MUNICIPAL STORMWATER MANAGEMENT PLAN
MASTER PLAN ELEMENT

BOROUGH OF MIDDLESEX
MIDDLESEX COUNTY, NEW JERSEY

Adopted: March 30, 2005

Final Draft dated: March 18, 2005

PREPARED FOR

BOROUGH OF MIDDLESEX PLANNING BOARD

PREPARED BY:

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March 2005

The original of this document has been signed and sealed in accordance with N.J.S.A. 45:14A-1 et. seq.
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RESOLUTION ADOPTING MUNICIPAL STORMWATER MANAGEMENT AS A PART OF THE MASTER PLAN AND RECOMMENDING ITS ADOPTION BY THE MAYOR AND COUNCIL OF THE BOROUGH OF MIDDLESEX.

WHEREAS, pursuant to THE PUBLICATION OF THE United States Environmental Protection Agency Phase 11 rules adopted in December 1999, the New Jersey Department of Environmental protection in compliance with the aforesaid publication adopted N.J.A.C. 7:14A-25 which requires all New Jersey Municipalities to adopt a Storm Water Management Plan; (Plan); and

WHEREAS, pursuant thereto the Planning Board reviewed the Plan at a public meeting held on March 30 2005 at which no members of the Public appeared; and

WHEREAS, after review of the Plan this board has decided to approve the same;

NOW, THEREFORE, BE IT RESOLVED, that the Municipal Storm Water Management Plan, prepared by T&M Associates, dated February 2005, is herewith approved, subject to the approval of the Middlesex County Planning Board

BE IT FURTHER RESOLVED, that this resolution and the Plan be referred to the Mayor and Council of the Borough of Middlesex for review, adoption. and submission to the Middlesex County Planning Board.

David Briggs, Chairman

Joseph Waide, Secretary
Dated: April 13, 2005

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INTRODUCTION

As a result of the publication of the United States Environmental Protection Agency (USEPA) Phase II rules in December 1999, the New Jersey Department of Environmental Protection (NJDEP) promulgated new stormwater regulations to address non-point source pollution entering surface and ground waters of the State of New Jersey. Under these regulations, municipalities where issued a New Jersey Pollutant Discharge Elimination System (NJPDES) Permit that established various statewide basic requirements. One of these requirements is the development and adoption of an amendment to their overall Master Plan to address stormwater pollution associated with major development.

As required by the Municipal Stormwater Regulations (N.J.A.C. 7:14A-25), the Borough of Middlesex has developed this Municipal Stormwater Management Plan (MSWMP) to outline their approach to addressing the impacts resulting from stormwater related issues associated with future development and land use changes. The MSWMP addresses groundwater recharge, stormwater quantity, and stormwater quality impacts through the incorporation of stormwater design and performance standards for new development and redevelopment projects that disturb one or more acres of land or increase the impervious cover by more than one-quarter acre. The standards are intended to minimize negative or adverse impacts of stormwater runoff such as decreased water quality, increased water quantity and reduction of groundwater recharge that provides base flow to receiving bodies of water. In addition to minimizing these impacts, the Borough's MSWMP provides long term operation and maintenance measures for existing and proposed stormwater management facilities.

The MSWMP also provides recommendations for ordinance modifications in order to expedite the implementation of stormwater management strategies and includes mitigation strategies to permit the Borough to grant variances or exemptions from proposed design and performance standards set forth by the Municipal Stormwater Regulations (N.J.A.C. 7:8-5.5).

GOALS AND OBJECTIVES

The goals of this MSWMP are to:

1. Reduce flood damage, including damage to life and property;
2. Minimize, to the extent practical, any increase in stormwater runoff from any new development;
3. Reduce soil erosion from any development or construction project;
4. Encourage the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
5. Maintain groundwater recharge;
6. Prevent, to the greatest extent feasible, an increase in non-point source pollution;
7. Maintain the integrity of stream channels for their biological function, as well as for drainage;
8. Minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, and other uses of water;
9. Protect public safety through the proper design and operation of stormwater basins.
10. Increase public awareness of stormwater management through public education.

In addition to the State mandated goals described above, the Borough also encourages the following as outlined in their 2000 Master Plan:

1. Retain and preserve the residential and neighborhood character of the community.
2. Maintain policy and program preventing development in designated flood areas of the Borough.

To achieve these goals, the MSWMP outlines specific stormwater design and performance standards for new development and proposes stormwater management controls for addressing

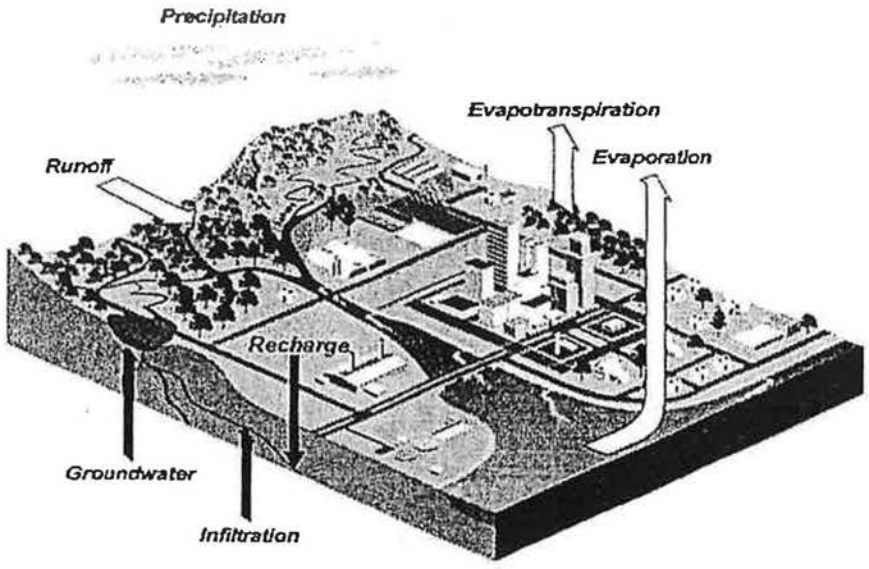
impacts from existing developments. Preventive and corrective maintenance strategies are also included to ensure the long-term effectiveness of stormwater management facilities and the MSWMP outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

STORMWATER DISCUSSION

HYDROLOGIC CYCLE

The hydrologic cycle, or water cycle (Figure 1), is the continuous circulation of water between the ocean, atmosphere, and land. The driving force of this natural cycle is the sun. Water, stored in oceans, depressions, streams, rivers, waterbodies, vegetation and even land surface, continuously evaporates due to solar energy. This water vapor then condenses in the atmosphere to form clouds and fog. After water condenses, it precipitates, usually in the form of rain or snow, onto land surfaces and waterbodies. Precipitation falling on land surfaces is often intercepted by vegetation. Plants and trees transpire water vapor back into the atmosphere, as well as aid in the infiltration of water into the soil. The vaporization of water through transpiration and evaporation is called evapo-transpiration. Infiltrated water percolates through the soil as groundwater, while surface water flows overland. Groundwater and surface water flow to major waterbodies and eventually flow to the Earth's seas and oceans. This constant process of evapo-transpiration, condensation, precipitation, and infiltration comprises the hydrologic cycle.

Figure 1: The Hydrologic Cycle



Source: http://www.creativille.org/kernriver/watershed.htm

IMPACTS OF STORMWATER

Prior to any land development, native vegetation often intercepts precipitation directly or absorbs infiltrated runoff into their roots. Development often replaces native vegetation with lawns or impervious cover, such as pavement or structures, thereby reducing the amount of evapo-transpiration and infiltration. Regrading and clearing of lots disturbs the natural topography of rises and depressions that can naturally capture rainwater and allow for infiltration and evaporation. Construction activities often compact soil, thereby decreasing its permeability or ability to infiltrate stormwater. Development activities also generally increased the volume of stormwater runoff from a given site.

Connected impervious surfaces and storm sewers (such as roof gutters emptying into paved parking lots that drain into a storm sewer) allows the runoff to be transported downstream more rapidly than natural areas. This shortens travel time and increases the rainfall- runoff response of the drainage area, causing downstream waterways to peak higher and quicker than natural areas, a situation that can cause or exacerbate downstream flooding, erosion, and sedimentation in stream channels. Furthermore, connected impervious surfaces do not allow pollutants to be filtered, or for infiltration and ground water recharge to occur prior to reaching the receiving waters. Increase volume combined with reduced base flows, results in a greater fluctuation between normal and storm flows allowing for greater channel erosion. Additionally, reduced base flows, increased fluctuation, and soil erosion can affect the downstream hydrology of the watershed, impacting the ecological integrity of the watershed.

Water quantity impacts combined with land development often adversely affect stormwater quality. Impervious surfaces collect pollutants from the atmosphere, animal wastes, fertilizers and pesticides, as well as pollutants from motor vehicle usage. Pollutants such as hydrocarbons, metals, suspended solids, pathogens, and organic and nitrogen counting compounds, collect and concentrate on impervious surfaces. During storm events, these pollutants are washed directly into municipal storm sewer systems. In addition to chemical and biological pollution, thermal pollution can occur from water collected or stored on impervious surfaces or heated in stormwater impoundments by the sun. Thermal pollution can affect aquatic habitats, adversely

impacting cold water fish. Removal of shade trees and stabilizing vegetation from stream banks also contributes to thermal pollution.

As towns and cities develop from rural agricultural communities, the landscape is altered in dramatic ways. Both residential and nonresidential development on former agricultural fields and pastures can have a great impact on the hydrologic cycle for the specific site. Localized impacts to the hydrologic cycle will ultimately impact the hydrologic cycle of the entire watershed encompassing that development site.

Proper stormwater management will help mitigate the negative impact of land development and its effects on stormwater. This MSWMP outlines the Borough's plan to improve stormwater quality, decrease stormwater quantity, and increase groundwater recharge. By managing stormwater, the Borough will improve the quality of aquatic ecosystems and restore some of the natural balance to the environment.

BACKGROUND

The Borough of Middlesex encompasses approximately 2,260 acres of western Middlesex County, New Jersey. Included in those 2,260 acres are approximately 10 acres of water area and 2,250 acres of land area. The Borough is primarily a medium density residential community with areas of concentrated commercial development. The Borough is bounded to the north by the Bound Brook and Green Brooks, which are tributaries of the Raritan River. To the east lies the Borough of Dunellen, and to the south lies Piscataway Township. The Borough is also traversed by Route 28 (from the northeast to the southwest) and the Lehigh Valley Railroad Lines. Figure 2 delineates the Borough's boundary on United States Geological Survey (USGS) quadrangle maps.

DEMOGRAPHICS AND LAND USE

The population of Middlesex has fluctuated slightly in the past 30 years, from its peak population of 15,038 in 1970 to 13,055 people in the year 2000. This is primarily due to natural aging of the existing population and tenancy change of the existing housing stock. According to the April 2000 *Borough of Middlesex Master Plan*, Middlesex Borough does not project much growth for the Borough's population.

Table 1 : Historical Population Trends 1930 - 2000

	Middlesex Borough		Middlesex County		New Jersey	
Year	*Population*	*% Change*	*Population*	*% Change*	*Population*	*% Change*
1930	3,504	--	212,208	--	4,041,334	--
1940	3,763	7.4	217,077	2.3	4,160,165	0.3%
1950	5,943	57.9	274,473	26.4	4,835,329	1.6%
1960	10,520	77.0	433,856	58.1	6,066,782	2.6%
1970	15,038	42.9	583,813	34.6	7,171,112	1.8
1980	13,480	-11.6	595,893	2.1	7,364,823	0.3
1990	13,055	-3.2	671,780	12.7	7,730,118	0.5
2000	13,717	5.1	750,162	11.7	8,414,350	0.9

Source: 1990, 2000 US Census

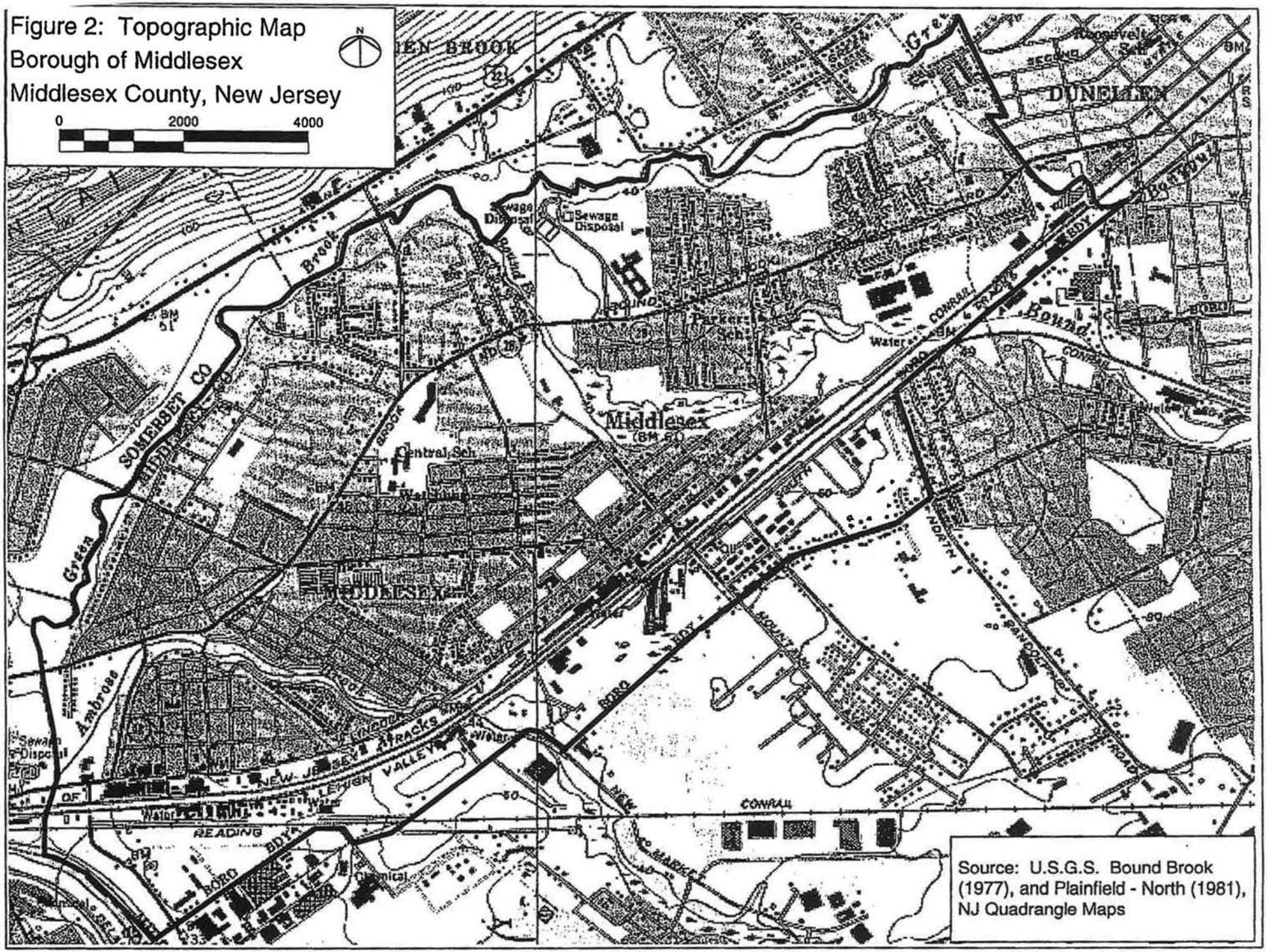


Figure 2: Topographic Map
Borough of Middlesex
Middlesex County, New Jersey
0
2000
4000
N
Middlesex
Bound Brook
DUNELLEN
Sewage Disposal
Parker Sch
Central Sch
Water
Green Brook
Ambrose Brook
SOMERSET CO
MIDDLESEX CO
NEW JERSEY
LEHIGH VALLEY
READING
CONRAIL
NORTH J
Source: U.S.G.S. Bound Brook (1977), and Plainfield - North (1981), NJ Quadrangle Maps

Table 2: General Housing Characteristics

	1990		2000		Change
	Number	Percent	Number	Percent	Number
OCCUPANCY STATUS					
Total Housing Units	4,920	100	5,130	100	210
Occupied Housing Units	4,732	96.2	5,048	98	316
Vacant Housing Units	188	3.8	82	2	- 106
Tenure					
Occupied Housing Units	4,732	100	5,048	100	316
Owner- Occupied Housing Units	3,633	76.8	3,789	75.1	156
Renter- Occupied Housing Units	1,099	23.8	1,259	24.9	160
Vacancy Status					
Vacant Housing Units	188	100	82	100	- 106
Population	13,055	100	13,717	100	662
Households	4,732	100	5,048	100	316
Family Household	3,670	77.6	3,739	74.1	69
1 Person Household	897	19.0	1,097	21.7	200
Persons/ Household	2.76		2.71		-0.05

Source: 1990, 2000 US Census

The expansion of the greater New York - New Jersey Metropolitan area and the construction of the Interstate and State highway system over the past 30 years has led to the development and suburbanizing of the Borough from a rural agricultural community to a suburban community. Residential, commercial and industrial development has consumed all agricultural uses within the Borough. Presently, the Borough is a mixture of single-family and multi-family homes with some commercial and industrial properties along State Route 28, Lincoln Boulevard and Baekeland Avenue.

In accordance with the vacant, private ownership survey conducted in 1999, Middlesex Borough

has approximately 119 acres of vacant land existing in tracts of greater than 0.8 acres (1999 Vacant Land Inventory). However, of the 119 acres, only 3.5 acres are not within the 100-foot flood zone and are suitable for residential development. As noted in the 2000 *Borough of Middlesex Master Plan*, the Borough has "very little" vacant land available for development and most development anticipated will either be redevelopment and/or renovation projects of existing properties. Figure 3 illustrates the Borough's zoning map.

In addition, the Land Use Element of the Borough's *Master Plan* indicates that all public and privately owned lands lying within the designated flood hazard area (this includes most land areas along the stream corridors) have been designated as conservation areas, thus, prohibiting development of these lands in accordance with NJDEP and Federal Emergency Management Agency (FEMA) regulations. Existing properties within the designated flood hazard areas must also comply with the Borough's Flood Damage Prevention Ordinance (Chapter 224). The intent of this ordinance is to limit and/or prohibit development within designated flood areas in order to promote the public welfare and minimize damage to properties and the Borough's natural resources.

WATERWAYS

The Raritan River Basin, which encompasses the entire Borough, drains approximately 1,100 square miles of urban, agricultural, and forested lands, as well as wetlands to the Raritan Bay through the Raritan River. The Raritan Basin spreads over 100 municipalities in seven counties. Major tributaries of the Raritan River Basin that are within Borough boundaries include the Green Brook, Bound Brook, and Ambrose Brook and their associated tributaries (Bonygut Brook) and wetlands. Figure 4 delineates the Borough waterways. The Lower Raritan subwatershed, an area draining 352 square miles of the Raritan River Basin, also encompasses the Borough. Over half of the Lower Raritan subwatershed is urban, followed by wetlands, and forested land. It should be noted that Bound Brook is a shared watershed within both Middlesex and Somerset Counties, therefore the Borough receives runoff from Somerset County and surrounding municipalities.

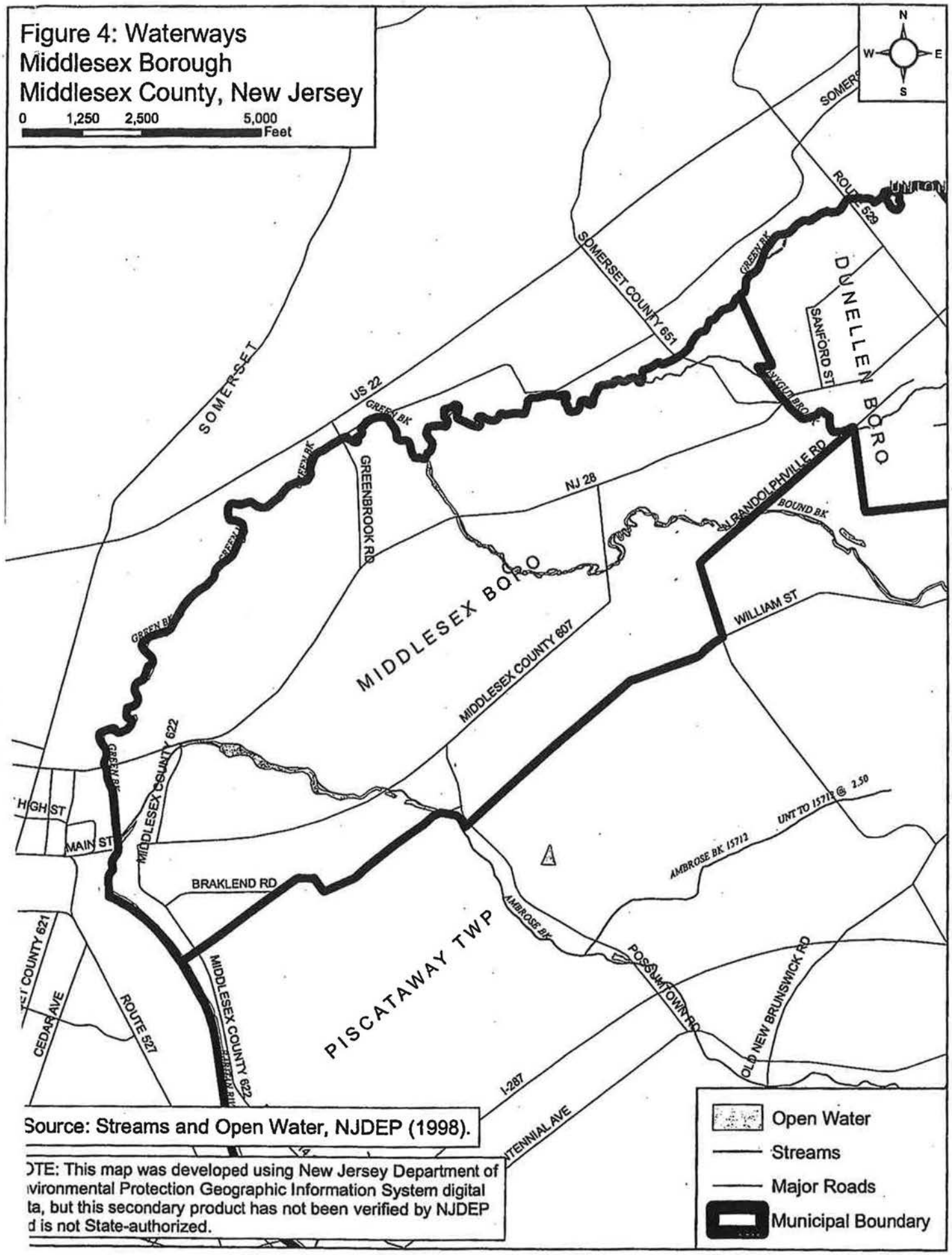


Figure 4: Waterways
Middlesex Borough
Middlesex County, New Jersey
0 1,250 2,500 5,000
Feet
N
W
E
S
SOMERSET
SOMERSET COUNTY 651
US 22
GREEN BK
GREENBROOK RD
NJ 28
RANDOLPHVILLE RD
BOUND BK
DUNELLEN BORO
SANFORD ST
MIDDLESEX BORO
MIDDLESEX COUNTY 607
WILLIAM ST
MIDDLESEX COUNTY 622
HIGH ST
MAIN ST
BRAKLEND RD
AMBROSE BK 15712
UNT TO 15712 @ 2.50
PISCATAWAY TWP
AMBROSE BK
POSSUMTOWN RD
OLD NEW BRUNSWICK RD
MIDDLESEX COUNTY 621
CEDAR AVE
ROUTE 527
I-287
TENNIAL AVE
Open Water
Streams
Major Roads
Municipal Boundary
Source: Streams and Open Water, NJDEP (1998).
OTE: This map was developed using New Jersey Department of
vironmental Protection Geographic Information System digital
ta, but this secondary product has not been verified by NJDEP
d is not State-authorized.

WATER QUALITY

The Ambient Biomonitoring Network (AMNET), established by the NJDEP, monitors and documents the health of New Jersey's waterways. AMNET currently has 820 sites in five drainage basins that it monitors for benthic macroinvertebrates on a five-year cycle. Waterways are scored based on the data to generate the New Jersey Impairment Score (NJIS) and then categorized as severely impaired, moderately impaired, and non-impaired. The NJIS is based on biometrics and benthic macroinvertebrate health. (http://www.state.nj.us/dep/wmm/bfbm/) Presently, there are no Category One waters, as defined NJDEP, within the Borough. (http://www.nj.gov/dep/cleanwater/c1_waters_list.pdf) The AMNET site does have monitoring sites listed for the Ambrose Brook, Green Brook, and Bound Brook. These three streams are listed as moderately impaired, with the exception of a section of the Ambrose Brook at School Street in North Stelton, which is listed as severely impacted. Table 3 notes the water bodies in the Borough's vicinity that are listed on the New Jersey's 2004 Integrated List of Waterbodies. This list ranks waterbodies in terms of water quality. Sublist 1 waterbodies have the highest water quality, while Sublist 5 waterbodies have the poorest.

In addition to biological health, chemical data are gathered by the NJDEP and other organizations, and used to determine the health of waterways. The data are then used to determine which waters require the development of Total Maximum Daily Loads (TMDLs). A TMDL is the carrying capacity of a waterbody for a given pollutant. This is the quantity of pollutants that can enter a waterbody without exceeding water quality standards or interfering with the ability to use the waterbody for its designated usage. Point and non-point source pollution, surface water withdrawals and natural background levels are included in the determination of a TMDL, as required by section 303(d) of the Clean Water Act. Point source pollution includes, but is not limited to NJPDES permitted discharges, while non-point source pollution may include stormwater runoff from agricultural lands or impervious surfaces. TMDLs determine the allowable load from each source, with a factor of safety, of the pollutant entering the waterbody. TMDLs can be used to limit further deterioration of a waterbody, or to improve the current water quality.

Table 3: 2004 Borough of Middlesex Vicinity Integrated Water Bodies

Sublist	Station Name/Waterbody	Site ID	Parameters	Data Source
3	Ambrose Brook at Behmer Rd in Piscataway	AN0425A	Benthic Macroinvertebrates	NJDEP AMNET
5	Ambrose Brook at Raritan Ave in Middlesex	AN0425	Benthic Macroinvertebrates	NJDEP AMNET
5	Ambrose Brook at School St. in No. Stelton	AN0425B	Benthic Macroinvertebrates	NJDEP AMNET
5	Bound Brook	Bound Brook	Fish-PCB, Fish-Dioxin	NJDEP Fish Tissue Monitoring
5	Bound Brook at Bound Brook Rd in Middlesex	AN0424	Benthic Macroinvertebrates	NJDEP AMNET
4	Bound Brook at Middlesex	01403900	Fecal Coliform	NJDEP/USGS Data
5	Bound Brook at Middlesex	01403900	Phosphorus, Total Suspended Solids	NJDEP/USGS Data
1	Bound Brook at Middlesex	01403900	Temperature, pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Unionized Ammonia	NJDEP/USGS Data
4	Bound Brook at Route 28 at Middlesex	01403385	Fecal Coliform	NJDEP/USGS Data
5	Bound Brook at Route 28 at Middlesex	01403385	Phosphorus	NJDEP/USGS Data
1	Bound Brook at Route 28 at Middlesex	01403385	Temperature, pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Bound Brook at Woodbrook Rd in South Plainfield	AN0424B	Benthic Macroinvertebrates	NJDEP AMNET
5	Green Brook at Apple Tree Rd in Watchung.	AN0421B	Benthic Macroinvertebrates	NJDEP AMNET
5	Green Brook at Clinton Ave in North Plainfield	AN0423	Benthic Macroinvertebrates	NJDEP AMNET
3	Green Brook at Green Brook Park, Park Dr. in Raritan R	Green Brook at Green Brook Park, Park Dr. in Raritan R	Benthic Macroinvertebrates	NJDEP AMNET
5	Green Brook at Main St in Bound Brook	AN0426	Benthic Macroinvertebrates	NJDEP AMNET
5	Green Brook at New Providence Rd in Seeleys Mill	AN0421A	Benthic Macroinvertebrates	NJDEP AMNET
4	Green Brook at North Plainfield	01403470	Fecal Coliform	NJDEP/USGS Data
3	Green Brook at North Plainfield	01403470	pH, Temperature, Dissolved Oxygen, Dissolved Solids, Total Suspended Solids	NJDEP/USGS Data
1	Green Brook at North Plainfield	01403470	Phosphorus, Nitrate, Unionized Ammonia	NJDEP/USGS Data
5	Green Brook at off Mill Rd in Sebrings Mill	AN0426A	Benthic Macroinvertebrates	NJDEP AMNET
5	Green Brook at Raymond Ave in Plainfield	AN0421	Benthic Macroinvertebrates	NJDEP AMNET
5	Ambrose Brook at School St. in No. Stelton	AN0425B	Benthic Macroinvertebrates	NJDEP AMNET

Source: New Jersey's 2004 Integrated List of Waterbodies. http://www.state.nj.us/dep/wmm/sgwqt/wat/index.html

An implementation plan should be developed to identify how the various sources of pollution

will be reduced to the levels specified in any issued TMDL. Some of the strategies implemented may include stormwater treatment, implementation of updated ordinances, restriction of impervious surfaces, retrofitting stormwater systems, disconnection of impervious surfaces, and other use of best management practices (BMPs).

Currently, several of the Borough's waterways have NJDEP established TMDLs for fecal coliform. The Bound Brook at Rt. 28 in Middlesex has two TMDLs listed; one for 17.8 river miles and one for 2.8 river miles. Also, the Green Brook in North Plainfield has a 17.8 river mile long TMDL. The Green and Bound Brook watersheds are included in the TMDL upstream of the confluence of the Green Brook and Brown Brook. This TMDL includes the tributary waterways of the Blue Brook, Cedar Brook, Bonygut Brook, Bound Brook, Crab Brook, East Branch Green Brook, Green Brook, Stony Brook, and West Branch Stony Brook. The other TMDL includes the watershed from the confluence of the Raritan and Mill Stone Rivers, including the Green Brook downstream of the confluence of the Green and Bound Brooks. However, according to the Division of Watershed Management of the NJDEP, there are no specific stormwater TMDLs for the waterways in the Borough of Middlesex, as such any current TMDLs for the waterways are not governed by this plan.

WATER QUANTITY

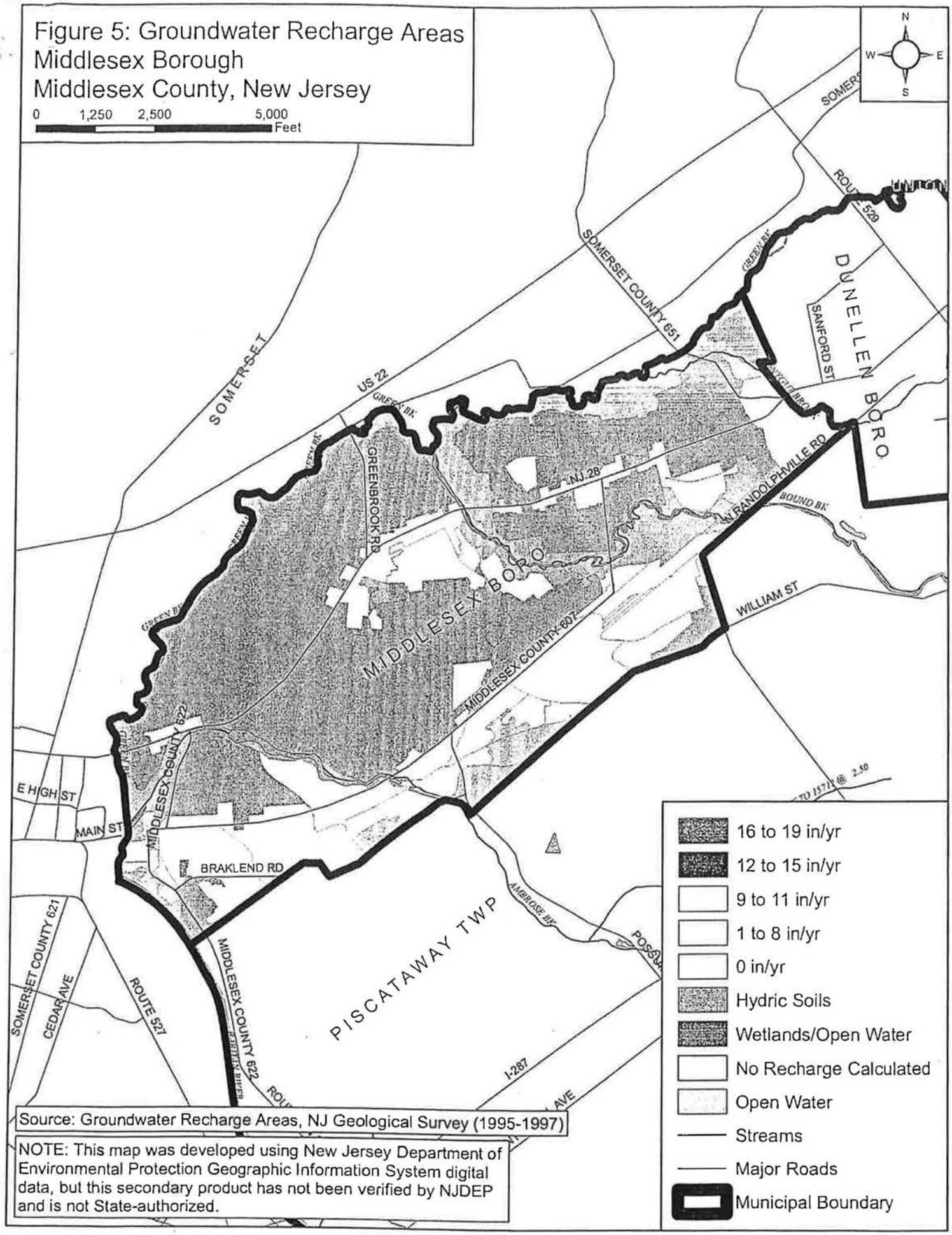
According to the Borough's *Master Plan*, flooding issues along the Ambrose Brook, Bound Brook, and Green Brook are well known. Additionally, due to the Borough's relatively flat grade, localized flooding can occur during storm events. The Borough is currently in the process of developing flood control projects in the Green Brook basin. The Green Brook Flood Control Plan was prepared by the U.S. Army Corps of Engineers and should soon be implemented. The first phase of this project includes the construction of levees and flood control gates along the Bound Brook.

GROUNDWATER RECHARGE

The Borough's drinking water is supplied by Elizabethtown Water Company (EWC). Four wells, owned by EWC, are located at the northern Borough boundary adjacent to Greenbrook

Road. While all of the Borough's water supply may not come from sources within the Borough, it should be noted that increases in development have increased impervious surface area and decreased ground water recharge. Increased imperious surface area can, as previously mentioned, result in an increase in peak and volumes of the Borough's stream flow. Any increase in the amount of water can result in stream erosion and degradation of stream habitats. Additionally, increasing impervious area, decreases the base flows of streams during dry weather periods which, in turn, can negatively impact stream habitats. The Borough's groundwater recharge areas are mapped in Figure 5.

Wellhead Protection Areas (WHPA) for public community water supplies are delineation's of the horizontal extent captured by well pumping at a given rate over a two-, five-, and twelve-year period of time. These areas are the first step in defining the source of a public drinking supply well. The Borough WHPAs are delineated on Figure 6. There are 4 WHPAs within the boundary of the Borough, which are owned by the Elizabethtown Water Company. In addition, there are fifteen WPHAs that encroach upon the Borough boundary, which are also owned by the Elizabethtown Water Company.



Source: Groundwater Recharge Areas, NJ Geological Survey (1995-1997)

NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

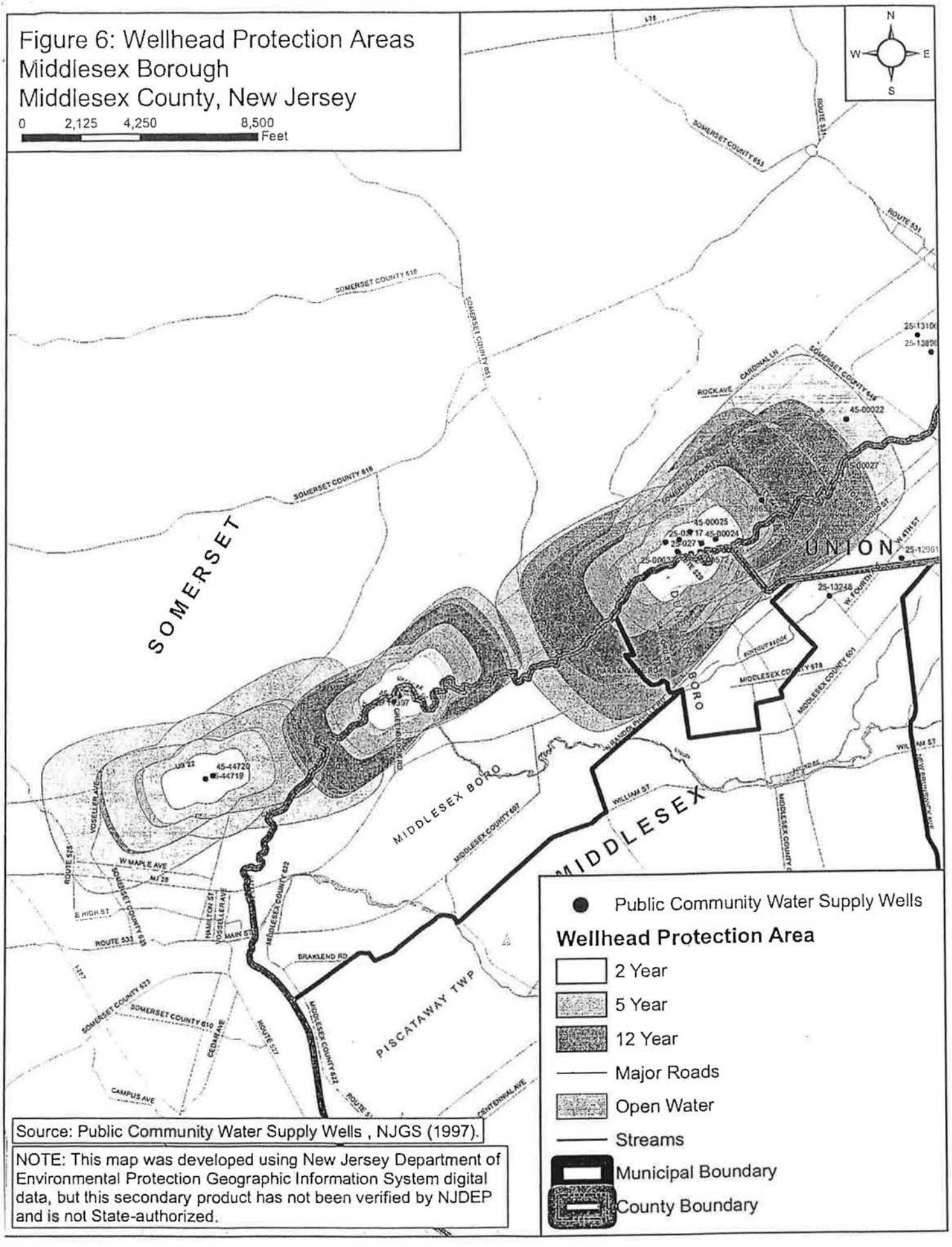


Figure 6: Wellhead Protection Areas
Middlesex Borough
Middlesex County, New Jersey
0 2,125 4,250 8,500
Feet
N
W
E
S
SOMERSET
UNION
MIDDLESEX BORO
PISCATAWAY TWP
MIDDLESEX
ROCK AVE
CARDINAL LN
W MAPLE AVE
E HIGH ST
MAIN ST
BRAKLEND RD
WILLIAM ST
CAMPUS AVE
CEDAR AVE
CENTENNIAL AVE
ROUTE 531
ROUTE 527
ROUTE 529
NJ 28
US 22
45-44720
45-44719
45-00022
45-00024
45-00025
25-13248
Public Community Water Supply Wells
Wellhead Protection Area
2 Year
5 Year
12 Year
Major Roads
Open Water
Streams
Municipal Boundary
County Boundary
Source: Public Community Water Supply Wells , NJGS (1997).
NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

DESIGN AND PERFORMANCE STANDARDS

The Borough should adopt applicable design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5 to reduce the negative impact of stormwater runoff on water quality and quantity, and loss of groundwater recharge in receiving waterbodies. The section of this MSWMP, entitled Stormwater Management Strategies, indicates actions appropriate for various types of development in Middlesex. Ultimately, design and performance standards will be created to contain the necessary language to maintain stormwater management measures consistent with the applicable stormwater management rules, N.J.A.C. 7:8-5.8 - Maintenance Requirements. This includes language for safety standards consistent with N.J.A.C. 7:8-6 - Safety Standards for Stormwater Management Basins. Ordinances will be submitted to the Middlesex County Planning Board for review and approval within 12 months of adoption of the MSWMP.

Proper inspection and maintenance are critical components for the successful performance of a stormwater management system. The Borough is presently preparing a Stormwater Pollution Prevention Plan (SPPP) to address inspection and maintenance for existing stormwater infrastructures throughout the Borough. Also included in the SPPP is the development of a Local Public Education Program to educate property owners on methods to reduce non-point source stormwater pollution such as proper waste disposal, solids and floatable controls, fertilizer and pesticide use, etc. New Development and redevelopment projects will be required to develop and submit a detailed operation and maintenance plan for each BMP established in accordance with the N.J.A.C. 7:8 - 5.8. Recommendations for proper maintenance procedures are available in the NJDEP's *New Jersey Stormwater Best Management Practices Manual* (BMP Manual). Copies of the maintenance plan(s) will be filed with the Borough's Department of Public Works.

A representative of the Borough will monitor construction of the BMP project to ensure that the appropriate stormwater management measures are constructed and function as designed. Borough personnel will conduct inspections as needed to ensure public systems are functioning properly and to identify maintenance needs, if any. For privately owned and operated BMPs, the

Owner shall inspect the BMPs as needed. After this, annual checks should be done to identify any additional maintenance needs required. This may include clearing of blockages from inlets and/or outlet structures, removal of unhealthy vegetation or accumulated debris/materials.

Borough ordinances should indicate that the inspection of systems is permissible on private property for the protection of public health and safety, as well as the protection of the health waterbodies. Ordinances should also indicate a time frame for maintenance procedures to occur upon receiving notice from the Borough that maintenance is required. Additionally, ordinances should require Maintenance Plans for privately owned BMPs which include information such as contact information for the responsible party, schedule of required maintenance, estimated costs of maintenance, etc in accordance with State regulations.

PLAN CONSISTENCY

REGIONAL STORMWATER MANAGEMENT PLANS

Currently, there are no Regional Stormwater Management Plans (RSWMP) for waterways or drainage areas within the Borough. This plan will be updated to be consistent with any RSWMP plan that is established in the future. The Borough shall take part in the development of any RSWMP that affects waterbodies or drainage areas within or adjacent to the municipality.

TOTAL MAXIMUM DAILY LOADS

The Bound Brook at Route 28 in Middlesex has two TMDLs for fecal coliform listed; one for 17.8 river miles and one for 2.8 river miles. Also, the Green Brook in North Plainfield has a 17.8 river mile long fecal coliform TMDL. Currently, however, according to the Division of Watershed Management of the NJDEP, there are no specific stormwater TMDLs for the Borough's waterways. This plan will be updated in the future, when such regulations are established.

RESIDENTIAL SITE IMPROVEMENT STANDARDS (RSIS)

This Municipal Stormwater Management Plan is consistent with regulations established under the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21, and will be updated to remain consistent with any future updates of RSIS. Additionally, the Borough will use the latest update of RSIS during its reviews of residential area development for stormwater management.

SOIL CONSERVATION

The NJDEP requires that all new development and redevelopment projects comply with the Soil Erosion and Sediment Control Standards of New Jersey. However, the Borough is exempt from jurisdiction of the Freehold Soil Conservation District. In other words, the Borough is responsible for securing approvals for erosion control plans, providing inspection and enforcement during construction. Therefore, the Borough's Stormwater Management Control Ordinance will require that all new development and redevelopment comply with Borough regulations.

STORMWATER MANAGEMENT STRATEGIES

The Borough has reviewed its Master Plan and pertinent development ordinances. Below is list of recommended revisions to existing ordinances and new strategies that the Borough should consider implementing in order to incorporate the NJDEP's non-structural strategies for stormwater management. It should be noted that the Borough is fully developed and minimal "major development[1]" is anticipated.

- **Chapter 248-16 Required Improvements:** This section describes the required improvements for site development.
  - Walkways: Walkways are required to be built on both sides of the street. This section should be evaluated and modified as needed to include grading requirements that allow stormwater to flow into a buffer zone. Additionally the use of permeable paving systems should be encouraged where practical.
  - Drainage: This section should be updated to comply with the Design and Performance Standards established by the NJDEP (N.J.A.C. 7:8) and outlined in this plan.
  - Curbing: This section should be updated to encourage the use of flush cut curbing and curb stops, or curb cuts where practical.

- **Chapter 248.17 Off-Street Parking and Loading: B) Design Standards:** This section outlines the Borough's Parking and Loading requirements. This section should be investigated to include the following:
  - The Design and Performance Standards established by the NJDEP (N.J.A.C. 7:8) and outlined in this MSWMP;
  - Encourage the use of native vegetation and permeable paving systems to act as a disconnection points for impervious surfaces;
  - Consider the reduction of parking ratios for parking lots or the evaluation of a

[1] Major Development – means any development that provides for ultimately disturbing one or more acres of land or increases impervious surface by one-quarter acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of 'major development' but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."

"parking bank" system to allow for reduction of impervious surfaces, where possible;

- Consider the use of curb cuts, or flush cut curbs and curb stops, where possible; and
- Encourage the use of landscape islands/buffer zones of native vegetation.

- **Chapter 248.18 Off-Tract Improvements:** This section states the requirements for off-tract improvements. This section should be modified to require the application of the Design and Performance Standards established by the NJDEP (N.J.A.C. 7:8) and outlined in this MSWMP.

- **Chapter 248.21 Design Standards:** This section should be modified to require the application of the Design and Performance Standards established by the NJDEP (N.J.A.C. 7:8) and outlined in this MSWMP.

- **Chapter 248.24 Easements; Preservation of Natural Features**: This section describes the Borough's Stormwater Easements that are required along stream corridors for protection. This section should be evaluated against the State's Stream Corridor Buffer regulations. Increasing the size of the Stormwater Easement should be investigated to protect natural drainage ways.

Amended ordinances will be submitted to the Middlesex County Planning Board for review and approval within 12 months of adoption of this MSWMP plan. Upon approval from the County, copies will be forwarded to the Department of Environmental Protection.

NON-STRUCTURAL STRATEGIES

This MSWMP encourages the use of Low Impact Design methods and recommends the practical use of the following non-structural strategies for all 'major developments' in accordance with the NJDEP BMP Manual:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.

2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.
3. Maximize the protection of natural drainage features and vegetation.
4. Minimize the decrease in the pre-construction "time of concentration."
5. Minimize land disturbance including clearing and grading.
6. Minimize soil compaction.
7. Provide vegetated open-channel conveyance systems that discharge into and through stable vegetated areas.
8. Provide preventative source controls.

In addition, the NJDEP's BMP Manual further requires an applicant seeking approval for a major development to specifically identify which and how these non-structural strategies have been incorporated into the development's design. Finally, for each of those non-structural strategies that were not able to be incorporated into the development's design due to engineering, environmental, or safety reasons, the applicant must provide a basis for this contention.

Recommended Measures

Recommendations in the BMP Manual may be implemented through the use of:

- **Vegetated Filter Strips**

  Vegetated filter strips are best utilized adjacent to a buffer strip, watercourse or drainage swale since the discharge will be in the form of sheet flow, making it difficult to convey the stormwater downstream in a normal conveyance system (swale or pipe).

- **Stream Corridor Buffer Strips**

  Buffer strips are undisturbed areas between development and the receiving waters. There are two management objectives associated with stream and valley corridor buffer strips:

  - To provide buffer protection along a stream and valley corridor to protect existing ecological form and functions; and

- To minimize the impact of development on the stream itself (filter pollutants, provide shade and bank stability, reduce the velocity of overland flow).

Buffers only provide limited benefits in terms of stormwater management; however, they are an integral part of a system of best management practices.

- **The Stabilization of Banks, Shoreline and Slopes**

  The root systems of trees, shrubs and plants effectively bind soils to resist erosion. Increasing the amount of required plant material for new and redeveloped residential and non-residential sites should be encouraged throughout the Borough. Planting schemes should be designed by a certified landscape architect to combine plant species that have complementary rooting characteristics to provide long-term stability.

- **Deterrence of Geese**

  Maintaining or planting dense woody vegetation around the perimeter of a pond or wetland is the most effective means of deterring geese from taking over and contaminating local lakes and ponds. Minimizing the amount of land that is mowed will limit the preferred habitat for geese.

- **Fertilizers**

  The use of fertilizers to create the "perfect lawn" is an increasing common problem in many residential areas. Fertilizer run-off increases the level of nutrients in water bodies and can accelerate eutrophication[2] in the lakes and rivers and continue on to the coastal areas. The excessive use of fertilizers causes nitrate contamination of groundwater. Good fertilizer maintenance practices help in reducing the amount of nitrates in the soil and thereby lower its content in the water. Initially, the Borough should work with the NJDEP to educate homeowners of the impacts of the overuse of fertilizers. This discussion should include other techniques to create a "green lawn" without over fertilizing. Almost as important as the use

[2] Eutrophication – The normally slow aging process by which a lake evolves into a bog or marsh and ultimately assumes a completely terrestrial state and disappears.

as fertilizer, is the combination of over fertilizing and over watering lawns. In many cases this leads to nutrient rich runoff, which ultimately migrate to a nearby stream, lake or other water body. If fertilizer is applied correctly, the natural characteristics of the underlying soils will absorb or filter out the nutrients in the fertilizer.

STRUCTURAL STORMWATER MANAGEMENT[3]

In Chapter 9 of the BMP Manual, the Department of Environmental Protection identifies several structural stormwater management options. Structural methods should only be used after all non-structural strategies are deemed impracticable or unsafe. It should be noted that each of these structures has advantages and disadvantages to manage stormwater. Specifically, the Borough encourages the use of structural stormwater management systems in a manner that maximizes the preservation of community character. As previously mentioned, Middlesex is a fully developed community and anticipates the majority of new construction as residential infill development that will disturb less than 1 acre of land.

- **Bioretention Systems**

  A bioretention system consists of a soil bed planted with native vegetation located above an underdrained sand layer. It can be configured as either a bioretention basin or a bioretention swale. Stormwater runoff entering the bioretention system is filtered first through the vegetation and then the sand/soil mixture before being conveyed downstream by the underdrain system. Runoff storage depths above the planting bed surface are typically shallow. The adopted Total Suspended Solids (TSS) removal rate for bioretention systems is 90%.

- **Constructed Stormwater Wetlands**

  Constructed stormwater wetlands are wetland systems designed to maximize the removal of pollutants from stormwater runoff through settling and both uptake and filtering by vegetation. Constructed stormwater wetlands temporarily store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants. The adopted removal

[3] Definitions provided in the NJDEP – Stormwater Best Management Practices Manual at: http://www.njstormwater.org/tier_A/ bmp_manual.htm

rate for constructed stormwater wetlands is 90%.

- **Dry Wells**

  A dry well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. Due to the relatively low level of expected pollutants in roof runoff, a dry well cannot be used to directly comply with the suspended solids and nutrient removal requirements contained in the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. However, due to its storage capacity, a dry well may be used to reduce the total stormwater quality design storm runoff volume that a roof would ordinarily discharge to downstream stormwater management facilities. Care should be taken with the location and size of drywells due to potential adverse impacts on basements and foundations.

- **Extended Detention Basins**

  An extended detention basin is a facility constructed through filling and/or excavation that provides temporary storage of stormwater runoff. It has an outlet structure that detains and attenuates runoff inflows and promotes the settlement of pollutants. An extended detention basin is normally designed as a multistage facility that provides runoff storage and attenuation for both stormwater quality and quantity management. The adopted TSS removal rate for extended detention basins is 40 to 60%, depending on the duration of detention time provided in the basin.

- **Infiltration Basins**

  An infiltration basin is a facility constructed within highly permeable soils that provides temporary storage of stormwater runoff. An infiltration basin does not normally have a structural outlet to discharge runoff from the stormwater quality design storm, but may require emergency overflow for extraordinary storm events. Instead, outflow from an infiltration basin is through the surrounding soil. An infiltration basin may also be combined with an extended detention basin to provide additional runoff storage for both stormwater

quality and quantity management. The adopted TSS removal rate for infiltration basins is 80%.

- **Manufactured Treatment Devices**

  A manufactured treatment device is a pre-fabricated stormwater treatment structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to remove pollutants from stormwater runoff. The TSS removal rate for manufactured treatment devices is based on the NJDEP certification of the pollutant removal rates on a case-by-case basis. Other pollutants, such as nutrients, metals, hydrocarbons, and bacteria can be included in the verification/certification process if the data supports their removal efficiencies.

- **Pervious Paving Systems**

  Pervious paving systems are paved areas that produce less stormwater runoff than areas paved with conventional paving. This reduction is achieved primarily through the infiltration of a greater portion of the rain falling on the area than would occur with conventional paving. This increased infiltration occurs either through the paving material itself or through void spaces between individual paving blocks known as pavers. Pervious paving systems are divided into three general types. Each type depends primarily upon the nature of the pervious paving surface course and the presence or absence of a runoff storage bed beneath the surface course. Porous paving and permeable paver with storage bed systems treat the stormwater quality design storm runoff through storage and infiltration. Therefore, these systems have adopted TSS removal rates similar to infiltration structures. Care must be taken in the use of pervious systems to avoid subgrade instability and frost related deterioration.

- **Sand Filters**

  A sand filter consists of a forebay and underdrained sand bed. It can be configured as either a surface or subsurface facility. Runoff entering the sand filter is conveyed first through the forebay, which removes trash, debris, and coarse sediment, and then through the sand bed to an outlet pipe. Sand filters use solids settling, filtering, and adsorption processes to reduce

pollutant concentrations in stormwater. The adopted TSS removal rate for sand filters is 80%.

- **Vegetative Filters**

  Vegetated filter strips are engineered stormwater conveyance systems that treat small drainage areas. Generally, a vegetated filter strip consists of a level spreader and planted vegetation. The level spreader ensures uniform flow over the vegetation that filters out pollutants, and promotes infiltration of the stormwater.

  A vegetative filter is an area designed to remove suspended solids and other pollutants from stormwater runoff flowing through a length of vegetation called a vegetated filter strip. The vegetation in a filter strip can range from turf and native grasses to herbaceous and woody vegetation, all of which can either be planted or indigenous. It is important to note that all runoff to a vegetated filter strip must both enter and flow through the strip as sheet flow. Failure to do so can severely reduce and even eliminate the filter strip's pollutant removal capabilities. The total suspended solid (TSS) removal rate for vegetative filters will depend upon the vegetated cover in the filter strip.

- **Wet Ponds**

  A wet pond is a stormwater facility constructed through filling and/or excavation that provides both permanent and temporary storage of stormwater runoff. It has an outlet structure that creates a permanent pool and detains and attenuates runoff inflows and promotes the settlement of pollutants. A wet pond, also known as a retention basin, can also be designed as a multi-stage facility that provides extended detention for enhanced stormwater quality design storm treatment and runoff storage and attenuation for stormwater quantity management. The adopted TSS removal rate for wet ponds is 50 to 90% depending on the permanent pool storage volume in the pond and the length of retention time provided by the pond.

Table 4, below, summarizes the approximate TSS removal rates for these structures. Final TSS removal rates should be calculated for each structure based on its final design parameters.

Table 4: TSS Removal Rates for BMPs

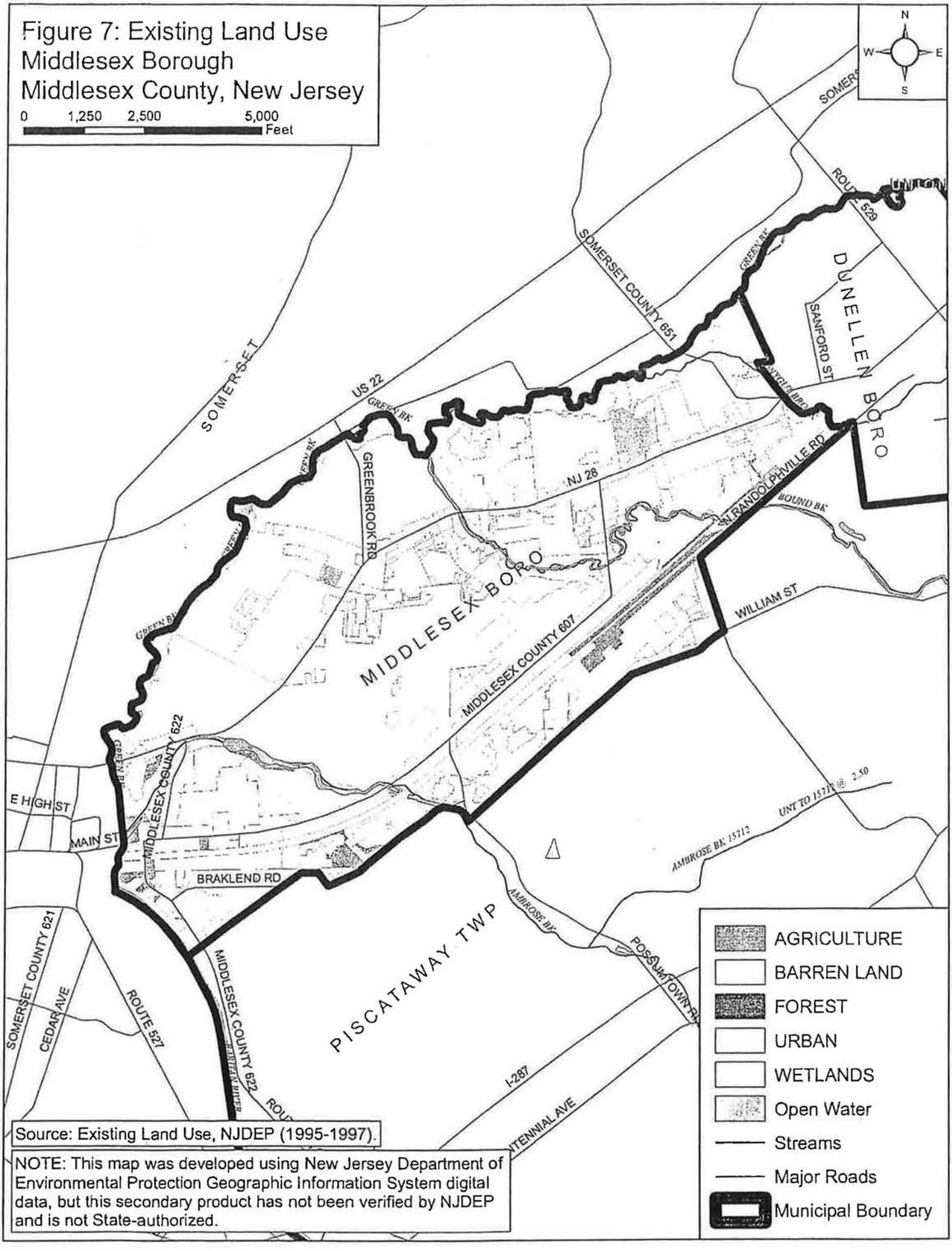
Best Management Practice (BMP)	Adopted TSS Removal Rate (%)
Bioretention System	90
Constructed Stormwater Wetland	90
Dry Well	Volume Reduction Only
Extended Detention Basin	40-60*
Infiltration Structure	80
Manufactured Treatment Device	See N.J.A.C 7:8-5.7(d)
Pervious Paving System	Volume Reduction Or 80 (with infiltration bed)
Sand Filter	80
Vegetative Filter	60-80
Wet Pond	50-90*

*based on volume and detention time
Source: NJDEP BMP Manual, Apr. 2004.

LAND USE/ BUILD-OUT ANALYSIS

As noted in their Master Plan, the Borough of Middlesex has less than one (1) square mile of developable or vacant land and therefore is exempt from the NJDEP regulations requiring the development of a full build-out analysis, which would indicate the potential for development within the Borough.

Refer to Figure 7 for a copy of the Borough's Existing Land Use Map. Figure 8 illustrates the Hydrologic Units (HUC-14s) within the Borough and Figure 9 shows the environmentally constrained lands.



Source: Existing Land Use, NJDEP (1995-1997).

NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

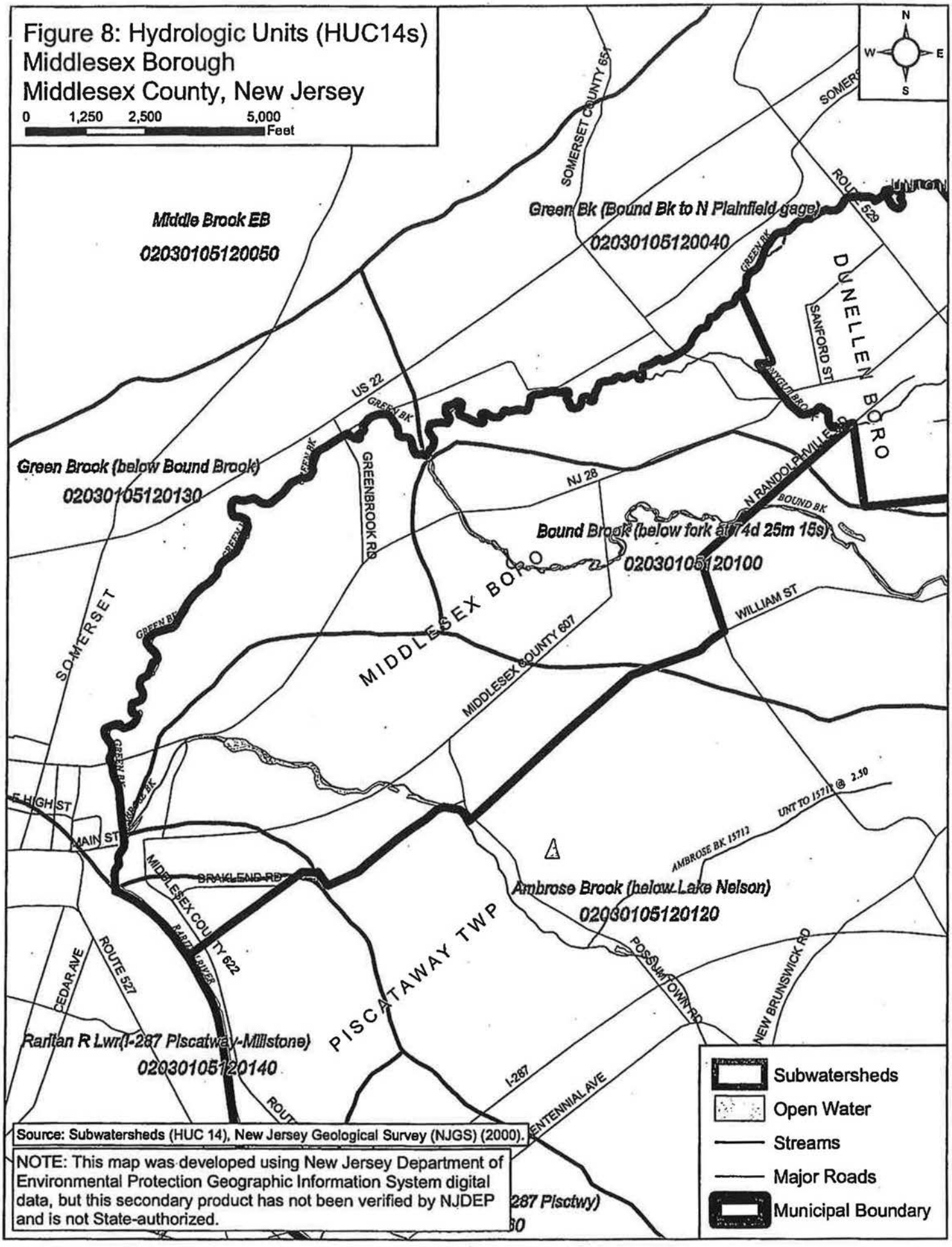


Figure 8: Hydrologic Units (HUC14s)
Middlesex Borough
Middlesex County, New Jersey
0 1,250 2,500 5,000
Feet
N
W
E
S
Middle Brook EB
02030105120050
Green Bk (Bound Bk to N Plainfield gage)
02030105120040
Green Brook (below Bound Brook)
02030105120130
Bound Brook (below fork at 74d 25m 15s)
02030105120100
Ambrose Brook (below Lake Nelson)
02030105120120
Raritan R Lwr(I-287 Piscatway-Millstone)
02030105120140
SOMERSET COUNTY 651
US 22
NJ 28
GREENBROOK RD
GREEN BK
BOUND BK
N RANDOLPHVILLE RD
SANFORD ST
DUNELLEN BORO
MIDDLESEX BORO
SOMERSET
MIDDLESEX COUNTY 607
WILLIAM ST
E HIGH ST
MAIN ST
BRAKLEND RD
MIDDLESEX COUNTY 622
RARITAN RIVER
CEDAR AVE
ROUTE 527
PISCATAWAY TWP
AMBROSE BK 15713
UNT TO 15713 @ 2.50
POSSUMTOWN RD
NEW BRUNSWICK RD
I-287
CENTENNIAL AVE
Subwatersheds
Open Water
Streams
Major Roads
Municipal Boundary
Source: Subwatersheds (HUC 14), New Jersey Geological Survey (NJGS) (2000).
NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

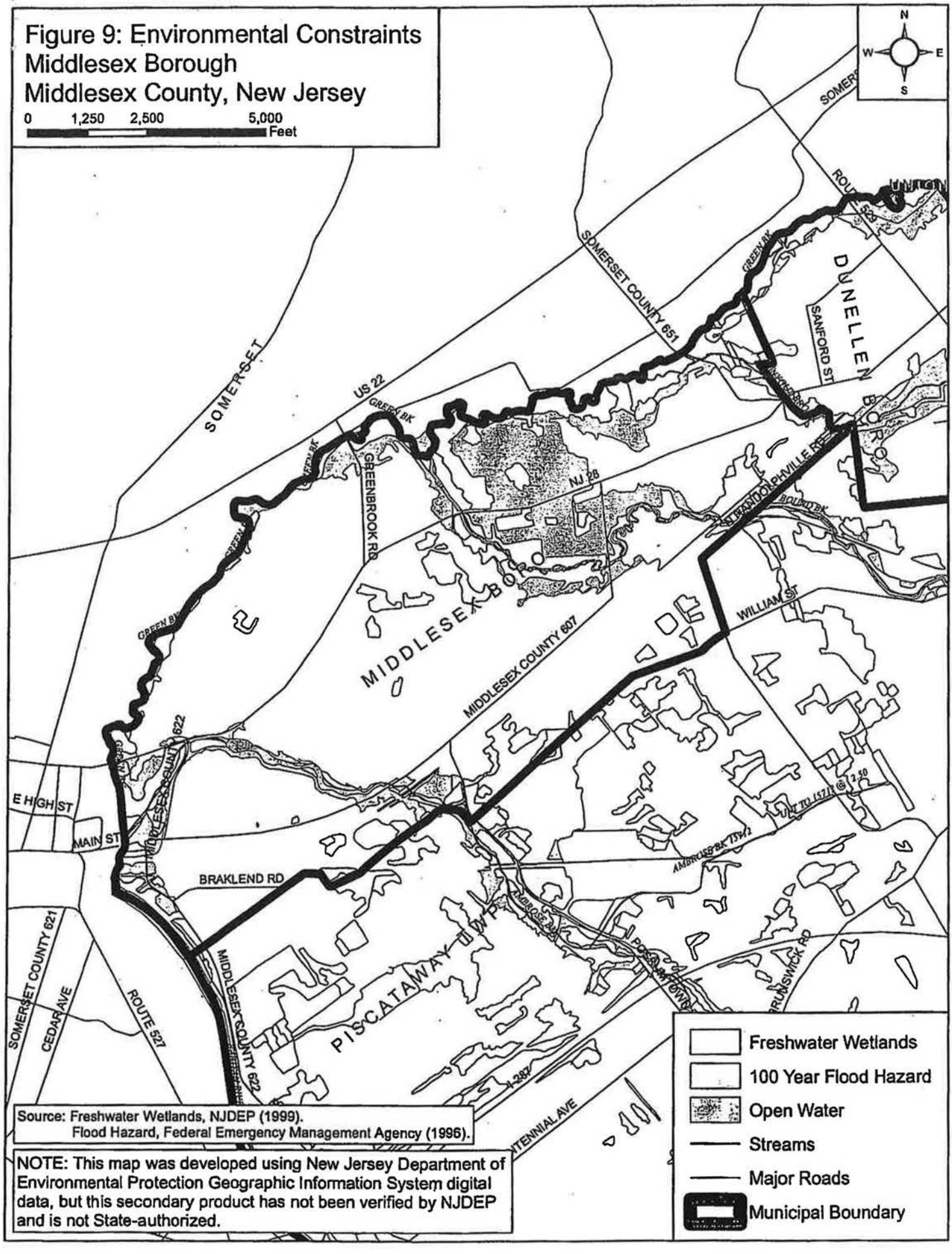


Figure 9: Environmental Constraints
Middlesex Borough
Middlesex County, New Jersey
0 1,250 2,500 5,000
Feet
N
W
E
S
SOMERSET
SOMERSET COUNTY 651
US 22
GREEN BK
GREENBROOK RD
NJ 28
DUNELLEN
SANFORD ST
RARITAN RIVER
BOUND BK
MIDDLESEX BORO
MIDDLESEX COUNTY 607
WILLIAM ST
E HIGH ST
MAIN ST
MIDDLESEX COUNTY 622
BRAKLEND RD
SOMERSET COUNTY 621
CEDAR AVE
ROUTE 527
PISCATAWAY TWP
AMBROSE BK
I-287
TENNIAL AVE
RUNSWICK RD
Freshwater Wetlands
100 Year Flood Hazard
Open Water
Streams
Major Roads
Municipal Boundary
Source: Freshwater Wetlands, NJDEP (1999).
Flood Hazard, Federal Emergency Management Agency (1996).
NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.

MITIGATION PLAN

This mitigation plan is provided for proposed development or redevelopment projects that seek a variance or exemption from the stormwater management design and performance standards set forth in this MSWMP and N.J.A.C. 7:8-5.

MITIGATION PROJECT CRITERIA

To grant a variance or exemption from the stormwater regulations, new development and redevelopment plan applications must propose a mitigation project located within the same drainage basin as the proposed development/redevelopment. Proposed mitigation projects must provide for additional groundwater recharge benefits, protection from stormwater runoff quantity or quality from previously developed property that does not currently meet the design and performance standards outlined in this MSWMP. Mitigation projects should also be as close in terms of hydrology and hydraulics to the proposed development/redevelopment as possible. The developer must also ensure the long-term maintenance of the project including all maintenance procedures required in Chapters 8 and 9 on the NJDEP's BMP Manual.

Projects must be proposed on an equivalent basis. Developers must propose a mitigation project similar in kind to the variance or exemption being requested. Proposed mitigation projects cannot adversely impact the existing environment.

DEVELOPER MITIGATION PLAN REQUIREMENTS

It is the Developer's responsibility to provide a detailed study of any proposed mitigation project, and provide a copy of the Proposed Mitigation Plan to the Borough for review and approval prior to granting final approval for site development. Developers should include the following in a Mitigation Plan:

- Mitigation Project Name, Owner name and address, Developer name and address, Mitigation Project Location, Drainage Area, Cost Estimate;
- Proposed mitigation strategy and impact to sensitive receptor. What is being impacted, mitigated, and how;

- Legal authorization required for construction and maintenance;
- Responsible Party including: required maintenance, who will perform the maintenance, proposed cost of maintenance, and how it will be funded;
- All other permits required for construction of the mitigation project;
- Cost estimate of construction inspection; and
- Reason a waiver or exemption is required and supporting evidence.

Due to the lack of vacant or developable land, it is anticipated that the majority of the mitigation projects proposed will result in retrofitting/rehabilitation of existing stormwater facilities and natural infrastructures.

RECOMMENDATIONS

The following are additional recommendations associated with this Stormwater Management Plan Element of the *Master Plan*:

- ***Recommendation A: Encourage the Planning Board and Council to review, discuss, update and amend the Borough's existing development ordinances to be in compliance with the design, performance and safety standards outlined in this MSWMP and in the NJDEP's Stormwater Regulations. Additionally, to require the adoption of a Stormwater Management Control Ordinance.***

  Portions of the existing development ordinances are inconsistent with recently adopted Stormwater Management Regulations and the NJDEP's BMP Manual. Some of these inconsistencies are identified in the Stormwater Management Strategies section above. The Borough should evaluate and update, as needed, their existing regulations to be in conformance with the NJDEP Stormwater Regulations and to minimize inconsistencies or conflicts. In addition, NJDEP requires the adoption of a Municipal Stormwater Control Ordinance that supports this plan within twelve months of the adoption date of this MSWMP.

- ***Recommendation B: Educate residents, commercial landscapers and Borough employees on the impacts of the overuse of lawn chemicals and good lawn chemical maintenance practices, as well as techniques to deter geese and other wildlife.***

  As stated in the Stormwater Management Strategies section above, the overuse of fertilizers has a significant detrimental impact on surface water bodies and groundwater. The Borough should work with the NJDEP to educate residents on these impacts and encourage residents to use techniques to create a "green lawn" without over-fertilizing and/or to convert lawn areas to other kinds of vegetation that do not require fertilization and other chemical treatments. Many lawn services also "overspray" fertilizer onto roadways and adjacent properties. The Borough should investigate methods to minimize the application of fertilizers beyond property lines.

Geese populations can also overtake and contaminate local water bodies. The planting of vegetation around the perimeter of a waterbody is an effective means of deterring geese.

- ***Recommendation C: Seek to ensure the inspection, monitoring, and maintenance of all stormwater management facilities and develop strategies for all existing and future maintenance and improvements.***

Stormwater facilities require regular maintenance to ensure effective and reliable performance. Failure to perform the necessary maintenance can lead to diminished performance, deterioration and failure. In addition, a range of health and safety problems, including mosquito breeding and the potential for drowning, can result from improperly maintained facilities. To minimize these risks, the Borough should implement a procedure for regular inspection, monitoring, and maintenance of Borough owned stormwater facilities.

Additionally, there may be privately maintained stormwater facilities within the Borough. The Borough should work with the various property owners, residents and business owners to identify maintenance and/or improvements needs and develop strategies for regular inspection and maintenance of these facilities.

The Borough should also encourage the use of low impact design methods and non-structural strategies that require less maintenance.

- ***Recommendation D: Evaluate the creation of a regional stormwater management plan for the Bound Brook.***

The Borough receives a portion of its runoff from the Bound Brook watershed. Multiple municipalities in Middlesex and Somerset Counties contribute to this watershed. The Borough should evaluate the need to create a regional stormwater management plan to include all contributing municipalities and create a watershed wide management plan.

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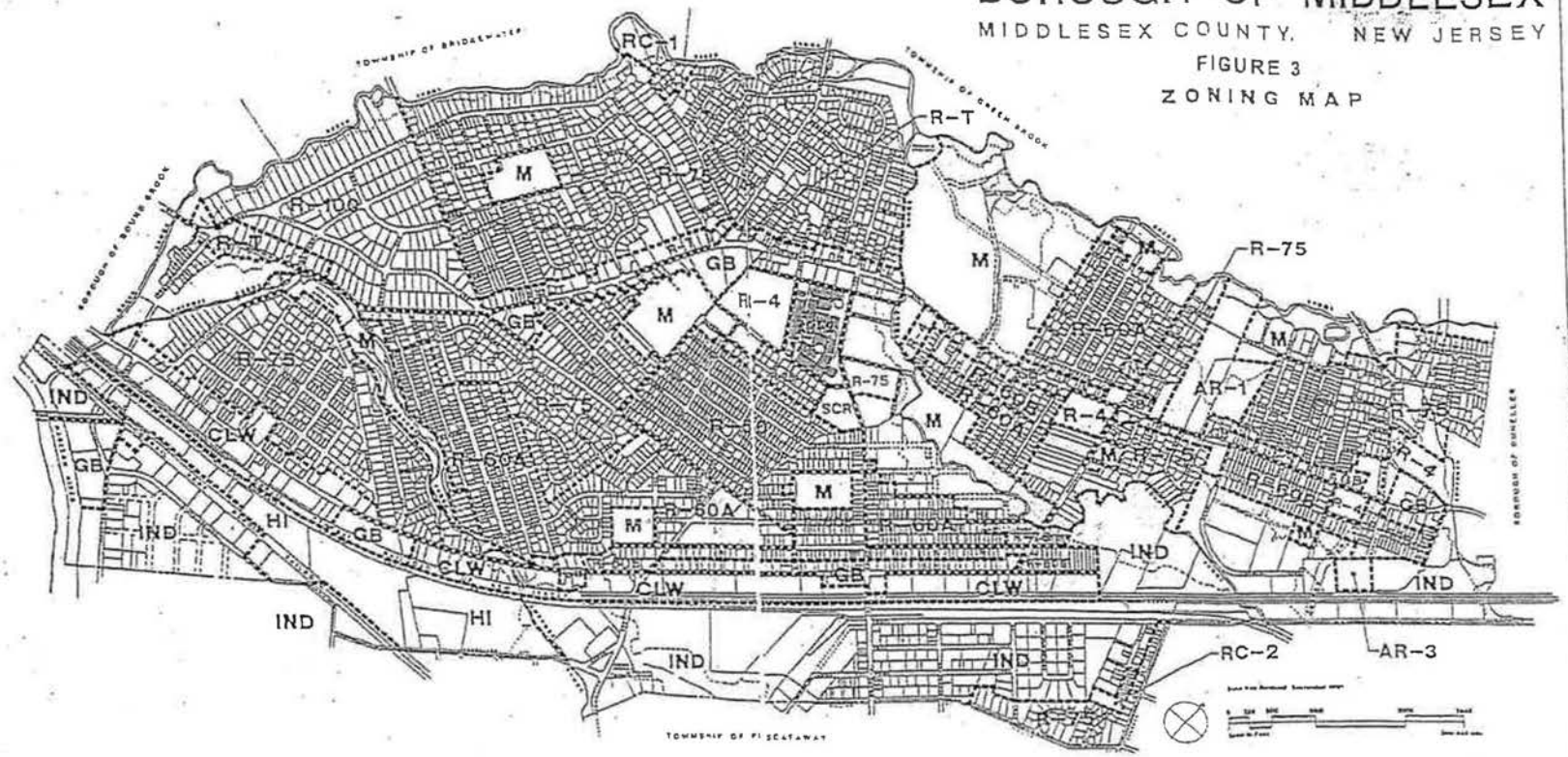
BOROUGH OF MIDDLESEX

MIDDLESEX COUNTY, NEW JERSEY

FIGURE 3

ZONING MAP



ZONING DISTRICTS

R--100	SINGLE FAMILY RESIDENTIAL	AR-1	ATTACHED RESIDENTIAL
R--75	SINGLE FAMILY RESIDENTIAL	AR-2	ATTACHED RESIDENTIAL
R--60A	SINGLE FAMILY RESIDENTIAL	AR-3	ATTACHED RESIDENTIAL
R--60B	SINGLE & TWO FAMILY RESIDENTIAL	SCR	SENIOR CITIZEN RESIDENTIAL
R--50	SINGLE FAMILY RESIDENTIAL	GB	GENERAL BUSINESS
RC--1	SINGLE FAMILY RESIDENTIAL CLUSTER	CLW	COMMERCIAL/LIGHT MANUFACTURING/ WHOLESALE
RC--2	ATTACHED RESIDENTIAL CLUSTER	IND	INDUSTRIAL
R--4	MULTI-FAMILY RESIDENTIAL	HI	HEAVY INDUSTRIAL
R--T	RESIDENTIAL-TRANSTION	M	MUNICIPAL