Appendix F

Spring Creek North Ecosystem Restoration Study

Appendix F

Biological Benchmarks

Biological Benchmark Data
Spring Creek Restoration Project
Brooklyn, Kings County, NY

Env. Stake ID	Bio-benchmark ID	Community Benchmark	Elevation (NAVD 88)
Area1 - Spring Creek			
24	sc37altlow	low marsh - lower	2.2
25	sc36altlow	low marsh - lower	1.3
26	sc35altlow	low marsh - lower	1.7
27	sc34altlow	low marsh - lower	1.5
28	sc33altmid	low marsh - middle	2.5
29	sc32pdlowalthigh	low marsh-high marsh interface	2.7
30	sc31pdhighphralo	high marsh-phragmites interface	3.1
31	sc30althighphrlo	low marsh-phragmites interface	2.8
32	sc29pdhighphrlo	high marsh-phragmites interface	3.1
33	sc25pdhigh	high marsh - lower	3.3
35	sc6altupperbnd	low marsh - upper	2.7
36	sc7altupperbnd	low marsh - upper	2.7
37	sc23pdhigh	high marsh - upper	3
38	sc22pdhigh	high marsh - upper	3
39	sc8altupperbnd	low marsh - upper	2.5
40	sc9altupperbnd	low marsh - upper	2.5
41	sc21pdhigh	high marsh - upper	2.8
42	sc10altupper	low marsh - upper	2.5
43	sc20pdhigh	high marsh - upper	3
44	sc11altupper	low marsh - upper	2.6
45	sc19pdhigh	high marsh - upper	2.6
46	sc15pdlow	high marsh - lower	2.5
47	sc14altlow	low marsh - lower	0.5
48	sc14pdlow	high marsh - lower	-0.2
51	sc16pdlow	high marsh - lower	2.5
52	sc12altlower	low marsh - lower	2.4
53	sc17mixlow	mixed low marsh	2.4
54	sc4alt	low marsh - lower	2.8
55	sc3alt	low marsh - lower	2.5
56	sc2alt	low marsh - lower	2.5
57	sc1alt	low marsh - lower	2.4
58	sc5alt	low marsh - lower	2.5
59	sc26pdlowalthigh	low marsh-high marsh interface	2.7
60	sc27pdlowalthigh	low marsh-high marsh interface	2.6
61	sc28saltpanne	salt panne	1.9
62	sc38altlow	low marsh - lower	1.3
Area 2 - Ralph's Creek			
1	sc50lmsalt	low marsh - lower	1.8
2	sm51lmsalt	low marsh - lower	1.7
3	sc52lmsalt	low marsh - middle	1.9
4	sc53lmsaltiva	low marsh/iva interface upper	2.4
5	sc54lmsaltiva	low marsh/iva interface upper	2.4
6	sc55lmsaltiva	low marsh/iva interface upper	2.4
7	sc56saltpan	salt panne	1.4
8	sc57lmsalt	low marsh - lower	1.8
9	sc58lmsaltiva	lowmarsh/iva interface upper	2.5
14	sc59lmsalt	low marsh - lower	2
15	sc60lmsaltiva	low marsh/iva interface upper	2.5
22	sc61lmsaltiva	low marsh/iva interface upper	2.2
23	sc62lmsalt	low marsh - lower	2.3

Env. Stake ID	Bio-benchmark ID	Community Benchmark	Elevation (NAVD 88)
Area 3 - Flatlands Ave			
1	SC-101	low marsh-phragmites interface	1.305
2	SC-100	low marsh - lower	-0.32
3	SC-103	low marsh-high marsh interface	1.146
4	SC-102	low marsh - lower	-0.169
5	SC-107	high marsh/iva interface	2.405
6	SC-110	low marsh/iva interface upper	1.67
7	SC-111	low marsh/iva interface upper	1.975
8	SC-112	low marsh/iva interface upper	1.78
9	SC-113	low marsh/iva interface upper	1.959
10	SC-114	low marsh/iva interface upper	1.848
11	SC-115	low marsh/iva interface upper	1.949
12	SC-116	low marsh - high	2.198
13	SC-117	low marsh-high marsh interface	2.17
14	SC-118	low marsh - high	2.27
15	SC-105	low marsh-high marsh interface	2.214
16	SC-106	high marsh/iva interface	2.225
17	SC-119	low marsh - high	2.133
18	SC-120	low marsh - lower	-0.521
19	SC-104	low marsh	-0.701
20	SC-121	low marsh - lower	-0.444
21	SC-122	low marsh - lower	-0.49
22	SC-123	low marsh - lower	-0.19

Average BioBenchmark Information

Spring Creek Restoration Project

Brooklyn, Kings County, NY

Hydrologic Area	Tide Range Elevations			Low Marsh		High Marsh		Iva		Panne
	MLW	MTL	MHW	Low	Upper	Low	Upper	Low	Upper	
Area 1 Spring Creek	-1.699	0.497	2.687	1.60	2.63	2.60	3.00	2.80	SHW+	1.90
Area 2 Ralph's Creek	-0.077	1.699	3.476	1.92	2.40	X	X	2.40	SHW+	1.40
Area 3 Flatlands	1.177	3.111	5.045	-0.41	1.9	2.20	2.32	1.98	SHW+	N/A
Troll 9000 Area 3	0.528	2.634	4.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*SHW to be determined.
X = benchmarks not recorded
N/A = not applicable

Spring Creek North Ecosystem Restoration Study

Appendix F

Evaluation of Planned Wetlands

US Army Corps of Engineers®
New York District

EVALUATION OF PLANNED WETLANDS REPORT

Spring Creek Ecosystem Restoration Project
Spring Creek Park
Brooklyn and Queens, NY

December 2003

Prepared By: U.S. Army Corps of Engineers
Planning Division
New York District
26 Federal Plaza
New York, New York 10278-0090

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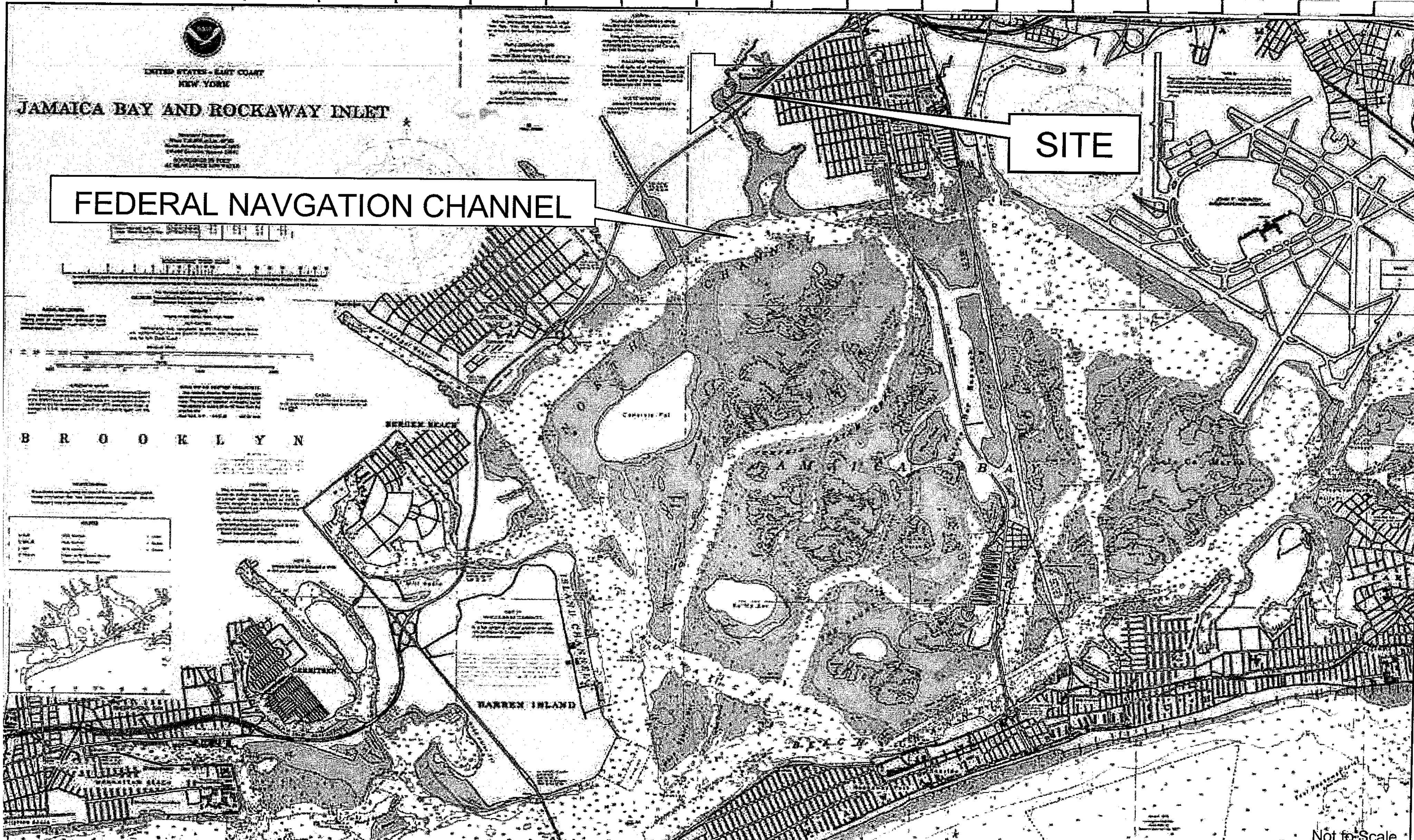
PART 1- INTRODUCTION

This report presents the data and documentation developed through an evaluation of wetland functions and values assessment conducted in support of the New York District of the U.S. Army Corps of Engineers (USACE) Spring Creek Ecosystem Restoration Project, Brooklyn, New York (Figure 1). The project site is bound to the north by Flatlands Avenue, to the south by the Belt Parkway to the west by NYCDEP 26th Ward Water Pollution Control Plant and to the east by residential development. Almost the entire area located to the south of Flatlands Avenue was comprised of intertidal wetlands at the turn of the 20th century. Over an 80-year period (1920's to the present), the salt marsh community at Spring Creek was altered by the dredging and filling activities associated with the construction and maintenance of the Jamaica Bay Federal navigation channel. The project as proposed would result in the restoration of approximately 22-acres of salt marsh and maritime upland in the Jamaica Bay wetlands complex.

The existing vegetative cover, both within and adjacent to the restoration areas, is relatively homogeneous. The disturbed/filled areas are dominated by typical invasive/exotic plant species found in New York City including but not limited to common mugwort (*Artemesia vulgaris*) and common reed (*Phragmites australis*). Intact salt marsh systems in New York City tend to be less diverse then their freshwater counterparts and in general tend to be dominated by two species smooth cordgrss (*Spartina alterniflora*) and salt meadow hay (*Spartina patens*). Three distinct vegetative community types were identified during preliminary field investigations: 1) low salt marsh, 2) high salt marsh and 3) disturbed/filled herbaceous/scrub-shrub.

The goal of the functional assessment was to evaluate and document the capacity of the proposed restoration site and adjacent reference marsh sites to perform specific wetland functions. As such, wetland assessment procedures, using the Evaluation of Planned Wetlands (EPW) assessment method (Bartoldus *et al.* 1994), were conducted on June 25, 2003. The reference sites selected for EPW assessment include two reference tidal salt marsh areas and two sites on the landfill in the proposed restoration area adjacent to the two reference sites (Figure 2).

The assessment results were used to provide baseline information to characterize existing functionality of both existing and proposed wetland communities; to aid the USACE in determining the most appropriate design for restoration of wetlands following removal of the fill



Source: National Oceanic and Atmospheric Administration, 1995
Chart # 12350

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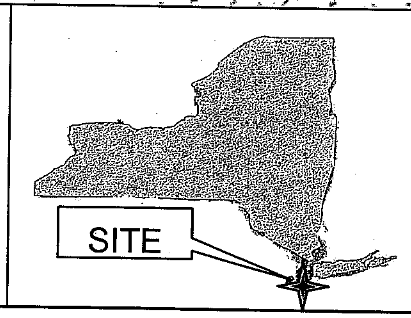
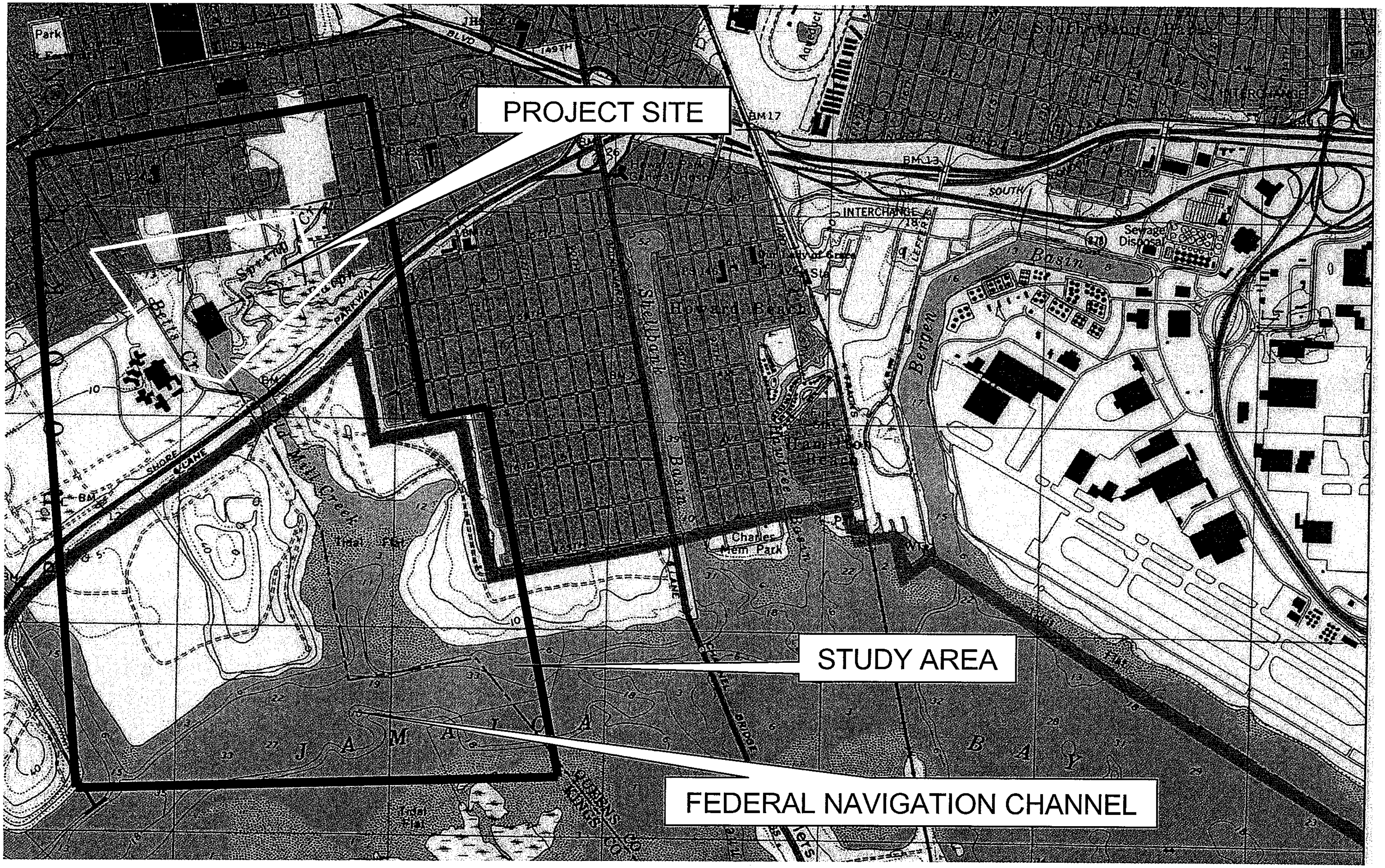
US Army Corps of Engineers
New York District

PROJECT SITE LOCATION MAP
NOAA NAVIGATION CHART
SPRING CREEK ECOSYSTEM RESTORATION PROJECT
BROOKLYN, KINGS COUNTY, NY

FIGURE 1





Source: USGS Topographic Map, Jamaica Quad, 1984

Not to Scale

USGS SITE LOCATION AND STUDY AREA MAP
SPRING CREEK ECOSYSTEM RESTORATION PROJECT
BROOKLYN, KINGS COUNTY, NY

US Army Corps of Engineers
New York District

FIGURE 2

material; and to provide a basis to measure success of the implemented restoration plan.

This report presents the pre-project results of the EPW assessment conducted within the project site. Section 2.0 of this report identifies the methods used and Section 3.0 presents the results of field assessments. In addition, Appendices A and B provide: EPW scoring data forms and Functional Capacity Index (FCI) calculation worksheets (Appendix A) and photo documentation of the wetland assessment areas (Appendix B).

PART 2 - METHODOLOGY

This section describes the methodology used in the collection and analysis of data used to assess the functions and values of existing and proposed tidal wetlands at the Spring Creek site, tributary to Jamaica Bay, Kings County, New York. The sampling effort used Global Information System (GIS) to map the cover types, in conjunction with field data measurements to evaluate the EPW assessment elements *(i.e.,* variables) and functions.

2.1 Evaluation of Planned Wetlands Method (EPW)

The EPW assessment method was used to characterize the functional capacity of tidal marshes in the vicinity of the restoration site as a baseline reference for estimating the potential benefit and monitoring success of the restoration project. Existing and proposed wetland functions of the restoration site were also documented relative to the same functions and values.

EPW provides a technique for determining the capacity of a wetland to perform certain ecological and watershed functions by evaluating elements of eight major wetland functions, although only five were evaluated for the project site. The wetland functions assessed during this evaluation include sediment stabilization (SS), water quality (WQ), wildlife (WL), fish—tidal (FT), and uniqueness/heritage (UH). The following provides a brief description of each of the functions assessed.

Function	Abbreviation	Definition
Sediment stabilization	SS	Capacity to stabilize and retain previously deposited sediments.
Water quality	WQ	Capacity to retain and process dissolved or particulate materials to the benefit of downstream surface water

		quality.
Wildlife	WL	Degree to which a wetland functions as habitat for wildlife as described by habitat complexity.
Fish (tidal)	FT	Degree to which a wetland habitat meets the food/cover, reproductive, and water quality requirements for fish.
Uniqueness/Heritage	UH	Presence of characteristics that distinguish a wetland as unique, rare, or valuable (e.g., presence of Threatened and Endangered species.)

Several additional wetland functions, fish, non-tidal river/stream (FS) and pond (FP), and Stream bank erosion stabilization may also be included in the EPW methodology as appropriate. However, these functions were not assessed for this project due to the tidal nature of the ecosystems in the Project area and the lack of erodible stream banks as defined in the EPW guidance. The specific functions evaluated for each assessment site at Spring Creek included:

Site	Description	SS	WQ	WL	FT	UH
Reference Site 1	High and low marsh habitat.	X	X	X	X	X
Reference Site 2	Low marsh habitat only.	X	X	X	X	X
Restoration Site 1	Disturbed herbaceous area north of reference site 2.			X		X
Restoration Site 2	Disturbed herbaceous area west of reference site 1.			X		X

Within each function, numerous elements *(i.e.,* physical, chemical, biological characteristics) are evaluated in order to identify a wetland's capacity to perform that function. The elements assessed for each function are listed on the data forms for each assessment area (Appendix A). An element score is a unit-less number ranging in value from 0.0 to 1.0 (where 1.0 represents the optimal score) that is assigned to each element based on a visual assessment of wetland characteristics within a wetland assessment area (WAA) as outlined in the EPW manual (Bartoldus *et al.* 1994). Element scores are combined based on equations presented on an EPW calculation worksheet to produce a Functional Capacity Index (FCI) value from 0.0 to 1.0, which provides a relative index of a WAAs capacity to perform a given function. Size *(i.e.,* acreage) of the WAA is then multiplied by the FCI value to produce a wetland functional capacity unit (FCU), which represents the WAAs capacity to perform each wetland function (Bartoldus *et al.* 1994) and accounts for wetland size. In this methodology an FCU is not calculated for the uniqueness/heritage (UH) function, as the size of the area is not considered to affect the value of this function. FCUs are used as the quantitative basis for wetland comparisons.

2.2 Field Sampling

Field personnel experienced in wetland and aquatic ecology, and wetland delineations conducted the field data collection activities on June 25, 2003. Unless otherwise noted, the field assessment methodology followed that specified in the EPW manual (Bartoldus *et al.* 1994).

Prior to field sampling, Wetland Assessment Areas (WAA) were identified within the project area. A WAA is defined as the wetland complex that a planned wetland will be compared to (*e.g.*, a reference wetland or wetland to be impacted by a project), and includes wetlands of a similar hydrogeomorphic type that are hydrologically connected (Bartoldus *et al.* 1994). Two reference sites were selected in the dominant unimpacted habitat within the Spring Creek project site that is, areas comprised of high and low tidal salt marsh adjacent to tidal creek channels. The proposed restoration area is presently comprised of upland habitat created by fill material that was historically deposited on tidal salt marshes and is presently characterized by barren ground and fields with a mix of herbaceous, scrub/shrub, and sapling vegetative cover.

Each assessment element was visually evaluated following the methods and conditions, outlined in the EPW manual (Bartoldus *et al.*, 1994). Assessments were based on the average condition across each selected reference site or restoration site (Figure 2). The field assessment involved recording a value from 0.0 to 1.0 or assigning NA (not applicable) to each element based on an assessment of characteristics that may, or may not, occur within each specific wetland community based on the scoring guidance provided in Bartoldus *et al.* (1994).

2.3 Data Processing

Based on field observations and photographic records, element values for the applicable functions in each WAA were recorded electronically on an EPW Element Spreadsheet (Appendix A). To eliminate transcription errors and assure data quality, FCI calculations were performed in an Excel© spreadsheet using the equations presented in the EPW manual (Bartoldus *et al.* 1994); all equations and spreadsheet cell references were validated. Preliminary FCU values were calculated for comparative purposes in this report based on the total area within the proposed restoration alternatives 3C and 4C, and the selected reference sites (Figure 2). (The recommended plan, Alternative 3D, was not developed at the time of the EPW study. It is evaluated in the Integrated Ecosystem Restoration report and Environmental Assessment, Section 5.2.2.)

PART 3 - RESULTS AND DISCUSSION

This section includes a general description of each of the WAA and a summary of the FCI and preliminary FCU values for the current wetland conditions in the Project flood control areas and the potential mitigations sites.

3.1 Reference Site 1 – High/Low Salt Marsh West of Spring Creek

Reference Site 1 is situated at the inside of a 180° bend on the west side of Spring Creek (Figure 2) immediately upstream of the confluence with Mill Creek Basin. The western boundary of this Site is the foot of the steep fill embankment. Typical of tidal salt marshes in the area the Site has relatively low vegetative diversity. Approximately 60 percent of the Site is high marsh dominated by salt meadow hay and a fringe of marsh elder (*Iva frutescens*); the remainder of the Site is low marsh dominated by smooth cordgrass. A small tidal ditch bisects the Site running east-west.

The EPW field assessment for Reference Site 1 evaluated five wetland functions (sediment stabilization, water quality, wildlife, fish—tidal, and uniqueness/heritage), and assigned scores ranging in value from 0.0 to 1.0 (where 1.0 represents the optimal score). The capacity of this wetland area to support ecological habitat functions, WL and FT is moderate, earning FCI values of 0.35 and 0.48, respectively. The SS and WQ functional capacities are high; the site was assigned FCI values of 1.00 and 0.86, respectively for these functions. The FCI and FCU scores for Reference Site 1 are summarized below.

Function	FCI Value	Acres	FCU Value
Sediment stabilization	1.00		
Water quality	0.86		
Wildlife	0.35		
Fish—tidal	0.48		
Uniqueness/heritage	0.25	NA	NA

3.2 Reference Site 2—High Salt Marsh North of Ralph's Creek

Reference Site 2 is situated along the north side of a series of meanders of tidal Ralph's Creek (Figure 2). The northern boundary of this Site is the foot of the steep fill embankment that transitions to upland through a stand of common reed. Reference Site 2 is predominantly low marsh dominated by smooth cordgrass with a narrow inland border of high marsh composed of marsh elder. The adjacent tidal channel of Ralph's Creek is composed of mud flats at low tide with negligible rooted submerged aquatic vegetation.

The EPW field assessment for reference site 2 evaluated five wetland functions (sediment stabilization, water quality, wildlife, fish—tidal, and uniqueness/heritage). The capacity of these wetlands to support ecological habitat functions, WL and FT is moderate; the site was assigned FCI values 0.35 and 0.48, respectively for these functions. The SS and WQ functional capacities are high, earning scores of 1.00 and 0.97, respectively. The FCI and FCU scores for Reference Site 2 are summarized below.

Function	FCI Value	Acres	FCU Value
Sediment stabilization	1.00		
Water quality	0.97		
Wildlife	0.35		
Fish—tidal	0.48		
Uniqueness/heritage	0.25	NA	NA

3.3 Restoration Site 1 – Upland Area North of Reference Site 2

Restoration site 1(Figure 2) was selected as representative of the functional capacity conditions of the existing disturbed upland in proposed Restoration Area B. It is located in the vicinity of vegetation survey plot SC03V-DU-04. This site is dominated by herbaceous, shrub, and sapling cover. Species identified in this area included common mugwort, tree of heaven (*Ailanthus altissima*), northern bayberry (*Myrica pensylvanica*), and white sweet clover (*Melolitus alba*). The embankment portion of restoration site 1 that transitions down to the low marsh is dominated by common reed.

The EPW field assessment for restoration site 1 evaluated five wetland functions (sediment stabilization, water quality, wildlife, fish—tidal, and uniqueness/heritage). This disturbed upland area provides no wetland functional capacity for sediment stabilization, water quality enhancement, or tidal fish habitat. The capacity of this area to support wildlife functions is relatively low compared to the two reference wetland areas; the FCI value for wildlife functions was 0.2. The FCI and FCU scores are summarized below.

Function	FCI Value	Acres*	FCU Value*
Sediment stabilization	NA	7.95	NA
Water quality	NA	7.95	NA
Wildlife	0.2	7.95	1.59
Fish—tidal	NA	7.95	NA
Uniqueness/heritage	0.25	NA	NA

*Preliminary value for proposed Restoration Area B. Final values to be determined following finalization of Project design plans

3.4 Restoration Site 2 – Upland Area West of Reference Site 1

Restoration Site 2 (Figure 2) was selected as representative of the functional capacity conditions of the existing disturbed upland in proposed Restoration Area A. It is located in the vicinity of vegetation survey plot SC02V-DU-02. This Site is primarily disturbed upland dominated by herbaceous, shrub, and sapling cover. Plant species identified in the area included common mugwort, tree of heaven, common reed, and black cherry (*Prunus serotina*).

The EPW field assessment for restoration site 2 evaluated five wetland functions (sediment stabilization, water quality, wildlife, fish—tidal, and uniqueness/heritage). This disturbed upland area provides no wetland functional capacity for sediment stabilization, water quality enhancement, or tidal fish habitat. The capacity of this area to support wildlife functions is relatively low compared to the two reference wetland areas primarily due to the disturbed conditions at the site; the FCI value assigned for wildlife function was less than 0.2. The FCI and FCU scores are summarized below.

Function	FCI Value	Acres*	FCU Value*
Sediment stabilization	NA	7.13	NA
Water quality	NA	7.13	NA
Wildlife	0.17	7.13	1.21
Fish—tidal	NA	7.13	NA
Uniqueness/heritage	0.25	NA	NA

*Preliminary value for proposed Restoration Area A. Final values to be determined following finalization of Project design plans

3.5 Summary

The vegetative cover and habitat are similar among the two reference sites and among the two restoration sites; this is reflected in the similarity in functional capacity reflected by the FCI values summarized below:

Site	SS	WQ	WL	FT	UH
Reference Site 1	1.00	0.86	0.35	0.48	0.25
Reference Site 2	1.00	0.97	0.35	0.48	0.25
Restoration Site 1			0.20		0.20
Restoration Site 2			0.17		0.25

For quantitative comparison, the FCU values (acre units) for the restored conditions for each alternative are provided below:

Table 1
EPW Assessment
Alternative 1

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.63	3.63	0.97	3.63	3.52	0.35	3.63	1.27	0.48	3.63	1.74	0.25	3.63	N/A	10.16
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Function Total			3.63			3.52			1.52			1.74				**10.41**
Area B																
Low Marsh	1.00	5.05	5.05	0.97	5.05	4.90	0.35	5.05	1.77	0.48	5.05	2.42	0.25	5.05	N/A	14.14
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.62	0.00	0.00	0.62	0.00	0.50	0.62	0.31	0.00	0.62	0.00	0.00	0.62	N/A	0.31
Function Total			5.05			4.90			2.08			2.42				**14.45**
Area C																
Low Marsh	1.00	1.18	1.18	0.97	1.18	1.14	0.35	1.18	0.41	0.48	1.18	0.57	0.25	1.18	N/A	3.30
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.41	0.00	0.00	0.41	0.00	0.50	0.41	0.21	0.00	0.41	0.00	0.00	0.41	N/A	0.21
Function Total			1.18			1.14			0.62			0.57				**3.51**
Area D																
Low Marsh	1.00	2.39	2.39	0.97	2.39	2.32	0.35	2.39	0.84	0.48	2.39	1.15	0.25	2.39	N/A	6.69
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	1.00	0.00	0.00	1.00	0.00	0.50	1.00	0.50	0.00	1.00	0.00	0.00	1.00	N/A	0.50
Function Total			2.39			2.32			1.34			1.15				**7.19**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	2.02
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
														Grand Total		**39.23**

Table 2
EPW Assessment
Alternative 2

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.99	3.99	0.97	3.99	3.87	0.35	3.99	1.40	0.48	3.99	1.92	0.25	3.99	N/A	11.17
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Function Total			3.99			3.87			1.64			1.92				**11.42**
Area B																
Low Marsh	1.00	5.78	5.78	0.97	5.78	5.61	0.35	5.78	2.02	0.48	5.78	2.77	0.25	5.78	N/A	16.18
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			5.78			5.61			2.12			2.77				**16.28**
Area C																
Low Marsh	1.00	1.18	1.18	0.97	1.18	1.14	0.35	1.18	0.41	0.48	1.18	0.57	0.25	1.18	N/A	3.30
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			1.18			1.14			0.51			0.57				**3.40**
Area D																
Low Marsh	1.00	2.39	2.39	0.97	2.39	2.32	0.35	2.39	0.84	0.48	2.39	1.15	0.25	2.39	N/A	6.69
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.97	0.00	0.00	0.97	0.00	0.50	0.97	0.49	0.00	0.97	0.00	0.00	0.97	N/A	0.49
Function Total			2.39			2.32			1.32			1.15				**7.18**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	2.02
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
														Grand Total		**41.94**

Table 3
EPW Assessment
Alternative 3A

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.63	3.63	0.97	3.63	3.52	0.35	3.63	1.27	0.48	3.63	1.74	0.25	3.63	N/A	10.16
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Function Total			3.63			3.52			1.52			1.74				**10.41**
Area B																
Low Marsh	1.00	5.05	5.05	0.97	5.05	4.90	0.35	5.05	1.77	0.48	5.05	2.42	0.25	5.05	N/A	14.14
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.62	0.00	0.00	0.62	0.00	0.50	0.62	0.31	0.00	0.62	0.00	0.00	0.62	N/A	0.31
Function Total			5.05			4.90			2.08			2.42				**14.45**
Area C																
Low Marsh	1.00	1.18	1.18	0.97	1.18	1.14	0.35	1.18	0.41	0.48	1.18	0.57	0.25	1.18	N/A	3.30
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.41	0.00	0.00	0.41	0.00	0.50	0.41	0.21	0.00	0.41	0.00	0.00	0.41	N/A	0.21
Function Total			1.18			1.14			0.62			0.57				**3.51**
Area D																
Low Marsh	1.00	2.55	2.55	0.97	2.55	2.47	0.35	2.55	0.89	0.48	2.55	1.22	0.25	2.55	N/A	7.14
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	1.08	0.00	0.00	1.08	0.00	0.50	1.08	0.54	0.00	1.08	0.00	0.00	1.08	N/A	0.54
Function Total			2.55			2.47			1.43			1.22				**7.68**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.62**
Function Total									1.66							**1.62**
															Grand Total	**39.72**

Table 4
EPW Assessment
Alternative 3B

	Function															
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			Total FCUs
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.15	3.15	0.97	3.15	3.06	0.35	3.15	1.10	0.48	3.15	1.51	0.25	3.15	N/A	8.82
High Marsh	1.00	0.49	0.49	0.86	0.49	0.42	0.35	0.49	0.17	0.48	0.49	0.24	0.25	0.49	N/A	1.32
Transition Area	0.00	0.44	0.00	0.00	0.44	0.00	0.50	0.44	0.22	0.00	0.44	0.00	0.00	0.44	N/A	0.22
Turtle Mound	0.00	0.14	0.00	0.00	0.14	0.00	0.50	0.14	0.07	0.00	0.14	0.00	0.00	0.14	N/A	0.07
Function Total			3.64			3.48			1.56			1.75				**10.43**
Area B																
Low Marsh	1.00	4.33	4.33	0.97	4.33	4.20	0.35	4.33	1.52	0.48	4.33	2.08	0.25	4.33	N/A	12.12
High Marsh	1.00	0.68	0.68	0.86	0.68	0.58	0.35	0.68	0.24	0.48	0.68	0.33	0.25	0.68	N/A	1.83
Transition Area	0.00	0.58	0.00	0.00	0.58	0.00	0.50	0.58	0.29	0.00	0.58	0.00	0.00	0.58	N/A	0.29
Turtle Mound	0.00	0.08	0.00	0.00	0.08	0.00	0.50	0.08	0.04	0.00	0.08	0.00	0.00	0.08	N/A	0.04
Function Total			5.01			4.78			2.08			2.40				**14.28**
Area C																
Low Marsh	1.00	0.79	0.79	0.97	0.79	0.77	0.35	0.79	0.28	0.48	0.79	0.38	0.25	0.79	N/A	2.21
High Marsh	1.00	0.44	0.44	0.86	0.44	0.38	0.35	0.44	0.15	0.48	0.44	0.21	0.25	0.44	N/A	1.18
Transition Area	0.00	0.38	0.00	0.00	0.38	0.00	0.50	0.38	0.19	0.00	0.38	0.00	0.00	0.38	N/A	0.19
Function Total			1.23			1.14			0.62			0.59				**3.59**
Area D																
Low Marsh	1.00	2.01	2.01	0.97	2.01	1.95	0.35	2.01	0.70	0.48	2.01	0.96	0.25	2.01	N/A	5.63
High Marsh	1.00	0.66	0.66	0.86	0.66	0.57	0.35	0.66	0.23	0.48	0.66	0.32	0.25	0.66	N/A	1.78
Transition Area	0.00	1.03	0.00	0.00	1.03	0.00	0.50	1.03	0.52	0.00	1.03	0.00	0.00	1.03	N/A	0.52
Function Total			2.67			2.52			1.45			1.28				**7.92**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
														Grand Total		**39.89**

Table 5
EPW Assessment
Alternative 3C

	Function															
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			Total FCUs
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.17	3.17	0.97	3.17	3.07	0.35	3.17	1.11	0.48	3.17	1.52	0.25	3.17	N/A	8.88
High Marsh	1.00	0.45	0.45	0.86	0.45	0.39	0.35	0.45	0.16	0.48	0.45	0.22	0.25	0.45	N/A	1.21
Transition Area	0.00	0.44	0.00	0.00	0.44	0.00	0.50	0.44	0.22	0.00	0.44	0.00	0.00	0.44	N/A	0.22
Turtle Mound	0.00	0.14	0.00	0.00	0.14	0.00	0.50	0.14	0.07	0.00	0.14	0.00	0.00	0.14	N/A	0.07
Function Total			3.62			3.46			1.56			1.74				**10.38**
Area B																
Low Marsh	1.00	4.33	4.33	0.97	4.33	4.20	0.35	4.33	1.52	0.48	4.33	2.08	0.25	4.33	N/A	12.12
High Marsh	1.00	0.67	0.67	0.86	0.67	0.58	0.35	0.67	0.23	0.48	0.67	0.32	0.25	0.67	N/A	1.80
Transition Area	0.00	0.58	0.00	0.00	0.58	0.00	0.50	0.58	0.29	0.00	0.58	0.00	0.00	0.58	N/A	0.29
Turtle Mound	0.00	0.08	0.00	0.00	0.08	0.00	0.50	0.08	0.04	0.00	0.08	0.00	0.00	0.08	N/A	0.04
Function Total			5.00			4.78			2.08			2.40				**14.26**
Area C																
Low Marsh	1.00	0.79	0.79	0.97	0.79	0.77	0.35	0.79	0.28	0.48	0.79	0.38	0.25	0.79	N/A	2.21
High Marsh	1.00	0.44	0.44	0.86	0.44	0.38	0.35	0.44	0.15	0.48	0.44	0.21	0.25	0.44	N/A	1.18
Transition Area	0.00	0.38	0.00	0.00	0.38	0.00	0.50	0.38	0.19	0.00	0.38	0.00	0.00	0.38	N/A	0.19
Function Total			1.23			1.14			0.62			0.59				**3.59**
Area D																
Low Marsh	1.00	1.95	1.95	0.97	1.95	1.89	0.35	1.95	0.68	0.48	1.95	0.94	0.25	1.95	N/A	5.46
High Marsh	1.00	0.61	0.61	0.86	0.61	0.52	0.35	0.61	0.21	0.48	0.61	0.29	0.25	0.61	N/A	1.64
Transition Area	0.00	1.03	0.00	0.00	1.03	0.00	0.50	1.03	0.52	0.00	1.03	0.00	0.00	1.03	N/A	0.52
Function Total			2.56			2.42			1.41			1.23				**7.62**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
														Grand Total		**39.50**

Table 6
EPW Assessment
Alternative 4A

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.99	3.99	0.97	3.99	3.87	0.35	3.99	1.40	0.48	3.99	1.92	0.25	3.99	N/A	11.17
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Function Total			3.99			3.87			1.64			1.92				**11.42**
Area B																
Low Marsh	1.00	5.78	5.78	0.97	5.78	5.61	0.35	5.78	2.02	0.48	5.78	2.77	0.25	5.78	N/A	16.18
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			5.78			5.61			2.12			2.77				**16.28**
Area C																
Low Marsh	1.00	1.18	1.18	0.97	1.18	1.14	0.35	1.18	0.41	0.48	1.18	0.57	0.25	1.18	N/A	3.30
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			1.18			1.14			0.51			0.57				**3.40**
Area D																
Low Marsh	1.00	2.39	2.39	0.97	2.39	2.32	0.35	2.39	0.84	0.48	2.39	1.15	0.25	2.39	N/A	6.69
High Marsh	1.00	0.00	0.00	0.86	0.00	0.00	0.35	0.00	0.00	0.48	0.00	0.00	0.25	0.00	N/A	0.00
Transition Area	0.00	0.97	0.00	0.00	0.97	0.00	0.50	0.97	0.49	0.00	0.97	0.00	0.00	0.97	N/A	0.49
Function Total			2.39			2.32			1.32			1.15				**7.18**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
															Grand Total	**41.94**

Table 7
EPW Assessment
Alternative 4B

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.26	3.26	0.97	3.26	3.16	0.35	3.26	1.14	0.48	3.26	1.56	0.25	3.26	N/A	9.13
High Marsh	1.00	0.59	0.59	0.86	0.59	0.51	0.35	0.59	0.21	0.48	0.59	0.28	0.25	0.59	N/A	1.59
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Turtle Mound	0.00	0.14	0.00	0.00	0.14	0.00	0.50	0.14	0.07	0.00	0.14	0.00	0.00	0.14	N/A	0.07
Function Total			3.85			3.67			1.66			1.85				**11.03**
Area B																
Low Marsh	1.00	4.42	4.42	0.97	4.42	4.29	0.35	4.42	1.55	0.48	4.42	2.12	0.25	4.42	N/A	12.38
High Marsh	1.00	1.28	1.28	0.86	1.28	1.10	0.35	1.28	0.45	0.48	1.28	0.61	0.25	1.28	N/A	3.44
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Turtle Mound	0.00	0.08	0.00	0.00	0.08	0.00	0.50	0.08	0.04	0.00	0.08	0.00	0.00	0.08	N/A	0.04
Function Total			5.70			5.39			2.13			2.74				**15.95**
Area C																
Low Marsh	1.00	0.85	0.85	0.97	0.85	0.82	0.35	0.85	0.30	0.48	0.85	0.41	0.25	0.85	N/A	2.38
High Marsh	1.00	0.14	0.14	0.86	0.14	0.12	0.35	0.14	0.05	0.48	0.14	0.07	0.25	0.14	N/A	0.38
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			0.99			0.94			0.44			0.48				**2.85**
Area D																
Low Marsh	1.00	0.86	0.86	0.97	0.86	0.83	0.35	0.86	0.30	0.48	0.86	0.41	0.25	0.86	N/A	2.41
High Marsh	1.00	0.56	0.56	0.86	0.56	0.48	0.35	0.56	0.20	0.48	0.56	0.27	0.25	0.56	N/A	1.51
Transition Area	0.00	0.97	0.00	0.00	0.97	0.00	0.50	0.97	0.49	0.00	0.97	0.00	0.00	0.97	N/A	0.49
Function Total			1.42			1.32			0.98			0.68				**4.40**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
															Grand Total	**37.91**

Table 8
EPW Assessment
Alternative 4C

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	3.26	3.26	0.97	3.26	3.16	0.35	3.26	1.14	0.48	3.26	1.56	0.25	3.26	N/A	9.13
High Marsh	1.00	0.59	0.59	0.86	0.59	0.51	0.35	0.59	0.21	0.48	0.59	0.28	0.25	0.59	N/A	1.59
Transition Area	0.00	0.49	0.00	0.00	0.49	0.00	0.50	0.49	0.25	0.00	0.49	0.00	0.00	0.49	N/A	0.25
Turtle Mound	0.00	0.14	0.00	0.00	0.14	0.00	0.50	0.14	0.07	0.00	0.14	0.00	0.00	0.14	N/A	0.07
Function Total			3.85			3.67			1.66			1.85				**11.03**
Area B																
Low Marsh	1.00	4.42	4.42	0.97	4.42	4.29	0.35	4.42	1.55	0.48	4.42	2.12	0.25	4.42	N/A	12.38
High Marsh	1.00	1.28	1.28	0.86	1.28	1.10	0.35	1.28	0.45	0.48	1.28	0.61	0.25	1.28	N/A	3.44
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Turtle Mound	0.00	0.08	0.00	0.00	0.08	0.00	0.50	0.08	0.04	0.00	0.08	0.00	0.00	0.08	N/A	0.04
Function Total			5.70			5.39			2.13			2.74				**15.95**
Area C																
Low Marsh	1.00	0.85	0.85	0.97	0.85	0.82	0.35	0.85	0.30	0.48	0.85	0.41	0.25	0.85	N/A	2.38
High Marsh	1.00	0.14	0.14	0.86	0.14	0.12	0.35	0.14	0.05	0.48	0.14	0.07	0.25	0.14	N/A	0.38
Transition Area	0.00	0.19	0.00	0.00	0.19	0.00	0.50	0.19	0.10	0.00	0.19	0.00	0.00	0.19	N/A	0.10
Function Total			0.99			0.94			0.44			0.48				**2.85**
Area D																
Low Marsh	1.00	0.86	0.86	0.97	0.86	0.83	0.35	0.86	0.30	0.48	0.86	0.41	0.25	0.86	N/A	2.41
High Marsh	1.00	0.56	0.56	0.86	0.56	0.48	0.35	0.56	0.20	0.48	0.56	0.27	0.25	0.56	N/A	1.51
Transition Area	0.00	0.97	0.00	0.00	0.97	0.00	0.50	0.97	0.49	0.00	0.97	0.00	0.00	0.97	N/A	0.49
Function Total			1.42			1.32			0.98			0.68				**4.40**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
															Grand Total	**37.91**

Table 9
EPW Assessment
Recommended Alternative (3D)

	Function															Total FCUs
	Sediment Stabilization			Water Quality			Wildlife			Fish-tidal			Uniqueness-Heritage			
	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	FCI	Area	FCUs	
Area A																
Low Marsh	1.00	1.6	1.6	0.97	1.6	1.55	0.35	1.6	0.56	0.48	1.6	0.77	0.25	1.6	N/A	4.48
High Marsh	1.00	0.70	0.70	0.86	0.70	0.60	0.35	0.70	0.25	0.48	0.70	0.34	0.25	0.70	N/A	1.88
Transition Area	0.00	1.01	0.00	0.00	1.01	0.00	0.50	1.01	0.51	0.00	1.01	0.00	0.00	1.01	N/A	0.51
Function Total			2.30			2.15			1.31			1.10				**6.87**
Area B																
Low Marsh	1.00	5.16	5.16	0.97	5.16	5.01	0.35	5.16	1.81	0.48	5.16	2.48	0.25	5.16	N/A	14.45
High Marsh	1.00	1.27	1.27	0.86	1.27	1.09	0.35	1.27	0.44	0.48	1.27	0.61	0.25	1.27	N/A	3.42
Transition Area	0.00	0.50	0.00	0.00	0.50	0.00	0.50	0.50	0.25	0.00	0.50	0.00	0.00	0.50	N/A	0.25
Function Total			6.43			6.10			2.50			3.09				**18.11**
Area C																
Low Marsh	1.00	0.68	0.68	0.97	0.68	0.66	0.35	0.68	0.24	0.48	0.68	0.33	0.25	0.68	N/A	1.90
High Marsh	1.00	0.19	0.19	0.86	0.19	0.16	0.35	0.19	0.06	0.48	0.19	0.09	0.25	0.19	N/A	0.50
Transition Area	0.00	0.50	0.00	0.00	0.50	0.00	0.50	0.50	0.25	0.00	0.50	0.00	0.00	0.50	N/A	0.25
Function Total			0.87			0.82			0.55			0.42				**2.65**
Area D																
Low Marsh	1.00	3.22	3.22	0.97	3.22	3.12	0.35	3.22	1.13	0.48	3.22	1.55	0.25	3.22	N/A	9.02
High Marsh	1.00	0.18	0.18	0.86	0.18	0.15	0.35	0.18	0.06	0.48	0.18	0.09	0.25	0.18	N/A	0.48
Transition Area	0.00	1.03	0.00	0.00	1.03	0.00	0.50	1.03	0.52	0.00	1.03	0.00	0.00	1.03	N/A	0.52
Function Total			3.40			3.28			1.70			1.63				**10.01**
Area 1																
Upland	0.00	4.03	0.00	0.00	4.03	0.00	0.50	4.03	2.02	0.00	4.03	0.00	0.00	4.03	N/A	**2.02**
Function Total									2.02							**2.02**
Area 2																
Upland	0.00	3.31	0.00	0.00	3.31	0.00	0.50	3.31	1.66	0.00	3.31	0.00	0.00	3.31	N/A	**1.66**
Function Total									1.66							**1.66**
														Grand Total		**41.32**

PART 4 – REFERENCES

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SITE: **Spring Creek--REF1**

CLIENT: USACE--NYD **DATE:** 6/25/03 **PROJ #:** 14023.02 000

PROJECT: Spring Creek Restoration **EVALUATOR:** P. Muessig/Brett Berkley

No.	Element	SB	SS	WQ	WL	FT	FS	FP
1a.	Water contact with toe of bank			1				
1b.	Shoreline bank stability					1		
2.	Fetch							
3.	Shoreline structures/obstacles							
4a.	Disturbance at site (SS)		1			1		
4b.	Disturbance at site (WQ)			1				
4c.	Disturbance of wildlife habitat				1			
4d.	Disturbance in channel/open water					1		
5a.	Surface runoff (bank erosion)							
5b.	Surface runoff (wetland erosion)			1				
6.	Boat traffic							
7a.	Water level fluctuation		1	1				
7b.	Most permanent hydroperiod					1		
7c.	Spatially dominant hydroperiod					0.5		
8a.	Hours of sunlight							
9a.	Substrate suitability for vegetation establishment							
9b.	Dominant substrate			1				
9c.	Substrate suitability for fish					1		
10a.	Plant (basal) cover - upper shore zone							
10b.	Plant (basal) cover - entire wetland		1	1				
10c.	Leaf litter and debris cover		0.3					
10d.	Plant (basal) cover - tidal					1		

10e.	Rooted vascular aquatic beds in erosion areas							
10f.	Rooted vascular aquatic beds (lower shore zone)					0.3		
10g.	Plant height - upper shore zone							
10h.	Plant height - entire wetland			0.8				
* Not used to calculate FCI.								
10i.	Root structure - upper shore zone							
10j.	Root structure - entire wetland		1					
10k.	Vegetation persistence - upper shore zone							
10l.	Vegetation persistence - entire wetland		1	1				
10m.	Vegetation overhang							
10o.	Aboveground plant biomass							
11a.	Layers				0.5			
11b.	Condition of layer coverage				0.3			
11c.	Spatial pattern of shrubs and/or trees				NA			
11d.*	Difference in layers				NA			
12a.	Cover types				0.185			
12b.	Ratio of cover types				0.5			
12c.	Cover type interspersion				0.1			
12d.	Undesirable species				1			
12e.*	Difference in cover types				NA			
13a.	Percent open water				0.5			
13b.	Vegetation/water interspersion				0.5			
14a.*	Steepness of existing shore							
14b.	Steepness of planned wetland shore							
14c.	Wetland slope		1	1				

15.	Hydrologic condition			0.5				
16a.	Wetland width			1				
16b.	Wetland site size				1			
16c.	Fish habitat size							
17.	Detention time			NA				
18.	Sheet vs. channel flow			NA				
19.	Average water depth			NA				
20a.	Gross contamination				1			
20b.	Water quality ratings					0.1		
20c.	Nutrient/sediment/contaminants					0.1		
20d.	Dissolved oxygen					INA		
20e.	pH range							
20f.	Maximum water temperature					INA		
20g.	Turbidity							
21a.	Shape of upland/wetland edge				0.1			
21b.	Shape of wetland/water edge					1		
22a.	Wildlife attractors				0			
22b.	Available fish cover/attractors					0.1		
23.	Islands				0.1			
24.	Obstruction to fish passage					1		
25a.	Percent pool area							
25b.	Current velocity within pools							
26.	Bank undercut							
27a.	Spawning substrate							
27b.	Spawning structures							

27c.	Drawdown							
28.*	Refuge during drought/freeze							
29.	Endangered species							
30.	Rarity							
31.	Unique features							
32.	Historical or archaeological significance							
33.	Natural landmark							
34.	Connected to Wild and Scenic River							
35.	Park, sanctuary, etc.							
36.	Scientific research site							
	TOTAL	16	7	14	17	15	20	1
	Number used to calculate FCI	15	7	14	15	15	20	1

Sediment Stabilization FCI

(4a); (7a); If both NA, record NA, otherwise record lowest score		1	
Equation: (10b (10j + 10l) + 10c (1 - 10b)) / 2	1.00	1.00	
(14c)	1		

Water Quality FCI

(15); If NA then Stop; WQ FCI not applicable	0.5		
Average (4b), (7a), (16a)		1.00	
Average (1a), (5b), (14c)	1.00	0.95	0.98
Equation: 10b (10h+10l) / 2	0.90		
Average (9b), (15), (17), (18), (19)			0.75

Wildlife FCI

(4c), (20a), (16b); If all NA, record NA; If any = 0.1, record 0.1		NA
Average (11a), (11b), (11c)	0.40	
Average (12a), (12b), (12c), (12d)	0.45	0.35
Average (13a, (13b)	0.50	
Average (21a), (22a), (23)	0.07	

Fish (tidal) FCI

(24); if 0.1, STOP; no potential for stream/river fish habitat		1
Average (1b), (4a), (4d), (16c), (24)	1.00	
Equation: 7c [9c + (1-x)(10d) + (x)(10f) + 21b + 2	0.35	

20b	0.10
Average (20c), (20d), (20f)	NA

Uniqueness/heritage FCI

Average (29), (30), (31), (32), (33), (34), (35), (36)

SITE: Spring Creek--REF2

CLIENT: USACE--NYD **DATE:** 6/25/03 **PROJ #:** 14023.02 000

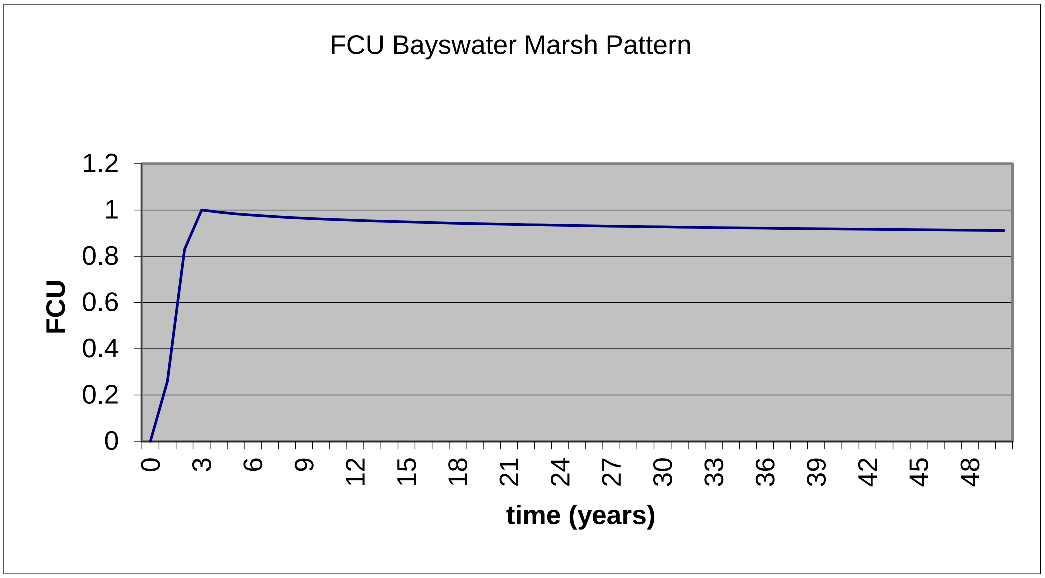
PROJECT: Spring Creek Restoration **EVALUATOR:** P. Muessig

No.	Element	SB	SS	WQ	WL	FT	FS	FP
1a.	Water contact with toe of bank			1				
1b.	Shoreline bank stability					1		
2.	Fetch							
3.	Shoreline structures/obstacles							
4a.	Disturbance at site (SS)		1			1		
4b.	Disturbance at site (WQ)			1				
4c.	Disturbance of wildlife habitat				1			
4d.	Disturbance in channel/open water					1		
5a.	Surface runoff (bank erosion)							
5b.	Surface runoff (wetland erosion)			1				
6.	Boat traffic							
7a.	Water level fluctuation		1	1				
7b.	Most permanent hydroperiod					1		
7c.	Spatially dominant hydroperiod					1		
8a.	Hours of sunlight							
9a.	Substrate suitability for vegetation establishment							
9b.	Dominant substrate			1				
9c.	Substrate suitability for fish					1		
10a.	Plant (basal) cover - upper shore zone							
10b.	Plant (basal) cover - entire wetland		1	1				
10c.	Leaf litter and debris cover		0.1					
10d.	Plant (basal) cover - tidal					1		

10e.	Rooted vascular aquatic beds in erosion areas							
10f.	Rooted vascular aquatic beds (lower shore zone)					0.1		
10g.	Plant height - upper shore zone							
10h.	Plant height - entire wetland			0.5				
* Not used to calculate FCI.								
10i.	Root structure - upper shore zone							
10j.	Root structure - entire wetland		1					
10k.	Vegetation persistence - upper shore zone							
10l.	Vegetation persistence - entire wetland		1	1				
10m.	Vegetation overhang							
10o.	Aboveground plant biomass							
11a.	Layers				0.5			
11b.	Condition of layer coverage				0.3			
11c.	Spatial pattern of shrubs and/or trees				NA			
11d.*	Difference in layers				NA			
12a.	Cover types				0.148			
12b.	Ratio of cover types				0.5			
12c.	Cover type interspersion				0.1			
12d.	Undesirable species				1			
12e.*	Difference in cover types				NA			
13a.	Percent open water				0.5			
13b.	Vegetation/water interspersion				0.5			
14a.*	Steepness of existing shore							
14b.	Steepness of planned wetland shore							
14c.	Wetland slope		1	1				

15.	Hydrologic condition			1				
16a.	Wetland width			1				
16b.	Wetland site size				1			
16c.	Fish habitat size							
17.	Detention time			NA				
18.	Sheet vs. channel flow			NA				
19.	Average water depth			NA				
20a.	Gross contamination				1			
20b.	Water quality ratings					0.1		
20c.	Nutrient/sediment/contaminants					0.1		
20d.	Dissolved oxygen					INA		
20e.	pH range							
20f.	Maximum water temperature					INA		
20g.	Turbidity							
21a.	Shape of upland/wetland edge				0.1			
21b.	Shape of wetland/water edge					1		
22a.	Wildlife attractors				0			
22b.	Available fish cover/attractors					0.1		
23.	Islands				0.1			
24.	Obstruction to fish passage					1		
25a.	Percent pool area							
25b.	Current velocity within pools							
26.	Bank undercut							
27a.	Spawning substrate							
27b.	Spawning structures							

Habitat Growth Pattern- Bayswater State Park Marsh



To calculate the average annual FCU the PDT team identified the cumulative FCUs over the 50 year life of the project, which was then be divided by 50 to arrive at the annual average (in this case 92%). Cumulative counts may differ based on the life cycle, growth rate, and protection levels of habitat components; for instance, a maritime forest can require 25 years to reach maturity and produce full habitat benefit, while low marsh will be established and fully functional within 10 years. Based on the existing and planned conditions at Bayswater State Park and using professional judgement, the PDT determined that the Bayswater marsh would reach 100% of the FCUs at 3 years. The PDT assumed that there would be some growth period with lower FCU leading up to peak, peak would be sustained for some time followed by some decrease in FCU.

Spring Creek North Ecosystem Restoration Study

Appendix F

Hazardous Toxic Radioactive Waste (HTRW) Results

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1.0 Introduction

Sub-surface soil characterization of the project site took place in four sampling events. All four events involved using either a truck mounted GeoProbe or a four-wheel drive all terrain vehicle drill rig. The primary purpose of this sub-surface characterization was to determine the areal and vertical extent of potentially contaminated soils. The drilling took place in areas proposed for excavation as part of an overall plan to restore the creek to past environmental condition. A second purpose for drilling was collection of sub-surface samples for geo-technical analyses. The geotechnical analysis is discussed in Section 3.2.1 of the Spring Creek Ecosystem Restoration Integrated Ecosystem Restoration Report and Environmental Assessment (ERR/EA).

Each boring was advanced using either continuous split spoons or Geoprobe macro samplers with dedicated acetate liners. Surface samples where taken using a hand held trowel. The purpose of this sub-surface characterization was to determine the aerial and vertical extent of potentially contaminated soils resulting from previous dumping activities and to collect geotechnical data as previously discussed. Boring locations were selected based on proposed construction, excavation, and/or soil placement plans as part of the salt marsh restoration project.

2.0 Sampling Events

The first sampling event took place on August 15 and 16, 2002. Eleven borings were advanced to depths ranging from 6 inches to 18 feet below ground surface (bgs). Six of these were advanced in the area referred to as the "north" side of Spring Creek (SC/SC Series) and the remaining five in an area called the "mound" (SCM Series). The "mound" is an elevated portion of the study area located to the east of Spring Creek and to the north of Ralph's Creek. Samples collected from the "north" side were taken at depths ranging from 12 to 18 feet bgs. Samples from the "mound" were taken at the surface interval from zero to six inches bgs.

Samples were collected at the final depth of the boring or at an interval where obvious changes in lithology were identified. No composite samples were taken. Samples were placed in clear glass, eight-ounce jars with no preserving agents. All samples were shipped under chain of custody documentation to the Fort Monmouth Environmental Laboratory (FMEL), Fort Monmouth, NJ. All samples were analyzed for Volatile Organics Compounds (VOCs) +15, Semi-volatile Organic Compounds (SVOCs) +25, Pesticides/polychlorinated biphenyls (PCBs), Resource Conservation and Recovery Act (RCRA) Metals, and pH using United States Environmental Protection Agency Methods 8260, 8270C, 8081/8082, 7417A, and 9045, respectively. Concentrations were reported in mg/kg and soil sample results were compared to the Technical Administrative Guidance Memorandum (TAGM) Recommended Soil Cleanup Objectives (RSCOs).

Laboratory analysis of the samples collected from the "north" side of Spring Creek identified the following. Acetone in sample SC/SC-1 was the only VOC identified above the RSCOs. SVOCs were identified in exceedence of the RSCOs in samples SC/SC-1 and SC/SC-5 (10'-12'). RCRA Metals were identified in exceedence of the RSCOs in samples SC/SC-1, SC/SC-2, SC/SC-5 (10'-12'), SC/SC-5 (14'-16'), and SC/SC-5 (16'-18'). No concentrations of Pesticides or PCBs were identified in samples SC/SC-1 through SC/SC-5 (16'-18'). The pH levels of the SC/SC series ranged from 7.71 to 8.46.

Laboratory analysis of the samples collected from the "mound" area identified the following. SVOCs and RCRA Metals were identified in exceedence of the RSCOs in all samples (SCM-6 through SCM-10). No concentrations of VOCs, Pesticides, or PCBs above the RSCOs were identified in samples SCM-6 through SCM-10. The pH levels of the SCM series ranged from

6.81 to 8.26. Table 1 summarizes the concentrations identified in the SC/SC and SCM series; sample locations are shown in Figure 1.

In December 2002, at the request of NYSDEC Region 2, Toxicity Characteristic Leaching Procedure (TCLP) tests, for lead, were conducted on three samples, SC-10, 10 to 12 feet bgs; SCM-9, 0 - 6 inches bgs; and SCM-10, 0 - 6 inches bgs. The sample locations are presented in Figure 1, while the results are presented in Table 2. The TCLP is designed to determine the mobility of both organic and inorganic compounds in a sample. If an analysis of any one of the liquid fractions of the TCLP extract indicates that a regulated compound is present at such high concentrations that the regulatory level for that compound is exceeded, then the waste is considered hazardous. The regulatory level for lead is 5.0 ppm. TCLP results for all three samples fell below the regulatory level.

On April 15 and 16, 2003, eight additional borings were advanced at the "upland" portion of the site, north of Spring Creek (SCII series). The purpose of these additional locations was to further characterize the aerial and vertical extent of potentially contaminated soils below this area of the project. The "upland" area is presently being used as part of a compost facility and is covered with as much as four feet of asphalt. Borings were advanced to depths of up to 18 feet bgs or until native meadow mat was encountered.

Samples were again collected at the final depth of the boring or at an interval where obvious changes in lithology were identified. No composite samples were taken. Samples were placed in clear glass, eight-ounce jars with no preserving agents. All samples were shipped under chain of custody documentation to FMEL and analyzed for VOC+15, SVOC+25, Pesticides/PCBs, RCRA Metals, and pH using USEPA Methods 8260, 8270C, 8081/8082, 7471A, and 9045, respectively. Concentrations were reported in mg/kg and soil sample results were compared to the TAGM RSCOs.

Laboratory analysis of the samples collected from the "upland" area identified the following. SVOCs were identified in exceedence of the RSCOs in samples SCII-B1, SCII-B7, and SCII-B8. RCRA Metals were identified in exceedence of the RSCOs in all samples (SCII-B1 through SCII-B9). No concentrations of VOCs, Pesticides, or PCBs above the RSCOs were identified in samples SCII-B1 through SCII-B9. The pH levels of the SCII series ranged from 7.43 to 10.82. Table 3 summarizes the concentrations identified in the SCII series; the sampling locations are shown in Figure 2.

In May 2003, eleven samples (SCMA series) from the "mound" area were collected for additional TCLP analysis. Collection depths ranged from 15 to 25 feet bgs. TCLP procedures conducted on these samples included VOCs, ABN's, Pesticide/PCBs and RCRA metals. There were no exceedences of the TAGM guidelines for any of these samples. The sample locations are presented in Figure 3, while the results are presented in Table 4.

On September 5, 2003, MATRIX conducted a Geoprobe investigation to further characterize soil contamination present at the placement site located north of the proposed restoration (cut) area and to delineate previously identified locations of high chromium contamination (SCM-5 and SCM-10) on the cut site. Previous soil investigations identified levels of SVOCs and RCRA Metals above the TAGM RSCOs on both the placement and cut sites.

TABLE 1
SUMMARY OF DETECTED ANALYTES IN SOIL
AUGUST 2002 SAMPLING EVENT

Sample ID	NYSDEC TAGM RSCOs	SC/SC 1	SC/SC 2	SC/SC 3	SC/SC 5 (10-12")	SC/SC 5 (14-16')	SC/SC 5 (16-18')	SCM 6	SCM 7	SCM 8	SCM 9	SCM 10
Lab Sample ID		2057001	2057002	2057003	2057101	2057102	2057103	2057104	2057105	2057106	2057107	2057108
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		17'	18'	18'	10-12'	14-16'	16-18'	0-6"	0-6"	0-6"	0-6"	0-6"
Volatile Organics+15 (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Acetone	0.2	**0.33**	.095	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	0.3	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semi-Volatile Organics (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
2-Methylnapthalene	36.4	ND	ND	ND	ND	ND	ND	ND	1.6 J	1.8	ND	ND
4-Methylphenol	0.9	**1.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	50	ND	ND	ND	ND	ND	ND	1.1 J	5.3	4.0	0.19	ND
Acenaphthylene	41	ND	ND	ND	ND	ND	ND	1.2 J	2.1	2.3	0.11 J	0.20
Anthracene	50	ND	ND	ND	ND	ND	ND	3.6	14	13	0.56	0.59
Benzo[a]anthracene	0.224	ND	ND	ND	0.20	ND	ND	**8.1**	**41**	**37**	**1.2**	**1.6**
Benzo[a]pyrene	0.061	ND	ND	ND	**0.23**	ND	ND	**8.5**	**45**	**40**	**1.3**	**1.5**
Benzo[b]fluoranthene	1.1	ND	ND	ND	0.34	ND	ND	**8.3**	**41**	**38**	**1.6**	**2**
Benzo[g,h,i]perylene	50	ND	ND	ND	ND	ND	ND	4.4	22	21	0.82	0.85
Benzo[k]fluoranthene	1.1	ND	ND	ND	ND	ND	ND	**3.7**	**9.1**	**13**	0.67	0.70
Bis(2-ethylhexyl)phthalate	50	3.3	ND	ND	0.30	0.56	ND	ND	ND	ND	0.42	0.20
Chrysene	0.4	ND	ND	ND	0.24	ND	ND	**9.1**	**47**	**42**	**1.3**	**1.7**
Dibenzofuranofuran	6.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.11 J	ND
Dibenz[a,h]anthracene	0.014	ND	ND	ND	ND	ND	ND	**1.2**	**6.2**	**.7**	**0.21**	**0.25**
Diethylphthalate	7.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.12 J	ND
Di-n-butylphthalate	8.1	ND	0.28 J	ND	0.38 J	0.43 J	0.48 J	ND	ND	ND	ND	0.28 J
Fluoranthene	50	ND	ND	ND	0.31	ND	ND	13	**61**	**55**	ND	3.8
Fluorene	50	ND	ND	ND	ND	ND	ND	1.6	5.0	4.2	0.19	0.12 J
Indeno [1,2,3-cd]pyrene	3.2	ND	ND	ND	ND	ND	ND	**3.5**	**18**	**16**	0.68	0.78
Naphthalene	13	ND	ND	ND	ND	ND	ND	ND	1.4 J	1.6 J	0.20	ND
Phenanthrene	50	ND	ND	ND	ND	ND	ND	12	44	38	2.1	2.5
Phenol	0.03	**6.9**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	50	ND	ND	ND	0.32	ND	ND	19	**95**	**82**	ND	3.0

TABLE 1 (CONT'D)
SUMMARY OF DETECTED ANALYTES IN SOIL
AUGUST 2002 SAMPLING EVENT

Sample ID	NYSDEC TAGM RSCOs	SC/SC 1	SC/SC 2	SC/SC 3	SC/SC 5 (10-12')	SC/SC 5 (14-16')	SC/SC 5 (16-18')	SCM 6	SCM 7	SCM 8	SCM 9	SCM 10
Lab Sample ID		2057001	2057002	2057003	2057101	2057102	2057103	2057104	2057105	2057106	2057107	2057108
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		17'	18'	18'	10-12'	14-16'	16-18'	0-6"	0-6"	0-6"	0-6"	0-6"
RCRA Metals (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Arsenic	7.5	**18.6**	3.44	ND	**67**	3.75	0.836	3.57	3.97	4.96	**11.5**	**30.6**
Barium	300	143	20.7	9.56	**2420**	47.5	58.8	76.8	49.9	112	**453**	**1410**
Cadmium	1	**4.01**	0.66	0.275	**21.3**	0.485	0.604	0.194	0.446	**1.4**	**4.72**	**17.3**
Chromium	10	**44.4**	**18.1**	8.6	**150**	**28.6**	**11**	**14.3**	**16.1**	**25.2**	**69.3**	**223**
Lead	200*	**612**	52.9	12.9	**6660**	42.4	63.3	133	121	234	**795**	**1130**
Mercury	0.1	ND	ND	ND	**3.83**	**0.189**	ND	**1.91**	**0.452**	0.840	**3**	**0.539**
Selenium	2	1.63	1.63	1.19	**3.3**	**3.16**	1.24	ND	ND	0.898	1.47	**19.6**
Silver	SB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pH		7.71	8.27	8.08	8.07	8.1	8.46	7.9	8.26	7.85	6.89	6.81

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for VOA+15, PEST/PCB, RCRA Metals, pH, % Solids
NYSDEC TAGM RSCOs = NYSDEC Technical and Administrative Guidance Memorandum #4046 Recommended Soil Cleanup Levels, 1/2/94
* = site background, NYSDEC TAGM states typical site background levels for lead of 4 to 61 mg/kg (rural) and 200 to 500 mg/kg (urban)
mg/kg = milligrams per kilogram, dry weight basis
ft bgs = feet below ground surface
Bold values indicate exceedances of NYSDEC Criteria
ND = parameter not detected
J = parameter estimated/below detection limit

Source: Aerial - NY City Department of Information and Technology Sanborn, 2000
Boring Locations - MATRIX, 2003 and Army Corps of Engineers, 2002

GEOTECHNICAL SAMPLING LOCATIONS

AUGUST 2002 EVENT

SPRING CREEK ECOSYSTEM RESTORATION PROJECT

BROOKLYN, KINGS COUNTY, NY

0 400 800 Feet

N E S W

Legend

- August 2002 Sampling Location
- Site Boundary

US Army Corps of Engineers®
New York District

FIGURE 1

TABLE 2
SUMMARY OF TCLP RESULTS
DECEMBER 2002 SAMPLING EVENT

Sample ID	NYSDEC TCLP Regulatory Level	SC/SC-5	SCM 9	SCM 10
Lab Sample ID		2081901	2081902	2081903
Matrix		Soil	Soil	Soil
Sample Depth (ft bgs)		10-12'	0-6"	0-6"
RCRA Metals (mg/L)				
Lead	5.0	0.429	0.555	0.036

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for RCRA Metals Only
mg/L = milligrams per kilogram, dry weight basis.

TABLE 3
SUMMARY OF DETECTED ANALYTES IN SOIL
APRIL 2003 SAMPLING EVENT

Sample ID	NYSDEC TAGM RSCOs	SCII-B1	SCII-B2A	SCII-B3	SCII-B5	SCII-B7	SCII-B8	SCII-B9
Lab Sample ID		3017401	3017403	3017404	3017405	3017406	3017407	3017408
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		19.5'	19.5'	19'	19'	19'	19'	19'
Semi Volatile Organics		Result	Result	Result	Result	Result	Result	Result
4-Methylphenol	0.9	0.73 J	ND	ND	ND	**1.3 J**	**1.5 J**	ND
Acenaphthene	50	0.19 J	ND	ND	ND	ND	ND	ND
Anthracene	50	0.91 J	ND	ND	ND	ND	ND	0.21 J
Benzo[a]anthracene	0.224	**1.5**	ND	0.21 J	0.34 J	ND	ND	0.83 J
Benzo[a]pyrene	0.061	1.1 J	ND	0.22 J	0.30 J	ND	ND	0.69 J
Benzo[b]fluoranthene	1.1	**1.7**	ND	0.27 J	0.33 J	ND	ND	0.90 J
Benzo[g,h,i]perylene	50	0.51 J	ND	ND	ND	ND	ND	0.38 J
Benzo[k]fluoranthene	1.1	0.51 J	ND	ND	0.26 J	ND	ND	0.41 J
Benzoic acid	2.7	ND	1.1 J	ND	ND	ND	0.55 J	ND
bis(2-Ethylhexyl)phthalate	50	0.84 J	ND	ND	0.51 J	ND	ND	ND
Butylbenzylphthalate	50	0.31 J	ND	ND	ND	ND	ND	ND
Chrysene	0.4	**1.6**	ND	0.28 J	0.60 J	ND	ND	0.93 J
Dibenzofuran	6.2	0.18	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	8.1	ND	1.6 JB	ND	ND	0.81 JB	ND	0.21 JB
Fluoranthene	50	3.8	ND	0.50 J	1.2 J	ND	0.43 J	2.1
Fluorene	50	0.39 J	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	3.2	0.69 J	ND	ND	ND	ND	ND	0.45 J
Naphthalene	13	0.16 J	ND	0.34 J	0.30 J	ND	ND	ND
Phenanthrene	50	3.5	ND	0.21 J	0.78 J	ND	ND	0.49 J
Pyrene	50	2.9	0.34 J	0.52 J	1.1 J	ND	0.38 J	1.8
Pesticides/PCB		Result	Result	Result	Result	Result	Result	Result
Alpha-BHC	0.11	.024	ND	ND	ND	ND	ND	ND
Beta-BHC	0.2	.012	ND	ND	ND	ND	ND	ND
Gamma-Chlordane	0.54	0.00071	ND	ND	ND	ND	ND	ND
4,4'-DDE	2.1	0.0037	ND	ND	ND	ND	ND	ND
4,4'-DDT	2.1	0.01	ND	ND	ND	ND	ND	ND
Alpha-Chlordane	*	0.0022	ND	ND	ND	ND	ND	ND
RCRA Metals (mg/Kg)		Result	Result	Result	Result	Result	Result	Result
Arsenic	7.5	**13**	**10.5**	**12**	**39.5**	**84.2**	**56.9**	**6.29**
Barium	300	**459**	56.7	**560**	**730**	**6200**	**915**	**451**
Cadmium	1	**3.39**	**1.77**	**3.11**	**2.97**	**11.1**	**15.5**	**1.45**
Chromium	10	**34.5**	**30.2**	**39.8**	**28.6**	**94.2**	**106**	**15.8**
Lead	200**	**730**	38.1	**1605**	**2795**	**3225**	**7100**	**1520**
Mercury	0.1	**1.07**	**0.24**	**0.42**	**0.87**	**0.27**	**0.29**	**0.73**
Silver	SB	1.7	ND	ND	ND	ND	ND	ND
pH		10.82	7.77	7.95	7.76	7.95	7.98	7.43

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for VOA+15, PEST/PCB, RCRA Metals, pH, % Solids
NYSDEC TAGM RSCOs = NYSDEC Technical and Administrative Guidance Memorandum #4046 Recommended Soil Cleanup Levels, 1/2/94
* = No TAGM value published
** = site background, NYSDEC TAGM states typical site background levels for lead of 4 to 61 mg/kg (rural) and 200 to 500 mg/kg (urban)
Bold values indicate exceedances of NYSDEC Criteria
mg/kg = milligrams per kilogram, dry weight basis
ft bgs = feet below ground surface
ND = parameter not detected
J = parameter estimated (below detection limit)
B = parameter identified in field blank

Source: Aerial - NY City Department of Information and Technology Sanborn, 2000
Boring Locations - MATRIX, 2003 and Army Corps of Engineers, 2002

GEOTECHNICAL SAMPLING LOCATIONS

APRIL 2003 EVENT
SPRING CREEK ECOSYSTEM RESTORATION PROJECT
BROOKLYN, KINGS COUNTY, NY

Legend

Site Boundary

Soil Boring

0 400 800 Feet

N W E S

US Army Corps of Engineers
New York District

FIGURE 2

Source: Aerial- NY City Department of Information and Technology
Sanborn, 2000
Geotechincal- Army Corps of Engineers, 2002

SOIL BORING LOCATIONS FOR TCLP ANALYSIS

SPRING CREEK ECOSYSTEM RESTORATION PROJECT

BROOKLYN, KINGS COUNTY, NY

0 400 800 Feet

N E S W

Legend

- ● Soil Borings
- ── Site Boundary

US Army Corps of Engineers®
New York District

FIGURE 3

TABLE 4
SUMMARY OF TCLP RESULTS
MAY 2003 SAMPLING EVENT

Sample ID	NYSDEC TCLP Regulatory Level	SCMA 1-1, 1-2	SCMA 2-2, 2-3	SCMA 3-1, 3-2, 3-3	SCMA 4-1, 4-2	SCMA 5-2	SCMA 6-1
Lab Sample ID		3020501	3020504	3020505	3020506	3020509	3020513
Matrix		Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		13-15'	20-22'	22-24'	21-23'	18-20'	24-26'
RCRA Metals (mg/kg)	-						
Arsenic	5.0	ND	0.022	0.018	0.019	0.009	0.020
Barium	100	0.198	0.0765	0.0962	0.0621	0.479	0.509
Cadmium	1.0	0.0031	ND	ND	0.0019	0.0057	0.0047
Chromium	5.0	0.0463	0.0930	0.0046	0.0104	0.0099	0.0109
Lead	5.0	0.014	0.015	0.009	0.008	0.316	0.29
Selenium	1.0	0.028	0.015	0.028	0.032	0.046	0.04
Silver	5.0	0.002	0.002	0.006	0.007	0.015	0.012
Mercury	0.2	ND	ND	ND	ND	ND	ND

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for VOA+15, PEST/PCB, RCRA Metals, Reactivity, Ignitability, and pH
mg/kg = milligrams per kilogram, dry weight basis.
ND = parameter not detected.

A total of eight locations (LC-1 through LC-8) were sampled to depths ranging from approximately 7 to 16 feet bgs on the placement site. Sample intervals ranged from approximately 4 to 16 feet bgs. Sample locations are presented in Figure 4.

Ten (10) locations (SCM-5-1 through SCM-5-5 and SCM-10-1 through SCM-10-5) were sampled to depths of approximately 8 feet bgs at the previously sampled locations SCM-5 and SCM-10 and at 5 foot intervals in a north, south, east, and west direction surrounding the original points. Samples were taken at approximately 6 to 8 feet bgs to delineate the actual proposed cut limits. Sample locations are presented in Figure 5A and 5B.

The soil samples were transported under chain-of-custody documentation and analyzed by ACCUTEST Laboratories of Dayton, New Jersey. Samples LC-1 through LC-8 were analyzed for SVOCs and RCRA Metals using USEPA Methods 8270C and 7471A, respectively. Samples SCM-5-1 through SCM-5-5 and SCM-10-1 through SCM-10-5 were analyzed for RCRA Metals only using USEPA Method 6010B/7417A. Concentrations were reported in mg/kg and soil sample results were compared to the TAGM RSCOs and previous analytical results for both areas. Table 5 summarizes the concentrations identified in the soil samples taken at the placement site. Table 6 summarizes the concentrations identified in the soil samples taken at the cut site.

Samples LC-1 through LC-8 identified no concentrations of SVOCs above the TAGM RSCOs. However, concentrations of arsenic, barium, cadmium, chromium, lead, mercury, and/or selenium were identified in exceedence of the RSCOs in all of the samples. This is consistent with previously identified levels of RCRA metals across both the proposed placement and cut sites. Concentrations of chromium identified in these samples were not greater than those found at the cut site; however, they are of the same general magnitude.

Samples SCM-5-1 through SCM-5-5 and SCM-10-1 through SCM-10-5 identified concentrations of arsenic, barium, cadmium, chromium, lead, mercury, and/or selenium in exceedence of the

RSCOs in all of the samples. This again is consistent with previous investigations. Concentrations of chromium were delineated to acceptable levels for excavation activities at all locations except SCM-5-3 and SCM-10-3. Both locations are directly south of the original SCM-5 and SCM-10 sampling locations. Concentrations in these samples still identified areas of higher chromium concentration than those on the proposed placement site.

3.0 Conclusion and Recommendation

In summary, RCRA levels at the cut and placement sites are consistent. Therefore fill material used for both areas should be considered to be very similar. Although chromium levels greater than those on the cut site have not yet been identified on the placement site, the levels are of the same general magnitude. AC has show that RCRA metals on the cut site are not leachable (TCLP results). Excavation of the SCM-5 and SCM-10 delineations should remove the chromium problem areas and allow placement of remaining cut materials.

Source: Aerial - NY City Department of Information and Technology Sanborn, 2000
Boring Locations - MATRIX, 2003 and Army Corps of Engineers, 2002

GEOTECHNICAL SAMPLING LOCATIONS

SEPTEMBER 2003 EVENT

SPRING CREEK ECOSYSTEM RESTORATION PROJECT

BROOKLYN, KINGS COUNTY, NY

0 400 800 Feet

N W E S

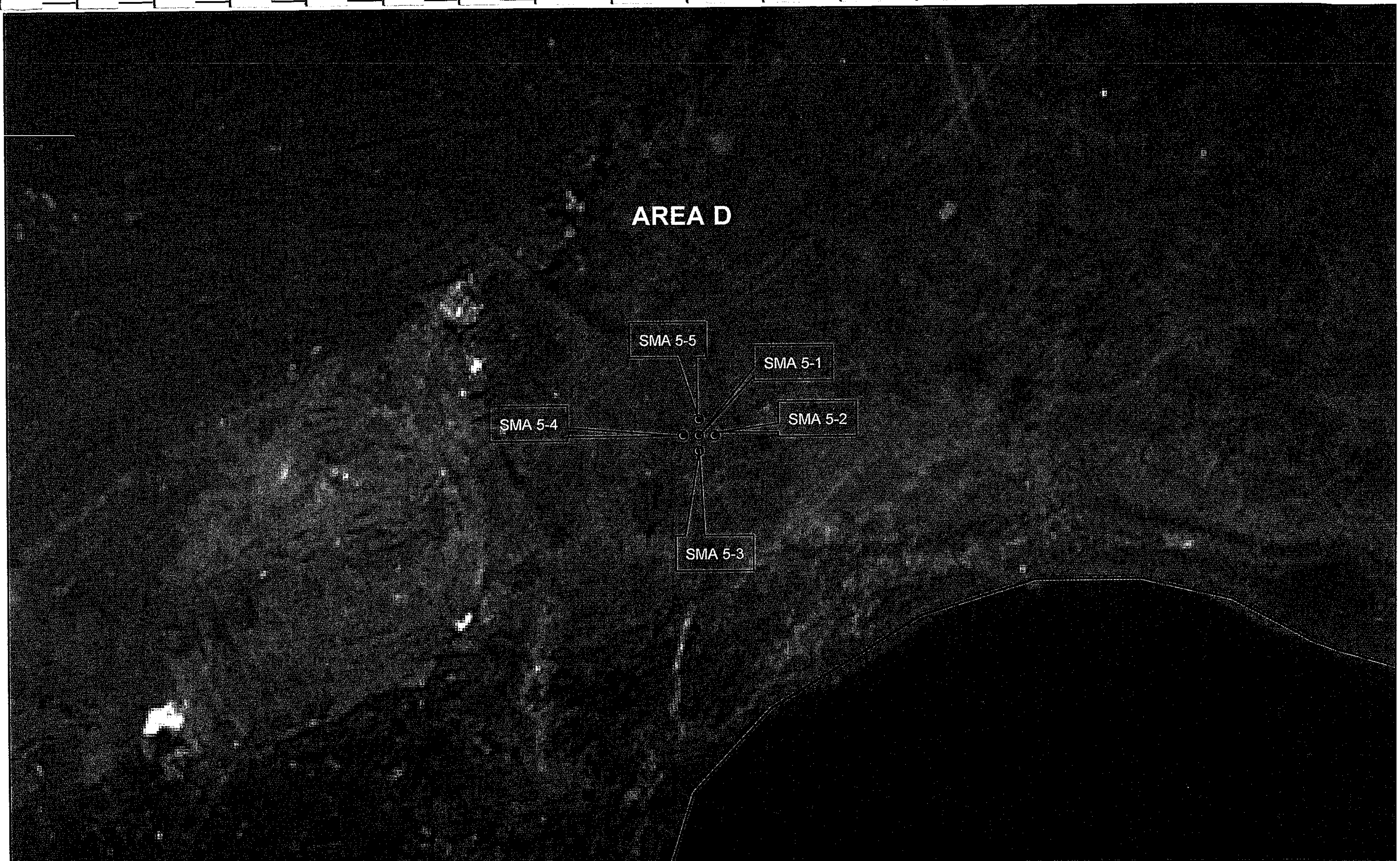
Legend

— Site Boundary

● September 2003 Sampling Location

US Army Corps of Engineers®
New York District

FIGURE 4



Source: Aerial - NY City Department of Information and Technology Sanborn, 2000
Boring Locations - MATRIX, 2003 and Army Corps of Engineers, 2002

SOIL BORING LOCATIONS FOR TCLP ANALYSIS
SEPTEMBER 2003

SPRING CREEK ECOSYSTEM RESTORATION PROJECT
BROOKLYN, KINGS COUNTY, NY

0 50 100 Feet

N W E S

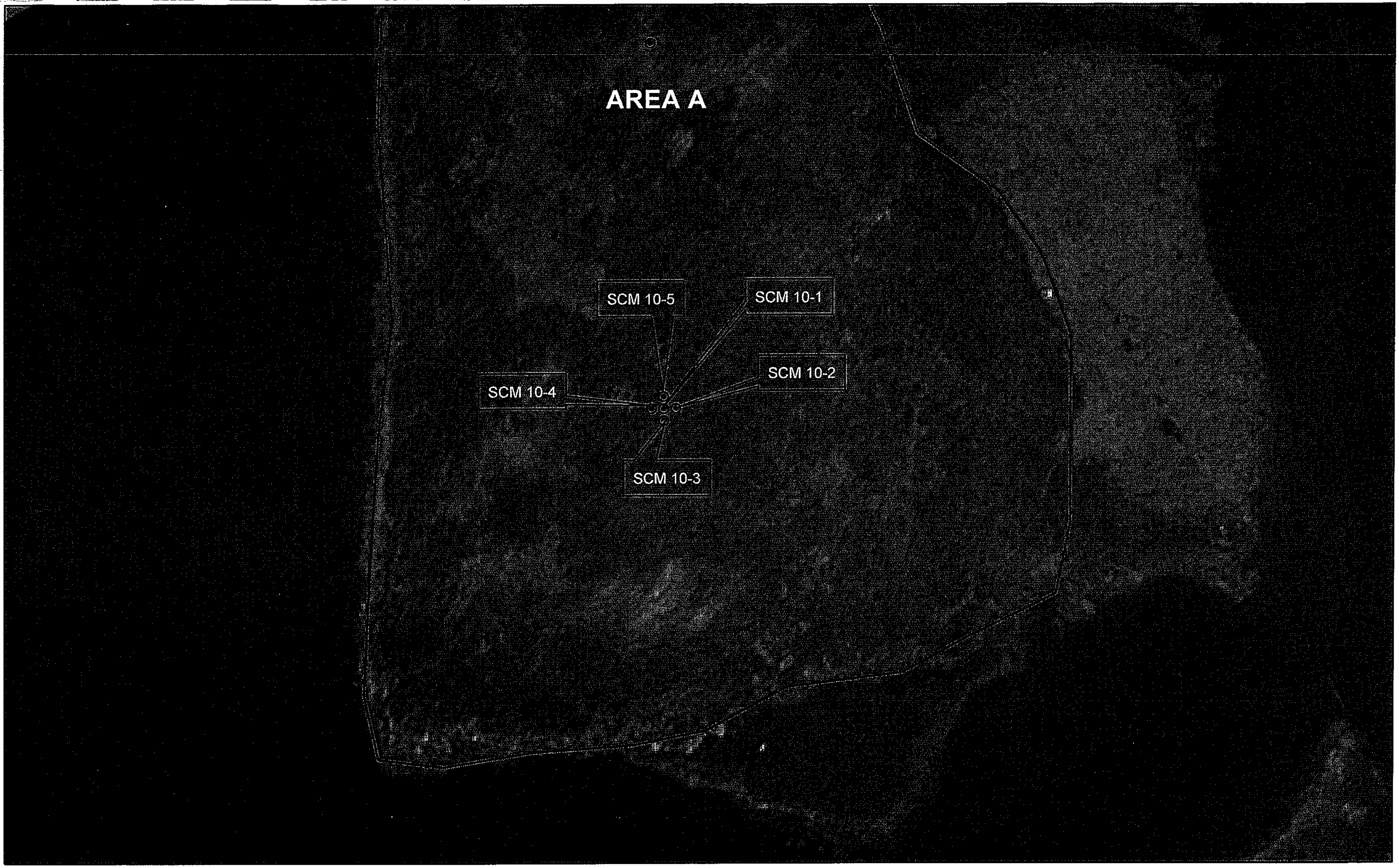
Legend

● September 2003 Sampling Location

—— Area D

US Army Corps of Engineers®
New York District

FIGURE 5A



Source: Aerial - NY City Department of Information and Technology Sanborn, 2000
Boring Locations - MATRIX, 2003 and Army Corps of Engineers, 2002

SOIL BORING LOCATIONS FOR TCLP ANALYSIS
SEPTEMBER 2003

SPRING CREEK ECOSYSTEM RESTORATION PROJECT
BROOKLYN, KINGS COUNTY, NY

Legend

● August 2002 Sampling Location

—— Area A

US Army Corps
of Engineers®
New York District

FIGURE 5B

TABLE 5
SUMMARY OF DETECTED ANALYTES IN SOIL (PLACEMENT SITE)
SEPTEMBER 2003 SAMPLING EVENT

Sample ID	NYSDEC TAGM RSCOs	N47714-11	N47714-12	N47714-13	N47714-14	N47714-15	N47714-16	N47714-17	N47714-18
Lab Sample ID		LC-1	LC-2	LC-3	LC-4	LC-5	LC-6	LC-7	LC-8
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		6' - 8'	4' - 6'	5' - 7'	10' - 12'	6' - 8'	4' - 6'	10' - 12'	14' - 16'
Semi-Volatile Organics (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result
2-Chlorophenol	800	ND	NC	NC	ND	ND	NC	ND	NC
4-Chloro-3-methyl phenol	240	ND	NC	NC	ND	ND	NC	ND	NC
2,4-Dichlorophenol	400	ND	NC	NC	ND	ND	NC	ND	NC
2,4-Dimethylphenol		ND	NC	NC	ND	ND	NC	ND	NC
2,4-Dinitrophenol	200	ND	NC	NC	ND	ND	NC	ND	NC
4,6-Dinitro-o-cresol		ND	NC	NC	ND	ND	NC	ND	NC
2-Nitrophenol	330	ND	NC	NC	ND	ND	NC	ND	NC
4-Nitrophenol	100	ND	NC	NC	ND	ND	NC	ND	NC
Pentachlorophenol	1000	ND	NC	NC	ND	ND	NC	ND	NC
Phenol	30	ND	NC	NC	ND	ND	NC	ND	NC
2,4,6-Trichlorophenol		ND	NC	NC	ND	ND	NC	ND	NC
Acenaphthene	50000	ND	NC	NC	ND	ND	NC	ND	NC
Acenaphthylene	41000	ND	NC	NC	ND	ND	NC	ND	NC
Anthracene	50000	ND	NC	NC	ND	ND	NC	ND	NC
Benzidine		ND	NC	NC	ND	ND	NC	ND	NC
Benzo(a)anthracene	224	ND	NC	NC	ND	ND	NC	ND	NC
Benzo(a)pyrene	61	ND	NC	NC	ND	ND	NC	ND	NC
Benzo(b)fluoranthene	1100	ND	NC	NC	ND	ND	NC	ND	NC
Benzo(g,h,i)perylene	50000	ND	NC	NC	ND	ND	NC	ND	NC
Benzo(k)fluoranthene	1100	ND	NC	NC	ND	ND	NC	ND	NC
4-Bromophenyl phenyl ether		ND	NC	NC	ND	ND	NC	ND	NC
Butyl benzyl phthalate	50000	ND	NC	NC	ND	ND	NC	ND	NC
2-Chloronaphthalene		ND	NC	NC	ND	ND	NC	ND	NC
4-Chloroaniline	220	ND	NC	NC	ND	ND	NC	ND	NC
Chrysene	400	ND	NC	NC	ND	ND	NC	ND	NC
bis(2-Chloroethoxy)methane		ND	NC	NC	ND	ND	NC	ND	NC
bis(2-Chloroethyl)ether		ND	NC	NC	ND	ND	NC	ND	NC
bis(2-Chloroisopropyl)ether		ND	NC	NC	ND	ND	NC	ND	NC
4-Chlorophenyl phenyl ether		ND	NC	NC	ND	ND	NC	ND	NC

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for VOA+15, PEST/PCB, RCRA Metals, pH, % Solids
NYSDEC TAGM RSCOs = NYSDEC Technical and Administrative Guidance Memorandum #4046 Recommended Soil Cleanup Levels, 1/2/94
* = site background, NYSDEC TAGM states typical site background levels for lead of 4 to 61 mg/kg (rural) and 200 to 500 mg/kg (urban)
Bold values indicate exceedances of NYSDEC Criteria
mg/kg = milligrams per kilogram, dry weight basis
ft bgs = feet below ground surface
NC = sample not analyzed for this parameter.
J = parameter estimated/below detection limit

TABLE 5 (CONT'D)
SUMMARY OF DETECTED ANALYTES IN SOIL (PLACEMENT SITE)
SEPTEMBER 2003 SAMPLING EVENT

Sample ID	NYSDEC TAGM RSCOs	N47714-11	N47714-12	N47714-13	N47714-14	N47714-15	N47714-16	N47714-17	N47714-18
Lab Sample ID		LC-1	LC-2	LC-3	LC-4	LC-5	LC-6	LC-7	LC-8
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		6' - 8'	4' - 6'	5' - 7'	10' - 12'	6' - 8'	4' - 6'	10' - 12'	14' - 16'
1,2-Dichlorobenzene	7900	ND	NC	NC	ND	ND	NC	ND	NC
1,2-Diphenylhydrazine		ND	NC	NC	ND	ND	NC	ND	NC
1,3-Dichlorobenzene	1600	ND	NC	NC	ND	ND	NC	ND	NC
1,4-Dichlorobenzene	8500	ND	NC	NC	ND	ND	NC	ND	NC
2,4-Dinitrotoluene		ND	NC	NC	ND	ND	NC	ND	NC
2,6-Dinitrotoluene	1000	ND	NC	NC	ND	ND	NC	ND	NC
3,3'-Dichlorobenzidine		ND	NC	NC	ND	ND	NC	ND	NC
Dibenzo(a,h)anthracene	14	ND	NC	NC	ND	ND	NC	ND	NC
Di-n-butyl phthalate	8100	ND	NC	NC	ND	ND	NC	ND	NC
Di-n-octyl phthalate	50000	ND	NC	NC	ND	ND	NC	ND	NC
Diethyl phthalate	7100	ND	NC	NC	ND	ND	NC	ND	NC
Dimethyl phthalate	2000	ND	NC	NC	ND	ND	NC	ND	NC
bis(2-Ethylhexyl)phthalate	50000	431	NC	NC	ND	ND	NC	545	NC
Fluoranthene	50000	27.4 J	NC	NC	ND	ND	NC	ND	NC
Fluorene	50000	ND	NC	NC	ND	ND	NC	ND	NC
Hexachlorobenzene	410	ND	NC	NC	ND	ND	NC	ND	NC
Hexachlorobutadiene		ND	NC	NC	ND	ND	NC	ND	NC
Hexachlorocyclopentadiene		ND	NC	NC	ND	ND	NC	ND	NC
Hexachloroethane		ND	NC	NC	ND	ND	NC	ND	NC
Indeno(1,2,3-cd)pyrene	3200	ND	NC	NC	ND	ND	NC	ND	NC
Isophorone	4400	ND	NC	NC	ND	ND	NC	ND	NC
Naphthalene	13000	ND	NC	NC	ND	ND	NC	ND	NC
Nitrobenzene	200	ND	NC	NC	ND	ND	NC	ND	NC
n-Nitrosodimethylamine		ND	NC	NC	ND	ND	NC	ND	NC
N-Nitroso-di-n-propylamine		ND	NC	NC	ND	ND	NC	ND	NC
N-Nitrosodiphenylamine		ND	NC	NC	ND	ND	NC	ND	NC
Phenanthrene	50000	24.6 J	NC	NC	ND	ND	NC	ND	NC
Pyrene	50000	32.8 J	NC	NC	ND	ND	NC	234	NC
1,2,4-Trichlorobenzene	3400	ND	NC	NC	ND	ND	NC	ND	NC
RCRA Metals (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result
Arsenic	7.5	**15.0**	**9.6**	**24.4**	**29.6**	**24.5**	**17.7**	6.9	6.4
Barium	300	**873**	**665**	**991**	**3420**	**620**	**697**	149	**307**
Cadmium	1	**3.7**	**3.1**	**1.5**	**1.8**	**3.9**	**2.7**	0.84	<0.78
Chromium	10	**52.4**	**34.1**	**58.2**	**48.9**	**99.2**	**60.5**	**23.7**	**12.3**
Lead	200*	**655**	**1830**	**943**	**1120**	**1700**	**990**	**1400**	**538**
Mercury	0.1	0.08	<0.036	<0.040	**0.14**	**0.65**	0.05	0.034	0.054
Selenium	2	<1.3	<1.3	**3.9**	**<2.7**	**<4.2**	1.2	<1.1	<1.6
Silver	SB	2	2.1	3.5	4.5	2	1.6	<1.1	<1.6

Notes:
Samples collected by the USACE and analyzed by Fort Monmouth Testing Laboratory
Samples analyzed for VOA+15, PEST/PCB, RCRA Metals, pH, % Solids
NYSDEC TAGM RSCOs = NYSDEC Technical and Administrative Guidance Memorandum #4046 Recommended Soil Cleanup Levels, 1/2/94
* = site background, NYSDEC TAGM states typical site background levels for lead of 4 to 61 mg/kg (rural) and 200 to 500 mg/kg (urban)
Bold values indicate exceedances of NYSDEC Criteria
mg/kg = milligrams per kilogram, dry weight basis
ft bgs = feet below ground surface
NC = sample not analyzed for this parameter.
J = parameter estimated/below detection limit

TABLE 6
SUMMARY OF DETECTED ANALYTES IN SOIL (CUT SITE)
SEPTEMBER 2003 SAMPLING EVENT

Lab Sample ID	NYSDEC TAGM RSCOs	SCM-10-1(Center)	SCM-10-2 (East)	SCM-10-3 (South)	SCM-10-4 (West)	SCM-10-5 (North)	SCM-5-1 (Center)	SCM-5-2 (East)	SCM-5-3 (South)	SCM-5-4 (West)	SCM-5-5 (North)
Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (ft bgs)		6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'	6' - 8'
RCRA Metals (mg/kg)		Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Arsenic	7.5	**44.3**	**17.2**	**40.6**	**37.5**	5.5	**32.5**	**37.1**	**23.9**	**21.7**	**37.4**
Barium	300	**424**	**631**	**2,070**	271	<79	**679**	**581**	**2,370**	**1,710**	**880**
Cadmium	1	<0.62	<0.79	**2.6**	**3.4**	**5.4**	**27.1**	**2.2**	**30.2**	<0.89	**5.6**
Chromium	10	**37.6**	**60**	**173**	**80.8**	**14.9**	**101**	**108**	**193**	**54.8**	**78**
Lead	200*	**848**	**680**	**1,100**	**554**	**496**	**574**	**3,550**	**849**	**2,050**	**1,300**
Mercury	0.1	**0.84**	**0.48**	**0.91**	**1.9**	**1.3**	**2.2**	**1.5**	**1.7**	**2.6**	**2.8**
Selenium	2	**3.8**	**5.2**	**3.7**	<2.4	<3.9	**5.5**	**9.9**	**7.1**	**5.4**	**9.3**
Silver	SB	2.8	3	4.2	3	<3.9	2.8	170	1.9	3.5	4.9

Notes:
Samples collected by MATRIX and analyzed by ACCUTEST
Samples analyzed RCRA Metals
NYSDEC TAGM RSCOs = NYSDEC Technical and Administrative Guidance Memorandum #4046 Recommended Soil Cleanup Levels, 1/2/94
* = site background, NYSDEC TAGM states typical site background levels for lead of 4 to 61 mg/kg (rural) and 200 to 500 mg/kg (urban)
Bold values indicate exceedances of NYSDEC Criteria
mg/kg = milligrams per kilogram, dry weight basis
ft bgs = feet below ground surface

4.0 References

New York State Department of Environmental Conservation (NYSDEC). 1994. Technical and Administrative Guidance Memorandum #4046 – Determination of Soil Cleanup Objectives and Cleanup Levels.