APPENDIX J

Spring Creek North Ecosystem Restoration Project

Appendix J

Monitoring and Adaptive Management

1.1 Introduction

This Monitoring & Adaptive Management Plan was prepared for the Spring Creek North Ecosystem Restoration Draft Feasibility Report/Environmental Assessment (FR/EA). Section 2039 of Water Resource Development Act (WRDA) 2007 (as amended by Section 1161 of WRDA 2016) directs the Secretary of the Army to ensure, when conducting a feasibility study for a project (or component of a project) under the U.S. Army Corps of Engineers (USACE) ecosystem restoration mission, that the decision document include a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. The monitoring and adaptive management plan shall include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met.

Section 2039 of WRDA 2007 also directs USACE to develop an adaptive management plan for all ecosystem restoration projects. The adaptive management plan must be appropriately scoped to the scale of the project. The information generated by the monitoring plan will be used by the New York District (the District) in consultation with the federal and state resources agencies and the USACE North Atlantic Division (NAD) to guide decisions on operational or structural changes that may be needed to ensure that the ecosystem restoration project meets the success criteria.

An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. Assessing status and trends includes both spatial and temporal variations. Gathered information under this monitoring plan will provide insights into the effectiveness of current restoration projects and adaptive management strategies, and indicate where goals have been met, if actions should continue, and/or whether more aggressive management is warranted.
Monitoring the changes at the project site is not a simple task. Restored wetlands can take decades to reach their dynamic equilibrium conditions, therefore the initial monitoring period of 5 years will be assessed as to whether the structural template has been established and if the site is on a trajectory toward ecological success. The task of tracking environmental changes can be difficult, and distinguishing the changes caused by human actions from natural variations can be even more difficult. This is why a focused monitoring protocol tied directly to the planning objectives needs to be followed.

This Monitoring and Adaptive Management Plan describes the existing habitats and monitoring methods that could be utilized to assess the project. By reporting on environmental changes, the results from this monitoring effort will be able to evaluate whether measurable results have been achieved and whether the intent of the Spring Creek North Ecosystem Restoration project is being met.

1.2 Guidance

The following documents provide distinct USACE policy and guidance that are pertinent to developing this monitoring and adaptive management plan:

1. Section 1161 of WRDA 2016. Completion of Ecosystem Restoration Projects.

2. USACE. 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water

Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration

3. Section 2039 of WRDA 2007 Monitoring Ecosystem Restoration

4. USACE. 2000. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies.

5. USACE. 2003a. ER 1105-2-404. Planning Civil Work Projects Under the Environmental Operating Principles.

1.3 Project Area Description

The recommended plan for this project is described in detail in Section 5 of the Draft FR/EA. In general the proposed plan will create approximately 7.6 acres of low marsh, 5.4 acres of high marsh, 1.0 acre of scrub-shrub, 2.1 acres of upland, and 19.0 acres of maritime forest for a total of 35.1 acres. The goal of this project is to contribute to the National Ecosystem Restoration by restoring degraded ecosystem structure, function, and dynamic processes to less degraded and more natural conditions. This goal would be accomplished by excavating and re-contouring uplands to intertidal elevations, removing invasive species, and replanting with native plant species. In addition, this plan recommends channel realignment to reintroduce sinuosity back into the creek and address ongoing erosion that has occurred on the eastern portion of the project area. Areas designed for maritime forest will tie into existing grade elevations and higher existing elevations will be re-graded to create low and high marsh. To achieve the designed wetland elevation, approximately 98,000 cubic yards of material excavated from onsite will be distributed onsite to create the upland and maritime forest communities.

The excavation and re-contouring used to restore the inter-tidal salt marsh system will establish an elevational gradient that gradually transitions from open water to wetland to upland. Wetland vegetation primarily smooth cordgrass) would occupy a gentle slope of increasing elevation. At low tide, mudflat areas will be exposed along the edges of the interface of the salt marsh and the open water area; at high tide, the mudflat and salt marsh will be flooded at varying depths, depending on final elevations.

2.1 Monitoring and Adaptive Management- Objectives, Strategy, and Procedures

Prior to implementation, the District along with the project Non-Federal Sponsor, New York City Parks and Recreation (NYC Parks) would develop a detailed monitoring plan that identifies the field variables that should be evaluated, the most appropriate field measurement methods, the recommended frequency, and duration of each field effort, the reporting requirements and schedule, and a cost estimate to implement the entire monitoring and management plan. All monitoring components will continue to be refined and designed as construction progresses. This version of the monitoring plan is based on feasibility level information. The following sections present some of the performance criteria and potential corrective actions that would be identified in the plan.

2.2 Objectives

The purpose of this monitoring and adaptive management program is to assess the progress towards, and the success or failure of, the restoration and the achievement of acceptable standards of salt marsh structure and function. The primary project objectives are to maximize restored intertidal salt marsh and increase/maximize wetland functions and values. To this end, the monitoring and adaptive management plan will focus on tracking the three ecological parameters that are the hallmarks of a functioning tidal marsh as per the *USACE Wetlands Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (USACE 2012):

- Hydrophytic Vegetation
- Wetland Soils
- Wetland Hydrology

Evaluating the success of the restoration site will be based on the establishment of the targeted habitats within the restoration site and on the ecological functioning of those habitats. Monitoring objectives include:

Monitoring:

- To support adaptive management of implemented projects;
- To assess and justify adaptive management expenditures;
- To minimize costs and maximize benefits of future restoration projects; and
- To determine "ecological success", document, and communicate it.

Adaptive Management:

Adaptive management measures are not the same as typical operation and maintenance activities. These measures are technically response actions to changes that adversely affect how the system was predicted to respond. In so being adaptive, there are no absolute measures that can be defined prior to the issue arising. However, general concerns and examples of adaptive management processes can be identified at this stage. Adaptive management recognizes that human knowledge regarding biological and physical systems are limited and that these systems may not always respond as expected. When a management or restoration project is to be implemented but there is some uncertainty regarding the response of the system to particular actions, adaptive management provides a way for management actions to respond to feedback from the system being managed.

2.3 Strategy

The District will monitor the restoration area following completion of construction activities in order to evaluate the success of project, and to take corrective actions, if necessary, to ensure success.

Monitoring
Post-construction monitoring and management will be performed over a period of five years, or until ecological success, based on the criteria defined above, has been met. An initial monitoring event will immediately follow completion of site restoration. Long-term monitoring activities will be conducted

annually for 5 years following completion of site restoration.

All monitoring components of the strategies will continue to be refined and design and construction progresses for the specific habitats restored. This monitoring plan is based on feasibility level information.

The purpose of the monitoring plan for wetland restoration/creation is to:

- Assess baseline conditions for water quality, vegetation, invertebrates, and other bioassessments;
- Evaluate the success of the wetland restoration/creation; and
- Develop a better understanding of wetland restoration/creation opportunities and protection needs in the study area.

Adaptive Management

Adaptive management will be implemented if specific restoration standards are not met or if it appears that actual conditions will diverge sufficiently far from the intended conditions to threaten the achievement of overall project goals. Funding for adaptive management will be included in the project cost estimates so that this option will be available in the future if needed.

The adaptive management program will consider the following conditions identified by the monitoring reports that may be limiting potential success.

- Roles current soil characteristics and topography are playing in the function of the site.
- Whether the vegetation species and sizes used during the initial planting were appropriate for site conditions.
- Determining the impact invasive species and herbivory damage to the planted vegetation has had on the restored site and identification and evaluation of potential remedies.
- Review of site hydrology
- Review of restoration and enhancement habitat designs to identify where design may not be appropriate to address the water resource problems.

2.4 Monitoring and Adaptive Management Procedures

Pre-restoration monitoring protocols will seek to obtain baseline data in order to establish the existing ecological conditions of the project site. This monitoring will take place within a one year period, with a Spring and Fall event, prior to the start of project implementation (during Preconstruction Engineering and Design Phase).

Post-restoration monitoring will begin four to five weeks after wetland restoration/creation is completed and continue each year for 5 years post restoration; at which point monitoring and adaptive management will be turned over to the local sponsor. This initial site visit will include an assessment of the construction site and photographic documentation of the completed restoration area. After this assessment, post-restoration monitoring will occur once annually for 5 years, assessing all ecological parameters that are listed above. Post-restoration monitoring will seek to assess the success of the restored habitat using the protocols proposed in 2000 by New York State Department of State and New

York State Department of Environmental Conservation in their New York State Salt Marsh Restoration and Monitoring Guidelines Report. Protocols below have been modified from protocols used during other salt marsh and wildlife monitoring projects conducted by other resource agencies, as well as those followed by USACE.

The monitoring protocol will progress towards showing appropriate coverage of plantings or target hydrophytes (target hydrophytes are noninvasive native species to the area and similar to ones identified on the planting plan); to document the development of hydric soils and an improved hydrologic regime across the restoration site. Lastly, monitoring will conclude to submit a field wetland delineation of the project based on the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) showing the exact acreage of the restored areas.

The following are monitoring procedures that will provide the information necessary to evaluate the success of the project. Further refinement of these procedures will be completed by USACE and its sponsors prior to the pre-construction monitoring period.

2.3.1 Hydrophytic Vegetation Monitoring

Timing and Performance Target:
Vegetation would be monitored in both the spring and fall, annually to document conditions that indicate achievement of the performance target of at least 85% coverage of planted vegetation or target hydrophytes. Sampling methods would include random circular plot sampling for woody vegetation and quadrat plot sampling for emergent vegetation.

Methods:
Random circular plot sampling:
Protocol would call for typically twenty foot radius plots; however, in areas of high planting density ten foot radius plots may be utilized. Plot locations would be chosen using a simple random sampling procedure. Data recorded at each plot for both herbaceous and woody species include; species name, percent area coverage, and dominance. For woody species, additional data included whether the species was planted or is a recruit, number of live, and number of dead stems, average height, and plant health. Plant health would be rated as "E" representing excellent health (plant is thriving and has little to no signs of herbivory), "G" representing good health (plant is healthy and may have some herbivory), "F" representing fair health (plant is moderately healthy and may have moderate herbivory), and "P" representing poor health (plant is dying and/or has heavy herbivory).

Quadrat sampling:
Protocol for emergent vegetation would consist of one square meter quadrat plots along random transects lines no more than 15 meters apart. At each transect, one quadrat will be randomly placed within the low marsh along the transect line and the existing vegetation of the plot will be monitored. Quadrats will be placed on either side (randomly chosen) within one meter of the measuring tape. Once placed, the meter mark on the upper and lower edge of each quadrat will be marked permanently with stakes and recorded on the measuring tape in meters. Plant species, plant height, stem density, flowering density, and percent cover data will be collected within each plot. A narrative description of plant health will also be collected. The exact location and side the quadrat will be placed on the transect line will be noted with a compass. This will facilitate relocating quadrats on subsequent monitoring visits. Each transect line and 1.0 m^2 quadrat will be photographed facing channel-ward at the time of vegetation monitoring. All photographs must be taken at low tide, in the same spot, and at the same height.

Adaptive Management:
If the restored site is not showing progress to meet the requirements of 85% vegetation cover, additional native vegetation would be planted to meet this goal. If, in the unlikely event, a native, sustainable ecosystem cannot be established within 2 years at the site, changes and modifications to the project site would be initiated immediately by restoration ecologists. A new monitoring plan will be redrawn by USACE to accommodate these changes and monitor the success of the alteration.

After 2 years post-restoration, the monitoring protocol will integrate the standard of 85% vegetative cover with a broad functional assessment focusing on the three ecological parameters listed above. If the restored site fails to meet the requirements of 85% vegetation cover during the first 2 years, the additional native vegetation will be planted to meet this goal. Invasive species will be managed via physical removal and or the use of pesticides.

2.3.2 Wetland Soil Monitoring

Timing and Performance Target:
Hydric Soil: Investigations to track the progression of hydric soil formation would occur annually starting in year 2. The performance target is for at least 80% of the area of disturbed soils to develop the wetland characteristics of hydric soils within the 5 year period of monitoring.

Soil Salinity: Investigations into soil salinity would occur bi-annually starting in year 2. The performance target for the restoration area that is at or below mean tide level is to have soil salinity levels within the range of at least 15 parts per thousand (ppt) to assist with saltmarsh development, for the duration of the 5 year monitoring program.

Methods:
Hydric Soil: The soil characteristics of texture, color, and structure would be used to help determine the presence or absence of groundwater and/or frequency of surface inundation. Soil texture would be estimated in the field using the U.S. Department of Agriculture (USDA) classification system. Other characteristics such as redoximorphic features, relative moisture content, and structure would also be noted. Color would be described using Munsell color charts.

Necessary laboratory analysis will be performed to identify the existing characteristics of the surficial and subsurface soils at the site. Soil samples would be analyzed for the following parameters: standard fertility analysis for soils (P, K, Mg, Ca, Zn, Cu, Mn, Fe, and B), soil pH and soil organic matter.

Soil Salinity: Soil salinity will be sampled during low tide at various ground elevations along transects across the site. Sampling timing will be focused on plant growing seasons and location will be focused on critical rooting depths.

Adaptive Management:
Soils would be evaluated for the potential benefit of soil modification (e.g. addition of clay to in-situ soil) to improve water retention after flood inundation. Management of salinity may include modifications to DEP controlled Spring Creek Auxiliary Waste Water Treatment Plant and other adjacent areas.

2.3.3 Wetland Hydrology Monitoring

Timing and Performance Target:
Inundation Regime- Monitoring of wetland inundation will occur for the first 2 years post construction, when the greatest change is expected to occur. The performance target for optimal inundation regimes will be measured through degree of inundation in the constructed creeks. For a planned marsh with slopes of 1%, the goal for creek construction is for inundation to be no further than 200 feet from any channel or creek.

Water Quality- Monitoring of Water quality will occur once a month from June through September throughout the 5 year period of monitoring. Sampling will occur at two locations within a project site. The sampling sites will be located at opposite ends of the site in order to get an accurate assessment of wetland functioning pre- and post- restoration within the project area. Water quality will be tested at approximately 1 hour prior to high tide, during the flood tide as the water is entering the wetland system.

Methods:
Inundation Regime- Visual hydrologic surveys will be used to characterize tidal inundation regimes and evaluate the development of the site through changes in morphology, erosion and sedimentation; and to measure increases in tidal circulation due to excavation of new channels and intertidal habitat. Measures of depth and duration of tidal inundation will be conducted visually and with a tidal staff for selected tidal cycles prior to alteration and following wetland construction.

Water Quality- A Hanna Instruments Multi-parameter Portable Meter (or similar device) will be used to record several aquatic parameters including salinity, temperature, pH, dissolved oxygen, total dissolved solids (TDS), and electric conductivity (EC).

Adaptive Management:
The hydrological regime will be evaluated so that depth and duration of flooding across the project sites is performing to maintain saturation levels determined necessary to maintain the wetlands. Changes may include altering drainage swales, employing some type of groundwater wicking method that could draw the groundwater closer to the root zone and provide hydrologic support to the wetlands, and refining existing models to better evaluate water flow velocities, volumes, duration, and inundation.

3.0 Monitoring Responsibilities

The responsible parties for the five year monitoring will be USACE and NYC Parks. Any standards presented in this plan are to be used as guidelines for evaluation. Closer investigation will be performed by the monitoring and adaptive management team which shall consist of at least one representative of the following agencies: USACE, NOAA Fisheries, USFWS, NYSDEC, NYSDOS, and NYCDEP. The regulatory agencies responsible for approving the restoration designs, monitoring protocols, and any required permitting for restoration activities is NYSDEC.

<u>Reporting Results</u>

A yearly monitoring summary report would be drafted by the USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report would be

drafted that details the outcomes of the constructed restoration project. Included in each report shall be the monitoring data, photographs, a brief summary of the collected data, and a discussion of the data collected.

4.0 Estimated Cost and Duration

The Monitoring and Adaptive Management program for the Spring Creek North Ecosystem Restoration project is scheduled to begin following construction (estimated 2021). The District and the non-federal sponsor will operate this program for 5 year following construction. The project has budgeted approximately $620,000 ($500,000 plus contingency) for the monitoring and adaptive management portion of this program as part of the total cost share with the non-federal sponsor (Table 1). Any monitoring or adaptive management that is conducted after the 5 years will not be part of the total project cost and will be 100% non-federal cost.

Table 1. Monitoring and Adaptive Management Cost Estimates

	Monitoring	Invasive Removal	Replanting	Soil Modifications	Hydrologic Alterations
Pre-construction	$8,000				
Year 1	$14,000				
Year 2	$14,000				
Year 3	$14,000	$6,000			
Year 4	$14,000	$6,000			
Year 5	$14,000	$6,000	$216,955	$50,000	$125,000
Total	$78,000	$30,000	$216,955	$50,000	$125,000

5.0 Operation & Maintenance

The Operation &Maintenance costs of the project are estimated to an average annual cost of $3,600 with a 3.125% interest rate over 50 years. A detailed O&M Manual containing all the duties will be provided to the non-Federal sponsor after construction is closed out. The O&M for ecosystem projects are practical and minimal due to initial project design efforts and design targets for sustainability. Mostly if not all of the O&M activities are no different than the specific activities that take place during construction. The O&M described here is not the same as the Adaptive Management measures described in the previous section.

Invasive Plant Species Control – The maintenance activity is probably the most important to conduct. Preventing the establishment of invasive species and weedy vegetation prevents the need for large scale herbicide or physical eradication and replanting efforts. An annual maintenance plan should be drafted in conjunction with input from NYC Parks taking into account the types of invasive and non-native species to be treated and the acreage of the treatment area. Problematic areas will include the bank transition and emergent marsh zones. Precautions should be taken to ensure that any long term herbicide application is appropriately dispensed to remove non-native plants and invasive species while avoiding native plant communities.

Native Plant Community Maintenance – It will be required to maintain the species richness, abundance and structure of the restored plant communities within the project area. Aside from minor re-plantings, it

will be important to continue to protect plant communities from external changes by man's daily activities, whether single incidents or chronic stressors. These can cause native plant communities to experience significant species richness declines even to the point of becoming monotypic stands.

6.0 References

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