VI. Analysis of Capacity to Meet Future Wastewater Needs

The next step in the wastewater management planning process was to assess whether or not sufficient wastewater treatment capacity exists to meet the needs of the County based on the projections described in Section V. For sewer service areas, this requires the aggregation of municipal wastewater projections by sewage treatment plant and a comparison of the projected future demand to the existing permitted capacity of the sewage treatment plant. Where a sewage treatment plant does not have sufficient remaining capacity to meet the future wastewater needs of the service area, three possible solutions exist:

1. reduce the proposed sewer service area,
2. reduce the intensity of development within the sewer service area or
3. demonstrate that the sewage treatment plant can be expanded without violating water quality standards

In areas outside of the sewer service area, the default wastewater management alternative is discharge to groundwater of less than 2,000 gallons per day, commonly referred to as septic systems. The assessment of water quality impacts from development on septic systems relies on nitrate concentration. In this analysis, nitrate acts as a conservative surrogate for any of a number of constituents that could be discharged from a septic system (e.g. cleaners, solvents, pharmaceuticals, etc.). Nitrate was chosen because it is highly soluble in water, and because it is a stable compound that by itself could render water unsuitable for human consumption. The capacity to support septic systems without violating groundwater quality standards is determined by the amount of dilution available. The Water Quality Management Planning Rules advocate a watershed approach to assessing the adequacy of available dilution to meet future development on septic systems. Using this approach, available dilution, (essentially groundwater recharge), is calculated within a HUC 11 watershed and translated into a finite amount of wastewater that can be discharged, which in turn can be translated into a finite number of housing units that can be supported while maintaining a target concentration of nitrate in groundwater. Zoning is then applied to the available land in that same watershed, outside of any sewer service area, to calculate the number of units that could be developed on septic systems. The results of these two analyses are then compared and if the number of units based on zoning does not exceed the maximum units that can be supported, adequate capacity has been demonstrated. If the number of units allowed by zoning exceeds that which can be supported in a particular watershed, then some adjustment to zoning within that watershed is required.

Table 22 provides a breakdown of future wastewater demands by service area and by general development category for the County, based on the development projections provided above. The final column determines whether facility capacity is or is not adequate for the projected flows. Where capacities are inadequate, the issue is addressed in later sections.

VI. Analysis of Capacity to Meet Future Wastewater Needs

Table 22
Future Wastewater Planning Flows by Facility or General Service Area

	Facility Permitted Flow	Existing Flows	Projected Urban Municipality Trend to 2035 (Includes Existing Population)	Projected Non-Urban Municipality Developable Areas	Projected Non-Urban Municipality Developable Areas Non-Residential Area	Projected Urban Municipality Trend to 2035	Projected Flows Residential	Projected Flows Non-Residential	Projected Flows from Outside Middlesex County + In-County Inflow and Infiltration + Itemized Industrial Facilities	Projected Flows Total Future Planning Flows	Excess Facility Capacity
	MGD	MGD	Population	Households	Millions of Square Feet	Jobs	MGD	MGD	MGD	MGD	MGD
Middlesex County Utilities Authority	147.000	104.434	571,491	4,692	95.943	314,407	59.299	19.144	44.990	123.433	23.567
Stony Brook Regional Sewerage Authority	13.700	4.186	11,787	370	20.443	15,846	2.723	1.321	0.760	4.805	N/A
Rahway Valley Sewerage Authority	40.000	6.910	55,942	0	0	13,777	4.196	0.344	1.230	5.770	N/A
United Water Princeton Meadows (DSW & DGW)	3.184	1.840	15,274	0	0	4,899	1.146	0.122	0.240	1.508	1.676
Western Monmouth Utilities Authority	0	0.022	0	0	0.031	0	0.011	0.046	0.000	0.057	N/A

Note: N/A denotes a facility outside of Middlesex County. Additional flows are indeterminate to MCOP.

Adequacy of Sewage Treatment Plant Capacity

Table 23 further separates the countywide projections by sewage treatment facility and municipality. Details of the projections are included within the municipal chapters, which also address any needs for new or expanded treatment facility discharges.

Table 23
Wastewater Generation by Sewage Treatment Facility and Municipality
1/2

Facility	NJPDES Permit	Facility Type (DGW/DSW)	Municipality	Projected Flow (MGD)
Middlesex County Utilities Authority (MCUA)	NJ0020141	DSW	Carteret	3.134
			Cranbury	0.672
			Dunellen	0.775
			East Brunswick	6.245
			Edison	12.919
			Helmetta	0.246
			Highland Park	1.884
			Jamesburg	0.726
			Metuchen	1.505
			Middlesex	1.687
			Milltown	0.869
			Monroe	3.800
			New Brunswick	8.212
			North Brunswick	5.794
			Old Bridge	6.197
			Perth Amboy	5.854
			Piscataway	8.493
			Plainsboro	0.00
			Sayreville	6.610
			South Amboy	0.899
			South Brunswick	5.402
			South Plainfield	3.410
			South River	1.935
			Spotswood	0.787
			Woodbridge	6.185

Adequacy of Sewage Treatment Plant Capacity (continued)

Table 23
Wastewater Generation by Sewage Treatment Facility and Municipality
2/2

Facility	NJPDES Permit	Facility Type (DGW/DSW)	Itemized Industrial Facilities	Municipality	Projected Flow (MGD)
Middlesex County Utilities Authority (MCUA) (continued)	NJ0020141	DSW	3.435	Ten municipalities outside of the MC planning area	25.757
Stony Brook Regional Sewerage Authority (SBRSA)	NJ0031119	DSW		Plainsboro	1.420
				South Brunswick	3.385
United Water Princeton Meadows (UWPM)	NJ0024104	DSW		Plainsboro	1.508
	NJ0089711	DGW			
Pine Brook STP	NJ0023728	DSW		Old Bridge	0.057
Rahway Valley Sewerage Authority (RVSA)	NJ0024643	DSW		Woodbridge	5.770

Compliance with Environmental Protection Standards

The County WMP must ensure that proposed wastewater service areas are in the proper areas and will minimize or eliminate primary and secondary environmental impacts. The identification of appropriate wastewater service areas begins with the analysis of environmentally sensitive areas in this chapter. Added to this result is the zoning build-out analyses. The analysis determines areas are both zoned for and appropriate for community sewer service, as well as which areas are not appropriate for sewers due to zoning, environmentally sensitive areas, or both. The WQMP rules require that development densities and aggregated demands or impacts remain within thresholds. Where the thresholds are exceeded, either the size or development density of a sewer service area, or the development density of a non-sewered area must be reduced, or the impact must be mitigated. This plan has demonstrated compliance with these capacity constraints.

However, there are other environmental considerations regarding pollutant loadings, water supply and other factors. In some cases (e.g., riparian zones and steep slopes) the WQMP rules require that municipal ordinances ensure protection of these areas regardless of their wastewater service area. Further, the WQMP rules establish that avoidable development within these areas is inconsistent with the statewide Water Quality Management Plans and the NJDEP cannot issue any permits or approvals for development of these areas. Table 25 provides the status of adoption of the required municipal ordinances.

TMDLs and Watershed Restoration/Regional Stormwater Management Plans

There are no applicable TMDLs or regional stormwater management plans adopted into a relevant Areawide WQMP for Middlesex County at this time. There are also no applicable watershed restoration plans approved by NJDEP relevant to the WMP for the County of Middlesex.

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand

Background

In non-sewer areas, also known as Septic Areas (SA), NJDEP regulations call for an environmental planning exercise to estimate the maximum number of properly functioning septic systems, also known as individual subsurface sewage disposal systems (ISSDS) that can be maintained in an area without causing undue risks from nitrate contamination to groundwater, and thus to drinking water and stream quality.

Some nitrates (NO3) are produced from ammonia found in human waste. Discharged from a septic system into the ground, nitrates may pose both human and ecological risks. Related health maladies, such as methemoglobinemia in infants, can cause lethargy, excessive salivation, loss of consciousness, and death. Eutrophication is the expression of an imbalance in nature sometimes due to the consequences of human introduction of Nitrogen and Phosphorus nutrients into stable water body ecosystems. Abnormally high concentration of nitrates in surface waters can promote excessive buildup and decomposition of algae that depletes oxygen levels in water. This condition can result in serious degradation of water and habitat quality. Nitrates from septic system discharge may be one out of many contributing sources, leading to this problem.

A nitrate dilution model estimates the average area an ISSDS residence requires within its watershed to generate enough groundwater recharge to dilute a septic system's effluent to acceptable levels as measured by its nitrate loading component. This report utilizes ***"A Recharge-Based HUC 11-Scale Nitrate-Carrying-Capacity Planning Tool for New Jersey, MS Excel Workbook, v1.0",*** the NJDEP model using HUC 11 recharge values per directives within *New Jersey Administrative Code 7:15-5.25 Evaluation criteria for wastewater management plans and amendments (N.J.A.C. 7:15-5.25)* of the Water Quality Management Planning rules. NJDEP has established a target maximum of 2 mg/L nitrate concentration in the groundwater on a watershed basis. The nitrate dilution model is based on a technique that enables the estimation of average annual groundwater discharge rates (Charles and Others, 1993). Data on climate, impervious cover and soils are used to determine the recharge rates.

The model requires information on the number of people per home and total amount of nitrate generated per person per year. For the regional planning analysis prepared within this report, the NJDEP has established an "Equivalent Dwelling Unit", a common metric with conversion factors for both residential and commercial uses, so that results are comparable for potential development allowed by municipal land use zoning determined by an "environmental build-out' analysis required by NJDEP regulations (N.J.A.C. 7:15-5.25).

Middlesex County Analysis

For county regional planning purposes, the target area of nitrate dilution analysis has been defined by the NJDEP as those areas of non-sewer service within NJDEP 11 Digit Hydrologic Unit Code delineations (HUC 11) of specific sub-watershed areas within Middlesex County.

To determine the adequacy of zoning provisions to meet nitrate dilution analysis (NDA) carrying capacity standards in SAs, NJDEP guidance allows for averaging the minimum land area per equivalent ISSDS unit using the entire HUC11 (see Map 8 – Zoning/ Nitrate Dilution Model Analysis Map in Appendix L). The areas of porous surfaces within the HUC11 contribute significantly to groundwater recharge volumes, and hence dilution of nitrates. Land areas in Sanitary Sewer Service Areas (SSAs) contribute to the nitrate dilution potential without negative impact upon development in the SSA. The groundwater recharge potential in the SSA is derived from a GIS analysis of the total impermeable areas existing in the SSA of each HUC 11, thereby using the empirical data specific to each sub watershed for these calculations. Ranging from 55 percent to 76 percent; permeable SSA lands provide pervious surfaces for infiltration. The specific percentage of permeable areas for each HUC 11 is shown in the detailed tables within Appendix D and reflected in the following Municipal Chapters.

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand (continued)

Middlesex County Analysis (continued)

This approach averages the potential nitrate dilution factor across municipal boundaries without impact to development potential of other municipalities within the HUC11(SSA land areas offset SA zoning densities to achieve the theoretical average minimum area determined for all ISSDS lots in the entire HUC11). While the overall yield of a HUC 11 nitrate dilution analysis can be averaged throughout the entire sub-watershed, only those areas within Middlesex County have been utilized for this report to consolidate these concerns within the new WMP planning area.

Several constraints common to land development (and beyond environmental constraints already taken into consideration) combine to actually limit the size of a development. These include, but may not be limited to, R.O.W. easements and dedications, stormwater management features, setback requirements, open space requirements, constraints that are mandated by lot configuration and/or topography, wetland transition areas (buffers), the retention of existing structures within redeveloped properties and the space requirements for the mandated septic systems. Existing literature and policies were reviewed to formulate a reasonable accounting for these potential limiting conditions, including the *Build-Out Analysis in GIS as a Planning Tool With a Demonstration for Roanoke County, Virginia* by Mary A. Zirkle (Thesis paper for Master of Urban and Regional Planning, Virginia Polytechnic Institute and State University, 2003), *How to Do a Build-Out Analysis* EPA website (http://www.epa.gov/greenkit/build_out.htm) and *2002a MassGIS Scope of Services for Build-out Analysis* and *2002b Buildout Book: Where Do You Want to be at Buildout?,* the Massachusetts Executive Office of Environmental Affairs.

Following the assumptions and guidelines of this research, Middlesex County again utilized GIS for those recognizable existing constraints that impact developable land areas, such as local R.O.W. (14%), major roadway improvements, utility easements, and stormwater management in detention basins. This GIS exercise determined that approximately 29 to 31 percent of the total developable land area can be said to accommodate lot configuration constraints and design requirements for on-site development and support of that development, an estimate comparable to the referenced guidelines and studies. Therefore, a 30 percent discount on total identified developable lands was factored in the analysis to reflect these constraints in our Environmental Build Out calculations for non urbanized municipalities.

The following Table 24 summarizes comparison results of environmental build-out development potential within Septic Areas (SA) for septic systems under 2,000 GPD versus municipal zoning provisions within those areas for each HUC11 sub-watershed area within Middlesex County. Table 24 provides the resulting equivalent unit yields for ISSDS densities by HUC 11 distributed among the municipalities based on an area-weighted analysis of all areas within the HUC 11 and rounded down to whole units. Minimum areas for equivalent units were calculated for each HUC 11 using a maximum of 2 mg/L nitrate concentration standard based on the overall dilution available in the watershed. In the fourth column, the nitrate dilution model equivalent dwelling unit yield is compared to the potential total yield of currently adopted zoning of each municipality and for the overall HUC 11. The detailed results for each HUC 11 are contained in tables presented in Appendix E for detailed comparisons to the allowable development density predicted by the nitrate dilution analysis. These same results are also to be presented together with water supply surplus and deficit information for each HUC 11 from the Statewide Water Supply Plan, pending future completion of that document by the NJDEP Division of Water Supply.

Conclusions

Middlesex County contains 25 municipalities with a diversity of community characteristics. The older municipalities have long played a major role as urban centers and suburban “bedroom communities” and are zoned in anticipation of sanitary sewer service for all developable properties. The NJDEP Water Quality Management Planning Rules define “urbanized municipalities” as those municipalities where less than 10

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand (continued)

Conclusions (continued)

percent of the total land area of the municipality is "available land for development" after subtracting out permanently preserved open space, rights-of-way, surface water, and wetlands. Nineteen municipalities in Middlesex County qualify for this classification (See Table 17). All are municipalities with little available land for development within non-sewer areas. The urbanized municipalities in Middlesex County are Carteret Borough, Dunellen Borough, Edison Township, Helmetta Borough, Highland Park Borough, Jamesburg Borough, Metuchen Borough, Middlesex Borough, Milltown Borough, New Brunswick City, North Brunswick Township, Perth Amboy City, Piscataway Township, Plainsboro Township, South Plainfield Borough, South River Borough, Spotswood Borough, and Woodbridge Township. Ten of these urbanized municipalities are located north of the Raritan River and 8 to the south of the Raritan River. Of these, Carteret, Edison, New Brunswick and Woodbridge all contain significant areas newly removed from sanitary sewer service by NJDEP criteria.

NJDEP regulations do not require NDA analysis for urbanized municipalities. The NJDEP regulations do allow averaging of the NDA minimum area standard throughout each HUC 11 sub-watershed (HUC 11 Averaging). In combination, these provisions will allow municipalities zoned for uses more intensive than the NDA acre per unit standard to retain existing zoning districts within that HUC 11, benefitting from the presence of open space, SSA lands and more conservatively zoned municipalities in their specific HUC 11 sub-watersheds. To better inform future decision making only, Middlesex County did include SA areas of urbanized municipalities in our analysis. This approach accounts for apparent disparities between overall HUC11 yields and those presented for individual non-urbanized municipalities.

Middlesex County's six non-urbanized communities with varying degrees of suburban, semi-rural and rural qualities may find these conclusions valuable in future planning assessments of zoning provisions and local SSA adequacy. These municipalities, generally with larger land areas and developable lands along major transportation corridors, relied upon prior NJDEP options for on-site treatment of up to 20,000 GPD and the prior target maximum of 5 mg/L nitrate concentration for residential projects exceeding 50 dwelling units[1], and anticipated future sanitary sewer access to be available for future local commercial, industrial and residential land uses. The non-urbanized municipalities are Cranbury Township, Monroe Township, Old Bridge Township, East Brunswick Township, Sayreville Borough and South Brunswick Township; all located south of the Raritan River. Current existing zoning provisions within all six non-urban municipalities are consistent with NDA standards for each respective HUC 11 subwatershed.

Participation of all HUC 11 municipalities by adoption of each WMP Municipal Chapter will preserve existing zoning provisions within the SAs for all Middlesex County municipalities.

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand (continued)

Table 24
Individual Septic System NDA Area Standard Density Yield versus Zoning Density Yield by HUC 11
1/3

HUC 11/NDA[1] Acre per Unit[2]	NDA Unit Yield SA[3]+SSA[4]	SA Zoning Yield[5]	Zoning Build-out versus Environmental/NDA Build-out[8]
Lawrence Brook/7.3	1,971	1,376	+595
Municipalities			HUC11 Averaging effective
East Brunswick	692	147	consistent[7]
Milltown	73	13	urbanized[8]
New Brunswick	29	154	urbanized
North Brunswick	349	479	urbanized
South Brunswick	827	583	consistent w/ HUC 11 averaging[9]
South River	2	0	urbanized
Manalapan Brook /5.5	1,750	203	+1,547
Municipalities			HUC11 Averaging effective
East Brunswick	316	7	consistent
Helmetta	70	0	urbanized
Jamesburg	71	4	urbanized
Monroe	1,141	168	consistent w/ HUC 11 averaging
South Brunswick	53	0	consistent
Spotswood	99	24	urbanized
Matchaponix Brook/6.2	585	158	+427
Municipalities			HUC11 Averaging effective
Monroe	319	144	consistent
Old Bridge	262	14	consistent
Spotswood	4	0	urbanized
Millstone River (above Carnegie Lake) / **6.3**	2,755	1,151	+1,604
Municipalities			HUC11 Averaging effective (<10% margin)
Cranbury	832	94	consistent
Monroe	777	306	consistent
Plainsboro	706	667	urbanized
South Brunswick	440	84	consistent
Millstone River (below/ incl. Carnegie Lake) **/ 6.5**	796	734	+62
Municipalities			HUC11 Averaging effective
North Brunswick	180	19	urbanized
Plainsboro	81	112	urbanized
South Brunswick	535	603	consistent w/ HUC 11 Averaging

KEY:

1. **NDA** denotes Nitrate Dilution Analysis
2. **Unit** denotes Equivalent Dwelling Units defined per NJDEP N.J.A.C. 7:15
3. **SA** denotes Septic Area (non-sewer service area) for individual subsurface sewage disposal systems of 2,000 gpd or less
4. **%SSA** denotes the percentage of permeable lands within the Sanitary Sewer Service Area specific to the HUC 11
5. **SA Zoning Yield** is calculated with a discount for configuration constraints specific to the HUC 11
6. **Zoning Build-out versus Environmental/NDA Build-ou**t denotes Equivalent Dwelling Units net balance for overall watershed
7. **"consistent" or "not consistent"** denotes a non-urbanized municipality's zoning consistency with NDA unit capacity of the HUC 11 watershed
8. **Urbanized** denotes an urbanized municipality not required to undergo an environmental build-out analysis (informational purpose)
9. **with HUC 11 averaging** denotes sharing of overall HUC 11 NDA unit capacity and inter-municipal participation.
10. "+" denotes NDA unit yield in excess of SA zoning yield demand.

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand (continued)

Table 24
Individual Septic System NDA Area Standard Density Yield versus Zoning Density Yield by HUC 11
2/3

HUC 11/NDA[1] Acre per Unit[2]	NDA Unit Yield SA[3]+%SSA[4]	SA Zoning Yield[5]	Zoning Build-out versus Environmental/NDA Build-out[8]
Rahway River/ Woodbridge Creek/9.3	1,295	588	+707
Municipalities			Urbanized HUC 11 (information only)
Carteret	155	457	urbanized
Edison	304	14	urbanized
Metuchen	13	0	urbanized
Perth Amboy	112	0	urbanized
South Plainfield	0	0	urbanized
Woodbridge	711	117	urbanized
Raritan Bay/Sandy Hook Bay/14.6	No Areas	No Areas	NA
Municipalities			
Old Bridge		NA	
Perth Amboy		NA	
Sayreville		NA	
South Amboy		NA	
Raritan Bay/Sandy Hook Bay tributaries/7.9	594	139	+455
Municipalities			HUC11 Averaging effective
Old Bridge	428	113	consistent
Sayreville	119	26	consistent
South Amboy	47	0	urbanized
Raritan R Lower (below Lawrence) /8.0	2,514	1,680	+834
Municipalities			HUC11 Averaging effective
East Brunswick	136	85	consistent
Edison	399	351	urbanized
Metuchen	83	0	urbanized
Old Bridge	991	309	consistent
Perth Amboy	73	0	urbanized
South Amboy	24	0	urbanized
Sayreville	508	801	consistent
South River	117	91	urbanized
Spotswood	36	5	urbanized
Woodbridge	145	38	consistent w/ HUC 11 averaging

KEY:

1. **NDA** denotes Nitrate Dilution Analysis
2. **Unit** denotes Equivalent Dwelling Units defined per NJDEP N.J.A.C. 7:15
3. **SA** denotes Septic Area (non-sewer service area) for individual subsurface sewage disposal systems of 2,000 gpd or less
4. **%SSA** denotes the percentage of permeable lands within the Sanitary Sewer Service Area specific to the HUC 11
5. **SA Zoning Yield** is calculated with a discount for configuration constraints specific to the HUC 11
6. **Zoning Build-out versus Environmental/NDA Build-ou**t denotes Equivalent Dwelling Units net balance for overall watershed
7. **"consistent" or "not consistent"** denotes a non-urbanized municipality's zoning consistency with NDA unit capacity of the HUC 11 watershed
8. **Urbanized** denotes an urbanized municipality not required to undergo an environmental build-out analysis (informational purpose)
9. **with HUC 11 averaging** denotes sharing of overall HUC 11 NDA unit capacity and inter-municipal participation.
10. "+" denotes NDA unit yield in excess of SA zoning yield demand.

Adequacy of Nitrate Dilution to Meet Future Non-Sewer Service Area Demand (continued)

Table 24
Individual Septic System NDA Area Standard Density Yield versus Zoning Density Yield by HUC 11
3/3

HUC 11/NDA[1] Acre per Unit[2]	NDA Unit Yield SA[3]+SSA[4]	SA Zoning Yield[5]	Zoning Build-out versus Environmental/NDA Build-out[8]
Raritan R Lower (Lawrence to Millstone) /6.8	2,427	811	+1,616
Municipalities			HUC11 Averaging effective
Dunellen	49	0	urbanized
East Brunswick	0	0	consistent
Edison	531	17	urbanized
Highland Park	100	0	urbanized
Metuchen	75	0	urbanized
Middlesex	158	31	urbanized
New Brunswick	201	26	urbanized
North Brunswick	61	0	urbanized
Piscataway	864	485	urbanized (information only)
South Plainfield	388	252	urbanized

KEY:

1. **NDA** denotes Nitrate Dilution Analysis
2. **Unit** denotes Equivalent Dwelling Units defined per NJDEP N.J.A.C. 7:15
3. **SA** denotes Septic Area (non-sewer service area) for individual subsurface sewage disposal systems of 2,000 gpd or less
4. **%SSA** denotes the percentage of permeable lands within the Sanitary Sewer Service Area specific to the HUC 11
5. **SA Zoning Yield** is calculated with a discount for configuration constraints specific to the HUC 11
6. **Zoning Build-out versus Environmental/NDA Build-out** denotes Equivalent Dwelling Units net balance for overall watershed
7. **"consistent" or "not consistent"** denotes a non-urbanized municipality's zoning consistency with NDA unit capacity of the HUC 11 watershed
8. **Urbanized** denotes an urbanized municipality not required to undergo an environmental build-out analysis (informational purpose)
9. **with HUC 11 averaging** denotes sharing of overall HUC 11 NDA unit capacity and inter-municipal participation.
10. "+" denotes NDA unit yield in excess of SA zoning yield demand.