Long Island
South Shore Estuary Reserve Council

FINAL REPORT
INVENTORY AND ANALYSIS OF BARRIERS TO FISH PASSAGE
FOR
SIX LONG ISLAND SOUTH SHORE ESTUARY RESERVE TRIBUTARIES

For Submission to:

New York State Department of State
South Shore Estuary Reserve
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1.0 INTRODUCTION

Fish species which migrate between fresh and marine waters during their life cycle are collectively referred to as diadromous fish. Among the species of diadromous fish within the South Shore Estuary Reserve (Reserve), they may be further broken down and characterized as anadromous (spawn in freshwaters, hatchlings migrate to marine waters where they mature and then migrate back to freshwaters to spawn) or catadromous (spawn in marine waters, hatchlings migrate to freshwaters where they mature and then migrate back to marine waters to spawn). Historically, Reserve tributaries provided unobstructed and valuable nursery and spawning habitat for diadromous fish. However, the installation of dams, road crossings, channelization of streams and the destruction of adjacent riparian buffer have created physical barriers to fish migration, as well as contributing to the degradation of fish habitat along the south shore of Long Island.

The Reserve Comprehensive Management Plan (CMP) addresses the need for diadromous fish habitat restoration and the assessment of barriers to fish passage between the estuary and its freshwater tributaries. A Diadromous Fish Work Group has been convened to provide guidance for the assessment and implementation of fish habitat restoration within the Reserve. The alewife and American eel have subsequently been identified as priority diadromous fish species which are of utmost concern due to their historic presence within the tributaries of the Reserve, but currently have limited distribution within Reserve tributaries. However, concern is extended to trout and other freshwater species whose habitats have been segmented within the tributaries. Improved access to breeding habitats for diadromous fishes can be accomplished through the modification of physical barriers and the installation of fish passage structures where removal is not feasible. Funding has been awarded through the New York Clean Water/Clean Air Bond Act and the State Environmental Protection Fund for assessments, removal and/or physical improvements to fish barriers within the Reserve. Several projects are currently being planned within the Reserve study area, including improvements to Brown's River, Mud Creek, Swan River and the Carman's River.

An inventory and assessment of in-stream physical barriers (including culverts, bridges, and dams) has been conducted within six prioritized tributaries of the Reserve: Carll's River (Babylon); Brown's River (Islip); and Swan River, Mud Creek, Beaver Dam Creek and Carman's River (Brookhaven). These tributaries were identified by the Diadromous Fish Work Group as having the greatest potential for habitat restoration through fish passage improvements due to the historic documentation of spawning runs and existing quality of natural habitat. The assessment categorized each structure into one of two categories, crossings or dams. The crossing inventory included culverts, bridges and temporary obstructions, such as log jams or fences. Culverts refer to structures placed beneath roadways which allow waters from a stream to flow without impedance. Bridges refer to structures which span the banks of and provide passage over a stream. Dam spillways were specifically located and assessed. For the purpose of this report, weirs located in association with USGS gauges were included within the dam inventory due to their structural form and consequent impounding of water within a channel. The results of these inventories and recommendations for improvements are provided in the following sections.

2.0 INVENTORY OF POTENTIAL BARRIERS

2.1 Development of Protocol Methodology & GIS Database

Nelson, Pope & Voorhis met with the Reserve office staff and members of the Diadromous Fish Work Group on May 31, 2007 to discuss the design of an inventory protocol methodology, data sheets and subsequent creation of a Geographic Information System (GIS) database characterizing barriers to fish passage within the six target Reserve tributaries. A draft field methodology protocol and data sheets for the SSER tributary crossing and dam inventory were prepared by NP&V based on similar physical barrier assessment methodologies for other regions (e.g., Massachusetts Riverway's Road-Stream Crossing Inventory) and discussed. Reserve Stream Barrier Inventory and Characterization Worksheets to characterize tributary crossings and barriers encountered during the inventory were finalized in accordance with comments from the Diadromous Fish Work Group. These field data sheets included relevant regional criteria for assessing whether a given dam, crossing or other impediment is a barrier to fish and wildlife passage.

The following criteria are contained within the Reserve field data sheets:

- Is the stream flowing (in the natural channel) during generally low-flow conditions?
- Are any problematic vegetation present (e.g. *Phragmites*) which are also posing a potential barrier to fish passage?
- If a dam is present,
    - What is the height of the dam?
    - Is there a functioning fish passage device?
    - Is the dam in disrepair or collapsed?
- For culverts, bridges and other crossing types,
    - Is stream flow constricted?
    - Does the crossing span constrict the channel?
    - Are tailwater scour pools present?
    - Is the crossing substrate comparable to the natural channel?
    - Does the water depth in the crossing match that of the stream?
    - Is there an inlet drop, and if so, is it < 6" or ≥ 6"?
    - What is the length and normal depth of water (normal high water mark) through the crossing?
    - Does the water velocity in the crossing match that of the stream?
    - Are crossing features in disrepair, collapsed, or partially blocked?
- Based on the above criteria, is the crossing a permanent or temporary barrier to fish and wildlife passage?

These criteria reflect the many passage requirements of target fish species. A given feature may be a barrier to some or all species of fish, or certain life stages of fish. For example, undersized culverts or culverts with slopes may cause high water velocities that prevent passage of fish through a structure. Inlet or outlet drops at a culvert can also pose problems for the passage of fish and other wildlife. Inlet drops can cause changes in water speed and turbulence, as well as create jumps that can also be physical barriers to fish and other aquatic animals as they pass

upstream. Outlet drops, either due to the original culvert design or erosion of material on the downstream side of the culvert, similarly create barriers to the upstream movement of fish and other aquatic animals that are unable to jump over the drop. When crossings are smaller than the stream width, the flow will also be constricted, increasing velocities and causing turbulence which can additionally impede fish and wildlife passage. The buildup of debris, sediment or trash in the stream or at a culvert can similarly create a physical barrier to fish and wildlife passage.

Additionally, it is noted that some culverts may act as behavioral barriers to fish due to the presence of conditions (e.g. extreme length, darkness, confined space, shallow depths) which may dissuade fish from entering or attempting passage, even when passage is possible (**FHA, 2007**). Excessively long culverts can require fish to increase energy expenditure to overcome slope or higher velocities, but even if the culvert contains natural substrates that do not present a velocity barrier, the darkness of such culverts can limit the entrance of fish (**Kemp et al., 2006, Weaver et al., 1976**). For this reason, the National Marine Fisheries Service (NMFS) Southwest Region requires the consideration of lighting for culverts which exceed 150 feet in length (**NMFS, 2001**).

Low flow conditions within a stream or culvert can also impede fish passage if water depth is too shallow to allow for full submergence of a fish (**Bates, 1992**). Alewives have been previously identified as a priority diadromous fish species within the Reserve because the size and habits of alewife cause greater restrictions on the passage of this species through barriers more so than other diadromous fish in the study area. Alewives migrate upstream in schools during April and May and can grow to a length of 15 inches, but generally average a length of 10 to 11 inches. Assessment criteria for minimum depth requirements vary among states and according to target species, but at minimum require that fish be fully submerged when passing through a structure. According to **Bigelow & Schroeder** (**1953**), alewife depth or thickness is equal to 3 1/3 of their length, so that a 15 inch alewife is approximately 4.5 inches deep. Therefore, a water depth of 6" is utilized as a criterion for alewife passage through existing structures.

American eels have also been identified as a priority species. Eels can remain in freshwater for 10 to 30 years before migrating downstream in the fall on their way back to the Sargasso Sea to spawn. Juvenile eels migrating upstream in the spring can circumvent dams to a degree by ascending the damp and rough vertical surface of a short spillway (if texture, slope and flow conditions allow), by "slithering" around the dam on wet ground (if access is not impeded by wingwalls) or swimming through cracks or other openings. But a large proportion of eels will not attempt to climb the vertical surface of a dam spillway; water velocity, jump barriers, and length of installed fishways are the greatest hurdles for eels (**Gulf of Maine, undated**).

Observations of problematic vegetation within the stream at each assessed crossing or dam was also recorded to ascertain potential impacts on fish habitat. The presence of aquatic vegetation within a water body is typically a desirable feature, as beds of aquatic vegetation (e.g. water lily, etc.) provide invertebrate attachment and fish cover. However, the establishment of problematic, non-native, aquatic plants can significantly alter aquatic systems. Aggressive, non-native aquatic plants have been documented as creating barriers to the foraging of largemouth bass as a result of

their typically large, structurally-complex canopies (**Lillie & Budd, 1992; Boylen et al., 1999**). The invasion of these alien plants into aquatic systems alters plant abundance, native plant assemblages and structure, having implications on food web dynamics as well as fish recruitment (**Rahman & Bremigan, 2002**). The presence of dense or clogging aquatic vegetation within the waterway is included within the Draft Hudson River Estuary Program's stream inventory and characterization methodology, as it is used as an indicator of excess nutrients, degraded water quality and habitat (**NYSDEC, 2006**). Very dense stands of emergent invasive vegetation (e.g. *Phragmites*) can sometimes occur within impounded sections of a waterway and have the potential to impede passage of fish or other aquatic wildlife if depths remain shallow and flow remains relatively stagnant within the impounded water body. Dense stands of non-native plants within an impoundment also pose problems for recreation. Various methods can be used to alleviate problems associated with non-native plants (e.g. herbicides, mechanical removal, etc.), however these methods can have potential negative impacts on fish and macroinvertebrate populations. In these cases, barrier removal should be considered as an option for control of non-native plants to restore natural flow conditions which do not promote their establishment. Therefore, the criterion of non-native vegetation is also included here to ascertain whether a potential barrier could exist in the future if these plant populations are not monitored.

The following attribute table (**Table 2-1**) summarizes the impacts of barriers to fish passage:

Table 2-1
Fish Barrier Attribute Table

Barrier Type	Description	Impact
Drop	Drop at outlet exceeds fish jumping ability, or jump pool is insufficient to generate sufficient thrust.	Fish cannot enter structure, can be injured, or will expend too much energy entering the structure to traverse other obstacles.
Velocity	High velocity exceeds fish swimming ability.	Fish tire before passing the crossing.
Turbulence	Turbulence within the culvert prevents fish from entering, or confuses sense of direction.	Fish do not enter culvert, or are unable to successfully navigate the waterway.
Length	Culvert length exceeding 150 feet in length (**NMFS Southwest Region, 2001**)	Fish may not enter structure due to darkness. Fish may fatigue before traversing the structure.
Depth	Low flow depth causes fish not to be fully submerged.	Fish will be unable to swim efficiently or unable to pass the structure.
Debris	Caught within a culvert, debris can block flow, or portions of flow.	Fish may not be able to pass by debris, or constricted flow may create a velocity or turbulence barrier within the culvert.
Cumulative	Series of culverts, each of which stresses fish during passage.	Group of culverts, each marginally passable, may be a combined barrier.
Vegetation	Dense stands of non-native aquatic vegetation caused by water impoundment can further slow flow and alter fish habitat.	Quality of fish habitat (e.g. foraging areas) can be drastically altered.

Adapted from *Design for Fish Passage at Roadway-Stream Crossings: Synthesis Report* (**FHA, 2007**).

Additionally, the United States Environmental Protection Agency's Habitat Assessment Worksheet for low-gradient streams (**Barbour *et al.*, 1999**) was determined to be the most appropriate protocol for characterizing the riparian and in-stream habitat at each inventoried crossing and dam within the target tributaries. The Reserve tributary inventory datasheets and USEPA Habitat Assessment Worksheets utilized in this study are contained within **Appendix A**.

Each crossing and dam location inventoried among the six tributaries would be recorded using a sub-meter accuracy Trimble GeoXT Global Positioning System (GPS). The resultant GPS points would be brought into a GIS database, which would then be populated with observations recorded on the inventory datasheets and associated with each respective crossing/dam data point.

2.2 Data Collection

All crossings and physical barriers within the main stems of the Carll's River (Babylon); Brown's River (Islip); and Swan River, Mud Creek, Beaver Dam Creek and Carman's River (Brookhaven) were inventoried using the approved field methodology protocol and data sheets. Geographic Information System (GIS) electronic shapefiles for the main stem and watershed of each target tributary were provided by the New York State Department of State (NYSDOS) Division of Coastal Resources. Although the overall study area includes all smaller creeks and waterways within each watershed leading to the main stem, it was agreed upon by the Diadromous Fish Work Group that only the main stem of each tributary would be the target of investigation for the current study. The limit of the main stem for each tributary, and the extent of the current inventory area, was understood to be the extent of each target tributary as was illustrated in the shapefile provided by the NYSDOS.

Using a GIS, careful interpretation of the most recently available georeferenced aerial photography (**NYSGIS Orthophotoimagery Program, 2004**) overlaid with the electronic SSER target tributary data was first conducted in the office to identify potential barrier locations for further investigation in the field. A new shapefile for potential crossings and a new shapefile for potential dams were created. A crossing or dam point was created over each potential barrier and automatically assigned a number, which was utilized on the respective data sheets and when recording location coordinates in the field.

Beginning at the mouth of each target tributary, a field crew of ecologists located each potential barrier identified in the office and assessed whether the point was a stream crossing, dam or other barrier to fish passage. A field inventory data sheet and habitat assessment (**Appendix A**) were completed for each point, the location was georeferenced with a GPS and the structure was digitally photographed. As conditions were found to greatly vary on the upstream and downstream sides of each inventory location, habitat assessments were limited to the observed conditions within 300 feet upstream of each location point. Additional crossings or barriers not visible from aerial photography but encountered within the field (i.e. crossings not visible below tree canopies, log jams) were also assessed and inventoried.

Following the collection of field data, the precise locations and attributes of identified crossings and dams were migrated into a GIS database. Final numbers were assigned to each dam and crossing, starting with the mouth of the westernmost river (Carll's River) and moving west to east with numbering always starting at the mouth of each tributary. Keys for each of the attribute fields in both the dams and crossings database files are included within **Appendix A.**

2.3 Inventory & Characterization of Fish Barriers

A total of 33 dams and 72 crossings were identified during the field inventory of six target tributaries of the Reserve. Maps for each target tributary were created from the GIS database to illustrate locations of crossings and dams along the waterway **(Figures 2-1 through 2-6)**. Each crossing and dam identified during field investigations is generally numbered in order from west to east, beginning with the mouth of the Carll's River, to allow easy reference to inventory sheets and discussions within the text of this report. Only a few additional crossings and dams identified at a later stage in the inventory do not follow this sequence.

As expected, the majority of crossings were determined to not be barriers to fish passage, while most dams were verified as physical barriers. However, some crossings were characterized as being permanent, temporary or potential barriers to fish passage. Some crossings which appeared to hinder fish passage due to partial collapse or the buildup of debris, sediment or trash were determined to be temporary barriers which could be relatively easily remediated. There were some crossings and weirs for which the assessment criteria could not readily discern whether certain observed conditions (i.e. excessive length, limited passage diameter, clogging with in-stream vegetation) were adequate for fish and wildlife passage. In these instances, the structure was determined to potentially be a barrier to some species or life stages of fish and further field monitoring or hydraulic modeling should be considered in the future.

Dams without fish passage devices typically present a physical barrier to the upstream passage of fish and aquatic wildlife. As indicated above, some eels will attempt to climb over the vertical surface of a smaller dam's spillway, but water velocity, substrate and length of the climb are all factors (**Gulf of Maine, undated**). Fish require the aid of a fish passage device (such as a steeppass or denil fish ladder), to ascend over a dam structure. Functioning dams which are not equipped with such a device present a permanent or partial barrier to the upstream migration of diadromous fish.

In general, dams of moderate height (less than 10 meters) with spillways are considered to be the safest way for downstream migrating fish to pass a dam as long as there is sufficient depth and no overaggressive baffles (e.g. pre-cast blocks, riprap, etc.) at the base of the dam (**Larinier, 2000**). All dams encountered within the study area were less than 10 meters in height. However, dams and other barriers do not necessarily hinder downstream migration of eels, especially low dams and other small structures where water flows over the dam or passes through open gates.

One (1) dam (located on the Carll's River approximately 200 feet east of Woodbury Road) was determined to not be a barrier to fish passage, as the control gate structure was no longer present and sufficient water was able to flow through the opening to accommodate passage of migratory fish. Therefore, tributary maps further illustrate whether each structure is a permanent, partial, or not a barrier to upstream fish passage using appropriate symbology. Two (2) USGS gauges (one located on the Carll's River at Southard's Pond and one located on the Carman's River at the Long Island Railroad overpass in Southaven County Park) were encountered within the study area and were determined to be barriers to at least some species of fish (e.g. alewife). As these structures do impound water, but cannot be considered a pedestrian or vehicular crossing over a tributary, they were both characterized and assessed as dams for the purpose of this inventory. Each crossing and dam is fully characterized within the GIS database. **Sections 2.3.1** through **2.3.6** provide a brief description and assessment, by tributary, of whether each inventoried dam and crossing encountered during field investigations is a barrier to fish passage. Dams without functioning fish passage devices are generally recommended for removal, where possible, to restore more natural stream flow and allow for fish passage. However, where dam removal may not currently be feasible, either due to significant cultural ties (e.g. Argyle Dam), significant warm water fisheries (e.g. Swan Lake Dam), or other potentially adverse impacts downstream, then modification to allow for fish passage is recommended as an alternative. Recommendations for the rehabilitation of crossings that were identified to be temporary or partial barriers to fish passage are also discussed.

2.3.1 Carll's River

Field investigations identified a total of 31 crossings and dams on the Carll's River, 9 of which were determined to be physical barriers to fish passage (see **Figure 2-1**, **Table 2-2**). These structures are characterized below.

Table 2-2
Dams and Crossings on Carll's River

ID	Name/Location	Barrier
Crossing 1	Montauk Highway	None
Dam 1	Argyle Dam	Partial
Crossing 2	S. Railroad Avenue	None
Crossing 3	Locust Ave.	None
Crossing 4	Park Ave.	None
Crossing 5	300 ft N/o Park Ave.	None
Crossing 6	Footbridge S/o Southard's Pond	None
Dam 2	USGS Gauge at Southard's Pond	Permanent
Dam 3	Southard's Pond Dam	Permanent
Crossing 7	200 ft NW of Washington	None
Crossing 8	Sunrise Highway	None
Crossing 9	2250 ft N of Sunrise Hwy	None
Crossing 10	Park Trail	None
Crossing 11	Park Trail	None

ID	Name/Location	Barrier
Crossing 12	Park Trail	None
Dam 4	Elda Lake Dam	Permanent
Crossing 13	Park Trail	None
Crossing 14	Park Trail	None
Crossing 15	300 ft S/o Southern Pkwy	None
Crossing 16	Park Trail	Potential
Crossing 17	Under Sylvan Rd	None
Crossing 18	Under Southern State Pkwy	None
Crossing 18.1	Belmont Lake Footbridge	None
Crossing 18.2	Grass Carp Gate	Temporary
Dam 5	Belmont Lake Dam	Permanent
Crossing 18.3	550 ft S/o August Road	Temporary
Crossing 19	Belmont Park North	None
Crossing 20	August Road	Potential
Crossing 21	Grand Blvd	None
Crossing 22	Grand Ave Park	None
Crossing 23	N Wyandanch Park	Potential
Dam 6	Long Island Avenue	Permanent
Dam 7	200 ft E/o Woodbury Road	None
Crossing 24	Nicolls Road	None

Crossing #1 – Montauk Highway

This crossing contains a concrete box culvert which has some signs of disrepair, but is not currently a barrier to fish passage. The water in this crossing was stained at the time of observation, and a local fisherman noted hundreds of dead fish (bass, perch, etc.) during the previous summer.

Dam #1 – Argyle Dam

Argyle Dam is a historically significant feature constructed in 1895 for the creation of Argyle Lake. Today, Argyle Dam and Lake, situated in Argyle Park, are historic features with high local cultural values. However, this dam is also the first large obstruction to fish passage on the Carll's River. Argyle Lake also has a water quality problem with high Coliform levels due to large waterfowl populations which are attracted to the area by extensive lawns to the calm water's edge and feeding from residents.

Two (2) 48" diameter corrugated pipes are located on either side of Argyle Dam at a relatively shallow slope and appear to have 10" depth of water during mean high water. At low tide, the flow of water within the pipes is much faster (approximately 3.8 ft/sec) than the slow flow of water within the impoundment. The original purpose of these pipes is unclear, but the roughness of the corrugated metal and shallow grade of this approximately 53-foot long structure may allow for some passage of fish species, particularly during favorable times in the tidal cycle. Therefore, this dam is considered to be a partial barrier to some species or life stages of fish. The installation of a more natural bypass channel, or a more accommodating fish ladder should be considered in place of these corrugated pipes to allow for greater passage of fish during all tidal cycles.

Crossing #2 – South Railroad Avenue
The crossing consists of three bridges with abutments constructed of concrete, one of which contains railroad tracks. The outermost bridges are in good condition, but the center bridge shows signs of disrepair. None of the bridges are currently barriers to fish passage.

Crossing #3 – Locust Avenue
A concrete box culvert is present under Locust Avenue which is currently in good condition, and does not currently present a barrier to fish passage.

Crossing #4 – Park Avenue
The Park Avenue crossing consists of a concrete bridge with abutments which is currently in good condition, and does not currently present a barrier to fish passage.

Crossing #5 - ~300 feet North of Park Avenue
This crossing consists of a bridge with abutments at a basketball and tennis court. The bridge is constructed of wood and has some signs of slight disrepair. The bridge itself is not a barrier to fish passage; however, the reed canary grass has currently formed an island and could potentially be a barrier to fish passage if it continues to expand. The vegetation at this location should continue to be monitored to ensure it does not become a barrier.

Crossing #6 – Footbridge South of Southards Pond
This bridge with abutments is constructed of metal, concrete, wood, and stone and is currently in good condition. This bridge does not currently present a barrier to fish passage.

Crossing #7 - ~200 feet Northwest of Washington Street
This bridge with abutments is constructed of concrete and wood, and is currently in good condition. The bridge does not currently present a barrier to fish passage; however, non-native vegetative species (*Cabomba*) were identified at the crossing and should be monitored to ensure they do not become a barrier to fish passage in the future.

Dam #2 – USGS Gauge ~100 feet South of Southard's Pond Dam
This is not a true dam, but is a concrete weir constructed for use as a USGS Gauge. There is some slight erosion in the center of the weir. The weir is likely passable by American eels and other species of strong-swimming fish, but the height of this structure may be a barrier to some species and replacement of the structure with an alternate stream gauging method is recommended.

Dam #3 – Southard's Pond Dam
Southard's Pond Dam is a dam that was constructed in 1895 for recreational purposes. The dam shows some erosion of the concrete and does not contain a fish passage device. Either removal of the dam or modification to allow fish passage, such as through the installation of a fish ladder, is recommended. NYSDEC has identified this dam as degraded and in need of substantial repairs or reconstruction.

Crossing #8 – Sunrise Highway
The Sunrise Highway crossing consists of two box culverts constructed of concrete. Both show slight signs of disrepair as evidenced by cracks in the culverts. Neither of the culverts are currently a barrier to fish passage.

Crossing #9 - ~2,250 feet North of Sunrise Highway
This is the first crossing of 13 located in Belmont Lake State Park. It consists of an embedded elliptical culvert constructed of corrugated metal, concrete, and stone which shows slight signs of disrepair. It is currently not a barrier to fish passage.

Crossing # 10 – Park Trail
This crossing also consists of an embedded elliptical culvert constructed of metal, concrete, and stone. The culvert shows slight signs of disrepair, and is currently not a barrier to fish passage.

Crossing # 11 – Park Trail
Crossing 11 is the third on the park trail, which is an embedded elliptical culvert constructed of metal, concrete and stone. The culvert shows slight signs of disrepair and is not currently a barrier to fish passage.

Crossing # 12 – Park Trail
This is also an embedded elliptical culvert constructed of metal, concrete, and stone which has collapsed. Even in its collapsed state, it is not currently a barrier to fish passage, but the culvert should be replaced or repaired to prevent a future barrier that may occur as a result of the potential collapse.

Dam # 4 – Elda Lake Dam
Elda Lake Dam is a dam which was constructed in 1880 for recreational purposes. Field inspection of this dam was not conducted for this study, as it was located beyond the limits of the main stem study area, but is included here due to it being a major structure on the Carll's River. As this dam does not have a fish passage device, one should be installed as this dam is also used for stormwater retention. It is also noted that the Town of Babylon has recently identified the presence of curly-leaf pondweed (*Potamogeton crispus*), an aggressive non-native plant, within the lake and are working with the NYSDEC to determine a course of action.

Crossing # 13 – Park Trail
This is the first bridge occurring along the park trail which is constructed of concrete, wood, and stone. The bridge shows signs of approximately 50% disrepair and is not currently a barrier to fish passage. Maintenance should be performed on the bridge to prevent further disrepair and eventual collapse.

Crossing # 14 – Park Trail
This crossing is also a bridge constructed of concrete, wood, and stone, which currently shows slight signs of disrepair. The bridge is not a barrier to fish passage; however, non-native aquatic plant species were identified at the crossing and should be monitored to ensure they do not become future vegetative barriers to fish passage.

Crossing #15 - ~300 feet South of Southern State Parkway
The bridge at this crossing is constructed of concrete, wood and stone, and is in good condition. The bridge does not present a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to ensure they do not become future vegetative barriers to fish passage.

Crossing #16 – Park Trail
The crossing at this location is best categorized as a "drop." It is comprised of concrete and stone which creates no inlet drop, but an outlet drop of greater than six inches. The drop may be a potential barrier to some species of fish or life stages. However, eel and strong swimming fish are likely able to pass through. Minor modification of the crossing to reduce the drop distance (which is currently greater than 6 inches) should be considered to allow for greater passage of various species and life stages of fish. Also, non-native vegetative species are present at this crossing and should be monitored to ensure they do not become future vegetative barriers to fish passage.

Crossing #17 – Under Sylvan Road
An open bottom arch constructed of concrete and stone is located under Sylvan Road and provides passage for both fish and humans underneath, as there is a trail along the east side of the crossing, which is part of Belmont Lake State Park. The crossing is in good condition and does not present a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to ensure they do not become future vegetative barriers to fish passage.

Crossing #18 – Under the Southern State Parkway
This is also an open bottom arch constructed of concrete and stone which is in good condition. The trail from the previous crossing continues through this crossing, and does not present a barrier to fish passage.

Crossing #18.1 – Belmont Lake Footbridge
This crossing consists of a wooden footbridge located approximately 20 feet north of Southern State Parkway. The bridge itself is in good condition and does not currently present a barrier to fish passage.

Crossing #18.2 – Grass Carp Gate
This crossing, a metal and concrete structure, was constructed for the purpose of grass carp control in the southern portion of the park. It is currently in good condition, but may present a temporary barrier to the passage of larger fish. This crossing should be routinely monitored for build up of floatable debris and cleaned as necessary.

Dam #5 - Belmont Lake Dam
Belmont Lake Dam, located approximately 100 feet north of the Southern State Parkway, was originally constructed as part of the private Belmont Estate. The estate (including the lake) was turned over to NYS in 1979 and soon became known as Belmont Lake Sate Park and is currently used for recreational purposes (**Carde Case, Wikipedia**). The dam is currently in good condition but lacks a device for fish passage, which should be installed. Also, the presence of an aquatic invasive plant, *Cabomba sp.,* was noted at this dam, and should be monitored to prevent future vegetative barriers to fish passage.

Crossing 18.3 – 550ft S/o August Road
This crossing is a metal chain link fence which spans the banks of the river. Currently, debris has gathered at the upstream side of the fence creating a 90 percent blockage of water flow through the structure. At minimum, the debris should be cleared from this fence to allow for fish passage. If possible, the fence should be removed entirely to prevent further gathering of debris.

Crossing #19 – Belmont State Park North
Crossing 19 consists of a bridge located approximately 330 feet to the west of the Belmont Lake State Park's picnic parking area, constructed of concrete and wood which shows slight signs of disrepair. The bridge currently does not present a barrier to fish passage.

Crossing #20 – August Road
Three culverts exist at the crossing. The first culvert is a box culvert, while the second two are embedded elliptical culverts, all of which are constructed of concrete. All show signs of slight disrepair, but only the middle culvert presents a potential barrier to fish passage. The middle culvert only contains 1-2 inches of water and is heavily silted. This culvert should be cleaned out and maintained on a regular basis to prevent a barrier to fish passage.

Crossing #21 – Grand Boulevard
This crossing consists of a metal open bottom arch which is in good condition. The open bottom arch does not currently present a barrier to fish passage.

Crossing #22 – Grand Avenue Park
The bridge at this location is constructed of concrete and wood and is almost entirely in disrepair. Although it currently does not present a barrier to fish passage, the bridge should be maintained or replaced to prevent future collapse.

Crossing #23 – North Wyandanch Park
This bridge is constructed of wood and shows signs of disrepair. The crossing is considered a potential barrier due to a combination of siltation and infringing Phragmites vegetation below it. Dredging and clearing of Phragmites vegetation in this area is recommended to improve fish passage. The bridge should be maintained to prevent future collapse.

Dam #6 – Above Long Island Avenue
This dam appears to have been constructed for the purposes of flood control and is comprised of earth, concrete and metal. The roadway itself acts as the southern extent of the impoundment. The dam is almost entirely eroded/rusted and has no fish passage device. The dam spillway should either be considered for removal, or maintained and modified for the purposes of fish passage. Improvements would likely require some modifications to the roadway.

Dam #7 - ~200 feet East of Woodbury Road
This dam is the first run-of-river dam encountered. The dam is constructed of concrete and is in good condition. It appears that at some point in the past there was a dam control

gate structure between the dam's two concrete abutments, but it is no longer present. Therefore, this is the only dam inventoried that is not presently a barrier to fish passage. It should be noted that the dam does impound water and therefore does cause backwater effects, which affect riverine habitat. Its removal could improve coldwater habitat downstream and prevent it from becoming a future barrier due to changes in its operation.

Crossing #24 – Nicolls Road
This is the final crossing identified on the Carll's River and consists of two elliptical culverts which are constructed of metal and concrete. Both seem to have some slight disrepair, but do not appear to be a barrier to fish passage.

2.3.2 Brown's River

The Brown's River is comprised of both an east branch (Sans Souci) and west branch (Mill Pond). The area located south of the LIRR between the east and the west branches of the river is identified as the John Ellis Roosevelt Estate and is listed on the National Register of Historic Places (ID#90NR01873). Both of these branches were assessed and a total of 20 crossings and dams of which 15 are barriers were identified during field investigations (see **Figure 2-2**, **Table 2-3**). These structures are characterized below.

Table 2-3
Dams and Crossings on Brown's River

ID	Name/Location	Barrier
Crossing 25	Middle Rd	None
Crossing 26	100ft N/o Middle Rd	None
Crossing 27	LIRR N/o Middle Rd	Temporary
Dam 8	N/o LIRR	Permanent
Crossing 27.1	Montauk Highway	Permanent
Dam 9	Mill Pond Dam	Permanent
Crossing 28	Aldrich Ln	Potential
Crossing 29	LIRR	None
Dam 10	Lotus Lake Dam	Permanent
Crossing 30	Montauk Hwy	None
Dam 11	Montauk Hwy	Permanent
Dam 12	400ft N/o Montauk Hwy	Permanent
Dam 13	600ft N/o Montauk Hwy	Permanent
Dam 14	SW/o Girl Scout Center	Permanent
Dam 15	NW/o Girl Scout Center	Permanent
Dam 16	W/o Girl Scout Center	Permanent
Dam 17	W/o Girl Scout Center	Permanent
Dam 18	W/o Girl Scout Pools	Permanent
Dam 19	NW/o Girl Scout Pools	Permanent
Dam 20	NW/o Girl Scout Pools	Permanent
Dam 21	NW/o Girl Scout Pools	Permanent

Mill Pond (West) Branch:

Crossing #25 – Middle Road
This is the first crossing encountered on the Brown's River just before the river splits into a west and east branch. The crossing consists of a bridge constructed of concrete and wood. The bridge shows signs of slight disrepair, but is not currently a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to ensure they do not cause obstruction to fish passage in the future. The Town of Islip's Green's Creek and Brown's River Watershed Management plan also recommends flow improvements at this location.

Crossing #26 - ~100 feet North of Middle Road
A single box culvert is present at this crossing which is constructed of concrete. The culvert is in good condition and is currently not a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage.

Crossing #27 – LIRR North of Middle Road
This crossing consists of the first temporary barrier (log jam) on the Brown's River. The log jam creates an inlet drop of greater than six inches. The crossing feature itself is a round culvert constructed of concrete which in itself is not a barrier to fish passage. The log jam inside the culvert should be removed to allow for fish passage. Non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage.

Dam #8 – North of the LIRR
This is the first dam encountered on the Brown's River, which is a relatively small, privately owned dam located adjacent to the north side of the LIRR (Crossing #27). This structure was only 3'4" high and 6-feet wide, impounding approximately 1.7 million gallons (5.2 ac-ft) of water. Removal of this structure would only entail hand removal of the wooden planks impounding the water. There is very low potential for flooding of downstream properties, as the banks of the downstream properties are wooded and the amount of impounded water is relatively low. Due to the disrepair and lack of apparent use, it should be removed to allow for fish passage. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage.

Crossing 27.1 – Montauk Highway
This culvert (Suffolk County Culvert #085.04) is a concrete box culvert which appears to be in a state of about 50 percent disrepair. This culvert has both an inlet drop and an outlet drop, both of which are greater than 6 inches in height. Due to the large inlet and outlet drops, this crossing is considered a permanent barrier to fish passage and should be modified.

Dam #9 – Mill Pond Dam
This is the final dam located on the western stem of Brown's River, just above Montauk Highway. The present dam was constructed in 1955 for recreational purposes, although as its name suggests, an earlier dam likely existed at this site prior to this date in

conjunction with a mill operation. The dam presently consists of earth and concrete and shows slight signs of disrepair, as evidenced by cracks in the concrete. Currently, it acts as a barrier to fish passage, and either removal of the dam or installation of a fish passage device should be considered.

Crossing #28 – Aldrich Lane
This is the final crossing encountered on the western stem of Brown's River which consists of an elliptical culvert constructed of concrete. The 81-foot long culvert currently shows slight signs of disrepair and constricts the channel, creating higher velocity through the crossing and creating a potential barrier to fish passage.

Sans Souci (Eastern) Branch:

Crossing #29 – LIRR
This crossing consists of an open bottom arch constructed of concrete that shows signs of disrepair. This crossing does not present a barrier to fish or wildlife passage, but a non-live electrical pole was observed on the north side of the LIRR and should be removed. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage.

Dam #10 – Lotus Lake Dam
This is the first permanent barrier to fish passage on the Sans Souci stem of Brown's River. The dam was constructed in 1980 for the purpose of flood control and recreational uses. The spillway has been known to have breached in the past due to an obstruction caused by debris. The dam, which is constructed of earth and metal, shows signs of slight disrepair as evidenced by rust and pitting. Currently, no fish passage device exists, and it is recommended that the dam either be removed or modified to allow for fish passage.

Crossing #30 – Montauk Highway
The box culvert present under Montauk Highway is constructed of concrete and is in good condition. Currently, the culvert does not present a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage.

Dam #11 – Montauk Highway
This is a concrete dam that shows slight signs of disrepair. Currently, it has no functioning fish passage device. Dam removal or modification should be considered to allow for fish passage. When planning removal or modification, access issues should be taken into account, as access to this dam may be difficult due to steep slopes. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage.

Dam #12 - ~400 feet North of Montauk Highway
This is the first dam which comprises the Sans Souci Lakes dams. These dams were originally constructed for the purpose of cranberry crops, but now function for recreational purposes. However, as the Sans Souci lakes are largely private land, recreation is limited to individual property owners as well as visitors of the Girl Scout camp. The dam is constructed of earth and concrete, and is currently privately owned.

The dam shows signs of slight disrepair as evidenced by cracks in the concrete where the spillway is located. Emergency repairs were conducted within the past year on this dam due to its deteriorated state (**Gibbons, Nick; personal communication**). Currently, no functioning fish passage device is installed at the dam. This dam should be modified or removed to allow for fish passage.

Dam #13 – North of Montauk Highway

This is also an earthen dam which showed signs of the spillway having washed away when observed from the next upstream dam during the stream inventory. Access is difficult, due to highly impenetrable vegetation along the dam. Emergency repairs were conducted within the past year on this dam due to its deteriorated state (**Gibbons, Nick; personal communication**).

Dam #14 – Southwest of Girl Scout Center

This is the first of the dams which is owned by the Suffolk County Girl Scout Council. The earthen dam shows slight signs of disrepair. No functioning fish passage device is currently installed on the dam. This dam should be modified or removed to allow for fish passage.

Dam #15 – Northwest of Girl Scout Center

This earthen dam is also heavily vegetated, making it inaccessible during field visits. However, as observed from aerial photography and the proceeding dam, this dam appears to be collapsed.

Dam #16 – Northwest of Girl Scout Center

Although heavily vegetated, this dam is accessible and is constructed of earth, concrete and wood. The spillway currently shows signs of disrepair as evidenced by several cracks in the concrete. Currently, the dam has no functioning fish passage device, and the dam should be modified or removed to allow for fish passage.

Dam #17 – Southwest of Girl Scout Center Pools

This earthen dam was also inaccessible due to heavy vegetation. Full determination of the status of the dam was not possible during field visits due to the access issue, but it appears that the dam was in disrepair.

Dam #18 – West of Girl Scout Center Pools

This dam is constructed of earth, concrete, and wood, and is currently used by the Girl Scout Center as a dock for canoeing. The dam is in good condition, but lacks a functioning fish passage device. The dam should be considered for removal or modified to allow for fish passage.

Dam #19 – Northwest of Girl Scout Center Pools

This dam is constructed of earth, concrete and wood, and was previously used by the Girl Scout Center as a dock for canoeing, as evidenced by collapsed docks. The dam shows signs of slight disrepair and currently lacks a fish passage device. The dam should be considered for removal or modified to allow for fish passage.

Dam #20 – Northwest of Girl Scout Center Pools
This dam is also constructed of earth, concrete, and wood, and is currently in good condition. No functioning fish passage device is currently installed on the dam. This dam should be modified or considered for removal to adequately allow for fish passage.

Dam #21 – Northwest of Girl Scout Center Pools
This is the final dam of the Sans Souci Lakes, and it is constructed of earth. The dam shows slight signs of disrepair, as evidenced by cracks in the plywood that was put over the spillway. Currently, the dam has no functioning fish passage device, and the dam should be modified or removed to allow for fish passage.

2.3.3 Swan River

The entirety of the Swan River is listed as a NYSDOS Significant Coastal Fish and Wildlife Habitat. Although no features along the river are OPRHP-listed historical sites, most of the River is located within an archaeologically sensitive area. A total of 8 crossings and dams were assessed, 6 of which were barriers identified during field investigations (see **Figure 2-3** and **Table 2-4**). These structures are characterized below.

Table 2-4
Dams and Crossings on Swan River

ID	Name/Location	Barrier
Crossing 31	Swezey Ln	None
Crossing 32	LIRR	Temporary
Crossing 32.1	Montauk Highway	Permanent
Dam 22	Swan Lake Dam	Permanent
Crossing 32.2	20ft N/o Montauk Hwy	None
Crossing 33	300ft S/o Sunrise Hwy	Temporary
Crossing 34	200ft S/o Sunrise Hwy	Temporary
Crossing 35	Sunrise Highway	Potential
Crossing 36	60ft S/o Barton Rd	Temporary
Crossing 37	Barton Rd	Permanent
Crossing 37.1	Woodside Avenue	None

Crossing #31 – Swezey Lane
This is the first crossing on the Swan River, which consists of a concrete box culvert in good condition. This crossing does not currently present a barrier to fish passage.

Crossing #32 – LIRR
This is the first temporary barrier on the Swan River. A timber platform was constructed by local youth within the River directly beneath the LIRR crossing. The crossing itself is a concrete open bottom arch beneath which the platform is located. Logs and other debris have become lodged behind the structure and pose a potential barrier to the passage of larger fish, particularly as further debris continue to wash downstream.

Removal of this platform and associated debris (beer kegs, shopping cart, etc.) is recommended. It should be noted that accessing this platform may be difficult, as the nearest access is from a privately owned property to the north between which there is dense vegetation and swampy terrain.

Crossing #32.1 – Montauk Highway
This crossing consists of a box culvert which passes under Montauk Highway. The culvert currently shows signs of a state of about 50 percent disrepair. This culvert also has a very large inlet drop which creates a high velocity through the culvert. Due to the large drop and high velocity, this culvert is considered a permanent barrier to fish passage, and should be modified. It should also be noted that approximately 10 feet south of the outlet of this culvert is a USGS gauge that does not have an associated weir.

Dam #22 – Swan Lake Dam
This is the first permanent barrier on Swan River. It is a large structure, approximately 1,500 feet in width along Montauk Highway, which impounds approximately 3 acre-feet of water within Swan Lake and shows slight signs of disrepair. The dam was originally constructed for the purpose of recreational uses, but there is limited public access to this lake. The NYSDEC is less inclined for dam removal on this river because of the excellent warmwater fishery located above the dam **(Guthrie, Chart; personal communication)**. Due to the current lack of a fish passage device, removal or at minimum, modification of the dam is recommended to allow for fish passage. Two conceptual fish passage designs (steeppass fishway and denil fishway) that would allow the passage of alewife at this location were prepared in 2001 by Curt Orvis of the USF&WS and are included in **Appendix D**.

Crossing #32.3 – Footbridge 20 feet North of Montauk Highway
This crossing is a wooden footbridge which is located just north of the inlet of the Montauk Highway culvert. The bridge is currently in good condition and does not present a barrier to fish passage. It should be noted that between this crossing and crossing #33, some accumulated floating debris, algae, leaves, etc. were noted on the surface, but the stream water was of sufficient depth (approximately 3 feet) to allow for the free passage of fish.

Crossing #33 – 300 feet South of Sunrise Highway
This crossing is a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage.

Crossing #34 – 200 feet South of Sunrise Highway
This crossing is also a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage.

Crossing #35 – Sunrise Highway
This crossing consists of two concrete box culverts underneath Sunrise Highway, which show slight signs of disrepair. Additionally, this culvert was nearly 300 feet long and dark, presenting a potential behavioral barrier to fish.

Crossing #36 – 60 feet South of Barton Road
This crossing is a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage.

Crossing #37 – Barton Road
This crossing consists of three round culverts made of metal. The crossing appears to begin as one large pipe on the upstream side which splits into three pipes on the downstream side. The culvert is currently collapsed which presents a permanent barrier to fish passage. The culverts should be maintained and/or replaced so as to not further impede fish passage. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage.

Crossing #37.1 – Woodside Avenue
This is the final crossing on Swan River, which consists of two elliptical concrete culverts, both of which are in good condition. This crossing does not currently present a barrier to fish passage; however, it should be noted that access to the inlet of the culvert is difficult due to a high locked fence and intervening vegetation.

2.3.4 Mud Creek

Although no features along Mud Creek are OPRHP-listed historical sites, most of the Creek is located within an archaeologically sensitive area. A total of 2 crossings and 2 dams were assessed, with both of the dams being characterized as permanent barriers during field investigations on Mud Creek (see **Figure 2-4**, **Table 2-5**). Each of these structures is characterized below.

Table 2-5
Dams and Crossings on Mud Creek

ID	Name/Location	Barrier
Dam 23	Robinson Pond Dam	Permanent
Crossing 38	Robinson Blvd at LIRR	None
Crossing 39	Montauk Hwy	None
Dam 24	Path SW/o Gazzola/Atlantic	Permanent
Dam 25	Gallo Duck Farm	Partial
Dam 26	500ft NW/o Gazzola and Atlantic	Permanent
Crossing 39.1	Gazzola Drive	Temporary

Dam #23 – Robinson Pond Dam
This is the first dam on Mud Creek as well as the first permanent barrier. The concrete dam, located at South Country Road, was built in 1914 for recreational purposes. The dam shows slight signs of disrepair as evidenced by cracks in the concrete. The roadway itself acts as the southernmost extent of the impoundment. A conceptual design for a proposed steeppass fishway that would allow the passage of alewife at this location was prepared in 2001 by Curt Orvis of the USF&WS and is included in **Appendix D**. Bond

Act funding was secured for the installation of a fish ladder, but no further progress has been made for installation of such a structure at this site (**McVoy, Chris; personal communication**). Currently, since there is no fish passage device present on the dam, and dam removal or modification is recommended to allow for fish passage.

Crossing #38 – Robinson Boulevard at the LIRR
This crossing spans both a roadway and railroad tracks. It consists of an embedded round culvert constructed of metal which is in good condition. This crossing is currently not a barrier to fish passage.

Crossing #39 – Montauk Highway
This crossing is a concrete box culvert which is currently in good condition. This crossing does not currently present a barrier to fish passage.

Dam #24 – Path Southwest of Gazzola Drive and Atlantic Street
This dam is an earthen berm which appears to have been constructed for the purposes of vehicular passage across the stream. Two (2) small diameter PVC pipes currently allow some water to pass through the earthen dam. Common reed (*Phragmites australis)* and Japanese knotweed vegetation are very dense both above and below this structure. The stream below the dam is very silty-sandy, shallow (approximately 2 inches) for a long distance and may not provide adequate fish passage during the summer season. Removal of this impoundment or installation of a large box culvert should be considered to allow for greater passage of water through this section of the Creek.

Dam #25 – Gallo Duck Farm
This dam is located approximately 225 feet north of Dam #24 on the former Gallo Duck Farm property. The farm is now owned by the Suffolk County Parks Department and is currently vacant. The earthen dam seems to have been washed away in several places and is heavily vegetated. Due to the vegetation and shallow water depth at the dam, it is considered a temporary barrier, as when water levels are higher, the dam may not present a barrier to fish passage. As the dam is no longer in use, and is already partially washed away, entire removal of the dam should be considered to allow for improved water flow and fish passage. It should be noted that access to this dam is difficult due to extensive stands of well-established *Phragmites* and thorny vegetation (e.g. multiflora rose, greenbrier, and wineberry).

Dam #26 – 500 feet Northwest of Gazzola Drive and Atlantic Street
This is the final dam encountered on Mud Creek. It is also located on the Gallo Duck Farm property and seems to have been originally constructed for creation of a farm pond. The metal pipes which allow for some streamflow through the earthen berm are almost entirely collapsed and rusted. During the inspection, a snapping turtle was observed trying to move upstream by attempting to enter the pipes. As this dam is no longer in use, and wildlife was observed trying to pass through collapsed and rusted pipes, this dam should be removed to allow for fish and wildlife passage. It should be noted that access to this dam is extremely difficult due to extensive stands of well-established *Phragmites* and thorny vegetation (e.g. multiflora rose, greenbrier, and wineberry).

Crossing #39.1 – Gazzola Drive
This is the final crossing located on Mud Creek, which consists of a single metal culvert which runs under the roadway. The culvert is currently approximately 90 percent blocked with sand which makes it a temporary barrier to fish passage. This culvert should be cleaned out and maintained to allow for the passage of fish and wildlife, and eventually replaced if possible.

2.3.5 Beaver Dam Creek

The tidal portion of Beaver Dam Creek, up to the Beaver Dam Road bridge, is considered a NYSDOS Significant Coastal Fish and Wildlife Habitat. Although no features along the river are OPRHP-listed historical sites, most of the river is located within an archaeologically sensitive area. A total of 14 crossings, 3 of which are barriers, were identified during field investigations (see **Figure 2-5**, **Table 2-6**). No dams were identified on the Creek. Each of these structures is characterized below.

Table 2-6
Crossings on Beaver Dam Creek

ID	Location	Barrier
Crossing 40	Beaver Dam Rd	None
Crossing 41	50ft S/o Gillespie Path	None
Crossing 42	Gillespie Path	None
Crossing 43	Montauk Hwy McLean Engin.	None
Crossing 44	419 South Country Rd	None
Crossing 45	423 South Country Rd	None
Crossing 46	423 South Country Rd	Temporary
Crossing 47	2 Trout Pond Ct	None
Crossing 48	Trout Pond Ct	None
Crossing 49	100ft N/o Trout Pond Ct	None
Crossing 50	LIRR	Temporary
Crossing 51	4ft N/o LIRR	Temporary
Crossing 52	100 ft S/o Montauk Hwy	None
Crossing 53	Montauk Hwy	None
Crossing 53.1	200ft W/o Old Town Road	Potential

Crossing #40 – Beaver Dam Road
This is the first crossing on Beaver Dam Creek which consists of a concrete box culvert which is almost entirely in disrepair. The culvert does not presently pose a barrier to fish passage, but should be repaired or replaced to prevent future obstructions to fish passage. Additionally, non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage.

Crossing #41 – 50 feet South of Gillespie Path
The crossing is the first bridge on Beaver Dam Creek which is constructed of wood and stone and is in good condition. It is currently not a barrier to fish passage; however, non-native vegetative species were identified at the crossing and should be monitored to prevent potential future vegetative barriers to fish passage.

Crossing #42 – Gillespie Path
This crossing is a concrete box culvert which shows signs of slight disrepair. Large amounts of sediment deposition were noted along the stream, which can potentially increase in the future and become a barrier. The culvert is currently not a barrier, but should be enlarged to prevent it from becoming a barrier in the future. Additionally, non-native vegetative species were identified at the crossing and should be monitored.

Crossing #43 – Montauk Highway, McLean Engineering
This crossing is unique in the sense that it is a building on stilts which is partially constructed over the Creek. This structure was originally constructed as an open air dining deck when the attached building used to operate as a restaurant. The deck has since become enclosed and the building is currently an office building occupied by McLean Associates. The wooden support posts show some signs of disrepair. This crossing is currently not a barrier to fish passage.

Crossing #44 – 419 South Country Road
This crossing is the first of several which are culverts under driveways to residential homes. This crossing in particular consists of two concrete round culverts which show signs of disrepair. Neither are currently barriers to fish passage.

Crossing #45 – 423 South Country Road
This crossing consists of a metal elliptical culvert which is in good condition. It is currently not a barrier to fish passage.

Crossing #46 – 423 South Country Road, South of the White Bridge
This crossing is the first temporary barrier which consists of a log jam. The blockage should be removed to allow for fish passage. Stream walks by volunteers should be performed on a regular basis to ensure that future log/debris jams are located and removed.

Crossing #47 – White Bridge
This crossing consists of a collapsing wooden bridge. It currently does not pose a barrier to fish passage, but should be removed or repaired to prevent a future blockage.

Crossing #48 – Trout Pond Road
This crossing consists of three round concrete culverts, one of which is not present upstream. The culverts show slight signs of disrepair and do not currently present a barrier to fish passage. It should be noted that a chemical odor resembling laundry detergent was noted at this crossing.

Crossing #49 – 100 feet North of Trout Pond Road
This crossing consists of two plastic round culverts which show signs of slight disrepair. Neither are currently barriers to fish passage.

Crossing #50 – LIRR
This crossing is the first to exhibit the flocculent indicative of a chemical spill or plume which is noted from this point north. It is a concrete round culvert which is almost entirely in disrepair, and is a temporary barrier to fish passage. The culvert should be repaired or replaced and the chemical spill between crossings 50 & 53 should be remediated (the spill was reported to NYSDEC Spills Division in August 2007).

Crossing #51 – 4 feet North of LIRR
This crossing is a temporary barrier which consists of a single short section of metal fence across the stream. The fence does not appear to have any particular function and should be removed to allow for fish passage.

Crossing #52 – 100 feet South of Montauk Highway
The crossing consists of a metal round culvert which is in almost entire disrepair. The culvert does not currently present a barrier to fish passage, but should be replaced to prevent future blockage.

Crossing #53 – Montauk Highway
This is one of the larger crossings on Beaver Dam Creek. It consists of a concrete round culvert which shows signs of disrepair. It currently does not pose a barrier to fish passage.

Crossing #53.1 – 200 feet West of Old Town Road
This is the final crossing located on Beaver Dam Creek. It is located at the unpaved roadway to a Town owned field. During the inspection of this crossing, no water was flowing within the channel. The culvert appeared to be in good condition, and if water was flowing, the culvert would not be expected to present a barrier to fish passage. However, due to the absence of water during the site visit in April 2008, this crossing is considered a potential barrier to fish passage.

2.3.6 Carman's River

The Carman's River is considered both a NYSDOS Significant Coastal Fish and Wildlife Habitat and a State Wild and Scenic Recreational River. Two historical features were identified along the River. The first is the Homan-Gerard House and Mills which is a nationally listed historic site (ID# 90NR01785). St. Andrew's Episcopal Church is also in the same vicinity as the mill house, and is also nationally registered (ID# 90NR01784). Most of the river is located within an archaeologically sensitive area. A total of 15 crossings and dams were identified, 6 of which are barriers, during field investigations on the Carman's River (see **Figure 2-6**, **Table 2-7**). Each of these structures is characterized below.

Table 2-7
Dams and Crossings on the Carman's River

ID	Name/Location	Barrier
Dam 27	Big Fish Creek	Partial
Crossing 54	20ft S/o LIRR	None
Crossing 55	LIRR at Wertheim	None
Crossing 56	Montauk Hwy	None
Crossing 57	Sunrise Highway	None
Dam 28	Suffolk Club Dam/Hard's Lake	Partial
Dam 29	Southaven Park Dam/C-Gate	Permanent
Crossing 58	Victory Blvd	None
Dam 30	USGS Gauge at LIRR	Permanent
Crossing 59	LIRR in Southaven Park	None
Crossing 60	LIE	None
Dam 31	Lower Lake Dam	Permanent
Crossing 61	Mill Rd, 50ft S/o Upper Lake	None
Dam 32	Upper Lake Dam	Permanent
Dam 33	Szuster Farms	Permanent
Crossing 62	E. Bartlett Rd	None
Crossing 63	Cathedral Pines Park Entrance	Potential

Dam #27 – Big Fish Creek Water Control Structure
Although Big Fish Creek is a tributary of Carman's River and not considered to be part of the main stem, this structure was identified by the USF&WS as a significant structure worthy of consideration within the comprehensive assessment of the river. Therefore, the location of this significant structure is included within the inventory, but no in-field assessment of this structure was conducted. The impoundment consists of a water control structure maintained by the USF&WS. It is considered a temporary barrier to fish passage, as it is a barrier to most fish species during the majority of the year. According to the USF&WS, eel are not obstructed by this structure; the structure is only easily passable by other fish species in summer when water draw down occurs simultaneously with spring high storm tides.

Crossing #54 - ~ 20 feet South of the LIRR in Wertheim National Wildlife Refuge
This is the first crossing encountered on the Carman's River. It consists of a metal bridge which shows slight signs of disrepair. It is currently not a barrier to fish passage.

Crossing #55 – Railroad at Wertheim National Wildlife Refuge
This crossing is an open bottom arch constructed of concrete which shows slight signs of disrepair. It is currently not a barrier to fish passage.

Crossing #56 – Montauk Highway
This crossing consists of a concrete bridge which is in good condition. It is currently not a barrier to fish passage.

Crossing #57 – Sunrise Highway
This crossing consists of two concrete box culverts which show slight signs of disrepair. Neither are currently barriers to fish passage.

Crossing #58 – Victory Boulevard
This crossing is a concrete box culvert which shows slight signs of disrepair. It is currently not a barrier to fish passage.

Dam #28 – Suffolk Club Dam at Hard's Lake
This dam is the first permanent barrier encountered on the Carman's River, just above Sunrise Highway and Victory Boulevard. It was originally the site of Carman's Mill, which dated back to at least the late 1700's, and was last reconstructed in 1915 for recreational purposes, but moved farther north to its present location in 1958 and is currently in good condition. The dam is nine feet high and impounds approximately 25 acre-feet of water within a 10-acre area known as Hard's Lake. The dam is not listed as an OPRHP historic site, although the site of the historic Suffolk Club & Hard Estate is in close proximity within Southaven County Park.

A steeppass fish ladder was installed at Hard's Lake by NYSDOT in March 2008. The designs were prepared by the NYSDOT Region 10 & USF&WS. This project represents the first permanent fish ladder on Long Island and will aid the restoration of alewife as well as a historic sea-run of brook trout to the river. The conceptual design for the steeppass fishway, prepared by Curt Orvis of USF&WS in 2001, is included in **Appendix C.** Although this fish passage device has been recently installed, removal of the dam in the future should be considered to allow for greater habitat connectivity within the lower reaches of the river.

Dam #29 – Southaven Park Dam (C-gate Dam)
This dam was originally constructed for recreational purposes. The dam shows slight signs of disrepair as evidenced by cracks in the concrete. The dam is 5 feet high and impounds 13 acre-feet of water over an 8 acre area. The dam currently lacks a fish passage device. Currently, Bond Act funding is allocated for the purpose of installing a fish ladder on this dam. The dam currently creates no impoundment upstream and its main use today is for fishing and crossing the river within Southaven Park. It should be noted that this crossing is inadequate and unsafe, and removing the dam may be the best social and ecological approach to allow full fish passage. Pedestrian passage could be accomplished with the installation of a bridge.

Dam #30 – LIRR at the USGS Gauge
This dam is a concrete weir constructed in association with a USGS Gauge. The structure currently acts as a barrier to fish passage, and modification of the structure or installation of a fish passage device is recommended, if possible.

Crossing #59 – LIRR in South Haven Park, at USGS Gauge
This crossing consists of a concrete open bottom arch which occurs over the USGS Gauge weir identified as Dam #27. It is currently in good condition and is not a barrier to fish passage.

Crossing #60 – Long Island Expressway

This crossing consists of two metal and concrete bridges with side slopes and abutments. The crossing totals 64 feet in length and the substrate of the crossing is comparable to that of the natural channel. Both are in good condition and neither presents a barrier to fish passage.

Dam #31 – Lower Lake Dam

This dam, located at Yaphank Avenue, was re-constructed in 1940 for recreational purposes. Originally, this dam was constructed for mill use in 1762. It is 12 feet in height and impounds 78 acre-feet of water over a 26 acre area. The dam is currently in good condition and does not contain a functioning fish passage device. Installation of a fish passage device is recommended. Non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage. The extensive non-native vegetation in Lower Lake significantly alters the plant structure and fish habitat within the lake. It should be noted that removal of this dam would restore natural, cool, flowing river conditions which do not favor the growth of non-native aquatic vegetation.

Crossing #61 – Mill Road, 50 feet South of Upper Lake

This crossing consists of two concrete and wood bridges that show slight signs of disrepair. Neither are barriers to fish passage. It should be noted that a local resident claimed that there may be a sewage spill break from the Mill House Inn. This same resident noted that an eel had been caught just below the dam approximately three (3) years ago.

Dam #32 – Upper Lake Dam

The dam was originally constructed in the 1740's for grist and saw mills. This dam was re-constructed in 1932 for recreational purposes and currently shows significant signs of disrepair as evidenced by erosion and deterioration of the wood and concrete. Water regularly seeps through the bulkhead and wingwalls, further weakening each structure and circumventing the spillway. The dam is 8 feet high and impounds 56 acre-feet over a 19 acre area. It should be noted that a local resident who also fishes in the area has noted that no perch have been caught in the last 10 years, and no catfish have been caught in the last 3 years. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future vegetative barriers to fish passage. The dam does not have a fish passage device, and either removal of the dam or installation of a passage device is recommended. Removal of this dam would restore habitat connectivity as well restore natural, cool, flowing river conditions which do not favor the growth of non-native aquatic vegetation.

Dam #33 – Szuster Farms Dam

This is the final dam located on the Carman's River which consists of an earthen dam previously used for farm access. Access is located from the Szuster farms property, but can be difficult if trying to access the dam through Suffolk County Parks Department property. This dam is almost entirely in disrepair, as one of the pipes which allows for water passage is collapsed. As this dam has no current use, it should be removed or modified to allow for fish passage.

Crossing #62 – East Bartlett Road

This crossing consists of a concrete box culvert which has collapsed on the downstream side. Despite its collapse, it is currently not a barrier to fish passage, but the culvert should be repaired or replaced and enlarged to prevent a future blockage.

Crossing #63 – Cathedral Pines Park Entrance

This is the last crossing encountered on the Carman's River. It consists of two culverts. The currently functioning round culvert is constructed of plastic and is in good condition. This culvert does not present a barrier to fish passage. The second culvert is an embedded elliptical culvert which is constructed of concrete and is almost entirely in disrepair. Despite the adjacent functioning culvert, the collapsed culvert presents a potential barrier to fish and should be replaced with a larger culvert to further facilitate fish passage.

3.0 ANALYSIS & RECOMMENDATIONS

The Diadromous Fish Work Group indicates that although alewife and American eel are the two priority diadromous fish species of focus for assessing barriers, concern also does get extended to other species of fish (e.g. trout, sunfish, perch) and wildlife. It is recognized that there are fewer sea-run brook trout than other species, but the brook trout's uniqueness, status as the state fish, recreational value, and role as an indicator species place great importance on them. Generally, any wildlife that preys on alewives is likely to prey on brook trout and would benefit from increases in the populations of both of these species.

In prioritizing tributaries for restoration, species-specific needs and restoration efforts should be considered. The diadromous fish technical report prepared for the Reserve Comprehensive Management Plan (**NYSDOS, 1999**) indicates that salmonid restoration efforts should be focused on supporting naturally spawning populations within tributaries proximal to existing inlets (e.g., Fire Island Inlet), which provide stable temperature regimes. Alewife restoration efforts do not relate to inlet proximity, as these species are less temperature-limited than salmonids, but should seek to promote preservation or enhancement of suitable habitat within tributaries to allow for natural alewife recovery between stronghold populations within the Reserve. NYSDOS (**1999**) further indicates that more information is required on the American eel's usage of the Reserve before restoration initiatives can be targeted. Smelt populations are also a concern in New York, but as they are at the southern extent of their range, a better understanding of the biology and habitat requirements of this species is required prior to restoration in this region.

Section 3.1 provides a characterization of current diadromous fish use within each of the six target tributaries in the study area. In **Section 3.2**, a scoring system for prioritizing the removal or modification of barriers to fish passage (e.g. inventoried dams) is presented. An Excel-based prioritization worksheet was prepared as a tool for comparing and scoring multiple criteria among dams to aid the decision-making process for barrier removal or modification by involved agencies and stakeholders. Barrier prioritization recommendations, preliminary design plans, cost estimates, timetables for construction, responsible entities, and potential funding sources are included within **Section 3.3** of this report.

3.1 Characterization of Fish Use in Target Tributaries

The U.S. Fish and Wildlife Service produced a GIS data layer of historical diadromous fish use which compiled the known extent of Reserve diadromous fish use in tributaries of Long Island based on information obtained from a NYSDEC 1938 biological survey. The results of this effort are discussed below and illustrated as the "Diadromous Fish Use" layer for each tributary in **Figures 2-1 through 2-6**. Additional known diadromous fish use observed within the six target tributaries is also presented below.

Carll's River

The Carll's River is known to support alewives and salmonids only up to Argyle Dam, the first permanent barrier on the River (**USFWS, 2005**). Above this dam, electrofishing surveys conducted by the NYSDEC since 1995 have recorded the presence of brown trout, as well as several occurrences of American eel. There have been no confirmed sightings of alewives above Argyle Dam. However, the well-protected watershed of the Carll's River provides potential spawning habitat for alewives, and unconfirmed sightings were observed by volunteers in 2006 (**Kritzer *et al*., 2007**).

Brown's River

The Brown's River has been identified as supporting salmonids and alewives up to the Mill Pond Dam (Dam #9) on the western branch, and up to the Lotus Lake Dam (Dam #10) on the eastern branch (**USFWS, 2005**). Electrofishing data from 1985 also recorded a population of brook trout, pickerel and American eel above Mill Pond. The 2007 alewife survey did not locate alewives in Brown's River; the river was not surveyed in 2006. However, no trout are currently known to occur above Lotus Lake, as the series of shallow impoundments collectively known as the Sans Souci Lakes result in waters too warm to support cold water fish. The 2007 barrier inventory identified a small, privately-owned wooden dam below the Mill Pond Dam immediately north of the LIRR crossing. This dam is not identified in the NYSDEC Dam Database, but does appear to be a barrier to migratory fish populations.

Swan River

The entirety of Swan River, including the tidal and freshwater segments, is a state-designated significant fish and wildlife habitat and maintains a recreational salmonid fishery of county-level significance (**NYSDOS, 1987**). This river is one of only six known locations on Long Island with a reproducing brook trout population, located above Swan Lake. According to the NYSDEC, there is an excellent warm water fishery above Swan Lake Dam (**Guthrie, personal communication**). Sea-run salmonids and alewives are known to occur up to the Swan Lake Dam at Montauk Highway (Dam #22) (**USFWS, 2005**). There has also been a confirmed sighting of a small number of alewives in the freshwater portion of the river in 2006 (**Kritzer, et al., 2007**). The 2007 alewife survey documented much larger numbers of alewives in Swan River than the handful observed in 2006. The brown trout occurring below the Swan River Dam make Swan River one of only five streams on Long Island which support significant concentrations of sea-run brown trout. Electrofishing data from 1994 to 2005 have recorded American eel as occurring within Swan Lake, as well as American eel, sea lamprey and American brook lamprey occurring above Swan Lake.

Mud Creek

No alewives are known to occur within any portion of Mud Creek, although sea-run salmonid populations have been identified up to the Robinson Pond Dam (Dam #23) (**USFWS, 2005**). Electrofishing data from 1991 through 2002 have recorded brook trout as well as significant numbers of American eel within the eastern branch of Mud Creek, above Montauk Highway. The NYSDEC and Cold Spring Harbor Fish Hatchery assisted the US Army Corps of Engineers in a survey of Mud Creek in September of 2005. During this survey, many brook trout were collected from the western tributary of Mud Creek above Montauk Highway. Eels were also

observed during this survey. It should be noted that the target of this survey was the restoration of Mud Creek, and due to the preliminary stage of these efforts, actual data regarding this collection is not currently available (**Megan Grubb, personal communication**).

Beaver Dam Creek

The tidal portion of Beaver Dam Creek, up to the Beaver Dam Road bridge, is a state-designated significant coastal fish and wildlife habitat and one of only five streams on Long Island which supports significant concentrations of sea-run brown trout. There are no dams or physical permanent barriers to migratory fish on this tributary. Therefore, salmonids and alewives have been known to occur along the entire length of the Creek (**USFWS, 2005**). The 2006 and 2007 alewife survey did not locate alewives within Beaver Dam Creek. However, the water quality within the freshwater portion of Beaver Dam Creek is currently highly degraded and not capable of supporting salmonid or alewife populations. Electrofishing data from 1996 only recorded small numbers of American eel and Eastern mudminnow within freshwater portions of the Creek.

Carman's River

Carman's River is one of only four relatively large, undisturbed, riverine ecosystems on Long Island, making it a state-designated significant coastal fish and wildlife habitat (both tidal and freshwater portions), as well as a state-designated wild and scenic recreational river (**NYSDOS, 1987**). This river is one of only six known locations on Long Island with a reproducing brook trout population. Sea-run brown trout occurring in the tidal portion below the Suffolk Club Dam (Dam #26) and Sunrise Highway provide a recreational fishery of regional significance. Brown and rainbow trout are currently stocked in the Carman's River each year by NYSDEC. The area below Suffolk Club Dam (Dam #28) is also known to be one of the few documented alewife spawning areas on Long Island (**NYSDOS, 1987**). Electrofishing data from 1990 to 2002 have recorded American eel as occurring below Crossing #60.

3.2 Dam Prioritization Methods and Criteria

Historically, the tributaries of Great South Bay were naturally free-flowing cold water streams that supported populations of diadromous fish species such as trout, alewives and American eel. Within the past two centuries, the construction of dams on these tributaries have created impoundments which promote warmer water temperatures and subsequently support fish populations which thrive in warm water, such as bass and sunfish. The removal of dams along target tributaries would ultimately have significant ecological benefits by restoring the connectivity of wildlife passage, improving diadromous fish habitat, and benefiting water quality within impacted stream systems.

However, ecological values (e.g. wildlife passage and water quality) must be considered in the context of other factors, including cultural values (e.g. economic and historic value), recreational values (e.g. excessive growth of aquatic vegetation), public safety (e.g. hazardous structures and flood control) and project feasibility (e.g. access issues). In order to assess the need for individual dam removal, a scoring system for prioritizing the removal or modification of

inventoried dams was developed using other prioritization tools being developed by the State of New Hampshire (**NHDES, 2003**), State of Massachusetts (**Leuchtenburg, personal communication**) and New York State (**USFWS, Undated**) as a basis for determining criteria to be considered when assessing dams for potential removal. The scoring system was constructed into an Excel-based prioritization worksheet, which was used to score each inventoried dam using recently collected or available information (**Appendix B**). The worksheets are automated and the resultant scores for each dam are tabulated in a summary prioritization matrix (see **Section 3.3** and **Table 3-1**) that allows comparisons among the 33 assessed dams. This prioritization matrix has been prepared as a tool for comparing and scoring multiple criteria among dams to aid the decision-making process for dam removal or modification by involved agencies and stakeholders.

The prioritization worksheets are comprised of five (5) categories consisting of several criteria for consideration. The categories are as follows and are further discussed in the proceeding sections:

- Hazard Mitigation and Public Safety
- Ecological Value
- Cultural Value
- Recreational Value
- Project Feasibility

Each item within each category was rated on a five point scale, or if data was unavailable, assigned an average score of "3" and indicated as "unknown" within the criteria's comment section. The scaling system was designed so that a higher score would reflect the greater need or support for dam removal or modification. Once all items were scored, the total score for each category was summed and incorporated into a "total score." Each category had a different number of criteria that were considered, and scores among each category were also corrected so that each category had an equal weight. Normalization was attained by dividing the total score for each category by the number of criteria within the category. The sum of the normalized categories was incorporated into a "cumulative average score." Both the total score and cumulative average scores were considered in the prioritization matrix. The matrix (**Table 3-1**) illustrates the results of weighing these wide-ranging concerns for each of the 33 inventoried dams within the study area.

In-stream and riparian habitat scores, as determined during field investigations using the US EPA's Habitat Assessment Worksheet for low-gradient streams (**Barbour *et al.*, 1999**), were utilized to score the Waterway Reach Condition criteria within the ecological values prioritization category. These habitat assessment scores rank a multitude of habitat conditions (e.g. available cover, pool variability, sediment deposition, sinuosity, bank stability, vegetative protection) with optimal conditions earning a highest possible cumulative score of 200 points. Poor in-stream and riparian habitat conditions will earn a stream the lowest numerical score. Habitat assessment worksheets for each crossing and dam are included as the last two pages of the Reserve Stream Barrier Inventory and Characterization Worksheets. The resultant cumulative habitat assessment scores for each assessed location are also included in the matrix

(**Table 3-1**) for comparison with assessment categories utilized in the dam prioritization worksheets.

3.2.1 Hazard Mitigation and Public Safety

Criteria in this category include items which reflect the structural integrity of the dam and regulations associated with the dam structure itself. Generally, a high score in this category would reflect a dam that has significant safety issues and is in need of repair, reconstruction, or removal to mitigate safety hazards. The cost of extensive dam repair or reconstruction often exceeds the cost of dam removal by as much as two-thirds (**Guthrie, personal communication**). Therefore, dams which do not provide substantial economic or cultural benefit should be considered for removal to defray the long-term costs of construction, maintenance, as well as hazards to public safety.

The following seven (7) criteria were considered within this category:

- *Dam Safety Enforcement* – A high score in this category indicates the dam being assessed has an outstanding Letter of Deficiency or Administrative Order issued by the NYSDEC Bureau of Flood Protection and Dam Safety. However, none of the inventoried dams within the study area currently have such a Letter or Administrative Order placed on them.

- *Dam Hazard Classification* – A high score in this category indicates the dam has been assigned a high or significant NYSDEC dam hazard classification. Hazard classifications are determined by NYSDEC based upon dam height and volume (gallons) of impounded water, as well as potential for the dam to cause hazards to downstream infrastructure:

  A. Low Hazard – Dam failure can damage only isolated farm buildings, vacant land or rural roads.
  B. Moderate Hazard – Dam failure can damage homes, major roads, minor railroads or interrupt use or service of relatively important public utilities.
  C. High Hazard – Dam failure can cause loss of life, serious damage to homes, industrial or commercial highways and railroads.
  D. No Hazard – Dam not built, or is breached, or failed to the extent that it no longer functions as a dam. Structure impounds no normal pool, and does not unduly impede the flow of water

  A NYSDEC dam safety permit is needed for any major repair work or alterations to a dam, including installation of fish ladders. It should be noted that some dams which are below 6 feet in height would not require a NYSDEC dam safety permit. For those dams not listed in the NYSDEC database, NP&V first determined whether a dam safety permit would be needed for major work on individual dams based upon the state's following criteria:

  < 6' height - No permit required
  6'-15' height and **< 3 million gallons** - No permit required
  15' height and **< 1 million gallons** - No permit required

A hazard classification was then determined by NP&V for unlisted dams based upon the criteria for a dam safety permit and the potential hazard to downstream infrastructure resulting from failure or mis-operation of the dam. Aerial photography overlayed with FEMA-designated Special Flood Hazard Areas (100-year floodplain) was utilized in determining potential impacts to infrastructure, such as downstream residential areas and roadways.

- *Dam Infrastructure Issues* – A high score in this category reflects that a dam has high levels of structural deficiencies, such as cracks, rusting, or eroded areas.

- *Dam Hazards to the Public* – A high score in this category indicates that removal of the dam would remove hazards to the public as a result of public access to the dam. These hazards could include hazards associated with falling off of the dam, hazards associated with injury on the dam structure itself, and hazards associated with accessing the dam.

- *Downstream Changes* – A high score in this category indicates that dam removal would cause significant changes to waterway width on the downstream side of the dam. Deeply cut, incised channels below existing dam structures are indicative of past breaches which may have occurred as mills and their associated dams became abandoned (**Walter & Merritts, 2008**). Although no hydrologic modeling was conducted to assess this criterion, current removal of a dam could also further incise a stream channel through bank erosion and cause significant widening of the waterway if the dam has a large storage capacity with a small outlet. Bank erosion and widening would likely be most significant in the area immediately below the stream channel, depending upon existing shape and width of the downstream channel. Downstream land uses below large, impounded areas were assessed to determine if residential structures or other infrastructure existed on the banks of the waterway which could be potentially impacted by increased channel flow. A widening of the downstream channel could be desirable in some cases from an ecological and recreational standpoint, but not if there is existing extensive infrastructure along the stream bank that has the potential to be negatively impacted. Small impounded areas would not be expected to result in significant downstream changes and were therefore assigned a low score.

- *FEMA Designation* – A high score in this category indicates that the dam is located in a Federally-mapped Special Flood Hazard Area (as depicted by presence of the 100-year flood plain on Flood Insurance Rate Maps).

- *Dam Age* – A high score in this category indicates a dam is approximately 50 years old or greater, which is the general life expectancy of a dam. Repair and renovation dates are considered when assessing this item.

3.2.2 Ecological Value

The impoundment of water behind dams causes significant alterations to historic, cold-water fish habitat within a stream channel. The backwater effect of an impoundment can be far-reaching upstream (**Walter & Merritts, 2008**), resulting in a broad, uniform expanse of shallow water which promotes the settling of fine silts and subsequent degradation of bottom-dwelling macroinvertebrate communities which are the main food source of many fish. Additionally, the shallow, slow-moving water warms to higher temperatures than would water flowing in the

natural stream channel, promoting the excess growth of algae and aquatic plants. The rapidly warming temperatures and low dissolved oxygen conditions that often occur within these impounded areas are not conducive to the sustainment of historic cold-water diadromous fish populations which are the target of this study.

Criteria in this category include items which reflect the status of the natural community surrounding the river, the potential for endangered species, the presence of invasive aquatic species, and the regulatory status of the river and surrounding areas as related to ecology. This category has the most items to consider, as many significant biological processes occur in both tidal and freshwater wetland systems.

The following 12 criteria were considered within this category:

- *Fishery Resource Value* – A high score indicates that the NYSDEC, USF&WS and/or others have identified removal of the dam as having a high likelihood to benefit migratory and/or resident fish population.

- *Existing Fish Passage* – A high score indicates that the dam is not equipped with an effective and functioning fish passage device.

- *Natural Resource Value* – A high score indicates that the NYSDEC, USF&WS and/or others have identified dam removal as highly likely to benefit wildlife, the river system, wetlands, water quality, or other natural resources.

- *Species of Concern Issues* – The Natural Heritage Program was contacted to determine if any endangered, threatened, or special concern species were present within the study area. A high score indicates that either no known sensitive species exist in the vicinity of the dam being assessed, or that listed sensitive species would not be negatively impacted by dam removal.

- *Invasive Species* – A high score indicates that there are currently high levels of aquatic invasive plants within the impounded area of the dam being assessed. There has been an increased desire to consider dam removal to assist in reduction of non-native, invasive plant species that thrive within impounded water (**Kritzer, 2007**). Dams cause areas of calm impounded water which favor the growth of numerous species of submerged, floating and emergent aquatic vegetation. Excessive growth of aquatic vegetation, particularly aggressive non-native species, can cause significant structural alterations of fish habitat and create barriers to foraging fish (**Lillie & Budd, 1992; Boylen et al., 1999**) as well as impediments to human recreation. Solutions for the removal of excessive vegetation vary greatly and include mechanical as well as chemical methods of control. However, there are advantages and disadvantages for each of the methods. For example, advantages to mechanical methods of control include lesser impacts to the surrounding environment (due to mechanical control being localized to the target area), and a high degree of effectiveness (**Boone et al. 1987**). Disadvantages to mechanical control as compared to chemical control include the need for high amounts of manpower, high cost associated with the manpower needed, and cost of materials needed for removal. In contrast, chemical control is advantageous in the sense that it is lower in cost than mechanical removal, but is disadvantageous due to the potential effects herbicides can have on the surrounding environment, particularly if appropriate products are not used or not applied correctly.

- *Wetlands* - A high score indicates that dam removal would not significantly affect wetlands in the waterway reach. Impacts to wetlands in the waterway reach may be considered positive or negative, depending upon several ecologic, economic, cultural and recreational values. For example, potential negative affects caused by removal of a dam could include a decrease in the area of impounded wetlands upstream of the dam, thereby decreasing potential habitat for sensitive aquatic species (if present) and reducing potential warm-water fishing habitat for recreational fishermen. However, potential positive impacts could include removing barriers to migratory fish passage, lowering temperatures within the wetland to facilitate re-establishment of native cold water diadromous fish, as well as increasing water flow to reduce conditions favorable to the establishment and choking growth of invasive aquatic plant species.

  The NY Natural Heritage Program (NHP) was contacted to determine if there were any sensitive, threatened or endangered plant or animal communities present within the vicinity of each of the investigated tributaries. According to the NHP, several sensitive plant communities, plants and one sensitive bird are currently known to occur in the immediate vicinity of some of the inventoried crossings and dams. Although none of the individual species were directly observed during field work, the recent records from the NHP are identified in the Additional Notes/Observations section of the datasheet for each pertinent crossing or dam. Historical plant records identified by the NHP are not considered within this analysis, as no recent information and no definitive location of these historic plant assemblages could be provided.

  On the Carll's River, both a red maple-black gum swamp community and the prothonotary warbler (a NYS-protected bird) were identified as being within the immediate vicinity of Dams 2 and 3. The extensive red maple-black gum swamp community occurs along the stream and associated lakes within Belmont Lake State Park. The swamp is of such large size and good condition that it is considered significant from a statewide perspective. The prothonotary warbler was specifically observed in 2000 utilizing the stream edge within the portion of the swamp located between Belmont Lake and Park Avenue. As fluctuating water levels and occasional flooding are characteristic of the swamp community, the increase in stream flow which would result from removal of existing dams on the Carll's River is not anticipated to negatively affect this plant community or its associated animal and individual plant populations. The removal of dams would in fact foster the desirable, natural and braided pathways of the river throughout this swamp.

  On the Big Fish Creek tributary of the Carman's River, high salt marsh is currently documented in the vicinity of Dam 27. Although high salt marsh has no legal status other than being a regulated wetland community, this very large area of marsh is in good to fair condition and therefore, is considered significant from a statewide perspective. Changes in water flow due to modifications at the dam's control structure would not have any negative consequences on the tidal marsh community as long as the footprint of disturbance during construction was minimized to the maximum extent practicable.

- *Waterway Reach Condition* – A high score is indicative of poor water quality within the impoundment, which would be positively impacted by dam removal that would aid increased flushing, lower temperatures, and reduced use by detrimental geese populations. In-stream habitat scores assigned in the field using the USEPA's Habitat Assessment Worksheet for low-gradient streams (**Barbour *et al.*, 1999**) were considered as part of this assessment item.

- *Sedimentation* – A high score indicates that dam removal is not likely to release contaminated sediment.

- *State Wild & Scenic River* – A high score indicates the dam is located on a waterway segment designated as a State Wild & Scenic River. The Carman's River is the only designated State Wild & Scenic River among the six assessed tributaries. Therefore, the Carman's River receives a score of "5", whereas the remaining tributaries receive a score of "1".

- *Habitat Significance* – A high score indicates the dam is located on a waterway segment designated as a Significant Coastal Fish & Wildlife Habitat. This designation applies to the entirety of the Swan River, the Carman's River and the tidal portion of Beaver Dam Creek. As there are no dams located on Beaver Dam Creek, only dams encountered on the Swan River and Carman's River are assigned scores of "5" for this criterion.

- *Headwater Length Above Dam (Distance to the next impassible barrier)* – A high score indicates a significant length of reach above the impoundment would be reintroduced to migratory fish populations if the dam were to be removed or modified to allow fish passage.

- *Dam Proximity to Mouth* – Higher scores indicate proximity of the dam to the mouth of the tributary.

3.2.3 Cultural Value

Criteria in this category reflect the cultural value associated with dams on the tributary. This category considers historical significance as well as economical and recreational values which may be attributed with a dam. The New York State Office of Parks and Historic Preservation on-line database was utilized to determine whether inventoried structures were listed or in the near vicinity of structures on the National or State Register of Historic Places, as well as whether the structures were located in or adjacent to archaeologically-sensitive areas.

The following 8 criteria were considered within this category:

- *Economic Value* – A high score indicates that the dam, its impoundment and/or associated facilities do not provide a significant economic benefit to the community and/or region (e.g., flood control, recreation).

- *Historic Value* – A high score indicates that the dam and/or its surroundings are not listed on the National or State Register of Historic Places, and are not likely to be determined eligible for listing.

- *Archaeological Site Assessment* – A high score indicates that the dam and/or its surroundings will not require either a Phase I or II Archaeological Survey to be completed if dam removal or significant modification occurs.

- *Abutter Issues* – A high score indicates that it is unlikely that abutters to the impoundment would lose their preferred use(s) of the waterbody if the dam were removed.

- *Infrastructure Issues* – A high score indicates that bridges wells, utility crossings, etc. would not be significantly affected by dam removal.

- *Community Resource Value* – A high score indicates it is unlikely that the dam and/or impoundment hold significant sentimental value to the community.

- *Consistency with Existing Plans* – A high score indicates a comprehensive plan exists for the waterway that supports the waterway restoration through dam removal. The South Shore Estuary Reserve Comprehensive Management Plan, Brown's River and Swan River Watershed Management Plans were reviewed to determine whether any existing structures were recommended for dam removal. However, these plans gave general recommendations for assessing feasibility of improvements to fish passage and therefore, most structures were assigned a median score of "3". As there are currently no plans that specify support for removal of a particular structure, only those structures with an existing plan & funding for installation of a fish ladder are assigned a score of "5". The dam nearest Montauk Highway on the Sans Souci lakes, for example, have a more specific recommendation of creating "step ponds" to allow for fish passage, as plans to reconstruct the dam are currently being considered (**McVoy, personal communication**).

- *Original Purpose of Dam* – A high score indicates the dam does not support its original intended function.

3.2.4 Recreational Value

Criteria in this category reflect the recreational value associated with dams on the tributary. The following 3 criteria were considered:

- *Boating Resource Value* – A high score indicates that free-flowing portions of the waterway are significantly valued for their existing and/or potential recreational use for boating (e.g., canoeing, kayaking, rowing).

- *Multiple Recreational Values* – A high score indicates that the impoundment created by the dam does not provide a significant recreational resource for boating, swimming, skating, fishing, etc.

- *Regionally Unique Recreational Value of Free-Flowing Portions of Stream* – A high score indicates that free-flowing portions of the waterway provide a unique regional recreational resource. Only the Carman's River has achieved this status among the six assessed tributaries, and therefore, it was the only tributary to be assigned a score of "5".

3.2.5 Project Feasibility

Criteria in this category reflect access and funding feasibility associated with removal or modification of a dam. These criteria are critical for determining dam removal or modification potential, as lack of access and funding are non-starters. The following 3 criteria were considered:

- *Access to the Dam* – A high score indicates that equipment can access the dam with limited or no adverse impact to the surroundings.

- *Land Access Issues* – A high score indicates that easements are not likely to be required to access the dam for removal/modification.

- *Project Funding* – A high score indicates that funding has already been set aside or that there is a high likelihood that sufficient funding will be obtained for the project (e.g., dam owner, public funding, private funding). This is hard to determine for some funding sources that are contingent upon budgeting. Several dams in the study area were assigned a score of "5" as they currently do have funding present for fish ladder installation through the NYS 1996 Clean Air/Clean Water Bond Act. These funded fish ladder projects are located at Swan Lake Dam (Dam #22) (Swan River), Robinson Pond Dam (Dam #23) (Mud Creek), Suffolk Club Dam (Dam #28), Southaven Park Dam (Dam #29), Lower Lake Dam (Dam #31) and Upper Lake Dam (Dam #32) (Carman's River). Additional funding is also likely for further improvements on Mud Creek, as Suffolk County and the U.S. Army Corps of Engineers are interested in fish habitat restoration to complement recent Gallo Duck Farm clean-up efforts in this tributary (**Kritzer et al., 2007**). The Suffolk County Department of Public Works and Suffolk County Parks also have improvements considered on Brown's River at Lotus Lake Dam and the Sans Souci dams using the 0.25% County real estate fund.

It should also be noted that dam owner willingness is of utmost importance for determining the feasibility of dam remediation and owners should be contacted as a follow-up to the barrier characterization and prioritization provided in this document.

Table 3-1

Prioritization Matrix

						Assessment Category - Average Score					
SSER Dam #	**NY ID #**	**Dam Name ***	**Location**	**River**	**Habitat Score**	**Hazard Mitigation & Public Safety**	**Ecological Value**	**Cultural Value**	**Recrea-tional Value**	**Project Feasi-bility**	**Cum. Avg. Score**
1	249-0356	Argyle Dam *	Argyle Park	Carll's	105	2.4	3.3	1.9	1.3	**5.0**	14
2	N/A	USGS Gauge	Southard's Pond	Carll's	158	2.0	3.1	2.8	2.7	4.3	15
3	249-0357	Southard's Pond Dam *	Southard's Pond	Carll's	148	**3.6**	3.3	2.6	1.3	4.3	15
4	249-0358	Elda Lake Dam *	Elda Lake	Carll's	-	2.4	2.8	2.8	2.7	4.7	15
5	249-0354	Belmont Lake Dam *	100 ft N/o Southern State	Carll's	122	1.9	2.8	2.9	2.0	4.0	13
6	N/A	N/A *	Long Island Ave	Carll's	167	2.9	2.5	3.5	2.7	4.7	16
7	N/A	N/A	200ft E/o Woodbury Rd	Carll's	171	1.7	1.9	4.0	2.3	3.0	13
8	N/A	N/A	N/o LIRR	Brown's	148	2.4	4.1	**4.5**	3.3	4.3	19
9	251-0495	Mill Pond Dam *	Montauk Hwy	Brown's	169	2.9	3.3	3.1	2.3	**5.0**	17
10	251-4753	Lotus Lake Dam *	S/o Lotus Lake	Brown's	183	2.7	3.6	3.6	2.3	**5.0**	17
11	N/A	N/A	Montauk Hwy	Brown's	169	2.7	3.3	3.4	3.0	4.7	17
12	N/A	N/A	400ft N/o Montauk Hwy	Brown's	159	2.6	3.3	4.0	3.0	3.0	16
13	N/A	N/A	600ft N/o Montauk Hwy	Brown's	164	2.6	2.8	4.0	3.0	3.0	15
14	N/A	N/A	SW of Girl Scout Center	Brown's	164	2.6	2.7	4.0	3.0	3.0	15
15	N/A	N/A	NW/o Girl Scout Center	Brown's	164	3.0	2.7	4.0	3.0	3.0	16
16	N/A	N/A *	W/o Girl Scout Center	Brown's	164	2.7	2.7	4.0	3.0	3.0	15
17	N/A	N/A	W/o Girl Scout Center	Brown's	164	3.0	2.7	4.0	3.0	3.0	16
18	N/A	N/A	W/o girl scout camp pools	Brown's	143	2.4	2.7	3.6	3.0	3.0	15
19	N/A	N/A	NW/o Girl Scout Pools	Brown's	171	2.3	2.7	3.6	3.0	3.0	15
20	N/A	N/A	NW/o Girl Scout Pools	Brown's	164	2.1	2.7	3.6	3.0	3.0	14
21	N/A	N/A	NW/o Girl Scout Pools	Brown's	170	2.3	2.8	3.6	3.0	3.0	15
22	252-0540	Swan Lake Dam *	Montauk Hwy	Swan	131	1.9	3.8	2.6	2.3	**5.0**	16
23	252-0545	Robinson Pond Dam *	South Country Road	Mud	116	1.9	3.3	3.5	1.7	**5.0**	15
24	N/A	N/A *	Path SW/o Gazzola/Atlantic St.	Mud	143	2.1	4.1	4.4	2.3	3.3	16
25	N/A	N/A	Gallo Duck Farm	Mud	139	3.0	3.6	4.9	2.3	2.0	16
26	N/A	N/A	500ft NW/o Gazzola/Atlantic St.	Mud	116	3.0	3.8	4.9	2.3	2.0	16
27	N/A	N/A	Big Fish Creek Pond	Carman's	-	2.3	3.4	2.6	2.3	4.3	15
28	252-0593	Suffolk Club Dam (Hard's Lake Dam) *	N/o Victory Blvd Southave	Carman's	**193**	2.3	4.0	2.8	4.7	**5.0**	19
29	252-4519	Southaven Park Dam (C Gate Dam)	1425ft to the NW of Sunse	Carman's	183	2.1	4.4	3.5	5.0	**5.0**	**20**
30	N/A	USGS Gauge	LIRR	Carman's	181	2.0	3.8	2.8	**5.0**	4.0	18
31	252-4520	Lower Lake Dam *	Yaphank Ave	Carman's	159	2.0	**4.6**	2.0	3.7	**5.0**	17
32	252-4519	Upper Lake Dam *	Upper Lake	Carman's	135	2.4	4.5	2.8	3.7	**5.0**	18
33	N/A	N/A	Szuster Farm	Carman's	192	2.6	3.3	4.0	5.0	3.0	18
				mean	157	2.4	3.3	3.5	2.9	3.9	16
				min	105	1.7	1.9	1.9	1.3	2.0	13
				max	193	3.6	4.6	4.9	5.0	5.0	20

* Indicates NYSDEC Dam Safety Permit is required.

3.3 Crossing Prioritization Methods and Criteria

3.3.1 Ecological Value

Criteria in this category include items which reflect the status of the natural community surrounding the river, proximity of other barriers to fish passage, as well as the regulatory status of the river. Only those crossings which have been identified as being a barrier to fish passage are identified in the crossing prioritization matrix (**Table 3-2**) below.

The following six (6) criteria were considered within this category:

- *Fishery Resource Value* – A high score indicates that restoration or modification of the crossing would have a high likelihood to benefit migratory and/or resident fish population.

- *Waterway Reach Condition* – A high score indicates a high habitat assessment score, which reflects the habitat conditions within 300 feet of the crossing.

- *State Wild & Scenic River* – A high score indicates the crossing is located on a waterway segment designated as a State Wild & Scenic River. The Carman's River is the only designated State Wild & Scenic River among the six assessed tributaries. Therefore, the Carman's River receives a score of "5", whereas the remaining tributaries receive a score of "1".

- *Habitat Significance* – A high score indicates the crossing is located on a waterway segment designated as a Significant Coastal Fish & Wildlife Habitat. This designation applies to the entirety of the Swan River, the Carman's River and the tidal portion of Beaver Dam Creek.

- *Headwater Length Above Crossing (Distance to the next impassible barrier)* – A high score indicates a significant length of reach above the crossing would be reintroduced to migratory fish populations if the crossing were to be restored or modified to allow or improve fish passage.

- *Crossing Proximity to Mouth* – Higher scores indicate proximity of the crossing to the mouth of the tributary.

3.3.2 Project Feasibility

Four (4) criteria were considered for this category, which include factors for access and cost issues, the primary influences when determining project feasibility for crossings.

- *Access to the Crossing* – A high score indicates that equipment can access the crossing with limited or no adverse impact to the surroundings.

- *Land Access Issues* – A high score indicates that easements are not likely to be required to access the crossing for restoration/modification.

- *Short Term Project Cost* – A high score indicates that immediate action regarding the crossing (modification or removal) would have a low cost associated with the action.

- *Long Term Project Cost* – A high score indicates that long term project costs (e.g. on-going maintenance or modification/removal) would be relatively low.

Table 3-2
Crossing Prioritization Matrix

				Assessment Category – Average Score			
SSER Crossing #	**Location**	**River**	**Habitat Score**	**Ecological Value**	**Project Feasibility**	**Cum. Avg. Score**	**Total Score**
16	Park Trail	Carll's	153	2.7	4.5	7	34
18.2	Grass Carp Gate	Carll's	118	2.7	3.3	6	29
18.3	550 ft S/o August Road	Carll's	147	2.3	**5.0**	7	34
20	August Road	Carll's	125	2.0	4.0	6	28
23	North Wyandanch Park	Brown's	143	2.2	4.3	6	30
27	LIRR N/o Middle Road	Brown's	175	2.5	3.3	6	28
27.1	Montauk Hwy	Brown's	169	3.3	3.8	7	35
32	LIRR	Swan	**192**	3.5	3.0	7	33
32.1	Montauk Hwy	Swan	131	3.7	3.8	7	37
33	300' S/o Sunrise Highway	Swan	180	2.5	3.0	6	27
34	200' S/o Sunrise Highway	Swan	180	3.0	3.0	6	30
36	60' S/o Barton Road	Swan	166	2.3	3.3	6	27
37	Barton Road	Swan	128	3.2	3.8	7	34
39.1	Gazzola Drive	Mud	139	3.0	3.8	7	33
46	423 South Country Road	Beaver Dam	150	3.0	4.0	7	34
50	LIRR	Beaver Dam	157	3.0	2.8	6	29
51	4' N/o LIRR	Beaver Dam	157	3.5	4.0	**8**	37
63	Cathedral Pines Park Entrance	Carman's	177	**4.5**	3.8	**8**	**42**
		mean	155	2.9	3.7	7	32
		min	118	2.0	2.8	6	27
		max	192	4.5	5.0	8	42

3.4 Implementation of Prioritization Strategy

3.4.1 Prioritization of Dams

Dam removal is the only technique that allows passage of all fish and wildlife species, as well as improves in-stream fish habitat for historic diadromous fish runs by moderating temperatures, improving dissolved oxygen, alleviating eutrophication problems and making conditions less

amenable to invasive, non-native aquatic plants. These habitat improvements cannot be accomplished by the installation of fish ladders. Dam removal should be a high priority when any of the following conditions occur:

- Dams are unsafe or failing
- Dams no longer serve a practical function
- Cost of fish ladder design and installation is not feasible
- Fish survival or reproduction of desirable fish species within the impoundment is compromised by high temperatures and low dissolved oxygen levels

To systematically prioritize the restoration of the 33 dams inventoried within the study area, the prioritization matrix illustrated in **Table 3-1** can further be summarized according to the overall value of a tributary for prioritization. In addition to inclusion of observed in-stream habitat conditions as a partial component within the ecological value criteria, field-assessed in-stream and riparian habitat scores were also included side by side in **Table 3-1** with the assessed dam prioritization values described in **Section 3.2** for comparison purposes. Those dams with higher habitat scores are good candidates for barrier modification because removal of the barrier would open up a segment of stream with higher quality fish habitat. **Table 3-3** illustrates that among the five tributaries containing dams, the Carman's River clearly has the greatest potential for successful dam restoration projects, as it achieved the highest field-assessed habitat scores in observed riparian and in-stream habitat, as well as highest scores for cumulative ecological value and recreational value. Within the Carman's River, the restoration at the Southaven County Park Dam received the single highest total score for prioritization; an Alaskan steep pass fish ladder is proposed to be installed at this location.

Table 3-3
Dam Prioritization Values among Target Tributaries

River	Habitat Score	Avg. Hazard Mitigation	Avg. Ecological Value	Avg. Cultural Value	Avg. Rec. Value	Avg. Project Feasibility	Avg. Cum. Avg. Score	Avg. Total Score
Carll's	145	2.4	2.8	2.9	2.1	4.3	15	93
Brown's	164	**2.6**	3.0	3.8	2.9	3.5	16	104
Swan	131	1.9	3.8	2.6	2.3	**5.0**	16	101
Mud	129	2.5	3.7	**4.4**	2.2	3.1	16	**113**
Carman's	**174**	2.2	**4.0**	2.9	**4.2**	4.5	**18**	**113**

Note: Scores in bold indicate highest value and/or feasibility for dam removal or modification.

One other dam shares the highest total score for prioritization, the small wooden dam (Dam #8) located just above the LIRR on the Brown's River. Dam #8 appears to have no current functional use, is deteriorated, is situated in a valuable fish habitat area, is the first impoundment to diadromous fish passage on the west branch of the Brown's River, possesses no recreational or cultural value, and could be restored at a very low cost (likely without the need for any

machinery) by the hand removal of a few slats of wood above the LIRR crossing. The owner of this privately-owned dam should be contacted to discuss its removal.

Individually, Southard's Pond Dam on Carll's River currently poses the greatest threat to public safety, as this dam impounds a large volume of water, is located in a FEMA-designated Special Flood Hazard Area, and has been reported by NYSDEC to be degraded and in need of substantial repairs or reconstruction. Collectively, the scores for the Brown's River illustrated the greatest potential hazards to public safety due to decaying dams, as it contained several large impounded areas located above FEMA-designated Special Flood Hazard Areas and with potential for causing damage to homes, major roads, minor railroads or interrupted use or service of relatively important public utilities. The Lotus Lake Dam and the dam above Montauk Highway on the east branch were of particular concern regarding hazard mitigation and public safety.

Mud Creek exhibited the highest overall prioritization scores for cultural value because it is expected to have the least amount of public opposition to the removal or modification of its two (2) dams. A fish ladder is currently proposed for installation at the Robinson Pond Dam through funding from the 1996 Clean Air/Clean Water Bond Act. Conceptual design plans for this fish ladder are included in **Appendix C**. Additionally, Suffolk County and the U.S. Army Corps of Engineers are interested in fish habitat restoration to complement the recent Gallo Duck Farm clean-up efforts (**Kritzer et al., 2007**). Although no alewives are currently known to occur within the tidal section of Mud Creek, sea-run salmonid populations have been identified up to the Robinson Pond Dam and electrofishing data have recorded brook trout as well as significant numbers of American eel within the eastern branch of Mud Creek, above Montauk Highway (**DEC Electrofishing data, 2007**). Therefore, modification of Dam #24 through possible installation of an appropriately-sized box culvert is strongly recommended.

Each tributary was identified to have at least one dam with optimal feasibility for modification due to current support, funding and access for installation of a fish ladder. Overall, the Swan River scored the highest in project feasibility, as it only contained one dam, which currently has funding and plans for fish ladder installation. Conceptual design plans for this fish ladder are included in **Appendix C**.

Following the Swan River, the Carman's River had the next highest feasibility scores, as at least three (3) dams on this river currently have funding for fish ladder installation. The first fish ladder on the Carman's River above Sunrise Highway, Suffolk Club Dam at Hard's Lake, was installed in March 2008. Conceptual design plans for this fish ladder are included in **Appendix C**. Funding for fish ladders is also available for the Southaven Park Dam (C-gate Dam) and Upper Lake Dam.

While installation of fish ladders may allow for passage of a number of migratory fish, one ladder type will not be suitable for passage of all fish species and optimal connectivity of habitat will not be achieved, and continuity of this regionally-significant river for recreation also will not be achieved. Furthermore, although fish ladders enable fish to pass dams that would otherwise be complete barriers, the impacts of multiple fish ladders on rivers with multiple dams have been

previously documented. As the number of fish ladders increases on a river, the number of fish making it upstream is considerably reduced (**Lenhart, 2000**). The number of fish which successfully migrate downstream past dams and reach the ocean is even further reduced (**Bickford & Skalski, 2000**). Consequently, fish passage projects occurring upstream of multiple dams are likely to have limited fish passage benefits, even if the passage structure itself is effective (**Lenhart, 2000**). Additionally, even if a fish ladder is considered to be 100% effective, a ladder may prove to be insufficient for maintaining the balance of a migratory population in the long term (**Larinier, 2000**).

Removal of all dams should also be carefully considered for the purpose of reducing long-term maintenance costs for these structures, as well as for the long-term benefit of managing nuisance aquatic plant species.

Currently, options for the removal of Carolina fanwort (*Cabomba caroliniana*) and variable milfoil (*Myriophyllum heterophyllum*) from Upper and Lower Lakes on the Carman's River are being considered by the Town of Brookhaven, Suffolk County and local residents. Control measures that are being considered include, but are not limited to harvesting, aquatic herbicides, benthic barriers, grass carp, dredging and dam removal. Of the vegetation control options being considered, the only one that also removes the barriers to fish passage at Upper and Lower Lakes is removal of the dams.

The following costs, timetables for construction, responsible entities and funding sources have been identified for dams within the study area. Conceptual design plans prepared by Curt Orvis of the USF&WS in 2001 for fish ladders targeted at alewife passage on the Swan River, Mud Creek and Carman's River are provided in **Appendix C** as template preliminary design plans for other dams in the study area. Costs are based on water quality improvement project applications for state assistance submitted by the Suffolk County Department of Public Works and the Town of Brookhaven in 2004/05 to fund the installation of fish passage structures on the Swan River, Mud Creek, Brown's River and Carman's River. Additional potential funding sources for those dams without current funding are included in **Appendix D.**

The design, permitting and installation of fish passage devices or removal of larger dams are anticipated to require a 1 to 3 year time frame for completion. Smaller scale projects, such as removal of minor earthen or wooden dams, may only require 6 months for permitting and removal. The design, permitting and installation of moderate structures such as step pools would likely require approximately 1 year for completion. Additionally, a 5 year monitoring period is recommended for projects involving installation of fish passage structures to determine how well the structure is functioning.

For dams that currently do not have specific improvement recommendations, the following fish passage improvements should be considered: installation of an Alaskan Steeppass fish ladder, step pools, rock ramps, or dam removal.

Alaskan Steeppass fish ladders are known as "baffle fishways" which use a series of symmetrical close-spaced baffles in a channel to redirect the flow of water, allowing fish to swim around the

barrier. Benefits of this type of fish ladder include the lack of need for resting areas, although they can be included if so desired. Cost associated with this type of fish ladder was approximated at $400,000 for Robinson Pond Dam on Mud Creek.

Step pools are meant to be grade control structures which are meant to have more natural stream features (**Hegberg et al., 2001**). Benefits associated with step pools include resistance to flood flows and a natural appearance within the stream. The cost for step pools is significantly less than an Alaskan Steepppass fish ladder, as an estimate from 2004 for Lotus Lake along Brown's River totaled $60,000 for the entire project.

Rock ramps form a sloped passage up a "drop" to allow for some fish to pass upstream, but not all species. These ramps would preserve the impoundment created by the dam. The ramp itself, however, would only provide for fish passage and would not improve upstream habitat. Cost estimates for local projects were not available; however, costs may be comparable to installation of step pools and fish ladders dependent upon selected design.

Dam removal is considered ideal in most situations. Theoretically, fish passage would be restored as well as connectivity of habitat and improvements in water quality. However, larger dam removal projects need to be carefully assessed, as removal can have significant impacts to surrounding areas due to the size of the impounded area and characteristics of impounded bottom substrates. Costs associated with removal of minor dams (e.g. Dam #8) are expected to be minimal, only requiring the cost of permitting and labor for hand removal of wooden slats. However, removal costs for earthen or more structural dams are anticipated to be approximately $200,000 to $300,000, dependent upon the size of the structure, machinery required, need for sediment sampling, and greater logistical coordination.

The following provides recommendations for each dam. If available, project specific costs are also included as identified in water quality improvement project applications submitted by the Suffolk County Department of Public Works and the Town of Brookhaven in 2004/05.

Carll's River: Dam #1 – Argyle Dam

Due to this dam being the first on the Carll's River, it should be considered a priority for modification or removal. Approximately 1 mile of upstream habitat would be reintroduced to migratory fish populations. Modification of this dam is considered the most feasible as there is easy access to the dam and it is anticipated that funding would be available for this site. Further engineering studies should be performed in order to determine the best method for fish passage improvement on this dam. The Village of Babylon would be responsible for implementing modifications to this dam.

Carll's River: Dam #2 – USGS Gauge at Southard's Pond

This dam is a weir that is associated with a USGS gauge. Eel may be able to pass the weir, but other fish species or smaller fish life stages may not be able to pass. As such, modification with an appropriate fish passage method should be implemented, or if possible, the weir should be removed and an alternative method for data collection should be implemented. Both the federal government and the State of New York would be responsible for implementing modifications to this dam.

Carll's River: Dam #3 – Southard's Pond Dam **Priority*
This dam is considered a priority due to its high score in the "Hazard Mitigation and Public Safety" category. No specific recommendations have been made for this dam, but an engineering study should be performed to determine which modification is the most appropriate for this dam. The State of New York would be responsible for implementing modifications to this dam.

Carll's River: Dam #4 – Elda Lake Dam
This dam currently functions to retain stormwater and creates the impoundment known as Elda Lake. No specific recommendations have been made for this dam, but an engineering study should be performed to determine which modification is the most appropriate for this dam. Suffolk County would be responsible for implementing modifications to this dam.

Carll's River: Dam #5 - Belmont Lake Dam
Belmont Lake Dam, located approximately 100 feet north of the Southern State Parkway, was originally constructed as part of the private Belmont Estate. The dam is currently in good condition but lacks a device for fish passage, which should be installed. No specific recommendations have been made for this dam, but an engineering study should be performed to determine which modification is the most appropriate for this dam. The State of New York would be responsible for implementing modifications to this dam.

Carll's River: Dam #6 – Above Long Island Avenue
This dam appears to have been constructed for the purposes of flood control and is comprised of earth, concrete and metal. The dam is almost entirely eroded/rusted and has no fish passage device. The dam spillway should either be considered for removal, or maintained and modified for the purposes of fish passage. An engineering study should be performed to determine which modification is the most appropriate for this dam. The State of New York would be responsible for implementing modifications to this dam.

Carll's River: Dam #7 - ~200 feet East of Woodbury Road
This dam is the first run-of-river dam encountered. The dam is constructed of concrete and is in good condition. It appears that at some point in the past there was a dam control gate structure between the dam's two concrete abutments, but it is no longer present. Therefore, this is the only dam inventoried that is not presently a barrier to fish passage. It should be noted that the dam does impound water and therefore does cause backwater effects, impacting water quality and riverine habitat. Its removal could improve coldwater habitat downstream and prevent it from becoming a future barrier due to changes in its operation. An engineering study should be performed to determine if removal of this dam is feasible. The Town of Babylon would be responsible for implementing modifications to this dam.

Brown's River: Dam #8 – Adjacent to north side of LIRR **Priority*
Due to this being the first permanent barrier on the western branch of the Brown's River, and this being a very small, deteriorated, wooden dam with little impoundment of water, removal of this structure should be considered a priority to allow for the passage of brook trout and river herring (alewife and possible blueback herring), as well as the American eel. Approximately 600 feet of high quality upstream habitat would be reintroduced to

migratory fish populations. Removal would only require hand removal of a few slats of wood above the LIRR crossing. The Long Island Railroad and private landowners would be responsible for modifications to this dam. Due to the minimal size of the existing wooden structure and no need for engineering design of any structural modification, the time required to permit and carry out this removal project is significantly reduced. A 6 month time frame is estimated to secure a Wetlands Permits from the NYSDEC and Town of Islip. Cost associated with permitting and removal of the structure is minimal.

Brown's River: Dam #9 – Mill Pond Dam **Priority*
Removal or modification of this final dam on the western branch of the river would reintroduce approximately 1.2 miles of good quality fish habitat upstream to diadromous fish as long as the small wooden dam below it (Dam #8) is also removed. Costs are estimated to be approximately $400,000 for installation of a typical Alaskan Steeppass fish ladder and accompanying eelway at the spillway. It is anticipated that dam removal would be less costly than installation of a fish passage structure. Suffolk County and private landowners would be responsible for implementing modifications to this dam.

Brown's River: Dam #10 – Lotus Lake Dam **Priority*
Series of step-pools descending away from the Lotus Lake Dam have been designed to allow for the passage of brook trout and river herring (alewife and possible blueback herring), as well as the American eel. Approximately 1.7 miles of upstream habitat would be reintroduced to migratory fish populations. Suffolk County would be responsible for implementing modifications to this dam.
Costs: $60,000 ($30,000 state funds, $30,000 Suffolk County DPW/Town of Islip cost share)

Brown's River: Dam #11 – Montauk Highway
Series of step-pools descending away from the small dam at the south end of the Sans Souci Lakes, extending to the culvert passing underneath Montauk Highway to allow for the passage of brook trout and river herring (alewife and possible blueback herring), as well as the American eel. The work will be integrated with needed repair work on the dam. Invasive aquatic plant inventory and control will also be conducted. Suffolk County would be responsible for implementing modifications to this dam.
Costs: $225,000 ($110,000 state funds, $115,000 Suffolk County DPW/Town of Islip cost share)

Brown's River: Dams #12-21 – Sans Souci Lake Dams
These dams currently serve no function as they were originally created for the purpose of cranberry crops. As some of the dams are already severely damage and/or eroded, removal of these dams should be considered and an engineering study should be performed to assess the feasibility of removal. Both Suffolk County and the Girl Scouts of America would be responsible for implementing modifications to these dams.

Swan River: Dam #22 – Swan Lake Dam **Priority*
A steep-pass fish ladder and an eel passage have been proposed to be added to the spillway at the outlet of Swan Lake to allow passage of American eels, river herring (alewife, and possibly blueback herring) and native brook trout. [Although awarded funds are allowed to be utilized for dam removal or fish ladder installation, dam removal should still be considered at this location to achieve the intended goal more effectively].

Invasive aquatic plant inventory and control will be conducted on Swan River from Montauk Highway to Sunrise Highway. Approximately 2.25 miles of suitable habitat in the upper reaches of the watershed would be reintroduced to American eel, as well as spawning river herring and sea-run trout. The Brooklyn Water Company and Suffolk County would be responsible for implementing modifications to the dam.
Costs: $720,000 ($360,000 state funds, $360,000 Suffolk County DPW/Town of Brookhaven cost share)

Mud Creek: Dam #23 – Robinson Pond Dam **Priority*
An Alaskan Steeppass fish ladder and accompanying eelway will be installed at the spillway at the south end of Robinson Pond, into the culvert passing beneath South Country Road (County Route 36). Invasive aquatic plant inventory and control will also be conducted. Approximately 1.25 miles of habitat in the upper reaches of the watershed would be reintroduced to American eel, as well as spawning river herring and sea-run trout. Suffolk County would be responsible for implementing modifications to this dam.
Costs: $401,000 ($186,000 state funds, $215,000 Suffolk County DPW/Town of Brookhaven cost share)

Mud Creek: Dam #24 – Path Southwest of Gazzola Drive and Atlantic Street
It is unclear to what extent this pathway is still being utilized for vehicular access. Excavation of the berm should be considered if vehicular access in this area is no longer needed. Alternatively, the installation of a box culvert could be considered. Suffolk County would be responsible for implementing modifications to this dam.

Mud Creek: Dam #25 – Gallo Duck Farm
As this area is now Suffolk County park land and there is no need for impoundment of water for duck farm operations, improvements to the property should include excavation of this earthen berm to promote improved water flow and wildlife passage. Suffolk County would be responsible for implementing modifications to this dam.

Mud Creek: Dam #26 – 500 feet Northwest of Gazzola Drive and Atlantic Street
As this area is now Suffolk County park land and there is no need for impoundment of water for duck farm operations, improvements to the property should include excavation of this earthen berm to promote improved water flow and wildlife passage. Suffolk County would be responsible for implementing modifications to this dam.

Carman's River: Dam #27 – Big Fish Creek Water Control Structure
This dam is a federally owned structure which controls water flow on Big Fish Creek. During high flows some fish can pass through the water structure, so modification to allow for fish passage during low flow would be necessary. An engineering study should be performed to determine the most appropriate method of fish passage on this structure. The federal government would be responsible for implementing modifications to this dam.

Carman's River: Dam #28 – Suffolk Club Dam (Hard's Lake Dam) **Priority*
A steeppass fish ladder was installed at Hard's Lake by NYSDOT in March 2008. The designs were prepared by the NYSDOT Region 10 & USF&WS. This project is considered a priority as it represents the first permanent fish ladder on Long Island and will aid the restoration of alewife as well as a historic sea-run of brook trout to the river.

The conceptual design for the steeppass fishway, prepared by Curt Orvis of USF&WS in 2001, is included in **Appendix C.** Although this fish passage device has been recently installed, removal of the dam in the future should be considered to allow for greater habitat connectivity within the lower reaches of the river. Suffolk County would be responsible for implementing modifications to this dam.

Carman's River: Dam #29 – Southaven Park Dam (C-gate Dam) and Dam #31 – Lower Lake Dam **Priority*
Project 1: An Alaskan Steeppass fish ladder is proposed to be added to the low dam near gate C in Southhaven County Park to allow upstream passage of river herring (alewife, and possibly blueback herring). The dam currently allows for the passage of trout species, but is impassable by river herring. The addition of a short length of Alaskan Steeppass fish ladder will allow river herring to pass this point. [River herring access upstream of Hard's Lake has recently been aided by installation of a steeppass fish ladder in March 2008 through a partnership between DEC, DOT, and Trout Unlimited, and funded by NOAA and DOT.] Approximately 1.4 miles of suitable habitat in the upper reaches of the watershed would be reintroduced to American eel, as well as spawning river herring and native trout.
Project 2: An Alaskan Steeppass fish ladder is proposed to be installed at the spillway from Lower Lake, and into the culvert passing underneath Yaphank Avenue to allow upstream passage of river herring and brook trout. Alongside this ladder, an eelway will be installed to allow passage of American eel. Invasive aquatic plants were inventoried during the summer of 2007. Both Carolina fanwort (*Cabomba caroliniana*) and variable milfoil (*Myriophyllum heterophyllum*) were found in Upper and Lower Lakes and are being considered for removal by the Town of Brookhaven, Suffolk County and local residents. Control measures that are being considered include, but are not limited to harvesting, aquatic herbicides, benthic barriers, grass carp, dredging and dam removal. Of the vegetation control options being considered, the only one that also removes the barriers to fish passage at Upper and Lower Lakes is removal of the dams. Approximately 1.4 miles of suitable habitat in the upper reaches of the watershed would be reintroduced to American eel, as well as spawning river herring and native trout. Suffolk County and the Town of Brookhaven would be responsible for implementing modifications to the dam.
Costs: $542,000 ($252,000 state funds, $290,000 Suffolk County DPW cost share)

Carman's River: Dam #30 – USGS Gauge at LIRR
This concrete weir should be considered for modification with an alternative stream gauging method or installation of a fish passage device should be considered. The USGS and Suffolk County would be responsible for implementing modifications to the weir.

Carman's River: Dam #31 – Lower Lake Dam **Priority*
See joint description under Dam #29 above.

Carman's River: Dam #32 – Upper Lake Dam **Priority*
A series of step-pools to allow passage for spawning river herring (alewife, and possibly blueback herring) and brook trout is proposed to be constructed at the Upper Lake Dam. An eelway is proposed to be constructed at the same point. Approximately 2 miles of suitable habitat in the upper reaches of the watershed would be reintroduced to American

eel, as well as spawning river herring and native trout. The Town of Brookhaven would be responsible for implementing modifications to the dam.
Costs: $1,000,000 ($500,000 state funds, $500,000 Suffolk County DPW/Town of Brookhaven cost share)

Carman's River: Dam #33 – Szuster Farms Dam
This is the final dam located on the Carman's River which was originally created for farm access. The dam was given to Suffolk County as it is no longer in use. As this dam does not have a large impoundment area, an engineering study should be performed to determine the feasibility of dam removal. Suffolk County would be responsible for implementing modifications to this dam.

Other fish passage approaches such as creation of more natural bypass channels could also be pursued with consideration of the required extensive and expensive analyses by the Dam Safety Office to determine hydraulic adequacy and structural integrity. Although they require greater room to construct, bypass channels are able to circumvent a dam or barrier and more closely mimic natural substratum and hydraulic conditions than a fish ladder (**Parasiewicz et al, 1998**). Bypass channels also have potentially higher passage success than conventional fish ladders because of their reduced slope and often more attractive flow (**Lenhart, 2000**).

Additional state assistance funding should be requested by Suffolk County and local municipalities to fund additional dam restoration projects within the study area. Potential funding sources for those dams without current funding are included in **Appendix D.**

3.4.2 Prioritization of Crossings

Eighteen (18) inventoried crossings within the study area were identified as temporary or permanent barriers to diadromous fish passage and improvements to these structures are recommended. To systematically prioritize the restoration of the 18 crossings inventoried within the study area as barriers, the prioritization matrix illustrated in **Table 3-2** can further be summarized according to the overall value of a tributary for prioritization. In addition to inclusion of observed in-stream habitat conditions as a partial component within the ecological value criteria, field-assessed in-stream and riparian habitat scores were also included side by side in **Table 3-2** with the assessed crossing prioritization values described in **Section 3.2** for comparison purposes. Those crossings with higher habitat scores are good candidates for barrier modification because removal of the barrier would open up a segment of stream with good quality fish habitat. **Table 3-4** illustrates that among the tributaries, the Carman's River clearly has the greatest potential for successful crossing improvement projects, as it achieved the highest field-assessed habitat scores in observed riparian and in-stream habitat, as well as highest scores for cumulative ecological value and average total value.

Table 3-4
Crossing Prioritization values Among Target Tributaries

River	Avg. Habitat Score	Avg. Ecological Value	Avg. Project Feasibility	Avg. Cum. Avg. Score	Avg. Total Score
Carll's	136	2.4	**4.2**	7	31
Brown's	162	2.7	3.8	6	31
Swan	163	3.0	3.3	6	31
Mud	139	3.0	3.8	7	33
Beaver Dam	155	3.2	3.6	7	33
Carman's	**177**	**4.5**	3.8	**8**	**42**

Note: Scores in bold indicate highest value and/or feasibility for crossing removal or modification.

Temporary barriers such as clogged culverts have reduced hydraulic capacity during high flows and could overtop or erode during flood events. Therefore, in the short term, undersized culverts should be monitored, cleaned out and maintained on a regular basis to prevent their becoming barriers to fish passage. However, undersized and silted culverts need to be widened in order to be able to pass debris and sediment. A long-term plan for replacement with fish-friendly bottomless culverts or bridges should be put into place.

Costs for culvert replacement may vary greatly depending upon the site conditions. For comparison purposes, the following describes costs for culvert replacement of a 12" round culvert and a 36" round culvert. Replacement of a 12" round culvert under a two lane town-owned road is expected to cost approximately $250/LF. Replacement of a 36" round culvert under a two lane, Town owned road is expected to cost approximately $500/LF. An additional $5,000 per site would be required for stream diversion while replacement of the culvert would be occurring. It is expected that 6-12 months would be needed (from engineering to actual construction) for culvert replacement.

Carll's River: Crossing #16 – Park Trail

The crossing at this location is best categorized as a "drop." It is comprised of concrete and stone which creates no inlet drop, but an outlet drop of greater than six inches. The drop appears to be a permanent barrier to passage by some species of fish, and should be modified to allow for passage. Also, extensive stands of non-native vegetative species are present at this crossing and should be monitored to ensure they do not become future vegetative barriers to fish passage. New York State would be responsible for implementing improvements on this crossing.

Carll's River: Crossing # 18.2 – Grass Carp Gate

This crossing, a metal and concrete structure, was constructed for the purpose of grass carp control in the southern portion of the park. It is currently in good condition, but may present a barrier to the passage of larger fish. This crossing should be routinely monitored for build up of floatable debris and cleaned as necessary. In the long term, this

structure should be considered for modification/removal to allow for fish passage. New York State would be responsible for implementing improvements on this crossing.

Carll's River: Crossing #18.3 – 550 feet S/o August Road **Priority*
This crossing is a metal chain link fence which spans the banks of the river. Currently, debris has gathered at upstream side of the fence creating a 90 percent blockage of water flow through the structure. At minimum, the debris should be cleared from this fence to allow for fish passage. If possible, the fence should be removed entirely to prevent further gathering of debris. In the long term, if this fence is removed then no further maintenance or other action would be required. This crossing is identified as a priority given the ease with which the fence can be removed from the site. New York State would be responsible for implementing improvements on this crossing.

Carll's River: Crossing #20 – August Road
Three culverts exist at the crossing. The first culvert is a box culvert, while the second two are embedded elliptical culverts, all of which are constructed of concrete. All show signs of slight disrepair, but only the middle culvert presents a temporary barrier to fish passage. The middle culvert only contains 1-2 inches of water and is heavily silted. In the short term, this culvert should be cleaned out and maintained on a regular basis to prevent a barrier to fish passage. However, a long-term plan for replacement of undersized culverts such as this one should be implemented. New York State and the Town of Babylon would be responsible for implementing improvements on this crossing.

Carll's River: Crossing #23 – North Wyandanch Park
This bridge is constructed of wood and shows signs of disrepair. The crossing is considered a temporary barrier due to a combination of siltation and infringing Phragmites vegetation below it. Dredging and clearing of Phragmites vegetation in this area is recommended to improve fish passage. The bridge should be maintained to prevent future collapse. The Town of Babylon would be responsible for implementing improvements on this crossing.

Brown's River: Crossing #27 – LIRR North of Middle Road **Priority*
Due to this crossing being the first temporary barrier (log jam) on the Brown's River, its location below Dam #8 and the ease with which this debris barrier could be removed, this barrier is listed as a priority for remediation. The log jam creates an inlet drop of greater than six inches. The crossing feature itself is a round culvert constructed of concrete which in itself is not a barrier to fish passage. The log jam inside the culvert should be removed to allow for fish passage. Non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage. The Long Island Railroad and Suffolk County would be responsible for implementing improvements on this crossing.

Brown's River: Crossing #27.1 – Montauk Highway
This culvert (Suffolk County Culvert #085.04) is a concrete box culvert which has signs of a state of about 50 percent disrepair. This culvert has both an inlet drop and an outlet drop, both of which are greater than 6 inches in height. In the short term, this culvert would need replacement or modification as fish cannot currently pass in this area due to the drop and the velocity. Once replaced or modified, maintenance costs are expected to

be low as an appropriately sized culvert would be installed. Suffolk County would be responsible for implementing improvements on this crossing.

Swan River: Crossing #32 – LIRR **Priority*
Due to this being the first temporary barrier on the Swan River, its location below Swan Lake Dam and the relative ease with which this debris barrier could be removed, it has been selected as a priority for remediation. A timber platform was constructed by local youth within the River directly beneath the LIRR crossing. The crossing itself is a concrete open bottom arch beneath which the platform is located. Logs and other debris have become lodged behind the structure and pose a potential barrier to the passage of larger fish, particularly as further debris continue to wash downstream. Removal of this platform and associated debris (beer kegs, shopping cart, etc.) is recommended. It should be noted that accessing this platform may be difficult, as the nearest access is from a privately owned property to the north between which there is dense vegetation and swampy terrain. The Long Island Railroad would be responsible for implementing improvements on this crossing.

Swan River: Crossing 32.1 – Montauk Highway
This crossing consists of a box culvert which passes under Montauk Highway. The culvert currently shows signs of a state of about 50 percent disrepair. This culvert also has a very large inlet drop which creates a high velocity through the culvert. In the short term, this culvert would need replacement or modification as fish cannot currently pass in this area due to the drop and the velocity. Once replaced or modified, long-term maintenance costs are expected to be low if an appropriately sized culvert were installed. The Brooklyn Water Company and Suffolk County would be responsible for implementing improvements on this crossing.

Swan River: Crossing #33 – 300 feet South of Sunrise Highway
This crossing is a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage. The private landowner would be responsible for implementing improvements on this crossing.

Swan River: Crossing #34 – 200 feet South of Sunrise Highway
This crossing is also a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage. The private landowner would be responsible for implementing improvements on this crossing.

Swan River: Crossing #36 – 60 feet South of Barton Road
This crossing is a temporary barrier created by the impoundment of logs and garbage. Removal of this blockage is recommended to alleviate the current barrier to fish passage. The Town of Brookhaven would be responsible for implementing improvements on this crossing.

Swan River: Crossing #37 – Barton Road
This is the final crossing on the Swan River, which consists of three round culverts made of metal. The crossing appears to begin as one large pipe on the upstream side which splits into three pipes on the downstream side. The culvert is currently collapsed which

presents a permanent barrier to fish passage. The culverts should be maintained and/or replaced so as to not further impede fish passage. Also, non-native vegetative species were identified at the crossing and should be monitored to prevent future potential vegetative barriers to fish passage. Suffolk County and the Town of Brookhaven would be responsible for implementing improvements on this crossing.

Mud Creek: Crossing 39.1 – Gazzola Drive

This crossing consists of a single metal culvert which runs under the roadway. The culvert is currently approximately 90 percent blocked with sand which makes it a temporary barrier to fish passage. In the short term, this culvert should be cleaned out and maintained to allow for the passage of fish and wildlife. A long term plan for this crossing should include the replacement of this culvert with a more appropriately sized and engineered one as to not allow for further sedimentation within the culvert. Suffolk County would be responsible for implementing improvements on this crossing.

Beaver Dam Creek: Crossing #46 – 423 South Country Road, South of the White Bridge **Priority*

Due to this being the first temporary barrier on Beaver Dam Creek and the relative ease with which this log jam barrier could be removed, it has been selected as a priority for remediation. The blockage should be removed to allow for fish passage. The private landowner would be responsible for implementing improvements on this crossing.

Beaver Dam Creek: Crossing #50 – LIRR

This crossing is the first to exhibit the flocculent indicative of a chemical spill or plume which is noted from this point north. It is a concrete round culvert which is almost entirely in disrepair, and is a temporary barrier to fish passage. The culvert should be repaired or replaced and the chemical spill between crossings 50 & 53 should be remediated (the spill was reported to NYSDEC Spills Division in August 2007). The Long Island Railroad would be responsible for implementing improvements on this crossing.

Beaver Dam Creek: Crossing #51 – 4 feet North of LIRR

This crossing is a temporary barrier which consists of a single short section of metal fence across the stream. The fence does not appear to have any particular function and should be removed to allow for fish passage. The private landowner would be responsible for implementing improvements on this crossing.

Carman's River: Crossing #63 – Cathedral Pines Park Entrance

This is the last crossing encountered on the Carman's River. It consists of two culverts. The currently functioning round culvert is constructed of plastic and is in good condition. This culvert does not present a barrier to fish passage. The second culvert is an embedded elliptical culvert which is constructed of concrete and is almost entirely in disrepair. Despite the adjacent functioning culvert, the collapsed culvert should be replaced with a larger culvert to further facilitate fish passage. Suffolk County would be responsible for implementing improvements on this crossing.

3.5 Conclusions

Prioritization of fish barrier remediation should be focused on the best method for barrier mitigation, including dam removal, fish passage device installation, culvert replacement or other method.

Community involvement and support is a critical aspect of dam removal feasibility that must be carefully undertaken regarding dams which occur on public lands. Warm water fishermen may oppose dam removal, as it could lead to the loss of recreationally-important warm water fish species within an impoundment, whereas cold water fishermen would typically support removal for the restoration of a traditional cold water fishery. While these two uses must remain represented within a community, warm water fishing opportunities can be encountered on inland lakes and ponds, whereas the goal of this study is to restore historic wildlife passageways of native, cold water fish. Additionally, lack of community support from local residents who consider the currently impounded areas as "natural" systems may be a further impediment to dam removal. For dams with historic community significance, such as Argyle Lake on the Carll's River, community values may sometimes dictate the ultimate preservation of the barrier. In instances such as this, modification of the barrier with installation of a fish ladder may be more appropriate than removal for cultural reasons. However, these cultural values must be weighed against hazard mitigation and public safety, ecological values (wildlife passage), recreational values (excessive growth of aquatic vegetation; water quality problems due to waterfowl populations) and project feasibility.

As owner willingness is of utmost importance in determining the feasibility of a dam removal or modification project, the owners of those structures determined to be top priorities for remediation should be carefully approached by involved entities (DOS, SSER, NYSDEC, Town, etc). No dam owners were contacted to determine willingness for dam removal or modification during this study. However, it is recommended that this step take place as a follow-up to this study. Incentives for the landowner should be discussed, especially if the dam owner initially seems unwilling for removal or modification. American Rivers has taken the lead on producing publications regarding how best to approach barrier owners regarding structural remediation and these helpful publications should be utilized.

In any case where an impoundment or wetland area may be reduced by dam removal or modification, the need for habitat restoration above and below the structure must be considered. Particularly, it is desirable to ensure that the new habitats along the banks of the channel resulting from the removal or modification are comprised of native plant communities, and not the establishment of non-native monocultures. This is best done by utilizing an adaptive management approach. The existing plants and habitats occurring along the edges of the impoundment and channel must first be determined, with special attention paid to the potential for invasive species to spread or become established. Rather than planning to direct a channel's path following dam removal, better success is often achieved when the channel is allowed to form its own path initially to avoid washing out a designed channel during extreme flood events (**Federal Interagency Stream Restoration Working Group, 1998**). Habitat restoration involving vegetation and other improvements should wait to occur until it is clear what path the

stream channel will establish itself. If native plants do not begin colonizing the newly uncovered bank areas, then action should be taken to remove invasives and establish native plantings.

Any modification to existing structures would require permits from several agencies. In all cases, permits from the NYSDEC for actions within a freshwater wetland (Article 24) or permits for actions within a tidal wetland (Article 25) will be required. Local town permits may also be required depending upon local regulations. For nearly half of the dams, NYSDEC Dam Safety permits will be required for removal or modification (see **Table 3-1**). Only the structure on Big Fish Creek is federally owned, and as such would be the only structure requiring permits from federal agencies.

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