

The Carmans River Conservation and Management Plan



Town of
Brookhaven
Long Island

FINAL OCTOBER 15, 2013

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**THE CARMANS RIVER CONSERVATION AND MANAGEMENT
PLAN**

*in the hamlets of Brookhaven, Middle Island, Shirley and Yaphank,
Town of Brookhaven, Suffolk County, New York*



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Town of Brookhaven Long Island

Edward P. Romaine, Supervisor

Dear Members of the Town Council:

I am pleased to submit to you the final draft of the Carmans River Conservation and Management Plan.

The Carmans River is one of Brookhaven's most critical resources. Protecting it not only protects the river watershed, but our drinking water and the Great South Bay.

The plan contains 19 categories of recommendations to preserve and protect the Carmans River. When implemented, it will guide land use in the watershed for many years to come and serve as a model for environmental preservation.

A strictly environmental document, this plan expands the core area of the Central Pine Barrens region by over 1,600 acres and, for the first time in history, expands the compatible growth region as well. It promotes open space acquisitions; recommends landmark nitrate and sanitary standards; and recommends a series of upzonings to truly protect the watershed.

I am proud of this plan and thank the members of our staff who worked tirelessly to make it a reality. I look forward to working with you to implement these recommendations and preserve the Carmans River Watershed.

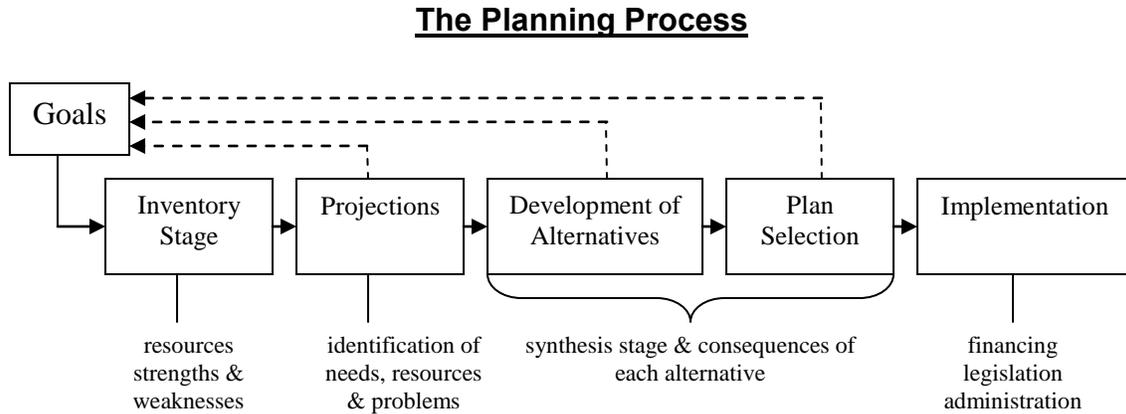
Sincerely,

Edward P. Romaine

Edward P. Romaine, Supervisor

PREFACE

The following figure depicts a generalized linear model of a typical planning process flow diagram.



The conduct of this effort to prepare a plan for the protection and management of the Carmans River generally followed the process cited in the above diagram with one modification. In place of a five stage study, the last three steps, "Development Alternatives," "Plan Selection" and "Implementation," the Study Group were combined into one heading, Implementation.

This approach makes sense in contrast with board-based community planning, which involves a plethora of approaches and often divergent objectives and interests; the effort in this study was unitary. Namely, the objective was to obtain the maximum protection and enhancement of the River.

Thus, this document proceeds from the statement of general goals listed in the plan's inventory section. The first segment presents a stage-setting account of the historical background of the River. This is followed by a series of data, maps and tables covering the gamut of existing conditions.

These include the identification and mapping of the River and its watershed. Initially, a boundary was set forth by the work conducted by Suffolk County's consultant, Camp, Dresser & McKee (CDM). CDM prepared a regional

groundwater flow model, which indicated the directional pattern of sub-surface flow that moved in the direction of the River; this work was a portion of the County's Comprehensive Water Resources Management Plan. CDM delineated for 2, 5, 10, 25, 50 and 100 year groundwater travel times.

In response to expressed concerns that the northern boundary in particular fell short, the study area was extended to Whiskey Road to insure that all concerns would be evaluated.

The second water flow impact on the River is from surface water. The inventory section of the plan discusses the town's programs to cope with storm water, as well as a listing and description of point sources problems and a discussion of the flooding in the area north of New York State Route 25.

This is followed by a discussion of the current chemical condition of the River based on the thousands of sampling measurements conducted over the years by the Suffolk County Department of Health Services, the United States Geological Survey, the Suffolk County Water Authority and other academic and individual sources. Additionally, an inventory of living resources, including aquatic and terrestrial, found in the river and watershed has been included.

The balance of the inventory stage is concerned with existing land uses for both the CDM boundary and the northern extension area. This includes a series of maps, tables and descriptions of privately owned vacant undeveloped land; Town and County owned land not designated for park use; Town and County designated parkland; land proposed for acquisition by the Town's Open Space Committee; and a list of proposed projects within the watershed.

Another important inventory concern is existing zoning. This information, when applied to currently undeveloped and/or vacant land, can provide potential build-out population at saturation. It is also essential to calculate the build-out based on proposed changes to current zoning. The potential contaminant loading to the

watershed and that portion of contamination that may reach the River is germane.

Related to the above is the descriptive inventory of the demographics within the watershed. This array of inventories yields a glimpse of the strengths, problems and weaknesses within the watershed and River, and provides input into the second, or “Projection” phase of the study.

Build-out data, when related to pollutant loadings, will indicate whether or not a desired level of water quality will be exceeded or can be maintained. If the results are excessive, a determination of mitigation efforts that will resolve the problem must be arrived at. If that is not feasible, then more stringent land use controls have to be enforced.

The last (combined) stage identifies the nitrogen standard chosen in order to achieve the goals of the plan, including sewage treatment plant (STP) options to minimize pollutant transport to the River. Individual home sanitary systems also have to be upgraded over time. Actions must be taken to eliminate existing point sources of pollution and to mitigate localized flooding, including the application of Better Management Practices (BMP) for stormwater control, use of fertilizers and turf management are described.

Issues on how to cope with invasive species and the installation of fish ladders are considered. In addition, the prospect of enlarging the Core Area boundary of the Pine Barrens Commission is contemplated, in order to achieve improved control and management of lands closest to the River. Other implementation actions include recommended zoning changes and land use site design improvements.

Since this plan is the first step – albeit an important effort – it recognizes that planning is a continuous process. Thus, additional research vital to a continuing process is also recommended. This includes a synoptic monitoring program, the

improvement of the Town's GIS system relative to environmental planning, and a detailed living resources research program. Consideration of administrative, fiscal, legal and statutory recommendations is also an important set of considerations in the plan.

Dr. Lee Koppelman
Chair, Carmans River Study Group

Brookhaven now has the opportunity to better protect the Carmans River and its watershed. In so doing, we can demonstrate a fair, straightforward, cost and time efficient method for equitable water resource protection in relation to improvements in where and how we live, work, and enjoy ourselves. The Carmans River Conservation and Management Plan intends to promote clear water and its protected land, with a clear purpose, by a clear process.

Water is life. That is a fundamental truth of biological existence and cannot be argued. Water is also a fundamental need of biological communities, including human ones, and that too cannot be argued. All too often in the past, though, fact and need have not been argued but simply ignored; expediency trumped the bother of argument. Particularly in places where abundant good water was perceived to be a simple unchangeable fact, many people used it unthinkingly and unthankfully.

Fortunately we have now seen several decades of advance against such a mindset and its accumulated consequences. America's surface waters are by and large cleaner and healthier than they were in the 1960s. Moreover, there is now better scientific understanding of both visible and underground waters, and of the obvious and not so obvious ways they can be harmed – and thereby harm ourselves and the living world around us. But perhaps, most importantly, there have been decades of increasing public awareness of the manifold importance of good water, increasing welcome of the fact that good water means a physically and fiscally healthier community, and increasing political will to protect and manage our common water resources scrupulously and wisely.

Conservation and restoration of natural habitat and improvement of human habitat can and must go hand in hand – precisely because there is actually no way of conceptually or factually separating them. We must recognize ourselves and how we live as inseparable from all aspects of the places where we live. We

must be conscious and responsible in what we choose to do and choose not to do. In order to do that specific goals must be set out, each with its measured benchmarks. Once goals are specified, a method of proceeding towards them can be specified, with the benchmarks providing the measure of progress.

The Plan envisions a series of clear and logical policy directions, which outline performance criteria to assure the health of the River. It further seeks to achieve four overarching goals in order to create a clearly defined plan to protect this treasured river. First, encourage land use that meets the needs of the community and the Town while also protecting the environmental health and quality of the river. Second, for the sake of everyone and everything, improve and protect water quality both above and below the surface. Third, protect and restore the species and biodiversity of the main kinds of habitat present in and along the River: streams and lakes; woodlands; and floodplains and riparian areas. Each sort of habitat has strengths and vulnerabilities to be understood in its nature. Fourth, reduce the territory invaded and held by non-native plant species, and encourage the return to dominance of native ones.

The Carmans River Conservation and Management Plan will help Brookhaven do at least two things. As its name signals, it will of course be an aid towards preserving, protecting, and restoring the beauty, health, and value of the River, of the lands around it, and of the plants and animals living in both. Beyond that, and even more importantly, it will help us better ourselves as a community by letting us more clearly define the nature of the places we call home, and planning for their future.

Tullio Bertoli, APA, AICP, LEED

Commissioner

Department of Planning, Environment and Land Management

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EXECUTIVE SUMMARY

The Carmans River, together with the Connetquot, Nissequoque, and Peconic Rivers, is one of Long Island's four major river systems and together with the Peconic River is one of the two major river systems that flow through the Central Pine Barrens Region of Long Island. The average annual flow of the Carmans River is 15.9 million gallons per day based on data from the United States Geological Survey (USGS) gaging station located one mile south of the Long Island Expressway. It is estimated that 94 percent of the flow of the Carmans River originates from groundwater (CDM 2011a), which means the groundwater contributing area for the River is integral to the health and quality of the River.

Available data suggests that the water quality and aquatic habitats in the Carmans River have undergone some degradation over the past several decades. Additionally, there is concern that the development of the remaining vacant land and the redevelopment of developed land in the Carmans River watershed will cause further deterioration of the River's water quality and aquatic habitats. For these reasons, the Town created the Carmans River Study Group to prepare a Management Plan that would provide a suite of recommendations to restore and preserve the water quality and habitats of the Carmans River. The goals of the Carmans River Conservation and Management Plan ("The Plan") are:

1. Environmentally sensitive lands that are critical to the ecological health and water quality of the Carmans River, or are significant habitats within the Carmans River watershed, should be protected and preserved.
2. There should be no further degradation of water quality in the Carmans River, and a concerted effort should be made to reduce the concentrations of water quality contaminants from their present levels.
3. Any new development or redevelopment in the Carmans River watershed should not adversely impact water quality in the Carmans River or the key ecological communities in the Carmans River watershed.

4. Degraded habitats should be restored, stormwater discharges mitigated, and the abundance of invasive species significantly reduced and, if possible, eliminated.
5. Environmental stewardship, outreach and education should be promoted by the Town of Brookhaven.

Because the quality of groundwater determines the quality of the water in the Carmans River, the groundwater contributing area for the Carmans River was mapped and made part of the Management Plan Area. In order to provide a greater comprehensive examination of the area, the area of the 100 year groundwater contributing area was used as the base Study Area. In addition, an area north of the groundwater contributing area was added to the Management Plan Area as it is part of the Carmans River system. The Study Area encompasses approximately 23,000 acres.

The Plan has a total of 19 recommendations, which, when implemented, will accomplish the goals set forth by the Carmans River Study Group. The recommendations fall into the following categories:

1. Expansion of the Central Pine Barrens Area
2. Proposed open space and farmland development rights acquisitions
3. Proposed zoning actions in the Study Area
4. New York State Wild and Scenic Recreational River (WSR) Act
5. Establishment of a Watershed Protection Improvement District
6. Protection of natural resources
7. Stormwater and flooding
8. Sanitary systems and sewage treatment plants and Nitrate-nitrogen Standards for projects
9. Water quality goal for the Carmans River
10. Water quality monitoring program
11. Biological inventories and monitoring
12. Invasive species
13. Restoration of degraded properties
14. Surface and groundwater remediation

15. Mitigate barriers to fish migration
16. Public education and outreach
17. Agricultural and golf course management
18. Management Plan Implementation and Establishment of the Carmans River Management Plan Performance Committee
19. Carmans River Management Plan Area

A key component of the Management Plan is adding select properties within the Management Plan Area to the Central Pine Barrens Core Preservation Area (“Core Expansion Area”) and Central Pine Barrens Compatible Growth Area. This would prevent these properties from being developed by providing property owners with the opportunity to obtain Pine Barrens Credits that can be redeemed for increased density and/or intensity of development at sites that have been deemed eligible to receive such development pursuant to the Pine Barrens Plan. A vigorous Town, New York State, and Suffolk County acquisition program for key properties is also recommended.

The New York State Legislature is presently in the process of amending the 1993 Central Pine Barrens Protection Act. . The legislation will add certain properties to the Core Preservation Area and the Compatible Growth Area of the Central Pine Barrens through the expansion of these two areas. If enacted and signed by the Governor, the Central Pine Barrens Joint Planning and Policy Commission should also amend the 1995 Central Pine Barrens Comprehensive Land Use Plan.

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CHAPTER 1. INTRODUCTION

The Carmans River is a groundwater fed river located on the south shore of Long Island in the Town of Brookhaven that originates in the hamlet of Middle Island and discharges into the Great South Bay in the hamlet of Brookhaven (Figure 1). The Carmans River is one Long Island's four major rivers (the others are the Peconic, Nissequoque and Connetquot). The Carmans River and the Peconic River are also Long Island's only major rivers that flow through the Central Pine Barrens region of Long Island and whose ecology reflects the biotic and abiotic conditions of the Central Pine Barrens.

From its headwaters within Cathedral Pines County Park in Middle Island, the Carmans River meanders approximately ten miles south to the Great South Bay. Of the River's ten miles, eight miles are freshwater, which includes three lakes (Upper Lake: 19 acres; Lower Lake: 25 acres; and Hards Lake in Southaven County Park: 30 acres), and two miles of the river are marine/tidal. The Carmans River discharges approximately 21 cubic feet (130.8 gallons) per second as measured at the US Geological Survey gauging station located one mile south of the Long Island Expressway, and about 54 cubic feet (405 gallons) per second as measured at Sunrise Highway, where the river becomes tidal (USGS, 2011).

The Carmans River and its watershed are environmentally and ecologically important on a local and regional scale, with more than a dozen ecological habitat types supporting a diversity of species. These habitats include red maple hardwood swamps, coastal plain ponds, coastal plain-pond shore, pitch pine-oak-heath woodlands, high and low salt marshes, lakes and streams.

Approximately 9,000 acres of the Carmans River's watershed is generally undisturbed and vegetated of which most is publicly owned, including Wertheim National Wildlife Refuge (2,400 acres), Southaven County Park (1,356 acres) and Cathedral Pines County Park (320 acres). The Carmans River was designated a New York State Wild, Scenic, and Recreational River in 1972 and is a New York State designated Significant Coastal Fish and Wildlife Habitat. Portions of the Carmans River and its watershed are situated within the Long

Island Central Pines Barrens Core Preservation Area and the Long Island Central Pine Barrens Compatible Growth Area.

The Carmans River is one of the major tributaries to the Great South Bay, a barrier island lagoon that is part of the New York State designated South Shore Estuary Reserve. As a result, the water quality and ecological conditions of the Carmans River have significant influence upon the environmental conditions in the Great South Bay.

While the Carmans River's water quality is relatively high and several thousand acres within its watershed have been preserved, there are concerns that development has adversely impacted the river and that the potential future development of the estimated 2,600 acres of vacant developable land in the watershed, as well as the redevelopment of existing developed properties, could further degrade the river. These concerns are based on:

- A review of historic water quality trends in the Carmans River indicate that several water quality parameters have declined, likely as a result of the development in the watershed and particularly the number of residential on-site sanitary systems.
- An assessment of benthic habitats in 2008 by the New York State Department of Environmental Conservation (2010) found some habitat impairments in the river.
- Upper and Lower Lakes have major infestations of invasive aquatic vegetation, and barriers to fish migration occur at several locations on the river.
- A review of historical land use trends shows a loss of natural habitats due to their conversion to commercial, industrial, and residential uses.

Because of the threats to the future water quality of the Carmans River, and by extension the Great South Bay, and a desire to reduce and mitigate existing impairments, in 2010 the Town of Brookhaven formed the Carmans River Study Group. This Study Group was tasked with preparing a management plan for the Carmans River that would assess existing conditions and identify a

suite of recommendations that would mitigate existing impairments and protect the future health of the river. The Carmans River Study Group, chaired by Dr. Lee Koppelman, was comprised of real estate developers, environmentalists, governmental agencies, and non-governmental organizations. The Study Group was aided by a Technical Advisory Committee, comprised of hydrogeologists and engineers, who provided information on technical issues.

Goals

Based on an analysis of existing conditions in the Carmans River and its watershed, and a vision for what the Carmans River and its watershed should look like in the future, the following goals were identified by the Study Group to guide the preparation of the management plan:

1. There should be no further degradation of water quality in the Carmans River (non-degradation goal), and an effort to reduce the concentrations of water quality contaminants to a level that protects the river's ecological health (restoration goal).
2. Environmentally sensitive lands that are critical to the ecological health and water quality of the Carmans River, or are significant habitats within the Carmans River watershed, should be protected and preserved.
3. Any new development or redevelopment in the Carmans River watershed should not adversely impact water quality in the Carmans River or the key ecological communities in the Carmans River watershed.
4. Degraded habitats should be restored, stormwater discharges mitigated, and invasive species controlled, significantly reduced or, if possible, eliminated.
5. Environmental stewardship, outreach and education should be promoted by the Town of Brookhaven.

Public Participation

The Study Group and the Technical Advisory Committee began meeting in early November 2010. All meetings were open to the public and public comment was accepted at the conclusion of each meeting. Technical documents and meeting minutes were posted on the Town's website.

The Town Board adopted a "Positive Declaration" pursuant to the State Environmental Quality Review Act (SEQRA) for the adoption of the Plan, which requires the preparation of a Draft Generic Environmental Impact Statement (DGEIS) in which the potential environmental impacts of adopting and implementing the Management Plan would be identified and analyzed. The DGEIS required by the Positive Declaration is a separate document and functions as a companion to the *Draft Management Plan*. Both the *Draft Management Plan* and the DGEIS will be subject to public review and comment including a public hearing. The *Draft Management Plan* and DGEIS will also be referred to the Suffolk County Planning Commission pursuant to New York State General Municipal Law and Central Pine Barrens Commission for comment.

A Final GEIS (FGEIS) will be prepared which addresses substantive comments on the contents of the DGEIS. Based on an assessment of the substantive comments and any additional analyses that may be undertaken, the *Draft Management Plan* will be revised as deemed appropriate into the *Final Management Plan*. A SEQRA Findings Statement that evaluates the environmental impacts of the *Final Management Plan's* adoption and implementation will be voted on by the Brookhaven Town Board prior to the Town Board taking action on the adoption of the *Final Management Plan*.

CHAPTER 2: A SOCIAL AND ENVIRONMENTAL HISTORY OF CARMANS RIVER

Courtesy of Thomas B. Williams¹

Since the last ice age ended over 10,000 years ago, the Carmans River served a variety of uses for area residents. First used by Native Americans for fishing and transportation, it is now used for hunting, fishing, recreation and the enjoyment of its wild beauty. As the one of the largest rivers on Long Island, it holds a special place in the hearts of residents of Brookhaven Town and Suffolk County.



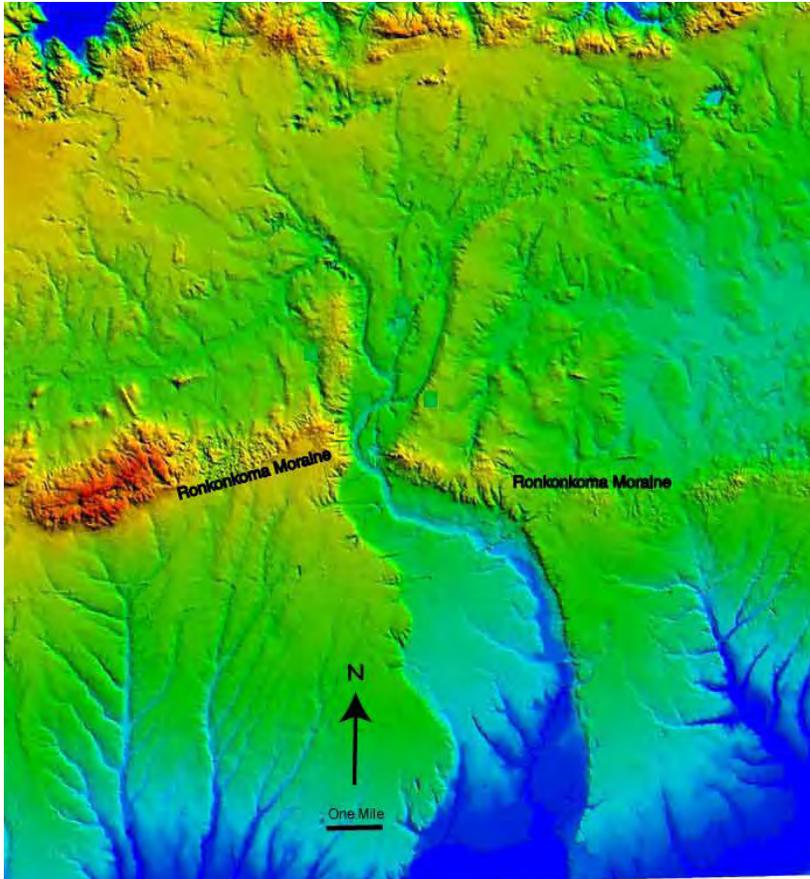
Aerial view of the Carmans River looking north from Bellport Bay

The River winds through the Pitch Pine – Oak woodlands of central Suffolk, yet the vegetation in the wetlands along its banks is different from the open Pine Barrens of the upland areas. Red Maples grow in moister places closer to the river and the thick shrub layer along the banks includes the sweetly perfumed Sweet Pepper Bush and tasty High Bush Blueberries. Deer browse the vegetation and red fox hunt small mammals in the upland areas, while the lower part of the river provides a haven for migrating and wintering waterfowl.²

The geologist explorer John Wesley Powell defines a watershed as; "that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and ...become part of a community." The Carmans River has been an integral part of human life throughout its history as well as being a complex ecological system that supports a wide variety of wildlife.

The Carmans River is a groundwater-fed system with over 95% of its water coming from groundwater. Eleven miles in length with a tidal portion of two miles from the Great South Bay to Sunrise Highway, the headwaters of the Carmans River fluctuates in relation to precipitation levels. From the source of the river down through the three lakes and over various dams, the river descends over 60 feet until it reaches the Great South Bay.

According to Gil Hanson from Stony Brook University's Department of Geosciences, the river valley was created by the retreat of the Wisconsin Glacier. Unlike other rivers on Long Island that were formed by the glacial melt in the outwash area below the moraine, the Carmans cuts right through the Ronkonkoma Moraine. According to Hanson, there was a tunnel created by melting ice running under the glacier long before it receded and thus no debris deposited (moraine) in the Carmans River valley.



Carmans River Tunnel Valley, Gil Hanson, SUNY Stony Brook

Native Americans used the river and its interface with the Great South Bay as a source of food including oysters, clams, and fish for thousands of years. European settlers arrived in Brookhaven Town at Setauket in 1655. In 1657 the first purchase of land on the south shore of Brookhaven was made from the Unkechaugs, a tribe that had lived in the area for many generations and was part of the Algonquin Nation, which was 256 acres of salt marsh meadow along the lower Carmans River.

Originally called the Connecticut River (a Native American term for a long tidal river), it was named after Samuel Carman (or by Samuel Carman who may have named it after his daughter) who developed a mill on the lower Carmans and used the river to provide goods and services to the community.

Seen as a great natural resource, there has been a long succession of efforts to preserve the integrity of the river. The watershed is considered to cover approximately 17,000 acres; between the Town of Brookhaven, Suffolk County and United States Government, over 5,600 acres of the watershed have been preserved.

PATCHOGUE, L. I., Feb. 17.—A suit for ejectment brought by W. E. T. Smith and others of the Manor of St. George, Brookhaven, against John J. Bartlett of Greenport, who represents the Brooklyn Water Syndicate, for the possession of Carman's River, the largest stream in the system bought by the syndicate three years ago, came before Justice Wilmot M. Smith in Special Term of the Supreme Court here yesterday.

The plaintiff's claim title to the stream through the original patent given by King William and Queen Mary in 1693 to William Tangier Smith, the ancestors of the plaintiffs in the present suit. Under the will of William Tangier Smith, dated April 23, 1704, the vast estate was sub-divided among his sons, Henry T. Smith, William Henry Smith, and Charles Jeffrey Smith, and his daughters, Eugenia and Gloriana, and the plaintiffs claim title, being the direct heirs of Tangier Smith's son, William Henry Smith.

The daughters, Eugenia and Gloriana, later parted with the holdings given them under their father's will, and the property subsequently, through a chain of deeds and wills, came into the possession of Henry W. Carman of Brookhaven, who sold it to John J. Bartlett in April, 1898, the agent of the water syndicate, who bid \$20,000 for one-half of Carman's River.

For the defense Henry W. Carman testified to holding title to the disputed property under deeds dating back to 1795 and an Indian deed dated Nov. 13, 1688. A number of the defendant's witnesses testified to having hunted and fished on the disputed premises up to within four years ago without interference. The case will continue next Saturday.

New York Times, 2/18/1901

Efforts have been made over the years to access the water from Carmans River (among others) for New York City. The Brooklyn Water Syndicate tried in 1901 to tap the water of the Carmans.

I.M. de Varona, the Engineer of Water Supply of Brooklyn, submitted a report on securing "an additional supply of 100,000,000 gallons of water per day" from Suffolk County for the Brooklyn Waterworks in January 1896.

'It is proposed to use the surface flow of eleven streams flowing into Long Island Sound, draining about 200 square miles of land in Suffolk County, 30 to 55 miles from the present Ridgewood Reservoir.'

Mr. de Varona's plan was to allow the water to flow by gravity conduits to the nearest one of three pumping stations, located at Babylon, the Connetquot River and the East Connecticut River [Carmans], respectively. At each of these stations the water was to be pumped to tanks placed on the tops of high trestles, whereby it would flow by gravity through riveted steel pipes to Ridgewood reservoir. From Babylon to Ridgewood is 30.4 miles, and the water was to be conveyed between these points in two 81-inch steel pipes.

The charter of the City of New York allowed the city to condemn land outside the city limits if the land was needed for municipal purposes. The Brooklyn Waterworks had acquired supply ponds beginning about 1862, and by 1889, these supply ponds were as far away as Rockville Centre. The Brooklyn Waterworks was then extended to Massapequa.

John P. Cranford, head of the Cranford Company, and a major contractor for Brooklyn, wanted to take advantage of this new opportunity. If it looked like the city was going to be purchasing some large tracts of property in Suffolk County, the thing to do was to purchase it first. Cranford's ancestors had owned a large farm on Long Island, near Jamaica, but he had been more interested in engineering and in commerce than in farming.

Cranford had obtained a patent on a "new improved composition pavement" in 1869 that was waterproof and impervious to frost. It was called "asphalt" that was applied to a surface as a "heated bituminous material." Cranford made a fortune through his contracts to supply asphalt for Brooklyn, and later for New York City, Boston, Washington, and San Francisco.

Cranford's group had already built aqueducts in the late 1880s and early 1890s to bring water from the ponds and streams of Nassau County to the city of Brooklyn. Cranford did not want to buy the land himself and engaged John Bartlett to act on behalf of the Brooklyn Water Syndicate. Suffolk residents were

alarmed and did manage to get a bill through the NY State Legislature to kill the idea, but new bills would be passed in the next session to resurrect the plan.

The idea received detailed examination. The Report of the Commission on Additional Water Supply for the City of New York in 1904 included calculations based on actual measurements, along with the proposed methods of getting the needed water to the city. Dug, driven, and infiltration wells were considered; methods that were devised for "intercepting the underflow," and the South Shore "pondage," rainfall, and stream flows were measured or estimated. The number of pumping stations and types of pumps were considered and the approximate cost of a pumping station computed. But for all of its 980 pages, it was still a general overview rather than a detailed plan.

With regards to the Carmans River, however, the descendants of William "Tangier" Smith sued to prevent the Brooklyn Water Syndicate from ever taking water from the Carmans.

The case eventually reached the Second Department of the Appellate Division of the Supreme Court of New York on 20 December, 1918. The court concluded that when William Smith wrote his will in 1704, he did in fact own Yaphank Neck and that he did not "devise it to his daughters Jeane and Glorianna". The judge concluded that the title that Bartlett had was derived from Terrill and not from the Smith sisters.

Thus the title to the land was not legally owned by John Bartlett from the Brooklyn Water Syndicate who had claimed to have purchased it from Samuel Terril, because Terril had never owned it legally in the first place. This complicated case that went on for 17 years, shows just how difficult it was to determine ownership of land in the Carmans River. In any case, water was never drawn from the Carmans River to supply water to the residents of Brooklyn." ³

The Carmans River can be separated into four sections:

- The tidal river from Great South Bay to Sunrise Highway, which includes the US Fish and Wildlife Wertheim refuge.
- Southaven County Park and Hards Lake

- The Yaphank area and two lakes (Willow and Lily Lakes, Upper and Lower Lakes respectively)
- The upper river from the headwaters in Middle Island south through Cathedral Pines, East Bartlett Road, and the Novak property to the northern regions of “Upper Lake” or Willow Lake, as it is now known.

The Tidal River



River flowing into Bellport Bay

Used by Native Americans, baymen, fishermen, sailors and farmers, the tidal area of the river is a rich source of nutrient material to the estuary, where the freshwater river meets the saltwater bay. This portion of the river is dominated by the Wertheim National Wildlife Refuge and also serves as a recreational area for fishing, sailing, kayaking and canoeing. Much of the shoreline to the west of the mouth of the Carmans River is under the auspices of the New York State Department of Environmental Conservation.

The River contributes 46 million gallons a day to the Great South Bay which allows abundant life to thrive in the estuary, and in turn, the ocean beyond.

Salt hay was one of many resources harvested by early European farmers, making this part of the river attractive to early settlers. Salt hay was collected by farmers as feed for their livestock and as insulation for storing ice through the summer months.



Collecting salt hay, 1905



Wallace Swezey on “Marshing Day”

Tar and turpentine were also much sought after. The abundant stands of pine trees provided the sap that enabled the early settlers to harvest this valuable commodity. It was noted that they made so much of it, the Town of Brookhaven initiated a tax on tar and turpentine. This area was called Tarmans Neck and was a relatively small piece of land west of Beaver Dam Creek. It was the western terminus of Old Town Road that ran from Setauket to ‘Fire Place’ and was created in 1665. Old Town Road split at Montauk highway and the eastern terminus of the road went down what is now Old Stump Road along the west side of Carmans River. This road was also used to cart salt hay north to Setauket. Old Town Road still exists although it is often interrupted by newly designed roadways throughout Brookhaven Town. The area between the Carmans River and Beaver Dam Creek is Fire Place Neck, the largest and most populous of the local necks of land and the entire area, from South Haven to Bellport was often referred to as Fire Place, later named Brookhaven Hamlet.

At the mouth of the river, Squassux Landing has traditionally been used as a place from which to sail to the barrier beach. For many years Squassux

(named after a Native American potter who worked there), an area on the west side of the river at the end of Beaver Dam road, was a place where ferries went to Old Inlet and Smith Point. Before that, Native Americans, and later European settlers, set out to hunt whales from Squassux. The Carmans River was also important as a landing place for whaling crews stationed on Fire Island. It is local legend that Fire Place (now Brookhaven Hamlet) was named for the fires that were lighted there to guide boats coming in through the inlet.



Ferries at Squassux Landing, 1905

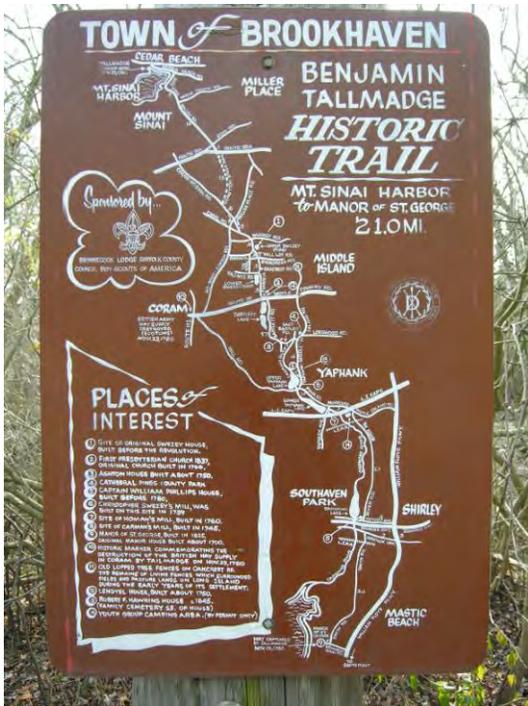
“Brookhaven town bought of Tobacus the Sachem of the Unkechaug tribe of Indians who inhabited the south side of the town, the right to all whales that should come within the bounds of their patent upon the beach. For this the Indians were to receive a royalty of five pounds of wampum or some other commodity for each whale they received. The inhabitants further agreed to give the Indians three fathoms of wampum for information of the coming of a whale upon the beach.

An entry in the town records under the date of may 18, 1675 states that Abraham Dayton and Thomas Bearsly sold 18 barrels of whale oil "lying on the south side of the island at a place commonly called Fire Place." the name fire place probably given to that point of land jutting out into the bay west of Connecticut river (Carman's river). This point was known as Woodhull's point in those days but now as Long's Point. South of it was an inlet from the ocean to the bay and fires were built on this point of land to guide

the whaling boats through the inlet and across the bay to the mouth of Connecticut river along whose banks were the landing places with such names as "Indian Landing," "Sgaussucks Landing," and "Zach's Landing," at which the boats docked. One landmark on the beach still bears the name of "Whale House Point." Places were established also, where the whales which had been harpooned and towed in were cut up and "tried" in big kettles for the oil they contained. One such place was maintained by the widow of Col. William Smith to which her Whaleboat manned by a crew of Indians brought an average of 20 whales a winter to be "tried." The oil and whalebones were sent to England. ”⁴

William “Tangier” Smith was granted a patent from the English King in 1693 for 90 square miles of Brookhaven Town on the east side of the Carmans River. The patent began at the south shore and continued north through Manorville to Flanders in the east, and included most of the east side of the Carmans River. There is a complicated line of ownership since 1693. Much of the land around the east side of the river was purchased from Native Americans, then given to William Tangier Smith by way of the Dongan Patent, and finally purchased in smaller lots from the Smith heirs. On the west side of the river, the Town of Brookhaven purchased land from Native Americans and later sold it to multiple owners. Subsequent purchasers would include Samuel Carman Sr., the Suffolk Club, Maurice Wertheim and various land owners in the Yaphank area.

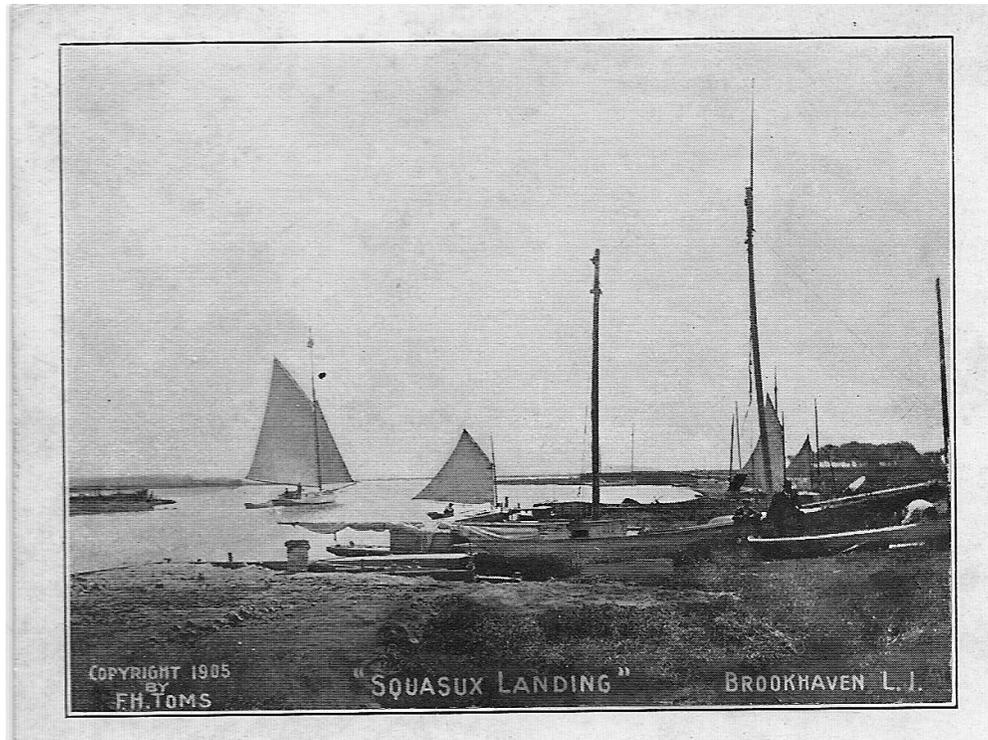
The Carmans River played a key role in the American Revolution. In 1780, the Battle of Mastic was fought at Fort St. George, led by Major Benjamin Tallmadge. He crossed Long Island Sound from Connecticut and coming south from Old Mans (now Mt. Sinai), traveled along the Carmans River. He surprised the British garrison there, captured approximately 50 soldiers, traveled back to Mt. Sinai and returned to Connecticut victorious. The Tallmadge Trail celebrates and traces this victory, crosses the river at Bartlett Road in the upper reaches of the river and travels south along the east side of the river to Mastic.



Map of the Talmadge Trail at E. Bartlett Road

The Carmans River area has also been attractive to land speculators and developers. In 1910, 4,000 acres were purchased by the Tangiers Manor Corporation from the heirs of William Smith in order to develop “Tangiers.” While the new owner was unable to make this dream a reality (he imagined a large hotel on Fire Island at Smith Point, among other ideas) and had abandoned the project by 1916, much of his planning was later used by Walter T. Shirley to develop Shirley, Mastic Beach and Mastic. Most of the 4,000 acres on the east side of the River was reclaimed at a tax auction by the Smith family after the Tangiers Corporation went bankrupt (the Smith family held the mortgage); some of this land was later purchased by Maurice Wertheim.

Much of the west side of the river was purchased from the Native Americans by the Town. An initial sale of what is known as Yaphank Neck, to Sam Terrell through a town approved purchase in 1688, subsequently became the property of Samuel Carman where he built his tavern and operated the mill.



Squassux Landing, 1905

In 1917, James Post purchased 13 acres at Squassux Landing to enable the community to keep their boats there for recreational uses, fishing and as a ferry service to Fire Island. This may be the first purchase of land along the River for a public use. It was donated to the Brookhaven Village Association in 1945. For the past 65 years, Squassux Landing has been used as a boatyard, park and gathering place for the Brookhaven Hamlet community.



Squassux Landing, circa 1906

Ship building also took place on the river. In 1900, Sam Newey opened a ship yard near the mouth of the river. Newey built fourteen tankers which went to India and Africa. He also built sloops, yachts, yawls, and boats for ferrymen and the oil trade, and commercial draggers equipped with heavy booms.



Robinson's Duck Farm along the river. The Old Southaven Church is in the middle foreground, before it was moved in 1960.

Duck farming had a controversial life on the river. The first duck farm was built along Little Neck Run, a tributary to the Carmans River in 1921. In 1923, the Robinson Duck Farm was started and operated until 1984. In the 1960s it produced over 200,000 ducks each year for market, which was typical of the approximately 90 duck farms on Long Island. The 87 acre Robinson Duck Farm was purchased by Suffolk County in 1991. The duck farming industry produced environmental impacts that the river is still recovering from. Widespread support for preservation led to the decline of duck farming on the river.



Robinson's Duck Farm, c. 1948

In the early 1900's, The president of the Bon Ami Corporation, Eversley Childs, along with the head of the advertising agency for Bon Ami, Alfred W. Erickson, bought up many parcels of land along both sides of the Carmans River and collected them into a single parcel. Childs and Erickson then placed all the properties under the name of a corporation they formed, the Carman River Corporation. The deeds make clear that "fishing, hunting, and fowling" was the reason Childs and Erickson wanted the property; Eversley was an avid sportsman and created a preserve in Old Field on the north shore called Crane's Neck. He was also a philanthropist who donated land to Stony Brook University

(Flax Pond), the YMCA and founded a hospital for leprosy (Hansen's disease) in the Philippines (the hospital exists today and is still called the Eversley Childs Sanitarium).

In 1938, Maurice Wertheim bought the land from the Carman River Corporation owned by Eversley Childs and A.W. Erickson, as well as a few other pieces of land along the River, to create his own private hunting preserve. It was alleged that he was a friend of Harold Ickes, the Director of the Department of the Interior. It is believed that Wertheim bought the land with the intent of donating it to the Federal Government. In 1947, Maurice Wertheim donated 1700 acres of his preserve to the United States Fish and Wildlife Service.

In 1976, some 600 additional acres were added to the Refuge, including a 167-acre donation by the Wellington family and the purchase of most of the land from Yaphank Creek west to Old Stump Road and south to the Carmans River, including Little Neck Run and Yaphank Creek.



Ducks on Carmans River, 1950

The Wertheim Refuge has been expanded and now encompasses approximately 2,550 acres along the Carmans River from the mouth of the river to Montauk Highway. The refuge was a hunting preserve and is now a sanctuary for wildlife. It is host to ducks and other wildlife and is an important resting place on the Atlantic Flyway for migrating birds.



Wertheim National Wildlife Refuge

Southaven Park And Hard's Lake

Probably originally built by Samuel Terrell around 1740, the mill at Southaven created what is now known as Hard's Lake. There were other dams created on the river that reflected the impact of the Industrial Revolution. The river provided power for lumber, grist, and fulling mills. The dams for these mills created barriers in the river that created the lakes in the river system.

The mill was located where Sunrise Highway is today and was in operation until 1910.⁵ There was a planing, or saw mill, as well as a fulling mill (processing of cloth from flax so that it thickened and shrunk) and a grist mill. The mill was subsequently purchased by John Havens in 1745, Samuel Carman in 1780, the Suffolk Club in 1875 and finally, the Hard family in 1923.



Carman's Mill, 1880

The mill was in operation in 1745, according to a deed of April 10 made by Richard and Nicoll Floyd and Mordecai Homan, who in consideration of 720 pounds sold to John Havens: *“All that tract or neck of land and meadow bounded on the east by a river called Connecticut, south by a small river called Yaphank, north by a swamp called Saswsunce, together with the grist mill, saw mill and fulling mill, and all ye other houses, orchards, gardens, improvements etc.”*⁶

Samuel Carman and his family operated the mill from 1780 until 1875 and developed a tavern and post office that formed the center of commercial activity along the River. This tavern was just to the west of the river by the “goin over,” a

narrow section of the river that can still be seen just north of the Montauk Highway where it crosses the river.



The “Goin Over” East of Carmans Tavern

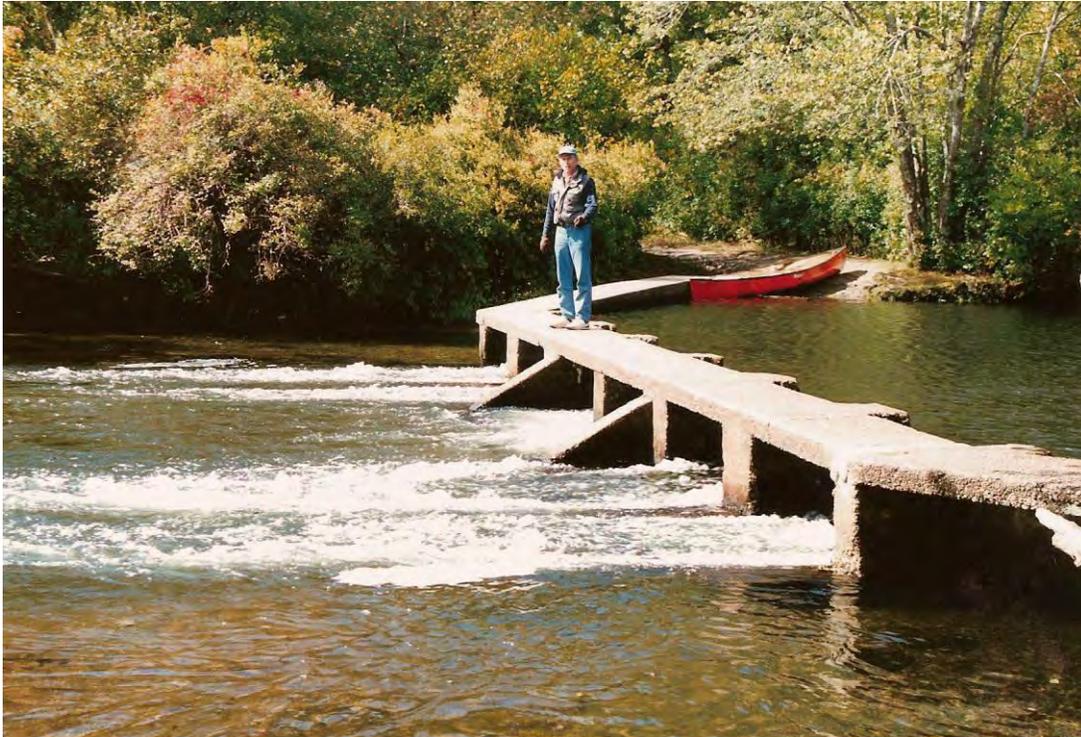
“As boats could come up the river to within a quarter mile of the store, and the weekly stagecoach from Brooklyn to Sag Harbor stopped regularly, the location of the establishment was ideal. Carman’s store provided everything from thimbles to velvet breeches – although rum was the most lucrative item. It also established, along with the South Haven Church, an important meeting place for early settlers. Roads from all directions converged here, providing a good location for political meetings and elections.”⁷

The large trout in the Carmans River were a draw for some notable fishermen. In 1827, Daniel Webster caught a 14 lb trout which he took to New York City to be served at the famous Delmonico's restaurant. The weathervane on the Old Southaven Presbyterian Church is symbolic of his historic catch.⁸ Samuel Carman's mill pond, now known as Hard's Lake, was used by fishermen for years and the river and its lakes still provide valuable recreational fishing to residents.



Because of his successful catch, in 1827 Daniel Webster rented land above the South Haven mill pond with fishing rights for him and a few friends, including Martin Van Buren, later the 8th President. This was the precursor to the Suffolk Club organized by August Belmont, a wealthy industrialist, in 1858. In 1875, the Suffolk Club bought approximately 1,200 acres from Henry Carman, mostly on the west side of the river, all the way from Yaphank down to the Great South Bay. The Suffolk Club bought the land as a shooting and fishing preserve and raised trout to stock the river. Theodore Roosevelt was one of the Club's most famous members.

Finally, in 1923 Anson Hard bought up all the remaining shares, nearly 1,300 acres, of the Suffolk Club and used the area as a private hunting preserve. The preserve raised pheasants and they also developed a trout nursery there to stock the river.



C-gate Dam, Southaven Park

Upon Hard's purchase he made it his private residence, calling it "Fireplace." He used it as a private hunting preserve for himself and friends, and in 1925 he hired a consultant Clyde Terrell, "a Specialist on Developing Attractive Places for Fins, Furs, Feathers and Folks", to increase gaming on the river. His son, Ken, raised trout, pheasants, ducks, and turkeys when he opened the Suffolk Lodge game preserve. He also introduced a herd of Sitka deer given to him by Walter Shirley who had used them as a promotion gimmick to sell his development scheme. Some of the exotic Sitka deer are still found in the area today. There is a "mid-river dam" also called the C-gate dam (because of the

entrance to the park at C-gate on River Road), built to create an impoundment by the Suffolk Club to back water to improve water fowling. It also separated the lake into a lower section where there were bass and perch, from the upper section where the Hards put the trout that came from the hatchery. The Trout hatchery is to the east of the present day entrance to the Park.⁹

Kenneth Hard lived and raised his family there and eventually sold the river and surrounding property to Suffolk County in 1962. The County condemned the land in order to clear title to it because of the difficulty in determining continuous ownership but paid him for the property. Since the Hards owned the water rights to the river up to the source, the course of the river above Suffolk Lodge was donated to the Town of Brookhaven by Kenneth Hard (shown on maps created for Suffolk County by Norton Brothers in October 1962). In 1964 all the remaining land of Suffolk Lodge was sold to the County to create Suffolk County's first park. Southaven Park now encompasses 1,356 acres that includes much of the river.



Map of Suffolk Lodge Game Preserve

It was about this time that Sunrise Highway was built over the river and the Carmans Mill was demolished along with other structures (1958). A new dam was constructed somewhat north of the original dam that was several feet higher. Some of the buildings that served the farm remain and are currently owned by Ron Bush. One such building is a barn with an extensive collection of farm tools. A few years after the Sunrise Highway Extension was built, the Old South Haven Presbyterian Church (known as the “Parish of South Haven” from 1802 to 1979) was moved from alongside the river to its present location at the corner of South Country and Beaver Dam Roads in Brookhaven Hamlet in 1960.



Old South Haven Presbyterian Church

At the northern reaches of Southaven Park lies Weeks Pond. Sometime around 1850, William Jones Weeks of Yaphank began cultivating cranberries by creating a bog at the east end of a pond on his property. His cranberries were sold locally and were also shipped in barrels to New York City by railroad. The cranberries grown at Weeks Pond were of high quality and frequently won first prize at the County Fair held in Riverhead. The bog was still producing cranberries at the turn of the century.¹⁰

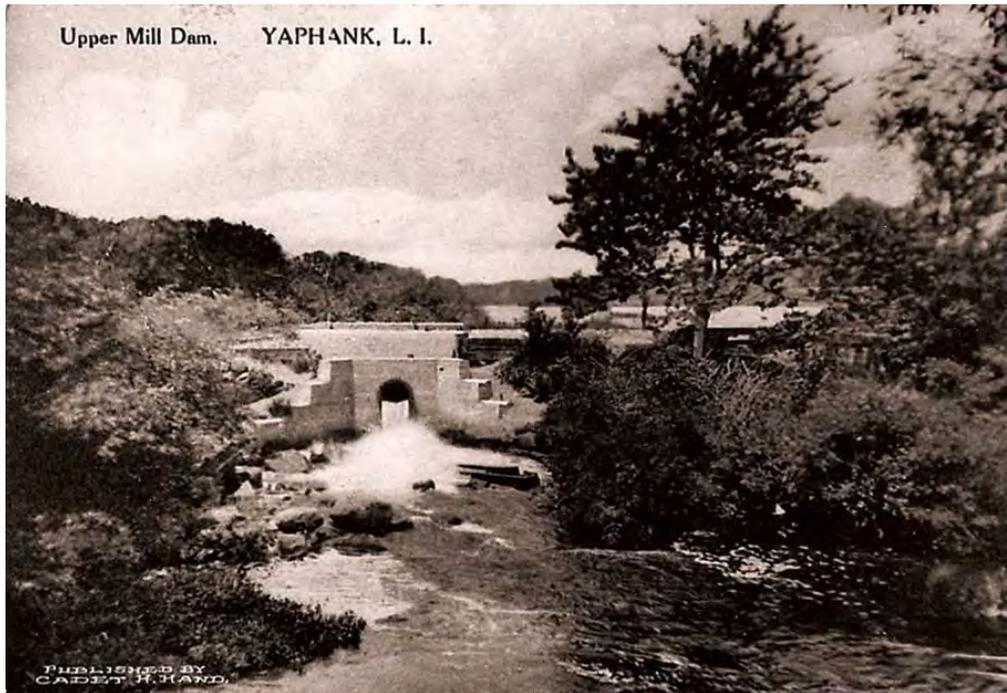
For the 200 years of its existence, the dam at Hard’s Lake prevented Alewives from spawning further north than Montauk Highway. The Alewives (a member of the Herring family) were very numerous and served as an important

food source for ospreys, wildlife and many commercially important finfish, such as bluefish, striped bass, and tuna. They were so numerous they were also harvested by local farmers and used as a source of fertilizer. There is now a fish passage at the south end of Hard's Lake that allows Alewives to once again access their ancestral spawning areas. Installed in 2007, the fish passage was a joint effort of many agencies including the New York State Department of Transportation, New York State Department Environmental Conservation, the County of Suffolk, the Town of Brookhaven, the United States Fish and Wildlife Service, Environmental Defense Fund, Trout Unlimited and the National Oceanic and Atmospheric Administration. There are plans to develop additional fish passages to enable the alewives to travel further up the river.



Fish passage at Sunrise Highway

Yaphank and Millville



Upper Mill Dam, Yaphank, 1930

Yaphank was given its former moniker, Millville, because of the several mills built in the 18th and 19th centuries. Because of the numerous Millvilles already in New York State in 1846 (12) and a desire for a post office, residents advocated to change the name to Yaphank, taken from the Native American name Yamphanke meaning “bank of a river.” In addition to their commercial value to the community, the lakes served as a recreational resource with fishing and swimming in the summer and ice skating in the winter.

Built in 1762, the Homan-Gerard Mill was originally a cotton mill and became a lumber and grist mill. It was later owned by the E.L. Gerard family who lived and operated the mill there until 1899. The family then sold it to the Suffolk Club in 1910. This mill burned down in 1919 but the 18th century Homan-Gerard House remains. The dam for this mill created the lower lake in Yaphank (now Lily Lake). A fish passage over this dam is currently in the planning stage.



Grist mill in Yaphank, circa 1905

Recently there have been serious problems with invasive plants in Lower Lake and it is the subject, along with the Upper Lake, of a study on managing the invasive aquatic plants. Although the water quality remains relatively good, the invasive plants have made it nearly impossible to swim, canoe and fish in the lakes (see later chapters on invasive species).

In 1736, the original Yaphank Mill located on Upper Lake was built by Captain Robert Robinson. Another fulling and grist mill, it was later owned by the Swezey family who lived in the Swezey-Avery house. The family sold the house to the Town of Brookhaven in 1965.



The Swezey-Avery House in 1906

There were other roads and dams built over the Carmans River through the years. One-half mile north of the mill on Upper Lake was the “old fulling mill.” In 1792, Town trustees granted Ebenezer Homan the “town right and no more” for the raising of his mill for 3 British pounds.¹¹ In 1799 a road was built from Granny Road on the west side of the river to Yaphank Road on the east, across the “old fulling mill dam”. This road was closed in 1823.

A family member of the Szuster family remembers a dirt road across the river from their farm. He said they used it to get to a field of corn on the other side.

“Part of the farm had half a mile of the Carmen's River running through it. As a kid, the river always intrigued me. It was one of my favorite places. There were two dams with pass through pipes that allowed vehicles to cross to a 40-acre parcel on the West Side of the river we called "low ground". Here each year my uncles raised corn. Some years there was a large problem with corn thieves. These were people who would go into the fields at night and pull 50-100 bags of corn. This cut into my uncle's profit margin and caused them late nights watching the fields. The river provided water in the summers for the crops in the fields.”¹²

The Szuster farm is still a working farm on the east side of the river on Yaphank/Middle Island Road, or County Road 21. The river still provides water to the Szuster farm and there are still those who try to cross the river in this area with ATVs and dirt bikes, and unfortunately compromise the fragile ecosystem in the upper river.

The first line of the Long Island Rail Road was built in 1844. It traveled through the middle of the Island and included the stop at Yaphank on the way to Greenport (which at that time, including a ferry across the Sound, was the preferred way to travel to Boston before the railroad went from New York City through Connecticut to Boston.)

The southern division was extended from Patchogue to Eastport in 1881. Thus the LIRR went over the river through the mill region of Yaphank and Brookhaven Hamlet. It was hoped that it would connect local industry to New York City; thus demonstrating more evidence of the flourishing commercial and recreational interests surrounding the River.



Long Island Railroad, 1897

The Upper River And Headwaters

The upper river is very beautiful and has inspired people to create recreational camps along the riverbank. Camp Sobaco to the north west of the Upper Lake remains an active summer youth camp owned and operated by the

Suffolk County Girl Scouts. Further to the north on the west side was Camp Wilderness owned by the Boy Scouts in Suffolk and sold to the County in 1968 to create Cathedral Pines County Park. There are still opportunities there to camp and enjoy the beauty of the upper river.

A third camp was developed by a group of Greek-Americans and called Camp Olympia. This camp was purchased by the Town in 2002 as open space and is located just below the Upper Lake on the west side of the River. Further down the River along the western side of the Lower Lake is the Brookhaven Country Day Camp. Approximately 24 acres in size, it is a proprietary camp for children that was started in 1968.

The following is a short history of Camp Siegfried which was on the west side of the Upper Lake just off of Mill Road. Camp Siegfried, a German-American summer camp located in Yaphank, was founded in 1935 by the German American Settlement League which owns the property to this day. Families first used the camp as a summer resort and it later became a year-round residence. Robert Kessler shares his recollections:

Camp Siegfried was purchased as a summer camp for people of German descent who lived in the city (mostly in Ridgewood). When the land was first purchased in 1935 it was a farm and it was open land. People would come out in droves on the weekends and camp on the grounds, swim in the lake and just socialize. In the late 30's and 40's some summer houses began to spring up on the property, and eventually people purchased them and it slowly became the community that it is today. The property consisted of 52 acres which went to the center of the lake. When the Town took the Lakes in the early 70's (the community) lost about 6 acres. The Town paid \$101.00 for the 6 acres, one dollar for the river bottom and one hundred dollars for a dock that was on the property.

We now own 46 acres of one of the most beautiful places on L.I. We have 43 homes in our community and we maintain a lot of open space. We have also agreed never to build any more new houses in our community. The property is privately owned and it takes in the entire west side of the lake.¹³



Camp Siegfried

The County acquired the 514-acre Cathedral Pines and 58-acre Prosser Pines in the northern reaches of the River in 1968. Purchased by Suffolk County from the Boy Scouts, Cathedral Pines was the first protected area in the upper regions of the river. Acquired in 1968, Cathedral Pines (514 acres) and Prosser Pines (58 acres) is made up of a beautiful stand of white pines planted in 1812 by William Dayton. Prosser Pines was originally purchased by James Dayton in 1793, and it was his son William who planted the pines. The property was sold to George Prosser in 1889 whose family owned the property until its sale to the county in 1968. The parks provide camping and nature walks for County residents and have protected the upper reaches of the River. In 1895 George Prosser dug a drainage ditch from Artist's Lake to alleviate flooding, that was to connect with the Carmans River. The ditch still exists, however it ends in a farm field short of the Carmans River.

The Long Island poet William Cullen Bryant wrote of the Cathedral Pines forest in 1910:

*"The groves were God's first temples. In the darkling wood, amid the cool and silence, man knelt down and offered to the mightiest, solemn thanks and supplication."*¹⁴



“Walking in Cathedral Pines”, County Park¹⁴

In 2006 the County incorporated the 700 acre Warbler Woods Dennis Puleston Nature Preserve into the Suffolk County Park system (south of Cathedral Pines County Park, east of County Road 21 and south of Longwood Road). Additional property along the northern part of the river has been purchased by the Town and County over the past 10 years with open space funding.

Though start of flow varies from year to year according to rainfall, historian Thomas R. Bayles noted the source of Carmans River originated north of Middle Country Road in what used to be called Pfeiffer’s Pond, named after the owner of a tavern and home on Middle Country Road. This tavern and stagecoach stop was similar to that belonging to Samuel Carman in Southaven.

The home was built before 1739 by the Brewster family. The building served as a general store and stagecoach stop and the store served as a social meeting place where people came to purchase supplies and pick up mail. At the heart of the store stood a potbellied stove, which was the sole source of heat in

the store. Around the stove people played checkers or discussed the politics of the day, or gathered for just a good gossip. From time to time, farm auctions were held in front of the general store.



Pfeiffer's store in Middle Island

Horace Randall bought the store in 1857 and ran it until his death in 1878; his son Joseph ran the store until 1892. Edward Pfeiffer, who had clerked in the store in his teens for owner Joseph Randall, later purchased the store. In 1901 Pfeiffer followed Miss Cynthia Hutchinson as Postmaster and ran the Post Office out of the general store. The Pfeiffer's ran the Post Office in Middle Island until 1957.

The store closed down in 1957. In 1971, it was declared unsafe and was burned down in order to make way for the gas station that currently occupies that site.¹⁵



Pfeiffer's Pond

Preserving The Beauty Of The River

In 1972 a group of students from Bellport High School, under the leadership of teacher Art Cooley, and naturalist Dennis Puleston, wrote "*The Carmans River Story: A Natural and Human History*," which helped designate the river as one of the first "Wild, Scenic and Recreational" rivers in New York State.

The state's Wild Scenic and Recreational Rivers Act protects those rivers of the state that possess outstanding scenic, ecological, recreational, historic, and scientific values. These attributes may include value derived from fish and wildlife and botanical resources, aesthetic quality, archaeological significance and other cultural and historic features.

State policy is to preserve designated rivers in a free flowing condition, protecting them from improvident development and use. This policy is intended to preserve the enjoyment and benefits derived from these rivers for present and future generations.¹⁶

The Carmans River was first added to New York State's Wild, Scenic and Recreational Rivers initiative as a "study" river in February of 1974 to determine if

it met all the characteristics and criteria to be added to the Wild, Scenic and Recreational River (WSRR) system. The Carmans River was officially designated into the WSRR system by the New York State Department of Environmental Conservation (DEC) via a Commissioner's Decision and Order on March 4th, 1977. The River is broken up into five segments. Three segments are designated Scenic portions, and two sections are designated Recreational. Scenic Rivers are supposed to be free of impoundments with limited development and road access. Scenic areas are managed to preserve and restore their ecological, cultural, and aesthetic qualities. Recreational Rivers are readily accessible and may have a significant amount of development. Recreational areas are managed to avoid adverse environmental impacts and loss of river values.

The river was designated because of heavy community interest in preserving its ecology and history. The Carmans River ranks with the Nissequogue, Connetquot, and Peconic as being one of the four most important streams on Long Island ecologically. The river extends from extensive salt marshes in the southern tidal portion to dense red maple deciduous forest in the north. The Carmans River is populated by over 40 species of fish including the native brook trout. Hundreds of species of birds, mammals, and other types of wildlife utilize the river and its surrounding upland habitat for forage, shelter, and breeding.

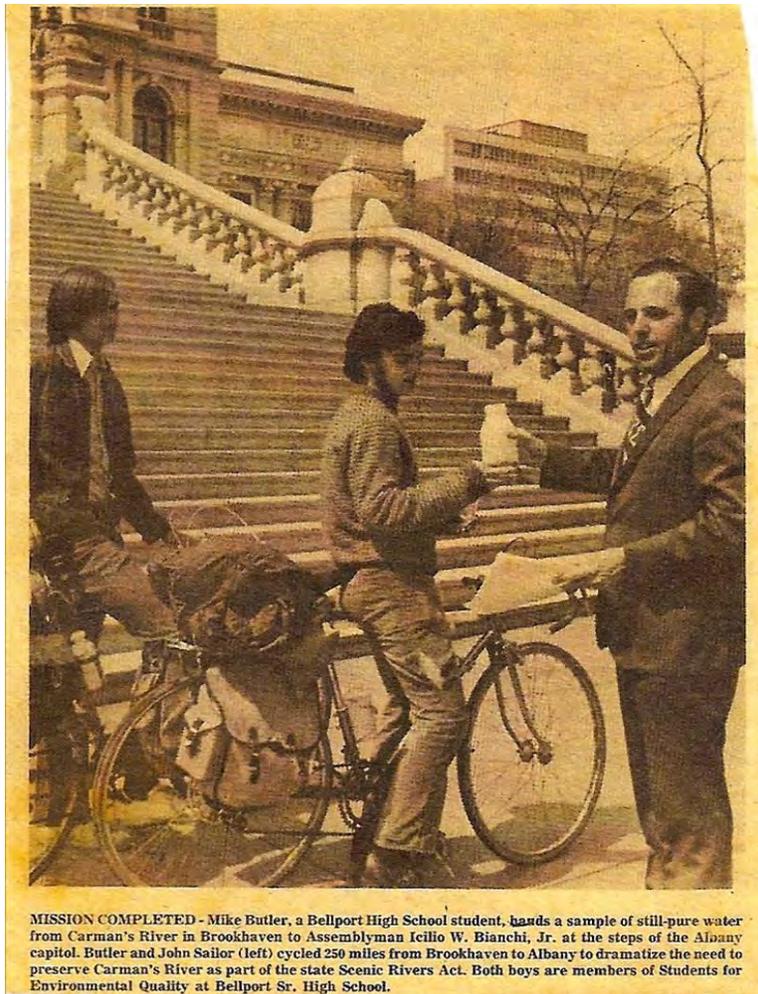
The regulated WSRR river corridor is approximately 10.25 miles in length and up to one half mile in width from either side of the river bank of the main branch of the Carmans and two tributaries- Little Neck Creek and Yaphank Creek. The drainage basin of the river is around 71 square miles.

The inclusion of the Carmans River in the WSRR system has helped to protect naturally vegetated buffers along its banks which serve as wildlife habitat, and act as open space and screening. The WSRR regulations have also helped address stormwater inputs to the river and contamination from onsite residential sanitary systems. The addition of the Carmans River to the WSRR system has

also served to protect the historic rural character of the corridor through lot size requirements and restrictions on commercial, industrial, and institutional development.¹⁷

Two Bellport High School students cycled 250 miles to Albany to present then New York State Assemblyman, Bill Bianchi, with a sample of “still-pure water” from the Carmans River to request the State Legislature to include Carmans River as a part of the Wild, Scenic and Recreational River’s act under newly passed legislation. Students for Environmental Quality at Bellport High School played an important part in passing the Carmans River Protection Act.

With their report, SEQ hoped to influence legislation “to improve [these] important resources for the benefit of future generations in terms of recreation, aesthetics, and wildlife. Over time, the students had recognized the significant value of these three attributes. For them, the undeveloped land along the riverbanks was not simply a place pregnant with profitable possibilities. From their perspective, the river represented a natural ecosystem which countless fish, birds, plants, animals, and micro-organisms had called home. At the same time, the students had also developed a relationship with the river through recreation. Indeed, many of them had spent their formative years paddling along its shoreline, swimming in its waters, and fishing along its banks. For most SEQ members, more than just a few childhood memories were bound to the local waterway, which often fueled their desire to preserve the landscape in its natural state.”¹⁹



MISSION COMPLETED - Mike Butler, a Bellport High School student, hands a sample of still-pure water from Carman's River in Brookhaven to Assemblyman Icilio W. Bianchi, Jr. at the steps of the Albany capitol. Butler and John Sailor (left) cycled 250 miles from Brookhaven to Albany to dramatize the need to preserve Carman's River as part of the state Scenic Rivers Act. Both boys are members of Students for Environmental Quality at Bellport Sr. High School.

Bellport High School Students Deliver Water to Albany, Long Island Advance

The Carmans River played a significant role in banning the use in this country of DDT and the subsequent creation of the Environmental Defense Fund (EDF), a national not-for-profit organization that has had a significant role in protecting the environment. The Suffolk County Mosquito Control Commission was seen dumping barrels of DDT into the river in 1965. This created a large fish kill in the Upper Lake. Carol Yannacone was dismayed at the dead fish in the lake where she used to swim and play as a youth and asked her husband, Victor Yannacone to do something about it.

“E.D.F. had its scattergun start on Long Island in 1967. In its first case, a fiery lawyer named Victor J. Yannacone Jr. went to court to stop the Suffolk County mosquito control commission from dousing marshlands with DDT. Rather than

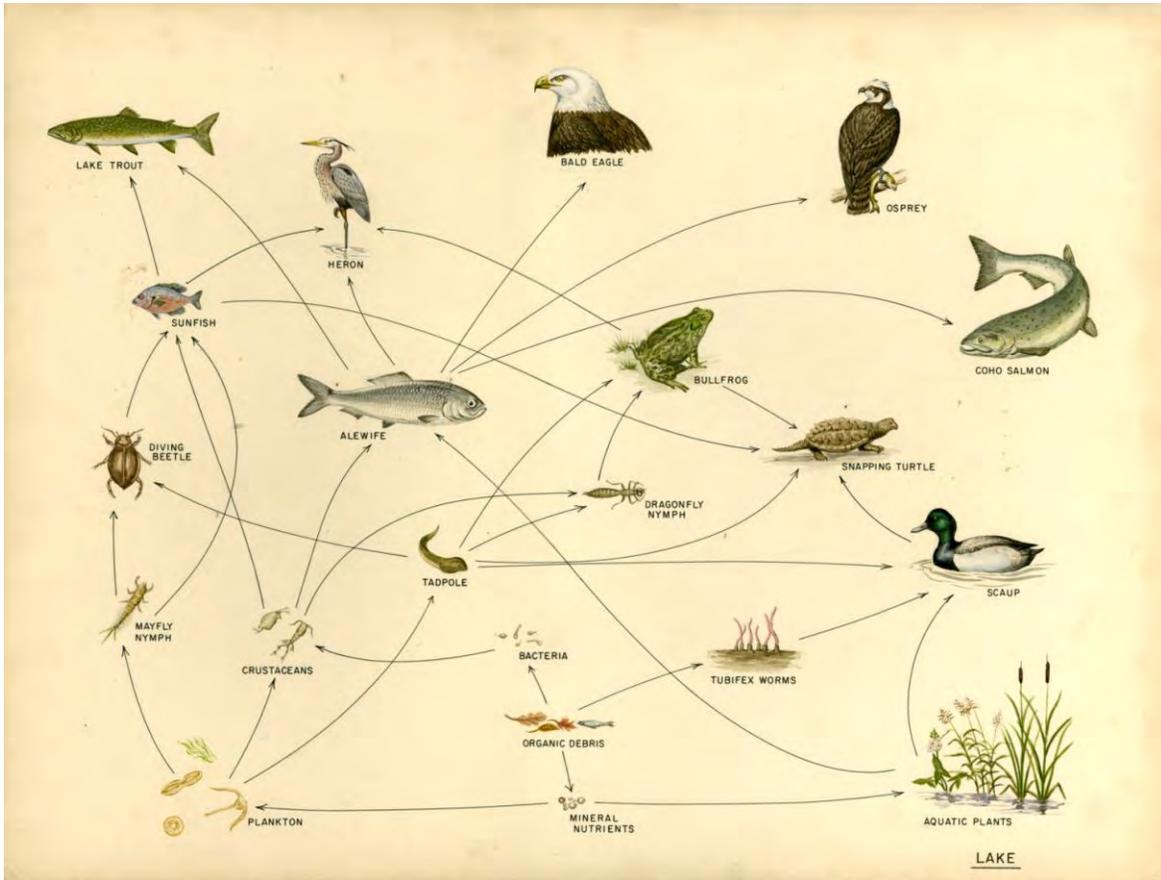
*alleging personal damages, he sued in the name of all the people of the U.S. and "generations yet unborn." Even though the court ducked the issue and declared it a problem for the state legislature, the mosquito commission was sufficiently impressed by expert testimony presented in court to quit using DDT. The complaint stated that Carol A. Yannacone and others had a "right" to enjoy a clean environment. He also sued on behalf of "generations yet unborn."*²⁰

*"The suit stood in limbo until Charlie Wurster joined the newly formed BTNRC (Brookhaven Town Natural Resources Committee) which I chaired. BTNRC was mostly interested in the destructive damage that two dredges owned by Suffolk County were doing on local salt marshes by making finger channels and using the spoil to raise the marsh for housing lots. Charlie was interested in DDT having just come from Dartmouth where he was studying the effects of DDT on bird populations. BTNRC gave him the task of trying to do something about DDT. He wrote a letter to the now defunct Long Island Press on DDT which Yannacone saw and he called Charlie. That led to a meeting of BTNRC when Victor convinced many in attendance to be scientists in his lawsuit that he had filed by not activated. The scientists included Dr. George Woodwell, Dr. Robert Smolker, Dr. Charles Wurster, Tony Taormina with the NYSDEC, Dennis Puleston and me."*²¹

(Cooley email 2010)

"As part of the lawsuit, Dennis Puleston, a local Brookhaven resident, well known naturalist and artist and one of the original board members of EDF, drew charts showing how DDT entered the food chain and ended up contaminating wildlife. DDT was found by Puleston to be the cause of the near extinction of the Osprey population in the United States. DDT thinned the shell of the Osprey eggs so that they were not viable.

Shown here is one of those charts showing how DDT becomes more concentrated as it travels up the food chain”.²²



*Lake; Exhibit #1, New York State Supreme Court, December 5, 1967, Drawn by Dennis Puleston, Courtesy of Jen Clement.*²²

DDT was banned in Suffolk County in 1967, New York State in 1970 and nationwide in 1972.

As one of three rivers in the Central Pine Barrens, the Carmans River lies partially in the Core Preservation Area and partially in the Compatible Growth Area. The watershed contains public, private and protected lands and the Carmans River is considered a Pine Barrens river. Some, but not all, of the river is protected through this legislation.

The Pine Barrens Protection Act, an amendment to New York State Environmental Conservation Law Article 57, was adopted by the New York State Legislature in 1993 to protect groundwater and ecological resources in the

Central Pine Barrens. The Act defined an area that encompasses approximately 100,000 acres, which includes the Core Preservation Area (52,500) acres, and the Compatible Growth Area (47,500 acres). The Act created the Central Pine Barrens Joint Planning and Policy Commission, a five member voting body to implement the provisions of Article 57. In 1995, the Commission adopted the Central Pine Barrens Comprehensive Land Use Plan to implement goals including protect, preserve and enhance the functional integrity of the Pine Barrens ecosystem and protect the quality of surface water and groundwater, discourage piecemeal and scattered development, promote active and passive recreational and environmental educational uses, accommodate development in a manner consistent with the long-term integrity of the Pine Barrens ecosystem, and to ensure that the pattern of development is compact, efficient, and orderly. In 1998, Wertheim National Wildlife Refuge, at the mouth of the river, was added to the boundary of the Central Pine Barrens in the Core Preservation Area²³.

In 2000 the Carmans River Partnership was formed after a successful effort was mounted to protect a 15 acre parcel directly on the east bank of the river north of Montauk Highway, which was slated to become a Home Depot site. The Partnership, consisting of Federal, State, County, Town and private individuals and civic groups, has met over the past 10 years to bring together all interested parties that seek to protect and preserve the Carmans River. This group proposed this document “Carmans River Conservation and Management Plan” to the Town of Brookhaven and the Pine Barrens Commission in order to determine what needs to be done to assure the long term preservation of the river corridor.

The Town of Brookhaven, together with the Pine Barrens Commission, created the Carmans River Groundwater Preservation and Management study group in the fall of 2010 to provide a framework for further protection of the river. This study group, composed of a variety of people concerned with the state of the River included scientists, environmentalists, Town officials, Pine Barrens staff, NYS DEC, citizens and members of the building industry, met for 90 days

and created the Carmans River Watershed Protection Plan. The Plan was further refined and revised into this Carmans River Conservation and Management Plan.

Caring For The River



Window on the River

Environmentalist Dennis Puleston worked for many years to save the osprey and was the co-founder and the first chairman of the Environmental Defense Fund. This quote written by him is placed on the Suffolk County Parks Department sign for the Dennis Puleston Nature Preserve at Warbler Woods, a 700 acre park in the Carmans River watershed on Yaphank/Middle Island Road.

“Surely, this still beautiful area and its wealth of natural resources deserve to be treated by all of us who live here, and also by our close neighbors... with a full measure of respect, understanding and love.”²⁴

Notes to the text

- #1** The author would like to thank the following for their assistance in compiling this history: Marty Van Lith (Brookhaven Hamlet Historian who provided many of the photos and much of the history of the river), The Post Morrow-Foundation, John Pavacic and Julie Hargrave (Pine Barrens Commission), Richard Amper (Pine Barrens Society), Robert Kessler (Yaphank Historical Society), Peter Scully (Regional Director for Region 1, NYS DEC), Karen Mouzakes (Yaphank Historical Society), Nick Gibbons (Suffolk County Parks and Recreation Department), Chart Guthrie (NYS DEC), Jennifer Puleston Clement, Kenneth Hard, Richard Thomas, Melanie Cardone (Longwood Library), Lillian Fais (Suffolk County Historian's Office), Barbara Russell (Brookhaven Town Historian), Anthony Graves (TOB DEP), John Turner (TOB, Director, DEP), Eva Greguski (TOB PELM) and of course, Supervisor Mark Lesko for establishing the study group, and Dr. Lee Koppelman for his leadership of the study group effort.
- #2** Suffolk County Parks brochure, www.suffolkcountyny.gov/parks
- #3** Information compiled by R. Thomas contained in an email from Richard Thomas, 12/7/10
- #4** Thomas R. Bayles, Long Island History: Whaling Once Popular in the Town, www.longwood.k12.ny.us/history
- #5** The mill stood idle from 1910 until 1960, when it was torn down to make way for Sunrise Highway.
- #6** Elizabeth Shreeve and Pamela Borg, *The Carmans River Story*, 1973.
- #7** Ibid
- #8** The shape of the trophy fish was traced onto a board that was made into this weathervane and placed on the Church steeple. The original is now in the Bellport/Brookhaven Historical Society Museum. The present day weathervane is a replica of the original. The Currier and Ives print does not represent the place very well, just the famous event.
- #9** Telephone conversation with Ken Hard, 12/7/10.
- #10** Karen Mouzakes, Yaphank Historical Society.
- #11** Thomas R. Bayles, Footnotes to Long Island History: www.longwood.k12.ny.us/history.

- #12 Charles Thuma, great grandson of Kazmier Szuster who bought the farm in 1914. The house was thought to have been built in the early 1800's. Longwood's Journey. www.longwood.k12.ny.us/history.
- #13 Email correspondence from Robert Kessler, Yaphank Historical Society, 2010.
- #14 Footnotes to Long Island's History, Thomas Bayles; Longwood's Journey, www.longwood.k12.ny.us/history.
- #15 Longwood's Journey, www.longwood.k12.ny.us/history.
- #16 NYS Department of Environmental Conservation website, www.dec.ny.gov/.
- #17 Compiled from email of Peter Scully, Director, NYS, DEC, Region 1.
- #19 Neil Buffet, *A River's Place: High School Activism and Environmental Protection on Long Island, New York, 1956-1974*, 2010.
- #20 *Sue the Bastards*, TIME, Oct. 18, 1971.
- #21 Email from Art Cooley, 2010
- #22 Post-Morrow Foundation, Newsletter, 2011.
- #23 Email from Julie Hargrave, Central Pine Barrens Commission, 2010.
- #24 Dennis Puleston, *A Nature's Journal*, 1992

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CHAPTER 3. PAST PLANS

Over the course of many years the Carmans River and its contributing areas have been a part of numerous past planning studies, comprehensive land use plans and other environmental studies and publications. Measures designed to enhance and protect surface and groundwater resources have previously been recommended in plans such as the Long Island Comprehensive Waste Treatment Management Plan (the "208 Plan"; Long Island Regional Planning Board, Hauppauge, NY, 1978), the Long Island Comprehensive Special Groundwater Protection Area Plan (the SGPA Plan; Long Island Regional Planning Board, Hauppauge, NY, 1993), and the Central Pine Barrens Comprehensive Land Use Plan (Central Pine Barrens Joint Planning and Policy Commission, Great River, NY 1996).

This section offers a summary of the recommendations and conclusions provided in those plans and studies that remain relevant to the future of the Carmans River Watershed.

The Long Island Comprehensive Waste Treatment Management Plan (1978, 208 Study)

Many of the groundwater and surface water standards and guidelines that are applied today were based on the science and recommendations contained in the 1978 *Long Island Regional Planning Board Long Island Comprehensive Waste Treatment Management Plan* (known as the 208 Study). The recommendations that relate to the Carmans River study area include the following:

- **Restrict the Use of Fertilizers.** Since fertilizers constitute one of the significant potential sources of nitrogen applied to the land surface, they are also a significant potential source of ground and surface water impairment. Pending further necessary study to better define their impacts

on water quality, public education should, and regulation may, be employed to limit or possibly eliminate the use of all specific types of fertilizers. Included in the Best Management Practices, some of which may also pertain to agriculture, are modification of application rates, discontinuance of reliance on fast-acting inorganic fertilizers, and promotion of low-maintenance lawns, which would require both less fertilizer and less consumptive use of water.

- **Control Stormwater Runoff.** To the extent feasible, surface runoff should be intercepted and disposed of as close as possible to the source. Best management Practices and/or structural systems should be employed to minimize the volume of runoff and the transport of sediments, nutrients, metals, organic chemicals and microorganisms to surface waters. Recharge basins may be needed to be modified, where feasible, to improve the removal of nutrients, metals and organic chemicals in stormwater runoff that contribute to groundwater contamination.

- **Minimize Population Density.** Minimize population density by encouraging large lot development (one dwelling unit/one or more acres), where possible, to protect the groundwater from future pollutant loadings.

- **Zone III: Highest Grade Reservoir.** Groundwater in this zone is generally of excellent quality. The groundwater resource in this zone offers a large potential for further development of public water supplies, provided that measures are taken to ensure the protection of groundwater quality.
 1. Wastewater Management Alternatives
 - Alternative A – Total Reliance on Non-Structural Controls
 - i. Permit no additional sewerage.
 - ii. Determine the acceptability of a given residential lots size and commercial and industrial activities on the basis of their

impact on groundwater quality.

- iii. Strictly control, and possibly upgrade, on-site systems.
- iv. Strictly regulate site development and management practices, such as grading and maintenance of vegetation, to control runoff.

Alternative B – Land Use Controls

- i. Land use controls should be employed to assure the least intensive use of land wherever possible. Development of this zone for residential, commercial, industrial or agricultural use should be discouraged. However, where residential development cannot be avoided, large lot development should be required. Large land holdings should be maintained and public holdings should be increased to the extent possible.

- **Highest Grade Reservoir.** Zone III encompasses the eastern portion of the Magothy recharge zone, which is generally very high in water quality. The plans suggest for protection of the Magothy aquifer in Zone III differ mainly in the extent of the protection that will be provided. Plan IIIB is a “watershed management” plan calling for land acquisition, land use controls and other non-point source controls. Plans IIIA, IIIC, IIID, and IIIE are more modest in level of control, calling for a combination of sewerage and non-point source controls.

Among the environmental advantages of Plan IIIB are (1) control density on on-site discharges, thus limiting nitrate loads to groundwater; (2) maintenance of natural recharge sites, thus maintaining water levels and natural treatment of recharge water; (3) preservation of terrestrial habitats, thus protection terrestrial populations.

Long Island’s groundwater derives from precipitation, which falls on the ground and percolates through the soil to the aquifers. Since the aquifers

are used as the only source of drinking water for the area, the quality of the recharge becomes critical. Urban development, through the clearing of land and the paving of many surfaces, has tended to decrease the amount of recharge to the groundwater and to increase the amount of runoff to surface waters. Thus, the maintenance of terrestrial open spaces, free of the influence of development, is of prime concern to Zone III. Furthermore, a good deal of open land exists in this zone at the present time, and it would be of great ecological value to preserve some of that land undisturbed. Thus, the watershed management option for Zone III is beneficial from an ecological point of view.

The Special Ground-water Protection Area Project (1986 SGPA 205J Study)

The objectives of this study are to maximize high quality recharge to the aquifers and to minimize pollutant loadings from all land uses. The recommendations include provisions for the protection of ground-water quality as well as for the improvement of ground-water quality in areas that have been subject to contamination. The Brookhaven SGPA was one of the pilot areas selected to examine and provide a broad range of recommendations for the deep aquifer recharge areas and where the protection of ground water is a concern. The recommendations as they relate to the Carmans River are summarized below:

- The Brookhaven (Western Pine Barrens) SGPA is located within Zone III and the quality of the underlying aquifer is generally good. Extensive areas are available for development. More than 11,000 acres are covered with typical pine barrens vegetation, lowland woods and freshwater wetlands. The area also includes a portion of two Scenic and Recreational River Corridors, part of the Carmans River and the headwaters of the Peconic River.

- The Brookhaven management package consists of a series of general recommendations that are applicable throughout the area and elsewhere as well, together with a number of more detailed site specific proposals. Recommendations for the Pilot Area include:
 - the amendment of the municipal zoning ordinance to increase minimum lot sizes, to contain strip commercial development, to limit industrial development, encourage the transfer of development rights to less sensitive parcels and to increase the effectiveness of site plan review.
 - New York State, County or Town acquisition of the fee or development rights to specific parcels; the protection of the river corridors and the creation of greenbelts; and the reduction of contaminant loads from existing point and nonpoint sources.

- This study area contains a number of ponds, streams, a portion of the Carmans River and the headwaters of the Peconic River. The surface water elevation of these water bodies generally reflects ground-water levels. Most of the lands adjacent to the isolated ponds have been developed or are being considered for development.

- Although the area is subject to increasing development pressures, the land area within the designated Scenic and Recreational River corridors extending for one half mile from the high water mark of the Carmans and Peconic Rivers remain primarily undeveloped and some of the wildlife habitats remain intact. However, many areas within these corridors and throughout the study area have been lost to development. Several species of fauna and flora in the general pine barrens area are endangered or threatened.

- The NYSDEC has proposed minimum lot size requirements for two to four acres per D.U. in order to preclude higher density development within the river corridors. The County of Suffolk has followed a policy since 1960 of

trying to place the majority of lands bordering these Rivers in the public domain. Wherever feasible the most stringent regulations should be applied to protect these watershed areas.

- There are several large freshwater wetlands located next to major highways that are subject to increasing development. If the upland portions of these properties were to be developed, it could result in irreversible damage to the wetlands. These parcels can be protected now with revision of zoning and the use of site plan review and the imposition of conservation easements and/or the transfer of development rights.
- A large percentage of lands present a short term opportunity to protect the existing water quality of the underlying aquifers. Under existing zoning regulations many of these lands may be subdivided at two to four units per acre, which is considered incompatible with ground water protection.
- Unless zoning ordinances are amended to include site clearance regulations that limit the extent of law areas, future nitrate loads in the recharge water may exceed 6 mg/l. There is an excellent opportunity to reduce nitrate loads to 2, 3, or 4 mg/l in residential areas.
- Table D-3 provides water and nitrogen comparisons between sewered and unsewered areas, with and without recharge basins. In order to reduce nitrate loadings in the unsewered areas, it is important to recharge stormwater on site.
- maximize the recharge of high quality ground water to the aquifers
- minimize the pollutant loads from existing and future land use activities within the protected area
- protect the natural environment, and the scenic, recreational, historic and archaeological resources associated with the river corridors.
- In order to reduce contamination loads, density of future development must be reduced below that currently permitted through changes in zoning, more effective site plan review and the acquisition or preservation of critical parcels.

- The Town of Brookhaven should implement the following zoning recommendations:
 - Eliminate spot zoning in order to prevent the juxtaposition of noncompatible land uses, such as high intensity uses within historic district, the Scenic and Recreation River Corridors (i.e. Carmans, Peconic) or next to public open space lands, and certain commercial or industrial uses adjacent to residential areas.
 - Adopt restrictive categories for commercial and industrial uses. (see commercial and industrial zoning recommendations).

- Revise the zoning of vacant lands that have not yet been subdivided as indicated below.
 - Upzone vacant subdividable parcels in developed areas that are presently zoned at 15,000, 22,500 or 30,000 sq. ft., to a minimum of 40,000 sq. ft. or 80,000 sq. ft., respectively. This is necessary to limit future contaminant loads to ground-water and to maximize high quality recharge.
 - Upzone large subdividable residential parcels in environmentally sensitive area to two or five acres per dwelling unit (see Figure 3-10).
 - In areas where endangered species, freshwater wetlands and other significant resources occur, rezone the area to assure compatibility with resource protection (See Figure 3-10).
 - Promote the public acquisition of land, or transfer of development rights in accordance with the Open Space and TDR recommendation (see Figures 3-11 & 3-12).

- The NYSDEC and the County should undertake the following actions to insure improved ground-water protection.
 - Provide increased personnel and funding to implement the

following recommendations.

- The NYSDEC and the County should evaluate the design, operation and maintenance of all treatment plant systems in the Pilot Area.
- Provide monitoring wells for any plant systems that are not currently monitored.
- Require upgrading of existing secondary treatment plants by using increased site inspections and imposing stiffer penalties for violations.
- Utilize the SPDES authority to require regularly scheduled ground-water monitoring and the upgrading of treatment plants as a condition for permit renewals.
- Investigate the existing treatment plant operation to determine if additional capacity is available for the extension of service to adjacent developing areas.
- Provide additional treatment plants where needed.

Wild Scenic Recreation Rivers Act (NYS DEC)

New York State Department of Environmental Conservation (NYSDEC) regulations implementing the state Wild, Scenic and Recreational Rivers System Act affect management, protection, enhancement, and control of land use and development on all designated river areas in New York State, excluding those rivers outside state/public owned lands within the Adirondack Park. The purpose of this Act is to establish statewide regulations for the management, protection, enhancement and control of land use and development in river areas on all designated wild, scenic and recreational rivers in New York State.

The Act encourages the participation of local governments in the management planning process necessary to achieve the goals of the act. The Act authorizes and encourages administration by local governments of those

provisions that are within their respective jurisdictions, in place of the Department's administration of such provisions, when such local governments are legally, technically and financially capable of administering such provisions in a manner consistent with the provisions of the ct and this Part.

River area management plans

A river area management plan for a particular river may be prepared by the Department, by an affected local government or group of affected governments or by any person or entity acting in cooperation with any affected local government or governments or this Department.

- A river area management plan will:
 - describe existing conditions in the river corridor, including: those natural, cultural and recreational resources identified in available information sources, such as the statewide rivers inventory; prevailing land and water uses; land ownership patterns; and existing management devices;
 - propose goals, objectives, policies, management guidelines and necessary actions to implement the plan which are consistent with the purposes and policies of the Act;
 - propose, if necessary, a river area regulation for full implementation of the plan; and

General regulations relating to the WSR program and applicable to the Carmans River regulations include the following:

- New structures constructed within 500 feet of the river bank (except fences, docks, bridges, water-access parking areas, boat launching sites and agricultural-use structures) shall be screened from the river by vegetation. All new structures proposed within 500 feet of the river bank require a permit.

- The harvesting, cutting, removal, thinning, or other disturbance of vegetation other than agricultural crops within 100 feet of the river bank requires a permit.
- New structures must be designed and developed to prevent significant erosion or direct runoff into the river.
- New roadways, trails, bridges, and signs are regulated as well as diversions and discharges of water or pollutants.

- Regulations relating to the Recreational zones established for the Carmans River regulations include the following:
 - In recreational river areas, new single and two-family homes may be built only on lots two acres or larger.
 - If a new lot fronts on the river or its designated tributary, it must have a shoreline frontage of at least 200 feet.
 - New structures other than fences, docks, bridges, water-access parking areas, boat launching sites and agricultural-use structures shall be constructed at least 150 feet from the river bank or beyond the limit of the 100-year floodplain, whichever distance is greater.
 - A new multiple family dwelling (three or more units) must be developed in a maximum ratio of one living unit per acre. Clustering is encouraged.
 - Commercial uses are limited to retail or rental facilities directly associated with the river-area recreational uses within 10,000 or less square feet of floor space. Structures must be compatible with the natural and scenic qualities of the river area.
 - Industrial uses are limited to light manufacturing or warehousing served by appropriate transportation facilities, and compatible with existing uses on adjacent and nearby sites.

- Regulations relating to the Scenic zones established for the Carmans River regulations include the following:
 - In scenic river areas, new single and two family homes may be built on lots four acres or larger.
 - In a new lot fronts on the river or its designated tributary, it must have a shoreline frontage of at least 300 feet.
 - New structures other than fences, docks, bridges, water-access parking areas, boat launching sites and agricultural-use structures shall be constructed at least 250 feet from the river bank or beyond the limit of the 100-year floodplain, whichever distance is greater.
 - New multiple family, dwellings, commercial and industrial uses are not permitted.

Community Rivers:

In 1994 this NYS River System category was added to cover portions of Recreational River Areas which are sufficiently developed to meet certain criteria. This category provides an opportunity for new land developments which were previously not allowed in any river area class. The regulatory provision for "community" designation allows for less restriction on land use in recreational river areas than the traditional recreational river area classification, and permits development on lands in and around river area hamlets, villages and towns that existed at the time the Recreational River was designated. (See Table of Use Guidelines in 6 NYCRR Part 663.13).

Central Pine Barrens Comprehensive Land Use Plan (Central Pine Barrens Joint Planning and Policy Commission, Great River, NY 1996)

In 1995, Suffolk County, New York State, and the Towns of Brookhaven, Southampton and Riverhead adopted the *Central Pine Barrens Comprehensive Land Use Plan (CLUP)*. The CLUP outlines land use controls for the protection

of groundwater, endangered and threatened plants and animals, and unique natural resources in the central Pine Barrens preserve. The plan provides a number of mechanisms to preserve the entire Pine Barrens preserve Core and to permit uses that are congruent with the essential character and natural resources of the Central Pine Barrens Compatible Growth Area (CGA).

In order to meet and implement the goals and objectives of the CLUP, in 1996 Brookhaven enacted a Central Pine Barrens District, "...whereby appropriate patterns of compatible residential, commercial, agricultural and industrial development are encouraged in order to accommodate regional growth influences in an orderly way while protecting the pine barrens environment from individual and cumulative adverse impacts and to promote development which is compact, efficient and orderly, and reasonably calculated to protect the quality and quantity of surface water, groundwater and the short-term and long-term integrity of the Pine Barrens ecosystem."

Brookhaven's portion of the preserve core totals 27,260 acres. Approximately 25,990 acres of the preserve core were improved prior to enactment of the 1995 law or have been protected via acquisition, purchase of development rights, transfer of development rights, easements and dedications. The town rezoned a number of parcels to A residential 2 and A residential 5 in the CGA.

The Pine Barrens Plan provided many recommendations and standards including:

- All development proposals subject to Article 6 of the Suffolk County Sanitary Code shall meet all applicable requirements of the Suffolk County Department of health Services. Projects which require variances from the provisions of Article 6 shall meet all requirements of the Suffolk County Department of Health Services Board of Review in order to be deemed to have met the requirement of this standard.
- Where deemed practical by the County or State, sewage treatment plant

discharge shall be outside and downgradient of the Central Pine Barrens. Denitrification systems that are approved by New York State Department of Environmental Conservation or the Suffolk County Department of Health Services may be used in lieu of a sewage treatment plant.

- A more protective goal of two and one half (2.5) ppm may be achieved for new projects through an average density of one (1) unit per two (2) acres (or its commercial or industrial equivalent), through clustering, or through other mechanisms to protect surface water quality for projects in the vicinity of ponds and wetlands.

Wetlands and surface waters

- Freshwater wetlands that exist within the Central Pine Barrens are considered to be an important natural resource, providing flood and erosion control, the filtering of contaminants and sediments from stormwater runoff, and habitat for plants and animals.
- Surface waters, including freshwater ponds, lakes, rivers and creeks, occur throughout the Central Pine Barrens. These are considered to be resources of significant value in economic, aesthetic and ecological terms. Their protection is judged to be vital to the dynamics of the pine barrens.
- Development proposals for sites containing or abutting freshwater or tidal wetlands or surface waters must be separated by a nondisturbance buffer area which shall be no less than that required by the New York State Tidal Wetland, Freshwater Wetland, or Wild, Scenic and Recreational Rivers Act or local ordinance.
- Buffer areas shall be delineated on the site plan, and covenants and/or conservation easements, pursuant to the New York State Environmental Conservation Law and local ordinances, shall be imposed to protect these areas as deemed necessary.

Wild, Scenic and Recreational Rivers Act compliance

- Development shall conform to the provisions of the New York State Wild, Scenic and Recreational Rivers Act, where applicable. Projects which require variances or exceptions under the New York State Wild, Scenic and Recreational Rivers Act shall meet all requirements imposed by the New York State Department of Environmental Conservation in order to be deemed to have met the requirements of this standard.
- Stricter non disturbance buffer areas may be established for wetlands as appropriate.

Stormwater runoff

- Development of lands within the pine barrens inevitably results in an increase of runoff water following precipitation. Runoff water originating from the roofs of buildings and from driveways is usually discharged directly to subsurface dry wells situated on the building lot. However, the great volume of runoff water originating from paved streets and roads is usually discharged by pipes into large open recharge basins or sumps. These basins may cover several acres and require the removal of considerable native vegetation to the detriment of the site's ecology and aesthetics.
- Development projects must provide that all stormwater runoff originating from development on the property is recharged on site unless surplus capacity exists in an off site drainage system.
- Natural recharge areas and/or drainage system designs that cause minimal disturbance of native vegetation should be employed, where practical, in lieu of recharge basins or ponds that would require removal of significant areas of native vegetation.

Town of Brookhaven Comprehensive Land Use Plan (1996)

The *Town of Brookhaven 1996 Comprehensive Land Use Plan* was the town's first comprehensive plan based on community planning initiatives; unprecedented community outreach efforts were made in the months leading up to the preparation of the plan. Eight individual community-based hamlet plans were developed and integrated into the overall plan: There were nine stated goals of the 1996 land use plan:

1. Create strong economic activity to provide jobs and an adequate tax base.
2. Establish a spatial relationship between land use, population and transportation. Population asymptotes (the maximum projected population number for an area) should be correlated more strongly with land use and transportation in individual hamlets, regionally and town-wide.
3. Develop appropriate zoning regulations to insure proper development.
4. Bring zoning into compliance with the comprehensive land use plan including the elimination of excess commercial zoning and addressing existing and future commercial and industrial zoning problems and needs.
5. Develop innovative land development techniques to insure maintenance of open space.
6. Provide receiving sites for the transfer of developed rights from the "core areas."
7. Provide open space and recreational facilities throughout the town.
8. Concentrate activity whenever possible to encourage public transportation usage.
9. Support appropriate roadway improvements to adequately serve adjacent land use.

Some of the more detailed recommendations made in the 1996 Comprehensive Plan were in support of the goals contained in this plan. The following are highlights of some of these recommendations:

- Develop Stream Corridor Management Plans which outline ultimate land use and environmental protection goals.
- Utilize zoning, sanitary code and other land use methods to limit or eliminate land uses which involve the storage, use and disposal of potential contaminants and to establish and maintain residential densities and controls which will minimize potential contamination from nitrates and household hazardous wastes.
- Upzone parcels of reasonable size to 5-acre minimum to ensure protection and enhancement of groundwater quality. Cluster within 5-acre zoned areas where possible. In already-developed areas, consider upzoning vacant, subdividable land to at least 1 acre to 2 acre zoning and 2 acres if possible.
- Maximize open space and preservation of existing natural vegetation and habitats through acquisition, clustering and other land use techniques to protect existing clean recharge areas and aquifer replenishment.
- In spite of upzonings and acquisitions of major portions of the lands adjacent to the Carmans and Peconic Wild, Scenic and Recreational Rivers, no management plans have been developed as part of a holistic next step in protecting these rivers. Plans to control stormwater runoff, manage existing public lands, restore and enhance ecologically-degraded areas and improve public access are some of the subjects which such a management plan may discuss.
- Determine additional means of preserving specific sensitive areas of the CGA such as the Carmans River WSR Corridor.
- Consider study of perched wetlands, especially in the Central Pine Barrens, and determine additional land use development criteria to be used to protect these systems.
- Although recent preservation efforts have focused on the Central Pine Barrens, this has overlooked the fact that the pine barrens are

interconnected with and part of the entire Brookhaven Town ecosystem and therefore there are lands outside the pine barrens upon which it is dependent. There are other areas of the Town which also contain lands in need of protection. These include but are not limited to areas within the south shore stream corridors, the South Setauket Pine Barrens, North Shore coastal areas and Harbor Hills Moraine area, the Carmans River Wild Scenic and Recreational River corridor, Special Groundwater Protection Areas, the Core Watershed Corridor encompassing the Groundwater Divide, certain parts of the more densely-developed western and central parts of the Town, including the Ronkonkoma Moraine, and selected wetlands.

- Site should not be prioritized for acquisition or preservation as open space merely because they are located in the core preserve. Parcels should be considered because of their significance to environmental quality or their sensitivity. In developing recommendations for acquisition or preservation of areas, consideration should be given to completing the various studies and plan discussed in the Plan, including the open space plan for the Central Suffolk SGPA, CGA and the Town and management plans for the Carmans and Peconic Rivers, in order to determine priority acquisitions.
- Identify and map drainage watersheds and stormwater drainage systems which lead directly into surface waters, both fresh and salt water. Categorize volumes and capacities handled by each watershed and system. Develop a program for upgrading and improving stormwater retention and filtration.
- For the most part, the remaining undeveloped residential are zoned for two acre single family development and are located inside the Central Pine Barrens Compatible Growth Area. Elsewhere, scattered larger parcels of land generally fronting on stream corridors have also been classified as two acre. This zoning reduces the impact of septic systems on the adjacent waterways by reducing the quantity of leachate.

- There is a need to rezone environmentally sensitive land to larger lot residential district.

To summarize all of these plans and studies it becomes clear that they contain similar recommendations, guidance and regulations to achieve common goals. These recommendations specifically apply to the Carmans River and its contributing areas. Those goals include:

- Preservation of land through acquisition and/or the transfer of development rights (Pine Barrens Credits).
- Development limitations through land use and zoning controls.
- Sanitary management controls in the form of limitations on nitrate loading.
- Stormwater management controls in the form of natural stormwater recharge.

Town of Brookhaven Middle Country Road Land Use Plan for Coram, Middle Island and Ridge (2006)

The Town of Brookhaven 2006 Middle Country Road Land Use Plan for Coram, Middle Island and Ridge was based on community planning initiatives and a visioning study. In response to a planned NYSDOT Transportation Improvement Project proposed for Middle Country Road, State Route 25, between C.R. 83 and Mount Sinai-Coram Road, civic leaders held a community planning charrette to formulate a vision to guide land use in the hamlets of Coram and Middle Island. The purpose of the Middle Country Road Land Use Plan is to examine the current land use and zoning trends, together with transportation and environmental needs in order to further the Town's and the community's development goals.

The Plan offered distinct recommendations for each of the four hamlets within the 17 mile Middle Country Road corridor. For the purposes of this Management

Plan, the summary of this adopted land use plan, will be based on those areas included within the Management Plan Study Area, specifically the Middle Island area.

The following highlights some of the recommendations from this adopted Hamlet Plan:

- In harmony with the community's vision for the Middle Island area two separate and distinct hamlet centers are proposed. The Middle Island Hamlet Center will be the focus and center of the Middle Island area and will extend approximately 2,000 feet along Middle Country Road or for approximately .40 of a mile. The Middle Island Hamlet Center combines existing commercial uses with vacant lands to create a walkable community. National chain retailers, restaurant, bar or tavern, banks, pharmacy, theater and movie theater and cultural centers with second or third story office and residential uses should be established in this Hamlet Center. The focus of this Center begins with the existing Longwood Public Library and Middle Island Post Office. The proposed Artist Lake Recreation Center will provide indoor and outdoor recreational and community activities with its focus on Artist Lake and scenic vistas.
- Single family and multi-family residential land uses are proposed within the centers to help support the centers and establish a walkable community. Transition areas will be established between the Coram Centers and the Middle Island Centers as well as between the two Middle Island Centers.
- Parks and open space are proposed for those parcels within the transition areas that have been identified as environmentally sensitive.
- Environmental constraints must be taken into consideration. A pond is found along Middle Island Road and should be preserved and perhaps enhanced as parkland. This pond has also been identified as a tiger salamander habitat. As a result a 500-foot natural buffer must be

maintained. Existing disturbed areas within the 500-foot buffer can be developed. However, any new roadways, including any reconstruction of Rocky Point Road C.R. 21 must provide culverts for the tiger salamander.

- To the north of the proposed Hamlet Center substantial portions of the industrially zoned parcels have undergone extensive sand mining over the course of several decades that continues today. In 1990, 65 acres of the overall site was the subject of a change of zone application to the Town Board for L-Industrial-1 and L-Industrial-2 zoning districts. At that time, several of the adjacent parcels had industrial uses sited on them and there was a chaotic assemblage of industrially zoned properties. The Town Board granted the change of zone applications on February 7, 1995, in order to support the orderly development of a 35-lot industrial subdivision.
- In 1998, Roanoke Sand & Gravel applied to the New York State Department of Environmental Conservation (NYSDEC) and was granted a renewal of their permit to sand mine the collective properties. The NYSDEC Mined Land Reclamation Permit was issued on July 26, 2000 allowing for renewal every five years until the Mined Use and Reclamation Plan, approved by the NYSDEC, can be realized. The mining permit, subject to covenants and restrictions, authorizes the excavation and reclamation of 218 acres of the property over the 25-year projected life of the mine.
- Although not specified in the Mined Land Reclamation Permit, documentation submitted by the applicant in support of the permit stated the mined land, once reclaimed would be available to the community for boating and fishing, while the lake and the surrounding area would be ideal habitat for wildlife with sufficient area for public parking and the development of nature trails. As a result of the action permitted by the NYSDEC Mining and Reclamation Plan and the activity presently occurring on these properties, this Plan recommends that approximately 260 acres of the site be dedicated to a municipality for management of the

man made lake, as well as general municipal purposes.

- In recognition of the importance of open space, this plan provides a number of important planning initiatives to preserve significant open space and identified specific sites for open space preservation as well as park and passive recreational purposes. Through aggressive use of clustering, public acquisition and other techniques, permanent preservation of open space can be achieved. The Town has purchased or jointly purchased with the County significant properties in the study area and throughout the Town. In addition to these efforts, the County of Suffolk and to a lesser extent, New York State, have also actively achieved acquisition and preservation of significant properties throughout Brookhaven and the study area. There are still significant open space areas throughout the study area, which do not have the protections of permanent preservation. Parcels with significance to their environmental quality or sensitivity should have the highest priority for public acquisition. Consideration should also be given to parcels that may connect to or complete a greenbelt.

The Town Board has continued to implement this land use plan with a series of rezoning on the Town Board's own motion, including a third phase of rezoning in early 2013, along with several other individual change of zone applications that have been approved in accordance with the land use plan.

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CHAPTER 4. THE CARMANS RIVER MANAGEMENT PLAN

It is estimated that 94 percent of the Carmans River's flow originates from groundwater, also known as baseflow, with precipitation and overland runoff making up the rest of the Carmans River's flow (CDM, 2011a). Land use is the major determinant of the quality of groundwater that discharges into the river, so in order to manage land use and thereby protect the quality and health of the river, it is necessary to know where the groundwater that discharges into the river originates and its flow path.

Groundwater models are useful tools to synthesize all of the factors affecting groundwater flow into a comprehensive description of the groundwater system. There are a number of different models that can be used to describe and analyze the movement of groundwater, and the following three have been used to map the groundwater flow to the Carmans River:

- Modflow, a USGS modular finite-difference flow model computer program that shows groundwater flow (O'Malley, 2008);
- A two dimensional model based on water table elevation and the hydrological convention that groundwater flows perpendicular to contour lines (Kinney and Valiela, 2011);
- Dynflow, a computer model that simulates fully 3-D multi-layer aquifer system (CDM, 2009).

Modflow is a well established and widely used model that has many versions and post-processing modules that provide various graphical outputs. Modflow is a finite difference based model with the model elements represented by rectangles with the equations solved at the middle of each rectangle. One of the limitations of the Modflow model as used by O'Malley (2008) is that it utilized 100 meter by 100 meter grids to represent the watershed, which reduces resolution.

O'Malley (2008) did not provide the area of the watershed or various landmarks, so it is not possible to compare it with the other models. The model

also does not divide the groundwater contributing area into different groundwater time of travel zones. There is also not enough information presented in O'Malley (2008) to completely assess the model's calibration. The boundary condition assignments are not identified and its steady-state calibration is based on water levels measured once at four wells, all of which were screened in the Upper Glacial aquifer, the shallowest of Long Island's three aquifers. The data sources that were used are good and the assignments are reasonable; however, it is not possible to assess the model's ability to represent conditions in the Magothy aquifer, as no monitoring points were used.

Also, the figures show the model area, which is relatively small, and the results of the model would be largely determined by the boundary condition assignments, which were not provided. The model used long term average precipitation records to represent water levels measured at a particular time – normally precipitation conditions preceding the monitoring event are used, as the shallow system responds quickly. The model does not appear to incorporate water supply pumping which can have a significant impact upon the local flow field, although there are few public supply wells in the Carmans River groundwater watershed.

Kinney and Valiela (2011) modeled groundwater flow along the south shore of Long Island as part of an investigation into nitrogen loading into Great South Bay. They used water table elevation contours from 1989 and then applied the hydrological convention that groundwater flow is normal to contour lines to delineate the watershed for each stream, estuary, or direct discharge into Great South Bay. There are several shortcomings with their approach:

1. It only considers two dimensions, which is not an adequate characterization of Long Island's three dimensional groundwater flow system.
2. The depiction of the groundwater contributing area does not provide any landmarks or scale, so it is difficult to compare it with the other models.

3. It didn't consider public water supply wells.
4. The groundwater times of travel are not provided.
5. The watershed is based on water table contours using 1989 data, the highest annual precipitation on record, 68.8 inches (there is a direct relationship between precipitation and groundwater elevations so water table elevations would be unusually high). In addition, the 1989 data does not take into account the subsequent effects of development, changes in stormwater flow and water supply pumping.

Dynflow is a finite element based model, with the model elements represented by triangles. Equations, which stem from algorithms representing draw from wells, are solved at the corners of the each of the triangles. The particle tracking/finite element approach used by Dynflow inherently conserves mass and the finite element based approach allows for a closer representation of physical characteristics, such as stratigraphy, rivers, and other boundaries. The Dynflow model is flexible in that the size of the triangles can be scaled up/down to focus on areas of interest and represent different stream paths. The model codes were approved and validated by the International Groundwater Modeling Center at the Colorado School of Mines in Boulder, Colorado, and the United States Environmental Protection Agency (USEPA) approved the use of the Dynflow model for Superfund sites.

CDM (Camp, Dresser and McKee), a private consulting company, used the Dynflow model to develop a regional 3-dimensional groundwater model of Suffolk County that included identifying different groundwater time of travel zones to surface waters. The model was calibrated to water levels measured at hundreds of wells during three independent events, and a semi-transient calibration was also performed. The inputs to the numerical model are a combination of published information and field data. For example, the USGS hydrogeologic framework was the basis for the regional model hydrogeology; it

was refined locally when more detailed data from Suffolk County Department of Health Services and Suffolk County Water Authority well logs were available. All available sources of data and information were used to check boundary condition assignments and stratigraphic representations and the model included several hydrogeologic layers, representing different zones within the aquifers. Development, calibration and application of the model have been summarized in a technical report entitled *Suffolk County Groundwater Model* (CDM, 2007).

CDM (2009) used their Dynflow model to determine the 0 to 2, 2 to 5, 5 to 10, 10 to 25 and 25 to 50 year time-of-travel contributing areas to the baseflow of several Suffolk County streams, including the Carmans River. CDM also superimposed the time of travel zones on land use classifications obtained from Suffolk County to assess land use in each time of travel zone because the type of land use plays a major role in determining groundwater quality and hence surface water quality resulting from the discharge of groundwater.

To better depict the groundwater flow impacting the Carmans River and to model the 50 to 100 year time of travel zone, the Town of Brookhaven retained CDM to enhance the model it used to determine baseflow to Suffolk County streams (CDM, 2011b) by:

- Reducing the node spacing from 500 to 1000 feet down to 200 to 700 feet in the Carmans River area.
- Extending the groundwater contributing area to include the 50 to 100 year groundwater time of travel zone (Figure 2).
- Using 2 foot ground elevations based on LIDAR (Light Detection And Ranging – a method using lasers to determine ground elevations) in place of the USGS 5 foot topographic contour intervals because the model-simulated groundwater baseflow is very sensitive to ground surface (stream bed) elevations. The two foot elevation contours were interpolated onto a revised model grid and the elevations of the nodes representing the river were updated accordingly.
- Simulating sustained wetter than average conditions of recharge and

precipitation and significantly wetter than average conditions of recharge and precipitation.

Compared to Suffolk County's Dynflow model results, the "enhanced" model results (CDM, 2011) showed some expansion of the groundwater time of travel zones to the north, east and west and the northern boundary of the 50 to 100 year contributing area was located approximately 200 feet north of Middle Country Road in Middle Island. Additional verification of the model is provided by the east and west boundaries of the groundwater contributing area adjoining the groundwater contributing areas to the adjacent streams on the west (Beaverdam Creek) and on the east (Forge River) (Figure 3).

The area of the 100 year groundwater contributing area (herein after referred to as The Study Area) under long term average conditions of recharge and precipitation is 19,310 acres. Under sustained wetter than average conditions of recharge and precipitation it is 19,927 acres. Since the difference between long term average and sustained wetter than average conditions is minimal (2.5%), and to be consistent with the other streams that were modeled by Suffolk County, the long term average conditions contributing area was selected as the Study Area.

The boundaries of the Study Area, which has an area of approximately 20,000 acres (Table 2), are shown in Figure 4. Although the Study Area encompasses the much larger 100 year groundwater contributing area, the Management Plan and some of the more detailed recommendations of *The Carmans River Conservation and Management Plan* are focused on the more critical 0 to 2 and 2 to 5 year groundwater contributing area. The boundaries of the Carmans River Management Plan Area, which has an area of 6,848 acres (Table 2) as shown in Figure 4a.

ENVIRONMENTAL CONDITIONS

Geology

The Carmans River is located in a valley that was formed approximately 20,000 years ago during the advance and retreat of the glaciers that deposited the sediments that comprise Long Island. The valley in which the Carmans River lies originates in the area now known as Rocky Point and cuts through the Ronkonkoma Moraine, the southern and older of Long Island's two moraines. The flow of glacial meltwater transformed the valley by making it broader and deeper and scouring what would become the bottom of the river bed and exposing the groundwater table; where the groundwater table is exposed, the river flows.

The Carmans River Management Plan Area and the Study Area are underlain by a number of distinct geologic units between the basement bedrock situated approximately 1,600 feet below the land surface and the surficial (surface) geology. The sequence and characteristics of stratigraphic units from deepest to shallowest is summarized as follows (Central Pine Barrens Joint Planning and Policy Commission, 1996):

- Early Paleozoic to Precambrian Bedrock (more than 400 million years old): impermeable, crystalline basement rock.
- Late Cretaceous deposits (60 to 100 million years old): deltaic clays, sands, and gravels deposited by streams along the continental margin or as marine sediments comprising the Lloyd sand (aquifer), Raritan clay (confining unit of lower permeability which retards flow), Magothy Formation (aquifer), and Monmouth Group (confining unit).
- Pleistocene (Wisconsinan) deposits (20,000 to 200,000 years old): various glacial sediments, such as till, outwash sand and gravel, and intermorainal clay comprising the Upper Glacial aquifer, as well as the Gardiners Clay.
- Holocene deposits (12 thousand years old): recent beach and marsh deposits.

Topography

The topography in the study area outside of the valley in which the Carmans River flows is relatively flat to gently sloping (Figure 5). However, slopes within the Study Area are steeper north of the Long Island Expressway, particularly in Yaphank and Middle Island, where the river valley cuts through the Ronkonkoma Moraine. In this area, slopes greater than 15 percent occur with prominent, steep hills adjacent to the river, most notably just south of Cathedral Pines County Park and west of County Road 21. These morainal areas are hilly and uneven with slopes ranging from 15 to 35 percent in many areas. As such, the topography of the northern Study Area tends to be rolling and includes a number of small, shallow depressions (kettle kames), forming a “knob and kettle” topography (alternating hills and circular depressions).

Maximum topographic elevations within the Study Area are approximately 200 feet above mean sea level north of the hamlet of Yaphank (east of the intersection of Barbara Lane and West Bartlett Road on the west side of the river and north of Shannon Boulevard, east of Middle Island Road on the east side of the river), along the western side of the ancestral glacial valley. Topographic contours on the USGS Quadrant Maps for Middle Island and Bellport, which cover the Study Plan Area, show 10 foot elevation changes roughly every half mile descending from the headwaters southward to the mouth of the River.

Soils

The *Soil Survey of Suffolk County, New York* (US Department of Agriculture, 1975) maps the different types of soils that occur in the Study Area and a list of the different soil types is given in Table 1.

Table 1. Soil types occurring in the Study Area from the *Suffolk County Soil Survey* (US Department of Agriculture, 1975).

Soil Name	% Slope	Symbol
Atsion Sand	N/A	At
Berryland Mucky Sand	N/A	Bd
Carver Plymouth Sands	0-3	CpA
Carver Plymouth Sands	3-15	CpC
Carver Plymouth Sandy Loams	15-35	CpE
Cut and Fill Land	Gentle Slope	CuB
Cut and Fill Land	Sloping	CuC
Deerfield Sand	N/A	De
Fill Land (Dredged Material)	N/A	Fd
Gravel Pits	N/A	Gp
Haven Loam	2-6	HaB
Haven Loam	0-2	HaA
Haven Loam	6-12	HaC
Haven Loam (Thick Surface Layer)	N/A	He
Made Land	NA	Ma
Montauk Fine Sandy Loam	3-8	MfB
Muck	N/A	Mu
Plymouth Gravelly Loamy Sand	3-8	PmB3
Plymouth Gravelly Loamy Sand	8-15	PmC3
Plymouth Loamy Sand	0-3	PIA
Plymouth Loamy Sand	3-8	PIB
Plymouth Loamy Sand	8-15	PIC
Recharge Basin	N/A	Rc
Riverhead and Haven Soils	0-8	RhB
Riverhead Sandy Loam	0-3	RdA
Riverhead Sandy Loam	3-8	RdB
Riverhead Sandy Loam	8-15	RdC
Scio Silt Loam	0-2	SdA
Sudbury Sandy Loam	0-3	Su
Urban Land	N/A	Ur
Wareham Loamy Sand	0-3	We
Water (less than 40 acres)	N/A	W

The *Soil Survey* (US Department of Agriculture, 1975) also provides a description of the characteristics of the soils which includes information on soil limitations with regards to various parameters including sewage disposal sites, home sites, streets, parking lots, lawns, landscaping and golf course fairways, among others. Since sanitary systems are a major concern in the Management Plan Area because their effluent contributes nitrate to the groundwater, the soils in the Management Plan Area were evaluated with respect to their limitations for sewage disposal. There were four separate classifications for soils with regards to their limitations in sewage disposal fields: slight; slight-moderate; moderate; and severe. These soil limitations within the Management Plan Area are shown in Figure 6.

Hydrogeology

The headwaters area of the Carmans River is located in the Middle Island area south of Middle Country Road with the start of flow determined by the elevation of the groundwater table relative to the topography. The start of flow varies from year-to-year with changes in the elevation of the water table which varies with changes in precipitation. The average annual precipitation on Long Island is 50 inches per year, of which 22.5 inches are recharged to groundwater (Busciolano, 2002).

There are three aquifers beneath the Study Area: the Upper Glacial Aquifer, the Magothy Aquifer and the Lloyd Aquifer (Monti and Busciolano, 2009; Busciolano, 2002). The Upper Glacial Aquifer ranges from 54 to 156 feet above sea level (the surface of the Upper Glacial Aquifer is known as the water table), has depth below the ground surface between 0 and 100 feet, and ranges in thickness from 179 to 281 feet. The top of the Magothy Aquifer is approximately 125 feet below sea level and has a thickness of approximately 800 feet. The Lloyd Aquifer is 1,100 feet below sea level and is approximately 325 feet thick.

A groundwater divide, at which groundwater flows vertically down and then flows either to the north or to the south, is located north of the River's

headwaters, north of Middle Country Road. The location of the groundwater divide is not fixed as it shifts north or south based on the precipitation levels; Figure 8 shows the simulated location under long term average precipitation, drier than average conditions (10 percent less recharge than longer term average conditions), and wetter than average conditions (10 percent more recharge than long term average conditions) (CDM, 2011a).

Most of the groundwater flow into the Carmans River comes from the Upper Glacial Aquifer with significantly less coming from the Magothy Aquifer (O'Malley, 2008). It is estimated that 94 percent of the flow of the Carmans River originates as groundwater discharges into the river, also known as baseflow (CDM, 2011a). In the Study Area, groundwater flows toward the south, eventually discharging into streams and creeks, the south shore bays (Bellport Bay and the Great South Bay) or the Atlantic Ocean (Central Pine Barrens Joint Planning and Policy Commission, 1996).

The depth from the land surface to the groundwater table in the Study Area based on the USGS's 2006 hydrologic conditions is shown in Figure 7. Depth to groundwater increases with increasing distance away from the river and from north to south in the study area.

The direction of horizontal groundwater flow follows the water table gradients. The water table has a maximum elevation of 50-55 feet above mean sea level at the northern area of the Study Area and becomes progressively shallower toward the south (Monti and Busciolano, 2009). CDM (2011b) modeled the groundwater flow paths originating at different locations within the Study Area. Those models resulted in the following conclusions:

- Precipitation entering the water table at East Bartlett Road in the northern part of the Study Area travels vertically down to the base of the Upper Glacial Aquifer as it travels southward and then upward to discharge into the river north of the Long Island Expressway greater than 50 years after entering the groundwater (Figure 9).
- Precipitation entering the water table along Moriches-Middle Island

Road on the east side of the river travels southward through the shallow Upper Glacial Aquifer before it discharges into the river approximately 15 years later (Figure 10).

- Precipitation recharging west of Yaphank Avenue travels relatively quickly through the shallow Upper Glacial Aquifer, discharging into the river in less than 10 years (Figure 11).

For the purpose of managing Long Island's groundwater, Long Island has been divided into eight hydrogeological zones by Suffolk County based on differences in groundwater flow patterns and groundwater quality (208 Study, Koppelman, 1978). The northern Study Area is located entirely in Groundwater Zone III, a deep recharge area with groundwater flowing into the Magothy and Lloyd aquifers, while the southern Study Area is in Groundwater Zone VI, in which groundwater discharges into surface waters.

Start of Stream Flow

Start of flow is where the flow of a stream can first be seen within its headwaters area. The location of the start of flow varies over time in response to annual changes in precipitation levels and hence groundwater recharge. In addition to variation in precipitation and recharge, development, groundwater pumping and road construction have, over time, modified the location of the start of flow. For example, the 1989 reconstruction and repositioning of Yaphank-Middle Island Road, which included the installation of five catch basins and the creation of a 15,000 square foot natural retention area at the intersection of East Bartlett Road and Yaphank-Middle Island Road (County Road 21), changed and re-directed the flow of the headwaters.

Over the last forty-five years, the location of the river's start of flow has varied approximately 12,491 feet with the southernmost point documented in 1967, located adjacent to Suffolk County property (SCTM# 0200-52900-0100-028002), and the northernmost point documented in 1991, south of the

Longwood Library property (Figure 12). Historical information, including historic topographic maps and period photographs, appear to indicate that at times in the past, the surface water of the Carmans River may have extended into the area north of Middle Country Road (CDM, 2011a).

Time Of Travel, Baseflow And The Groundwater Contributing Area

Time of travel is a measure of the time required for water to travel from where it enters the groundwater system as recharge to where it is discharged into a body of water. The groundwater discharging into the Carmans River is a composite of the water recharged at various distances from the river. To give a temporal-spatial perspective to groundwater flow, CDM divided the groundwater contributing area into six time of travel zones: 0 to 2 years, 2 to 5 years, 5 to 10 years, 10 to 25 years, 25 to 50 years, and 50 to 100 years (Figure 13). The baseflow contribution from each of the time of travel zones under long term average conditions of recharge and precipitation is given in Table 2.

Table 2. Area and relative and cumulative percent contributions to baseflow based on the time of travel zones under long term average conditions of recharge and precipitation.

<u>Time of travel zone in years</u>	<u>area (acres)</u>	<u>relative % contribution</u>	<u>cumulative %</u>
0 – 2	3,891	20.0	20.0
2 – 5	3,023	15.5	35.5
5 – 10	3,366	17.3	52.8
10 – 25	5,020	25.8	78.6
25 – 50	2,832	14.6	93.2
50 – 100	1,311	6.7	100
Total	19,422	100	N/A

Hyporheic Zone

A key but underappreciated feature of any stream or river is the hyporheic zone – the zone immediately beneath and next to the stream or riverbed. This area, where groundwater and surface water mix, can play an important role in affecting water quality in the stream or river. For example, groundwater can discharge nutrients utilized by stream organisms found on the bottom of the stream while stream water can provide nutrients and oxygen to organisms in the sediments. Both chemical and nutrient transformation can occur here affecting water quality. Unfortunately there appears to have been little research to better characterize and understand the functioning and role of the hyporheic zone of the Carmans River.

Groundwater Quality: Nitrate and Other Contaminates

Nitrate is highly soluble and mobile in water. In the absence of uptake by plants and microorganisms and denitrification processes, nitrate can travel long distances in groundwater with little or no reduction in concentration. According to CDM (2009), the pre-development nitrate levels in the Upper Glacial Aquifer were less than 1 mg/l and the pre-development nitrate levels in the deeper Magothy and Lloyd Aquifers were less than 0.05 mg/l.

Figure 14 shows the measured nitrate concentrations in private groundwater wells within the Upper Glacial, aquifer which is assumed to be shallow. According to CDM (2011) the majority of the nitrate samples were less than 2 mg/l with a few wells above 5 mg/l. Groundwater well data from the Yaphank area of the Management Plan Area averages 1.23 to 1.37 mg/l of nitrate.

Once nitrate enters the groundwater, it does not undergo significant chemical transformations due to lack of carbon and oxygen, although its concentration can be reduced by dilution. Before groundwater enters the river, it must pass through a biologically active layer of sediment on the river bed, and this is where chemical transformations of the nitrate can occur, although they are

not well understood. For these reasons, the relationship between the groundwater nitrate concentrations and river nitrate concentrations is difficult to model.

CDM (2011b) used water quality data obtained from the Suffolk County Department of Health Services, the New York State Department of Environmental Conservation and the Brookhaven National Laboratory to identify contaminant plumes, potential contaminant sources and spills within and surrounding the Study Area (Figure 15). It should be noted that some of the investigations were conducted one or more decades ago, such that depending upon the characteristics of the contaminant, the location of the source, and the time of release, the contaminant may have traveled through the aquifer and discharged into the river years ago. Figure 16 shows the location of inactive and closed spills.

Stormwater

Stormwater runoff is precipitation (rain or snowmelt) that flows across impermeable surfaces such as pavement or building roofs. As stormwater travels over these surfaces, it can pick up any contaminants, sediments, and debris that may be present. If this stormwater enters surface waters, it can result in impairments and water quality degradation. In the past, the typical approach for managing stormwater on roadways was to get the stormwater off the road as quickly as possible, which often meant directing it into surface waters.

Amendments to the 1972 Federal Clean Water Act required municipalities, beginning in 2003, to implement programs and practices that target stormwater discharges under a program known as Phase II stormwater. The Phase II program requires government entities that own and maintain stormwater infrastructure that may discharge into surface waters to obtain and comply with a permit from the New York State Department of Environmental Conservation for the discharge of stormwater into surface waters. As a condition of this permit, government entities must develop and implement a comprehensive stormwater

management program that includes mandated programs and practices in the following six categories: public education and outreach on stormwater impacts; public involvement and participation; illicit discharge detection and elimination; construction of site stormwater runoff controls; post-construction stormwater management in new development and/or redevelopment; and pollution prevention and good housekeeping for municipal operations. The Town of Brookhaven, Suffolk County and NYS Department of Transportation all have stormwater infrastructure in the Management Plan Area and are thereby required to comply with the requirements of Phase II.

Under Phase II, the Town has mapped all of its recharge basins and discharges of its stormwater catch basins in the Management Plan Area. Because much of the Management Plan Area has not been developed or lacks high density development, only 21 direct stormwater discharges (pipes and road drainage) into the river have been identified as of 2011 (Table 3, Figure 17 and Appendix G). The mapping of stormwater infrastructure maintained by Suffolk County Department of Public Works and NYS Department of Transportation that might impact the Carmans River may have been completed; however that information has not been shared with the Town of Brookhaven.

Table 3. Direct stormwater discharges into the Carmans River.

Outfall number	Location
1	Longwood Library outfall
2	Pipe located on east side of SC Route 21
3	Road end at Siegfried Park Blvd.
4	Mill Road and SC Route 21 at Upper Lake
5	Mill Road
6	Swale along SC Route 21
7	Boat access southeast corner Lower Lake
8	Pavement along Lower Lake dam
9	Yaphank Avenue at southeast corner Lower Lake
10	Northeast side of SC Route 21
11	South side road along Lower Lake
12	Southeast side of SC Route 21
13	West side of river at north side of Long Island Expressway
14	East side of river at north side of Long Island Expressway
15	North side of SC Route 56 at park entrance
16	SC Route 56, 0.6 miles east of fishing entrance
17	Sunrise Highway bridge
18	Montauk Highway bridge
19	End of Beaver Dam Road
20	Southeast corner of Brookhaven Village Association marina
21	Boat basin of Post Morrow Foundation

Flooding At Middle Island Road

An area, outside of the Study Area, of episodic flooding occurs on and along Middle Island Road which intersects Middle Country Road opposite the Longwood Library. Middle Island Road is situated in a topographic depression relative to the surrounding area and as with numerous similar areas in Suffolk County, high water table conditions and/or low water infiltration rates may be creating or contributing to this periodic flooding, as the flooding is most pronounced during and immediately after periods of above average precipitation. That stormwater may not readily infiltrate into the ground or that there is a shallow water table is further supported by the presence of Town of Brookhaven

and New York State regulated wetlands (wetland vegetation requires saturated soils) located east of the road. In addition, the Town has identified freshwater wetlands along the west side of Middle Island Road.

According to the Suffolk County Soil Survey (US Department of Agriculture, 1975), soils on both the east and west sides of Middle Island Road are well drained and consist almost exclusively of Carver and Plymouth Sands with a 0-3% slope. Near the intersection of Middle Island Road and Rocky Point Road there is a pocket of Carver and Plymouth Sands with 3-15% slopes which are classified as soils with a slight-moderate impairment for sewage disposal fields (which reflects its ability to drain). Directly north of this intersection, soils are well drained and comprised of a mixture of soil types including; gravel pit, Haven Loams and Carver Plymouth Sands (with a 0-3% slope). At the intersection of Middle Island Road and Middle Country Road, between Middle Island Road and Rocky Point Road is an area of slight-moderately impaired soils with respect to sewage disposal. This area consists again of Carver Plymouth Sands with a 3-15% slope and contains a wetland at the lowest elevation between Middle Island Road and Rocky Point Road, approximately 300 feet north of Middle Country Road.

In the fall of 2010, an inspection of the area was undertaken by Town of Brookhaven staff within 24 hours of the cessation of a rainfall event that produced more than 1 inch of rain. The inspection found a large ponding area on the east side of Middle Island Road just north of Middle Country Road and the 10 stormwater catch basins along the roadway contained water, with one basin having water within 4 inches of the road surface. While it may be possible to reduce the flooding with improvements to the drainage infrastructure in and near the affected area, no stormwater should be directed into the Carmans River.

Surface Waters

The Carmans River descends in a southerly direction and the gradient of the river bed is generally steeper on the northern end than at the southern end.

Over its entire length, the Carmans River elevation decreases approximately 50 feet, an average drop of 6.5 feet per mile and an approximate gradient of 0.125 percent.

The freshwater segment of the Carmans River can be divided into three stream segments: the start of flow to Upper Lake, Upper Lake to Lower Lake, and Lower Lake to Hards Lake. The three lakes (Upper Lake: 19 acres; Lower Lake: 25 acres; and Hards Lake in Southaven County Park: 30 acres) are not natural lakes having been created by dams.

The tidal portion of the Carmans River is approximately 2 miles in length and is under the influence of the flow of freshwater and tidal exchange with Bellport Bay. There are a number of tributary streams in the tidal portion of the Carmans River within Wertheim National Wildlife Refuge, including Yaphank Creek and Little Neck Creek on the west side of the river.

There are also a number of small ponds located within the Carmans River Study Area including Twin Ponds, Spring Lake, Moon Lake and Weeks Pond. Additionally, there are a number of vernal ponds located within the Management Plan Area, notably in the publicly owned land known as Warbler Woods and along East Bartlett Road.

Surface Water Quality

The quality of surface water is indicated by the concentrations of a suite of chemicals, sediments, and harmful microorganisms. Surface water quality in the freshwater section of the Carmans River is determined by the quality of groundwater that discharges into the surface water, atmospheric deposition of contaminants, runoff of contaminants into surface water, and biological activity that can remove contaminants. Land use is a major factor in determining water quality as it affects the volume of sanitary waste discharged to groundwater, stormwater runoff, spills, fertilization, and the nature and extent of vegetation.

Surface Water Quality Classifications

New York State has classified various sections of the freshwater segment of the Carmans River as either “Class B” or “Class C” according to the surface water’s best usage (New York State Department of Environmental Conservation, 2011b). The best usage of “Class B” waters is for swimming and other contact recreation, but not for drinking water. The best use of “Class C” waters is fishing but not active recreation. Parts of the river are also designated as “Subclass T” and “Subclass TS”. “Subclass T” indicates that waters may support trout populations. “Subclass TS” indicates that the waters may support trout spawning. Water classified as C(T), C(TS) and B are considered to be “protected streams,” and are therefore subject to the stream protection provisions of the New York State Protection of Water regulations.

The tidal portion of the Carmans River is classified as “SC” (New York State Department of Environmental Conservation, 2011b). The best usage of “SC” waters is fishing and the waters shall be suitable for fish, shellfish, and wildlife propagation and survival. Water quality is to be suitable for primary and secondary contact recreation but not the harvest of shellfish for direct human consumption.

Surface Water Quality Standards

New York State has existing narrative water quality standards for phosphorous and nitrogen that is set forth in 6NYCRR 703.2 (New York State Department of Environmental Conservation, 2011a) which sets limits for these two elements (both are plant nutrients) as “none in amounts that will result in growth of algae, weeds and slime that will impair the waters for their best usage.” At the direction of the US Environmental Protection Agency, New York is developing a numerical nutrient criteria derived from data collected from New York State waters. The New York State Department of Environmental Conservation has recently released its *New York State Nutrient Standards Plan revised July 7, 2011* (New York State Department of Environmental

Conservation, 2011a) which describes New York's progress on establishing a numerical standard and how it plans to derive and establish criteria to protect the best uses of flowing and ponded freshwaters and estuaries from excess nutrients. No date is provided as to when the numeric standards will be released for public review.

Numeric standards are expected to be a significant factor in the listing of waters on *New York's Section 303(d) List of Impaired Waters* (New York State Department of Environmental Conservation, 2011c), and as such the numeric standards must be able to make the distinction between impaired waters (in need of restoration) and impacted waters (in need of protection). The adoption of a numeric nitrogen standard will be significant and have far reaching consequences, as it will drive State Pollution Discharge Elimination System (SPDES) permit limits, Municipal Separate Storm Sewer Systems (MS4) management, other permit requirements, and the water quality targets for Total Maximum Daily Loads (TMDLs). Accordingly, it is expected that the numeric standards will undergo extensive public review prior to being adopted.

Surface Water Quality: Volatile Organic Chemicals (Vocs) And Pesticides

Volatile organic chemicals (VOCs) and most pesticides are organic compounds which can adversely affect environmental and human health. According to an analysis done by CDM of Suffolk County Department of Health Services data (CDM, 2007), the median concentration of VOCs detected in Suffolk County streams from 1981 through 2005 was 1 part per billion; the VOCs and pesticides detected in the Carmans River together with their highest concentration is given in Table 4.

Table 4. VOCs and pesticides in the Carmans River from 1981 through 2005 as reported by CDM (2007). The number in parentheses is the highest observed concentration in parts per billion.

1,1 DCA (2)
 1,1,1-TCA (2)
 Bis(2-ethylhexyl) phthalate (8.5)
 Carbon disulfide (5)
 Carbon tetracholide (0.6)
 Chloroform (2)
 Methyl sulfide (0.9)
 MTBE (53)
 Tert-amyl-methyl-ether (12)
 Methoprene (0.73)

Of 128 samples from the Carmans River that were analyzed for VOCs, VOCs were detected in 48 (38%) of the samples, while pesticides were detected in 3 of 128 samples (2%). To put the Carmans River levels into perspective, Table 5 provides the percentage of samples with VOCs in other streams sampled by Suffolk County and Table 6 provides the percentage of samples with pesticides.

Table 5. The frequency of VOCs detected in selected Suffolk County Streams (CDM, 2007).

Santapogue Creek	100%
Sampawams Creek	98%
Champlins Creek	92%
Carlls River	81%
Nissequogue River	67%
Connetquot River	45%
Forge River	44%
Peconic River	40%
Carmans River	38%
Brushes Creek	33%
Sawmill Creek	23%
Meetinghouse Creek	17%

Table 6. The frequency of pesticides detected in selected Suffolk County streams (CDM, 2007).

Meetinghouse Creek	90%
Brushes Creek	85%
Sawmill Creek	23%
Peconic River	5%
Sampawams Creek	2%
Carmans River	2%
Carlls River	0%
Champlins Creek	0%
Connetquot River	0%
Forge River	0%
Nissequoque River	0%
Santapogue Creek	0%

Surface Water Quality: Sodium Chloride

Salt (sodium chloride [NaCl]) can adversely impact plants and animals and originates primarily from road deicing and septic systems. According to Cashin Associates (2002), salt concentration in the Carmans River at the USGS gaging station doubled between 1966 and 2002. According to O'Malley (2008), sodium chloride concentrations are relatively low in the Carmans River but its spatial distribution concentration reflects anthropogenic activities. Sampling in 2005 showed that sodium chloride concentrations were high in the headwaters, lower in the middle reach of the river, and then increased in the lower reach of the river (O'Malley, 2008). The concentrations of sodium chloride correlate with the distribution of road density in the Management Plan Area, with the highest concentrations occurring where the road density is the highest.

Surface Water Quality: Phosphorous

In freshwater systems, phosphorous (as orthophosphate) is often a limiting nutrient for primary producers (photosynthetic organisms such as phytoplankton, algae and aquatic plants). If the concentration of phosphorus is less than what is needed to support primary production, primary production will

cease no matter how much nitrogen (the other major limiting nutrient) is available. Conversely, if phosphorous is added to phosphorous limited aquatic systems by anthropogenic activities, it can result in primary production when it might not normally occur or at above normal levels (eutrophication). The two principal causes of elevated phosphate concentrations are agricultural activities (mainly the application of commercial fertilizers, manure, and pesticides) and wastewater.

The New York State ambient water quality guidance value for phosphorous is .2 mg/l, but in upstate waters it can be as low as .1 mg/l (New York State Department of Environmental Conservation, 2011a). Water quality monitoring by the Suffolk County Department of Health Services has found orthophosphate concentrations at each of their 10 sampling stations to be less than .5 mg/l of orthophosphate. The mean concentration of orthophosphate in 2009-2010 in Lower Lake was .009 mg/l and in Upper Lake was .007 mg/l (Nelson, Pope & Voorhis, 2011).

Surface Water Quality: Dissolved Oxygen

Nelson, Pope & Voorhis (2011) sampled dissolved oxygen in Upper and Lower Lakes in 2009-2010. Dissolved oxygen in the upper water column was above 6 mg/l in both lakes, except for during the summer sampling, when it was between 2.02 and 2.87 mg/l. Closer to the lake bottoms in some locations, dissolved oxygen was less than 2 mg/l; low oxygen concentrations are expected in bottom waters in the summer months due to stratification of the water column.

Surface Water Quality: Chlorophyll A

Nelson, Pope & Voorhis (2011) sampled chlorophyll a (a measure of the concentration of planktonic algae) in Upper and Lower Lakes in 2009-2010. During this period, chlorophyll a levels were generally low, between 1 and 4 ug/l. According to Nelson, Pope & Voorhis (2011), these chlorophyll a concentrations would classify the lakes as oligotrophic/mesotrophic; oligotrophic lakes have low

concentrations of the nutrients required for plant growth while mesotrophic lakes have moderate concentrations of nutrients required for plant growth. However, at the southernmost ends of Upper Lake and Lower Lake chlorophyll a levels often exceeded 12 ug/l which would classify these two sections as eutrophic due to excessive nutrient concentrations.

Surface Water Quality: Nitrogen

Nitrogen (molecular nitrogen is N_2 which is a gas) is an element that is essential to life and comprises two biologically important molecules: ammonium (NH_4) and nitrate (NO_3). When an organism dies and decays or its waste products (including human and animal waste) are released into the environment, the nitrogen based molecules contained therein are converted into ammonium. Certain bacteria convert ammonium into nitrite (NO_2) and thence into nitrate (NO_3). Nitrate can also enter the environment directly via fertilizers and atmospheric deposition. Denitrification is the conversion of nitrate into nitrogen gas by microorganisms in the absence of oxygen.

Nitrate is the form of nitrogen that is most important in primary production (photosynthesis) and is highly soluble in water, mobile and is transported conservatively in groundwater (it does not undergo chemical transformations). Anthropogenically elevated concentrations of nitrate in surface water can stimulate primary production, alter community structure and result in eutrophication which can lead to low dissolved oxygen (hypoxia) or no dissolved oxygen (anoxia) as the primary production decays. Elevated nitrate concentrations in drinking water can be harmful to humans; the drinking water standard for nitrate in drinking water is 10 mg/l (CDM, 2009).

Nitrate In Surface Waters: Temporal Trends

The USGS maintains a gauging station on the Carmans River south of the Long Island Railroad tracks in Yaphank. From 1971 to 1997, 231 samples were analyzed for a number of chemical constituents. For nitrate, the maximum

concentration was 8.3 mg/l (which may have been due to a rainfall event prior to the collection of the sample), the minimum concentration was 0.53 mg/l, and the median concentration was 1.25 mg/l.

CDM (2008) has compiled available nitrate concentrations in the Carmans River south of the Long Island Expressway (Table 7). The maximum concentration of nitrate was 8.3 mg/l (which may have been due to a rainfall event prior to the collection of the sample), the minimum concentration was 0.53 mg/l, and the median was 1.25 mg/l.

Table 7. Nitrate concentrations in the Carmans River in mg/l as determined by the Suffolk County Department of Health Services from the 1960s to the 2000s as reported by CDM (2008).

	1960s	1970s	1980s	1990s	2000s
Number of samples	11	47	21	18	103
Average	1.3	1.1	1.1	1.4	1.4
Maximum	2.5	4.8	1.5	1.9	4.1
Minimum	0.3	0.1	0.6	0.7	0.1
10 th percentile	0.4	0.2	0.7	0.8	0.7
50 th percentile (median)	1.2	0.8	1.0	1.5	1.4
90 th percentile	2.3	2.9	1.4	1.7	2.0

Monti and Scorca (2003) estimated the annual nitrogen discharged by the Carmans River into Bellport Bay from 1972 to 1997 by multiplying the annual mean nitrogen concentration by the annual mean discharge (Table 8). The annual variation reflects fluctuations in recharge from precipitation and changes in land use (development).

Table 8. Estimated annual nitrogen discharge from the Carmans River into Bellport Bay between 1972 and 1997 from Monti and Scoraca (2003).

<u>Year</u>	<u>ton/year</u>	<u>kg/year</u>
1972	27.1	24,600
1973	32.3	29,300
1974	27.5	24,900
1975	24.3	22,000
1976	26.3	23,900
1977	25.9	23,500
1978	31.1	28,200
1979	43.3	39,300
1980	32.6	29,600
1981	22.3	20,000
1982	47.7	43,300
1983	35.7	32,400
1984	55.2	50,100
1985	33.2	30,100
1986	25.9	23,500
1987	27.7	24,100
1988	25.0	22,700
1989	39.4	35,700
1990	52.2	47,400
1991	44.3	40,200
1992	28.0	25,400
1993	33.8	30,700
1994	34.8	31,600
1995	20.8	18,900
1996	24.7	22,400
1997	31.1	28,200

Nitrate In Surface Waters: Spatial Trends

O'Malley (2008) undertook synoptic sampling of nitrate in July and October 2005 and July 2006 at a number of locations along the freshwater segment of the river, beginning at the start of flow. Her analysis of the data found the following:

- The average nitrate concentration was 5.5 mg/l;
- The nitrate concentration peaked at Bartlett Road at 9.64 mg/l, near a farm which could be due to either agricultural activities or a significant

- influx of groundwater;
- Peaks in nitrate concentration decreased with increasing distance from the headwaters;
 - Nitrate concentration levels were highest north of the Upper Lake dam;
 - Nitrate concentrations increased immediately north of the Lower Lake dam;
 - Nitrate concentrations increased from approximately 3.7 mg/l to approximately 6 mg/l just north of the Lower Lake Dam.

Nitrate In Upper and Lower Lakes

Water column sampling of nitrate in Upper Lake and Lower Lake was conducted by the SUNY Stony Brook School of Marine and Atmospheric Sciences in October 2009, April 2010, June 2010, and August 2010 at four sites in each lake (Nelson, Pope & Voorhis, 2011); the nitrate concentrations for Lower Lake are given in Table 9 and for Upper Lake in Table 10.

Table 9. The nitrate concentrations in mg/l in Lower Lake as reported by Nelson Pope & Voorhis (2011).

<u>Station</u>	<u>October</u>	<u>April</u>	<u>June</u>	<u>August</u>
LL1	1.347	1.214	1.591	2.173
LL2	1.402	0.839	1.374	1.384
LL3	1.629	0.933	1.369	1.738
LL4	N/A	1.150	0.799	0.760

LL1 is located 2400 feet west of Yaphank Avenue in the stream that flows into the lake
 LL2 is located 1500 feet west of Yaphank Avenue in the stream that flows into the lake
 LL3 is located 350 feet west of Yaphank Avenue in the central lake
 LL4 is located at the spillway that flows beneath Yaphank Avenue at the east end of the lake

Table 10. The nitrate concentrations in mg/l in Upper Lake as reported by Nelson Pope & Voorhis (2011).

<u>Station</u>	<u>October</u>	<u>April</u>	<u>June</u>	<u>August</u>
UL1	1.741	1.206	1.546	1.757
UL2	1.400	1.002	0.977	1.782
UL3	1.085	1.045	1.135	1.412
UL4	N/A	1.169	1.075	1.167

UL1 is located 1800 feet north of Mill Road in the stream just before the lake
 UL2 is located 800 feet north of Mill Road in the mid section of the lake
 UL3 is located on the north side of Mill Road at the south end of the lake
 UL4 is located on the north side of Mill Road at the south end of the lake

Assessment of Nitrate Concentrations

Based on a review of historical nitrogen data for the Carmans River, nitrate concentrations that would be expected in the absence of development, comparison of nitrogen concentrations in similar surface waters, and nitrate concentrations that are known to cause impairments, Marilyn Jordan of The Nature Conservancy undertook an analysis of what the nitrogen concentration of the Carmans River should be to protect the river (personal communication, 2011). Based on her analysis, Jordan recommended an interim nitrogen non-degradation standard for the surface water of the Carmans River of 1.27 mg/l total N and/or 1.0 mg/l nitrate-N initially and a restoration standard of .7 mg/l nitrate-N.

Nitrogen Budget

In order to manage nitrogen in surface waters, it is necessary to construct a nitrogen budget which identifies all of the sources of nitrogen to the Management Plan Area. The major pathways of nitrogen into the Carmans River are atmospheric deposition (the nitrate concentration in rainwater falling over

Suffolk County, ranges from 0 to 1.38 mg/l with an average value of .25 mg/l (Munster, 2008)), wastewater, and fertilizer.

Kinney and Valiela (2011) undertook a modeling study of the inputs and fates of nitrogen in the watershed they delineated for the Carmans River. According to the model they used, the nitrogen loading to the Carmans River watershed was as follows:

Atmospheric: 182,472 kilograms of nitrogen per year (43% of total)

Wastewater: 167,295 kilograms of nitrogen per year (40% of total)

Fertilizer: 70,772 kilograms of nitrogen per year (17% of total)

Different land uses have different nitrogen loadings and as such different contributions to the Carmans River via groundwater discharge and surface runoff. Golf courses and agricultural uses, for example, have a higher nitrogen contribution from fertilization than would residential or commercial uses, but residential uses would have a higher loading from sanitary waste. Thus, in order to manage nitrogen loadings, it is necessary to examine the contributions of different land uses.

LAND USE

How much land in the Study Area is naturally vegetated, how much land is developed, and how the developed land is used are all key factors in determining the quality of groundwater, surface water and terrestrial habitats. Undeveloped land has minimal adverse impacts on the environment and as the intensity of development increases so to do the negative environmental impacts. For example, going from 5 acre residential to 1/2 acre residential, there is a significant increase in discharge of nitrate to groundwater, stormwater runoff, fertilization, and loss of habitat. The distribution of land uses in the Study Area is given in Figure 18 and the land use in the 100 year groundwater contributing area of the Study Area, as determined by CDM (2011a), is provided in Table 11 and Figure 19.

Table 11. The distribution of land uses in the groundwater contributing area of the Study Area as determined by CDM (2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	6,472	33.3
Medium density residential	2,767	14.2
Vacant	2,507	12.9
Transportation	2,536	12.5
Institutional	1,891	9.7
Low density residential	1,191	6.1
Agricultural	889	4.6
Industrial	469	2.4
Waste disposal	270	1.4
Commercial	257	1.3
High density residential	151	0.8
Utilities	141	0.7
Unclassified	0	0
Total	19,442	100

Land Use In The Different Groundwater Time Of Travel Zones

In order to better understand the relationship between land use and water quality in the Carmans River, CDM superimposed the six groundwater time of travel zones (0 to 2 years, 2 to 5 years, 5 to 10 years, 10 to 25 years, 25 to 50 years and 50 to 100 years) on a map of land uses based on Suffolk County's land use classification data (CDM, 2011a). This data was then used to determine the area of each land use in the six time of travel zones (Tables 12, 13, 14, 15, 16 and 17).

Table 12. Land uses in the Management Plan Area 0 to 2 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	2,269	58.3
Medium density residential	461	11.8
Vacant	191	4.9
Transportation	398	10.2
Institutional	80	2.1
Low density residential	347	8.9
Agricultural	67	1.7
Industrial	35	.9
Waste disposal	0	0
Commercial	15	.4
High density residential	6	.2
Utilities	21	.5
<u>Unclassified</u>	<u>0</u>	<u>0</u>
Total	3,891	100

Table 13. Land uses in the Management Plan Area 2 to 5 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	1,184	39.2
Medium density residential	475	15.7
Vacant	457	15.1
Transportation	361	11.9
Institutional	136	4.5
Low density residential	186	6.1
Agricultural	118	3.9
Industrial	47	1.6
Waste disposal	8	0.3
Commercial	21	0.7
High density residential	15	0.5
Utilities	15	0.5
<u>Unclassified</u>	<u>0</u>	<u>0</u>
Total	3,023	100

Table 14. Land uses in the Study Area 5 to 10 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	837	24.9
Medium density residential	621	18.5
Vacant	547	16.3
Transportation	495	14.7
Institutional	120	3.6
Low density residential	264	7.9
Agricultural	239	7.1
Industrial	52	1.5
Waste disposal	76	2.3
Commercial	64	1.9
High density residential	9	0.3
Utilities	42	1.2
Unclassified	0	0
Total	3,366	100

Table 15. Land uses in the Study Area 10 to 25 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	1,339	26.7
Medium density residential	703	14.0
Vacant	709	14.1
Transportation	709	14.1
Institutional	854	17.0
Low density residential	187	3.7
Agricultural	185	3.7
Industrial	115	2.3
Waste disposal	122	2.4
Commercial	55	1.1
High density residential	11	0.2
Utilities	32	0.6
Unclassified	0	0
Total	5,020	100

Table 16. Land uses in the Study Area 25 to 50 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	576	20.3
Medium density residential	320	11.3
Vacant	477	16.8
Transportation	348	12.3
Institutional	531	18.8
Low density residential	110	3.9
Agricultural	103	3.6
Industrial	157	5.5
Waste disposal	62	2.2
Commercial	40	1.4
High density residential	88	1.4
Utilities	20	0.7
Unclassified	0	0
Total	2,832	100

Table 17. Land uses in the Study Area 50 to 100 year time of travel zone under long term average conditions of recharge and precipitation (CDM, 2011a).

<u>Land use</u>	<u>acres by land use</u>	<u>percentage</u>
Open space	267	20.4
Medium density residential	186	14.2
Vacant	126	9.6
Transportation	125	9.5
Institutional	170	13.0
Low density residential	98	7.5
Agricultural	177	13.5
Industrial	63	4.8
Waste disposal	2	0.1
Commercial	63	4.8
High density residential	23	1.7
Utilities	11	0.8
Unclassified	0	0
Total	1,311	100

Residential Development In The Study Area

The total number of single-family, two-family, three-family and multi-family residentially developed properties were identified in each of the groundwater time of travel zones and the area north of the 100 year groundwater time of travel boundary to determine the extent of residential development and to provide a basis for estimating population size and septic system density and distribution (Table 18). For comparison, Table 18 also includes the total number of non-residential lots. Within the Study Area there are a total of 11,068 dwelling units in the 30.6 square miles of the Study Area, the residential housing density is 361.7 dwelling units per square mile.

Table 18. Developed land in the Study Area

Area	Single-Family Lots	Two-Family Lots ¹	Three-Family Lots ⁴	MF Developed Sites by Centroid ³	Total Res. Lots/Sites	MF DUs ² by Zone	Total Non-Res. Lots	Total Lots/Sites	Total DUs
0-2 yr time of travel	984	97	5	0	1,086	0	43	1,129	1,193
2-5 yr time of travel	1,124	104	0	0	1,228	0	28	1,256	1,332
5-10 yr time of travel	1,395	91	4	0	1,490	12	32	1,522	1,601
10-25 yr time of travel	1,555	105	3	1	1,664	426	66	1,730	2,200
25-50 yr time of travel	745	42	1	2	790	851	81	871	1,683
50-100 yr time of travel	341	24	0	2	367	611	33	400	1,000
North of the 100 year time of travel	837	25	0	5	867	1,172	42	909	2,059
Total Lots	6,981	488	13	10	7,492	N/A	325	7,817	N/A
Total Dwelling Units	6,981	976	39	N/A	N/A	3,072	N/A	N/A	11,068

1. This includes single-family residences with accessory apartments;
2. DU = "Dwelling Units"; MF units based on estimated portion of property in each zone;
3. Multifamily lots for each MF development determined using Suffolk County Planning Department multifamily residence inventories;
4. Two dwelling units for each two-family lot; three-dwelling units for each three-dwelling unit lot.

Population in the Study Area

According to the 2010 United States Census (US Census Bureau, 2011), the average number of persons in a household in the four census designated places in the Study Area (Yaphank, Shirley, Mastic, and Middle Island) is 2.95. Multiplying the number of existing dwelling units in each of the groundwater time of travel zones and in the area north of the 100 year groundwater contributing

area boundary by the average number of persons provides an estimate of the population in each of these areas (Table 19). The estimated total population in the Study Area is 32,650 persons and an estimated population density of the watershed is 1,067 persons per square mile.

Table 19. Carmans River Study Area population estimates.

Area	Total Dwelling Units	Person/Household Multiplier	Estimated Population
0-2 yr time of travel	1,193	2.95	3,519
2-5 yr time of travel	1,332	2.95	3,929
5-10 yr time of travel	1,601	2.95	4,723
10-25 yr time of travel	2,200	2.95	6,490
25-50 yr time of travel	1,683	2.95	4,965
50-100 yr time of travel	1,000	2.95	2,950
North of the 100 year time of travel	2,059	2.95	6,074
Total	11,068	N/A	32,650

Private And Public Lands

The Study Area contains several thousand acres of publicly owned land that have been protected from development. Figure 20 shows the location of these publicly owned lands and Figure 21 shows the location of developed and undeveloped privately owned land.

Land Cover Analysis

In order to show the distribution of land uses in the Study Area graphically, the Town retained Cameron Engineering & Associates to prepare an analysis of land cover using spectral analysis (Cameron Engineering & Associates, 2011). Using 2005 color-infrared images covering the Study Area obtained from the New York State GIS Clearinghouse and the spectral ranges for different land uses, the following land cover classes were identified and mapped (Figure 22):

1. bare ground: pervious, bare surfaces including soil, sand, and gravel

2. conifer: evergreen trees
3. cultivated: active agricultural areas including areas that are recently fallow
4. deciduous: broad-leaved trees whose leaves undergo senescence in the fall
5. developed dark: impervious, man-made surfaces of low light reflectivity or high thermal absorption (useful for heat-island effects analysis)
6. developed light: impervious, man-made surfaces of high light reflectivity and low thermal absorption
7. shrub: low, woody growth areas also containing grasses and herbs, areas that are transitioning to forest
8. swamp-wetland: freshwater and tidal wetlands
9. turf: managed grass and lawns, i.e., mowed and/or fertilized, around homes, commercial areas, recreational fields, institutions, along highways, etc.
10. unmanaged grass: grasslands in natural areas and grassy areas in low-density settings, that are never or rarely mowed
11. water: open water, fresh or brackish

The area of each of the land cover classes is given in Table 20.

Table 20. Areas of the different land cover classes in the Study Area as determined by Cameron Engineering & Associates (2011).

Land Cover Class	Area (Acres)	Percentage of Total
Bare Ground	927.41	4.09%
Conifer	3821.82	16.86%
Cultivated	862.53	3.80%
Deciduous	9459.62	41.73%
Developed (Impervious)	3259.73	14.38%
Shrub	213.40	0.94%
Swamp Wetland	440.86	1.94%
Turf	2334.01	10.30%
Un-managed Grass	978.53	4.32%
Water	371.93	1.64%
Total	22669.88	100.00%

Zoning

Chapter 85 of the Code of the Town of Brookhaven sets forth the Town's zoning and land use requirements for the unincorporated areas of the Town. The major use districts occurring in the Study Area are given in Table 21 and shown in Figure 23; the number of parcels and their total acreage in each zoning district is given in Table 22.

Table 21. Zoning districts occurring in the Study Area.

B Residence	(single family residential development on 15,000 SF lots)
B Residence 1	(single family residential development on .5 acre lots)
A Residence 1	(single family residential development on 1 acre lots)
A Residence 2	(single family residential development on 2 acre lots)
A Residence 5	(single family residential development on 5 acre lots)
A Residence 10	(single family residential development on 10 acre lots)
Multi-Family Residence (MF)	(attached or semi-attached rental/owner-occupied residential units)
Planned Retirement Community Residence (PRC)	
Planned Retirement Congregate Housing Community Residence (assisted-living) (PRCHC)	
NHH Health Facility (nursing home)	
Horse Farm Residence (HF)	
J Business (transitional commercial)	
J Business 2 (neighborhood commercial)	
J Business 4 (transitional and business offices)	
J Business 5 (high intensity commercial)	
J Business 6 (main street commercial)	
J Business 8 (hotel-motel district)	
Pet Cemetery (PC)	
Commercial Recreation (CR)	
L Industrial 1 (light industry)	
L Industrial 2 (heavy industry)	
L Industrial 4 (electrical energy generation and transmission industry)	
Planned Development District (PDD)	
Wetlands Overlay	
Central Pine Barrens District	
Historic District	

Table 22. Number of parcels and acreage for each of the zoning districts in the Study Area.

Zoning	Parcels	Acreage
A1	10,196	17,309.74
A2	405	697.87
A5	1,206	2,905.61
A10	68	7,013
B	19	34.78
B1	9	64.76
HF	4	32.18
J	9	5.18
J2	131	338.79
J4	9	11.72
J5	14	12.58
J6	46	21.49
J8	2	1.89
L1	549	2,121.32
L2	14	146.28
MF	978	156.31
PC	1	25.43
PRC	3	90.77
A1, J2	69	236.79
A1, A2	1	0.5
A1, A5	2	42.34
A1, B, L1	1	32.24
A1, B, L1, ROW	1	28.59
A1, J2, L1	1	21
A1, J2, L1, L2	1	91.4
A1, J2, L2	1	5.16
A1, J4	1	0.75
A1, L1	4	491.94
A1, MF	1	46.41
A1, NHH	1	11.47
A1, ROW	2	2.18
A2, J2	2	16.89
A10, MF, PRC	1	149.04
J2, J6, ROW	1	6.28
J5, L1	1	0.7
L1, ROW	9	50.78
L1, L2	1	8.75
	Total Parcels	Total Acreage
	13,764	32,232.91

Restriction On Land Use: Wetlands

Both New York State and the Town of Brookhaven regulate activities on, and adjacent to, freshwater and tidal wetlands in order to protect and preserve these habitats that provide many ecological services. These services include flood and stormwater control, commercial and recreational fishing and shellfishing opportunities, pollution reduction, wildlife habitats, open space, aesthetics, erosion control, and nutrient cycling. Regulations prohibit various activities that are deemed incompatible with the values of wetlands and mitigate adverse impacts through standards and conditions attached to regulated activities.

New York State regulates freshwater wetlands under Article 24 of the New York State Environmental Conservation Law. Article 24's legislative intent is to preserve, protect and conserve freshwater wetlands and the many benefits they provide. The New York State Department of Environmental Conservation (NYSDEC) regulates freshwater wetlands which are depicted on official maps. Although the regulations focus primarily on freshwater wetlands of 12.4 acres or greater in size, wetlands of smaller acreages, generally known as "ULI" wetlands (wetlands of Unusual Local Importance), are also protected. NYSDEC categorizes wetlands according to their significance with Class I being the highest and Class IV being the lowest level of importance. Class I wetlands include those which contain habitat of endangered or threatened wildlife species or plants and those which are "hydraulically connected to an aquifer which is used for a public water supply." The majority of the Carmans River is mapped by NYSDEC as a Class I freshwater wetland and is designated as wetland number B-2.

Pursuant to 6 NYCRR Part 663, NYSDEC regulates activities within the freshwater wetland itself as well as the area which lies within 100 feet of the landward boundary of the wetland (the delineation of which is verified by NYSDEC). This 100-foot-wide boundary is known as the "Adjacent Area." Generally, NYSDEC encourages applicants to shift regulated activities outside of

the Adjacent Area or maximize the distance between the wetland and the regulated activity.

The lower portion of the Carmans River (south of the Hards Lake Dam, contained almost entirely by Wertheim National Wildlife Refuge) contains extensive tidal wetlands. New York State regulates tidal wetlands pursuant to Article 25 of the New York State Environmental Conservation Law. Article 25's legislative intent is to preserve and protect tidal wetlands, including preventing damage to them or their outright destruction. Under Article 25, the New York State Department of Environmental Conservation is to implement the statute and has promulgated appropriate regulations under 6 NYCRR Part 661. NYSDEC regulates activities within the wetland itself as well as the area which lies within 300 feet of the landward boundary of the wetland (the delineation of which is verified by NYSDEC) which is known as the "Adjacent Area." (There are certain exceptions to the 300-foot rule which include being located above the 10 foot elevation contour and the presence of a man-made structure [such as a bulkhead] which is at least 100 feet long, is in functional condition and was constructed prior to August 20, 1977). Generally, NYSDEC encourages applicants to shift regulated activities outside of the Adjacent Area, when and where possible, to maximize the distance between the wetland and the regulated activity.

The Code of the Town of Brookhaven regulates both freshwater and tidal wetlands, under Chapter 81: Wetlands and Waterways. Chapter 81 regulates and permits construction and development activities including drainage, dredging, excavation or removal of soil, mud, sand, shells, gravel, or other aggregate, dumping, filling, constructing structures and roads, clearing of vegetation, grading, installation of bulkheads, retaining walls, pilings, docks, catwalks, etc., discharges, mariculture and subdivisions and site plans occurring on wetlands or surface waters and within 150 feet of a wetland or surface water.

Restriction On Land Use: Town Of Brookhaven Historic Districts

Pursuant to the Code of the Town of Brookhaven, Article XVII (Historic Districts), Chapter 85-183, the Town can designate Historic Districts, defined as an area that contains buildings, structures or places which have a special character and ambiance based on historical value, notable architectural features representing one or more periods or styles of architecture of an area of history or the cultural and aesthetic heritage of the community and Historic Landmarks (historically significant structures). The Historic District and Landmark regulations focus on maintaining the historic character of the Historic District or Landmark through architectural review and do not generally restrict development.

The Town has three Historic Districts in the Study Area: Yaphank, Longwood Estate, and Fireplace (Brookhaven Hamlet). In the Study Area, the following places have been designated by the Town as Historic Landmarks: Union Cemetery (Middle Country Road, Middle Island), Middle Island Presbyterian Church (Middle Country Road, Middle Island), Holy Trinity Lutheran Church (Yaphank-Middle Island Road, Middle Island), J. Brown House (Park Street, Yaphank), Yaphank Garage (Yaphank Avenue, Yaphank), and the Homan-Gerard House (Yaphank Avenue, Yaphank).

The National Register of Historic Places is the nation's official list of historic properties worthy of preservation. The designation is primarily honorific and the property owner maintains the right to alter their properties at their discretion as long as there are no federal monies associated with the property. Owners of listed properties that are income producing may qualify for federal income tax benefits and listed properties owned by municipalities and not-for-profit organizations are eligible to apply for state historic preservation matching grants. Within the Study Area there are six properties listed on the National Register of Historic Places: Smith Estate (Longwood & Smith Roads, Ridge), Middle Island Presbyterian Church (Middle Country Road, Middle Island), Homan-Gerard House (Yaphank Avenue, Yaphank), Robert Hawkins Homestead (Yaphank Avenue, Yaphank), Saint Andrews Episcopal Church (Main Street,

Yaphank) and the Suffolk County Almshouse Barn (Yaphank Avenue, Yaphank).

Restriction On Land Use: Pine Barrens Protection Act

As previously discussed in this Plan, in 1993, the New York State Legislature passed the Pine Barrens Protection Act (New York State Environmental Conservation Law Article 57). In 1995, the Central Pine Barrens Joint Planning and Policy Commission (CPBJPPC) adopted the Central Pine Barrens Comprehensive Land Use Plan (CLUP) which was amended in 1996 to take into account comments received after adoption (Central Pine Barrens Joint Planning and Policy Commission, 1996). On lands that are designated as “Core Preservation Area,” development is prohibited unless a hardship permit is granted by the CPBJPPC. Property in the Pine Barrens Core Preservation Area is eligible for “Pine Barrens Credits,” transferable development rights that are sold on the private market and utilized for additional development on designated receiving sites in exchange for a permanent conservation easement on the sending site.

For existing residentially zoned, developed properties, which are in the Pine Barrens Core Preservation Area, the following actions are allowed (Central Pine Barrens Joint Planning and Policy Commission, 1996) pursuant to Article XXXVII of Brookhaven Town Code and all other applicable rules and regulations:

- Addition to a house which increases its footprint
- Addition of a new pool
- Addition to a house which increases square footage but not footprint
- New construction of shed
- New clearing, landscaping, fertilizer dependent vegetation
- Existing uses, structure
- Variances from Town Code (but no variances from Pine Barrens legislation)

The following are not permitted on existing developed, residentially zoned properties:

- Subdivision or land division

The following are not permitted on existing residentially zoned undeveloped properties:

- Construction of a new house
- Subdivision of a conforming parcel
- Subdivision of a non-conforming parcel
- Change of zone to commercial or industrial
- Clearing for agricultural purposes

The following are not permitted on existing commercially or industrially zoned, developed properties:

- Expansion of structure / addition to structure
- New construction
- Subdivision or land division
- Change of zone
- New clearing

Change of use is permitted provided it is in the same class.

For existing commercially or industrially zoned, undeveloped properties, the following are not permitted:

- New construction
- Subdivision or land division
- Change of zone
- New clearing
- Clearing for agricultural purposes

A change of use is permitted provided it is in the same class

On lands designated as “Compatible Growth Area,” development must adhere to the land use restrictions set forth in the 1996 CLUP and in accordance with Article XXXVII of Brookhaven Town Code unless a permit is issued by the CPBJPPC.

For existing residentially zoned, developed properties, which are in the Pine Barrens Compatible Growth Area, the following actions are allowed (Central Pine Barrens Joint Planning and Policy Commission, 1996) pursuant to Article XXXVII of Brookhaven Town Code and all other applicable rules and regulations:

- Addition to a house which increases its footprint
- Addition of a new pool
- Addition to a house which increases square footage but not footprint
- New construction of shed
- New clearing, landscaping, fertilizer dependent vegetation
- Existing uses, structure
- Variances from Town Code (but no variances from Pine Barrens legislation)

The New York State Legislature has amended the 1993 Pine Barrens Protection Act. The legislation will add certain properties in the Management Plan Area to the Pine Barrens Core Preservation Area and expand the boundaries of the Central Pine Barrens to include certain properties in the Management Plan Area to the Pine Barrens Compatible Growth Area. The Central Pine Barrens Joint Planning and Policy Commission should also amend the 1995 Central Pine Barrens Comprehensive Land Use Plan as a result of this legislative amendment.

Restrictions On Land Use: New York State Wild, Scenic And Recreational Rivers Act

As previously discussed, the Carmans River was officially added to the New York State Wild, Scenic, and Recreational Rivers (WSRR) system in 1977 by the New York State Department of Environmental Conservation Commissioner's Decision and Order and was added by law into the system in 1982 when the New York State Legislature passed Article 15, Title 27 of the Environmental Conservation Law (Wild, Scenic and Recreational Rivers System). Wild, scenic and recreational rivers are regulated under 6 NYCRR Part 666.

The entire length of the Carmans River is in the WSRR, with sections of the river designated as either "Scenic" or "Recreational" (Figure 25) with greater restrictions applying to the "Scenic" designation (New York State Department of Environmental Conservation 2011a).

Scenic River Segments:

1. From the headwaters just south of the Longwood Library to approximately two and one-quarter miles south where Cathedral Pines Suffolk County Park (formerly Camp Wilderness), intersects the southern boundary of Camp Sobaco (Girl Scout Camp);
2. Approximately two and one-half miles from Yaphank Avenue, Yaphank, southerly to the concrete wing dam in Southaven County Park; and
3. Approximately two and one-half miles from the south side of Sunrise Highway, Suffolk County, southerly to the mouth of the river (a line between Long Point and Sandy Point) at its confluence with Bellport Bay.

Scenic River Restrictions:

1. New single and two family residential structures may be built on lots four acres or larger. New lots that border the river must have a minimum of 300 feet of river frontage. These restrictions do not apply to those lots that

are single and separate.

2. New primary structures must be set back 250 feet from the river bank or beyond the limit of the 100 year flood plain, whichever is greater.
3. Multifamily structures, commercial structures, and industrial uses are not permitted.

Recreational River Segments

1. Approximately two miles from its intersection with the southern boundary of Camp Sobaco (Girl Scout Camp), southerly to Yaphank Avenue Yaphank; and
2. Approximately one mile southerly from the concrete wing dam in Southaven County Park, Yaphank, to Sunrise Highway.

Recreation River Restrictions

1. New single and two family residential structures may be built on lots 2 acres or larger. New lots that border the river must have a minimum of 200 feet of river frontage. These requirements do not apply to those lots that are single and separate.
2. New primary structures must be setback 150 feet from the river bank or beyond the limit of the 100 year floodplain, whichever is greater.
3. Multifamily structures may not exceed one living unit per acre.
4. Commercial uses are limited to retail or those uses directly associated with the river are also limited to 10,000 sq.ft. of floor space or less and must be sited in those areas where there is sufficient transportation access. Industrial uses are also limited to light manufacturing or warehousing and compatible with existing uses on adjacent and nearby sites.

Others Restrictions On Land Use:

Other significant regulations which affect and may restrict land use include New York State Pollution Discharge Elimination System (SPDES), SCDHS Article 6 requirements and NYSDEC ECL Article 11 statute and regulations regarding endangered, threatened and special concern species.

Land Use And Groundwater And Surface Water Quality

While land use can contribute a wide range of contaminants to groundwater and surface water, it was determined that nitrogen, and in particular nitrate, was of the greatest concern to the ecological and environmental quality of the Carmans River. Increased nitrate can cause eutrophication and changes in aquatic community structure. In addition, elevated nitrate concentrations in the Great South Bay, into which the Carmans River discharges, are a major threat to that ecosystem as well. Of all the nitrate sources to groundwater and surface water from land use, on-site sanitary systems associated with residential development are the greatest contributor.

The nitrate concentrations in groundwater down gradient of various land uses have been reported by Dvirka and Bartilucci (1987) and are given in Table 23.

Table 23. Nitrate concentrations in groundwater down gradient of specified land uses as reported by Dvirka and Bartilucci (1987).

<u>Land use</u>	<u>average nitrate (mg/L)</u>	<u>range</u>
Low density residential	3.35	2.97 - 3.70
Medium density residential	5.82	4.40 - 7.94
High density residential	2.60	0.34 - 8.03
Commercial	1.74	0.08 - 4.05
Industrial	4.25	1.14 - 6.99
Institutional	8.20	7.87 - 8.53
Recreational/open space	3.91	2.40 - 6.07
Agricultural	7.83	5.62 - 10.00
Vacant	1.15	1.00 - 1.30
Transportation	2.39	0.59 - 4.54

In order to estimate the nitrate loading from different land uses, it is necessary to know the effluent nitrate concentration and the flow rate (concentration times the flow rate equals the loading). To model simulated nitrogen loading for non-residential land uses in the Montauk Highway Corridor in the Forge River watershed, CDM (2008) developed non-residential loading factors for several land uses (Table 24); these factors are believed to be applicable to the Management Plan as the Forge River watershed is adjacent to the east side of the Study Area. The sanitary effluent flow rates for different uses and structures as determined by the Suffolk County Department of Health Services (2009) are given in Table 25.

Table 24. Sanitary effluent flow rates and nitrate concentrations for non-residentially used land (CDM, 2008).

<u><i>Land use</i></u>	<u><i>flow rate</i></u>	<u><i>nitrate concentration (mg/l)</i></u>
Commercial	0.07	3.38
Industrial	0.04	4.25
Institutional	0.06	1.02
Recreational/open space	0.04	1.15
Agricultural	0.04	7.83
Vacant	0.04	1.15
Transportation	0.04	2.39
Utilities	0.04	1.02

Table 25. Suffolk County Department of Health Services (2009) design flow rates.

<u>Structure/use</u>	<u>design flow rate</u>
Single family residence	300 gpd
Apartment/condo <600 sf	150 gpd/unit
Apartment/condo 601-1,200 sf	225 gpd/unit
Apartment/condo >1,200 sf	300 gpd/unit
General industrial	0.04 gpd/sf (gross floor area)
Non medical office space	0.06 gpd/sf (gross floor area)
Medical arts space	0.10 gpd/sf (gross floor area)
Theater	3 gpd/seat
Wet store	0.15 gpd/sf (gross floor area)
Dry store	0.03 gpd/sf (gross floor area)
Wet store (no food)	0.10 gpd/sf (gross floor area)
Restaurant (with sewers)	30 gpd/seat
"sf" is square feet	
"gpd" is gallons per day	

Predicting And Measuring Nitrate Concentrations

For point sources of nitrogen, such as sewage treatment plants, the nitrogen entering groundwater can be measured at the point of discharge. However, for non-point sources, such as on-site sanitary systems and fertilization, measuring nitrogen levels in their effluent is not possible. Consequently for residential development which generates significant non-point nitrogen, the approach has been to model the nitrogen concentration at the boundary of a property using a mass balance model such as the New Jersey Nitrogen Dilution Model (Hoffman and Cronance, 2004) and the New Jersey Pinelands Commission Septic Dilution Model (New Jersey Pinelands Commission, 2011).

In a mass balance model, the nitrogen concentration at a property boundary is determined by dividing the quantity of nitrogen by the volume of effective groundwater recharge and reporting the results in milligrams per liter (mg/l). The mass balance concept assumes that nitrogen is diluted by

precipitation minus evaporation plus overland flow, which is computed for each of the types of land coverage on a parcel to account for changes in the quantity of evapotranspiration to give the effective recharge. The quantity of nitrogen produced on the parcel is diluted by the volume of effective recharge to compute a concentration in milligrams per liter.

Residential Sanitary Systems And Nitrate Concentrations

Before 1973, the standard “conventional” residential sanitary system in Suffolk County consisted of leaching pools which received wastewater directly from the home. After 1973, the Suffolk County Health Department modified the standard conventional residential sanitary system to include a septic tank before the wastewater entered the leaching pools in order to remove and treat solids. In the septic tank, anaerobic conditions enable bacteria to convert the organic forms of nitrogen into ammonium which can be converted into nitrogen gas. It is estimated that 10 to 50 percent of the nitrogen can be removed before the effluent reaches groundwater. Based on an analysis of land uses by CDM, it is estimated that there are 7,492 residential lots with 7,996 dwelling units and an estimated population of approximately 25,253 that rely on residential leaching pools or septic tanks with leaching pools in the Study Area. In addition, there are 325 non-residential lots which contain private sanitary systems consisting of either leaching pools or septic tanks with leaching pools.

Nitrogen is a major component of sanitary wastewater and can be as high as 60 mg/l in septic tank effluent (University of Florida IFAS Extension, 2011). It is estimated that the average family of four can produce 40 to 60 pounds (18 to 27 kilograms) of nitrogen per year (Minnesota Department of Agriculture, 2011) and that one person typically discharges 11.2 grams of nitrogen per day. Based on these values, a single family residence in the Study Area with an average of 2.95 persons pre dwelling generates approximately 12 kilograms of nitrogen per year. Of the total nitrogen load, 78 percent comes from toilets, 17 percent from baths, sinks and appliances and 5 percent from kitchen sinks (US

Environmental Protection Agency, 1992).

As part of the Suffolk County Comprehensive Water Resources Management Plan, a modeling assessment of the impacts of hypothetical unsewered areas of various densities on nitrogen levels in groundwater was performed (CDM, 2008). The purpose of this modeling assessment was to evaluate the potential effects of nitrogen loading resulting from various uniform residential densities on groundwater nitrate concentrations. The model assigned nitrogen loadings per household on the following assumptions and changes in the assumptions were found to influence the nitrogen loading:

- 2.95 persons per household
- 10 pounds (4.5 kilograms) nitrogen per person, per year
- 35 percent of the nitrogen load is removed within the septic system

The simulated groundwater nitrogen levels in unsewered areas increased along with housing density increases:

- One unit per quarter acre has an increased risk of 10 mg/l nitrate in shallow groundwater.
- One unit on less than 1 acre (but more than one quarter acre) is likely to exceed 6 mg/l nitrate in shallow groundwater.
- One unit per 1 to 2 acres will have less than 4 mg/l nitrate in shallow groundwater.
- One unit per 2 acres will have less than 2.5 mg/l nitrate in shallow groundwater.

Residential Fertilization

Residential fertilization can be a significant source of nitrate to groundwater. It is estimated that 2.5 pounds (1.1 kilograms) of nitrogen is applied to each 1,000 square feet of lawn and that 23 percent of a typical residential parcel is fertilized (CDM, 2011c); of this amount, it is estimated that 20 percent of the nitrogen reaches groundwater.

Sewage Treatment Plants (STPs)

As set forth in New York State Pollution Discharge Elimination System (SPDES) permits for the wastewater discharged to groundwater by sewage treatment plants (STPs), the nitrate concentration in the effluent cannot currently exceed 10 mg/l. Some SPDES permits for plants discharging to surface waters have much lower limits established for nitrates.

An inventory of the Study Area identified ten multifamily housing developments that use sewage treatment plants (STPs) to treat their wastewater (Table 26). Strathmore Ridge's wastewater is piped to the Whispering Pines STP which is located in the Study Area and Atlantic Point Apartment's wastewater is disposed of at Suffolk County Sewer District #7 which is located outside of the watershed. There is one Suffolk County facility in the watershed that has its own STP (the Yaphank County Facility) and while part of the Brookhaven National Laboratory property is within the Study Area, the STP is located outside of the watershed area. A total of 3,072 dwelling units in the watershed are connected to a sewage treatment plant and these units have a total estimated population of 7,397 people.

Table 26. Developments in the Study Area that use STPs for wastewater disposal; it is assumed that all MF developments that are on the boundary of the Study Area are located fully within the Study Area.

Development Name	Dwelling Units ¹	Per DU Population Factor	Estimated Population ²	Existing STP Flow (MGD) ³	Permitted Flow (MGD)
Hidden Meadows Cooperative	142	2.25	320	0.011-0.031 Avg. 0.018	0.150
Coventry Manor Condominium	267	2.25	601	0.037-0.045 Avg. 0.041	0.070
Artist Lake Fairview & Artist Lake Condo.	692	2.25	1,557	0.088 – 0.095 Avg. 0.092	0.097
Lake Pointe Apartments	180	2.79	503	0.030 – 0.143 Avg. 0.086	0.177
Whispering Pines Condominium	244	2.25	549	0.120-0.150 Avg. 0.130	0.105
Strathmore on the Green Condominium	273	2.25	615	0.0445-0.0764 Avg. 0.0610	0.062
Chelmsford Weald Condominium	36	2.25	81	0.026-0.029 Avg. 0.027	0.036
Mill Pond Estates Senior Citizen-Owned	289	2.25	651	No data; new system	0.050
Atlantic Point Apartments ⁴	711	2.79	1,984	Pump Station	N/A (Flow to STP outside study area)
Strathmore Ridge	238	2.25	536	Pump Station	N/A flow sent to Whispering Pines STP
TOTAL	3,072	N/A	7,397	N/A	0.747
Suffolk County Yaphank Facility	N/A	N/A	N/A	0.084-0.109 Avg. 0.093	0.250
TOTAL PERMITTED	N/A	N/A	N/A	N/A	0.997

1-Number of dwelling units from Suffolk County Planning Department Multifamily Housing Inventory

2-Population estimates based on Rutgers Demographic Multipliers for New York (2006). Average for condominiums 5+ units, 1-3 bedrooms, owner occupied, all values is 2.25. Average for 5+ units, rental, 1-3 bedrooms, all values is 2.79

3-Sewer flow and capacity data from Suffolk County Department of Public Works

4-Sewage is pumped to Sewer District # 7 which is located outside of the Study Area

Nitrate Concentration In A Development Of Regional Significance (DRS)

In the Pine Barrens Compatible Growth Area, projects that meet the following criteria are designated as Developments of Regional Significance (Central Pine Barrens Joint Planning and Policy Commission, 1996). These criteria are:

1. A commercial, industrial or office development project exceeding 300,000 square feet of gross floor area, or an addition to an existing commercial, industrial or office development where the addition is 100,000 square feet or more and that addition causes the total square footage to exceed 300,000 square feet.
2. A multifamily residential development project consisting of three hundred (300) or more units.
3. A single family, detached residential development project consisting of two hundred (200) or more units.
4. A development project resulting in a traffic impact which would reduce service by two (2) levels below existing conditions or to a level of service of D or below.

Development projects which meet all of the following three criteria are not considered to be Developments of Regional Significance:

1. The development project is situated within a designated receiving district; and
2. The development project results from a transfer of development rights from a sending area (the Core Preservation Area); and
3. The development project contains a minimum of fifteen percent (15%) of residential units, or a minimum of fifteen percent (15%) of commercial, industrial or office use square footage, which is a direct result of the transfer of development rights.

Farmland

There are over twenty farms within the Study Area that are designated Agricultural Lands in Suffolk County's Agricultural District (Figure 26). These lands total approximately 1,000 acres (Table 27). The largest of these is the 308 acre Suffolk County Farm and the largest privately owned parcel is the 208 acre sod farm owned by Green Meadows, LLC located on the west side of Wading River Hollow Road in Middle Island. In addition, two large privately owned farms are located just off of the Carmans River in Middle Island; one farm is 102 acres in the southeast corridor of Yaphank-Middle Island Road and Longwood Road and the other is a 46 acre farm in the southwest corridor of Yaphank-Middle Island Road and East Bartlett Road.

Table 27. Agricultural Lands in the Carmans River Study Area.

Suffolk Map #	County	Tax	Property Owner	Acreage	Purchased
					Development Rights
0200 66500 0100 001000			SUFFOLK COUNTY	308.0000	No (Already Publicly Owned)
0200 70300 0100 039002			LIERE ROBERT & LORRAINE & JOHN	2.2800	No
0200 43400 0200 006003			GREEN MEADOWS LLC	204.9400	Yes
0200 50100 0100 002002			BORELLA WILLIAM L JR	52.9300	Yes
0200 61300 0100 015002			WUBKER GLENN R	4.9500	No
0200 61300 0100 011000			YAPHANK HOLDING CORP	10.0000	No
0200 61300 0100 015001			WUBKER HELGA R	16.7100	No
0200 50100 0100 002001			BORELLA WILLIAM L JR	48.7500	Yes
0200 50400 0100 001003			SIPALA RICHARD	58.2700	Yes
0200 84900 0300 010003			BUSH H RONALD	1.3000	No
0200 97420 0200 010004			RED BARN FARM LLC	12.3000	No
0200 66500 0100 002000			SUFFOLK COUNTY	22.2000	No (Already Publicly Owned)
0200 84900 0300 008000			BUSH H RONALD	1.3900	No
0200 50000 0100 001003			THE JOHN SZUSTER RVCBL TRUST	46.0400	No
0200 84700 0300 030002			GLOVER KENNETH G	1.9700	No
0200 97630 0100 018001			RED BARN FARM LLC	1.6600	No
0200 84800 0200 005000			SUTHERLAND DONALD & MELISSA	1.0000	No
0200 70600 0100 004000			SCHMITT FERDINAND H JR &	50.5500	No
0200 84800 0200 006000			SUTHERLAND DONALD & MELISSA	2.2500	No
0200 61300 0100 010000			LIERE HOLDING INC	4.9800	No
0200 57800 0300 001001			SM RODGERS INC	28.0200	Yes
0200 66200 0200 001001			LIERE ROBERT & LORRAINE & JOHN	28.0000	No
0200 66200 0200 001003			LIERE ROBERT & LORRAINE & JOHN	45.1400	No
0200 70300 0100 025001			LIERE ROBERT & LORRAINE & JOHN	10.7500	No
0200 97630 0100 018002			PULESTON CEDRIC & VIRGINIA MATZEK	0.9200	No
2000 84700 0300 030004			GLOVER KENNETH G	35.0000	Yes
Total Parcels				Total Acreage	
26				1000.3000	

Agriculture is known to contribute nitrate/nitrogen to groundwater. According to CDM (2011c), different types of agriculture contribute different amounts of nitrate to groundwater; for example, fertilization of row crops can result in groundwater nitrate concentrations that are well in excess of 10 mg/l,

while nitrate concentrations in groundwater down gradient of vineyards are closer to 5 mg/l. Row crop agriculture contributes more than twice the nitrogen concentration to groundwater compared to vineyards and unsewered residential development at two dwelling units per acre and more than three times the average nitrogen concentrations observed at golf courses and unsewered residential development at one dwelling unit per acre.

Golf Courses

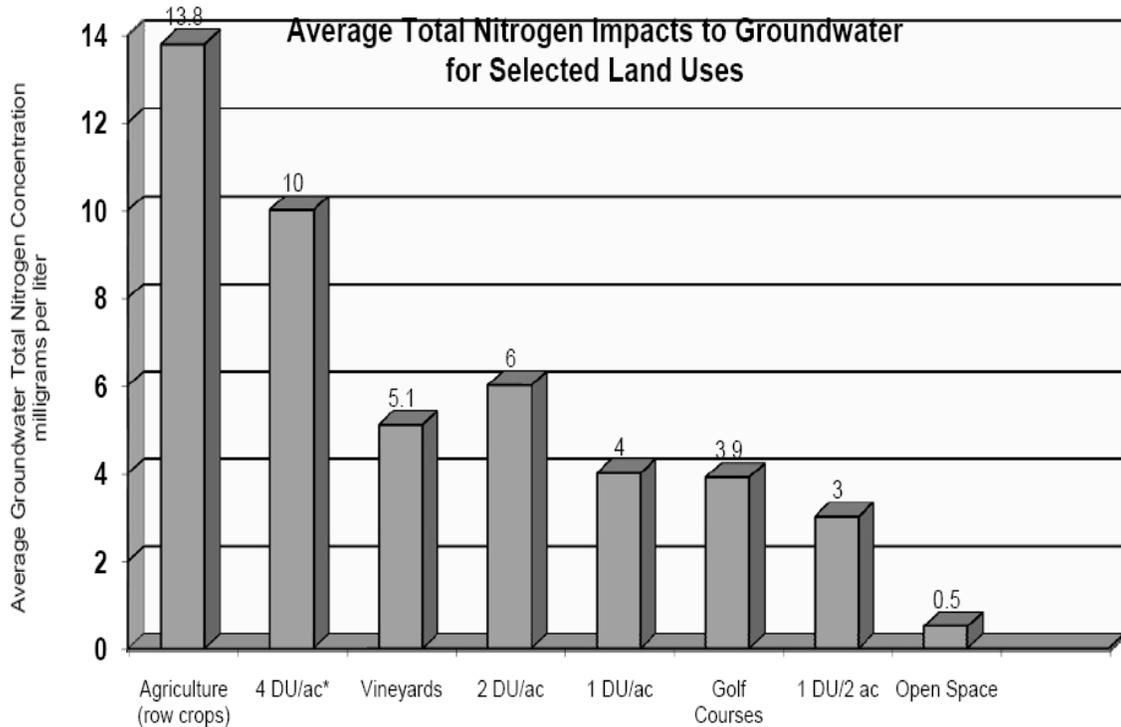
Golf courses are known contributors of nitrogen to both the groundwater and surface watersheds due to their use of fertilizers on the expansive areas of turf. There are three golf courses in the Study Area totaling approximately 500 acres: Spring Lake (187 acres), Middle Island Country Club (187 acres) and Mill Pond (124 acres). Nitrogen levels in groundwater in golf courses were estimated at a concentration of 3.58 mg/l; best management practices were estimated to be able to reduce the concentration in groundwater by 25 percent to 2.69 mg/l, or if aggressively managed in the watersheds of the impaired waters, by 50 percent (Peconic Estuary Program, 2007).

Summary Of Land Use And Nitrogen

A comparative nitrogen impact to groundwater from various land uses is summarized in Table 28 (CDM, 2011c). It should be noted that:

1. The groundwater nitrogen concentration is the result of the mixing of the various sources which results in dilution, and;
2. The groundwater nitrogen will undergo poorly understood transformations as it seeps through the river bed of the Carmans River such that the concentration in the Carmans River is less than that in groundwater.

Table 28. Average total nitrogen impacts to groundwater from selected land uses (CDM, 2011c).



There are a variety of strategies that can be used to reduce the impact of land use on groundwater quality by either changing the type of development or reducing the intensity of development including:

1. Designate properties to be added to the Core Preservation Area of the Pine Barrens: properties in the Core Preservation Area cannot be developed and private property owners can obtain Pine Barrens Credits which can be sold and used to increase the intensity or density of development of other properties outside of the Management Plan Area.
2. Acquisition: a government agency or not-for-profit organization can purchase a property or acquire its development rights to prevent future development.
3. Up-zoning property: reduce the intensity of development, for

example, by rezoning from one dwelling unit per acre to one dwelling unit per five acres.

4. Cluster Development: concentrating the development (smaller lot sizes than permitted by zoning) on a portion of a property. Although clustering does not reduce the density of development permitted by zoning, it does enable a portion of the property to remain in its natural state which reduces the total nitrogen loading.

LIVING RESOURCES OF THE CARMANS RIVER MANAGEMENT PLAN

Ecological Communities

The ecological communities in the Carmans River Management Plan can be assigned to one of three broad categories: aquatic (freshwater), marine (salt water), and terrestrial (upland). Each of these categories can be subdivided into specific communities based on the assemblage of species and the physical environment. Communities observed in the Carmans River watershed that have been identified by the Town based on the descriptions provided by Edinger et. al. (2002) include the following:

- Coastal plain pond: A shallow pond fed by groundwater, this community type occurs on the outwash plain of Long Island's south shore and is represented by kettle holes or shallow depressions. The water level varies seasonally and annually, depending on the underlying groundwater table. This results in a variety of plant species being present at any one time. Coastal plain ponds are an important habitat for flora species such as rushes, bladderworts and pickerel weed as well as animals including the New York State endangered tiger salamander.
- Coastal plain-pond shore: The shoreline of a coastal plain pond, this community type changes seasonally depending on water levels. The

substrate varies between areas of sand, muck or gravel and can feature a heavily vegetated cover consisting of sedges, rushes and herbs. During wet years, these plants are scarce or not present and may be replaced by floating leaved aquatics. This community can be divided into four distinct zones. These zones are determined by their vegetative cover and location in proximity to the actual pond.

- Pitch pine-oak-heath woodlands: Exclusive to Long Island's sandy soils, this type of eco-system is dominated by pitch pines and various species of oak trees, with white oak being the dominant species of oak. A shrub layer beneath the canopy consists mostly of scrub oak, but may also contain huckleberry and blueberry shrubs among others. There is an inverse relationship between the shrub layer and the canopy, so in areas with a dense canopy the shrub layer is sparse and vice versa.
- Red maple hardwood swamp: Found in areas of poorly drained inorganic soils, these swamps consist predominantly of red maples, but occasionally contain other species such as swamp white oak. A shrub layer is often well defined and includes species such as spice bush, highbush blueberry, and swamp azalea. These swamps are good habitat for a variety of fauna species including river otters, spring peepers and wood ducks.
- Red maple-black gum swamp: A coastal or maritime forest, these swamps feature red maples and black gum trees (also known as black tupelos) in poorly drained soils near streams or coastal plains. A well defined shrub layer is present beneath the canopy and features sweet pepperbush and fetterbush, among other species. While there is an herbaceous layer, it is typically low in diversity, with skunk cabbage and cinnamon fern being main components.
- Pine plantation: A large stand of pines which has been planted for the purpose of cultivation, soil erosion prevention, habitat enhancement, to act as a windbreak or for general landscaping purposes. These plantations are typically dominated by one species, but can be mixed. Within the

Management Plan Area, the most distinct example is Cathedral Pines County Park.

- Pine Barrens shrub swamp: A freshwater wetland dominated by shrubs located in shallow ponds or in the coastal plain. These communities are usually transitions between uplands and the coastal plain pond shoreline. Shrubs that are found in this community include inkberry, highbush blueberry, leatherleaf, and sheep laurel.
- High salt marsh: A marsh located along sheltered areas of the coast, high salt marshes are only inundated during spring tides and flood tides, especially during tropical storms or nor'easters. The high saltmarsh is distinguished by vegetation, which includes salt-meadow grass, black-grass and bladderworts. Seaside lavender and seaside gerardia are also two species of flowers found in these high marshes.
- Low salt marsh: Found along sheltered areas of the coast, the low salt marsh is defined by its location, between mean high tide and mean sea level. Vegetation is almost exclusively saltmarsh cordgrass, but glasswort and some species of seaweeds may be present. Animal species that are typically found include ribbed mussels, clapper rails, willets and saltmarsh sparrows.
- Lake: A body of water whose water chemistry and shape has not been altered to a great extent by man. Lakes consist of both native and non-native species of plant and animal, although introduced species are typically not dominant. Depending on a variety of factors (including depth, winds, substrate and size) lakes can be further categorized into their specific community types.
- Stream: Areas of flowing water where the water chemistry and general shape has not been significantly altered by man and/or where native plants and animals are dominant. While some introduced species may occur (like fish that have been stocked) the vast majority of species are native. There are some streams located in the upper reaches of the

Management Plan Area in the Cathedral Pines County Park area.

- Tidal River: A continuously flooded area that does not contain emergent vegetation. There are two distinct zones in tidal rivers: deepwater zones and shallow zones. Deepwater zones contain at least six feet of water at low tide, and shallow zones have less than six feet of depth at low tide. Since there is no emergent vegetation within tidal rivers, they are partially defined by the species of fish which are found. These species include the banded killifish, American shad and alewives. The lower portion of the Carmans River is considered a tidal river.
- Freshwater wetlands: Non-tidal, perennial wetlands comprised of freshwater aquatic vegetation which are permanently saturated via seepage, or which are seasonally or intermittently flooded. The underlying soils are hydric and the vegetative cover can be thin or sparse depending on a variety of factors.
- Estuarine: Areas of deepwater tidal habitats and tidal wetlands that have partial obstructions or sporadic access to both open ocean and tidal fresh waters. The ocean water is readily diluted by freshwater seeps or streams and salinity remains below 30.0 parts per thousand (ppt). The limits are from the upstream limits of tidal influence to the mouth of the bay or river. The majority of Wertheim National Wildlife Refuge falls in this category.
- Along with other species not specifically identified herein.

All ecological communities in New York are ranked based on their local and global population status by the New York Natural Heritage Program (New York Natural Heritage Program, 2011). The ranking system provides a means to assess threats to the survival of each community type. The heritage rankings refer to the rarity of the element occurrence, with a “G” prefix representing the global status of the element and the “S” prefix representing its status in New York State:

G1: Critically imperiled globally because of extreme rarity (5 or fewer

occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.

G2: Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.

G3: Either rare or local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.

G4: Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH: Historically known, with the expectation that it might be rediscovered.

GX: Species believed to be extinct.

S1: Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2: Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3: Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.

S4: Apparently secure in New York State.

S5: Demonstrably secure in New York State.

SH: Historically known from New York State, but not seen in the past 15 years.

SX: Apparently extirpated from New York State.

SZ: Present in New York State only as a transient migrant.

New York State also ranks the status of at risk individual species in New York pursuant to Environmental Conservation Law 11-0535 (State Endangered Species Act). As set forth in 6 NYCRR Part 182 (New York State Department of Environmental Conservation 2011e), at risk species are ranked as:

- Extinct: no longer living
- Extirpated: not extinct but no longer occurring within New York State
- Endangered: any native species in imminent danger of extirpation or extinction in New York State
- Threatened: any native species likely to become an endangered species within the foreseeable future in New York State
- Special Concern: any native species for which a welfare concern or risk of endangerment has been documented in New York State

Aquatic Resources

The dominant woodland community in areas of shallow groundwater is the red maple-black tupelo forest. This forest often contains a well-developed tree canopy, below which a number of wetland adapted shrubs and herbaceous plants grow, including swamp azalea, buttonbush, fetterbush and sweet pepperbush, skunk cabbage, tussock sedge, and cinnamon fern.

As land contours drop near the river, the soils become increasingly saturated with water. A variety of emergent plants grow along the edges of the river forming, in some cases, extensive lateral herbaceous wetlands that through time fill significant portions of the river channel. Representative species of these freshwater communities include swamp loosestrife or water willow, cardinal flower, several species of sedge including bur-reed (whose seeds are valued by waterfowl), nutrushes, spikerushes, rushes, and two species of cattail.

From the dam at Hards Lake north to the headwaters of the river are flowing water and lake communities as well as freshwater wetlands. The streams are considered coastal plain streams, an aquatic community of slow-

moving, often darkly-stained streams of the coastal plain of Long Island. Often, there is abundant submerged vegetation including species of pondweeds, waterweeds, stonewort, bladderwort, duckweed, and white water lily, in this community type.

Along with the presence of native aquatic vegetation, there is a significant abundance of aquatic invasive species, specifically fanwort (*Cabomba caroliniana*) and variable watermilfoil (*Myriophyllum heterophyllum*), which are found in Upper and Lower Lake. Optimum conditions for these invasive species include slow moving, variably acidic waters, high nutrient concentration and depths up to 10 feet, making the lakes an optimal place for their growth and survival.

The shoreline of the river, ponds, and the lakes within the Study Area are characterized as emergent wetlands. An emergent wetland is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. Normally, this vegetation is present for most of the growing season and these wetlands are usually dominated by perennial plants. Persistent emergent wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season and the Carmans River is an example of this community type. The persistent emergent tidal wetlands within the Carmans River are dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), and needlerush (*Juncus roemerianus*), as well as several species of rushes and sedges.

Freshwater swamp forests exist further inland of the surface waters. Freshwater swamp forest habitat is typically found on the low lying coastal plains and associated with river and stream systems. Freshwater swamp forests come about when level, low lying land close to the coast becomes inundated due to such conditions as: rainfall, road runoff, installation of roadways at low lying areas, water inflow from surrounding elevated terrain, or tidal effects restricting the outflow of water from streams. In swamp forests, the water table is typically very close to the surface and the ground is saturated, with the soils being hydric

in nature.

Red maple (*Acer rubrum*) is abundant in the Study Area's red maple swamp habitat. Red maple is tolerant of various site conditions, and red maple swamps occur in various hydrogeological settings. Red maple is a moderately flood-tolerant tree that is most common on sites that are intermediate in wetness, between permanent flooding and temporary or intermittent flooding. The red maple's ability to persist under these adverse conditions when compared with other wetland tree species lies in its ability to produce a heavy seed crop nearly every spring, its rapid seed germination, and its ability to vigorously sprout from stumps and damaged seedlings on a variety of disturbed sites. Water levels in red maple swamps are highly dynamic and typically vary between seasons. The distribution of plant species in a swamp is influenced by how long the soil remains saturated. Red maple trees are predominant in swamps where soils are saturated or flooded from late fall through early summer in most years.

Buttonbush (*Cephalanthus occidentalis*) swamps, which are also found within the Study Area, form in ponds where standing water is present for most or all of the growing season. The persistence of standing water throughout the growing season limits shrub and grass diversity. While these swamps are usually flooded, exposed soil is periodically required for buttonbush regeneration. Buttonbush (*Cephalanthus occidentalis*) typically dominates with a moderate to dense cover, and other species located in this community type include red maple (*Acer rubrum*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea, speckled alder (*Alnus incana*), winterberry (*Ilex verticillata*), and swamp rose (*Rosa palustris*). Floating or submerged aquatic species such as lesser duckweed (*Lemna minor*), broadleaf pondweed (*Stuckenia striata*) and white waterlily (*Nymphaea odorata* ssp. *Odorata*) may be present with mosses and lichens often found clinging to tree and shrub bases.

The freshwater section of the Carmans River supports a fairly diverse assemblage of fish including brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), yellow perch (*Perca*

flavescens), carp (*Cyprinus carpio*), American eels (*Anguilla rostrata*), and alewives. Pirate perch (*Aphredoderus sayanus*), which are unusual to Long Island watersheds, are abundant. According to the State of New York Conservation Department (1939), the Carmans River in the 1930s was “probably the best of Long Island’s trout streams,” and during the cooler months, the New York State Department of Environmental Conservation stocks brown and rainbow trout in Upper and Lower Lakes. According to Nelson, Pope & Voorhis (2011), Upper and Lower Lakes support a mix of warm water fish species including largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), pumpkinseed sunfish (*Lepomis gibbosus*), black crappie (*Pomoxis nigromaculatus*) (Upper Lake only) brown bullhead (*Ameiurus nebulosus*), brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*).

In 2010 and 2011, the New York State Department of Environmental Conservation stocked portions of the Carmans River, Upper Lake, Lower Lake and Hards Lake with Brown Trout and Rainbow Trout (New York State Department of Environmental Conservation, 2011). Nearly 10,000 trout were stocked in these areas in both 2010 and 2011, with the highest concentration being rainbow trout (*Oncorhynchus mykiss*) yearlings (which accounted for nearly half the total). Stocking of the River and associated lakes took place in March, April, May, October and November and included both yearling and 2 year old fish.

In 2008, NYSDEC sampled five ripple areas on the Carmans River between Yaphank and Southaven (New York State Department of Environmental Conservation, 2010). The NYSDEC used a traveling kick sample to characterize water quality based on the benthic macroinvertebrate communities. Resident communities at all sites were dominated by scud, sowbugs or flatworms. The Biological Assessment Profile (BAP) scores indicated that conditions ranged from slightly to moderately impacted, which was probably due to the low gradient habitat of the river, its warm-water character, and the large amount of aquatic

vegetation present at all sites. The Nutrient Biotic Index suggested eutrophic conditions from excess phosphorous and nitrogen at all stations except the one located in the headwater sections at East Bartlett Road, Yaphank; however, the excess nutrient loads could be the natural state of the river given its high volume of aquatic vegetation, low gradient habitat and warm-water.

The NYSDEC collected over 50 macroinvertebrate species in the Carmans River, which was dominated by Diptera (fly larvae). Species richness ranged from a low of 12 under the County Road 80 bridge, South Haven station, to a high of 19 thirty meters south of the railroad bridge in Yaphank.

In 1989, water quality at the Yaphank station was assessed and determined to be impacted based on macroinvertebrate sampling (New York State Department of Environmental Conservation, 2010). However, the site was assessed as non-impacted in 1994, 1998, and 1999; the change was apparently a result of a change in criteria, with the 1994 and later criteria being more realistic.

Barriers To Fish Migration

Many fish species require access to both fresh and salt water habitats during different phases of their life history. In the Carmans River, alewives (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) (both commonly referred to simply as herring), brook trout (*Salvelinus fontinalis*), and the American eel (*Anguilla rostrata*) are important species that require access to both fresh and salt water to thrive. Barriers to fish migration have been constructed at several locations along the Carmans River. Nelson, Pope & Voorhis (2008) documented nine barriers that block or inhibit fish passage on the Carmans River, as described below.

Big Fish Creek Dam

Big Fish Creek is a tributary on the eastern side of the Carmans River, 1,500 feet from the mouth of the river. The dam is located at the head of Big

Fish Creek one-half mile east of the main stem of the Carmans River in the Wertheim National Wildlife Refuge and is owned by the United States Fish and Wildlife Service.

Yaphank Creek Headwaters Railroad Trestle Culvert

This culvert is within Wertheim National Wildlife Refuge and is at the headwaters of Yaphank Creek 2.07 miles upstream from the mouth of the river. The culvert runs underneath the Long Island Railroad. While brook trout have been documented above and below the culvert, the culvert may restrict fish passage.

Hards Lake Dam

Hards Lake dam is located 2.84 miles from the mouth of the river, immediately north of Sunrise Highway. In 2008, an Alaskan steep-pass fish passage was installed by the New York State Department of Transportation to allow fish to pass over the dam. There is evidence that the fish passage is functioning and that fish, including alewives, are making their way upstream above the Hards Lake Dam and it is likely that blue back herring and brook trout are also using the fish passage. American eels are observed to pass this barrier by climbing a portion of the dam's face that remains wet.

C-Gate Dam

A small concrete low-head dam with timber weir boards, C-Gate is located 3.88 miles from the mouth of the river within Southaven County Park. There is evidence that alewives are able to swim up the spillway and continue upstream. The dam shows slight signs of disrepair as evidenced by cracks in the concrete and currently creates a small impoundment upstream. The dam was improved in 2007-2008 when the top-most and center weir boards were removed to improve fish passage, effectively notching the dam by 4 inches. Further minor modifications to the dam structure are possible and warranted to enable greater

passage of fish and wildlife.

United States Geological Survey (USGS) Office Gaging Station

Located 4.73 miles above the mouth of the river in Southaven County Park, a 14 inch concrete weir creates a dam. American eels and brook trout are most likely not impeded by the weir, although river herring are likely to be impeded. The weir was constructed in association with a USGS flow gage and is maintained by the USGS. In 2010, a small school of alewife was found above the USGS gage, indicating that at least some alewife are able to pass the C-Gate Dam and USGS gage.

Lower Lake Dam

A 12 foot high earthen dam at the south end of Lower Lake that created Lower Lake was originally constructed in 1762 as a mill dam and was reconstructed in 1940. Located 5.24 miles north of the river mouth, County Road 21 runs along the top of the dam. The spillway is a concrete box culvert, 12 feet high and 12 feet wide. Water falls down a vertical drop of 10 feet on to the concrete floor of the culvert, and runs as sheet flow approximately 60 feet beneath the dam and discharges over a 1 foot drop into the river.

Upper Lake Dam

Upper Lake dam is an 8 foot high earthen mill dam located 6 miles north of the mouth of the river that was originally constructed in the 1740s and reconstructed in 1932. The spill consists of vertical concrete walls and a concrete and rock bottom. The water from the lake spills down a series of five vertical drops between one and two feet in height spaced over approximately 15 feet.

County Earthen Dam Adjacent To South End Of Szuster Farm Property.

7.3 miles from the mouth of the river, there exists a County earthen dam adjacent to the south end of the Szuster Farm property. It is a low-head dam and

is located on County owned open space property. It impounds about 1 acre-foot of water (approximately 325,853 US gallons). A 12 inch culvert flows under the dam and appears passable by fish, although it may impede fish because some will not enter dark culverts.

Cathedral Pines County Park Entrance Road Culverts

Located 7.7 miles from the mouth of the river, this is the northernmost fish barrier on the Carmans River and consists of two culverts. The first culvert, round-shaped and constructed of plastic, is in good condition. This culvert does not present a barrier to fish passage. The second culvert is an embedded elliptical culvert constructed of concrete that is 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.

Aquatic Invasive Vegetation

From late spring to early fall, fanwort (*Cabomba caroliniana*) covers almost all of the water surface of Upper Lake, while variable watermilfoil (*Myriophyllum heterophyllum*) forms dense monospecific stands in Lower Lake. The common reed (*Phragmites australis*) is a tall growing emergent reed found throughout the watershed area and is especially concentrated in the southern tidal portion of the river. These species limit recreational opportunities and adversely impact the native flora and fauna.

Both variable watermilfoil and fanwort are native to the southern United States but are considered invasive in much of the northeast. Optimum conditions for fanwort and variable watermilfoil include slow moving waters high in nutrients, warm temperatures, soft bottoms, and shallow depths generally less than 10 feet, making the lakes a hospitable place for their inhabitation. Once these two species were introduced, their rapid growth rate, few herbivores or competitors and ability to spread by fragmentation enabled them to form dense mats.

In 2009, Suffolk County commissioned the consulting firm of Nelson, Pope

& Voorhis to prepare a feasibility study to eradicate the aquatic invasive species in Upper and Lower Lakes and Canaan Lake in North Patchogue. In April 2011, *Feasibility Study to Eradicate Aquatic Invasive/Nuisance Species in Canaan Lake, North Patchogue and Upper and Lower Lakes, Yaphank* was released by Suffolk County (Nelson, Pope & Voorhis, 2011). In Upper Lake, the study recommended treating the lake with the herbicide SONAR® and then dredging the accumulated soft-sediments (muck layer) to expose the original sand/gravel bottom of the lake to remove any remaining vegetation and to discourage re-establishment of the vegetation (it was subsequently decided to dredge first and then apply the herbicide). In Lower Lake, it was recommended that the muck be removed.

Marine Resources

The mouth of the Carmans River encompasses 26 acres of submerged rooted aquatic vegetation beds. These beds are dominated primarily by eelgrass (*Zostera marina*), with some wigeon grass (*Ruppia maritima*) (New York State Department of State, 2011). These submerged aquatic vegetation beds provide spawning and foraging habitat, as well as protection for many species of mollusks, crustaceans and juvenile fish. The distribution and abundance of benthic species in these communities is likely controlled by a number of factors that include eelgrass density, water temperature and salinity, sediment type, predation, food supply, and human harvest.

The Carmans River is considered a tidal ecosystem from the mouth of the river to just north of Sunrise Highway at the Hards Lake dam. The areas of the River between the low and high water marks are considered tidal marshes. A tidal marsh is a community of emergent grasses or low shrubs rooted in soils that are alternately inundated and drained by tidal action. They are found mostly at higher tidal levels in areas of protected water in association with estuaries, such as Bellport Bay. Due to the tidal cycles in the River, there are constant fluctuations of salinity, temperature, and nutrients. As such, the vegetation in

these tidal marshes consists of hardy, salt tolerant plant species. The tidal marsh vegetation within the Carmans River consists mostly of salt marsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*) and the common reed (*Phragmites australis*).

Filter feeders, such as the bivalve mollusks occurring at the mouth of the Carmans River, filter nutrients from the water column for nourishment and therefore are especially susceptible to exposure to pathogenic bacteria that may inhabit the water column or bottom sediment of water bodies. For example, high levels of coliform bacteria due to increased population levels, land development, stormwater runoff and wildfowl populations, has resulted in year round closure of the mouth of the Carmans River and portions of Bellport Bay to shellfishing.

Terrestrial Resources

Within the Carmans River Study Area, a diverse variety of habitats exist. One of these habitats, found throughout the Study Area, are successional old field communities which are established on previously disturbed land, typically cleared for agriculture or some other purpose. In early stages herbaceous or non-woody plants, such as grasses and numerous wildflower species, dominate old-field communities. In later stages, trees often become established; common species in this regard are eastern red cedar (*Juniperus virginiana*) and black cherry (*Prunus serotina*).

Various forests form a mosaic of community types in upland environments. These range from mixed oak forests, to oak-pine forests to pine-oak forests. They vary in relative proportion of species due to disturbance and soil characteristics. They typically contain a variety of heath species in the understory, including black huckleberry (*Gaylussacia baccata*) and several lowbush blueberry (*Vaccinium angustifolium*) species. Bracken fern (*Pteridium aquilinum*) can form monotypic stands in certain locations within these forests. Successfully propagating white pine populations can be found on county parkland in the northern portion of the Management Plan Area.

Terrestrial Flora

Several hundred species of woody and herbaceous plant species grow throughout the watershed of the Carmans River. Common woody plants include red maple (*Acer rubrum*), black tupelo (*Nyssa sylvatica*), pitch pine (*Pinus rigida*), pitch pine-oak forest, flowering dogwood (*Cornus florida*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), spicebush (*Lindera benzoin*), scarlet (*Quercus coccinea*), white (*Quercus alba*) and black oak (*Quercus velutina*), shadbush (*Amelanchier arborea*), sweet pepperbush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), buttonbush (*Cephalanthus occidentalis*), southern arrowwood (*Viburnum dentatum*), and various heath species including fetterbush (*Lyonia lucida*), highbush blueberry (*Vaccinium corybosum*), successional old fields and black huckleberry (*Gaylussacia baccata*).

There are ten plant species that are ranked by the New York Natural Heritage program (discussed in detail above) in the Study Area:

- Blunt-lobe grape fern (*Bluntlobe grapefern*) (G4,S3S4)
- Button sedge (*Carex bullata*) (G5,S1)
- Two occurrences of Collins' sedge (*Carex collinsii*) (G4S1)
- Featherfoil (*Hottonia inflata*) (G4,S2)
- Few-flowered nutrush (*Scleria pauciflora*)(G5,S4)
- Fibrous bladderwort (*Utricularia striata*) (G4G5,S2)
- Screw-stem (*Bartonia paniculata* ssp. *Panuculata*) (G5,S1)
- Two occurrences of trinerved white boneset (*Eupatorium album* var. *subvenosum*) (G5,S2S3)
- Water pygmyweed (*Crassula aquatica*) (G5,S1)
- Whip nutrush (*Scleria triglomerata*) (G5,S1).

Three natural communities occur within the watershed are ranked by the New York Natural Heritage Program based on their rarity, with a "G" prefix

representing the global status of the element and the "S" prefix representing its status in New York State. The three are:

- coastal plain ponds (ranked G3G4S2)
- red maple-black gum swamp (ranked G3G4S2)
- brackish tidal marsh (ranked G4S3S4)

Other rare plant species found in the Study Area include:

- Rose coreopsis (*Coreopsis rosea*)
- Water pygmyweed (*Crassula aquatica*)
- Little-leaf tick-trefoil (*Desmodium ciliare*)
- Three-ribbed spikerushy (*Eleocharis tricostata*)
- Purple everlasting (*Gamochaeta purpurea*)
- Slender pinweed (*Lechea tenuifolia*)
- Narrow-leafed bush clover (*Lespedeza augustifolia*)
- Velvety bush-clover (*Lespedeza stuevei*)
- Dwarf bulrush (*Lipocarpa micrantha*)
- Clustered bluets (*Oldenlandia uniflora*)
- Carey's smartweed (*Persicaria careyi*)
- Rough hedge-nettle (*Stachys hyssopifolia*)
- Small floating bladderwort (*Utricularia radiata*)

Due to the variety and extent of wetland habitats, more than a dozen fern species occur in the wetter portions of the watershed. Cinnamon (*Osmunda cinnamomea*), Marsh (*Thelypteris palustris*), and Netted Chain Fern (*Woodwardia areolata*) are especially common. Several dozen herbaceous plants occur in the freshwater wetlands that fringe the river's banks. These include bulrush (*Schoenoplectus maritimus*), water-hemlock (*Cicuta douglasii*), cardinal flower (*Lobelia cardinalis*), blue flag iris (*Iris versicolor*), and several species of sedges and rushes and allied plants; many species found in this habitat are important food sources for muskrats and waterfowl that depend,

respectively, upon their tubers and seeds.

Pink lady's-slipper (*Cypripedium acaule*), also known as Indian moccasin, is one of about a half dozen orchid species that are found within the watershed. Two groups of carnivorous plants – sundews and bladderworts are found in wetland habitats along the river. A large population of round-leaved sundew (*Drosera rotundifolia*) occurs in a wetland at the headwaters to Yaphank Creek.

Terrestrial Fauna

Due to the diversity of habitats, there is a large diversity of animals is found within the Study Area. Three animal species occur within the watershed that are ranked by the New York Natural Heritage Program as very rare: barn owl (*Tyto alba*) (ranked G5, S1S2), eastern mud turtle (*Kinosternon subrubrum*) (ranked G5, S1), and eastern tiger salamander (*Ambystoma tigrinum*) (ranked G5, S1S2).

Mammals

Several dozen native mammal species utilize habitats within the Study Area. Wide ranging species such as raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern cottontail rabbits (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus*), white-tailed deer (*Odocoileus virginianus*), woodchuck (*Marmota monax*), and eastern grey squirrel (*Sciurus Carolinensis*) are common in suitable field and forested habitats. Meadow voles (*Microtus pennsylvanicus*), white-footed mice (*Peromyscus leucopus*), both short-tailed (*Blarina brevicauda*) and masked shrews (*Sorex cinereus*) and eastern moles (*Scalopus aquaticus*) are common as well. Pine voles (*Microtus pinetorum*) can also be found, although probably in slightly lesser abundance. The wetlands habitat preferred by the star-nosed mole (*Condylura cristata*) is fairly extensive along the river but no evidence of this species has been found. The meadow jumping mouse (*Zapus hudsonius*) has been observed at Wertheim National Wildlife Refuge and at Robinson Duck Farm County Park.

Southern flying squirrels (*Glaucomys volans*) have been reported from numerous locations along the course of the river. Numerous bat species, both resident and migratory, such as big brown bats (*Eptesicus fuscus*) and little brown Myotis (*Myotis lucifugus*), and red (*Lasiurus borealis*) and hoary bats (*Lasiurus cinereus*) take advantage of the abundant hatch of aquatic insects that occur over the river.

Historically, river otters (*Lontra canadensis*) are believed to have been found within the river; the most recent evidence is one road-kill animal being recorded in the early 1990s on Victory Avenue near where the river flows under the road, adjacent to Southaven County Park. Muskrat (*Ondatra zibethicus*) are numerous, finding the river's wetland environments ideal habitat. Mink (*Neovison vison*), the muskrat's main predator, has also been reported. Long-tailed weasel (*Mustela frenata*) are known to frequent forest habitats within the Study Area, but the status of short-tailed weasels (*Mustela erminea*) in the Study Area is not known; if it does occur it is probably quite rare, given its apparent scarcity throughout Long Island.

Grey (*Urocyon cinereoargenteus*) and red fox (*Vulpes vulpes*) can be found in both field and forested environments throughout the Study Area. Grey fox, the rarer of the two species (once thought to be extirpated from the Island), has been confirmed with two fox dens occurring on properties situated on the west side of the river. The status of both New England cottontail (*Sylvilagus transitionalisa*), a New York State Special Concern Species, and striped skunk (*Mephitis mephitis*) within the Study Area is unclear, although given the skunk's apparent resurgence on the east end of Long Island, it may occur near the river. Non-native mammals including feral cats, Norway and black rats, and house mice also occur.

Birds

Nearly one hundred resident and breeding (migratory) bird species occur in and near the Carmans River and in the terrestrial areas of the Study Area, and

more than a dozen species of waterfowl overwinter in the river, feeding on the abundant stems, seeds, and tubers produced by a large number of sub-emergent and emergent plant species. Species include dabbling ducks, such as American wigeon (*Anas americana*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), and mallard (*Anas platyrhynchos*), and diving ducks, such as ring-necked (*Aythya collaris*), canvasback (*Aythya valisineria*), and bufflehead (*Bucephala albeola*). On an annual basis, surveys are conducted of bird species that breed in New York State with a grid system established for the entire state, resulting individual census blocks to which observed species are referenced; Breeding Bird Atlas census blocks 6652B, 6752A, 66520, 6752C, 6751 A and 6751 C encompasses the majority of the Carmans River.

The main river channel and adjacent tidal marshes provide significant overwintering habitat for the American black duck (*Anas rubripes*), a species that has experienced significant long-term decline. Wood ducks (*Aix sponsa*) find suitable habitat in the upper reaches of the river, where the wooded wetland habitats it prefers are found.

The extensive vegetated freshwater and tidal wetlands situated along the river provide suitable habitat to a number of wading bird species. Both egret species – Great (*Ardea alba*) and snowy (*Egretta thula*) – occur here, as do great blue herons (*Ardea herodias*), yellow-crowned (*Nyctanassa violacea*) and black-crowned night herons (*Nycticorax nycticorax*), and tricolored (*Egretta tricolor*) and little blue herons (*Egretta caerulea*). Green herons (*Butorides virescens*) prefer the narrower, freshwater portions dominated by assorted trees and woody shrubs.

Osprey (*Pandion haliaetus*), a New York State Special Concern Species sometimes referred to as a fish hawk, are common along the Carmans River during both spring and fall migration, as well as during the several month long breeding season. Numerous platforms have been erected along the river to provide desirable nesting substrate upon which the birds build their distinctive bulky nests made of large sticks. Bald eagles (*Haliaeetus leucocephalus*), a New

York State Threatened Species, both adult and immature, are becoming increasingly common during migration and are common winter visitors in the river's environs and are now nesting in Wertheim National Wildlife Refuge. Red-tailed hawks (*Buteo jamaicensis*) are seen throughout the watershed area, and short-eared owls (*Asio flammeus*), a New York State Endangered Species, are regular winter visitors to the tidal marshes that fringe the mouth of the river. Merlins (*Falco columbarius*) can be observed during fall migration catching dragonflies which are common along the river. Both great horned (*Bubo virginianus*) and screech owls (*Otus asio*) nest in woodlands in the terrestrial portions of the watershed. The belted kingfisher (*Ceryle alcyon*) is a common bird found along the banks of the river.

Several species of game birds occur in suitable upland habitats in the Study Area. Wild turkeys (*Meleagris gallopavo*), the subject of a successful reintroduction effort undertaken more than a decade ago, are common throughout the watershed. Northern bobwhite (*Colinus virginianus*), and ring-necked pheasant (*Phasianus colchicus*) (which is not a native species) are found as well, although probably in lesser abundance. The status of ruffed grouse (*Bonasa umbellus*) is unclear.

During both the breeding season and migration, several species of swallows take advantage of the abundance of aerial insects that emerge during the warmer months, feeding actively on the wing over the river and adjacent wetland areas. In the fall, large flocks of swallows (mostly tree swallows [*Tachycineta bicolor*]) can be seen descending into common reed beds where they spend the night. These flocks often number in the thousands.

Several tern and gull species also occur in the Study Area. These species are especially common along some of the freshwater impoundments, as well as along the lower reaches of the river. Common (*Sterna hirundo*) and least terns (*Sterna antillarum*) (both of which are New York State Threatened Species) are the most commonly seen species of tern.

At least six species of woodpeckers inhabit woodlands and other habitats

within the Study Area during the course of the year. These include downy (*Picoides pubescens*), hairy (*Picoides villosus*), red-bellied (*Melanerpes carolinus*), and red-headed woodpeckers (*Melanerpes erythrocephalus*) (NYS Special Concern), along with northern flicker (*Colaptes auratus*) and yellow-bellied sapsucker (*Sphyrapicus varius*).

Several dozen songbird species utilize suitable wetland and terrestrial environments. As with some of the other species mentioned above, songbirds use these habitats for breeding, overwintering and during migration. Species groups include sparrows, warblers, thrushes (including the eastern bluebird [*Sialia sialis*], New York State's official bird), cuckoos, grosbeaks, tanagers, finches, buntings, chickadees, wrens, and titmice.

A number of songbirds are neotropical migratory species. These are birds that overwinter in southern latitudes, such as the Caribbean and South America, and migrate to North America during the spring for mating and nesting. The Carmans River area is especially important for many of these species, which are decreasing in numbers due to habitat loss, both in North America and their overwintering habitat. The large amount of contiguous forested habitat present in the Study Area is significant for such forest-interior dependent or area-sensitive species. The Warbler Woods area (located just south of Middle Island Country Club, east of the Carmans River) of the Management Plan Area in particular is renowned for the large variety of warblers (more than 30 species of warblers that have been observed) that either breed there or spend some part of their life cycle there.

Many New York State listed bird species (New York State Department of Environmental Conservation, 2011e) have been found in the Study Area (listed here with their protection status):

- Northern harrier (*Circus cyaneus*) (NYS Threatened)
- Sharp-skinned hawk (*Accipiter striatus*) (NYS Special Concern)
- Cooper's hawk (*Accipiter cooperii*) (NYS Special Concern)
- Northern goshawk (*Accipiter gentilis*) (NYS Special Concern)

- Red-shouldered hawk (*Buteo lineatus*) (NYS Special Concern)
- Peregrine falcon (*Falco peregrinus*) (NYS Endangered)
- Black rail (*Laterallus jamaicensis*) (NYS Endangered)
- King rail (*Rallus elegans*) (NYS Threatened)
- Upland Sandpiper (*Bartramia longicauda*) (NYS Threatened)
- Roseate tern (*Sterna dougallii*) (US and NYS Endangered)
- Black tern (*Chlidonias niger*) (NYS Endangered)
- Black skimmer (*Rynchops niger*) (NYS Special Concern)
- Common nighthawk (*Chordeiles minor*) (NYS Special Concern)
- Whip-poor-will (*Caprimulgus vociferous*) (NYS Special Concern)
- Horned lark (*Eremophila alpestris*) (NYS Special Concern)
- Sedge wren (*Cistothorus platensis*) (NYS Threatened)
- Loggerhead shrike (*Lanius ludovicianus*) (NYS Endangered)
- Golden-winged warbler (*Vermivora chrysoptera*) (NYS Special Concern)
- Cerulean warbler (*Dendroica cerulean*) (NYS Special Concern)
- Yellow-breasted chat (*Icteria virens*) (NYS Special Concern)
- Grasshopper sparrow (*Ammodramus savannarum*) (NYS Special Concern)
- Seaside sparrow (*Ammodramus maritimus*) (NYS Special Concern)
- Vesper sparrow (*Pooecetes gramineus*) (NYS Special Concern)

Reptiles And Amphibians

Several dozen species of reptiles and amphibians occur within the Study Area, including seven listed species pursuant to New York State Environmental Conservation Law: Eastern tiger salamander (*Ambystoma tigrinum*) (NYS Endangered), marbled salamander (*Ambystoma opacum*) (NYS Special Concern), worm snake (*Carphophis amoenus*) (NYS Special Concern), Eastern hognose snake (*Heterodon platyrhinos*) (NYS Special Concern Species), Eastern box turtle (*Terrapene carolina*) (NYS Special Concern), Mud Turtle (*Kinosternon*

subrubrum) (NYS Endangered Species) and the spotted turtle (*Clemmys guttata*) (NYS Special Concern).

Anurans (frogs) are well represented in the Study Area. Green (*Rana clamitans*) and American bullfrogs (*Rana catesbeiana*) are common in permanent wetlands and Fowler's Toads (*Bufo fowleri*), wood frogs (*Rana sylvatica*) and spring peepers (*Pseudacris crucifer*) can be found in upland environments. Eastern spadefoot toads (*Scaphiopus holbrookii*) have been recorded at Wertheim National Wildlife Refuge.

There are several salamander species which occur in the Study Area. By far the most abundant is the red-backed salamander (*Plethodon cinereus*) which is common in woodlands throughout the Study Area. The three mole salamander species previously mentioned occur in seasonal wetlands or vernal ponds where eastern newts (*Notophthalmus viridescens*) also occur.

Ten snake species are found in the Study Area, some of which are fossorial (soil dwelling) and are thus rarely seen. Snakes known to occur in the Study Area include the eastern brown snake (*Pseudonaja textilis*), the ring-necked snake (*Diadophis punctatus*), the northern red-bellied snake (*Storeria occipitomaculata*) (status unclear), the Eastern hognose snake (*Heterodon platyrhinos*), the Black racer (*Coluber constrictor*), the eastern milk (*Lampropeltis triangulum*), the eastern ribbon (*Thamnophis sauritus*), the garter snake (*Thamnophis sirtalis*) and the Northern watersnake (*Nerodia sipedon*). The status of the rough green snake (*Opheodrys aestivus*) is uncertain within the Study Area, although it has been reported by Wertheim National Wildlife Refuge and has been observed and tracked at Brookhaven National Laboratory.

A number of turtle species are found within the Study Area. The eastern box turtle (*Terrapene carolina*), a tortoise, is the most widespread turtle species, occurring in a variety of upland habitats. It is declining in abundance due to habitat fragmentation, most notably from roads and associated vehicular traffic, as it is easily killed attempting to cross roads. A population of Mud Turtle (*Kinosternon subrubrum*) is found in the lower reaches of the river. Snapping

(*Chelydra serpentine*) and painted turtles (*Chrysemys picta*) are widespread throughout the river. False map turtles (*Graptemys pseudogeographica*) and red-eared sliders (*Trachemys scripta elegans*), two non-native introduced species, also occur throughout the river, especially in impoundments. Diamondback terrapins (*Malaclemys terrapin*), a turtle that frequents brackish water, can be encountered in lower reaches of the river. Scattered populations of spotted turtles (*Clemmys guttata*) exist at Wertheim and other large public land holdings.

Butterflies

Several dozen butterfly species are found within the Carmans River Study Area. Families with species representation within the watershed include: swallowtails, whites and sulfurs, coppers, hairstreaks, blues, brush-footed butterflies, browns, milkweed butterflies (monarch), and skippers.

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CHAPTER 5: MANAGEMENT PLAN RECOMMENDATIONS

Carmans River Management Plan Recommendations

These recommendations were developed to meet the numerous goals of the *Carmans River Conservation and Management Plan*. Some of the recommendations can be implemented solely by the Town of Brookhaven while others apply to or involve other agencies, which may have or share jurisdiction over the implementation of the recommended strategy. In addition, some of the recommendations require Brookhaven Town funding and hence their implementation is subject to the availability of funds and approval by the Town Board. The recommendations also reflect the amendment to the Pine Barrens Protection Act (Appendix A).

The Carmans River Management Plan Area encompasses that area within the 0 to 2 and 2 to 5 year groundwater time of travel contributing area to the Carmans River, which include the areas that may affect the environmental health and quality of the Carmans River (water quality, habitats, biodiversity, and species abundance and distribution), and the aquatic, riparian and terrestrial communities that comprise the ecosystem of the Carmans River.

It should be noted that while the recommendations for the Management Plan of *The Carmans River Conservation and Management Plan* are generally focused on the most critical 0-2 and 2-5 year groundwater contributing area, some of the recommended strategies have relevance to the entire Study Area. The Study area consists of the 100 year groundwater contributing area

1. Expansion of the Central Pine Barrens Area.

In order to provide greater protection to the Carmans River and its groundwater contributing areas, it is recommended that the Central Pine Barrens Protection Act be amended to include lands within the 0 to 2 and 2 to 5 year groundwater contributing areas of the Management Plan Area. Expansion of the Central Pine Barrens boundaries to include lands south of the Long Island

Expressway, between Yaphank Avenue and William Floyd Parkway will bring properties in this area under the jurisdiction of the Land Use Standards and Guidelines that govern development with the Compatible Growth Area of the Central Pine Barrens. These standards and guidelines include clearing limitations, fertilizer dependant vegetation limitations, preservation of steep slopes and an overall reduction in nitrate concentrations. Similarly, expansion of the Core Preservation Area will ensure that undeveloped properties within the Management Plan Area will be preserved as development is generally prohibited within the Core Preservation Area. The total Increase in the area of the Central Pine Barrens south of the LIE which is equal to the Total new CGA area plus the Expanded Core Area south of the LIE is approximately 2,400 acres.

RECOMMENDATION:

A. The properties that meet the following criteria are added to the Compatible Growth Area of the Central Pine Barrens and are collectively referred to hereafter as the “Pine Barrens Expansion Area”:

1. Properties within the 0 to 2 and 2 to 5 year groundwater time of travel contributing area south of the Long Island Expressway, Interstate 495, between Yaphank Avenue and William Floyd Parkway.
2. The land area includes approximately 2,185 acres of land consisting of 2,941 parcels of land.

B. Parcels proposed for inclusion in the Compatible Growth Expansion Area are shown in Figure 27 and the list of the specific tax map numbers for the parcels to be added to the Central Pine Barrens is provided in Appendix B. A metes and bounds description areas of the Pine Barrens proposed to be expanded has been prepared and provided in Appendix C.

C. Properties that meet the following criteria are added to the Core Preservation Area of the Central Pine Barrens and are collectively referred to hereafter as the

“Core Expansion Area”:

1. Properties within the 0 to 2 and 2 to 5 year groundwater time of travel contributing area, except for those in areas of the Management Plan Area that are predominately developed.
2. Publicly owned properties that have been acquired since the Core Preservation Area boundaries were originally established in 1993.
3. The land area includes approximately 1,600 acres of land and includes approximately 571 parcels. Approximately 487 acres are privately-owned and 1,173 acres are publicly-owned property.
4. Expanded Core Area north of the Long Island Expressway includes approximately 1,462 acres of land and includes approximately 349 parcels. Approximately 425 acres (255 parcels) are privately owned and 1,037 acres (94 parcels) are publically owned.
5. Expanded Core Area south of the Long Island Expressway includes approximately 215 acres of land and includes approximately 222 parcels. Approximately 73 acres (59 parcels) are privately owned and 142 acres (163 parcels) are publically owned property.

D. Parcels included in the Core Preservation Expansion Area are shown on Figure 27 and the list of the specific tax map numbers for the parcels to be added to the Central Pine Barrens Core Preservation Area is provided in Appendix B. A metes and bounds description of the Core Preservation Expansion Area has been prepared and is provide in Appendix C.

E. Pine Barrens Credits should be allocated to qualifying privately owned properties in the Core Preservation Expansion Area based on existing zoning as of December 31, 2013.

1. It is estimated that approximately 135 credits will be made available based on the current zoning of the parcels, the size of the parcels and the location of the parcels.

2. The fee simple acquisition of lands is the principal protection measure. Establish a goal of credit redemption of 75% acquisition of the lands within the Core Preservation Area.
3. The exact number of Pine Barrens Credits is subject to the review and the issuance of credit certificates by the Pine Barrens Credit Clearing House.

F. The Town of Brookhaven requested that the New York State Legislature amend the Central Pine Barrens Protection Act of 1993, and as subsequently amended, to add those parcels within the proposed Central Pine Barrens Expansion Area (CGA) and Core Preservation Expansion Area to the Central Pine Barrens (Appendix B). It is noted that the state legislation necessary to affect this change - A.7905 and S. 5727 - has passed both houses in the 2013 state legislative session and has been signed by the Governor. The legislation will become effective on January 1, 2014.

G. The Town of Brookhaven requests that the Pine Barrens Commission amend the Central Pine Barrens Comprehensive Land Use Plan to include the new lands within the Central Pine Barrens Core Preservation Area and Compatible Growth Area and to incorporate the appropriate issues and recommendations contained in the Management Plan that pertain to the Central Pine Barrens.

H. The Town of Brookhaven has taken steps to increase the redemption of Pine Barrens Credits (PBCs) through land use legislation and should continue to develop innovative ways to redeem PBCs in accordance with the recommendations contained in the Central Pine Barrens Comprehensive Land Use Plan.

2. Proposed Open Space and Farmland Development Rights Acquisitions.

The Town of Brookhaven recognizes the importance acquiring and preserving properties within the Study Area for open space and this Management Plan identifies specific sites for open space preservation (Please see Figure 28). Past preservation efforts has resulted in significant open space acquisitions within this Study Area, particularly those parts of the Study Area that are within the Central Pine Barrens. There are still significant privately-owned properties throughout the Study Area, however, which have not been acquired yet, merit protection. The proposed open space and preservation efforts work together with the Pine Barrens expansion efforts. The Pine Barrens expansion recommends the fee simple acquisition of lands as the principal protection measure. This open space acquisition initiative pursuant to the Plan is a voluntary one in which the property owner makes the determination to sell or not to sell to the town with all legal rights being retained by the owner up until the time of purchase.

The Town has purchased, alone and in conjunction with Suffolk County and New York State, many properties in the Study Area. In addition, Suffolk County, New York State, and private, non-profit conservation organizations such as the Nature Conservancy and the Post Morrow Foundation have also acquired open space areas in the Study Area. Further cooperation between the municipalities as well as private, non-profit organizations, to acquire additional open space in this Study Area is recommended.

In addition to acquisition, the aggressive use of clustering and other techniques can also achieve a permanent preservation of open space. The use of clustering should continue to be used as a tool in order to preserve these sensitive lands or to create, connect, or complete greenbelts.

RECOMMENDATION:

A. Prioritize lands for acquisition utilizing the previously developed Land Acquisition Prioritization Framework (Appendix D). Aggressively move to protect

the lands identified through this process by acquisition by the Town individually, and in partnership with its private and public partners. The ranking of primary and secondary for open space properties is meant to reflect those in the top half of the numerical ranking list (primary) and those in the bottom half of the numerical ranking list (secondary), see Appendix H.

- B. Other sources of funding to acquire open space should be explored, such as bonds.
- C. New public land acquisitions and existing Town holdings should be dedicated to the Town Nature Preserve system to ensure protection of sensitive habitats and resources.
- D. The Town will make it a priority to preserve and if necessary restore any historic buildings and structures slated for acquisition.

3. Proposed Zoning Actions in the Study Area

It is well established and documented that zoning can play a critical role in limiting the density of development, thereby reducing nitrogen loading to groundwater and surface waters. In implementing its Comprehensive Land Use Plan, the Town has taken great strides in establishing zoning patterns adjacent to and within stream corridors, including the Carmans River Study Area. The “Past Plans” section of this Management Plan finds that where residential development cannot be avoided, large lot development should be required. This Plan provides specific zoning recommendations that are illustrated in Figure 29. Adoption of the large lot rezoning will help to achieve the 2.5mg/l nitrate goal recommended for new development.

RECOMMENDATION:

A. Undertake a comprehensive zoning initiative for the Carmans River Study Area as shown in Figure 29.

B. Re-zone all residentially zoned parcels within the 0 to 5 year Management Plan Area to a minimum 2-acre residential zoning (A Residential 2) in order to achieve the 2.5mg/l nitrate goal recommended for new development, (Figure 29). Approximately 2,084 acres (2142 parcels of land) proposed to be rezoned to A Residential 2.

C. Re-zone all residentially-zoned, publicly-owned parcels within the Study Area to 5 acre residential (A Residential 5) unless the parcel is already zoned 10 acre residential (A Residential 10), in which case the 10 acre residential zoning should be applied (Figure 29). Approximately 1,471 acres (137 parcels of land) proposed to be rezoned to A-5. Approximately 605 acres (194 parcels of land) proposed to be rezoned to A-10.

D. The Town of Brookhaven Board of Zoning Appeals, to the extent permitted by Town Law Section 267-b, should evaluate all requests for variances relating to their consistency with the goals and recommendations of this Management Plan.

4. New York State Wild and Scenic Recreational River (WSR) Act.

The New York State Wild and Scenic Recreational River Act (WSR) provides the standards for the Scenic and Recreational portions of the Carmans River Corridor. The requirements of the WSR have long been upheld and implemented by the Town of Brookhaven and New York State Department of Environmental Conservation. However as required by the Act, a management plan has never been prepared for this river. Therefore, the following recommendations are offered:

RECOMMENDATION:

A. This *Carmans River Conservation and Management Plan* should be considered by New York State as the management plan for the Carmans River in accordance with the provisions of The New York State Wild and Scenic Recreational River (WSR) Act regulations (6 NYCRR Part 666).

B. Continue to take concrete, assertive steps to ensure compliance with existing WSR regulations already in place, including zoning and land use restrictions.

C. Identify additional measures, if necessary, to further strengthen the implementation and application of the Wild, Scenic and Recreational Rivers Act regulations, including the need to expand the WSR boundaries to further protect the River.

5. Establishment of a Watershed Protection Improvement District.

In April, 2011, New York State amended New York State Town Law to provide for the establishment of Watershed Protection Improvement Districts as an addition to the list of improvement districts a township may enact. The Act states that: "THE TOWN BOARD MAY TAKE SUCH ACTION AS MAY BE REQUIRED TO ADOPT PLANS AND SPECIFICATIONS AND ENTER INTO A CONTRACT OR CONTRACTS, OR TAKE SUCH OTHER ACTIONS AS MAY BE REQUIRED, FOR THE PROTECTION AND RESTORATION OF GROUNDWATER, SURFACE WATERS, AND DRINKING WATER QUALITY AS IT MAY DEEM TO BE NECESSARY OR DESIRABLE, INCLUDING BUT NOT LIMITED TO STORMWATER TREATMENT PROJECTS AND WETLAND CONSTRUCTION. SUCH DISTRICT SHALL ALSO BE EMPOWERED TO PROVIDE REBATES TO PROPERTY OWNERS IN THE DISTRICT TO PROMOTE WATERSHED PROTECTION, INCLUDING BUT NOT LIMITED TO

SEPTIC SYSTEM UPGRADES, ALTERNATIVE SEPTIC SYSTEMS, CONSERVATION LANDSCAPING, STORMWATER COLLECTION, RESTORATION OF NATURAL SHORELINES AND SHORELINE BUFFERS, AND REMOVAL OF IMPERMEABLE SURFACES.

As a result this Management Plan recommends the following:

RECOMMENDATION:

A. Investigate the merits of establishing a Watershed Protection Improvement District, encompassing the boundaries of the Carmans River Management Plan Area and Study Area. Establishment of a Watershed Protection Improvement District can provide the Town with a long-term and comprehensive funding mechanism to permit the advancement of numerous water quality and habitat improvement projects within the Study Area and the river. Funding for on-site sanitary system upgrades should be the highest priority strategy in the use of District funds.

6. Protection of natural resources

The Study Area contains a large quantity of environmentally-sensitive lands, including wetlands, and geological features such as kettle holes, moraines, steep slopes and glacial erratic. It also contains rare and endangered or otherwise important wildlife and vegetation species and significant ecosystems and habitats.

These lands are a positive aspect of the quality of life for the communities in the Carmans River Management Plan Area and Study Area. Efforts have been undertaken to preserve these sensitive lands through public acquisition as well as acquisition by organizations such as the Nature Conservancy and the Post Morrow Foundation. The majority of the environmentally sensitive lands, particularly those along the Carmans River, are presently under the control of the

Town of Brookhaven, Suffolk County, New York State and the United States of America.

In order to further protect the natural resources of the Management Plan Area and Study Area, the following is recommended:

RECOMMENDATION:

A. Amend Chapter 81 of the Brookhaven Town Code (Wetlands and Waterways) to prohibit new construction of primary and accessory structures, clearing, and fertilization within 50 feet of the landward edge of wetlands and surface waters in the Management Plan Area.

B. Construct infrastructure to reduce mortality of wildlife from road kill in the Management Plan Area subject to further approvals and funding.

C. Seek the routing of trails and other enhancements on public lands (the Town, Suffolk County and New York State) in the Management Plan Area to avoid situations that cause erosion, runoff and siltation.

D. Prohibit the use of pesticides on any Town owned property within the Management Plan Area, except in instances of protecting the public health and/or compulsory directives and/or mandates. In addition, the Town should offer this same recommendation to other levels of government and municipalities with respects to their land holdings within the Management Plan Area.

7. Stormwater and flooding

The Town has mapped recharge basins and stormwater discharges under Town jurisdiction in the Study Area. Large portions of the Management Plan Area have not been developed or lack high density development. Direct stormwater discharges (pipes and road drainage) into the river have been

identified (Table 3, Figure 17 and Appendix G). The following recommendations should be implemented with the goal to reduce adverse stormwater impacts to the Carmans River:

RECOMMENDATION:

- A. Implementation of public education and outreach on stormwater impacts. Publish information that describes common actions likely to adversely impact groundwater and surface water from the discharge of pollutants through storm water systems. Alternatives to the above-mentioned actions resulting in lesser potential adverse environmental impact should be promoted and encouraged.

- B. Continue to work with Suffolk County Department of Public Works and New York State Department of Transportation to implement development plans and strategies to mitigate the stormwater discharges in the Management Plan Area.

- C. Development projects must comply with Stormwater Pollution Prevention guidelines and requirements.

- D. Reduce impervious surfaces in the watershed including reduced roadway and driveway widths to minimize runoff.

- E. Use innovative stormwater retention including rain gardens and drainage swales.

- F. The reduction and/or elimination of illicit stormwater discharge from existing development should be encouraged with the application of Best Management Practices.

- G. Petition Suffolk County and New York State officials to adopt an accelerated schedule to upgrade and maintain catch basins in the Management Plan Area

located on Suffolk County and New York State roadways in key areas that potentially impact the Carmans River.

H. Town, Suffolk County and New York State adoption of an accelerated schedule to install and/or repair catch basins and other drainage infrastructure to mitigate adverse environmental impacts due to the stormwater discharges in the Management Plan Area, as listed in Appendix G.

I. Implement the following measures to resolve flooding concerns:

1. Undertake an engineering study for the amelioration of flooding along Mill Road and Middle Island Road.
2. The area generating run-off to Middle Island Road and Mill Road should be mapped and the water table elevation in the area surrounding Middle Island Road and Mill road should be mapped and monitored.
3. Opportunities for redirecting and/or treating run-off on Middle Island Road and Mill Road should be identified and pursued but in no case should stormwater be directly discharged into the Carmans River.

8. Sanitary Systems, Sewage Treatment Plants and Nitrate-nitrogen standards for projects

Although it is recognized that standards for sanitary systems and sewage treatment facilities are largely beyond the control of the Town, the Town has developed a series of recommendations that should be considered by Suffolk County.

RECOMMENDATION:

A. Establish standards for onsite wastewater treatment systems that provide for

higher daily design flow rate per bedroom and improved technologies including BESST and Nitrex as well as alternative systems not currently permitted by the Suffolk County Department of Health Services.

B. Adopt a local law to require that new sanitary systems, or upgrades to existing systems, designed to treat intermediate sewage flows or greater (1000 gallons per day or greater but less than 30,000 gallons per day), situated within the Carmans River 100-year watershed, be required to utilize best available technology for treatment of sanitary waste. Specifically, best available technology means the sanitary system meets the following operating conditions: nitrogen shall not exceed 3ppm as measured over a twelve month rolling average, and at no point shall the monthly average exceed 5ppm. Said sanitary system shall be warranted by a licensed Professional Engineer.

C. Suffolk County Department of Health Services and the Suffolk County Legislature should amend Article 6 of the Suffolk County Department of Health Services Code to allow for new and innovative sanitary systems which decrease nitrate-nitrogen concentrations associated with residential, institutional, and commercial development. These alternative systems should be considered by Suffolk County:

1. New sanitary systems and replacement systems for failed sanitary systems should take advantage of improved technologies including BESST and Nitrex as well as alternative systems not currently permitted by the Suffolk County Department of Health Services that will significantly reduce the effluent nitrogen concentration produced compared to conventional sanitary systems.
2. The wastewater treatment technology and infrastructure at existing sewage treatment plants (STPs) should be updated and new STPs should be designed to provide for enhanced nitrogen removal.

D. Consider establishing a Wastewater Disposal District, as permitted by NYS Town Law, with the District encompassing the Study Area of the Carmans River. The establishment of Wastewater Disposal Districts is permitted pursuant to Article 190-e of the NYS Town Law. The purpose of these districts is: the administration and planning (including educational programs), design, installation, construction, rehabilitation, replacement, operation and maintenance (including pumping and inspections), monitoring, residual treatment and disposal and regulation of private on-site wastewater disposal systems of such district. Said districts can provide a means by which to comprehensively and effectively manage sanitary waste emanating from on-site sanitary systems that are having an impact on the water quality of the Carmans River.

E. Consider both rebates and low interest homeowner financing to encourage septic system upgrades. Septic system rebate programs to assist homeowners in financing on-site sanitary system upgrades have been successfully implemented in a number of local communities throughout the country. The Town of Southampton, for example, has just completed such a successful program involving system upgrades. The Town and/or Suffolk County should strongly consider establishing a program to provide funding to homeowners to incentivize the upgrading of antiquated and obsolete on-site sanitary systems. Related to this proposed upgrade program the Town Board should strongly consider establishing a pilot program, utilizing Suffolk County Funds made available pursuant to the Drinking Water Protection Program, involving the East Yaphank community. This area is among the most densely developed areas within the Carmans River watershed and upgrading sanitary systems here would likely result in the greatest water quality improvements.

F.. Investigate the technical and financial feasibility of utilizing reclaimed wastewater from Sewage Treatment Plants (STP's) located within the Carmans

River Study Area for golf course and landscape irrigation purposes, thereby reducing the loading of nitrogen to groundwater originating from STP's. There are many examples throughout the country that promote the reuse of treated wastewater emanating from sewage treatment plants. Golf course and landscape irrigation are especially common targets for reclaimed wastewater. Article 15, Title 6 of the NYS Environmental Conservation Law provides the regulatory framework for water reuse. Major benefits of water reuse include a reduction of nutrients into water bodies due to the diversion of the reclaimed wastewater for irrigation, resulting in plant growth/uptake and lessening of stress on virgin water sources.

G. Ensure that adequate signage is installed at town facilities to fully inform residents of the provisions of the waterfowl feeding ban. The Town, which has enacted a waterfowl feeding ban, also recommends that the County of Suffolk considers amending Section 643-4 of the Suffolk County Code to prohibit the feeding of waterfowl in county parks.

9. Water quality goal for the Carmans River

As discussed in this Carmans River Conservation and Management Plan, the surface water quality in the freshwater section of the Carmans River is determined by the quality of groundwater that discharges into the surface water, atmospheric deposition of contaminants, runoff of contaminants into surface water, and biological activity that removes or alters contaminants. The purpose of this Carmans River Conservation and Management Plan is to ensure non-degradation of the current water quality of the Carmans River over the short-term (non-degradation goal), and an improvement in current water quality levels over the long term (restoration goal). The following recommendations are intended to achieve this goal. The current water quality in the Carmans River is used as the baseline.

RECOMMENDATION:

A. Adopt a goal of 1.27 mg/l total nitrogen and a 1.0 mg/l goal of nitrate nitrogen as its numerical standard. Further, establish a restoration goal of .5 mg/l for total nitrogen and a .35 mg/l goal for nitrate-nitrogen. These goals should be amended as new information is made available regarding the impact of nitrogen on ecological systems, communities, and species. Please see Appendix F.

B. If the water quality in any Carmans River segment exceeds the mean concentration by more than 20%, taking into account seasonal variation, a study should immediately be commenced to identify the possible cause(s) of the exceedence and the remedial actions whose implementation should be a priority.

C. Upon the adoption of a numeric water quality standard applicable to the Carmans River by the New York State Department of Environmental Conservation or the United States Environmental Protection Agency, adopt this numeric water quality standard, only if this state/federal standard is more restrictive than the standard established by the Town.

D. If upon statistical analysis of multiple water samples, the water quality in the Carmans River is found to exceed the water quality restoration standard that is the New York State Department of Environmental Conservation or the United States Environmental Protection Agency numeric standard, the Town should work with NYS DEC and EPA to prepare a Total Maximum Density Load (TMDL) evaluation that will:

1. Determine the nitrate-nitrogen load that is necessary to meet the restoration goal (loading capacity).
2. Identify the nitrate-nitrogen sources and estimate their contributions of nitrate.

3. Analyze the current nitrate-nitrogen load and determine the needed reductions.
4. Allocate the allowable nitrate-nitrogen load among the different contributors in a manner that the restoration water quality goal is achieved.

10. Water quality monitoring program

The Town along with the New York State Department of Environmental Conservation and/or the United States Environmental Protection Agency should cooperate with other agencies and academic institutions to develop a comprehensive water quality monitoring program.

RECOMMENDATION:

- A. Cooperate with other agencies and academic institutions to develop a comprehensive water quality monitoring program.
- B. The monitoring program should be designed to determine if the protective measures in the Management Plan are protecting water quality. Evaluation of the effectiveness of the Management Plan should be conducted within five (5) years of the Plan's adoption and every three (3) years thereafter.
- C. The monitoring of the Carmans River should follow the protocols of the USGS National Water Quality Assessment Program and the New York State Department of Environmental Conservation.
- D. Continuous monitoring stations with telemetric capabilities should be established to measure water level, temperature conductivity, pH, turbidity and dissolved oxygen.

E. Semi-annual monitoring of the water quality of an array of well-distributed shallow groundwater wells should be undertaken.

F. Surface water, bottom water and pore water near the sediment-water interface should be sampled quarterly along a transect of stations along the Carmans River's axis for water quality parameters consistent with past monitoring done by the Suffolk County Department of Health Services.

G. The USGS 3-D GIS framework for groundwater hydrogeology should be maintained and a data base of publicly available water quality data should be established.

H. To assess water quality in the Carmans River, the Suffolk County Health Department and New York State Department of Environmental Conservation should continue to monitor water quality at the following locations (segments) on the Carmans River (the stations are Suffolk County Health Department and New York State Department of Environmental Conservation stations):

1. 240-220 north side Bartlett Road at culvert
2. 240- 170 Mill Road at Upper Lake spillway
3. 240-135 Main Street and Long Island Avenue at Lower Lake spillway
4. 240-30 North side Victory Avenue at Hards Lake spillway
5. NYS DEC CARM-02
6. NYS DEC CARM-03

I. Water quality should be monitored at least once every two months and monthly during the warm season (May - August) with a minimum of nine (9) sampling events per year. Upon the water quality data becoming available, it should be analyzed using appropriate statistical methodologies and taking into account seasonal variability and stormwater events to determine a final

restoration water quality goal for each of the Carmans River segments.

11. Biological inventories and monitoring

A key barometer or measure of the ecological health of the Carmans River is through an assessment of the composition and structure of numerous ecological communities that collectively make up the river's ecosystem.

RECOMMENDATION:

A. While recognizing previous inventory efforts, the Town of Brookhaven along with the New York State Department of Environmental Conservation and/or the United States Environmental Protection Agency shall cooperate with other agencies and academic institutions to develop a comprehensive biological/ecological inventory and monitoring program for the Carmans River. This monitoring program should be updated periodically.

B. Following existing ecological protocols, inventories of the aquatic, riparian and terrestrial biological resources of the Carmans River and the entire Management Plan Area should be periodically updated.

C. Encourage academic institutions and governmental agencies to conduct research to better characterize and quantify the hyporheic zone of the Carmans River and the species and natural communities that occur there.

12. Invasive species

In April, 2011, the Suffolk County Department of Environment and Energy prepared (NP&V) a Feasibility Study to Eradicate Aquatic Invasive/Nuisance Species In Canaan Lake, North Patchogue and Upper and Lower Lakes, Yaphank. These lakes were assessed to determine the current extent of

invasive aquatic weeds and to determine the feasibility of various control options that could be implemented to allow for the long-term control of these nuisance species.

RECOMMENDATION:

A. The recommendations and the implementation of the Feasibility Study to Eradicate Aquatic Invasive/Nuisance Species In Canaan Lake, North Patchogue and Upper and Lower Lakes, Yaphank is currently underway. Continue to implement the recommendations of the feasibility study and the remediation of Upper and Lower Lakes.

B. Based on the recommendations of the Feasibility Study, develop and implement a long term strategy to address invasive aquatic species within the Upper and Lower lakes.

C. Develop and implement a detection and monitoring program for invasive species for the entire river corridor.

13. Restoration of degraded properties

Although degraded properties were not specifically identified in this Management Plan, the following general recommendations should be considered.

RECOMMENDATION:

A. Work cooperatively with Suffolk County and New York State to identify degraded natural sites on public lands and to develop/implement site specific restoration plans.

B. Implement measures to restore Town owned public lands that have been

degraded by ATV use and/or dumping measures to restore these lands and to deter these and other illegal uses.

C. To promote appropriate passive use consider the creation of a river crossing in the Carmans River Headwaters Suffolk County Nature Preserve and at other suitable locations.

D. Continue investigating private properties with alleged violations of the Town Code and other local and state laws that may be negatively impacting groundwater quality and surface water quality in the Management Plan Area and the natural resources of the Carmans River.

14. Surface and groundwater remediation

The following recommendations present the programs and practices affecting the Study Area, including those focusing on point and non-point source pollution management and watershed ecology.

RECOMMENDATION:

A. Contaminated groundwater from known point sources should be remediated consistent with United States Environmental Protection Agency, New York State Department of Environmental Conservation and Suffolk County Department of Health Services standards, regulations, and requirements by the party responsible for the contamination.

B. Sources and causes of the degradation of surface water and groundwater quality should be remediated consistent with United States Environmental Protection Agency, New York State Department of Environmental Conservation and Suffolk County Department of Health Services standards, regulations, and requirements by the party responsible for the contamination.

15. Mitigate barriers to fish migration

The Town, County of Suffolk, New York State DEC, and United States Geological Survey should work together to evaluate the following barriers to fish migration, and where and where feasible, eliminate them subject to all permit requirements, deed restrictions, and funding:

RECOMMENDATION:

A. Hards Lake dam, 2.84 miles from the mouth of the river:

1. Ensure that the installation of the fish passage will not prevent American Eels from climbing over the dam (which could occur if the flow characteristics were changed and the dam face is not continually wet).
2. Monitor the existing fish passage to determine whether or not maintenance is required and to ensure it adequately passes fish.

B. C-Gate dam, 3.88 miles from the mouth of the river:

1. The dam should be evaluated to determine if alteration to the spillway is required.
2. If feasible, the dam should be partially or wholly removed.
3. If not feasible, repairs to the dam should be considered.

C. United States Geological Survey Gauging Station, 4.73 miles above the mouth of the river:

1. The weir should be modified to facilitate fish passage in a manner that allows for the continued integrity and functioning of the USGS gauging station.
2. Consideration should be given to the installation of a manufactured fish passage to allow river herring to pass the weir.

D. Lower Lake dam, 5.24 miles from the mouth of the river:

1. The dam's structural integrity should be evaluated. If reconstruction of the dam is recommended, the installation of a manufactured fish passage should be considered

E. Upper Lake dam, 6 miles above the mouth of the river:

1. The dam should be upgraded and a manufactured fish passage installed.

F. County earthen dam adjacent to south end of Szuster Farm property, 7.3 miles from the mouth of the river:

1. The dam should be removed subject to any deed restrictions that might be in effect on the property.

G. Cathedral Pines County Park entrance road culverts, 7.7 miles from the mouth of the river:

1. The functioning of the existing culverts should be evaluated and if replacement is recommended, the replacement should facilitate fish passage.

16. Public education and outreach

An essential component of this Carmans River Conservation and Management Plan is the education of the general public. The following recommendations should be considered:

RECOMMENDATION:

A. Develop and publicize general information that describes the environmental, ecological and historical importance and significance of the Carmans River.

B. Develop and implement a public educational program targeting residents who live in the Carmans River Study Area about threats to groundwater and surface water quality and what actions they can take to enhance and protect the Carmans River and its groundwater contributing area. Priority elements should be reduction in fertilizer use, the value in using native plants, information on the Suffolk County ban on fertilizer use in the winter season, on-site wastewater system maintenance, the Town ban on waterfowl feeding, and other personal activities and strategies that might impact water quality and the environment

C. Install signs on key roadways to inform drivers they are entering or leaving the Carmans River watershed.

D. Develop and publicize information to homeowners within the Management Plan Area that describes the environmental impacts of fertilizers as well as the proper disposal of chemicals and other hazardous household waste and items.

17. Agricultural and Golf Course Management

The presence of farms is significant in terms of the regular fertilizer and pesticide applications associated with farming. Agricultural land in the study area comprises field crops and nurseries. The following recommendations should be considered:

RECOMMENDATION:

A. Work cooperatively with farmers within the Management Plan Area, Cornell Cooperative Extension, the Long Island Farm Bureau and other governmental agencies to reduce the application of fertilizers, pesticides, and herbicides on agricultural lands and to develop and implement Groundwater and Surface Water Protection Measures (GSPMs) that will reduce the impact of agricultural activities on the Carmans River.

B. If a sufficient number of groundwater wells are not currently available to adequately assess groundwater quality beneath and adjacent to a farm, additional groundwater wells should be installed. These groundwater wells should be monitored for parameters and at a frequency needed to assess the groundwater quality emanating from the farm.

C. Work cooperatively with golf course owners and operators within the Management Plan Area to reduce the application of fertilizers, pesticides, and herbicides on golf courses and to implement Groundwater and Surface Water Protection Measures (GSPMs) that will reduce the impact of golf related activities on the Carmans River.

D. If a sufficient number of groundwater wells are not available to assess the water quality of the groundwater leaving a golf course and flowing to towards the Carmans River, additional groundwater wells should be installed. These groundwater wells should be monitored for parameters and at frequency need to assess the groundwater quality emanating from the golf course.

E. Both farm and golf course management plans should have a goal of 50% reduction in nitrogen use (using a 2010 baseline) over a three-year period.

F. Perform periodic review of farms and golf course operations to ensure that Best Management Practices are being used.

18. Management Plan Implementation and Establishment of the Carmans River Management Plan Performance Committee

Management Plan Performance Committee will play a vital role in ensuring that the recommendations contained herein are implemented, and

evaluating their effectiveness.

Their overall responsibilities are summarized below.

RECOMMENDATION:

A. Evaluate the Carmans River Conservation and Management Plan annually to determine its effectiveness in meeting its goals.

B. Take the lead in coordinating implementation of this Management Plan's recommendations and implementation with other agencies and academic institutions.

C. Establish a Carmans River Management Plan Performance Committee, which meets on at least a quarterly basis to work with the Town in implementing plan elements and assessing their success. The Committee should produce an annual progress report on the effectiveness of the implementation of *Carmans River Conservation and Management Plan*. The Committee should include planning and environmental professionals from relevant local, state, and federal agencies, and representatives from civic and local, regional, and national environmental organizations, that have had a demonstrable interest and involvement in the protection of the river .

D. Based on Committee's annual report, recommendations to improve the effectiveness of the preservation efforts and the redemption of Pine Barrens Credits should be offered.

E. The Committee established above should oversee the implementation of the Plan's recommendations as contained in the Implementation Schedule (Appendix E).

19. Carmans River Management Plan Area.

The Carmans River Management Plan Area encompass that area within the 0 to 2 and 2 to 5 year groundwater time of travel contributing area to the Carmans River, areas that may otherwise affect the environmental health and quality of the Carmans River (water quality, habitats, biodiversity, and species abundance and distribution), and the aquatic, riparian and terrestrial communities that comprise the ecosystem of the Carmans River and as shown on Figure 4a of this Plan.

RECOMMENDATION:

A. Prepare, using tax map parcels, roadways, landmarks or other information as applicable, a map and written description of the boundaries of the Management Plan Area that reflects as closely as possible the Management Plan Area boundaries shown in Figure 4a.

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