

UTILITY SERVICES PLAN



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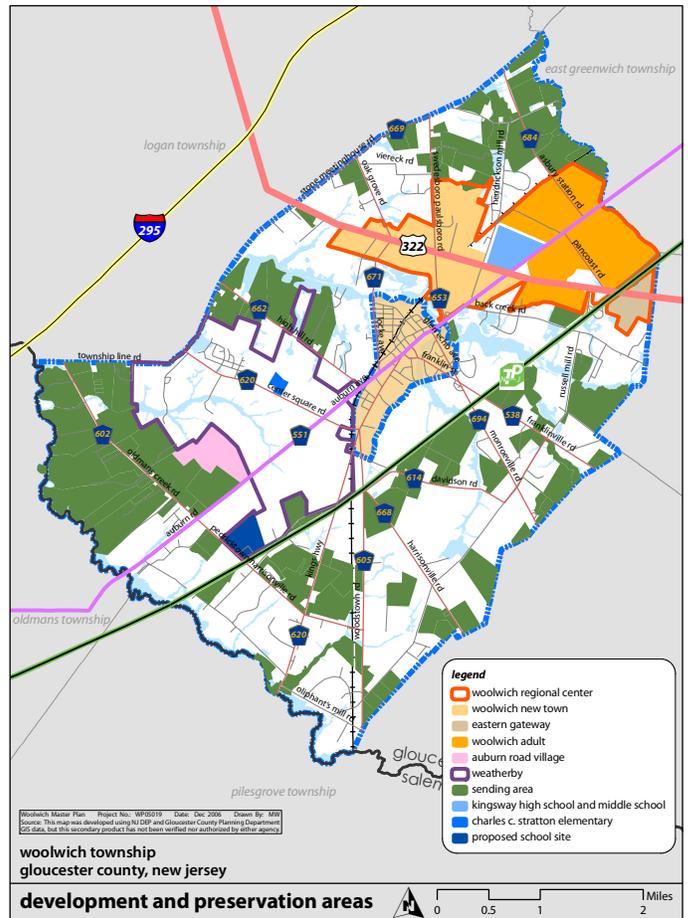
INTRODUCTION

The Woolwich Regional Center and Auburn Road Village are key to Woolwich Township's overall strategy for sustainability. This document provides the strategy to bring sewer and water necessary for implementation.

PURPOSE

Woolwich Township in Gloucester County, New Jersey proposes to implement the Transfer of Development Rights (TDR) and achieve consistency with the State Development and Redevelopment Plan. To this end, the Township has designated specific growth areas and preservation areas. The largest of the growth areas is Woolwich Regional Center along the US 322 corridor. This includes several subareas. First is a TDR Receiving Zone that consists of two noncontiguous areas. The larger of the two is a planned new town called Woolwich New Town. Woolwich New Town will contain a mix of residential, commercial, office, civic uses and outdoor public spaces. The second component of the TDR Receiving Zone is a commercial zone east of the NJ Turnpike. The two areas surround a 750 acre tract owned by Woolwich Adult LLC as well as a middle and high school. Woolwich Adult plans to construct a mix of residential, retail and office space. A second Receiving Zone – Auburn Road Village – lies contiguous to the Weatherby development. This will be predominantly residential when built out.

Approximately 4,000 acres are designated as preservation areas, called a Sending Zone. Implementation of Woolwich Township's future vision requires that the planned growth areas be served by a comprehensive wastewater collection, treatment and disposal system. Based on current development projections, it is anticipated that 1.9 million gallons per day (mgd) of wastewater treatment and disposal capacity will be required. The purpose of the following report is to outline the water and wastewater needs and permitting requirements that the proposed development will generate and to identify the coordination requirements between the overall planning effort and the wastewater management planning effort.



WATER PLAN

OVERVIEW OF EXISTING AND FUTURE WATER SUPPLY

Aqua New Jersey holds the water supply franchise in Woolwich Township. As such, it will arrange for, own and operate the facilities needed to satisfy this demand in accordance with existing and/or future service agreements with the Township and developers.

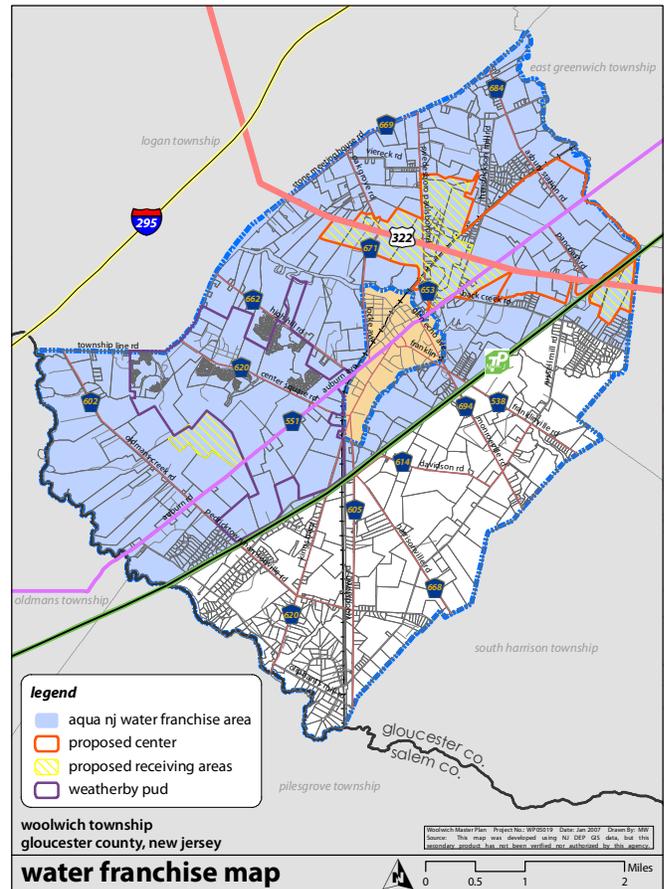
Currently, public water supply in Woolwich Township is limited to the Weatherby development and immediately adjacent areas along Center Square Road. Aqua's current source of water is groundwater, as permitted by NJDEP's Bureau of Water Allocation. Existing water supply infrastructure includes four wells, one treatment plant, 1.65 million gallons of storage, a booster station and water distribution mains serving existing subdivisions within and adjacent to Weatherby.

Aqua's current water allocation is sufficient for near-term needs, but will be supplemented by purchased water from New Jersey American Water Company in the future to meet expected growth within Weatherby. Aqua will provide for construction of the portion of transmission main within Woolwich Township to interconnect with the New Jersey American transmission main. Within Woolwich Township, the water main alignment will generally follow US 322 to Locke Avenue, then along Locke Avenue to High Hill Road, and then along High Hill Road to connect to Aqua's existing water distribution system. The timing of this water transmission main construction is dependent upon the pace of growth in the service area. The planned alignment could readily serve planned development along US 322. A water main extension from Aqua's existing water plant to Auburn Road Village is required to provide public water service to that area.

PROPOSED DEVELOPMENT AND WATER SUPPLY

Future development in Woolwich Township within the receiving zones and proposed Regional Center includes both residential and commercial usage. Tables 1 and 2 describe the planned developments and projected annual average day water demands. The breakdown enables each type of development unit to be assigned a water demand consistent with New Jersey Department of Environmental Protection (NJDEP) and NJ Department of Community Affairs (NJDECA) criteria.

The projected water demand from each unit is calculated by multiplying the quantity of each unit times the respective demand criteria. The residential and commercial demands are then totaled. Accordingly, the total water demand, identified as the average daily demand, is 1.749 mgd for the proposed Regional Center, .02 mgd for expansion of an existing warehousing area on the western end of the US 322 Corridor, and .143 mgd for Auburn Road Village (1.9 mgd total).



Although slightly different per customer use factors apply (pursuant to NJDEP/NJDECA criteria), the average water demand parallels the wastewater flow estimates. Peak water demands for new developments such as this are projected at three times the average day demand pursuant to the NJDEP/NJDECA methodology used in this analysis.

This number forms the basis for identifying other design parameters such as peak flows and pumping rates. The detailed design process for the water supply systems will require engineering calculations to determine pumping horsepower needs and size other system components.

WATER SUPPLY ALTERNATIVES

Water supply planning for this project is comprised of three elements: source, treatment and transmission. Distribution and storage will be addressed with future developers of these planning areas, as part of subdivision layout and planning.

Source options include groundwater and surface water, either through source development projects undertaken by Aqua, or through purchased water contracts between Aqua and other water suppliers.

Table 1: Proposed Development and Water Demand Estimates - Woolwich Regional Center

Woolwich Adult Residential Development Project				
1,029	2 bedroom	@	215 gpd	221,335 gpd
			Subtotal	221,335 gpd
TDR Residential Development				
100	Single Family	@	395 gpd	39,500 gpd
500	2 Bedroom Units	@	215 gpd	107,500 gpd
1,000	Duplex Units	@	274 gpd	275,000 gpd
1,207	3 Bedroom Twnhse	@	210 gpd	253,470 gpd
410	2 Bedroom Twnhse	@	150 gpd	61,500 gpd
			Subtotal	735,970 gpd
			Total Residential	958,205 gpd
Woolwich Adult Development Project				
2,700,000 sq. ft.		@	.125 gpd/sq. ft.	337,500 gpd
			Subtotal	337,500 gpd
TDR Commercial Space				
3,625,000 sq. ft.		@	.125 gpd/sq. ft.	453,125 gpd
			Subtotal	453,125 gpd
			Total Commercial	790,625 gpd
Add'l Commercial Space on US 322 Outside of Regional Center				
750,000		@	.031 gpd/sq. ft.	23,250 gpd
			Subtotal	23,250 gpd
			Total Commercial	813,875 gpd
			Regional Center Total	1,749 mgd
			US 322 Outside of Regional Center Total	0.23 mgd

Table 2: Proposed Development and Water Demand Estimates - Auburn Road Village Receiving Area

Auburn Road Residential Development				
157	3 Bedroom Twnhse	@	210 gpd	32,970 gpd
53	2 Bedroom Twnhse	@	150 gpd	7,950 gpd
161	Single Family	@	275 gpd	44,275 gpd
130	Duplex Units	@	395 gpd	51,350 gpd
			Subtotal	136,545 gpd
Commercial Space				
50,000 sq. ft.		@	.125 gpd/sq. ft.	6,250 gpd
			Subtotal	6,250 gpd
Auburn Road Receiving Zone Total				.143 mgd

Based on recent groundwater modeling and water allocation decisions undertaken by NJDEP, serving these planning areas from groundwater supplies does not appear to be a viable alternative. NJDEP does not believe additional groundwater withdrawals can be made without adverse impact to the aquifers. Moreover, Aqua's current interim allocation quantities will be reduced, once New Jersey American Water Company's Tri-County transmission main is extended to provide surface water to this area. This being the case, purchasing water from other area suppliers is also not a viable alternative, since they also rely on groundwater supply. Development of a surface water source utilizing the Delaware River is similarly viewed as non-viable, due to salinity and the type and cost of treatment that would be required.

The selected plan therefore relies upon surface water from New Jersey American Water Company's Tri-County pipeline to provide water supply to the Woolwich Township proposed Regional Center and Receiving Zones. Because of the pricing structure associated with water purchase from New Jersey American, alternatives to attenuate peak period purchase utilizing Aqua's available groundwater allocation, aquifer storage and recovery, and/or Logan Township Municipal Utility Authority's proposed groundwater recharge project need to be considered. This is further discussed below.

WATER SUPPLY PLAN

Aqua New Jersey has a water supply contract with New Jersey American to serve the Township's above-described growth areas, and will modify this contract to reflect the supply needs of these areas. Water infrastructure needs to accommodate this increased demand will depend upon the timing of the projects and related developer commitments.

If commitments and contracts are in place prior to construction of the currently planned transmission main, Aqua's contract with New Jersey American can be modified to utilize currently available source and treatment capacity at New Jersey American's Tri-County Treatment Plant. This also allows the planned transmission mains to be built by New Jersey American and Aqua to be upsized to provide capacity for the growth areas.

If such commitments are deferred, New Jersey American's capacity may be fully committed and an expansion of the Tri-County Plant may be required. Also, if such com-

mitments are made after the currently planned transmission mains are constructed, paralleling those mains will be required to provide service to the growth areas. Under either scenario, a booster station along US 322 will be necessary, as will a main extension from Aqua's current water plant in Weatherby to the Auburn Road Receiving Zone. Also, developer provided infrastructure will include distribution mains, storage, and possibly booster stations.

The pricing structure associated with this purchased water contract encourages a steady purchase amount and penalizes "peaking" type purchase, making it prudent to consider alternative sources of water to supplement peak period needs (primarily summertime irrigation and recreational water use). Fully utilizing Aqua's groundwater allocation during these periods will help cut peak purchased water demand, but will not be sufficient to adequately "equalize" water purchases. Other options to accomplish this include aquifer storage and recovery (ASR) and utilization of the proposed LTMUA groundwater recharge project.

ASR involves purchasing additional quantities of water from New Jersey American during low-demand periods, pumping it into the underlying aquifer, and then withdrawing it for use during peak periods. In this manner, monthly purchased quantities can be somewhat “normalized.”

LTMUA has proposed a groundwater recharge project and has been awarded grant funding by NJDEP to demonstrate and if approved, to implement it. This project involves injection of highly treated wastewater into the aquifer for recharge purposes.

LTMUA has requested NJDEP to allow it to sell equal quantities of groundwater to area water suppliers to provide revenues that offset the increased costs of treatment and injection that LTMUA will incur. Aqua was noted as a potential “buyer” in LTMUA’s application to NJDEP. The actual water withdrawn by Aqua would not be the actual

water injected by LTMUA, due to the distances involved.

This project is still in the review and approval process with NJDEP, but may present a less capital intensive water supply option than ASR. In either case, Aqua will need to add treatment capacity for the water withdrawn from the aquifer. These options will be studied further as planning proceeds.

Regulatory approvals will be somewhat dependent upon the timing of the commitments. Permits and approvals will be more extensive if expansion of the Tri-County Plant is needed or if parallel water mains are needed. If existing treatment capacity can be used and planned water mains upsized, additional permitting will be limited to the booster station and local distribution and storage infrastructure. Extensive permitting will also be associated with implementation of ASR or the LTMUA recharge project.

CONCEPTUAL COST ESTIMATES

Preliminary costs for this project are based upon the foregoing discussion. The costs are broken down (Table 3) and are based on the assumption that developer commitments are made in time to allow use of available Tri-County treatment plant capacity and to allow upsizing of planned transmission mains. It further assumes the LTMUA groundwater injection program can be used to help manage peak demands and that ASR is not required. If this turns out not be the case (which is quite possible) and a Tri-County plant expansion, and/or parallel transmission mains, and/or ASR are required, costs will be significantly higher. The costs associated with this project are based on the facilities that are necessary for conveying water supply to the development sites. The costs associated with on-site facilities (including additional storage) are to be determined by developers in the future, primarily through their individual permitting and approval process.

Table 3: Conceptual Construction Costs

Upsize 27,000' of NJA T-Main (20" to 24")	\$500,000
Upsize 13,000' of Aqua T-Main (20" to 24")	\$250,000
Construct Booster Station along US 322	\$700,000
Construct 4,000' T-Main Main from Weatherby to Auburn Rd Receiving Zone	\$400,000
Construct additional treatment capacity for groundwater withdraws allowed due to LTMUA recharge project	\$1,000,000
Construction cost Subtotal	\$2,850,000
Engineering, construction management, contingencies @ 25%	\$713,000
Grand Total	\$3,563,000

The foregoing cost estimates are conceptual, in 2006 dollars, and are based on the design concept under consideration. Costs could be four or more times higher if Tri-County Plant expansion, parallel transmission mains, and ASR are needed. Final estimates are to be prepared once detailed design information is available. The cost estimate does not include any costs for land acquisitions.

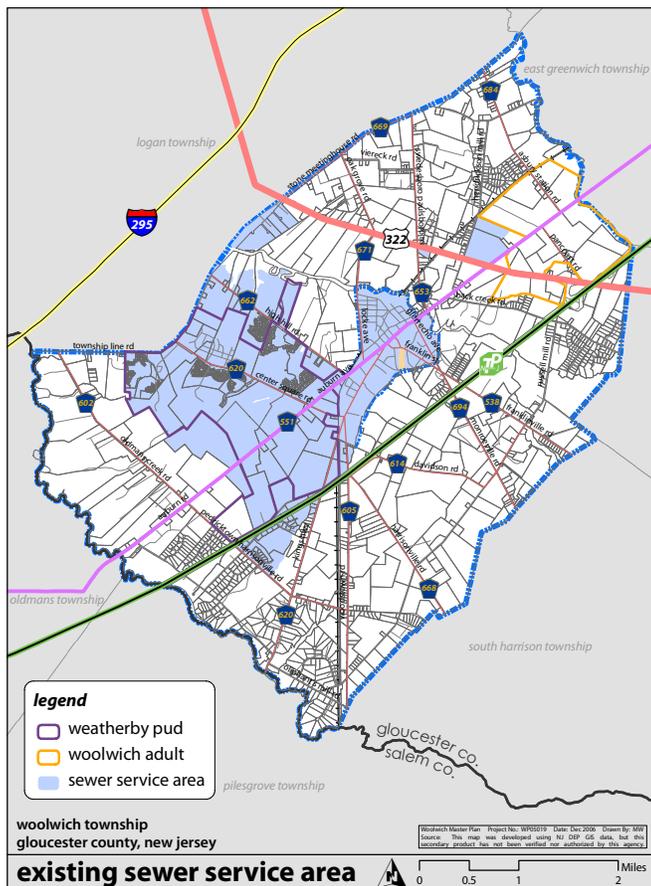
SEWER PLAN

OVERVIEW OF EXISTING AND FUTURE SEWER SERVICE

Aqua New Jersey holds the wastewater disposal franchise in Woolwich. As such, it will arrange for, own and operate the facilities needed to satisfy this demand in accordance with existing and/or future service agreements with the Township and developers. Currently Woolwich Township is partially served by the Logan Township Municipal Utilities Authority (LTMUA), which operates a wastewater treatment facility with a discharge to the Delaware River. The Kingsway Middle School and High School campus is served by the Swedesboro wastewater treatment plant via a force main dedicated exclusively to them. There is also a private wastewater treatment plant serving a Wawa store along US 322. Both of these sites will fall in the boundaries of the proposed Regional Center.

The existing sewer service areas for Woolwich Township are proposed to be amended to accommodate planned growth areas and to bring the sewer service areas into consistency with changes that the Township proposes to the State Plan Policy Map. These modifications are described below:

- Expand the sewer service area to include the proposed Regional Center.



- Expand the sewer service area west of the Regional Center along US 322 to accommodate planned commercial growth on either side of the highway and contiguous to existing warehousing facilities. (Block 11, Lots 17,18,19,20,21; Block 6 Lots 2,3)
- Remove five properties north of High Hill Road from the existing approved sewer service area. These properties are proposed to be removed from Planning Area 2 – Suburban Planning Area and placed in Planning Area 5 – Environmentally Sensitive Planning Area and to be reflected accordingly on the State Plan Policy Map. (Block 5 Lots 1,2,3,4,5)
- Remove properties bounded by the NJ Turnpike, Pe-dricktown-Harrisonville Road and tributary to Oldmans Creek from the existing sewer service area. These properties consist of a combination of homes on septic systems and undeveloped land designated as Sending Zone properties. Furthermore, they are located in Planning Area 4 – Rural Planning Area.
- Expand the sewer service area to include two parcels, one on which at least two new schools will be sited, and another zoned Light Industry and Office that may be used for future municipal services. (Block 28, Lots 2,3,17)
- Add two parcels that are located in Planning Area 2 but outside of an approved sewer service area. (Block 5, Lots 7.01, 7.02)
- The Auburn Road Receiving Zone is primarily located within an existing sewer service area that is tributary to the LTMUA sewage treatment plant.
- Whether or not the Kingsway Regional School District and/or Wawa hooks into the new wastewater system serving the Regional Center is a determination that will be made at the time Woolwich Township submits a wastewater management plan to NJDEP.

A substantial sewer service area expansion is required to implement Woolwich's land use planning objectives. This level of wastewater management planning will trigger Executive Order 109 requirements. This Executive Order requires, among other things, that major expansions of the sewer service areas consider the overall water resources and particularly, water supply impacts of extending the sewer service areas. The significant environmental concern is a potential depletion of groundwater supply sources. This concern can be substantially ameliorated by importing surface water and/or by proposing a wastewater disposal system, which can provide for beneficial recharge of groundwater.

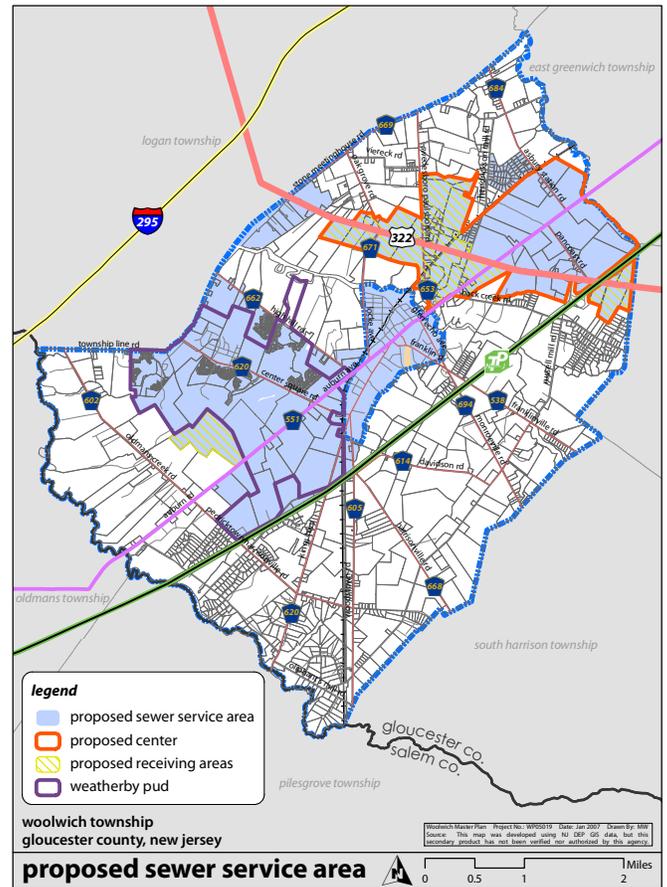
The required facilities to accomplish wastewater disposal as described above requires facilities for wastewater conveyance, treatment and disposal. Prior to the design and construction of wastewater conveyance, treatment and disposal facilities, it is necessary to establish a new sewer service area under N.J.A.C. 7:15. Also under these regulations, any existing or new domestic treatment works (DTW) not identified in an existing State Water Quality Management Plan that requires a NJPDES discharge permit and/or that has a design capacity of 2,000 gallons per day (gpd) or more must be established by way of a Wastewater Management Plan (WMP). A WMP is a document that provides a 20-year planning horizon for wastewater and certain other water quality concerns. The WMP must address a specific planning area and must be approved by NJDEP. Any concerns of the Delaware Valley Regional Planning Commission will also need to be addressed.

Hatch Mott MacDonald (HMM) has been retained to assist Aqua New Jersey in establishing a new sewer service area, which is prerequisite to necessary NJDEP, permits to convey, treat and discharge treated wastewater quantities associated with the proposed development.

CURRENT WASTEWATER PLANNING STATUS

The Gloucester County Utility Authority (GCUA) is the designated planning agency for the Tri-County Water Quality Management Plan in Gloucester County. The Delaware Valley Regional Planning Commission had previously delegated this responsibility to them. Wastewater planning responsibility for Logan Township and a portion of Woolwich Township was delegated to Logan Township MUA by the GCUA when it prepared the existing LTMUA Wastewater Management Plan. In order to adopt a new Wastewater Management Plan for Woolwich Township, the designated planning agency needs to be changed to authorize Woolwich Township to do so. A pre-application meeting with the NJDEP Division of Watershed Management was held on October 3, 2006 to review the procedural requirements of the submission process for the Wastewater Management Plan. The NJDEP advised that the change in responsibility could be accomplished by the GCUA providing a written consent to the NJDEP and also a consenting letter from LTMUA.

The critical submission to the NJDEP is the actual Wastewater Management Plan document (WMP). The NJDEP regulations provide for the exact mapping and narrative requirements for this document. Included in the mapping will be delineating the new service area for the proposed development along US 322. Also included to be mapped is the portion of Woolwich Township (known as Auburn Road Village) that will remain as a sewer service area to LTMUA, but Woolwich Township will be responsible for the wastewater planning for this area. Other service areas and any septic system over 2,000 gallons per day will also be delineated and mapped.



In addition to the mapping requirements, there are narrative sections of the application that will need to be prepared. Some of the tasks identified in the application require the Township to coordinate and respond to comments from the various government units that have regulatory or planning jurisdiction over wastewater or land use in the wastewater management planning area. This includes all government units and public utilities that own, operate, or have contracts or Department permits for sewerage facilities identified in the WMP (other than facilities for their own buildings).

At the Pre-Application meeting held in October, NJDEP confirmed that an Executive Order 109 analysis must be performed in conjunction with the WMP. As noted above, this requires an evaluation of depletive and consumptive water use, detailed land use, environmental build-out and pollutant loading, Riparian Corridor Analysis, Endangered/Threatened Species Analysis and Alternatives Analysis.

A WMP is valid only upon its adoption by the Governor or his designee as WQM plan amendment; therefore, a WMP must be submitted to the NJDEP and the appropriate designated planning agency along with a written plan amendment request. Agencies required to be noti-

fied of the preparation of the WMP will also be requested to endorse the WMP during the WQM plan amendment process. Once the WMP is adopted, Woolwich will then be authorized to receive its permits for the wastewater facilities it proposes which are consistent with the WMP.

Table 1: Proposed Development and Water Demand Estimates - Woolwich Regional Center

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1,029	2 bedroom	@	215 gpd	221,335 gpd
			Subtotal	221,335 gpd
TDR Residential Development				
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			Total Residential	958,205 gpd
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3,625,000 sq. ft.		@	.125 gpd/sq. ft.	453,125 gpd
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Add'l Commercial Space on US 322 Outside of Regional Center				
750,000		@	.031 gpd/sq. ft	23,250 gpd
			Subtotal	23,250 gpd
			Total Commercial	813,875 gpd
			Regional Center Total	1.749 mgd
			US 322 Outside of Regional Center Total	0.23 mgd

PROPOSED DEVELOPMENT AND WASTEWATER CAPACITY

The development in Woolwich Regional Center and the two receiving zones includes both residential and commercial usage. Table 1 below is a breakdown of the development associated with the Regional Center and estimated wastewater flows. Table 2 provides the same for Auburn Road Village. The breakdown enables each type of development unit to be assigned a wastewater flow criteria consistent with NJDEP criteria as stipulated in NJAC 7:14A-23. The projected wastewater flow from each unit is calculated by multiplying the quantity of each unit times the NJDEP flow criteria. The residential and commercial flows are then totaled. Accordingly, the total wastewater flow, identified as the average daily flow, is 1.761 mgd for the proposed Regional Center, .019 mgd for commercial development along US 322 west of the Regional Center, and .151 mgd for Auburn Road Village (1.9 mgd total). It is noted that this number forms the basis for identifying other design flow numbers such as peak flows and pumping rates. The detailed design process for the conveyance, treatment and disposal systems will require engineering calculations to determine pumping horsepower needs and size other system components.

Table 2: Proposed Development and Water Demand Estimates - Auburn Road Village Receiving Area

Auburn Road Residential Development				
157	3 Bedroom Twnhse	@	210 gpd	32,970 gpd
53	2 Bedroom Twnhse	@	150 gpd	7,950 gpd
161	Single Family	@	275 gpd	44,275 gpd
130	Duplex Units	@	395 gpd	51,350 gpd
			Subtotal	136,545 gpd
Commercial Space				
50,000 sq. ft.		@	.125 gpd/sq. ft.	6,250 gpd
			Subtotal	6,250 gpd
Auburn Road Receiving Zone Total				.143 mgd

WASTEWATER MANAGEMENT FOR ROUTE 322 CORRIDOR

Wastewater Management for this project is comprised of three components: conveyance, treatment and disposal. Since the proposed development is comprised of attached dwelling units in addition to single dwelling units on small lots, the alternative of individual septic systems is not feasible. A centralized wastewater system is proposed which will provide an environmentally sound means of satisfying the significant quantity of wastewater to be generated by the proposed sewer service area.

Advantages of the use of centralized wastewater system for this project over on-site alternatives include the following:

- Provides reliable protection to surface and groundwater (drinking water) resources
- Prevents toxic substances from entering groundwater through the on-site wastewater stream

- Does not rely primarily on individual owner/users' actions to provide proper conveyance and treatment
- Provides for pollutant levels in effluent wastewater and biosolids to be regulated by law through NJPDES program
- Utilizes existing central treatment facilities providing a high degree of treatment to wastewater and biosolids
- Utilizes qualified and licensed staff for collection and treatment of wastewater solids.

1. Collection

The type of collection system will depend on studies of the topography, geology, and the location of the disposal area (s). It is anticipated that conventional gravity sewers and pressurized force mains would be

used for conveyance from the various development sites to the location (s) of treatment/disposal. Once the disposal areas are approved, a detailed study of the most appropriate form or combination of conveyance will be performed.

2. Treatment

The treatment method is dependent upon the means of treatment plant effluent disposal as the regulations differ with the different disposal methods. The NJDEP has discouraged the concept of a new surface water discharge and has indicated a discharge to groundwater is preferred. The benefit of a discharge to groundwater is the ability to recharge the underlying aquifer in this region. A discharge to local streams entails exhaustive stream studies to establish discharge criteria. Even if ultimately allowed, a surface discharge requires additional treatment to accommodate N.J.A.C. 7:9B (New Jersey Surface Water Quality Standards). This includes treatment to address Phosphorus removal, thermal effects on receiving waters and more sophisticated nitrogen-based compounds removal. For these reasons, the concept of a discharge to local surface water has not been given further consideration.

It is estimated that the area required for the treatment plant is between two and three acres (Figure 4 of the "Design of Municipal Wastewater Treatment Plants, Volume 1, WEF Manual of Practice No. 8, ASCE Manual of Engineering Practice No. 7."). N.J.A.C. 7:14A-23 requires that a treatment plant:

"be located as far from existing or future residential structures as practical

to the extent possible, the treatment plant units shall not be situated within 500 feet of the plant property lines;

Treatment plants shall be raised above the flood elevation level or adequately flood proofed."

In addition, as with any land development project, there may be environmental buffers (ie stream corridor or wetlands buffers) that may also constrain location of the plant. It may be possible to locate within buffered areas some if not all of the disposal area.

3. Disposal

During the NJPDES permitting process, NJDEP may stipulate site-specific requirements for discharge parameters which would affect treatment. It will be necessary to either treat wastewater to NJDEP Groundwater Standards prior to discharge or alternatively, demonstrate through a nitrate dilution mod-

el that nitrate levels will be within the 10 mg/l drinking water and groundwater quality standard.

Discharge to groundwater (DGW) disposal is proposed in Woolwich Township. Several methods for DGW are approvable under NJDEP regulations. This includes subsurface infiltration, spray or drip irrigation, overland flow, infiltration/percolation lagoons and surface impoundments. The criteria to determine which of these alternatives best suits this project is based upon that fact that a successful disposal system should:

- Provide adequate treatment prior to disposal
- Provide sufficient storage for periods during which meteorological conditions preclude wastewater disposal
- Utilize the ability of the soils and aquifer to treat and dissipate the hydraulic loading that is not removed by vegetative uptake and evapotranspiration
- Operate year-round without:
 - a. unacceptable odors breaking out at the surface of any hydraulic mound induced by infiltration,
 - b. causing seepage into subsurface structures,
 - c. adversely affecting the groundwater flow direction in nearby ground-water contamination sites.

Based upon conceptual analysis, drip irrigation appears to be the best alternative. In addition, the NJDEP has noted its preference for drip irrigation rather than spray irrigation. Drip irrigation applies water slowly to the roots of plants, by depositing the water either on the soil surface or directly to the root zone, through a network of valves, pipes, tubing, and emitters. This is accomplished by locating this network in dedicated "drip" fields that would be maintained by Aqua New Jersey. These drip fields are to be located based upon their hydrogeologic suitability that will be determined by initial literature review and then field investigation.

One of the benefits of drip irrigation is that the area requirement for the field (s) can be accomplished on one contiguous site or smaller non-contiguous sites. This allows flexibility beyond the required hydrogeological conditions in selecting sites. Multiple locations can also serve to prevent one or more of the year-round operational constraints noted above from reducing the long-term capacity of the system. Based

upon a site with the most hydraulically restrictive permeability (based upon permeability classes of ASTM STANDARD D 422) the disposal area criteria per gallons per day would be 3 square feet per gallon. For this application of a 1.9 mgd facility, the area would be conceptually estimated at 124 acres. It is noted that this is a conceptual estimate and that the required field and onsite testing, modeling and analysis during the detailed design process will determine the appropriate permeability class.

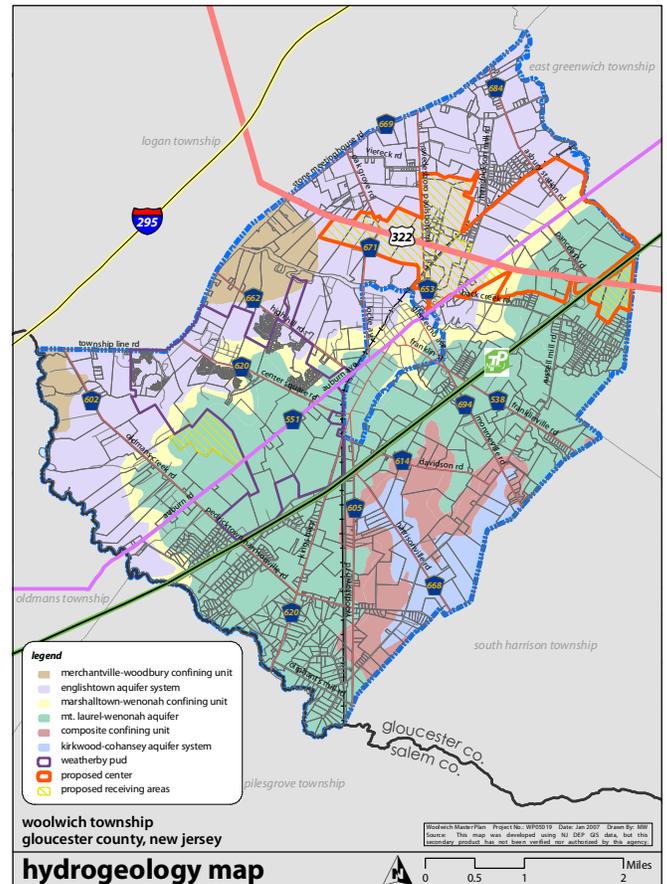
Other benefits of drip irrigation including the following:

- Since the water is applied at the root zone, water loss to evaporation is minimized
- Leveling of the field not necessary
- Drip irrigation results in beneficial reuse of water
- Soil erosion is minimized
- Dosing can be regulated through the mechanical equipment and piping

HYDROGEOLOGY OF WOOLWICH TOWNSHIP

Woolwich Township is located in the Atlantic Coastal Plain Physiographic Province. The geology consists of several formations, some of which sustain major aquifers. They are as follows:

- The Kirkwood Formation is exposed in a small area in the southeastern portion of Woolwich Township. It is comprised primarily of fine micaceous sands, with local beds of dark clay. Like all the Coastal Plain formations, its strata dip toward the southeast and disappears into the subsurface beneath younger formations. Where it is shallow and permeable, it forms part of the Kirkwood-Cohansey Aquifer, which may be locally prolific. The soils that form on this formation range from good to poorly suitable for septic absorption fields.
- The Hornerstown Formation is exposed in a few areas in the southeastern portion of the Township. The largest of these areas forms a narrow band around the exposure of the Kirkwood Formation. The Hornerstown Formation is comprised of dark green glauconitic marl with varying amounts of quartz sand, silt, and clay. It is rather poorly permeable and together with the underlying Navesink Formation, comprise the Composite Confining Unit that separates the Mt. Laurel Wenonah Aquifer from the shallower aquifers above. It is called that because further to the northeast, there are one or two other poorly permeable formations in between the Hornerstown and the



Navesink. The soils that form on this formation are generally fair to poorly suitable for septic absorption fields.

- The Navesink Formation is exposed in a few areas in the southern and southeastern portion of the Township. Most of these areas form a narrow band around the Hornerstown Formation. The Navesink Formation is composed primarily of dark green, glauconitic marl. It is very poorly permeable and, as described above, comprised the lower portion of the Composite Confining Unit. The soils that form on the exposures of the Navesink Formation tend to be fair to poorly suitable for septic absorption fields.
- The Mt. Laurel-Wenonah Aquifer is comprised of permeable sands of the Mt. Laurel Formation and of the upper part of the Wenonah Formation. The Mt. Laurel Formation generally consists of un-cemented quartz sand, that is fine- to coarse-grained, and slightly glauconitic. This unit is exposed along the easterly portion of the Township, generally parallel to the divide created by King's Highway (County Road 551) and north of Swedesboro.

- The Wenonah Formation is generally comprised of fine-grained quartz sand in its upper portion, and silty and clayey micaceous sand in its lower portion. This formation is exposed also along the eastern portion of the township, but generally south of Swedesboro. The upper portion of the Wenonah Formation is more permeable and forms part of the Mt. Laurel-Wenonah Aquifer. The Mt. Laurel-Wenonah Aquifer is generally classified as much less prolific water-bearing unit than the Englishtown Aquifer. The soils found in this area based upon the USDA Gloucester County Soil Survey are rated as good for septic system suitability, which requires a greater permeability. There are small, scattered patches of soil that only have a fair rating and are less permeable. The lower portion of the Wenonah Formation along with the underlying Marshalltown Formation comprises the Marshalltown-Wenonah Confining Unit.
- The Marshalltown Formation is comprised of quartz and glauconite sand, and silty and clayey micaceous quartz sand. It overlies the Englishtown Formation to the west. The Marshalltown-Wenonah Confining Unit resists groundwater flow between the Englishtown Aquifer and the Mt. Laurel-Wenonah Aquifer. Because the Marshalltown Formation contains clay-

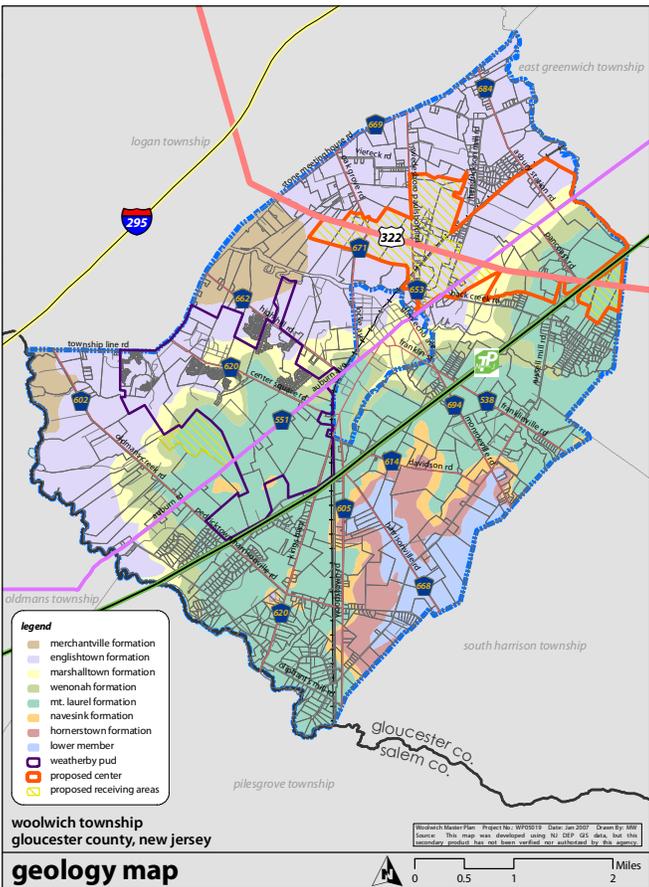
ey and silty sand intervals, the soils that form on it can be rather poorly permeable. Consequently, there is a mix of septic suitability rating from good to fair to poor. Near the proposed sewer service area in Woolwich, the soils are rated as good to fair, which would appear to indicate that the Marshalltown Formation beds that are exposed in this area are primarily composed of the more permeable quartz and glauconite sand.

- The Englishtown Formation is comprised of fine to coarse-grained quartz sand, locally interbedded with thin to thick beds of clay. This formation is exposed in band that runs roughly parallel to the northwestern boundary of the Township, displaced approximately 7,000 feet to the southeast. The Englishtown Aquifer is constituted primarily in this formation. Since this is the most prolific aquifer that intersects the water table within the Township, it would be the best able to dissipate the hydraulic loading of a large municipal subsurface disposal system. The soils found in this area based upon the USDA Gloucester County Soil Survey are rated as good for septic system suitability and generally can be expected to have better permeability than soils formed upon exposures of neighboring formations. There are small, scattered patches of soil that only have a fair or poor rating primarily near stream corridors.
- A small portion of Woolwich, along the northwestern municipal boundary, is underlain by the Merchantville Formation, which is composed of deposits that range from clayey and silty glauconite sand to quartz-glauconite sand. This formation underlies all of the other units that are exposed in the Township and forms the upper portion of the Merchantville-Woodbury Confining Unit. The soils here are primarily rated poor for septic system suitability and generally have relatively poorer permeability.

A defined surficial aquifer system is not found in Woolwich.

According to the NJDEP, groundwater recharge is estimated using the NJGS methodology from NJ Geological Survey Report GSR-32 "A Method for Evaluation of Ground-Water-Recharge Areas in New Jersey." Land-use/land-cover, soil and municipality-based climatic data were combined and used to produce an estimate of groundwater recharge in inches/year. Recharge was then ranked by volume (billions of gallons/year) using natural breaks in the percentage of total volume.

Based upon these data, recharge in Woolwich is predominately 8 to 10 inches per year. There are some variations to this in pockets of land tracts where the recharge is as high as 11 to 15 inches per year. Recharge generally does not occur in open water or wetland areas or places of impervious coverage.



PRELIMINARY SITE EVALUATION/LAND REQUIREMENT

Preliminary screening of candidate sites involves the collection of the pertinent data, from the hydrogeologic and soil science literature, Township files, and NJDEP databases and records, for the area within and immediately surrounding the proposed development area in Woolwich. The data will be used to recommend several prospective disposal area sites that can be further evaluated from the perspective of availability, operational, and permitting-related constraints. A preliminary screening has been undertaken to establish areas of interest where wastewater disposal is most likely to be successful for drip irrigation. This review has considered the following criteria:

- Location within the Englishtown Aquifer System.
- Soils Septic Suitability based upon the Gloucester County Soil Survey
- Lot size or contiguous tract sizes greater than 50 acres
- Generally near the northern boundary of Woolwich Township

The results of this preliminary screening identified the following properties are shown in Table 3 below.

Table 3: Potential Disposal Areas - Groundwater Recharge

Block	Lot	Area (sf)	Area (ac)	Comments
14	5	304,832	7.00	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
14	5.01	1,846,834	42.40	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
14	6	884,530	20.31	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
14	12	2,459,114	56.45	Mostly USDA Group 1 and 2 soils, Septic Suitability rated Good, some soils on site rated fair or poor
14	13	3,548,190	81.46	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
18	4	5,227,931	120.02	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
18	7	2,123,198	48.74	Primarily USDA Group 1 and 2 soils, Septic Suitability rated Good
21	1	1,990,121	45.69	Mostly USDA Group 1 and 2 soils, Septic Suitability rated Good, some soils on site rated fair
21	3	703,806	16.16	Mostly USDA Group 1 and 2 soils, Septic Suitability rated Good, some soils on site rated fair or poor within stream buffer
21	4	2,430,194	55.79	Mostly USDA Group 1 and 2 soils, Septic Suitability rated Good, some soils on site rated fair or poor within stream buffer
21	5	466,356	10.71	Mostly USDA Group 1 and 2 soils, Septic Suitability rated Good, some soils on site rated fair or poor
22	2	1,483,282	34.05	USDA Group 1 and 2 soils, Septic Suitability rated Good
22	3	1,316,616	30.23	USDA Group 1 and 2 soils, Septic Suitability rated Good
22	4	2,466,748	56.63	USDA Group 1 and 2 soils, Septic Suitability rated Good
Total: 14 Sites		27,251,751	625.61	

Regardless of the properties selected, Woolwich Township/Aqua will have to acquire the land from the current owners. Such acquisitions require a due-diligence assessment. The final property selections should be preceded by a full investigation that requires obtaining and reviewing records of industrial use, inspection of historical aerial photographs, site inspections, soil sampling and analysis for contamination, and full reporting in accordance with established protocol. Consequently, an on-line database search, review of historical aerial photographs, and brief

site visits will be performed during the pre-acquisition phase. Identifying a potential problem during this phase of the investigation will not necessarily reject an individual site, but it may help determine some of the protocols followed there during the subsequent site investigations. However, several properties in a single cluster that exhibit potential problems may result in the removal of the entire cluster from consideration, even if it contains some lots that appear fine during screening.

Site-specific investigations should be conducted to determine the suitability of the site as well as effluent loading rates. This will allow the acreage required for drip irrigation to be determined. It is expected that use of the full area of one or more of the recommended properties will be constrained by infrastructural or environmental considerations and consequently may be reduced in area or eliminated altogether.

It will be necessary for Aqua and/or the Township to contact the owners of the candidate sites, and request permission to visit and perform suitability testing for the alternative wastewater disposal methods.

During this phase of the investigation, the remainder of the due-diligence effort, described above, will be performed. This will include collecting and reviewing land use records for each of the candidate properties, collecting and testing soil samples for contaminants pertinent to the history of use, and completing the due-diligence reporting requirements.

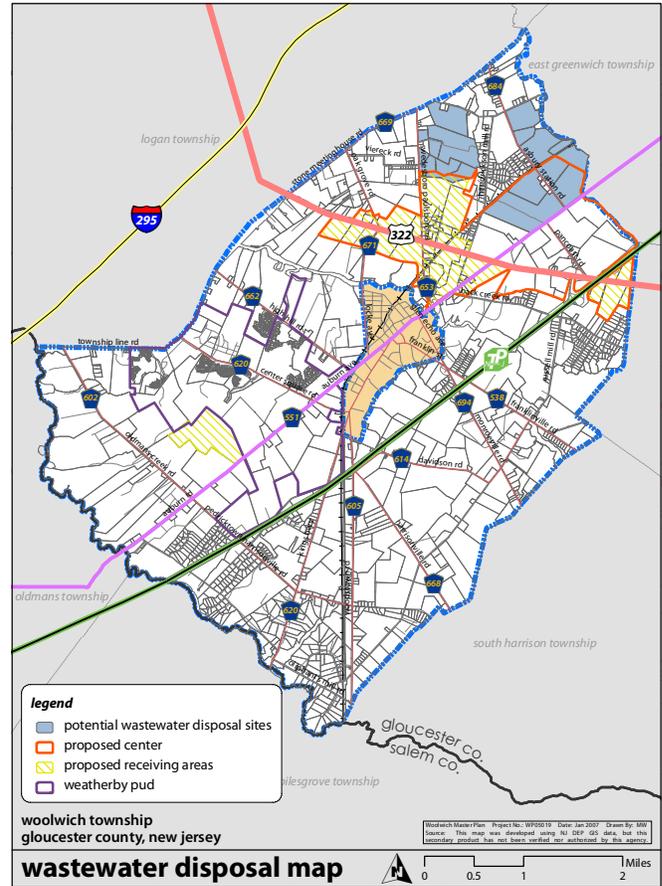
With permission to access the candidate properties, HMM will prepare a program of soil and hydrologic investigations that will include test pits to confirm accuracy of the published soil maps and to perform some preliminary soil textural and permeability testing.

Based upon analysis of these preliminary field measurements and the results of the due-diligence investigation, HMM will make recommendations for each of the properties that would need to be acquired.

The proposed testing plan will recommend the preferred sites. Upon receipt of approval from Aqua New Jersey, HMM will conduct further testing at the selected properties. The testing will include additional test pits with soil sample collection and textural and hydraulic testing of identified low-permeability horizons, the installation of monitoring wells and aquifer hydraulic testing, and ambient water-quality testing.

During this phase, the conceptual design of the proposed disposal systems will be determined, including the boundaries and set-backs of the disposal and wastewater storage areas, the means of disposal in each area, and the application rates and schedules. The materials to be used for construction and any necessary re-grading will be completed to the extent necessary for permitting the discharge to ground water.

Part of this phase will be to determine the points of compliance for each of the subsurface disposal areas. If the effluent is not treated to groundwater quality criteria



(GWQC) of each of the contaminants of concern, a dilution analysis must be performed to demonstrate that the concentrations will all be less than the respective GWQC for each of the pollutants. Hydraulic mounding analyses will also be conducted as necessary to support the application to NJDEP for a groundwater discharge permit. Some of the field-testing that may be required in this task can only be accomplished during certain seasons of the year.

The application form, NJPDES-1, and its supplement related to the disposal of residuals, "Form R," will be filled out and submitted to the NJDEP Bureau of Non-point Pollution Control, along with the required maps and technical report. This process may take 8-10 months to complete. Once the application is submitted, there may be additional testing or analysis performed for the defense of the application and any additional data or fieldwork required by NJDEP.

WASTEWATER MANAGEMENT FOR AUBURN ROAD VILLAGE

Aqua New Jersey currently has a wastewater contract with LTMUA. This contract provides for treatment of wastewater from the portion of Aqua's Woolwich franchise area that is located within the Logan Township MUA service area, delineated in LTMUA's Wastewater Management Plan (as amended from time to time). The Auburn Road Receiving District is primarily located within the current LTMUA service area approved by NJDEP.

LTMUA expects to initiate an expansion to its wastewater treatment plant in the near future to provide capacity for certain planned development projects in Woolwich Township. This does not include capacity for the Auburn Road Receiving Zone described in this report. If commitments are made to purchase capacity now for the Auburn Road Zone, it may be possible to include this capacity in the currently planned expansion; however, if such commitments are not made now, a subsequent expansion of its treatment plant will be needed. This can be accomplished through the existing contract between Aqua and LTMUA.

The type of collection system will depend on studies of the topography, geology, and the existing sewer systems between this area and the LTMUA system. It is anticipated that conventional gravity sewers and pressurized force mains will be used for conveyance from the various development sites to the location (s) of treatment / disposal. This will likely include some paralleling of sewers and force mains within the currently approved Weatherby Development to reach the connection point with the LTMUA wastewater conveyance system. The LTMUA conveyance system is believed to have adequate capacity for the projected flows from the Auburn Road area.

If further plant expansion is needed, NJDEP permits will be required. LTMUA's plant discharges to the Delaware River, and through a separate project, a portion of its effluent may be used to recharge groundwater. Considering these discharge plans, further expansion of the plant is believed to be viable.

CONCEPTUAL COST ESTIMATE

Preliminary costs for this project are based upon the foregoing discussion. The costs are broken down in Table 4 and 5 below.

Costs associated with this project are based upon the facilities that are necessary for carrying received flows from the development sites and not facilities that would be constructed as onsite conveyance systems. The costs associated with onsite facilities are not considered and are to be determined by developers in the future, primarily through their individual permitting and approval process.

Table 4: Conceptual Cost Estimate - Woolwich Regional Center

Preparation and Submission of the Wastewater Management Plan					
				Total	\$50,000
Preparation and Submission of the NJPDES Permit					
<i>Hydrogeological Testing</i>					
Due Diligence Testing	6 Sites	@	\$5000/Site	\$30,000	
Site Geological Testing	3 Sites	@	\$40,000/Site	\$120,000	
Engineering Fees				\$70,000	
				Total	\$220,000
Construction of Conveyance Facilities					
8" to 12" Gravity Sewers	24,400 LF	@	\$80/LF	\$1,952,000	
Force Main Sewer Piping	15,000 LF	@	\$70/LF	\$1,050,000	
Pumping Stations	2 LS	@	\$400,000/LS	\$800,000	
				Total	\$3,802,000

Table 4 (continued)

Construction of Treatment and Disposal Facilities				
Treatment Facilities	1,800,000 Gallons	@	\$15.00/Gal	\$27,000,000
Disposal Fields	1,800,000 Gallons	@	\$8.00/Gal	\$14,400,000
			Total	\$41,400,000
			Construction Cost Sub Total	\$45,202,000
Engineering Design, Construction Management & Contingencies		@	25% of the Construction Cost Sub Total	\$11,300,500
			Regional Center Total	\$56,772,500

Table 5: Conceptual Cost Estimate - Auburn Road Village

Construction of Conveyance Facilities				
Force Main Sewer Piping	8,000 LF	@	\$70/LF	\$560,000
Pumping Stations	1 LS	@	\$400,000/LS	\$400,000
			Total	\$960,000
Construction of Treatment and Disposal Facilities				
LTMUA Plant Expansion	152,000 Gallons	@	\$12.00/Gal	\$1,824,000
			Total	\$1,824,000
			Construction Cost Sub Total	\$2,784,000
Engineering Design, Construction Management & Contingencies		@	25% of the Construction Cost Sub Total	\$696,500
			Auburn Road Village Total	\$4,480,000
			Woolwich Regional Center and Auburn Road Village Total	\$60,252,500

The foregoing cost estimates are conceptual to 2006 dollars and are based on the design concept under consideration. Final estimates are to be prepared once detailed design information is available. The cost estimate does not include any costs for land acquisitions.

