Long Island Duck Farm History
and
Ecosystem Restoration Opportunities
Suffolk County, Long Island, New York

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APPENDIX D

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Duck Farm Industry and Impacts Report

prepared by

Suffolk County Department of Planning
H. Lee Dennison Building - 4th Floor
100 Veterans Memorial Highway
P.O. Box 6100
Hauppauge, New York 11788

DeWitt S. Davies, Ph.D.
Chief Environmental Analyst

Duck Farm Industry Impacts on the Environment

Introduction

As documented in the historical overview section, the duck farm industry in Suffolk County was an extremely intensive land use along stream and bay shorelines. Inventory work by the Department of Planning indicates that approximately 2,000 acres of upland property and almost 20 miles of shoreline along freshwater creeks/rivers and estuary tributaries – primarily in the Towns of Brookhaven, Riverhead and Southampton – were utilized during the last century in Suffolk County for duck production.

The impacts of duck farming were dramatic, both on-site and off-site. Extensive landform alterations were made to construct animal pens, feed lots and swim ponds, which were often located in or directly adjacent to streams/coves of the bays. Waste effluent discharges from the farms created thick organic matter deposits, degraded water quality and altered phytoplankton and benthic population in near-by surface waters.

Duck Farms – An Intensive Land Use

The significance of the impacts is reflected by the magnitude of the industry and the waste load generated. Effluent waste loadings from the farms in the form of suspended solids, nutrients and coliform bacteria were huge, especially prior to the required use of treatment technology under water pollution control laws.

The pollution load from the 34 duck farms operating in Suffolk County during 1968, which raised about 7 million that year, was calculated. In total, the loads were as follows (Davids and Cosulich 1968): 70 tons total solids/day (43 tons suspended solids/day); 11 tons of Biochemical Oxygen Demand (BOD)/day; 4 tons phosphates/day; 2.5 tons nitrogen compounds /day; and 40 billion-trillion M.P.N of coliform organisms/day.

Let us look at the intensity in another way, as it pertains to the loading of one pollutant - nitrogen. According to Dr. William Dean, the former director of the Cornell University Duck Research Laboratory, an average human excretes about 7,300 grams (g) of nitrogen (N) per year, or 20 g N per day. One market duck excretes 93.6 g N over its seven week life cycle, or 1.91 g N per day. Including the N fraction attributed to one breeder duck for each market duck produced (0.029 g N per day) gives a total N loading rate of 1.94 g N per day for each market duck (W. Dean, personal communication). Dividing 20 g by 1.94 g gives a nitrogen equivalency of 10.3 market ducks per one person.

To illustrate this further with respect to land use, the Robinson Duck Farm in South Haven adjacent to the Carmans River will be used as an example. At its peak, this farm utilized 13.4 acres of pens (including swim pond area) to grow 200,000 ducks per year, and the average density of ducks at any one time was calculated to be 6,716 ducks per acre of pens (Eberhard n.d.). Using the relationship above, the daily nitrogen output from 6,716 ducks per acre during the growing season would be equivalent to the daily nitrogen output from 652 people. The corresponding human population density of 652 people per

acre is over six times the population density of Manhattan Island (105.3 people/acre) in 2002. In comparison, the overall population density in Suffolk County was 2.47 people per acre in 2002.

The impacts of duck farm effluent on receiving water quality necessitated the implementation of a waste abatement program over a 20-year period. The four phases of this program are outlined below (Cosulich 1966).

Phase 1: Remove ducks from open waters (diking duck runs from main stream). This started in 1951.

Phase 2: Remove settleable solids and floating solids from the waste stream (lagoon system) before discharge to surface waters.

Phase 3: Disinfect effluent.

Phase 4: Remove nutrients. Treatment facilities had to be constructed and in operation by April 1968.

Costs to implement this program were high, treatment technology issues were apparent, and as a result, compliance was not very good (Villa 1964). Over time, many duck farms went out of business. The legacy of the duck farm industry leaves us today with degraded shoreline sites, altered bay tributary and creek hydraulics, and bay bottoms that are soft and oxygen depleted.

On-site Impacts of Duck Farm Operation

Duck farms needed access to a source of fresh water. This is why they were located along freshwater streams and the upper reaches of tidal tributaries (where waters were only slightly brackish). Typical site modifications involved various types of disturbance, e.g., vegetation clearing, land surface elevation changes for construction of buildings, pens and yards; hydrological modifications for water flow/control in swim ponds and tidal lagoons, and for waste treatment. Some of the larger duck farms included areas devoted to the production of field crops.

The magnitude of habitat change associated with duck farm activity was indeed, large. On-site alterations associated with pond, berm and lagoon creation resulted in destruction/alteration of freshwater wetland habitats (riverine systems, ponds, lakes, swamps and bogs) and estuarine and tidal marsh habitats. Upland areas were cleared of trees/mature vegetation. Biodiversity and fish and wildlife values were compromised.

Duck farm operation and abandonment created conditions that were ideal for invasive species. Today, dense stands of *Phragmites* are found in former swim ponds and along the shores of tidal lagoons. Conditions that favored *Phragmites* invasion include soil disturbance and tree/upland buffer removal in duck yards and along swim ponds; hydrological changes/land surface elevation in wetlands due to the placement of fill for construction of berms and dikes; groundwater pumpage and impoundment; and high nutrient loading in fresh water/low salinity environments associated with duck waste

discharge. Figures 1 through 3 show examples of typical buildings, duck/brooder houses and processing facilities that remain on duck farms in various states of disrepair.

Figure 1: Dilapidated structure, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Figure 2: Dilapidated structure, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Figure 3: Dilapidated structure, former Robinson Duck Farm, Carmans River, South Haven, New York.

Outdoor Areas
Duck pens and yards consisted of large, open areas covered in sand that were adjacent to swim ponds and dredged lagoons, as shown in Figures 4 through 9. Low fences constructed of metal and wood were used to separate ducks by age group. Duck feed hoppers and other types of equipment remain in some of these areas.

Figure 4: Swim pond, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Figure 5: Swim pond, former Robinson Duck Farm, Carmans River, South Haven, New York.

Figure 6: Tidal lagoon, former Broad Cove Duck Farm, Terry Creek, River head, New York.

Figure 7: Tidal lagoon, Fanning Landing Road, Forge River, Brookhaven, New York.

Figure 8: Duck yard, former Hubbard Duck Farm, Sawmill Creek, Riverhead, New York.

Figure 9: Abandoned fencing, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Hydraulic Modifications
Major hydraulic modifications occurred on duck farm sites. Water conveyance and control structures, e.g., concrete sluiceways, piping; and berms constructed by cut-and-fill are shown in Figures 10 through 15. It is often difficult today to visualize the remnant pattern of water retention and flow at the old duck farm sites given site obstruction by growth of dense stands of invasive vegetation.

Figure 10: Dams, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

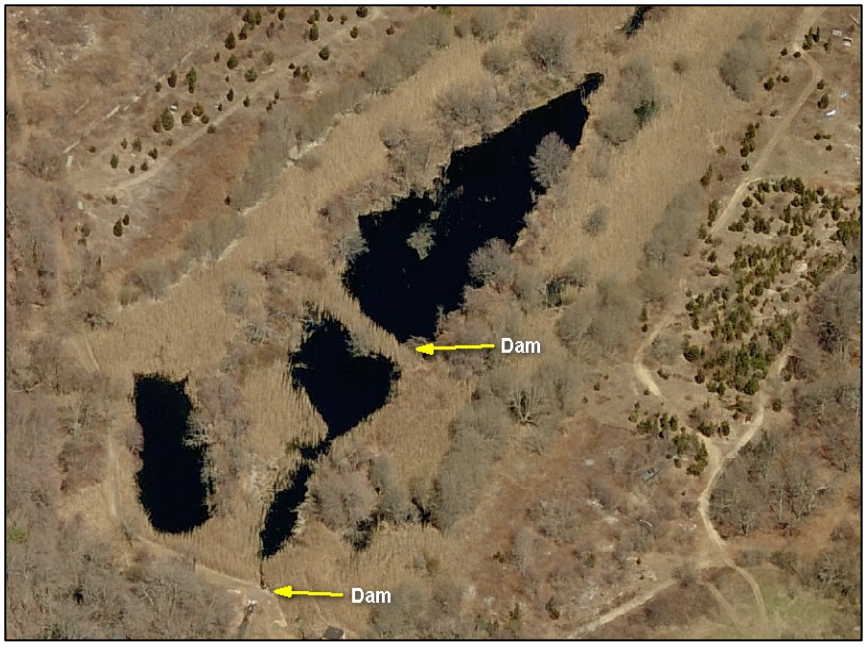

Figure 11: Old bulkhead, former Schubert Duck Farm, Sawmill Creek, Riverhead, New York.

Figure 12: Piping, former Hubbard Duck Farm, Sawmill Creek, Riverhead, New York.

Figure 13: Abandoned sluiceway, former Hubbard Duck Farm, Sawmill Creek, Riverhead, New York.

Figure 14: Water control structure at former duck farm, Eastport, New York.

Figure 15: Impoundment, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Duck Waste Treatment Facilities
Duck farmers had to collect effluent from swim ponds and divert it via pumps and piping to various types of settling pits and lagoons to meet the requirements of duck waste treatment. Remnants of waste treatment facilities (i.e., aerated lagoon-chlorination systems) are shown in Figures 16 through 21.

Figure 16: Settling ponds, former Robinson Duck Farm, Carmans River, South Haven, New York.

Figure 17: Settling pond berm, former Robinson Duck Farm, Carmans River, South Haven, New York.

Figure 18: Settling pond berm, former Robinson Duck Farm, Carmans River, South Haven, New York.

Figure 19: Settling pond, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Figure 20: Settling ponds, former Gallo Duck Farm, Mud Creek, East Patchogue, New York.

Figure 21: Waste treatment structure, former Robinson Duck Farm, Carmans River, South Haven, New York.

Off-site Impacts of Duck Farm Operation

The off-site impacts of duck farms were apparent in both the degraded quality of receiving surface waters, as well as by the alteration of stream and tributary bottom habitats as a result of the deposition of thick layers, or so-called blankets, of duck sludge. The off-site impacts also manifested themselves in the curtailment of commercial and recreational activities due to the contravention of water quality standards for shellfishing and swimming, and the use of shoreline sites (many located in parkland) for the upland disposal of duck sludge dredged from creek bottoms by Suffolk County (Travelers Research Corp. 1970).

This section begins with an overview of the impacts of duck farm waste effluents on water quality and phytoplankton blooms in the south shore bays, where most of the early historical research on these topics was conducted. Similar relationships would be expected to hold for other estuarine areas subject to duck waste pollutant loadings. The duck sludge problem is also described, and the historical response of government agencies to managing this problem is summarized. Many former duck farm sites have been privately developed for commercial and residential uses. The section concludes with a look at the unique remnants of former duck farms at these developed sites.

Surface Water Quality

On the order of 8 million ducks per year were grown in Suffolk County during the peak of the duck industry circa 1960. The magnitude of production was reflected in the

significant effluent waste loadings in the forms of suspended solids, nutrients, and coliform bacteria, much of which entered Flanders Bay, Moriches Bay, and Great South Bay via streams and tributaries. The effluent discharged from the duck farms dramatically impacted the water quality of the freshwater streams and bays, altering phytoplankton assemblages, benthic communities, and the biogeochemistry of the systems.

Figure 22: Duck weed (*Lemna* sp.), a floating vascular surface plant and an indicator of a nutrient enriched freshwater environment, in the headwaters of Mud Creek at the former Gallo Duck Farm in East Patchogue.

The south shore estuaries had high concentrations of nutrients, especially nitrogen compounds, due to the large number of duck farms in the watershed, cesspool seepage, and ephemeral closure of the Moriches Inlet. This excessive nutrient input to the system dramatically altered the water quality by consequently stimulating dense algal blooms.

Prior to the increase in duck effluent, the south shore estuaries were composed of a mixed algal assemblage, dominated by larger phytoplankton species, such as diatoms (~5 µm) (Ryther 1954). However, following the rise in duck farm production along the south shore, the phytoplankton composition began to shift to a unialgal community, dominated by smaller forms (1-4 µm) or chlorophytes (Ryther 1954; Nichols 1964; Lively et al. 1983; Carpenter et al. 1991). Consequently, blooms as concentrated as tens of billions of cells per liter turned the bay a pea green color during the summer months due to the green tides (Carpenter et al. 1991). The algal shifts were directly correlated with the increase in nitrogen-rich excretory products generated from the local duck farms. The most common excretory product, uric acid, is converted to urea via bacteria in seawater (Carpenter et al. 1991). Unlike larger phytoplankton, smaller forms are able to directly assimilate urea due to the presence of specific enzymes, giving them a competitive advantage over many

of the common diatom species (Carpenter et al. 1991). Additionally, the physical nature of the south shore estuaries including, low flushing rates and shallow water depths, led to a rise in water temperatures in back-bays and a retention of large concentrations of nutrients, further supplying algal growth (Ryther 1954).

The presence of these dense algal blooms in the south shore estuaries consequently altered a variety of conditions and instigated degradation of the bays. The increase and decomposition of organic matter, derived directly from the duck waste as well as the increase in algal biomass, contributed to anaerobic benthic conditions impacting flora, such as submerged aquatic vegetation; and fauna, such as benthic invertebrates and foraminfera. Dense algal blooms prevented light penetration to the benthos, causing plant decay and additional organic deposits (O'Connor 1972). These organic rich sediments, often several feet deep, became soupy, black, clayey silt that had a rich odor of hydrogen sulfide, so potent that homeowners adjacent to Moriches and Great South Bays complained that the paint on their homes was being discolored (Nichols 1964; O'Connor 1972). Ecological degradation that was associated with the accumulation of nutrients throughout the estuarine bays continued throughout the history of the duck industry, and was heightened when the Moriches Inlet was temporarily closed (Nichols 1964; Lively et al. 1983) in the early 1950s.

Duck Sludge Deposits

Prior to the late 1950s/early 1960s, duck farm operations were not legally required to install facilities to eliminate the discharge of settleable solids to surface waters. Therefore, thousands of tons of duck farm waste had freely entered, accumulated and polluted streams and adjacent wetlands for decades prior to implementation of a regulatory program.

As the duck waste entered surface waters, heavier suspended particles settled to the bottom near the discharge point, while lighter particles were distributed tidally until they too settled throughout the estuaries. These settled particles of decomposing organic matter created blankets of sludge that consisted of a homogeneous, black, plastic material with a strong, unpleasant odor. Duck waste is a concentrated source of bacteria, nitrogen, phosphorus, potassium and BOD. The organic content of duck sludge deposits is typically higher than that found in naturally occurring muds.

The decomposable organic matter depleted dissolved oxygen, and anaerobic digestion resulted in generation of hydrogen sulfide gas (Federal Water Pollution Control Administration 1966). The anoxic condition during warm summer months reduced species diversity, biomass and numbers of benthic invertebrates in those areas that were highly impacted. The high organic content and fine grained texture of duck sludge also made it an unsuitable substrate for shellfish setting and growth.

The enforcement of additional wastewater treatment requirements in the 1960s/1970s resulted in the decline in the number of operating duck farms and a substantial reduction in the volume of effluent discharged. Duck sludge deposits are associated with phased-out duck ranch operations on tidal creeks and tributaries in local waters. Areas where

such deposits are likely to be encountered were identified in the historical overview section.

The volume of sludge in these creeks was significant. A 1968 field survey estimated that over 7.3 million cubic yards of sludge were deposited on creek bottoms tributary to Moriches Bay (Forge River, Old Neck Creek, Terrell River, Tuthill Cove, Seatuck Creek, East River, etc.) at that time (Dona 1968). Deposits were reported to be up to 10 feet thick in some areas, and the sludge was covered by only a few inches of water.

Figure 22: Corps of Engineers and Suffolk County Department of Planning personnel sampling duck sludge deposits in the freshwater pond located north of Montauk Highway, Forge River. The survey conducted by Dona (1968) estimated that over 5.2 million cubic yards of duck sludge were deposited on the bottom of Forge River and its tributaries.

As discussed in the next section, it was an agreed upon practice to conduct large scale dredging projects to remove duck sludge from the bottoms of impacted waterways. The Suffolk County Department of Public Works removed about 1.5 million cubic yards of material from the tributaries in Moriches Bay prior to 1968; and about 1.6 million cubic yards after 1968 (Suffolk County Department of Planning 1985). It is apparent that some measure of the old sludge remains in these areas, in some altered state. The dredged spoil was disposed in upland sites on the mainland and barrier island, on the beach and in the ocean surf zone.

Figures 23 and 24 show the Suffolk County dredge removing the blanket of duck sludge in Seatuck Cove. About 400,000 cubic yards were removed in this 1972 wall-to-wall dredging project and pumped across Moriches Bay and the barrier island for disposal in the surf zone. This strategy and method for managing duck sludge was endorsed by all

government levels at that time. (Photos supplied by Thomas Rogers, Suffolk County Department of Public Works.)

Figure 23: Duck sludge dredging operation, Seatuck Cove, Brookhaven, New York.

Figure 24: Duck sludge dredging operation, Seatuck Cove, Town of Brookhaven, New York.

No survey designed to measure the extent of duck sludge deposits in the tributaries to Flanders Bay (Peconic River, Sawmill Creek, Terry Creek, Reeves Creek/Bay, Meetinghouse Creek) was conducted, although anecdotal information suggests that such

deposits were quite substantial. The Suffolk County Department of Public Works dredged over 2.0 million cubic yards of material from these tributaries prior to 1985, all of which was placed in upland disposal sites (Suffolk County Department of Planning 1985). The extent to which aged sludge remains on the bottom in these areas is not known.

Figure 25 shows a 2004 photo of the dredged spoil disposal site located in the Indian Island County Park adjacent to Flanders Bay. Approximately 400,000 cubic yards of duck sludge were pumped to this site after removal from near-by Terry Creek, Reeves Creek and Meetinghouse Creek. Three dredging projects were conducted, with the first occurring in 1948, and the third in 1975. Typically, such sites do not re-vegetate quickly, due to fine grained, compacted, poorly-drained, organically enriched sediment, which is acidic and has a high salt content.

Figure 25: Dredged spoil disposal site, Indian Island County Park, Riverhead, New York.

Figure 26: Remnant of a former duck farm swim pond/berm in tidal wetlands along the shoreline of Speonk River. The upland area has been developed for large lot residential use.

Former duck farm sites have been developed for private residential and commercial uses. These new uses often mask the origin of shoreline features that were created when the farms operated. In many instances, the relict shoreline features (berms, swim ponds, etc.) remain left as is, as shown in Figure 26, to avoid complicated and expensive environmental review/permit procedures. Opportunities in the future may exist for coordinating the restoration of these privately owned shoreline areas in conjunction with management of adjacent underwater lands that are owned by the public. Figures 27 and 28 show aerial views of former duck farm sites along Old Neck Creek, Center Moriches that have been developed for residential use. Long boat docks are shown traversing old swim ponds and berms.

Figure 27: Redevelopment of former duck farm site for residential use, Old Neck Creek, Center Moriches, New York.

Figure 28: Redevelopment of former duck farm site for residential use, Old Neck Creek, Center Moriches, New York.

Some former duck farms have been purchased and the buildings restored and used for other purposes. Figure 29 shows restored duck farm buildings located on the east side of Terrell River, Center Moriches. Again, the *Phragmites*-dominated shoreline remains in its abandoned condition. The many duck farms that formerly operated along the eastern shore of the Terrell River contributed hundreds of thousands of cubic yards of duck sludge to the 68-acre tributary, which has never been dredged by the Suffolk County Dept. of Public Works, and is adjacent to the 260-acre Terrell River County Park.

Figure 29: Re-use of former duck farm structures, Terrell River, Center Moriches, New York.

Management Response in the 1960s/1970s

The Federal Water Pollution Control Administration conducted conferences in 1966 and 1967 on the water quality problems in eastern Great South Bay and Moriches Bay that were caused by duck farm operation. Dredging and ocean disposal of duck sludge were endorsed as acceptable practices in the late 1960s. The findings of these conferences are outlined below (Federal Water Pollution Control Administration 1966; 1967).

- Agreed that sludge removal was desirable, but that disposal should not occur in wetlands or bay waters.
- An accurate survey of duck sludge deposits was needed.
- Pending completion of survey, dispose of dredged sludge in ocean below low water ("winter" time window; 1.5 miles away from Moriches Inlet).
- Determine measures to rehabilitate duck sludge spoil sites.

The debate continued over how duck sludge deposits on tributary underwater lands should be managed. The U.S. Fish & Wildlife Service National Estuary Study (1970) stated the following with respect to removal of sludge deposits via dredging.

- The effects of disturbing organic-rich sediments at the site of dredging were not well understood.

- Concern was expressed over water quality impacts of sludge removal due to recycling of nitrogen and phosphorus from newly exposed substrate.

- The need for a study on the feasibility of removing sludge from tributaries was cited.

The question remained: "Should sludge be removed, or left as is?"

The Long Island Regional Planning Board inventoried 29 duck farms as point sources of pollution to local waters in 1976 and discussed related water quality problems in the "208 Plan" (Long Island Regional Planning Board 1978). Conclusive data did not exist to establish whether or not the old sludge represents a bacterial or nutrient source to the water column. It was possible that the bulk of nutrients had been leached upward through the sludge by groundwater movements; however, this transport was undocumented. Pertinent findings from the plan appear below.

- No estimate of the amount of nitrogen trapped in duck sludge on creek bottoms.

- No clear evidence of the role that sludge deposits play as contributors of nitrogen to surface waters.

- No known measurements of nitrogen input from sludge deposits.

Recommendations in the plan included the following:

- Determine the impact of duck sludge as a source of nitrogen and bacteria, and the feasibility of their removal.

- Require that duck farms' treatment facilities conform to compliance schedules which call for zero discharge by 1983.

Eventually, many issues associated with the treatment of duck farm effluent were, in a sense, resolved by the decline in the number of active farms during the 1980s. However, old deposits of organically-rich duck waste in shallow water tributaries continue to impact water and habitat quality long after the duck farms have ceased operation. These sediments exhibit highly eutrophic nitrogen and oxygen fluxes which contribute to phytoplankton blooms and oxygen depletion in bottom waters (Howes et al. 1998). Such conditions are generally associated with a depauperate benthic community.

Management Implications Today

The duck farm legacy has important ramifications for coastal development, open space acquisition, stream corridor/wetland habitat restoration, and marine resource management. Many of the actions in the *Long Island South Shore Estuary Reserve Comprehensive Management Plan* and the *Peconic Estuary Program Comprehensive Conservation and Management Plan* (e.g., development of watershed plans; restoration of tidal wetlands; habitat restoration in tributaries; restoration of anadromous fish; acquisition of open space; development of a dredging management plan) interface in one way or another with this legacy (South Shore Estuary Reserve Council 2001; Peconic Estuary Program 2001). The extent to which habitats on former duck farm sites, tributaries and bay bottoms can/should be restored remains a subject for technical evaluation and regulatory debate.

The future duck farm legacy poses unique planning challenges for both public and private property:

- How should publicly owned former duck farm sites be restored and used in the future?

- How and to what extent should publicly owned freshwater stream, pond, tidal wetland, tidal creek and bay bottom habitats that were modified and degraded by duck farming activities be restored to improve fish, wildlife and water quality values?

- How should site development plans for privately owned duck farms be reviewed?

- How should private property with shore-edge remnant features from old duck farms be changed/restored?

The answers to these questions will be of significant value in developing a regional response to this issue, as well as site-specific restoration work plans.

It is clear that the location, extent, and condition of the organically-rich sediments that remain in local waters should be determined, and the impacts on water quality and fish and wildlife values assessed. Science-based management alternatives can then be designed to mitigate the problem.

Current work in this regard is just getting at underway Meetinghouse Creek in Aquebogue. The Suffolk County Department of Health Services is conducting a feasibility study on a dredging project to remove about 250,000 cubic yards of duck sludge deposits that have accumulated in the creek since the last dredging cycle in 1975. The goal here would be to improve dissolved oxygen levels in the western Peconic Bay estuary by removing the sediment source of nitrogen to the water column, which has fueled harmful algal blooms.

Significant effort is also being devoted to reverse the decline in water quality in the Forge River, which has been attributed to historical duck farm effluent discharge, urban runoff,

and polluted groundwater underflow. Local citizens through "Save The Forge River, Inc." have been very successful in marshalling New York State, Suffolk County and Town of Brookhaven resources to assess the problem and prepare a watershed action plan.

Restoration of old duck farm sites could proceed in phases, such as general site evaluation, removal of structures and debris, removal of water control structures and berms coupled with grading former swim ponds to regain more natural water flows, and longer-term invasive species control and management. It could be useful to start restoration work first at locations that are "upstream," and then proceed to "downstream" locations. (Different approaches will no doubt be needed for freshwater, brackish and saline environments.) This phased approach will be evaluated during conduct of the Robinson Duck Farm County Park Habitat Restoration Feasibility Study by the Suffolk County Department of Planning under Capital Project No. 8710.113.

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