Preliminary Engineering Report
Collection System Upgrade Project

Prepared Pursuant to the USDA Rural Development (RD)
Bulletin 1780-3

Town of Brooklyn
Water Pollution Control Authority

Brooklyn, Connecticut

April 17, 2013

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Disciplines to Deliver

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Project No. 2011.0464.A20

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Town of Brooklyn WPCA

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1 General

1.1 Introduction

This Preliminary Engineering Report is prepared pursuant to grant and loan funding assistance from USDA Rural Development's Water and Waste Loan and Grant program for the Town of Brooklyn, Connecticut.

The Town of Brooklyn owns a sanitary collection system that includes two pump stations and their force mains, gravity sewers, and a Parshall flume that is used to measure wastewater flows originating from the Town. Wastewater from Brooklyn is treated at the Killingly Water Pollution Control Facility (WPCF), which is operated and maintained by United Water. United Water also operates and maintains the Town of Brooklyn's sanitary collection system.

Due to concerns of the existing sanitary collection system performance, the Town of Brooklyn has hired Fuss & O'Neill to evaluate the existing collection system and to perform an initial screening of wastewater treatment and disposal alternatives to determine the feasibility of an independent WPCF to treat wastewater produced within the Town of Brooklyn.

A Facilities Planning Study was prepared for the Town of Brooklyn Water Pollution Control Authority (WPCA) by Fuss & O'Neill Consulting Engineers entitled "*Facilities Planning Study, Sewer System Evaluation*" May 2012. The scope of the study included a review of the existing infrastructure, an analysis of the current flows and rainfall data to determine if infiltration and inflow (I/I) were problematic, and a simplified hydraulic capacity analysis. Fuss and O'Neill also performed an analysis for wastewater treatment and disposal options for the entire Town. See **Figure 1** for Location Map.

2 Project Planning Area

2.1 Planning Area Description

The majority of homes within the Town of Brooklyn are situated on relatively large lots that include septic systems. However, approximately 883 residential and 114 commercial and other businesses in Town are served by sanitary sewers. The sewer service area (SSA) is indicated in **Figure -1**.

The planning area is defined by two sanitary collection systems include an area in the eastern portion of Town (referred to as the Eastern Sewershed), and an area in the western portion of Town (referred to as the Western Sewershed). Each sewershed includes a pump station, gravity sewers and their force mains which transports flows to the Killingly Water Pollution Control Facility (WPCF).

2.2 Environmental Resources Present

The Town's sanitary collection system is in good condition. The pumping stations are well maintained, but some modifications are necessary to improve the efficiency and overall reliability of the system.

Based on the summary of the environmental resources present for the proposed project, "*Environmental Report, Collection System Upgrade*" prepared by Fuss & O'Neill dated January 14, 2013. The Proposed

Action will have minimal long-term negative environmental impacts or consequences since the activities are proposed in previously disturbed areas such as pump station sites and air release/vacuum valves structures along force main located underground in the roadways and are not expected to disturb any land or water resources. Mitigation measures will be implemented to address any potentially unavoidable adverse impacts.

2.3 Growth Areas and Population Trends

Approximately 883 residential users, 114 commercial and other users in Town of Brooklyn are served by sanitary sewers. The Town can generally be broken up into two sewersheds as shown in **Figure 1.** The West Sewershed generally includes flows from Brooklyn Center, the Brooklyn Correctional Institution, Senior Center, and schools. The East Sewershed includes the parcels within the vicinity of Route 6 by the Quinebaug River. The existing and future wastewater flow information summarized below is obtained from the "*Facilities Planning Study*" by F&O dated May 2012.

2.3.1 Existing Wastewater Flow

The actual wastewater flow from the west sewershed is measured by the Tatnic Road Pump Station. The actual wastewater flows from the east sewershed can be determined by subtracting the Brooklyn Townwide Flume measurements from the Tatnic Road meter. Presented in Table 2-1 is a summary of the average daily flow rates during dry weather.

Table 2-1: Dry Weather Average Daily Flow Rates

Description	Sewershed		
	West Sewershed	*East Sewershed*	*Townwide*
	Gallons per Day	*Gallons per Day*	*Gallons per Day*
Average Daily Flow	149,000	101,000	250,000

Dry Weather period: August 18, 2009 to November 19, 2009

2.3.2 Future Wastewater Flow

Future capacity in the study was estimated by adding future build-out projections, plus infilling of the existing service area. Future flows were considered to be those likely over the next 20 years, shown in **Table 2-2**.

Future build-out and wastewater flows in the study were obtained from the "*Draft Sewer Service Plan*" for the Town of Brooklyn Water Pollution Control Authority by Design Professionals, Inc. dated June 23, 2004. The plan is a build-out analysis which estimated future build-out flow rates of 453,100 gallons per day. The projected flows from unsewered lots were estimated in that report based on the following:

- Direct access to sanitary sewers that could reasonably expect to connect if developed,
- Existing properties would be developed based upon zoning designations,
- Presently developed unsewered lots would be connected to sanitary sewers,
- Presently developed properties would not be further developed, except for the existing Quinebaug River Mill on Tiffany Street,

- Sewers extension to parcels zoned commercial and industrial to encourage business development while protecting the local groundwater.

Table 2-2: Build-out Analysis Future Flow Apportionment (by Others)	
Build-out Description	**Future Flow Rate Increase**
Full Build-out of Existing Sewershed	39,500* gallons per day
Extension of Sewers to Existing Commercial Zoned Parcels	44,200 gallons per day
Industrial Zoned Land (1/4 heavy)	106,200 gallons per day
Industrial Zoned Land (3/4 light)	12,750 gallons per day
Total Apportioned Future Wastewater Flow Increase (rounded)	**202,700 gallons per day**
*Reduced by 10,500 gpd for building developments since connected to public sewers.	

The draft January 21, 2010 "Planned Commercial: Route 6 Corridor Design Guidelines" for the Town of Brooklyn by the Planning and Zoning Commission specifically targeted the planned commercial district from Brick Yard Road to Day Street; which has already allocated build-out flow as part of the 2004 Build-Out Analysis. Likewise, the 1999 "Plan of Conservation and Development for the Town of Brooklyn Connecticut" has also been incorporated into the future build-out flow rates estimated in the 2004 report.

3 Existing Facilities

3.1 Sanitary Collection System

3.1.1 Existing Conditions

The majority of homes within the Town of Brooklyn are situated on relatively large lots that include septic systems. However, approximately 883 residential and 114 commercial and other users in Town are served by sanitary sewers. The sanitary collection system includes an area in the eastern portion of Town, and an area in the western portion of Town. Each sewershed includes a pumping station which transports flows to the Killingly Water Pollution Control Facility (WPCF). The Killingly WPCF and the Town of Brooklyn's sanitary collection system are operated and maintained by United Water, which is a privately owned company.

The majority of the sanitary collection system was constructed under three separate contracts, the first of which was completed in the late 1970's. The sewers in the eastern sewershed are the oldest and were constructed after the Clean Water Act was passed in the 1970's. The infrastructure in the western sewershed was constructed in the early 1990's after the Brooklyn Correctional Institution (Prison) was expanded.

According to the record drawings, all of the manholes in the collection system are constructed from precast concrete. The majority of the sewers and service connections to the homes and businesses are polyvinyl chloride (PVC) pipe. The force mains from each of the pump station and a small portion of the gravity sewer that is installed are constructed from ductile iron pipe.

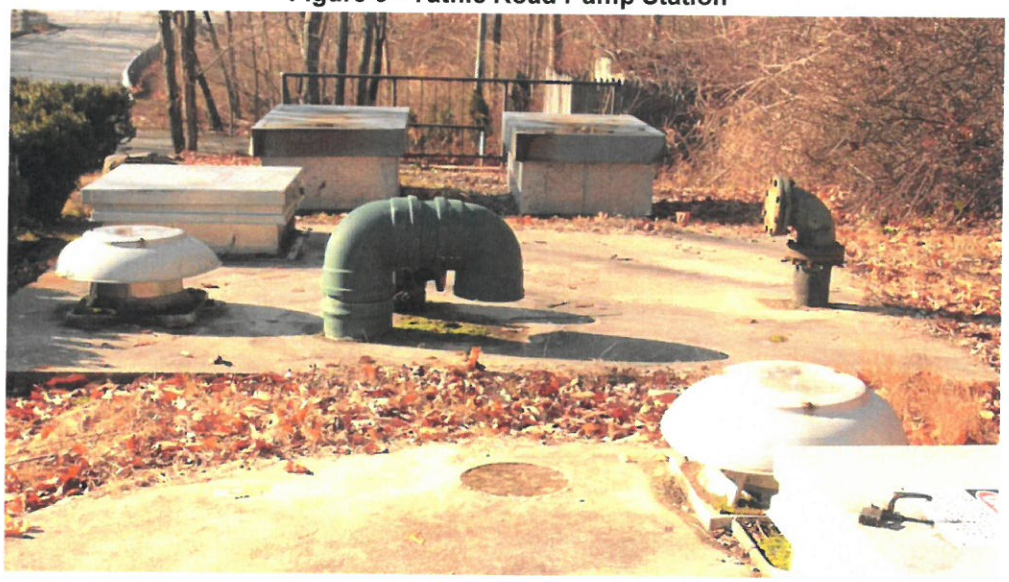
A relatively small amount of reinforced concrete pipe (RCP) is installed in the eastern portion of the sewershed. This pipe includes 15-inch and 18-inch diameter pipe within the Town of Brooklyn, and increases to 21-inch diameter across the river in Killingly.

Flows from the Town of Brooklyn are transported to the Killingly WPCF through a triple-barrel siphon that transports the wastewater under the Quinebaug River. The siphon is comprised of three high density polyethylene (HDPE) pipes with diameters of 6, 8 and 10-inches. These pipes are encased in concrete.

3.1.1.1 Tatnic Road Pump Station and Force Main

The Tatnic Road Pump Station is the largest of the two pump stations in the sewer system and is located in a small residential area just south of Route 6, near the intersection of Fairground and Tatnic Roads (**Figure 3**). The Tatnic Road Pump Station and the sewer system that serves the western sewershed were constructed in 1990. The station includes a separate drywell, wetwell and a below grade chamber that houses an emergency generator and the pump station controls.

Figure 3 - Tatnic Road Pump Station



WHAT BRAND OF PUMPS?

The station includes two constant-speed, dry pit submersible centrifugal sewage pumps. Pumps were completely rebuilt in August of 2009, and operators reported that it was difficult, expensive, and requires long lead times to obtain parts since the pumps are no longer manufactured.

Discharge piping consists of 6-inch ductile iron piping that includes a check valve and plug valve on each pump discharge. A magnetic flowmeter is used to measure flows from the station. These flowrates are transmitted to the Killingly WPCF by a control panel that was installed at the station in 2007. This panel also transmits alarms generated at the station to the SCADA system at the Killingly WPCF.

The pumps are controlled by the level in the wet well, which is sensed by an Electrogage from EG Pump Controls. This system uses a bubbler system that contains mercury to determine the wet well level.

When the pump station was originally constructed, equipment was installed to automatically alternate the lead and lag pump. This equipment is no longer functional so operators manually alternate the pumps once a week.

The station includes a generator and automatic transfer switch that are sized to provide power to the pumps when normal power is not available.

Flows from the Tatnic Road Pump Station are transported through an 8-inch ductile iron force main that is installed below Route 6. The force main is approximately 3-1/2 miles long and discharges at the intersection of South Main Street and South Street. Air release/vacuum valves are installed at the high points and drain valves at the low points along the force main.

A number of deficiencies exist at the Tatnic Road Pump Station, the largest of which relates to the pumps. Operating costs might also be reduced if the pumps were controlled by variable frequency drives (VFDs) rather than at constant speed.

In addition to the VFDs, a new control system should also be provided. The existing control system no longer functions as intended, so operators are forced to manually alternate the lead and lag pumps.

3.1.1.2 Plaza Street Pump Station

The Plaza Street pump station is located in a residential area that is just north of Route 6, and is close to a nearby shopping plaza. Flow to the station originates from the surrounding residential neighborhood, several fast-food establishments, a car wash, gas stations, and other commercial establishments (**Figure 4**). The station was manufactured by the Smith & Loveless Company and was constructed in 1981. Two vacuum-primed, suction-lift pumps that operate at constant speed were replaced in 2003, as were the check valves on the discharge piping.

The wet well consists of a four-foot diameter concrete manhole. A hinged fiberglass cover is installed at the top of the manhole to protect the pumps, control panel, and heater that are below it. The level in the wet well is sensed by floats that contain mercury. Bypass piping is installed to allow temporary pumps to transport flows through the 4-inch diameter force main. This force main is approximately 1,000 feet long and discharges into a gravity sewer located on Route 6/Providence Road.

The control panel includes an electrical connection that allows a portable generator to be connected if normal power is not available. This portable generator is also used to provide power to some of the pumping stations that are located in Killingly.

There is currently no standard method to measure the flows from this station or even the running time of the pumps. The commercial district along Route 6 has grown substantially since this station was constructed nearly thirty years ago, and this area is still being developed. If larger pumps are required, the Town should consider replacing them with submersible pumps that are easier to operate and maintain than the existing suction-lift pumps.

Figure 4 - Plaza Street Pump Station

The existing pump station does not meet the requirements specified in NFPA 820, which is the *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*. The existing floats that are used to sense the level in the wet well contain mercury which is considered a hazardous material.

3.1.1.3 Parshall Flume

Flows from the Town of Brooklyn are measured using an ultrasonic flowmeter that measures the level of wastewater as it flows through a Parshall Flume at the Killingly WPCF. The Town reported many issues with the accuracy of this meter. The ultrasonic level sensor was replaced approximately 3 years ago when it stopped working.

The flume still appears to be suseptiable to backwater condtions that surcharge the flowmeter during large wet weather events when more flow enters the Killingly WPCF than can be instantanously processed. The flowmeter then records flow measurements potentially much higher than actual Brooklyn wastweater flows, which is then used for billing purposes. Additional sensor equipment is still needed to alleviate this ongoing issues at the Parshall flume to improve accuracy during backwater conditions.

3.1.1.4 Correctional Institution Pump Station

The Brooklyn Correctional Institution has a dedicated sewage pump station on site that is owned and operated by the State of Connecticut. The force main from this station discharges into the gravity sewer on Route 6 that ultimately discharges into the Tatnic Road Pump Station.

4 Need for Project

4.1 Health, Sanitation and Security

The purpose of the Proposed Action is to address the aging facilities and evaluate/reduce the infiltration/inflow that is problematic in the western watershed, which the area is served by the Tatnic Road Pump Station.

The need for the Proposed Action is to improve Brooklyn's sanitary collection system quality,

address and replace the aging equipment and mechanical systems for two pump stations to meet the requirements of the Standard for Fire Protection, I/I analysis and rehabilitation to reduce the flows during significant rainfall events, inspect and address the operational issues related to the air release/vacuum valves located along the force main, clean and televise sewer pipe, perform hydraulic capacity analysis to evaluate the pipe capacity and need for larger pipes, and update sewer service area

4.2 System O&M

For any proposed sewer collection and treatment system, the residents of the Brooklyn will pay for any operation and maintenance (O&M) fees via a user fees. The sewage collection system will continue to be operated and maintained by United Water.

4.3 Growth

As noted earlier in this report, the anticipated future wastewater flow within the two sewershed areas were considered to be those likely over the next 20 years and therefore any proposed upgrade and improvements will be designed based upon the existing flow plus the capacity for future increases.

A breakdown the total future wastewater flows based on dry weather average daily flows is presented in **Table 4-1**. The total Build-out Future Wastewater Flow is 453,200 gallons per day (gpd) without I/I. The intermunicipal agreement with the Town of Killingly has been negotiated in 2012 and in the new agreement, the capacity limit increased from 400,000 gpd to 500,000 gpd. **See Attachment A.**

Table 4-1: Future Flow Apportionment based on Build-out Analysis (by Others)

Description	Future Flow Rate
Existing Dry Weather Average Daily Flow	250,500 gallons per day
Future Build-Out Wastewater Flow Increase (without I/I)	202,700 gallons per day
Future Wastewater Flow (without I/I)	453,200 gallons per day

5 Alternatives Considered

The *Facilities Planning Study* evaluated the existing collection system and performed an initial screening of wastewater treatment and disposal alternatives to determine the feasibility of an independent WPCF to treat wastewater produced within the Town of Brooklyn. These alternatives include:

1. Improvements to the existing collection system and construct a conventional water pollution control facility (WPCF) on the town-owned parcel of land with a direct discharge to the Quinebaug River.

2. Improvements to the existing collection system and construct subsurface sewage disposal system (SSDS) on the town-owned parcel of land with an indirect discharge to the Quinebaug River.

3. Improvements to the existing collection system and discharge to the Killingly WPCF to treat the wastewater (continue the current treatment at Killingly WPCF).

Each of the alternatives is technically feasible, however, based on the effectiveness in each option, costs and other issues to consider, it appears that improvements to the existing sewer collection system and discharge to the Killingly WPCF would result in the most long-term solution for the Brooklyn sanitary collection system, treatment and disposal needs.

Both alternatives 1 and 2 require specific levels of treatment based upon the receiving water quality criteria. However, upgrading the existing system has fewer environmental impacts than constructing a new WPCF or SSDS.

Each of the wastewater treatment and disposal alternatives that were evaluated *in Facilities Planning Study* requires improvements to the existing collection system. The following upgrades are recommended and described in more detail in **Section 7** of this Report:

- Improvements to the Tatnic Pump Station
- Improvements to the Plaza Street Pump Station
- Clean and Televise Sewer Pipes
- Update Sewer Service Map
- Infiltration/Inflow Analysis, and subsequent investigation/rehabilitation activities.
- Inspect Air Release and Drain Valves
- Perform Hydraulic Capacity Analysis

5.1 Construction of a Conventional WPCF

In this alternative, other than improvements to the existing collection system listed above, the Town of Brooklyn would construct a conventional WPCF that would be independent of the Killingly WPCF.

5.1.1 Design Criteria/Environmental Impacts

Based on *Facilities Planning Study*, treated wastewater from the proposed conventional WPCF would be discharged into the Quinebaug River. This river is classified as a Class B River. According to the 2002 Water Quality Standards issued by the CTDEEP, discharges from municipal and industrial wastewater treatment systems are permitted in Class B Rivers.

The Water Quality Standards indicate that disinfection will be required from May 1 to October 1 at the sewage treatment plants. Seasonal disinfection is intended to protect the sanitary quality of bathing waters, and minimize adverse impacts to aquatic life associated with disinfection. An alternative schedule, including continuous disinfection, may be required if found necessary by the CTDEEP to protect existing or designated uses.

The CTDEEP was contacted to determine the expected permitted effluent requirements if the Town decided to construct a conventional WPCF to treat its own wastewater, and indicated that the WPCF would be expected to produce an effluent that needs to meet the requirements limits for; Biochemical Oxygen Demand, Total Suspended Solids, and Fecal Coliforms. In addition, the WPCF would need to remove phosphorus and nitrogen.

For the anticipated effluent requirements in Brooklyn, the activated sludge process is the most commonly used process to treat wastewater. Operationally, wastewater containing organic material is introduced into an aerated tank that contains bacteria that are maintained in suspension referred to as mixed liquor. These bacteria consume the organic matter and nutrients in the wastewater. Effluent from the aerated tank typically flows into a clarifier where the solids separate from the liquid. A portion of the sludge that settles in the bottom of the tank is returned to the aerated tank and the rest is wasted from the system.

Although selection of the most appropriate nutrient removal technology depends upon many factors, design begins with a generalized approach based on a few important external conditions:

- Target effluent limits for TN
- Target effluent limits for TP
- Available Space
- Temperature

A review of the wastewater industry reveals numerous process technologies and their variations can meet the effluent requirements for Brooklyn. The principal technologies identified as Anoxic/Oxic (A/O) process, Activated Sludge process (ASP), Denitrification Filters (DNF), four stage and five stage Bardenpho processes (BARD), Integrated Fixed-film Activated Sludge (IFAS), and Sequencing Batch Reactors (SBR). A more detailed description of these processes is **described in** "*Facilities Planning Study*".

An assessment matrix was utilized to determine the technology most appropriate for Brooklyn. the SBR process was selected for the direct discharge option. Sequencing Batch Reactors are a form of suspended growth activated sludge technology where the influent is batched and aeration and settlement is undertaken in the same tank.

Sequencing Batch Reactors are ideally suited for the flows and loads that are expected to occur in the Town of Brooklyn and have been used to treat both municipal and industrial wastewaters and are typically used to treat wastewater with low or varying flow patterns. The SBR can be designed to achieve nitrogen reduction by increasing the aeration duration for nitrification and adding an anoxic phase onto the batching cycle by turning the air off.

To consistently achieve low levels under all conditions, chemical addition should also be provided for assurance. **Recommendations for the design and operation for nutrient removal in SBR's are** as follows:

- The design should include a minimum of two SBR basins to allow for maintenance, handling of high flows, and seasonal variations. Designs should also consider influent equalization basins with capacity to hold peak flows during one treatment cycle.
- For nitrogen removal, an initial anoxic phase should be followed by an aerobic phase.
- Multiple anoxic phases within a single SBR cycle can improve performance (i.e., a second anoxic phase after the aerobic phase can be used to mimic a 4-stage Bardenpho process).

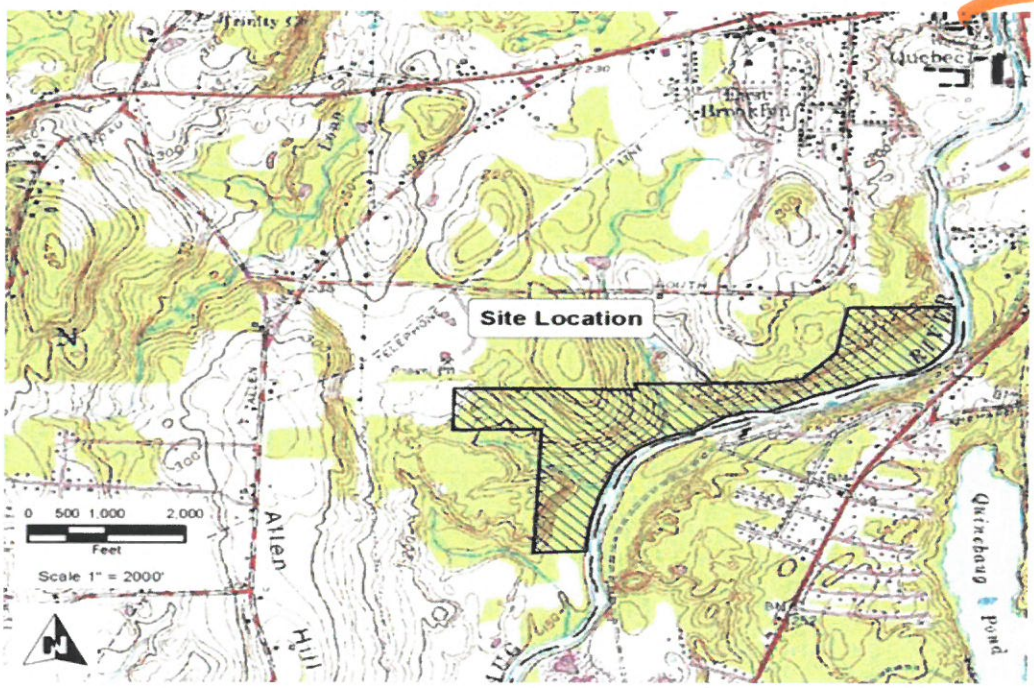
Additional process components are also needed for a complete facility. Raw wastewater must be screened and the grit removed before it is treated by the SBRs, so a headworks facility would be required. Sludge processing equipment would be needed to dewater the sludge produced. Sludge would be transported off site for incineration. Disinfection equipment for the final effluent will also be needed.

In terms of the components associated with the new SBRs, typical design guidelines suggest that two basins would be required to treat the anticipated flows and loads, with the ability to treat typical loading with one basin out of service. Aeration would be supplied by blowers; pumps would be needed to transport flows where gravity cannot be achieved, and to waste excess sludge.

5.1.2 Land Requirements

The most cost effective location for a new facility would be in close proximity to the existing siphon. The Water Pollution Control Authority indicated that they own a relatively large plot of land near the siphon and along the river, as indicated in **Figures 5-1**. It was assumed that the proposed water pollution control plant would be constructed on this parcel of land.

Figure 5-1: Proposed Location for Water Pollution Control Facility



5.1.3 Construction Problems

In addition to the actual treatment system, numerous appurtenances would be needed for the installation of a new WPCF system. These appurtenances include an adequately sized building(s), intercept the sewer trunk line prior to the existing siphon across the Quinebaug River, constructing an access road, preparing security measures, installing emergency power, adding telephone service, determining a source for potable water (potentially on-site well) and extending sufficient electrical capacity (infrastructure upgrade to provide three phase power to the site).

5.1.4 Cost Estimate

The estimated capital cost associated with construction of a conventional WPCF is presented in **Table 5-1**. As shown, the estimated cost to construct a new facility is approximately **$12,000,000.** The cost of the collection system upgrade is approximately **$1,490,000** shown in **Table 7-2,** and would be added to the cost of the new facility.

Table 5-1: Estimated Capital Costs for New WPCF	
Items	**Opinion of Cost**
Headworks Building	$1,365,000
Sequencing Batch Reactors	$1,927,500
Sludge Processing Building	$1,222,500
Disinfection	$210,000
Administration Building	$465,000
Site/Civil	$225,000
PERMITS, INSURANCE, ETC.	$1,145,000
ESTIMATED CONSTRUCTION COSTS	**$6,560,000**
ENGINEERING	
Construction Administration/Oversight (12%)	$787,200
Engineering/ Legal and Administration (10%)	$656,000
TOTAL ENGINEERING	$1,443,000
SUBTOTAL	**$8,003,200**
CONTINGENCY	$4,002,000
TOTAL	**$12,000,000**

Therefore, based on the CTDEEP effluent requirements, and associated cost, construction of a new a WPCF was not recommended.

5.2 Subsurface Disposal System

In this alternative also, other than improvements to the existing collection system, the Town of Brooklyn would construct a subsurface sewage disposal system (SSDS). The screening analysis conducted in *Facilities Planning Study* focused on the same town-owned parcel of land that was used to determine if a conventional water pollution control facility could be constructed. This parcel of land is indicated in **Figure 5-1** above. A topographical map of the parcel of land was obtained from the US Geological survey and it was indicated, the site is relatively flat along the river, but some hilly areas exist.

5.2.1 Design Criteria/Environmental Impacts

The SSDS considered in this analysis would be regulated by the CTDEEP. Therefore, the screening analysis was conducted using methods and criteria in *"Guidance for Design of Large-Scale On-Site Wastewater Renovation Systems, 2006"* by the Connecticut DEEP.

The SSDS would essentially consist of a large septic tank or series of septic tanks to trap primary solids and materials that would float to the surface. Depending upon the regulated disposal characteristics, pretreatment for nitrogen and other parameters may be required. The CTDEEP requires that nitrogen in groundwater be less than 10 mg/l at downgradient environmental receptors (water supply wells, watercourses, wetland areas, or a property line). In addition, if sufficient dilution from rainfall in the contributing watershed is not available, pretreatment would be required. Treated wastewater from the pretreatment facilities would flow to a subsurface leaching system.

The topography, location of property lines, floodplains, soil type, location of wetlands and watercourses, and other factors were taken into account to estimate the area available for a subsurface disposal system. The DEEP would not allow a SSDS to be located within floodplains or wetland areas, so they were excluded from this analysis. The remaining areas of the property were split into three regions: Leaching Area West, Leaching Area Central and Leaching Area East. These regions are shown in **Figure 5-2**. Leaching Area Central does not appear to be feasible for subsurface wastewater disposal because it would be difficult to meet hydraulic travel time requirements for pathogen attenuation.

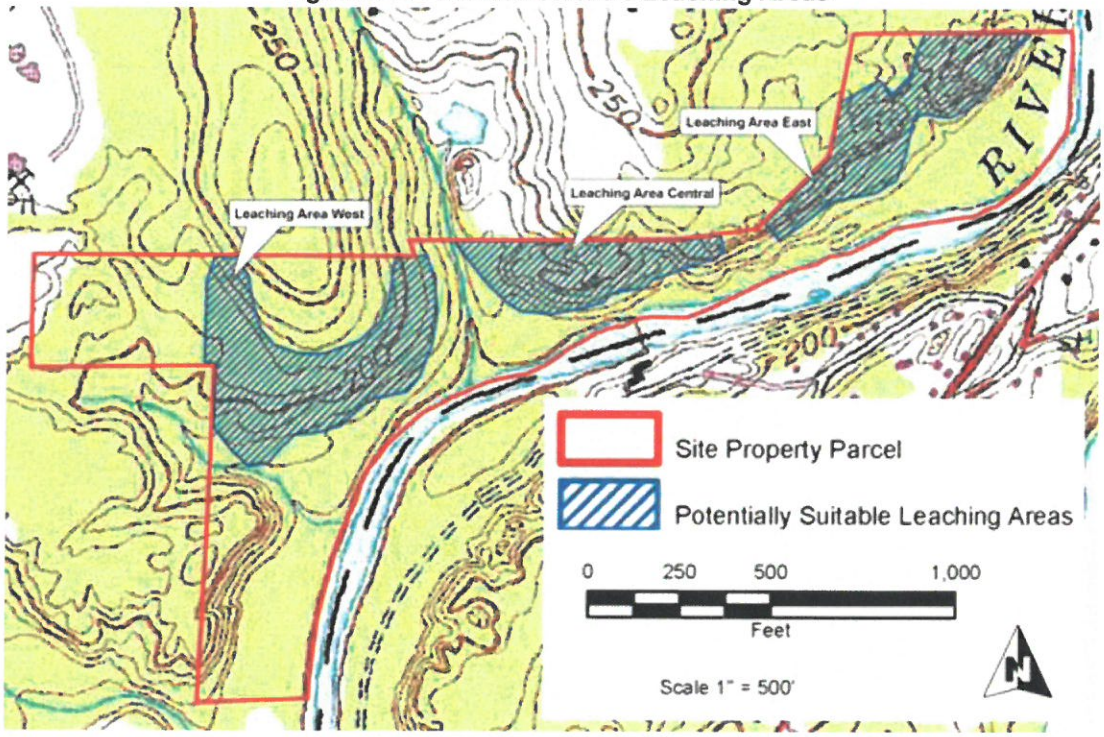
The hydraulic conductivity was used along with Darcy's Law to calculate how much treated wastewater could flow through the soil along the length of the leaching system. The travel time from the subsurface disposal system through the soil to the nearest environmental receptor was calculated. Sufficient travel time must be provided to attenuate pathogens in treated wastewater.

An acceptable loading rate to the soil was calculated based on wastewater characteristics obtained from the CTDEEP Guidance Document. These calculations were used to size a standard leaching system to disperse the wastewater (included in Appendix H of *Facilities Planning Study).*

5.2.2 Land Requirements

Results of these calculations indicated that the site may have a disposal capacity of approximately 70,000 gpd of wastewater. Since this value is much less than the estimated future flowrate of 453,000 gpd, it was concluded that the town-owned parcel of land was not large enough to accommodate flows from the entire town. Therefore, land acquisition would be required for this alternative.

Figure 5-2: Potential Suitable Leaching Areas



5.2.3 Construction problems

In addition to the actual subsurface sewage disposal system, numerous appurtenances would be needed for the installation of a new SSDS system. These appurtenances include an adequately sized structure, intercept the sewer line prior to the existing siphon across the Quinebaug River, access road, and security measures.

Therefore, based on results of this analysis construction of a new subsurface sewage disposal system was not cost effective and was not recommended.

5.2.4 Cost Estimates

Typically, the construction cost of a subsurface sewage disposal system (SSDS) is very site specific. The cost of a SSDS system that is large enough, readily accessible, has suitable soil, low groundwater and no boulders or ledge/rock with minimal landscaping would be less costly than construction of a system on a site that is difficult to access and located in poor soils with high groundwater and/or ledge and is surrounded with extensive landscaping.

Since this alternative was eliminated from further consideration, therefore no construction cost was estimated.

5.3 Discharge to the Killingly WPCF

This is a recommended alternative. In this alternative, the existing collection system will be updated and wastewater continues to discharge to the Killingly WPCF for treatment. There are some improvements to Brooklyn's sewer infrastructure located at the Killingly WPCF that may need to be evaluated for this alternative:

- Replacing the existing flowmeter and transmitter
- Upgrade existing flowmeter controls

5.3.1 Environmental Impacts

These have been discussed in the *Environmental Report* prepared by Fuss & O'Neill dated January 14, 2013. The Proposed Action will have minimal long-term negative environmental impacts or consequences since the activities are proposed in previously disturbed areas such as pump station sites and air release/vacuum valves structures along force main located underground in the roadways. Mitigation measures will be implemented to address any potentially unavoidable adverse impacts.

5.3.2 Land Requirements

No land requirements are anticipated, since wastewater from Brooklyn is proposed to be treated at the existing Killingly Water Pollution Control Facility (WPCF). Also, upgrade and improvements to the existing collection system doesn't require any land acquisition.

5.3.3 Construction Problems

An improvement to the existing collection system is relatively straightforward and no significant problems are anticipated.

5.4 Cost Estimates

Typically, the upgrade cost of the sanitary collection system, treatment and disposal would be paid for by the Town, the homeowners who benefit from such improvements and upgrade would be charged a user fee for operation and maintenance of the system.

Cost estimates for each of the recommended upgrade to the collection system are presented in **Table 7-2**. Note that a total opinion of cost of approximately **$1,490,000**, collection system upgrade should be added to each of the alternatives discussed above.

5.5 Advantages and Disadvantages

As described above, to improve the efficiency and overall reliability of the collection system, the upgrade and improvements identified in the "*Facilities Planning Study*" are necessary to be added to each of the three treatments and disposal alternatives.

Options for treating wastewater from the entire Town of Brooklyn were investigated as part of the study. The analysis focused on two types of treatment: a conventional water pollution control facility with a direct discharge to the Quinebaug River; and an indirect discharge through a subsurface disposal system. The advantages and disadvantages for each the wastewater treatment alternative options are:

Construction of a Conventional Water Pollution Control Facility (WPCF) - If the Town decided to construct a conventional WPCF to treat its own wastewater, the WPCF would be expected to produce an effluent that meets the CTDEEP permitted effluent requirements. In addition to the parameters, the WPCF would need to have the appropriate nutrient removal technology to remove phosphorus and nitrogen to reduce pollution to the River. It is the most expensive alternative to construct.

The town-owned parcel of land examined, appears to have adequate space available for the conventional treatment facility, but additional investigations would be needed to determine if wetlands and other natural resource impacts. Subsurface information would be needed to determine if the soils are suitable for supporting the proposed structures, and local zoning regulations would need to be reviewed to determine if the proposed facility would conform to local regulations.

Construct of a Subsurface Sewage Disposal System (SSDS) - Such systems could result in improved nutrient removal and moderately reduce nutrient pollution to the River, if properly operated, maintained, and monitored. Such systems require large space and are costly to install and requires regular maintenance. Results of the analysis indicate that the town-owned parcel of land examined was not large enough to accommodate the flows that are expected to occur.

Construction of a subsurface disposal system requires a much larger parcel of land and a more in-depth site investigation to confirm the leaching capacity. To purchase a quantity of land large enough for construction of a wastewater treatment facility and subsurface wastewater absorption system would be very expensive, therefore this alternative was dismissed.

? EXPANSION CONTRIBUTION?

Discharge to Killingly Water Pollution Control Facility (WPCF) - This option is the least expensive alternatives, since only minor upgrade is required to the flow monitoring system at the Killingly WPCF. The Town should undertake all efforts possible to institute water conservation measures to limit the wastewater flow to Killingly, including a public awareness campaign and a low flow fixture replacement program to reduce water consumption in residential housing units. This reduction in flow would reduce the amount spent by the WPCA to treat flows at the Killingly WPCF.

6 Selection of an Alternative

Each of the alternatives is technically feasible, however, based on the effectiveness in each option, costs and other issues to consider, it appears that improvements to the existing sewer collection system and discharge to the Killingly WPCF would result in the most long-term solution for the Brooklyn sanitary collection system, treatment and disposal needs. In addition, minor upgrade to the Killingly WPCF system has no environmental impacts than constructing a new WPCF or SSDS.

Based on results of evaluation and studies the following upgrades are recommended for the collection system subject to review during final design:

1. Improvements to the Tatnic Pump Station
2. Improvements to the Plaza Street Pump Station
3. Clean and Televise Sewer Pipes
4. Update Sewer Service Map
5. Infiltration/Inflow Analysis, and subsequent investigation/rehabilitation activities.
6. Inspect Air Release and Drain Valves
7. Perform Hydraulic Capacity Analysis

The following items are recommended for WPCA consideration upon funding availability:

1. Generator for pump stations
2. Modify the flowmeter at Killingly WPCF for backwater conditions to improve billing accuracy during wet weather flow
3. Evaluate and implement extension of sewers to the industrial zoned area
4. Investigate and install a new flow monitoring manhole for the prison.

7 Proposed Project (Recommended Alternative)

7.1 Project Design

The proposed project is the upgrade and improvement necessary to the Town of Brooklyn's collection system and wastewater disposal to the Killingly WPCF that have been identified and recommended in the "*Facilities Planning Study*". The purpose of the Proposed Project is to improve the efficiency and overall reliability of the collection system. This solution is less costly than the other two alternatives.

The proposed project consists of improvements to Brooklyn's sanitary collection system, address and replace the aging equipment and mechanical systems for two pump stations, I/I analysis and rehab, reduce the flows during significant rainfall events, inspect and address the operational issues related to the air release/vacuum valves located along the force main, clean and televise sewer pipe, perform hydraulic capacity analysis to evaluate the pipe capacity and need for larger pipes, and update sewer service area. Evaluate and implement extension of sewers to the industrial zoned area, investigate and install a new flow monitoring manhole for the prison, and upgrade existing Brooklyn flow meter controls (located at the Killingly WPCF) are recommended for the WPCA consideration upon funding availability.

7.2 Design Criteria (Recommended Alternative)

The following upgrade and improvements to the Brooklyn collection system are proposed subject to review during final design:

7.2.1 Tatnic Road Pump Station

The pumps at the Tatnic Road Pump Station are no longer manufactured, difficult to repair, and are deteriorating rapidly. The existing level sensing equipment includes components that contain mercury which is considered to be a hazardous material and is no longer available. For these reasons, the following improvements recommended to the station:

- Install a new dry pit submersible pump with pump base
- Provide variable frequency drives (VFD's) for the pump
- Replace existing level sensing which contains mercury, which is a hazardous material, with a submersible pressure transducer and backup floats.
- Replace existing building heaters and dehumidifier
- Replace force main pressure gauge assembly
- Extend the generator exhaust pipe (min. of 10 feet) from the air intake fan to meet the code requirement.
- Provide architectural improvements (replacing the exterior door and painting interior and exterior items such as the structure walls/ceilings, railing, louver, and air intakes for the generator). Update site landscaping to improve serviceability of the station.
- Repair check valves, wet well exhaust fan
- Degrit wet well

7.2.2 Plaza Street Pump Station

The Plaza Street Pump Station does not meet the requirements of the Standard for Fire Protection in Wastewater Treatment and Collection Facilities as required by National Fire Protection Agency (NFPA) 820. This code requires that all electrical items located within 1-1/2 feet of the top of a wet well be rated for Class 1 Division 1 environments. The existing electrical components are located in top of the wet well and are not rated as such and must either be replaced or raised so they are more than 1-1/2 feet above the wet well.

For these reasons, we recommend the following improvements to the station:

- Remove undersized suction-lift pumps and provide larger submersible pumps with larger capacity.
- Provide soft starts or variable frequency drives (VFD's) for the pumps
- Replace the floats (contain mercury) with a submersible pressure transducer and backup floats.
- Replace controls with equipment that meets the requirements specified in NFPA 820
- Provide odor control at the pump station to reduce the emission of hydrogen sulfide and minimize odors from the sewer system.
- Upgrade force main if required
- Provide a dedicated backup generator to increase the reliability of this station. The generator could either be installed near the station, or could be a portable type that is dedicated for this station rather than shared with other stations (cost of a new generator is not included in the opinion of cost).

7.2.3 Clean and Televise Sewer Pipe

The sewer collection system is a fairly spread out system. The force main that transports flows from the Tatnic Road Pump Station is several miles long and may contribute to the formation of corrosive hydrogen sulfide gas. When released, these gases are not only odorous, but can also damage distribution piping into which they are discharged. It is recommended that portions of the gravity sewer pipe network be cleaned and televised so the condition of these pipes can be determined.

7.2.4 Sewer Service Area (SSA)

The sewer service area (SSA) map created with data from the State DEEP indicates the existence of bifurcated parcels (i.e., the sewer SSA boundary divides the parcel). The existence of bifurcated parcels opens the WPCA to potential litigation by property owners who want to connect facilities outside of the SSA into public sewers, based on the argument that the connection point is within the SSA. Therefore the update of the SSA map is recommended. If bifurcated parcels are allowed to remain, strong policy must be created and included in the Sewer Ordinance describing the allowed actions under this specific situation.

7.2.5 Infiltration/Inflow (I/I)

Since infiltration and inflow (I/I) appear to be an issue throughout the Brooklyn collection system, it has been recommended that the WPCA take steps to identify sources of I/I in the sewered area. The I/I investigation will be performed to locate the source of infiltration and inflow. Such investigations may include installing temporary meters to measure flows, dyed water testing to see if catch basins are connected to the sanitary sewers, smoke testing to find out if roof leaders, yard drains, or other sources are tied into the sewers, chemical flow dilution testing to quantify the amount of infiltration, and house-to-house surveys to determine if sump pumps are discharging to the sanitary sewer system.

7.2.6 Air Release/Vacuum Valves and Drain Valves

A number of air release/vacuum valves and drain valves are located along the force main from the Tatnic Road Pump Station. It has been reported that many of the air release/vacuum valves have operational issues and failed to operate properly; therefore they have been closed and need to be replaced. The drain valves also, have not been exercised for many years and may no longer be operable. We recommend that the air release/vacuum valves be exercised to allow built of gases to be released from the force main and kept open and to be replaced as required.

If these valves remain closed, gases may accumulate inside the force main and reduce the capacity of the pipe and would result in an increase in energy costs to transport flows through the force main. If odors are present, alternative means such as manhole inserts or small odor control systems can be used to eliminate them. We also recommend that the drain valves be replaced.

7.2.7 Hydraulic Capacity Analysis

A simplified analysis was performed to determine if sufficient capacity exists within the collection system to transport the current and future flowrates. The results of this analysis indicated that two sections of pipe did not appear to have adequate capacity to transport the existing peak flowrate, and additional sections did not have adequate capacity to transport future flowrates. A more sophisticated hydraulic model of the collection system should be created to perform a more detailed analysis. If results of this model agree with the analyses that were performed in Facilities Planning Study, the capacity should be increased by installing larger pipes or relief sewers. This effort will require digization of the collection system record drawings.

7.3 Other Items for Consideration

The following upgrade, evaluation and investigation are recommended for WPCA consideration upon funding availability.

7.3.1 Modify the Flowmeter at Killingly WPCF for backwater conditions

Flows from the Town of Brooklyn are measured using an ultrasonic flowmeter that measures the level of wastewater as it flows through a Parshall Flume at the Killingly WPCF. The ultrasonic sensor has been replaced within the last 3 years but the flow meter station was not upgraded to detect back flow conditions which occur during wet weather flows. The *facilities planning report* identified that this flume appears to receive backwater flows when the treatment plant is inundated with wet weather flow faster than the plant can accept such flow. The surcharged Parshall Flume would report significantly higher flow rates than those actually from the Town of Brooklyn, potentially resulting in overbilling during heavy rainfall events. The surcharging of the Parshall Flume currently cannot be detected or accounted for during the billing measurements of Brooklyn's wastewater flows. It is recommended that the existing flowmeter station be upgraded to add additional equipment to allow for improved operations during surcharging.

7.3.2 Industrial Zoned Area

An evaluation and/or sewer extension design will be undertaken of sewershed infilling and connection of commercially zoned parcels and extension of sewers to the industrial zoned area to encourage business development while protecting the local groundwater.

7.3.3 Flow Monitoring Manhole for Prison

An investigation will be conducted to determine the feasibility of providing new sewage grinding equipment and flow monitoring equipment for the prison wastewater flow.

7.4 Total Project Cost Estimate

Table 7-1 summarizes preliminary opinion of costs associated with the upgrade and improvements of the collection system and pump stations. Two of the line items are capital projects (i.e. items 1 and 2). For these two items there is an allowance for Engineering of 20%. A contingency allowance of 25% is provided for all items.

Table 7-1: Order of Magnitude Opinion of Costs	
Collection System Improvements	**Opinion of Cost**
1) Tatnic Road PS Improvements	$214,000
2) Plaza Street PS Improvements	$502,000
3) Clean and Televise Sewer Pipes	$100,000
4) Update Sewer Service Map	$20,000
5) Inspect Air Release and Drain Valves	$20,000
6) Infiltration and Inflow Analysis	$180,000
7) Perform Hydraulic Capacity Analysis	$40,000
TOTAL (Rounded)	**$1,076,000**
Other Items for Consideration	
Generator for pump stations	
Modify Flowmeter at Killingly WPCF	
Sewer Extension Evaluation to Industrial Zone	
Flow Monitoring Manhole at Prison	

The following summarizes the Total Project Cost Estimate:

Table 7-2: Recommended Upgrade Total Cost Estimate	
Construction Cost	1,076,000
20% Engineering added to Items 1&2	143,200
25% Contingency added to Items 1 to 7	269,000
Total	$1,488,200
Total Estimated Cost (Rounded)	**$1,490,000**

7.5 Annual Operating Budget

7.5.1 Income

The WPCA utilizes sewer rates as their source of income for operating and maintaining the sewer collection and sewer treatment at Killingly. The total income collected on the current list (year end 6/30/12) was $261,096.00.

See Attachment B for existing WPCA sewer usage charge **"Adopted Budget for 2013" dated June 28,** 2012.

7.5.2 Operations and Maintenance Cost

Table 7-3 summarizes the WPCA annual operation and maintenance budget including annual payment to Killingly, legal fees, equipment costs, power costs, operation and maintenance budget and also proposed Short Lived Asset Account (Reserve for Capital Non-Re-occurring).

Table 7-3: Annual O&M Cost Estimate & Present Worth	
Description	**O&M Cost**
O&M and Other Annual Costs	
Annual Payment to Killingly	$200,500
Maintenance Fees	$10,000
Meter Maintenance	$1,000
Contingency	$1,800
Electrical Expense	$18,000
Fuel Expense	$700
Legal Fees	$3,000
Postage	$1,000
Print/Advertising	$2,000
Secretary Fees	$1,000
Software maintenance	$1,550
Short Lived Asset Account (Reserve for Capital Non-Re-occurring)1	$6,000
Annual O&M Cost (Rounded)	**$247,000**
O&M Present Worth	**$3,780,000**
No. of EDUs(2)	**1,250**
User Fee -Annual Cost/EDU	**$198**
Present Worth =A*(P/A, i=2.7%, n=20 years) (3)	15.30

NOTES:

1) Short Lived Asset Account Reserve for;
   i. Pump life is 10-20 years. Should consider replacement of all pumps within 20 years
2) Assume 1,250 EDU for O&M
3) Annualized at 2.7% interest rate over 20 years. Per Appendix C of OMB Circular A-94 Revised December 2012.

7.6 Debt Repayments

WPCA currently does not have any outstanding debt on existing facilities. Brooklyn is intending to finance the project through USDA RD. It has been represented that the Town will qualify for a low interest (2.5%) loan from USDA that can be carried out for up to 40 years. Brooklyn is also seeking USDA grants to defray the capital cost of improvements. Table 7-4 presents the debt service repayments amount under different loan and grant scenarios. There are no pre-payment penalties, and the Town can choose to pay off earlier if desired.

Table 7-4: Annual Debt Service Repayment Calculation						
					Annual Debt Service @ 2.5% Interest	
No	Assumption	Total Cost Capital	RD Grant Percentage	Total Loan Amount	20 years	40 years
1	100% Loan No Grant	$1,490,000	$0	$1,490,000	$95,579	$59,356
2	80% Loan, 20% Grant	$1,490,000	$298,000	$1,192,000	$76,463	$47,485
3	75% Loan, 25% Grant	$1,490,000	$372,500	$1,117,500	$71,684	$44,517

7.7 Reserves

WPCA currently does not have any debt service repayment. Reserve amount is budgeted to provide for timely replacement of short-lived assets, which include pump/motor overhaul or replacement, and small equipment replacement. Short-lived asset reserve amounts of $6,000 are considered, as shown on Table 7-3.

8 Conclusions and Recommendations

The analyses performed for the study compared three alternatives for resolving wastewater disposal and it was found through a detailed analysis that the most cost effective alternative was to continue transferring the wastewater to Killingly WPCF.

The need for the Proposed Action is to improve Brooklyn's sanitary sewer collection system performance, perform hydraulic capacity analysis to evaluate the pipe capacity and need for larger pipes, reduce the flows during significant rainfall events, inspect and address the operational issues related to the air release/vacuum valves located along the force main, and to address and replace the aging equipment and mechanical systems for two pump stations to meet the requirements of the Standard for Fire Protection in Wastewater Treatment and collection Facilities as required by National Fire Protection Agency (NFPA) 820.

The following items are recommended for WPCA consideration upon funding availability:

1. Generator for pump stations
2. Modify the flowmeter at Killingly WPCF for backwater conditions to improve billing accuracy during wet weather flow
3. Evaluate and implement extension of sewers to the industrial zoned area
4. Investigate and install a new flow monitoring manhole for the prison.

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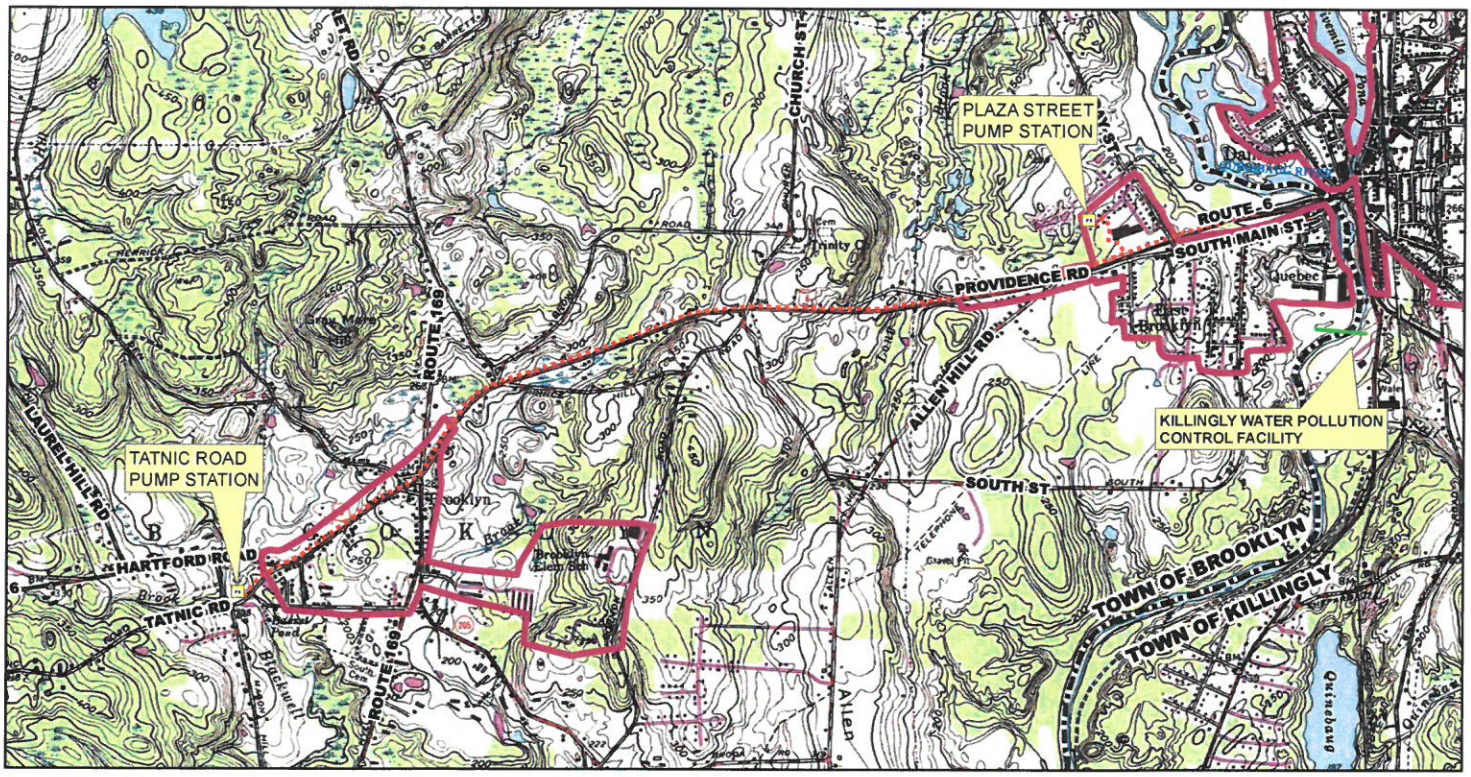
Figures



JANUARY 2013

Legend

- Force Main
- DEP GIS Sewer Service Area
- Town Line

Location Map
Collection System Upgrade
Brooklyn, CT

0 0.45 0.9 Miles

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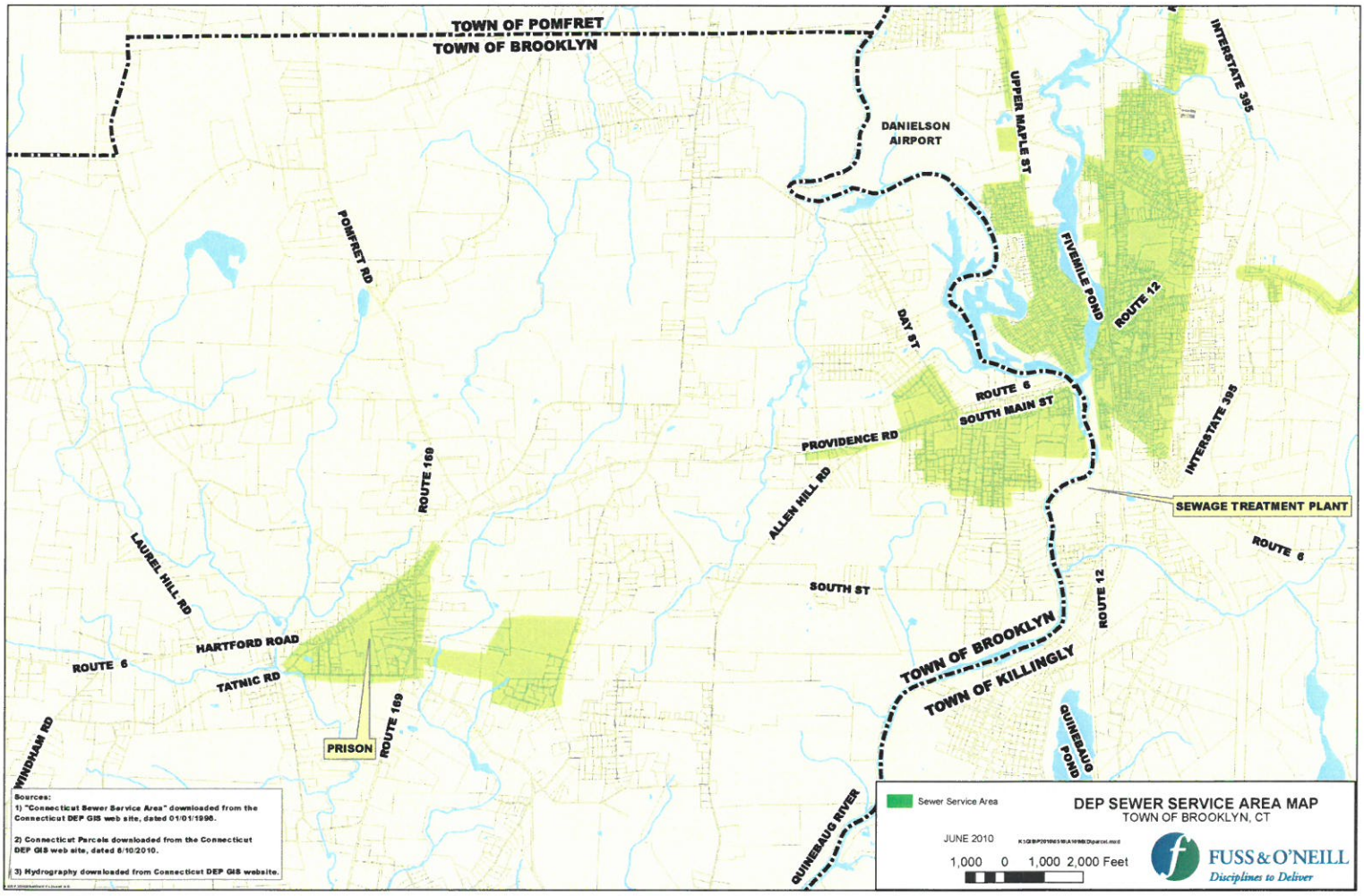
Path: K:\GIS\P2011\0464\A20\MXD\01 Location Map.mxd


TOWN OF POMFRET
TOWN OF BROOKLYN
DANIELSON AIRPORT
UPPER MAPLE ST
INTERSTATE 395
FIVEMILE POND
ROUTE 12
DAY ST
ROUTE 6
SOUTH MAIN ST
PROVIDENCE RD
ALLEN HILL RD
SEWAGE TREATMENT PLANT
ROUTE 6
SOUTH ST
ROUTE 12
TOWN OF BROOKLYN
TOWN OF KILLINGLY
QUINEBAUG POND
QUINEBAUG RIVER
POMFRET RD
ROUTE 169
LAUREL HILL RD
HARTFORD ROAD
ROUTE 6
TATNIC RD
PRISON
ROUTE 169
WINDHAM RD
Sources:
1) "Connecticut Sewer Service Area" downloaded from the Connecticut DEP GIS web site, dated 01/01/1998.
2) Connecticut Parcels downloaded from the Connecticut DEP GIS web site, dated 8/10/2010.
3) Hydrography downloaded from Connecticut DEP GIS website.
Sewer Service Area
DEP SEWER SERVICE AREA MAP
TOWN OF BROOKLYN, CT
JUNE 2010
1,000 0 1,000 2,000 Feet
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Disciplines to Deliver