National Park Service
U.S. Department of the Interior

National Capital Region

WETLAND RESTORATION ACTION PLAN

CATOCTIN MOUNTAIN PARK
CHESAPEAKE & OHIO CANAL NATIONAL HISTORICAL PARK
HARPERS FERRY NATIONAL HISTORICAL PARK
MONOCACY NATIONAL BATTLEFIELD

FEBRUARY 2017

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EXECUTIVE SUMMARY

The National Park Service (NPS) is preparing this Wetland Restoration Action Plan (WRAP) to provide a comprehensive approach to restoring, enhancing, and/or protecting wetlands, waterways, and riparian habitats (collectively referred to as 'wetlands and waterways') at four National Capital Region (NCR) parks when opportunities or mitigation needs arise.

The four NCR parks currently participating in this include:

- Chesapeake & Ohio Canal National Historical Park (CHOH) – Maryland, District of Columbia, and West Virginia
- Monocacy National Battlefield (MONO) – Maryland
- Harpers Ferry National Historical Park (HAFE) – Maryland, Virginia, and West Virginia
- Catoctin Mountain Park (CATO) – Maryland

When faced with construction projects that may negatively affect park resources, the NPS will be able to refer to the recommendations in this WRAP when determining priorities for restoration.

A total of 68 potential project sites were assessed through a desktop analysis and then a detailed field screening process to determine suitability for potential stream and wetland restoration. Nine of the potential sites were removed from consideration prior to the field assessment stage due to issues with existing easements and ownership, while an additional 17 sites were removed after the field review based on the lack of degraded wetlands and streams within the project sites. A total of 42 projects were identified for potential future restoration.

Within the four NCR parks currently participating in this WRAP, 42 potential sites were identified that total almost 50 acres of wetland restoration opportunity, and almost 20,000 linear feet of stream restoration opportunity.

Available Restoration Amounts by Park

Park	Number of Sites	Potential Wetland Restoration Acreage	Potential Stream Restoration Length
CATO	12	3.33 acres	5,073 linear feet
MONO	7	10.39 acres	9,535 linear feet
HAFE	5	0.93 acres	826 linear feet
CHOH	18	34.73 acres	4,551 linear feet
Total	**42**	**49.38 acres**	**19,985 linear feet**

Additional restoration opportunities may exist within the parks that have not been identified within this study as well as additional restoration techniques may also be appropriate at the potential sites. At this time, the restoration concepts proposed for this WRAP are general in nature and additional surveys would be required to propose more detailed restoration designs for construction.

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ACRONYMS AND ABBREVIATIONS

CATO	Catoctin Mountain Park
CHOH	Chesapeake & Ohio National Historical Park
HAFE	Harpers Ferry National Historical Park
MHT	Maryland Historic Trust
MONO	Monocacy National Battlefield
NCR	National Capital Region
NEPA	National Environmental Policy Act
NPS	National Park Service
NWI	National Wetland Inventory
PWS	Professional Wetland Scientist
USACE	U.S. Army Corps of Engineer
WRAP	Wetland Restoration Action Plan
WUS	Waters of the United States

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1.0 INTRODUCTION

The National Park Service (NPS) is preparing this Wetland Restoration Action Plan (WRAP) to provide a comprehensive approach to restoring, enhancing, and/or protecting wetlands, waterways, and riparian habitats (collectively referred to as 'wetlands and waterways') at four National Capital Region (NCR) parks when opportunities or mitigation needs arise. This WRAP provides information on the existing physical and biological conditions of wetland and waterways within these parks; evaluates their functional value to determine what, if any, actions are necessary for restoration or enhancement; and provides general concepts for restoration at the potential sites. The information in this report will be used as input into the National Environmental Policy Act (NEPA) planning process for the WRAP Environmental Assessment.

The four NCR parks currently participating in this effort lie within the Chesapeake Bay Watershed (appendix A: figure 1) and include:

- Chesapeake & Ohio Canal National Historical Park (CHOH) – Maryland, District of Columbia, and West Virginia
- Monocacy National Battlefield (MONO) – Maryland
- Harpers Ferry National Historical Park (HAFE) – Maryland, Virginia, and West Virginia
- Catoctin Mountain Park (CATO) – Maryland

These four parks will be able to utilize the restoration projects proposed in this WRAP to enhance the larger watershed. This WRAP will help the parks understand steps that can be taken to meet the larger objective to track "functional gains" on wetlands and floodplains. When faced with construction projects that may negatively affect park resources, the NPS will be able to refer to the recommendations in this WRAP when determining priorities for restoration.

This WRAP describes the methods, results, and recommendations for restoration, enhancement, or protection of streams and wetlands at the four NPS parks listed above. Chapter 2 describes the methods and results of the preliminary site selection (initial screening and aerial review) as well as coordination with the four parks. Chapter 3 describes the field assessment methods and results. Chapter 4 describes opportunities for restoration and enhancement. Chapter 5 provides a summary of the results and recommendations.

2.0 PRELIMINARY SITE SELECTION METHODS AND RESULTS

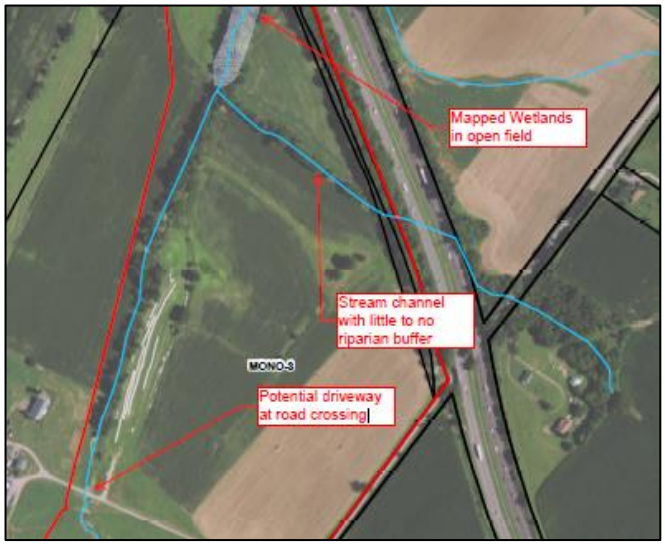
A desktop review of available GIS layers and online resources was performed by qualified wetland scientists to locate areas for potential wetland and stream enhancement projects to be proposed for further field evaluations. In general, GIS data provided by the four parks were used to develop the baseline database for the desktop review. The GIS data provided by the NPS included the following information:

- Park boundaries
- National Wetland Inventory (NWI) mapped wetlands
- Previously delineated wetland areas
- GIS hydro layers including mapped stream channels
- Known Maryland Historic Trust (MHT) sites

2.1 PRELIMINARY SITE SELECTION METHODS

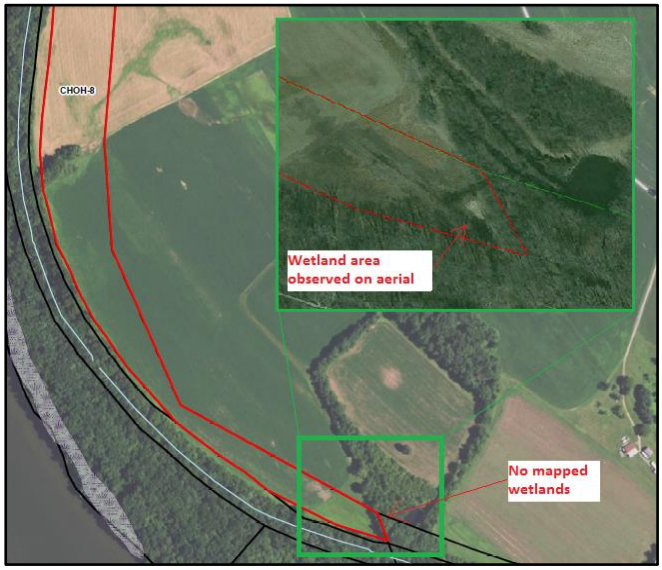
2.1.1 Wetlands

Initial Screening. The desktop review was initiated by overlaying the GIS data provided by the NPS onto GIS readily available aerial photographs, and searching for areas within the parks' boundaries where mapped wetlands and streams occurred in open agricultural fields or in areas of known development or disturbance such as road crossings, parking lots, or residential areas along the parks' boundary edges. Typically, areas where mapped wetlands or streams appeared to occur adjacent to impacted areas were identified (example 1). In addition to mapped wetlands/streams provided by the NPS or mapped by the NWI, an aerial review of the entire park boundaries of all four parks was conducted to identify potential wetlands observed on current and recent aerials (between 2012 - 2015) that may not have been included in the mapped data.



Example 1: Initial Review of Mapped Resources at MONO.

Aerial Review. The aerial review included identifying areas with distinct darker signatures and drainage patterns, as well as areas along stream channels and open water with distinct changes in vegetation cover. When these areas were identified on the aerials within the park boundaries, the surrounding areas were reviewed to determine if they could potentially have caused degradation to the wetland's function or value.

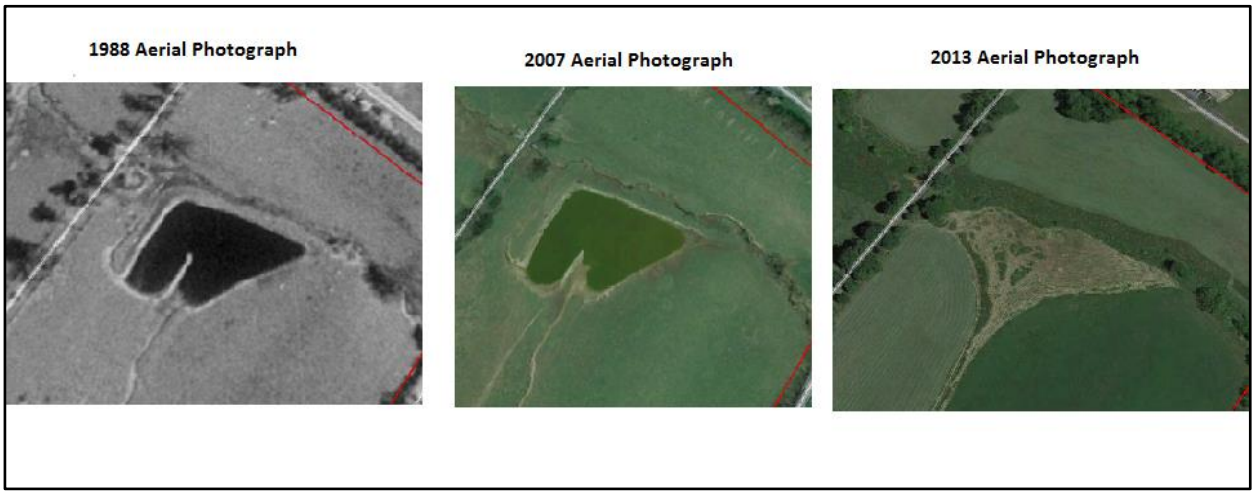


Example 2 - Aerial Review of Unmapped Resources at CHOH.

In the case of example 2, an area of an apparent wetland was identified during the aerial review, which was not within the provided NPS data or shown on the mapped NWI wetlands. Distinct drainage features and inundation are observed on the aerials, which indicate the potential presence of wetlands. Additionally, as this wetland area is located within a corner of a cleared field, wetland degradation is likely and the site may have potential for enhancement in the form of restoring the natural hydrology in the area, fencing the wetland off from the agricultural field, and planting of native trees and shrubs.

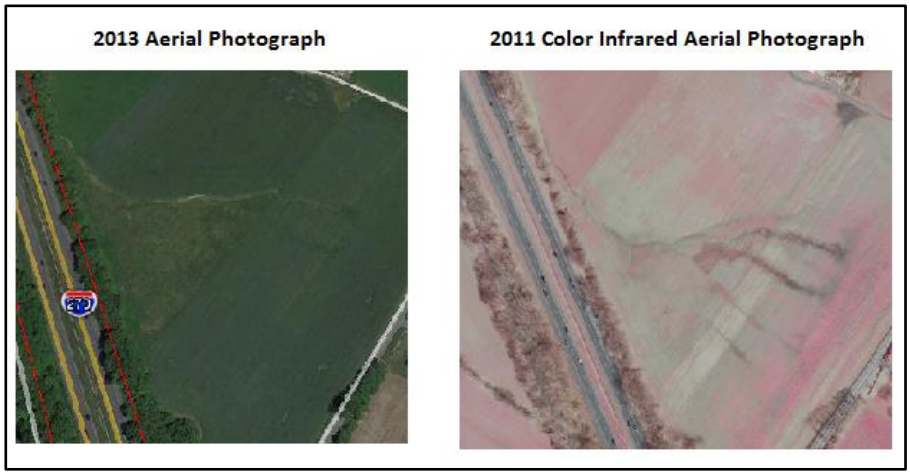
In addition to identifying existing wetlands and streams, areas which may have historically supported these features but which may have been altered in a way that removed the resources or impacted resources to the extent that they are not easily identified through the desktop review were also identified. These areas are typical in agricultural land use as wetland areas and streams may have been altered through practices in an effort to increase crop production and land use.

To identify these impacted areas, a review of multiple chronological historical aerials was conducted to identify potential wetland areas or streams that appear to be altered compared to recent aerials (example 3).



Example 3 - Aerial Photograph Comparison showing Impacted Resources at MONO.

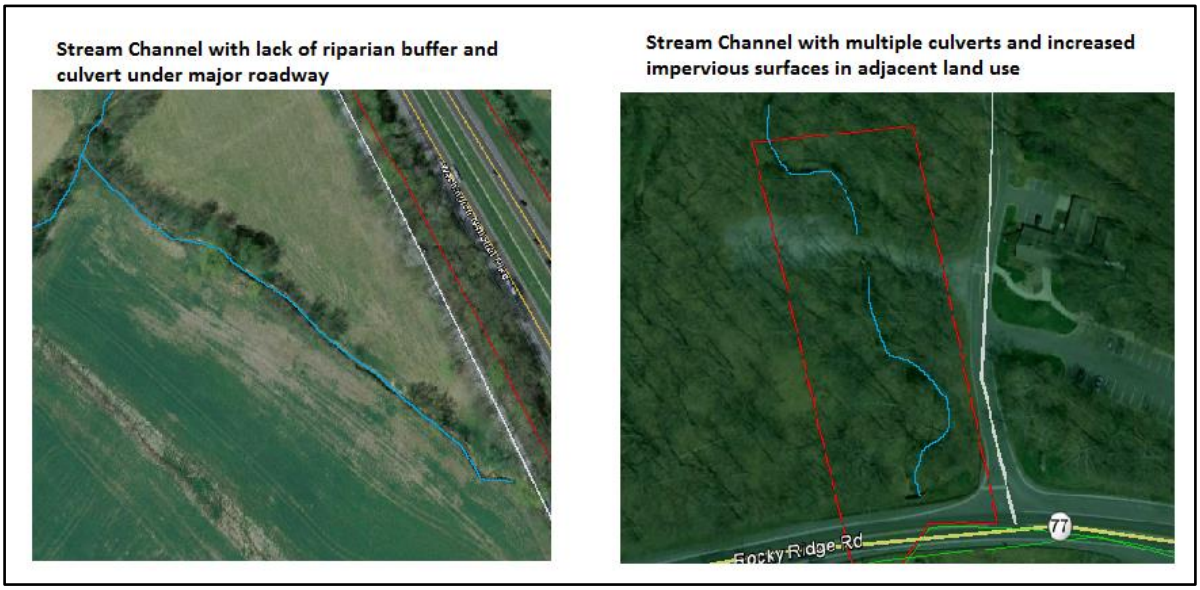
Additionally, during the review of multiple chronological aerials, some sites — particularly in agricultural fields — were identified as having less noticeable wetland characteristics. However, these features were more apparent on various aerials, including available color infrared aerials over high-resolution aerial photographs (example 4). These areas were identified as potential prior converted wetlands within existing agricultural fields.



Example 4 - Color Infrared Aerial Use to Identify Prior Converted Wetlands at MONO.

2.1.2 Streams

Existing stream channels were also included in the evaluation of potential sites. Bridges and culverts present along stream channels, as well as impervious surface and reduced riparian buffers typically have negative effects on the hydrology and ecology of streams. Streams can become disconnected to their adjacent floodplain, stream velocity and bank erosion downstream can increase, and shear stress can increase, which can exacerbate bed and bank degradation and increases sediment loads into the watershed. Therefore, areas where apparent streams have been identified near impervious surfaces, or streams, which lack an adequate existing riparian buffer were identified as having potential restoration opportunities (example 5).



Example 5. Example of Potential Stream Restoration Opportunities at CATO

Once a potential site was identified based on the data review, the site was given a discrete name starting with the 4-letter park code location (e.g., CHOH-1, CATO-5).

2.2 PRELIMINARY SITE SELECTION RESULTS BY PARK

The desktop review identified sites with existing degraded wetlands or streams that could have restoration or enhancement opportunities. A total of 55 potential study areas, totaling 1,486 acres, were identified from the desktop screening effort across each park, and are briefly described in table 1 and the paragraphs that follow. These 55 sites were selected through the desktop screening effort only and did not include any field component prior to selection.

Table 1. Potential Site Breakdown by Park from Desktop Review

Park	Number of Sites	Acreage of Study Areas
CATO	16	165
MONO	6	390
HAFE	6	190
CHOH	27	741
Total	**55**	**1486**

2.2.1 Catoctin Mountain Park

During the desktop evaluation, 16 potential sites were identified within CATO totaling approximately 165 acres (excluding sites later added during the field assessment). The majority of the sites within CATO (13 of 16) were identified for potential stream channel restoration due to the presence of culvert crossings, or inadequate riparian areas from existing roads or development which may cause increased bed scour or bank erosion. These 13 stream sites were identified as potential for riparian buffer enhancement (tree planting), bank stabilization, or culvert replacement opportunities. These sites were typically located along existing roads or at the edge of the park boundaries, and therefore should reduce impacts to resources if enhancement opportunities are implemented. Additionally, three potential sites which were identified as having man-made open water ponds during the desktop review phase. These ponds were located either adjacent to or in-line with existing streams and may also have stream restoration opportunities as well as wetland enhancement potential. Open water ponds can often be converted to emergent or forested wetlands by manipulating the water control structure or even by removing the berms and structures completely to return the site to its historical natural state. These three sites were identified as having potential for restoration opportunity due to the obvious impacts to existing resources and variety of enhancement opportunities including stream and wetland enhancement. Sites CATO-1 through CATO-16 were the initial sites identified through the desktop screening process and are depicted on Figure 2 within appendix A. Figure 2 also identifies additional sites which were added during the field screening process.

2.2.2 Monocacy National Battlefield and Harpers Ferry National Historical Park

Through the desktop evaluation, 12 potential sites across MONO and HAFE were identified, with 6 sites located in each park (390 acres in MONO and 190 acres in HAFE). Both MONO and HAFE have a large amount of agricultural land use within their boundaries, and the majority of the sites were identified as having altered stream channels with little to no riparian buffer, or areas were wetlands that appear to have been converted to cropland. Additionally, multiple sites at both MONO and HAFE also have man-made ponds — similar to those described within CATO — which would provide similar restoration opportunities. The areas identified as prior converted wetlands could be restored by removing or filling existing ditches, crushing drain tiles, or in some cases simply preventing the wetland area from continuous mowing or planting. Riparian buffer and culvert removal opportunities also exist within these sites similar to those discussed for CATO in Section 2.2.1. Sites MONO-1 through MONO-6 and Sites HAFE-1 though HAFE-6 were the initial six sites identified at each of these parks and are identified on Figures 3 and 4 within appendix A. Figures 3 and 4 also identify additional sites which were added during the field screening process.

2.2.3 Chesapeake & Ohio Canal National Historical Park

Due to the size of the park, increased development, and agricultural land leased within the park and on adjacent lands, CHOH had the most identified potential restoration sites (27 sites) and acres of review (741 acres) — excluding sites later added during the field assessment — compared to the other parks. Potential opportunities at CHOH included sites with potential prior converted wetlands, areas of apparent open water man made ponds, existing culverts along stream channels, and areas of development directly adjacent to resources that may cause degradation, as well as a combination of these opportunities. Additionally, it was known that existing wetland areas within the park boundary are dominated by invasive plant species. As a result, these sites were added to the potential site list as invasive species management (ISM) that can be implemented to enhance the existing wetlands. Sites CHOH-1 through CHOH-27 were the initial sites identified through the desktop screening process and are depicted on Figures 5a-5c within appendix A. Figures 5a-5c also identify additional sites, which were added during the field screening process.

2.3 WORKSHOP FOR FURTHER SITE SELECTION

After identifying 55 potential study areas, totaling 1,486 acres, NPS reviewed the selected sites as well as the site selection methods to identify concerns with any of the 55 sites that may cause removal from the study prior to the field assessment effort. Removal causes included: privately-owned sites, state-owned sites, or sites with scenic easements. During the workshop, nine sites were removed from consideration in the field effort. Eight sites located in CHOH and one located in HAFE, were removed due to existing easements and property ownership concerns.

Additionally, during the site selection workshop NPS staff discussed the potential to add additional sites or adjust site boundaries during the future field assessment effort. Although no sites were added to the site selection list prior to the field effort, some of the site boundaries were slightly altered to include a larger area of review during the site assessments.

Table 2 provides sites that were dropped from further consideration after NPS staff discussions. A total of 46 sites remained for the next phase of the project, the field assessment, described in section 3.0.

Table 2. Sites Removed Prior to Field Effort

Site	Rationale
HAFE-5	Privately owned – not NPS property
CHOH-2	Owned by the State of Maryland
CHOH-3	Site within scenic easement
CHOH-4	Site within scenic easement
CHOH-7	Site within scenic easement
CHOH-8	Site within scenic easement
CHOH-14	Owned by the State of Maryland
CHOH-15	Owned by the State of Maryland
CHOH-16	History of site access issues with adjacent land owner

3.0 FIELD ASSESSMENT

Beginning in March 2016, a certified Professional Wetland Scientist conducted a field review of the 46 potential sites described during the preliminary site selection process. Each of the 46 sites were visited to ground-truth the assumptions made in the preliminary analysis, assess each site for existing wetlands and waterways, and determine the degree of degradation and potential for restoration. This section describes the field assessment methods and the results. The first step of the field assessment methods consisted of an initial reconnaissance at the potential project sites to determine if wetlands and/or waterways existed onsite. If wetlands and/or waterways were present, an informal wetland delineation was conducted. The next step included describing the existing functions and values of the wetland and/or waterway at each site. The final step included ranking each site and determining potential restoration measures.

3.1 FIELD ASSESSMENT METHODS

3.1.1 Initial Site Reconnaissance

A general visual reconnaissance was first conducted for each site. If during the initial site reconnaissance, the wetland scientists did not observe a wetland or waterway within the potential site, the site was removed from further consideration and no additional assessment was performed on these sites. Similarly, if during the initial site reconnaissance, an existing wetland or waterway within the site was present, but appeared to be of high quality with no degradation, the site was removed from further consideration and no additional assessment was performed.

When a potential site was determined to contain a wetland or waterway that had potential for restoration, the next step was to adjust the site boundaries accordingly. The original boundaries were developed during the preliminary desktop analysis and typically included a larger tract of land to ensure surrounding wetlands and streams were included in the field assessment. During the field reconnaissance, the boundary for each potential site was adjusted as necessary to ensure that the areas of proposed restoration and existing wetland and waterway resources were encompassed at each site.

In addition, a general reconnaissance survey was conducted at each of the four parks for potential sites not originally identified during the preliminary desktop analysis. This reconnaissance included a windshield survey of easily accessible areas along park roads during the field assessment as well as walking to more remote areas that could potentially support wetlands and/or streams based upon site topography. If new potential sites were identified during the reconnaissance effort, these sites were added and further assessed as noted in the following sections.

3.1.2 Informal Wetland Delineation

Once the areas of review were established at each site, an informal delineation of wetlands and waterways was performed. Although a formal delineation was not conducted, including the placement of survey flagging along the wetland/waterway boundaries and the collection of wetland and upland data forms, wetland scientists determined the boundaries of wetlands and waterways according to the guidance in NPS DO #77-1 and “Routine Determination” procedures outlined in the *1987 Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and the applicable Regional Supplements. Following DO #77-1 and the U.S. Army Corps of Engineers (USACE) manuals, areas were identified that contained all three parameters required for a wetland (i.e., wetland hydrology, hydric soils and hydrophytic vegetation) and were classified following the "Classification of Wetlands and Deepwater Habitats of the United States" (FWS/OBS-79/31; Cowardin et al. 1979). The boundaries of these wetland areas were surveyed in the field using a Trimble Geo7X handheld global positioning system (GPS).

Additionally, areas that appeared to have been disturbed or degraded to the point of not having all three wetland parameters were also identified in the field as historical wetland areas, and were included in the GPS mapping. In addition to identifying wetlands, stream channels were identified by the presence of a defined bed and bank, as well as a defined ordinary high water mark. The wetland delineation conducted for the purpose of this planning level effort was an informal delineation and is based upon the opinion of Professional Wetland Scientists (PWSs).

3.1.3 Wetland Function and Value Assessment

In addition to completing an informal wetland delineation, a function and value assessment of the wetlands was performed at each potential site. Wetland functions are physical, chemical, and biological processes or attributes of wetlands that are vital to the integrity of a wetland system; wetland values are attributes not necessarily important to the integrity of a wetland system but perceived as valuable to society. The methodology from the *New England District of the USACE for Wetland Functions and Values: A Descriptive Approach* was used for the assessment. A brief description of the common functions and values assessed with this method is provided below.

- **Groundwater Recharge/Discharge —** The potential for the wetland to contribute water to an aquifer or potential for the wetland to serve as an area where groundwater can be discharged to the surface.
- **Floodflow Alteration (Storage and Desynchronization) —** Effectiveness of the wetland in reducing flood damage by attenuation of floodwaters for prolonged periods following precipitation events.
- **Fish and Shellfish Habitat —** Effectiveness of seasonal or permanent water bodies associated with the wetland in question for fish and shellfish habitat.
- **Sediment/Toxicant/Pathogen Retention —** Prevents degradation of water quality relating to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens.
- **Nutrient Removal/Retention/Transformation —** Ability for the wetland to prevent adverse effects of excess nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.
- **Production Export (Nutrient) —** Wetland ability to produce food or usable products for humans or other living organisms.
- **Sediment/Shoreline Stabilization —** Effectiveness of a wetland to stabilize stream banks and shorelines against erosion.
- **Wildlife Habitat —** Ability to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered.
- **Recreation (Consumptive and Non-Consumptive) —** Ability for the wetland and associated watercourses to provide recreational opportunities such as canoeing, boating, fishing, hunting, and other active or passive recreational activities. Consumptive activities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland, whereas non-consumptive activities do not.
- **Educational/Scientific Value —** Value of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.
- **Uniqueness/Heritage —** Ability for the wetland or its associated water bodies to produce certain special values. Special values may include such things as archaeological sites, unusual aesthetic quality, historical events, or unique plants, animals, or geologic features.
- **Visual Quality/Aesthetics —** The presence of visual and aesthetic qualities of the wetland for society.

3.1.4 Site Ranking and Potential Restoration Determination

Upon completion of delineating the wetlands and streams within the sites and performing the assessment of wetland functions and values, a detailed field assessment of the degraded portions of the wetlands and stream channels was conducted by completing the field assessment forms for each site.

Field assessment forms were developed to streamline field data collection and provide a standard approach to assessing each of the sites for potential wetland and stream restoration (appendix B). These forms were developed to not only document the conditions of each potential site and provide information to develop the restoration concepts, but also to provide a scoring system for restoration potential and provide a priority ranking system to compare sites.

The field assessments forms assessed the conditions of the wetlands and streams onsite, and documented the general site conditions such as:

- Existing and adjacent land use
- Distance to nearest road
- Presence of rare, threatened, and endangered species
- Known cultural resource concerns, and
- Site access issues

The above general conditions were documented for both stream and wetland sites. The remaining information included on the field assessment forms was specific to the type of resource found onsite (wetland or stream). Examples of each of the field assessment forms are included in appendix B. In general, these forms documented the site conditions of the resources including but not limited to, vegetation coverage, observed disturbances to hydrology, erosion, habitat quality, etc. Each of the wetland and stream field assessment forms included a restoration site ranking section which scored each site out of 100 points based upon established criteria that determined site suitability for restoration. In addition to documenting the general site conditions and restoration ranking, the field assessment forms were also used to document the potential restoration opportunity at each of the potential sites.

3.2 FIELD ASSESSMENT RESULTS

3.2.1 Initial Site Reconnaissance

During the initial site reconnaissance effort of the 46 potential sites, 7 sites were removed from further analysis because no wetland or waterway features were observed. Similarly, 10 sites were removed from further analysis because they supported an existing wetland or waterway that appeared to be of high quality with no degradation. No additional assessment was performed at these 17 dropped sites (table 3). Sites that were removed from further assessment due to the lack of existing wetlands or waterways were determined to be unlikely to have been wetlands prior to agricultural practices. The other dropped sites, such as many of the sites at CHOH, were dropped from further consideration due to the lack of invasive species or degradation. These sites typically included areas of mapped NWI wetlands identified during the desktop review within the floodplain of the Potomac River that had a high likelihood of invasive species based on NPS input. However, based on the initial field reconnaissance it was determined that many of these areas either did not meet the wetland criteria or lacked the presence of invasive species and did not require restoration.

Table 3. Sites Removed After Field Assessment

Site	Rationale For Removal
CATO-4	No stream degradation upstream or downstream of existing culvert. Culvert is properly sized and aligned with stream channel, and stream is well connected to floodplain and adjacent wetlands.
CATO-6	No stream degradation upstream or downstream of existing culverts. Culverts are properly sized and aligned with stream channel, and stream is well connected to floodplain and adjacent wetlands.
CATO-8	No stream degradation upstream or downstream of existing culvert. Culvert is properly sized and aligned with stream channel, and stream is well connected to floodplain and adjacent wetlands.
CATO-10	Stream banks along road are not eroded and the channel is stable with a large amount of bedrock and boulder grade control.
CATO-12	No bank erosion or channel incision in area near forest clearing. Forest clearing on private land is not emergent wetland pocket but an old growth field.
MONO-1	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
MONO-2	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
MONO-9	Surficial drainage feature – no stream channel present
HAFE-1	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
HAFE-3	No bank erosion or channel incision along stream channel. Areas of mapped NWI wetlands thought to have issues with invasive species and beaver activity altering hydrology. Invasive species is well controlled currently by NPS staff and beaver activity has apparently discontinued.
CHOH-9	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
CHOH-10	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
CHOH-11	Surficial drainage swale in upland agricultural field. No wetlands or stream onsite.
CHOH-20	No presence of invasive species within existing wetland areas. Mapped NWI wetland area not considered wetlands in the field.
CHOH-21	No presence of invasive species within existing wetland areas. Mapped NWI wetland area not considered wetlands in the field.
CHOH-22	High quality wetland with no degradation or invasive species.
CHOH-26	No presence of invasive species within existing wetland areas. Mapped NWI wetland area not considered wetlands in the field.

During the field assessment effort, a reconnaissance survey of each of the four parks for areas not identified during the desktop analysis was conducted. This reconnaissance included a windshield survey of easily accessible areas along park roads as well as walking to more remote areas that may have contained wetlands and streams based on site topography. During this reconnaissance effort, 13 additional potential sites were identified and included the field assessment for restoration potential.

- CATO-17
- CHOH-28
- CHOH-29
- CHOH-30
- HAFE-7
- HAFE-8
- HAFE-9
- CHOH-31
- CHOH-32
- CHOH-33
- MONO-7
- MONO-8
- MONO-10

At the completion of the initial site reconnaissance, a total of 42 sites across the four parks were determined to be suitable for potential restoration and were included in the detailed site assessments as described in the sections that follow. A breakdown of the sites by park is included in table 4.

Table 4. Potential Site Breakdown by Park after Field Review

Park	Number of Sites
CATO	12
MONO	7
HAFE	5
CHOH	18
Total	42

3.2.2 Informal Wetland Delineation

General Regional Characteristics

In general, the four parks evaluated for this WRAP fall within the eastern deciduous forest ecosystem. These forests are dominated by broad-leafed trees that shed their leaves annually, with evergreen cone-bearing seed plants (e.g., pines and hemlocks) common in some areas. The eastern deciduous forest canopy is dominated by oak species (*Quercus* spp.), hickories (*Carya* spp.), tulip poplar (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), and maples (*Acer* spp.).

Most of the forested areas throughout these parks are fragmented by agricultural uses or development including homes, roads and other infrastructure. The fragmentation of the forest ecosystems appears to have caused an increased density of invasive species in the understory, which in general is dominated by multiflora rose (*Rosa multiflora*) and Japanese honeysuckle (*Lonicera japonica*). Common native understory species identified throughout the four parks included spicebush (*Lindera benzoin*), common greenbriar (*Smilax rotundifolia*), mountain laurel (*Kalmia latifolia*), and lowbush blueberry (*Vaccinium angustifolium*).

Wildlife observed throughout the parks in this region are similar from park to park and included eastern grey squirrel (*Sciurus carolinensis*), chipmunks (*Tamias striatus*), white-tailed deer (*Odocoileus virginianus*), box turtles (*Terrapene carolina*), wood frogs (*Lithobates sylvaticus*), spring peepers (*Pseudacris crucifer*), groundhog (*Marmota monax*), bullfrogs (*Rana catesbeiana*), spotted salamander (*Ambystoma maculatum*), redback salamander (*Plethodon cinereus*), two-lined salamander (*Eurycea bislineata*), garter snakes (*Thamnophis sirtalis*), and various song birds.

Native brook trout (*Salvelinus fontinalis*) were identified at CATO, and wood turtles (Glyptemys insculpta) were identified at CHOH.

Catoctin Mountain Park

Approximately 90 percent of CATO is covered with forest. Most of the park contains a mixture of oaks, hickories, maple, and tulip poplar. Japanese barberry (*Berberis thunbergii*) was by far the most dominant understory species throughout the upland areas and is an invasive species found throughout the uplands of the entire park. Other types of trees that can be found include black cherry (*Prunus serotina*), ash (*Fraxinus spp.*), sassafras (*Sassafras albidum*), black walnut (*Juglans nigra*), eastern hemlock (*Tsuga canadensis*), and white pine (*Pinus strobus*).

The majority of the wetlands at the park include headwater forested wetland seeps, which are dominated by skunk cabbage (*Symplocarpus foetidus*) in the understory, and red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) in the canopy. Highbush blueberry (*Vaccinium corymbosum*) and spicebush are common dominant understory shrubs found in the forested wetlands throughout CATO.

Since the majority of the park is dominated by forested land, wetland scientists did not observe a large amount of emergent wetlands throughout the park. Emergent wetlands were typically observed along the fringes of manmade open water ponds (CATO-1 and CATO-5) and were dominated by cattails (*Typha latifolia*) and soft rush (*Juncus effusus*). One exception was a larger emergent wetland at CATO-11, which was dominated by an invasive herbaceous species along a floodplain of a perennial stream channel.

Harpers Ferry National Historical Park

Approximately 70 percent of the park is covered with eastern deciduous forest. Well-drained forest ridges are characterized by chestnut oak (*Quercus prinus*), black oak (*Quercus velutina*), and northern red oak (*Quercus rubra*). Some of the better drained slopes are covered with bitternut hickory (*Carya cordiformis*), tulip poplar, and sugar maple (*Acer saccharum*). Shrub species common to this area include mountain laurel, mapleleaf viburnum (*Viburnum acerfolium*), spicebush. Some of the most abundant vine species found in the park include greenbrier, Virginia creeper (*Parthenocissus quinquefolia*), and wild grape (*Vitis spp*.).

The wetlands within the park are mainly located along the floodplains as forested wetland systems or as emergent wetland seeps typically found along upland slopes. Other wetlands within HAFE consist of open water ponds where natural wetlands have been impacted by the creation of berms to increase water levels.

The forested floodplain wetlands within the park consist of similar vegetation as the headwater wetlands of CATO. The emergent wetlands identified within HAFE were typically dominated by cattail and *Carex* spp. However, with the disturbance of many of the wetland areas by continuous mowing practices and adjacent agricultural uses, many of the emergent wetlands identified were dominated by upland grass species such as tall fescue (*Festuca arundinacea*), common dandelion (*Taraxacum officinale*), and annual rye grass (*Lolium multiflorum*).

Monocacy National Battlefield

A majority of MONO's land consists of agricultural fields; leaving a small portion of forest cover. Much of the forest at MONO consists of a deciduous floodplain forest type with the underlying parent material being made up of a fertile limestone base. Although the park is situated in an area dominated by oak/hickory deciduous forest, the park's forest is so fragmented by open fields that the majority of the fragmented riparian buffer edges consisting of young growth red maple, box elder (*Acer negundo*), and sweet gum.

Many of the wetland areas identified within MONO consisted of historically disturbed wetlands that have been impacted by agricultural uses and are identified as emergent wetlands with disturbance to the vegetation. These emergent wetlands are routinely mowed or brushed to keep shrub and tree species from developing and maturing. These wetlands are dominated by upland plant species similar to that of HAFE emergent wetlands and include soft rush and woolgrass (*Scirpus cyperinus*).

Similar to HAFE and CATO, the lower lying floodplain areas along the stream channels are dominated by silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*), in the canopy, as well as

American sycamore (*Platanus occidentalis*). The understory species within these lower elevations include box elder.

Chesapeake & Ohio Canal National Historical Park

The Chesapeake & Ohio Canal is situated along the floodplain of the Potomac River, and is dominated by a silver maple floodplain forest. This community is most common on low terraces and levees of the floodplain and islands of large tributaries and Rivers. The canopy of Silver Maple Floodplain Forests is strongly dominated by silver maple (*Acer saccharinum*), red maple, and American sycamore. Along the river edge black willow (*Salix nigra*) and American sycamore dominate. The understory of the forest along the canal is dominated by box elder, American elm (*Ulmus americana*), and slippery elm (*Ulmus rubra*), gray dogwood (*Cornus racemosa*), poison-ivy (*Toxicodendron radicans*), spicebush, and elderberry (*Sambucus canadensis*).

Commonly occurring invasive plant species are multiflora rose (*Rosa multiflora*), bush honeysuckle (*Lonicera* spp.), Japanese barberry, Japanese stiltgrass (*Microstegium vimineum*), Japanese knotweed (*Fallopia japonica*), and garlic-mustard (*Alliaria petiolata*).

Along the upper slopes of the CHOH, the forested areas are dominated by the typical oak/hickory forests found throughout the other parks.

The wetlands throughout CHOH are primarily depressions and seeps within the forested floodplain that are dominated by red and silver maple in the canopy and box elder, spicebush, and multiflora in the understory. The presence of the canal and towpath have caused some flooding of natural wetland areas which have created some open water pond areas with emergent fringes. These emergent wetland areas along the impoundments are typically dominated by cattails, common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*) and button bush (*Cephalanthus occidentalis*).

In addition to the forested wetlands and impoundments, CHOH also contains some wetland areas that have been disturbed by mowing and agricultural uses. These emergent wetlands are dominated by upland grasses and soft rush similar to those described at MONO and HAFE.

The informal wetland delineation was completed at the 42 potential sites deemed suitable for restoration. A complete list of the 42 sites along with the delineated features is provided in table 5. The wetlands and streams identified during this delineation were located using a Trimble Geo7X handheld GPS and are depicted on the figures provided in appendix A (figures 6-47). Photographs of each of the sites are also provided in appendix C.

Table 5. Wetland Delineation Results

Site Number	Resources Identified
CATO-1	One stream channel, two open water ponds, two emergent wetlands, and three forested wetlands
CATO-2	One perennial stream channel, one intermittent stream channel, and one forested wetland seep
CATO-3	Two perennial stream channels and one ephemeral stream channel
CATO-5	One open water pond, two emergent wetlands, and one shrub wetland
CATO-7	One open water pond, one forested wetland seep, and one intermittent stream channel

Site Number	Resources Identified
CATO-9	One perennial stream channel
CATO-11	One perennial stream channel and two emergent wetlands
CATO-13	One perennial stream channel
CATO-14	One perennial stream channel
CATO-15	One perennial stream channel
CATO-16	One perennial stream channel
CATO -17	Two perennial stream channels, two intermittent stream channels, and one forested wetland
MONO-3	Three intermittent stream channel, and two emergent wetlands
MONO-4	One perennial stream channel, two emergent wetlands, and one open water pond
MONO-5	Three prior converted wetlands (emergent)
MONO-6	One perennial stream channel and one emergent wetland
MONO-7	One emergent wetland
MONO-8	One perennial stream channel
MONO-10	One intermittent stream channel
HAFE-2	One intermittent stream channel and one emergent wetland
HAFE-4	One emergent wetland and one open water pond
HAFE-6	One emergent wetland
HAFE-7	One perennial stream channel
HAFE-9	One intermittent stream channel
CHOH-1	One intermittent stream channel and one forested wetland
CHOH-5	One prior converted, historical wetland
CHOH-6	One emergent wetland
CHOH-12	One perennial stream channel
CHOH-13	One emergent wetland and one intermittent stream channel
CHOH-17	One perennial stream channel
CHOH-18	One forested wetland
CHOH-19	One open water pond
CHOH-23	One forested wetland and one emergent wetland
CHOH-24	One open water pond
CHOH-25	One forested wetland and one perennial stream channel
CHOH-27	One emergent wetland and one forested wetland
CHOH-28	One forested wetland
CHOH-29	One perennial stream channel
CHOH-30	One open water wetland with emergent fringe
CHOH-31	One perennial stream channel
CHOH-32	One perennial stream channel
CHOH-33	Concrete filled historical wetland area

3.2.3 Wetland Function and Value Assessment

A function and value assessment of the wetlands informally delineated within each potential site was performed. The function and value assessment was performed on the wetlands only and did not include the stream channels. Generally the wetlands delineated have the primary function of groundwater recharge/discharge, nutrient removal, and wildlife habitat. The results of the function and value assessment are summarized in table 6.

Wetland values are attributes not necessarily important to the integrity of a wetland system but perceived as valuable to society. Many of the common values assessed with this function and value assessment include educational value and aesthetics. Three of the sites included in the wetland delineation consisted of prior impacted wetland areas that are currently not functioning as wetlands and therefore were not included in the function and value assessment results provided in table 6.

Table 6. Wetland Function and Values for Each Site

Site Number	Groundwater Recharge / Discharge	Floodflow Alteration	Fish & Shellfish Habitat	Sediment / Toxicant Retention	Nutrient Removal	Production Export	Sediment / Shoreline Stabilization	Wildlife Habitat	Recreation	Educational / Scientific Value	Uniqueness / Heritage	Visual Quality / Aesthetics
CATO-1	X	X	--	X	X	--	--	X	--	--	--	--
CATO-2	X	X	--	X	X	--	--	X	--	--	--	--
CATO-5	--	--	--	--	--	--	--	X	--	--	--	X
CATO-7	X	--	--	X	X	--	--	X	--	--	--	X
CATO-11	X	X	--	X	X	--	--	X	--	--	--	--
CATO -17	X	X	--	X	X	--	--	X	--	--	--	--
MONO-3	X	--	--	X	X	--	--	X	--	--	--	--
MONO-4	X	--	--	X	X	--	--	X	--	--	--	X
MONO-6	X	X	--	X	X	--	--	X	--	--	--	X
MONO-7	X	--	--	X	X	--	--	--	--	--	--	--
HAFE-2	X	--	--	X	X	--	--	--	--	--	--	--
HAFE-4	X	--	--	X	X	--	--	X	--	--	--	X
HAFE-6	--	--	--	--	--	--	--	X	--	--	--	--
CHOH-1	X	X	--	X	X	--	--	--	--	--	--	--
CHOH-6	X		--	X	X	--	--	--	--	--	--	--
CHOH-13	X	X	--	X	X	--	--	X	--	--	--	--
CHOH-18	X	X	--	X	X	--	--	X	--	--	--	--
CHOH-19	X	--	--	X	X	--	--	X	--	--	--	--
CHOH-23	X	--	--	X	X	--	--	X	--	--	--	X
CHOH-24	X	--	--	X	X	--	--	X	--	--	--	X

Site Number	Groundwater Recharge / Discharge	Floodflow Alteration	Fish & Shellfish Habitat	Sediment / Toxicant Retention	Nutrient Removal	Production Export	Sediment / Shoreline Stabilization	Wildlife Habitat	Recreation	Educational / Scientific Value	Uniqueness / Heritage	Visual Quality / Aesthetics
CHOH-25	X	X	--	X	X	--	--	X	--	--	--	--
CHOH-27	X	--	--	X	X	--	--	X	--	--	--	X
CHOH-28	X	--	--	X	X	--	--	X	--	--	--	X
CHOH-30	X	--	--	X	X	--	--	X	--	--	--	X

X – indicated function or value was observed at the wetland

3.2.4 Site Assessment Results and Rankings

Upon completion of the informal wetlands delineation and the assessment of wetland functions and values, a detailed field assessment of the degraded portions of the wetlands and stream channels was conducted by completing field assessment forms for each site.

As described in Section 3.1.4. the field assessment forms were developed to score each site from 0 to 100 based on potential for restoration opportunities. The site rating forms include an assessment of 10 categories including the presence of existing disturbance to plants, soils, and hydrology as well as the evaluation of the ability to conduct restoration such as ease of access, land use, likelihood of future disturbance, etc. Highly degraded larger sites with clear evidence of past or ongoing disturbance with good access and adjacent to other resources would typically score on the higher end of the rankings, while small isolated sites surrounding by developed areas or high quality resources with little disturbance would tend to rank lower. Examples of each of the field assessment forms are included in appendix B.

The detailed results of the field assessment are provided on the restoration concept figures provided in appendix A (figures 6 - 47). Tables 7 and 8 summarize the site assessments and include rankings. In general, the wetlands identified for restoration ranked between 59 and 80 out of 100 points, and the stream restoration sites had a larger variation in ranking with scores between 31 and 87 out of 100 points.

Table 7. Wetland Site Assessment Results

Site Number	Wetland Restoration Ranking	Field Assessment Notes
CATO-1	80	Groundwater seep feeding pond, berm separates from stream hydric soils within seep groundwater seep on northeast edge. Pond overflows to stream through vertical pipe. Pond is open water with trees and shrubs along border. Water level could be lowered and planted to increase habitat and diversity, improve connection to stream. Barberry and multiflora rose along edge culvert and berm continue to alter stream flow.
CATO-5	73	Groundwater seep feeding pond, berm separates from large forested wetland complex downslope. Water level could be lowered by deep notching of existing berm and reconnected downstream and planted to increase habitat and diversity, improve hydrological connection including the upslope seep. Some invasive species along the pond edge
CATO-7	73	Open pond previously used for fishing and picnicking. Site near roadway with good access and visitor opportunities. Cultural resources present – spring has historic rock and foundations. Spring provides hydrology to pond. Currently submerged under open water. Direct runoff from forested slope adjacent to pond. Open water surrounded by turf grass and some recent tree plantings. Pond adjacent to a steep, forested slope. Berm around pond very high and steep. Restoring area would require reworking topography at site. NPS forested land, private homeowner, and existing road. Invasive species not an issue but mowed and maintained turf throughout site. Site still maintained as open water and turf. Some planted trees present and portions of site are a little steep. Overland flow from adjacent forested and maintained areas. Entire open water area could be converted to open wet meadow with a small defined channel in meadow from spring to channel. Remove portions of berm.
CATO-11	64	Wetland dominated by mile a minute and low species diversity. Will require private property access. Treatment of invasive species and increase diversity with native plantings.
MONO-3	79 and 76	Agricultural practices have degraded wetland; remains of crop vegetation present. Lack of forest species and presence of invasive species. Wetland seep in middle of agricultural field. Vegetation disturbed and dominated by thistle, fescue, and rye. Fence or agricultural exclusion and native plantings with invasive control.
MONO-4	65 and 63	Wetland surrounded by meadow. Separated from other wetland by raised grass path. Likely used to be connected and wetland area was much larger. Sparsely vegetated with grasses. Partially developed park service land. Historical wetland that is functioning at lower capacity. Raise grass path and surrounding development. Create shrub wetland, connect to other wetland. Small open water pond likely man made impoundment. Ground water likely present. Soils saturated at approximately 10 inches. Some trees around pond. Low, concave, disconnected flood plain. Open meadow and park service maintained grounds. Existing wetland opportunity to increase function. Believed to have been connected to WET1 historically.
MONO-5	75	Three prior converted crop land areas appear to be historically wet but have been recently planted with crop. Existing hydrocarbon soils observed and hydrology indicators such as standing water drainage patterns saturated soils. Agricultural concave depressions. No invasive but monotypic agricultural crop. Agricultural road to field over railroad tracks. Prior converted cropland. Take three depressions out of agricultural practice and replant with natives.
MONO-6	69	Wetland area recently planted with trees hydrology is likely from runoff and groundwater small channel exists along west side. Ground water likely, surface water runoff from surrounding field. Grass and recently planted trees. Adjacent to stream, surrounding topography slopes to wet area. Disconnected from stream due to erosion. Road bisects wetland. Wetland area adjacent to road has standing water and small channel flowing to stream
MONO-7	76	Low concave wetland appears to be historically farmed and is now dominated by invasive species. Reed canary grass dominated wetland. Hydric soils present. Invasive dominated existing wetland. Monotype stand of reed canary grass in old farmed field not actively farmed. Treat invasive reed canary and plant natives.
HAFE-2	78	Wetland currently dominated by upland invasive species. Tall fescue, bull thistle onion grass etc. part of wetlands extends into agricultural field. Plant native trees and shrubs and include agricultural or mowing exclusion practices such as signs and or fencing.
HAFE-4	78	Open pond with invasive edge and mowed wetland seep above. Pond has no outfall/structure just an overflow area on side of berm. Small channel to pipe downstream appears to be off park property. Large number of invasive species around pond edge. Honeysuckle, multiflora, olive, wine berry, English ivy, ground ivy, and garlic mustard. Wetland seep mowed and maintained so vegetation is disturbed. Exclude mowing with signs or fence, increase plant community in mowed area. Restore natural wetland in open water pond area. Invasive control needed.
HAFE-6	62	Small isolated pond with no outfall. Low diversity of plants dominated by broadleaf cattail.
CHOH-1	61	Hydrology at site impacted by stormwater management. Existing tributary has no adjacent wetlands; hydrology from this tributary could be used for wetland restoration to make a larger emergent wetland. Hydric soils located adjacent in mapped emergent wetland. Upland grasses and Japanese stilt grass located adjacent to stormwater management berm. Potential for endwall and gabion baskets to be maintained in future; same with storm water management pond and berm. Adjacent closed private community. Storm water from adjacent community. Small area of restoration; potential to increase adjacent wetland using the existing tributary as hydrology. Some trees would require removal but very open canopy.

Site Number	Wetland Restoration Ranking	Field Assessment Notes
CHOH-5	68	Site previously disturbed from farming; gravel sills placed across site perpendicular to flow channels on site. There is also a dry ephemeral channel at the site that does not qualify as a stream but likely holds flow from overland runoff. Sampled down to 18 inches - no hydric soils present. Dominated by Japanese stiltgrass; also soft rush and green bulrush sporadically. Local concave position but along a somewhat steep slope. Open land in a rural location. ATV and truck tracks throughout site; gravel sills as well to reduce erosion from storm water flow. Small rustic road provides access. Extensive excavation would be required to provide hydrology at this site to support a restored wetland
CHOH-6	69	A small portion of the site currently is a mapped wetland the majority of the site is non-wetland. Only secondary hydrology indicators exist. Hydric soils at 7- 10 inches below surface. Dominant vegetation in wetland is soft rush (*Juncus effuses*) and sub dominated by green bulrush. Locally concave area within overall rolling topography. Existing marginal wetland with potential to improve function and value. Some multiflora rose. Site was probably originally farmed; currently there are some truck and ATV tracks across the site. Potential to increase herbaceous wetland as an open wet meadow. Would likely need to do extensive grading to reach groundwater and improve hydrology.
CHOH-13	59	Portion of site identified as wetland, and remaining open area identified as previous wetland that appears to have been historically drained. Old abandoned channels that are dry were observed. Dominated by reed canary grass and jewelweed smartweed. Some standing live and some standing dead sycamores were also observed scattered. Potential to remove invasive species from existing wetlands and improve hydrology to previously drained area.
CHOH-18	66	Forested wetland with large multiflora stand. Requires invasive species control.
CHOH-19	79	Isolated wetland with no apparent outfall. Wetland is open water pond with large area of reed canary grass and button bush. Half wetland open water and other half dominated by reed canary grass. Site directly off towpath and easily accessed. Site can be treated for invasive species and planted for diversity to enhance wetland.
CHOH-23	70	Wetland partially drained by ditch. Many invasive species identified within forested shrub area of wetland and. Outer edge of wetland disturbed by agricultural practices. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to invasive upland species.
CHOH-24	62	Large emergent wetland/open water complex north of historic canal footprint. Not dominated by invasive species, but large monotypic stand of cattails.
CHOH-25	71 and 73	Wetland partially drained by ditch. Tree of heaven. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to upland. Wetland disturbed in agricultural field. Agricultural exclusion with signs or fence.
CHOH-27	76	Wetland partially drained by ditch. Many invasive species identified within forested shrub area of wetland. Outer edge of wetland disturbed by agricultural practices. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to invasive upland species.
CHOH-28	76	Forested wetland between towpath berm and old road bed. Large amount of multiflora and garlic mustard as well as old concrete walkway/foundation and concrete posts. Removal of concrete as well as debris and invasive species.
CHOH-30	71	Open water area previously disturbed. Remnants of rock from the locks and canal are present. dominant wetland type = emergent. Upland and wetland boundary is at rock line; potential for listed species. Site functions as existing emergent wetlands and open water. Existing emergent vegetation; dominated by lizards tail, soft rush, Rose mallow (*hibiscus moscheutos*), and invasive lesser celandine (*Ficaria verna*). Potential conversion of existing open water area to increase existing emergent wetland fringe; potential increase in educational value.
CHOH-33	71	Potential for restored rare, threatened, and endangered species. Site is completely paved. Historical hydrology may have been Potomac River floodplain and groundwater inflow. No vegetation on paved area but surrounding area is sycamore dominated. Upland forested park land to northeast. No stormwater influence observed. Existing pavement appears abandoned and could be removed. Floodplain and native plantings could be restored. Visitor access could be improved aesthetically. Could create fishing pier and bird viewing area.

Table 8. Stream Site Assessment Results

Site Number	Stream Restoration Ranking	Field Assessment Notes
CATO-1	44	Small channel appears to have been diverted from natural flow around the pond embankment and through a culvert beneath the driveway, causing minor bank erosion and fish passage issues. Lack of riparian buffer below the existing driveway.
CATO-2	39	Residential yard on right bank is eroded and lacking riparian buffer, needs stabilization. May be able to use existing boulders and rock for bank protection. Invasive control needed on banks. Increased erosion on banks may impact stream quality and habitat. Mostly forested but some residential yard. Forest clearing or private property access required. Microstegium and barberry along right bank.
CATO-3	68	Stream at road crossing near Owens campground. Issues with stream alignment to culvert wing wall and eroding bank downstream. Protection of existing left stream bank downstream of culvert with Boulder placement. Also opportunity for larger rock check damn along roadside drainage to reduce gravel wash entering stream. Also opportunity to protect existing wing wall on left bank.
CATO-9	58	Historical culvert on upstream portion with 3-4 foot high banks. Mostly forested but road access on upstream and downstream ends. Slightly incised eroded banks downstream of culvert and over widened channel as well; 2-3 foot drop at historical culvert. Grade control structures can be implemented downstream of culvert to reduce fish blockage and bank erosion.
CATO-11	66	Stream appears to be flow cut and eroded, existing wetlands dominated by mile a minute. Upper left bank highly eroded. Open area in floodplain allows for realignment of channel. Recommendations include bank stabilization and reconnection to floodplain as well as riparian planting through floodplain. Also has existing wetlands that can be treated for invasive species.
CATO-13	41	Stabilize railroad embankment failure and place rock and vegetation at toe of slope along stream.
CATO-14	59	Fish passage at culvert. Two 16-inch corrugated metal pipes. There is a 15 inch drop at culvert. Fish passage can be established at site with grade control below culvert.
CATO-15	61	Highly eroded channel at head cut near hiking trails and maintenance building parking area. Head cut is creating fish blockage and has the potential to migrate upstream impacting stream further and decreasing stream quality. Stream habitat for multiple salamander species.
CATO-16	35	Stream adjacent to road. Area consists of bedrock and lots of trees. Though the stream is healthy, the banks are unstable. Severe erosion located on outer meanders. Bank incision is only adverse on one bank. Area across from erosion area is connected to flood plain. Sedimentation is present in the channel and undermining of road. Difficult for construction equipment to access. Invasive species located in surrounding area may spread.
CATO -17	59	Parking area nearby, but mostly forested. Highly eroded channel at head cut near parking area and buildings, has potential to migrate upstream impacting stream further. Good grade control upstream and downstream and little invasive and stormwater influence. Large head cut creating fish blockage and highly eroded banks may be stabilized.
MONO-3	86 and 64	Severely eroded stream in narrow riparian corridor surrounded by agricultural fields. Multiple wetlands identified and ranked on separate forms. Recommend full channel restoration; including structures bank armory get increased connection to floodplain and riparian enhancements. Highly eroded and extremely incised stream channel with very low sinuosity and riparian buffer. Full stream restoration potential.
MONO-4	67	Stream is disconnected from floodplain. Wet meadows were observed in open meadow adjacent to stream. Immediately surrounding is forest but beyond narrow riparian strip is meadow. Reduce erosion and sedimentation, increase habitat and forested buffer.
MONO-6	63	Paved road crosses stream channel, concrete culvert carries stream under road, channel is much more seriously eroded after culvert. Open field on either side of channel with minimal invasive species. Mild to moderate erosion in upper reach, erosion is more severe in lower reaches. Banks are soft soil. Topography of surrounding land slopes down to the channel. Some small vegetated beaches exist adjacent to channel. Area consists of mostly grasses with some trees along bank. Recommendations include: old field habitat creation, channel stabilization, restoration of fish passage, and reduction of sedimentation.
MONO-8	51	Degraded stream channel caused from lack of riparian buffer. Existing road and crossings are present. Eroded banks of stream were previously patched in some areas but may benefit from a reach-wide restoration instead of bank patching. Limited area due to existing road driveway and steep slopes. Recommendations include reach-wide restoration with some grade control structures and bank stabilization to grade down right bank, and provide some flood relief and floodplain connection away from road.
MONO-10	69	Highly eroded and extremely incised stream channel with very low sinuosity and riparian buffer. Full stream restoration potential but channel within tighter valley so floodplain development might be limited. Existing historical spring house at head of channel.
HAFE-7	58	The stream channel has severely incised and eroded right stream bank downstream of existing culvert at road crossing. High velocity from the culvert is likely the cause of bank instability. The upland floodplain is dominated by invasive species which are along the stream banks. Right bank 6-foot bank height. Stream bank and floodplain continue to degrade. Forested but stream adjacent to road with crossing. Bank stabilization and potential floodplain improvement on right bank as well as invasive treatment along stream. Culvert partially blocked by rip rap.

Site Number	Stream Restoration Ranking	Field Assessment Notes
HAFE-9	42	Eroded partially incised stream channel. Eroded forested stream originates behind residential homes and has multiple outfall inputs from nearby roads. Potential for bank stabilization and grade control structures in upper portion of stream near existing hiking trail.
CHOH-1	31	Both wetland and stream restoration could occur if end wall and gabion baskets are removed and area is restored. Erosion estimated 200 linear feet. No associated floodplain with stream; backwater conditions from canal likely cause water to come out of channel during high storm events. Erosion present at upstream portion of the reach by stormwater management end wall. Stormwater management flow during storm events impacts existing stream resources from erosion. Forested park land dominated by maple, oak, hickory, and beech. Site is not easy to access; private community upstream and downstream towpath and canal. Stormwater management influence at top of reach; existing berm for stormwater management access. Should not rank high; local areas of erosion in the channel could be addressed but majority of site should not be restored. Backwater conditions at confluence with canal would complicate restoration.
CHOH-12	69	Banks are steep and high but not severely eroding. Vegetated with lesser celadine which is likely reducing erosion. At upstream portion of reach, erosion is extreme at over 20 feet. At downstream portion of reach, channel has recovered and is completely connected to the floodplain. Out of bank flooding does not occur at upstream portion of reach due to bank height. Channel disconnected to floodplain. Forest is young in age and dominated by Chinese wisteria, pawpaw, silver maple, elm, and box elder (new mature trees). No immediate threat but potential future threat of erosion continues. Could reconnect floodplain to improve habitat. May require equipment under pedestrian bridge; would have to cross canal. Stream appears straightened. Surrounding area is upland and dominated by invasive species at upstream end. Downstream most of the reach is stable, connected to floodplain but with Japanese knotweed. Stream and floodplain restoration proposed at upstream portion of reach to reconnect stream to floodplain and treat for invasive species.
CHOH-17	47	Channel lacking riparian buffer for approximately 150 feet, has small patchy areas of bank erosion and invasive species on banks. Small bank armoring in patches and enhance riparian area and treat garlic mustard on banks.
CHOH-25	59	Partially drained wetland by ditching stream channel. Recommend lifting ditch elevation or completely plugging to restore wetland hydrology.
CHOH-29	72	Highly eroded stream channel causing mass bank failure and culvert collapse. Historic canal culvert collapsing into channel and mass erosion near towpath. Bank armoring required
CHOH-31	87	Potential relocation of stream since flow makes a tight turn or improvement of instream resources in restoration design to make channel and stream banks stable. Possible reconnection with Potomac River floodplain that currently does not exist. Extreme erosion on both banks. Most extreme cases 10 feet or more high. Channel likely too wide for out of bank flooding. Potential for floodplain restoration but currently a picnic and camping area. Grassy picnic area with some large box elders and silver maples scattered throughout. Could improve surrounding vegetation and instream habitat. Excellent access but would have to cross canal; narrow bridge across canal. Recent large tree plantings have just occurred along stream. Construction would require closure of some park resources to the public temporarily. Hydrology not natural because source from canal. Fish passage cannot be improved upon because of canal.
CHOH-32	48	Breach of canal lock resulted in stream channels, woody debris accumulation, and stream erosion. Restoration could include creating defined channels flowing to the Potomac River. Overflow from canal, especially during storm events which adds to erosion and creation of channels. Minor channelization is present now but has potential to worsen and further incise given time. Channels only exist due to overflow from canal waters. Narrow floodplain width opportunity. Degrading of cultural resources currently occurring. Canal lock has potential to further degrade and lead to destabilization of canal and historic rock. Mature forest and forested riparian buffer along Potomac River. Flow velocities currently too high for sustaining aquatic community. Development of channels and floodplain could improve habitat diversity. Access good but via towpath. Surrounded by NPS land.

4.0 OPPORTUNITIES FOR RESTORATION AND ENHANCEMENT

When developing restoration strategies for the 42 potential sites, a specific set of restoration techniques was established for the wetland and stream sites. Typical techniques proposed for wetland restoration in this WRAP include:

- Invasive Species Control
- Native Plantings
- Restoration of Natural Hydrology
- Increase Plant Diversity
- Converting Open Water to Vegetated Wetlands
- Increasing Aesthetics or Educational Value
- Agricultural/Disturbance Exclusion Fencing

Typical techniques proposed for stream restoration in this WRAP include:

- Invasive Species Control
- Riparian Buffer Enhancement
- Restoration of Natural Hydrology
- Increase Fish Passage
- Full Channel Restoration
- Increasing Aesthetic or Educational Value
- Agricultural/Disturbance Exclusion Fencing

In an effort to streamline the proposed restoration concepts for the 42 selected sites, the techniques listed above were used when developing the restoration strategies. Although additional restoration techniques may be employed at the sites, the restoration concepts proposed for this WRAP are general in nature and additional survey would be required to propose more detailed restoration design.

From the list of techniques considered above, a proposed concept was then generated for each of the 42 potential sites. These concepts were developed to enhance and restore wetlands and streams within the four parks based upon the desktop and field assessments described in this report. The proposed concepts are provided in appendix A: figures 6 – 47 and summarized in tables 9 and 10.

4.1 INVASIVE SPECIES CONTROL

Technique includes removal of invasive species of plants along stream banks or within wetlands. This technique can be accomplished in many ways and typically includes manual removal of the plant either by hand or by mowing and other mechanical equipment. Use of herbicide is also typical for treatment of invasive species and the most effective treatment usually includes a combination of manual and chemical control throughout the year. Invasive species control can typically be accomplished with not ground disturbance and little to no impact to other resources in the area.

4.2 NATIVE PLANTINGS/ RIPARIAN BUFFER ENHANCEMENT AND INCREASED PLANT DIVERSITY

Planting of vegetation within the wetland or along the streambanks. Installing trees, shrubs and other herbaceous material would require small ground disturbance for the placement of the material. Trees and shrubs would typically require a pit to be dug approximately 2-4 feet in diameter and a few feet deep,

depending on the size of the plant material used. The dug material would then be used as backfill and not removal of material offsite would be required. Similarly, the placement of herbaceous material would require some ground disturbance although pits would only require a few inches to be dug for the insertion of plugs.

4.3 RESTORATION OF NATURAL HYDROLOGY

Many of the wetlands proposed for hydrology restoration have been ditched or drained and would include the removal of these features through filling practices. Additionally, some wetlands along floodplains and within agricultural fields have been impacted through filling and would require excavation to restore natural hydrology and interaction with the groundwater at the surface of the wetland. Restoration of stream hydrology typically will require the reconnection of the stream to the floodplain by lowering of the bank elevations through grading practices.

4.4 CONVERTING OPEN WATER TO VEGETATED WETLANDS

Altering of the water control structure would be required such as removal of existing berms or culverts that would require ground disturbance and the use of heavy equipment. Removal or altering the water control structure to lower water elevations in the wetland in order to allow more vegetation to establish and reduce the amount of open water in the area. Once the water levels are altered, the technique would also include the planting of vegetation as described above.

4.5 INCREASE FISH PASSAGE

This technique focuses on restoring safe upstream and downstream fish passage to streams and stream reaches that have become isolated by culverts and other artificial obstructions. Man-made in-stream structures (e.g., culverts, dams, levees) can become physical barriers that impede fish passage and reduce connectivity through habitat fragmentation. This technique focuses on restoring fish passage longitudinally within the stream. This technique could be accomplished in a few ways. Removal of the obstruction such culverts and bringing the site back to an open natural channel could be done only if the culvert is no longer needed. However, in most cases the culverts are placed in order for access across the existing stream. If full removal of the culvert is not possible then the culvert can be replaced with a similar structure but altered in a way to reduce the drop of elevation at the end of the culvert. This can be accomplished two ways which include lowering of the culvert and crossing so the bottom of the culvert is partially buried on both ends or the placement of instream structures such as cross vanes of rock or logs to create small step ups along the stream over a longer length rather than one large drop that blocks fish passage.

4.6 FULL CHANNEL RESTORATION

For the purposes of this restoration technique, the NPS is considering the placement of structures within the stream channel and would require the grading of stream banks and potential grading along the banks or lowering of the adjacent floodplain areas. Slight reshaping of the stream may also be included in this technique on a case-by-case basis, which would require a larger scale of grading, excavation, and filling of existing channel areas.

Instream structures refer to features intentionally placed in the stream or floodplain for habitat restoration. These features are often variously referred to as drop structures, vanes, porous weirs, roughened channels/constructed riffles, or boulder placements. Large wood (LW) and log jams that are placed for habitat complexity are technically considered instream structures as well. The structures are typically

large material that required placement by heavy machinery and require some earth disturbance along the stream banks. The structures are typically buried partially in the existing banks and required some excavation before setting the structure and then backfilling with the existing material. Construction access typically require a temporary construction access road made of mulch or timber mats for heavy equipment access.

In addition to placement of structures, this technique may also require larger grading of the stream banks or floodplain to lower the elevations of the land to allow the stream channel to overtop banks during high flood events.

Bank armoring refers to the placement of rock or logs along portions of the stream banks that receive high-energy flows along the bank and area actively eroding. The placement of this material may also require some grading back of the banks depending on the slope of the bank.

4.7 INCREASING AESTHETIC OR EDUCATIONAL VALUE

Many of the proposed sites within the NPS are within areas of public access and could include the placement of educational signs near wetlands and or streams to provide information about the habitat and resources sensitive to the area. Placement of signs would typically require minimal ground disturbance for the placement of posts. Sites with limited access could increase aesthetic and educational value simply by providing easier access to the site such as creation of trails or boardwalks within the vicinity of the project area.

4.8 AGRICULTURAL/DISTURBANCE EXCLUSION FENCING

Many of the surrounding land practices such as agricultural or maintenance/mowing activities are continuously impacting the vegetation along the edge of the wetlands or streams and can be reduced by the placement of barriers along the edge of the resources so surrounding land uses practices can no longer impact the resource. Placement of fencing around the resources or even signs to keep a buffer around the resources would require minor disturbance to the ground of placement of posts. An alternative to this may be the placement of large natural barriers such as boulders or logs along the edge of the resource to keep equipment away from the resources and would not require land disturbance.

Table 9. Proposed Wetland Restoration Opportunities

Site Number	Wetland Restoration Acreage (AC)	Invasive Species Control	Native Plantings Wetlands	Restoration of Natural Hydrology	Increasing Plant Diversity	Converting Open Water to Vegetated	Increasing Aesthetics or Educational Value	Exclusion Fencing
CATO-1	0.57	X	X	X	X	X	X	--
CATO-5	0.09	X	X	X	X	X	X	--
CATO-7	0.42	--	X	X	X	X	--	--
CATO-11	2.23	X	X	--	X	--	X	--
MONO-3	1.21	X	X	--	X	--	X	X
MONO-4	3.48	--	X	X	X	X	X	--
MONO-5	3.00	--	X	--	X	X	X	X
MONO-6	2.57	--	X	X	X	--	X	--
MONO-7	0.13	X	X	--	X	--	X	--
HAFE-2	0.59	X	X	--	X	--	X	X
HAFE-4	0.29	X	X	X	X	X	X	X
HAFE-6	0.05	X	X	--	X	--	X	--
CHOH-1	0.09	X	X	X	X	--	--	--
CHOH-5	1.11	X	X	X	X	--	X	--
CHOH-6	0.04	--	X	X	X	--	X	--
CHOH-13	1.53	X	X	X	X	--	X	--
CHOH-18	0.26	X	X	--	--	--	--	--
CHOH-19	2.51	X	X	X	X	X	X	--
CHOH-23	2.11	X	X	X	X	--	--	X
CHOH-24	4.32	--	X	X	X	X	X	--
CHOH-25	12.17	X	--	X	X	--	--	X
CHOH-27	2.04	X	X	X	X	--	--	X
CHOH-28	1.20	X	X	--	X	--	X	--
CHOH-30	6.87	X	X	--	X	X	X	--
CHOH-33	0.48	--	X	X	X	--	X	--

Table 10. Proposed Stream Restoration Opportunities

Site Number	Stream Restoration Length (linear feet)	Invasive Species Control	Riparian Buffer Enhancement	Restoration of Natural Hydrology	Increase Fish Passage	Full Channel Restoration	Increasing Aesthetics or Educational Value	Exclusion Fencing
CATO-1	628.42	X	X	X	X	X	X	--
CATO-2	448.96	X	X	--	--	X	X	--
CATO-3	567.38	X	--	X	--	X	X	--
CATO-9	423.80	--	--	--	X	X	X	--
CATO-11	608.92	X	X	--	--	X	--	--
CATO-13	91.97	--	X	--	--	X	X	--
CATO-14	138.10	--	--	--	X	--	--	--
CATO-15	312.75	--	--	--	X	X	X	--
CATO-16	661.67	--	--	--	--	X	--	--
CATO -17	733.90	--	--	X	X	X	X	--
MONO-3	4690.76	--	X	X	--	X	X	X
MONO-4	1382.54	--	X	X	--	X	X	--
MONO-6	1991.17	--	X	X	X	X	X	--
MONO-8	793.01	X	X	--	--	X	X	--
MONO-10	676.83	X	X	X	--	X	--	--
HAFE-7	406.77	X	--	--	X	X	--	--
HAFE-9	323.50	--	--	--	--	X	X	--
CHOH-1	811.13	X	X	--	--	X	--	--
CHOH-12	568.09	--	--	--	--	--	--	--
CHOH-17	389.66	X	X	--	--	X	--	--
CHOH-25	2063.84	X	--	X	--	X	--	--
CHOH-29	217.64	--	--	--	--	X	X	--
CHOH-31	315.01	X	X	--	--	X	X	--
CHOH-32	149.04	--	X	X	--	X	X	--

5.0 SUMMARY OF RESULTS AND RECOMMENDATIONS

Within the four NCR parks currently participating in this WRAP, 42 potential sites were identified that total almost 50 acres of wetland restoration opportunity, and almost 20,000 linear feet of stream restoration opportunity. A breakdown of restoration identified by park site is provided in table 11. Site-

specific restorations recommendations are summarized in table 12 and depicted on Figures 6-47 in appendix A.

Table 11. Available Restoration Amounts by Park

Park	Number of Sites	Potential Wetland Restoration Acreage	Potential Stream Restoration Length
CATO	12	3.33 acres	5,073 linear feet
MONO	7	10.39 acres	9,535 linear feet
HAFE	5	0.93 acres	826 linear feet
CHOH	18	34.73 acres	4,551 linear feet
Total	**42**	**49.38 acres**	**19,985 linear feet**

Additional restoration opportunities may exist within the parks that have not been identified within this study as well as additional restoration techniques may also be appropriate at the potential sites. At this time, the restoration concepts proposed for this WRAP are general in nature and additional surveys would be required to propose more detailed restoration designs for construction.

It is also important to note that the wetland delineation conducted for the purpose of this planning level effort was an informal delineation and is based upon the professional opinion of PWSs. The USACE is the federal agency that determines the official jurisdictional status of wetlands/waterways. Furthermore, the states and the District of Columbia may regulate wetlands/waterways considered non-jurisdictional by the USACE. Prior to developing detailed restoration designs for any of the proposed sites, a detailed formal wetland delineation should be performed and submitted to the USACE for approval.

Prior to developing any detailed design, a formal wetland delineation should be conducted at the proposed site and coordination carried out with the USACE as well as state regulatory agencies to determine of a 404/401 permit will be required. In addition to a detailed wetland delineation, the proposed sites may require additional studies such as hydrologic and hydraulic modeling, archeological surveys, soil borings, etc., depending on the extent of the proposed restoration design. A general list of future data needs for each site is provided in table 12. These additional data needs may change depending on the proposed restoration action and will be determined by the NPS and regulatory agencies as projects are selected and moved into the design phase.

6.0 PREPARERS

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Table 12. Summary of Restoration Recommendations

Site Number	Figure # (Page #)	Issues	Proposed Restoration	Future Data Needs for Detailed Design
CATO-1	Figure 6 (A-8 & A-9)	Man-made berm separates wetlands from streams. Pond is open water with low to no wetland diversity or habitat. Barberry and multiflora rose along edge culvert and berm continue to alter stream flow. Small channel appears to have been diverted from natural flow around the pond embankment and through a culvert beneath the driveway, causing minor bank erosion and fish passage issues. Lack of riparian buffer below the existing driveway.	Water level could be lowered and planted to increase habitat and diversity of wetlands as well, improve connection to stream. Introduction of minor grade control structures in stream to reduce fish passage issues and erosion directly below the culvert. Riparian plantings along the lower stream channel to increase stream buffer habitat and diversity.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Geotechnical evaluation of existing berm • Cultural resource clearance
CATO-2	Figure 7 (A-12)	Residential yard on right bank is eroded and lacking riparian buffer, needs stabilization to reduce erosion. Invasive control needed on banks, Microstegium and barberry along right bank.	May be able to use existing boulders and rock for bank protection along eroded channel bank for armoring. Channel cross vane structures can be implemented to reduce stream flow into eroded bank and slow stream flows. Bank armoring would likely remove invasive species along bank edge.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO-3	Figure 8 (A-13)	Stream at road crossing near Owens campground. Issues with stream alignment to culvert wing wall and eroding bank downstream of culvert. Gravel wash from road entering stream channel and stream flows to culvert causing minor scour upstream of culvert.	Protection of existing left stream bank downstream of culvert with boulder placement. Also opportunity for larger rock check damn along roadside drainage to reduce gravel wash entering stream. Also opportunity to protect existing wing wall on left bank by altering stream alignment with minor grading and stream work.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO-5	Figure 9 (A-14)	berm separates wetland from large forested wetland complex downslope. Some invasive species along the pond edge	Water level could be lowered by deep notching of existing berm and reconnected downstream and planted to increase habitat and diversity, improve hydrological connection including the upslope seep.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance • Geotechnical evaluation of existing berm
CATO-7	Figure 10 (A-15)	Open pond with man-made berm around pond very high and steep. Open water pond with low habitat quality and diversity.	Entire open water area could be converted to open wet meadow with a small defined channel in meadow from spring to channel. Remove portions of berm. Area currently being treated for invasive Multiflora rose can be planted with native trees.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance • Geotechnical evaluation of existing berm
CATO-9	Figure 11 (A-16)	Historical culvert on upstream portion with 3-4 foot high banks. Mostly forested but road access on upstream and downstream ends. Slightly incised eroded banks downstream of culvert and over widened channel as well; 2-3 foot drop at historical culvert.	Grade control structures can be implemented downstream of culvert to reduce fish blockage and bank erosion along with placement of bank armoring along eroded banks.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO-11	Figure 12 (A-17)	Wetland dominated by invasive mile a minute and low species diversity. Stream channel Upper left bank highly eroded. Open area in floodplain allows for realignment of channel.	Treatment of invasive species and increase diversity with native plantings. Recommendations include bank stabilization and reconnection to floodplain as well as riparian planting through floodplain.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO-13	Figure 13 (A-20)	Stream bank along existing railroad embankment is failing and causing large amount of sediment to enter the stream and may cause major failure to embankment.	Stabilize railroad embankment failure and place rock and vegetation at toe of slope along stream.	• Formal wetland delineation • Geotechnical evaluation of existing embankment
CATO-14	Figure 14 (A-21)	There is a 15 inch drop from downstream end of the existing culvert to the stream causing a concern for fish passage.	Fish passage can be established at site with grade control below culvert. To gradually raise stream to the culvert bottom elevation without altering the historic culvert.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance

Site Number	Figure # (Page #)	Issues	Proposed Restoration	Future Data Needs for Detailed Design
CATO-15	Figure 15 (A-22)	Highly eroded channel at head cut near hiking trails and maintenance building parking area. Head cut is creating fish blockage and has the potential to migrate upstream impacting stream further and decreasing stream quality. Stream habitat for multiple salamander species.	Stream bank armoring required along highly eroded banks and grade control structures should be implemented to correct the head cutting issue.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO-16	Figure 16 (A-23)	Severe erosion located on outer meanders. Area across from erosion area is connected to flood plain. Sedimentation is present in the channel and undermining of road.	Bank armoring with natural bedrock type material can be used on outer meanders to reduce erosion and protect existing roadway.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance
CATO -17	Figure 17 (A-24 & A-25)	Highly eroded channel at head cut downstream of historic culvert has potential to migrate upstream impacting stream further. Channel incised below culvert.	Bank armoring and grade control structures are needed to reduce bank erosion and control flows downstream of existing culvert.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
MONO-3	Figure 18 (A-26, A-27, & A-28)	Agricultural practices have degraded wetland; remains of crop vegetation present. Lack of forest species and presence of invasive species. Wetland seep in middle of agricultural field. Vegetation disturbed and dominated by thistle, fescue, and rye. Site also contains severely eroded streams with narrow riparian corridor surrounded by agricultural fields.	Fence or agricultural exclusion and native plantings with invasive control can be employed to enhance the wetlands while full channel restoration can be done on the streams; including grade control structures, bank armoring and floodplain and riparian enhancements.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
MONO-4	Figure 19 (A-31)	Wetland surrounded by meadow and separated by raised grass path. Small open water pond likely man made impoundment. Wet meadows were observed in open meadow adjacent to stream. Natural hydrology of existing wetlands impacted by land development. Stream channel on north end has highly eroded outer meanders and lacking riparian buffer on south bank.	Existing utility line on south bank of stream may limit riparian plantings or bank grading and therefore hard armoring of the banks may be required. Restore wetland hydrology by removing berm from western end of open water pond and covert open water wetland to diverse emergent wetland with native plantings similar to existing wet meadow.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance • Geotechnical investigation of existing berm
MONO-5	Figure 20 (A-34)	Three prior converted crop land areas appear to be historically wet but have been recently planted with crop. Existing hydrocarbon soils observed and hydrology indicators such as standing water drainage patterns saturated soils. agricultural concave depressions. No invasive but monotypic agricultural crop.	Take three depressions out of agricultural practice and replant with natives. Protect areas with exclusion fencing or signs.	• Formal wetland delineation • Cultural resource clearance
MONO-6	Figure 21 (A-35)	Wetland and stream disconnected due to erosion and incision. Paved road crosses stream channel, concrete culvert carries stream under road, channel is much more seriously eroded after culvert. Open field on either side of channel with minimal invasive species. Mild to moderate erosion in upper reach, erosion is more severe in lower reaches.	Minor grading of southern stream bank to reconnect channel to emergent wetland and increase riparian plantings along the channel. Channel grade control structures placed in channel to reconnect to floodplain and reduce erosion and incision within the channel.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
MONO-7	Figure 22 (A-38)	Low concave wetland appears to be historically farmed and is now dominated by invasive species. Reed canary grass dominated wetland. Hydric soils present. Invasive dominated existing wetland. Monotype stand of reed canary grass in old farmed field not actively farmed.	Invasive species control and replanting with native trees and shrubs similar to the adjacent forested floodplain to the north.	• Formal wetland delineation • Cultural resource clearance
MONO-8	Figure 23 (A-39)	Degraded stream channel caused from lack of riparian buffer. Existing road and crossings are present. Eroded banks of stream were previously patched in some areas but may benefit from a reach-wide restoration instead of bank patching.	Recommendations include reach-wide restoration with some grade control structures and bank stabilization to grade down right bank, and provide some flood relief and floodplain connection away from road.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance

Site Number	Figure # (Page #)	Issues	Proposed Restoration	Future Data Needs for Detailed Design
MONO-10	Figure 24 (A-40)	Highly eroded and extremely incised stream channel with very low sinuosity and riparian buffer.	Full stream restoration potential including re-alignment of stream channel and grading of floodplain.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
HAFE-2	Figure 25 (A-41)	Wetland currently dominated by upland invasive species. Tall fescue, bull thistle onion grass etc. part of wetlands extends into agricultural field.	Plant native trees and shrubs and include agricultural or mowing exclusion practices such as signs and or fencing.	• Formal wetland delineation • Cultural resource clearance
HAFE-4	Figure 26 (A-42)	Open pond with invasive edge and mowed wetland seep above. Pond has no outfall/structure just an overflow area on side of berm. Small channel to pipe downstream appears to be off park property. Large number of invasive species around pond edge. Honeysuckle, multiflora, olive, wine berry, English ivy, ground ivy, and garlic mustard. Wetland seep mowed and maintained so vegetation is disturbed.	Exclude mowing with signs or fence, increase plant community in mowed area. Restore natural wetland in open water pond area. Invasive control needed. Replanting of the pond edge with native trees and shrubs as well as establishing an emergent wetland in place of the open water to increase habitat value and plant diversity.	• Formal wetland delineation • Cultural resource clearance
HAFE-6	Figure 27 (A-43)	Small isolated pond with no outfall. Low diversity of plants dominated by broadleaf cattail.	Native plantings can be added to the wetland to increase diversity and wildlife use. Plantings such as buttonbush or black willow to increase shrubs along the edge.	• Formal wetland delineation • Cultural resource clearance
HAFE-7	Figure 28 (A-44)	The stream channel has severely incised and eroded right stream bank downstream of existing culvert at road crossing. High velocity from the culvert is likely the cause of bank instability. The upland floodplain is dominated by invasive species which are along the stream banks. Right bank 6-foot bank height. Stream bank and floodplain continue to degrade. Forested but stream adjacent to road with crossing.	Bank stabilization and potential floodplain improvement on right bank to reduce erosion as well as invasive treatment along stream. Step pool complex to be utilized directly below the existing culvert to reduce the drastic drop in stream elevation below culvert. Bank armoring and grade controls along the stream channel to reduce velocities on the right bank and protect from future erosion. Invasive species treatment can be employed.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
HAFE-9	Figure 29 (A-45)	Eroded partially incised stream channel. Eroded forested stream originates behind residential homes and has multiple outfall inputs from nearby roads.	Potential for bank stabilization and grade control structures in upper portion of stream to reduce bank erosion along hiking trail.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-1	Figure 30 (A-46)	Hydrology at site impacted by stormwater management. Gabion baskets located in upper reach of stream channel. Erosion estimated 200 linear feet. No associated floodplain with stream. Erosion present at upstream portion of the reach by stormwater management end wall.	Removal of existing gabions and replacement with channel cross-vanes for grade control and help prevent sedimentation. Minor bank armoring of channel to reduce erosion from higher stormwater flows.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-5	Figure 31 (A-49)	Site previously disturbed from farming; gravel sills placed across site perpendicular to flow channels on site. Dominated by Japanese stiltgrass; also soft rush and green bulrush sporadically. Local concave position but along a somewhat steep slope. ATV and truck tracks throughout site; gravel sills as well to reduce erosion from storm water flow.	Excavation of existing depression to lower base elevation closer to groundwater and remove gravel sills placed throughout the wetland area. Treatment for invasive Japanese stiltgrass and replant wetland with native rushes and sedges.	• Formal wetland delineation • Cultural resource clearance
CHOH-6	Figure 32 (A-50)	Locally concave area within overall rolling topography. Existing marginal wetland with potential to improve function and value. Some multiflora rose. Site was probably originally farmed; currently there are some truck and ATV tracks across the site.	Potential to increase herbaceous wetland as an open wet meadow. Would likely need to do extensive grading to reach groundwater and improve hydrology. Placement of fencing or signs around wetland to exclude vehicle traffic and agricultural practices from future impact to the wetland. Native plantings of wetland sedges and rushes to increase plant diversity and habitat quality.	• Formal wetland delineation • Cultural resource clearance

Site Number	Figure # (Page #)	Issues	Proposed Restoration	Future Data Needs for Detailed Design
CHOH-12	Figure 33 (A-51)	Banks are steep and high but not severely eroding. Vegetated with lesser celadine which is likely reducing erosion. At upstream portion of reach, erosion is extreme at over 20 feet. At downstream portion of reach, channel has recovered and is completely connected to the floodplain. Out of bank flooding does not occur at upstream portion of reach due to bank height. Channel disconnected to floodplain. Stream appears straightened. Surrounding area is upland and dominated by invasive species.	Stream and floodplain restoration proposed at upstream portion of reach to reconnect stream to floodplain and treat for invasives along both banks of the stream channel. Channel crossvanes implemented for grade control to reconnect stream baseflow to the floodplain and bank armoring along the channel to reduce erosion on the stream banks.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-13	Figure 34 (A-52)	Portion of site identified as wetland, and remaining open area identified as previous wetland that appears to have been historically drained. Old abandoned channels that are dry were observed. Dominated by reed canary grass and jewelweed smartweed. Some standing live and some standing dead sycamores were also observed scattered.	Invasive species removal and native plantings throughout the site with some bottom excavation to bring wetland hydrology back to the surface.	• Formal wetland delineation • Cultural resource clearance
CHOH-17	Figure 35 (A-53)	Channel lacking riparian buffer for approximately 150 feet, has small patchy areas of bank erosion and invasive species on banks.	Small bank armoring in patches and enhance riparian area and treat garlic mustard on banks.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-18	Figure 36 (A-54)	Forested wetland with large multiflora stand. Requires invasive species control.	Removal of multiflora rose from the existing wetland and surrounding adjacent uplands.	• Formal wetland delineation
CHOH-19	Figure 37 (A-55)	Isolated wetland with no apparent outfall. Wetland is open water pond with large area of reed canary grass and button bush. Half wetland open water and other half dominated by reed canary grass.	Site can be treated for invasive species and planted for diversity to enhance wetland. Native wetland shrubs and understory trees such as black willow and buttonbush can be planted as well as wet meadow herbaceous material.	• Formal wetland delineation • Cultural resource clearance
CHOH-23	Figure 38 (A-56)	Wetland partially drained by ditch. Many invasive species identified within forested shrub area of wetland and. Outer edge of wetland disturbed by agricultural practices. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to invasive upland species.	Placement of exclusion fencing or signs to remove ongoing impacts to vegetation. Plugging or removal of the existing ditch which drains the wetland on the southwest corner and replanting the site with native trees and shrubs after invasive species control is implemented. American sycamore, river birch and silver maple to be planted to increase diversity and habitat value.	• Formal wetland delineation • Cultural resource clearance
CHOH-24	Figure 39 (A-57)	Large emergent wetland/open water complex north of historic canal footprint. Not dominated by invasive species, but large monotypic stand of cattails.	Native plantings along the north side of the wetland such as black willow and other water tolerant shrubs to increase habitat value and plant diversity.	• Formal wetland delineation • Cultural resource clearance
CHOH-25	Figure 40 (A-58)	Wetland partially drained by ditch. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to upland. Wetland disturbed in agricultural field. Partially drained wetland by ditching stream channel.	Agricultural exclusion with signs or fence to remove ongoing disturbance to vegetation. Recommend lifting ditch elevation or completely plugging to restore wetland hydrology. Channel can be reshaped within the existing wetland to increase sinuosity and habitat value. Cross vane implemented along the channel to lift base flow and reconnect to the wetland.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-27	Figure 41 (A-61)	Wetland partially drained by ditch. Many invasive species identified within forested shrub area of wetland. Outer edge of wetland disturbed by agricultural practices. Drained wetland still functioning and delineated as wetland but reduced hydrology and some vegetation changing over to invasive upland species.	Agricultural exclusion with signs or fence to remove ongoing disturbance to vegetation. Forested wetland to be treated for invasive species control and planted with native trees and shrubs to increase diversity.	• Formal wetland delineation • Cultural resource clearance
CHOH-28	Figure 42 (A-62)	Forested wetland between towpath berm and old road bed. Large amount of multiflora and garlic mustard as well as old concrete walkway/foundation and concrete posts. Removal of concrete as well as debris and invasive species.	Removal of invasive species and replanting with native trees and understory shrubs. Concrete within wetland should be removed if not considered to be cultural resources.	• Formal wetland delineation • Cultural resource clearance

Site Number	Figure # (Page #)	Issues	Proposed Restoration	Future Data Needs for Detailed Design
CHOH-29	Figure 43 (A-63)	Highly eroded stream channel causing mass bank failure and culvert collapse. Historic canal culvert collapsing into channel and mass erosion near towpath.	Bank armoring and protection of severely eroded stream bank along tow path.	• Formal wetland delineation • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-30	Figure 44 (A-64 & A-65)	Open water area previously disturbed and existing rock along the upland boundary to the wetland. Invasive species also identified along the wetland edge.	Potential to increase emergent wetland fringe around the open water edge to increase plant diversity and habitat value.	• Formal wetland delineation • Cultural resource clearance
CHOH-31	Figure 45 (A-66)	Extreme erosion on both banks. Most extreme cases 10 feet or more high. Channel likely too wide for out of bank flooding.	Bank armoring to protect existing banks without impacting the existing adjacent park use areas. Grade control structures throughout channel can be utilized to reconnect the channel to the floodplain downstream along the Potomac River.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-32	Figure 46 (A-67)	Breach of canal lock resulted in stream channels, woody debris accumulation, and stream erosion. Overflow from canal, especially during storm events which adds to erosion and creation of channels. Minor channelization is present now but has potential to worsen and further incise given time. Channels only exist due to overflow from canal waters. Development of channels and floodplain could improve habitat diversity.	Restoration could include creating defined channels flowing to the Potomac River and placement of grade control structures to reduce down cutting and future incision or migration of erosion upslope to further impact the canal wall.	• Formal wetland delineation • Stream Fluvial Geomorphic Survey • Hydrologic & Hydraulic Study • Cultural resource clearance
CHOH-33	Figure 47 (A-68)	Site is completely paved. Historical hydrology may have been Potomac River floodplain and groundwater inflow. No vegetation on paved area but surrounding area is sycamore dominated.	Floodplain and native plantings could be restored. Visitor access could be improved aesthetically. Could create fishing pier and bird viewing area. Removal of impervious surface and planting with native trees and shrubs to increase floodplain habitat.	• Formal wetland delineation • Cultural resource clearance

ATTACHMENT A

FIGURES

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ATTACHMENT B

EXAMPLE FIELD ASSESSMENT FORMS

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ATTACHMENT C

PHOTOGRAPHS

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