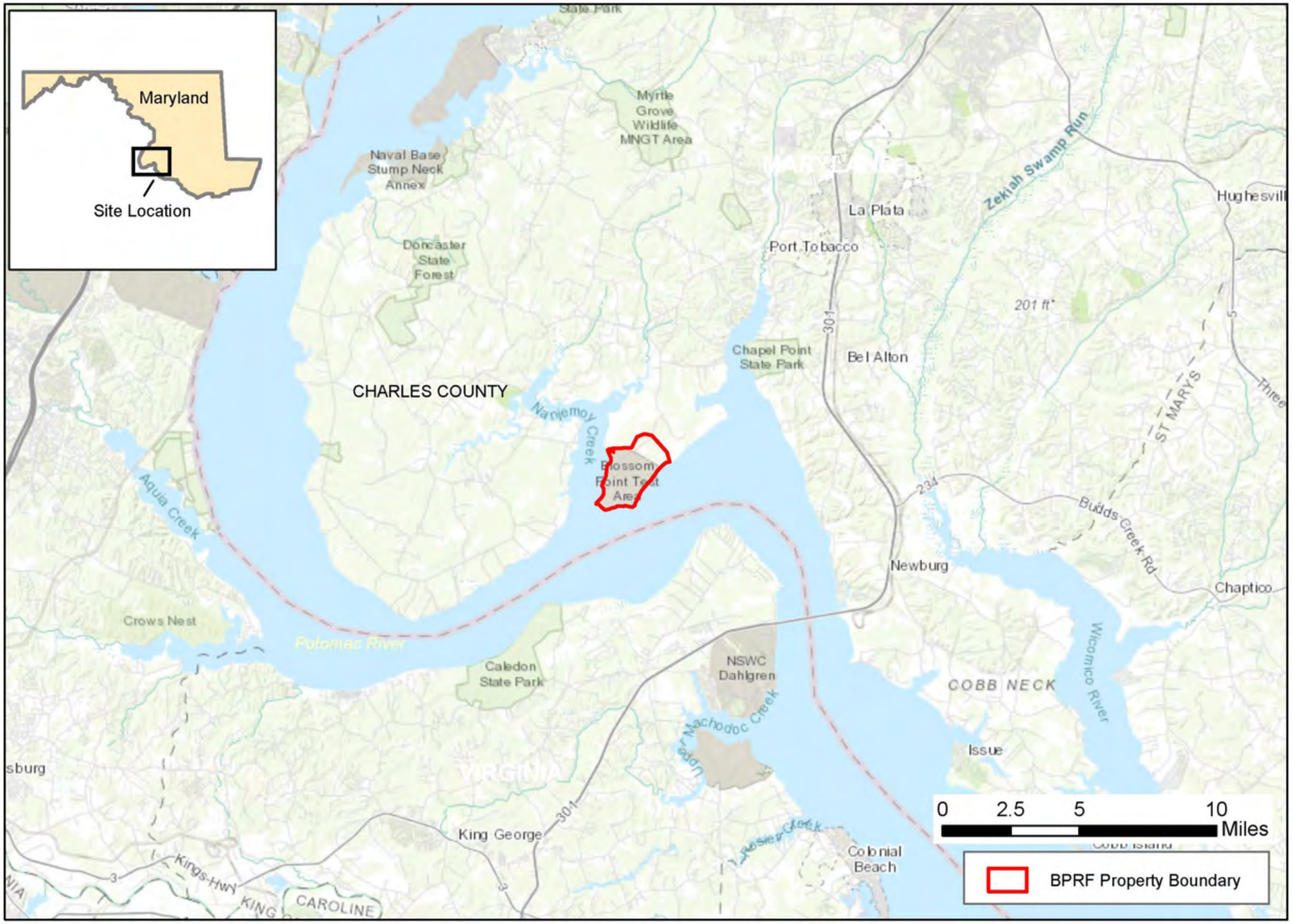
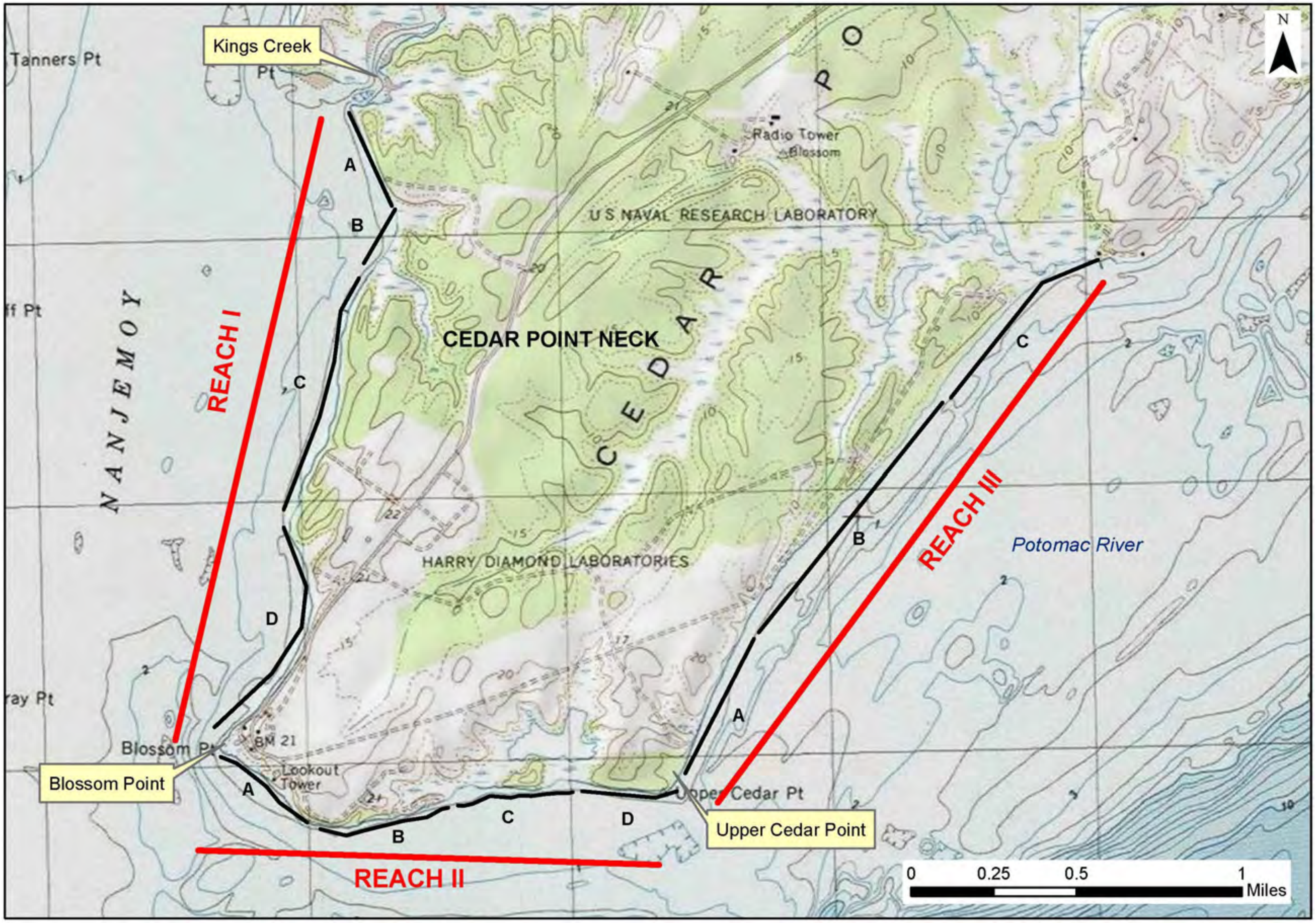


Figure 2. Reaches and Subreaches of the ALC BPRF Shoreline



MARYLAND DEPARTMENT OF
PLANNING
MARYLAND HISTORICAL TRUST

Larry Hogan, Governor
Boyd Rutherford, Lt. Governor

Robert S. McCord, Secretary
Sandy Schrader, Deputy Secretary

March 28, 2019

Mr. James Krake
Chief, Environmental Division
Director of Public Works
U.S. Army Garrison Adelphi Laboratory Center
2800 Powder Mill Rd.
Adelphi, MD 20783-1138

Re: Implementation of the Blossom Point Research Facility Shoreline Management Plan for the Potomac River and Nanjemoy Creek (SMP) (2016)
Charles County, MD

Dear Mr. Krake:

Thank you for your recent letter, dated March 6, 2019 and received by the Maryland Historical Trust (Trust) on March 12, 2019, regarding the above-referenced undertaking. Your letter initiated consultation with the Trust, Maryland's State Historic Preservation Office, pursuant to Section 106 of the National Historic Preservation Act. We offer the following preliminary comments and await further coordination during the project planning process.

According to the submittal, the Army proposes the phased implementation of the Blossom Point SMP to address serious and recurrent shoreline erosion issues along the Potomac River and Nanjemoy Creek. Implementation will be contingent on availability of funding and give priority to critical areas. Initially identified critical areas include Reach ID and Reach IIA of the SMP. The erosion not only threatens critical infrastructure at this facility but also endangers the property's sensitive and irreplaceable archeological heritage. Numerous inventoried archeological sites reflecting the property's long span of human occupation and use from prehistoric through historic periods are located along and near these eroding shorelines. The Trust agrees with the Army that construction of the shoreline improvements will not affect any historic structures but has the potential to impact archeological sites. Once the Army has developed more detailed construction plans it will be able to make an informed assessment of the project's effects on archeological resources and determine the need for additional archeological investigations as part of the planned work. In addition to the shoreline improvements, the Army will need to examine construction access, equipment/materials storage and staging areas.

We look forward to further coordination with the Army and other involved parties as the planning proceeds to complete the Section 106 consultation for this undertaking. If you have questions or need further assistance, please contact Troy Nowak, Assistant State Underwater Archeologist at troy.nowak@maryland.gov or me at beth.cole@maryland.gov. Thank you for providing us this opportunity to comment.

Sincerely,

Beth Cole

Beth Cole
Administrator, Project Review and Compliance

BC/TJN/201901090
cc: Bridget Kelly Butcher (Army Garrison Adelphi Laboratory)

March 15th, 2019 19-MIS-158

Bridget Kelly Butcher
U.S. Army Garrison Adelphi Laboratory Center
2800 Powder Mill Rd.
Adelphi, MD 20783-1138

Subject: Fisheries Scoping Information for the EA for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek
Charles County, Maryland

Dear Ms. Butcher;

The above referenced project has been reviewed to determine fisheries species near the proposed project area. The proposed activities include physical shoreline improvements which will be constructed at the ALC BPRF to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek.

The project will impact both the Potomac and Nanjemoy Creek which are classified as a Use II streams with records of yellow perch. Generally no in-stream work is allowed in Use II streams with yellow perch from February 15th through June 15th of any given year in order to protect spawning fish. In addition the project site falls within a Waterfowl Concentration Area. Typically for large scale projects such as this, there would be a Time of Year Restriction placed on this project from November 15th through March 1st of any given year in order to protect overwintering waterfowl. MDDNR Environmental Review staff are available to meet in order to further discuss any issues or questions related to restrictions you might have.

The Potomac River and Nanjemoy Creek support many resident fish species. Species documented by our Maryland Biological Stream Survey in this and other nearby streams can be accessed via the MDDNR web page at http://streamhealth.maryland.gov.

Please note that this fisheries review is for scoping purposes only and does not constitute a full environmental review by the Department of Natural Resources Environmental Review Program. Once a final permit application has been submitted with a full set of plans to MDE, a determination will be made if further review by the MDDNR Environmental Review Program is warranted.

If you have any further questions, please feel free to contact me at 410 260-8736.

Sincerely;

Christopher Aadland

Christopher Aadland
Environmental Review Program

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

April 4, 2019

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
U.S. Army Garrison Adelphi Laboratory Center
2800 Powder Mill Road
Adelphi, MD 20783-1138

Re: Magnuson-Stevens Fishery Conservation and Management Act Consultation: Environmental Assessment for the Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek, Charles County, Maryland

Dear Mr. Krake:

Thank you for your March 6, 2019, letter and essential fish habitat (EFH) assessment for the United States Army Garrison (USAG) Adelphi Laboratory Center's (ALC's) intent to implement the ALC Blossom Point Research Facility Shoreline Management for the Potomac River and Nanjemoy Creek in Charles County, Maryland. ALC is preparing an Environmental Assessment (EA) to evaluate the potential effects of constructing the physical shoreline improvements to reduce erosion of the peninsula and decrease sedimentation into the Potomac River and Nanjemoy Creek. The proposed shoreline protection would include a combination of stone structures, sand nourishment, and planting of wetland vegetation.

Proposed project plans were not included so we are limited to providing general recommendations at this time. These recommendations are designed to minimize impacts to EFH and prey species.

- Minimize stone and sand fill to the extent practicable while meeting project goals.
- Submerged aquatic vegetation (SAV) is present in Kings Creek. Without plans, it is unclear how close to SAV the shoreline stabilization activities would occur. Avoid placement of stone or sand in areas where SAV has been mapped in the last five years and minimize impacts from wave refraction to the extent practicable.
- Nanjemoy Creek and the Potomac River provide spawning habitat for striped bass (*Morone saxatilis*) in the immediate project area. Nanjemoy Creek provides spawning habitat for alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and white perch (*Morone americana*) farther upstream. Time of year restrictions may be necessary to protect migrating and spawning anadromous fish in this area from February 15 through June 15, annually.

Magnuson Stevens Fisheries Management and Conservation Act (MSA)
The Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Fish and Wildlife Coordination Act (FWCA) require federal agencies to consult with one another on projects such as this which may adversely affect EFH and other aquatic resources. In turn, we must provide recommendations to conserve EFH. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from actions or proposed actions authorized, funded, or undertaken by that agency. This process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments and generally outlines each agency's obligations in this consultation procedure. The project area has been designated as EFH for a variety of life stages of federally managed species including bluefish *(Pomatomus saltatrix*), and summer flounder (*Paralichthyes dentatus*).

The EFH final rule published in the Federal Register on January 17, 2002, defines an adverse effect as "any impact which reduces the quality and/or quantity of EFH" and further states that:

> An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

SAV has been designated as a habitat area of particular concern (HAPC) for summer flounder by the Mid-Atlantic Fishery Management Council. HAPCs are discrete subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation. In addition, the U.S. Environmental Protection Agency has designated SAV as a special aquatic site under Section 404(b)(1) of the federal Clean Water Act, due to its important role in the marine ecosystem for nesting, spawning, nursery cover, and forage areas for fish and wildlife, and it is a priority habitat for us for the same reasons.

We agree with your determination that the adverse effect on EFH is not substantial and that an abbreviated EFH consultation is appropriate. However, until you provide proposed project plans we are unable to make EFH conservation recommendations on ways to minimize the impacts of the project. Please incorporate the general recommendations provided above as you develop your EA and project plans. We may have more specific recommendations once plans are provided.

Endangered Species Act
Threatened or endangered species under our jurisdiction including shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrhynchus*) may be present in the project area. As the lead federal action agency, you are responsible for determining the nature and extent of effects and for coordinating with our Protected Resources Division as appropriate. Please be aware that we have recently provided on our website (http://www.greateratlantic.fisheries.gov/section7) guidance and tools to assist action agencies with their description of the action and analysis of effects to support their determination. Should

you have any questions about the section 7 consultation process, please contact Brian Hopper at 410-573-4592 or brian.d.hopper@noaa.gov.

We look forward to continued coordination with you as the project plans are developed. If you have any questions or need additional information, please contact Kristy Beard of our Annapolis field office at kristy.beard@noaa.gov or 410-573-4542. Thank you for the opportunity to review and comment as you prepare your EA.

Sincerely,

Karen Greene

Karen Greene
Mid-Atlantic Field Office Supervisor
Habitat Conservation Division

cc: PRD- B. Hopper

Appendix B – Federal Consistency Determination, FONPA, RONA

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
ADELPHI LABORATORY CENTER
2800 POWDER MILL ROAD
ADELPHI, MD 20783-1138

August 21, 2019

Mr. Elder Ghigiarelli
Federal Consistency Coordinator
Deputy Program Administrator
Maryland Department of the Environment
Wetlands and Waterways Program
1800 Washington Boulevard, Suite 430
Baltimore, MD 21230

RE: Federal Consistency Determination – Shoreline Improvements at the U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center, Blossom Point Research Facility, Welcome, Maryland: Potomac River and Nanjemoy Creek

Dear Mr. Ghigiarelli,

In accordance with the Federal Coastal Zone Management Act (CZMA) of 1972, as amended, and the CZMA Memorandum of Understanding (MOU) between the State of Maryland and the U.S. Department of Defense, the U.S Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) requests concurrence with the Negative Determination for the proposed shoreline improvements at the APG/ALC Blossom Point Research Facility (BPRF) in Welcome, Charles County, Maryland.

As required by the MOU, the proposed project description and site location are provided with this letter as Enclosure 1. Enclosure 2 provides the basis for this Negative Determination in relation to Maryland's enforceable coastal policies. Enclosure 3 includes a copy of the Draft Environmental Assessment (EA) for the *U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center Shoreline Improvements at the Blossom Point Research Facility: Potomac River and Nanjemoy Creek.*

APG/ALC respectfully requests the Maryland Department of the Environment's concurrence with its Negative Determination within 60 days of receipt of this letter.

Please direct all correspondence to Bridget Kelly Butcher, Conservation Specialist, USAG APG/ALC; 2800 Powder Mill Road, IMAL-PWE, Adelphi, MD 20783; p. 301-394-1062; or bridget.c.kellybutcher.civ@mail.mil.

Thank you for your attention to this matter.

Sincerely,

James Krake

Mr. James Krake
Chief, Environmental Division
Directorate of Public Works
USAG APG/ALC

Enclosures:

Enclosure 1 - Proposed Project Description and Site Location
Enclosure 2 - Basis of Negative Determination
Enclosure 3 - Draft EA for *U.S. Army Garrison Aberdeen Proving Ground Adelphi Laboratory Center Shoreline Improvements at the Blossom Point Research Facility: Potomac River and Nanjemoy Creek*

Copies to:

Joe Abe, Coastal Policy Coordination Section Chief
Chesapeake and Coastal Service
Maryland Department of Natural Resources

Lisa Hoerger, Regulations Coordinator
Department of Natural Resources
Critical Area Commission for the Chesapeake & Atlantic Coastal Bays

Rick Ayella, Division Chief
Maryland Department of the Environment
Tidal Wetlands Division- Baltimore Office

Elizabeth J. Cole, Administrator, Review & Compliance
Department of Planning
Maryland Historical Trust- Crownsville Office

Catherine McCall, Assistant Director
Coastal and Marine Assessment
Maryland Department of Natural Resources

Enclosure 1 – Proposed Project Description and Site Location

1 Site Location and Details

The United States Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) supports the mission to execute fundamental and applied research to provide the U.S. Army with the key technologies and the analytical support necessary to assure supremacy in future land warfare. The Blossom Point Research Facility (BPRF), located in the unincorporated community of Welcome, in southern Charles County, Maryland (MD), is operated as a satellite facility and serves the ALC as a primary test facility for fuzes, explosive and pyrotechnic devices, and telemetry systems. ALC manages and operates ALC BPRF in an equitable, effective manner to support on-going research, enable the well-being of soldiers and civilians, improve infrastructure, and preserve the environment.

The ALC BPRF is located on an approximately 1,600-acre peninsula, locally known as Cedar Point Neck. The peninsula is bounded to the east and south by the Potomac River, and to the west by its tidal tributary Nanjemoy Creek (Figure 1).

As depicted on Figure 2, the shoreline of Cedar Point Neck consists of three reaches, or lengths of shoreline, that are defined by common physical, chemical or biological conditions. The reaches of Cedar Point Neck are defined by fetch exposure (the length of water over which a given wind has blown), shore orientation, and geology. The three reaches are further divided into several subreaches according to land use and shore zone geomorphology as designated in the following list (VIMS, 2016):

- Reach I on the western shore of the peninsula on Nanjemoy Creek. Reach I consists of subreaches A, B, C and D, from upstream to downstream.
- Reach II at the southern edge of the peninsula on the Potomac River. Reach II consists of subreaches A, B, C and D, from west to east.
- Reach III on the eastern shore of the peninsula on the Potomac River. Reach III consists of subreaches A, B and C, from downriver to upriver.

Figure 1. Blossom Point Research Facility Site Location Map

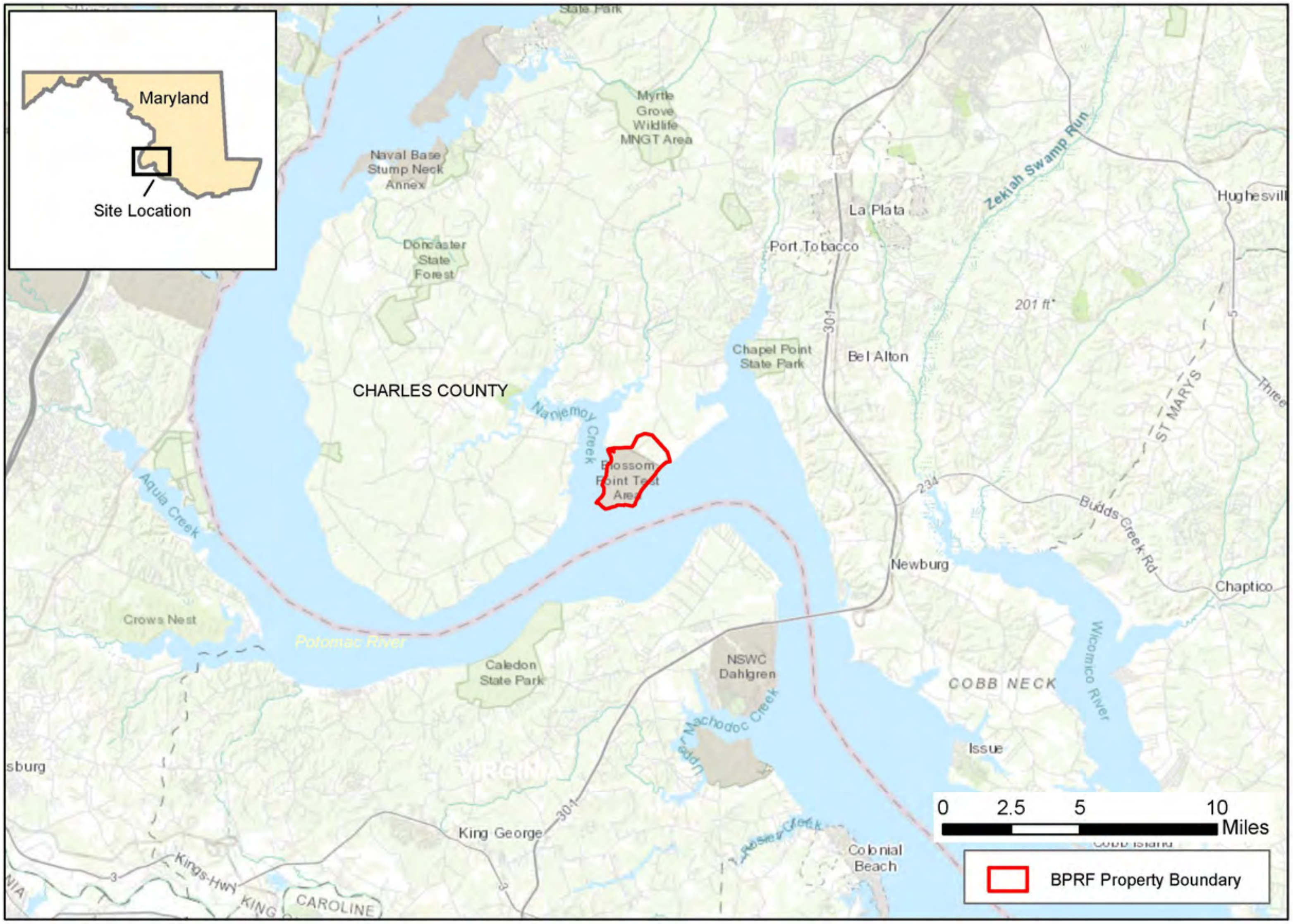
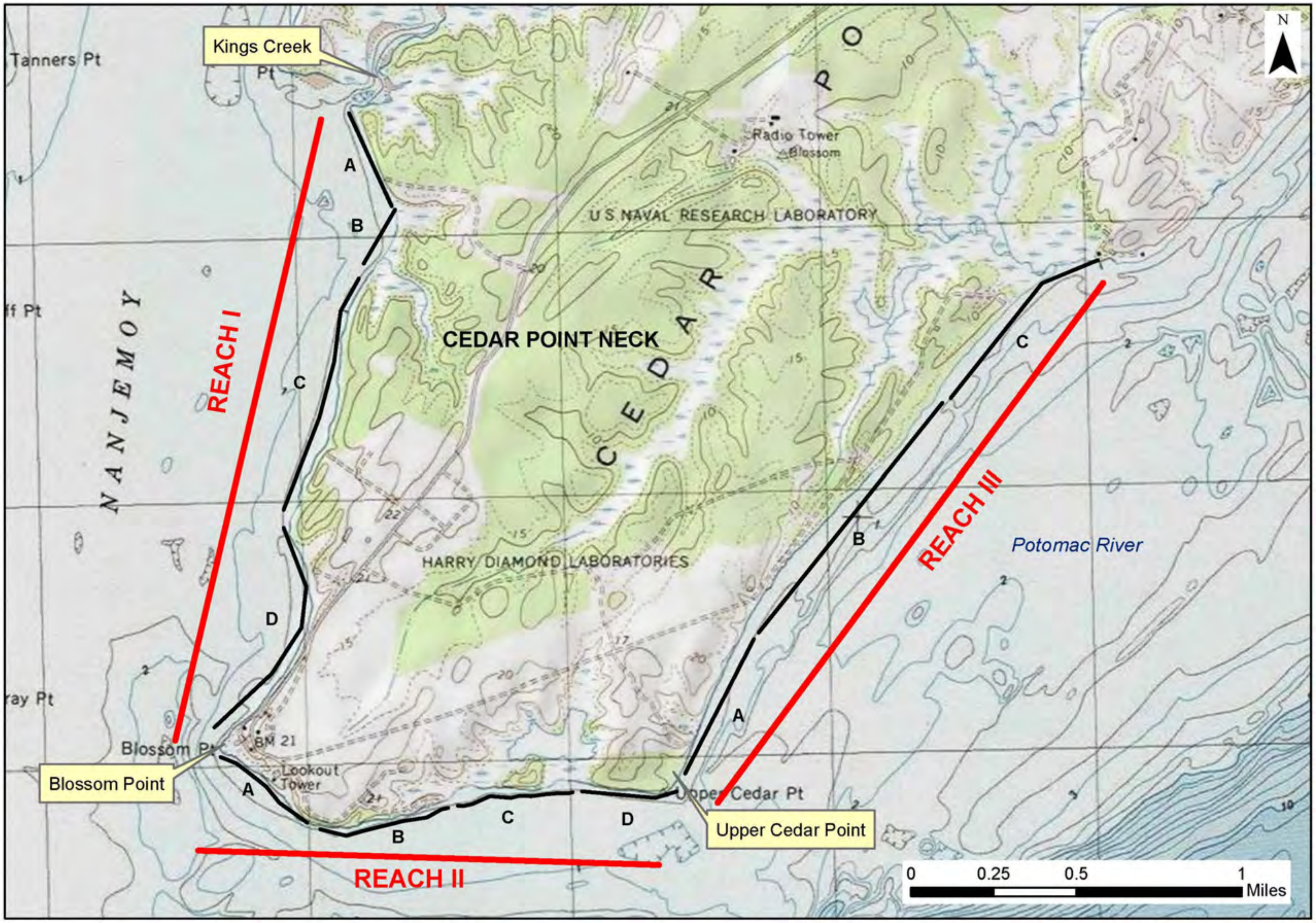


Figure 2. Reaches and Subreaches of the ALC BPRF Shoreline



2 Proposed Project Description

The ALC BPRF is subject to extensive erosive wind-driven wave-forces that threaten the long-term function and stability of infrastructure at the ALC BPRF. The shorelines of the ALC BPRF are eroding at an average rate of one to three feet per year (VIMS, 2016). Erosion threatens the stability of the shorelines at the ALC BPRF and endangers the long-term coastal resilience of the property and its critical infrastructure. The rapid shoreline erosion has already reached the foundation of a small building, which had to be demolished to prevent it from falling to the shoreline below, and in other areas, the infrastructure is within only 30 feet of the shoreline. Erosion also damages water quality by releasing large amounts of sediments and associated pollutants into the Potomac River and Nanjemoy Creek, which can be harmful to important aquatic and terrestrial habitat and wildlife.

Accordingly, ALC, in conjunction with the Virginia Institute of Marine Science (VIMS), has prepared the *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* ("SMP") (VIMS, 2016). Under the Proposed Action, the SMP would be implemented, and physical shoreline improvements would be constructed and operated at the ALC BPRF to reduce erosion of the peninsula and extend the longevity of the ALC BPRF.

2.1 Phasing

Under the Proposed Action, the SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority (VIMS, 2016).

To date, two critical areas have been identified, Critical Area 1 and Critical Area 2. Critical Area 1 is located within Reach ID, where rapid shoreline erosion has reached the edge of the foundation of a restroom building (Building 501A), which required it to be demolished in order to prevent the building from falling to the shoreline below. Critical Area 2 is located within Reach IIA, where erosion threatens the existing lookout tower, a building, and a road; this infrastructure is now within 30 feet of the shoreline. Once Critical Areas 1 and 2 are addressed, the remaining subreaches will be addressed based on priority and contingent upon funding.

2.2 Project Elements

Under the Proposed Action, the elements detailed in the SMP would include the construction of shoreline protection structures including sills, gapped sills, gapped brills, spurs, and revetments along approximately 18,500 feet (3.5 miles) of total shoreline along the Potomac River and Nanjemoy Creek (VIMS, 2016). Sand nourishment measures to create stable substrate for establishing marsh vegetation would occur in areas where sills, brills, and spurs are the preferred structures. These improvements will be designed to protect against a 25-year storm event and a storm surge that is five feet above mean low water (MLW) (VIMS, 2016).

Construction of shoreline improvement structures at the ALC BPRF will involve the anchoring of filter fabric on the existing bottom of the nearshore and the placement of stones on the filter fabric base to the desired width and height. The area behind the sill and brill structures will be graded and backfilled with clean sand and planted with native, non-invasive marsh grasses. Stone, sand fill, and construction equipment will be transported to the construction areas by a combination of barge and truck, depending on the depth of the nearshore and the capability of equipment to reach the proposed construction locations.

The SMP recommends shoreline management strategies and improvement structures specific to each subreach. It is noted that improvements are only recommended for parts of the ALC BPRF shoreline; selected areas of the shoreline that are stable are not recommended for improvement.

Table 1 depicts shoreline improvements by reach and subreach. Specifically, the Proposed Action includes the following elements:

- Stone Shoreline Improvement Structures, including
  - Thirty-two (32) gapped sills
  - Sixteen (16) gapped brills
  - One (1) standalone sill
  - One (1) spur
  - One (1) revetment
- Shore Stabilization through Sand Nourishment, including
  - Establishment of sand fill between the structures and the bank at a slope of approximately 10:1 from the base of the bank to the back of the stone structure.
  - Strategic planting of wetland vegetation including *Spartina alterniflora*, *Spartina patens,* and *Scirpus cyperinus* in order to stabilize the new sand substrate and create permanent marsh habitat.

Table 1. Proposed Shoreline Structures by Reach and Subreach

Reach	**Subreach**	**Structures Recommended**	
		Type	Number
I	A	Gapped Sill	5
	C	Gapped Sill	9
	D (Critical Area 1 is within this subreach)	Gapped Sill	4
		Spur	1
		Revetment	1
II	A (Critical Area 2 is within this subreach)	Gapped Sill	6
	B	Gapped Sill	5
	D	Gapped Sill	3
III	A	Gapped Brill	4
	B	Gapped Brill	8
	C	Gapped Brill	4
		Sill	1

3 Public Participation

The Draft EA will be released for a 30-day public review and comment period. A notice of availability (NOA) will be published in *The Maryland Independent* and the Draft EA will be published and available for review at the Charles County Public Library at 2 Garrett Avenue, La Plata, MD 20646. The Final EA and, if warranted, a Finding of No Significant Impact (FONSI), will also be made available to the public once complete and following the same procedures as the Draft EA.

4 Agency Consultations

ALC has initiated consultation with U.S. Fish and Wildlife Service, NOAA Fisheries Service, NOAA National Marine Fisheries Service, Maryland Department of Natural Resources, and Maryland Historic Trust State Historic Preservation Office. Copies of these correspondences will be provided in Appendix C of the Draft and Final EA. Additionally, ALC will submit the Draft EA to the Maryland State Clearinghouse for review.

5 References

VIMS. (2016). *U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek.* Shoreline Studies Program, Virginia Institute of Marine Science, College of William and Mary

Enclosure 2 – Basis for Determination

Enforceable Policy	Relevant to Project	Not Relevant to Project	Impact to Resources
General Policies			
Core Policies	X	Core Policies 3, 4, 5, 7, 8, 9, 10, 12, 13, and 14 are not applicable to the proposed project.	Policy 1 – Air Quality – Air pollutant emissions from transportation of materials and equipment and construction activities would be below General Conformity *de minimis* thresholds for all criteria pollutants. Policy 2 – Noise – Estimated noise levels for the nearest residential receptors would be less than 64 dbA. No other sensitive receptors are within one mile of the ALC BPRF. Construction noises would be further minimized by scheduling construction activities during daylight hours on weekdays, maintaining construction equipment in good working order, and providing protection to workers for activities that exceed permissible noise exposure levels. Policy 6 – Waterway Aesthetics – The aesthetics of the Potomac River and Nanjemoy Creek shorelines would be improved over time by the reduction in shoreline erosion and the installation of marsh vegetation. Construction related adverse impacts would be temporary and last only as long as each phase of construction. Policy 11 - Soil Erosion – The Proposed Action would have a significant long-term beneficial impact on soil erosion by preventing further erosion of the ALC BPRF shorelines. Any potential short-term construction-related soil erosion would be minimized by installing and

			maintaining sedimentation and erosion control Best Management Practice (BMP) engineering controls and administrative measures.
Water Quality	X	Water Quality Policies 4 through 11 are not applicable to the proposed project.	Policies 1 and 3 – The Proposed Action would not involve discharging or introducing any substance into any State waters. Construction activities may temporarily expose upland soils if lanes are needed to provide access from inland portions of LAC BPRF to the shoreline. To avoid erosion of exposed soils, the construction contractor would install and maintain sedimentation and erosion control BMPs to minimize any potential adverse impacts. Policy 2 – Operation of the Proposed Action would have long-term significant beneficial impacts on water quality by reducing erosion and related sedimentation, and by installing native, non-invasive marsh vegetation along 3.5 miles of shoreline. This would prove beneficial to aquatic life and wildlife.
Flood Hazards	X	Flood Hazard Policies 2 and 3 are not applicable to the proposed project.	Policy 1 – The Proposed Action would occur within the 100-year floodplain but would not alter floodplains or contribute to

			increased flooding. Construction would be conducted in compliance with the Maryland Model Floodplain Management Ordinance (FPMO). Operation of the Proposed Action would reduce the intensity of coastal flood events at the ALC BPRF by providing long-term shoreline protection structures and marsh vegetation, which temporarily store flood waters.
Coastal Resources			
The Chesapeake and Atlantic Coastal Bays Critical Area	X	Critical Area Policies 1 through 8, 11 through 25, and 27 through 30 are not applicable to the proposed project.	Policy 9 – The Proposed Action would occur within the Chesapeake Bay Critical Area. The 100-foot vegetated buffer may be temporarily disturbed during construction of measures to improve and protect the shoreline from further erosive forces. Any temporary disturbances would be restored with vegetation following construction activities. Policy 10 – Disturbance to the buffer would occur only for shore erosion control measures, which is an authorized activity under this policy. Policy 26 – A soil erosion and sedimentation control plan will be implemented for the construction activities occurring within the Critical Area. Policy 31 – The Proposed Action would reduce sedimentation of the Potomac River and Nanjemoy Creek and therefore improve the quality of water within the Chesapeake Bay.
Tidal Wetlands	X		Construction would avoid all known tidal wetland areas. Therefore, no adverse impacts are anticipated. Long-term, significant beneficial impacts to tidal wetlands are anticipated due to the installation of new marsh

			vegetation along approximately 3.5 miles of Potomac River and Nanjemoy Creek shoreline.
Non-tidal Wetlands		X	All known non-tidal wetland areas would be avoided during construction.
Forests		X	No impacts to forest resources.
Historical and Archaeological Sites	X		Construction would avoid all known cultural resources and archaeological sites. ALC has initiated Section 106 consultation with the Maryland Historic Trust State Historic Preservation Office (SHPO).
Living Aquatic Resources	X	Living Aquatic Resources Policies 2 through 14 are not applicable to the proposed project.	Policy 1 – Short-term disturbance to aquatic habitat is anticipated during construction activities. Potential minimal loss of life to non-mobile species is possible. No impact to federally or state listed species is anticipated due to their unlikely presence at the project site and the implementation of avoidance measures. Long-term, significant beneficial impacts to living aquatic resources from operation due to improved water quality and habitat.
Coastal Uses			
Mineral Extraction		X	The Proposed Action does not involve any mineral extraction.
Electrical Generation and Transmission		X	The Proposed Action does not involve any electrical generation and/or transmission.
Tidal Shore Erosion Control	X		The shorelines of the ALC BPRF along the Potomac River and Nanjemoy Creek are eroding at a rate of 1-to-3-feet per year. Shoreline erosion control measures included in the Proposed Action are consistent with State policy and include beach nourishment, marsh creation, and construction of stone sills, brills, spurs and revetments. All stone for protection structures and sand fill for sand nourishment will meet State requirements.

Oil and Natural Gas Facilities		X	The Proposed Action does not involve any oil and/or natural gas facilities.
Dredging and Disposal of Dredged Material		X	The Proposed Action does not involve dredging or disposal or dredged material.
Navigation		X	The Proposed Action does not involve navigation projects.
Transportation		X	The Proposed Action does not involve transportation projects.
Agriculture		X	The Proposed Action does not involve agricultural projects.
Development		X	The Proposed Action does not involve development beyond the construction of shoreline protection structures.
Sewage Treatment		X	The Proposed Action does not involve sewage treatment.

Enclosure 3 – Draft Environmental Assessment

(see attached CD-ROM)

Executive Order (EO) 11988 Floodplain Management
Finding of No Practicable Alternative for the
U.S. Army Garrison Aberdeen Proving Ground
Adelphi Laboratory Center
Shoreline Improvements at the Blossom Point Research Facility
Potomac River and Nanjemoy Creek

The Department of the Army (Army) proposes to improve the shoreline at Blossom Point Research Facility, located in Welcome, Charles County, Maryland. U.S. Army Garrison (USAG) Aberdeen Providing Ground (APG), Adelphi Laboratory Center (ALC proposes construction and operation of shoreline stabilization measures at the ALC Blossom Point Research Facility (BPRF) that are located within the 100-year floodplain, which is the area subject to flooding by the 1-percent annual-chance flood. Since building in the floodplain is required for shoreline restoration, a Finding of No Practicable Alternative, or FONPA is required.

This FONPA documents that there is no practicable alternative other than within the 100-year floodplain and specifies that proposed projects will be designed or modified to minimize potential harm to the floodplain, and place facilities or infrastructure above floodplain elevations as feasible. This finding is based on a rigorous analysis contained in the supporting EA.

The ALC BPRF is identified on the Federal Emergency Management Agency floodplain map Charles County Unincorporated Areas 24017C0315D effective May 4, 2015. According to this map, approximately one third of the ALC BPRF property, including the majority of the eastern shoreline along the Potomac River and the western shoreline along Nanjemoy Creek, is located within the 100-year floodplain (Zones AE and VE). VE zones are designated coastal hazard areas and are subject to high velocity wind and wave action in addition to tidal flooding.

Executive Order (EO) 11988, *Floodplain Management*, directs all federal agencies to "take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities," and to "avoid direct or indirect support of floodplain development wherever there is a practicable alternative."

Additionally, the Proposed Action would be consistent with E.O. 13690, *Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*, issued January 30, 2015. E.O. 13690 amended E.O. 11988 and established the Federal Flood Risk Management Standard (FFRMS) to improve the Nation’s resilience to current and future flood risks, which are anticipated to increase over time due to the effects of climate change and other threats. In accordance with E.O. 13690, the Proposed Action design considers a higher vertical flood elevation and corresponding horizontal floodplain than the base flood to address current and future flood risk to ensure its resiliency and lasts as long as intended.

The proposed shoreline stabilization measures would be located within the 100-year floodplain and would be designed to comply with E.O. 11988 and 13690, and there is no practicable alternative to the various construction and operational actions proposed in support of the mission. The proposed shoreline stabilization measures do not have the potential to cause a significant adverse impact on the environment, as detailed in the Environmental Assessment, referenced herein in its entirety, and, as such, qualify for a Finding of No Significant Impact under the National Environmental Policy Act. These actions do not require further environmental analysis in an Environmental Impact Statement and meet the requirements set forth in EO 11988.

APPROVED: DATE:

Mr. Paul D. Cramer
Deputy Assistant Secretary of the Army
Installations, Housing & Partnerships

Record of Non-Applicability
In Accordance with the Clean Air Act – General Conformity Rule for the
U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center
Shoreline Improvements at the Blossom Point Research Facility
Potomac River and Nanjemoy Creek
Welcome, Charles County, Maryland

[Date]

The United States Army Garrison (USAG) Aberdeen Proving Ground (APG), Adelphi Laboratory Center (ALC) proposes to construct and operate the 2016 *USAG APG ALC Blossom Point Research Facility Shoreline Management Plan for Potomac River and Nanjemoy Creek* ("SMP") at the ALC Blossom Point Research Facility (BPRF), located in the unincorporated town of Welcome, Charles County, Maryland. Located on a peninsula in the Potomac River, the ALC BPRF shoreline has been extensively eroded, and action is needed to improve the stability and resiliency of this shoreline and prevent further loss of land, allowing continued operation of the ALC BPRF as a testing facility at its current location. Under the Proposed Action, shoreline improvements at the ALC BPRF would be constructed in a phased approach, contingent on the availability of funding, with critical areas given priority. Constructed improvements would include stone shoreline protection structures such as sills, brills, spurs, and revetments, along with associated sand nourishment and marsh vegetation planting along approximately 3.5 miles of shoreline. The shoreline improvements would prevent further shoreline erosion, provide coastal resiliency, and extend the longevity of the ALC BPRF at its present location.

The proposed alignment the shoreline protection structures is described in further detail in Section 2 of the accompanying Environmental Assessment (EA) for the Proposed Action. The air quality impacts associated with constructing and operating the Proposed Action, including the estimated emissions calculations, are presented in Section 3.3 of the EA. As described therein, General Conformity under the Clean Air Act, Section 176 has been evaluated according to the requirements of Title 40 of the Code of Federal Regulations Part 93, Subpart B. The requirements of this rule are not applicable to the action because:

> The highest total annual direct and indirect emissions from the Proposed Action have been estimated at 7.6 tons of carbon monoxide (CO), 18.9 tons of nitrogen oxides (NOx), 1.77 tons of particulate matter ($PM_{2.5+10}$), 0.02 tons of sulfur dioxide (SO_2), and 1.77 tons of volatile organic compounds (VOCs; ozone precursor), per year, which would be below the applicable threshold values of 50 tons for VOCs and 100 tons each for NOx, PM_{10}, CO, and SO_2.

Supported documentation and emission estimates:

[ ] Are Attached

[X] Appear in the National Environmental Policy Act Documentation

[ ] Other (not necessary)

15 Jan

Timothy E. Druell
Colonel, U.S. Army
Garrison Commander
Aberdeen Proving Ground

Appendix C – Public Involvement Documentation and Comments

APG Media of Chesapeake, LLC
P.O. Box 600
29088 Airpark Drive
Easton, MD 21601

08/22/19
2865538

CERTIFICATE OF PUBLICATION

STATE OF : MARYLAND

COUNTY OF: Charles County

This is to certify that the annexed legal advertisement has been published in the publications and insertions listed below. "PUBLIC NOTICE NOTICE OF AVAILABILITY..." **was published in the:**

Maryland Independent 08/28/19

Jam F. Nml

James F. Normandin
President & Publisher

NOTICE OF AVAILABILITY

Draft Environmental Assessment

U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center

Implementation of the 2016 Shoreline Management Plan

Blossom Point Research Facility

Charles County, Maryland

The U.S. Army Garrison (USAG) Aberdeen Proving Ground, Adelphi Laboratory Center (ALC) herby gives Notice of Availability (NOA) for the Draft Environmental Assessment (EA) for the ALC's Proposed Action to implement the 2016 Shoreline Management Plan (SMP) for shoreline improvements at the Blossom Point Research Facility (BPRF) located in Welcome, Charles County, Maryland. Under the Proposed Action, ALC would construct shoreline protection structures including sills, brills, spurs, and revetments, and associated sand nourishment and marsh vegetation planting along approximately 3.5 miles of shoreline of the Potomac River and Nanjemoy Creek. The SMP would be implemented in a phased approach contingent on the availability of funding, with critical areas given priority. The shoreline improvements would prevent further erosion of the ALC BPRF shoreline, provide coastal resiliency, and extend the longevity of the ALC BPRF at its present location.

The Draft EA was prepared pursuant to the National Environmental Policy Act of 1969 ([NEPA]); 42 United States Code [USC] 4321 et seq.), the President's Council on Environmental Quality (CEQ) Regulations Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and 32 CFR Part 989, Environmental Impact Analysis Process.

This NOA starts the 30-day review period for the Draft EA. The Draft EA is available for review in print at the Charles County Library, 2 Garrett Avenue, La Plata, Maryland 20646.

Any substantive comments received during the 30-day review period will be documented and addressed in the Final EA.

All comments on the Draft EA are requested within 30 days of the publication of this NOA. Please address all comments to Mr. Philip H. Jones, Chief, Public Affairs, U.S. Army Garrison Aberdeen Proving Ground, Adelphi Laboratory Center; 2800 Powder Mill Road, IMAL-PWE, Adelphi, Maryland 20783; philip.h.jones.civ@mail.mil. Please reference "Blossom Point Research Facility SMP EA" in all correspondence.

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APPENDIX K:
Migratory Bird Management and Avian Surveys

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The Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703–712) protects all migratory birds and prohibits the taking of migratory birds, their young, nests, and eggs, except as permitted by the USFWS. The USFWS recommends that, to avoid impacting birds protected under the MBTA, ALC survey for nesting birds in proposed disturbance areas and, if necessary, wait until the nesting and fledging process is complete. Alternatively, the USFWS recommends conducting activities outside of nesting areas or outside of the general migratory bird nesting season that extends from March through August to help avoid direct impacts.

In addition, Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) directed all Federal agencies taking actions that have a potential to affect migratory bird populations negatively to develop and implement an MOU with USFWS by January 2003 that shall promote the conservation of migratory bird populations.

The list of birds protected under the MBTA can be found at:
https://www.federalregister.gov/documents/2020/04/16/2020-06779/general-provisions-revised-list-of-migratory-birds.

Specific actions for the management of migratory birds at ALC are discussed in this INRMP in **Section 3.2.3**, **Section 4.5,** Fish and Wildlife Management and **Section 4.8,** Migratory Bird Management, and specific projects are outlined in **Appendix B**.

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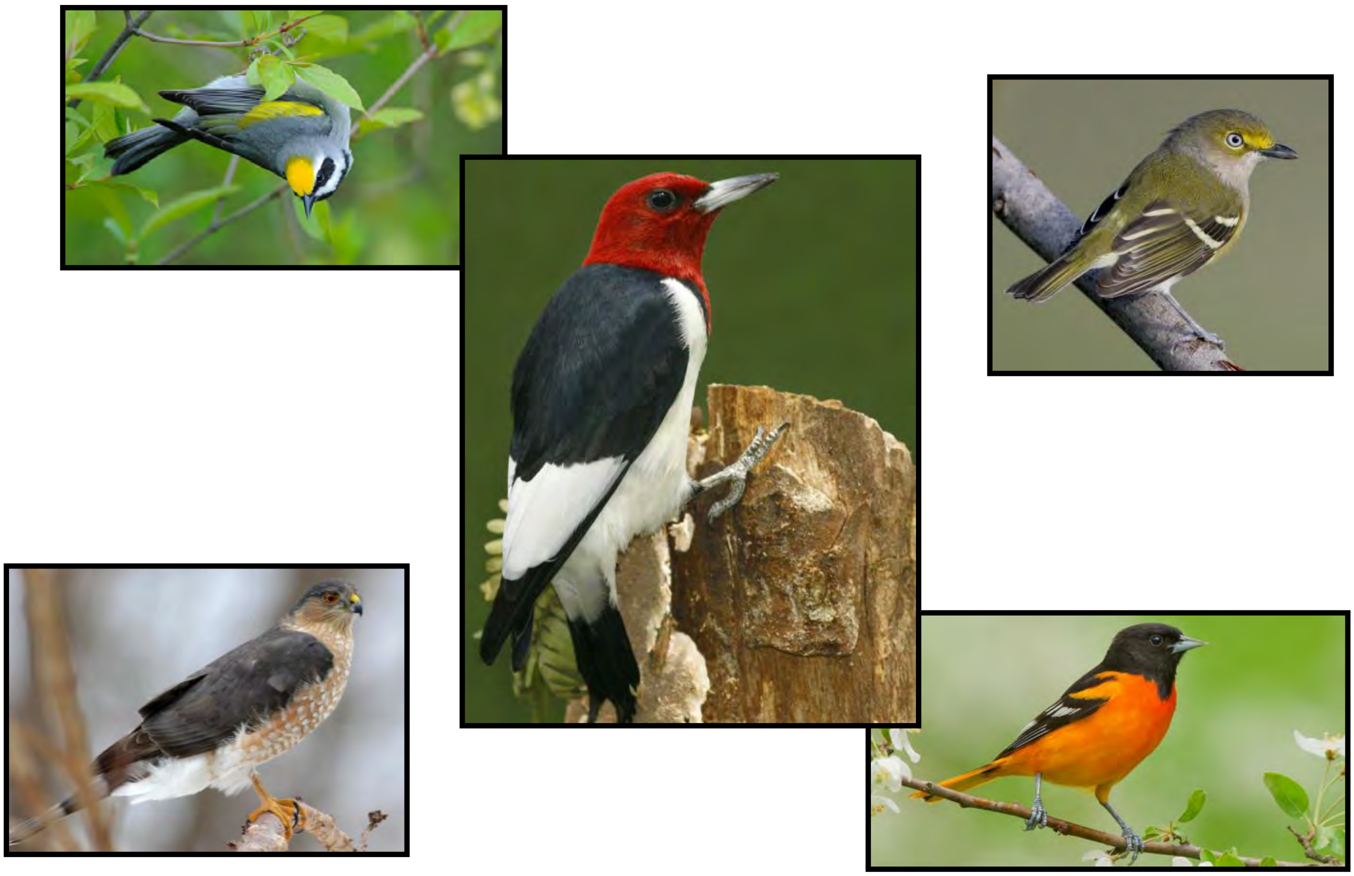
US Army Corps of Engineers
Baltimore District

Avian Surveys

U.S. Army Garrison Adelphi Laboratory Center and Blossom Point Research Facility Prince Georges and Charles Counties, Maryland



Prepared for: **U.S. Army Garrison Adelphi Laboratory Center,**
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Prepared by: **U.S. Army Corps of Engineers, Baltimore District**
2 Hopkins Plaza
Baltimore, Maryland 21201

January 2019

AVIAN SURVEYS

U.S. ARMY GARRISON ADELPHI LABORATORY CENTER AND BLOSSOM POINT RESEARCH FACILITY
Prince Georges and Charles Counties, Maryland

Prepared for:

U.S. Army Garrison Adelphi Laboratory Center
Environmental Division
2800 Powder Mill Road
Adelphi, Maryland 20783

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Baltimore District
2 Hopkins Plaza
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January 2019

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Baltimore District (USACE) conducted migratory and breeding bird surveys at U.S. Army Garrison Adelphi Laboratory Center (ALC) and Blossom Point Research Facility (BPRF). Surveys were conducted at both facilities between March and October 2018 to record presence of various species of migratory and breeding birds found on the facilities. ALC, headquarters of the Army Research Laboratory, is an active military research and development facility, approximately 207 acres in size, located in both Prince Georges and Montgomery Counties, Maryland (Figure 1). BPRF, a satellite installation to ALC, is an active military testing range, approximately 1,600 acres in size, located in Charles County, Maryland (Figure 1).

2.0 STUDY PURPOSE

The purpose of this study was to conduct point count surveys in the spring, summer and fall to observe avian species using the sites during migration and for breeding. No population statistics were calculated as part of this study. Incidental observations of avian species that occurred outside of the timed point counts were also recorded. These surveys are a supplement to the existing Integrated Natural Resource Management Plan (INRMP) and Planning Level Surveys (PLS) for ALC and BPRF.

3.0 METHODS

This study was accomplished through (1) a desktop reconnaissance of available studies conducted on and around the environs of ALC and BPRF; (2) field surveys at the installations to document species findings; and (3) creation of maps depicting sampling locations.

3.1 Desktop Reconnaissance

Prior to conducting field surveys, USACE reviewed available data from ALC and BPRF, including the 2015 Rare Threatened and Endangered Survey Report (RTE), the 2014 INRMP and associated agency coordination, and Planning Level Surveys. A United States Fish and Wildlife Service (USFWS) Migratory Bird report (Appendix B) was also downloaded in the winter of 2018 for ALC and BPRF in order to determine if any Birds of Conservation Concern (BCCs) or species that warrant special attention are located at ALC and BPRF.

3.2 Data Collection

The timed avian surveys were conducted at ALC on 5, 14, and 16 June 2018 and 27 September 2018. They were conducted on BPRF from 21-25 May 2018 and 18-20 September 2018. Additionally, incidental observations of avian species that occurred outside of the timed point counts were recorded. Survey point locations were collected utilizing the Trimble GeoXH handheld GPS system, yielding sub-meter horizontal accuracy. GPS data was then downloaded to ArcGIS for mapping. This survey horizontally references the North American Datum of 1983 (NAD83), Geographic Coordinate System, World Geodetic System 1984.

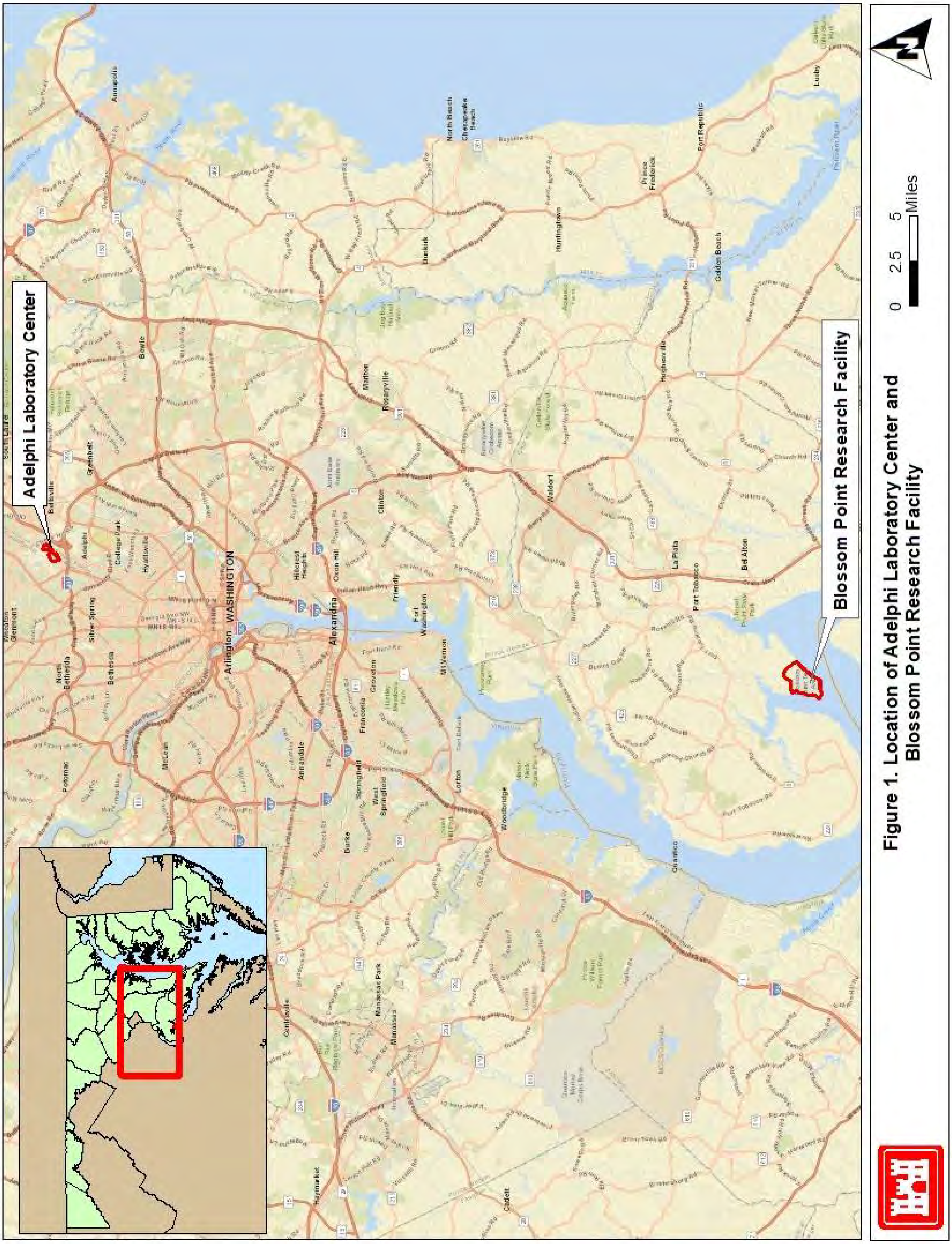

Figure 1. Location of Adelphi Laboratory Center and Blossom Point Research Facility

3.3 Survey Methods

The surveys were conducted using the point count method (Blondel et.al., 1981), but with a fixed radius around the point (Hutto et.al, 1986). Points were selected throughout the two installations which would sample the most area of the multiple habitats found on each installation, while avoiding areas of high human traffic. Each point had a fixed radius of 50 meters and were spaced at least 100 meters apart. Each point was sampled for 10 minutes during two sampling events. The first event occurred in the spring and the second in the fall. Species information was recorded on the data sheets found in Appendix A and included species name (common and scientific), whether the observation was auditory or visual, the habitat the species were using, the activity in which the individual was engaged, and the number of individuals of each species observed.

4.0 SURVEY RESULTS

A total of 98 species were recorded at both ALC and BPRF during the timed point counts and the incidental observations recorded throughout the study period from March to October 2018.

4.1 Adelphi Laboratory Center

The location of the nine avian survey points at ALC can be found on Figure 2. The survey points were located in undeveloped areas, including forested areas, stream corridors, and open old field habitats, in order to increase the likelihood of observations.

A total of 49 species were observed at ALC during the survey. Table 1 is a consolidated list of all species seen/heard at both installations during the entire survey season. The table details which species use the area during migration, for breeding, or as year-round residents. Species status in the state of Maryland is also listed (MDNR, 2016). Three species were recorded at ALC which are state-listed as rare (S2), state watchlist (S3), or state watchlist for breeding (S3B). This included the sharp-shinned hawk (*Accipiter striatus*) (S2/S3B), the brown creeper (*Certhia americana*) (S3), and the dark-eyed junco (*Junco hyemalis*) (S3B).

Habitat for Forest Interior Dwelling Species (FIDS), some of which are listed as RTE, does exist on-site and is contiguous with similar habitat in the surrounding area. These large tracts of forest are important habitat for certain bird species (MDNR, 2000). Nine species recorded at ALC are listed as FIDS and include the red-shouldered hawk (*Buteo lineatus*), hairy woodpecker (*Leuconotopicus villosus*), Acadian flycatcher (*Empidonax virescens*), brown creeper, wood thrush (*Hylocichla mustelina*), red-eyed vireo (*Vireo olivaceus*), northern parula (*Setophaga americana*), Louisiana waterthrush (*Parkesia motacilla*), and scarlet tanager (*Piranga olivacea*).

The only BCC recorded at ALC was the wood thrush. BCCs represent USFWS's highest conservation priorities (beyond those already designated as Federally threatened or endangered) and include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species.

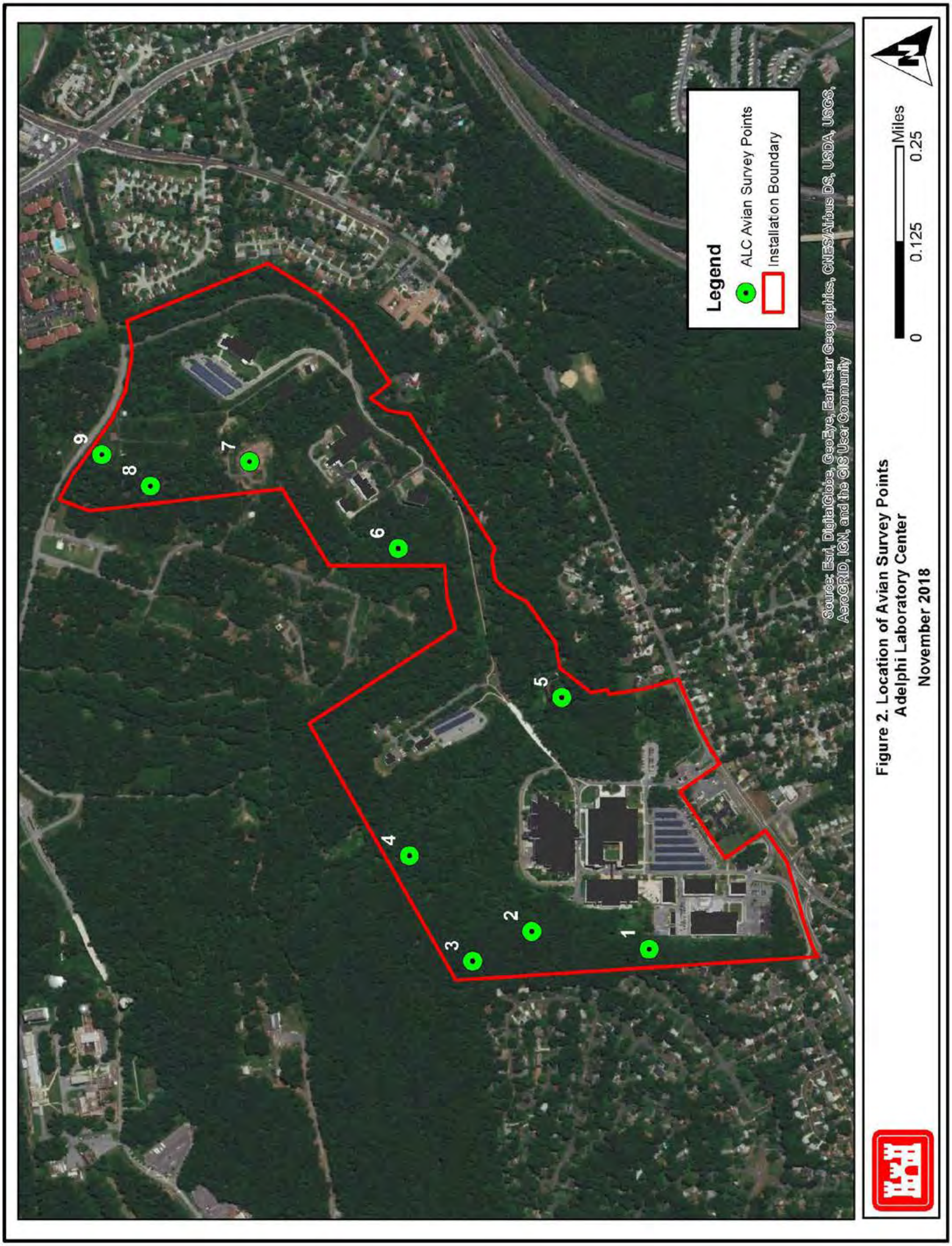

Figure 2. Location of Avian Survey Points
Adelphi Laboratory Center
November 2018

4.2 Blossom Point Research Facility

The location of the 23 avian survey points at BPRF can be found on Figure 3. The survey points were located in undeveloped areas, including forested areas, stream corridors, wetlands, and open old field habitats, in order to increase the likelihood of observations.

A total of 94 species were observed at BPRF during the survey. Table 1 is a consolidated list of all species seen/heard at both installations during the entire survey season. The table details which species use the area during migration, for breeding, or as year-round residents. Species status in the state of Maryland is also listed (MDNR, 2016). Eight species were recorded at BPRF which are state-listed as rare (S2), state watchlist (S3), or state watchlist for breeding (S3B) and/or historically breeding in the state (SHB). This included the bald eagle (*Haliaeetus leucocephalus*) (S3), least flycatcher (*Empidonax minimus*) (S3), brown creeper (S3), red-breasted nuthatch (*Sitta canadensis*) (S3B), golden-crowned kinglet (*Regulus satrapa*) (S3B), Swainson's thrush (*Catharus ustulatus*) (SHB), golden-winged warbler (*Vermivora chrysoptera*) (S2), and dark-eyed junco (S3B).

Habitat for Forest Interior Dwelling Species (FIDS), some of which are listed as RTE, does exist on-site and is contiguous with similar habitat in the surrounding area. These large tracts of forest are important habitat for certain bird species (MDNR, 2000). Sixteen species recorded at BPRF are listed as FIDS and include the red-shouldered hawk, barred owl (*Strix varia*), hairy woodpecker, pileated woodpecker (*Dryocopus pileatus*), Acadian flycatcher, brown creeper, wood thrush, yellow-throated vireo (*Vireo flavifrons*), red-eyed vireo, northern parula, black-throated green warbler (*Setophaga virens*), black and white warbler (*Mniotilta varia*), American redstart (*Setophaga ruticilla*), prothonotary warbler (*Protonotaria citrea*), ovenbird (*Seiurus aurocapilla*), and scarlet tanager.

BCCs recorded at BPRF include the long tailed duck, prothonotary warbler, red-headed woodpecker, golden winged warbler, double crested cormorant, and wood thrush. The bald eagle is considered Non-BCC Vulnerable as it warrants attention because of its protection under the Bald and Golden Eagle Protection Act.

Figure 3. Location of Avian Survey Points on Blossom Point Research Facility
November 2018

Table 1: Avian species observed at ALC and BPRF*

Common name	Scientific name	Habitat	Migrant/Breeding	State Status	Installation
Double-crested cormorant	*Phalacrocorax auritus*	Nanjemoy River	Migrant/nonbreeding	Secure	BPRF
Great blue heron	*Ardea herodias*	Tidal marsh	Resident/breeding	Secure	BPRF
Green heron	*Butorides virescens*	Tidal marsh	Migrant/breeding	Secure	ALC
Canada goose	*Branta canadensis*	Maintained lawn	Resident/breeding	Secure	ALC/BPRF
Wood duck	*Aix sponsa*	Forested wetland	Resident/breeding	Secure	BPRF
Mallard	*Anas platyrhynchos*	Nanjemoy River	Resident/breeding	Secure	BPRF
Lesser scaup	*Aythya affinis*	Nanjemoy River	Migrant/nonbreeding	Secure	BPRF
Long tailed duck	*Clangula hyemalis*	Nanjemoy River	Migrant/nonbreeding	Secure	BPRF
Bufflehead	*Bucephala albeola*	Nanjemoy River	Migrant/nonbreeding	Secure	BPRF
Ruddy duck	*Oxyura jamaicensis*	Nanjemoy River	Migrant/nonbreeding	Secure	BPRF
Black vulture	*Coragyps atratus*	Forest edge	Resident/breeding	Secure	BPRF
Turkey vulture	*Cathartes aura*	Fly over	Migrant/resident/bree ding	Secure	ALC/BPRF
Osprey	*Pandion haliaetus*	Shoreline	Migrant/breeding	Secure	BPRF
Bald eagle	*Haliaeetus leucocephalus*	Shoreline	Migrant/breeding	S3**	BPRF
Sharp-shinned hawk	*Accipiter striatus*	Upland forest	Migrant/breeding	S2/S3B**	ALC
Red-shouldered hawk	*Buteo linneatus*	Forest edge	Migrant/breeding	Secure	ALC/BPRF
Red-tailed hawk	*Buteo jamaicensis*	Forest edge	Breeding	Secure	ALC/BPRF
Wild turkey	*Meleagris gallopavo*	Upland forest	Resident/breeding	Secure	ALC/BPRF
Killdeer	*Charadrius vociferous*	Open field	Resident/breeding	Secure	ALC
American woodcock	*Scolopax minor*	Forested wetland	Resident/breeding	Secure	BPRF
Ring-billed gull	*Larus delawarensis*	Potomac River	Migrant/nonbreeding	Secure	BPRF
Mourning dove	*Zenaida macroura*	Forest edge	Resident/breeding	Secure	ALC/BPRF
Yellow-billed cuckoo	*Coccyzus americanus*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Eastern screech-owl	*Megascops asio*	Mature forest	Resident/breeding	Secure	BPRF
Barred owl	*Strix varia*	Mature forest	Resident/breeding	Secure	BPRF
Chimney swift	*Chaetura pelagica*	Open field	Migrant/breeding	Secure	BPRF
Ruby-throated hummingbird	*Archilochus colubris*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Belted kingfisher	*Ceryle alcyon*	Paint Branch/Nanjemoy River	Resident/breeding	Secure	ALC/BPRF
Red-headed woodpecker	*Melanerpes erythrochephalus*	Mature forest	Resident/migrant/bre eding	Secure	BPRF
Red-bellied woodpecker	*Melanerpes carolinus*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Downy woodpecker	*Dryobates pubescens*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Hairy woodpecker	*Dryobates villosus*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Northern flicker	*Colaptes auratus*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Pileated woodpecker	*Dryocopus pileatus*	Mature forest	Resident/breeding	Secure	BPRF

Common name	Scientific name	Habitat	Migrant/Breeding	State Status	Installation
Eastern wood-peewee	*Contopus virens*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Acadian flycatcher	*Empidonax virescens*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Least flycatcher	*Empidonax minimus*	Mature forest	Migrant/breeding	S3**	BPRF
Eastern phoebe	*Sayornis phoebe*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Great crested flycatcher	*Maiarchus crinitus*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Eastern kingbird	*Tyrannus tyrannus*	Open field	Migrant/breeding	Secure	BPRF
White-eyed vireo	*Vireo griseus*	Forest edge	Migrant/breeding	Secure	ALC/BPRF
Yellow-throated vireo	*Vireo flavifrons*	Mature forest	Migrant/breeding	Secure	BPRF
Blue-headed vireo	*Vireo solitaries*	Mature forest	Migrant/breeding	Secure	BPRF
Red-eyed vireo	*Vireo olivaceus*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Blue jay	*Cyanocitta cristata*	Mature forest	Resident/breeding	Secure	ALC/BPRF
American crow	*Corvus brachyrhynchos*	Shoreline, field, forest	Resident/breeding	Secure	ALC/BPRF
Purple martin	*Progne subis*	Open field	Migrant/breeding	Secure	ALC/BPRF
Carolina chickadee	*Poecil carolinensis*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Tufted titmouse	*Baeolophus bicolor*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Barn swallow	*Hirundo rustica*	Open field	Migrant/breeding	Secure	BPRF
Brown creeper	*Certhia americana*	Mature forest	Resident/breeding	S3**	ALC/BPRF
Red-breasted nuthatch	*Sitta canadensis*	Mature forest	Migrant/nonbreeding	S3B**	BPRF
White-breasted nuthatch	*Sitta carolinensis*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Carolina wren	*Thryothorus ludovicianus*	Forest edge/marsh edge	Resident/breeding	Secure	ALC/BPRF
House wren	*Troglodytes aedon*	Forest edge	Migrant/breeding	Secure	ALC
Golden crowned kinglet	*Regulus satrapa*	Mature forest	Migrant/nonbreeding	S3B**	BPRF
Ruby-crowned kinglet	*Regulus calendula*	Mature forest	Migrant/nonbreeding	Secure	BPRF
Blue-gray gnatchatcher	*Polioptila caerulea*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Eastern bluebird	*Sialia sialis*	Open field	Migrant/breeding	Secure	BPRF
Swainson's thrush	*Catharus ustulatus*	Mature forest	Migrant/nonbreeding	SHB**	BPRF
Wood thrush	*Hylocichla mustelina*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
American robin	*Turdus migratorius*	Maintained lawn	Resident/breeding	Secure	ALC/BPRF
Gray catbird	*Dumetella carolinensis*	Forest edge	Resident/breeding	Secure	ALC/BPRF
Northern mockingbird	*Mimus polyglotis*	Maintained lawn	Resident/breeding	Secure	ALC/BPRF
Brown thrasher	*Toxostoma rufum*	Mature forest	Resident/breeding	Secure	ALC/BPRF
European starling	*Sturnus vulgaris*	Field/maintained lawn	Resident/breeding	Secure	ALC/BPRF
Cedar waxwing	*Bombycilla cedrorum*	Forest edge	Resident/breeding	Secure	BPRF
Golden-winged warbler	*Vermivora chrysoptera*	Mature forest	Migrant/breeding	S2**	BPRF
Northern parula	*Parula Americana*	Mature forest	Migrant/breeding	Secure	ALC/BPRF

Common name	Scientific name	Habitat	Migrant/Breeding	State Status	Installation
Yellow warbler	*Setophaga petechia*	Forest/marsh edge	Migrant/breeding	Secure	BPRF
Yellow-rumped warbler	*Setophaga coronata*	Forest edge	Migrant/nonbreeding	Secure	BPRF
Black-throated green warbler	*Setophaga virens*	Mature forest	Migrant/nonbreeding	Secure	BPRF
Yellow-throated warbler	*Setophaga dominica*	Marsh edge	Migrant/breeding	Secure	BPRF
Pine warbler	*Setophaga pinus*	Pine forest	Migrant/breeding	Secure	BPRF
Blackpoll warbler	*Setophaga striata*	Mature forest	Migrant/nonbreeding	Secure	BPRF
Black-and-white warbler	*Mniotilta varia*	Pine forest	Migrant/breeding	Secure	BPRF
American redstart	*Setophaga ruticilla*	Mature forest	Migrant/breeding	Secure	BPRF
Prothonotary warbler	*Protonotaria citrea*	Forested wetland	Migrant/breeding	Secure	BPRF
Ovenbird	*Seiurus aurocapillus*	Mature forest	Migrant/breeding	Secure	BPRF
Louisiana waterthrush	*Seiurus motacilla*	Stream side	Migrant/breeding	Secure	ALC
Common yellowthroat	*Geothlypis trichas*	Scrub/shrub marsh	Migrant/breeding	Secure	BPRF
Summer tanager	*Piranga rubra*	Mature forest	Migrant/breeding	Secure	BPRF
Scarlet tanager	*Piranga olivacea*	Mature forest	Migrant/breeding	Secure	ALC/BPRF
Eastern towhee	*Pipilo erythrophthalmus*	Forest edge	Resident/breeding	Secure	BPRF
Chipping sparrow	*Spizella passerina*	Open field	Resident/breeding	Secure	BPRF
Grasshopper sparrow	*Ammodramus savannarum*	Open field	Migrant/breeding	Secure	BPRF
Song sparrow	*Melospiza melodia*	Open field	Resident/breeding	Secure	ALC/BPRF
White-throated sparrow	*Zonotrichia albicollis*	Forest edge	Migrant/nonbreeding	Secure	ALC/BPRF
Dark-eyed junco	*Junco hyemalis*	Forest edge	Migrant/nonbreeding	S3B**	ALC/BPRF
Northern cardinal	*Cardinalis cardinalis*	Mature forest	Resident/breeding	Secure	ALC/BPRF
Indigo bunting	*Passerina cyanea*	Mature forest	Migrant/breeding	Secure	BPRF
Red-winged blackbird	*Agelaius phoenicius*	Marsh	Migrant/breeding	Secure	ALC/BPRF
Eastern meadowlark	*Sturnella magna*	Open field	Resident/breeding	Secure	BPRF
Common grackle	*Quiscalus quiscula*	Field/marsh edge	Resident/breeding	Secure	ALC/BPRF
Brown-headed cowbird	*Molothrus ater*	Open field	Resident/breeding	Secure	BPRF
Orchard oriole	*Icterus spurius*	Marsh/forest edge	Migrant/breeding	Secure	BPRF
Baltimore oriole	*Icterus galbula*	Forest edge	Migrant/breeding	Secure	ALC/BPRF
American goldfinch	*Spinus tristis*	Forest/marsh edge	Resident/breeding	Secure	ALC/BPRF

*This list is based on the Official List of the Birds of Maryland, 21 June 2018 version, compiled by the MD/DC Records Committee of the Maryland Ornithological Society. Species ordering and names conform to the Check-List of North American Birds, 59th supplement, by the American Ornithologist's Union.

**SHB – Historical (possibly extirpated) for breeding within MD
S2 - State rare – High risk of extinction or extirpation within MD
S3 - Watchlist – at moderate risk of extinction or extirpation within MD
S3B - Watchlist for breeding – species is a migrant, rank applies to the status of the breeding population in MD

5.0 CONCLUSIONS/RECOMMENDATIONS

The avian species surveys were conducted between March and October 2018 at ALC and BPRF, Prince Georges and Charles Counties, Maryland, respectively. The purpose was to survey for the presence of avian species which use the site as breeding grounds, during migration, or as year round residence.

Three species observed at ALC and eight at BPRF are Maryland state-listed as rare, watchlist and/or watchlist for breeding. No federally-listed species were observed at either ALC or BPRF. Nine species recorded at the two sites are listed as FIDS. Implementation of the ALC and BPRF Forest Management Plan will substantially increase suitability of the interior forest habitat for FIDS. Guidelines and recommendations provided in the INRMP and Habitat Management Plan should continue to be followed for the protection and management of avian species and surrounding habitats. Future night surveys may produce greater diversity in observations for nocturnal species such as owls, nightjars and rails.

Seven BCC species were observed at ALC and BPRF that were listed in USFWS Migratory Bird report. The bald eagle was also identified at BPRF as a non-BCC that is protected under the Bald and Golden Eagle Protection Act. For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds, the Migratory Bird report included in Appendix B contains a probability of presence survey that describes when these birds are most likely to be present and breeding at ALC and BPRF. Appendix C includes USFWS's comprehensive list of conservation measures that should be employed at project development sites in order to reduce impacts to birds and their habitats.

The results of this survey should not be interpreted as meaning no other potential avian species could exist on ALC and BPRF. The potential for other species (including RTE, FIDS, and BCCs) is possible. For areas proposed for development, a more in-depth study of the specific site should be performed, as well as future periodic surveys of the entire sites to monitor for potential new occurrences of avian species.

6.0 REFERENCES

Blondel, J.; Ferry, Camille; Frochot, Benard. 1981. Point Counts with Unlimited Distance. Studies in Avian Biology No. 6; 414-420.

Chesser, R. T., K. J. Burns, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., D. F. Stotz, B. M. Winger, and K. Winker. 2018. Check-list of North American Birds (online). American Ornithological Society. http://checklist.aou.org/taxa

Hutto, Richard L.; Pletschet, Sandra M.; Hendricks, Paul. 1986. A Fixed-Radius Point Count Method for Nonbreeding and Breeding Season Use. The Auk No. 103, 593-602. Department of Zoology, University of Montana, Missoula, Montana 59812.

Maryland Critical Area Commission. 2000. A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area. Maryland Department of Natural Resources, 580 Taylor Avenue, Annapolis, MD 21401.

Maryland Natural Heritage Program. 2016. List of Rare, Threatened, and Endangered Animals of Maryland. Maryland Department of Natural Resources, 580 Taylor Avenue, Annapolis, MD 21401.

Maryland/DC Records Committee of the Maryland Ornithological Society. 2018. Official List of the Birds of Maryland. 21 June 2018.

Ralph, C. John; Droege, Sam; Sauer, John R. 1995. Managing and Monitoring Birds Using Point Counts: Standards and Applications. Gen. Tech. Rep. PSW-GTR-149. Albany, CA: Pacific Southwest Research Station, Forest Service, Department of Agriculture.

Ralph, C. John; Geupel, Geoffrey R.; Pyle, Peter; Martin, Thomas E.; DeSante, David F. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, Department of Agriculture.

U.S. Army Adelphi Laboratory Center. 2011. U.S. Army Adelphi Laboratory Center Planning Level Surveys. ALC Department of Public Works, Adelphi, Maryland.

U.S. Army Adelphi Laboratory Center. 2014. U.S. Army Adelphi Laboratory Center Integrated Natural Resources Management Plan. ALC Department of Public Works, Adelphi, Maryland.

U.S. Army Adelphi Laboratory Center. 2015. U.S. Army Adelphi Laboratory Center Rare, Threatened and Endangered Species Surveys. ALC Department of Public Works, Adelphi, Maryland.

U.S. Army Adelphi Laboratory Center. 2016. U.S. Army Adelphi Laboratory Center. Habitat Management Plan. ALC Department of Public Works, Adelphi, Maryland.

U.S. Army Adelphi Laboratory Center. 2015. U.S. Army Adelphi Laboratory Center Forest Management Plan. ALC Department of Public Works, Adelphi, Maryland.

U.S. Fish and Wildlife Services (USFWS). 2018a. Information for Planning and Conservation (IPaC) Trust Resource Report. https://ecos.fws.gov/ipac/.

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APPENDIX A

Point Survey Data Sheets

Adelphi Laboratory Center

Point No. 1
Habitat: Mature hardwood forest
Coordinates: 39°01'44.14", 76°58'02.84"
Time: 0920-0930
Date: 5-Jun-2018
Weather: 61°, clear and calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American robin	*Turdus migratorius*	visual	calling	interior forest	1
Wood thrush	*Hylocichla mustelina*	auditory/visual	calling	interior forest	2
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	forest edge	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	singing	adjacent SWM pond	2

Time: 1024-1034
Date: 27-Sep-2018
Weather: 65°, mostly cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue jay	*Cyanocitta cristata*	auditory	calling	interior forest	1
Northern flicker	*Colaptes auratus*	auditory	calling	deciduous forest	2
American crow	*Corvus brachyrhyncos*	auditory	fly over		1
Canada goose	*Branta canadensis*	visual	fly over		2

Adelphi Laboratory Center

Point No. 2

Habitat: Mature hardwood forest

Coordinates: 39°01'53.36", 76°58'00.85"

Time: 0935-0945

Date: 5-Jun-2018

Weather: 61°, clear calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Common grackle	*Quiscalus quiscula*	auditory	singing	forest edge	1
Great crested flycatcher	*Myiarchus crinitus*	auditory	calling	subcanopy	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	singing	canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	canopy	1
Northern flicker	*Colaptes auratus*	auditory	calling	canopy	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	canopy	1

Time: 1049-1059

Date: 27-Sep-2018

Weather: 65°, moslty cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue jay	*Cyanocitta cristata*	auditory	calling	interior forest	1
Northern flicker	*Colaptes auratus*	auditory	calling	deciduous forest	2
American robin	*Turdus migratorius*	visual	calling	interior forest	1
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	forest edge	1
Sharp-shinned hawk	*Accipiter striatus*	visual	fly through	interior forest	1

Adelphi Laboratory Center

Point No.	3
Habitat:	Mature hardwood forest
Coordinates:	39°01'55.86", 76°58'04.08"
Time:	0720-0730
Date:	14-Jun-2018
Weather:	61°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	forest edge	1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	subcanopy	2
Blue jay	*Cyanocitta cristata*	visual	feeding	canopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	subcanopy	2
Wood thrush	*Hylocichla mustelina*	auditory	singing	ground	3
Northern cardinal	*Cardinalis cardinalis*	visual	singing	forest edge	1
White breasted nuthatch	*Sitta carolinensis*	auditory	calling	forest canopy	1
American Robin	*Turdus migratorius*	visual	feeding	forest floor	3
Yellow billed Cuckoo	*Coccyzus americanus*	auditory	calling	forest canopy	1
Eastern wood pewee	*Contopus virens*	auditory	calling	forest understory	1
Downy woodpecker	*Picoides pubescens*	auditory	singing	canopy	1

Time:	1109-1119
Date:	27-Sep-2018
Weather:	67°, moslty cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	forest edge	1

Adelphi Laboratory Center

Point No. 4

Habitat: Mature hardwood forest, near Paint Branch

Coordinates: 39°02'00.07", 76°57'53.48"

Time: 0738 - 0748

Date: 14-Jun-2018

Weather: 62°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest edge	2
Easter wood pewee	*Contopus virens*	auditory	calling	understory	1
Wood Thrush	*Hylocichla mustelina*	auditory	singing	understory	1
Common gracle	*Quiscalus quiscula*	auditory	calling	forest edge	3
Scarlet tanager	Piranga olivacea	auditory	singing	canopy	1

Time: 1126-1136

Date: 27-Sep-2018

Weather: 67°, moslty cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	understory	1
Blue jay	*Cyanocitta cristata*	auditory	fly over		1

Adelphi Laboratory Center

Point No. 5

Habitat: mature hardwood forest, flooplain of Paint Branch

Coordinates: 39°01'51.84", 76°57'40.38"

Time: 0800 - 0810

Date: 14-Jun-2018

Weather: 67°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue Jay	*Cyanocitta cristata*	auditory	calling	canopy	3
Northern Cardinal	*Cardinalis cardinalis*	auditory	singing	understory	1
Carolina Wren	*Thryothorus ludovicianus*	auditory	singing	understory	1
Acadian Flycatcher	*Empidonax virescens*	auditory	calling	understory	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	canopy	2

Time: 1158-1208

Date: 5-Oct-2018

Weather: 66°, mostly cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue Jay	*Cyanocitta cristata*	auditory	calling	understory	1

Adelphi Laboratory Center

Point No. 6

Habitat: Mid successional pine forest

Coordinates: 39°02'02.19", 76°57'27.66"

Time: 0821-0831

Date: 14-Jun-2018

Weather: 67°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	subcanopy	1
Blue jay	*Cyanocitta cristata*	auditory	singing	subcanopy	1
Mourning Dove	*Zenaida macroura*	visual	flyover		1
Northern Cardinal	*Cardinalis cardinalis*	auditory	calling	understory	2
Red bellied woodpecker	*Melanerpes carolinus*	auditory	calling	canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	understory	2

Time: 0905-0915

Date: 5-Oct-2018

Weather: 65°, Cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue Jay	*Cyanocitta cristata*	auditory	calling	forest canopy	1
White-breasted Nuthatch	*Sitta carolinensis*	auditory	calling	forest canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous canopy	1
Red bellied woodpecker	*Melanerpes carolinus*	auditory	calling	canopy	1

Adelphi Laboratory Center

Point No. 7

Habitat: Maintained open field

Coordinates: 39°02'13.21", 76°57'19.65"

Time: 0849-0859

Date: 14-Jun-2018

Weather: 67°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue jay	*Cyanocitta cristata*	auditory	calling	subcanopy	1
Common Grackle	*Quiscalus quiscula*	visual	feeding	understory	3
Red Shouldered Hawk	*Buteo lineatus*	visual	flyover		2
Blue-gray Gnatcatcher	*Polioptila caerulea*	auditory	feeding/calling	subcanopy	1
Pileated woodpecker	*Dryocopus pileatus*	auditory	calling	canopy	1

Time: 0926-0936

Date: Oct-5-2018

Weather: 65°, Cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue Jay	*Cyanocitta cristata*	auditory/visual	calling	canopy	1
Northern Cardinal	*Cardinalis cardinalis*	auditory	calling	understory	1
Carolina Wren	*Thryothorus ludovicianus*	auditory	calling	understory	1
American Crow	*Corvus brachyrhyncos*	auditory	calling	subcanopy	1
Red-breasted Nuthatch	*Sitta canadensis*	auditory	calling	canopy	1
Hairy Woodpecker	*Picoides villosus*	visual	feeding	canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	subcanopy	1

Adelphi Laboratory Center

Point No.	8
Habitat:	mature forest, drainage
Coordinates:	39°02'19.11", 76°57'22.15"
Time:	0933-0943
Date:	14-Jun-2018
Weather:	69°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina chickadee	*Poecile carolinensis*	auditory	singing	understory	2
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	canopy	1
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	understory	1
Eastern towhee	*Pipilo erythrophthalmus*	visual	feeding	forest floor	1
American crow	*Corvus brachyrhynchos*	auditory	flyover	canopy	2
Scarlet tanager	*Piranga olivacea*	visual	singing	forest edge	1
Red-shouldered Hawk	*Buteo lineatus*	auditory	flyover	canopy	1

Time:	1021-1031
Date:	5-Oct-2018
Weather:	65°, Cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue jay	*Cyanocitta cristata*	auditory	calling	subcanopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	subcanopy	1

Adelphi Laboratory Center

Point No.	9
Habitat:	Open old field
Coordinates:	39°02'23.46", 76°57'18.88"
Time:	0949-0959
Date:	14-Jun-2018
Weather:	71°, mostly sunny

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American Robin	*Turdus migratorius*	auditory	calling	open field	1
Northern Cardinal	*Cardinalis cardinalis*	auditory	calling /feeding	forest edge	1
Red Shouldered Hawk	*Buteo lineatus*	visual	flyover		1
Turkey Vulture	*Cathartes aura*	visual	flyover		1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	forest edge	1
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	forest edge	1

Time:	1044-1054
Date:	5-Oct-2018
Weather:	67°, Cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Mourning Dove	*Zenaida macroura*	visual	flyover		1
Northern flicker	*Colaptes auratus*	auditory	calling	deciduous forest	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	subcanopy	1
Blue jay	*Cyanocitta cristata*	visual	feeding	canopy	1
Turkey Vulture	*Cathartes aura*	visual	flyover	forest edge	1

Incidentals (not heard or observed during timed survey)

Common Name	*Scientific Name*	Observation Type	Habitat	Tally
Great Blue Heron	*Ardea herodias*	Visual	USGS Gage, Paint Branch	1
Pileated Woodpecker	*Dryocoypus pileatus*	visual	Between Point 6 and 7	1

Blossom Point Research Facility

Point No.	1
Habitat:	Northeast corner of site on Potomac River
Coordinates:	38°25'27.52", 77° 4'35.38"
Time:	1208-1218
Date:	21-May-2018
Weather:	75°, mostly sunny, light to moderate E wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Osprey	*Pandion haliaetus*	auditory	calling	forest edge/open water	1
Yellow-billed cuckoo	*Coccyzus americanus*	auditory/visual	calling	deciduous forest	2
Ruby-throated hummingbird	*Archilochus colubris*	visual	fly over	road clearing	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	singing	tidal marsh	2
Blue-grey gnatcatcher	*Polioptila caerulea*	auditory	singing	upper canopy of forest	1
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	forest edge	1
Yellow-rumped warbler	*Setophaga coronata*	visual	singing	understory of forest	1
Orchard oriole	*Icterus spurius*	auditory/visual	singing	forest edge over marsh	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	deciduous forest canopy	1
Chipping sparrow	*Spizella passerina*	auditory/visual	feeding	sholder of gravel road	2
Indigo bunting	*Passerina cyanea*	auditory	singing	deciduous forest canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	deciduous forest canopy	2

Time:	0952-1002
Date:	20-Sep-2018
Weather:	72°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Blue jay	*Cyanocitta cristatta*	auditory	calling	Forest canopy	3
Common yellowthroat	*Geothlypis trichas*	visual	calling	marsh edge	2
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	forest edge	1
American goldfinch	*Spinus tristis*	visual	feeding	marsh edge	4
Great blue heron	*Ardea herodias*	visual	fly over	marsh	1

Blossom Point Research Facility

Point No. 2

Habitat: Upland deciduous forest

Coordinates: 38°25'23.22", 77° 4'46.52"

Time: 1320-1330

Date: 21-May-2018

Weather: 75°, mostly sunny, light E wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest edge	1
Yellow-billed cuckoo	*Coccyzus americanus*	auditory/visual	calling	deciduous forest	1
Bald eagle	*Haliaeetus leucocephalus*	visual	fly over	road clearing	1
Eastern screech owl	*Megascops asio*	auditory	calling	deciduous forest	1
Blue-grey gnatcatcher	*Polioptila caerulea*	auditory	singing	upper canopy of forest	1
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	forest edge	1
Blackpoll warbler	*Setophaga striata*	visual	singing	deciduous canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	deciduous forest canopy	1
Chipping sparrow	*Spizella passerina*	auditory/visual	feeding	shoulder of gravel road	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	deciduous forest canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	deciduous forest canopy	2
Northern parula	*Setophaga americana*	auditory	singing	deciduous forest	1

Time: 0916-0926

Date: 20-Sep-2018

Weather: 72°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	forest edge	1
Eastern wood peewee	*Contopus virens*	auditory/visual	calling	deciduous forest	1
Bald eagle	*Haliaeetus leucocephalus*	visual	fly over	road clearing	1
Red bellied woodpecker	*Melanerpes carolinus*	auditory	calling	deciduous forest	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	upper canopy of forest	1

Blossom Point Research Facility

Point No.	3
Habitat:	Forest/field edge
Coordinates:	38°25'10.09", 77° 4'57.48"
Time:	1335-1345
Date:	21-May-2018
Weather:	75°, mostly sunny, light E wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	forest edge	1
Yellow-billed cuckoo	*Coccyzus americanus*	auditory	calling	deciduous forest canopy	2
Brown-headed cowbird (♂)	*Molothrus ater*	visual	feeding	field	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	deciduous forest	2
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory of forest	3
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	forest edge	1
White-eyed vireo	*Vireo griseus*	auditory	singing	deciduous canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	deciduous forest canopy	1
Northern parula	*Setophaga americana*	auditory	singing	deciduous forest canopy	1

Time:	0900-0910
Date:	20-Sep-2018
Weather:	70°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	forest edge	1
American redstart	*Setophaga ruticilla*	auditory	calling	deciduous forest canopy	2
Pileated woodpecker	*Dryocopus pileatus*	visual	feeding	deciduous forest canopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	deciduous forest	2
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory of forest	3
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	forest edge	1
Downy woodpecker	*Picoides pubescens*	auditory	singing	deciduous canopy	1
Wood duck	*Aix sponsa*	visual	singing	deciduous forest canopy	1
Blue-headed vireo	*Vireo solitarius*	auditory	singing	deciduous forest canopy	1
Golden-crowned kinglet	*Regulus satrapa*	auditory	singing	understory of forest	2

Canada goose	*Branta canadensis*	visual	flyover		1
Northern flicker	*Colaptes auratus*	auditory	calling	deciduous forest canopy	1

Blossom Point Research Facility

Point No. 4

Habitat: Forest/tidal marsh edge

Coordinates: 38°25'26.42", 77° 5'1.72"

Time: 0800-0810

Date: 22-May-2018

Weather: 65°, mostly cloudy, occasional light rain, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Great-crested flycatcher	*Myiarchus crinitus*	auditory	calling	deciduous forest	1
Chipping sparrow	*Spizella passerina*	auditory	fly over	marsh edge	1
Blue-grey gnatcatcher	*Polioptila caerulea*	auditory	singing	upper canopy of forest	1
Mourning dove	*Zenaida macroura*	auditory	calling	forest edge	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous forest canopy	2
Brown-headed cowbird	*Molothrus ater*	auditory	singing	deciduous forest canopy	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	singing	marsh	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest edge	2
Acadian flycatcher	*Empidonax virescens*	auditory	calling/feeding	understoy of forest	1
Indigo bunting	Passerina cyanea	auditory	singing	canopy of forest edge	1
Scarlet tanager	Piranga olivacea	auditory	singing	canopy of forest edge	1

Time: 1020-1030

Date: 20-Sep-2018

Weather: 73°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Eastern wood peewee	*Contopus virens*	auditory	calling	deciduous forest	1
Carolina chickadee	*Poecile carolinensis*	visual	feeding	marsh edge	1
Gray catbird	*Dumetella carolinensis*	visual	singing	upper canopy of forest	1
Red bellied woodpecker	*Melanerpes carolinus*	auditory	calling	forest edge	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous forest canopy	2
Pileated woodpecker	*Dryocoypus pileatus*	auditory	calling	deciduous forest canopy	1
Bald eagle	*Haliaeetus leucocephalus*	visual	fly over		1

Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest edge	2
Turkey vulture	*Cathartes aura*	auditory	fly over		1
Scarlet tanager	*Piranga olivacea*	auditory	singing	canopy of forest edge	1

Blossom Point Research Facility

Point No.	5
Habitat:	Upland deciduous forest
Coordinates:	38°25'24.63", 77° 5'11.05"
Time:	0820-0830
Date:	22-May-2018
Weather:	67°, mostly cloudy, light rain, light wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	deciduous canopy	1
Mourning dove	*Zenaida macroura*	auditory	singing	deciduous forest	1
Blue-grey gnatcatcher	*Polioptila caerulea*	auditory	calling	canopy of forest	1
Wood thrush	*Hylocichla mustelina*	auditory	singing	forest floor	1
Yellow-throated vireo	*Vireo flavifrons*	auditory	singing	deciduous canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous canopy	2
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	deciduous canopy	1

Time:	1050-1100
Date:	20-Sep-2018
Weather:	78°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Red bellied woodpecker	*Melanerpes carolinus*	auditory	calling	deciduous canopy	1
Eastern wood peewee	*Contopus virens*	auditory	singing	deciduous forest	1
Blue-grey gnatcatcher	*Polioptila caerulea*	auditory	calling	canopy of forest	2
white breasted nuthatch	*Sitta carolinensis*	auditory	calling	forest floor	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous canopy	3

Blossom Point Research Facility

Point No.	6
Habitat:	Forested wetland
Coordinates:	38°25'17.37", 77° 5'13.08"
Time:	0850-0900
Date:	22-May-2018
Weather:	64°, mostly cloudy, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	deciduous canopy	1
Blue jay	*Cyanocitta cristata*	auditory	singing	deciduous forest	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	feeding	understory	2
Wood thrush	*Hylocichla mustelina*	auditory	singing	forest floor	1
Yellow-billed cuckoo	*Coccyzus americanus*	auditory	singing	deciduous canopy	2
Eastern wood-pewee	*Contopus virens*	auditory	singing	deciduous canopy	1
Ruby-throated hummingbird	*Archilochus colubris*	visual	fly over	deciduous canopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	singing	forest floor	1
American goldfinch	*Spinus tristis*	auditory	fly over		1
Least flycatcher	*Empidonax minimus*	auditory	singing/feeding	understory	1

Time:	1140-1150
Date:	20-Sep-2018
Weather:	78°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Downy woodpecker	*Picoides pubescens*	auditory	calling	mid story forest	1
Blue jay	*Cyanocitta cristata*	auditory	calling	deciduous forest	1
Northern flicker	*Colaptes auratus*	auditory	calling	understory	2
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	deciduous canopy	2
Eastern wood-pewee	*Thryothorus ludovicianus*	auditory	singing	deciduous canopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	visual	calling	deciduous canopy	1

Blossom Point Research Facility

Point No. 7

Habitat: interior upland forest

Coordinates: 38°25'0.77", 77° 5'13.65"

Time: 0928-0938

Date: 22-May-2018

Weather: 65°, mostly cloudy, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Bald eagle	*Haliaeetus leucocephalus*	auditory/visual	calling	deciduous canopy	2
Blue jay	*Cyanocitta cristata*	auditory	calling	deciduous forest	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	feeding	subcanopy	1
Osprey	*Pandion haliaetus*	visual	fly over		1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	deciduous canopy	2
Eastern towhee	*Pipilo erythrophthalmus*	auditory	singing	deciduous canopy	1
American crow	*Corvus brachyrhynchos*	visual	fly over	deciduous canopy	1
Mourning dove	*Zenaida macroura*	auditory	singing	forest floor	1
Orchard oriole	*Icterus spurius*	auditory	fly over		1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing/feeding	understory	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	subcanopy	1
Red-eyed vireo	*Vireo olivaceus*	visual	singing	canopy	1
Downy woodpecker	*Picoides pubescens*	visual	feeding	understory	1

Time: 0835-0845

Date: 20-Sep-2018

Weather: 72°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American crow	*Corvus brachyrhynchos*	visual	calling	deciduous canopy	3
Blue jay	*Cyanocitta cristata*	auditory	calling	deciduous forest	1
Carolina wren	*Thryothorus ludovicianus*	auditory	feeding	subcanopy	1
Eastern wood-peewee	*Thryothorus ludovicianus*	auditory	singing	subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	deciduous canopy	3

Blossom Point Research Facility

Point No. 8

Habitat: Tidal marsh/field edge

Coordinates: 38°24'56.76", 77° 5'43.50"

Time: 1003-1013

Date: 22-May-2018

Weather: 65°, mostly cloudy, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
White-eyed vireo	*Vireo griseus*	auditory	calling	deciduous canopy	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory/visual	calling	marsh	2
Northern oriole (♂)	*Icterus galbula*	visual	fly over	field	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	forest near field	1
Scarlet tanager	*Piranga olivacea*	visual	singing	forest near field	1
Orchard oriole	*Icterus spurius*	visual	singing	field	1
Summer tanager	*Piranga rubra*	auditory	singing	forest near field	1

Time: 0801-0811

Date: 19-Sep-2018

Weather: 75°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Common yellowthroat	*Geothlypis trichas*	visual	calling	marsh	1
Red-breasted nuthatch	*Sitta canadensis*	auditory	calling	Pine canopy	1
Tufted titmouse	*Baeolophus bicolor*	visual	fly over	forest edge	1
Eastern towhee	*Pipilo erythrophthalmus*	auditory	singing	field edge	1
Gray catbird	*Dumetella carolinensis*	visual	singing	marsh/forest edge	1
Yellow-throated vireo	*Vireo flavifrons*	auditory	singing	deciduous canopy	1
White-breasted nuthatch	*Sitta carolinensis*	auditory	singing	forest near field	1

Blossom Point Research Facility

Point No.	9
Habitat:	Marsh/forest edge
Coordinates:	38°25'7.69", 77° 5'38.21"
Time:	1038-1048
Date:	22-May-2018
Weather:	69°, overcast, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Indigo bunting	Passerina cyanea	auditory	singing	forest edge	1
Brown thrasher	*Toxostoma rufum*	auditory	feeding	forest floor	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	singing	marsh	1
Mourning dove	*Zenaida macroura*	auditory	singing	deciduous forest	2
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	calling	upper canopy of forest	1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	forest edge	1
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	deciduous canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	forest understory	1
White-eyed vireo	*Vireo griseus*	auditory	singing	forest/marsh edge	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	deciduous forest canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	deciduous forest canopy	2
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	deciduous forest	1
Golden-winged warbler	*Vermivora chrysoptera*	auditory	singing	deciduous forest canopy	1

Time:	0821-0831
Date:	19-Sep-2018
Weather:	75°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Downy woodpecker	*Picoides pubescens*	auditory	calling	forest edge	1
White-breasted nuthatch	*Sitta carolinensis*	auditory	calling	forest understory	1
Eastern bluebird	*Sialia sialis*	auditory	singing	marsh/forest edge	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	deciduous forest	1
American crow	*Corvus brachyrhynchos*	visual	calling	upper canopy of forest	2

Blossom Point Research Facility

Point No.	10
Habitat:	Forested wetland/vernal pool
Coordinates:	38°25'18.12", 77° 5'41.68"
Time:	0800-0810
Date:	23-May-2018
Weather:	68°, mostly sunny, light wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Scarlet tanager	*Piranga olivacea*	auditory	singing	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest floor	1
Northern flicker	*Colaptes auratus*	auditory	singing	forest canopy	1
Mourning dove	*Zenaida macroura*	auditory	singing	deciduous forest	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	forest subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	forest edge	1
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	deciduous canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	forest understory	2

Time:	0841-0851
Date:	19-Sep-2018
Weather:	77°, mostly sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
White-eyed vireo	*Vireo griseus*	auditory	singing	canopy	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	forest floor	1
Eastern wood-peewee	*Contopus virens*	auditory	singing	forest canopy	1
White-breasted nuthatch	*Sitta carolinensis*	auditory	singing	deciduous forest	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	forest subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	calling	forest edge	1
Yellow-throated vireo	*Vireo flavifrons*	auditory	singing	deciduous canopy	1

Blossom Point Research Facility

Point No.	11
Habitat:	Interior forest/vernal pool
Coordinates:	38°25'34.54", 77° 5'44.84"
Time:	0821-0831
Date:	23-May-2018
Weather:	68°, mostly sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Scarlet tanager	*Piranga olivacea*	auditory	singing	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest floor	1
Yellow warbler	*Setophaga petechia*	auditory	singing	forest canopy	1
Mourning dove	*Zenaida macroura*	auditory	singing	deciduous forest	1
Common grackle	*Quiscalus quiscula*	auditory	feeding	forest subcanopy	4
Summer tanager	*Piranga rubra*	auditory	calling	forest edge	1
Northern cardinal	*Cardinalis cardinalis*	auditory	singing	deciduous canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	forest understory	1
Northern parula	*Setophaga americana*	auditory	singing	canopy	1
Eastern towhee	*Pipilo erythrophthalmus*	auditory	singing	forest floor	1

Time:	0859-0909
Date:	19-Sep-2018
Weather:	77°, sunny, light wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
White-eyed vireo	*Vireo griseus*	auditory	singing	canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	canopy	1
Northern cardinal	*Cardinalis cardinalis*	auditory	singing	understory	1
Wood thrush	*Hylocichla mustelina*	auditory	singing	deciduous forest	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	subcanopy	4

Blossom Point Research Facility

Point No.	12
Habitat:	Upland interior forest
Coordinates:	38°25'46.04", 77° 6'1.31"
Time:	0841-0851
Date:	23-May-2018
Weather:	70°, mostly sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Northern cardinal	*Cardinalis cardinalis*	auditory	singing	canopy	4
Blue-gray gnatcatcher	*Polioptila caerulea*	visual	singing	forest canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	deciduous forest	1
Red-eyed vireo	*Vireo olivaceus*	auditory	feeding	forest subcanopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	calling	forest edge	1
Northern flicker	*Colaptes auratus*	visual	calling	deciduous canopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	forest understory	1
Northern parula	*Setophaga americana*	auditory	singing	canopy	1

Time:	0928-0938
Date:	18-Sep-2018
Weather:	70°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American crow	*Corvus brachyrhynchos*	auditory	calling	canopy	1
Acadian flycatcher	*Empidonax virescens*	auditory	singing	forest canopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory	1
Blue jay	*Cyanocitta cristata*	auditory	calling	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	ground	2

Blossom Point Research Facility

Point No. 13

Habitat: Utility easement/upland forest/tidal marsh

Coordinates: 38°25'52.98", 77° 5'56.57"

Time: 0905-0915

Date: 23-May-2018

Weather: 70°, mostly sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Northern cardinal	*Cardinalis cardinalis*	auditory	singing	canopy	1
Blue-gray gnatcatcher	*Polioptila caerulea*	visual	feeding	subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	forest subcanopy	1
Pine warbler	*Setophaga pinus*	auditory	calling	forest edge	1
Indigo bunting	Passerina cyanea	visual	calling	canopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	visual	singing	forest understory	2
Brown-headed cowbird (♀)	*Molothrus ater*	visual	singing	canopy	1
Northern oriole (juvenile)	*Icterus galbula*	visual	feeding	canopy	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	calling	emergent wetland	2
Red-tailed hawk	*Buteo jamaicensis*	visual	fly over		1
Great-crested flycatcher	*Myiarchus crinitus*	visual	calling	forest edge	1
Summer tanager	*Piranga rubra*	auditory	singing	forest canopy	1

Time: 0920-0930

Date: 19-Sep-2018

Weather: 75°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American crow	*Corvus brachyrhychos*	auditory	singing	canopy	1
Eastern wood-peewee	*Contopus virens*	visual	feeding	subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1

Blossom Point Research Facility

Point No. 14

Habitat: Forested wetland

Coordinates: 38°25'50.29", 77° 5'39.91"

Time: 0923-0933

Date: 23-May-2018

Weather: 73°, mostly sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Yellow-billed cuckoo	*Coccyzus americanus*	auditory	singing	canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	canopy	1
Wood thrush	*Hylocichla mustelina*	auditory	singing	forest floor	2
Black and white warbler	*Mniotilta varia*	auditory	singing	forest understory	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	singing	forest subcanopy	1

Time: 1006-1016

Date: 18-Sep-2018

Weather: 75°, partly cloudy, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	canopy	1

Blossom Point Research Facility

Point No. 15

Habitat: Upland forest near wetland

Coordinates: 38°25'18.84", 77° 6'4.84"

Time: 1101-1111

Date: 23-May-2018

Weather: 76°, mostly sunny, light wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Eastern wood-pewee	*Contopus virens*	auditory	singing	subcanopy	1
Red-eyed vireo	*Vireo olivaceus*	visual	singing	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest floor	1
Red-bellied woodpecker	*Melanerpes carolinus*	visual	singing	forest understory	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	singing	forest subcanopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	singing	forest floor	1
Pileated woodpecker	*Dryocopus pileatus*	auditory	calling	forest subcanopy	1
Indigo bunting	*Passerina cyanea*	visual	singing	forest canopy	1

Time: 0830-0848

Date: 18-Sep-2018

Weather: 76°, partly cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Eastern wood-pewee	*Contopus virens*	auditory	singing	subcanopy	1
White-eyed vireo	*Vireo griseus*	auditory	singing	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest floor	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	forest understory	3
White-breasted nuthatch	*Sitta carolinensis*	auditory	calling	forest subcanopy	1

Blossom Point Research Facility

Point No.	16
Habitat:	Upland forest
Coordinates:	38°25'30.69", 77° 6'2.60"
Time:	1125-1135
Date:	23-May-2018
Weather:	76°, mostly sunny, light wind

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Summer tanager	*Piranga rubra*	auditory	singing	canopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	canopy	1
Great-crested flycatcher	*Myiarchus crinitus*	auditory	singing	canopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	singing	subcanopy	1
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	singing	forest subcanopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	singing	forest floor	1
Acadian flycatcher	*Empidonax virescens*	auditory	calling	forest subcanopy	1
White-eyed vireo	*Vireo griseus*	auditory	singing	understory	1
Ruby-throated hummingbird	*Archilochus colubris*	auditory	calling	understory	1

Time:	0853-0903
Date:	18-Sep-2018
Weather:	76°, partly cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	singing	canopy	2
Eastern wood-peewee	*Contopus virens*	auditory	singing	understory	1

Blossom Point Research Facility

Point No. 17

Habitat: Open field near wooded edge

Coordinates: 38°25'4.02", 77° 6'18.46"

Time: 0751-0801

Date: 24-May-2018

Weather: 62°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Osprey	*Pandion haliaetus*	visual	flyover		3
Yellow-billed cuckoo	*Coccyzus americanus*	auditory	singing	edge of forest	1
Mourning dove	*Zenaida macroura*	auditory	singing	edge of forest	1
Ruby-throated hummingbird	*Archilochus colubris*	visual	singing	subcanopy	1
Northern mockingbird	*Mimus polyglottus*	visual	singing	perched on fence	1
Eastern phoebe	*Sayornis phoebe*	auditory	calling/feeding	perched on tree	1
Eastern meadowlark	*Sturnella magna*	visual	singing	perched on fence	1
Eastern bluebird (M)	*Sialia sialis*	visual	singing	perched on fence	1
Cedar waxwing	*Bombycilla cedrorum*	visual	flyover		50+
Savannah sparrow	*Passerculus sandwichensis*	visual	feeding	on ground in grass	1

Time: 0758-0808

Date: 18-Sep-2018

Weather: 75°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Red-headed woodpecker (Juv)	*Melanerpes erythrocephalus*	visual	feeding	edge of forest	1
Blue jay	*Cyanocitta cristata*	auditory	calling	edge of forest	3
Downy woodpecker	*Picoides pubescens*	auditory	calling	edge of forest	1
Turkey vulture	*Cathartes aura*	visual	flyover		1
Hairy woodpecker	*Leuconotopicus villosus*	visual	calling	edge of forest	1

Blossom Point Research Facility

Point No. 18

Habitat: Open field

Coordinates: 38°25'7.83", 77° 6'6.74"

Time: 0816-0826

Date: 24-May-2018

Weather: 65°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Osprey	*Pandion haliaetus*	visual	flyover		1
Common grackle	*Quiscalus quiscula*	visual	singing	open field	1
Brown-headed cowbird	*Molothrus ater*	visual	singing	open field	1
Chipping sparrow	*Spizella passerina*	auditory	singing	open field	1
Northern mockingbird	*Mimus polyglottus*	visual	singing	on telephone pole	1
Eastern kingbird	*Tyrannus tyrannus*	visual	calling/feeding	perched on fence	1
American crow	*Corvus brachyrhynchos*	visual	singing	perched on fence	1
Eastern bluebird (F)	*Sialia sialis*	visual	singing	perched on fence	1
Grasshopper sparrow	*Ammodramus savannarum*	visual	singing	perched on fence	1

Time: 0817-0827

Date: 18-Sep-2018

Weather: 75°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
No observations					

Blossom Point Research Facility

Point No.	19
Habitat:	Interior mixed pine/deciduous
Coordinates:	38°25'54.46", 77° 5'26.20"
Time:	0841-0851
Date:	24-May-2018
Weather:	72°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Yellow-rumped warbler	*Setophaga coronata*	auditory	singing	canopy	1
Common grackle	*Quiscalus quiscula*	auditory	calling	flyover	1
Carolina chickadee	*Poecile carolinensis*	auditory	singing	subcanopy	1
Eastern wood-pewee	*Contopus virens*	auditory	singing	subcanopy	2
Blue-gray gnatcatcher	*Polioptila caerulea*	auditory	calling	subcanopy	1
American crow	*Corvus brachyrhynchos*	auditory	singing	canopy	2
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	understory	2
Brown thrasher	*Toxostoma rufum*	auditory	singing	understory	1
Ruby-throated hummingbird	*Archilochus colubris*	visual	flyover		1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1
Blue jay	*Cyanocitta cristata*	auditory	calling	subcanopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling/drumming	subcanopy	1
Indigo bunting	*Passerina cyanea*	auditory	singing	canopy	1

Time:	1027-1037
Date:	18-Sep-2018
Weather:	77°, partly cloudy

Common name	Scientific name	Observation type	Activity	Habitat	Tally
American crow	*Corvus brachyrhynchos*	visual	flyover		3

Blossom Point Research Facility

Point No.	20
Habitat:	Interior Virgina pine stand
Coordinates:	38°26'1.78", 77° 5'16.68"
Time:	0900-0910
Date:	24-May-2018
Weather:	74°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Pine warbler	*Setophaga pinus*	auditory	singing	canopy	2
Ovenbird	*Seiurus aurocapilla*	auditory	calling	forest floor	1
Black-throated green warbler	*Setophaga virens*	auditory	singing	subcanopy	1
Eastern wood-pewee	*Contopus virens*	visual	singing	subcanopy	2
Blue-gray gnatcatcher	*Polioptila caerulea*	visual	calling	subcanopy	1
Red-eyed vireo	*Vireo olivaceus*	auditory	singing	canopy	1

Time:	0945-0955
Date:	19-Sep-2018
Weather:	77°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Red-shouldered hawk	*Buteo lineatus*	visual	flyover		2
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	understory	1
American crow	*Corvus brachyrhynchos*	auditory	calling	canopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	forest floor	1
White-breasted nuthatch	*Sitta carolinensis*	auditory	singing	subcanopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling	subcanopy	1
Pileated woodpecker	*Dryocopus pileatus*	auditory	calling	canopy	1

Blossom Point Research Facility

Point No. 21

Habitat: Interior Virgina pine stand

Coordinates: 38°26'8.80", 77° 4'58.88"

Time: 0928-0938

Date: 24-May-2018

Weather: 74°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Pine warbler	*Setophaga pinus*	auditory	singing	canopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	calling	flyover	1
Summer tanager	*Piranga rubra*	auditory	singing	subcanopy	1
Black and white warbler	*Mniotilta varia*	auditory	singing	subcanopy	1
Northern cardinal	*Cardinalis cardinalis*	auditory	calling	subcanopy	1
Brown-headed cowbird	*Molothrus ater*	auditory	singing	canopy	1
Indigo bunting	Passerina cyanea	auditory	singing	canopy	1
Yellow warbler	*Setophaga petechia*	auditory	singing	understory	1

Time: 1012-1022

Date: 19-Sep-2018

Weather: 77°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Carolina wren	*Thryothorus ludovicianus*	auditory	singing	understory	1

Blossom Point Research Facility

Point No.	22
Habitat:	Interior pine/mixed deciduous wetland
Coordinates:	38°26'1.91", 77° 4'54.31"
Time:	0747-0757
Date:	25-May-2018
Weather:	68°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Eastern wood pee-wee	*Setophaga pinus*	auditory	singing	subcanopy	1
Ovenbird	*Seiurus aurocapilla*	auditory	singing	ground	1
Summer tanager	*Piranga rubra*	auditory	singing	canopy	1
Blue-gray gnatcatcher	*Mniotilta varia*	auditory	singing	subcanopy	1
Brown-headed cowbird	*Molothrus ater*	auditory	calling	ground	1

Time:	0900-0910
Date:	19-Sep-2018
Weather:	77°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1
Carolina wren	*Thryothorus ludovicianus*	auditory	calling	understory	1

Blossom Point Research Facility

Point No.	23
Habitat:	Fresh water tidal scrub/shrub wetland adjacent to mature forest
Coordinates:	38°25'56.41", 77° 4'43.27"
Time:	0957-1007
Date:	25-May-2018
Weather:	67°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Osprey	*Pandion haliaetus*	visual	flyover		1
Yellow-throated warbler	*Setophaga dominica*	auditory	singing	edge of forest	1
Red-winged blackbird	*Agelaius phoeniceus*	auditory	singing	edge of forest	1
Turkey vulture	*Cathartes aura*	visual	singing	subcanopy	2
American goldfinch	*Spinus tristis*	auditory	singing	edge of marsh	1
Scarlet tanager	*Piranga olivacea*	auditory	calling/feeding	forest canopy	1
Eastern towhee	*Pipilo erythrophthalmus*	auditory	singing	ground	1
Red-tailed hawk	*Buteo jamaicensis*	visual	flyover		1
Chimney swift	*Chaetura pelagica*	visual	flyover		2
Red-shouldered hawk	*Buteo lineatus*	visual	flyover		1
Ruby-throated hummingbird	*Archilochus colubris*	visual	feeding	subcanopy	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	subcanopy	1
Red-bellied woodpecker	*Melanerpes carolinus*	auditory	feeding	edge of forest	1

Time:	1050-1100
Date:	19-Sep-2018
Weather:	80°, sunny, calm

Common name	Scientific name	Observation type	Activity	Habitat	Tally
Acadian flycatcher	*Empidonax virescens*	visual	feeding	edge of forest	1
Tufted titmouse	*Baeolophus bicolor*	auditory	singing	edge of forest	1
Yellow warbler	*Setophaga petechia*	auditory	singing	edge of marsh	1
Eastern wood-peewee	*Contopus virens*	visual	feeding	subcanopy	2
White-eyed vireo	*Vireo griseus*	auditory	singing	edge of forest	1

Red-bellied woodpecker	*Melanerpes carolinus*	auditory	calling/feeding	forest canopy	1

Incidentals (not heard or observed during timed survey)

Common name	**Scientific name**	Observation Type	Habitat	Tally
Red-headed woodpecker	*Melanerpes erythrocephalus*	visual	Forested wetland	1
Northern parula	*Setophaga americana*	auditory	upland forest	1
Blackpoll warbler	*Setophaga striata*	visual	pine forest	1
Canada goose	*Branta canadensis*	visual	Nanjamoy River	12
Barred owl	*Strix varia*	auditory/visual	forest/marsh edge	1
Long-tailed duck	*Clangula hyemalis*	visual	Nanjamoy River	5
Lesser scaup	*Aythya affinis*	visual	Nanjamoy River	8
Ruddy duck	*Oxyura jamaicensis*	visual	Nanjamoy River	3
Bufflehead	*Bucephala albeola*	visual	Nanjamoy River	3
Wood duck	*Anix sponsa*	visual	flooded forest	2
Ring-billed gull	*Larus delawarensis*	visual	Potomac River	1
Killdeer	*Charadrius vociferus*	visual	open field	1
Prothonotary warbler	*Protonotaria citrea*	visual	Forested wetland	1
Purple martin	*Progne subis*	visual	open field	5
Swainson's thrush	*Catharus ustulatus*	visual	Mature forest	1
Golden crowned kinglet	*Regulus satrapa*	visual	upland forest	1
American woodcock	*Scolopax minor*	visual	forested wetland	1

APPENDIX B

USFWS Migratory Bird Report (Photos and Probability of Presence)

Bald Eagle
Haliaeetus leucocephalus

Black-billed Cuckoo
Coccyzus erythropthalmus

Bobolink
Dolichonyx oryzivorus

Bonaparte's Gull
Chroicocephalus philadelphia

Canada Warbler
Cardellina canadensis

Cerulean Warbler
Dendroica cerulea

Common Loon
gavia immer

Double-crested Cormorant
phalacrocorax auritus

Dunlin
Calidris alpina arcticola

Eastern Whip-poor-will
Antrostomus vociferus

Golden-winged Warbler
Vermivora chrysoptera

Great Black-backed Gull
Larus marinus


Non-BCC Vulnerable
Herring Gull
Larus argentatus


BCC Rangewide (CON)
Kentucky Warbler
Oporornis formosus


BCC Rangewide (CON)
Lesser Yellowlegs
Tringa flavipes


Non-BCC Vulnerable
Long-tailed Duck
Clangula hyemalis


BCC Rangewide (CON)
Prairie Warbler
Dendroica discolor


BCC Rangewide (CON)
Prothonotary Warbler
Protonotaria citrea


Non-BCC Vulnerable
Red-breasted Merganser
Mergus serrator


BCC Rangewide (CON)
Red-headed Woodpecker
Melanerpes erythrocephalus

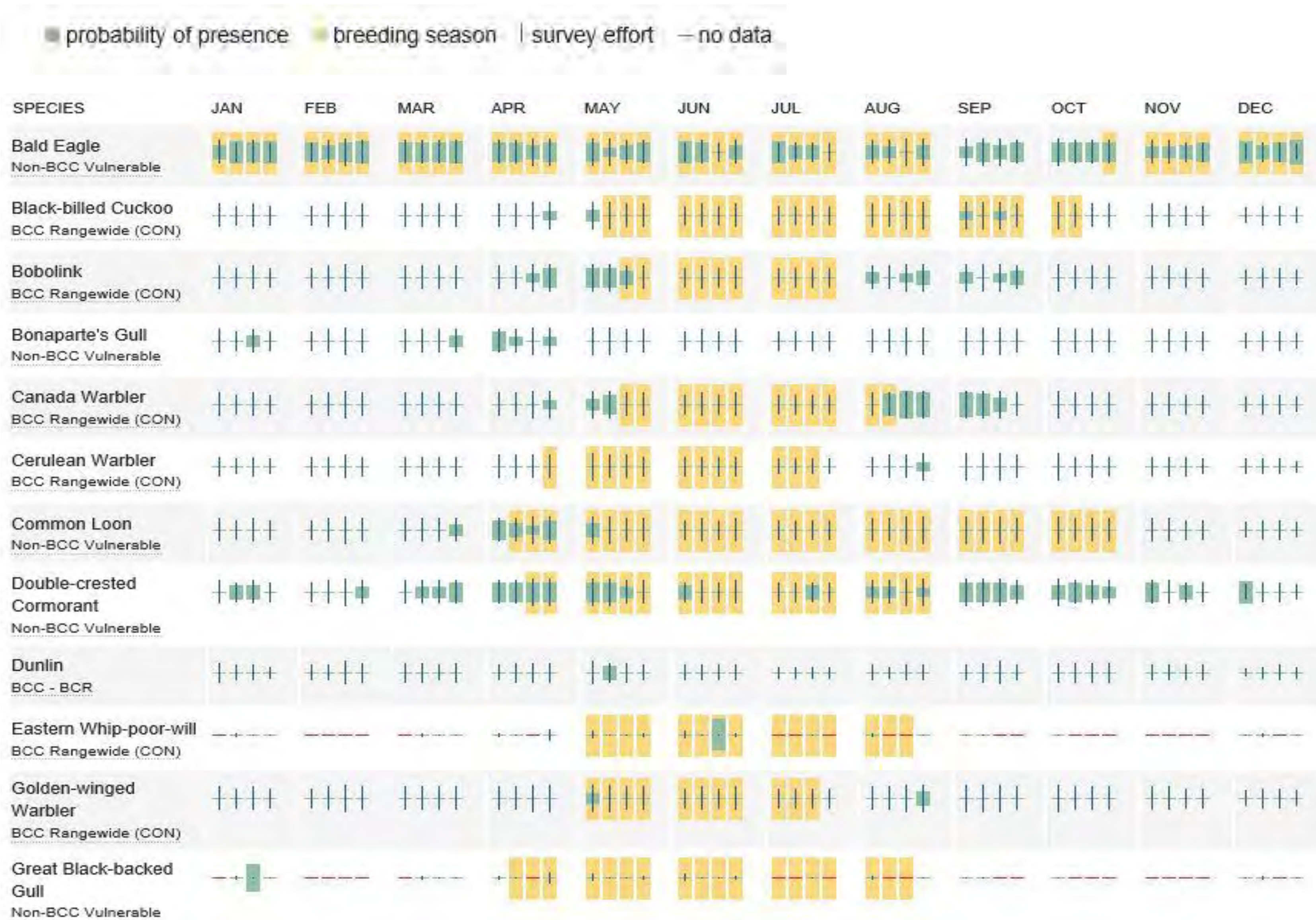

Non-BCC Vulnerable
Ring-billed Gull
Larus delawarensis

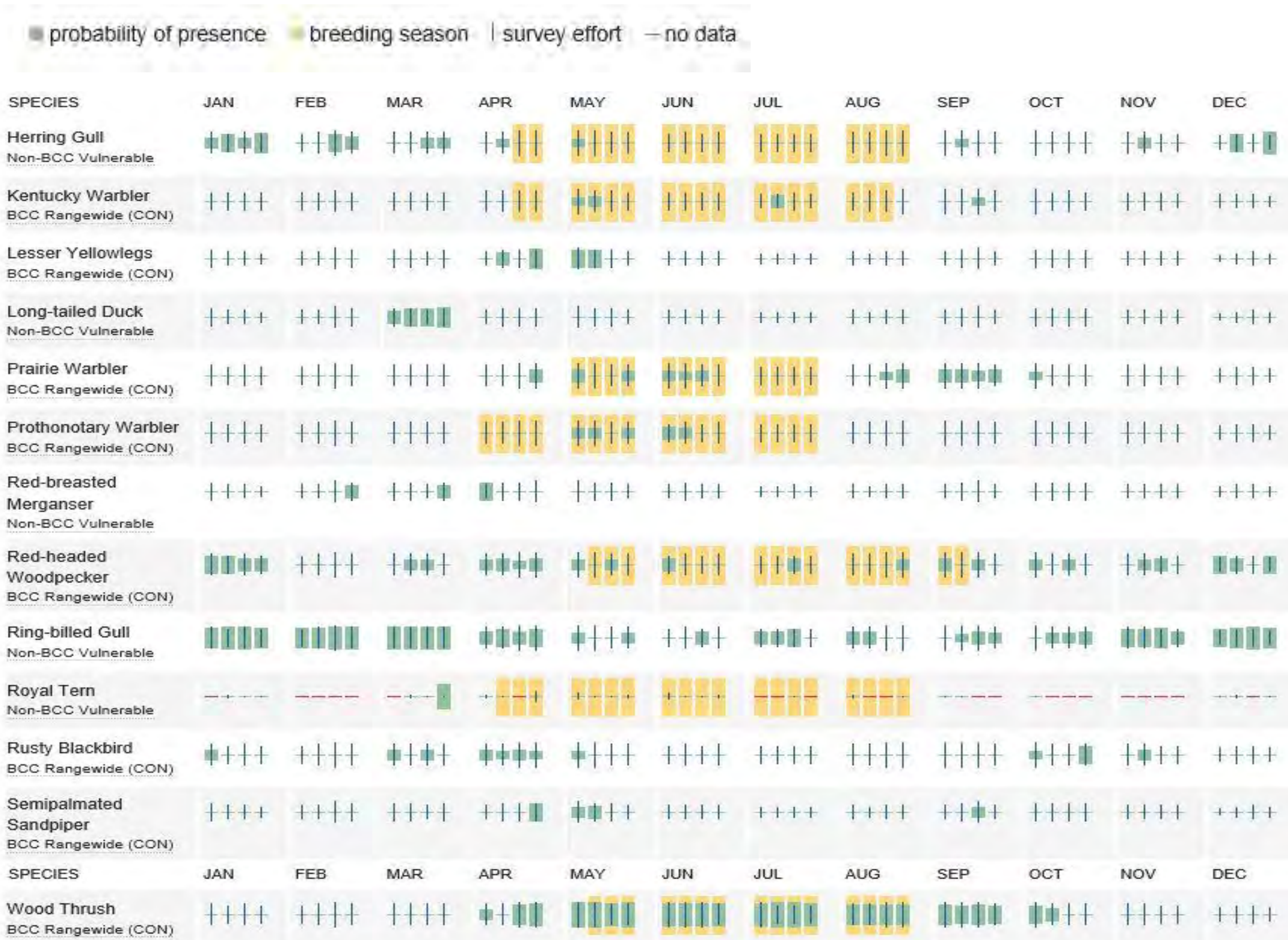

Non-BCC Vulnerable
Royal Tern
Thalasseus maximus


BCC Rangewide (CON)
Rusty Blackbird
Euphagus carolinus


BCC Rangewide (CON)
Semipalmated Sandpiper
Calidris pusilla

ALC and BPRF Migratory Birds- Probability of Presence




probability of presence
breeding season
survey effort
no data
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Herring Gull
Non-BCC Vulnerable
Kentucky Warbler
BCC Rangewide (CON)
Lesser Yellowlegs
BCC Rangewide (CON)
Long-tailed Duck
Non-BCC Vulnerable
Prairie Warbler
BCC Rangewide (CON)
Prothonotary Warbler
BCC Rangewide (CON)
Red-breasted Merganser
Non-BCC Vulnerable
Red-headed Woodpecker
BCC Rangewide (CON)
Ring-billed Gull
Non-BCC Vulnerable
Royal Tern
Non-BCC Vulnerable
Rusty Blackbird
BCC Rangewide (CON)
Semipalmated Sandpiper
BCC Rangewide (CON)
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Wood Thrush
BCC Rangewide (CON)

APPENDIX C

Nationwide Standard Conservation Measures

NATIONWIDE STANDARD CONSERVATION MEASURES

Listed below are effective measures that should be employed at all project development sites nationwide with the goal of reducing impacts to birds and their habitats. These measures are grouped into three categories: General, Habitat Protection, and Stressor Management. These measures may be updated through time. We recommend checking the Conservation Measures website regularly for the most up-to-date list.

1. General Measures

a. Educate all employees, contractors, and/or site visitors of relevant rules and regulations that protect wildlife. See the Service webpage on Regulations and Policies for more information on regulations that protect migratory birds.
b. Prior to removal of an inactive nest, ensure that the nest is not protected under the Endangered Species Act (ESA) or the Bald and Golden Eagle Protection Act (BGEPA). Nests protected under ESA or BGEPA cannot be removed without a valid permit.
    i. See the Service Nest Destruction Policy
c. Do not collect birds (live or dead) or their parts (e.g., feathers) or nests without a valid permit. Please visit the Service permits page for more information on permits and permit applications.
d. Provide enclosed solid waste receptacles at all project areas. Non-hazardous solid waste (trash) would be collected and deposited in the on-site receptacles. Solid waste would be collected and disposed of by a local waste disposal contractor. For more information about solid waste and how to properly dispose of it, see the EPA Non-Hazardous Waste website.
e. Report any incidental take of a migratory bird, to the local Service Office of Law Enforcement.
f. Consult and follow applicable Service industry guidance.

2. Habitat Protection

a. Minimize project creep by clearly delineating and maintaining project boundaries (including staging areas).
b. Consult all local, State, and Federal regulations for the development of an appropriate buffer distance between development site and any wetland or waterway. For more information on wetland protection regulations see the Clean Water Act sections 401 and 404.
c. Maximize use of disturbed land for all project activities (i.e., siting, lay-down areas, and construction).
d. Implement standard soil erosion and dust control measures. For example:
    i. Establish vegetation cover to stabilize soil
    ii. Use erosion blankets to prevent soil loss
    iii. Water bare soil to prevent wind erosion and dust issues

3. Stressor Management

Stressor: Vegetation Removal

Conservation Goal: Avoid direct take of adults, chicks, or eggs.

Conservation Measure 1: Schedule all vegetation removal, trimming, and grading of vegetated areas outside of the peak bird breeding season to the maximum extent practicable. Use available resources, such as internet-based tools (e.g., the FWS's Information, Planning and Conservation system and Avian Knowledge Network) to identify peak breeding months for local bird species; or, contact local Service Migratory Bird Program Office for breeding bird information.

Conservation Measure 2: When project activities cannot occur outside the bird nesting season, conduct surveys prior to scheduled activity to determine if active nests are present within the area of impact and buffer any nesting locations found during surveys.

1) Generally, the surveys should be conducted no more than five days prior to scheduled activity.
2) Timing and dimensions of the area to be surveyed vary and will depend on the nature of the project, location, and expected level of vegetation disturbance.
3) If active nests or breeding behavior (e.g., courtship, nest building, territorial defense, etc.) are detected during these surveys, no vegetation removal activities should be conducted until nestlings have fledged or the nest fails or breeding behaviors are no longer observed. If the activity must occur, establish a buffer zone around the nest and no activities will occur within that zone until nestlings have fledged and left the nest area. The dimension of the buffer zone will depend on the proposed activity, habitat type, and species present and should be coordinated with the local or regional Service office.
4) When establishing a buffer zone, construct a barrier (e.g., plastic fencing) to protect the area. If the fence is knocked down or destroyed, work will suspend wholly, or in part, until the fence is satisfactorily repaired.
5) When establishing a buffer zone, a qualified biologist will be present onsite to serve as a biological monitor during vegetation clearing and grading activities to ensure no take of migratory birds occurs. Prior to vegetation clearing, the monitor will ensure that the limits of construction have been properly staked and are readily identifiable. Any associated project activities that are inconsistent with the applicable conservation measures, and activities that may result in the take of migratory birds will be immediately halted and reported to the appropriate Service office within 24 hours.
6) If establishing a buffer zone is not feasible, contact the Service for guidance to minimize impacts to migratory birds associated with the proposed project or removal of an active nest. Active nests may only be removed if you receive a permit from your local Migratory Bird Permit Office. A permit may authorize active nest removal by a qualified biologist with bird handling experience or by a permitted bird rehabilitator.

Conservation Measure 3: Prepare a vegetation maintenance plan that outlines vegetation maintenance activities and schedules so that direct bird impacts do not occur.

Stressor: Invasive Species Introduction
Conservation Goal: Prevent the introduction of invasive plants.

Conservation Measure 1: Prepare a weed abatement plan that outlines the areas where weed abatement is required and the schedule and method of activities to ensure bird impacts are avoided.

Conservation Measure 2: For temporary and permanent habitat restoration/enhancement, use only native and local (when possible) seed and plant stock.

Conservation Measure 3: Consider creating vehicle wash stations prior to entering sensitive habitat areas to prevent accidental introduction of non-native plants.

Conservation Measure 4: Remove invasive/exotic species that pose an attractive nuisance to migratory birds.

Stressor: Artificial Lighting
Conservation Goal: Prevent increase in lighting of native habitats during the bird breeding season.

Conservation Measure 1: To the maximum extent practicable, limit construction activities to the time between dawn and dusk to avoid the illumination of adjacent habitat areas.

Conservation Measure 2: If construction activity time restrictions are not possible, use down shielding or directional lighting to avoid light trespass into bird habitat (i.e., use a 'Cobra' style light rather than an omnidirectional light system to direct light down to the roadbed). To the maximum extent practicable, while allowing for public safety, low intensity energy saving lighting (e.g. low pressure sodium lamps) will be used.

Conservation Measure 3: Minimize illumination of lighting on associated construction or operation structures by using motion sensors or heat sensors.

Conservation Measure 5: Bright white light, such as metal halide, halogen, fluorescent, mercury vapor and incandescent lamps should *not* be used.

Stressor: Human Disturbance
Conservation Goal: Minimize prolonged human presence near nesting birds during construction and maintenance actions.

Conservation Measure 1: Restrict unauthorized access to natural areas adjacent to the project site by erecting a barrier and/or avoidance buffers (e.g., gate, fence, wall) to minimize foot traffic and off-road vehicle uses.

Stressor: Collision
Conservation Goal: Minimize collision risk with project infrastructure and vehicles.

Conservation Measure 1: Minimize collision risk with project infrastructure (e.g., temporary and permanent) by increasing visibility through appropriate marking and design features (e.g., lighting, wire marking, etc.).

Conservation Measure 2: On bridge crossing areas with adjacent riparian, beach, estuary, or other bird habitat, use fencing or metal bridge poles (Sebastian Poles) that extend to the height of the tallest vehicles that will use the structure.

Conservation Measure 3: Install wildlife friendly culverts so rodents and small mammals can travel under any new roadways instead of over them. This may help reduce raptor deaths associated with being struck while tracking prey or scavenging road kill on the roadway.

Conservation Measure 4: Remove road-kill carcasses regularly to prevent scavenging and bird congregations along roadways.

Conservation Measure 5: Avoid planting "desirable" fruited or preferred nesting vegetation in medians or Rights of Way.

Conservation Measure 6: Eliminate use of steady burning lights on tall structures (e.g., >200 ft).

Stressor: Entrapment
Conservation Goal: Prevent birds from becoming trapped in project structures or perching and nesting in project areas that may endanger them.

Conservation Measure 1: Minimize entrapment and entanglement hazards through project design measures that may include:

1. Installing anti-perching devices on facilities/equipment where birds may commonly nest or perch
2. Covering or enclosing all potential nesting surfaces on the structure with mesh netting, chicken wire fencing, or other suitable exclusion material prior to the nesting season to prevent birds from establishing new nests. The netting, fencing, or other material must have no opening or mesh size greater than 19 mm and must be maintained until the structure is removed.
3. Cap pipes and cover/seal all small dark spaces where birds may enter and become trapped.

Conservation Measure 2: Use the appropriate deterrents to prevent birds from nesting on structures where they cause conflicts, may endanger themselves, or create a human health and safety hazard.

1. During the time that the birds are trying to build or occupy their nests (generally , between April and August, depending on the geographic location), potential nesting

surfaces should be monitored at least once every three days for any nesting activity, especially where bird use of structures is likely to cause take. It is permissible to remove non-active nests (without birds or eggs), partially completed nests, or new nests as they are built (prior to occupation). If birds have started to build any nests, the nests shall be removed before they are completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.

2. If an active nest becomes established (i.e., there are eggs or young in the nest), all work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied. Construction activities that may displace birds after they have laid their eggs and before the young have fledged should not be permitted. If the project continues into the following spring, this cycle shall be repeated. When work on the structure is complete, all netting shall be removed and properly disposed of.

Stressor: Noise

Conservation Goal: Prevent the increase in noise above ambient levels during the nesting bird breeding season.

Conservation Measure 1: Minimize an increase in noise above ambient levels during project construction by installing temporary structural barriers such as sand bags

Conservation Measure 2: Avoid permanent additions to ambient noise levels from the proposed project by using baffle boxes or sound walls.

Stressor: Chemical Contamination

Conservation Goal: Prevent the introduction of chemicals contaminants into the environment.

Conservation Measure 1: Avoid chemical contamination of the project area by implementing a Hazardous Materials Plan. For more information on hazardous waste and how to properly manage hazardous waste, see the EPA Hazardous Waste website.

Conservation Measure 2: Avoid soil contamination by using drip pans underneath equipment and containment zones at construction sites and when refueling vehicles or equipment.

Conservation Measure 3: Avoid contaminating natural aquatic and wetland systems with runoff by limiting all equipment maintenance, staging laydown, and dispensing of fuel, oil, etc., to designated upland areas.

Conservation Measure 4: Any use of pesticides or rodenticides shall comply with the applicable Federal and State laws.

1. Choose non-chemical alternatives when appropriate
2. Pesticides shall be used only in accordance with their registered uses and in accordance with the manufacturer's instructions to limit access to non-target species.

3. For general measures to reducing wildlife exposure to pesticides, see EPA's Pesticides: Environmental Effects website.

Stressor: Fire

Conservation Goal: Minimize fire potential from project-related activities.

Conservation Measure 1: Reduce fire hazards from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off road).

Conservation Measure 2: Consider fire potential when developing vegetation management plans by planting temporary impact areas with a palate of low-growing, sparse, fire resistant native species that meet with the approval of the County Fire Department and local FWS Office.

APPENDIX L:
Bald Eagle Management Plan

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Bald Eagle Management Plan
2016-2021

U.S. Army Garrison Adelphi Laboratory Center
Blossom Point Research Facility

Prepared for:

Environmental Division
U.S. Army Garrison Adelphi Laboratory Center
Adelphi, Maryland 20783

Prepared by:

U.S. Army Environmental Command
2450 Connell Road, Bldg 2264
Fort Sam Houston, Texas 78234-7664

February 2016

EXECUTIVE SUMMARY

PURPOSE AND SCOPE

This Bald Eagle Management Plan supplements the update to the U.S. Army Garrison Adelphi Laboratory Center (ALC) and Blossom Point Research Facility (BPRF) Integrated Natural Resources Management Plan (INRMP) 2014-2018 by providing additional information on the management of bald eagles (*Haliaeetus leucocephalus*) at BPRF. The primary purpose of this Plan is to ensure that ongoing activities at BPRF are conducted in a manner that avoids disturbance to bald eagles by conforming to the National Bald Eagle Management Guidelines (USFWS 2007). Specifically, the purposes of this Eagle Plan are to:

a) provide biological and ecological information on the bald eagle and its associated habitat at the BPRF to adequately inform staff about the existence and life cycle needs of the bald eagle;

b) outline steps taken to ensure that operations and individuals at BPRF avoid disturbance to bald eagles; and

c) describe the standard operating procedure (SOP) for reporting an eagle mortality/carcass.

This Eagle Plan will be reviewed for operational effect in concert with the ALC & BPRF INRMP (every five years) and in coordination with the U.S. Fish and Wildlife Service (USFWS) and the Maryland Department of Natural Resources (MD DNR). DoD Instruction 4715.03 also requires military installations to internally review their INRMP implementation and effectiveness annually. Any significant changes in mission activities, management, or bald eagle status are addressed during these annual self-assessments and, if it is determined that a mid-cycle update to this Eagle Plan is necessary, it will be updated in coordination with the USFWS.

MANAGEMENT GOAL AND OBJECTIVES

The principle management goal for the bald eagle population at BPRF is to protect eagles and their nesting, roosting, and foraging habitats, while managing for a healthy ecosystem and ensuring military operations are fully supported. In support of this overarching goal, ALC will manage bald eagles in accordance with the following objectives:

- <u>OBJECTIVE 1:</u> Design and implement new projects to avoid adverse impacts on bald eagles and their nests.
- <u>OBJECTIVE 2:</u> Execute intermittent activities in a manner that avoids adverse impacts on bald eagles.
- <u>OBJECTIVE 3:</u> Protect and enhance bald eagle nest locations, roost sites, and foraging areas.
- <u>OBJECTIVE 4:</u> Investigate and report eagle fatalities.

SUMMARY OF KEY IMPLEMENTATION ACTIONS

1. Monitor for, document, and protect all eagle nest sites by excluding activities within 330’ of eagle nests.
2. Maintain the forested buffers within 330’ of nests.
3. Demarcate the 330’ buffer zone around eagle nests using signs, tree paint, and/or durable flagging.
4. Continue to use the installation Environmental Review process to screen projects for adverse impacts to bald eagles.
5. Develop and deliver environmental awareness media and training events on the bald eagle, its management, and its standard operating procedure for sick, injured, or dead eagles or eagle parts.
6. Limit all forest thinning or timber harvesting within 660’ of eagle nests to outside the breeding season. Maintain the forested buffer within 330’ of eagle nests by preserving mature trees. Preserve known and potential roosts trees within 100 m of Nanjemoy Creek, the mid-facility marshlands, and the Potomac River.
7. Limit all prescribed burns, anywhere on BPRF, to outside the breeding season and protect eagle nest trees as necessary.
8. Implement the SOP for handling sick, injured, or dead eagles or eagle parts by educating BPRF staff on proper procedures.

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INTRODUCTION

LEGAL REQUIREMENTS

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.”

The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.”

> "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagles return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

SITE DESCRIPTION

Blossom Point Research Facility (Latitude 38 -24 -50"N, Longitude 77 5 -50"W) occupies 648 hectares (1,599 acres) on Cedar Point Neck in southern Charles County, Maryland. It is an active installation. It is located approximately 104 kilometers (65 miles) from ALC by roadway. BPRF is approximately 56 km (35 miles) south of the District of Columbia. The closest town is La Plata, MD approximately 14.4 km (9 miles) northeast of the Facility. BPRF is bordered on three sides by the Potomac River and Nanjemoy Creek.

The topography of the site gently slopes from two to five percent towards the Potomac River and Nanjemoy Creek. Steep bluffs approximately 6 meters (20 feet high) are present at the edges of Cedar Point Neck along the Potomac River and Nanjemoy Creek. The area to the north of the facility includes sparsely populated agricultural and forest lands. BPRF is largely forested with wetlands, open fields, testing areas, and a few buildings.

The wetlands survey of the BPRF conducted in 1994 documented that there are 37 acres of palustrine-forested, 13 acres of palustrine scrub-shrub, 92 acres of palustrine emergent and 87 acres of estuarine wetland designations. The BPRF shoreline is characterized by intertidal beaches and emergent wetlands at the base of the steep bluffs. The entirety of BPRF is in a Coastal Zone Management Area, most of which is defined by Maryland as Critical Area for the Chesapeake Bay. The forests on the BPRF are predominantly classified as oak-hickory-pine forest. Dominant species are hickories, loblolly pine, and white and post oaks. The natural vegetation that presently occurs on the Installation is native to the area.

The BPRF is a satellite installation of the ALC, which is the Headquarters for the Army Research Laboratory (ARL). The primary military mission at BPRF is the field testing of fuses, ordnance, pyrotechnical devices, and electronic telemetry in support of the ARL research. Typical types of field tests include aircraft tests for light scatter studies; radar air target, encounter simulation; and helicopter drop/recovery of telemetry-instrumented, simulated projectiles for purposes of gathering baseline data on developmental proximity fusing. In addition, the BPRF tests firing, recovery, and disassembly of explosive-loaded, fused projectiles for rockets, mortars, and cannons. The explosive testing facilities at the BPRF are also available to other interested parties. Range management practices have changed over the years. Ranges were once fully cleared. Current practices allow ranges to revert to grassy vegetation. Appropriate areas are maintained and cleared as firebreaks. Firebreaks, at least 50-feet wide, are required around each aboveground magazine.

The U.S. Naval Research Laboratory (NRL) holds a lease on 117.8 hectares (291 acres) for Project Vanguard, a long-range communications tracking station for satellites. The BPRF NRL uses 41 acres for antennas and related infrastructure and maintains an additional 34 acres for antenna line of sight that is critical to the mission.

BALD EAGLE LIFE HISTORY & HABITAT[1]

IDENTIFICATION AND DISTRIBUTION

The bald eagle (*Haliaeetus leucocephalus*) is the only species of the genus Haliaeetus (fish eagles) that is considered a resident of North America. Adult bald eagles will typically attain thirty-two inches in length and eighty inches in wingspan, although considerable variation in size amongst individual bald eagles and bald eagle populations is normal (Robbins, 1983). Even small and immature bald eagles will seem massive relative to other raptors and similar large dark birds. The bald eagle flies with deep, powerful wing beats that reach higher on the upstroke. Soaring, the bald eagle presents wings held at right angles to the body, and kept flat throughout their length. The bird may flap continuously, or soar for lengthy periods. The head and tail appear of equal length when flying (Dunne, 1988). Adult birds develop their distinctive white heads and tails, with brown bodies and wings, by the third or fourth year. Immature bald eagles are dark brown, but may be mottled with speckles of white. Second and third year bald

[1] Information in this section was obtained from the previous version of the Adelphi Bald Eagle Management Plan (USAG Adelphi 2001) and the Bald Eagle Management Plan for Pennsylvania (PA Game Commission 2011).

eagles develop a more extensive pattern of white feathers on the underwings, back and belly. By the fourth year bald eagles will develop full adult plumage (Robbins, 1983). Like most raptors, females are larger than the males (about 25% larger in bald eagles), but the sexes are otherwise similar.

The bald eagle is widely distributed throughout North America, from Alaska and northern Canada to northern Mexico and Florida. Within its range bald eagles may vary from locally common to rare. Bald eagles in the Chesapeake Bay region are distributed variably, with concentrations of breeding sites, roosting sites and foraging areas that remain reasonably stable from year to year. Adult breeding bald eagles tend to stay near their nests and territory throughout the year; Buehler et al. 1991a found 81% of breeding bald eagle observations were less than three kilometers from the nest, with none more than seven kilometers from the nest. Sub-adult and nonbreeding bald eagles reared on the Chesapeake Bay tend to stay within the Chesapeake Bay region, moving southerly in the winter and northerly in the summer. A few nonbreeding Chesapeake Bay bald eagles have traveled as far as Maine and North Carolina (Buehler et al. 1991a). Southern and northern nonbreeding bald eagles will migrate into the Chesapeake Bay region seasonally. The northern eagles will enter the region as early as late November and depart as late as mid-April. Southern eagles will enter the region as early as mid-April and depart as late as mid-October (Buehler et al. 1991a).

Bald eagle nests and roosts are found all along the Potomac River where BPRF is located. A major summer roost used by southern bald eagles is found in Virginia, across the Potomac River from the BPRF, at and in the vicinity of the Caledon State Park (US Fish and Wildlife Service 1990).

HABITAT REQUIREMENTS

Bald eagles generally hunt from perches or on the wing. Chesapeake Bay bald eagles are primarily fish-eating, but forage and scavenge opportunistically depending upon the availability of various food sources (Fraser et al. 1991; Lefranc and Cline 1983). Lefranc and Cline (1983) found birds comprised 35% of prey, mammals comprised 14% and turtles 10% of prey, with fish comprising 41% of prey remains recovered at Chesapeake Bay active bald eagle nests from 1979 through 1981. Bald eagles in the Chesapeake Bay region are more opportunistic than selective, and whether scavenging carrion or hunting fish will eat whatever food is most available (Fraser et al. 1991). Bald eagles will scavenge on dead fish and mammal carcasses, including large herbivores such as deer and livestock. Eagles notoriously will pirate food from other fish-eating birds such as osprey, mergansers, herons, or other eagles.

Breeding habitat for bald eagles generally require the following characteristics:

(1) sufficient prey base to meet the eagles' food requirements

(2) suitable nest trees no more than 1.5 km (0.9 mile) from the edge of open water

(3) relatively isolated from human activity and development

Bald eagles prefer sites with several characteristics in common (Andrew and Mosher 1982; Buehler 1990; Buehler et al. 1991b; Chandler et al. 1995; Todd and Owen 1986; US Fish and Wildlife, 1990.). Particularly important for nesting, roosting and perching is the presence of mature forested woodland, with outstanding super-canopy trees of open crown. Preferred sites have large, overmature trees with open crowns that rise above the canopy. Particularly preferred are loblolly pines in the Chesapeake Bay region, although other overmature trees are often used for nesting and roosting. In the Chesapeake Bay region, loblolly pines comprise more than 60% of all nest trees.

Bald eagles, both nesting and roosting, prefer sites with easy access to prey, especially fish. Most sites are within 1.5 kilometers of a shoreline and frequently closer (Andrew and Mosher 1982). Typically, nesting territories of Chesapeake Bay bald eagles cover about one square mile. The territory usually covers a significant expanse of wooded area. One or more nests may be built within this territory, with the birds alternating between multiple nests irregularly. At times more than five years may pass before an old nest site is re-occupied, and any nest should be treated with the same management practices as an occupied nest.

Bald eagles will form communal roosts: areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

Bald eagles generally avoid areas with human activity and development; however, the tolerance of human activity and development is variable amongst individual eagles (Abbott, 1978; Buehler 1990; Chandler et al. 1995). Bald eagles have been observed to relocate and abandon nests due to development activity occurring at considerable distances from the nests. Eagles often avoid areas where boating, fishing, camping, and other recreational activities take place even when these areas have not been developed (Byrd et al. 1990). Bald eagles are very sensitive to human presence, and will flush at the presence of boats, vehicles, pedestrians and other activity and avoid flying into developed areas (Cline 1985; Buehler et al. 1991c). Distance, presence of visual barriers, and the nature of the development activity all play a role in the effect the development may have on bald eagle behavior (Therres et al.1993).

REPRODUCTIVE BIOLOGY

Bald eagles are not mature until their sixth year, but some individuals will pair off at an earlier age (Buehler 2000). Bald eagles are known for their spectacular courtship, including acrobatic flight displays (Stalmaster 1987). Different displays described by observers include the Cartwheel Display, the Chase Display, and Roller-coaster Flight. The Cartwheel Display is perhaps the best known. In this courtship act, the pair flies to great altitude, lock their talons in flight, and tumble in cartwheels back toward the earth, breaking off their hold at the last moment before colliding with the ground. These flight displays often occur in winter, giving support to the idea that many pairs remain bonded through the year (Harmata 1984 *in* Buehler 2000). Pair bonds tend to last more than one year but, although bald eagles are generally believed to bond for life, this is poorly studied because of the difficulties in capturing and marking each bird (Buehler 2000). The persistence of pairs at sites from year to year, sometimes for decades, suggests long-term pair bonds. However, pair bonds might break up after nesting failures (Gerrard et al. 1983).

Nest-building generally begins one to three months before egg-laying (Buehler 2000). In some cases, it seems that pairs build or start to build a nest a year previous to egg-laying. Both sexes contribute to nest-building, but the female may place the sticks. Sticks are collected from the ground near the nest tree or broken off from nearby trees. Eagles sometimes use a previously built raptor nest as a base for building their own nest. Sometimes pairs build two nests that they use in alternative years, especially after nest failures (Buehler 2000). The second nest may be in a very different kind of location, an island rather than a hillside or a swamp rather than a forest or hedgerow.

Bald eagles generally rebuild or refit their old nest each year (Bent 1961). The normal time for this activity in this area is December through February, but increased nest activity generally occurs during late November and early December as they are selecting a specific nest for the year (Fraser et al. 1991). A bald eagle nest may weigh 1,000 pounds, with some more than double that weight. Mean nest longevity in Maine has been noted at 20 to 25 years (Todd and Owen 1986).

Although bald eagles have the deserved reputation of territory fidelity and reuse of their nests, there is an annual turn-over of nests used by pairs. Bald eagles can live to about 20-30 years, often returning to their nests year after year with the same mate. Although it's possible for bald eagles to reuse the same nest for over 20 years, it may not be likely given numerous ecological and environmental factors. In the coastal plain of Virginia, nests inventoried each year for a 20 year study (1,463 nests, 1977-2007) were analyzed for turnover rate. The probability of a Virginia nest being used in subsequent years was 0.739 (SE = 0.0055) leading to an annual turnover rate for nests of 0.261, using 1.00 as 100% usage (Watts and Deuerr 2010). Similarly, a ten year study in north-central California observed to bald eagles to have an average nest fidelity of 4-6 years (Jenkins and Jackman 1993).

In the Chesapeake Bay region, breeding season is considered to be **December 15 through June 15,** but the nesting season can vary. Breeding bald eagles will lay one to three eggs between January and March, with incubation lasting about 35 days. Chicks will typically fledge at ten to twelve weeks, with the last of the chicks leaving the nest by late July. The newly fledged bald eagles will still return to the nest and obtain food from their parents for up to two months past their fledging (Cline 1985; Fraser et al. 1991; US Fish and Wildlife Service, 1982). During this time the young eagles develop their hunting skills and gradually spend more time away from the nest. Sub-adult bald eagles do not develop adult plumage until their fourth year. It is unusual for a bald eagle to establish breeding territory prior to its fourth year.

BPRF POPULATION STATUS AND TREND

In 1990, the Chesapeake Bay region hosted only 230 pairs of nesting eagles (USFWS 1990). In 2001, the Chesapeake Bay population increased to 601 pairs with an average doubling time of 8.2 years (Watts et al. 2008). Today, the population in Chesapeake Bay is expected to be over 1,000 breeding pairs.

BPRF occupies roughly 2.5 square miles (1,600 acres). Given that bald eagle nesting territories cover about one square mile, it could be expected that BPRF would host no more than 1-3 breeding pairs. Additionally, BPRF falls within the USFWS's Mid-Atlantic bald eagle management unit and the estimated population size for the Mid-Atlantic bald eagle management unit is 14,021 eagles encompassing 237,687 square miles of landscape, or approximately 0.06 eagles per square mile (USFWS 2009). The population density of bald eagles on BPRF currently exceeds either of these measures.

In 1996, three bald eagle nests were known to occur on BPRF. Two nests were found adjacent to the inland marsh on the Potomac River side of the property and one was located east of the Nanjemoy Creek near the main entrance. Ground observations by facility personnel in the winter of 2000 indicated that all of these nests were occupied by nesting bald eagles (USAG ALC 2001). Today, BPRF has documented 4-5 breeding pairs and this level has remained fairly consistent in recent years (Table 1). One of the active nests (BP-04) is located just outside the BPRF boundary; however the management buffer for the nest falls within BPRF and this nest is monitored along with other BPRF nests.

All of the eagle nests on BPRF have a forested buffer between the nests and human activities (Figure 1). In 2014, BPRF obtained a permit to remove 3 bald eagle nests during their inactive period in support of the U.S. Navy's expansion of satellite ground communications at the NRL site. Two of the permitted inactive eagle nests were previously undocumented (shown as A & B on Figure 1). The third permitted nest (BP-12) has been active each year since its documentation. The tree clearing is expected to be implemented in the summer months of 2016, after the eagles in the active nest have fledged. Figure 1 (Potential LOS Area) highlights the potential line-of-sight where 34 acre of forest will be cleared.

From past accounts and current documentation, it appears bald eagles at BPRF do not always return to the same nests from previous years. Many of the inactive nests had reported storm damage and were not rebuilt. Currently, the data (ranging from 1-6 years) is too limited to estimate nest turnover rate at BPRF.

Roosting and foraging trees are very important to breeding eagles and sub-adults at the BPRF. Such trees have similar characteristics to those used for nesting, with minor distinctions. Good roosting and foraging trees, in addition to being taller than surrounding trees, may be standing dead trees. In any event, they should be less than 100 meters from the source of prey, and preferably closer. Trees used for foraging currently exist along Nanjemoy Creek, the mid-facility marshlands, and the Potomac River.

Table 1. Location and activity (as defined below the table) of all documented bald eagle nests on BPRF.

NESTCode	X_Coord	Y_Coord	Y2009	Y2013	Y2014	Y2015
BP-01	1281490	269826	Inactive	Inactive	Inactive	Absent
BP-02	1281766	273538	Inactive	Inactive	Absent	Absent
BP-03	1282990	275709	Active	Inactive	Absent	Absent
BP-04	1283943	278624	Active	Active	Active	Active
BP-05	1288403	277031	Active	Inactive	Inactive	Inactive
BP-06	1289306	275538	Active	Inactive	Inactive	Inactive
BP-07	1286959	275352	Active	Inactive	Absent	Absent
BP-08	1283875	272071		Active	Active	Active
BP-09	1286154	274423		Active	Inactive	Failed
BP-10	1283677	274664			Active	Inactive
BP-11	1288552	275439			Inactive	Active
BP-12	1289481	277260		Active	Active	Active
Breeding Pairs			5 BP	4 BP	4 BP	5 BP

Definitions

Active	nest used for breeding, observed to have eggs, chicks, and/or fledglings
Failed	nest occupied by adults without eggs, chicks, fledglings - recorded as failed
Inactive	nest not occupied, may be alternate nest, damaged or remnant nest
Absent	nest previously documented but no longer present

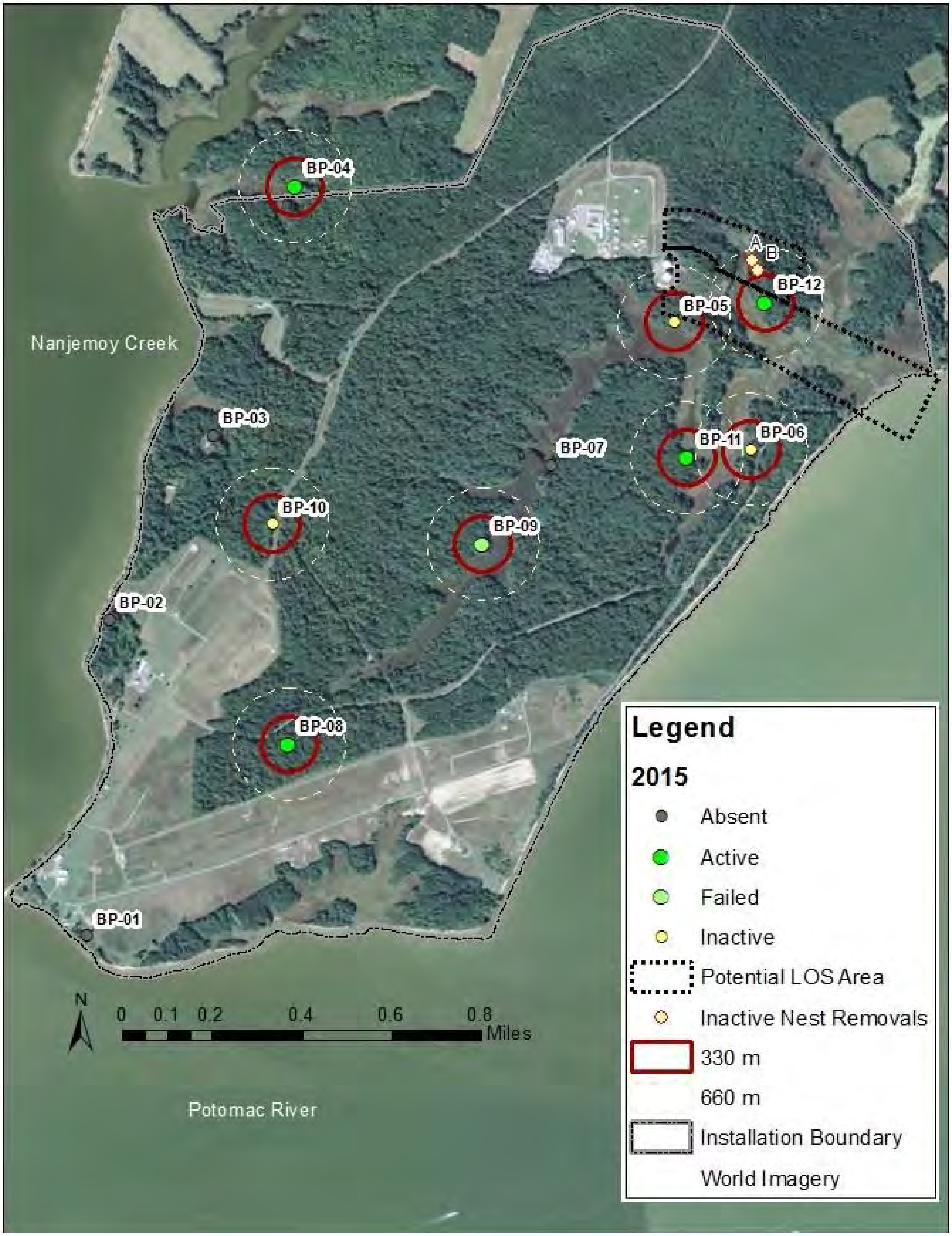

Figure 1. Documented bald eagle nests at Blossom Point.

EXISTING AND INTERMITTENT ACTIVITIES

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles.

Human activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them. Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles.

BPRF MISSION ACTIVITIES

The primary mission of BPRF is to field test fuzes, explosives and pyrotechnic devices, and electronic telemetry systems. Fuze and related ordnance testing has been conducted at this site since 1942. Typical types of field tests include aircraft tests for light scatter studies; radar air target, encounter simulation; and helicopter drop/recovery of telemetry-instrumented, and simulated projectiles for purposes of gathering base line data. In addition, the BPRF tests firing, recovery, and disassembly of explosive-loaded, fuzed projectiles for rockets, mortars and cannons. Much of this research and testing are voluntarily limited to 15 pounds per explosion and the test explosions usually result in short bursts of noise.

No fixed-wing aircraft operations take place at BPRF. Unmanned aircraft, rockets, and parachutes are used at times for testing. On limited occasions, helicopters use the facility for night-time training. Aircraft routinely fly over this facility in route to local airports, including nearby Maryland Airport, located in Pomonkey, Maryland.

The mission activities described above are intermittent activities that fall into Category G (helicopters and fixed-wing aircraft) and Category H (blasting and other loud noises) of the USFWS Eagle Management Guidelines (USFWS 2007). These activities occur in the southern portion of the peninsula where historic nest sites, inactive nests, and a currently active eagle nest (BP-08) occur within the suggested ranges of avoidance (i.e. 1000’ for aircraft and ½ mile for blasts). Given the long history of operations at BPRF and the high density of breeding pairs, the eagles at BPRF have demonstrated tolerance for both of these intermittent activity categories. Therefore, in accordance with the USFWS Guidelines, use of the 1000’ and ½ mile buffer zones will not be further discussed.

The northern portion of BPRF is isolated, quiet, and relatively free of electronic interference, making if the perfect place for the U.S. Naval Research Laboratory (NRL). NRL supports Navy mission requirements and new technologies for use in space. The NRL antennas receive data from and transmit commands to several types of satellites. The 41-acre facility has a 265-acre wooded acoustical buffer zone to prevent interference with the sensitive satellite antenna radio receivers. There are 54 NRL employees and 24 NASA employees, a subset of which would be on site at any given day and time. Intermittent operations at NRL do not adversely affect the bald eagles at BPRF; however the NRL facility recently assessed the environmental effects of expanding the line-of-sight (LOS) for its antennas by clearing roughly 34 acre of trees. Unfortunately, this tree clearing would take 2 documented inactive and 1 documented active bald eagle nests (outside the breeding season). The project has been coordinated with USFWS and an intentional take permit was obtained. To date, the tree-clearing has not occurred and a renewed permit will be obtained to remove inactive eagle nests prior to tree-clearing activities. Once this one-time project is complete, the vegetation around NRL will be maintained to meet mission requirements (refer to the following section on vegetation control).

VEGETATION CONTROL

The mission activities on BPRF require intermittent maintenance of vegetation at range sites and at the NRL site. Annual mowing maintains the semi-improved grounds at the range sites in the southern portion of BPRF. Mowing occurs outside the eagle breeding season, in late summer or early fall. The mowing frequency provides for a diverse wildlife habitat and supports bald eagle foraging. Intermittent vegetation maintenance at the NRL site occurs within the LOS zone to maintain vegetation at the height of the antennas. Control mechanisms may consist of prescribed burning, mechanical removal, herbicide application, or a combination of these methods every 2 to 3 years, depending on the rate of vegetation growth. In accordance with DoD policy and legal requirements, all pesticides are applied by a DoD or State certified applicator and in accordance with the label. Vegetation control in the LOS at the NRL falls into Category C (timber operations and forestry practices) of the USFWS Eagle Management Guidelines (USFWS 2007). Where prescribed burning or mechanical thinning techniques are used, they will be implemented in accordance with the bald eagle protection measures described in this Eagle Management Plan.

FOREST MANAGEMENT

Forest management at BPRF is implemented in accordance with the ALC/BPRF INRMP. As described in the INRMP, one of the primary objectives of BPRF’s forest management is to preserve and enhance wildlife habitat. Trees that provide essential habitat for wildlife are maintained and not targeted for thinning or timber harvesting. Timber harvests at BPRF are very rare. The only timber harvest occurred once in 1988, but ALC continues to seek opportunities where a timber harvest would support BRPF forest management objectives. Prescribed burns have not been implemented on BPRF to date. ALC plans to analyze the feasibility of using prescribed fire to accomplish its forest management objectives and, if feasible, will develop a prescribed burn plan. As described in the INRMP, prescribed burns would be performed when temperatures are cool, winds calm to light, and fuels not excessively dry. Forest management practices at BPRF have been very limited, but plans for future projects (which would fall into Category C, timber operations and forestry practices of the USFWS Guidelines) will incorporate the protection measures described in the following section of this Eagle Management Plan.

BALD EAGLE PROTECTION

The principle management goal for the bald eagle population at BPRF is to protect eagles and their nesting, roosting, and foraging habitats, while managing for a healthy ecosystem and ensuring military operations are fully supported. In support of this overarching goal, ALC will manage bald eagles in accordance with the following objectives and specific actions:

OBJECTIVE 1: Design and implement new projects to avoid adverse impacts on bald eagles and their nests.

- 100% of BPRF projects will receive an environmental review from the ALC Environmental Division prior to any obligation of funds.
- The ALC Environmental Division will coordinate with project proponents and adjust projects in order to avoid adverse impacts to eagles to include:
  - protecting all active and inactive nest sites;
  - protecting roosting and foraging habitat;
  - protecting forested buffers within 330’ of eagle nest sites;
  - avoiding all human activity within 330’ of eagle nests during the breeding season (15 December – 15 June); and
  - avoiding any tree clearing >330’ and <660’ of active nests during the breeding season.
- Where impacts are unavoidable, ALC will contact with the U.S. Fish and Wildlife Service (USFWS) and work to obtain the appropriate permit or other authorization for the project prior to any obligation of funds.

OBJECTIVE 2: Execute intermittent activities in a manner that avoids adverse impacts on bald eagles.

- Human activity will be avoided within the 330’ protection zone from December 15 to June 15 each year when the nest is active, except where eagles have demonstrated tolerance to such activity.
    - Eagle awareness media and standard operating procedures regarding the bald eagle will be posted at each facility and annual eagle conservation training will be presented to BPRF environmental compliance staff by the Conservation Specialist from the ALC Environmental Division.
    - Signs, tree paint, and/or durable flagging will be used to demarcate the 330’ buffer boundaries around each eagle nest and installation staff and visitors will be made aware of what the signs/flagging mean by utilizing environmental awareness techniques such as presentations, newsletters, signs, pamphlets, and word-of-mouth.
- Where breeding pairs establish a new nest that is <330’ from existing facilities that engage in intermittent activities, additional measures will be implemented to avoid disturbance.
    - Enhanced awareness training will be executed at the facility to include: incorporation of eagle conservation/awareness into daily safety briefings and other frequent face-to-face instruction, handing out media, posting signs, and additional patrols of the site and facility by the Conservation Specialist from the ALC Environmental Division.
    - Coordination of intermittent activities with the ALC Conservation Specialist will ensure activities occur away from the nest or outside the breeding season.
- Recreational hunting will not be permitted within 330’ of eagle nests during the breeding season.
    - All hunters will receive eagle conservation/awareness training with their mandatory safety briefing.
    - Deer stands are permitted to be built and maintained within the protection zones; however, hunters will only be permitted to utilize these stands prior to December 15.
- Forest management projects will be implemented to avoid adverse impacts to eagles.
    - All tree thinning and timber harvest within 660’ of eagle nests and all prescribed burns will be implemented outside the breeding season and occur between 15 June and 15 December.

  - When thinning or harvesting is necessary to rejuvenate forest stands, wildlife habitat trees and mature trees within 330' of an eagle nest will be preserved by flagging these trees and marking the boundary of the 330' protection area prior to implementation. Wildlife habitat trees are defined as snags, den trees, and eagle roost trees (i.e. known and potential roost trees that are particularly tall or standing dead trees within 100 m from Nanjemoy Creek, the mid-facility marshlands, and the Potomac River.)
  - When a prescribed burn is necessary to rejuvenate forest stands, a prescribed burn plan will incorporate the following measures:
    - Prescribed burns should be implemented when temperatures are cool, winds calm to light, and fuels not excessively dry.
    - Prescribed burns must be implemented outside the bald eagle breeding season, preferably (mid-September – mid-November).
    - Prior to implementation, inspect eagle nest trees in the project area to assess if mid-story or duff levels around the tree need to be cleared to protect it from burning. If necessary, rake around the tree and/or mechanically thin mid-story immediately adjacent the tree.

<u>OBJECTIVE 3:</u> Protect and enhance bald eagle nest locations, roost sites, and foraging areas.

- Leverage opportunities to survey for eagle nests, roost sites, breeding success and/or track nest failures. All survey data will be reported to USFWS and the state, MD DNR.
- Leverage opportunities to thin unnaturally dense forested areas between eagle nests, roost sites and their feeding areas.
- To the extent practicable, where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.
- Manage BPRF habitats for eagle prey in accordance with INRMP goals and objectives.

<u>OBJECTIVE 4:</u> Investigate and report eagle fatalities.

- The USFWS will be contacted immediately upon the discovery of dead or injured bald eagles found at BPRF.

- BPRF staff charged with environmental compliance responsibilities will follow the standard operating procedure (Appendix A) to report sick, injured, or dead eagles or eagle parts.
- The USFWS Eagle Handling Quick Reference will be modified for relevance to BPRF staff and posted at facilities.
- The ALC Conservation Specialist will train new BPRF staff charged with environmental compliance responsibilities and provide refresher training.

ANNUAL MONITORING AND REPORTING

Because BPRF is a very small installation (2.5 square miles), it is not practicable or cost-effective to execute aerial eagle surveys for BPRF alone. Currently, the Navy is performing annual eagle nest and breeding success surveys for the entire BPRF as part of a larger eagle survey effort in the region. This effort also supports the requirements listed in the intentional take permit for the expansion of the line-of-sight at the NRL facility. ALC staff will leverage this and other opportunities to conduct annual aerial eagle surveys. When such opportunities are absent, ALC staff will perform ground surveys to verify documented nests, identify new nests, and observe the presence of fledglings. Ground observations will be conducted using the minimal number of personnel to avoid nesting disturbance.

Annual survey data will be reported to the USFWS Migratory Bird Permit Office and the MD DNR no later than one year after the survey completion.

REFERENCES

ABBOTT, J.M. 1978. Chesapeake Bay Bald Eagles. Delaware Conservationist. 22(2): 3-9.

ANDREW, J.M. AND J.A. MOSHER. 1982. Bald eagle Nest Site Selection and Nesting Habitat in Maryland. Journal of Wildlife Management. 46:383-390.

BENT, A. C. 1961. Life Histories of North American Birds of Prey, Part 1. New York: Dover Publications, Inc.

BUEHLER, DAVID A. 1990. Bald Eagle Distribution, Abundance, Roost Use and Response to Human Activity on the Northern Chesapeake Bay, Maryland. PhD Dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

BUEHLER, DAVID A. 2000. Bald Eagle, *Haliaeetus leucocephalus*, *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA

BUEHLER, DAVID A., T. J. MERSMANN, J.D. FRASER AND J.K.D. SEEGAR. 1991a. Differences in Distribution of Breeding, Nonbreeding, and Migrant Bald Eagles on the Northern Chesapeake Bay. The Condor 93:399-408.

BUEHLER, DAVID A., T. J. MERSMANN, J.D. FRASER AND J.K.D. SEEGAR. 1991a. Differences in Distribution of Breeding, Nonbreeding, and Migrant Bald Eagles on the Northern Chesapeake Bay. The Condor 93:399-408.

BUEHLER, DAVID A., T. J. MERSMANN, J.D. FRASER, AND J.K.D. SEEGAR. 1991b. Nonbreeding Bald Eagle Communal and Solitary Roosting Behavior and Roost Habitat on the Northern Chesapeake Bay. Journal of Wildlife Management 55(2):273-281.

BUEHLER, DAVID A., T. J. MERSMANN, J.D. FRASER, AND J.K.D. SEEGAR. 1991c. Effects of Human Activity on Bald Eagle Distribution on the Northern Chesapeake Bay. Journal of Wildlife Management 55(2):282-290.

BYRD, M. A., G. D. THERRES, AND S. N. WIEMEYER. 1990. Chesapeake Bay Region Bald Eagle Recovery Plan, First Revision. U.S. Fish and Wildlife Service. Region Five. Newton Corner, Mass.

CHANDLER, S.K., J.D. FRASER, D.A. BUEHLER, J.K.D. SEEGAR. 1995. Perch Trees and Shoreline Development as Predictors of Bald Eagle Distribution on Chesapeake Bay. Journal of Wildlife Management 59(2):325-332.

CLINE, KEITH. 1985 (rev. 1990). Bald Eagles in the Chesapeake: A Management Guide for Landowners. National Wildlife Federation, Washington, DC.

DEPARTMENT OF DEFENSE AND CHARLES COUNTY COMMISSIONERS. 2012. Blossom Point Research Facility Charles County, Maryland Joint Land Use Study.

DUNNE, P., D. SIBLEY AND C. SUTTON. 1988. Hawks in Flight. Houghton Mifflin Company, Boston, MA.

FRASER, J.D., D.A. BUEHLER, G.D. THERRES AND J.K.D. SEEGAR. 1991. Bald Eagle, Haliaeetus leucocephalus. in Habitat Requirements for Chesapeake Bay Living Resources, Second Edition. Living Resources Subcommittee, Chesapeake Bay Program, Annapolis, Maryland.

GERRARD, J. M., P.N. GERRARD, G. R. BORTOLOTTI, AND D.W. A. WHITFIELD. 1983. A 14-year study of Bald Eagle reproduction on Besnard Lake, Saskatchewan. Pp. 47-57 in Biology and management of bald eagles and osprey (D. M. Bird, ed.). Harpell Press, Ste. Anne de Bellevue, Quebec.

HARMATA, A. R. 1984. Bald eagles of the San Luis valley, Colorado: their winter ecology and spring migration. Ph. D. dissertation, Montana State University, Bozman.

JENKINS, J.M. AND R.E. JACKMAN. 1993. Mate and nest site fidelity in a resident population of bald eagles. The Condor 95: 1053-1056.

LEFRANC, M.N. AND K.W. CLINE. 1983. The Occurrence of Birds as Prey at Active Bald Eagle Nests in the Chesapeake Bay Region. In Biology and Management of Bald Eagles and Ospreys. Harewell Press, Ste. Anne de Bellevue, Quebec, Canada.

MILLAR, J.G. 1999. Endangered and threatened wildlife and plants; Proposed rule to remove the Bald Eagle in the lower 48 states from the list of endangered and threatened wildlife. Federal Register 64:36454–36464.

PENNSYLVANIA GAME COMMISSION, BUREAU OF WILDLIFE MANAGEMENT. 2011. Bald Eagle Management Plan for Pennsylvania (2010-2019). PA Game Commission. May 2011.

ROBBINS, C.S., B. BRUUN, AND H.S. ZIM. 1983. Birds of North America. Golden Press, New York.

SPRUNT, A., IV. 1963. Continental Bald Eagle project: progress report no. III. Proceedings of the National Audubon Society’s Convention. Miami, FL U.S.A.

STALMASTER, M. V. 1987. The Bald Eagle. University Books, New York, NY.

THERRES, G.D., M.A. BYRD, D.S. BRADSHAW. 1993. Effects of Development on Nesting Bald Eagles: Case Studies from Chesapeake Bay. Transactions of the 58th North American Wildlife and Natural Resources Conference.

TODD, C.S. AND R.B. OWEN, JR. 1986. Management of Bald Eagle and Osprey Nest Sites. in Is Good Forestry Good Wildlife Management? Misc. Publication No. 689. Maine Agricultural Experiment Station, University of Maine.

U.S. ARMY GARRISON ADELPHI LABORATORY CENTER. 2001. Endangered Species Management Plan for Chesapeake Region Bald Eagle, Haliaeetus leucocephalus. USAG Adelphi Laboratory Center, Blossom Point Research Facility.

U.S. FISH AND WILDLIFE SERVICE (USFWS). 1982. The Chesapeake Bay Region Bald Eagle Recovery Plan. Region Five, Newton Corner, Massachusetts.

USFWS. 1990. Chesapeake Bay Region Bald Eagle (Haliaeetus leucocephalus) Recovery Plan, First Revision. Region Five, Newton Corner, Massachusetts

USFWS 2007. National Bald Eagle Management Guidelines. U.S. Fish and Wildlife Service. May 2007.

USFWS. 2009. Final Environmental Assessment: Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act. USFWS. Washington, D.C.

WATTS, B. D. AND A. E. DUERR. 2010. Nest turnover rates and list frame decay in bald eagles: Implications for the National Monitoring Plan. Journal of Wildlife Management, 75: 940-944.

WATTS, B. D., G.D. THERRES, AND M.A. BYRD. 2008. Recovery of the Chesapeake Bay Bald Eagle nesting population. Journal of Wildlife Management 72:152–158.

WATTS, B.D., G.D. THERRES, AND M.A. BYRD. 2008. Recovery of the Chesapeake Bay Bald Eagle Nesting Population. The Journal of Wildlife Management 72:152-158.

APPENDIX A: STANDARD OPERATING PROCEDURE FOR REPORTING EAGLE MORTALITY/CARCASS/PARTS

LEGAL REQUIREMENTS

The Bald and Golden Eagle Protection Act prohibits unpermitted possession of an eagle, alive or dead, and any part (feather or any body part), nest, or egg thereof.

Anyone handling an eagle or its parts must either be covered by a migratory bird permit or a permit exception as listed in 50 CFR 21.12. In general, you should not be handling or transporting live or dead eagles or their parts unless you are:

- A wildlife biologist, or other natural resource staff, employed by the ALC Environmental Division.
- A conservation law enforcement officer, or game warden, employed by the state or USFWS.
- A licensed veterinarian.

RESPONSIBILITIES

<u>BPRF staff</u> with responsibilities in environmental compliance are responsible for the following:

1. Posting this SOP in an accessible place in accordance with the installation's ISO 14001: Environmental Management System.
2. Educating facility staff on reporting bald eagle mortality, carcass, or eagle parts.
3. Following this SOP should a discovery of eagle mortality or parts thereof occur.

In addition to the above responsibilities<u>, the ALC Conservation Specialist</u> is responsible for the following:

1. Ensure that any incidences of an injured, sick, or dead eagle or eagle parts are handled by contacting and coordinating a response with the USFWS law enforcement office or MD Natural Resources Police if USFWS cannot be reached.
2. Report injured, sick, dead eagles or essential eagle parts (parts essential to survival and productivity, i.e. not feathers) to the USFWS Chesapeake Bay Field Office and/or the USFWS Regional Office, as appropriate.
3. Send all eagle carcasses, parts and feathers (not taken into possession by law enforcement officers) to the National Eagle Repository regardless of condition.

PROCEDURES

SICK OR INJURED EAGLE:

1. Do not approach the eagle. Identify its location from a safe distance.

    a. Eagles are powerful and dangerous animals that can cause serious injury. Unless you have been properly trained, do not approach or handle the eagle yourself unless absolutely necessary.

2. Immediately contact the USFWS Office of Law Enforcement to respond and ask for guidance on how to handle the scene.

3. Ensure the area the eagle is occupying is protected from human disturbances.

4. Contact the ALC Conservation Specialist to report the incident.

FRESHLY DEAD EAGLE:

1. Protect the carcass from predators but do not move or disturb the area.

2. Contact the USFWS Office of Law Enforcement to respond or ask for guidance on how to handle the carcass and the scene. If USFWS does not respond, contact the MD Natural Resource Police for investigation support.

3. Protect the scene from human disturbance.

4. Contact the ALC Conservation Specialist to report the incident.

DEAD EAGLE OR EAGLE PARTS:

1. Protect the carcass/parts from predators but do not move or disturb the area.

2. Contact the USFWS Office of Law Enforcement to respond or ask for guidance on how to document, collect, and transfer the parts. If USFWS does not respond, contact the ALC Conservation Specialist for support.

3. Contact the ALC Conservation Specialist to report the incident.

EAGLE SHIPPING GUIDELINES – NATIONAL EAGLE REPOSITORY:

With the exception of eagles suspected or confirmed with West Nile Virus and/or poisoning, except lead poisoning, and an ALL eagle carcasses, parts and feathers should be sent to the Repository regardless of condition. ALL CARCASSES SUSPECTED OF OR CONFIRMED WITH WEST NILE VIRUS SHOULD BE DISPOSED OF BY INCINERATION.

Collection of Dead Eagles:

1. Remember to protect yourself as eagles can carry diseases and toxins that are hazardous to humans.

2. Use rubber gloves when picking up dead eagles. If you do not have gloves, insert your hand into a plastic bag.

3. Place each bird in a sturdy plastic bag and tape or tie closure to prevent leakage. Please use care when bagging not to tie the bag too close to the tail feathers.

4. Place in a freezer as soon as possible.

5. Transport carcasses in areas separate from your direct contact (back of pickup.)

6. Necropsies are not required prior to shipping unless suspected of poisoning (other than lead) or West Nile Virus.

Packaging and Shipping:

It is important that eagles/parts and feathers be properly packaged in order to prevent damage and further decomposition in shipping. Feathers damaged in transit to the Repository are unusable to Native Americans and will have to be disposed of. Following are shipping requirements which MUST be followed to meet carrier (FEDEX) requirements. Failure to comply with these requirements may result in revocation of the Repository's shipping privileges.

Packaging Methods:

1. Select a sturdy size box to accommodate the number of eagles being shipped and to allow adequate room for the length of the feathers. Please DO NOT bend wing or tail feathers as this could cause breakage. Appropriate size coolers may be used, except Styrofoam coolers may only be used when inserted in a cardboard box. All coolers will be return upon request with a return address.

2. Ship eagles in a frozen state.

3. Place each eagle in a double plastic bag to prevent leakage.

4. Line the bottom of the box and fill the remaining space with absorbent material, i.e. shredded or wadded up paper or newspaper. This will prevent the birds from moving causing damage, help insulate the cold and absorb any leakage.

5. You may use gel packs for ice, but it is NOT necessary if birds are in a frozen solid state when shipped overnight.

Shipping methods:
The best method to ship is overnight mail. Ship the bird no later than Wednesday to guarantee receipt before the weekend. Federal Express is the preferred carrier when shipping eagles to the Repository. The packaging specifications listed above are in direct compliance with their dead animal shipping requirement.

The eagle Repository's FEDEX account may be used to absorb shipping costs. You may contact the Repository for a prepaid shipping label for shipping whole eagle carcasses.

If you do not have access to FEDEX you may use any other overnight carrier, however, the Repository will not be able to absorb those shipping costs nor is there a mechanism to reimburse the costs. Please make note of the tracking number in case packages are delayed or lost.

Please call the repository (303) 287-2110 if you have any questions regarding the shipping of eagles to the Repository.

BALD EAGLE SOP POINTS OF CONTACT

FIRST RESPONSE

USFWS Office of Law Enforcement, Cambridge
Phone: (410) 228-2475
828 Airpax Rd.,
Ste. 100, Building A
Cambridge, MD 21613-6406

Maryland Natural Resources Police
Phone: (301) 274-0461
17823 Prince Frederick Road
Hughesville, MD 20637

ALC Conservation Specialist
Phone: 301-394-1062
Bridget Kelly Butcher
Conservation Specialist
2800 Powder Mill Rd
Adelphi, MD 20783

SECOND RESPONSE

USFWS Chesapeake Bay Field Office
Phone: 410-573-4599
177 Admiral Cochrane Drive
Annapolis, MD 21401

Regional Migratory Bird Office
Phone: 413-253-8643
The Wildlife Center of Virginia
1800 South Delphine Ave
Waynesboro, VA 22980

Federally Permitted Bald Eagle Rehabber
Phone: 410-628-9736
Phoenix Wildlife Center, Inc.
Kathleen Woods
Northern Baltimore County

Federally Permitted Bald Eagle Rehabber
Phone: 540-942-9453
The Wildlife Center of Virginia
1800 South Delphine Ave
Waynesboro, VA 22980

National Eagle Repository
Phone: 303-287-2110
6550 Gateway Road, RMA Bldg 128
Commerce City, CO 80022

APPENDIX M:
Forest Management Plan

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U.S. Army Corps of Engineers
Baltimore District

FORESTMANAGEMENT PLAN UPDATE 2016-2017

U.S. Army Garrison Adelphi Laboratory Center Blossom Point Research Facility

Prepared for:	**Environmental Division** **U.S. Army Garrison Adelphi Laboratory Center** **Adelphi, Maryland 20783**
Prepared by:	**U.S. Army Corps of Engineers, Baltimore District** **10 South Howard Street** **Baltimore, Maryland 21201** **U.S. Army Corps of Engineers, Norfolk District** **803 Front Street** **Norfolk, Virginia 23510**

FOREST MANAGEMENT PLAN UPDATE

U.S. Army Garrison Adelphi Laboratory Center
Blossom Point Research Facility

CHARLES COUNTY, MARYLAND

Prepared for:	Environmental Division U.S. Army Garrison Adelphi Laboratory Center Adelphi, Maryland 20783
Prepared by:	U.S. Army Corps of Engineers, Baltimore District 10 South Howard Street Baltimore, Maryland 21201
	U.S. Army Corps of Engineers, Norfolk District 803 Front Street Norfolk, Virginia 23510

2016-2017

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DRAFT FOREST MANAGEMENT PLAN
FOR BLOSSOM POINT RESEARCH FACILITY

1.0 Introduction

The purpose of this Forest Management Plan is to update the existing Forest Management Plan (FMP) (1997) for U.S. Army Garrison Adelphi Laboratory Center (ALC) Blossom Point Research Facility (BPRF) and prepare management actions in order to meet mission requirements, maintain and enhance wildlife habitat, promote healthy forest ecosystems, protect streams and wetlands, and to enhance recreational value including hunting.

This updated Forest Management Plan includes an inventory of forest resources and habitat, assessment of forest health, GIS mapping, forest management prescriptions, and a review of pertinent rules, regulations and policies regarding forest management at BPRF.

2.0 Site Description

2.1 Location

BPRF (Latitude 38 -24 -50"N, Longitude 77 5 -50"W) occupies approximately 1,600 acres on Cedar Point Neck in southern Charles County, Maryland (Figure 1). Cedar Point Neck is bounded by the Potomac River to the south and east and by Nanjemoy Creek on the west. Agricultural and state owned land border the site to the north. BPRF is approximately 35 miles south of the District of Columbia.

The closest town is La Plata, Maryland, which is approximately 9 miles northeast of the facility. BPRF is largely forested with wetlands, open fields, testing areas, and a few buildings.

The study area, covered within this report, is divided into 7 Compartments. These Compartments were further divided into Forest Stands (Figure 2). Tables 1 and 2 present the total acreages in the Compartments and the various Stands.

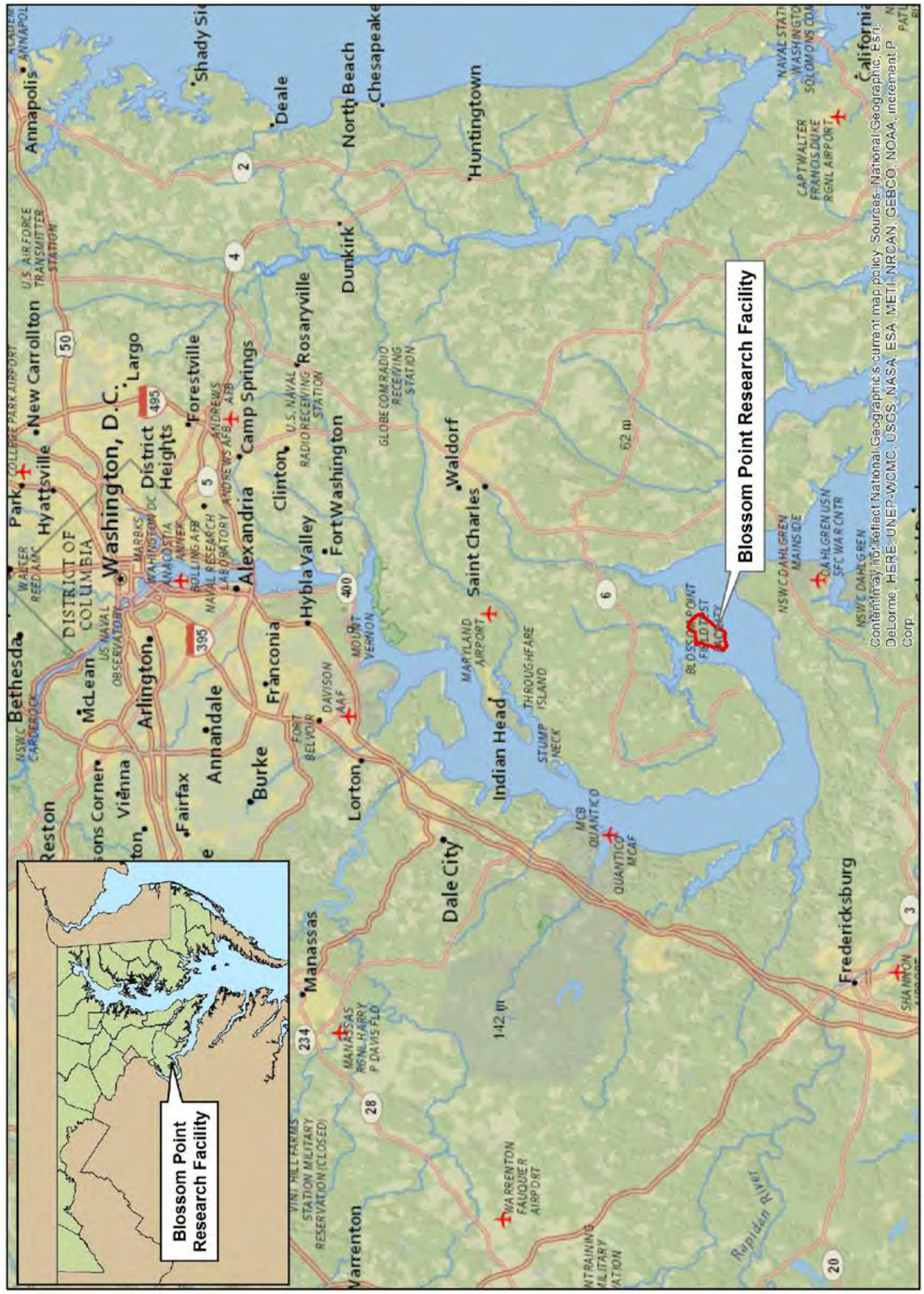


Figure 1. Blossom Point Research Facility Location
Charles County, MD

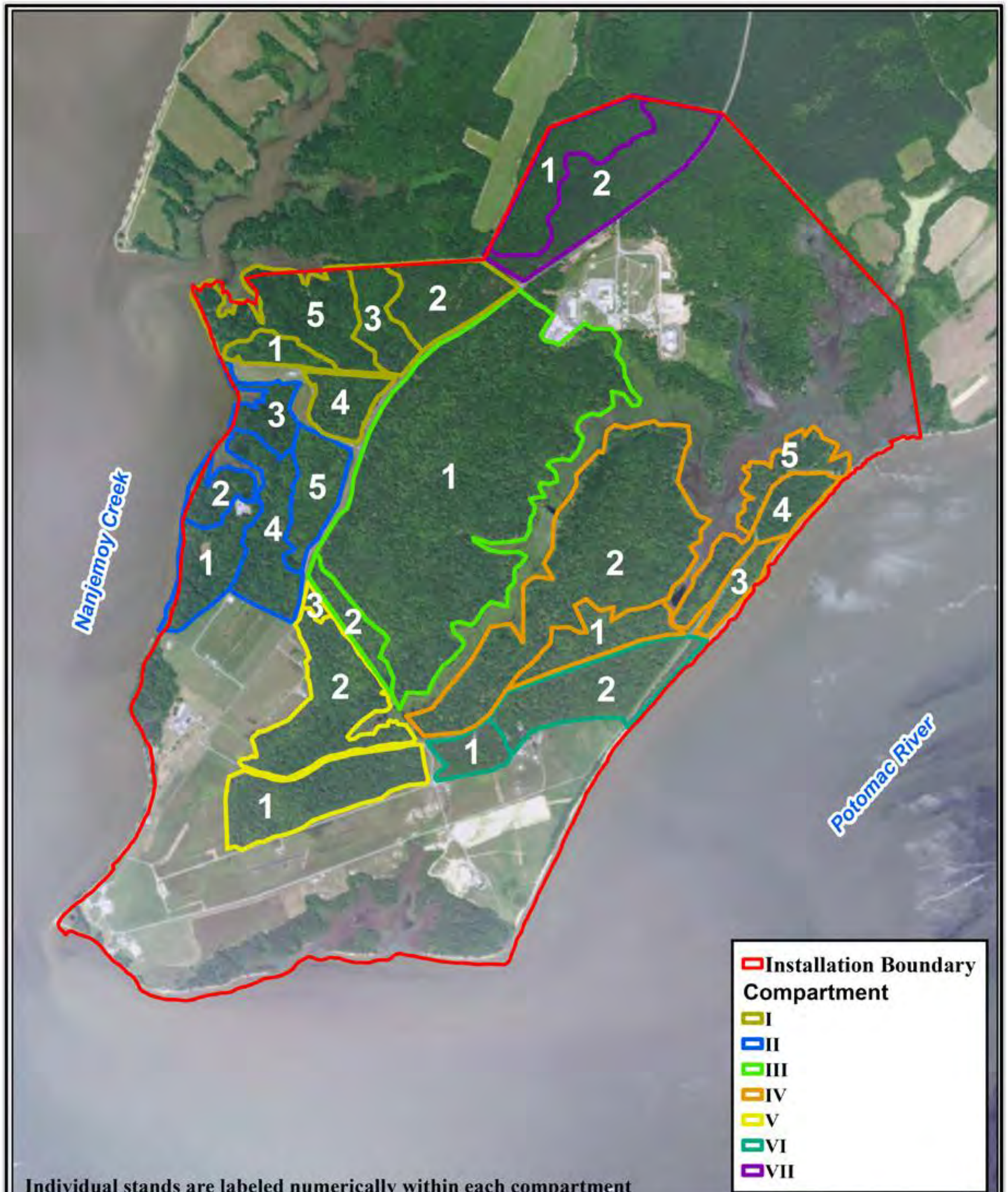


Figure 2. Blossom Point Research Facility
Forest Compartment and Stand Delineations
2016-2017

Table 1. Total Acreages for Compartments 1-7	
Compartment	**Acreage**
I	85
II	95
III	251
IV	180
V	83
VI	38
VII	76
Total Acreage	**808**

Table 2. Total Acreages of Management Stands with Compartments 1-7		
Compartment	**Management Stand**	**Acreage**
I	1	8
	2	6
	3	18
	4	12
	5	41
II	1	22
	2	11
	3	11
	4	31
	5	20
III	1	240
	2	11
IV	1	20
	2	123
	3	9

Table 2. Total Acreages of Management Stands with Compartments 1-7		
Compartment	**Management Stand**	**Acreage**
	4	16
	5	12
V	1	39
	2	43
	3	1
VI	1	7
	2	31
VII	1	32
	2	44

2.2 Topography and Soils

Topography at BPRF is characterized by rolling hills with narrow ridge tops and valleys drained by non-tidal and tidal tributaries to Nanjemoy Creek and the Potomac River. Elevations range from mean sea level (MSL) along the Potomac River and Nanjemoy Creek to 25 feet above MSL at Upper Cedar Point. In general, the installation is relatively flat with slopes of 2 to 5 percent.

The BPRF is located in the Atlantic Coastal Plain Physiographic Province. The unconsolidated sediments overlie crystalline rock of Precambrian to early Cambrian age. The underlying geology is comprised of the Nanjemoy Formation, the Aquia Formation, and the Raritan and Patapsco Formation. The surficial deposits are of both Recent and Pleistocene Age and are derived in large measure from erosion and re-deposition of older surfaces to the west and north.

Fifteen soil types are present at the BPRF as shown in the Integrated Natural Resources Management Plan (INRMP) and Figure 3. The soils are generally poorly to moderately well drained and range in texture from fine sand to silty loams and clay to coarse sands and gravels. Many of these soils types are listed as hydric.

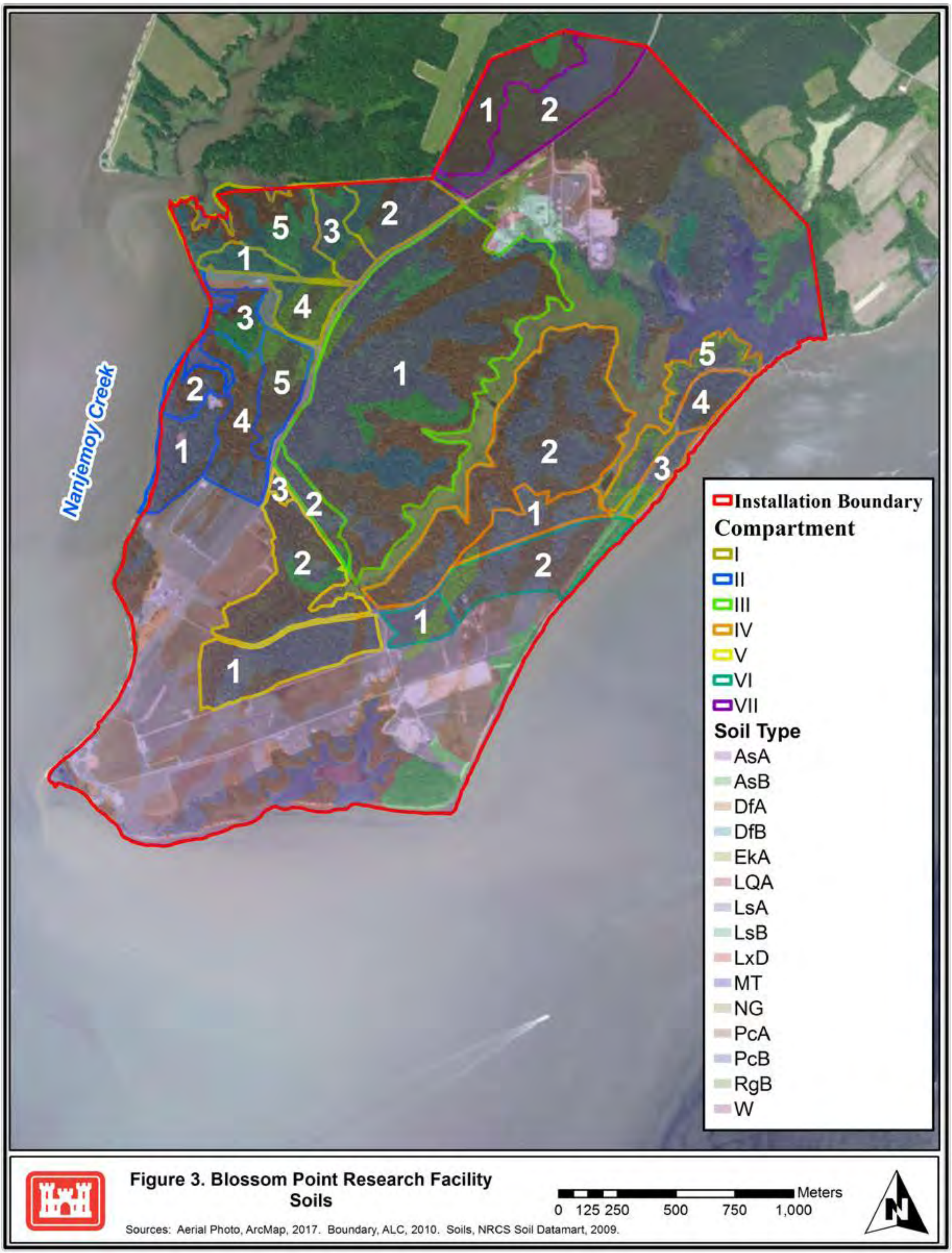


Figure 3. Blossom Point Research Facility Soils

Sources: Aerial Photo, ArcMap, 2017. Boundary, ALC, 2010. Soils, NRCS Soil Datamart, 2009.

3.0. Methodology

The determination of inventory techniques was attained following a site visit of all of the compartments and stands. This initial baseline survey set the standard for best available measurement techniques and a point of reference when assessing variation among the property to survey. Understanding the amount of variability among a landscape can help shape the scope and target of data to collect.

3.1 Compartment Identification

Field sampling for this report was based on forestry compartment and stand boundaries provided by BPRF. Per the 1997 BPRF FMP, the original boundaries had been established in a 1981 timber cruise. In the 1981 timber cruise, eight forest compartments were designated. They were identified by Roman numerals I through VIII. During field work for the 1997 study, it became apparent that compartment boundaries between Compartments III and V and between Compartments IV and VI, respectively, had been subjectively established. No biological distinction could be ascertained between stands of trees on either side of these compartment lines, and no man-made or naturally occurring feature (such as a road, power line right-of-way, or stream) separated them.

Reestablishment of the old compartment boundaries would have required time and effort while providing little practical value. At the instruction of BPRF, the land areas of Compartments III and V were combined. The resultant area was designated Compartment III. In similar fashion, the land areas of Compartments IV and VI were combined and designated Compartment IV. Compartments I and II were re-designated Compartments I and II, respectively. Compartment VII was re-designated Compartment V, and Compartment VIII was re-designated Compartment VI.

The field effort for this study generally used the previously assigned Compartments in order to provide continuity with the previous management reports (BPRF, 1997) with the exception combining stands in Compartment VI and the addition of Compartment VII, an area formerly considered non-project lands. The merge of Stands 2-7 within Compartment VI occurred after careful consideration of their lack of individual diversity among the commercial overstory as well as the understory. Geographic features and barriers were considered when changing the stand designation and despite the geography the changes were determined suitable for the purpose of the FMP. The new Stand "2" which represents old Stands 2 through 7 can be seen in the stand level map.

The new Compartment VII is located in the northern section of BPRF. Compartment VII was identified as "Non Project Area" in previous reports. The Non Project Area was designated into a

Compartment because it was determined by BPRF to be included in the FMP. Compartment VII easily by virtue of stand type. Stand 1 forest type is oak and mixed hardwood and Stand 2 forest type is pine.

3.2 Stand Identification

A majority of the stand delineation is derived from the prior forest inventory which was found to be accurate and of value. Physical and geographic features often “set” the edges or boundaries of the stands. Vegetation type plays a significant factor in determining stand boundaries as the vegetation type changes frequently.

There are pockets within stands that do not represent the majority of a stand, these areas were found and determined to be beneficial for each stand as delineated. Overanalyzing otherwise known as excessive breaking or lumping of stands within stands can lead to confusion and inaccurate information which then becomes difficult to implement during that phase of management. A better way to handle any anomaly found within a stand is to allow for greater flexibility in the future. For example a stand typed as Oak may have a small portion(s) which are considered a pine stand, however since the pine representation is not considered significant or perhaps infrequent as compared with the rest of the stand the pine gets lumped as part of the oak stand. In this circumstance management objectives may change to emphasize or deemphasize the anomaly based on factors such as species diversity, seed year for regeneration, natural or other disturbances. At such time the implementation phase can adjust to the current need for the micro stand or stand within a stand rather than on the front end of planning.

3.3 Survey Techniques

A stocking level survey was used to assess the amount of basal area squared per acre using a 10 factor prism. A 10 factor prism was used at each plot center to measure the amount of current stocking levels of merchantable material. At each randomly located plot data was recorded as to which species, product, and merchantable height exists. Plot location was not influenced by any geographical feature, current stocking level, or any other feature. Assessments of variability were made for stands to determine the best frequency levels for plots. In general a ratio of 1 plot per each 4 acres was used as a baseline for plot frequency. In large stands which appeared homogenous in species composition and volume across the stand whole plots represent a greater number of acres in order to maximize field effort.

4.0. Results

Field efforts were conducted from June 2016 through January 2017. The study area was divided into 7 Compartments. These Compartments were further divided into forest stands.

Figure 2 depicts the approximate location boundaries of management stands. A photographic record of the forest conditions during field efforts can be found in Appendix A. Stand descriptions and management recommendations can be found in the following sections. Stand variations result from changes in topographic position, degree of slope, and amount and type of historical disturbance. Forest stand conditions and forest structure were assessed at sample plots within the stand as detailed in the following stand descriptions and in forest sampling data sheets located in Appendix B.

Generally, the most common forest cover type within the study area is oak dominated with some smaller stands of Virginia pine (*Pinus virginiana*) and loblolly pine (*Pinus taeda*). American holly (*Ilex opaca*) is common, and in many areas dense, in the understory. Other understory species include black gum (Nyssa sylvatica), sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and tulip poplar (*Liriodendron tulipifera*).

Fuel loading, in the form of dead standing and fallen timber, are present in many of the compartments. In addition, American holly forms a dense understory in most of the stands, which not only increases the fuel load, but inhibits regeneration of desirable species by heavily shading the forest floor. Fuel loading in these areas should be reduced, either by manual removal or by controlled burns. These recommendations are addressed further in the stand descriptions.

The opportunities within all Compartments for wildlife management are high. The white-tailed deer (*Odocoileus virginianus*) population remains above optimum carrying capacity for the site based on a lack of observed climax tree species regeneration. Increased white-tailed deer harvest/culling should be implemented in order to insure the regeneration of the oak dominant forest. Currently, little to no regeneration of oaks is evident in all the Compartments due to excessive white-tailed deer browse and the dense understory of American holly. The dense understory of American holly is partially a result of it being undesirable to the deer.

Table 3 below presents a list of wildlife species observed during the field efforts, either by direct visual observation or observation of sign in the form of calls, tracks, or scat.

Table 3. Wildlife Species Observed During Field Efforts	
Common Name	**Scientific name**
Reptiles and Amphibians	
Spotted turtle	*Clemmys guttata*
Green frog	*Rana clamitans*
Gray Tree frog	*Hyla versicolor*
Spring peeper	*Pseudoacris crucifer*
Five-lined skink	*Plestiodon fasciatus*
Eastern Box turtle	*Terrapene carolina carolina*
Pickerel frog	*Lithobates palustris*
American toad	*Anaxyrus americanus*
Garter snake	*Thamnophis sirtalis*
Birds	
American woodcock	*Scolopax minor*
Bald eagle	*Haliaeetus leucocephalus*
Red-tailed hawk	*Buteo jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Golden crown kinglet	*Regulus satrapa*
Red belied woodpecker	*Melanerpes carolinus*
Pileated woodpecker	*Hylatomus pileatus*
Tufted titmouse	*Baeolophus bicolor*
Carolina chickadee	*Poecile carolinensis*
White Breasted nuthatch	*Sitta carolinensis*
Osprey	*Pandion haliaetus*
Goldfinch	*Spinus tristis*
Great crested flycatcher	*Myiarchus crinitus*
Wood thrush	*Hylocichla mustelina*
Acadian flycatcher	*Empidonax virescens*
Eastern wood pewee	*Contopus virens*
Blue-gray gnatcatcher	*Polioptila caerulea*
Fish crow	*Corvus ossifragus*
Northern cardinal	*Cardinalis cardinalis*
Blue jay	*Cyanocitta cristata*
Wild turkey	*Meleagris gallopavo*
Turkey vulture	*Cathartes aura*

Table 3. Wildlife Species Observed During Field Efforts	
Common Name	**Scientific name**
Eastern bluebird	*Sialia sialis*
American robin	*Turdus migratorius*
American kestrel	*Falco sparverius*
Mourning dove	*Zenaida macroura*
Mammals	
White-tailed deer	*Odocoileus virginianus*
Red fox	*Vulpes vulpes*
Eastern mole	*Scalopus aquaticus*
Eastern cottontail	*Sylvilagus floridanus*
Gray squirrel	*Sciurus carolinensis*

Multiple invasive plant species were observed during site visits. The most common were Japanese stilt grass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), and wineberry (*Rubus phoenicolasius*). Wavy-leaved basket grass (*Oplismenus undulatifolius*) was also observed in Compartment II Stand 1. These species were observed in areas of previous disturbance, such as forest edges, opening from fallen trees and along forest access roads. Non-native, invasive species generally have low value as wildlife food or cover. To improve forest health and regeneration, as well as wildlife value, management of invasive species is recommended.

The presence of the emerald ash borer (*Agrilus planipennis*) (EAB) in the Midwestern and Eastern United States is a potential threat to the ash on site. While neither white nor green ash is abundant on BPRF, it can be commercially important. No evidence of EAB was documented during site visits, but, the probability of its future presence is high. EAB has been detected in Charles County and in all neighboring counties. Currently, the statewide ban on inter-county transport of timber products has been lifted, but the federal ban, prohibiting inter-state transport is still in effect. Harvest of saleable white ash within management areas is recommended while these trees are still healthy. Currently, three parasitoids are approved for release to control EAB. Permits must be obtained from the USDA in order to release biological control organisms.

The gypsy moth (*Lymantria dispar*) is an invasive species from Europe that was accidentally released in the northeastern United States in 1869. Since that time infestations have spread and are a continuing threat to most hardwoods and especially oaks. In Maryland, more than one million acres of hardwood forest have been defoliated since 1980. If defoliation occurs in two or more successive years, mortality of affected trees can be high. The gypsy moth has a high potential to inflict significant damage to the forest resources at BPRF.

Aerial spraying has produced the best results for suppression of moth populations; although, biological controls are also available. Annual aerial surveys for gypsy moth defoliation are conducted by the U.S. Department of Agriculture's Forest Service. These surveys can be used to determine the potential for outbreaks at BPRF and if control measures should be implemented to protect the forest resources at BPRF.

5.0. Forest Stand Prescriptions

The information collected within each stand is summarized within the pages that follow. Data sheets for the plots supporting the descriptions are located within Appendix B.

Compartment I

Stand 1 (S-1)

COMPARTMENT: I	**STAND:** 1	**FORMER:** 1/1

KEY STAND ATTRIBUTES											
Acres	**Forest Type**	**Est. Age**	**Fire Mgmt. Priority**	**Fire Risk**	**CWD %**	**Wildlife Habitat**	**Mid-story S/U**	**Understory % Cover**	**% Vegetation ≥ 6.0" DBH**		
									Trees	**Grass**	**Vines**
8	Oak/Pine	~76	Critical	High	28	Fair	U	60	40	10	25

EXISTING MERCHANTABLE SPECIES COMPOSITION									
DBH in inches Range	**BA (sq. ft./ acre) by Species and Diameter Class**								
	Loblolly Pine *(PITA)*	**Virginia Pine *(PIVI2)***	**Southern Red-Oak *(QUFA)***	**Sweet Gum *(LIST2)***	**Yellow Poplar *(LITU)***	**Willow-Oak *(QUPH)***	**Hickory**	**Other Hardwood**	**Total**
6.0 - 7.9	--	--	--	--	--	--	--	--	**--**
8.0 - 9.9	--	--	5	--	--	--	--	--	**5**
10.0 – 11.9	--	5	--	5	--	--	--	--	**10**
12.0 – 13.9	--	--	--	--	--	--	--	--	**--**
14.0 -- 15.9	--	--	--	--	--	--	--	15	**15**
16.0 – 17.9	--	--	--	--	--	5	5		**10**
18.0 – 19.9	--	--	--	--	--	15	--	10	**25**
20.0 – 21.9	10	--	--	--	--	5	--	--	**15**
22.0 +	5	--	--	--	--	5	5	--	**15**
Total	**15**	**5**	**5**	**5**	**--**	**30**	**10**	**25**	**95**

EXISTING STAND CONDITION

- Some dieback of Virginia pine due to wind-throw and suppression from competition of dominant trees
- Adjacent to open areas and roads with invasive species encroachment and high fuel loads ladder fuels near these edges
- Flat topography; average slope = 0-5%; tidal gut leads toward stand perimeter
- Little to no desirable regeneration found in the stand, American holly restricting sunlight from reaching the ground
- Diversity found in infrequent tree species
- Limited natural or manmade disturbance to the site to establish regeneration and foster growth

DESIRED STAND CONDITION

- Reduction in available fuel loads
- Oak seedlings are well established, well distributed and adequate in abundance to ensure quality oak that currently exists in the overstory are retained until their removal is desirable to allow free room saplings to grow
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Establish a two-age structure, identify and protect any oak that have potential to regenerate high-quality trees
- Consider soil scarification and harvest when oak seed is present
- Gain control of deer browsing to reduce impacts to desirable regeneration within the reach of a standing deer
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining legacy mature trees
- Enhance native plant and wildlife species to promote diversity
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread of non-native invasive species with clean equipment transport, repetitive fire and other controls • Provide commercial wood products via competitive timber sales to interested parties within the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Recruit oak into dominant and/or codominant canopy positions by converting to even aged management • Maintain a healthy oak/ loblolly pine community where a balanced ecosystem is maintained to include Rx fires • Enhance hard mast production fostering trees with high live crown ratios • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintain coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	**Residual BA**
Shelterwood Establishment Cut	50 sq. ft. per ac.

Preparatory Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features

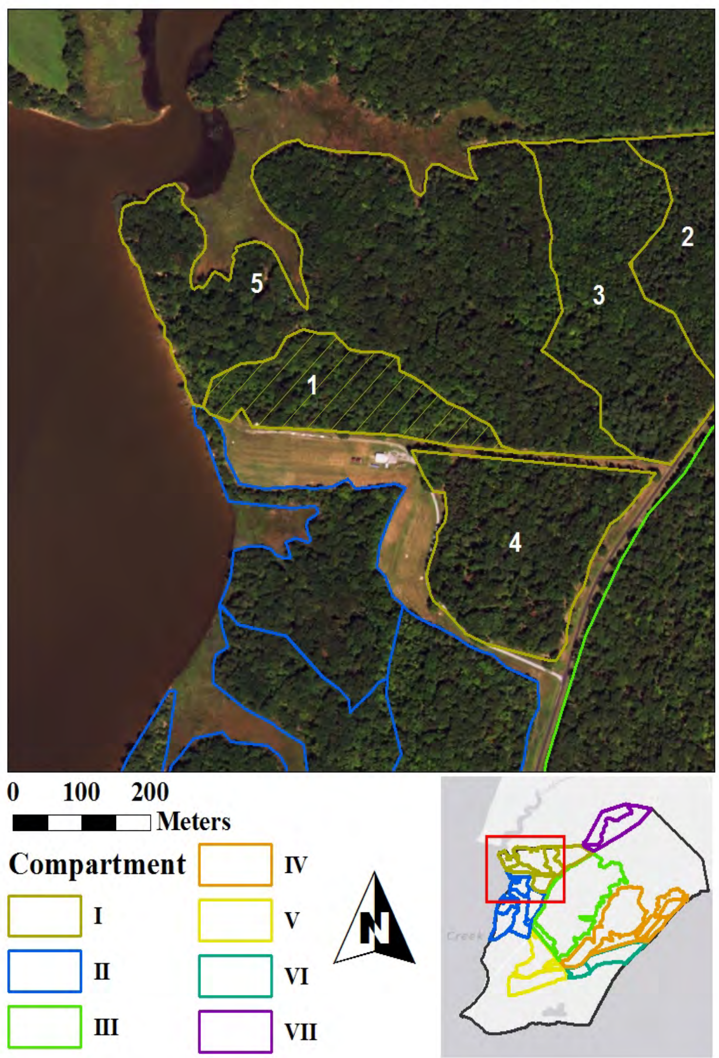
Retention Priority:

- Healthy, well-formed oak (approximately 16-20 in. DBH) with large crowns which have the most potential to generate high yields of seed, well distributed throughout the stand
- Healthy loblolly pine
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 per acre. Snags should be designated as leave trees
- Any native tree which occurs infrequently and would enhance the stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios and weaknesses in the crown or boles
- Remove all Virginia pine, Sweet-gum, and American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to ALC Directorate of Public Works (DPW).

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are require and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure short-term management objectives
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure short-term management objectives
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Medium intensity fire to top-kill competition and enhance the competitive status of oak
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal Even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	**USACE Titles: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment I</u>

<u>Stand 2</u> (S-2)

COMPARTMENT: I	**STAND:** 2	**FORMER:** 1/2

KEY STAND ATTRIBUTES											
Acres	Forest Type	Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
23	Mixed Hwd/Pine	~74	Critical	Medium	17	Good	U	25	35	40	30

EXISTING MERCHANTABLE SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Loblolly Pine *(PITA)*	Virginia Pine *(PIVI2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	7	--	5	--	3	--	2	**17**
8.0 - 9.9	--	12	--	12	--	8	--	3	**35**
10.0 – 11.9	--	3	--	12	--	5	--	7	**27**
12.0 – 13.9	2	2	--	6	--	2	--	2	**14**
14.0 -- 15.9	--	2	--	5	--	--	--	--	**7**
16.0 – 17.9	--	2	2	--	2	--	--	2	**8**
18.0 – 19.9	--	--	--	--	2	--	--	2	**4**
20.0 – 21.9	2	--	--	--	--	--	--	--	**2**
22.0 +	3	--	--	--	--	--	--	--	**3**
Total	**7**	**28**	**2**	**40**	**4**	**18**	**--**	**18**	**117**

EXISTING STAND CONDITION

- Some dieback of Virginia pine due to wind-throw and suppression along the edge of the stand
- Adjacent to roads and perimeter fence clearing impacting the understory
- Flat topography; average slope = 0-5%
- Little to no desirable regeneration found in the stand, pockets of American holly, areas with stem exclusion found
- Diversity found in infrequent tree species
- Limited natural or manmade (only roads) disturbance to the site to establish regeneration and foster growth

DESIRED STAND CONDITION

- Reduction in available fuel loads
- Oak seedlings are well established, well distributed and adequate in abundance to ensure quality oak that currently exists in the overstory are retained in the future generation of trees
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Establish a two-age structure, Identify and protect any oak that have potential to regenerate high-quality trees
- Consider soil scarification and harvest when oak seed is present
- Gain control of deer browsing to reduce impacts to desirable regeneration within the reach of a standing deer
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable
- Reduce the spread non-native invasive species with clean equipment transport, repetitive fire and other controls
- Provide potential wood products via competitive timber sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Recruit oak into dominant and/or codominant canopy positions
- Maintain a healthy oak/ loblolly pine community where a balanced ecosystem is maintained to include Rx fires
- Enhance hard mast production fostering trees with high live crown ratios
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of high-quality forest products to local area wood markets
- Recruit current and future snags while managing the stand for wildlife benefits and maintain coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Commercial Thinning	70-80 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics to improve the overall stand health and vigor. Trees that will benefit wildlife can be retained as well as trees that exhibit desirable seed source post second entry and lumber producing trees

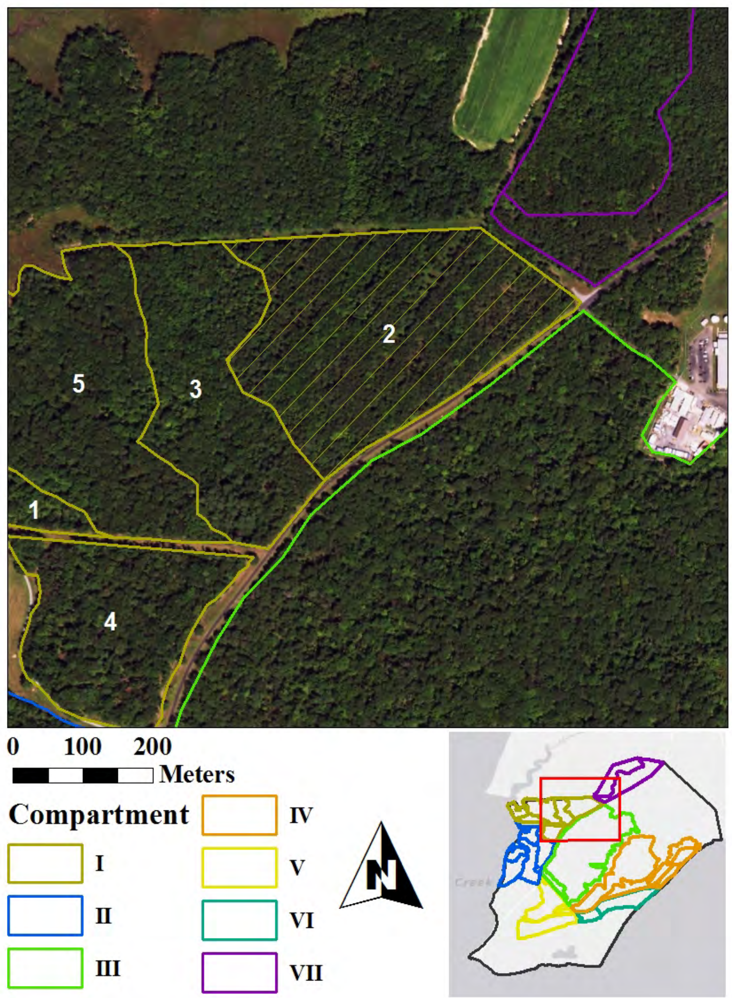
Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios and weaknesses in the crown or boles
- All Virginia pine, Sweet-gum, and American holly

Retention Priority:

- Healthy, well-formed oak (approximately 12-18 in. DBH) with large crowns or crowns likely to fill canopy gaps which will be well distributed throughout the stand
- Healthy loblolly pine
- Enough snags or otherwise wildlife trees to fulfill a minimum of 3 trees per acre when safe to do so.
- Infrequent species of native trees which promote stand diversity

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	First stage thinning cut uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction
3	PST-HVST	Conduct stand stocking survey surveys	Ensure canopy must be opened further
4-10	TMBR-HVST	Second stage seed-tree cur uneven-aged	Set stand seed trees to ensure high seed production
4-10	POST RX-FIRE	Seed year fire	Time fire to enhance successful seeding
7	RX-FIRE	Prescribed fire	Medium intensity fire to top-kill competition and enhance the competitive status of oak
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
15-20	TMBR-HVST	Overstory removal/final cut	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

Compartment I

Stand 3 (S-3)

COMPARTMENT: I	STAND: 3	FORMER: 1/3

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
18	Pine/Mixed Hwd	~74	Critical	Extremely High	29	Fair	U	30	35	10	45

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Loblolly Pine *(PITA)*	Virginia Pine *(PIVI2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	2	2	2	3	2	2	--	--	**13**
8.0 - 9.9	--	7	--	7	1	3	--	3	**21**
10.0 – 11.9	2	8	3	3	5	5	--	5	**31**
12.0 – 13.9	3	8	--	--	--	--	--	--	**11**
14.0 -- 15.9	--	2	--	--	--	--	--	--	**2**
16.0 – 17.9	7	2	--	--	--	--	--	--	**9**
18.0 – 19.9	8	2	--	--	--	--	--	--	**10**
20.0 – 21.9	2	--	--	--	--	--	--	--	**2**
22.0 +	2	--	--	--	--	--	--	--	**2**
Total	**26**	**31**	**5**	**13**	**8**	**10**	**0**	**8**	**101**

EXISTING STAND CONDITION

- Heavy dieback of Virginia Pine due to wind-throw and suppression from competition of dominant trees
- Extremely high fuel loads elevating the risk of ignition and spread from this source of fuel loads
- Flat topography; average slope = 0-5%; northern portion of stand boarders perimeter fence; standing water in stand
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Potential for diversity found in infrequent tree species
- Natural disturbance to the site to has established regeneration of both Virginia pine and Loblolly pine

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- Pine seedlings are well established, well distributed and adequate in abundance to ensure quality pine that currently exists in the overstory are retained until their removal is desirable to allow free room for saplings to grow
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to loblolly pine seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable pine is in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of pine trees perhaps multiple aged structure depending on frequency of treatment • Maintain a healthy pine community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of regeneration • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	**Residual BA**
Commercial Thinning	80-90 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics, remove trees in small patches where abundance of pine seedlings will benefit from additional sunlight, limit disturbance to any advanced regeneration seedlings where found

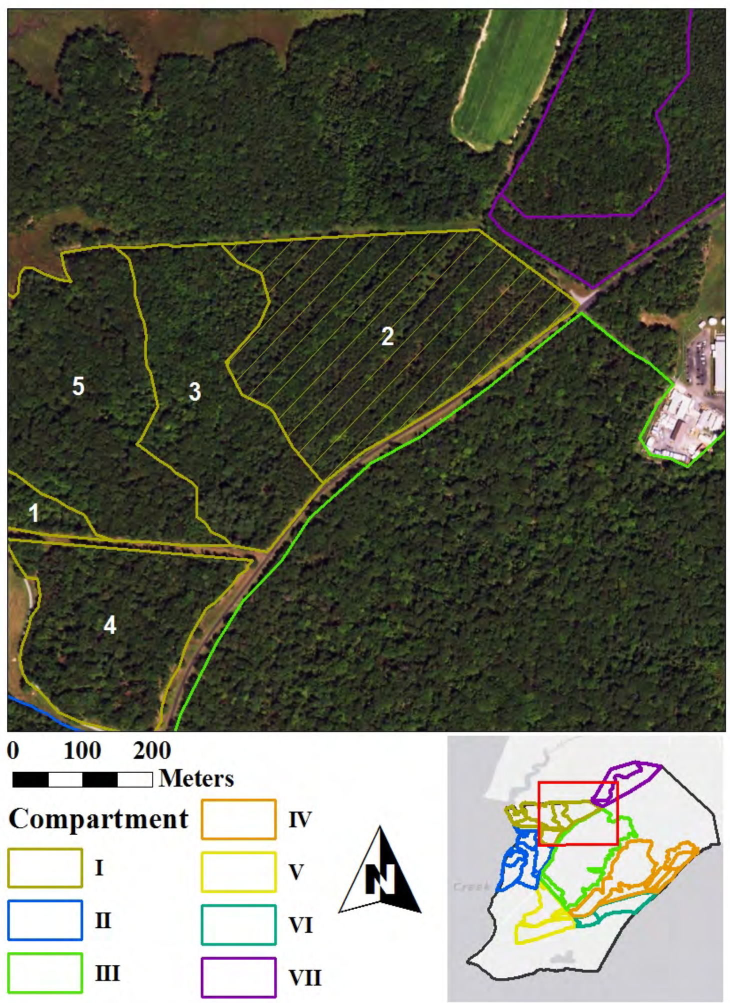
Removal Priority:

- Target poor quality trees of all species for removal, loblolly pine trees with low live crown ratios which are considered suppressed
- All Virginia pine, Sweet-gum, and American holly

Retention Priority:

- Healthy, well-formed Loblolly pine (approximately 12-18 in. DBH) with good live crown ratios well distributed throughout the stand.
- Healthy trees of all species with good form.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as either a leave tree or wildlife tree
- Infrequent species of native trees which promote stand diversity

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental should be established to ensure proper procedures are utilized and deposits can be made into appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Thinning uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release pine seedlings from competition
7	RX-FIRE	Prescribed fire	low intensity fire to top-kill competition and enhance the competitive status of pine
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Thinning as desired uneven-aged	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

<u>Compartment I</u>

<u>Stand 4</u> (S-4)

COMPARTMENT: I	STAND: 4	FORMER: 1/4

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
12	Oak/Mxd Hwd	~75	Moderate	High	20	Good	U	70	70	40	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	3	2	2	--	14	**21**
8.0 - 9.9	--	--	--	3	1	3	--	3	**10**
10.0 – 11.9	--	--	--	4	5	5	--	--	**14**
12.0 – 13.9	--	--	--	--	--	--	--	--	**0**
14.0 -- 15.9	--	3	3	--	--	--	--	--	**6**
16.0 – 17.9	3	--	3	--	--	--	--	3	**9**
18.0 – 19.9	--	4	7	7	--	--	--	--	**18**
20.0 – 21.9	--	--	13	--	--	--	--	--	**13**
22.0 +	--	--	7	--	3	3	--	--	**13**
Total	**3**	**7**	**33**	**17**	**11**	**13**	**--**	**20**	**104**

EXISTING STAND CONDITION

- Occasional dieback of Virginia pine due to wind-throw and suppression from competition of dominant trees
- Mid-story dense with American holly
- Flat topography; average slope = 0-5%; northern portion of stand boarders roads, field and utility line corridor
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Potential for diversity found in infrequent tree species due to neighboring seed sources
- Encroachment of understory vegetation where additional sunlight is exposed to the edges of the stand

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- Oak seedlings are well established, well distributed and adequate in abundance to ensure quality oak that currently exists in the overstory are retained until their removal is desirable to allow free room for saplings to grow
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable oak is in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer of 100' from tidal water delineation line if within the stand
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of oak trees perhaps multiple aged structure depending on frequency of treatment • Maintain a healthy oak community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of oak regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers.

SILVICULTURAL GUIDE

Treatment:	**Residual BA**
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high seed producing oak trees vs. snag trees both of which are acceptable to retain in different circumstances

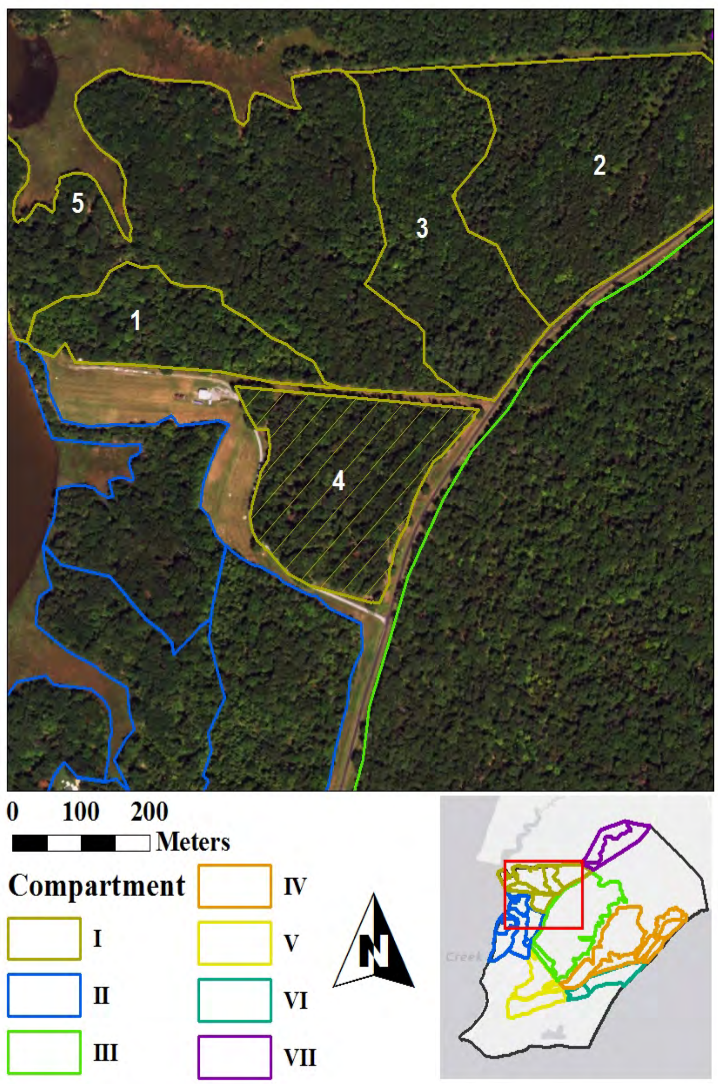
Retention Priority:

- Healthy, well-formed oak (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Healthy trees of all species with good form.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as either a leave trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release pine seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal Even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment I

Stand 5 (S-5)

COMPARTMENT: I	STAND: 5	FORMER: 1/5

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
41	Oak/Mixed Hwd	~80	Moderate	High	12	Good	U	75	75	30	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	Chestnut Oak *(QUPR2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	1	--	--	--	1	--	**2**
8.0 - 9.9	--	--	1	1	--	--	4	--	**6**
10.0 – 11.9	--	--	--	1	--	--	2	6	**9**
12.0 – 13.9	--	1	1	1	3	--	--	--	**6**
14.0 -- 15.9	--	1	1	--	2	--	--	--	**4**
16.0 – 17.9	3	--	1	1	2	--	--	--	**7**
18.0 – 19.9	--	2	3	1	7	1	--	--	**14**
20.0 – 21.9	--	5	8	--	7	2	--	--	**22**
22.0 +	--	11	12	--	14	3	--	--	**40**
Total	**3**	**20**	**28**	**5**	**35**	**6**	**7**	**6**	**110**

EXISTING STAND CONDITION

- Occasional dieback of Virginia pine due to wind-throw and suppression from competition of dominant trees
- Mid-story dense with American holly
- Flat topography; average slope = 0-5%; north of stand boarders tidal gut, west of stand boarders Nanjemoy Creek
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the edges of the stand

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- Oak seedlings are well established, well distributed and adequate in abundance to ensure quality oak that currently exists in the overstory are retained until their removal is desirable to allow free room for saplings to grow
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable oak is in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of oak trees perhaps multiple aged structure depending on frequency of treatment • Maintain a healthy oak community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of oak regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high seed producing oak trees vs. snag trees both of which are acceptable to retain in different circumstances

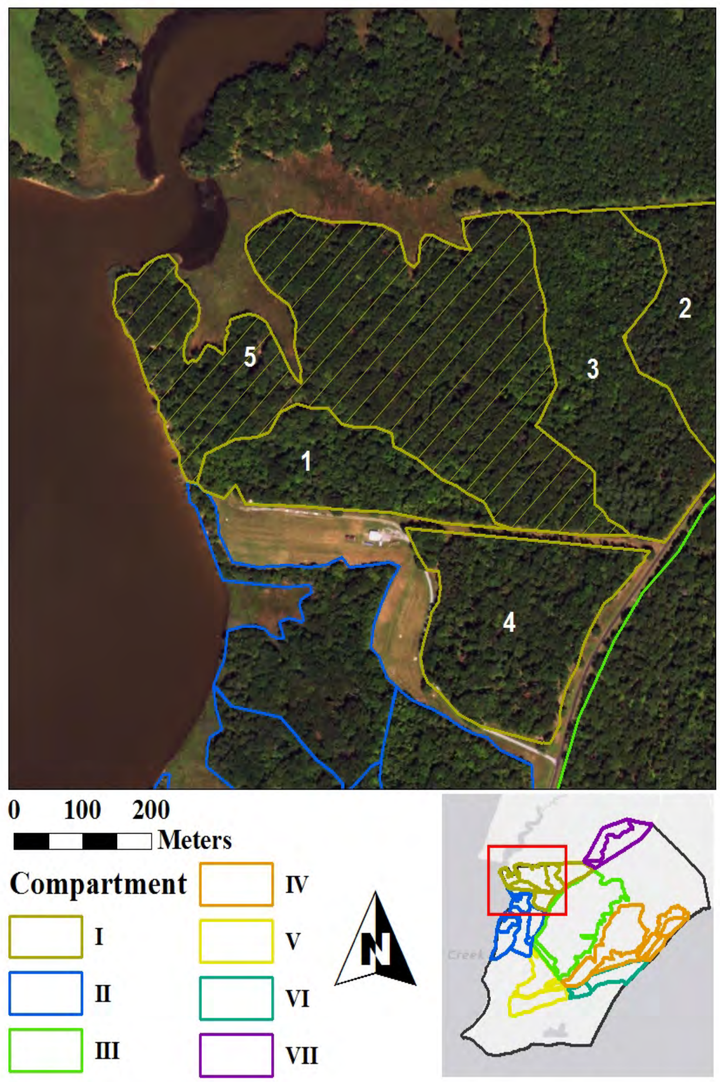
Retention Priority:

- Healthy, well-formed oak (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Healthy trees of all species with good form.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

Compartment II

Stand 1 **(S-1)**

COMPARTMENT: II	STAND: 1	FORMER: 2/1

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
22	Mixed Hwd	~80	Critical	High	23	Fair	U	50	40	45	45

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	Chestnut Oak *(QUPR2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	--	--	--	--	2	**2**
8.0 - 9.9	--	--	--	--	--	--	--	2	**2**
10.0 – 11.9	--	--	--	3	2	--	2	5	**12**
12.0 – 13.9	--	--	--	--	--	--	3	--	**3**
14.0 -- 15.9	--	--	--	2	--	--	--	1	**3**
16.0 – 17.9	--	2	--	--	5	--	--	--	**7**
18.0 – 19.9	--	--	--	2	13	--	--	--	**15**
20.0 – 21.9	--	--	--	--	20	--	--	--	**20**
22.0 +	--	--	9	--	15	8	--	--	**32**
Total	**0**	**2**	**9**	**7**	**55**	**8**	**5**	**10**	**96**

EXISTING STAND CONDITION

- Abundance of invasive species encroachment
- Mid-story dense with American holly; significant ladder fuels
- Flat topography; average slope = 0-5%; west of stand boarders Nanjemoy Creek
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- A mix of hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of hardwood trees depending on frequency of treatment • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE	
Treatment: Thinning w/small patch cuts	**Residual BA** 70 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

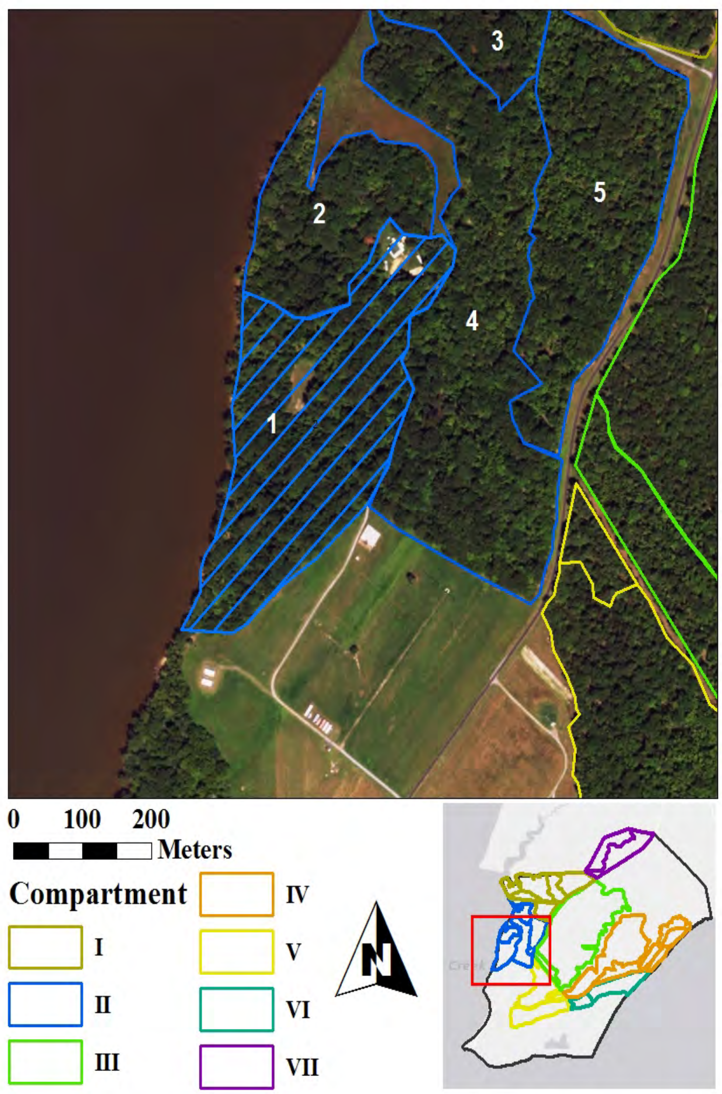
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Commanders must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Thinning cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release hardwood seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Thinning uneven-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment II

Stand 2 (S-2)

COMPARTMENT: II	**STAND:** 2	**FORMER:** 2/2

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
11	Mixed Hwd	~75	Moderate	Medium	25	Fair	U	50	40	20	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	--	--	--	--	7	**7**
8.0 - 9.9	--	--	--	--	--	--	7	10	**17**
10.0 – 11.9	--	--	--	--	--	--	--	3	**3**
12.0 – 13.9	--	--	--	3	--	--	--	3	**6**
14.0 -- 15.9	--	--	--	--	--	--	--	4	**4**
16.0 – 17.9	--	--	--	--	--	--	--	7	**7**
18.0 – 19.9	--	--	--	--	--	--	--	3	**3**
20.0 – 21.9	--	--	--	3	--	3	--	3	**9**
22.0 +	--	7	7	--	7	20	--	--	**41**
Total	**0**	**7**	**7**	**6**	**7**	**23**	**7**	**40**	**97**

EXISTING STAND CONDITION

- Abundance of invasive species encroachment
- Mid-story dense with American holly; significant ladder fuels
- Flat topography; average slope = 0-5%; north of stand boarders a tidal gut, west of stand boarders Nanjemoy Creek
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of hardwood trees depending on frequency of treatment • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

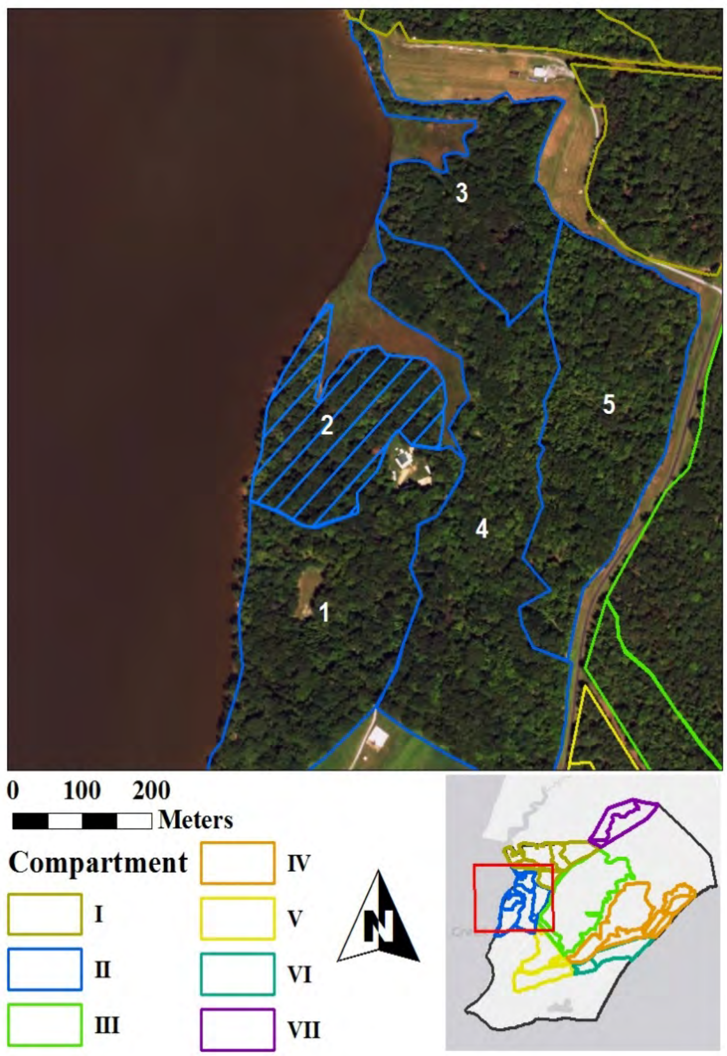
Treatment:	**Residual BA**
Commercial Thinning	70 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Thinning cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release hardwood seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Thinning unven-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment II
Stand 3 **(S-3)**

COMPARTMENT: II	STAND: 3	FORMER: 2/3

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
11	Mixed Hwd	~80	Moderate	Medium	15	Fair	U	65	60	10	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Chestnut Oak *(QUPR2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	--	--	--	3	10	**13**
8.0 - 9.9	--	--	--	--	--	--	--	3	**3**
10.0 – 11.9	3	--	--	--	--	--	--	4	**7**
12.0 – 13.9	--	--	--	--	--	--	--	--	**0**
14.0 -- 15.9	--	--	3	--	--	--	--	--	**3**
16.0 – 17.9	3	3	4	--	--	--	--	--	**10**
18.0 – 19.9	4	4	3	3	--	--	--	3	**17**
20.0 – 21.9	3	--	13	--	3	--	--	--	**19**
22.0 +	14	--	7	--	--	10	--	--	**31**
Total	**27**	**7**	**30**	**3**	**3**	**10**	**3**	**20**	**103**

EXISTING STAND CONDITION

- Invasive species encroachment along perimeter of field opening
- Mid-story dense with American holly; significant ladder fuels
- Flat topography; average slope = 0-5%; north of stand boarders a field, west of stand boarders Nanjemoy Creek
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create small canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of hardwood trees depending on frequency of treatment • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

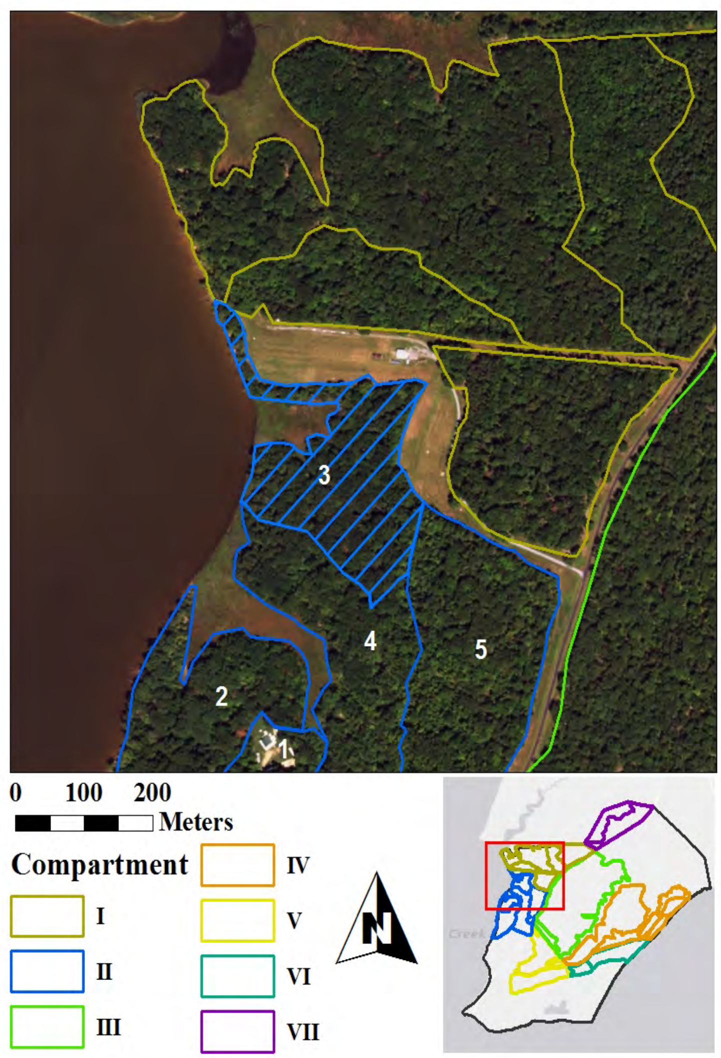
Treatment:	**Residual BA**
Thinning w/small patch cuts	70 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Thinning cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Thinning uneven-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

<u>Compartment II</u>

<u>Stand 4</u> (S-4)

COMPARTMENT: II	STAND: 4	FORMER: 2/4

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
31	Oak/Mixed Hwd	~98	Critical	High	22	Good	U	30	20	15	15

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Chestnut Oak *(QUPR2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	3	--	--	1	3	**7**
8.0 - 9.9	--	--	1	1	--	--	--	--	**2**
10.0 – 11.9	--	--	--	4	1	--	--	2	**7**
12.0 – 13.9	1	--	--	5	--	--	--	3	**9**
14.0 -- 15.9	--	--	--	--	--	--	--	1	**1**
16.0 – 17.9	--	1	4	--	--	--	1	3	**9**
18.0 – 19.9	--	--	4	2	5	4	--	1	**16**
20.0 – 21.9	3	--	7	1	4	--	--	--	**15**
22.0 +	1	--	9	--	7	--	--	1	**18**
Total	**5**	**1**	**25**	**16**	**17**	**4**	**2**	**14**	**84**

EXISTING STAND CONDITION

- Invasive species encroachment along perimeter of field opening
- Mid-story dense with American holly; significant ladder fuels
- Flat topography; average slope = 0-5%; south of stand boarders a field, west of stand boarders Nanjemoy Creek tidal gut
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create small canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of hardwood trees depending on frequency of treatment • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

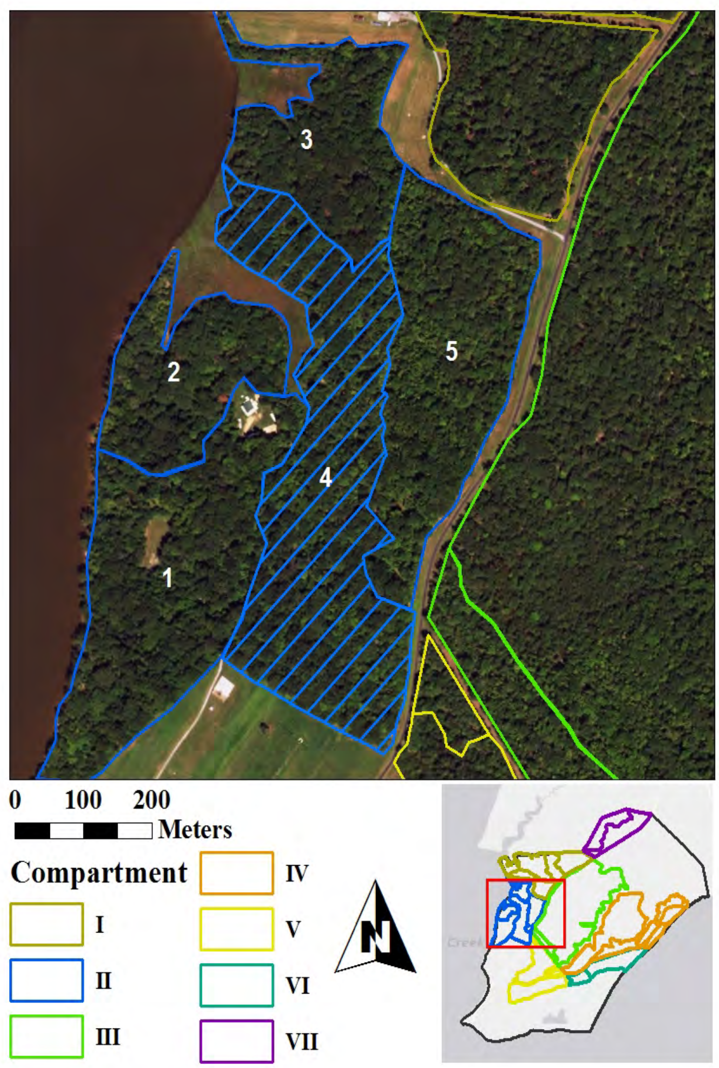
Treatment:	Residual BA
Commercial Thinning	70 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Thinning cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release hardwood seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Thinning uneven-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

Compartment II

Stand 5 **(S-5)**

COMPARTMENT: II	STAND: 5	FORMER: 2/5

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
20	Oak/Mixed Hwd	~98	Moderate	Medium	15	Fair	U	45	30	20	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Chestnut Oak *(QUPR2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	2	--	--	--	--	**2**
8.0 - 9.9	--	--	--	2	--	--	2	6	**10**
10.0 – 11.9	--	--	2	4	--	2	4	6	**18**
12.0 – 13.9	--	--	2	--	--	--	--	--	**2**
14.0 -- 15.9	--	--	--	6	--	--	--	--	**6**
16.0 – 17.9	--	--	--	6	--	--	--	--	**6**
18.0 – 19.9	--	--	2	4	--	10	--	4	**20**
20.0 – 21.9	--	--	4	--	2	6	--	2	**14**
22.0 +	4	2	6	--	2	8	--	--	**24**
Total	**4**	**2**	**16**	**24**	**4**	**26**	**6**	**20**	**102**

EXISTING STAND CONDITION

- Invasive species encroachment along perimeter of field opening
- Mid-story dense with American holly; significant ladder fuels
- Flat topography; average slope = 0-5%; east and north of stand boarders roads
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the north and east edge along roads

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create small canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create an even-aged structure of oak and hardwood trees • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

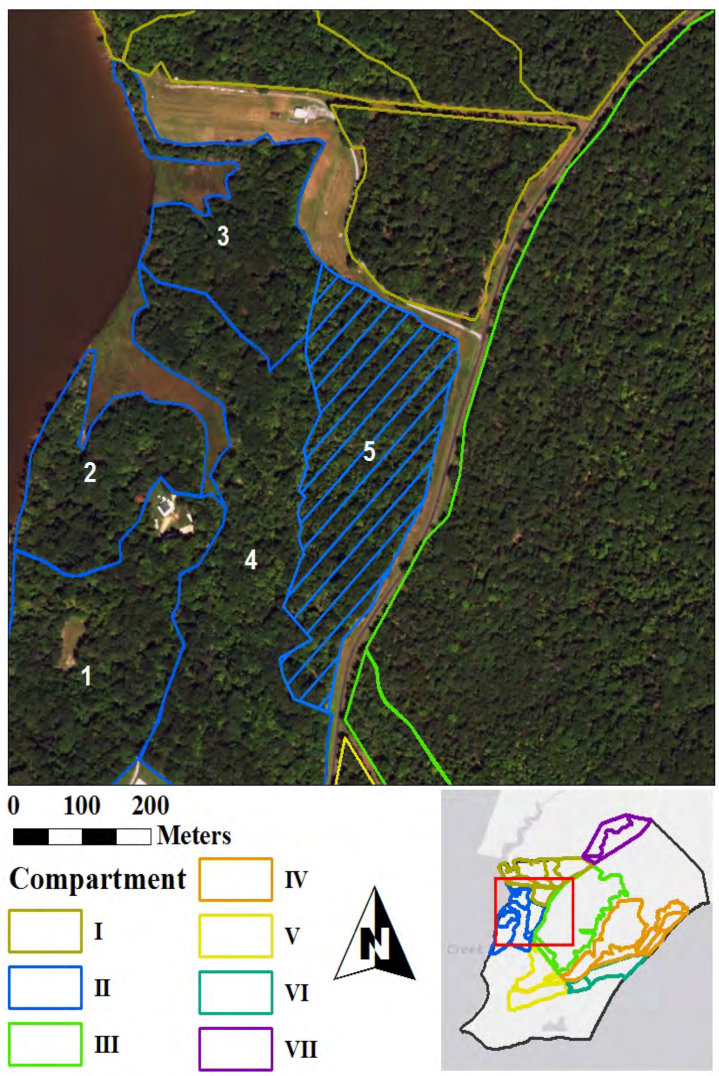
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities such as timber sales or prescribed fire an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal Even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment III</u>

<u>Stand 1</u> (S-1)

COMPARTMENT: III	**STAND:** 1	**FORMER:** 3/1

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
240	Oak/Mixed Hwd	~98	Moderate	Medium	16	Good	U	75	60	30	15

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	6	--	--	--	5	**11**
8.0 - 9.9	--	--	1	--	--	--	--	1	**2**
10.0 – 11.9	--	--	4	4	--	--	--	2	**10**
12.0 – 13.9	--	--	4	4	--	--	--	1	**9**
14.0 -- 15.9	--	--	--	3	--	--	--	--	**3**
16.0 – 17.9	2	1	9	4	--	--	--	--	**16**
18.0 – 19.9	--	1	4	2	--	--	--	1	**8**
20.0 – 21.9	1	2	12	--	--	--	--	--	**15**
22.0 +	--	9	13	--	--	--	--	--	**22**
Total	**3**	**13**	**47**	**23**	**0**	**0**	**0**	**10**	**96**

EXISTING STAND CONDITION

- American Chestnut found in stand
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west of stand boarders roads and east of stand boarders tidal wetland
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create an even-aged structure of oak and hardwood trees • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

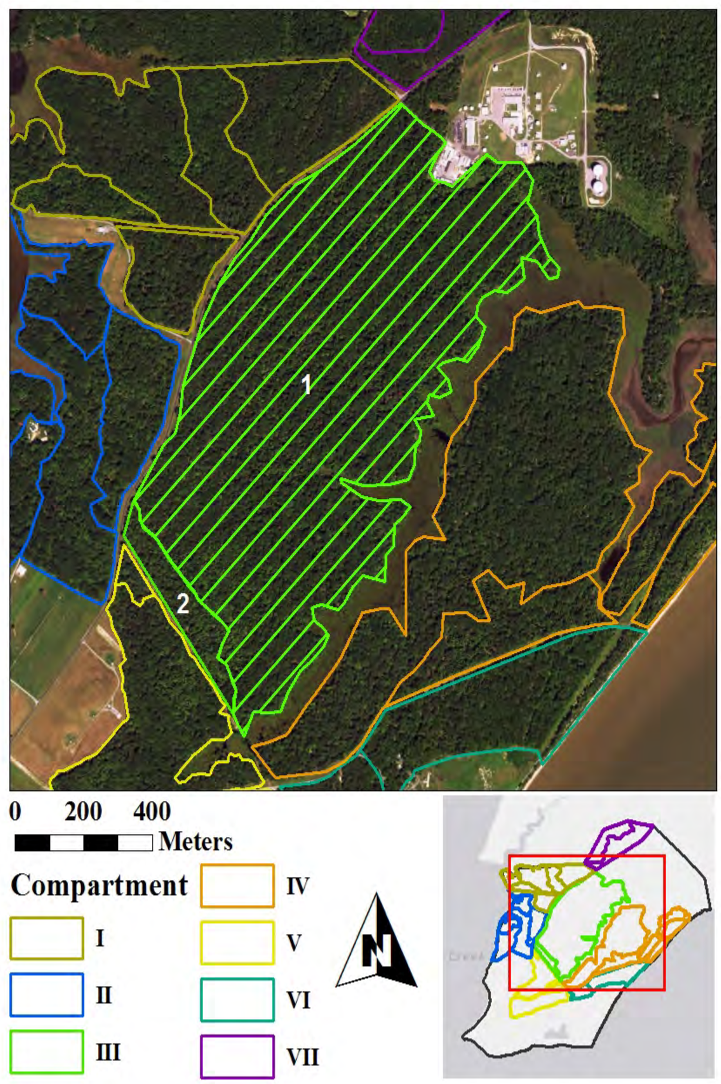
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES
Botany • Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works. **Wildlife** • Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service. • An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat. • Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand. **Recreation** • Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives. • Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters. **Other** • Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared. • Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity. • Garrison Manager must approve of activities which relate to land management. • Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts. • Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales. • ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment III

Stand 2 **(S-2)**

COMPARTMENT: III	**STAND:** 2	**FORMER:** 3/2

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
11	Mixed Hwd/Pine	~60	Moderate	Medium	52	Poor	U	70	55	20	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	Loblolly Pine *(PITA)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	3	--	--	--	--	17	**20**
8.0 - 9.9	--	--	--	--	--	--	--	3	**3**
10.0 – 11.9	--	--	3	--	--	--	--	--	**3**
12.0 – 13.9	--	--	--	--	--	--	--	3	**3**
14.0 -- 15.9	--	--	4	--	3	--	3	--	**10**
16.0 – 17.9	7	3	3	--	3	--	--	--	**16**
18.0 – 19.9	--	--	--	--	--	--	--	--	**0**
20.0 – 21.9	--	--	4	--	--	--	--	--	**4**
22.0 +	--	--	--	--	--	--	--	--	**0**
Total	**7**	**3**	**17**	**0**	**6**	**0**	**3**	**23**	**59**

EXISTING STAND CONDITION

- Virginia pine and loblolly pine seedlings/saplings, sweet gum and red maple saplings abundant
- Mid-story with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west and south of stand boarders roads
- Little to no desirable regeneration found in the stand
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and pine seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods and pine that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Establish a new stand with early successional and desirable species, ultimately producing higher quality trees

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Remove all merchantable trees besides legacy trees
- Monitor site conditions to ensure successful management goals are met
- Use Rx fire to manage desirable regeneration
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand as they become available

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create an even-aged structure of oak and pine trees • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

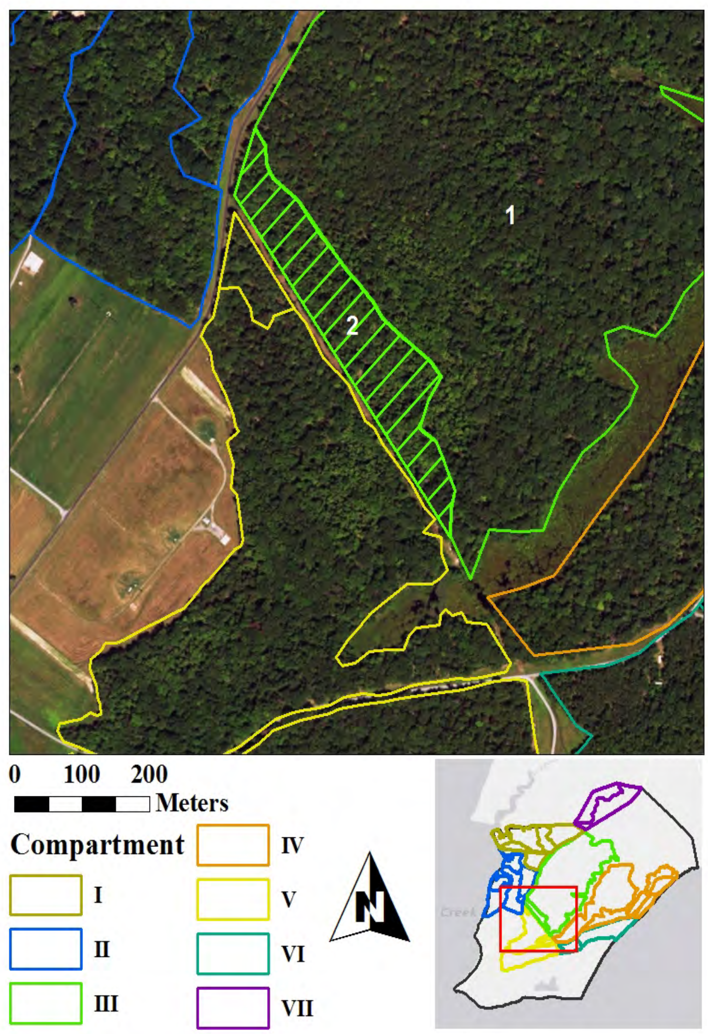
Treatment:	**Residual BA**
Overstory Removal	<10 sq. ft. per ac.

Notes:
- Remove all trees other than those which are considered legacy trees, not to exceed one per acre

Retention Priority:
- Legacy trees up to one per acre

Removal Priority:
- Remove all merchantable trees
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Overstory Removal even-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment IV

Stand 1 (S-1)

COMPARTMENT: IV	STAND: 1	FORMER: 4/1

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
19	Oak/Mixed Hwd	~98	Moderate	High	15						

EXISTING STAND CONDITION

- Virginia pine mortality has created canopy gaps and heavy fuel loads
- Mid-story with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; south of stand boarders road, northeast portion approaches tidal gut
- Little to no desirable regeneration found in the stand
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and pine seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods and pine that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Establish a new stand with early successional and desirable species, ultimately producing higher quality trees

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Remove all merchantable trees besides legacy trees
- Monitor site conditions to ensure successful management goals are met
- Use Rx fire to manage desirable regeneration
- Establish a healthy site condition retaining at least one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand as they become available

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via competitive timber sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create an even-aged structure of oak and pine trees
- Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of desirable regeneration from quality on-site seed sources
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of forest products to local area wood markets
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

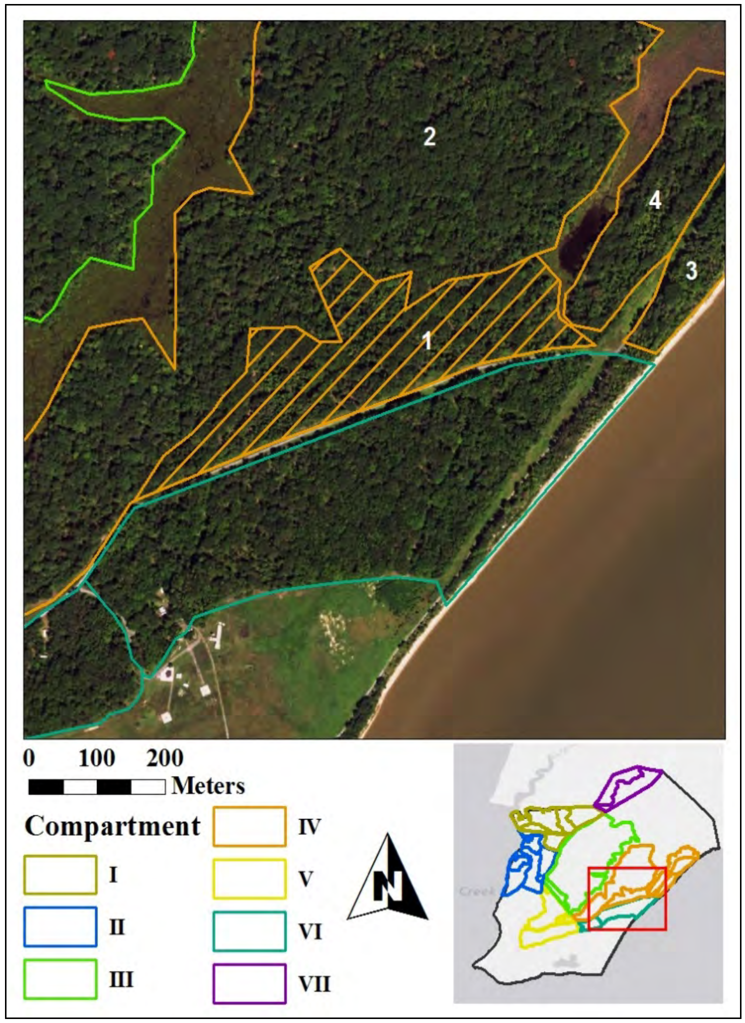
Treatment:	Residual BA
Low-Density Shelterwood	<20 sq. ft. per ac.

Notes:
- Remove all trees other than those which are considered legacy trees, not to exceed one per acre

Retention Priority:
- Legacy trees up to one per acre

Removal Priority:
- Remove all merchantable trees
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany
- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife
- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation
- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the

success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Low-density shelterwood uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment IV

<u>Stand 2</u> (S-2)

COMPARTMENT: IV	STAND: 2	FORMER: 4/2

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
123	Oak/Mixed Hwd	100+	Moderate	Medium	12	Good	U	55	40	30	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Chestnut Oak *(QUPR2)*	Other Hardwood	Total
6.0 - 7.9	--	1	1	1	--	--	1	6	**10**
8.0 - 9.9	--	--	2	2	--	--	--	2	**6**
10.0 – 11.9	--	--	1	3	--	--	--	1	**5**
12.0 – 13.9	--	1	5	1	--	--	--	--	**7**
14.0 -- 15.9	--	--	2	2	--	--	--	--	**4**
16.0 – 17.9	--	1	6	2	--	--	1	--	**10**
18.0 – 19.9	--	1	10	2	--	--	1	--	**14**
20.0 – 21.9	1	1	11	1	1	--	2	--	**17**
22.0 +	--	1	8	--	--	--	--	--	**9**
Total	**1**	**6**	**46**	**14**	**1**	**0**	**5**	**9**	**82**

EXISTING STAND CONDITION

- Encroachment of understory fuels along perimeter along edge of stand where sunlight can reach the forest floor
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west of stand boarders tidal wetland, south of stand boarders road
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create an even-aged structure of oak and hardwood trees • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

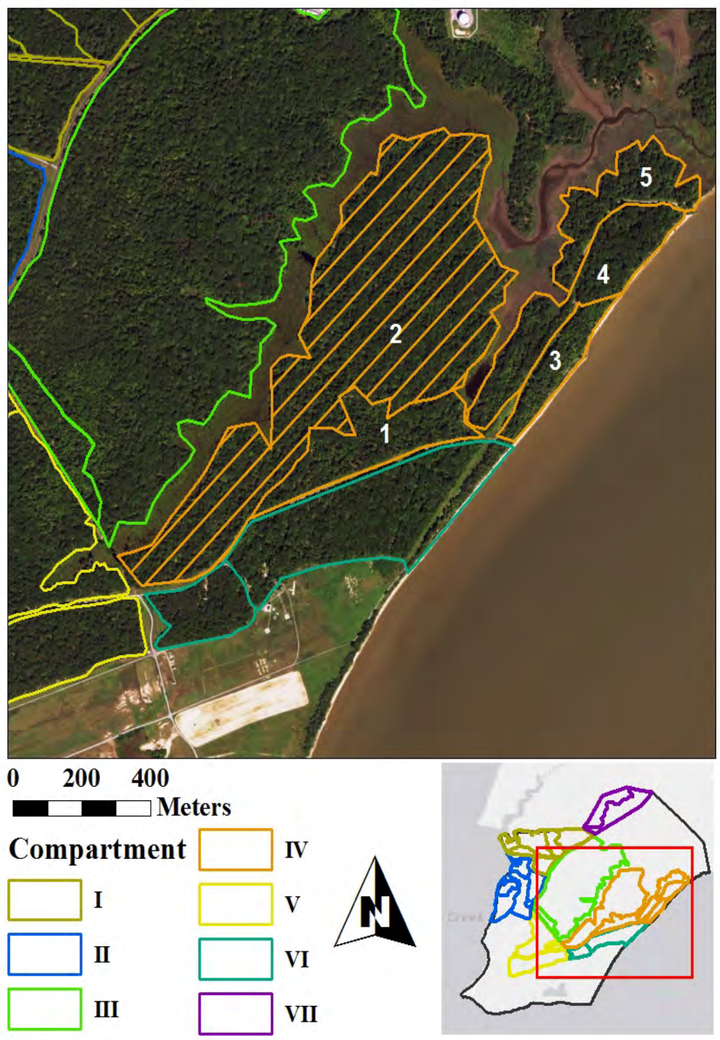
Treatment:	**Residual BA**
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES
Botany • Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works. **Wildlife** • Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service. • An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat. • Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand. **Recreation** • Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives. • Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters. **Other** • Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared. • Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity. • Garrison Manager must approve of activities which relate to land management. • Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts. • Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales. • ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment IV

<u>Stand 3</u>   (S-3)

COMPARTMENT: IV	**STAND:** 3	**FORMER:** 4/3

KEY STAND ATTRIBUTES											
Acres	**Forest Type**	**Est. Age**	**Fire Mgmt. Priority**	**Fire Risk**	**CWD %**	**Wildlife Habitat**	**Mid-story S/U**	**Understory % Cover**	**% Vegetation ≥ 6.0" DBH**		
									Trees	**Grass**	**Vines**
9	Oak/Mixed Hwd	~94	Moderate	Medium	42	Fair	U	60	45	5	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	**BA (sq. ft./ acre) by Species and Diameter Class**								
	Virginia Pine *(PIVI2)*	**White Oak *(QUAL)***	**Southern Red-Oak *(QUFA)***	**Sweet Gum *(LIST2)***	**Yellow Poplar *(LITU)***	**Willow-Oak *(QUPH)***	**Chestnut Oak *(QUPR2)***	**Other Hardwood**	**Total**
6.0 - 7.9	--	--	3	--	--	--	--	13	**16**
8.0 - 9.9	--	--	7	7	--	--	--	7	**21**
10.0 – 11.9	--	--	--	10	--	--	--	7	**17**
12.0 – 13.9	--	--	--	7	--	--	--	--	**7**
14.0 -- 15.9	3	--	--	10	--	--	--	6	**19**
16.0 – 17.9	4	--	3	--	3	--	--	--	**10**
18.0 – 19.9	--	--	4	3	--	--	--	--	**7**
20.0 – 21.9	--	--	--	--	--	--	--	--	**0**
22.0 +	--	--	--	--	--	--	--	--	**0**
Total	**7**	**0**	**17**	**37**	**3**	**0**	**0**	**33**	**97**

EXISTING STAND CONDITION

- Encroachment of understory fuels along perimeter along edge of stand where sunlight can reach the forest floor
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; east of stand boarders Potomac River, west of stand boarders road
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Retain stand structure for canopy closure and soil stabilization
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site by removing poor quality trees which are not desirable for wildlife
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by limiting management activities
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via firewood sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create an uneven-aged structure of oak and hardwood trees
- Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of desirable regeneration from quality on-site seed sources
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of forest products to the local area
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	**Residual BA**
Thinning from below	70-80 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

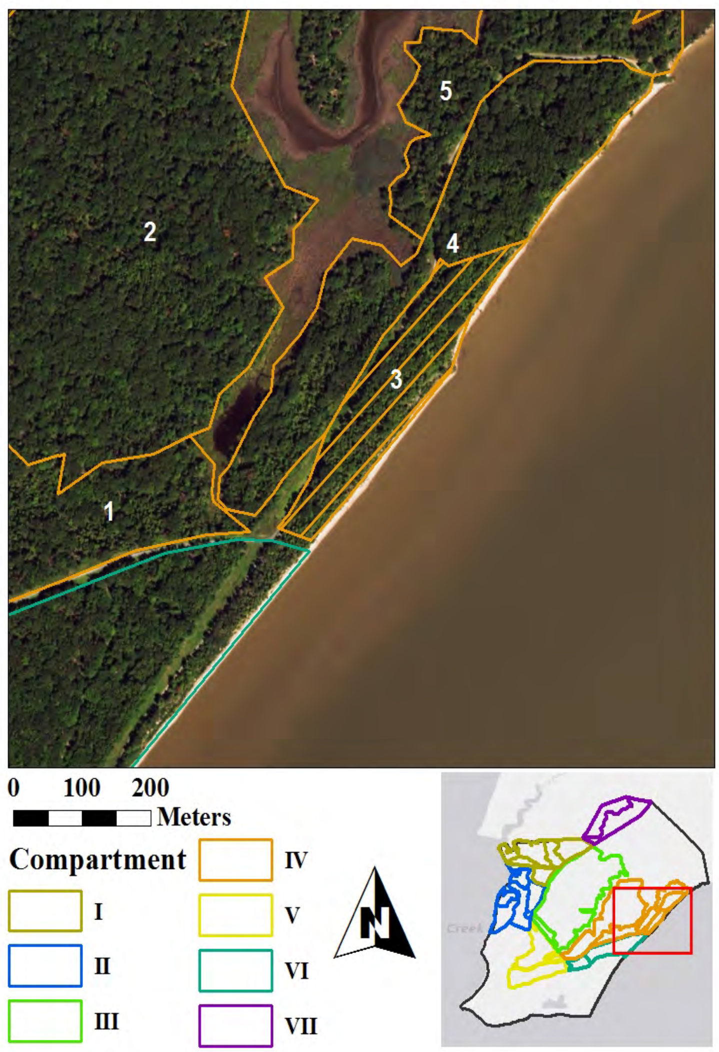
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- Most Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to firewood sale coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	SITE-PREP	Timber stand improvement cut (firewood sale)	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment IV

Stand 4 (S-4)

COMPARTMENT: IV	STAND: 4	FORMER: 4/4

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
9	Oak/Mixed Hwd	~94	Moderate	Medium	35	Fair	U	40	40	5	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Chestnut Oak *(QUPR2)*	Other Hardwood	Total
6.0 - 7.9	--	--	--	3	--	--	--	15	**18**
8.0 - 9.9	--	--	--	8	--	--	--	10	**18**
10.0 – 11.9	--	--	--	--	--	--	--	5	**5**
12.0 – 13.9	--	--	3	--	--	--	--	3	**6**
14.0 -- 15.9	--	--	--	7	--	--	--	3	**10**
16.0 – 17.9	--	--	--	--	--	--	--	--	**0**
18.0 – 19.9	--	--	--	5	2	--	--	--	**7**
20.0 – 21.9	--	--	5	10	--	--	--	--	**15**
22.0 +	--	--	20	--	3	--	--	--	**23**
Total	**0**	**0**	**28**	**33**	**5**	**0**	**0**	**36**	**102**

EXISTING STAND CONDITION

- Encroachment of understory fuels along perimeter along edge of stand where sunlight can reach the forest floor
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west of stand boarders tidal wetland, south of stand boarders road
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Retain stand structure for canopy closure and soil stabilization
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site by removing poor quality trees which are not desirable for wildlife
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by limiting management activities
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via firewood sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create an uneven-aged structure of oak and hardwood trees
- Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of desirable regeneration from quality on-site seed sources
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of forest products to the local area
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Thinning from below	70-80 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

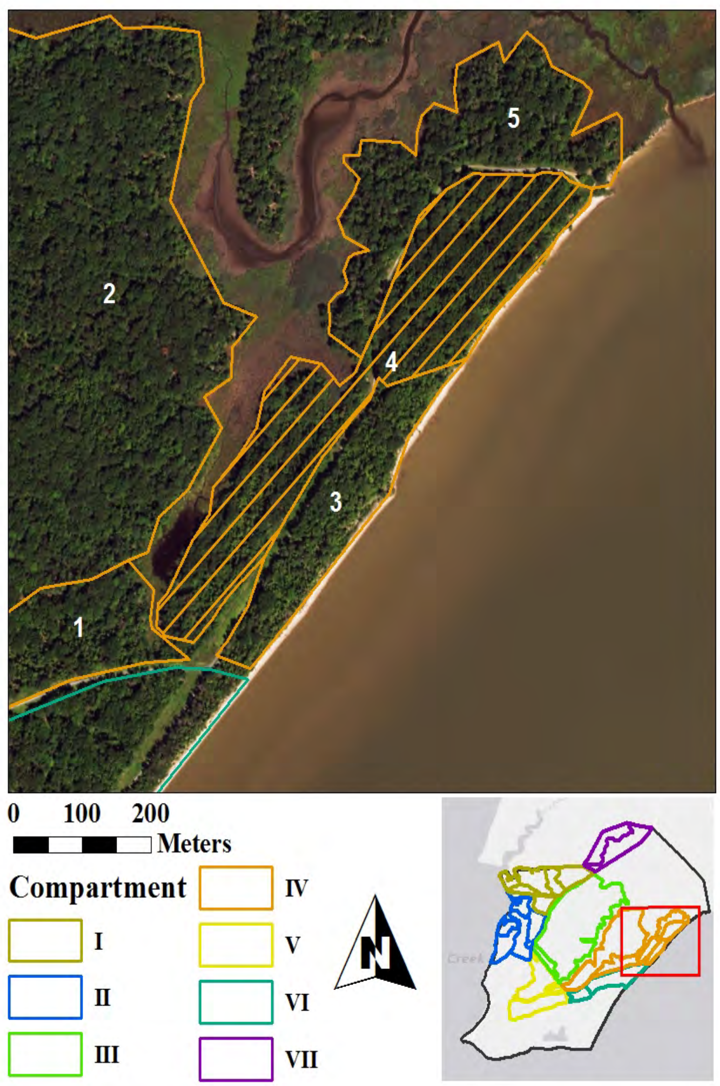
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- Most Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES
Botany • Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works. **Wildlife** • Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service. • An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat. • Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand. **Recreation** • Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives. • Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters. **Other** • Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared. • Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity. • Garrison Manager must approve of activities which relate to land management. • Prior to firewood sale coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts. • Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales. • ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	SITE-PREP	Timber stand improvement cut (firewood sale)	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment IV

Stand 5 (S-5)

COMPARTMENT: IV	STAND: 5	FORMER: 4/5

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
12	Oak/Mixed Hwd	~99	Moderate	Medium	20	Fair	U	80	65	5	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Virginia Pine *(PIVI2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Chestnut Oak *(QUPR2)*	Other Hardwood	Total
6.0 - 7.9	--	--	--	--	--	--	--	3	**3**
8.0 - 9.9	3	--	--	--	--	--	--	10	**13**
10.0 – 11.9	3	--	--	--	--	--	--	10	**13**
12.0 – 13.9	--	--	10	--	--	--	--	--	**10**
14.0 -- 15.9	3	--	3	7	--	--	--	--	**13**
16.0 – 17.9	--	--	3	7	--	--	--	--	**10**
18.0 – 19.9	--	--	3	3	--	--	--	--	**6**
20.0 – 21.9	--	--	7	--	3	--	--	--	**10**
22.0 +	--	--	34	--	--	--	--	--	**34**
Total	**9**	**0**	**60**	**17**	**3**	**0**	**0**	**23**	**112**

EXISTING STAND CONDITION

- Encroachment of understory fuels along perimeter along edge of stand where sunlight can reach the forest floor
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west of stand boarders tidal wetland, south of stand boarders road
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Retain stand structure for canopy closure and soil stabilization
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site by removing poor quality trees which are not desirable for wildlife
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by limiting management activities
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via firewood sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create an uneven-aged structure of oak and hardwood trees
- Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of desirable regeneration from quality on-site seed sources
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of forest products to the local area
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Thinning from below	80-90 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics for the benefit of the residual stand wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

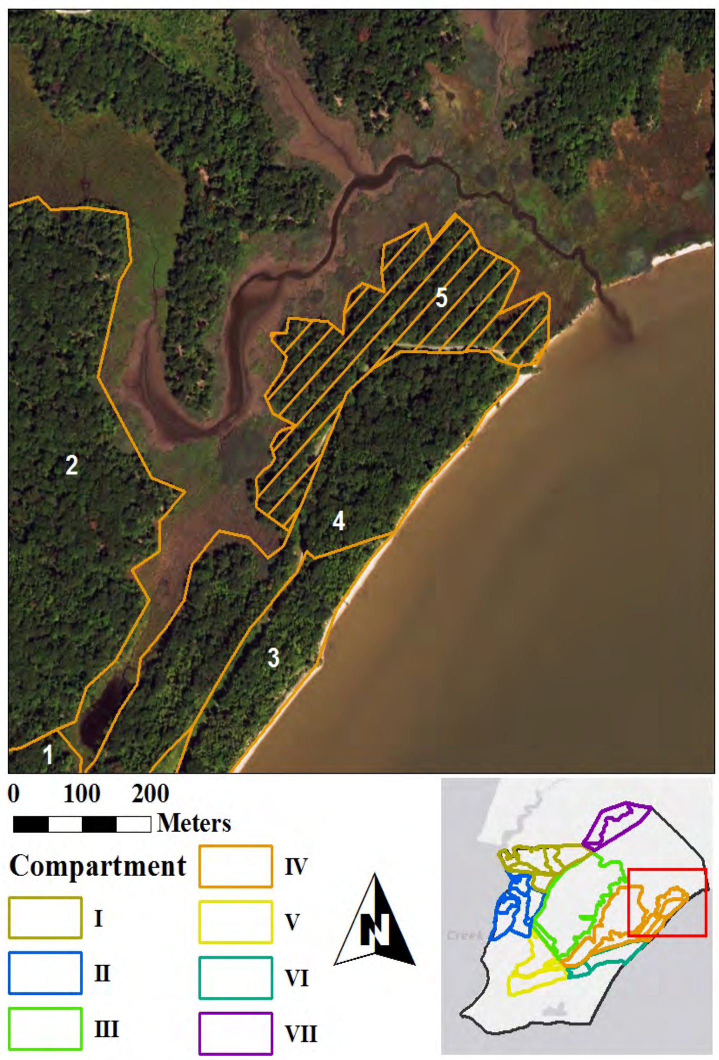
Retention Priority:

- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- Most Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to firewood sale coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	SITE-PREP	Timber stand improvement cut (firewood sale)	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment V</u>

<u>Stand 1</u> (S-1)

COMPARTMENT: V	STAND: 1	FORMER: 5/1

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH Trees	Grass	Vines
39	Oak/Mixed Hwd	+100	Critical	Very High	32	Fair	U	75	60	10	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Chestnut Oak *(QUPR2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	2	--	--	5	7	**14**
8.0 - 9.9	--	--	--	1	--	--	1	3	**5**
10.0 – 11.9	--	--	--	2	1	2	--	2	**7**
12.0 – 13.9	--	--	--	--	--	--	--	--	**0**
14.0 -- 15.9	1	--	5	--	--	1	--	--	**7**
16.0 – 17.9	--	--	4	1	--	--	1	1	**7**
18.0 – 19.9	--	--	8	1	--	2	--	--	**11**
20.0 – 21.9	--	--	20	--	--	1	--	--	**21**
22.0 +	--	--	8	--	--	5	--	-	**13**
Total	**1**	**--**	**45**	**7**	**1**	**11**	**7**	**13**	**85**

EXISTING STAND CONDITION

- Invasive species encroachment throughout the understory
- Pockets of Mid-story dense with American holly
- Flat topography; average slope = 0-5%; south and west of stand boarders a field, entire stand bound by roads
- Little to no desirable regeneration found in the stand, areas with stem exclusion found outside of invasive vegetation
- Diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in available fuel loads and reduction in invasive species composition
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create small canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of hardwood trees depending on frequency of treatment • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

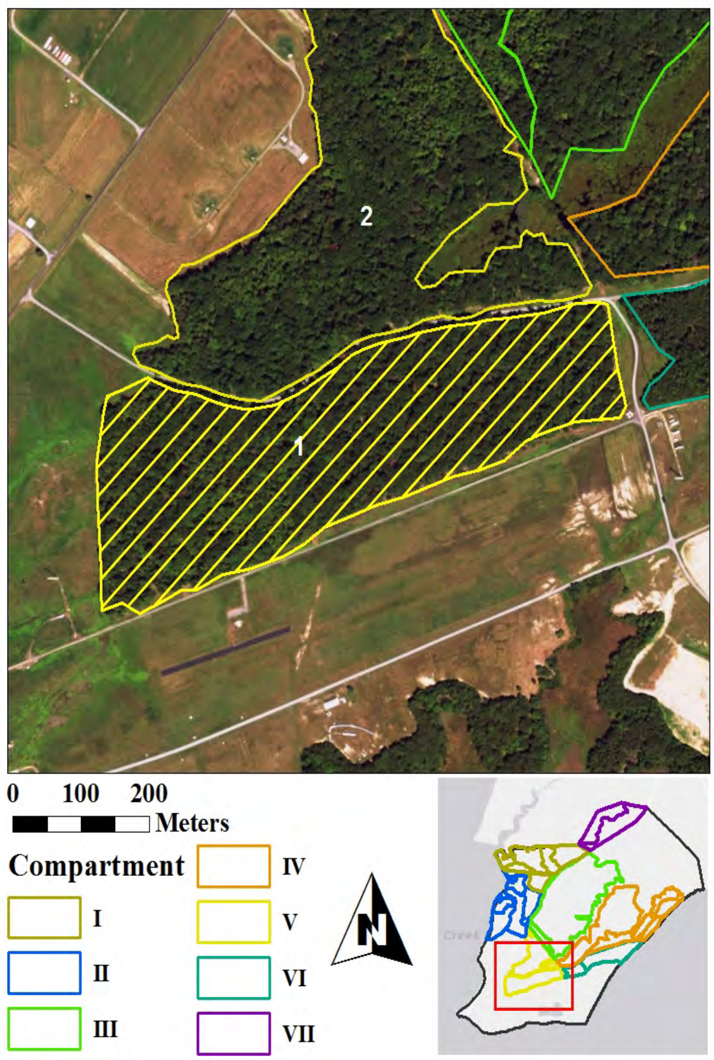
Treatment:	**Residual BA**
Single-Tree Selection	70-80 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees from all age classes that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (in all 2" DBH size classes) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE

Year	Activity Code	Activity	Comment
0	TMBR-HVST	Single-tree Selection	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release hardwood seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Single-tree Selection	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	USACE Title: District Forester / Ecologist / Geographer	Date: 18 MAR 2017

<u>Compartment V</u>

<u>Stand 2</u> (S-2)

COMPARTMENT: V	**STAND:** 2	**FORMER:** 5/2

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
43	Oak/Mixed Hwd	~95	Critical	High	21	Good	U	65	45	40	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Loblolly Pine *(PITA)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Chestnut Oak *(QUPR2)*	Other Hardwood	Total
6.0 - 7.9	--	--	--	--	--	--	--	3	**3**
8.0 - 9.9	--	--	--	--	--	--	--	3	**3**
10.0 – 11.9	--	--	8	2	--	--	--	3	**13**
12.0 – 13.9	--	--	3	5	--	--	--	8	**16**
14.0 -- 15.9	--	--	2	7	--	--	--	2	**11**
16.0 – 17.9	--	--	5	3	--	--	--	5	**13**
18.0 – 19.9	--	--	3	--	--	--	--	2	**5**
20.0 – 21.9	--	--	18	--	1	--	--	--	**19**
22.0 +	2	--	7	--	--	--	--	--	**9**
Total	**2**	**0**	**46**	**17**	**1**	**0**	**0**	**26**	**92**

EXISTING STAND CONDITION

- Encroachment of understory fuels along perimeter along edge of stand where sunlight can reach the forest floor
- Mid-story dense with American holly; ladder fuels available throughout stand
- Flat topography; average slope = 0-5%; west of stand boarders field, remainder of stand boarders roads
- Little to no desirable regeneration found in the stand, areas with stem exclusion found
- Little diversity found in infrequent tree species
- Loss of oak presence without treatment

DESIRED STAND CONDITION

- Reduction in available fuel loads
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create an even-aged structure of oak and hardwood trees • Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of desirable regeneration from quality on-site seed sources • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

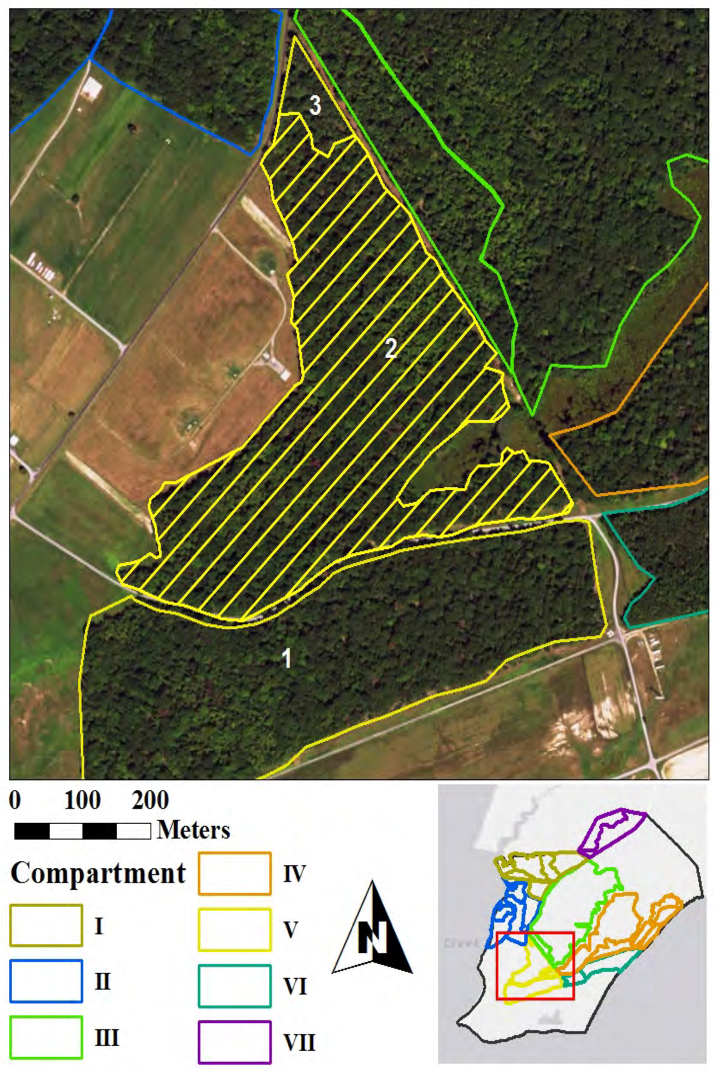
Treatment:	**Residual BA**
Shelterwood Establishment Cut	50 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics for the benefit of wildlife/seed source trees/lumber. In some cases leave trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

Retention Priority:
- Healthy, well-formed hardwood trees (approximately 12-18 in. DBH) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Shelterwood establishment cut 2-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release oak seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory removal even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment V

Stand 3 (S-3)

COMPARTMENT: V	**STAND:** 3	**FORMER:** 5/3

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
1	Pine/Mixed Hwd	~61	Moderate	High	7	Fair	S	30	15	10	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Loblolly Pine *(PITA)*	Virginia Pine *(PIVI2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	5	--	--	--	--	--	--	5	**10**
8.0 - 9.9	5	--	--	--	--	--	--	--	**5**
10.0 – 11.9	10	--	--	--	--	--	--	5	**15**
12.0 – 13.9	5	--	--	--	--	--	--	--	**5**
14.0 -- 15.9	30	5	--	--	--	--	--	--	**35**
16.0 – 17.9	35	--	5	--	--	--	--	--	**40**
18.0 – 19.9	15	--	--	--	--	--	--	--	**15**
20.0 – 21.9	20	--	5	--	--	--	--	--	**25**
22.0 +	20	--	--	--	--	--	--	--	**20**
Total	**145**	**5**	**10**	**0**	**0**	**0**	**0**	**10**	**170**

EXISTING STAND CONDITION

- Dieback of Virginia Pine due to wind-throw and suppression from competition of dominant trees
- High fuel loads elevating the risk of ignition and spread from this source of fuel loads
- Flat topography; average slope = 0-5%; northern and western portions of stand boarders roads
- Some desirable regeneration found in the stand
- Little potential for diversity found in infrequent tree species
- Natural disturbance to the site to has established regeneration of both Loblolly pine and Virginia Pine

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- Pine seedlings are well established, well distributed and adequate in abundance to ensure quality pine that currently exists in the overstory are retained until their removal is desirable to allow free room for saplings to grow
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to Loblolly pine seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable pine is in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Create at least a two-aged structure of pine trees depending on frequency of treatment • Maintain a healthy pine community where a balanced ecosystem is maintained to include Rx fires • Enhance productivity of regeneration • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Commercial Thinning	80-90 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics, remove trees in small patches where abundance of pine seedlings will benefit from additional sunlight, limit disturbance to any advanced regeneration seedlings where found

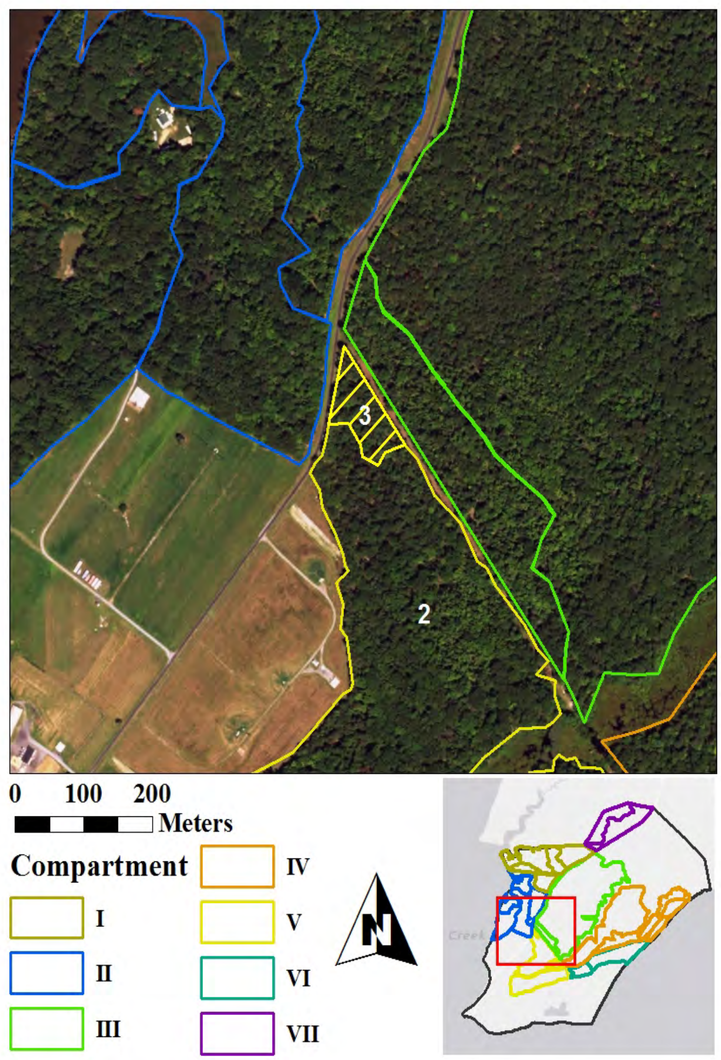
Removal Priority:

- Target poor quality trees of all species for removal, loblolly pine trees with low live crown ratios which are considered suppressed
- All Virginia pine, Sweet-gum, and American holly

Retention Priority:

- Healthy, well-formed Loblolly pine (approximately 12-18 in. DBH) with good live crown ratios well distributed throughout the stand.
- Healthy trees of all species with good form.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees, however not to exceed 6 snags. Snags should be designated as either a leave tree or wildlife tree
- Infrequent species of native trees which promote stand diversity

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- Three to six cavity and/or snag trees should be retained in the stand.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental should be established to ensure proper procedures are utilized and deposits can be made into appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Thinning uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release pine seedlings from competition
7	RX-FIRE	Prescribed fire	low intensity fire to top-kill competition and enhance the competitive status of pine
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Overstory Removal even-aged	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment VI</u>

<u>Stand 1</u>   (S-1)

COMPARTMENT: VI	STAND: 1	FORMER: 6/1

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
7	Virginia Pine	~53	Critical	High	38	Poor	S	20	10	5	5

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Loblolly Pine *(PITA)*	Virginia Pine *(PIVI2)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	60	--	--	--	--	--	--	**60**
8.0 - 9.9	--	50	--	--	--	--	--	--	**50**
10.0 – 11.9	--	35	--	--	--	--	--	--	**35**
12.0 – 13.9	--	5	--	--	--	--	--	--	**5**
14.0 -- 15.9	--	--	--	--	--	--	--	--	**0**
16.0 – 17.9	--	--	--	--	--	--	--	--	**0**
18.0 – 19.9	--	--	--	--	--	--	--	--	**0**
20.0 – 21.9	--	--	--	--	--	--	--	--	**0**
22.0 +	--	--	--	--	--	--	--	--	**0**
Total	**0**	**150**	**0**	**0**	**0**	**0**	**0**	**0**	**150**

EXISTING STAND CONDITION

- Heavily stocked with Virginia Pine, nearly a monoculture stand with exception to little Loblolly Pine regen
- High fuel loads elevating the risk of ignition and spread from this source of fuel loads
- Flat topography; average slope = 0-5%; south of stand boarders open field; west and north of stand boarder roads
- Little desirable regeneration found in the stand, areas with stem exclusion exist
- Little potential for diversity found in infrequent tree species
- Evidence of man-made disturbance to the site to has established nearly a pure Virginia pine stand

DESIRED STAND CONDITION

- Reduction in abundance of available fuel loads
- Pine seedlings are well established, well distributed and adequate in abundance to ensure quality pine that currently exists in the overstory are retained until their removal is desirable to allow free room for saplings to grow
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to loblolly pine seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable pine is in a seed year
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via competitive timber sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create at least a two-aged structure of pine trees perhaps multiple aged structure depending on frequency of treatment
- Maintain a healthy pine community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of regeneration
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of high-quality forest products to local area wood markets
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Overstory Removal	< 10 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark leave trees that exhibit quality characteristics, limit disturbance to any advanced regeneration of Loblolly Pine seedlings where found

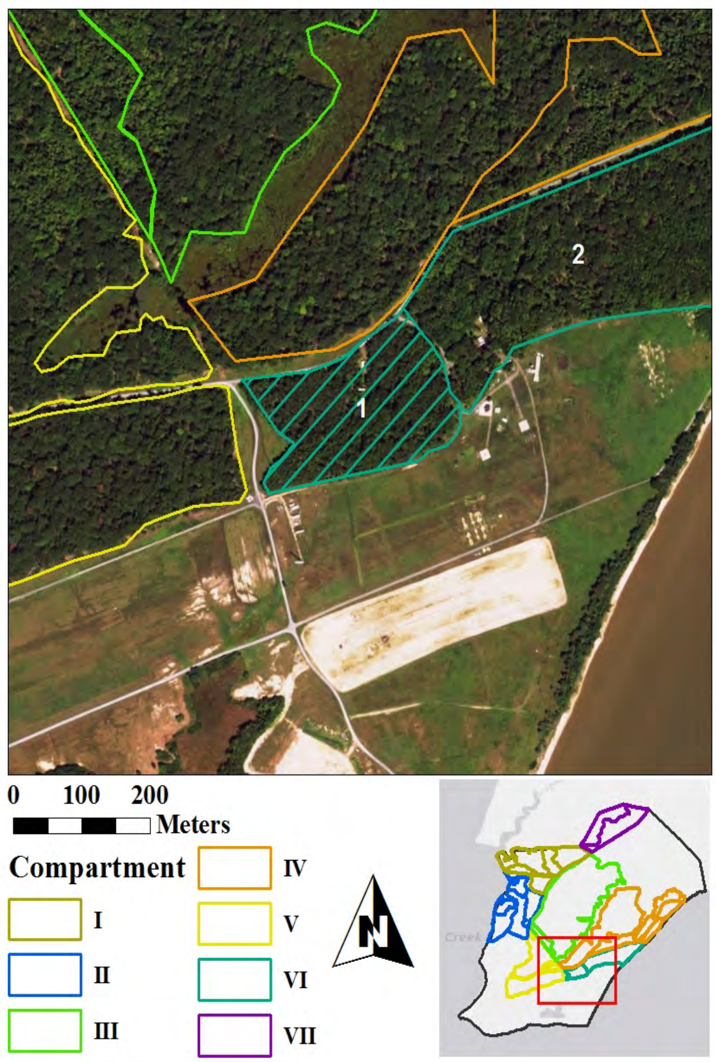
Removal Priority:

- Target poor quality trees of all species for removal
- All Virginia pine, Sweet-gum, and American holly

Retention Priority:

- Healthy, well-formed Loblolly pine (of any DBH) with good live crown ratios well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 1 trees per acre, average per acre can be higher however not to exceed 3 snags per acre. Snags should be designated as either a leave tree or wildlife tree
- Infrequent species of native trees which promote stand diversity

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of one to six cavity and/or snag trees per acre should be retained in the stand not to exceed three/acre.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental should be established to ensure proper procedures are utilized and deposits can be made into appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Overstory Removal even-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction and establish seeding opportunity
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release pine seedlings from competition
7	RX-FIRE	Prescribed fire	low intensity fire to top-kill competition and enhance the competitive status of pine
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	

Prepared by: USACE NAB/NAO Districts	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment VI</u>

<u>Stand 2</u> (S-2)

COMPARTMENT: VI	STAND: 2	FORMER: 6/1-2-3-4-5-6-7

KEY STAND ATTRIBUTES											
Acres	Forest Type	Est. Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
31	Virginia Pine/Mixed Hwd	~79	Critical	Very High	39	Fair	U	30	20	20	10

EXISTING SPECIES COMPOSITION									
DBH in inches Range	BA (sq. ft./ acre) by Species and Diameter Class								
	Chestnut Oak *(QUPR2)*	White Oak *(QUAL)*	Southern Red-Oak *(QUFA)*	Sweet Gum *(LIST2)*	Yellow Poplar *(LITU)*	Willow-Oak *(QUPH)*	Hickory	Other Hardwood	Total
6.0 - 7.9	--	--	--	2	--	--	5	7	**14**
8.0 - 9.9	--	--	--	1	--	--	1	3	**5**
10.0 – 11.9	--	--	--	2	1	2	--	2	**7**
12.0 – 13.9	--	--	--	--	--	--	--	--	**0**
14.0 -- 15.9	1	--	5	--	--	1	--	--	**7**
16.0 – 17.9	--	--	4	1	--	--	1	1	**7**
18.0 – 19.9	--	--	8	1	--	2	--	--	**11**
20.0 – 21.9	--	--	20	--	--	1	--	--	**21**
22.0 +	--	--	8	--	--	5	--	-	**13**
Total	**1**	**--**	**45**	**7**	**1**	**11**	**7**	**13**	**85**

EXISTING STAND CONDITION

- Invasive species encroachment throughout the understory
- Pockets of Mid-story dense with American holly
- Flat topography; average slope = 0-5%; south of stand boarders a field, east of stand boarders Potomac River
- Little to no desirable regeneration found in the stand, areas with stem exclusion found outside of invasive vegetation
- Little diversity found in infrequent tree species
- Encroachment of understory vegetation where additional sunlight is exposed to the south edge along the field

DESIRED STAND CONDITION

- Reduction in available fuel loads and reduction in invasive species composition
- A mix of oak and hardwood seedlings are well established, well distributed and adequate in abundance to ensure quality hardwoods that currently exists in the overstory are retained until their removal is desirable
- Reduction in the amount of undesirable trees to manageable quantities
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Limit damage to oak and other desirable seedlings and saplings with any forest management activities
- Consider soil scarification and harvest when desirable species are in a seed year, create small canopy gaps
- Monitor site conditions to ensure successful management goals are met
- Protect riparian areas with a tree harvest buffer see buffer management plan
- Establish a healthy site condition retaining one per acre legacy mature trees
- Enhance native plants to promote diversity for wildlife species control invasive species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable
- Reduce the spread non-native invasive species by requiring clean equipment transport, repetitive fire and other controls
- Provide potential wood products via competitive timber sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

- Create at least a two-aged structure of hardwood trees depending on frequency of treatment
- Maintain a healthy diverse community where a balanced ecosystem is maintained to include Rx fires
- Enhance productivity of desirable regeneration from quality on-site seed sources
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of forest products to local area wood markets
- Recruit current and future snags while managing the stand for wildlife benefits and maintaining coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE

Treatment:	Residual BA
Single-Tree Selection	70-80 sq. ft. per ac.

Notes:

- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees from all age classes that exhibit poor quality characteristics for the benefit of the residual stand; wildlife/seed source trees/lumber. In some cases cut trees will inherently exhibit opposing qualities and features example: high quality hardwood trees vs. snag trees both of which are acceptable to retain in different circumstances

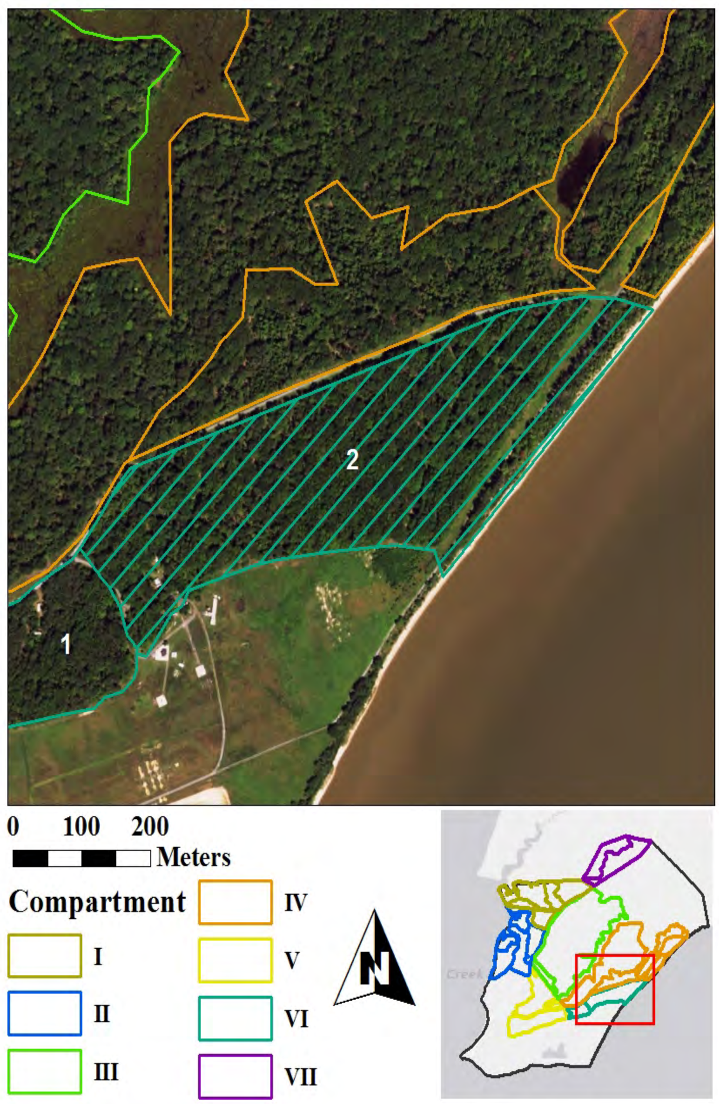
Retention Priority:

- Healthy, well-formed hardwood trees (in all 2” DBH size classes) with large crowns well distributed throughout the stand.
- Current snags and recruit snags or any other potential wildlife trees to fulfill a minimum of 3 trees per acre, average per acre can be higher however not to exceed 6 snags per acre. Snags should be designated as leave trees or wildlife trees
- Infrequent species of native trees which promote stand diversity

Removal Priority:

- Target poor quality trees of all species for removal, trees with low live crown ratios with weaknesses in the crowns or boles which may be considered suppressed
- All Virginia pine, Sweet-gum, American holly

STAND LEVEL HARVEST MAP



DESIGN CRITERIA AND MITIGATION MEASURES

Botany

- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife

- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent "wildlife" trees should be retained in the stand.

Recreation

- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	Single-tree Selection	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel and invasive species reduction
3	PST-HVST	Conduct stand stocking survey surveys	Ensure management objectives short-term on track
3	SITE-PREP	Determine the need for TSI or understory thinning	Ensure management objectives short-term on track
4-10	SITE-PREP	Monitor success of desirable regeneration	Release hardwood seedlings from competition
7	RX-FIRE	Prescribed fire	Low intensity fire to top-kill competition and enhance the competitive status of oak and other hardwood and reduce the invasive species risk
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
10-15	TMBR-HVST	Single-tree Selection	Once successful advanced regeneration is established

Prepared by: USACE NAO/NAB	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

Compartment VII

Stand 1 **(S-1)**

COMPARTMENT: VII	STAND: 1	FORMER: Non-Project Land

KEY STAND ATTRIBUTES											
Acres	Forest Type	Age	Fire Mgmt. Priority	Fire Risk	CWD %	Wildlife Habitat	Mid-story S/U	Understory % Cover	% Vegetation ≥ 6.0" DBH		
									Trees	Grass	Vines
32	Oak/Mixed Hwd	~75	Critical	High	20	Good	S	30	25	10	5

EXISTING STAND CONDITION

- Some dieback of Virginia pine due to wind-throw and suppression along the eastern edge of the stand
- Adjacent to perimeter fence clearing allowing for a buffer point of control for burning
- Flat topography; average slope = 0-5%
- Little to no desirable regeneration found in the stand, pockets of American holly, areas with stem exclusion found
- Diversity found in infrequent tree species
- Limited natural or manmade (only roads) disturbance to the site to establish regeneration and foster growth

DESIRED STAND CONDITION

- Reduction in available fuel loads
- Oak seedlings are well established, well distributed and adequate in abundance to ensure quality oak that currently exists in the overstory are retained in the future generation of trees
- Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration
- Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES

- Establish a two-age structure, Identify and protect any oak that have potential to regenerate high-quality trees
- Consider soil scarification and harvest when oak seed is present
- Gain control of deer browsing to reduce impacts to desirable regeneration within the reach of a standing deer
- Establish a healthy site condition retaining legacy mature trees
- Enhance native plants to promote diversity for wildlife species
- Increase stand vigor and resilience to insect and disease epidemics
- Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*

- Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable
- Reduce the spread non-native invasive species with clean equipment transport, repetitive fire and other controls
- Provide potential wood products via competitive timber sales to interested parties with the local area
- Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES

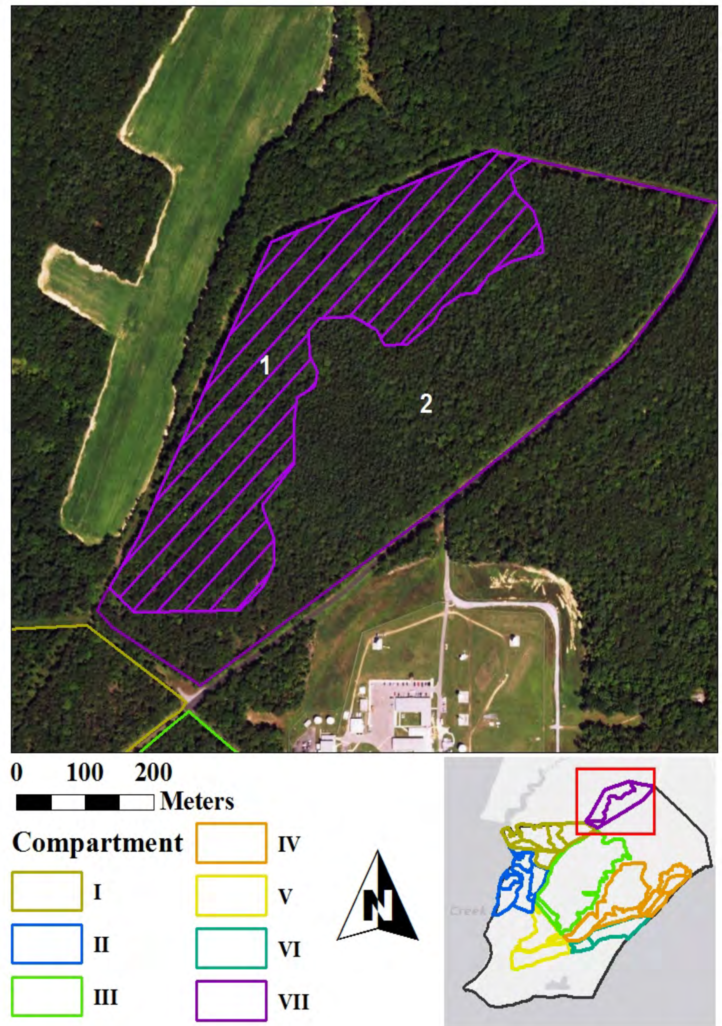
- Recruit oak into dominant and/or codominant canopy positions
- Maintain a healthy oak/ loblolly pine community where a balanced ecosystem is maintained to include Rx fires
- Enhance hard mast production fostering trees with high live crown ratios
- Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS
- Provide a periodic supply of high-quality forest products to local area wood markets
- Recruit current and future snags while managing the stand for wildlife benefits and maintain coarse woody debris
- Showcase managed stand and findings with interested resource program managers & researchers

SILVICULTURAL GUIDE		STAND LEVEL HARVEST MAP
Treatment: Commercial Thinning	**Residual BA** 70-80 sq. ft. per ac.	

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics to improve the overall stand health and vigor. Trees that will benefit wildlife can be retained as well as trees that exhibit desirable seed source post second entry and lumber producing trees

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios and weaknesses in the crown or boles
- All Virginia pine, Sweet-gum, Red maple, and American holly

Retention Priority:
- Healthy, well-formed oak (approximately 12-18 in. DBH) with large crowns or crowns likely to fill canopy gaps which will be well distributed throughout the stand
- Healthy loblolly pine
- Enough snags or otherwise wildlife trees to fulfill a minimum of 3 trees per acre when safe to do so.
- Infrequent species of native trees which promote stand diversity



DESIGN CRITERIA AND MITIGATION MEASURES

Botany
- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife
- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation
- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities during hunting season to increase the success rates for hunters.

Other
• Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared. • Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity. • Garrison Manager must approve of activities which relate to land management. • Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts. • Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales. • ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	First stage thinning cut uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction
3	PST-HVST	Conduct stand stocking survey surveys	Ensure canopy must be opened further
4-10	TMBR-HVST	Second stage seed-tree cur uneven-aged	Set stand seed trees to ensure high seed production
4-10	POST RX-FIRE	Seed year fire	Time fire to enhance successful seeding
7	RX-FIRE	Prescribed fire	Medium intensity fire to top-kill competition and enhance the competitive status of oak
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
15-20	TMBR-HVST	Overstory removal/final cut	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

<u>Compartment VII</u>

<u>Stand 2</u> (S-2)

COMPARTMENT: VII	**STAND:** 2	**FORMER:** Non-Project Land

KEY STAND ATTRIBUTES											
			Fire Mgmt.	Fire	CWD	Wildlife	Mid-story	Understory	% Vegetation ≥ 6.0" DBH		
Acres	Forest Type	Age	Priority	Risk	%	Habitat	S/U	% Cover	Trees	Grass	Vines
44	Pine	~60	Critical	High	20	Fair	S	25	15	5	5

EXISTING STAND CONDITION
• Some dieback of Virginia pine due to wind-throw and suppression along the edge of the stand • Adjacent to entrance road • Flat topography; average slope = 0-5% • Little desirable regeneration found in the stand, pockets of American holly, areas with stem exclusion found • Little diversity found in infrequent tree species • Limited natural or manmade (only roads) disturbance to the site to establish regeneration and foster growth

DESIRED STAND CONDITION
• Reduction in available fuel loads • Loblolly pine seedlings are well established, well distributed and adequate in abundance to ensure quality pine that currently exists in the overstory are retained in the future generation of trees • Reduction in the amount of undesirable trees with manageable amounts of undesirable regeneration • Retention of some poor quality trees of all species to fill canopy gaps and provide habitat for wildlife

SHORT TERM OBJECTIVES
• Establish a two-age structure, Identify and protect any Loblolly pine that have potential to regenerate high-quality trees • Consider soil scarification and harvest when Loblolly pine seed is present • Gain control of deer browsing to reduce impacts to desirable regeneration within the reach of a standing deer • Establish a healthy site condition retaining legacy mature trees • Enhance native plants to promote diversity for wildlife species • Increase stand vigor and resilience to insect and disease epidemics • Retain wildlife trees (minimum three per acre) scattered throughout the stand

SHORT TERM OBJECTIVES *Cont.*
• Minimize impacts to soil and water resources by placing harvest restrictions and equipment restrictions as applicable • Reduce the spread non-native invasive species with clean equipment transport, repetitive fire and other controls • Provide potential wood products via competitive timber sales to interested parties with the local area • Reduce fuel loads with initiating structured forest management activities

LONG TERM OBJECTIVES
• Recruit pine into dominant and/or codominant canopy positions • Maintain a healthy loblolly pine community where a balanced ecosystem is maintained to include Rx fires • Enhance hard mast production fostering trees with high live crown ratios • Protect any rare or threatened and endangered species within or near the stand following recommendations of USFWS • Provide a periodic supply of high-quality forest products to local area wood markets • Recruit current and future snags while managing the stand for wildlife benefits and maintain coarse woody debris • Showcase managed stand and findings with interested resource program managers & researchers

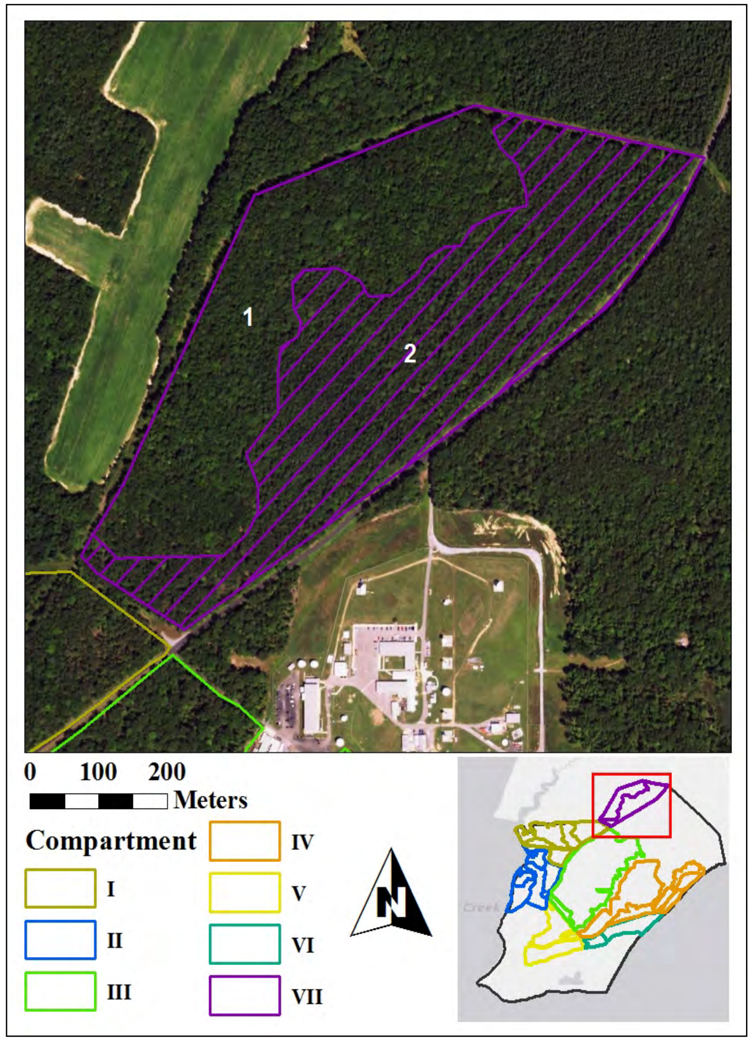
SILVICULTURAL GUIDE	STAND LEVEL HARVEST MAP

Treatment:	Residual BA
Commercial Thinning	70-80 sq. ft. per ac.

Notes:
- The optimal time to mark the stand is late fall through early spring (leaf-off condition)
- Mark cut trees that exhibit poor quality characteristics to improve the overall stand health and vigor. Trees that will benefit wildlife can be retained as well as trees that exhibit desirable seed source post second entry and lumber producing trees

Removal Priority:
- Target poor quality trees of all species for removal, trees with low live crown ratios and weaknesses in the crown or boles
- All Virginia pine, Sweet-gum, Red maple, and American holly

Retention Priority:
- Healthy, well-formed Loblolly pine (approximately 12-18 in. DBH) with large crowns or crowns likely to fill canopy gaps which will be well distributed throughout the stand
- Enough snags or otherwise wildlife trees to fulfill a minimum of 3 trees per acre when safe to do so.
- Infrequent species of native trees which promote stand diversity



DESIGN CRITERIA AND MITIGATION MEASURES

Botany
- Finding of rare or threatened and endangered species as well as invasive or non-native species outside of what is established in this document should be reported to U.S. Army Garrison Adelphi Laboratory Center Directorate of Public Works.

Wildlife
- Harvest restrictions for the protection of threatened and endangered species should be followed per the guidelines of the U.S. Fish and Wildlife Service.
- An average of three to six cavity and/or snag trees per acre should be retained in the stand for wildlife habitat.
- Raptor nest trees, amphibian habitat found to foster the health of turtle population should be protected, maintained, and monitored, and decadent “wildlife” trees should be retained in the stand.

Recreation
- Opportunities for local area hunters should be developed to maintain a healthy deer population that is supported by the availability of food sources without being detrimental to forest management objectives.
- Consider restricting forest management activities (such as timber harvesting) during hunting season to increase the success rates for hunters.

Other

- Preceding management activities an Environmental Assessment or other appropriate NEPA documentation must be prepared.
- Must have an approved INRMP that addresses forest management. Actions associated with forest management must be included in the NEPA analysis and documentation. Harvesting and other management activities must be applicable with all laws and regulations pertaining to the activity.
- Garrison Manager must approve of activities which relate to land management.
- Prior to timber harvest coordination between on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental must be established to ensure proper procedures are utilized and coordination for reimbursable deposits which will be deposited into the appropriate accounts.
- Prior to timber harvest reports of availability are submitted annually by 30 May for the following FY based on the INRMP over a five year period to determine the level of sales.
- ROA to include (volume and type of timber, acreage of sale, type of harvest, term of sale, maps of sale, specific harvest requirements or contract requirements, products to be advertised for bid, and method of sale). Additional sale procedures are required and should be arranged prior to an agreement.

RECOMMENDED ACTIVITIES TIMELINE			
Year	**Activity Code**	**Activity**	**Comment**
0	TMBR-HVST	First stage thinning cut uneven-aged	Seek environ review from supporting Army agency
1-3	RX-FIRE	Prescribed Fire	Fuel reduction
3	PST-HVST	Conduct stand stocking survey surveys	Ensure canopy must be opened further
4-10	TMBR-HVST	Second stage seed-tree cur uneven-aged	Set stand seed trees to ensure high seed production
4-10	POST RX-FIRE	Seed year fire	Time fire to enhance successful seeding
7	RX-FIRE	Prescribed fire	Medium intensity fire to top-kill competition and enhance the competitive status of pine
10	RX-FIRE	Prescribed fire	
13	RX-FIRE	Prescribed fire	
15-20	TMBR-HVST	Overstory removal/final cut	Once successful advanced regeneration is established

Prepared by: USACE NAB/NAO Districts	**USACE Title: District Forester / Ecologist / Geographer**	**Date: 18 MAR 2017**

6.0. Management Strategies

Through the use of forest management tools such as timber harvest and timber stand improvement cuts, the forested land of BPRF may be improved in order to maintain and enhance wildlife habitat, promote healthy forest ecosystems, protect streams and wetlands, and to enhance recreational value including hunting. Timber harvest could provide the funds needed to make improvement cuts, planting, and management of non-native, invasive plants and animals. In order to provide a variety of cover types, areas of windblown Virginia Pine should be replanted in Loblolly Pine.

Control of American holly, throughout most of the site, will allow more opportunity for regeneration of desirable species. Management may be achieved through either application of approved herbicides or manual thinning.

A schedule of activity for the next 15 years of management for each forest stand is located above in Section 5.0. Timber harvests, white tailed deer management and American Holly control are the main concentration, but other minor maintenance issues are also addressed in more detail the language below.

6.1 Coastal Zone Management Act and Chesapeake and Atlantic Coastal Bays Critical Area Act

BPRF contains sensitive habitat to include wetlands, streams, shorelines, forested areas and is entirely within the Federal Coastal Zone Management Act (CZMA) area of influence and consists of Maryland Chesapeake Bay Critical Area as outlined in the Chesapeake and Atlantic Coastal Bays Critical Area Act. Compliance with these two acts will be necessary when planning forest management activities.

The Chesapeake Bay Critical Area is defined as "all land within 1,000 feet of the mean high water line of tidal waters, or the landward edge of tidal wetlands and all waters of and lands under the Chesapeake Bay and Atlantic Coastal Bays and tributaries." Additionally, there is a 100 foot buffer, within the 1000 foot Critical Area, which is a minimum width of 100 feet and is the area immediately adjacent to these waters and wetlands. Forest management practices within the 100 foot buffer will require approval in the form of a Buffer Management Plan submitted to the Maryland Critical Area Commission. Further, timber harvests conducted in Critical Areas classified as Resource Conservation Areas (RCA) must be done pursuant to a Timber Harvest Plan approved by the Maryland Department of Natural Resources (MDNR). Locations of Resource Conservation Areas for BPRF have been demarcated below in Figure 4.

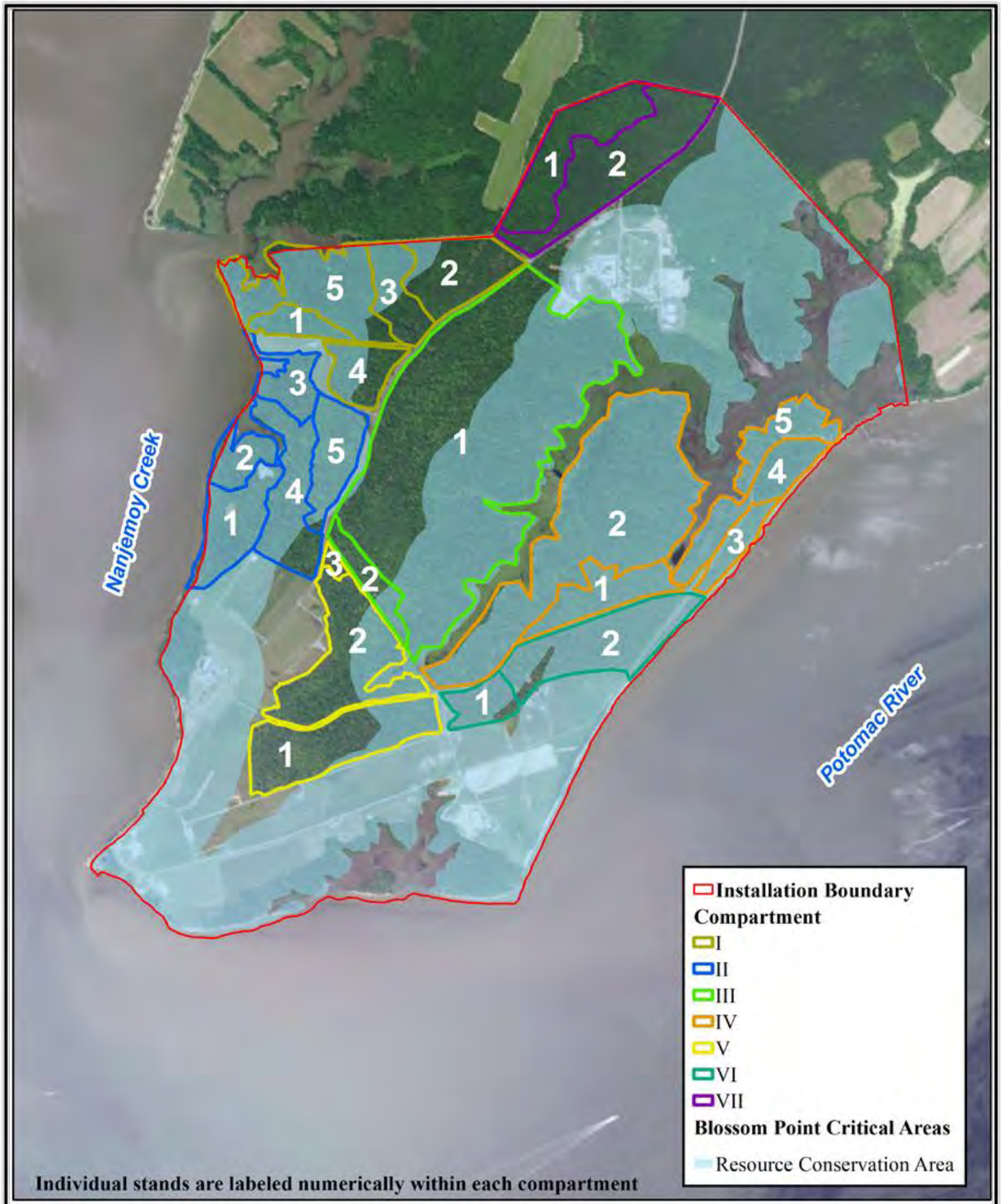


Figure 4. Blossom Point Research Facility Critical Areas

Sources: Aerial Photo, ArcMap, 2017. Boundary, ALC, 2010. Citical Areas, Maryland GIS Catalog, 2016.

6.2 Hardwood Management

Use of silvicultural practices for the long-term commercial management of hardwood stands is prescribed throughout the landscape. Management of the hardwood focuses on retention of current species by using practices which incorporate initiating and fostering the regeneration of oak. Shelterwood silvicultural treatments focus on retaining trees that are good for seed reproduction or trees with large crowns which generate a lot of seed. Retention of hardwood particularly oak is an important attribute since disturbance will generally create opportunity for early successional tree species, invasive species, and Virginia pine.

6.3 Invasive Species Management

Invasive species and pest management during forest management activities will enhance the natural ecosystems and should be implemented according to the BPRF Invasive Species Management Plan (2012) and the Integrated Pest Management Plan (2014).

Disturbances, such as timber stand improvement activities, have a greater potential to spread invasive species; therefore, measures should be taken to reduce/eliminate this potential. Equipment and tools used for forest management activities should be cleaned prior to moving between management locations within the site and also, prior to moving off site or to the site from other installations/locales.

6.4 Prescribed Fire

Controlled burns, to thin the understory, remove excessive dead plant material, and eliminate invasive plants will decrease fuel loads within the forests of BPRF, thereby decreasing the potential of wild fire frequency and severity. The Integrated Wildland Fire Management Plan (2017) details the use of prescribed burns in greater detail and should be consulted for the planning of prescribed burns.

6.5 Rare, Threatened and Endangered Species

Consultation with both U.S. Fish and Wildlife Service and the MDNR indicated that there are no known occurrences of rare, threatened and endangered species on BPRF. This does not necessarily mean that no other potential Rare, Threatened and Endangered (RTE) species exist on the site. Per the Rare Threatened and Endangered Species Survey Report (2016), an American chestnut (*Castanea dentate*) was located in Compartment III, Stand 1. The American chestnut is state-listed as S2/S3 (State rare/watchlist). The tree had a diameter at breast height (DBH) of 6 inches and a height of approximately 30 feet. It exhibited no signs of the chestnut blight. Prior to any forest management practices in this Stand, the American chestnut and a protection zone radius of 50 feet around it will have to be established and marked in the field. Figure 5 below demarcates the location of the American chestnut.

The northern long-eared bat (*Myotis septentrionalis*) is listed as a threatened species under the Endangered Species Act, due largely to the impacts of white-nose syndrome. It roosts singly or in colonies underneath bark or in crevices of live and dead trees during the summer. During the winter, the bats hibernate in caves and mines. Female northern long-eared bats roost in maternity colonies in the summer months, and typically give birth between late May and late July.

An acoustic bat survey with focus on the NLEB was conducted at BPRF during the summer of 2016. The NLEB was recorded at one sample site on BPRF. BPRF is also within the White-nose Syndrome Buffer Zone for the northern long-eared bats. The White-nose Syndrome Buffer Zone identifies the portion of the range of the northern long-eared bat within 150 miles of the boundaries of U.S. counties or Canadian districts where white-nose syndrome or the associated fungus has been detected. Under Section 7 of the Endangered Species Act, federal agencies must consult with the Service to ensure that any action they authorize, fund, permit or carry out does not jeopardize the existence of a listed species.

6.6 Bald Eagle Habitat Management

Bald eagles (*Haliaeetus leucocephalus*) - while removed from the Federal List of Endangered and Threatened Species in 2007 - are still protected under the Federal Bald Eagle and Golden Eagle Protection Act and Migratory Bird Treaty Act. All forest management activities at BPRF will be executed in alignment with the INRMP and in a manner that enhances protection of bald eagle habitat. Tree thinning or timber harvesting within 660 feet of bald eagle nests is only permitted outside of the breeding season (breeding season is December 15 through June 15). When thinning or harvesting is necessary in order to improve forest stands, wildlife habitat trees and mature trees within 330' of an eagle nest must be flagged and the 330' boundary protection zone demarcated prior to the implementation of these forest management activities.

Prescribed burns within 660' of eagle nests must also occur outside of the breeding season - preferably mid-September – mid-November - and can only be implemented when temperatures are cool, winds calm to light, and fuels are not excessively dry. The midstory, understory, and duff levels that surround trees containing eagle nests are to be inspected and managed in order to protect the tree prior to burning implementation.

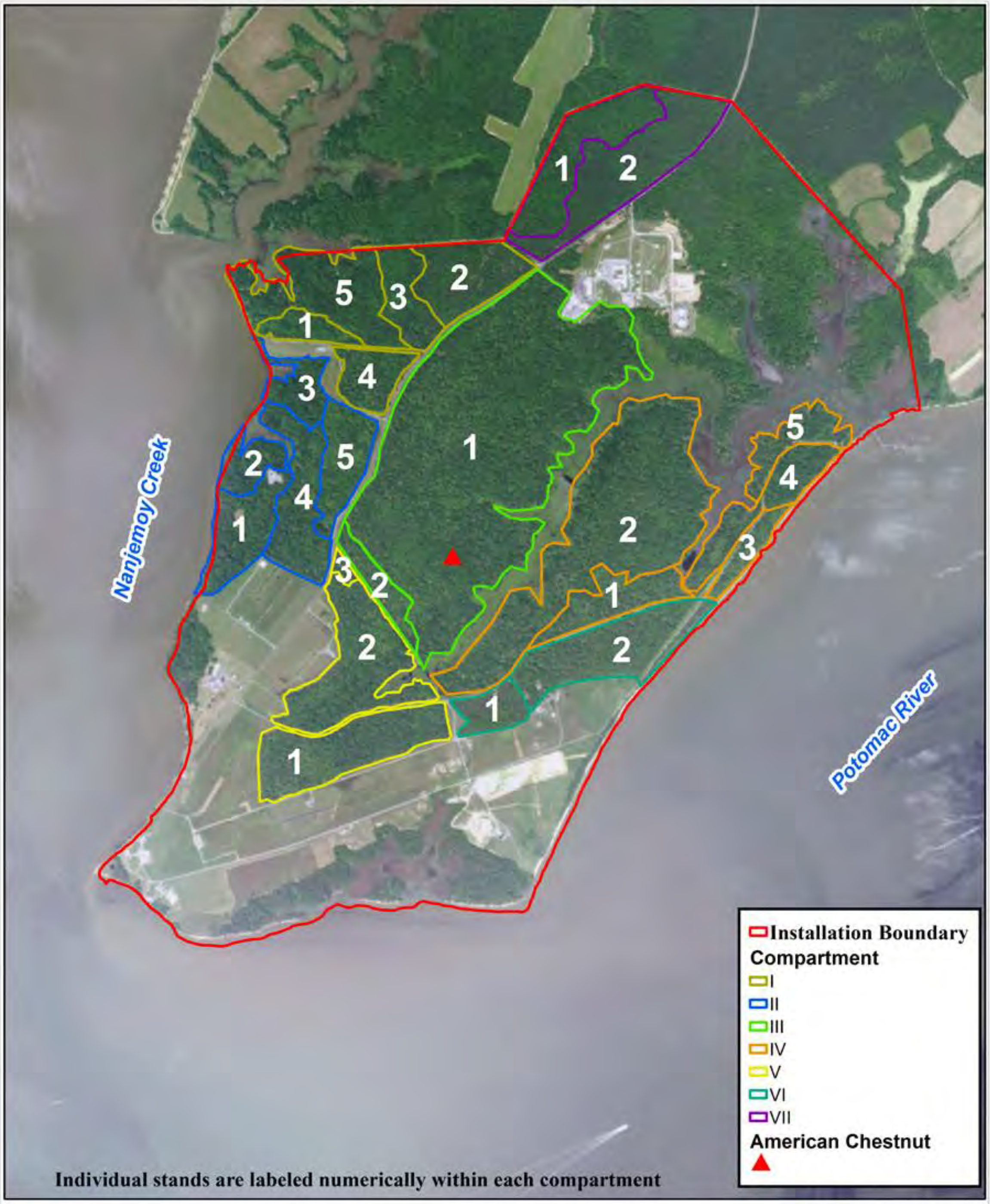


Figure 5. Blossom Point Research Facility
Rare, Threatened and Endangered Species

Sources: Aerial Photo, ArcMap, 2017. Boundary, ALC, 2010. Wetlands, NAB, 2016

6.7 White-tailed Deer Management

The forests at BPRF have an understory limited to almost exclusively American holly with little to no oak regeneration. This is due to the over-population of white-tailed deer which consume desirable species. American holly is considered to be deer "resistant" by the MDNR. Additionally, American holly has formed a dense understory in most stands which prevents natural regeneration.

In order for forest management to be successful at BPRF, reduction of the deer population is paramount and removal of the dense understory of American holly is equally important. Reducing the population of deer can be accomplished by either holding hunts for local hunters and or culling with the use of sharp shooters. It is also recommended that the land manager consider restricting forest management activities during the hunting season to increase the success rates for hunters.

6.8 Wetlands

All activities that affect wetlands require an environmental analysis in accordance with requirements of AR 200-1 and AR 200-2 as well as applicable federal and state laws and regulations. Under Section 10 of the Rivers and Harbors Act of 1899, permits must be obtained before beginning any work or building any structures in a navigable water of the United States. Section 404 of the Clean Water Act requires permits for the discharge of dredge or fill material into waters of the United States, including wetlands.

The regulations established in Title 33 of the CFR Parts 320 to 330, prescribe statutory authorities and general and special policies and procedures relevant to the review of applications for USACE permits. Before beginning any new work in waters of the United States, a district engineer must be contacted and a permit must be obtained, as appropriate.

Figure 6. Blossom Point Research Facility Wetlands

Sources: Aerial Photo, ArcMap, 2017. Boundary, ALC, 2010. Wetlands, NAB, 2016

7.0. Implementation

The 2017 BPRF INRMP shall be updated to include potential forestry management recommendations prior to the implementation of any outlined forest management activity in this plan. Additionally, NEPA documentation will be prepared to analyze and document the potential impacts of any proposed forestry management project before they are undertaken. Impacts to cultural resources, water resources, and threatened and endangered species shall be avoided.

7.1 Responsibility

The Installation or proponent must develop an annual Report of Availability (ROA) for the following FY to AEC/OACSIM Environmental by 30-May based on the INRMP over a five year period. OACSIM has oversight of the forestry program in order to ensure projected revenue will occur for the FY and approve funding to execute. OACSIM requires an ROA be submitted to approve of reimbursable funding.

7.2 Coordination

The Installation or proponent should initiate engagement with on-site staff, DPW, supporting USACE District, and AEC/OACSIM Environmental.

7.3 Regulations Review

Before undertaking forest management actions, the installation must be aware of all Army, Federal, state and local requirements, including best management practices and permits, involved in the conservation and management of natural resources and the proper disposal activities. Below is an overview of the applicable regulations for the BPRF FMP.

• **10 U.S. Code 2665, (**Sale of Certain Interests in Land; Logs), dated 7 January 2011, states that the President, through an executive department, may sell to any person or foreign government any forest products produced on land owned or leased by a military department. Each State is entitled to 40 percent of net proceeds for the year from which forest products are sold. Proceeds from timber sales may be used for:
– Improvements of forest lands.
– Unanticipated contingencies in the administration of forest lands and the production of forest products for which other sources of funds are not available in a timely manner.
– Natural resource management that implement approved plans and agreements. The reserve account may not exceed $4 million on 31 December of any calendar year. Unobligated balances exceeding $4 million on that date shall be deposited into the United States Treasury.

• **Sikes Act Improvement Act of 1997,** requires all military installations to prepare and implement an Integrated Natural Resources Management Plan (INRMP), including forest management. Timber sales may not be conducted unless the effects of the sales are compatible with the purposes of the plan.

• **DOD Instruction 4715.03**, (Natural Resources Conservation Program), dated 18 March 2011, establishes policy and assigns responsibility for compliance with applicable Federal, State, and Local statutory and regulatory requirements, policy on integrated management of natural resources on property and lands managed or controlled by the DoD, and implements new Natural Resources Conservation metrics.

• **FMR, Volume 11A, Chapter 16,** (Accounting for Production and Sale of Forest Products), prescribes policies and procedures used to account for the production and sale of forest products. DoD appropriations that incur obligations to fund the production and sale of forest products must be reimbursed from collections made as a result of the sale of those products. The chapter also outlines allowable uses of net proceeds and the establishment of a reserve account consistent with **10 U.S. Code 2665**. Chapter 16 Army Annex establishes the Army as the DoD executive agent for the Forestry Reserve Account (21X5285).

• **Maryland Forest Conservation Act,** The main purpose of the Maryland Forest Conservation Act (Natural Resources Article Section 5-1601 through 5-1613) enacted in 1991 was to minimize the loss of Maryland's forest resources during land development by making the identification and protection of forests and other sensitive areas an integral part of the site planning process. Identification of priority areas prior to development makes their retention possible. Of primary interest are areas adjacent to streams or wetlands, those on steep or erodible soils or those within or adjacent to large contiguous blocks of forest or wildlife corridors.

Although the MDNR Forest Service administers the FCA, it is implemented on a local level. Gaining approval of the required Forest Conservation Plan (development of more than one acre) may require long term protection of included priority areas or planting/replanting (afforestation or reforestation) a sensitive area off-site.

• **AR 200-1,** (Environmental Protection and Enhancement), dated 13 December 2007, (Replaced AR 200-3) covers environmental protection and enhancement, and provides framework for the environmental management system. It implements Federal, State, and local environmental laws and DoD policies for preserving, protecting, conserving, and restoring the quality of the environment. Environmental stewardship includes the management of natural resources that encompasses land. Chapter 4-3 provides program requirements for the Army's Forestry program that include the implementation of an INRMP and the management of Conservation Reimbursable funds into the Army's forestry account. This regulation provides reporting requirements of financial information related to the reimbursable forestry program and the DoD Forestry Reserve account in HQAES.

• **AR 405-80,** (Management of Title and Granting Use of Real Property), dated 10 October 1997, prescribes policy on the management and use of Army controlled real property. It consolidates and delegates authority to issue, execute, manage, renew, supplement or revoke out grants authorizing the use of Army real property and to perform certain management activities. Real property includes (among other things), timber and embedded gravel, sand, stone, or underground water under the control of the Army whether designated for disposition by the Army or by severance and removal from the land. Exclusions/exceptions include timber felled, water stored and gravel, sand or stone excavated by or for the Government prior to disposition. AR 405-80 is currently under review.

• **AR 405-90,** (Disposal of Real Estate), dated 10 May 1985, establishes authorities, responsibilities, policies, and procedures for the disposal of military and industrial real estate under the custody and control of DA. It assigns installations the responsibility for forestry management and USACE district commanders with the responsibility for selling timber. The AR allows installation commanders to sell timber valued under $1,000 at a time, not to exceed $20,000 for the fiscal year. USACE is responsible for all other sales. However, Chapter 6 (DA Disposal of Real Property) of the regulation doesn’t apply to the Army National Guard. AR 405-90 is currently under review.

• **DoD 7000.14-R Volume 11A, Chapter 16,** (Financial Management Regulation), dated August 2002, Establishes the policy and procedures used to account for the production and sale of forest products. This chapter also assigns responsibility for DoD reimbursement and for the entitlement of a state to a share in the net proceeds derived from forest products sold from military installations or facilities The DoD reserve account is covered in this chapter. Financial Management Regulation (Currently OACSIM ISE Proposal) is under legislative review. Additional information will be available by FY18.

• **Endangered Species Act,** The Endangered Species Act (ESA) of 1973 requires all federal agencies to carry out programs for the conservation of endangered and threatened species. In addition, each agency shall ensure that any action authorized, funded or carried out, is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. BPRF shall conduct Section 7 consultation with the USFWS on forest management actions that may affect listed species.

• **National Historic Preservation Act,** Section 106 of the National Historic Preservation Act of 1966, as amended, requires Garrison Commanders to identify, evaluate, and take into account the effects of undertakings on historic properties. Section 106 also requires consultation with the State Historic Preservation Officer when an agency action may have an adverse impact on eligible and historic properties. Known cultural resources at BPRF are identified and mapped in the ICRMP.

• National Environmental Policy Act, The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4321 et seq) is a federal law that requires all federal agencies to identify and analyze the potential environmental effects of certain proposed actions before those actions take place. NEPA requires all branches of the federal government to coordinate with State and local governments, and other concerned public and private organizations in the federal decision-making process and to make NEPA documentation available to all interested parties.

• **Environmental Analysis of Army Actions,** The Environmental Analysis of Army Actions; Final Rule, 32 CFR Part 651, establishes specific procedures for intra-Army NEPA implementation using a systematic, interdisciplinary, analytical approach and provides intra-agency guidance for the preparation of NEPA documents. 32 CFR Part 651 states that the integration of NEPA with other Army projects and programs planning must occur at the earliest possible time. Early integration of NEPA into the Army's decision-making process allows the Army to "identify and describe the range of reasonable alternatives to accomplish the purpose and need for the proposed action or project. 32 CFR provides Army specific guidance on Categorical Exclusions (CX), Records of Environmental Consideration (REC), Environmental Assessments, and Environmental Impact Statements (EIS). NEPA documentation will be prepared to analyze and document the potential impacts of any proposed forestry management project before they are undertaken.

• **The Clean Water Act,** The Clean Water Act (CWA) (33 USC 1251 - 1376), establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES), on the amounts of specific pollutants that are discharged to surface waters in order to restore and maintain the chemical, physical, and biological integrity of the water as established by ambient water quality standards. Potential impacts on wetland areas would be subject to a Section 404 Clean Water Act permit that would be obtained through the USACE.

• **DoD Instruction 6055.06,** DoD Fire and Emergency Services (F&ES) Program, dated 21 December 2006, establishes uniform professional qualification standards, standardized training, and certification procedures for all DoD Fire and Emergency Services personnel.

• **DoD Instruction 6055.17,** DoD Installation Emergency Management (IEMP) Program, dated 19 November 2010, establishes policy, assigns responsibilities, and prescribes procedures for developing, implementing, and sustaining IEM programs at DoD installations worldwide for 'all hazards' as defined in the glossary and aligns DoD emergency management (EM) activities with the National Incident Management System (NIMS), the National Preparedness Guidelines (NPG), and the National Response Framework (NRF).

8.0. References

DOD. 2014 Financial Management Regulation Volume 11A. Reimbursable Operations Policy (DOD 7000.14-R) Washington D.C.

DOD. 2013 Integrated Natural Resources Management Plan (INRMP) Implementation Manual (DOD Instruction 4715.03) Washington D.C.

Lister, T.W.; Widmann, R.H. 2016. Forests of Maryland, 2015. Resource Update FS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

Maryland Dept. of Natural Resources, 3rd ed., 1997. State Forest Conservation Technical Manual. Dept. of Natural Resources, Annapolis, Maryland.

Maryland Dept. of Natural Resources, 1995. Forestry Best Management Practices: Managing to Save the Bay, Annapolis, Maryland.

Maryland Dept. of Natural Resources. 2012. Critical Area Commission for the Chesapeake and Atlantic Coastal Bays Website. Annapolis, MD. Available online at: http://www.dnr.state.md.us/criticalarea/. Accessed on March 30, 2017.

Maryland Dept. of Natural Resources, 2017. Forest Conservation Act Website. Available online at: http://dnr.maryland.gov/forests/Pages/programapps/newFCA.aspx. Accessed on April 13, 2017.

Smith D.M. 9th ed., 1996. The Practice of Silviculture: Applied Forest Ecology. New York: John Wiley & Sons, Inc.

U.S. Army Adelphi Laboratory Center. 1997b. Forest Delineation and Conservation Report for U.S. Army Research Laboratory Center. ALC Department of Public Works, Adelphi, Maryland.

U.S. Army Adelphi Laboratory Center. 2017. U.S. Army Adelphi Laboratory Center Integrated Natural Resources Management Plan. ALC Department of Public Works, Adelphi, Maryland.

U.S. Department of Agriculture (USDA) Forest Service Northern Research Station. 2017. FIA Species Codes. Available online at: https://www.nrs.fs.fed.us/fia/datacollection/fieldguides/ver6.0/Appendix%203.pdf Accessed March 31, 2017.

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. 2009. Web Soil Survey for Charles County, Maryland. Available online at: http://websoilsurvey.nrcs.usda.gov. Accessed March 30, 2017.

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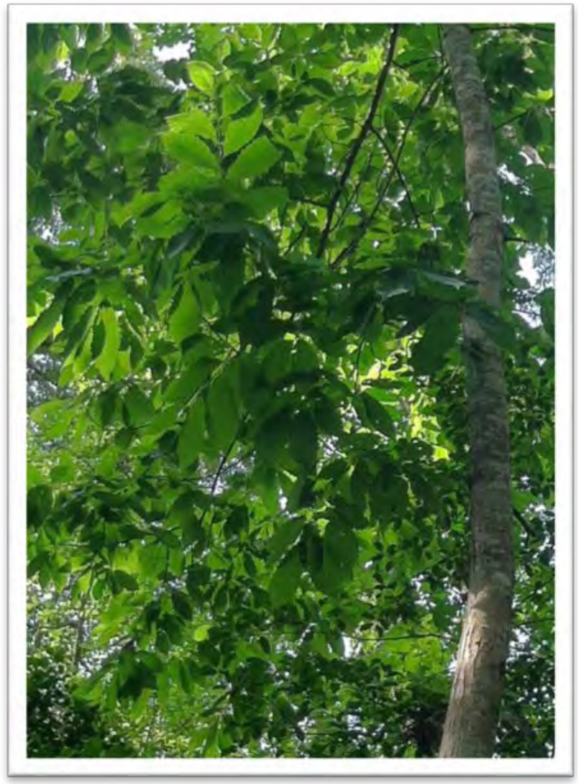
APPENDIX A
PHOTOGRAPHIC RECORD

Photographic Record

Blossom Point Research Facility
Forest Stand Delineation
June 2016– January 2017

Compartment II - Stand 4 (40” DBH Yellow Poplar)



Compartment III – Stand 1 (American Chestnut)

Compartment II – Stand 4 (Eastern Box Turtle)

Compartment III- Stand 2 (Windblown Virginia Pine)

Photographic Record

Blossom Point Research Facility
Forest Stand Delineation
June 2016– January 2017

Compartment IV- Stand 1 (American Holly mid story)

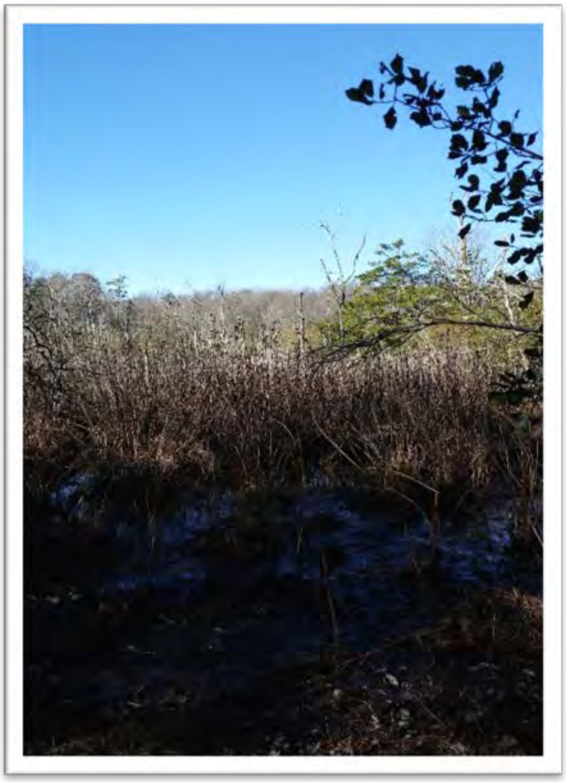
Compartment IV- Stand 2
(open understory & no oak regeneration)

Compartment V - Stand 3 (Loblolly Pine)

Compartment V (American Holly and deer stand)

Photographic Record

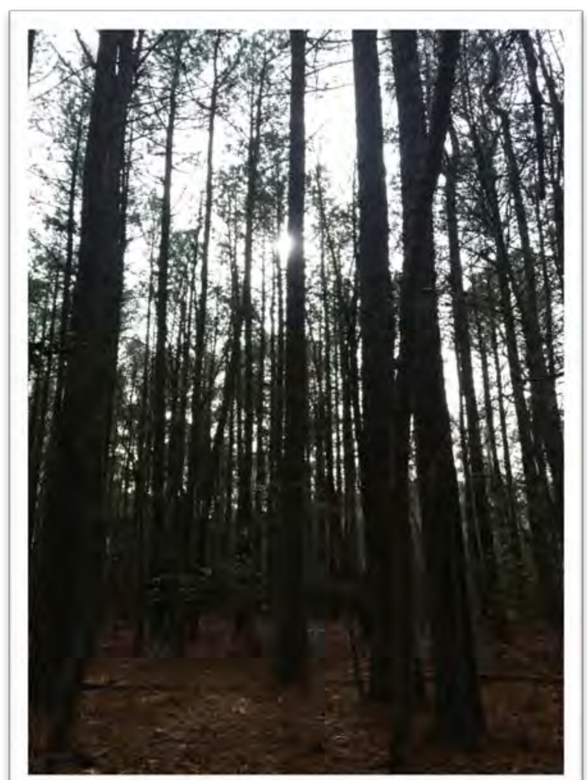
Blossom Point Research Facility
Forest Stand Delineation
June 2016– January 2017



Compartment IV (Edge of wetlands)

Compartment VII Stand 1 (White Oak)

Compartment VII-Stand 2 (American Holly)



Compartment VII- Stand 2 (Loblolly Pine)

APPENDIX B

FOREST INVENTORY DATA SHEETS

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp I Stand 1
LANDCOVER: Poplar/Hwd
ACRES: 8
PLOTS: 2
DATE: 01/04/17
CRUISER: AW

	6"			8"			10"							12"							14"						
SPECIES	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																											
Longleaf/Pitch/ Other Pine																											
Virginia Pine Pinus virginiana					5.0			5.0																			
White Oak Quercus alba																											
Chestnut Oak Quercus prinus																											
Southern Red Oak Quercus falcata & B O																											
Sweet Gum Liquidambar styraciflua									5.0																		
Yellow Poplar Liriodendron tulipifera																											
Willow Oak																											
Hickory																											
Other Hardwoods																						5.0	10.0				

	16"							18"							20"							22+"							TOTALS	
SPECIES	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																		10.0							5.0					15
Longleaf/Pitch/ Other Pine																														
Virginia Pine Pinus virginiana																													10	
White Oak Quercus alba																														
Chestnut Oak Quercus prinus																														
Southern Red Oak Quercus falcata & B O																														
Sweet Gum Liquidambar styraciflua																													5	
Yellow Poplar Liriodendron tulipifera																														
Willow Oak				5.0						10.0	5.0							5.0							5.0				10	20
Hickory				5.0																					5.0					10
Other Hardwoods										10.0																			25	

TOTALS:	PW	PW	PW	ST	PW	ST	PW	ST	PW	ST	PW	ST	PW	ST	PW	ST	PW	ST
SOFTWOOD:		5	5											10		5	10	15
HARDWOOD:			5				15			10	20	5		5		10	40	30

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -122

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp I Stand 2
LANDCOVER: Hwd/Pine
ACRES: 23
PLOTS: 6
DATE: 01/23/17
CRUISER: AW

SPECIES	6" 16	6" 32	6" 48	8" 16	8" 32	8" 48	10" 16	10" 32	10" 48	10" 1	10" 2	10" 3	10" 4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana	6.7				11.7			3.3					
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O													
Sweet Gum Liquidambar styraciflua	5.0			3.3	8.3			11.7					
Yellow Poplar Liriodendron tulipifera													
Willow Oak	3.3			6.7	1.7		1.7	1.7	1.7				
Hickory													
Other Hardwoods	1.7			3.3				3.3	3.3				

SPECIES	12" 16	12" 32	12" 48	12" 1	12" 2	12" 3	12" 4	14" 16	14" 32	14" 48	14" 1	14" 2	14" 3	14" 4
Loblolly Pine Pinus taeda					1.7									
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana		1.7							1.7					
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua			3.3	3.3							5.0			
Yellow Poplar Liriodendron tulipifera														
Willow Oak			1.7											
Hickory														
Other Hardwoods		1.7												

SPECIES	16" 16	16" 32	16" 48	16" 1	16" 2	16" 3	16" 4	18" 16	18" 32	18" 48	18" 1	18" 2	18" 3	18" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana		1.7												
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				1.7										
Sweet Gum Liquidambar styraciflua														
Yellow Poplar Liriodendron tulipifera				1.7							1.7			
Willow Oak														
Hickory														
Other Hardwoods		1.7									1.7			

SPECIES	20" 16	20" 32	20" 48	20" 1	20" 2	20" 3	20" 4	22+" 16	22+" 32	22+" 48	22+" 1	22+" 2	22+" 3	22+" 4	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda				1.7							3.3					7
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana															27	
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O																2
Sweet Gum Liquidambar styraciflua															32	8
Yellow Poplar Liriodendron tulipifera																3
Willow Oak															18	
Hickory																
Other Hardwoods															15	2

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	PW	ST
SOFTWOOD:	7	12	3		2	2	2		2					2		3	27	7
HARDWOOD:	10	23	23		7	3		5	2	3		3					65	15

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -47

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp I Stand 3
LANDCOVER: Pine/Hwd
ACRES: 18
PLOTS: 6
DATE: 01/23/17
CRUISER: AW

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda	1.7							1.7					
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana	1.7				6.7			5.0	3.3				
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O	1.7								3.3				
Sweet Gum Liquidambar styraciflua	3.3			1.7	5.0			3.3					
Yellow Poplar Liriodendron tulipifera		1.7			1.7				5.0				
Willow Oak	1.7				3.3			3.3	1.7				
Hickory													
Other Hardwoods				1.7	1.7			5.0					

SPECIES	12"							14"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda				3.3										
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana		6.7		1.7				1.7						
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua														
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods														

SPECIES	16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda				1.7	5.0							8.3		
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana		1.7									1.7			
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua														
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods														

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda					1.7							1.7			3	22
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana															27	3
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O															5	
Sweet Gum Liquidambar styraciflua															13	
Yellow Poplar Liriodendron tulipifera															8	
Willow Oak															10	
Hickory																
Other Hardwoods															8	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	PW	ST
SOFTWOOD:	3	7	10		7	5	2		2	7		10		2		2	30	25
HARDWOOD:	8	15	22														45	

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -12

BASAL AREA PER ACRE

TRACT: BPRF
SEC-TWN-RNG: Comp I Stand 4
LANDCOVER: Mixed Hwd

This only applies when 10-BAF Prism cruise design is used.

ACRES: 12
PLOTS: 3
DATE: 01/24/17
CRUISER: AW

SPECIES	6"	8"	10"	12"	14"	16"	18"	20"	22+"	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda											
Longleaf/Pitch/ Other Pine											
Virginia Pine Pinus virginiana						3.3					3
White Oak Quercus alba					3.3		3.3				7
Chestnut Oak Quercus prinus											
Southern Red Oak Quercus falcata & B O					3.3	3.3	3.3 3.3	3.3 3.3 3.3 3.3	6.7	13	20
Sweet Gum Liquidambar styraciflua		3.3	3.3	3.3			6.7			10	7
Yellow Poplar Liriodendron tulipifera									3.3		3
Willow Oak									3.3		3
Hickory					3.3						3
Other Hardwoods	13.3	3.3				3.3				17	3

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:										3								3
HARDWOOD:	13	7	3		3		3	7	3	3		17	7	7		13	40	47

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -111

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp I Stand 5
LANDCOVER: Oak/Poplar
ACRES: 41
PLOTS: 10
DATE: 01/24/17
CRUISER: AW

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O	1.0			1.0									
Sweet Gum Liquidambar styraciflua						1.0			1.0				
Yellow Poplar Liriodendron tulipifera													
Willow Oak													
Hickory	1.0			1.0	3.0			2.0					
Other Hardwoods								6.0					

SPECIES	12"							14"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus		1.0							1.0					
Southern Red Oak Quercus falcata & B O				1.0						1.0				
Sweet Gum Liquidambar styraciflua			1.0											
Yellow Poplar Liriodendron tulipifera				1.0	2.0						1.0	1.0		
Willow Oak														
Hickory														
Other Hardwoods														

SPECIES	16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus										1.0	1.0			
Southern Red Oak Quercus falcata & B O				1.0							2.0	1.0		
Sweet Gum Liquidambar styraciflua					1.0					1.0				
Yellow Poplar Liriodendron tulipifera					2.0						4.0	2.0	1.0	
Willow Oak												1.0		
Hickory														
Other Hardwoods														

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba																
Chestnut Oak Quercus prinus			1.0		4.0					1.0	9.0	9.0	1.0		5	24
Southern Red Oak Quercus falcata & B O				3.0	5.0						3.0	7.0	2.0		3	25
Sweet Gum Liquidambar styraciflua															4	1
Yellow Poplar Liriodendron tulipifera				1.0	2.0	4.0					4.0	10.0				35
Willow Oak					1.0	1.0					1.0	2.0				6
Hickory															7	
Other Hardwoods															6	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	PW	ST
SOFTWOOD:																		
HARDWOOD:	2	6	9		2	4	2	2		4	2	12	1	21	1	48	25	91

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -103

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp II Stand 1
LANDCOVER: Poplar/Hwd
ACRES: 22
PLOTS: 6
DATE: 01/24/17
CRUISER: AW

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O													
Sweet Gum Liquidambar styraciflua								3.3					
Yellow Poplar Liriodendron tulipifera								1.7					
Willow Oak													
Hickory								1.7					
Other Hardwoods	1.7				1.7		1.7	3.3					
								1.7					
TOTALS:	PW			PW			PW			ST			
SOFTWOOD:													
HARDWOOD:	2			2			13						

SPECIES	12"							14"							16"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																					
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana																					
White Oak Quercus alba																					
Chestnut Oak Quercus prinus																		1.7			
Southern Red Oak Quercus falcata & B O																					
Sweet Gum Liquidambar styraciflua									1.7												
Yellow Poplar Liriodendron tulipifera																	1.7	1.7	1.7		
Willow Oak																					
Hickory		1.7		1.7																	
Other Hardwoods											1.7										
		1.7							1.7		1.7							1.7			
TOTALS:	PW			ST				PW			ST				PW			ST			
SOFTWOOD:																					
HARDWOOD:	3			2				3			3				2			7			

SPECIES	18"							20"							22+"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																					
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana																					
White Oak Quercus alba																					
Chestnut Oak Quercus prinus																					
Southern Red Oak Quercus falcata & B O																	1.7	1.7	5.0		
Sweet Gum Liquidambar styraciflua			1.7																		
Yellow Poplar Liriodendron tulipifera			1.7	11.7						3.3	6.7	10.0						6.7	8.3		
Willow Oak																		8.3			
Hickory																					
Other Hardwoods																					
TOTALS:	PW			ST				PW			ST				PW			ST			
SOFTWOOD:																					
HARDWOOD:	3			12				3			17				2			30			

SPECIES	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda		
Longleaf/Pitch/ Other Pine		
Virginia Pine Pinus virginiana		
White Oak Quercus alba		
Chestnut Oak Quercus prinus		2
Southern Red Oak Quercus falcata & B O	2	7
Sweet Gum Liquidambar styraciflua	7	
Yellow Poplar Liriodendron tulipifera	8	47
Willow Oak		8
Hickory	3	2
Other Hardwoods	8	2
	5	3
SOFTWOOD:		
HARDWOOD:	33	70

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -108

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp II Stand 2
LANDCOVER: Oak/Hwd
ACRES: 11
PLOTS: 3
DATE: 01/24/17
CRUISER: AW

SPECIES	6"			8"			10"							12"						
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																				
Longleaf/Pitch/ Other Pine																				
Virginia Pine Pinus virginiana																				
White Oak Quercus alba																				
Chestnut Oak Quercus prinus																				
Southern Red Oak Quercus falcata & B O																				
Sweet Gum Liquidambar styraciflua															3.3					
Yellow Poplar Liriodendron tulipifera																				
Willow Oak																				
Hickory				3.3	3.3															
Other Hardwoods	6.7			6.7	3.3			3.3							3.3					

SPECIES	14"							16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																					
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana																					
White Oak Quercus alba																					
Chestnut Oak Quercus prinus																					
Southern Red Oak Quercus falcata & B O																					
Sweet Gum Liquidambar styraciflua																					
Yellow Poplar Liriodendron tulipifera																					
Willow Oak																					
Hickory																					
Other Hardwoods		3.3								6.7							3.3				

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba											3.3	3.3				7
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O											3.3	3.3				7
Sweet Gum Liquidambar styraciflua					3.3										3	3
Yellow Poplar Liriodendron tulipifera											3.3	3.3				7
Willow Oak					3.3						3.3	13.3	3.3			23
Hickory															7	
Other Hardwoods				3.3											37	3

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:																		
HARDWOOD:	7	17	3		7		3		7		3			10		40	47	50

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -108

BASAL AREA PER ACRE

TRACT: BPRF

SEC-TWN-RNG: Comp II Stand 3

This only applies when 10-BAF Prism cruise design is used.

LANDCOVER: Oak/Hwd | ACRES: 11 | # PLOTS: 3

DATE: 01/24/17 | CRUISER: AW

SPECIES	6"			8"			10"							12"						
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																				
Longleaf/Pitch/ Other Pine																				
Virginia Pine Pinus virginiana																				
White Oak Quercus alba																				
Chestnut Oak Quercus prinus								3.3												
Southern Red Oak Quercus falcata & B O																				
Sweet Gum Liquidambar styraciflua																				
Yellow Poplar Liriodendron tulipifera																				
Willow Oak																				
Hickory	3.3																			
Other Hardwoods	10.0				3.3		3.3													
TOTALS:	PW			PW			PW			ST				PW			ST			
SOFTWOOD:																				
HARDWOOD:	13			3			7													

SPECIES	14"							16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																					
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana																					
White Oak Quercus alba											3.3							3.3			
Chestnut Oak Quercus prinus											3.3								3.3		
Southern Red Oak Quercus falcata & B O			3.3						3.3									3.3			
Sweet Gum Liquidambar styraciflua																3.3					
Yellow Poplar Liriodendron tulipifera																					
Willow Oak																					
Hickory																					
Other Hardwoods																		3.3			
TOTALS:	PW			ST				PW			ST				PW			ST			
SOFTWOOD:																					
HARDWOOD:	3							3			7				3			13			

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba																7
Chestnut Oak Quercus prinus					3.3					3.3		6.7	3.3		7	20
Southern Red Oak Quercus falcata & B O					6.7	6.7						3.3	3.3		7	23
Sweet Gum Liquidambar styraciflua															3	
Yellow Poplar Liriodendron tulipifera					3.3											3
Willow Oak											6.7		3.3			10
Hickory															3	
Other Hardwoods															17	3
TOTALS:	PW			ST				PW			ST				PW	ST
SOFTWOOD:																
HARDWOOD:				20				3			27				37	67

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -108

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF				DATE:	01/24/17
SEC-TWN-RNG:	Comp II Stand 4	LANDCOVER: Oak/Poplar	ACRES: 31	# PLOTS: 8	CRUISER:	AW

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O					1.3								
Sweet Gum Liquidambar styraciflua	2.5			1.3				3.8					
Yellow Poplar Liriodendron tulipifera								1.3					
Willow Oak													
Hickory	1.3												
Other Hardwoods	2.5							2.5					

SPECIES	12"							14"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus		1.3												
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua		1.3		3.8										
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods		2.5								1.3				

SPECIES	16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba				1.3										
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O		1.3		2.5							3.8			
Sweet Gum Liquidambar styraciflua										1.3	1.3			
Yellow Poplar Liriodendron tulipifera										2.5	2.5			
Willow Oak											3.8			
Hickory				1.3										
Other Hardwoods				2.5						1.3				

SPECIES	20"							22+"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana			1.3											
White Oak Quercus alba														
Chestnut Oak Quercus prinus				2.5							1.3			
Southern Red Oak Quercus falcata & B O			2.5	1.3	3.8						1.3	7.5		
Sweet Gum Liquidambar styraciflua			1.3											
Yellow Poplar Liriodendron tulipifera				3.8							2.5	3.8		
Willow Oak														
Hickory														
Other Hardwoods										1.3				

SPECIES	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda		
Longleaf/Pitch/ Other Pine		
Virginia Pine Pinus virginiana	1	
White Oak Quercus alba		1
Chestnut Oak Quercus prinus	1	4
Southern Red Oak Quercus falcata & B O	5	20
Sweet Gum Liquidambar styraciflua	11	5
Yellow Poplar Liriodendron tulipifera	4	13
Willow Oak		4
Hickory	1	1
Other Hardwoods	11	3

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:													1					
HARDWOOD:	6	3	8		5	4	1		1	8	5	11	4	11	1	16	34	50

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High	Southern Pine Beetle Hazard Score:	-108

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp II Stand 5
LANDCOVER: Oak/Hwd
ACRES: 20
PLOTS: 5
DATE: 01/24/17
CRUISER: AW

SPECIES	6"			8"			10"							12"						
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																				
Longleaf/Pitch/ Other Pine																				
Virginia Pine Pinus virginiana																				
White Oak Quercus alba																				
Chestnut Oak Quercus prinus																				
Southern Red Oak Quercus falcata & B O								2.0							2.0					
Sweet Gum Liquidambar styraciflua	2.0				2.0				4.0											
Yellow Poplar Liriodendron tulipifera																				
Willow Oak								2.0												
Hickory					2.0		2.0		2.0											
Other Hardwoods				2.0	4.0			4.0	2.0											

SPECIES	14"							16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																					
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana																					
White Oak Quercus alba																					
Chestnut Oak Quercus prinus																					
Southern Red Oak Quercus falcata & B O																			2.0		
Sweet Gum Liquidambar styraciflua			2.0	4.0							2.0	4.0						2.0	2.0		
Yellow Poplar Liriodendron tulipifera																					
Willow Oak																		4.0	6.0		
Hickory																					
Other Hardwoods																2.0	2.0				

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba												2.0				2
Chestnut Oak Quercus prinus										2.0		2.0			2	2
Southern Red Oak Quercus falcata & B O				4.0							4.0	2.0			4	12
Sweet Gum Liquidambar styraciflua															10	14
Yellow Poplar Liriodendron tulipifera				2.0								2.0				4
Willow Oak					6.0						2.0	6.0			2	24
Hickory															6	
Other Hardwoods			2.0												18	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:																		
HARDWOOD:	2	10	18		2		2	4		6	4	16	2	12	2	20	42	58

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -96

BASAL AREA PER ACRE

TRACT: BPRF
SEC-TWN-RNG: Comp III Stand 1
LANDCOVER: Oak/Hwd

This only applies when 10-BAF Prism cruise design is used.

ACRES: 240
PLOTS: 10
DATE: 02/22/17
CRUISER: AW

SPECIES	6" 16	6" 32	6" 48	8" 16	8" 32	8" 48	10" 16	10" 32	10" 48	10" 1	10" 2	10" 3	10" 4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O					1.0			3.0	1.0				
Sweet Gum Liquidambar styraciflua	4.0	2.0						2.0	2.0				
Yellow Poplar Liriodendron tulipifera													
Willow Oak													
Hickory													
Other Hardwoods	5.0				1.0			1.0	1.0				

SPECIES	12" 16	12" 32	12" 48	12" 1	12" 2	12" 3	12" 4	14" 16	14" 32	14" 48	14" 1	14" 2	14" 3	14" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O		1.0		3.0										
Sweet Gum Liquidambar styraciflua				4.0					1.0		1.0	1.0		
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods		1.0												

SPECIES	16" 16	16" 32	16" 48	16" 1	16" 2	16" 3	16" 4	18" 16	18" 32	18" 48	18" 1	18" 2	18" 3	18" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana				1.0	1.0									
White Oak Quercus alba					1.0							1.0		
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				1.0	8.0						1.0	3.0		
Sweet Gum Liquidambar styraciflua				1.0	3.0							2.0		
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods										1.0				

SPECIES	20" 16	20" 32	20" 48	20" 1	20" 2	20" 3	20" 4	22+" 16	22+" 32	22+" 48	22+" 1	22+" 2	22+" 3	22+" 4	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana				1.0												3
White Oak Quercus alba					2.0						2.0	7.0				13
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O				5.0	5.0	2.0					3.0	10.0			6	41
Sweet Gum Liquidambar styraciflua															11	12
Yellow Poplar Liriodendron tulipifera																
Willow Oak																
Hickory																
Other Hardwoods															10	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:										2				1				3
HARDWOOD:	11	2	10		2	7	1	2		14	1	7		14		22	27	66

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -95

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp III Stand 2
LANDCOVER: Hwd/Pine
ACRES: 11
PLOTS: 3
DATE: 02/22/17
CRUISER: AW

SPECIES	6"			8"			10"							12"						
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																				
Longleaf/Pitch/ Other Pine																				
Virginia Pine Pinus virginiana																				
White Oak Quercus alba																				
Chestnut Oak Quercus prinus																				
Southern Red Oak Quercus falcata & B O	3.3							3.3												
Sweet Gum Liquidambar styraciflua																				
Yellow Poplar Liriodendron tulipifera																				
Willow Oak																				
Hickory																				
Other Hardwoods	16.7				3.3												3.3			
TOTALS:	PW			PW			PW			ST				PW			ST			
SOFTWOOD:																				
HARDWOOD:	20			3			3										3			

SPECIES	14"							16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda												3.3									
Longleaf/Pitch/ Other Pine																					
Virginia Pine Pinus virginiana											6.7										
White Oak Quercus alba																					
Chestnut Oak Quercus prinus																					
Southern Red Oak Quercus falcata & B O		3.3									3.3										
Sweet Gum Liquidambar styraciflua																					
Yellow Poplar Liriodendron tulipifera				3.3						3.3											
Willow Oak																					
Hickory				3.3																	
Other Hardwoods																					
TOTALS:	PW			ST				PW			ST				PW			ST			
SOFTWOOD:											10										
HARDWOOD:	3			7				3			3										

SPECIES	20"							22+"							TOTALS PW	TOTALS ST
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																3
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																7
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O					3.3										10	7
Sweet Gum Liquidambar styraciflua																
Yellow Poplar Liriodendron tulipifera															3	3
Willow Oak																
Hickory																3
Other Hardwoods															20	3
TOTALS:	PW			ST				PW			ST				PW	ST
SOFTWOOD:																10
HARDWOOD:				3											33	17

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -121

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF	DATE:	02/22/17
SEC-TWN-RNG:	Comp IV Stand 2	CRUISER:	AW
LANDCOVER:	Oak/Hwd	ACRES:	123
# PLOTS:	16		

SPECIES	6"			8"			10"							12"							14"							16"							18"							20"							22+"							TOTALS	
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																																																									
Longleaf/Pitch/ Other Pine																																																									
Virginia Pine Pinus virginiana																																														0.6												1
White Oak Quercus alba	0.6																1.3														0.6							0.6							0.6	0.6						0.6	0.6			1	5
Chestnut Oak Quercus prinus	0.6																												1.3											0.6						0.6	1.3											2	3
Southern Red Oak Quercus falcata & B O	0.6				2.5			0.6							1.9		3.1							2.5							3.8	1.9						6.9	1.9	1.3					6.9	4.4						2.5	5.0			6	40
Sweet Gum Liquidambar styraciflua	0.6			0.6	1.9			2.5							0.6		0.6							1.3	0.6						1.9							0.6	0.6	0.6					0.6	0.6										6	8
Yellow Poplar Liriodendron tulipifera																																														1.3											1
Willow Oak																																																									
Hickory																																																									
Other Hardwoods	5.6			1.3	0.6			1.3																																																9	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:														1				1
HARDWOOD:	8	7	4		3	5		4	1	8		13		17		9	23	56

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: #VALUE!

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF			DATE:	02/22/17
SEC-TWN-RNG:	Comp IV Stand 3	LANDCOVER:	Mxd Hwd	ACRES:	9
# PLOTS:	3	CRUISER:	AW		

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O	3.3				3.3								
Sweet Gum Liquidambar styraciflua					6.7			10.0					
Yellow Poplar Liriodendron tulipifera													
Willow Oak													
Hickory													
Other Hardwoods	13.3			6.7				6.7					

SPECIES	12"							14"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana											3.3			
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua		3.3		3.3							6.7	3.3		
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods									3.3			3.3		

SPECIES	16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana					3.3									
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				3.3							3.3			
Sweet Gum Liquidambar styraciflua												3.3		
Yellow Poplar Liriodendron tulipifera					3.3									
Willow Oak														
Hickory														
Other Hardwoods														

SPECIES	20"							22+"							TOTALS PW	TOTALS ST
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																7
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O															7	7
Sweet Gum Liquidambar styraciflua															20	17
Yellow Poplar Liriodendron tulipifera																3
Willow Oak																
Hickory																
Other Hardwoods															30	3

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:								3		3								7
HARDWOOD:	17	17	17		3	3	3	13		7		7					57	30

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -90

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT: BPRF
SEC-TWN-RNG: Comp IV Stand 4
LANDCOVER: Mxd Hwd
ACRES: 16
PLOTS: 4
DATE: 02/22/17
CRUISER: AW

SPECIES	6"			8"			10"						
	16	32	48	16	32	48	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O													
Sweet Gum Liquidambar styraciflua		2.5			7.5								
Yellow Poplar Liriodendron tulipifera													
Willow Oak													
Hickory													
Other Hardwoods	12.5	2.5		10.0			2.5	2.5					

SPECIES	12"							14"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				2.5										
Sweet Gum Liquidambar styraciflua										2.5	2.5	2.5		
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods		2.5									2.5			

SPECIES	16"							18"						
	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O														
Sweet Gum Liquidambar styraciflua												5.0		
Yellow Poplar Liriodendron tulipifera													2.5	
Willow Oak														
Hickory														
Other Hardwoods														

SPECIES	20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O					5.0						10.0	10.0				28
Sweet Gum Liquidambar styraciflua					2.5	7.5									13	20
Yellow Poplar Liriodendron tulipifera												2.5				5
Willow Oak																
Hickory																
Other Hardwoods															33	3

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:																		
HARDWOOD:	18	18	5		3	3	3	8				8		15		23	45	55

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -112

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF			DATE:	02/22/17
SEC-TWN-RNG:	Comp IV Stand 5	LANDCOVER:	Mxd Hwd	ACRES:	12
# PLOTS:	3	CRUISER:	AW		

SPECIES	6"			8"			10"							12"							14"						
	16	32	48	16	32	48	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4
Loblolly Pine Pinus taeda																											
Longleaf/Pitch/ Other Pine								3.3																			
Virginia Pine Pinus virginiana				3.3																					3.3		
White Oak Quercus alba																											
Chestnut Oak Quercus prinus																											
Southern Red Oak Quercus falcata & B O																	10.0							3.3			
Sweet Gum Liquidambar styraciflua																								6.7			
Yellow Poplar Liriodendron tulipifera																											
Willow Oak																											
Hickory																											
Other Hardwoods	3.3			10.0				10.0																			

SPECIES	16"							18"							20"							22+"							TOTALS	
	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	16	32	48	1	2	3	4	PW	ST
Loblolly Pine Pinus taeda																														
Longleaf/Pitch/ Other Pine																													3	
Virginia Pine Pinus virginiana																													3	3
White Oak Quercus alba																														
Chestnut Oak Quercus prinus																									3.3					3
Southern Red Oak Quercus falcata & B O				3.3							3.3							6.7					3.3	3.3	6.7	13.3	6.7		7	53
Sweet Gum Liquidambar styraciflua				3.3	3.3							3.3																		17
Yellow Poplar Liriodendron tulipifera																				3.3										3
Willow Oak																														
Hickory																														
Other Hardwoods																													23	

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:		3	3					3									7	3
HARDWOOD:	3	10	10			10		10		10		7		10	7	30	30	77

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: -71

BPRF_FMP_Comp-IV_Stand-5_12ac_tally_sheet22Feb17xlsx.xlsx3/23/2017

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF			DATE:	02/22/17
SEC-TWN-RNG:	Comp V Stand 1	LANDCOVER:	Oak/Hwd	ACRES:	39
# PLOTS:	10	CRUISER:	AW		

SPECIES	6" 16	6" 32	6" 48	8" 16	8" 32	8" 48	10" 16	10" 32	10" 48	10" 1	10" 2	10" 3	10" 4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O													
Sweet Gum Liquidambar styraciflua		2.0			1.0			1.0	1.0				
Yellow Poplar Liriodendron tulipifera								1.0					
Willow Oak					2.0								
Hickory	4.0	1.0		1.0									
Other Hardwoods	7.0				3.0			2.0					

SPECIES	12" 16	12" 32	12" 48	12" 1	12" 2	12" 3	12" 4	14" 16	14" 32	14" 48	14" 1	14" 2	14" 3	14" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O											5.0			
Sweet Gum Liquidambar styraciflua														
Yellow Poplar Liriodendron tulipifera														
Willow Oak											1.0			
Hickory														
Other Hardwoods														

SPECIES	16" 16	16" 32	16" 48	16" 1	16" 2	16" 3	16" 4	18" 16	18" 32	18" 48	18" 1	18" 2	18" 3	18" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana												1.0		
White Oak Quercus alba														
Chestnut Oak Quercus prinus		1.0												
Southern Red Oak Quercus falcata & B O				2.0	2.0					1.0	5.0	2.0		
Sweet Gum Liquidambar styraciflua				1.0							1.0			
Yellow Poplar Liriodendron tulipifera														
Willow Oak											2.0			
Hickory				1.0										
Other Hardwoods				1.0										

SPECIES	20" 16	20" 32	20" 48	20" 1	20" 2	20" 3	20" 4	22+" 16	22+" 32	22+" 48	22+" 1	22+" 2	22+" 3	22+" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O			1.0	6.0	13.0						1.0	7.0		
Sweet Gum Liquidambar styraciflua														
Yellow Poplar Liriodendron tulipifera														
Willow Oak					1.0						2.0	3.0		
Hickory														
Other Hardwoods														

SPECIES	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda		
Longleaf/Pitch/ Other Pine		
Virginia Pine Pinus virginiana		1
White Oak Quercus alba		
Chestnut Oak Quercus prinus	1	
Southern Red Oak Quercus falcata & B O	2	43
Sweet Gum Liquidambar styraciflua	5	2
Yellow Poplar Liriodendron tulipifera	1	
Willow Oak	2	9
Hickory	6	1
Other Hardwoods	12	1

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:												1						1
HARDWOOD:	14	7	5					6	1	7	1	10	1	20		13	29	56

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High

Southern Pine Beetle Hazard Score: #VALUE!

BASAL AREA PER ACRE

This only applies when 10-BAF Prism cruise design is used.

TRACT:	BPRF							DATE:	02/22/17
SEC-TWN-RNG:	Comp V Stand 2	LANDCOVER:	Oak/Hwd	ACRES:	43	# PLOTS:	6	CRUISER:	AW

SPECIES	6" 16	6" 32	6" 48	8" 16	8" 32	8" 48	10" 16	10" 32	10" 48	10" 1	10" 2	10" 3	10" 4
Loblolly Pine Pinus taeda													
Longleaf/Pitch/ Other Pine													
Virginia Pine Pinus virginiana													
White Oak Quercus alba													
Chestnut Oak Quercus prinus													
Southern Red Oak Quercus falcata & B O								8.3					
Sweet Gum Liquidambar styraciflua								1.7					
Yellow Poplar Liriodendron tulipifera													
Willow Oak													
Hickory													
Other Hardwoods	1.7	1.7			3.3			3.3					

SPECIES	12" 16	12" 32	12" 48	12" 1	12" 2	12" 3	12" 4	14" 16	14" 32	14" 48	14" 1	14" 2	14" 3	14" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				3.3								1.7		
Sweet Gum Liquidambar styraciflua				5.0							3.3	3.3		
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods				8.3						1.7				

SPECIES	16" 16	16" 32	16" 48	16" 1	16" 2	16" 3	16" 4	18" 16	18" 32	18" 48	18" 1	18" 2	18" 3	18" 4
Loblolly Pine Pinus taeda														
Longleaf/Pitch/ Other Pine														
Virginia Pine Pinus virginiana														
White Oak Quercus alba														
Chestnut Oak Quercus prinus														
Southern Red Oak Quercus falcata & B O				3.3	1.7							3.3		
Sweet Gum Liquidambar styraciflua				1.7	1.7									
Yellow Poplar Liriodendron tulipifera														
Willow Oak														
Hickory														
Other Hardwoods			1.7		3.3							1.7		

SPECIES	20" 16	20" 32	20" 48	20" 1	20" 2	20" 3	20" 4	22+" 16	22+" 32	22+" 48	22+" 1	22+" 2	22+" 3	22+" 4	TOTALS PW	TOTALS ST
Loblolly Pine Pinus taeda												1.7				2
Longleaf/Pitch/ Other Pine																
Virginia Pine Pinus virginiana																
White Oak Quercus alba																
Chestnut Oak Quercus prinus																
Southern Red Oak Quercus falcata & B O				1.7	16.7							6.7			8	38
Sweet Gum Liquidambar styraciflua															2	15
Yellow Poplar Liriodendron tulipifera																
Willow Oak																
Hickory																
Other Hardwoods															13	13

TOTALS:	6" PW	8" PW	10" PW	10" ST	12" PW	12" ST	14" PW	14" ST	16" PW	16" ST	18" PW	18" ST	20" PW	20" ST	22+" PW	22+" ST	TOTALS PW	TOTALS ST
SOFTWOOD:																2		2
HARDWOOD:	3	3	13			17	2	8	2	12		5		18		7	23	67

Southern Pine Beetle Rating:	<10 Very Low	11 to 61 Low	62 to 167 Medium	168 to 219 High	<219 Very High	Southern Pine Beetle Hazard Score:	-99

APPENDIX C
FOREST INVENTORY AND ANALYSIS (FIA) SPECIES CODES

This list includes all tree species tallied in the Continental U.S., Alaska, and the Caribbean. 'Tally trees' are defined as all live and standing dead trees in accessible forest land condition classes encountered on the subplot the first time a subplot is established, and all trees that grow into a subplot thereafter. Species designated East/West/Caribbean are commonly found in those regions, although species designated for one region may occasionally be found in another. Each FIA unit uses a volume equation to compute this volume based on diameter, taken either at breast height (DBH) or root collar (DRC), and other tree and/or stand attributes. Species that have an "X" in the Core column are tallied in all regions. All other species on the list are "core optional". The North tallies all *Core* and "core optional" species.

NRS Note: Not all tree species are listed in this table that may occur in the North. If not listed, invasive tree species are tallied using species code 0999. The use of code 0999 requires a tree NOTE with the species identified. Dead trees are coded in the following order of identification hierarchy: Species code, Genus code, 0299 or 0998, or 0999.

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
	E	W		0010	ABIES	Fir spp.	Abies	spp.
X	E	W		0012	ABBA	balsam fir	Abies	balsamea
X		W		0015	ABCO	white fir	Abies	concolor
X	E			0016	ABFR	Fraser fir	Abies	fraseri
	E	W		0040	CHAMA4	cedar spp.	Chamaecyparis	spp.
X	E			0043	CHTH2	Atlantic white-cedar	Chamaecyparis	thyoides
	E	W		0057	JUNIP	redcedar, juniper spp.	Juniperus	spp.
X	E	W		0061	JUAS	Ashe juniper	Juniperus	ashei
X	E	W	w	0066	JUSC2	Rocky Mountain juniper	Juniperus	scopulorum
X	E			0068	JUVI	eastern redcedar	Juniperus	virginiana
	E	W		0070	LARIX	larch spp.	Larix	spp.
X	E	W		0071	LALA	tamarack (native)	Larix	laricina
	E	W		0090	PICEA	spruce spp.	Picea	spp.
X	E			0091	PIAB	Norway spruce	Picea	abies
X	E	W		0094	PIGL	white spruce	Picea	glauca
X	E	W		0095	PIMA	black spruce	Picea	mariana
X	E	W		0096	PIPU	blue spruce	Picea	pungens
X	E			0097	PIRU	red spruce	Picea	rubens
	E	W	C	0100	PINUS	pine spp.	Pinus	spp.
X	E			0105	PIBA2	jack pine	Pinus	banksiana
X		W		0108	PICO	lodgepole pine	Pinus	contorta
X	E			0110	PIEC2	shortleaf pine	Pinus	echinata
X		W		0113	PIFL2	limber pine	Pinus	flexilis
X	E	W		0122	PIPO	ponderosa pine	Pinus	ponderosa
X	E			0123	PIPU5	Table Mountain pine	Pinus	pungens
X	E			0125	PIRE	red pine	Pinus	resinosa
X	E			0126	PIRI	pitch pine	Pinus	rigida

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
X	E			0128	PISE	pond pine	Pinus	serotina
X	E			0129	PIST	eastern white pine	Pinus	strobus
X	E			0130	PISY	Scotch pine	Pinus	sylvestris
X	E			0131	PITA	loblolly pine	Pinus	taeda
X	E			0132	PIVI2	Virginia pine	Pinus	virginiana
X	E			0136	PINI	Austrian pine	Pinus	nigra
		W		0200	PSEUD7	Douglas-fir spp.	Pseudotsuga	spp.
X		W		0202	PSME	Douglas-fir	Pseudotsuga	menziesii
	E			0220	TAXOD	cypress spp.	Taxodium	spp.
X	E			0221	TADI2	baldcypress	Taxodium	distichum
X	E			0222	TAAS	pondcypress	Taxodium	ascendens
	E	W		0230	TAXUS	yew spp.	Taxus	spp.
	E	W	C	0240	THUJA	Thuja spp.	Thuja	spp.
X	E			0241	THOC2	northern white-cedar	Thuja	occidentalis
	E	W		0260	TSUGA	hemlock spp.	Tsuga	spp.
X	E			0261	TSCA	eastern hemlock	Tsuga	canadensis
X	E	W	C	0299	2TE	unknown dead conifer	Tree	evergreen
	E	W		0310	ACER	maple spp.	Acer	spp.
X	E	W		0313	ACNE2	boxelder	Acer	negundo
X	E			0314	ACNI5	black maple	Acer	nigrum
X	E			0315	ACPE	striped maple	Acer	pensylvanicum
X	E			0316	ACRU	red maple	Acer	rubrum
X	E			0317	ACSA2	silver maple	Acer	saccharinum
X	E			0318	ACSA3	sugar maple	Acer	saccharum
	E			0319	ACSP2	mountain maple	Acer	spicatum
	E			0320	ACPL	Norway maple	Acer	platanoides
		W	w	0321	ACGL	Rocky Mountain maple	Acer	glabrum
	E	W		0330	AESCU	buckeye, horsechestnut spp.	Aesculus	spp.
X	E			0331	AEGL	Ohio buckeye	Aesculus	glabra
X	E			0332	AEFL	yellow buckeye	Aesculus	flava
	E			0336	AEPA	red buckeye	Aesculus	pavia
X	E			0341	AIAL	ailanthus	Ailanthus	altissima
X	E	W		0345	ALJU	mimosa/silktree	Albizia	julibrissin
		W		0350	ALNUS	alder spp.	Alnus	spp.
X	E			0355	ALGL2	European alder	Alnus	glutinosa
	E	W		0356	AMELA	serviceberry spp.	Amelanchier	spp.

Core	East	West	WdInd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
	E	W		0357	AMAR3	common serviceberry	Amelanchier	arborea
	E	W		0358	AMSA	roundleaf serviceberry	Amelanchier	sanguinea
X	E			0367	ASTR	pawpaw	Asimina	triloba
	E	W		0370	BETUL	birch spp.	Betula	spp.
X	E			0371	BEAL2	yellow birch	Betula	alleghaniensis
X	E			0372	BELE	sweet birch	Betula	lenta
X	E			0373	BENI	river birch	Betula	nigra
X	E			0374	BEOC2	water birch	Betula	occidentalis
X	E	W		0375	BEPA	paper birch	Betula	papyrifera
X	E			0379	BEPO	gray birch	Betula	populifolia
X	E			0391	CACA18	American hornbeam, musclewood	Carpinus	caroliniana
	E			0400	CARYA	hickory spp.	Carya	spp.
X	E			0401	CAAQ2	water hickory	Carya	aquatica
X	E			0402	CACO15	bitternut hickory	Carya	cordiformis
X	E			0403	CAGL8	pignut hickory	Carya	glabra
X	E			0404	CAIL2	pecan	Carya	illinoinensis
X	E			0405	CALA21	shellbark hickory	Carya	laciniosa
X	E			0407	CAOV2	shagbark hickory	Carya	ovata
X	E			0408	CATE9	black hickory	Carya	texana
X	E			0409	CAAL27	mockernut hickory	Carya	alba
X	E			0410	CAPA24	sand hickory	Carya	pallida
X	E			0412	CAOV3	red hickory	Carya	ovalis
	E	W		0420	CASTA	chestnut spp.	Castanea	spp.
	E			0421	CADE12	American chestnut	Castanea	dentata
X	E			0422	CAPU9	Allegheny chinkapin	Castanea	pumila
	E			0423	CAPUO	Ozark chinkapin	Castanea	pumila var. ozarkensis
X	E	W		0424	CAMO83	Chinese chestnut	Castanea	mollissima
	E		C	0450	CATAL	catalpa spp.	Catalpa	spp.
X	E			0451	CABI8	southern catalpa	Catalpa	bignonioides
X	E			0452	CASP8	northern catalpa	Catalpa	speciosa
	E	W	C	0460	CELTI	hackberry spp.	Celtis	spp.
X	E	W		0461	CELA	sugarberry	Celtis	laevigata
X	E	W		0462	CEOC	hackberry	Celtis	occidentalis
	E	W		0463	CELAR	netleaf hackberry	Celtis	laevigata var. reticulata

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
X	E			0471	CECA4	eastern redbud	Cercis	canadensis
X	E			0481	CLKE	yellowwood	Cladrastis	kentukea
	E	W		0490	CORNU	dogwood spp.	Cornus	spp.
X	E			0491	COFL2	flowering dogwood	Cornus	florida
	E			0500	CRATA	hawthorn spp.	Crataegus	spp.
	E			0501	CRCR2	cockspur hawthorn	Crataegus	crus-galli
	E			0502	CRMO2	downy hawthorn	Crataegus	mollis
	E			0503	CRBR3	Brainerd hawthorn	Crataegus	brainerdii
	E			0504	CRCA	pear hawthorn	Crataegus	calpodendron
	E			0505	CRCH	fireberry hawthorn	Crataegus	chrysocarpa
	E			0506	CRDI	broadleaf hawthorn	Crataegus	dilatata
	E			0507	CRFL	fanleaf hawthorn	Crataegus	flabellata
	E			0508	CRMO3	oneseed hawthorn	Crataegus	monogyna
	E			0509	CRPE	scarlet hawthorn	Crataegus	pedicellata
	E			5091	CRPH	Washington hawthorn	Crataegus	phaenopyrum
	E			5092	CRSU5	fleshy hawthorn	Crataegus	succulenta
	E			5093	CRUN	dwarf hawthorn	Crataegus	uniflora
	E		C	0520	DIOSP	persimmon spp.	Diospyros	spp.
X	E			0521	DIVI5	common persimmon	Diospyros	virginiana
X	E			0531	FAGR	American beech	Fagus	grandifolia
	E	W	C	0540	FRAXI	ash spp.	Fraxinus	spp.
X	E			0541	FRAM2	white ash	Fraxinus	americana
X	E			0543	FRNI	black ash	Fraxinus	nigra
X	E			0544	FRPE	green ash	Fraxinus	pennsylvanica
X	E			0545	FRPR	pumpkin ash	Fraxinus	profunda
X	E			0546	FRQU	blue ash	Fraxinus	quadrangulata
	E			0550	GLEDI	locust spp.	Gleditsia	spp.
X	E			0551	GLAQ	waterlocust	Gleditsia	aquatica
X	E			0552	GLTR	honeylocust	Gleditsia	triacanthos
X	E	W		0561	GIBI2	Ginkgo, maidenhair tree	Ginkgo	biloba
X	E			0571	GYDI	Kentucky coffeetree	Gymnocladus	dioicus
	E			0580	HALES	silverbell spp.	Halesia	spp.
X	E			0591	ILOP	American holly	Ilex	opaca
	E	W	C	0600	JUGLA	walnut spp.	Juglans	spp.
X	E			0601	JUCI	butternut	Juglans	cinerea
X	E	W		0602	JUNI	black walnut	Juglans	nigra

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
	E	W		0605	JUMI	Texas walnut	Juglans	microcarpa
X	E			0611	LIST2	sweetgum	Liquidambar	styraciflua
X	E			0621	LITU	yellow-poplar	Liriodendron	tulipifera
X	E			0641	MAPO	Osage-orange	Maclura	pomifera
	E		C	0650	MAGNO	magnolia spp.	Magnolia	spp.
X	E			0651	MAAC	cucumbertree	Magnolia	acuminata
X	E			0652	MAGR4	southern magnolia	Magnolia	grandiflora
X	E			0653	MAVI2	sweetbay	Magnolia	virginiana
X	E			0654	MAMA2	bigleaf magnolia	Magnolia	macrophylla
X	E			0655	MAFR	mountain magnolia, Fraser magnolia	Magnolia	fraseri
X	E			0658	MATR	umbrella magnolia	Magnolia	tripetala
	E	W		0660	MALUS	apple spp.	Malus	spp.
X	E			0662	MAAN3	southern crabapple	Malus	angustifolia
X	E			0663	MACO5	sweet crabapple	Malus	coronaria
X	E			0664	MAIO	prairie crabapple	Malus	ioensis
	E		C	0680	MORUS	mulberry spp.	Morus	spp.
X	E		C	0681	MOAL	white mulberry	Morus	alba
X	E			0682	MORU2	red mulberry	Morus	rubra
X	E		C	0684	MONI	black mulberry	Morus	nigra
	E			0690	NYSSA	tupelo spp.	Nyssa	spp.
X	E			0691	NYAQ2	water tupelo	Nyssa	aquatica
X	E			0693	NYSY	blackgum	Nyssa	sylvatica
X	E			0694	NYBI	swamp tupelo	Nyssa	biflora
X	E			0701	OSVI	eastern hophornbeam	Ostrya	virginiana
X	E			0711	OXAR	sourwood	Oxydendrum	arboreum
X	E			0712	PATO2	paulownia, empress-tree	Paulownia	tomentosa
	E	W	C	0720	PERSE	bay spp.	Persea	spp.
X	E			0722	PLAQ	water-elm, planertree	Planera	aquatica
	E	W		0729	PLATA	sycamore spp.	Platanus	spp.
X	E			0731	PLOC	American sycamore	Platanus	occidentalis
	E	W		0740	POPUL	cottonwood and poplar spp.	Populus	spp.
X	E	W		0741	POBA2	balsam poplar	Populus	balsamifera
X	E			0742	PODE3	eastern cottonwood	Populus	deltoides
X	E			0743	POGR4	bigtooth aspen	Populus	grandidentata
X	E			0744	POHE4	swamp cottonwood	Populus	heterophylla

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
X	E	W		0745	PODEM	plains cottonwood	Populus	deltoides ssp. monilifera
X	E	W		0746	POTR5	quaking aspen	Populus	tremuloides
X		W		0747	POBAT	black cottonwood	Populus	balsamifera ssp. trichocarpa
X		W		0749	POAN3	narrowleaf cottonwood	Populus	angustifolia
X	E			0752	POAL7	silver poplar	Populus	alba
X	E			0753	PONI	Lombardy poplar	Populus	nigra
	E	W	C	0760	PRUNU	cherry and plum spp.	Prunus	spp.
	E	W		0761	PRPE2	pin cherry	Prunus	pensylvanica
X	E			0762	PRSE2	black cherry	Prunus	serotina
	E	W		0763	PRVI	common chokecherry	Prunus	virginiana
	E			0764	PRPE3	peach	Prunus	persica
X	E			0765	PRNI	Canada plum	Prunus	nigra
X	E			0766	PRAM	American plum	Prunus	americana
	E			0769	PRAL5	Allegheny plum	Prunus	alleghaniensis
	E	W		0770	PRAN3	Chickasaw plum	Prunus	angustifolia
X	E			0771	PRAV	sweet cherry (domesticated)	Prunus	avium
	E			0772	PRCE	sour cherry (domesticated)	Prunus	cerasus
	E			0773	PRDO	European plum (domesticated)	Prunus	domestica
	E			0774	PRMA	Mahaleb plum (domesticated)	Prunus	mahaleb
	E	W		0800	QUERC	oak – deciduous spp.	Quercus	spp.
X	E			0802	QUAL	white oak	Quercus	alba
X	E			0804	QUBI	swamp white oak	Quercus	bicolor
X	E			0806	QUCO2	scarlet oak	Quercus	coccinea
X	E			0809	QUEL	northern pin oak	Quercus	ellipsoidalis
X	E			0812	QUFA	southern red oak	Quercus	falcata
X	E			0813	QUPA5	cherrybark oak	Quercus	pagoda
X	E			0816	QUIL	scrub oak	Quercus	ilicifolia
X	E			0817	QUIM	shingle oak	Quercus	imbricaria
X	E			0820	QULA3	laurel oak	Quercus	laurifolia
X	E			0822	QULY	overcup oak	Quercus	lyrata
X	E			0823	QUMA2	bur oak	Quercus	macrocarpa
X	E			0824	QUMA3	blackjack oak	Quercus	marilandica

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
X	E			0825	QUMI	swamp chestnut oak	Quercus	michauxii
X	E			0826	QUMU	chinkapin oak	Quercus	muehlenbergii
X	E			0827	QUNI	water oak	Quercus	nigra
X	E			0828	QUBU2	Nuttall oak	Quercus	buckleyi
X	E			0830	QUPA2	pin oak	Quercus	palustris
X	E			0831	QUPH	willow oak	Quercus	phellos
X	E			0832	QUPR2	chestnut oak	Quercus	prinus
X	E			0833	QURU	northern red oak	Quercus	rubra
X	E			0834	QUSH	Shumard's oak	Quercus	shumardii
X	E			0835	QUST	post oak	Quercus	stellata
X	E			0837	QUVE	black oak	Quercus	velutina
X	E			0840	QUMA6	dwarf post oak	Quercus	margarettiae
	E			0845	QUPR	dwarf chinkapin oak	Quercus	prinoides
X	E	W		0901	ROPS	black locust	Robinia	pseudoacacia
	E	W		0919	SASAD	western soapberry	Sapindus	saponaria var. drummondii
	E	W	C	0920	SALIX	willow spp.	Salix	spp.
	E	W		0921	SAAM2	peachleaf willow	Salix	amygdaloides
	E	W		0922	SANI	black willow	Salix	nigra
	E	W		0923	SABE2	Bebb willow	Salix	bebbiana
X	E			0925	SACA5	coastal plain willow	Salix	caroliniana
X	E			0926	SAPY	balsam willow	Salix	pyrifolia
	E	W		0927	SAAL2	white willow	Salix	alba
X	E			0929	SASE10	weeping willow	Salix	sepulcralis
X	E			0931	SAAL5	sassafras	Sassafras	albidum
	E			0934	SORBU	mountain ash spp.	Sorbus	spp.
	E			0935	SOAM3	American mountain ash	Sorbus	americana
X	E			0936	SOAU	European mountain ash	Sorbus	aucuparia
X	E			0937	SODE3	northern mountain ash	Sorbus	decora
	E			0950	TILIA	basswood spp.	Tilia	spp.
X	E			0951	TIAM	American basswood	Tilia	americana
	E			0952	TIAMH	white basswood	Tilia	americana var. heterophylla
	E			0953	TIAMC	Carolina basswood	Tilia	americana var. caroliniana
	E			0970	ULMUS	elm spp.	Ulmus	spp.
X	E			0971	ULAL	winged elm	Ulmus	alata

Core	East	West	Wdlnd/ Cribn	FIA	PLANTS Code	Common Name	Genus	Species
X	E			0972	ULAM	American elm	Ulmus	americana
X	E			0973	ULCR	cedar elm	Ulmus	crassifolia
X	E			0974	ULPU	Siberian elm	Ulmus	pumila
X	E			0975	ULRU	slippery elm	Ulmus	rubra
X	E			0976	ULSE	September elm	Ulmus	serotina
X	E			0977	ULTH	rock elm	Ulmus	thomasii
	E	W	C	0991	TAMAR2	saltcedar	Tamarix	spp.
X	E		C	0993	MEAZ	chinaberry	Melia	azedarach
X	E			0996	COOB2	smoketree	Cotinus	obovatus
	E	W		0997	ELAN	Russian-olive	Elaeagnus	angustifolia
X	E	W	C	0998	2TB	unknown dead hardwood	Tree	broadleaf
X	E	W	C	0999	2TREE	other, or unknown live tree	Tree	unknown

*Gray lettering indicates potential changes