Section 2. Review of Existing Data (Task 2)

2.0 Grand Canal Environmental Assessment Report- 2005

Microbial, chemical, and vector data were collected in 2004 for the Grand Canal system as part of the Grand Canal Environmental Assessment (2005); results were published by SCDHS and SCDPW in the 2005 'Grand Canal Environmental Assessment Report'.

Water quality monitoring was performed at 12 sites within the Grand Canal on four occasions from July to September 2004. Parameters analyzed included nutrients, salinity, coliform bacteria, and various organic constituents (e.g., solvents, pesticides, etc.). Physical measurements (depth, temperature, dissolved oxygen, salinity, secchi) were also recorded at each site. Main findings from the water monitoring were:

- Coliform levels found in the Grand Canal were found to be consistently elevated, with total coliform averages ranging from 290 to 5,713 organisms/100 mL and fecal coliform averages ranging from 130 to 967 organisms/100 mL. Report authors concluded that these levels would make the waters of Grand Canal unsuitable for bathing or shellfishing.
- Average dissolved inorganic nitrogen (DIN) levels found in Grand Canal ranged from 0.09 to 0.67 mg/L. This is considerably higher than long-term DIN levels typically found in the Great South Bay (less than 0.05 mg/l).
- Results were negative for all pesticide analytes, including the larvicide that is used in adjacent wetlands by Suffolk County Vector control.
- The gasoline additive MTBE was detected.

The report summarized that the water quality in the canal is significantly impacted by nutrient enrichment, and potentially, by pathogen contamination. High nitrogen levels and low dissolved oxygen levels were common occurrences. The study also found that although mosquitoes did not breed directly within the Grand Canal, the adjacent wetlands were primary breeding areas. West

Nile Virus affected birds and mosquito breeding pools were identified in the region. However, none of these areas/vectors were identified within the canal system or associated wetlands.

The 2005 report concluded that dredging the Grand Canal in conjunction with a comprehensive Open Marsh Water Management (OMWM) strategy would improve the ecology of the canal system, particularly by improving water quality and reducing the use of pesticides. The report does note, however, that any dredging project must be conducted in a manner which avoids adverse impacts to existing fish and wildlife habitat.

2.1 Historical Aerial Photographs

CA reviewed the history of the Grand Canal using historical aerial photographs. CA reviewed historical aerial photographs for the years 1947 through 2013 (intermittent) which were obtained from the Suffolk County GIS Viewer website. Aerial photographs are included as Appendix B.

In 1947, the Grand Canal appears similarly as it exists today with a few exceptions. The most notable differences are the amount of residential development, the re-configuration of the southern portion of the canal system, and the addition of a finger canal. Similar to all communities located along the south shore of Long Island, residential development in proximity to Grand Canal has increased over the last half century. Prior to 1947, the majority of the residential development was located along the Connetquot River and along the historically existing finger canals. Other areas in the study area were primarily undeveloped.

From 1962 and 1978, the largest amount of new development (mainly residential) in the area was observed; the conversion of undeveloped land and wetlands into developed areas continued through 2010. From 2010 to 2013 no new development appeared in the aerials.

The southern portion of the Grand Canal system has changed significantly over the last half century, especially when the Shore Drive bridge was constructed over the canal. Originally the southern portion of the Grand Canal system ran along what is now Shore Drive. However, sometime between 1947 to 1962, and again sometime between 1962 and 1978, changes were made near the southern entrance of Grand Canal. These cumulative changes altered the straight-line path of the canal where it enters the mouth of the Connetquot River and created a narrow southern entrance with two 90 degree turns. In addition, the original location of the Grand Canal which ran along what is now Shore Drive was physically moved landward approximately 50 to 100 feet. Also, sometime between 1962 and 1978, a new finger canal was excavated between the currently existing roads of Riverview Court and Roxbury Court. These changes resulted in substantial physical restrictions to tidal exchange at the southern entrance from the Connetquot River.

2.2 New York Rising Oakdale/West Sayville Report

In response to the catastrophic damage inflicted by Superstorm Sandy (2012), Hurricane Irene (2011), and Tropical Storm Lee (2011), the State of New York developed a community-driven planning program for reconstruction that focuses on resiliency and sustainability. The New York Rising Community Reconstruction (NYRCR) Program combines local community participation with technical experts to identify the most pressing needs and the most innovative and appropriate solutions. The Oakdale/West Sayville NYRCR, which was finalized in March 2014, is one of 45 plans statewide and one of eight in Suffolk County. The plan identified 12 projects that align with the objectives of the NYRCR program and the local community. The projects included: Living Marsh-Grand Canal Levee Improvement, Check-Valves on Drainage Outfalls, and Public Access to Waterfront/Coastal Restoration, among other projects. These three projects are highlighted here due to how they may relate to this overall study on the Grand Canal and a brief description of each is described below:

The Living Marsh-Grand Canal Levee Improvement project aims to improve the tidal exchange between Grand Canal and the Pickman-Remmer Wetland. The earthen berm created when the Grand Canal was excavated over 100 years ago has closed off the wetland from its natural tidal exchange. The purpose of the Living Marsh-Grand Canal Levee Improvement project is to increase the wetland's capacity to absorb storm surges and stormwater runoff, as well as improve the health of wetland. The project is estimated to cost $410,000 which includes an engineering study to identify the most appropriate method for increased tidal flow. The project also specifically calls for the installation of seven 24-inch pipes through the levee (earthen berm), and a hiking trail on top of the berm. The hiking trail is intended to terminate before the properties located to the south of the berm. However, in a separate project (Multimodal Transportation/Tourism Development), some of the private properties will potentially be included in the NY Rising Buyout Program and the trail could be continued through to Shore Drive.

The Backflow Prevention/Check Valves for Storm Drainage Systems project aims to help control flooding and provide storm surge protection. Vulnerable outfalls would be replaced with new catch basins and in-line check valves that would only allow storm water to flow seaward. The project is estimated to cost $300,000 which includes 12 installations. It is possible that some of the outfall pipes located in the study area could benefit from these types of structure. These areas are very limited in extent, and there effect on tidal flow is not considered substantial, especially considering that the entrance of the canal for Connetquot River is very restricted.

The main entrance to the canal from the Connetquot River is restricted by the narrow opening between the bulkheads of two private properties, Oakdale Yacht Club at the east side and Snapper inn Restaurant on the west side. The width of the opening between the bulkheads is approximately 24 feet, representing one of the narrowest segments of the entire canal. Based on the bathymetric survey, the cross-sectional area of the opening is estimated at 123 square feet. The cross-sectional area of the canal upstream of the Shore Drive Bridge and at approximately 1,800 feet beyond that are 148 and 172 square feet, respectively. Cross-sectional area directly affect the amount of water that can be exchanged on a tidal cycle. The geometry of the entrance represents a restriction to tidal exchange for the canal.

The Public Access to the Waterfront and Coastal Restoration project aims to restore waterfront properties to their natural state that are acquired through the NY Rising Buyout Program. This would include the removal of structures and the restoration of natural shoreline grades with appropriate soils and vegetation. In addition, one or more of the restored properties may be open to the public for recreational purposes. The purpose of this project is to increase storm surge protection, increase resilience and environmental benefits of coastal natural habitats and increase public access to recreational opportunities. The project is estimated to cost $620,000.

2.3 Data on Other Canal and Wetland Systems

2.3.0 Wertheim National Wildlife Refuge

Wertheim National Wildlife Refuge is located on an urbanized watershed in the Town of Brookhaven on the south shore of Long Island approximately 14 miles east of the Grand Canal. The refuge and adjacent wetlands make up the largest continuous salt marsh on Long Island, New York. Similar to the Grand Canal, the Wertheim marshes have been subject to numerous anthropogenic stressors, including urbanization, ditching and tidal restrictions. The marshes also produced several mosquito vector species (Rochlin et al. 2012).

A large scale, long-term integrated marsh management project (2003 to 2010) was undertaken at the Wertheim Refuge. Two treatment marshes within the refuge were subject to several management methods, including reconfiguration of the tidal flow network by creating new tidal channels and redesigning fish habitats to closely resemble natural marsh pools. The new channel network enabled tidal waters to reach high marsh mosquito larval habitats and areas with dense invasive species coverage (*Phragmites australis).* Salinity, water table depth, vegetation, nekton, birds, and mosquitos were monitored for one to three years prior to modification and three to five years post-modification (monitoring occurred from 2003 to 2010). Parameters were also monitored in two adjacent control marshes (Rochlin et al., 2012).

The treatment marshes experienced decreased mosquito production, reduced coverage of *Phragmites australis*, an expansion of native marsh vegetation, increased nekton species abundance, and increased avian and waterbird diversity and abundance. In the treatment marshes, the frequency of finding mosquito larvae decreased 70% after marsh management; the control areas did not see the same decrease. The magnitude of mosquito larvae production decreased in the treatment marshes, but not in the controls. Considerable changes in marsh vegetation were observed in the treatment marshes, particularly a decrease in *Phragmites australis* and an increase in native vegetation. The modifications in the treatment marshes led to significant changes in nekton populations and increases in bird diversity and abundance (Rochlin et al., 2012).

The Wertheim project demonstrated the potential benefits that can be achieved by integrated marsh management approaches (Rochlin et al., 2012). Some of the techniques applied to the treatments marshes in the Wertheim Refuge (e.g., increasing tidal flow into the marsh) may prove successful in other similar marshes, such as the wetlands adjacent to the Grand Canal.

2.3.1 Green's Creek and Brown's River

A Watershed Management Plan (WMP) was developed for Green's Creek and Brown's River in response to evidence that the waterways may have been impaired (Cashin Associates, 2007). The Plan's objective was to protect, restore, and enhance water quality and living resources in the canals. Green's Creek and Brown's River are adjacent canals located in the Town of Islip, on the south shore of Long Island approximately five miles east of the Grand Canal. Impairments identified as impacting the water quality in Green's Creek and Brown's River included nutrient enrichment, toxic substances (e.g., oils, pesticides), pathogens (e.g., *E. Coli),* and oxygen demanding wastes (e.g., sewage). The 2007 Plan recommended a series of measures to improve Green's Creek and Brown's River, including: habitat protection and management, such as tidal flow improvement; invasive species removal; hydrologic improvements; and improvements to fish passages. The Plan also recommended point and nonpoint source pollution management including pesticide use reduction and installation of drainage infrastructure to capture and recharge storm water (Cashin Associates, 2007).

The Grand Canal has experienced some similar impairments and stressors to those of Green's Creek and Brown's River (these issues are discussed in detail throughout this Project Report). Similar impairments include tidal flow restrictions and invasive species proliferation. As a result, some of the recommended action measures for Green's Creek and Brown's River may also be effective at improving the ecological and public health of the Grand Canal. Particularly, the WMP suggests that actions to improve tidal flow in restricted areas of Green's Creek and Brown's River can assist with restoring native vegetative and wildlife habitat.

2.4 Reference Area

CA identified a reference area similar to the Grand Canal study area but where the water quality is considered good, wetlands are considered healthy, and water flow is considered optimal for maintenance of water/wetlands quality. The reference area selected by CA was Indian Creek which is located on the border of West Sayville and Oakdale approximately two miles east of the Grand Canal (Map 2).

CA environmental personnel collected data at the Indian Creek reference area on June 16, and September 3, 2015. This creek was chosen as the reference wetland due to its relatively healthy appearance (e.g., clean and not dominated by *Phramites australis*) and its proximity and similarities to the Grand Canal. Similarities between the canal systems include their tidal ranges, their use for vessel docking, and their integral connections to wetlands. On June 16, 2015 physical water quality parameters were measured in ten locations throughout the reference canal and wetland system that were accessible by kayak. The site locations included two within the main canal (Ref 8 and 9), four along a secondary, dead-end, canal (Ref 1, 2, 5, and 6), two within wetlands via mosquito ditches (Ref 3 and 4), one at the northern most kayak-accessible area (Ref 7), and one taken from the Great South Bay immediately outside the main channel/boat basin. The observations were made during mid-incoming tide and over an inch of rain had fallen on the previous day. Table 1 shows the water quality parameter data for the reference area collected on June 16.

north

NOT TO SCALE

MAP 2

Indian Creek Reference Area

Cashin Associates, P.C.
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Table 1. June Reference Area Physical Water Quality

Site ID	Temperature (°C)	Salinity (PSU)	D.O. (mg/L)	Turbidity (FNU)	Depth (feet)	Latitude (°N)	Longitude (°W)
Ref 1	22.37	19.37	2.15	8.30	2	40.72040	73.10015
Ref 2	22.59	21.29	4.56	6.91	2	40.72083	73.10109
Ref 3	23.02	24.19	6.46	9.41	2	40.72069	73.10302
Ref 4	22.88	22.29	6.38	8.03	3	40.72023	73.10342
Ref 5	23.28	24.58	7.16	19.73	3	40.72159	73.10372
Ref 6	23.25	20.21	6.50	6.13	3.5	40.72246	73.10468
Ref 7	19.56	11.53	3.85	5.00	3	40.72851	73.10987
Ref 8	23.30	22.43	6.37	7.05	3.5	40.72208	73.10768
Ref 9	23.46	25.45	7.44	8.52	6	40.72126	73.11078
Ref 10	23.39	24.25	8.14	7.90	8	40.72038	73.11139

On September 3, 2015, physical water quality parameters were measured at two locations within the Indian Creek reference area. Water samples were also collected from Indian Creek on this day for bacterial analysis. This day was selected for reference area bacterial sampling because it was the same day that dry-weather bacterial samples were taken in the Grand Canal. This allowed for fair comparisons to be made between the data from the Grand Canal and the reference area. In the reference area, one water sample was taken at the intersection of the main channel and a secondary channel in a low flow/stagnant area. A second sample was taken from within the main channel at a discharging conduit that connects to the adjacent wetlands. The first sample location, WL-Ref-1 was chosen to simulate the conditions of a trapped/stagnant area of water. The second location was chosen to simulate the conditions of tidal water exchanges within adjacent wetlands. These samples and observations were collected during the beginning of an incoming tide and no rain had been reported for several previous consecutive days. Table 2 shows the physical and bacterial water quality data collected from the reference area on September 3.

Table 2. September Reference Area Physical and Bacterial Water Quality

Site ID*	Temp. (°C)	Salinity (PSU)	D.O. (mg/L)	Turbidity (FNU)	Depth (feet)	Enter-ococci	Total Coliforms	Fecal Coliforms
						(MPN/100mL) 10X Dilution		
Ref-1	24.14	22.56	1.70	8.4	2	776	2400	2400
Ref-2	25.02	22.62	1.62	7.9	3	292	300	300

*GPS coordinates: Ref 1 – 40.72347, 73.10586; Ref 2 – 40.72214, 73.10837

During the June water quality monitoring event, the dissolved oxygen (DO) data were the most notable observations. June DO levels ranged from 2.15 to 8.14 mg/L with an average of 5.9 mg/L. However, the September round of sampling in Indian Creek had much lower dissolved oxygen levels (average of 1.66 mg/L). The average DO was 5.2 mg/L when data from both sampling events were averaged for Indian Creek.

DO levels from Indian Creek were compared to those from the Grand Canal. The highest average daily DO concentration for the Grand Canal sampling events was 3.3 mg/L (details of these sampling events in the Grand Canal are provided in section 3). This comparison suggests that DO levels are generally lower in the Grand Canal than the reference area. Salinity levels appeared to be similar in Indian Creek and the Grand Canal. Daily salinity averages for the Grand Canal sampling events ranged from approximately 18 to 22 PSU; daily averages for Indian Creek (not including the northernmost head waters or the Great South Bay observations) was 18.5 PSU. However, considering the direct freshwater input that was observed at the northernmost sample site in Indian Creek, but the relatively similar daily average salinity levels with the Grand Canal, it is possible that Indian Creek has a much greater tidal exchange with the Great South Bay than the Grand Canal.

With regards to bacterial sampling, data indicated elevated coliform levels in both the reference canal and the Grand Canal. However, the bacterial levels in the Grand Canal exceeded those reported for the reference area. In the reference area, coliform levels were much higher from the sampling site representing a region with stagnant waters compared to the sampling site with flowing waters. This suggests that stagnant areas of the canal are more likely to have elevated bacteria levels. However, caution should be taken when comparing data from one canal to the other due to the multitude of factors (e.g., tidal state, weather, time of day, season, limited sampling at the reference site) which may influence water quality. Therefore, the information and observations garnered from the reference area can only provide anecdotal and preliminary conclusions.

The ‘Grand Canal Public Health Evaluation Report and Sediment Risk Assessment’ (Appendix C) compares the water quality results from the reference area to those from the Grand Canal in terms of public health impacts. When comparing data from the reference location to that from the Grand Canal, it was found that neither the Grand Canal nor the reference area surface waters were likely to be safe for primary contact recreation due to unsuitable bacteriological quality.