

Forge River Nitrogen Reduction Report
Sewering of Mastic/Shirley

EFC Report C1-5140-01-00

August 2014

Amended June 2015

Acknowledgement

This August 2014 report was a modification of a March 2014 report titled "Feasibility Study, Map and Plan for Mastic/Shirley" prepared for Suffolk County by CDM Smith in association with H2M and Bowne AE&T Group. The previous modifications included a reduced scope to address sewerage of the Montauk Highway Corridor and residential parcels west of the Forge River and north of the Poospatuck Creek. It is also recognized that this June 2015 report reflects updated project information with a Map and Plan to be developed during the final design utilizing cost opinions based on DPW criteria and applications for low interest loans and grants.

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Executive Summary

Background

Located in the Town of Brookhaven, Mastic-Shirley was one currently unsewered areas that the Suffolk County Sewer District/Wastewater Treatment Task Force identified as a critical area of need for this capital project, where implementation of sanitary sewers could provide environmental, economic or social benefits. A Feasibility Study was prepared to document sewage collection and treatment/effluent discharge requirements, along with the associated capital and operation costs and environmental and economic benefits and has been updated and modified herein.

Based on meetings held with Legislator Browning, the Town of Brookhaven and other stakeholders, establishment of a Sewer District is being considered to allow the Mastic-Shirley community to realize the vision for the Montauk Highway Corridor articulated in the **Montauk Highway Corridor Study and Land Use Plan for Mastic Shirley**¹ and to improve the quality of groundwater baseflow to the Forge River as it relates to coastal resiliency and the reduction of nitrogen loading to the water bodies. The environmental benefits associated with sanitary sewerage were of such importance to area stakeholders that the original study area boundaries were significantly extended beyond the original Montauk Highway Corridor to almost 750 acre area that included the Montauk Highway Corridor from just west of the William Floyd Parkway through Mastic and Shirley east to the Forge River as well as the existing residential areas within the two year groundwater travel time in the western part of the Forge River watershed.

Existing land uses include storefronts, offices and restaurants along the Montauk Highway Corridor, and primarily residential properties throughout the remainder of the study area. It is important to note, however, that there is no intent to sewer unbuildable lots, including currently vacant parcels within the proposed Mastic- Shirley Conservation area.

Infrastructure Requirements

Collection System

The majority of the parcels within the study area are residential and there are no specific re-development plans in place. Wastewater flow projections were based upon Suffolk County Department of Health Services (SCDHS) design criteria and zoning. The total sanitary flow from the Mastic-Shirley Study Area is projected to be approximately 1.0 million gallons per day (MGD). The average daily flow density for the entire study area is over 1,000 gpd/acre, which is more than three times as much as the 300 gpd/acre wastewater flow rate established for Groundwater Management Zone VI².

Based upon topography, relative depth to groundwater and current build-out of the area, a combination of gravity sewers and low-pressure sewers is recommended to provide wastewater

¹ Town of Brookhaven Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley Phase II. Final Draft, 2009. Prepared for the Town of Brookhaven by Nelson, Pope & Voorhis, LLC

² Groundwater Management Zones were established by Suffolk County based on differences in hydrogeology and groundwater quality.

collection for the proposed Mastic-Shirley Sewer District. Eight drainage areas are identified. Gravity sewers were recommended where the depth to groundwater permitted, to reduce long term operation and maintenance costs to property owners within the district. The Montauk Highway Corridor and residential areas where the depth to groundwater was generally greater than 10 feet will be served by gravity sewers. Low pressure sewers would be constructed in those areas within each drainage zone where USGS data estimated that the groundwater is less than 10 feet below grade. These areas mainly include residential properties located in close proximity to the Forge River and its tributaries. Properties located on the Poospatuck Reservation will also be serviced by low pressure sewers due to their proximity to the Forge River, anticipated shallow groundwater conditions and non-conforming build-out conditions to current building code standards. Presently, it is planned to have a contractor available to cost effectively abandon the on-site system and make the house connection with the cost within the total project cost. A commercial incentive program is being considered.

A grinder pump station will be located on each property located within the area to be served by the low pressure collection system. The grinder pump stations will be located within the basements of the buildings served, or will be buried outside in the vicinity of the existing onsite septic systems or cesspools.

Wastewater Treatment

Sanitary wastewater from the proposed Mastic-Shirley sewer district will be conveyed to a new sewage treatment plant to be constructed on a 12.9 acre parcel located on the Town of Brookhaven's Calabro Airport. An additional 17.0 acre parcel in close proximity will be used for expansion. Selection of the treatment option recommended for the Mastic-Shirley study area was guided by the target effluent nitrogen reduction requirements in this environmentally sensitive area, given the sewage treatment plant's location within the Forge River watershed. Because the poor water quality of the downgradient Forge River was identified as one of the driving forces for sewerage, a Membrane Bioreactor (MBR) facility was recommended for the Sewage Treatment Plant because it provides the limits of technology for nitrogen removal (currently, between 3 and 5 mg/L).

Legal Requirements

Creation of a Mastic-Shirley Sewer District requires approval by the majority of the property owners within the study area by a public referendum. The District would be formed as a County sewer district according to Article 5-A, Section 256 of New York State (NYS) County Law. Other regulatory requirements for sewer district formation and construction include compliance with the State Environmental Quality Review Act (SEQRA), State Historic Preservation, storm water permitting, including preparation of a Stormwater Pollution Prevention Plan (SWPPP) and other construction-related permits including road opening and NYSDEC dewatering. (Currently, the Airport sites totaling 29.9 acres have had survey work completed for an appraisal with the likely need for a long term easement to be negotiated or acquisition).

Schedule

If approved, it is anticipated that the sewerage program could be implemented within approximately five years. Construction of the new facilities is scheduled to be completed 2019, such that the new facilities could be operational during late 2019.

Capital and Operation and Maintenance Costs

The cost to establish a Mastic-Shirley Sewer District includes:

- Construction and engineering for the wastewater collection and conveyance systems;
- Construction and engineering for the wastewater treatment plant and recharge facilities;
- Planning costs including survey, SEQRA compliance, soil borings, utility mark-out;
- Sewer system connection fund;
- Septic system abandonment fund, and
- Grinder pump station fund for properties located in the area served by low pressure sewers.

The total estimated capital cost to establish a Mastic-Shirley Sewer District is over \$188,000,000, as summarized by **Table ES-1**, with construction costs escalated to the anticipated mid-point of construction, and assuming that funds for septic system abandonment, sewer system connection and grinder pump station purchase and installation are financed along with the construction costs. It is anticipated that financing would be obtained through a combination of grants and the New York Environmental Facilities Corporation using 30 year loans at 2 percent interest rates, however, a 1.84 percent fee is applied.

Annual costs for each property owner would include financing costs for the capital project and operation and maintenance costs. Operation and maintenance costs include the operation and maintenance charges associated with the sewer district (collection, conveyance and treatment systems) and, for those property owners located within the areas served by a low pressure system, the costs associated with operation and maintenance of the grinder pump stations. Because operation and maintenance costs are based upon wastewater flow, they will typically be higher for commercial property owners than for residential property owners.

Table ES-1 – Capital Cost Summary

Project Component	Total Capital Cost (\$)
Collection System & Force Main Construction	\$78,680,800
Pump Stations	\$11,550,000
Wastewater Treatment Facility	\$66,000,000
Total Construction	\$156,230,800
Design Engineering	\$10,000,000
Construction Management	\$10,300,000
Grinder Station Fund for Low Pressure Sewer Areas and Abandonment & Connection Fund	\$11,550,000
Total Cost	\$188,080,800



The Map and Plan will be completed with the final design and confirm the annual cost to the typical property.

Residential Affordability

The annual cost of sewerage to the typical residential property owner would be significant without subsidy. Based upon projected annual costs for residences in the Mastic-Shirley study area developed in the March 2014 Feasibility Study and the USEPA Residential Indicator metric, the projected annual cost of the sewer district would represent approximately 3.9 to 4.4 percent of median household income for properties located within the areas served by gravity sewers and low pressure sewers, respectively. This is significantly greater than the 2 percent of median household income that the USEPA identified as the high cost burden threshold. In order to meet the 2 percent threshold, external grant funding would be required. While the avoided costs of septic system maintenance would partially offset the sewerage cost, the existing project would only be economically feasible for residential property owners if significant grant funding is available, which is a strong likelihood.

Non-Residential Properties

Implementation of sewers would facilitate the community's vision of the Mastic and Shirley Main Street Business Districts and transitional zone that was described in the Town's **Montauk Highway Corridor Study and Land Use Plan for Mastic & Shirley**. The construction and availability of sanitary sewers in the Mastic-Shirley study area would trigger economic multiplier effects, according to the theory that a dollar spent within a regional economy will generate more than a dollar of economic activity through indirect and induced impacts. The construction of wastewater systems has an economic multiplier of 1.5 to 3.5, therefore the \$188 million in estimated capital costs would be expected to generate between \$288 million to \$670 million in ripple effect economic activities. The new business and residential activities that would be facilitated through the availability of sewers would have continuing multiplier effects. While the economic benefits to the larger community could be significant, they would not all accrue to the property owners within the Sewer District that would be paying for the sewer system. The new business and residential growth that could be facilitated by the availability of sewers would have continuing multiplier effects, although much of the benefit would be realized by businesses outside of the sewer district boundaries.

While accurately predicting the employment impacts of any sewerage project prior to detailed designs and cost estimates is not feasible, national statistics may be used to provide some estimates. Based upon national statistics and the estimated construction cost, it is estimated approximately 31 job-years could be generated by sewer district implementation. It is anticipated that at least two full time County employees would be needed for the District once the collection system is operational. The low-pressure components of the collection system will be maintained through a service contract, although the number of employees required for this service is unknown.

Water Quality Benefits

Sewering the Mastic-Shirley study area is anticipated to reduce nitrogen loading to area groundwater under existing conditions by approximately 201 pounds each day. Sewering would result in a significant improvement in shallow groundwater quality, and in the quality of groundwater baseflow

to the Forge River. Reducing nitrogen with this project aims to restore salt marsh and other tidal wetlands and expand growth of sub-aquatic vegetation such as sea grass and eelgrass, thus reducing the damaging effects of wave attack, storm surge, and flood height.

Section 1

Introduction

1.1 Background

Recognizing the need to protect the environment, and responding to community requests for downtown revitalization and more affordable housing while continuing to protect Suffolk County's groundwater supply, Suffolk County worked together with local community representatives to identify areas where investment in sanitary sewers and treatment facilities could provide environmental, economic and/or social benefits. The Suffolk County Sewer District/Wastewater Treatment Task Force (Task Force) established by the Suffolk County Legislature held a series of hearings throughout the County to identify "critical areas of need" where the potential for implementation of sewerage infrastructure should be evaluated based upon environmental improvement, economic revitalization or construction of workforce housing.

Currently, on-site septic systems and cesspools provide sanitary wastewater disposal for approximately 70 percent of Suffolk County. To protect the underlying sole source aquifer, the only source of potable water for the County's nearly 1.5 million residents, development density must be limited to prevent excessive nitrogen loads to the groundwater supply. In order to allow the development density that can support the types of downtown development that can provide economic revitalization without jeopardizing the sustainability of groundwater and surface water resources, sanitary wastewater must be collected and treated before discharge to the environment.

The Mastic-Shirley Corridor was one unsewered study area that was identified by the Task Force as a critical area of need for this project. Consequently, a Feasibility Study was prepared to document sewage collection and treatment and effluent discharge requirements, along with the associated capital and operation costs, and environmental and economic benefits. That report became the basis for this report focusing on the priority area.

This report modifies the Feasibility Report scope, cost estimates, and schedule of tasks as modified in August 2014. It references the proposed layout and design of the selected sanitary infrastructure, as well as the financial impacts.

1.2 Study Area Location and Description

Based on input received by the Wastewater Treatment Task Force, the original Mastic-Shirley study area consisted of the Montauk Highway Corridor. The study area encompassed properties located on the north and south sides of CR-80 (i.e. Montauk Highway) between the William Floyd Parkway and the Forge River. This area was identified primarily to allow the redevelopment and additional density required to benefit the local economy by promoting business development within the Mastic and Shirley Main Street Business Districts, as described in the Town of Brookhaven's **Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley**, Phases I and II (Town of Brookhaven, 2004, and Nelson, Pope & Voorhis, 2009).

In response to input provided by Legislator Kate Browning and additional comments received from stakeholders at the May 3, 2012 public meeting, the study area was expanded to address the community's environmental concerns and desire to improve the water quality of the Forge River. The study area was expanded to include the primarily residential areas located within the area contributing groundwater baseflow to the Forge River within a two year travel time.

The revised study area included 2,094 individual tax lots (2,893 single family equivalents). The study area generally extended along the Montauk Highway Business Corridor from just west of the William Floyd Parkway, east to the Forge River, and included most of the densely developed residential area within the two-year groundwater travel time to the Forge River and its tributaries from Sunrise Highway on the north to Poospatuck Creek on the south, as shown on **Figure 1-1**. It is possible that minor boundary conditions will be recognized during final design.

The Montauk Highway Corridor was characterized in the **Draft Generic Environmental Impact Statement to for the Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley, Phase II**, prepared by Nelson Pope & Voorhis (2010) as "commercial sprawl" with a mix of retail stores, businesses, and offices. The remainder of the study area is primarily residential in nature. The topography within the study area generally slopes downward from north to south and from west to east towards the water, with elevations ranging from approximately 50 feet to 0 feet above mean-sea-level (MSL). Groundwater is found at depths ranging from approximately 40 feet below ground surface (BGS) to less than 5 feet BGS according to data obtained from the United States Geological Survey (USGS).³

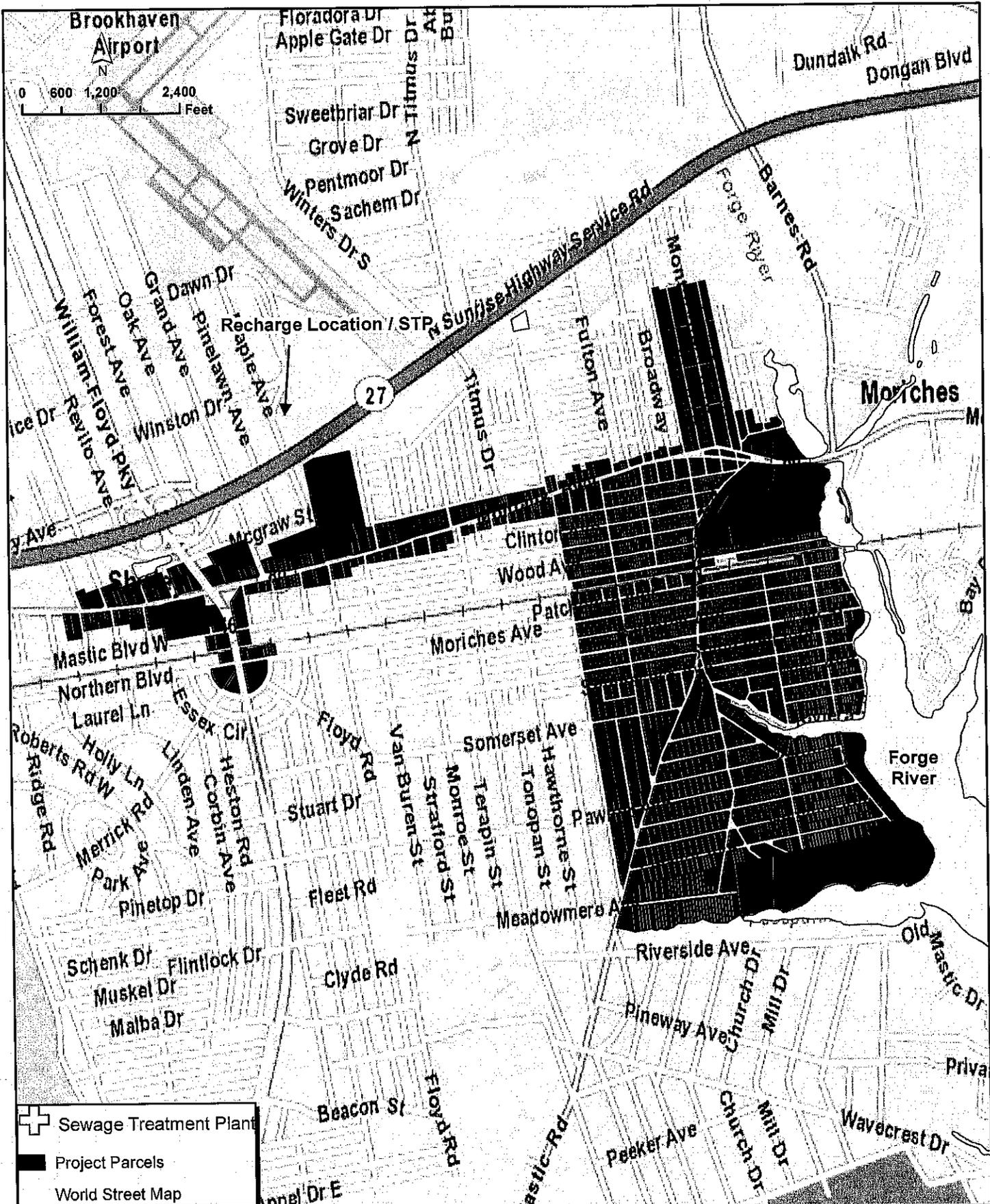
The eastern boundary of the study area consists of the Forge River and its tributaries. The River is an estuary that has been identified as an impaired water body and is included in the New York State Department of Environmental Conservation (NYS DEC) 303 (d) list for pathogens, nitrogen and dissolved oxygen/oxygen demand. Incorporation of the densely developed residential area in the western part of the Forge River watershed to the potential Sewer District boundary provides a significant environmental benefit which helps to satisfy the stakeholder goals associated with improving the water quality of the Forge River and increases the eligibility to receive funding from a variety of funding sources (NYS EFC, ESDC, CDBG-DR and HMGP). The funding allocation is discussed in Sections 5 and 6.

The southern boundary of the study area is the Poospatuck Creek running westerly past Mastic Road. Incorporation of the existing residential areas within the study area will both reduce nitrogen loading to the River, and will also prevent the release of other contaminants (e.g., pathogens and pharmaceuticals) that could be directly transmitted to surface waters during storm events if the septic systems are flooded. Provision of sanitary sewers to this area will also help to maintain the long term resiliency of this area as sea level rise in the coming decades reduces the separation distance between the septic systems and the groundwater table, further reducing the on-site system effectiveness along with restoration of the natural storm and wave buffers.

1.3 Sewering Objectives

Suffolk County residents depend completely on groundwater for their potable water supply. Consequently, the County has established a variety of programs to protect the aquifer system that

³ Depth-to-ground water information was obtained from the USGS Long Island Depth to Water Viewer, 2012.
<http://ny.water.usgs.gov/maps/li-dtw/>



Sewage Treatment Plant
 Project Parcels
 World Street Map

Suffolk County Department of
 Public Works
 Mastic/Shirley
 Sewering Feasibility Study
 CP 8189

FIGURE 1-1
 August
 2014

Mastic/Shirley
 Project Study Area

in association with:
CDM Smith

provides our water supply from contaminants that may be introduced by human activity. Sanitary wastewater is one of the most significant sources of nitrogen to the County's groundwater. Sanitary wastewater throughout most of the County is discharged to on-site wastewater systems, which are usually either septic systems or cesspools. Sanitary wastewater discharged to groundwater can introduce a variety of contaminants to the environment; nitrogen and pathogens are the two contaminants that have traditionally been the focus of attention, although other contaminants such as volatile organic compounds (VOCs), phosphates and pharmaceuticals and personal care products (PPCPs) are also of potential concern. In fact, sanitary wastewater is one of the most significant sources of nitrogen to the County's groundwater. The County has long recognized the importance of protecting the County's groundwater supply from the impacts of sanitary wastewater disposal.

Suffolk County has studied the issue of nitrate contamination from wastewater management for decades, as reported in documents such as the **Comprehensive Public Water Supply Study, Suffolk County, New York** (H2M, 1970), the **Long Island Comprehensive Waste Treatment Management Plan** (Nassau Suffolk Regional Planning Board, 1978), the **1987 Suffolk County Comprehensive Water Resources Management Plan** (Dvirka and Bartilucci, 1987) and most recently, the **2010 Suffolk County Comprehensive Water Resources Management Plan** (CDM, 2010). Each of these studies identified the maximum population density (or alternatively, minimum residential lot size) that would result in compliance with the 10 mg/L drinking water standard for nitrate, considering the nitrogen load that could be introduced to the aquifer from on-site disposal of sanitary wastewater in unsewered areas along with the nitrogen load from turf fertilization.

In response to the need to protect groundwater quality and the County's water supply, the County established sanitary sewer districts in some of the most densely developed parts of the County and constructed systems to collect and treat the wastewater and discharge the treated wastewater to ground or surface waters. In 1980, the County enacted Article 6 of the Suffolk County Sanitary Code to protect groundwater in areas of the County where sewers do not exist. Article 6 establishes minimum lot sizes of ½ acre or 1 acre for properties where residential development utilizing on-site wastewater disposal is planned, depending on the hydrogeological zone where the property is located. Article 6 also establishes population density equivalents (PDEs) for non-residential land use types.

Because the cost of land in Suffolk County is high, developers seek to build at a higher density per acre than is permitted by Article 6, to make development investments feasible. Similarly, the population density equivalents allowed by Article 6 do not typically provide sufficient capacity to allow establishment of 'wet' businesses such as restaurants that would support economic development in unsewered downtown areas.

In response to community requests to protect the environment, for downtown redevelopment and for more affordable housing while continuing to protect the County's groundwater supply and surface water resources, the County sought to identify areas where investment in sanitary sewers and treatment facilities could provide environmental, economic and/or social benefits. The Mastic-Shirley area was one of the areas identified by the Suffolk County Sewer District/Wastewater Treatment Task Force for evaluation of the feasibility of sanitary sewerage. Properties in the Mastic-Shirley study area are located within Suffolk County Groundwater Management Zone (GMZ) VI. The Suffolk County Sanitary Code limits sanitary wastewater in these unsewered areas to a maximum of 300 gallons per day per acre in GMZ VI (Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other than Single-Family Residents, Section 7). Much of the residential development in the study area was constructed prior to establishment of Article 6 of the Sanitary Code and exceeds the density limits identified in the Code.

The **Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley, Phase II** (Nelson, Pope & Voorhis, LLC, 2009) described the community's vision for increased density within the existing Main Street Business District areas along the corridor. In addition to the economic and social benefits that could result from redevelopment of properties in the area, stakeholders identified improvement of water quality in the Forge River as a second significant objective. The **Forge River Watershed Management Plan**, (Cameron Engineering & Associates, LLP, 2012) identified nitrogen from on-site wastewater systems as the most significant source of nitrogen loading to the Forge River.

1.4 Potential Benefits of Sewering

1.4.1 Social Benefits

The availability of sanitary infrastructure along the Montauk Highway Corridor will enable the community to implement the vision that has been articulated in the **Montauk Highway Corridor Study and Land Use Plan for Mastic & Shirley** (2004) and **Montauk Highway Land Use Plan for Mastic & Shirley, Phase II**. The plan describes redevelopment within the two existing Main Street Business Districts in Mastic and Shirley, with a less densely developed transitional zone between the two. Sewering will allow the addition of establishments such as full-service restaurants within the Main Street Business Districts. The convenience of having more densely developed walkable Main Street Business Districts along the corridor will help to create a greater sense of place and community for local residents.

1.4.2 Economic Benefits

Enabling high density commercial development the ability to occur based on the availability of sanitary infrastructure can result in significant economic benefits, as further described in **Section 6** of this document. Initial economic benefits would be attributed to the construction activities resulting from the installation of the supporting sanitary infrastructure and the re-development and development of businesses; and long term future economic benefits would be generated by increased employment opportunities and indirect economic activity resulting from the multiplier effect, although not all of the benefits will accrue to property owners within the study area.

1.4.3 Environmental Benefits

Wastewater generated within the Mastic-Shirley study area is currently discharged to groundwater through septic tanks and leaching pools, or directly through leaching pools. These discharges include a variety of contaminants contained in sanitary wastewater, including nitrogen, which can affect the quality of the underlying groundwater and the downgradient surface waters, including the Forge River, the Carmans River and Great South Bay. The **Forge River Watershed Management Plan** identified nitrogen loading from the residential areas that were developed prior to the establishment of Suffolk County Sanitary Code Article 6 density limitations as the most significant source of nitrogen loading to the Forge River and its tributaries. The river has been defined as the most eutrophic water body in the County.

Discharges from wastewater treatment facilities are treated to reduce the concentrations of these contaminants found in wastewater to meet permissible levels identified in State Permit Discharge Elimination System (SPDES) permits. Construction and operation of a sanitary sewer system would help to protect groundwater quality and downgradient surface water quality by treating sanitary wastewater to reduce the concentrations of contaminants, such as nitrate before they are introduced into the environment. Reducing nitrogen with this project aims to restore salt marsh and other tidal wetlands and expand growth of sub-aquatic vegetation such as sea grass and eelgrass, thus reducing

the damaging effects of wave attack, storm surge, and flood height. The reduction in nitrogen loading to the groundwater that could be expected to result from sanitary sewerage is 201 pounds per day, estimated to be a reduction in 15% of the load to the River.

1.5 Report Objectives

The purpose of this report is to provide the information needed to move forward with sewer funding opportunities, detailed design, financial/legal approvals, and sewer district formation. Specifically, this report will:

- Identify the sanitary sewage collection and treatment requirements necessary to make and provide wastewater treatment to the Mastic-Shirley study area;
- Estimate the capital and operation and maintenance costs associated with the implementation of the recommended infrastructure;
- Identify the schedule and legal requirements necessary for sewer district establishment, and
- Summarize the benefits that could result from sewerage.

Section 2

Work Plan and Project Development

2.1 Background

Recognizing the need to protect the environment, and responding to community requests for more affordable housing and downtown re-development, while continuing to protect the County's groundwater supply, Suffolk County sought to identify areas where investment in sanitary sewers and treatment facilities could provide environmental, economic and/or social benefits. Consequently, the Suffolk County Sewer District/Wastewater Treatment Task Force (Task Force) held a series of hearings throughout the County to identify "critical areas of need" where the potential for implementation of sewerage infrastructure should be evaluated based upon the potential for environmental improvement, economic revitalization and/or construction of workforce housing. Each "critical area of need" was identified based upon possible growth of businesses, the economy and jobs, provision of work force housing and/or protection of public health and the environment.

The Mastic-Shirley area was identified as a critical area of need, based upon potential economic, social and environmental benefits to the community. As part of the Feasibility Study prepared by CDM Smith, et al, March 2014, a number of tasks were completed and support this report.

2.2 Work Plan

Suffolk County developed a scope of work for the Suffolk County Wastewater Sewer Capacity Study (CP 8189) that included six tasks, each of which is briefly summarized below along with the seventh task resulting in decisions to modify the feasibility report for the focused area.

1. **Public Education and Outreach** – The Public Education and Outreach task includes attendance at stakeholder meetings and establishment and maintenance of a project website to provide project related documents, information and notification of upcoming events to the public. The website established for the Feasibility project is <http://suffolksewerstudy.cdmims.com/home.aspx>. The website includes a page where information pertaining to the Mastic-Shirley study area can be accessed.

A number of stakeholder meetings have been held to share project-related information and to obtain stakeholder input. Legislator Kate Browning and her staff, Brookhaven Town officials and community stakeholders provided input on objectives for sewerage the area, anticipated plans for future development and land use and the recommended location for a sewage treatment plant (STP) to treat wastewater generated within the study area. Legislator Browning proposed that the original study area be significantly expanded to include existing residential areas, to provide a greater benefit to area groundwater and the downgradient Forge River, and the County formally modified the study area accordingly.

Meetings with community stakeholders, Legislator Browning and the Town were held on:

- April 18, 2011 (Town of Brookhaven)
- October 21, 2011 (Town of Brookhaven)

- February 28, 2012 (Legislator Browning)
- May 31, 2012 (Legislator Browning hosted community stakeholders at the Mastic Firehouse)
- September 12, 2012 – (Legislator Browning)
- September 27, 2012 –(Legislator Browning hosted community stakeholders at the Mastic Firehouse)
- March 29, 2013 – (Legislator Browning)
- May 30, 2013 –(Legislator Browning and other stakeholders at SCPDW’s Yaphank office)
- October 2, 2013 (Legislator Browning hosted community stakeholders at the Mastic Firehouse)
- June 18, 2015 (Legislator Browning hosted community stakeholders at the William Paca Middle School)

In addition, a coordination meeting was held with SCPDW and Cameron Engineering and Associates, LLP to coordinate sewerage plans between the Mastic-Shirley and adjacent Center Moriches study areas.

2. Feasibility Study – Area-specific Feasibility Studies, including a Report/Map & Plan were prepared to document the sanitary sewerage infrastructure and associated costs that would be required for each of the seven study areas identified by the County. The Work Plan for the Feasibility Study included:

- Review of background information
- Coordination with stakeholders;
- Expansion of Mastic-Shirley study area to include the area contributing groundwater baseflow to the Forge River within a two year travel time;
- Expansion of the study area to include Mastic Beach Village and Smith Point at Shirley
- Establishment of design flows and organic loading for the Mastic-Shirley study area;
- Selection of an appropriate collection and conveyance system for the Mastic-Shirley study area;
- Identification of effluent limits and selection of treatment technology to achieve the required effluent limits;
- Establishment of required area for STP and effluent recharge and identification of potential STP site;
- Preliminary design of proposed collection system, STP and effluent recharge facilities;
- Estimate of capital and operational costs;
- Identification of the legal steps necessary to establish a Sewer District;
- Estimation of residential property owner affordability, and of the economic benefits that could result from implementation of a sanitary sewer system;
- Development of an implementation schedule;

- Documentation of the study, map, plan and report.

The Feasibility Study documented the costs and benefits associated with sewerage each study area, so that stakeholders could make an informed decision as to whether or not to proceed to implementation. The study was modified in August 2014 and again herein due to emerging details of the funding agencies.

3. Environmental Tasks – A Generic Environmental Impact Statement (GEIS) is being prepared to document the environmental impacts associated with potential future implementation of one or more of the sewerage programs identified in the Feasibility Studies. Working together with the SCDPW, the Suffolk County Planning Department and the Suffolk County Legislature, the Council on Environmental Quality (CEQ) first issued a Draft Scoping Document in July, 2011. A Public Scoping Hearing was convened on July 26, 2011 at 6:30 PM at Brookhaven Town Hall in Farmingville to provide an opportunity for public comment on the Draft Scoping Document. In addition, the Draft Scoping Document was posted on both the Suffolk County Planning Department website and the Suffolk County Sewer District Capacity website <http://suffolksewerstudy.cdmims.com>, and written comments were accepted through August 5, 2011. The Scope was revised for presentation to CEQ on August 17, 2011. Additional written comments were received after the deadline, and members of CEQ offered additional comments at, and after, the August CEQ meeting. The Final Scope includes the relevant issues identified during the public scoping process, including all comments received through August 23, 2011.
4. Geographic Information Systems (GIS) – The GIS task included development of a GIS database structure for the County’s sanitary sewage infrastructure, collection of all readily available information characterizing the sanitary sewer infrastructure present within the study areas and incorporation of all of this data into the SCDPW’s new GIS database.
5. Project Management – The Project Management task includes preparation of monthly progress reports, attendance at monthly progress meetings, preparation of subcontracts, preparation of monthly invoices and team coordination.
6. Deliverables – The Deliverables task includes printing of all project deliverables.
7. Based on evaluating the potential implementation of a viable project, the Feasibility Report was first modified in August 2014 to reflect the project area boundary including the Montauk Highway Corridor and the residential area between the Corridor, Forge River, Poospatauck Creek, and Cumberland Street. The work plan of the Feasibility Study was modified and herein further updated due to developments between August 2014 and May 2015. See Section 2.3.

2.3 Project Development

A general description of the original Mastic-Shirley study area, defined by SCDPW, is described in the excerpt from the RFP below:

“This area has been evaluated in the past and would run from west of William Floyd Parkway (Smith Road) to the Forge River along CR 80 – Montauk Highway including the business district to surrounding the Mastic Long Island Railroad Station. The proposed service area could produce 300,000 gallons per day. The length of this system is approximately 2 miles. It is noted that approximately 5 acres are required for this particular facility with two pumping stations. Benefits include steps to improve the quality of the Forge River, revitalization of the area with the potential of affordable and workforce housing along with other area economic developments.”

The original boundaries described in RFP encompassed approximately 141 acres located along a 1.8 mile stretch of Montauk Highway between William Floyd Parkway and the Forge River. These boundaries were based on prior planning studies conducted by the Town of Brookhaven (e.g., Montauk Highway Corridor Studies and Land Use Plans) as well as input received by the Task Force from community stakeholders. The initial objectives of sewerage for this area were focused on benefitting the local economy by promoting business development and the creation of a local “downtown” for the residents of Mastic and Shirley.

In response to input provided by Legislator Kate Browning and additional comments received from stakeholders at the May 3, 2012 public meeting, the study area was expanded to address the community’s environmental concerns and desire to improve the water quality of the Forge River. The study area was expanded to include primarily residential areas located within the area contributing groundwater baseflow to the Forge River within a two year travel time. Much of this area was developed prior to implementation of Article 6 of the Suffolk County Sanitary Code and exceeds the density established for Groundwater Management Zone (GMZ) VI. The expanded study area is shown by **Figure 1-1**.

Many systems in this project area that were not subjected to surface water flooding were located in areas proximal to surface water flooding and in areas of very shallow groundwater. Water table elevations rise throughout this project area in response to extreme rainfall and tidal flooding events, causing groundwater to enter many of the systems in shallow groundwater areas. When groundwater enters these systems, system hydraulic capacity is significantly reduced, thereby inhibiting or eliminating system treatment capability for extended periods.

2.4 Baseline Groundwater Quality Assessment

As previously discussed in **Section 1**, protection of the County’s sole source aquifer and drinking water supply is the primary driving force behind the County’s Sanitary Code restriction of the density of on-site wastewater disposal. Because groundwater in the study area ultimately discharges to the Forge River, the protection of groundwater quality also helps to protect downgradient surface water quality. Nitrogen loading under existing land use conditions was estimated for the Mastic-Shirley study area. Existing zoning, available land use information and typical sanitary wastewater loading rates were incorporated into a spreadsheet loading model to estimate the nitrogen load associated with each property in the study area, and to estimate the total nitrogen load resulting from sanitary wastewater discharge to groundwater under existing conditions.

All nitrogen loads to the Mastic-Shirley area (e.g., sanitary loads, fertilizer loads, and atmospheric loads) were also estimated for incorporation into a groundwater modeling assessment of nitrogen levels in the Forge River watershed.

2.4.1 Nitrogen Loading

The assessment to estimate the nitrogen loading reduction that could be expected to result from provision of sanitary sewers focused on the total nitrogen load introduced to groundwater from on-site septic systems. Based on Suffolk County land use data, most of the Mastic-Shirley study area lots are residential, although the design flows are similar from the total of residential and commercial lots with the residential nitrogen being higher than the commercial load.

2.4.1.1 Discharge from Septic Systems

Residential Properties

Nitrogen load from residential land uses was calculated as follows:

- Assume 3.5 people per household (from Forge River Watershed Management Plan, 2012)
- Apply a residential mass loading rate of 10 lbs./N per person per year
- Assume that 35% of the nitrogen is removed in the septic system

The nitrogen load due to septic discharge from each household is calculated as follows:

$$\left(10 \frac{\text{lbs} - \text{N}}{\text{peron} - \text{year}}\right) \times \left(\frac{3.5 \text{ persons}}{\text{household}}\right) \times \left(\frac{1 \text{ year}}{365 \text{ days}}\right) \times (0.65) = 0.0623 \frac{\text{lbs} - \text{N}}{\text{day}}$$

Therefore, each residential lot receives a load of 0.0623 lbs. of nitrogen due to septic discharge. For purposes of this analysis, it has been assumed that there is one household per lot, although two family homes are a possibility.

Commercial/Industrial/Institutional Land Uses

For commercial, industrial and institutional land uses, nitrogen loading was calculated utilizing SCDHS design flows (gpd/so) based on the type of facility present. For those parcels, the approximate building footprint was determined from an aerial survey and was multiplied by the corresponding flow rate (gpd/so).

The average daily water use was multiplied by 25 mg/L, which is an assumed representative wastewater nitrogen concentration leaving the septic system. This was calculated using typical sanitary wastewater influent concentrations found in the literature (approximately 40 mg-N/L; Metcalf & Eddy, 2003) reduced by a removal percentage in the septic system (approximately 35 percent).

In summary, nitrogen loads from commercial, industrial, and institutional properties were calculated as follows:

$$\left(25 \frac{\text{mg} - \text{N}}{\text{L}}\right) \times \left(\frac{\text{gallons}}{\text{day} - \text{sf}}\right) \times (\text{sf}) \times \left(\frac{3.785 \text{ L}}{\text{gallon}}\right) \times \left(\frac{1 \text{ lb}}{453,592.4 \text{ mg}}\right)$$

2.4.1.2 Loading from Fertilizer Application

For residential land uses, additional nitrogen loading associated with fertilizer application has been incorporated into the modeling assessment. Various estimates of fertilization are found in the literature ranging from 3.0 pounds per year per 1,000 square feet (USEPA), 2.5 pounds per year per 1,000 square feet (Dvirka and Bartilucci, 1987) to 1.08 to 3.0 pounds per year per lawn (average lawn = 5,000 sq. feet; Massachusetts DEP and SMAST, 2007).

The **1987 Suffolk County Comprehensive Water Resources Management Plan** (Dvirka and Bartilucci, 1987) reported a nitrogen application rate from fertilizer of 2.5 pounds per year per 1,000 square feet. The Forge River Management Plan (2012) is consistent, and includes an application rate of 2.4 pounds of nitrogen per year per 1,000 square feet. In order to estimate a nitrogen contribution to groundwater, a leaching rate must also be assumed. The Massachusetts Estuaries Project utilized a groundwater leaching rate of 20 percent (Massachusetts DEP and SMAST, 2007).

For this study to account for nitrogen load from fertilizer, a 20 percent leaching rate was assumed, using a nitrogen application rate of 2.4 lbs./1,000 sq. ft./year (consistent with the Forge River Management Plan). Fertilization is applied to residential land uses and is applied to a percentage of each parcel, depending on housing density as listed below:

Percent of parcel fertilized:	Low density residential:	12%
	Medium-density residential:	34%
	High-density residential:	10%

These percentages are based on a brief desktop analysis of the lot percentage available for fertilization using land use data and aerial photographs from areas within the Forge River watershed. Note that low density residential parcels generally have significant portions of wooded areas which would not be fertilized. It is assumed that every residential parcel is applying fertilizer. This is almost certainly not the case in reality, so this represents a conservative approach with respect to fertilizer loading in residential areas.

Nitrogen loading due to fertilizer application for non-residential land uses was not included in this analysis, based on aerial surveys. Many of the commercial facilities are located along the Montauk Highway Corridor and have large areas of impervious cover with very little turf area. In addition, most of the 66 acres of institutional land use within the study area is attributed to a single 55 acre parcel, the Poospatuck Reservation (although made up of dozens of homes within the community). Based on apparent lawn conditions from an aerial survey across the study area, it is assumed that little fertilizer is applied to the reservation site.

While it is likely that fertilizer is being applied at some commercial and institutional land uses, it is assumed that the assumption of all residential parcels applying fertilizer will account for discrepancies in the total load. Similarly, fertilizer may be applied to recreation and open space land uses, but based on an aerial survey, most of the land comprising this category is open space (no fertilizer applied).

In summary, nitrogen loads from fertilizer was calculated as follows:

$$\left(2.4 \frac{\text{lbs} - \text{N}}{1,000 \text{ sf/yr}} \right) \times \left(\frac{1 \text{ year}}{365 \text{ days}} \right) \times (\text{sf of lot}) \times (\% \text{ of lot fertilized}) \times (0.20)$$

2.4.1.3 Atmospheric Deposition

Although atmospheric nitrogen loading is not affected by sewerage, it was also estimated for each parcel within the study area to provide a more complete assessment to evaluate groundwater quality. The precipitation weighted annual mean nitrogen concentration from the National Atmospheric

Deposition Program (NADP) station in Southold was multiplied by a recharge flow rate and applied across all parcels. Assuming that 24 inches per year is recharged to the aquifer on an annual average basis, the corresponding flow rate is 0.04 gpd/sf. Although much of the parcel area, particularly in commercial areas, is impervious cover and the rainfall will not infiltrate at the site, the load to the overall study area would not likely change very much because the runoff would ultimately be infiltrated somewhere within the watershed. The nitrogen load resulting from atmospheric deposition was calculated as follows:

$$\left(0.258 \frac{\text{mg} - \text{N}}{\text{L}}\right) \times \left(0.04 \frac{\text{gallons}}{\text{day} - \text{sf}}\right) \times (\text{sf of parcel}) \times \left(\frac{3.785 \text{ L}}{\text{gallon}}\right) \times \left(\frac{1 \text{ lb}}{453,592.4 \text{ mg}}\right)$$

During the growing season, a portion of the nitrogen load is lost to plant uptake and would therefore be lower during the growing season. However, since this contribution to the overall nitrogen load is very small compared to the load resulting from sanitary wastewater discharge, the difference will not be significant. Atmospheric loading was the only load applied to vacant and transportation land uses for this evaluation.

2.4.2 Results

A summary of the estimated nitrogen loading to groundwater from on-site wastewater disposal systems based on existing land uses is provided in Table 2-1 of the Feasibility Study. Approximately 90 percent of the nitrogen load discharged to groundwater within the Forge River watershed is contributed by existing residential land, and less than 5 percent of the nitrogen load conveyed to the Forge River via groundwater originated from non-residential lots. If all of the currently vacant, residentially zoned parcels within the study area were to be developed in the future, the nitrogen load to the groundwater would be significantly higher. It has been calculated that sewerage will reduce nitrogen loads to the Forge River by 201 lbs. per day, representing a 15% reduction. Reducing nitrogen with this project aims to restore salt marsh and other tidal wetlands and expand growth of sub-aquatic vegetation such as sea grass and eelgrass, thus reducing the damaging effects of wave attack, storm surge, and flood height.

Section 3

Technical Information

3.1 Wastewater Flow Analysis

3.1.1 Introduction

One of the key pieces of information required to select and size sanitary wastewater collection, conveyance and treatment infrastructure is the rate of wastewater generation within the study area. The wastewater flow rate is part of the basis of design for both the collection system and the wastewater treatment plant.

There are several alternative approaches that can be used to project future wastewater generation rates. For developed areas where significant changes in land use are not anticipated in the future, existing water records may be used to estimate wastewater flow. For developed areas where future redevelopment plans are in place, or undeveloped areas where development plans have been established, zoning and Suffolk County Department of Health Services (SCDHS) design criteria found in the County's Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other than Single Family Residences may be used to estimate wastewater flow rates. For developed and undeveloped areas without specific redevelopment plans, wastewater flow generated in other similar existing developed areas may be used as the basis for estimating future wastewater flow.

In order to adequately size the sanitary infrastructure for the Mastic-Shirley study area, the flow projections must consider the effects of future development and the expansion of businesses that the new sanitary infrastructure would allow.

Since the Mastic-Shirley study area consists of a combination of existing occupied and unoccupied properties, and areas where re-development could be stimulated by the provision of sanitary infrastructure, the selected wastewater flow projection approach estimates future sanitary flow from zoning and SCDHS design criteria.⁴ The projections of future development are based on existing zoning limitations and land use classifications and the design criteria associate sanitary flow with property usage, build out and occupancy. Appendix A of the Feasibility Study includes a copy of the SCDHS design criteria used to project future sanitary flows from the Mastic-Shirley study area.

3.1.2 Methodology

The maximum projected build-out for currently undeveloped commercial properties located along the Montauk Highway business corridor are based on the adopted zoning changes described in the **Final Generic Environmental Impact Statement for the Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley Phase II** as a supplement to the **Generic Environmental Impact Statement for the Montauk Highway Corridor and Land Use Plan for Mastic and Shirley, NY** prepared for the Town of Brookhaven (Nelson, Pope & Voorhis, LLC, September 2010). Maximum build-out for all remaining properties in the study area is based on current zoning restrictions and New York State Land Use Classifications.

⁴ SCDHS sewage design criteria are provided in Table 1 of the "Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences." July 15, 2008.

New York State Land Use Classifications describe the primary use of a property on a tax assessment roll. Properties within New York State (NYS) are categorized by one of the following nine classifications:

- NYS Land Class. 100 – Agricultural
- NYS Land Class. 200 – Residential
- NYS Land Class. 300 – Vacant Land
- NYS Land Class. 400 – Commercial
- NYS Land Class. 500 – Recreation & Entertainment
- NYS Land Class. 600 – Community Services
- NYS Land Class. 700 – Industrial
- NYS Land Class. 800 – Public Services
- NYS Land Class. 900 – Wild, Forested, Conservation Lands & Public Parks

Each classification listed above is identified by a three digit numerical code. The first digit identifies the land use category; the second digit represents a division within that category. The third digit is used to represent a sub-division of a particular division. The “0” number is used when the description of a particular property is not defined clearly enough to identify it by the division and/or sub-division levels. The properties that make-up the Mastic-Shirley Sewer District, summarized by their New York State Land Use Classification Code, are listed in Table 3-1 of the Feasibility Study.

Suffolk County Department of Health Services (SCDHS) design wastewater generation and organic loading rates associate sanitary wastewater generation to building occupancy and building gross square footages. Residential wastewater flow projections are based on the SCDHS single family equivalent wastewater generation rate of 300 gpd/residence for single family detached residences. Sanitary flow projections for attached residences (i.e. townhouses, condos, co-ops, apartments, hotels, motels, etc.) are based on the number of units and the square footage of each unit. Comparative data is also used to determine occupancy ratings for undeveloped properties based on their NYS Land Use Classification and existing zoning. Flow projections for all other commercial property types are based on the gross floor area of existing buildings located on the specific tax lots.

The determination of maximum allowable gross floor area for undeveloped/vacant commercial properties is based on the floor-area-ratio⁵ (FAR) associated with the local zoning code. The maximum allowable FARs for commercial and industrial properties located in the Mastic-Shirley study area is summarized in **Table 3-1**.

Table 3-1 - FAR Zoning Restrictions

Town Zoning Code	Classification Description	Maximum Allowable Stories/Height	FAR (%)
J-6	Highway Limited Business	2 / 30 ft.	30
J-5	Gasoline Filling Station	1 / - ft.	25

⁵ Floor-area-ratio (FAR) is the total building square footage divided by the site size square footage.

J-2	General Business	3 / 50 ft.	50
L-1	Industrial	3 / 50 ft.	60

In many instances, these maximum FARs cannot be achieved due to property line set back requirements stipulated by the local zoning code. The future wastewater flow projections for undeveloped properties in the Mastic-Shirley study area considered the set back limitations required by zoning to avoid overestimation of future wastewater flows.

3.1.3 Wastewater Flow Summaries for Mastic-Shirley Area

Wastewater flow projections for the Mastic-Shirley study area utilized the property type classification, Town zoning and Department of Health Standards to develop the residential and commercial flows, as well as vacant land development. The residential parcels total 1,815 while the area total residential single family equivalent units total 2,893. The resulting flow for design purposes is based on Health Department Standards of 300 gpd/unit with an assignment of approximately 90,000 gpd build-out and a 5% contingency resulting in a design flow of nearly 1 million gallons per day. Minor refinement of the lots to be served may occur during final design.

3.2 Proposed Collection and Conveyance System

3.2.1 Introduction to Collection and Conveyance System Options

Sanitary wastewater collection systems are used to collect and convey wastewater generated from individual properties to treatment facilities to remove contaminants of concern prior to discharge back to the environment. The layout and design of collection systems in Suffolk County are typically done in accordance with the *10 States Recommended Standards for Wastewater Treatment Facilities*, and SCDHS and Suffolk County Department of Public Works (SCDPW) design standards.

Several different collection system options were considered to identify the most appropriate alternative for the Mastic-Shirley study area. The main driving force behind the selection of a collection system alternative and collection system design is the local topography, as further explained in **Section 3.2.4**. Groundwater elevations, construction costs and operation and maintenance requirements are other important considerations. The collection system(s) must be designed to convey both the daily flow and peak hourly flow that will be generated by properties within the proposed sewer district.

The three different types of collection systems considered for the Mastic-Shirley Sewer District (District) are:

- Option I: Gravity Sewers
- Option II: Vacuum Sewers
- Option III: Low Pressure Sewers

Each of these collection system alternatives has a range of applicability; therefore each alternative was evaluated to identify the most appropriate option for sewerage the area. Based on the Feasibility Study, only gravity and pressure sewers are to be used, thus the vacuum sewer discussion is not presented further.

3.2.2 Option I - Gravity Sewers

Most sewers in the United States are gravity sewers (USEPA, WEF) that are designed to use gravity to convey sanitary wastewater from its source to a treatment facility. Gravity sewers are appropriate for areas where the pipe installation can follow the natural inclines of the terrain so that wastewater can flow to a treatment facility or intermediate pump station strategically located at a low point in the landscape. The gravity sewer main is situated such that wastewater flow follows the pitch of the pipe all the way to the treatment facility and/or intermediate pump station; the major advantage of this collection system option is its autonomous operation – once in place, the system does not require pumping or other energy inputs to operate. No on-site wastewater storage or pumping is required to convey flow from the connecting properties to the sewer main. The slope of the gravity sewer must be steep enough to maintain a self-cleansing velocity in order to prevent clogging and decay of untreated wastewater within the sewer pipe. Periodic cleaning and pipe inspections are the only routine maintenance activities necessary. Gravity sewers are typically configured with one main sewer line running the length of a street with branch laterals connecting each abutting property to the main line.

Gravity sewers can also be installed in areas with varying terrain. This is accomplished by locating pump stations at intermediate low points to convey the collected wastewater to another gravity-flow segment of the collection system or directly to a treatment facility via selected sewage pump and force main. These pump stations are powered by electricity and provisions must be made so that continuous operation can be maintained during periods of power outage. Installing gravity sewers in areas with varying terrain increases the capital and operational costs of the system, due to both the deep excavations that are required as well as the cost of constructing and operating intermediate pump stations. Another major disadvantage of gravity sewers is the need to open-cut the entire length of roads where the pipe installation is to occur, which increases excavation, dewatering and site restoration costs.

3.2.3 Option II – Low Pressure Sewers

Low pressure sewer systems are a third option that is applicable in relatively flat areas or where the groundwater table is high. The Village of Patchogue is served by low pressure sewer systems in areas where both the groundwater table is shallow and topography does not lend itself to the use of gravity sewers. Low pressure sewer collection systems require each property within the collection area to operate and maintain an on-site grinder pump station. All grinder pump stations are connected to a pressurized sewer main, which conveys wastewater generated within the collection area directly to a treatment facility, to a gravity sewer or to an intermediate centralized pump station.

The wastewater generated from each property flows by gravity into an onsite storage tank. The onsite storage tank is fitted with level sensing equipment and a submersible positive displacement grinder pump. Positive displacement pumps are able to achieve near constant flow at the wide range of head conditions typical of low pressure sewer collection systems. However, certain applications allow the use of submersible centrifugal pumps. The grinder pumps are turned on when a pre-set fill level is sensed in the storage tank, and turned off after the storage tank is drained to a low level condition. The pump cycles are controlled by the capacity of the onsite wet well, the real-time pressure within the common sewer main and the daily wastewater generation rate of the property.

The size of the sewer mains used in a low pressure collection system is based on flow and head requirements and to maintain a self-cleansing velocity. The sizes of the low pressure sewer mains

range from 2-inch diameter HDPE piping to 4-inch diameter HDPE piping. Similar to vacuum sewers, low pressure sewers can also be installed at shallow depths and do not need to follow the natural grade of the terrain. Directional drilling can be used to install low pressure sewers, which is advantageous in developed areas and locations with shallow depths to groundwater so as to minimize road excavation, restoration, and dewatering.

3.2.4 Selection of Collection and Conveyance System

Topography within the Mastic-Shirley study area generally trends from north to south and west to east towards the Great South Bay and Forge River. Groundwater elevation data obtained from the United States Geological Survey (USGS) depicts depth-to-groundwater to range from less than 11 feet below grade near the Forge River, to 11 to 30 feet below grade for more inland properties, and 31 to 50 feet below grade along the Montauk Highway commercial corridor. Analysis of the topography and USGS groundwater data has resulted in the selection of a hybrid collection system, consisting of low pressure and gravity sewers, as the most feasible option for wastewater collection in the Mastic-Shirley study area. Vacuum sewers were eliminated from consideration due to the relatively high operation and maintenance costs associated with these systems, as well as lack of local operator experience.

3.2.5 Collection System Overview

Intermediate high and low points located throughout the study area were used to subdivide the area into drainage zones. Each drainage zone was created to maximize the use of gravity sewers by encompassing areas where existing roadway configurations followed the natural slopes of the terrain. This helps to minimize the depths of sewer installation and minimize the total number of drainage zones. This analysis resulted in the identification of eight separate drainage zones within the study area.

The entire commercial corridor located along Montauk Highway and the majority of residential lots that make up the District will be served by gravity sewers.

Areas within each drainage zone where USGS data indicated groundwater to be less than 10 feet below grade were identified to be serviced by low pressure sewers. These areas mainly include properties located in close proximity to the Forge River and its tributaries. Properties located on the Poospatuck Reservation will also be serviced by low pressure sewers due to their proximity to the Forge River, anticipated shallow groundwater conditions and non-conforming build-out conditions to current building code standards. The house laterals and abandonment of the on-site system are included in the project cost. A commercial incentive program is being considered.

3.2.5.1 Preliminary Low Pressure Sewer Collection System Design

The low pressure sewers proposed to service the Mastic-Shirley Sewer District will consist of approximately 3,000 linear feet of parallel 3-inch diameter DR-11 HDPE low pressure mains and approximately 7,000 linear feet of singular 3-inch diameter DR-11 HDPE low pressure mains. The low pressure sewer mains will be installed approximately 6 feet below grade to provide the required clearances between existing utilities. Each property within the study area that will be serviced by a low pressure sewer will be connected to the low pressure sewer mains by either a 1 ¼" or 2" diameter HDPE building connection. Each building connection will include a lateral assembly consisting of a buried check valve and curb stop located at the property line.

These lateral assemblies are intended to eliminate potential backflow from the low pressure sewer mains to the onsite grinder pump stations and provide a way to shut individual property services off from the rest of the collection system. The size of the building connection piping is based on the pump station configuration used at each individual property. Each grinder pump station will be dedicated to one individual tax lot; these stations cannot be shared by property owners to avoid liability issues that can result during future maintenance and/or repair activities.

Each low pressure grinder station will be sized based on the estimated average daily wastewater generation rate expected from the property that it will serve. The proposed pump stations will be configured to operate with one, two, three or four duty pumps; the configuration selected is based on the average daily and peak hourly flows expected from each property. On-line standby spare pumps will be included in each pump station to satisfy SCDHS redundancy requirements.

The pumps used within the onsite low pressure grinder stations will be either positive displacement or centrifugal grinder type pumps. Either pump type will operate on a single speed controller and be capable of running off of portable emergency power back-up generator(s) during utility power outages. The operation of the emergency standby generators will be the responsibility of sewer district operation and maintenance personnel, not the individual property owners. Each pump station will be located either inside the basement of the building it serves or buried outside in the vicinity of the existing onsite septic system or cesspool. The locations of each grinder station will be determined on a case by case basis to minimize modifications to each building's existing plumbing configuration and minimize the duration of the disturbance to each individual property owner.

Low pressure sewer cleanouts will be located approximately 300 feet apart along each stretch of low pressure sewer main installed. Air release manholes and drain manholes will be located at all relative high and low points throughout the low pressure sewer network, respectively. Parallel force mains will be installed in areas where high flows are expected and along streets that have connecting properties located on both sides. Areas where parallel force mains are installed will require cross-over manifolds (see **Figure 3-1**) to provide a built-in by-pass capability to maintain operation during maintenance activities and repair work. Singular mains will be run in areas where low flows are expected and/or where properties connecting to the sewer service abut only one side of the street.

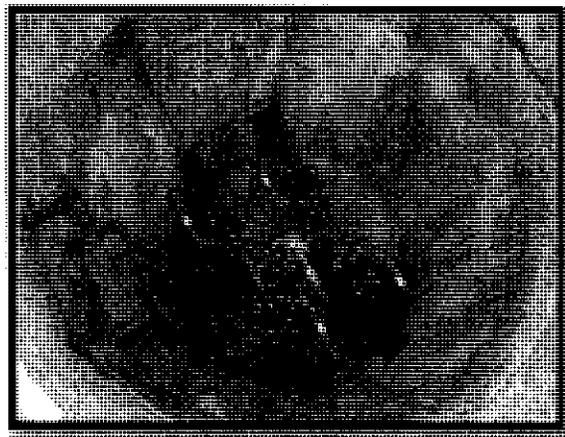


Figure 3-1 – Typical Low Pressure Cross-Over Manifold for Parallel 3-Inch Diameter LPS Mains

The proposed low pressure collection system will be installed within right-of-ways and will be routed towards gravity sewers that drain to a local pump station within each drainage zone. The final locations of all force mains, laterals, valves, manholes and cross-over manifolds will be determined during the engineering design phase so that they can be coordinated with all final building connection locations and utility crossings to avoid potential conflicts.

All cleanouts, air release manholes, drain manholes and cross-over manifolds will be required to transition from HDPE pipe material to class-53 ductile iron pipe at each location. All manholes will be constructed to meet H-20 load ratings, and all castings will be SCDPW approved.

3.2.5.2 Preliminary Gravity Sewer Collection System Design

The proposed gravity sewer collection system serving the proposed district will consist of approximately 87,700 linear feet of 8-inch diameter, 14,700 linear feet of 10-inch diameter, 6,400 linear feet of 12-inch diameter and 3,400 linear feet of 20-inch diameter DR-18 PVC gravity sewer piping. Each property within the study area serviced by gravity sewers will be connected by either a 6-inch diameter or 8-inch diameter DR-18 PVC building lateral. Gravity sewer mains will be installed at depths no less than 6 feet below grade to provide the required clearances between existing utilities and maintain sufficient slope to facilitate a self-scouring velocity within the pipe. This minimum depth will also ensure positive drainage through each building lateral connection.

All sanitary gravity sewer manholes will be located in accordance with the minimum distances recommended in the *10 States Recommended Standards for Wastewater Treatment Facilities*. Distances between manholes along sewer mains that are 15-inches in diameter or less will be no greater than 400 linear feet. Distances between manholes will be limited to 500 linear feet for sewer mains between 18-inch and 20-inch diameter. All gravity sewers will be located within the right-of-ways and drain towards the pump station in their respective drainage zone. Approximately 410 manholes are proposed to service the gravity-sewered portions of the study area, consisting of 343 four foot diameter manholes and 67 five foot diameter manholes. The five foot diameter manholes will be located where 3 or more gravity sewer mains intersect at roadway junctions and all locations where proposed force mains and low pressure sewers discharge to the gravity collection system. All manholes will be constructed to meet H-20 load ratings, and all castings will be SCDPW approved.

3.2.6 Conveyance System Overview

Flow collected in each drainage zone will drain to its own pump station. The preliminary pump station sites have been located at intermediate low points on publicly owned properties. Each pump station will be designed to convey flow directly to the tributary sewers of the treatment plant's influent pump station via force main. Designing each pump station to pump directly to the treatment plant's influent pump station will eliminate numerous "stepped" pumping configurations (i.e. where one drainage zone pumps into another and then another and continues in this fashion until the total flow from the District is ultimately conveyed to the treatment facility). Eliminating the stepped pumping scenario minimizes pump horsepower requirements, eliminates interdependence between pump stations in different drainage zones and reduces the overall impact to the District in the event a pump station(s) is out-of-service for an extended period of time.

3.2.6.1 Preliminary Conveyance System Design

Each of the proposed pump station sites will occupy a minimum area of 2,500 square feet. Additional space may be required at some locations to facilitate site access and storage of materials and

equipment during construction activities. The pump station located in Drainage Zone II (DZ-II) will serve as the influent pump station to the proposed treatment facility. This pump station will be provided with dual force mains and a chambered wet well to provide operational flexibility during initial low flow periods. All other pump stations will require single chamber wet wells and singular force mains. The storage capacity of each pump station will be based on the anticipated average daily design flow. The pump sizes will be sized to handle the peak hourly flows anticipated within each drainage zone.

The force mains will consist of approximately 2,700 linear feet of 4-inch diameter DR-18 PVC piping, 7,000 linear feet of 6-inch diameter piping DR-18 PVC piping, approximately 6,500 linear feet of 8-inch diameter piping DR-18 PVC piping, approximately 5,000 linear feet of 10-inch diameter piping DR-18 PVC piping, and approximately 4,700 linear feet of 16-inch diameter DR-18 PVC piping. All force mains will be installed at a minimum depth of 4 feet below grade surface. Common trenches will be used to minimize construction costs when the locations of the force mains coincide with the proposed gravity sewers and low pressure sewers.

Cleanouts will be located at distances of approximately 400 linear feet and at locations where bends in the force main exceed 45 degrees along the entire route. The pipe material will be required to transition from PVC to class 53 ductile iron at locations where fittings and cleanouts will be installed. Thrust blocking will also be required to prevent separation of pipe materials in locations where fitting bends exceed 45 degrees. Air release manholes and drain manholes will also be installed at relative high and low points, respectively, along the force main routes to minimize the potential for pressure surges and water hammer.

Each proposed pump station site will include a pre-cast concrete wet well, pre-cast concrete valve and flow meter pits, a pre-cast concrete control building and emergency back-up generator. The emergency back-up generators will be sized to meet the electrical demands of all equipment installed at each pump station site. These generators will be constructed with sound attenuating enclosures to minimize disturbances to the surrounding areas. The proposed pre-cast concrete control building(s) will be designed with exterior architectural accents to blend in with the surrounding area(s). All of the proposed pump station sites will be fenced off to inhibit vandalism, and landscaping will be used to provide natural screening of the structures and generator.

Each wet well will be provided with submersible pumps that will be variable speed controlled and capable of passing 3-inch diameter solids, minimum. Redundant stand-by pumps will also be provided in accordance with the requirements of the SCDPW and SCDHS. The control panels for each pump station will be located inside of each pre-cast concrete control building. All pump stations will also be provided with odor control systems, since many of the sites are located in close proximity to residential properties, to minimize the potential for nuisance odors to migrate offsite. The use of natural gas powered generators will also be implemented to the maximum extent possible where gas utility service is available. In those parts of the study area where natural gas is unavailable, the use of diesel powered generators may be required.

The Feasibility Report included the preliminary collection and conveyance system layout within the proposed sewer district. It is noted that the Feasibility Study considered a phased project where this report has one project previously defined as Phase I and Phase II of the Feasibility Report.

3.2.7 Wastewater Design Flow Analysis

The projected average design flow (ADF) within each drainage zone is based on the approach described in Section 3.1.1. The ADF, broken down by drainage zone for the 2,094 parcels, are summarized in **Table 3-2** below.

Table 3-2 - ADF Summary by Drainage Zone

Drainage Zone ID	Projected Flow (gpd)
DZ-I	29,227
DZ-II	105,575
DZ-III	111,881
DZ-IV	138,919
DZ-V	150,160
DZ-VI	104,623
DZ-VII	63,859
DZ-VIII	163,903
Totals:	Approximately 900,000

In addition to ADF projections, peak hourly flows must also be calculated in order to size collection and conveyance systems to accommodate potential flow surges through the infrastructure. These flow surges are attributed to the diurnal water use cycles that occur throughout each day. The peak water usage during each day is typically found to be inversely related to the population within a sewer area. The determination of peak hourly flows is also dependent upon the type of collection system. As indicated in **Figure 3-2**, numerous pumping stations discharge to the sewers of other drainage zones and must be pumped again.

3.2.7.1 Peak Hourly Design Flow Analysis for Gravity Sewered Areas

Peak hourly flows from areas serviced by gravity sewers are based on paragraph 11.243 – *Hydraulic Capacity for Wastewater Facilities to serve New Collection Systems* in the **10 States Recommended Standards for Wastewater Treatment Facilities**. This methodology identifies the peak hourly flow rate from gravity sewers as a function of the population served. 10 States Standards recommends using a per capita flow rate, equal to 100 gpd/capita, to determine the population equivalent for a particular service area. The 100 gpd/capita flow is “intended to cover normal infiltration for systems built with modern construction techniques.”

The formula used to calculate the peak hourly flow for the gravity sewer portions of each drainage zone is provided below:

$$PF = (18 + SP) \div (4 + SP)$$

PF = Ratio of Peak Hourly Flow Rate to Average Daily Flow Rate

P = Population in Thousands

The population equivalent, based on the 10 States Standards recommended per capita flow rate of 100 gpd/capita, is calculated as follows:

$$P \div 1000 = ADF \div 100 \text{ gpd/capita}$$

P = Population in Thousands

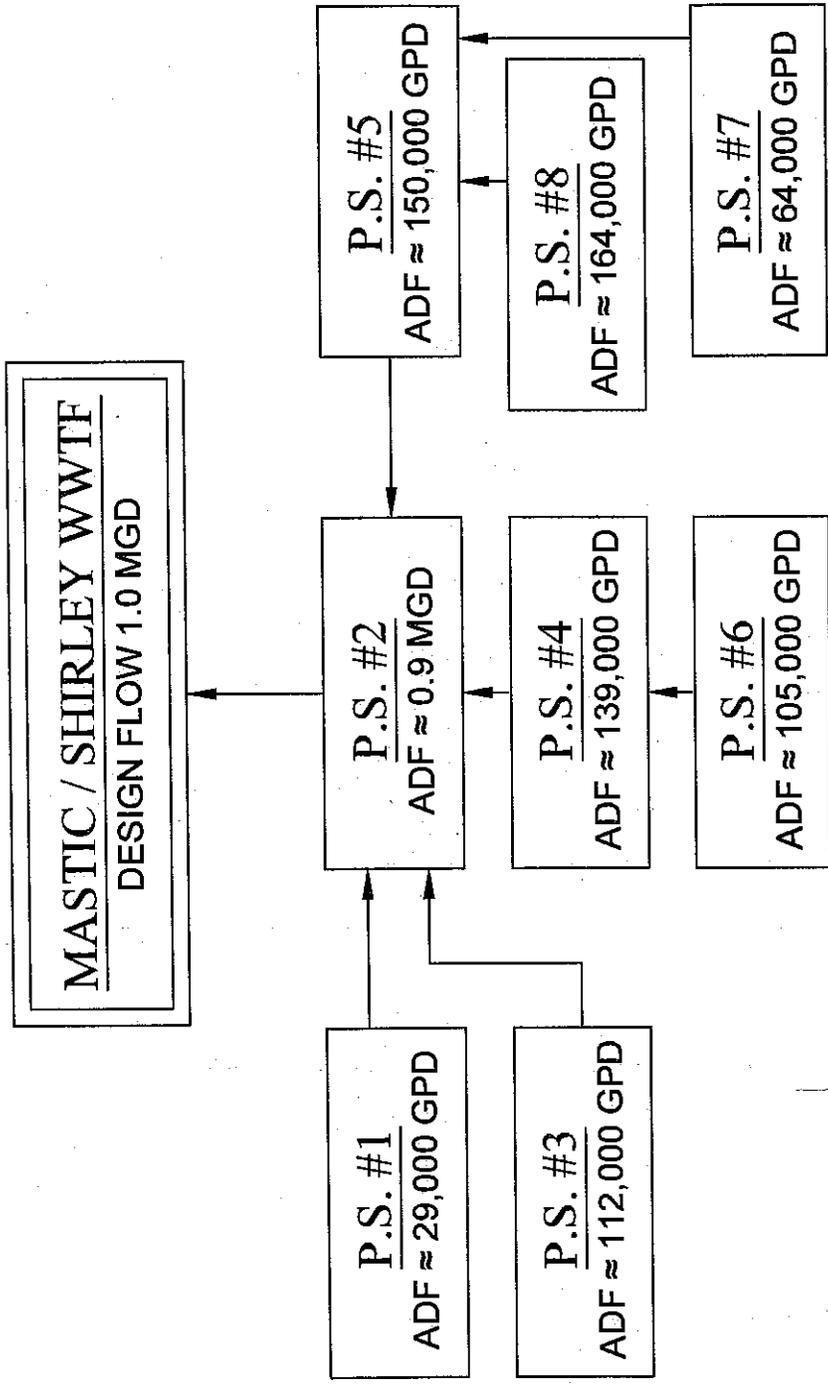


FIGURE 3-2
PUMP STATION FLOW SCHEMATIC

ADF = Average Daily Flow (gpd)

3.2.7.2 Peak Hourly Design Flow Analysis for Low Pressure Sewered Areas

The peak hourly flow from low pressure sewers is a function of the maximum number of grinder pumps that can operate simultaneously. The maximum number of grinder stations that can simultaneously operate is physically limited by the head capabilities of the low pressure grinder pumps in conjunction with the total head loss within the common low pressure sewer force main. The peak flows associated with low pressure sewers are often lower than what would be seen from a gravity sewer serving the same area since each onsite grinder station provides flow equalization capacity. Peak flows observed in existing low pressure sewer service areas located in the Village of Patchogue Sewer District are roughly 1.5 times their ADF. Since the proposed low pressure sewer service areas within the Mastic-Shirley Sewer District are similar in size to those found in the Village of Patchogue, this peak factor was used to estimate preliminary peak flow contributions. Actual peak flows will be calculated during later design phases when the locations of the low pressure sewer infrastructure are finalized based on data collected during site survey and soil boring field work.

3.2.7.3 Peak Hourly Design Flow Summary

A summary of the proposed flow distributions and associated peak hourly flow factors and rates for both gravity and low pressure sewer service areas summarized by drainage zone are provided in Table 3-3.

Table 3-3 - Peak Hourly Flow Summary by Drainage Zone

Drainage Zone ID	ADF		Peaking Factor		Total Peak Hourly Flow (gpd)
	LPS System (gpd)	Gravity System (gpd)	LPS System	Gravity System	
DZ-I	0	29,227	1.50	4.08	119,343
DZ-II	0	105,575	1.50	3.78	399,568
DZ-III	0	111,881	1.50	3.77	421,571
DZ-IV	0	138,919	1.50	3.70	514,475
DZ-V	1,500	148,660	1.50	3.68	549,671
DZ-VI	23,173	81,450	1.50	3.86	348,805
DZ-VII	0	63,859	1.50	3.92	250,150
DZ-VIII	60,983	102,919	1.50	3.79	481,735
Totals:	85,656	782,490	1.50	3.94	3,085,318

3.3 Wastewater Treatment Facility

3.3.1 Introduction

The design of the proposed wastewater treatment facility for the Mastic-Shirley Sewer District is based on the location selected and the technology required to meet the target effluent concentrations. The location for the treatment facility must have sufficient space to accommodate process tankage, control and storage buildings, access roads and parking, leaching areas and buffer requirements. The

size of the treatment facility is a function of the design flow and the selected process technology. The process technology is typically selected based on costs, area constraints and level of treatment desired. Each of these parameters is important in determining the optimal wastewater treatment facility configuration.

3.3.2 Sewage Treatment Plant Capacity, Siting and Effluent Quality

The capacity of the sewage treatment plant (STP) required to treat wastewater generated within the Mastic-Shirley study area is based on the average daily and the peak hourly flow estimates. The peak hourly flows from the district are summarized in **Table 3-3** in **Section 3.2.7.3** of this report.

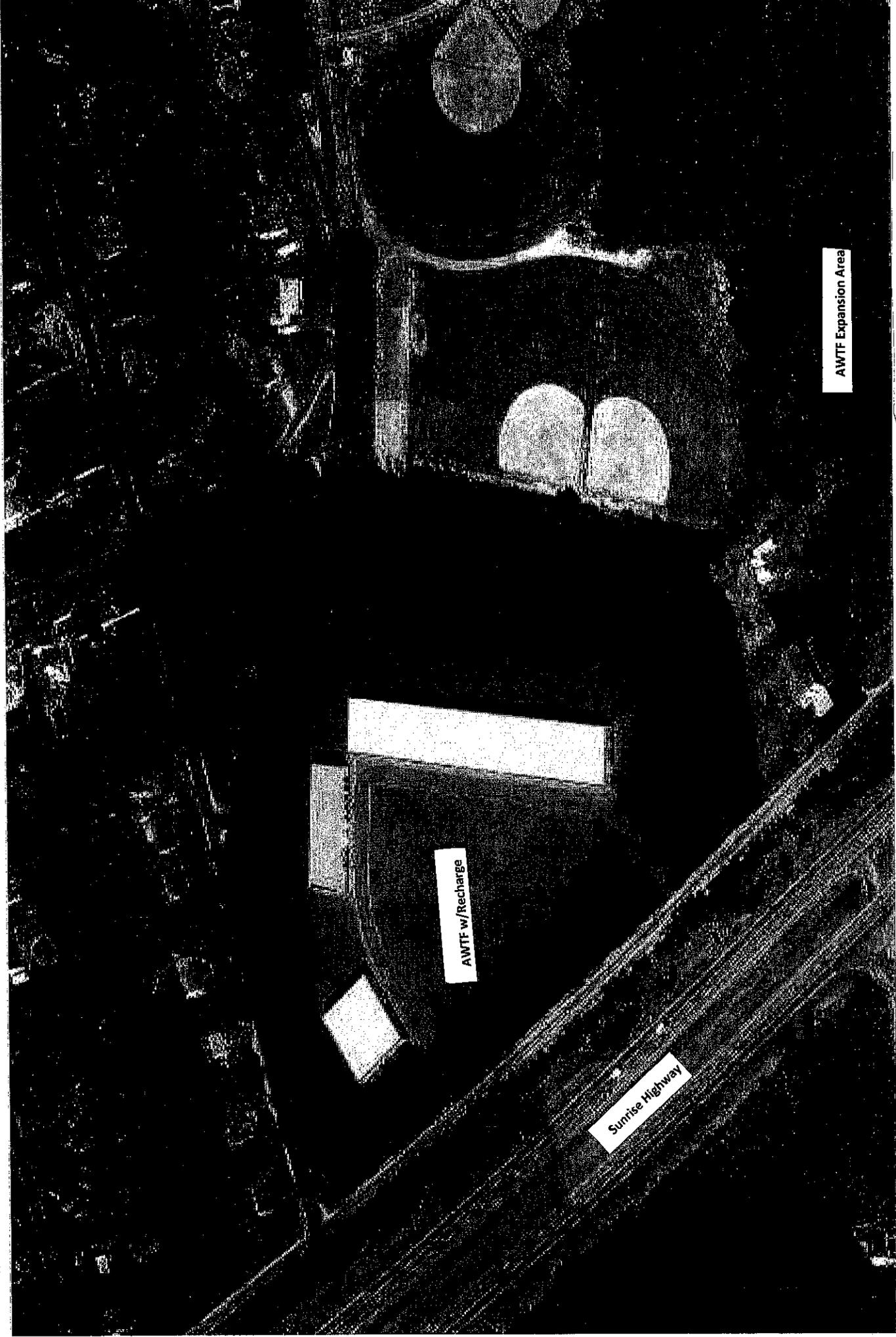
The location for the sewage treatment plant to treat wastewater from the Mastic-Shirley area is on the Town's Calabro Airport.

The site located at the Airport was previously identified in the "*Mastic-Mastic Beach - Shirley Sewering Feasibility Study*", January 2009. Because the area available at the Calabro Airport provides adequate space to site the treatment plant tankage and equipment, subsurface recharge pools, and buffers between adjacent properties as required by SCDPW and SCDHS as shown by **Figure 3-3** and because of the greater depth to groundwater it was selected as the most appropriate STP location. During coordination meetings with SCDPW and the Town of Brookhaven, it was agreed that the most suitable location for the proposed STP is on the Brookhaven Calabro Airport (Airport) property. The area reserved for the treatment facility and future expansion is comprised of approximately 29.9 acres of non-contiguous vacant/undeveloped land generally defined by Victory Drive to the south, Maple Avenue to the west, Dawn Drive and the Dowling College School of Aviation to the north and the northwest runway approach of the Airport to the east. The 29.9 acres of available land on the Airport property has been divided into two components; the westernmost component, which encompasses 12.9 acres and the easternmost component that encompasses 17.0 acres. After consultation with the Town of Brookhaven, the 12.9 acre area was selected to site the treatment facility, a paved parking lot, site access driveway and subsurface recharge pools for disposing of the treated effluent. The remaining 17.0 acres will be reserved for future expansion and/or additional recharge area. The approximate elevation of this site is located at approximately 60 feet above mean-sea-level, which is located outside of the future flood zone projected for the Mastic-Shirley area. Since the facility will be located on an airport property, the effluent disposal must consist of sub-surface leaching pools; open recharge beds are not an acceptable alternative due to their attraction of birds which is a known hazard to airplane traffic.

The following three treatment process technologies were considered during the feasibility study:

- 1) Modified Ludzack-Ettinger (MLE) Process
- 2) Sequencing Batch Reactor (SBR) Process
- 3) Membrane Biological Reactor (MBR) Process

Removal of nitrogen from sanitary wastewater to protect the County's water resources is one of the primary reasons why wastewater treatment is required when the existing or desired development density exceeds the allowable development densities identified in Suffolk County Sanitary Code Article 6. State Pollutant Discharge Elimination System (SPDES) permits for wastewater discharges to groundwater in Suffolk County currently limit effluent nitrogen to less than 10 mg/L. However, because groundwater provides the baseflow to the County's surface water resources, and considering



AWTF Expansion Area

AWTF w/ Recharge

Sunrise Highway

MASTIC-SHIRLEY PROPOSED TREATMENT FACILITY AREA/LAYOUT

FIGURE 3-3

the study area's proximity to the Forge River and to the Carmans River, Suffolk County has recognized that reduction of effluent nitrogen to the lowest levels that can be practically achieved by the current limits of technology is appropriate for this study area. All three treatment processes that were identified for evaluation are effective in meeting the current effluent nitrogen limit of 10 mg/L for groundwater discharge. However, for the Mastic-Shirley study area, the selected treatment process must be capable of reducing effluent nitrogen levels, and reliably achieving the current limit of technology (effluent nitrogen between 3 mg/l and 5 mg/l). Based on the evaluation presented in the March 2014 Feasibility Study, the Membrane Biological Reactor (MBR) was selected.

3.3.2 Selected Treatment Plant Process Technology

Selection of the treatment option recommended for the Mastic Shirley study area was guided by the target effluent nitrogen reduction requirements. Removal of nitrogen from the County's water resources is one of the primary factors driving the need for wastewater treatment. Since the poor water quality of the down gradient Forge River was identified as one of the driving forces for sewerage, it has been determined that the best available process option for the Mastic-Shirley Sewage Treatment Plant is the MBR Process. Wastewater treatment using an MBR provides the limits of technology for nitrogen removal (currently, between 3 and 5 mg/L), and MBR facilities have the smallest footprint compared to other treatment options. Please see **Figure 3-4** for a typical process schematic.

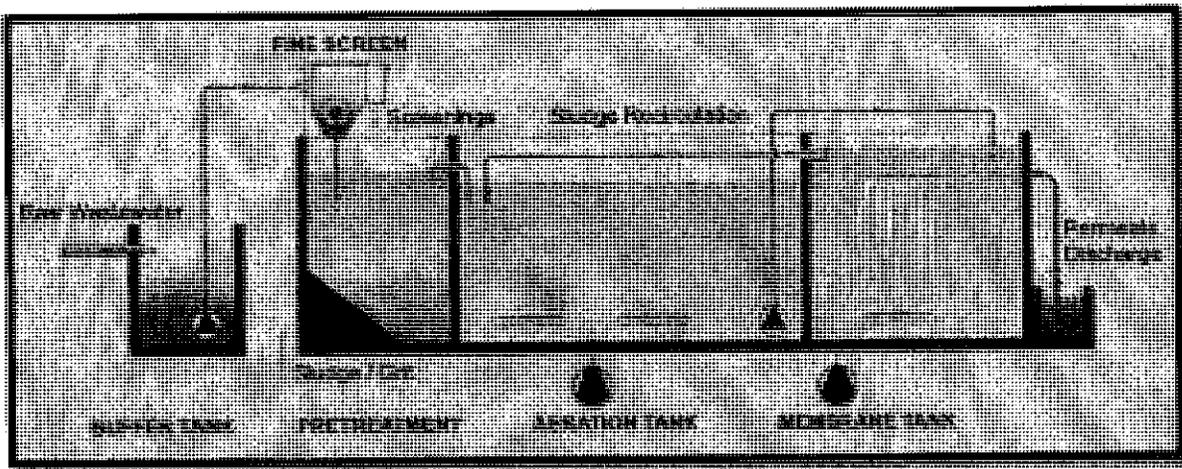


Figure 3-4 – Typical MBR Process Schematic

3.3.2.1 Hydraulic Capacity

The wastewater treatment facility for the Mastic-Shirley Sewer District will be designed to treat the average daily design flow from the District. In order to optimize the sizing of all equipment and process tankage, an influent equalization tank will be provided to buffer peak hourly flow surges that will be generated within the collection and conveyance system(s). The average daily design flow at full build out is 1.0 mgd.

3.3.2.2 Organic Capacity

The projected wastewater strength from the study area was determined based on *10 States Recommended Standards for Wastewater Treatment Facilities*, paragraph 11.253 – Organic

Capacity of Wastewater Treatment Facilities to Serve New Collection Systems, which identifies the organic strength of wastewater on the following loading rates:

- **BOD₅** = 0.17 pounds per capita per day; and
- **Total Suspended Solids (TSS)** = 0.20 pounds per capita per day

These rates are representative of the waste strength expected to be generated within the study area.

Applying the wastewater strength design criteria from 10 States Standards to the projected average daily sanitary flow results in a BOD₅ concentration of 207 milligrams per liter (mg/L) and a TSS concentration of 240 mg/L. Anticipated Total Nitrogen and Alkalinity concentrations are 65 mg/L and 100 mg/L, respectively, and are based on typical loading rates seen in other districts comprised of similar land use and density.

3.3.2.3 Treated Effluent Disposal

The overall area required for treatment plant tankage and equipment is based on the selected technology and room for 100 percent future expansion. In addition to SCDPW and SCDHS space requirements, the *FAA Advisory Circular for Hazardous Wildlife Attractants on or Near Airports*, dated 8/28/2007, requires a 5-mile buffer between potential hazardous wildlife attractants and the runway approach, or stipulates that any and all potential attractants must be covered or housed inside of a structure. Therefore, since the proposed STP site is within the required 5-mile buffer, subsurface leaching pools and a treatment facility located inside of a building are required.

SCDPW requires all subsurface leaching pools to have an 8 foot buffer between one another and not exceed an effective depth of 16 feet. The area available for leaching exceeds 200 percent of the design flow. Space buffers between the treatment facility, leaching pools and adjacent properties must also be in accordance with SCDPW and SCDHS requirements, and account for the remaining area required to construct the wastewater treatment facility for the proposed Mastic-Shirley Sewer District.

Based on SCDPW and SCDHS requirements, the total area required for subsurface recharge is nearly ten acres out of the 12.9 available acres for the treatment facility. This area includes the land needed to treat and recharge the design flow, and is based on an effluent loading rate of 10 gpd/sq. ft. with 8-foot diameter leaching pools with an effective depth of 16 feet per pool and a separation distance between pools of 8 feet. The leaching area is approximately one acre per 100,000 gpd of flow. Five foot diameter distribution pools are included. This preliminary leaching configuration leaves 1.5 acres of open land for the construction of the treatment facility. If during detailed design it is determined that additional space is required, leaching pools can also be accommodated on the 17.0 acre area at the airport.

3.3.2.4 Detailed Description of Treatment Option – Membrane Biological Reactor (MBR)

The membrane biological reactor (MBR) is a suspended growth type activated sludge process used for nitrogen removal. The MBR process requires pre-anoxic, aeration and membrane filtration to achieve total nitrogen removal. Flow into the pre-anoxic zone is comprised of screened plant influent and recycled process flow from the downstream MBR basin(s). These recycle flows are necessary to maintain a stable carbon source and nitrate feed while increasing the total nitrogen removal efficiency of the process.

The MBR treatment process is capable of reliably producing an effluent nitrogen concentration approaching 3 mg/L; commonly described as the "limit of technology" for nitrogen removal. MBR technology eliminates the need for secondary clarification and effluent filtration. This process can also operate at higher mixed-liquor suspended solids (MLSS) concentrations when compared to those of an MLE or SBR.

The ability to eliminate secondary clarification and operate at higher MLSS concentrations provides the following advantages: (1) higher volumetric loading rates and thus shorter reactor hydraulic retention times; (2) longer sludge retention times (SRTs) resulting in less sludge production; (3) operation at low dissolved oxygen (DO) concentrations with potential for simultaneous nitrification-denitrification in long SRT designs; (4) high-quality effluent in terms of low turbidity, bacteria, total suspended solids (TSS), and biological oxygen demand (BOD); and (5) less space required for the wastewater treatment facility footprint.

A vacuum differential created by permeate pumps extracts clarified water through the membranes. This filtration process results in solids concentrations typically ranging from 1% to 3% in the MBR tank(s). Routine membrane "fouling," or the embedding of solids within the membrane pores and onto the membrane surface, is a disadvantage of using this technology. Membrane "fouling" must be mitigated to maintain proper MBR function. As such, aeration is used to mechanically scrape solids from the membrane surfaces, in addition to periodic backwashing and chemical cleaning cycles to loosen particles lodged within the pores.

3.3.2.5 Preliminary Treatment Process Descriptive Design

Wastewater generated by the Mastic-Shirley Sewer District will be collected and conveyed to the treatment plant via combination of gravity and low pressure sewers. The flow will be pumped to the treatment facility via pump station and discharged directly to influent screening equipment. The influent screening equipment will be sized to remove solids and debris larger than 2-mm diameter. The influent screening will remove large solids and debris that can impede process performance and damage downstream pumps, equipment, and the membranes. The debris and solids removed by the screens will be washed and compacted onsite and conveyed into a container for offsite disposal. The wastewater passing through the influent screen(s) will flow by gravity into an aerated equalization tank. The screens will be sized to handle the peak hourly flows from the District.

The aerated equalization tank will be sized to provide 20 percent of the average daily flow, and will be used to regulate constant flow through the facility. This value is representative of typical equalization capacities of around 20 percent of the average daily flow for sewer systems. Maintaining constant flow through the facility maintains the process and results in more consistent treatment efficiency. Wastewater from the equalization tank will be pumped into the anoxic basin(s).

Flow from the equalization tank will discharge into parallel pre-anoxic basins. Each pre-anoxic basin will provide mechanical mixing (only) to facilitate de-nitrification of the wastewater. Following the de-nitrification step in the pre-anoxic basins, wastewater will flow via gravity into downstream aeration basins where nitrification of the wastewater will occur.

Following the nitrification step, wastewater from the aeration basins will be conveyed to downstream post-anoxic basins for additional de-nitrification. Effluent from the post-anoxic basins will enter parallel downstream membrane reactors to remove solids remaining in the process stream and to filter the wastewater prior to discharging to the onsite subsurface leaching pools. Each membrane tank will be sized to handle a proportioned amount of the process flow to provide redundancy in the

event that one must be taken offline for maintenance. One of the membrane tanks will be used as an Membrane Bioreactor Thickening (MBT)/standby MBR in the event that one of the online MBR basins must be taken offline for maintenance. The solids removed in the clarification portion of the process will be either returned to the biological process to maintain the proper ratio of food to incoming organic material or pumped to a sludge holding tank for further conditioning. All process tanks will be covered.

Sludge thickening will be provided in conjunction with this process to increase the solids concentration to 3 percent prior to liquid sludge disposal to the Bergen Point Water Pollution Control Facility. The design must also consider a future thickened sludge concentration of 5 percent as per SCDPW requirements. Since MBR technology is going to be used for treatment, sludge thickening will also be achieved through the use of MBT thickening. MBT does not require a polymer system like that needed for a gravity belt thickener (GBT).

Due to the proximity of residential properties, aesthetics of the area, and FAA guidelines, all process tanks will be located inside of a building designed with architectural features that blend into the surrounding area. The building will be provided with an odor control system to minimize potential odors from migrating offsite during normal operations. An emergency stand-by power generator will also be provided to maintain system operation during periods of power loss. The generator will be fueled by natural gas and will be located inside an onsite weather-proof enclosure. The process controls, laboratory, motor control center, pumps, storage, and a small locker room will also be integral to this building.

3.4 Sewering Impacts on Groundwater Quality

The March 2014 Feasibility Report included a calibrated groundwater model that was used to simulate groundwater flow in the Mastic-Shirley study area and an average annual nitrogen load was calculated for each parcel within the Forge River watershed. The reduction in nitrogen loading to the Forge River, Great South Bay, and Carmans River watersheds associated with provision of sanitary sewerage were summarized. The nitrogen loads were also incorporated into a contaminant transport model and used to simulate average nitrogen concentrations in the groundwater within the Forge River watershed.

Simulated nitrogen concentrations in shallow groundwater in the study area under existing conditions with wastewater disposal conducted via on-sites septic systems within the Forge River watershed is documented. Three additional model simulations were performed to estimate the improvement in groundwater quality associated with sewerage the proposed sewer district; e.g., those within the Forge River groundwater contributing area. All simulations assumed that the MBR discharges an effluent concentration of 5 mg/L, rather than the possibility of achieving 3 mg/L.

The baseline conditions included nitrogen loading from each occupied parcel in the area. The second model simulation assumed that sanitary sewers were implemented in the Montauk Highway Corridor area, and consequently all sanitary nitrogen loads were removed from those parcels. As a result of sewerage the Montauk Highway Corridor area, the net nitrogen loading to the groundwater would be reduced by almost 70 pounds per day. Nitrogen concentrations are simulated to decline to less than 6 mg-N/L in much of the Montauk Highway Corridor area. Sewerage the Montauk Highway Corridor area also results in improved groundwater quality further downgradient in the southerly residential area as well, although high nitrogen loading immediately to the north of the Montauk Highway Corridor continues to transport elevated nitrogen concentrations into that area.

For the southerly residential area model simulation, all sanitary nitrogen loads from the Montauk Highway Corridor and the southerly residential areas were removed from the simulation. The model results showed continued improvement in shallow groundwater quality, as nitrogen concentrations in much of the study area are simulated to be less than 6 mg-N/L. **Table 3-4** indicates the approximate nitrogen loading from various sources and the resulting load of providing advanced treatment.

Table 3-4 - Estimated Nitrogen Load Under Existing & Sewered Conditions

Nitrogen Loading Source - Land Use Type or STP	Nitrogen Load (pounds/day)
Residential	235
Commercial	2.5
Industrial	0
Institutional	6.1
Total	243.6
WWTP @ 5 mg/l 1 MGD	41.7

Reduction = ~ 201 pounds/day

The total estimated nitrogen load released to groundwater after the sewerage program is implemented includes nitrogen discharged at an estimated 5 mg/L after treatment at the wastewater treatment plant. The total nitrogen removed from the Forge River is 201 lbs. per day or 15% of the current load. Reducing nitrogen with this project aims to restore salt marsh and other tidal wetlands and expand growth of sub-aquatic vegetation such as sea grass and eelgrass, thus reducing the damaging effects of wave attack, storm surge, and flood height.

Section 4

Legal Considerations and Map and Plan

4.1 Sewer District Area Formation Requirements

The final design contract will include modification of and/or development of a Map and Plan leading to sewer district formation. This task will be prepared in accordance with Article 5-A, Section 256 of New York State (NYS) County Law.

Article 5-A, Section 256 of NYS County Law requires the County to determine by resolution that:

- All property and property owners within the proposed district are benefited;
- All property and property owners who are benefitted are included in the boundaries of the district;
- The establishment of the district is in the best interest of the public, and
- The allocation of costs of the facilities is proportionately distributed among all benefited properties.

The majority of the property owners within the district must provide their consent to the creation of the district via public referendum.

4.2 Regulatory Requirements

Implementation of a Mastic-Shirley Sewer District requires consideration of a variety of regulatory requirements, including:

- State Environmental Quality Review Act (SEQRA) and most likely State Historic Preservation (SHPO) compliance
- State Pollutant Discharge Elimination System permitting
- Storm water permitting
- Other construction-related permits including road opening and New York State Department of Environmental Conservation (NYSDEC) dewatering

4.2.1 SEQRA and SHPO Compliance

According to the SEQR Handbook (NYSDEC, 2010), the New York State Legislature identified the following intent for SEQR:

"... to declare a state policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and enhance human and community resources; and to enrich the understanding of the ecological systems, natural, human and community resources important to the people of the state."

The SEQR Handbook also describes how SEQR “establishes a process to systematically consider environmental factors early in the planning stages of actions that are directly undertaken, funded or approved by local, regional and state agencies.” The objective of incorporating environmental reviews early in the planning process is to allow for project modification to avoid adverse impacts.

Consistent with the SEQR intent, the Suffolk County Department of Public Works (SCDPW) has initiated the SEQR process for the Mastic-Shirley study area and for implementation of sanitary sewer planning and design that has received a Type II determination. GOSP with consultant assistance is to prepare the construction phase SEQRA documents and gain approval.

SCDPW is preparing a Generic Environmental Impact Study (GEIS) for the Suffolk County Sewer District Capacity Study for Bellport, Sayville, Ronkonkoma Hub, Middle Island Corridor, Mastic-Shirley, and Yaphank. The GEIS considers the impacts of construction and operation of the 1,000,000 gpd facility for the Mastic-Shirley study area, as well as the criteria or conditions that would trigger the need for preparation of a supplement to the final GEIS.

In addition and due to the potential for grants or loans, the approval of the New York State Historic Preservation Office must be obtained. Suffolk County DPW has submitted documents to have the planning and design SHPO considered.

4.2.2 SPDES Permitting

All sewage treatment plants operating in Suffolk County must operate in compliance with a State Pollutant Discharge Elimination System (SPDES) permit and Suffolk County Article 6 and Article 7 requirements. The SPDES permit establishes the maximum allowable concentration for each potential contaminant of concern that may be contained in the treated wastewater. For STPs discharging to groundwater, SPDES permit discharge limits are typically established at 10 mg/L for nitrogen. Based on the environmentally sensitive area to which a Mastic-Shirley STP would discharge, effluent nitrogen levels will be reduced to the limits of technology.

Monitoring wells are sited to monitor the impacts of the treated effluent upon groundwater quality; samples are collected and analyzed on a quarterly basis from these wells. Municipal STPs are inspected on a quarterly basis by NYSDEC.

4.2.3 Storm water Permitting

Construction of the sewerage facilities will require disturbance of more than one acre of soil. Therefore, the activity would require coverage under the NYS General Permit for Storm water Discharges from Construction Activities as well as the preparation of a Storm water Pollution Prevention Plan (SWPPP). The SWPPP would address measures to be in place to prevent discharge of construction-related pollutants to waters of the state.

4.2.4 Other Construction Related Permits

Based upon the locations and types of construction activities required to implement the sewer system, it is anticipated that a NYS Department of Transportation permit may be required, Town of Brookhaven road opening permits and/or easements may be required and building permits may be required. Compliance with Suffolk County Sanitary Code Article 9 and Article 12 for use and storage of construction chemicals and petroleum products will also be required.

4.2.5 Inter-Municipal Agreement

Inter-municipal agreements are required when one municipality enters into a cooperative effort with another. The IMA identifies the statutes of which the cooperative effort is based. An IMA between Suffolk County DPW and the Poospatuck Indian Reservation will be required for this project in order to perform work within the reservation. An IMA is necessary to outline the legal agreement between the two entities and document the work to be performed and available funding.

4.2.6 Legal Requirements

After the District is formed, all improvements to the district are to be paid for by the property owners within the District. According to Article 5-A, Section 267, all improvements to the District include the amount of all contracts, the costs of all lands acquired, the costs to construct all facilities and appurtenances necessary to operate and/or administrate the improvement, printing, publishing, interest on loans, legal and engineering services and all other expenses incurred as a result of the establishment of the district. Properties normally exempted from taxation, which are connected to the improvements of the district, are not exempt from user charges and are required to pay based on "sewer unit charges" developed by the governing authority of the District.

Following acceptance of the Map and Plan, the County must file a copy with and receive approval from the local New York State Health Department representation (i.e. SCDHS). The County must also obtain approval from the New York State Comptroller to ensure the costs of the improvement do not increase the tax impacts on property owners within the district above the New York State Comptroller predetermined threshold amount. If costs exceed the threshold, formation of a District could only proceed after additional scrutiny by the Comptroller.

A listing of the Suffolk County Tax Map (SCTM) identification numbers of the properties within the Mastic-Shirley Sewer District would be reported to the State Controller's office. A metes and bounds description would be required. Conveyance of the lands located on the Calabro Airport property from the Town of Brookhaven to Suffolk County for the sewage treatment facility will also be necessary, either lease or acquisition.

Section 5

Project Cost Options and Trends

5.1 Capital Construction and Soft Costs

The capital costs associated with the establishment of a Mastic-Shirley Sewer District are presented in this section. The project costs include:

- Construction and engineering costs for wastewater collection, conveyance and treatment;
- Planning costs , including survey, SEQRA compliance, soil borings and utility mark-out;
- Sewer District Establishment; and
- Funds for septic system abandonment, low pressure grinder station purchase and individual property connection to the new infrastructure.
- Modification of unit prices included in the March 2014 Feasibility Report by DPW.

The cost opinions provided are based on the best available information available at the time of its preparation. The cost opinion is prepared without the benefit of a detailed engineering design that defines the exact scope of the constructed project. The cost opinions were based on assumptions relating to subsurface conditions, including suitable soils, location of groundwater and the anticipated need for and extent of dewatering operations. The location of underground utilities can also significantly impact the project cost and schedule.

The cost opinion reflects the project as it has been identified, which may change during future design phases based on client preferences for equipment, materials of construction, systems, finishes and unanticipated conditions. Cost opinions are typically considered the following elements:

1. Construction difficulty;
2. Anticipated means and methods of qualified and competent contractors who have the prerequisite experience with the size and complexity of the project;
3. Escalation for labor and fringe benefits necessary to design and construct the project based on historical escalation rates;
4. Insurance and cost of obtaining bonds and warranties that are in accordance with industry standards;
5. A construction schedule that reflects the time needed to gain regulatory approvals, advertisement for bids, timely award and execution of the construction contract(s);
6. Inflation and the economic climate (bidding environment) when the project is to be undertaken;
7. Estimated quantities and projected unit prices for items that will be incorporated into the project;

8. An approximation of the detailed design elements that are usually added during consultation with the client, regulatory agencies, and stakeholder input, such as aesthetic architectural components and materials of construction typical of wastewater treatment facilities.
9. Direct costs for contractor general requirements, which include such items as project management and coordination, quality control, temporary facilities and controls, cleaning and waste management;
10. Reasonable and customary indirect costs for profit, overhead and contractor contingencies are used by the bidder, and
11. Recent bids received for similar projects.
12. An adequate contingency based on the degree of assumptions and unknowns involved with implementing the construction. Minimal investigation work has been performed to determine existing grades or groundwater elevations.

The cost opinion is predicated on the project consistently moving forward without delays in accordance with the preliminary project schedule described in **Section 7**. Because of the considerable size of the study area, it is anticipated that the construction of the proposed collection, conveyance and treatment systems may be completed in multiple contracts bid concurrently. One contract will encompass all infrastructure in DZ-I, Drainage Zone (DZ)-II, DZ-III and DZ-IV as well as the influent pump station to the proposed treatment facility located in DZ-II. It is logical that the 1.0 mgd WWTP be part of the first contract. The second contract will include the construction of the collection and conveyance infrastructure located in DZ-V, DZ-VI, DZ-VII and DZ-VIII. It is anticipated that construction of all infrastructure of the Mastic-Shirley Sewer District will begin in 2017, and that construction will be completed in accordance with the schedule in **Section 7**.

Project related construction costs are escalated to the anticipated midpoint of construction. The compounded annual increase to the 20 Cities Construction Cost Indices (CCI) over the past 10 years, 3.4 percent, is an appropriate factor to guide the escalation of project costs for the Mastic-Shirley Sewer District.

5.1.1 Total Project Cost Opinion

The estimated total project costs for the installation of the collection, conveyance and treatment infrastructure assume restoration of all areas disturbed by work; curb to curb restoration of roadways where sewers are installed is not accounted for in the project cost opinion shown below. The cost opinion does include costs for temporary pavement to be placed at the end of each work day to enable the re-opening of major roadways during non-working hours. Open-cut installation methods for both gravity and low pressure sewers form the basis of the cost opinion(s). An alternate bid line item can be incorporated during the subsequent design and bidding phases of this project, to obtain contractor pricing for trenchless installation methods for sections of the proposed low pressure sewer system and force mains. This will provide alternate bid pricing that will identify the method that results in the greatest cost savings to the overall project. The project cost estimate for the sewage treatment facility includes but is not limited to the cost to install all structures, piping, mechanical equipment, leaching, and electrical appurtenances, including an emergency stand-by power generator.

The project budget is summarized in **Table 5-1**. All construction costs assume a single prime construction contract for the sewage collection, conveyance and treatment facilities.

Table 5-1 – Project Cost Opinion

Item	Cost (Millions)
Collection System & Force Main Construction	\$78,680,800
Pump Stations	\$11,550,000
Wastewater Treatment Facility (1,000,000 gpd MBR)	\$66,000,000
Total Construction * (includes contingency)	\$156,230,800
Engineering for design report, construction plans and specifications, construction administration	\$10,000,000
Construction Management (assumes 36 month construction period)	\$10,300,000
Total Engineering and Soft Costs	\$20,300,000
Total Construction Cost	\$176,530,800
<i>Refer to Section 5.1.2 for additional costs</i>	

5.1.2 Additional Project Costs to be Financed

In addition to the capital costs associated with the planning, design and construction of the new sanitary sewerage infrastructure, property owners within the sewer district would incur additional up-front costs associated with connection to the district, including abandonment of existing septic systems and connection to the collection system. These additional up-front costs can add thousands of dollars to the property owner costs. SCDPW has determined that it would be beneficial to the property owners within the district if these costs are included in the capital project cost to be financed. Similarly, each property owner within the area to be served by low pressure sewers would be required to purchase a grinder pump station. The fund to purchase the grinder pump stations has also been included in the costs to be financed. The following two funds have been included in the project cost:

1. Fund to pay for all low pressure sewer grinder stations, and
2. Fund to pay for the abandonment of all existing septic systems and connection of each property to the new collection systems.

Adding these line items to the total project bond amount will reduce or eliminate the out-of-pocket costs that will be required for property owners to pay upon connecting to the District. Incorporation of these capital costs into the bond financing reduces/eliminates the up-front costs, but increases the annual sewer assessments. An incentive program is being considered for commercial properties.

The total project funds for the grinder stations and abandonment/connection fund are estimated to be **\$11.55 million, bringing the total project cost to over \$188 million.** It has been calculated that \$500 of the abandonment and connection cost is on public right-of-way.

5.1.2.1 Basis of Grinder Station Fund

The low pressure sewer grinder pump station funds are based on the capital cost required to purchase each grinder pump station for properties that will be served by low pressure sewers in the project. The capital costs for the purchase of these stations are directly related to the flow that they will convey. Based on the flow projections for the Mastic-Shirley Sewer District and the proposed collection system layout, properties within the low pressure service areas within the District will require one of two different grinder stations. The capital cost summary for the two different stations is presented in **Table 5-2**.

Table 5-2 - "Typical" Low Pressure Sewer Grinder Station Costs

Property Type	Low Pressure Sewer Grinder Station Unit Cost (\$)
Residential	\$4,500.
Commercial	\$9,000.

Note: The grinder station costs are estimates based on present day values and were escalated for consistency with the total project cost phasing projections.

5.1.2.2 Basis of "Abandonment and Connection Fund"

Costs for the abandonment of existing sanitary septic systems and connection to the sewer district are based on the type of sewer each property will connect to and the sizes of the existing onsite sanitary systems that are being abandoned. The costs associated with the connection and abandonment activities range from \$2,000 for properties that are currently vacant to \$30,000 for the large regional shopping center located on CR-80. The cost for existing residential property owners is projected to be approximately \$2,500 to abandon the existing septic system and connect to a gravity sewer and \$6,000 to abandon the existing septic system and connect to a low pressure sewer. Additional capital costs are incurred when connecting to a low pressure sewer to account for the installation of the electrical and mechanical components associated with the grinder stations. The cost for an average commercial connectee to abandon their septic system and connect to the District is estimated to be \$9,000.

5.2 Estimated Operation and Maintenance Costs

5.2.1 Sewer District Operation and Maintenance Costs

Annual operation and maintenance (O&M) costs associated with the proposed sewer district include utility and chemical costs and staff salaries. Based on SCDPW Division of Sanitation experience at other County owned and operated districts, typical annual operation and maintenance costs are \$1.71/gpd. This annual O&M rate is subject to an annual increase of 3 percent after several billing cycles when the District is no longer subsidized by the County's Assessment Stabilization Reserve Fund (ASRF). After the 3 percent increase, the District will once again be stabilized for several billing cycles, and repeat the same cycle.

The annual costs anticipated to be paid by residential properties will range from \$385 (i.e. 225 gpd per single family equivalent or SFE x \$1.71/gpd) for single family residences to approximately \$1,200 (i.e. 225 gpd SFE x 3 family x \$1.71/gpd) for three family residences. Commercial properties

generating 3,000 gpd would be subject to an O&M charge equal to \$5,130. See **Table 5-3** below for estimated annual operation and maintenance costs for typical residential and commercial properties.

Table 5-3 - Estimated Annual User Fees

Property Type	Wastewater Generation (gpd)	Annual User Fee (\$)
Single Family Residential	225	\$385/year
Two Family Residential	450	\$770/year
Three Family Residential	675	\$1,154/year
Dry Store Retail	1 - 3,000	\$2,565/year
Wet Store Retail	3,001 - 5,000	\$6,840/year
Bar/Restaurant	5,001 - 8,000	\$11,115/year

5.2.2 Operation and Maintenance Requirements for Grinder Pump Stations

Properties that are served by onsite low pressure sewers will be subject to additional maintenance charges associated with the operation and maintenance of the grinder pump stations. All properties that require the use of a grinder station will be required to enter into service contracts with the grinder station manufacturers. The annual costs for the service contracts currently range from \$275/year for residential grinder stations to \$1,700/year for commercial stations.

In addition to the service contracts, electric utility costs for the grinder stations will also be the responsibility of property owners; each station requires a 120V power feed from the existing electrical distribution panel on the property. The electrical costs for these low pressure grinder stations are approximately \$100 per year for residential users and \$150 per year for commercial users. A summary of typical low pressure grinder station costs is provided by **Table 5-4**.

Table 5-4 - Grinder Station Operation and Maintenance Cost Summary

Property Type	Flow Capacity (gpd)	Annual Electricity Cost (\$)	Annual Service Contract Cost (\$)
Single Family Residential	225	\$100/year	\$275/year
Two Family Residential	450	\$100/year	\$275/year
Three Family Residential	675	\$100/year	\$275/year
Dry Store Retail	1 - 3,000	\$100/year	\$275/year
Wet Store Retail	3,001 - 5,000	\$150/year	\$1,700/year
Bar/Restaurant	5,001 - 8,000	\$250/year	\$1,700/year

5.2.3 Annual O&M Costs for Users Connected to Low Pressure Sewers

Estimated annual operation and maintenance costs for typical residential and commercial properties connected to low pressure sewers are summarized in Table 5-5.

Table 5-5 - Annual O&M Cost Summary for Low Pressure Sewer Connectees

Property Type	Wastewater Generation (gpd)	Annual User Fee (\$)	Annual Electricity Cost (\$)	Annual Service Contract Cost (\$)	Total Annual O&M Cost (\$)
Single Family Residential	225	\$385/year	\$100/year	\$275/year	\$760/year
Two Family Residential	450	\$770/year	\$100/year	\$275/year	\$1,145/year
Three Family Residential	675	\$1,154/year	\$100/year	\$275/year	\$1,529/year
Dry Store Retail	1 - 3,000	\$2,565/year	\$100/year	\$275/year	\$2,940/year
Wet Store Retail	3,001 - 5,000	\$6,840/year	\$150/year	\$1,700/year	\$8,690/year
Bar/Restaurant	5,001 - 8,000	\$11,115/year	\$250/year	\$1,700/year	\$13,065/year

Section 6

Financing Considerations

6.1 Capital Construction and Soft Costs Debt Service

The capital construction and soft costs not reduced by grants (refer to Section 6.2.5) must be paid by all taxable properties located within the District. Neither the parcel identified for the Sewage Treatment Plant (STP) site nor the non-buildable properties (e.g. parking lots, roadways, reforested lands, etc.) are responsible for the debt service of the District since they will not benefit from the infrastructure.

The debt service for each property is determined on an “ad valorem” basis. An ad valorem based debt service distributes the overall project costs across the assessed value of all properties within the benefitted District. The multiplier used to determine the annual debt service is referred to as the capital recovery factor (CRF). The CRF is calculated using the following formula:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

i = interest rate

n = payback period

The CRF is dependent upon the interest rate and payback period associated with the bond used to fund the capital cost of the district.

Three bonding options have been identified for this project and could be modified if grants are received. The first two options are bonds available through the County, which are based on an interest rate of 4 percent with terms of 20 years and 30 years, respectively. The third option is a low interest bond from the Environmental Facilities Corporation (EFC). This bond is based on an interest rate of 2 percent with a 30 year payback period. The EFC bond also includes a 1.84 percent administrative charge that is added to the project cost that is bonded. **Table 6-1** provides a summary of the CRFs calculated for the bonding options described above.

Table 6-1 - Capital Recovery Factor Options

Bond	Interest Rate	Term	CRF
Suffolk County	4%	20	0.07358
Suffolk County	4%	30	0.05783
Environmental Facilities Corporation	2%	30	0.04465

The total annual debt service for the district is determined by multiplying the CRF and the bond amount. The bond amount is based on the total estimated project costs summarized in **Section 5**. The

assessment rate for the District is calculated by dividing the annual debt service by the total assessed value of taxable properties within the proposed District.

The total assessed value (A.V.) for properties located within the proposed Mastic-Shirley Sewer District will be updated for development from the final Map & Plan.

The total assessed value does not include properties that will not be connected to the District; total project costs will be distributed among these totals. In accordance with New York State Law requiring evaluation of the annual assessment impacts to a “typical” property, a “typical” property is defined by the property value equal to the mode of the assessed values within that District. The mode of the assessed values for the District will be obtained for the Map & Plan.

6.2 Economic Analysis

6.2.1 Mastic-Shirley Study Area Overview

The Mastic-Shirley project area consists of approximately 750 acres and 2,094 individual tax lots (2,893 single family equivalents). The boundaries of the study area are generally defined by Sunrise Highway to the north, the Forge River to the east, Poospatuck Creek to Cumberland Road on the south and Cumberland Road to Montauk Highway to the west. Minor refinement may result as the final design progresses. The overall Mastic and Shirley area is recognized by the U.S. Census Bureau as “designated places”, a term used to recognize communities that are identifiable by name but are not discrete incorporated municipalities. Mastic’s and Shirley’s populations in 2010 were approximately 15,500 and 27,900 respectively. There are around 4,730 households (2010) in Mastic, with an average of 3.3 residents per household. Shirley has around 8,450 households (2010) also with an average of 3.3 residents per household. Median household income (2011) in Mastic was \$71,000⁶ and \$85,800 in Shirley. These values will be updated and used as the Map & Plan.

6.2.2 Projected Capital Costs

As detailed in **Section 5**, the estimated capital costs to provide sanitary sewer services within the area, including grinder station and abandonment/connection costs total just over \$188 million. The derivation of this amount is as shown on **Table 6-2**.

Table 6-2 - Mastic – Shirley Sewer District Estimated Capital Costs

Item	Total Phases 1 & 2
Collection System & Force Main Construction	\$78,680,800
Pump Stations	\$11,550,000
Wastewater Treatment Facility	\$66,000,000
Total Construction	\$156,230,800
Design Engineering	\$10,000,000
Construction Management & Engineering & Soft Costs	\$10,300,000
Total Engineering & Soft Costs	\$20,300,000
Total Construction Cost	\$176,530,800

⁶ U.S. Census Bureau – American Fact Finder. 2011 inflation adjusted dollars.

Item	Total Phases 1 & 2
Capitalized Project Funds	
Grinder Station Fund and Abandonment & Connection Fund	\$11,550,000
Subtotal	\$11,550,000
Total Project Capital Cost	\$188,080,800

6.2.3 Affordability Analysis

A Map & Plan will be prepared and utilize information from an affordability analysis to establish the cost per typical property and what is affordable in the service area. Annual wastewater management costs for typical residential units can be estimated using residential equivalent units (REU) or single family equivalents (SFE). Residential equivalent units are derived by dividing the average daily wastewater flow by the water usage of the typical residency. Projected average daily water use in the Mastic-Shirley District is a build-out total estimated flow of 1,000,000 per day. The annual cost per typical family residents can be estimated by utilizing the annual operation, maintenance, and debt service cost of all sewerage infrastructure. This cost can be compared to certain guidelines that had been established with respect to the affordability of the service area typical property. The USEPA Construction Grants Program in the early 1980's included a metric called "a residential indicator". That indicator established low mid-range and high values for the cost of household and determined what was affordable. The low mid-range and high criteria were less than 1% of the median household income, 1%-2%, and greater than 2%, respectively. This analysis will be included within the Map & Plan to be prepared.

6.2.4 On-Lot Cost Avoidance

Partially offsetting the potential annual costs of the sewer project would be the avoided costs associated with the maintenance of current on-lot wastewater systems once public sewers were available. The U.S. Environmental Protection Agency recommends that septic tanks be pumped every three to five years.⁷ A typical fee for this service in Suffolk County is approximately \$300 for a residential property. On-lot systems comprised of septic tanks, distribution headers, and leaching beds have a typical useful life of 20 to 30 years⁸ before reconstruction is necessary. In eastern Long Island, the reconstruction of a residential on-lot system would likely cost between \$3,000 and \$10,000. For a twenty year planning period the annualized cost for a typical single family residence would be around \$425 per year.

6.2.5 Grant and Loans

As of the time in preparing this amended report, the funding for the Forge River Nitrogen Reduction Project includes SRF loans for architectural and engineering services and Hazardous Mitigation Grant Program funding for construction which was the subject of a grant application on April 30, 2015. The

⁷ Onsite Wastewater Treatment Systems Manual 2002 EPA/625/R-00/008

⁸ Pipeline volume 16, number 1(winter 2005) published by the National Environmental Services Center (Small Flows Clearinghouse) West Virginia University.

funding required for the project includes \$10 million for engineering design assistance and \$178,080,800 in construction and management funds. It is proposed that a portion of the SRF loan for engineering assistance would be repaid by Empire State Development Corporation grants. The allocation of funds is to be determined as all projects associated with coastal resiliency in Suffolk County are implemented. Presently, the annual debt per typical property is in the range of \$400-\$450.

6.2.6 Conclusion

Based upon the affordability analysis presented in the March 2014 Feasibility Report and considering the costs required to maintain and eventually replace existing septic systems that would be avoided if a sanitary sewer system was constructed, the existing project could impose a significant burden on the users without the benefit of significant grant funding. However, due to the relatively favorable economies of scale represented by the Mastic-Shirley project, the costs per residential equivalent unit is feasible if an external grant funding is received, which is a good possibility.

6.3 Non-Residential Impact Analysis

6.3.1 Potential Development and Economic Growth

As detailed in **Section 3** of this report, the design average daily flow of wastewater for the Mastic-Shirley Sewer District totals 1.0 million gallons. More than 50% of the projected wastewater flow would be generated by residential properties.

The Montauk Highway Corridor area of the proposed Sewer District has a direct projection of economic activity that could be created through denser redevelopment than is currently allowed under Article 6 are not available based on Town land use plans for the area. Implementation of the land use plan is also contingent upon rezoning. The 2010 DGEIS for the Phase II Montauk Highway corridor study noted that:

“Development in the TAOD (Transitional Area Overlay District) area encouraged by the Phase II Plan (and its associated rezonings) would cause an improvement in the overall economic conditions in the study area. As a result of promoting revitalization and beneficial development, the Phase II Plan provides better assurance that the scale and density of proposed uses is more in keeping with the needs of the area as based upon the Market Analysis. *This would result in potential economic growth would come in the form of increased commercial (retail and office) spaces* (if the Town Board chooses to adopt the recommended zone changes to support higher density residential use near the Shirley MSBD). The combination of increased business spaces and increased customer bases for these businesses, along with increased property taxes, would incrementally increase the level and breadth of economic activity of the study area, and represents a beneficial impact in terms of economic condition.”⁹

⁹ Draft Generic Environmental Impact Statement for the Montauk Highway Corridor Study and Land Use Plan for Mastic and Shirley – Phase II Page 27. Prepared by Nelson, Pope & Voorhis, LLC

The implementation of the Mastic-Shirley Sewer District would greatly facilitate portions of the Grand Avenue, Twin Ponds, and Hawkins Neighborhood Town Centers as envisioned in **Brookhaven Town's 2004 Montauk Highway Corridor Study and Land Use Plan for Mastic and Shirley**.¹⁰

6.3.2 Non-Residential On-Lot Cost Avoidance

Similar to residential properties, the potential annual costs of the sewer project would be partially offset by the costs associated with the maintenance of current on-lot wastewater systems that would be avoided. Annualized on-lot costs for the typical residential property were estimated as \$425. Non-residential properties may have considerably higher on-lot maintenance costs based on their wastewater generation rates.

6.3.3 Economic Multiplier Effects

The "multiplier effect" is a well-established principle of macro-economic theory that explains the second through Nth order impacts of economic activity. Under the theory, a dollar that is directly spent within a regional economy (e.g. Suffolk County) will generate more than a dollar of economic activity through indirect and induced impacts.

There are various estimates of the multiplier effect of wastewater construction projects nationally, ranging from around 1.5 to 3.5; meaning that for a \$1 spent directly on wastewater construction would generate between \$1.50 and \$3.50 in economic activity. The 1.5 factor comes from a 2010 study by the University of Nebraska of \$20 million in ARRA (Stimulus) spending in Nebraska. The 3.5 factor comes from a national study by the Clean Water Council, which is comprised of various professional and trade groups in the water and wastewater industry. Other studies have quoted multipliers of around 3.0. As shown on **Table 6-3**, using multipliers in these ranges, the estimated \$188 million for the construction of the Mastic-Shirley District collection sewer system and the wastewater treatment facility would be expected to generate somewhere between \$288 and \$670 million in economic activity.

Table 6-3 - Mastic - Shirley District

Estimated Economic Multiplier Effect from Construction and Related Expenditures

Wastewater Construction Multipliers		Multiplier		"Multiplied" Economic Impact (million \$)
				Total
Clean Water Council ¹¹	\$188M	X	3.50 =	\$658
Northeast Ohio Regional Sewer District ¹²		X	3.27 =	\$615
Other Studies		X	3.00 =	\$564

¹⁰ As summarized in the Montauk Highway Corridor Study & Land Use Plan for Mastic & Shirley Phase II prepared by Nelson, Pope & Voorhis, LLC page 2.

¹¹ Sudden Impact: An Assessment of Short-Term Economic Impacts of Water and Wastewater Construction Projects in the United States. Clean Water Council, 2009 09 NUCA Study-36.

¹² Northeast Ohio Regional Sewer District: Economic Impact of Operating and Capital Expenditures, 2012-2016 Cleveland State University, Maxine Goodman Levin College of Urban Affairs.

University of Nebraska ¹³	X	1.50	=	\$294
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6.3.4 Employment Impacts of Sewer District Implementation

Accurately predicting the employment impacts of any sewerage project prior to detailed designs and cost estimates is not feasible. There are some national statistics that may be used to provide rough projections. A 1981 study¹⁴ by the U.S. Bureau of Labor Statistics estimated that \$1,000 (1980 dollars) spent on contract expenditures for sewer lines would generate 45.5 employee hours. The hours include direct construction labor and of-site labor (e.g. workers at a pipe manufacturer). The hours do not include indirect employment, e.g. the hiring of an additional staff by local restaurants to serve the construction workers. Adjusting for inflation, the cost to generate 45.5 hours would be \$2,910. Using the estimated project capital costs of \$188 million and assuming 2,080 hours per year for a full time job, around 31 job-years could be predicted. It should be noted that most of this employment will be located outside of the proposed Mastic Shirley Sewer District and will not directly benefit property owners.

It is also anticipated that two full time equivalent employees would be needed to maintain system infrastructure after the system is operational.

6.4 Conclusions

The total estimated capital costs to create the Mastic-Shirley District are approximately \$188 million (inflated to mid-point of construction dollars). As indicated in Section 6.2.5, there is anticipation that funding will be made available through loans from the Environmental Facilities Corporation for architectural and engineering consultant assistance along with Hazardous Mitigation Grant Program grants for construction. Due to the concept of normalizing rates over a number of projects receiving grants from various sources, the percentage of cost estimates for each of those areas with an amount associated with the Mastic/Shirley area is the basis for developing the cost for residential parcels. The low-interest loan would be through the New York State Environmental Facilities Corporation using a 30 year loan at half the market rate which would be approximately 2% at this time. The Map & Plan to be prepared would incorporate the cost associated with installing the infrastructure along with the operation and maintenance with reductions considering any grants. The amortization of the cost to the typical property would be established and would be the basis of the application to the State Comptroller's office. Presently, the annual debt per typical property is in the range of \$400-\$450.

The provision of wastewater services within the District would facilitate the implementation of the Town's 2004 vision of the Neighborhood Town Centers along the Montauk Highway Corridor. The construction and availability of wastewater systems within the Mastic-Shirley study area would trigger economic multiplier effects. The construction of wastewater systems has an economic multiplier of 1.5 to 3.5, therefore the roughly \$188 million in construction costs would be expected to generate between \$288 to \$670 million in ripple effect economic activities and around 31 full time

¹³ Special Multiplier Study for Wastewater Systems Infrastructure The Bureau of Business Research, University of Nebraska – Lincoln and Labor Market Information, Nebraska Department of Labor

¹⁴ Robert Ball, Employment Created by Construction Expenditures *Monthly Labor Review* December 1981, U.S. Bureau of Labor Statistics, U.S. Department of Labor.

equivalent job-years. The new business and residential activities that would be facilitated through the availability of sewers would have continuing multiplier effects.

Section 7

Schedule

A preliminary schedule for implementation of the Mastic-Shirley Sewer District is shown by **Figure 7-1**. It is anticipated that the project could be completed within approximately six years, recognizing that approval by the State Comptroller's office schedule may take months. If the first milestone, Suffolk County acceptance of the Map & Plan is completed in the first half of 2017, the majority of new facilities could be on-line by the last quarter of 2019. It is noted that the engineering design can start prior to the controller's approval.

It is currently envisioned that construction contracts of the Mastic Shirley Sewer District will proceed simultaneously.

Section 8

Results and Conclusions

8.1 Results

8.1.1 Background

Mastic-Shirley was one of the seven study areas that the Suffolk County Sewer District/Wastewater Treatment Task Force identified as a critical area of need, where implementation of sanitary sewers could provide environmental, economic or social benefits. A Feasibility Study was prepared to document sewage collection and treatment/effluent discharge requirements, along with the associated capital and operation costs and environmental and economic benefits. This report modified the March 2014 Feasibility Report to provide details on the project area illustrated on **Figure 1-1**.

Located in the Town of Brookhaven, the Mastic-Shirley study area included the Montauk Highway Corridor from just west of the William Floyd Parkway through Mastic and Shirley east to the Forge River and the existing residential areas within the two year groundwater travel time in the western part of the Forge River watershed south to Poospatauck Creek and along Cumberland Road to the west. Existing land uses include storefronts, offices and restaurants along the Montauk Highway corridor and primarily residential properties throughout the remainder of the study area. Based on meetings held with Legislator Browning, the Town of Brookhaven and other stakeholders, establishment of a Sewer District will allow the Mastic-Shirley community to realize the vision for the Montauk Highway Corridor articulated in the **Montauk Highway Corridor Study and Land Use Plan for Mastic-Shirley**, which will help to develop a sense of community and an increased tax base. The Legislator, the Town, and stakeholders also identified improvement of the Forge River water quality as a significant concern, while the County is in agreement and also recognizes the restoration of sea grass and eelgrass provide coastal resiliency and buffer against storm surge, etc.

8.1.2 Infrastructure Requirements

The majority of the study area is already developed; over 50 percent of the total study area is residential. Wastewater flow projections were based upon Suffolk County Department of Health Services design criteria and zoning. The total sanitary flow from the Mastic-Shirley Study Area is projected to be 1,000,000 gallons per day (gpd). The average daily flow density for the area is above the 300 gpd/acre wastewater flow rate established for Groundwater Management Zone VI.

The proposed Sewer District was divided into drainage zones. Wastewater flow collected within each of the eight drainage zones will drain to a pump station. Each of the preliminary pump station sites have been located at intermediate low points within the drainage areas on publicly owned properties. Each pump station will be designed to convey flow directly to the tributary sewers of the treatment plant's influent pump station via force main.

8.1.2.1 Collection System

Based upon topography, relative depth to groundwater and current build-out of the area, a combination of gravity sewers and low-pressure sewers is recommended to provide wastewater collection for the proposed Mastic-Shirley Sewer District. Based upon topography, the study area was divided into a number of drainage zones. Gravity sewers were used where depth to groundwater permitted, to reduce long term operation and maintenance costs to property owners within the district. The Montauk Highway Corridor and the majority of the residential properties west of the Forge River will be served by gravity sewers. Low pressure sewers would be constructed in those areas within each drainage zone where USGS data indicated groundwater to be less than 10 feet below grade. These areas mainly include properties located in close proximity to the Forge River. Properties located on the Poospatauck Reservation will also be serviced by low pressure sewers due to their proximity to the Forge River, anticipated shallow groundwater conditions and non-conforming build-out conditions to current building code standards.

The proposed gravity sewer collection system will consist of over 21 miles of DR-18 PVC gravity sewer piping. Each property within the study area serviced by gravity sewers will be connected by either a 6-inch diameter or 8-inch diameter DR-18 PVC building lateral. Gravity sewer mains will be installed at depths no less than 6 feet below grade to provide the required clearances between existing utilities and maintain sufficient slope to facilitate a self-scouring velocity within the pipe. All gravity sewers will be located within the right-of-ways and drain towards the pump station in their respective drainage zone.

The low pressure sewers proposed to service the Mastic-Shirley Sewer District will include approximately 2.5 miles of 3-inch diameter DR-11 HDPE low pressure mains. The low pressure sewer mains will be installed approximately 6 feet below grade to provide the required clearances between existing utilities. Each property within the study area that will be serviced by a low pressure sewer will be connected to the low pressure sewer mains by either a 1 ¼" or 2" diameter HDPE building connection. Each building connection will include a lateral assembly consisting of a buried check valve and curb stop located at the property line. A grinder pump station will be located on each property within the areas served by the low pressure system. Each low pressure grinder station will be sized based on the estimated average daily wastewater generation rate expected from the property that it will serve. Each pump station will be located either inside the basement of the building it serves or buried outside in the vicinity of the existing onsite septic system or cesspool. The locations of each grinder station will be determined on a case by case basis to minimize modifications to each building's existing plumbing configuration and minimize the duration of the disturbance to each individual property owner. The proposed low pressure collection system will be installed within right-of-ways and will be routed towards gravity sewers that drain to a local pump station within each drainage zone.

8.1.2.2 Wastewater Treatment

Sanitary wastewater from the proposed Mastic Shirley sewer district will be conveyed to a new 1.0 million gallon per day (MGD) sewage treatment plant to be constructed on a 12.9 acre parcel located on the Town of Brookhaven's Calabro Airport. Selection of the treatment process recommended for the Mastic Shirley study area was guided by the target effluent nitrogen reduction requirements in this environmentally sensitive area, given the sewage treatment plant's location within the Forge River watershed. Because the poor water quality of the downgradient Forge River was identified as

one of the driving forces for sewerage, a Membrane Bioreactor (MBR) facility was recommended for the Sewage Treatment Plant because it provides the limits of technology for nitrogen removal (currently, between 3 and 5 mg/L).

Due to the proximity of residential properties, aesthetics of the area, and FAA guidelines, all process tanks will be located inside of a building designed with architectural features that blend into the surrounding area. The building will be provided with an odor control system to minimize potential odors from migrating offsite during normal operations.

8.1.3 Project Costs

8.1.3.1 Capital Costs

Capital costs for establishment of the Mastic-Shirley Sewer District include:

- Construction and engineering for the wastewater collection and conveyance systems;
- Planning costs including survey, SEQRA compliance, soil borings, utility mark-out;
- Sewer system connection fund;
- Septic system abandonment fund,
- Grinder pump station fund for properties located in the area served by low pressure sewers and
- Sewer District start-up fund.

Construction costs have been escalated to the projected mid-point of construction. Capital costs for implementation of a new Mastic Shirley Sewer District are summarized on **Table 8-1**.

8.1.3.2 Operation and Maintenance Costs

Operation and maintenance costs include the operation and maintenance charges associated with the collection, conveyance and treatment systems, and for those property owners located within the area served by the low pressure system, costs associated with operation and maintenance of the low pressure pump stations. Annual operation and maintenance costs will be higher for commercial property owners than for residential property owners as summarized on **Table 8-2**.

Table 8-1 - Construction Cost Summary

Project Component	Capital Cost
Collection System & Force Main Construction (1)	\$78,680,800
Pump Stations (1)	\$11,550,000
Wastewater Treatment Facility (1)	\$66,000,000
Total Construction	\$156,230,800

Design Engineering	\$10,000,000
Construction Management	\$10,300,000
Construction Management and Engineering	\$20,300,000
Capitalized Project Funds	
Grinder Station Fund for Low Pressure Sewer Areas and Abandonment & Connection Fund (2)	\$11,550,000
Total Cost	\$188,080,800

- (1) Includes contingency
- (2) Located on/or a portion of private property

Table 8-2 - Typical Annual Operation and Maintenance Costs (in 2015 \$)

Property Use and Collection System Area	Annual O&M Cost (\$/year)
Properties within the Area Served by Gravity Sewers	
Typical Residential Property	\$385.
Typical Commercial Property	\$2,565.
Properties within the Area Served by Low Pressure Systems	
Typical Residential Property	\$760.
Typical Commercial Property	\$2,940.

8.1.3.3 Annual Cost to Property Owners

The annual cost to each property owner in the district includes debt service and annual operation and maintenance costs. The Map & Plan will summarize the cost for a “typical” commercial property owner and a typical residence located in the proposed sewer district, if the project were to be funded with a thirty year loan from Environmental Facilities Corporation (EFC). If grants are received, the Map and Plan would be adjusted accordingly. Currently, the annual costs are estimated to be \$400-\$450 (debt) and \$350-\$400 (O&M) for a typical residential property.

8.1.4 Sewer District Formation and Legal Requirements

If creation of a Mastic Shirley Sewer District is approved by the property owners which is subject to a permissive referendum, the District would be formed as a County sewer district according to first Article 5-A, Section 256 of New York State (NYS) County Law. Other regulatory requirements for sewer district formation and construction include compliance with the State Environmental Quality Review Act (SEQRA), storm water permitting, including preparation of a Stormwater Pollution Prevention Plan (SWPPP) and other construction-related permits including road opening and NYSDEC dewatering.

8.1.5 Schedule

If approved, it is anticipated that the sewerage program could be implemented within approximately six years. If the first milestone, Suffolk County must accept the Map & Plan, following a referendum projected for 2016.

8.2 Conclusions

8.2.1 Residential Affordability Analysis

Based upon projected annual costs for residences in the Mastic-Shirley study area and the USEPA Residential Indicator metric, the projected annual cost of the sewer district without subsidy would represent over 3 percent of median household income for the area served by gravity sewers and the area served by low pressure sewers, respectively. This is significantly greater than the 2 percent of median household income that the USEPA identified as the high cost burden threshold. In order to meet the 2 percent threshold, external grant funding of between 49 percent and 55 percent would be required. In fact, when outside grant funding is available, it typically subsidizes capital costs only, and not annual operation and maintenance costs. Therefore, greater capital funding would be required to reduce total annual property owner costs down to the 2 percent of median household income threshold. While the avoided costs of septic system maintenance would partially offset the sewerage cost, the existing project would only be economically feasible for residential property owners if significant grant funding is available.

8.2.2 Non-Residential Economic Impacts

Implementation of sewers would facilitate the community's vision of the Mastic and Shirley Main Street Business Districts and transitional zone that was described in the Town's **Montauk Highway Corridor Study and Land Use Plan for Mastic & Shirley**.

8.2.2.1 Economic Multiplier Effects

The "multiplier effect" is a well-established principle of macro-economic theory that explains the second through Nth order impacts of economic activity. Under the theory, a dollar that is directly spent within a regional economy (e.g. Suffolk County) will generate more than a dollar of economic activity through indirect and induced impacts. There are various estimates of the multiplier effect of wastewater construction projects nationally, ranging from around 1.5 to 3.5; meaning that a \$1 spent directly on wastewater construction would generate between \$1.50 to \$3.50 in economic activity. The 1.5 factor comes from a 2010 study by the University of Nebraska of \$20 million in ARRA (Stimulus) spending in Nebraska. The 3.5 factor comes from a national study by the Clean Water Council, which is comprised of various professional and trade groups in the water and wastewater industry. Other studies have quoted multipliers of around 3.0. Therefore, the roughly \$188 million in construction costs would be expected to generate between \$288 and \$670 million in ripple effect

economic activities. The new business and residential activities that would be facilitated through the availability of sewers would have continuing multiplier effects.

Much of this benefit, however, would be realized by property owners and businesses outside of the sewer district boundaries.

8.2.2.2 Septic System Cost Avoidance

Similar to residential properties, the potential annual costs of the sewer project would be partially offset by the costs associated with the maintenance of current on-lot wastewater systems that would be avoided once public sewers were available. The U.S. Environmental Protection Agency recommends that septic tanks be pumped every three to five years.¹⁵ A typical fee for this service in Suffolk County is approximately \$300. On-lot systems comprised of septic tanks, distribution headers, and leaching beds have a typical useful life of 20 to 30 years¹⁶ before reconstruction is necessary. In eastern Long Island, the reconstruction of a residential on-lot system would likely cost between \$3,000 and \$10,000. For a twenty year planning period the annualized cost for a typical single family residence would be around \$425 per year.

8.2.2.3 Employment Impacts of Sewer District Implementation

While accurately predicting the employment impacts of any sewer project prior to detailed designs and cost estimates is not feasible, national statistics may be used to provide some estimates. A 1981 study¹⁷ by the U.S. Bureau of Labor Statistics estimated that \$1,000 (1980 dollars) spent on contract expenditures for sewer lines would generate 45.5 employee hours. The hours include direct construction labor and off-site labor (e.g. workers at a pipe manufacturer), but not indirect employment, (e.g. the hiring of an additional staff by local restaurants to serve the construction workers). Adjusting for inflation, the cost to generate 45.5 hours would be \$2,910. Using the estimated project capital costs of over \$188 million and assuming 2,080 hours per year for a full time job, around 31 job-years could be predicted.

It is anticipated that at least two full time County employees would be needed for the District after the system is operational. The low-pressure components of the collection system will be maintained through a service contract. The number of employees required for this service is not known.

8.2.3 Summary

The total estimated capital costs to create the Mastic-Shirley Sewer District and to implement the Feasibility Study are approximately \$188 million (inflated to the mid-point of construction). It is anticipated that financing would be obtained through the New York Environmental Facilities Corporation using 30 year loans at 2% interest rates. Due to grants being received, the typical property annual cost would be revised in the Map and Plan. Without subsidy, the annual cost per property would be substantial. The Map & Plan will develop the cost per typical property. Based on the projected median household income of \$92,197, the annual costs per household could represent 3 percent of median household annual income. These costs per household are significantly above the

⁶⁻¹⁵ Onsite Wastewater Treatment Systems Manual 2002 EPA/625/R-00/008

⁶⁻¹⁶ Pipeline volume 16, number 1(winter 2005) published by the National Environmental Services Center (Small Flows Clearinghouse) West Virginia University.

⁶⁻¹⁷ Robert Ball, Employment Created by Construction Expenditures *Monthly Labor Review* December 1981, U.S. Bureau of Labor Statistics, U.S. Department of Labor.

USEPA Residential Indicator threshold for high burden wastewater costs. For these annual costs to be brought down to the 2 percent high burden threshold, outside funding would be required.

On the positive side, the commercially zoned properties currently located along the Montauk Highway Corridor within the Main Street Business District could potentially benefit economically if a sanitary sewer system was available, thereby allowing for business expansion. Moreover, the availability of wastewater service would facilitate establishment of full service restaurants that the community has requested. A commercial incentive program is being considered with details under development.

The construction and availability of wastewater systems within the Mastic-Shirley study area would trigger economic multiplier effects. The construction of wastewater systems has an economic multiplier of 1.5 to 3.5, therefore the project would be expected to generate between \$288 and \$670 million in ripple effect economic activities. The new business and residential activities that would be facilitated through the availability of sewers would have continuing multiplier effects. While the economic benefits to the larger community could be significant, they would not all be realized by the property owners within the Sewer District that would be paying for the sewer system.

8.2.4 Water Quality Benefits

Sewering the Mastic-Shirley area is anticipated to reduce nitrogen loading to area groundwater under existing conditions by approximately 201 pounds each day. Sewering would result in a significant improvement in shallow groundwater quality, and in the quality of groundwater baseflow to the Forge River. Reducing nitrogen with this project aims to restore salt marsh and other tidal wetlands and expand growth of sub-aquatic vegetation such as sea grass and eelgrass, thus reducing the damaging effects of wave attack, storm surge, and flood height.

8.2.5 Projected Cash Flow

Table 8-3 indicates the projected cash flow for all elements of the project. Engineering design is accelerated in late 2015 and 2016 with assistance during construction maximized as construction proceeds. The connection program cannot be initiated until the system is operational following the three year construction period.

Section 9

References

References cited herein are included in the March 2014 Feasibility Study, **Section 9**.