# Appendix H

# Wetland Habitat Condition and Health Assessment Report

DRAFT

# Wetland Habitat Condition and Health Assessment Report

## Grand Canal
## Suffolk County, Oakdale, New York

**January 29, 2016 (Draft)**

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## 1.0 INTRODUCTION

This report presents the results of a wetland assessment performed to document a number of baseline conditions for hydrology, vegetation, soils and avian species within the wetlands associated with the Grand Canal, and to provide an assessment of the current health of those wetlands. The specific Tasks performed include:

1. Background data collection and review
2. Cover type mapping;
3. Field data collection; and,
4. Wetland habitat characterization and health evaluation.

### 1.1 Project Description and Background

Describe project, setting. Identify Suffolk County (County), Reference Figure 1.

## 2.0 METHODS

The methodology used in this wetland habitat characterization and health assessment follows the United States Environmental Protection Agency's (USEPA) 3-tiered approach to wetland assessments, which combines: 1) landscape-level analysis; 2) a rapid assessment and scoring of overall wetland health; and, 3) a component of more intensive field-based data collection for user-defined parameters (USEPA 2015). More specifically, tier 2 of this assessment utilized many of the concepts from the USEPA-recommended Mid-Atlantic Tidal Rapid Assessment Method; which was modified slightly to meet the specific characteristics of the Grand Canal area and goals and objectives of the project (Mid-TRAM 2010). Tier 3 included additional field-based data collection for several biological parameters such as vegetation, soils, and avifauna, and follows the methodology outlined the New York State Salt Marsh Restoration and Monitoring Guidelines (Niedowski 2000).

Collectively, the wetlands of the Grand Canal area are referred to as the Pickman-Remmer wetlands. However, for study purposes the three marsh complexes that comprise the Pickman-Remmer marsh system were demarcated based on clear physical separations between the marsh areas, and were labeled based on their geographic position within the site; the southwest marsh, east marsh, and northwest marsh (Appendix A, Figure 2).

### 2.1 Background Data Collection and Review

This wetland habitat assessment utilized available maps, aerial photography, and background reports and data, as well as field data collected on site to document and assess conditions of the Grand Canal marsh system. The following resources provided valuable background information in that effort:

- Google Earth, current and historic satellite imagery;
- Mid-Atlantic Tidal Rapid Assessment Method (Mid-TRAM);
- Natural Resource Conservation Service Riverhead Service Center, information on soil properties/leaching potential;

- New York State Department of Environmental Conservation,
    - Bureau of Marine Resources (tidal wetlands inventory and other wetland GIS data)
    - GIS data clearinghouse
    - Division of Fish, Wildlife and Marine Resources
    - Natural Heritage Program
- Suffolk County;
    - GIS Data (property maps, environmental resources/concerns)
    - Project reports and background information
- U.S. Department of Agriculture, online soil survey data;
- U.S. Department of Agriculture, invasive species information;
- U.S. Fish and Wildlife Service Long Island Field Office, information on Rare, Threatened and Endangered (RTE) species and habitats;
- U.S. Fish and Wildlife Service, National Wetland Inventory (NWI) database; and,
- U.S. Geological Survey 7.5-minute series topographic maps.

## 2.2 Cover Type Mapping

A Geographic Information System (GIS) wetland data layer was created for the study area using ArcMap™ 10.1, ArcToolbox™ and Conversion Tools (ESRI™ 2015), and was based on a desktop overlay and evaluation of the relevant spatial data. The data layer included potential locations of wetlands that are hydrologically-connected to the Grand Canal and that could be potentially affected by future project activities. Preliminary wetland boundaries were overlaid onto satellite imagery maps and hardcopies were produced for use by biologists in the field to assess boundaries and identify any needed boundary modifications. In addition, an IPad™ was preloaded with the preliminary wetland boundaries which allowed biologists to identify their real-time location in the field relative to locations of wetland boundary lines to facilitate the wetland verification effort.

Wetland biologists then performed systematic field verifications, or “ground-truthing”, of the wetland data layer while on site for avian and vegetation survey efforts performed between March and October, 2015, to confirm that the preliminary wetland layer was an accurate representation of wetland boundary shapes and sizes. Biologists also classified the wetland type per the widely accepted Cowardin wetland classification system (Cowardin et. al., 1979) and dominant plant community type, and also noted the locations of abutting upland areas as well as large infestations of the invasive species common reed (*Phragmites australis*).

Where necessary, revisions to wetland locations and boundaries were documented on hardcopy maps and used to update the project GIS wetland data layer using ArcMap™ 10.1. It should be noted that this effort did not include a delineation of wetland boundaries per USACE wetland delineation requirements (Environmental Laboratory 1987, USACE 2012), as such the boundaries depicted in project data and maps are not intended to be used for permitting purposes.

## 2.3 FIELD DATA COLLECTION

### 2.3.1 Avian Surveys

The goal of the avian survey effort was to document the presence of bird species in the project area to **(a)** identify which species are utilizing habitats associated with the Grand Canal, **(b)** help the County to evaluate/anticipate if there are birds which may be negatively affected by changes to the marsh, and, **(c)** ensure the County is aware of the presence of any state or federally-lists species in the project area.

Avian surveys were performed by qualified biologists on March 16-17, May 21-22, and June 25-26, 2015. Surveys closely followed the methodology of the US Geologic Survey (USGS) Standardized North American Marsh Bird Monitoring Protocol (Conway 2009), and US Fish and Wildlife Service (USFWS) Landbird Monitoring Protocol (Knutson 2008). The focus of the survey effort was to identify as many bird species possible in the Project area, as opposed to surveys performed for the purpose of documenting specific habitat associations and population trends. As such, surveys included several methods (point counts and area searches) which were performed under different tidal amplitude conditions, and the points were placed in locations that captured the broadest area and as many different habitat types as possible at any given survey point. Birds were recorded if seen/heard within the marsh and open water complexes of the study area and adjacent upland/developed habitats. Survey locations are shown in Appendix A, Figure 2, and the x, y coordinates of those locations are provided in Appendix B.

#### Point Counts

A distance point count consisted of standing at a predetermined location and recording visual and/or auditory observations of birds, and distances to those observations, during a 10-minute time period on an Avian Survey Data Form (Appendix B). Nine point count stations were established at key vantage points around each of the marsh complexes and were placed at least 250m (820ft.) apart to minimize duplication of detections (Appendix A, Figure 2). An additional three points were established for use during broadcast call surveys. These points were spaced in different locations than the point count stations due to the long distances that the broadcast call sounds travel, and the increased ability of observers to detect calls across larger areas during these survey periods. In an effort to capture avian activity in a broad range of land uses, vegetative communities, soil types, and topographic locations, each of the point count stations were situated in locations that would capture several habitats and land uses within the survey area of each point. All points were surveyed at least twice during each monthly survey event (e.g., March, May, and June). Surveys were conducted between sunrise and three and a half hours after sunrise.

March and May survey events also included surveys at three broadcast call stations (Appendix A, Figure 2), to target nocturnal species such as owls and nightjars, and were conducted beginning at least ½ hour after sunset up to one hour before sunrise. The May and June events included surveys at the same broadcast stations to target secretive marsh bird species such as bitterns and rails, and were conducted beginning at least two hours before sunset and ending at sunset.

Upon arrival at each point, observers waited for 2 minutes before recording birds to allow birds to acclimate to the disturbance of the approach as well as the observers' presence. Weather conditions were noted on each data form, however, surveys were not conducted during rain, under windy conditions (i.e., > 10 mph), or when hearing was significantly impaired due to temporary adjacent activities (e.g., loud trucks or boats, construction activities). With the exception of late day marsh bird surveys and nocturnal surveys (which included the use of marsh bird and owl broadcast calls) observers did not use sounds to attract birds to the point or induce calling. No "spishing", "squeaking", recorded calls, or any other methods that encourage birds to alter their behavior were used.

### Area Searches

Area searches were conducted following each morning point count survey and involved meandering slowly along a specified survey area (Appendix A, Figure 2). The area search method is not a timed or fixed point event, which allows the observers more flexibility in spending any amount of time needed to evaluate bird activities and to survey a variety of habitats. In this case, surveyors focused efforts along the earthen berm which abuts approximately 3,800 feet (ft.) of the east side of the Grand Canal since this area was easily navigable by observers and also provided good coverage of each of the target marsh areas. Visual and/or auditory observations were recorded on the Avian Survey Data Form (Appendix B). No specific time periods were used during area searches; surveys were performed during daylight hours and were made until no new avian species could be recorded for the area.

### Incidental Observations

Incidental observations were recorded for any species that was seen/heard in the study area, but not otherwise recorded during formal point count or area surveys; including other wildlife species. Incidental observations were recorded in field log books and on the Avian Survey Data Form (Appendix B).

### Rare, Threatened and Endangered Species

The USFWS and New York Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources (DFWMR) were consulted to identify any known occurrences of federal or state listed species in the project area (NYSEDC 2014, USFWS 2015).

## 2.3.2 Vegetation Surveys

The goal of the vegetation survey effort was to **(a)** document the characteristics of vegetation within the dominant plant communities in the project area, **(b)** establish baseline conditions which will help the County to evaluate/anticipate if changes are/will occur on the marsh, and, **(c)** ensure the County is aware of the presence of invasive species in the project area.

Vegetation sampling was conducted within 1.0 square meter ($m^2$) quadrats situated along seven survey transects; labeled A through G (Appendix A, Figure 2). Transects extended across the marsh surfaces from areas of lowest elevation and hydrologic input (i.e., the canal or primary tidal channels from the canal) to highest elevation along a marsh-upland edge. Since changes to marsh conditions are typically most noticeable at transition zones where slight differences in chemical and physical parameters can quickly affect the flora and fauna species, surveys targeted transition zones from the canal/marsh edge to the upland edge, and also targeted locations within the marsh that had notable differences in the density/height of the invasive species common reed. From three to five zones were targeted along each transect, and three quadrats were sampled at each of the zone transitions, for a total of 78, 1.0 $m^2$ quadrats. Transect and plot locations were marked with semi-permanent wooden stakes and the locations were recorded using a Global Positioning System (GPS) with sub-meter accuracy. Survey locations are shown in Appendix A, Figure 2, and the coordinates of sample quadrats are provided in Appendix B.

Various vegetation metrics were collected within each quadrat and recorded on a Vegetation Sampling Data Form (Appendix B), including a list of all live and dead standing vascular plants and macro-algae species (with distinction made between native and non-native species), stem density, plant height, and percent (%) cover of bare ground, trash, rock, micro-algae, fungus, dead plant material (not standing), and wrack.

The vegetation survey effort also included the establishment of photo-stations to document baseline conditions and to facilitate visual comparisons of baseline and future marsh conditions. Photo-stations were established at the center quadrat (i.e., the quadrat located on the transect line) of each transition zone along the transect. Four photographs were collected per photo station facing each cardinal direction (i.e., N, S, E and W) in sequence. Additional photographs were collected as needed to document overall marsh conditions in the vicinity of each transect. Photo Station locations were marked with semi-permanent stakes and the locations were recorded using a GPS with sub-meter accuracy. The coordinates of photo station locations are provided in the photographic documentation in Appendix D.

### 2.3.3 Soil Surveys

The goal of the soil survey effort was to **(a)** document the characteristics of soils within the dominant plant communities in the project area, and **(b)** establish baseline conditions which will help the County to evaluate/anticipate if changes are/will occur on the marsh. Soil metrics were collected within many of the same 1.0 $m^2$ quadrats as used in the vegetation sampling and were collected concurrent to the vegetation survey effort (Appendix A, Figure 2). Data forms from the survey effort and the coordinate locations of survey quadrats are provided in Appendix B.

Soil compaction was measured in the center of one 1.0 $m^2$ quadrat per each survey transect and transition zone (i.e., 26 sample quadrats) using a DICKEY-John® soil penetrometer with a ¾ inch probe tip. The probe tip was inserted with steady and even pressure into the soil to 18-inches depth, or until full resistance was met. Any resistance was recorded in pounds per square inch.

Soil electrical conductivity was measured using a FieldScout® Direct Soil Electrical Conductivity Meter. Samples were taken in the center of all 1.0 $m^2$ quadrats (i.e., 3 quadrats per transects and transition zone for 78 total samples) by inserting the probe tip to a depth of 4 inches below the soil surface. Conductivity values were recorded in microsiemens (uS) then converted to salinity in parts per thousand (ppt).

Soil organic matter from marsh substrates was measured by loss on combustion. A 5 cm diameter cylindrical push corer was used to remove a sediment core to the depth of 10 cm from the center of one 1.0 $m^2$ survey quadrat per transect and zone (i.e., 26 sample quadrats). Samples were dried, weighed, combusted at 500 degrees Celsius for ~8 hours, then weighed again. The difference in weight between the dried and combusted samples, expressed as a percentage of the dried weight, represents the organic matter content of the marsh soil sample.

The local Natural Resources Conservation Service (NRCS) was also consulted for information on the soil types and leaching potential of project area soils (USDA 2014).

### 2.3.4 Wetland Condition and Health Assessment

Concurrent to all field survey efforts, biologists gathered information to identify potential stressors in the area surrounding each survey transect using a rapid assessment approach recommended by the USEPA EPA; the Mid-Atlantic Tidal Rapid Assessment Method (Mid-TRAM 2010). Evaluation parameters included field evidence of stressors affecting key marsh functions such as: altered hydroperiod; which included ditches/channelization, deeply cut or slumping channels, drains/culverts/pipes, upland plant species encroaching into wetlands, vegetation die-off, tidal restrictions, dikes, fill, filamentous algae, excavation, riprap, inlets/outlets; stormwater input such as habitat/vegetation disturbance, such as mowing, cutting, herbicide use, excessive herbivory, insect damage, and invasive species; and, residential stressors, for example. adjacent and on-site land uses, infrastructure, and dumping of yard waste or other debris. The goal of the wetland condition and health assessment was to **(a)** document the overall health of wetlands in the project area, **(b)** identify the stressors affecting wetland health, and **(c)** establish baseline conditions which will help the County to evaluate/anticipate if changes are/will occur on the marsh.

Field based information regarding site stressors and actual data from the vegetation and soil surveys were combined with a landscape evaluation to produce a wetland score by closely following the methodology of the Mid-Atlantic Tidal Rapid Assessment Method (Mid-TRAM 2010). The approach uses high resolution variables that can be quickly assessed to help predict stress responses and relationships. The assessment includes metrics in four major attribute categories that are significant in driving the overall health of a wetland: buffer, hydrology, habitat/plant community (biotic and physical structure), and shoreline characteristics (Table xx).

Each metric is given a score between three and 12 and then combined into attribute scores by summing the metric scores and dividing by the total possible value, depending on the number of metrics in that group. That value is calculated then adjusted to be on a 0-100 scale using the following formula:

**Buffer** = $((((\sum(B1 \ldots B6))/72)*100)-25)/75)*100$
**Hydrology** = $((((\sum(H1 \ldots H4))/48)*100)-25)/75)*100$
**Habitat** = $((((\sum(HAB1 \ldots HAB5))/60)*100)-25)/75)*100$
**Shoreline** = $((((\sum(S1 + S2))/24)*100)-25)/75)*100$

**Table 1.  Attributes Evaluated for Grand Canal Marsh Complexes.**

| Attribute | Metric | Description |
|---|---|---|
| Buffer/Landscape | Percent of Perimeter with 5m-Buffer | Percent of perimeter that abuts at least 5m (16 ft.) of natural or semi-natural condition land cover |
| Buffer/Landscape | Average Buffer Width | The average buffer width that is in natural or semi-natural condition |
| Buffer/Landscape | Surrounding Development | Percent of developed land within 250 m (280 ft.) from the edge of the area |
| Buffer/Landscape | Landscape Condition | Landscape condition within 250 m (820 ft.) surrounding the area based on the nativeness of vegetation, disturbance to substrate and extent of human visitation |
| Buffer/Landscape | Barriers to Landward Migration | Percent of landward perimeter of wetland that has physical barriers preventing wetland migration inland |
| Hydrology | Ditching & Draining | The presence of ditches in the wetland area |
| Hydrology | Fill & Fragmentation | The presence of fill or wetland fragmentation from anthropogenic sources in the wetland |
| Hydrology | Wetland Diking / Tidal Restriction | The presence of dikes, berms, culverts or other tidal flow restrictions |
| Hydrology | Point Sources | The presence of localized sources of pollution |
| Habitat | Bearing Capacity | Soil resistance measured with a penetrometer |
| Habitat | Vegetative Obstruction | Visual obstruction by vegetation < 1 m (3 ft.) |
| Habitat | Number of Plant Layers | Number of plant layers in the wetland based on plant height |
| Habitat | Percent Dominant/Co-dominant Invasive Species | Percent of co-dominant invasive species in the wetland |
| Habitat | Percent Invasive | Percent cover of invasive species in the wetland |
| Shoreline | Shoreline Alteration | Percent of shoreline that has been unnaturally altered |
| Shoreline | Shoreline Erosion | Score based on amount of shoreline that is eroding/stable/accreting |

A final score is also calculated for each site by averaging the four attribute group scores:

**Health Score** = ((Buffer + Hydrology + Habitat + Shoreline)/4)

A **Comparative Health Score** was also calculated based on three of the four metrics (buffer, hydrology, and habitat) and placed into three condition categories; minimally stressed (scores $\geq$ 83), moderately stressed (scores from 83 to 61), or severely stressed (scores < 61). These condition class breakpoints were determined from scores form 90 sites assessed using Mid-TRAM in Pennsylvania (PA), New Jersey (NJ), and Delaware (DE) (Jennette et. al., 2014, Pedeletti et. al., 2012) since data comparable to the Mid-TRAM approach was not available for the Suffolk County study area. The fourth category, shoreline, was not included since it was not a component of the DE/NJ/PA data. It should be noted that category breakpoints could vary somewhat from site to site depending on the ranges of health scores included in the assessment. Nonetheless the stressors and general landscape setting of the locations used in DE/NJ/PA are likely similar to those of the Grand Canal study area, and although not in the same region, the breakpoints are a suitable starting point for comparative discussions of overall marsh health.

# 3.0 RESULTS AND DISCUSSION

## 3.1 Cover Type Map

Six vegetated community types, and two open water types (excluding the grand canal) covering 131 acres, were differentiated and mapped in the Grand Canal study area to create a project cover type map (Appendix A, Figure 3) and included:

- Forest_Scrub-shrub;
- Intertidal marsh;
- High marsh_pool_panne;
- High marsh_Marsh elder (*Iva frutescens*);
- Common reed_stunted growth form;
- Common reed_tall growth form;
- Pond; and,
- Tidal channels.

In addition, significant features such as culverts and sampling station locations were recorded using GPS and included as additional layers on the cover type map and related project area figures (Appendix A, Figures 2 and 3).

## 3.2 Avian Surveys

The study area falls within the NYSCDEC-designated South Shore Tidal Wetlands Bird Conservation Area (NYSDEC 2004). The area is designated as such due to its unique assemblages of tidal salt marshes, upland habitats and open water creeks, channels and ditches, which are known to support a diverse mix of uncommon bird species such as seaside sparrow (*Ammodramus maritimus*), saltmarsh sparrow (*Ammodramus caudacutus*), common tern (*Sterna hirundo*), osprey (*Pandion haliaetus*), clapper rail (*Rallus crepitans*), and northern harrier

(*Circus cyaneus*), while the uplands provide critical migration habitat for birds crossing the ocean and bays.

Sixty-three bird species were observed in the study area, including 36 unique species identified in March before many of the migrant species had arrived, 52 observed in May, and 47 in June (Table 2). Survey results excluded species that were observed flying over the site unless the species was known to be utilizing marsh resources (e.g., northern harrier, swifts and swallows, and terns seen foraging over the marsh open water areas). In comparison, eBird (a professionally maintained and monitored web-based bird data portal that allows birders to record local bird observations), has 70 recorded unique species near the Grand Canal area that would typically be associated with the habitat types of the Grand Canal (eBird 2016). The species most commonly observed during all Grand Canal survey events were common grackle (*Quiscalus quiscula*), red-winged blackbird (*Agelaius phoeniceus)*, and song sparrow (*Melospiza melodia*); consistent with the most commonly reported birds on eBird for similar habitat types in the vicinity. While many of the species observed within the study area utilize a diversity of habitats during their life cycle, 24 species are closely associated with marsh and open water habitats of the study area and are the most susceptible to changes in the availability and quality of marsh habitats (Table 2). This includes species that while they may be associated with upland habitats for breeding and nesting activities, depend on the marsh habitats for food.

Focused evening surveys for nocturnal species detected two separate eastern screech owls (*Megascops asio*). One was detected during both the March and May survey events and was located in the forest at the north end of the east marsh. The second owl was detected along the tree line/residential area at the west end of the southwest marsh, and was heard during the May survey. No marsh bird species were detected during dusk marsh bird broadcast call surveys.

**Table 2. Avian Species Documented in the Grand Canal Study Area.**

| Common Name | Scientific Name | March | May | June | Predominant Habitat Association | Listed or Special Concern Species |
|---|---|---|---|---|---|---|
| American Crow | *Corvus brachyrhynchos* | 1 | 1 | 1 | Upland | No |
| American Goldfinch | *Spinus tristis* | | 1 | 1 | Upland | No |
| American Redstart | *Setophaga ruticilla* | | 1 | 1 | Upland | No |
| American Robin | *Turdus migratorius* | | 1 | 1 | Upland | No |
| Barn Swallow | *Hirundo rustica* | | 1 | 1 | Wetland/Open Water | No |
| Black-capped Chickadee | *Poecile atricapillus* | 1 | 1 | 1 | Upland | No |
| Belted Kingfisher | *Megaceryle alcyon* | 1 | | 1 | Wetland/Open Water | No |
| Brown-headed Cowbird | *Molothrus ater* | 1 | 1 | 1 | Upland | No |

**Table 2. Avian Species Documented in the Grand Canal Study Area (continued).**

| Common Name | Scientific Name | March | May | June | Predominant Habitat Association | Listed or Special Concern Species |
|---|---|---|---|---|---|---|
| American Black Duck | *Anas rubripes* | 1 | | | Wetland/Open Water | No |
| Blue Jay | *Cyanocitta cristata* | 1 | 1 | 1 | Upland | No |
| Blackpoll Warbler | *Setophaga striata* | | 1 | | Upland | No |
| Canada Goose | *Branta canadensis* | 1 | 1 | 1 | Wetland/Open Water | No |
| Carolina Wren | *Thryothorus ludovicianus* | 1 | 1 | 1 | Upland | No |
| Cedar Waxwing | *Bombycilla cedrorum* | | 1 | 1 | Upland | No |
| Chimney Swift | *Chaetura pelagica* | | 1 | 1 | Wetland/Open Water | No |
| Common Grackle | *Quiscalus quiscula* | 1 | 1 | 1 | Upland | No |
| Common Tern | *Sterna hirundo* | | 1 | | Wetland/Open Water | State-Threatened |
| Common Yellowthroat | *Geothlypis trichas* | | 1 | 1 | Upland | No |
| Downy Woodpecker | *Picoides pubescens* | 1 | 1 | 1 | Upland | No |
| Eastern Kindbird | *Tyrannus tyrannus* | | 1 | 1 | Upland | No |
| Eastern Phoebe | *Sayornis phoebe* | | 1 | 1 | Upland | No |
| Eastern Screech-Owl | *Megascops asio* | 1 | 1 | | Upland | No |
| European Starling | *Sturnus vulgaris* | 1 | 1 | 1 | Upland | No |
| Fish Crow | *Corvus ossifragus* | 1 | 1 | 1 | Upland | No |
| Great Blue Heron | *Ardea herodias* | | | 1 | Wetland/Open Water | No |
| Great Crested Flycatcher | *Myiarchus crinitus* | | 1 | | Upland | No |
| Gray Catbird | *Dumetella carolinensis* | | 1 | 1 | Upland | No |
| Great Egret | *Ardea alba* | | 1 | 1 | Wetland/Open Water | No |
| Green Heron | *Butorides virescens* | | 1 | 1 | Wetland/Open Water | No |
| Greater Yellowlegs | *Tringa melanoleuca* | | 1 | | Wetland/Open Water | No |
| Hairy Woodpecker | *Picoides villosus* | 1 | | 1 | Upland | No |
| Herring Gull | *Larus argentatus* | 1 | 1 | 1 | Wetland/Open Water | No |

**Table 2. Avian Species Documented in the Grand Canal Study Area (continued).**

| Common Name | Scientific Name | March | May | June | Predominant Habitat Association | Listed or Special Concern Species |
|---|---|---|---|---|---|---|
| House Finch | *Haemorhous mexicanus* | 1 | 1 | 1 | Upland | No |
| Hooded Merganser | *Lophodytes cucullatus* | 1 | | | Wetland/Open Water | No |
| House Sparrow | *Passer domesticus* | 1 | 1 | 1 | Upland | No |
| House Wren | *Troglodytes aedon* | | | 1 | Upland | No |
| Killdeer | *Charadrius vociferus* | 1 | 1 | 1 | Upland | No |
| Laughing Gull | *Leucophaeus atricilla* | | | 1 | Wetland/Open Water | No |
| Mallard | *Anas platyrhynchos* | 1 | 1 | 1 | Wetland/Open Water | No |
| Marsh Wren | *Cistothorus palustris* | | 1 | 1 | Wetland/Open Water | No |
| Mourning Dove | *Zenaida macroura* | 1 | 1 | 1 | Upland | No |
| Mute Swan | *Cygnus olor* | 1 | 1 | 1 | Wetland/Open Water | No |
| Northern Cardinal | *Cardinalis cardinalis* | 1 | 1 | 1 | Upland | No |
| Northern Flicker | *Colaptes auratus* | 1 | 1 | 1 | Upland | No |
| Northern Harrier | *Circus cyaneus* | 1 | 1 | | Wetland/Open Water | State-Threatened |
| Northern Mockingbird | *Mimus polyglottos* | 1 | 1 | 1 | Upland | No |
| Baltimore Oriole | *Icterus galbula* | | 1 | | Upland | No |
| Osprey | *Pandion haliaetus* | | 1 | 1 | Wetland/Open Water | Special Concern |
| Ring-billed Gull | *Larus delawarensis* | 1 | 1 | | Wetland/Open Water | No |
| Red-bellied Woodpecker | *Melanerpes carolinus* | 1 | 1 | 1 | Upland | No |
| Ring-necked Duck | *Aythya collaris* | 1 | | | Wetland/Open Water | No |
| Rock Pigeon | *Columba livia* | 1 | 1 | 1 | Upland | No |
| Red-tailed Hawk | *Buteo jamaicensis* | 1 | | | Upland | No |
| Red-winged Blackbird | *Agelaius phoeniceus* | 1 | 1 | 1 | Wetland/Open Water | No |
| Savannah Sparrow | *Passerculus sandwichensis* | | 1 | | Upland | No |
| Snowy Egret | *Egretta thula* | | 1 | | Wetland/Open Water | No |
| Song Sparrow | *Melospiza melodia* | 1 | 1 | 1 | Upland | No |

**Table 2. Avian Species Documented in the Grand Canal Study Area (continued).**

| Common Name | Scientific Name | March | May | June | Predominant Habitat Association | Listed or Special Concern Species |
|---|---|---|---|---|---|---|
| Tree Swallow | *Tachycineta bicolor* | 1 | | 1 | Wetland/Open Water | No |
| Tufted Titmouse | *Baeolophus bicolor* | 1 | 1 | 1 | Upland | No |
| Willow Flycatcher | *Empidonax traillii* | | 1 | 1 | Wetland/Open Water | No |
| White-throated Sparrow | *Zonotrichia albicollis* | 1 | | | Upland | No |
| Yellow-billed Cuckoo | *Coccyzus americanus* | | 1 | | Upland | No |
| Yellow Warbler | *Setophaga petechia* | | 1 | 1 | Upland | No |
| **63** | **TOTAL** | **36** | **52** | **47** | | |

Correspondence with federal and state natural resource agencies did not reveal any rare, threatened or endangered species that are known to be present, or were identified as likely to occur in the study area (NYSEDC 2014, USFWS 2015). However, two listed birds, northern harrier and common tern were observed foraging over the marsh surfaces and open water areas of the Grand Canal during survey events (Table 2). These listed species were also confirmed in the general vicinity of the study site during the spring and summer of 2015 through postings of rare bird sightings on eBird (eBird 2016). In addition, several ospreys (a state species of special concern), were also documented during surveys. Two man-made osprey nest platforms are located adjacent to Shore Road along the south border of the study area and a natural nest is located within the Grand Canal marsh complex study area (Appendix A, Figure 2); all were active during the 2015 breeding/nesting season. Additional state or federally-listed listed avian species and those of special concern are known to utilize tidal marsh habitats similar to those in the study area and have been reported nearby (eBird 2015). These species could potentially be found in habitats of the project area; the most probable being king rail, least tern, and seaside sparrow. Most listed and special concern species are very uncommon and/or secretive in nature, and would require additional focused surveys to confirm their presence/absence in the study area.

Efforts did not include surveys for other wildlife species, although several medium to large-sized mammal species that are generalists and commonly associated with highly-developed urban settings were noted. Based on direct observation, or as evidenced by tracks or scat, additional wildlife species in the study area include: white-tailed deer (*Odocoileus virginianus*); raccoon (*Procyon lotor*); muskrat (*Ondatra zibethicus*); red fox (*Vulpes vulpes*); gray squirrel (*Sciurus carolinensis*); and, chipmunk (*Tamias striatus*). Numerous sighting of the non-native house cat (*Felis catus*) were also observed throughout the study area, and a cat feeding station is located within 100 ft. of bird survey point #9. Outdoor cats are voracious opportunistic predators that can have devastating impacts on ground and low-shrub nesting species such as birds. Overall, the study site and much of the surrounding area of Long Island lack the large high-quality undisturbed habitats needed to support most of the mammal species that occurred in this region prior to urban development. Nonetheless, forested areas adjacent to the east marsh may provide roosting habitat for bats. Several bats, including the northern long-eared bat (*Myotis septentrionalis*), are federal or state-listed protected species.

### 3.3 VEGETATION SURVEYS

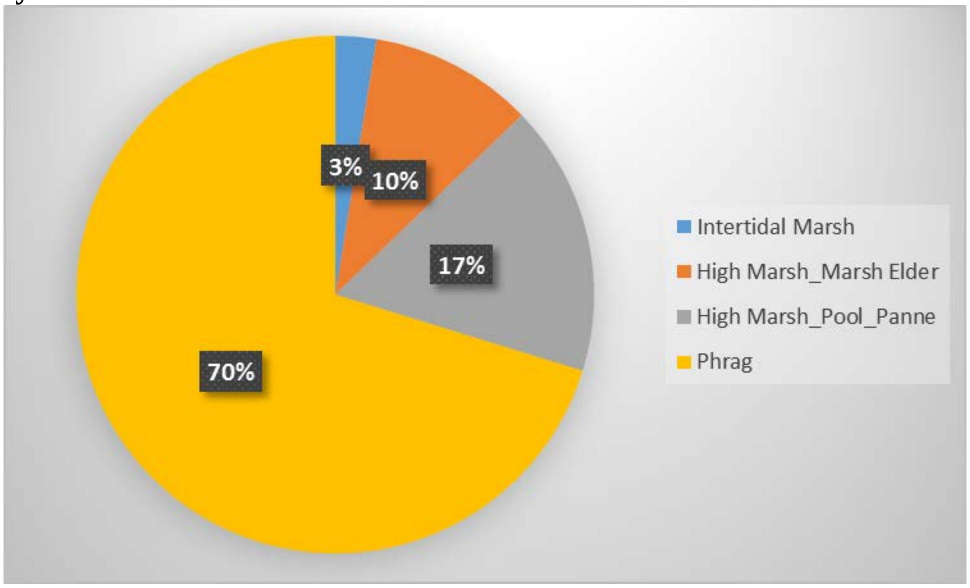
Wetland communities within each of the three major marsh areas of the site (east, southwest, northwest sites), were delineated for survey based on the dominant plant species present, resulting in four major community types: intertidal marsh; high marsh/pool/panne; high marsh/marsh elder; and common reed. Each of these community types were targeted during survey efforts, which involved surveys at 26 sampling points established along 7 transects; for a total of 78 1m$^2$ data plots (Appendix A, Figure 2). In most cases plots were placed along the transition zones from one community type to another, since these areas would be most likely to show shifts in plant species composition over time, should marsh conditions change. Three transects (A, B, and C) and a total of 39 plots were sampled within the southwest marsh, two transects (D and E) with 21 plots were sampled within the northwest marsh, and two transects (F and G) with 18 plots were sampled in the east marsh (Appendix A, Figure 2). Additional plots were not needed in the east and northwest marsh complexes due to the lack of diversity of the marsh communities encountered.

Estuarine emergent marsh wetlands comprise 88 acres in the Grand Canal study area: 50 acres in the east marsh complex; 16 acres in the southwest complex; and, 12 in the northwest complex (Table 3). The common reed community type dominates in all three marsh complexes; comprising 70% of all emergent wetlands in the project area (Graph 1). Within each complex, common reed comprises 39 acres (78%) of the wetlands found in the east marsh, 8 acres (66%) of the wetlands in the northwest marsh, and 8 acres (50%) of wetlands in the southwest marsh. Additionally, although not considered a wetland marsh community type, tidal channels (excluding the Grand Canal) cover 3.5 acres of the east marsh, 0.7 in the northwest marsh, and 0.9 acres in the southwest marsh (Table 3).

**Table 3. Acres of Marsh Community Types and Tidal Channels in Grand Canal Marsh Complexes.**

| Community Type | East Marsh (Transects A, B, C) | Southwest Marsh (Transects D and E) | Northwest Marsh (Transects (F and G) |
|---|---|---|---|
| **Intertidal Marsh** | 0 | 2.0 | 0 |
| **High Marsh_Pool_Panne** | 7.2 | 2.5 | 3.5 |
| **High Marsh_Marsh Elder** | 3.6 | 3.7 | 0.7 |
| **Common Reed** | 38.7 | 8.0 | 7.9 |
| **Tidal Channels** | 3.5 | 0.9 | 0.7 |
| **Total** | 53.1 | 17.0 | 12.8 |

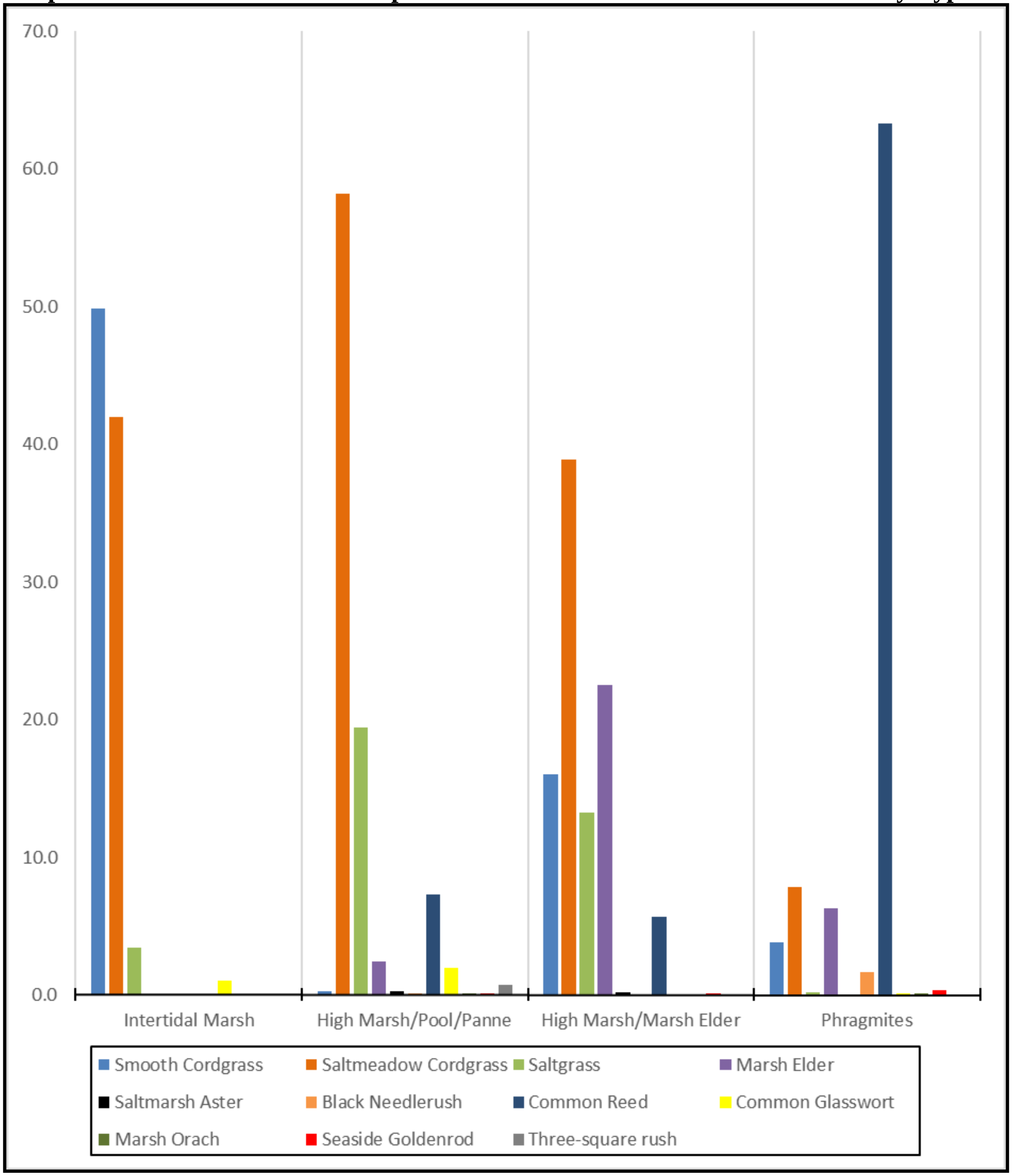
**Graph 1. Percent of Each Estuarine Emergent Marsh Community Type in the Grand Canal Study Area.**



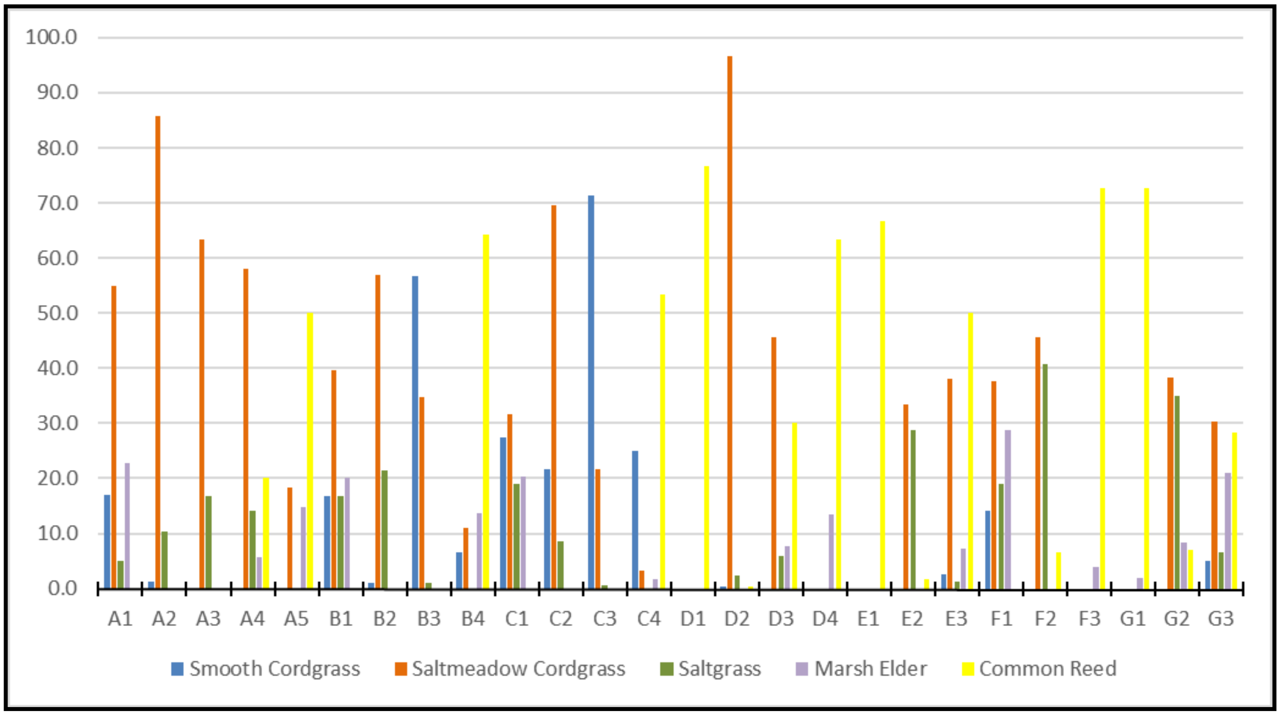

***Intertidal Marsh*** **–** covers 2.0 acres (2.6 %) of the 78 acres of estuarine emergent marsh wetlands of the Grand Canal study area, and occurs in regularly flooded areas that typically receive daily tidal flooding and by definition have at least 50% cover of smooth cordgrass (*Spartina alterniflora*) (Graph 2). The smooth cordgrass found throughout the study area is the short form which is generally less than 1.5 ft. (45 cm) tall. This community is located in relatively protected areas between mean sea level and mean high tide, and are typically flooded and exposed by the tide twice a day. The average cover of smooth cordgrass in this community ranged from 57% to 72%, followed by saltmeadow cordgrass (*Spartina patens*) (Graph 2). Other much less common species include saltgrass (*Distichlis spicata*) and common glasswort (*Salicornia depressa*). Algae and bare ground were also encountered and occupied from 1% to 18% of the plot area.

The intertidal marsh community was found only within the southwest marsh complex (Appendix A, Figure 3), where it comprises 12.3% of the wetlands and is represented by data from survey plots B3 and C4 (Graph 3). However, the primary plant indicator for this community type, saltmeadow cordgrass, was also found in lower densities within other community types in the southwest marsh (plots A1, A2, B1, B4, C1, C2, C5), northwest marsh (plots D2 and E3), and east marsh (plots F1 and G3) (Graph 3). This suggests that these marsh complexes may have originally supported this community type before major land and hydrological alterations occurred in the area.

**Graph 2. Percent Cover of Plant Species in Grand Canal Salt Marsh Community Types.**



**Graph 3. Average Percent Coverage of Dominant Salt Marsh Plant Species Per Survey Plot[1].**




[1]Southwest Marsh = Plots A, B and C; Northwest Marsh = Plots D and E; East Marsh = Plots F and G

**High Marsh/Pool/Panne –** this community type occurs in areas on the marsh system that are typically flooded only during higher than average high tides, and therefore tend to be somewhat drier and to have less salinity than intertidal marsh areas. The high marsh/pool/panne community covers 13.2 acres (16.9 %) of the estuarine emergent wetland communities on the site and is found in all marsh complexes: southwest, 2.5 acres; northwest, 3.5 acres; and, 7.2 in the east marsh (Graph 2). Pools and panne features are included within this community and are bare or sparsely vegetated concave depressions situated within the high marsh vegetation. The Pools typically retain water through the summer, whereas pannes do not. With the exception of the relatively bare pool and panne areas, this community by definition is dominated by at least 50% cover of saltmeadow cordgrass and co-dominated by another quintessential high marsh species saltgrass (Graph 2). Other less common species include smooth cordgrass, marsh elder, glasswort, and common reed and to a lesser extent saltmarsh aster (*Symphyotrichum subulatum*), marsh orach (*Atriplex patula*), seaside goldenrod (*Solidago sempervirens*), and three-square rush (*Scirpus Americanus*) (Graph 2). Higher elevations along the margins of this community are typically only flooded during spring tides and storm surges and in many areas are also influenced by freshwater input from adjacent upland areas; particularly in developed areas along the edges of each marsh complex. These areas can have a broad diversity of plant species; however, in most cases in the Grand Canal study area these areas while dominated by saltmeadow cordgrass have a prevalence of the stunted form of the invasive common reed.

The high marsh community was found throughout all three marsh complexes; east (plots F2 and G2); southwest (plots A2, A3, A4, B2, C1, C2, and C3); and, northwest (plots D2, D3, and E2) (Appendix A, Figure 3) (Graph 3). In addition, the primary plant indicator for this community type, saltmeadow cordgrass, was also found (in lower densities) in every plot sampled with the exception of D1, D4, E1, G1, and F3, all of which are areas that are dominated by common reed (Graph 2). This suggests that common reed will, and has obviously, displaced this community type.

**High Marsh/Marsh Elder –** this community includes roughly the same species composition as the high marsh/pool/panne community type, but this community also has marsh elder as a co-dominant plant; by definition with at least 20 % cover (Graph 2). The high marsh/marsh elder community covers 8.0 acres (10.3 %) of the wetlands of the study site and is found in all marsh complexes: southwest, 3.7 acres; northwest, 0.7 acres; and, 3.6 in the east marsh. The community is typically found along the more elevated margins of the high marsh community where the marsh complex transitions into adjacent upland areas, but in the Grand Canal area, this community is also found along the tidal channels, and in a relatively extensive area within the southwest marsh complex where it is also comprised of relatively high densities of smooth cordgrass; a low marsh species (Appendix A, Figure 3).

The marsh elder community is represented by survey plots in the southwest marsh (A1 and B1) and east marsh (plots F1 and G3), but is also found in lower densities in plots A4, A5, B4, C5, D4, E3, F3, G1, and G2 (Graph 3). Marsh elder is commonly found within common reed dominated areas and appears to be the last salt marsh species to occupy an area before complete dominance by the invasive common reed.

**Common Reed Dominated (tall and stunted forms) –** common reed is an aggressive invasive wetland plant that by definition, dominates at least 50% cover this community type. This community covers 54.6 acres (70.2%) of wetlands of the site and is found in all marsh complexes: southwest, 8.0 acres; northwest, 7.9 acres; and, 38.7 in the east marsh) and is the most common community type encountered (Graph 2). Two distinct phenotypes of this community are found in the study area: a stunted growth form; where the average height is < 5 ft. and stalks are weak (< ¼ inch diameter); and, a tall form with robust stalks (> ¼ inch diameter) and height is > 5 ft. In most areas of the marsh the stunted form is found in narrow transition zones from the high marsh to the tall form of common reed along the marsh upland edge; except in the northwest complex, where the stunted form is dominant; in wide transition zones from the high marsh/pool/panne community into the tall common reed community along the upland edge, as well as in fingerlike growth into the high marsh (Appendix A, Figure 3).

The common reed community is represented by survey plots in the southwest marsh (A5, B4 and C5), where it makes up 49.6% of the wetlands on site and occurs primarily in the western most portion of the complex and at transition zones into adjacent upland areas and occupies approximately (Appendix A, Figure 3, and Graph 3). In the northwest marsh, this community is extensive covering 65% of the wetlands on site and was dominant in plots D1, D4, E1, and E3. Transects were placed in a linear fashion from the edges of tidal areas (Plot D1 and E1) and extended across the marsh to the upland (plot D4 and E3). In this marsh, the stunted form of common reed completely surrounds the remaining high marsh community and the marsh edges are dominated by the tall form of common reed. Within the east marsh, the common reed community is represented by plots F3 and G1 and occupies 78.1% of the wetlands on the site. However, common reed is also present in plots F2, G2, and G3. Similar to the northwest marsh, high marsh habitat in the east marsh are only found in relatively small low-lying pockets and in the east marsh nearly all of them are completely surrounded by dense stands of the tall and robust form of common reed.

### 3.4 Soil Surveys

Soils within approximately 53% of the study area, which includes a portion of developed areas adjacent to the marsh complexes (Appendix A, Figure 4), are classified as Tidal Marsh (TM); a frequently flooded/ponded hydric soil with deep organic composition (Table 4). The remaining soils are found along the marsh margins and urban areas and are comprised primarily of highly disturbed, filled and/or graded soils covering approximately 12 percent of the study area, and areas of coastal sandy-loam/loamy-sand soil types which occur within undeveloped forest-scrub-shrub communities and cover about 35 % of the site (Table 4).

**Table 4. Soil Types of the Grand Canal Project Area.**

| Map Unit Symbol | Unit Name | Hydric Soil | % coverage in Study Area | Soil Description |
|---|---|---|---|---|
| De | Deerfield sand | Yes | 2.5 | Gently sloping, moderately well-drained soils comprised of a shallow organic layer (< 3 inches) over sandy material. The water table is generally at a depth of about 18 to 36 inches. Includes areas classified as Farmlands of Statewide Importance. |
| Du | Dune | | .2 | Sand |
| Fd | Fill (dredged material) | | 2.9 | Highly disturbed, fill. |
| Fs | Fill (sandy) | Yes | 3.0 | Some areas occur in former wetlands and are hydric. |
| PIA | Plymouth loamy sand | | 1.4 | Gently sloping, excessively-drained soils comprised of up to 27 inches of loamy sand over gravelly coarse sand material. Includes areas classified as Farmlands of Statewide Importance. |
| RdA | Riverhead sandy loam | | 13.4 | Gently sloping (0 to 3 percent slope), well-drained soils comprised of up to 27 inches of sandy loam over 8 inches of gravelly loamy sand material, then stratified coarse sand/gravelly sand to a depth of 65 inches. All areas are classified as Prime Farmlands. |

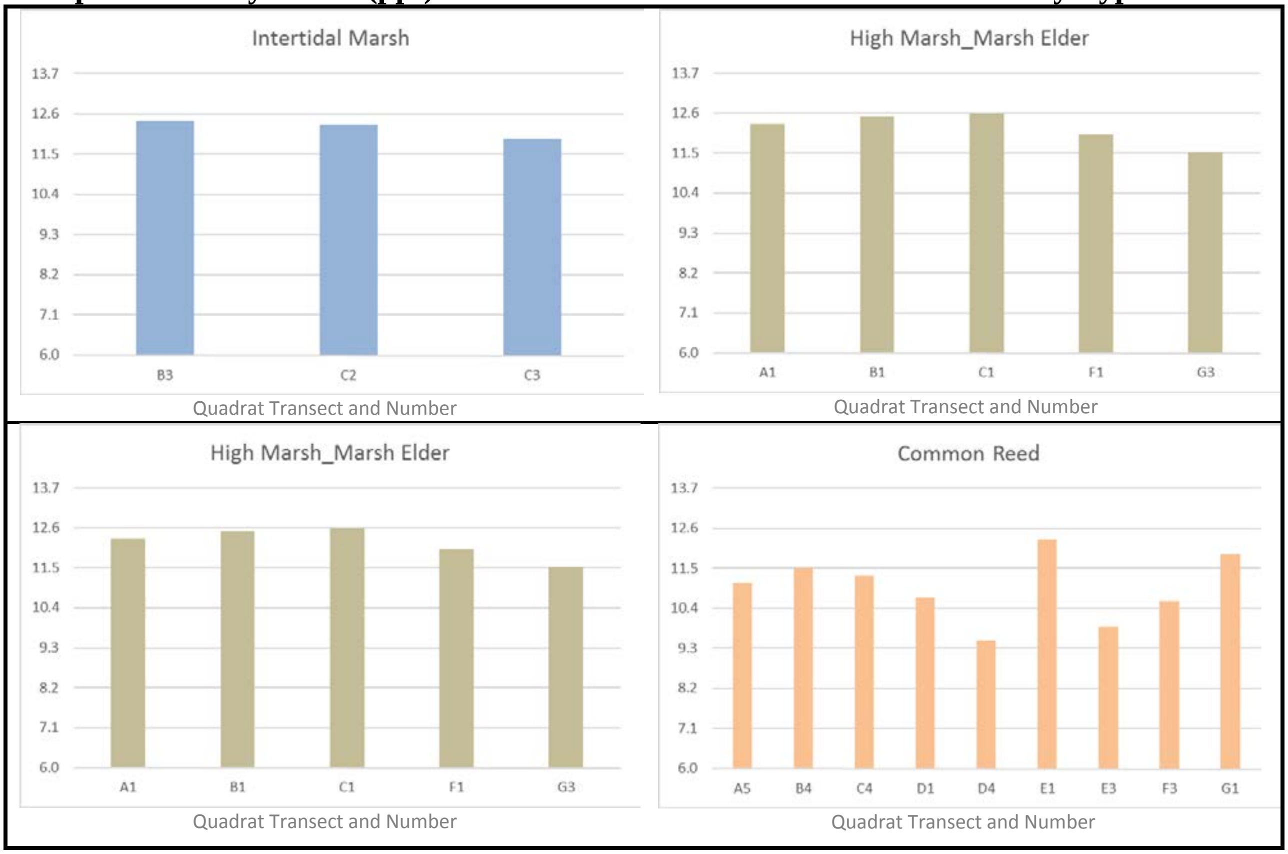
**Table 4. Soil Types of the Grand Canal Project Area (continued).**

| Map Unit Symbol | Unit Name | Hydric Soil | % coverage in Study Area | Soil Description |
|---|---|---|---|---|
| RhB | Riverhead and Haven (modified-graded) | | 3.9 | Graded, gently sloping (0 to 8 percent slope), well-drained soils. Riverhead soils are comprised of up to 27 inches of sandy loam over 8 inches of gravelly loamy sand material, then stratified coarse sand/gravelly sand to a depth of 65 inches. Haven soils are comprised of up to 19 inches of loam over 9 inches of gravelly loam material, then stratified gravelly sand to a depth of 60 inches. |
| Tm | Tidal marsh | Yes | 53 | Concave to gently sloping (0 to 1 percent slope), very well-drained soils comprised of up to 80 inches of organic material. The water table is at the surface and areas are frequently flooded and/or ponded. |
| Ur | Urban | | 0.8 | Highly disturbed, filled, developed. |
| Wd | Walpole sandy loam | Yes | 17.9 | Gently sloping (0 to 3 percent slope), poorly-drained soils comprised of a shallow layer ($\leq$ 1 inches) of peat, over up to 21 inches of sandy loam, over 4 inches of gravelly sandy loam material, then very gravelly sand to a depth of 65 inches. The water table is generally at about 4 inches. Some areas are classified as Farmlands of Statewide Importance. |

Based on field data collection, soils throughout the marsh complexes were typical of the TM soil unit type and were comprised of highly saturated deep organic material, greater than 18 inches deep. When evaluated with a soil penetrometer, less than 200 pounds per square inch (psi) of resistance was encountered; indicating no compaction, as is typical for moist soils with high organic composition. Where slight resistance was encountered, it was primarily due to a dense root system, not compacted soil or fill material. There are undoubtedly some areas within the marsh complexes, particularly along the marsh edges and berm, that contain fill material as evidenced by areas of exposed gravel and dumped fill. But these are uncommon and do not appear to be driving factors in the health or vegetative composition within the marsh.

Salinity, which is often identified as one of the major contributing factors that drives the vegetative communities present on a site, were inconclusive. Typical salinity levels in intertidal and high marsh areas of estuarine tidal marsh systems in New York range from 18–30 parts per thousand (ppt) (citation xxx). Results for the study area range form 9.4 to 12.6 (Graph 4) and appear to indicate that the marsh system is mesohaline (i.e., salinity from 5 to 18 ppt). Results are not consistent with reported salinities for the Long Island area and an alternate, more intensive, survey approach to should be investigated for future marsh salinity monitoring.

**Graph 4. Salinity Levels (ppt) in Grand Canal Estuarine Marsh Community Types.**



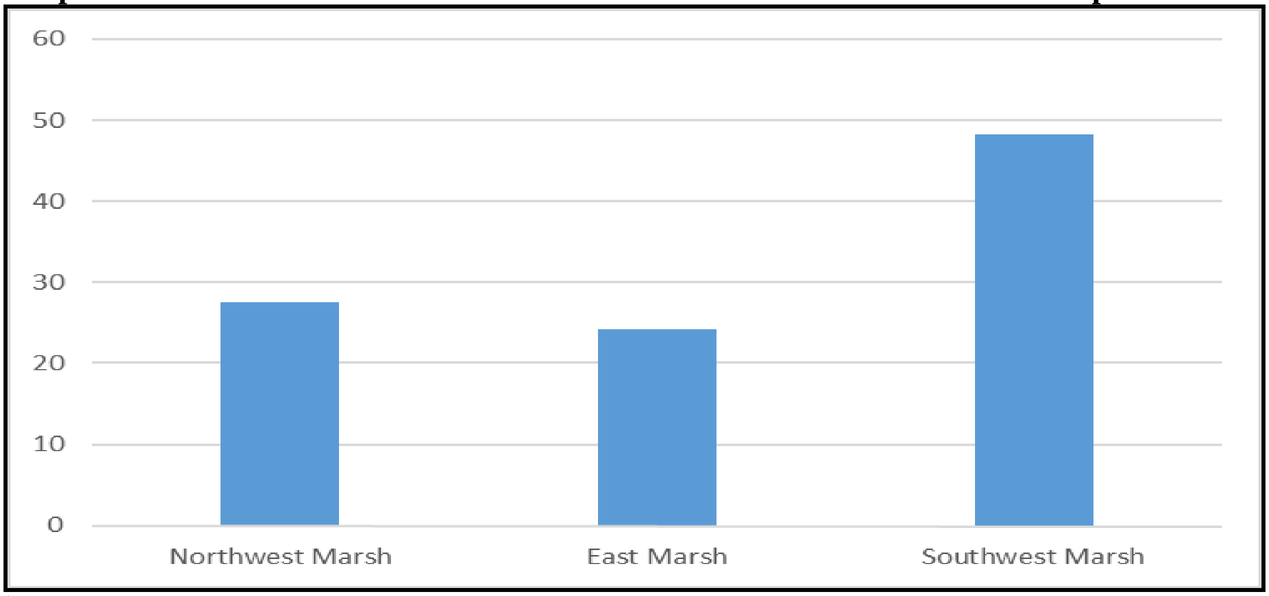

## 3.5 WETLAND CONDITION AND HEALTH ASSESSMENT

Wetlands throughout the United States have experienced dramatic losses throughout history; primarily a direct result of human expansion (Dahl 2011). Despite the laws and ordinances put in place since the 1970's to protect wetlands, the losses continue; although the rate of loss is substantially less than those reported through the 1980's. The United States reportedly experienced an estimated 2.4% loss of intertidal estuarine wetland alone habitat between 2004 and 2009 (Dahl 2011). The wetlands that remain are typically substantially smaller than their original size, located within highly-developed landscapes, and are subjected to a wide variety of additional stressors that can undoubtedly have a negative affect on the ability of the wetlands to perform key functions such as nutrient transformation, sediment retention, surface water detention, and to serve as wildlife habitat.

This loss of wetland function is captured in the results of the study area wetland health assessment. The Collective Comparative Total Health Score for wetlands assessed in the Grand Canal area is 35, which when using the stress categories identified for wetlands evaluated using

Mid-TRAM in Pennsylvania, New Jersey, and Delaware (Jennette et. al., 2014, Pedeletti et. al., 2012), indicates that the wetlands of the Grand Canal area are severely stressed (severely stressed = a Comparative Total Health Score < 61). When assessed individually to evaluate Total Scores among the three complexes of the Grand Canal study area, each complex also falls within the severely stressed category: northwest marsh (Total Health Score = 28); east marsh (Total Health Score = 24); and, southwest marsh (Total Health Score = 48); of these, the southwest marsh is the least stressed and this is evidenced by the diversity of tidal marsh communities and somewhat higher ratio of native vegetation to invasive species (51:49) observed in the marsh system (Graph 5).

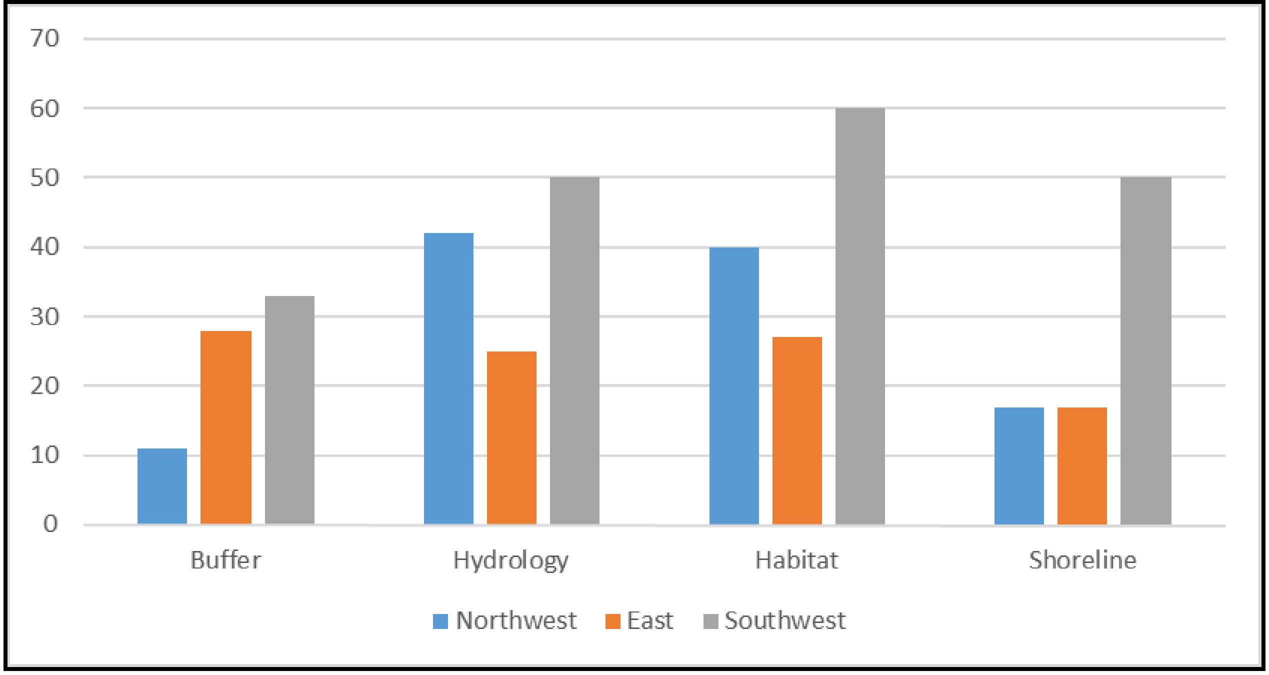
**Graph 5. Total Wetland Health Condition Scores for Grand Canal Marsh Complexes[1].**




[1] Health condition categories = minimally stressed (scores $\geq$ 83), moderately stressed (scores from 83 to 61), or severely stressed (scores < 61)

The total wetland health scores are based on the variables assessed within four attribute groups: buffer, hydrology, habitat and shoreline condition. A review of these attribute scores, as shown in Graph 6, helps to identify which attributes are contributing the least (or most) to the overall wetland condition and overall health scores.

**Graph 6. Attribute Scores for Each Marsh Complex of the Grand Canal Study Area.**




The average score for the **buffer** attribute group was 24, with attribute scores ranging from 11 to 33 (Graph 6). The northwest marsh system scored lowest (11), followed by the east marsh (28), then the southwest marsh (33). Each of the marsh systems evaluated are completely surrounded by urban development and impervious surfaces; most of which are immediately abutting the perimeter of the marsh system. Notable factors and stressors which are contributing to the low buffer attribute scores include (Table 5):

1) Lack of suitable vegetated buffer > 5 m (16 ft.) wide around the marsh perimeter which can lead to influx of pollutants and sediments.
2) Residential development and roadways covering at least 50% of the 250 m (820 ft.) area surrounding the marsh, which contributes to direct disturbance, nutrient/pollutant loading, and dumping of debris along wetland edges.
3) Nearly complete barriers to landward migration along the wetland/upland boundaries, which does not allow the tidal wetlands to respond to rising sea levels by migrating inland.

**Table 5. Summary of Most Notable Stressors Affecting Marsh Health in the Grand Canal.**

| Evaluation Metric/Dominant Stressor | Northwest Marsh | East Marsh | Southwest Marsh |
|---|---|---|---|
| **Buffer** | | | |
| < 60% of marsh perimeter has a buffer ≥ 5 m wide | x | x | |
| > 50% of surrounding landscape is developed | x | x | x |
| > 75% of marsh perimeter is obstructed (unable to expand) | x | x | x |
| **Hydrology** | | | |
| > 50% of marsh is ditched/drained | | x | x |
| Alterations that have resulted in > 25% of normal tidal range being altered | x | x | |
| | | | |
| At least one source of pollutant/nutrient loading via storm drains identified | x | x | x |
| **Habitat** | | | |
| The density of vegetation is significant enough to impede wildlife | x | x | |
| > 45 % of plant strata are dominated or co-dominated by the invasive species common reed | x | x | x |
| > 50% of the marsh complex is dominated by common reed | x | x | |
| **Shoreline** | | | |
| > 25% of shoreline has been altered | x | x | |
| Shoreline is unstable/eroding[1] | x | | x |

[1]Not unstable in east marsh due to presence of a man-made berm that is now the shoreline

The average score for the **hydrology** attribute group was 39, with attribute scores ranging from 25 to 50 (Graph 6). The east marsh system scored lowest (25), followed by the northwest marsh (42), then the southwest marsh (50). Each of the marsh systems have been affected by human-induced alterations of the natural channels and marsh surfaces which have changed the flow and hydroperiod (duration that a marsh is inundated). Notable factors and stressors which are contributing to the overall poor condition of the hydrology attribute of marshes in the study area include (Table 5):

1) Ditching within a significant amount of the wetland complex, which can carry tidal water into the complex but also allows it to drain rapidly thus lowering the hydroperiod.
2) Alterations, such as a 900 ft. earthen berm which forms a partial barrier between the northwest marsh and its primary source of tidal flow (i.e., Grand Canal), and a 3,800 ft. berm which forms a nearly complete barrier between the northwest marsh, and its sole source of tidal flow.
3) Four undersized culverts within the earthen berm are the only direct sources of tidal flow from the Grand Canal into the east marsh. One low lying breach area on the south end of the berm allows periodic tidal input.
4) Stormwater drains on adjacent roadways that deposit sediment, contaminants, and surges of freshwater directly into the marsh complex.

5) Other observations - gray water deposition into the canal from residences, high turbidity in canal water, stormwater runoff via storm drains into marshes, oil sheen on marsh and open water surfaces, stagnant areas of the canal and marshes, and erosion.

The average scores for the **habitat** attribute group were slightly better than all of the other attribute groups assessed; scoring 42, with scores ranging from 27 to 60 (Graph 6). The east marsh system scored lowest (27), followed by the northwest marsh (40), then the southwest marsh (60). Although the scores are marginally better than the other attribute scores, the habitat attribute for wetlands of the Grand Canal area are still considered to be severely stressed; and this is primarily due to the prevalence of the invasive species common reed. Each of the most notable factors and stressors which are contributing to the overall condition of the habitat attribute of marshes in the study area (Table 5) are directly the result of the presence of common reed. Notable factors and stressors which are contributing to the overall poor condition of the habitat attribute of marshes in the study area include:

1) The east marsh complex is nearly entirely dominated by a robust tall growth form of common reed which completely surrounds a few remaining remnant pockets of high marsh/pool/panne habitat.
2) Common reed occupies over 50% of the northwest marsh, and occurs there in both a robust tall form around the marsh perimeter, as well and a weak-stemmed short growth form that is a common species even within other high marsh community types in the complex.
3) The southwest marsh still has relatively large areas of low and high marsh habitat remaining that do not have high densities of common reed, although the reed is found in both the tall form along the marsh margins and in the stunted form along tidal channels and the transitions from high marsh to the tall form.
4) The tall form of common reed occurs in monocultures; at the expense of native vegetation species.
5) The high density growth of vegetation (primarily common reed) inhibits wildlife maneuverability.

The average score for the **shoreline** attribute group was 28, with attribute scores ranging from 17 to 50 (Graph 6). The northwest and east marsh systems were tied for the lowest score (17), whereas the southwest marsh scored 50. Only two parameters are evaluated for the shoreline attribute: alteration and erosion. Notable factors and stressors which are contributing to the overall poor condition of the shoreline attribute of marshes in the study area include (Table 5):

1) A significant portion of the northwest marsh shoreline has been altered by the 900 ft. earthen berm. The berm itself is experiencing some erosion, but overall is stable.
2) Remaining portion of the northwest marsh complex that is not altered, is experiencing erosion (some of which can be attributed to boat use and wave action in the Grand Canal and adjacent channels).
3) The east marsh has much higher alteration due to the 3,800 ft. berm along its entire length, but the berm itself is protecting the wetland itself from erosion, resulting in a lower erosion score. The berm itself is experiencing some erosion, and several areas appear to be somewhat unstable.

4) Southwest complex shoreline is unaltered, but wave action is resulting in some instability and erosion.
5) Elsewhere along the Grand Canal, the shoreline is lined with retaining walls or other hardened structures; many are in poor condition and in need of significant repair.

## 4.0 SUMMARY AND RECCOMENDATIONS

Based on field data and the wetland health assessment, the marshes in the study area are all severely-stressed, particularly when compared to large salt marsh complexes in less disturbed landscape settings. Each assessed marsh in the Grand Canal Pickman-Remmer system is surrounded by intensive development which has reduced protective buffers, halted the ability of the marsh to shift landward with increasing sea levels, and has subjected the marshes to inputs of contaminants, sediments, freshwater, yard waste and other debris. All marshes are artificially ditched, two of the three marshes (northwest and east) have significant restrictions in tidal flow from the Grand Canal (which itself is somewhat restricted), and all are experiencing some shoreline erosion from wave action. In addition, invasive common reed occurs throughout all marsh complexes and is dominant in two of the three systems (east and northwest). Wetlands of the east marsh, which is nearly completely impounded, are comprised of xx% of the tall robust form of common reed. Further, a review of historic aerial images (Suffolk County 2015) and hydric soil mapping (USDA 2014) show significant loss of wetlands in the Grand Canal study area, as well as throughout Long Island, and those wetlands that remain have been experiencing changes in the vegetation types within the complexes over time.

Results from water quality monitoring conducted in the Grand Canal study area in 2004 further support these findings (Levy 2005). Those results indicate the canal and connected tidal areas are significantly impacted by sediment and nutrient enrichment, as evidenced by low dissolved oxygen levels, high levels of nitrogen and phosphorus, elevated coliform bacteria levels, high levels of volatile organic compounds (VOCs) and semi-volatile organics (SVOCs), highly turbid water, and brown algae blooms. Poor tidal flushing, petroleum products used in boats, and stormwater runoff input from adjacent developed areas and storm drains were identified as significant contributing factors. During this study, brown algal blooms, gray water deposition into the canal from residences, high turbidity in canal water, stormwater runoff via storm drains into marshes, oil sheen on marsh and open water surfaces, stagnant areas of the canal and marshes, and erosion, were all observed.

To address the declining condition of the Pickman-Rimmer marshes, the following general recommendations are offered:

1. Increase tidal flow into the marsh systems where and when possible.
2. Increase hydroperiod on marshes (plug ditches to allow water to be retained longer).
3. Identify and address locations of stormwater inputs into the marsh system - assess for opportunities to reduce sediment loading, contaminates, and freshwater input into marshes.
4. Identify and address sources of trach, debris, cutting, fertilizer use along marsh perimeter.
5. Identify opportunities to reduce wave action from boats, jet skis, etc., which are contributing to shoreline erosion and degradation of bulkheads and berms.

6. Perform targeted surveys for state or federally-listed species and those of special concern. Presence of these can also improve grant/funding opportunities for restoration.
7. Continue monitoring. Increase level of effort and/or add sampling efforts for parameters deemed most important in restorations efforts.

Several recommendations have been made and are currently under consideration by the County to address the declining state of wetlands in the study area; an equally important component involves the potential of each to also address flooding issues. Three of the more prominent recommendations include: 1) dredging the canal to increase tidal flow in the cannel; 2) removal of portions of the man-made berm along the west perimeter of the east marsh complex to allow for increased tidal flow throughout the marsh; and, 3) plugging many of the man-made ditches on the marsh surfaces to improve normal marsh surface flow and hydroperiod. This assessment supports the premise that while the Grand Canal area is still supporting a notable suite of flora and fauna, the marshes are in a highly stressed condition, and the stressors contributing to this condition must be addressed else most of the remaining functions and values provided by the Pickman-Remmer marsh complexes will undoubtedly continue to decline. Each of the recommended strategies to address the stressors and overall flooding issues has merit; however, the options and potential consequences of each must be carefully considered.

Additional work is needed to fully evaluate options and assess the cost-benefits of the various management recommendations. However, based on the information currently available, the highest gains in terms of measures that would likely improve the health of the marsh system and potentially also provide flood control, for the least cost/effort, would involve removing portions of the berms along the northwest and east marsh complexes and allowing the water to enter the natural marsh system where it can be contained and slowly absorbed. These efforts, when combined with efforts to manage water at the sources of the problems, through practices that will slow, spread, and filter water and allow it to slowly reabsorb, would likely address most of the flooding issues and benefit the overall health of the marsh without the need for high-risk and costly dredging efforts. At a minimum, since some berm removal would likely be necessary even if the dredging option were pursued, berm removal should be attempted first; followed by dredging if necessary.

Dredging is primarily a tool for improving navigation, but is also often considered a tool to address flooding issues. While dredging may improve tidal flow in the Grand Canal and may have some effect on addressing flooding, its use as a means of dealing with flooding in the vicinity of the Grand Canal may have unintended consequences. For example:

- The holding capacity of the canal (even after dredging) is extremely small relative to the surrounding area of stormwater input during a major flood event.
- Many of the developed areas which are experiencing repeated flooding will still fall within the lowest elevations (former flood plains) in the area. Water will continue to flow to these low points.
- Bridges, culverts and the already highly deteriorating bulkheads and retaining walls along the canal may be exposed and/or undermined.
- Expense – costly studies, engineering planning and design, construction, disposal – once dredged these often are required over the long-term due to maintenance requirements.

- Potential release of toxins in the dredge sediment.
- Disposal needs – locations may be limited and costs are high (particularly if sediments are contaminated).
- Consequence of a potential increase in boat size, use, and traffic on the environment and adjacent residences (noise, activity levels, contaminants).
- Impacts of faster flow on existing marsh shorelines and developed upland areas along canal.
- Deepening channel may contain some additional flow (beneficial during flood events), but over the long term will likely result in less water entering adjacent wetlands.
- Removal of some portions of the berms that are currently restricting tidal flow from the canal into the east and northwest marsh complexes would still be necessary if marsh health is to be improved and to get the full benefit of flood control.

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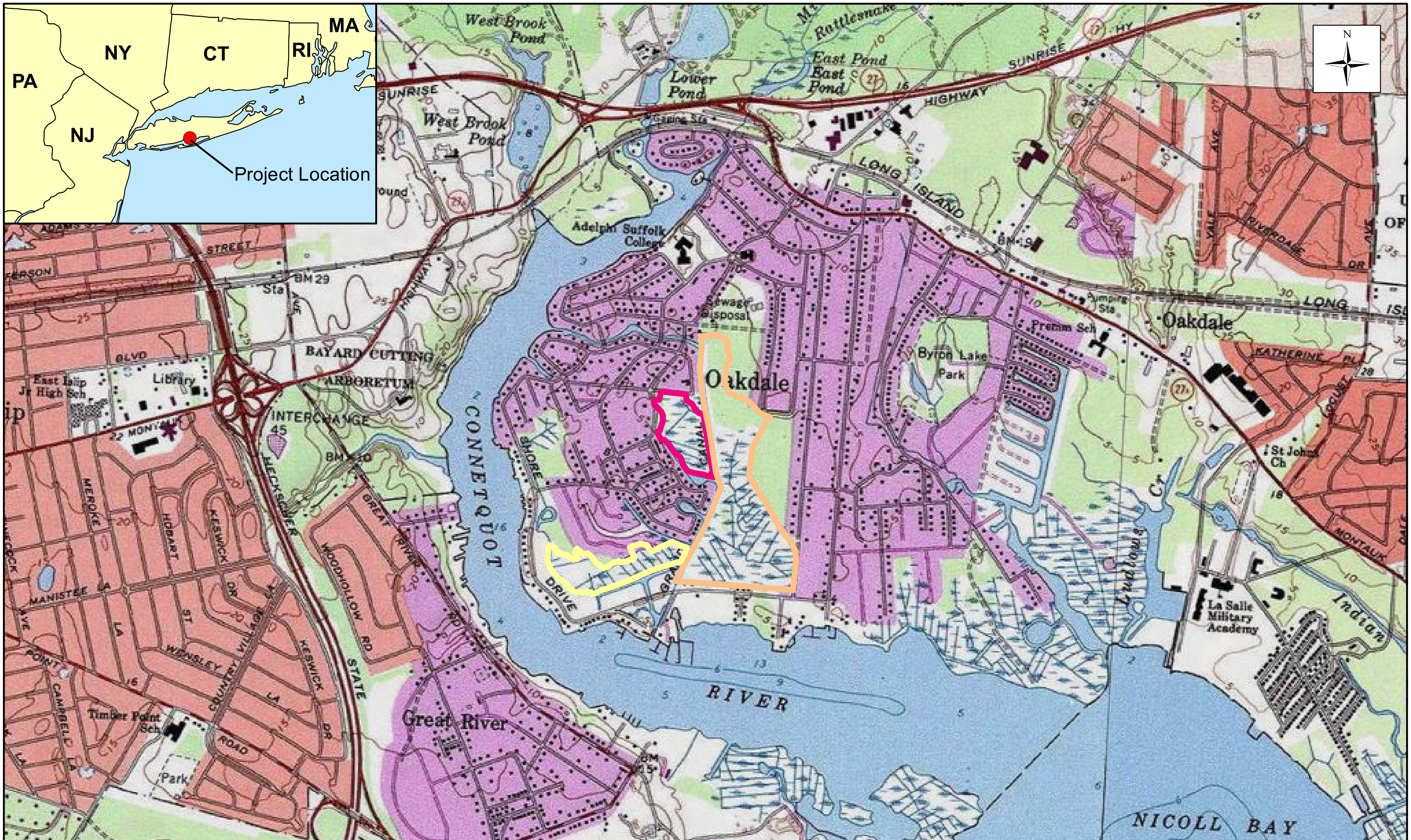


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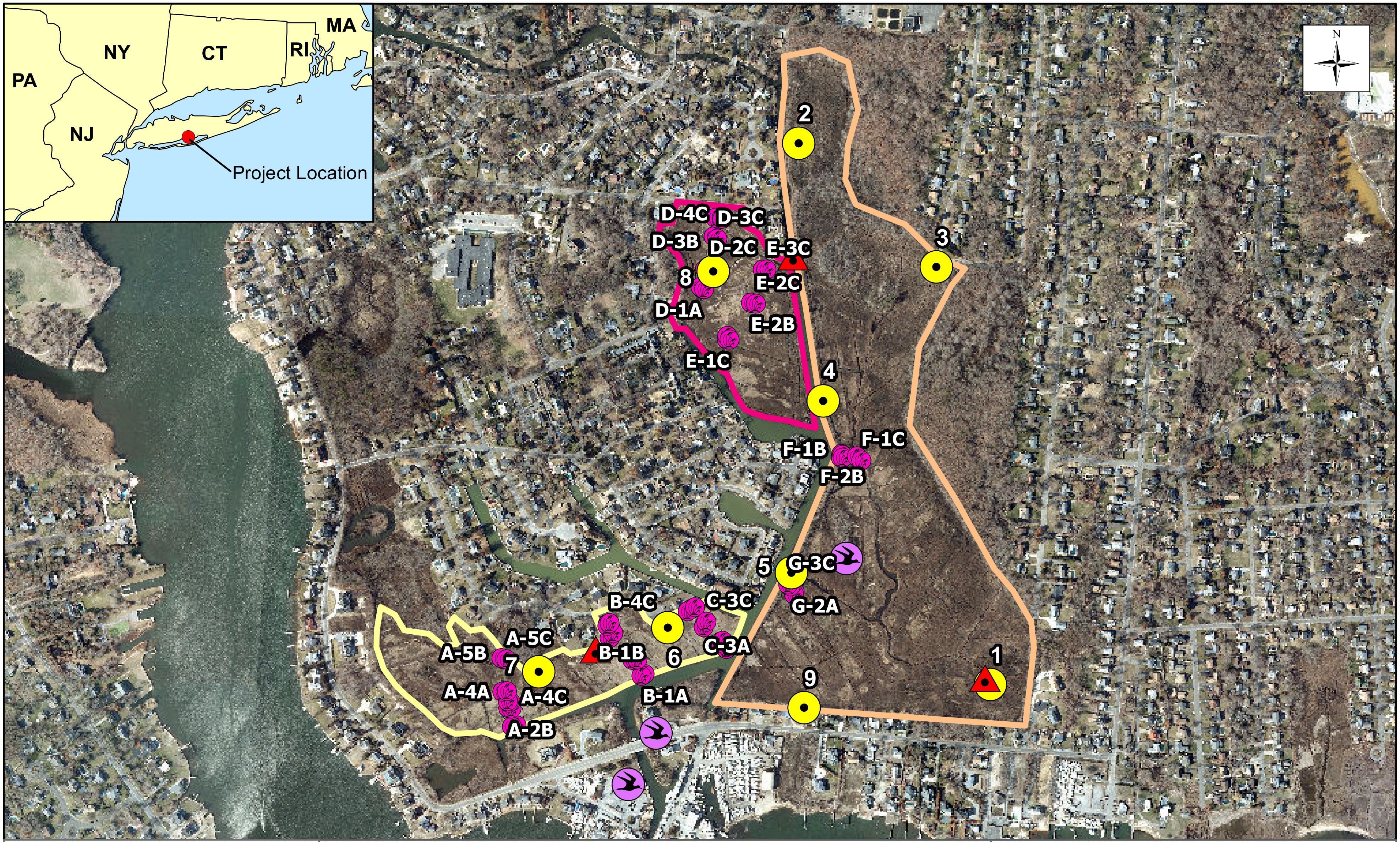
| Prepared For: | **Legend** | Figure 1. Site Location<br>Grand Canal Project Area<br>Oakdale, New York. |
| Prepared By:<br>NewEarth<br>ECOLOGICAL CONSULTING, LLC | East Marsh<br>Southwest Marsh<br>Northwest Marsh<br>0 0.5 1 Miles | Source: Copyright:© 2013 National Geographic Society, i-cubed<br>Date: 1/29/2016 |

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**Legend**

East Marsh
Northwest Marsh
Southwest Marsh
Bird Sample Location
Broadcast Call Station
Osprey Nest Sites
Vegetation Plots

0 500 1,000 2,000 Feet

Figure 2. Assessment Areas and Survey Locations
Grand Canal Project Area
Oakdale, New York.

Source: United States Department of Agriculture, 2013.
NewEarth Ecological Survey, October 2015.

Date: 1/29/2016


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## Legend

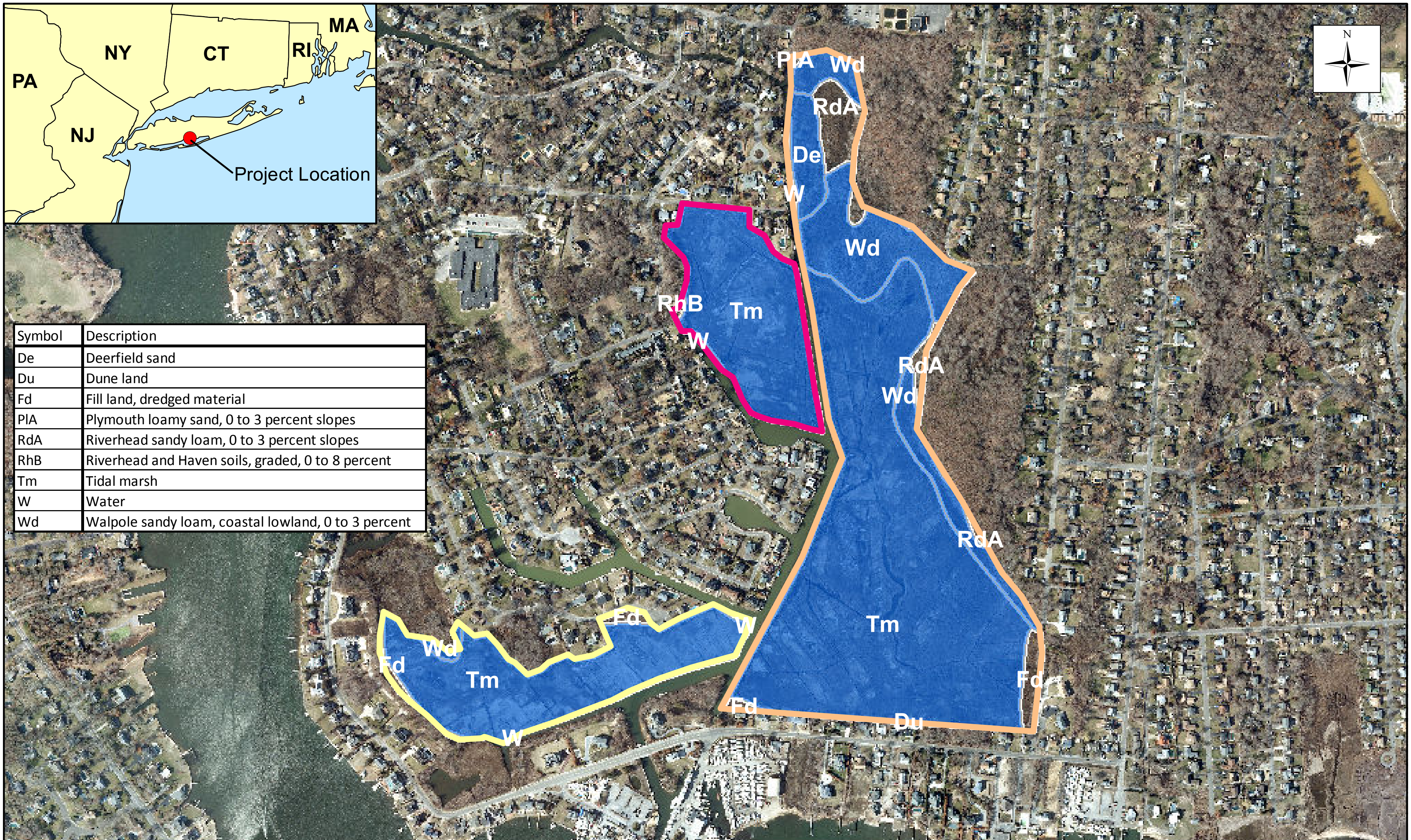
| | | |
|---|---|---|
| Forest_Scrub-Shrub | High Marsh_Marsh Elder | Tidal Channels |
| Common Reed_Tall | High Marsh_Pool_Panne | Pond |
| Common Reed_Stunted | Intertidal Marsh | |

0 500 1,000 2,000 3,000 Feet

Figure 3. Major Community Types
Grand Canal Project Area
Oakdale, New York.

Source: United States Department of Agriculture, 2013.
NewEarth Ecological Survey, October 2015.

Date: 1/29/2016




| Symbol | Description |
|---|---|
| De | Deerfield sand |
| Du | Dune land |
| Fd | Fill land, dredged material |
| PlA | Plymouth loamy sand, 0 to 3 percent slopes |
| RdA | Riverhead sandy loam, 0 to 3 percent slopes |
| RhB | Riverhead and Haven soils, graded, 0 to 8 percent |
| Tm | Tidal marsh |
| W | Water |
| Wd | Walpole sandy loam, coastal lowland, 0 to 3 percent |

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Prepared By:

NewEarth ECOLOGICAL CONSULTING, LLC

## Legend

East Marsh

Southwest Marsh

Northwest Marsh

Hydric

0 500 1,000 2,000 3,000 Feet

Figure 4. Soil Types
Grand Canal Project Area
Oakdale, New York.

Source: United States Department of Agriculture, 2013.
NewEarth Ecological Survey, October 2015.

Date: 1/29/2016