TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY

Municipal Stormwater Management Plan (MSWMP)

NJPDES #: NJG0148482
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Adopted
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MUNICIPAL STORMWATER MANAGEMENT PLAN (MSWMP)

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Introduction

The Township of Cranbury has prepared this Municipal Stormwater Management Plan (MSWMP) to address development impacts and existing land use impacts on stormwater related water quality, groundwater recharge, and water quantity. The creation and implementation of the Municipal Stormwater Management Plan or MSWMP is required under N.J.A.C. 7:14A-25 Municipal Stormwater Regulation Program, and the MSWMP has been prepared in accordance with the requirements of N.J.A.C. 7:8 Stormwater Management.

The Township of Cranbury through Land Development Ordinances will incorporate design standards and maintenance responsibilities for new development to address soil erosion control, groundwater recharge, stormwater quality, and stormwater quantity impacts. The design and performance standards for new development will preserve water quality and groundwater recharge from stormwater runoff in order to maintain existing aquifers and protect receiving watercourses and bodies of water. The stormwater quantity design standards incorporated by the Township will ensure normal downstream water levels and preserve critical storage volume within the downstream floodplains. The long term maintenance and operation of future stormwater management facilities will be addressed in the Land Development Ordinance of the Township of Cranbury and enforced at the Planning Board and Zoning Board levels.

The MSWMP or Plan describes operation and maintenance measures for existing stormwater management facilities owned and operated by the Township of Cranbury, including the retrofitting of existing inlets to address nonpoint source pollution.

The final section of the Plan describes the requirements for mitigation measures that must be undertaken by developers as a condition for the granting of variances, exemptions, and/or waivers from design and performance standards for stormwater measures in the Land Development Ordinance of the Township of Cranbury.

The MSWMP will be posted on the official website for Cranbury Township at www.cranburytownship.org for general accessibility of the MSWMP, to promote knowledge of the municipality's Stormwater Management Program, and provide the general public an understanding of the appropriate water quality requirements of the National Pollutant Discharge Elimination System Phase II rule of the Federal Clean Water Act and the New Jersey Department of Environmental Protection, Division of Watershed Management, Municipal Stormwater Regulation Program.

Goals

The following is a list of goals to be obtained through the adoption and implementation of the MSWMP:

- Reduction of flood damage to life and property.

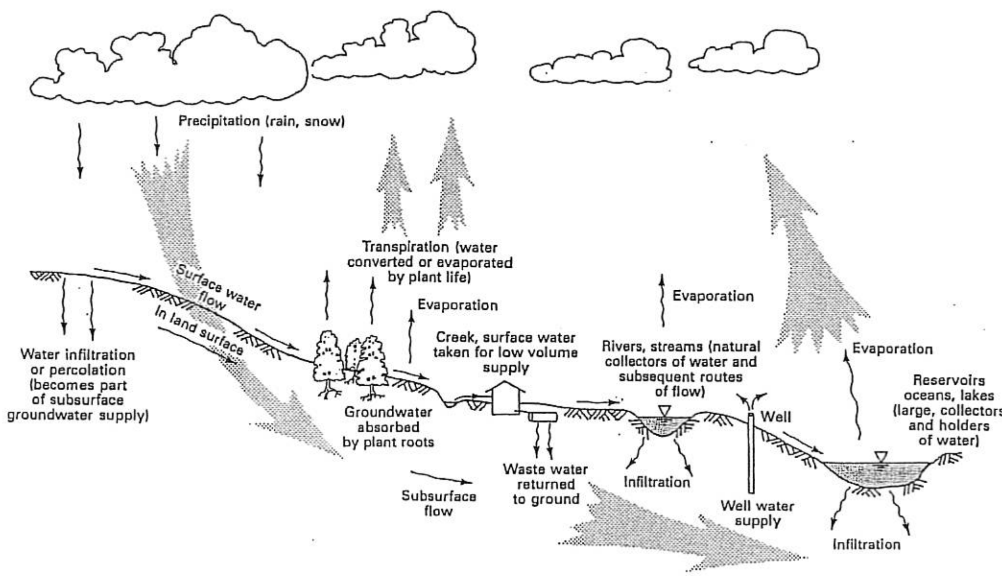
- Minimization of the increase in stormwater runoff volume from new development.
- Reduction of soil erosion and sedimentation of watercourses from development.
- Investigation and determination of the adequacy of existing and proposed culverts and bridges, and other in-stream structures.
- Maintenance of groundwater recharge.
- Prevention of nonpoint source pollution.
- Maintenance of the integrity of stream channels for their biological functions, as well as for drainage.
- Protection of the public safety in regards to stormwater basin facilities.
- Reduction of stormwater pollutants from new and existing development runoff to enhance water quality for protecting biota (fauna and flora of a region), provide for cleaner potable water supplies, and enhance sources of recreational activities.

Instituting design and performance standards for new development, retrofitting existing stormwater management measures, and establishing operational and maintenance standards for existing development will implement the goals of the Plan. The Plan will also establish long-term monitoring procedures for quality control and quality assurance of new and existing stormwater management facilities. Standards for stormwater basins will be described in the MSWMP for the well-being and safety of the general public, including safety ledges for retention basins and elimination of potential mosquito breeding habits for detention basins.

Stormwater Discussion

The hydrologic cycle is the circulation of water at or near the surface of the earth involving precipitation, evaporation, transpiration, infiltration, runoff, groundwater flow, subsurface flow, stream flow, and lake or ocean storage. The development of land within a watershed or basin directly affects and disturbs the balance of the natural hydrologic cycle. A watershed or basin is a region defined by topography or ridgelines that separate drainage of stormwater to specific watercourses and bodies of water.

In the natural hydrologic cycle, moisture enters the atmosphere from water evaporation from runoff, oceans, lakes, and watercourses, including streams, brooks, rivers, runs, etc. Moisture also enters the atmosphere through transpiration from plants, and the combination of the two methods is called evapotranspiration. The moisture returns to earth as precipitation in the form of rain, snow, sleet, hail, frost, and dew. Precipitation that runs off the land's surface, is transmitted to the subsurface, or is captured by impoundments and drainage facilities is defined as stormwater. The water flow on the surface of the ground or in storm sewers, resulting from precipitation, is defined as stormwater runoff. The hydrologic cycle continues with stormwater runoff discharging into bodies of surface water and the infiltration of precipitation into groundwater. The stormwater runoff will feed tributaries of lakes and oceans with natural depressions holding water long enough to infiltrate or recharge the earth's aquifers. Stormwater will also reach watercourses through precipitation seepage of the upper layers of soil above the groundwater table. The movement of storm seepage is also known as subsurface flow. Groundwater flow is the movement of groundwater within an aquifer to channels or watercourses. Groundwater flow takes a considerable amount of time before the water enters a channel or watercourse, but groundwater flow is the major dry-weather water supply for watercourses. This groundwater flow generates the base flow for watercourses. Disruption to water body base flows can result in major negative impacts on biota habitats and wetlands. Plants have root zones where the plants are fed to promote transpiration. The movement of stormwater through groundwater flow, subsurface flow, and runoff supplies water bodies, and with evapotranspiration, the hydrologic cycle continues.



Hydrologic cycle.

Table-1

Source: Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Fourth Edition, David F. McCarthy, P.E.

With development of impervious surfaces, including building roofs, parking lots, roads, sidewalks, and driveways, the hydrologic cycle is interrupted, resulting in the depletion of groundwater recharge and increased stormwater runoff. The plant vegetation is destroyed during development for impervious surfaces and lawn areas, thus reducing evapotranspiration. Typically, new development will consist of a connected system of impervious stormwater conveyance from roof and parking lots to curb gutter lines into solid wall piping that discharges directly to surface water. Without a separation of the impervious surfaces, the precipitation cannot infiltrate the soil to recharge the groundwater supply. The increased volume of precipitation discharged to surface water bodies result in a loss of downstream flood storage volume and increases the potential of property damage and loss of human life in the event of a flood. The connected impervious surfaces from development will create an increase in the flow rate of stormwater due to generally smoother ground surfaces, with a reduction in friction creating an increase in velocity. With an increase in stormwater flow rate and velocity, water quality for lakes, streams, and ponds are affected by turbidity, soil erosion, and sedimentation. Sedimentation of watercourses and water bodies destroy natural habits for biota existing in the riparian corridors. An increase in pathogens and nutrients, including nitrogen and phosphorous, resulting in a decrease in water quality, can arise from fertilization of lawn areas and from an increase in animal waste conveyed to receiving waters by the additional stormwater runoff. The adjacent wetlands and potable water supplies are impacted by the reduced water quality. Vital habits for fauna and flora are depleted causing an imbalance in the natural ecosystem. The fiscal cost for the treatment of water for potable water supply for the local communities will have a direct financial impact on the local residents.

The increased impervious coverage from land development can lead to an increase in pollutants from vehicles, including oils, gas, volatile organic compounds (VOCs), suspended solids, and hydrocarbons, that do not filter through vegetated cover but are conveyed directly to water bodies. Detention basins installed to increase water quality and decrease stormwater flow rates can create additional problems with a thermal increase in water temperature and potential mosquito breeding habitats.

Background

The Township of Cranbury is located in the southwest corner of Middlesex County, New Jersey, and contains ±13.42 square miles within the municipal boundaries. Cranbury Township is bordered by South Brunswick Township to the north, Monroe Township to the east, East Windsor Township to the south, and Plainsboro Township to the west. The adjoining municipality of East Windsor Township is located within Mercer County, New Jersey. The Millstone River serves as a natural, municipal, and county boundary between Cranbury and East Windsor. The Township is a mix of commercial, industrial, residential, and farmland land uses, with the New Jersey Turnpike and New Jersey State Highway U.S. Route 130 both traversing the Township in a north/south direction. Route 130 almost equally divides the Township, with the majority of the land west of Route 130 farmland and residential and land east of Route 130 consisting of industrial, office, research and commercial uses.

The total population of Cranbury Township was 3,227 in 2000, according to the U.S. Bureau of the Census. Table-2 below provides population data for Cranbury Township.

Township of Cranbury			
		Population Change	
Year	Population	Number Change	Percent Change
1950	1,797	---	---
1960	2,001	204	11.35%
1970	2,253	252	12.59%
1980	1,927	-326	-14.47%
1990	2,500	573	29.74%
2000	3,227	727	29.08%

Table-2

Source: U.S. Bureau of the Census, Censuses 1950, 1960, 1970, 1980, 1990, & 2000, and the Cranbury Township Master Plan.

The Township has experienced growth in both industrial/commercial and residential development. The rural farmland on the west side of Route 130 has been for the most part preserved through the Farmland Preservation program. Land development within Cranbury Township has resulted in changes to the watershed with increased stormwater runoff volumes, reduction in groundwater recharge, and pollutant loading.

The watercourses and water bodies within the Township of Cranbury are depicted on Figure-2, and the location of the Township of Cranbury with the municipal boundaries indicated are provided on the United States Geological Survey quadrangle map depicted on Figure-1.

The Township of Cranbury has several watercourses and one major water body. The four larger watercourses in Cranbury include the Millstone River, Cranbury Brook, Cedar Brook, and Shallow Brook; all flow generally from the east toward the west. Cedar Brook has a confluence with Cranbury Brook in the Township along the municipal boundary of Plainsboro Township. A tributary to Cranbury Brook is Horse Run Brook, which flows generally from the north to south, with a confluence within the Township. Shallow Brook flows through the north side of the Township of Cranbury for approximately 0.34 miles adjacent to the Township of South Brunswick. The Millstone River defines the Township's southern municipal boundary line with the Township of East Windsor, and a tributary to the Millstone River is Indian Run, which flows generally from the northeast to the southwest, with a confluence within the Township. Several unnamed tributaries are located within the Township for the Millstone River, Cedar Brook, and Cranbury Brook, inclusive of wetlands. A dam is located on Cranbury Brook within the Cranbury Village (the historic downtown location which is designated with the State of New Jersey as a

Center of Place) under Main Street (Middlesex County Route 614). The dam has created Brainerd Lake, a source of recreation activities adjacent to Village Park.

In accordance with the N.J.A.C. 7:9B, the NJDEP has State surface water classifications for the waterbodies or portions thereof within the Township of Cranbury. Cranbury Brook, Millstone River, Shallow Brook, Cedar Brook, and Brainerd Lake are classified as FW2-NT, an abbreviation for "Fresh Water Category Two – Nontrout Waters". Category Two waters are those waters not designated as Outstanding National Resource Waters or Category One waters, and in all FW2 waters the designated uses are as follows: maintenance, migration and propagation of the natural and established biota; primary and secondary contact recreation; industrial and agricultural water supply; public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and any other reasonable uses.

Cranbury Township is located in the Raritan Basin Watershed and the Millstone Watershed Management Area, which is designated by the New Jersey Department of Environmental Protection (NJDEP) as WMA 10. WMA 10 includes the Millstone River and the tributaries to the Millstone River, including Cranbury Brook, Cedar Brook, and Shallow Brook, which all flow within Cranbury Township. The Millstone River is a tributary of the Raritan River. WMA 10 is approximately 285 square miles with 100% of Cranbury Township located within the Millstone Watershed Management Area. Table-3 represents the land use percentages of the Millstone Watershed Management Area, WMA 10, in 1995.

Millstone Watershed Management Area – WMA 10	
Land Use Percentages in 1995	
Agriculture	24.5%
Barren Land	1.6%
Forest	22.0%
Urban	31.0%
Water	1.1%
Wetlands	19.9%

Table-3

Source: NJDEP, Office of Information Resources Management, Bureau of Geographic and Information Analysis.

The New Jersey Department of Environmental Protection has established the Ambient Biomonitoring Network (AMNET) program to sample benthic macroinvertebrate to evaluate the water quality of New Jersey's watersheds. The benthic macroinvertebrate provide the NJDEP with an excellent indication of water quality for assessing both point and non-point sources of pollution, thermal pollution, dissolved oxygen levels, eutrophication, and excessive sedimentation. Benthic macroinvertebrate are typically found in abundance in all water bodies. There are over 800 AMNET sample sites or stations in New Jersey with 164 AMNET stations in the Raritan Drainage Basin and 37 AMNET sites in WMA 10. Samples are obtained every five years from the AMNET sites by the NJDEP Bureau of Freshwater and Biological Monitoring; samples were taken first in 1993-1994 and again in 1998-1999. The streams with AMNET sampling stations are ranked as non-impaired, moderately impaired, or severely impaired, and the AMNET data is used to generate a New Jersey Impairment Score (NJIS). Table-3 lists the findings of the AMNET program for the WMA 10, including the Millstone River and its tributaries.

Watershed Management Area 10						
Bioassessment Results						
	Rated as Non-impaired	% Non-impaired	Rated as Moderately Impaired	% Moderately Impaired	Rated as Severely Impaired	% Severely Impaired
Sites Surveyed in 1994	4 Sites	11.1%	31 Sites	83.3%	2 Sites	5.6%
Sites Surveyed in 1999	2 Sites	5.4%	30 Sites	81.1%	5 Sites	13.5%

Table-4

Source: Ambient Biomonitoring Network, Watershed Management Areas 7, 8, 9, and 10, Raritan Region, 1999 Benthic Macroinvertebrate Data, New Jersey Department of Environmental Protection, June 2000.

As stated in the Ambient Biomonitoring Network, Raritan Region, NJDEP, June 2000, Report, "In WMA #10, habitat and NJ Impairment Score (NJIS) scores are at sub-optimal and moderately impaired levels, respectively, throughout. A slight upward trend in both parameters is seen from upstream to downstream (north to south in this case); this indicates that stream quality is primarily a function of habitat quality in this area. In the current study, six sites (16% of sites sampled) exhibited significant levels of abnormalities in chironomid larvae. Two of these sites (AN0384 [Bear Brook] and AN0405 [Pike Run]) also had significant levels in 1993/1994. In the current sampling, these were the only two sites in the Raritan Water Region yielding 'chronic' abnormalities."

The following are definitions AMNET classifications:

Non-impaired: benthic community comparable to other undisturbed streams within the region; characterized by a maximum taxa richness, balanced taxa groups, and good representation of intolerant individuals. (NJ Impairment Score: 30-24)

Moderately Impaired: macroinvertebrate richness reduced, in particular EPT taxa; reduced community balance and numbers of intolerant taxa. (NJ Impairment Score: 21-9)

Severely Impaired: benthic community dramatically different from those in less impaired situations; macroinvertebrates dominated by a few taxa, but with many individuals; only tolerant individuals present. (NJ Impairment Score: 0-6)

One AMNET station is within Cranbury Township located along the Millstone River at the Old Trenton Road (Middlesex County Route 535) bridge crossing. The AMNET program designates codes for all sampling stations, and the AMNET code for the Old Trenton Road station is AN0382B. Two AMNET stations are located upstream of Cranbury Township along the Millstone River (AN0378 – Baird Road in Millstone Township, AN0379 – Route 33 in Millstone Township, and AN0382D – Applegarth Road in Monroe Township). One AMNET survey station is located upstream of Cranbury Township along the Cranbury Brook at AMNET site AN0385 at Applegarth Road in Monroe Township. In accordance with the 1994 and 1999 AMNET surveys, site AN0385 along Cranbury Brook in Monroe has received a negative change in classification from Non-impaired to Severely Impaired. Site AN0382B along the Millstone River in Cranbury was classified as Moderately Impaired in 1994 and re-evaluated as Moderately Impaired in 1999 with the NJ Impairment Score maintained for both survey years at 15. Site AN0382B has a Habit Score of Sub-optimal at a value of 120. Based on the upstream AMNET site, the Cranbury Brook within the Township is classified as Severely Impaired with an NJIS of 6 and with a Habitat Score of Sub-optimal at a value of 148. Another AMNET station, site AN0386, is located along Cranbury Brook in Plainsboro Township at Maple Avenue, but due to bridge construction, the site was not sampled in 1999. The AMNET site AN0386 in Plainsboro along Cranbury Brook had a classification of Moderately Impaired with an NJIS of 12.

The sample at site AN0382B (Millstone River at Old Trenton Road) was retrieved on 7-13-99. The deficiency noted for the sample was a paucity or scarcity of clean water organisms. The observations noted on 7-13-99 during the sample retrieval are listed in Table-5.

AMNET Station AN038B2 Observations	
Category	Comments
Streamwater:	Turbid
Stream Flow:	Slow
Stream Width:	14 Feet
Stream Depth:	2 Feet
Stream Substrate:	Mud
Stream Bank Vegetation:	Trees, Shrubs, & Weeds

Stream Bank Stability:	Poor
Canopy:	Mostly Open
General Description:	Forested
Water Color:	Greenish Brown
Biota:	Crayfish & Macrophytes
Water Temperature:	21.1° C
pH:	7.5 SU (Standard Units)
Dissolved Oxygen (DO):	9.8 mg/L
Electrical Conductivity:	238 umhos

Table-5

Source: Ambient Biomonitoring Network, Watershed Management Areas 7, 8, 9, and 10, Raritan Region, 1999 Benthic Macroinvertebrate Data, New Jersey Department of Environmental Protection, June 2000.

The dissolved oxygen (DO) level of 9.8 mg/L obtained at the Old Trenton Road sampling site is adequate to support aquatic life. DO levels below 5.0 mg/L will place aquatic life under stress, and DO levels below 1 – 2 mg/L for duration of a few hours can result in the death of aquatic life. Fish will begin gasping for air at the water surface, a phenomenon called piping, when DO levels begin to drop below 2 mg/L.

In accordance with N.J.A.C. 7:9B-1.14(c), the State has established Surface Water Quality Standards (SWQS), which set forth surface water quality criteria for FW2 waters, including bacterial quality, DO, petroleum hydrocarbons, pH, total phosphorus (TP), radioactivity, suspended solids, total dissolved solids, sulfate, taste and odor producing substances, temperature, toxic substances, and turbidy. Another term associated with the Surface Water Quality Standards is Total Maximum Daily Load (TMDL). TMDL will quantify the amount of pollutant a water body can assimilate without violating the State's SWQS.

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), States were required to prepare and submit to the USEPA a report, the Impaired Waterbodies List, that identifies water bodies that do not meet the SWQS as "Impaired Waters", and the State must establish a TMDL for specific pollutants for the "Impaired Waters". Section 305(b) of the Clean Water Act mandates each State to submit a report, the Water Quality Inventory Report, to the EPA biennially on the quality of the individual State's water bodies. In 2001, the EPA issued guidance to the States to integrate the requirements of Section 303(d) and Section 305(b) into one consolidated report.

The NJDEP has submitted to the EPA the New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report (inclusive of the 303(d) List and 305(b) Report). The Integrated Report identify stations for the sampling the subject water bodies.

The Millstone River was sampled and identified in the Integrated Report. Stations along the Millstone River in Manalapan, Grovers Mills, Weston, Kingston, and Blackwells Mills have sample tests results exceeding the SWQS for total phosphorus (TP). Manalapan is upstream of Cranbury Township, and Grovers Mills, Weston, Kingston, and Blackwells Mills are downstream of Cranbury Township. The Kingston, Weston, and Manalapan stations exceeded the SWQS for pH. The Kingston station on the Millstone River (downstream of Cranbury) had test results for temperature exceeding the SWQS, and the Manalapan station exceeded the SWQS for total suspended solids (TSS).

The Cranbury Brook was also sampled and identified in the Integrated Report. A station near Prospect Plains has produced test results exceeding the SWQS for pH.

The following Table-6 is a summary of Sublist 5 or 303(d) List compiled from the New Jersey Integrated Water Quality Monitoring and Assessment Report for station sample results within Cranbury Township or the closest available relevant data upstream and downstream of water bodies within Cranbury Township.

Data from Sublist 5 of the 2004 Integrated Report with Priority Ranking						
Region	**WMA**	**Station Name / Waterbody**	**Site ID#**	**Impairment**	**Priority**	**Data Source**
Raritan	10	Cranbury Brook near Prospect Plains	01400690	pH	Medium	NJDEP/USGS Data, EWQ
Raritan	10	Cranbury Brook / Monroe	AN0385	Benthic Macroinvertebrates	Low	NJDEP AMNET
Raritan	10	Cranbury Brook at Edgemere Ave in Plainsboro	AN0386	Benthic Macroinvertebrates	Low	NJDEP AMNET
Raritan	10	Millstone River at Applegarth Rd, Monroe	AN0382D	Benthic Macroinvertebrates	Low	NJDEP AMNET
Raritan	10	Millstone River at Rt 33, Millstone	AN0379, AN0378, MB-MILL2	Benthic Macroinvertebrates	Low	NJDEP AMNET, Monmouth County HD
Raritan	10	Millstone River at Rt 535, East Windsor	AN0382B	Benthic Macroinvertebrates	Low	NJDEP AMNET
Raritan	10	Millstone River near Grovers Mills	01400640, 01400650	Arsenic	High	NJDEP/USGS Data, Metal Recon
Raritan	10	Millstone River near Grovers Mills	01400640, 01400650	Phosphorus	Medium	NJDEP/USGS Data, Metal Recon

Raritan	10	Millstone River near Manalapan	01400540, 01400530, 5, 10-MIL-1	Arsenic	High	NJDEP/USGS Data, Monmouth Co HD, Metal Recon
Raritan	10	Millstone River near Manalapan	01400540, 01400530, 5, 10-MIL-1	pH	Medium	NJDEP/USGS Data, Monmouth Co HD, Metal Recon
Raritan	10	Millstone River near Manalapan	01400540, 01400530, 5, 10-MIL-1	Phosphorus	High	NJDEP/USGS Data, Monmouth Co HD, Metal Recon
Raritan	10	Millstone River near Manalapan	01400540, 01400530, 5, 10-MIL-1	Total Suspended Solids	Medium	NJDEP/USGS Data, Monmouth Co HD, Metal Recon
Raritan	10	Millstone River, Rte 1, Plainsboro	10-MIL-7	Arsenic	High	NJDEP Metal Recon

Table-6

Source: New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report (inclusive of the 303(d) List and 305(b) Report).

Arsenic impairment in the Millstone River has a priority level of high. The Land Development Ordinance for the Township of Cranbury has standards for soil disturbance, including the exportation and importation of earthen fill. The Cranbury Township Planning Board has been establishing conditional approvals for the importing of fill material, enforcing the import of clean material through soil testing with NJDEP Direct Contact Soil Cleanup Criteria for priority pollutants (PP+40), including arsenic.

The Integrated Report states that the stations along the Millstone River at Grovers Mills and Manalapan will establish a TMDL for total phosphorus by 2006. The Integrated Report also states that the Millstone River (Grovers Mills and Manalapan stations) and Cranbury Brook (Prospect Plains station) have been de-listed from Sublist 5 for the fecal coliform parameter due to compliance with the TMDL.

Several roadway/bridge crossings of water bodies for the existing circulation system are located within the Township of Cranbury. The majority of existing culverts have been designed to convey stormwater volumes for storm events with characteristics reflective of the Township's land use prior to substantial land development. With the Township undergoing substantial land development, the culverts may experience problems conveying certain storm events, which in the past were not generating a flooding condition. Increased impervious coverage upstream of the culverts has increased the volume of stormwater runoff that must be conveyed by the culverts, and subsequently, a ponding condition at the upstream end of a culvert will create a rise in the upstream water level. Any increase in a watercourse's water level will reduce the flood storage volume historically available to impound floodwaters. Land development will also create soil erosion and sediment runoff into receiving water bodies. Sedimentation of water bodies not only destroys biota habitats, but sedimentation also reduces the historic flood storage volume.

Drainage problems exist at certain culvert locations in the Township due to undersized culverts, which is a result of increase stormwater runoff and sedimentation of the culvert and streambed. The culvert located under Petty Road for Cedar Brook creates an occasional flooding problem during severe storm events. A culvert located under Dey Road for a tributary to Cedar Brook also experiences problems during certain storm events. The Township is within the Delaware and Raritan Canal Commission review zone for major development, and as an approval condition from the Commission, many sites developed along the riparian corridors in the Township have filed conservation easements to maintain the existing riparian corridors and minimize disturbance.

The Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Rate Maps (FIRMs) for the Township of Cranbury are included in Appendix B of the MSWMP. Specific areas that experience frequent flooding problems can be recorded on the FIRMs along with any pertinent historical data and field findings.

Groundwater recharge replenishes aquifers and potable water supplies, and the groundwater recharge areas in the Township of Cranbury are reflected on Figure-3. Wellhead protection areas for the conservation of potable public water supply, as shown on Figure-4, has been included as part of the MSWMP.

Design and Performance Standards

The Township of Cranbury will adopt amended stormwater design and performance standards in accordance with N.J.A.C. 7:8-5. The current Land Development Ordinance of the Township of Cranbury entails stringent requirements that address stormwater quantity, water quality, and basin facility safety. The Township will amend the current stormwater design and performance standards to address groundwater recharge, maintenance of stormwater measures, and implementation of non-structural Best Management Practices. The stormwater facility maintenance standards will be in accordance N.J.A.C. 7:8-5.8, and the Township's amended stormwater standards for basin safety standards will comply with N.J.A.C. 7:8-6.

Currently, and in the future, inspectors for the Township Engineer's office will observe construction activities by land developers to ensure compliance with the Cranbury Township Planning Board and Zoning Board approved plans, which have been reviewed and approved by the Township Engineer's office for compliance with the Township's standards.

Plan Consistency

The Raritan Basin Regional Stormwater Management Planning Area encompasses WMAs 7, 8, 9, and 10, including the Township of Cranbury. The Regional Stormwater Management Plan Advisory Committee is currently preparing a Regional Stormwater Management Plan for the Devil's Brook, Shallow Brook, Cedar Brook, and Cranbury Brook Watersheds. The Cranbury MSWMP will be updated, if necessary, to maintain consistency with the Regional Stormwater Management Plan.

The Regional Stormwater Management Plan will include a Quality Assurance Project Plan (QAPP) that monitors water quality through sampling and testing for nonpoint source related pollution. The proposed testing for QAPP consists of quarterly grab samples of surface water and laboratory analysis for water quality. The sample locations for the Regional Stormwater Management Plan's QAPP are proposed at four locations within the study area. The first location will be on Devil's Brook just upstream of Walker Gordon Pond in Plainsboro Township. The second location will be on Shallow Brook at Scotts Corner Road on the South Brunswick Township and Plainsboro Township municipal boundary line. The third location will be on Cedar Brook at Petty Road on the Cranbury Township and Plainsboro Township municipal boundary line, and the fourth location will be on Cranbury Brook just upstream of Plainsboro Pond in the Township of Plainsboro.

In addition to the QAPP, the Regional Stormwater Management Plan will address future build-out with long- term pollution load projections and flood studies. The results of the stream hydraulic analysis and stormwater load analysis will be summarized in a Watershed Characterization Report. The proposed Watershed Characterization Report will provide an estimate of the current status of the Devil's Brook, Shallow Brook, Cedar Brook, and Cranbury Brook watersheds with regard to hydrology and water quality.

The Township of Cranbury is within the Freehold Soil Conservation District's (FSCD) review and enforcement jurisdiction. Land development must comply with the FSCD Soil Erosion and Sediment Control Plan Certification. The Township Engineer, currently and in the future, notifies the Freehold Soil Conservation District of any deficiency or violation of the developer's Soil Erosion and Sediment Control Plan Certification.

Nonstructural Stormwater Management Strategies

The current Land Development Ordinance of the Township of Cranbury will be reviewed and amended to incorporate nonstructural stormwater management strategies for future development impact remediation. The implementation of nonstructural stormwater management measures will contribute to Low Impact Development (LID) resulting in the treatment of development impacts closer to the source rather than at a collective location near the on-site discharge point. The treatment of stormwater runoff with Low Impact Development will reduce the overall impact from land development, assist in controlling an increase in water quantity, increase water quality, and promote the recharge of groundwater aquifers.

LID not only emphasizes the use of nonstructural stormwater management strategies, but LID protects the subject sites' resources through sound site planning to preserve important on-site resources, disconnect impervious surfaces, flatten proposed slopes, utilize natural vegetation for landscaping, reduce the amount of turf grass coverage, and maintain natural drainage features and characteristics. Sound site planning with nonstructural measures for land development is referred to as nonstructural LID-BMP's. The following is a list of nonstructural LID-BMP's:

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 low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.
8. Provide vegetated open-channel conveyance system discharge into and through stable vegetated areas.
9. Provide preventative source controls.

As a summary of the above listed nonstructural LID-BMP's, four (4) categories can be grouped as follows: 1. Vegetation and Landscaping; 2. Minimization of Site Disturbance; 3. Impervious Coverage Management; and 4. Pre-development Time of Concentration Preservation.

1. Vegetation and Landscaping

Preservation of Natural Areas. With the preservation of existing site vegetation, the stormwater runoff quantity and peak flow rates can be reduced through infiltration, surface storage, an increase in the time of concentration, and evapotranspiration. The vegetated areas can promote groundwater recharge through infiltration, and on-site stormwater runoff filtering across existing vegetation will improve water quality with the removal of total suspended solids and pollutants, including hydrocarbons, heavy metals, and nutrients. The mechanisms for pollutant removal include sedimentation, filtration, absorption, infiltration, biological uptake, and microbacterial activity.

The preservation of existing vegetation and the implementation of proposed natural local vegetation can significantly reduce the impacts of land development on downstream receiving waterbodies. As previously stated, the pervious vegetated areas can reduce runoff volumes and peak flow rates through infiltration, surface storage, evapotranspiration, and increasing the stormwater flow path resulting in an increased time of concentration and reduced rainfall intensity.

Existing vegetated areas with areas of great importance (i.e. riparian corridors, floodplains, well head recharge areas, old growth woodlands, etc.) should be incorporated into land development planning and preserved within conservation easements and/or deed restrictions for future preservation and notification of potential future property owners.

Native Ground Cover. As indicated in the NJDEP New Jersey Stormwater Best Management Practices Manual, the typical ground cover after land development is turf grass, which generates more surface water runoff than other types of vegetative ground cover. The post-development condition for a site stabilized with turf grass as compared with the pre-development condition of the subject site's wooded or forest habitats will experience a substantial increase in the rate of stormwater runoff. As a goal of LID-BMP's, the use of native plants should be proposed for re-vegetation of a developed site.

The use of native vegetation will also result in decreased maintenance including the reduction of fertilizers, reduction in pesticide applications, and reduction of irrigation. Planting native trees and large shrubs in lieu of turf grass will create shade and wind protection resulting in the conservation of energy for the on-site facilities. Cost savings are not the only benefit of proposing native flora for land development projects: the natural community will benefit from the provided on-site habitats and improved quality of downstream habitats.

For project sites with agricultural pre-developed existing conditions, the re-vegetating of the project site with natural flora will greatly improve the water quality and water quantity of the post-construction conditions. The downstream receiving waterbodies will experience a net reduction of fertilizers, nutrients, and sedimentation conveyed from runoff. The native vegetation re-introduced onto a developed cultivated field will reduce water quantity and velocity for stormwater runoff with an increase in the time of concentration. Land containing native vegetation will impound runoff, infiltrate the stormwater, and recharge local aquifers, whereas land cultivated for agriculture will have a greater volume of runoff. Land development can compensate for proposed impervious coverage with native vegetated areas.

Vegetative Filters and Buffers. Both turf grass and native ground cover can provide a vegetated buffer to assist with filtration of pollutants from stormwater runoff, infiltration to promote aquifer recharge, and the removal of total suspended solids. The most effective LID-BMP for vegetative filters incorporates dense ground cover and flat ground slopes resulting in increased flow paths of stormwater runoff. An increased flow path or time of concentration will allow the stormwater to infiltrate the soil and reduce the overall rainfall intensity for the subject site.

The vegetative filter and buffer are methods to disconnect impervious surfaces such as sidewalks, driveways, parking lots, and building entrances. Applying vegetative buffers downstream of an impervious surface will address the site's water quality and quantity requirements closer to the source as a supplemental treatment measure to any on-site downstream impoundment facility. Disconnecting impervious coverage surfaces will accomplish a reduction in the velocity of the stormwater runoff. This is desirable because increase in the post-development condition's velocity contributes to downstream erosion, an increased time of concentration with an associated increased rainfall intensity (stormwater quantity), and the potential for conveyance of pollutants to receiving waterbodies.

2. Minimizing Land Disturbance

The non-structural LID-BMP of minimizing land disturbance can be implemented throughout the project phase. The goal of the non-structural LID-BMP of minimizing land disturbance is to fit the proposed development into the subject site's existing topography, as opposed to altering the existing topography to meet the needs of the proposed development. A land development project cane be planned to minimize land disturbance through a reduction in the limits of clearing, by reducing grading, and by reducing environmental impacts such as filling of wetlands and encroachments of wetland buffers.

An evaluation of the on-site soil classifications will identify the areas with limited ability for infiltration and high potential of erodibility, and a design using LID-BMP's will attempt to develop the areas of the site with hydrological soil groups with low permeability rates. By developing the site's poorer hydrological soil groups with impervious coverage, the remaining portion of the site containing a greater permeability rate will generate greater recharge, filter larger volumes of stormwater prior to the final structural measure, and reduce the overall volume of stormwater to be attenuated on-site.

By reducing the proposed limits of clearing for land development, the on-site soil compaction will also be reduced. The compaction of the on-site soils will lower the soil permeability rate, reduce infiltration, and increase stormwater quantity.

Any major development will require the procurement of a Soil Erosion and Sediment Control Certification from the local Soil Conservation District. Land development performed under a Soil Erosion and Sediment Control Certification will implement the Standards for Soil Erosion and Sediment Control in New Jersey, including protection of receiving waters before construction starts, maintaining soil erosion control measures during the construction phase, and requiring the site to be permanently stabilized prior to final completion.

3. Impervious Coverage Management

As mentioned in the NJDEP BMP Manual, studies have shown that impervious coverage in a watershed is a negative indicator of the health of a waterbody: low water quality is correlated with high impervious coverage within a watershed. Large impervious areas within a watershed have been linked in studies to the direct degradation of water quality, especially in watershed areas with impervious coverage directly adjacent to the downstream receiving waterbodies. Impervious areas accumulate pollutants, which can be conveyed to the waterbody via stormwater runoff and affect the downstream water quality.

With the use of vegetative filters and buffers to disconnect the links of impervious coverage, the negative impacts of impervious areas can be greatly reduced. With the reduction of a developed site's impervious area, the translation of said reduction can be seen in greater infiltration into the aquifers, reductions in the runoff quantity, an increase in the runoff quality, reduced runoff peak flow rates, reduced velocities, decreased costs of storm sewer construction, and a reduction in long term maintenance and repair costs for the developer.

Some considerations for reducing impervious coverage of a developed site include: reducing the quantity of unnecessary parking spaces, land bank future parking spaces until the need requires further development, utilizing pervious pavements or pervious parking pavers, establishing vegetation within cul-de-sac bulbs, medians, and islands, implementation of pervious pavement sidewalks, or designing with innovative green roofs or vegetated roof systems.

4. Pre-development Time of Concentration Preservation

The time of concentration (Tc) is defined as "the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed." Fluctuations in peak flow rates are a direct result of changes in the time of concentration. An increase in the site's peak flow rate for stormwater runoff is a result of a decrease in the time of concentration. With higher roughness coefficients (indicating a rougher surface) and/or a decrease in slope gradients, the time of concentration is increased. Roughness coefficients are a reflection of the runoff surface and the ability of the surface to retard flow. The development of a site with impervious coverage will create a condition with an effect on flow velocity that is less retardant to flow.

An increase in the surface slope gradients of the site due to earthwork or grading activities will also decrease the Tc. Preserving the natural drainage pattern slope gradients in conjunction with maintaining the pre-development surface roughness characteristics can minimize the land development impacts on stormwater runoff and the downstream waterbodies.

The flow path and time of concentration for a subject site dictates the site's runoff characteristics. With the LID-BMP's, a decrease in the Tc for the post-development condition can be minimized, and the subject site's pre-development Tc can be preserved.

The four categories of nonstructural stormwater management strategies, discussed above, were partially codified in the current Land Development Ordinance of the Township of Cranbury, and additional LID-BMP's have been incorporated into the Amended Land Development Ordinance of the Township of Cranbury. The following is a description of current and proposed amended ordinance sections for the applicable LID-BMP's:

Section 150-41.C of the Cranbury Township Ordinance requires an applicant to describe the existing conditions of the subject parcel, including hedgerows, woodland areas, unique vegetation, topography, streams, ponds, and vistas. The section also requires the applicant to minimize site disturbance, minimize soil export and import, maintain natural land features, and establish conservation easements to preserve critical areas. The above referenced section applies to the entire Township regardless of the Zoning District.

Section 150-41.D requires an applicant to integrate natural features into the subdivision and site plans for the A-100, RLD-1, RLD-3, R-LI, and V/HR Zone Districts.

Section 150-41.E describes lot averaging design standards for the A-100 Zone. Lot averaging design standards preserve open space areas through permanent deed restrictions for environmentally sensitive areas, scenic viewsheds, and open space areas. The design standards provide buffers between the proposed buildings and streets.

Section 150-43.B. describes the parking area design standards and parking area layout. *This section will be amended to include mandatory vegetative filters and buffers for parking layout, including sidewalks, to disconnect the flow of runoff over impervious surfaces.*

Section 140-43.B.(2).(d) describes the requirement for landscaped dividers and islands within curbed parking areas. *This section will be amended to allow for flush curbs with wheel stops to encourage developers to allow for the discharge of impervious areas into landscaped areas for stormwater management.*

Section 150-43.B.(2).(g) requires a site to provide pedestrian walkways throughout a parking lot with a capacity of 40 or more spaces, and *this section will be amended to require pervious materials for walkways as the design standard to minimize stormwater runoff.*

Section 150-43.B.(5) describes the construction standards for parking lots. *This section will be amended to require pervious paving materials over a ¾" clean stone base course in lieu of bituminous concrete to minimize stormwater runoff, increase water quality, and promote infiltration and groundwater recharge.*

Section 150-44 details the design standards for driveways. *The section will be amended to include standards for pervious paving materials for major site plans as a stormwater management measure for non-point source pollution, stormwater runoff reduction, and infiltration measure for groundwater recharge.*

Section 150-45.B.(7) of the Land Development Ordinance requires landscaped islands in the center of cul-de-sacs. *This section will be amended to allow for flush* *curbs to encourage developers to allow for the discharge of impervious areas into landscaped areas for stormwater management.*

Section 150-56 provides the design standards for landscaping. *This section will be amended to include standards listed in category 1. Vegetation and Landscaping listed above.*

Section 150-61 details the design standards for stormwater management. This section has been amended to incorporate nonstructural stormwater management measures, recharge aquifers, and improve water quality.

Section 150-58 of the Land Development Ordinance details the purpose, intent, and regulations for conservation easements.

The Amended Land Development Ordinance will include specific requirements and standards for the implementation of nonstructural stormwater management via Low Impact Development – Best Management Practices to reduce stormwater runoff quantity, increase water quality, and promote groundwater recharge.

Land Use and Build-Out Analysis

The Township of Cranbury contains less than one square mile of vacant and agricultural land, and therefore, the municipality did not complete a build-out analysis.

Mitigation Plans

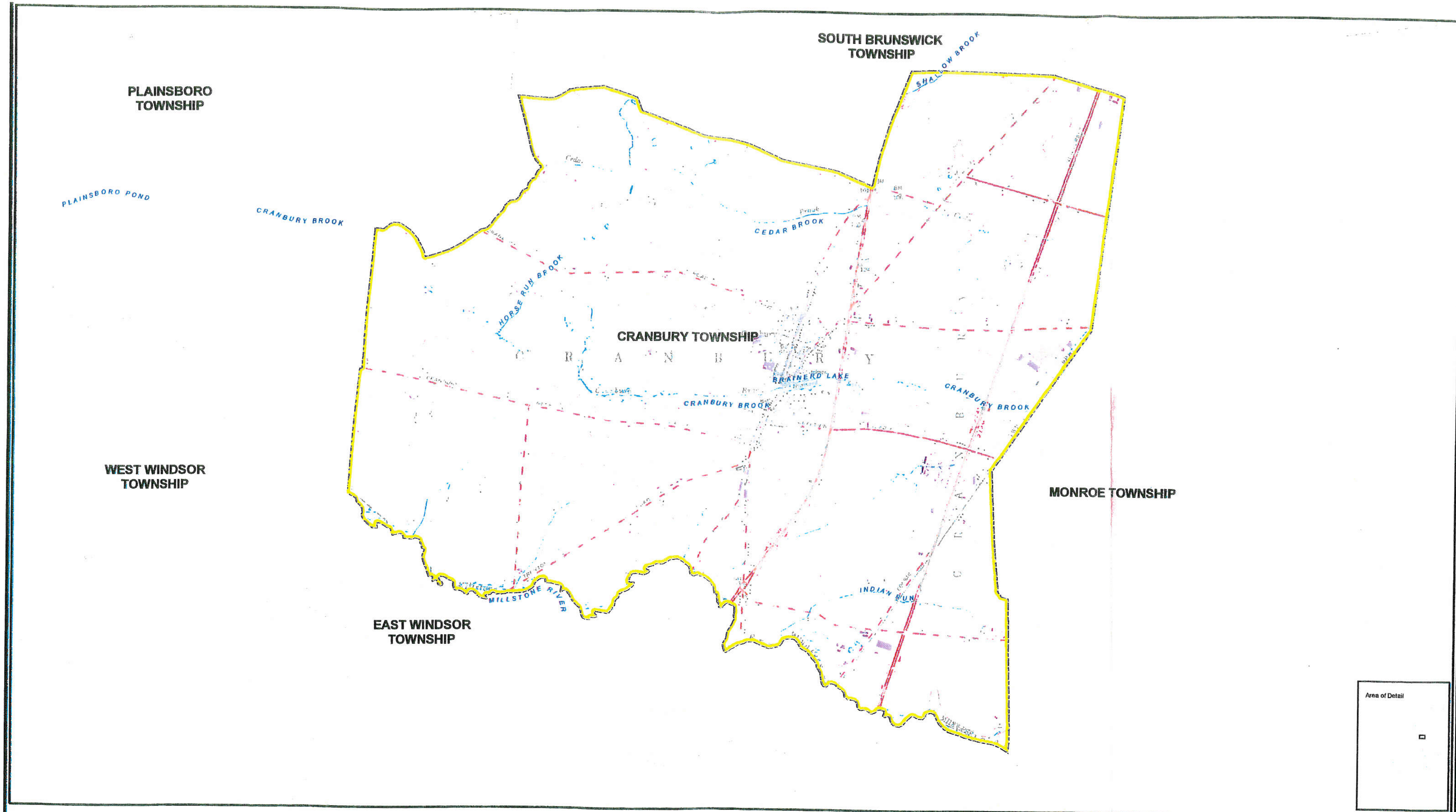
Any developer requesting a waiver, variance, or exemption from the design and performance standards of N.J.A.C. 7:8-5 or of Section 150-61 of the Cranbury Township Ordinance must propose specific mitigation measures to offset the deficit created by granting the waiver, variance, or exemption. The proposed mitigation must apply to the specific project site drainage area for which the waiver, variance, or exemption is requested. A mitigation measure for the performance standards from which the waiver, variance, or exemption is requested should be applied as mitigation for the immediate areas downstream or upstream of the project site. The Cranbury Township Planning and Zoning Boards must, through their review and approval process, ensure that any waivers, variances, or exemptions granted are suitably mitigated according to these principles.

The application of mitigation actions at off-site locations beyond the drainage area of the project site, for which the waiver, variance, or exemption was granted, must also comply with the Regional Stormwater Management Plan for the Raritan Basin Regional Stormwater Management Planning Area.

The applicant's engineer of record, who must be licensed in the State of New Jersey, must provide scientific and engineering evidence and support for the request for a specific waiver, variance, or exemption from N.J.A.C. 7:8-5. The engineer of record must also provide a mitigation plan specifying the mitigation measures with supporting scientific and engineering calculations, specifications, and drawing details, and all else necessary as required by the Cranbury Township Planning and Zoning Boards, to offset the requested waiver, variance, or exemption. The Cranbury Township Planning Board and/or Zoning Board may request additional information, calculations, or documentation from the applicant to further review the applicant's request for mitigation and mitigation plans. Mitigation measures shall be in accordance with the standards of the Cranbury Township Ordinance, N.J.A.C. 7:8-5, the NJDEP New Jersey Stormwater Best Management Practices Manual, and the Regional Stormwater Management Plan for the Raritan Basin Regional Stormwater Management Planning Area.

APPENDIX

A



Legend

Municipal Boundary

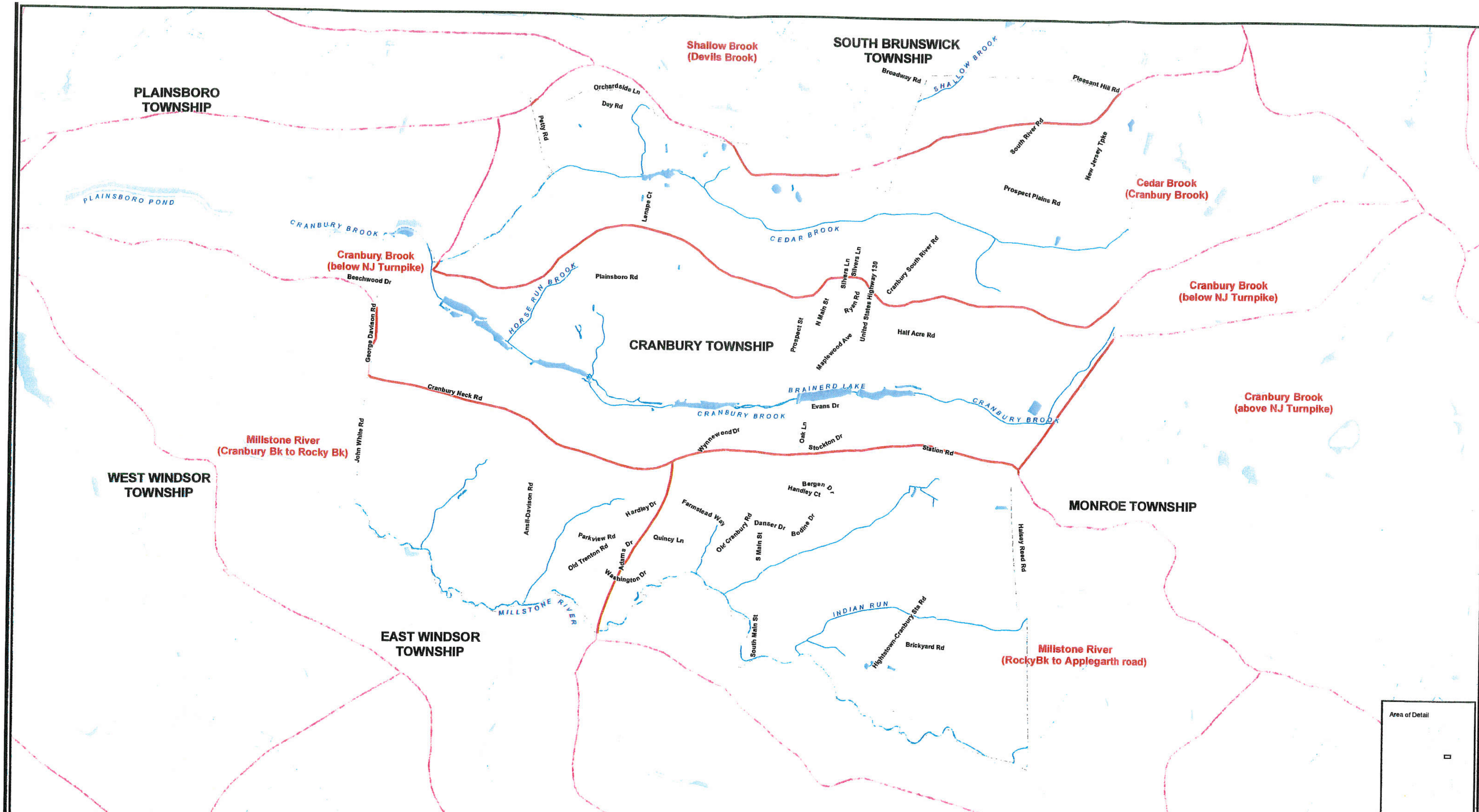
0 3,000 6,000 Feet

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.

Hatch Mott MacDonald
27 Bleeker Street
Millburn, New Jersey 07041

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 1 - MUNICIPAL BOUNDARY

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		05/31/2005



Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Watershed Boundary (HUC14)
- Municipal Boundary

0 3,000 6,000 Feet

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.

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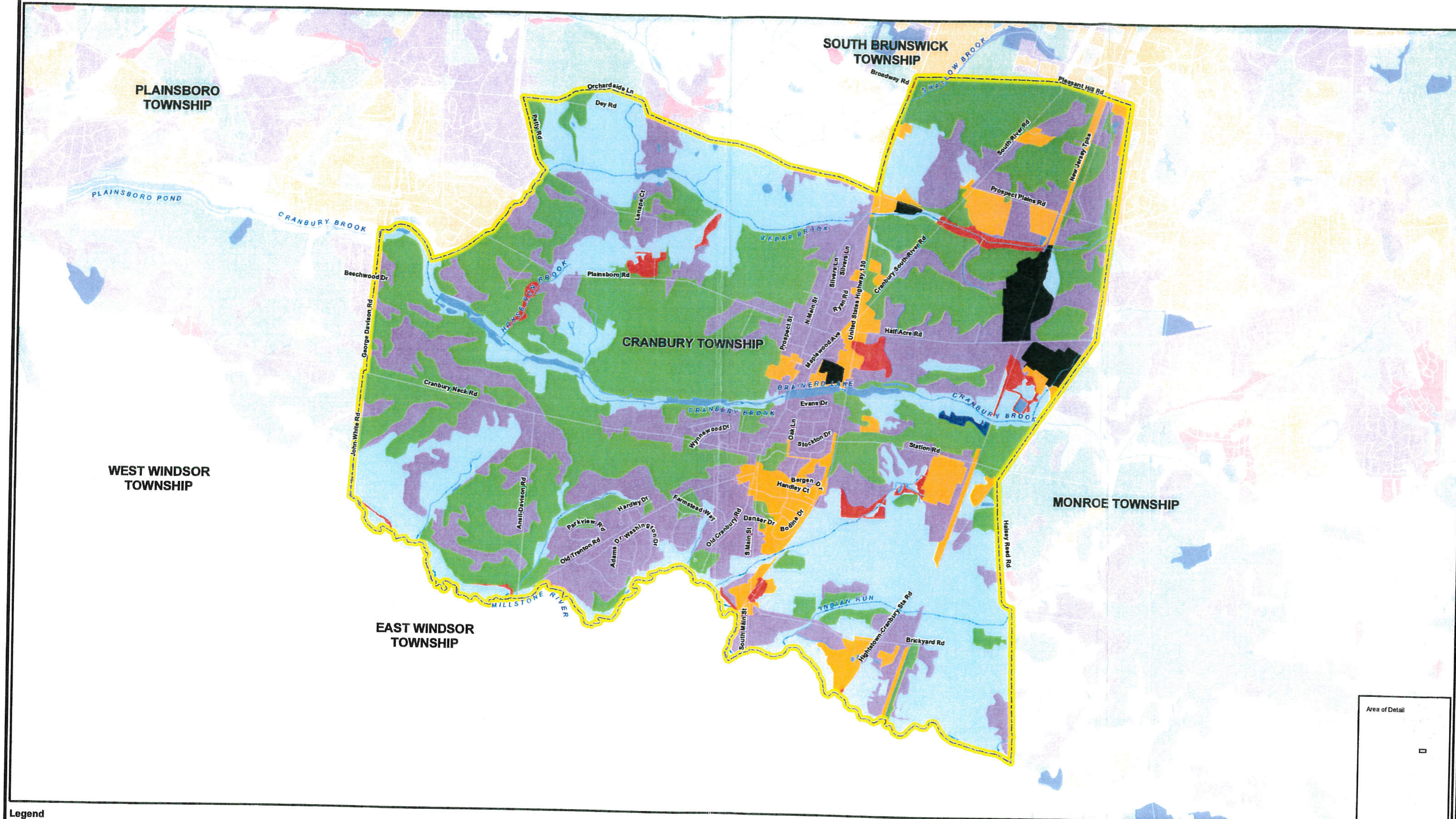
TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 2 - MUNICIPAL WATER BODIES

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		02/16/2005



Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Municipal Boundary

Groundwater Recharge Rates *

- 15 to 17 in/yr
- 12 to 14 in/yr
- 9 to 11 in/yr
- 1 to 8 in/yr
- 0 in/yr
- Hydric Soils
- Wetlands and Open Water
- No Recharge Calculated

* Groundwater Recharge Rates provided from New Jersey Geologic Survey (DGS02-3: Ground-Water Recharge for New Jersey).
Recharge rates are based on soil survey delineations, as a result discrepancies exist between areas mapped as wetlands on Figure 8.

0 3,000 6,000 Feet

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TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 3 - GROUNDWATER RECHARGE AREAS

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		05/31/2005

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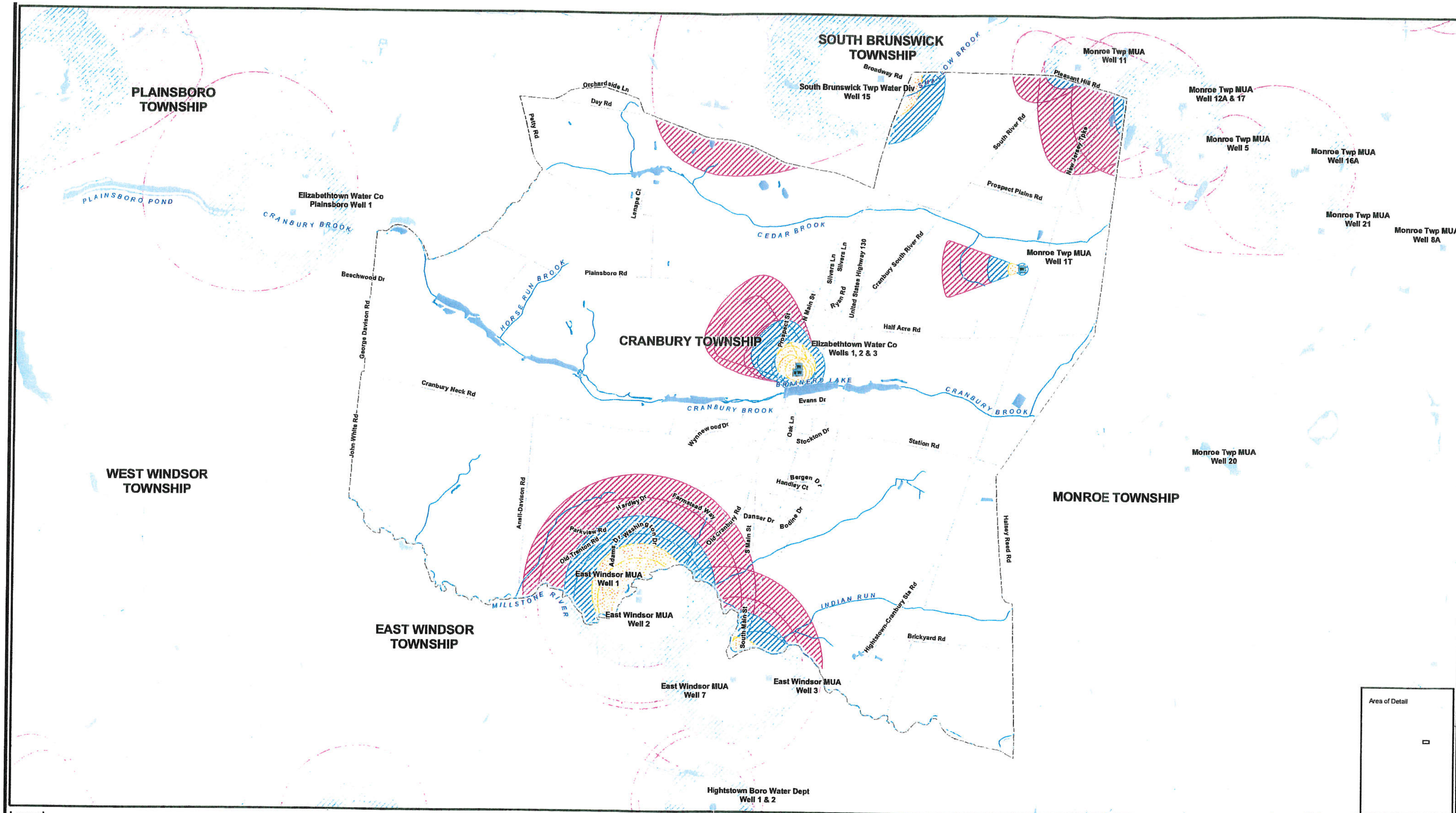

Legend

- Public Community Supply Well
- Road
- Rivers & Streams
- Lakes & Ponds
- Municipal Boundary

Well Head Protection Area

- 2 Year Time of Travel
- 5 year Time of Travel
- 12 Year Time of Travel

0 3,000 6,000 Feet

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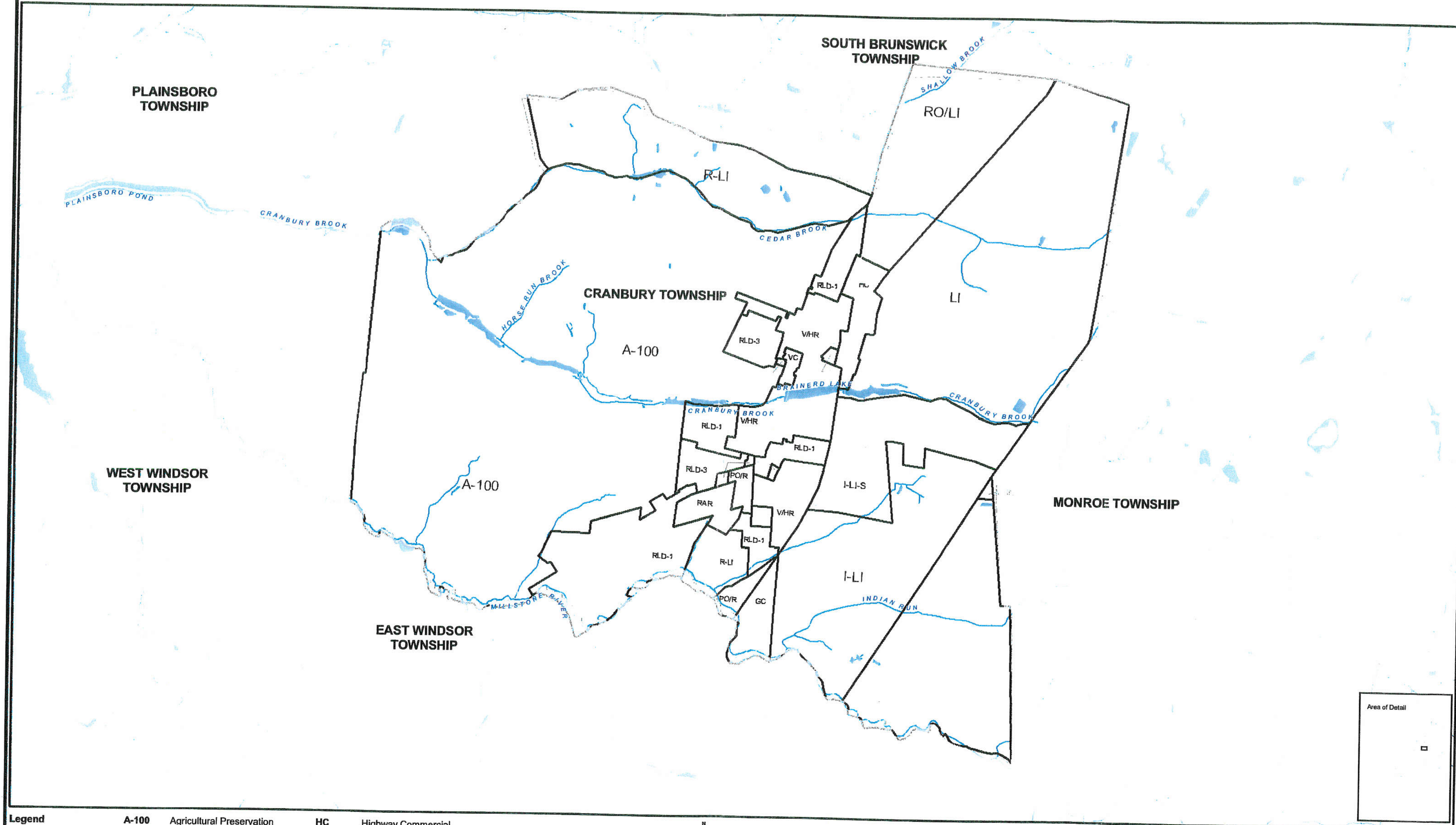
TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 4 - PUBLIC COMMUNITY SUPPLY WELLHEAD PROTECTION AREAS

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		02/16/2005



Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Zoning Boundary
- Municipal Boundary

A-100	Agricultural Preservation	HC	Highway Commercial
R-LI	Residential - Light Impact	GC	General Commercial
RLD-1	Residential - Low Density (1)	RO/LI	Research Office & Light Industrial
RLD-3	Residential - Low Density (3)	I-LI	Light Impact Industrial
R-ML	Residential - Mt. Laurel	LI	Light Industrial
V/HR	Village / Hamlet Residential	R-AH	Residential - Affordable Housing
VC	Village Commercial	RAR	Residential - Age Restricted
PO/R	Professional Office / Residential	I-LI-S	Light Impact Industrial - Sewer Area

0 3,000 6,000 Feet

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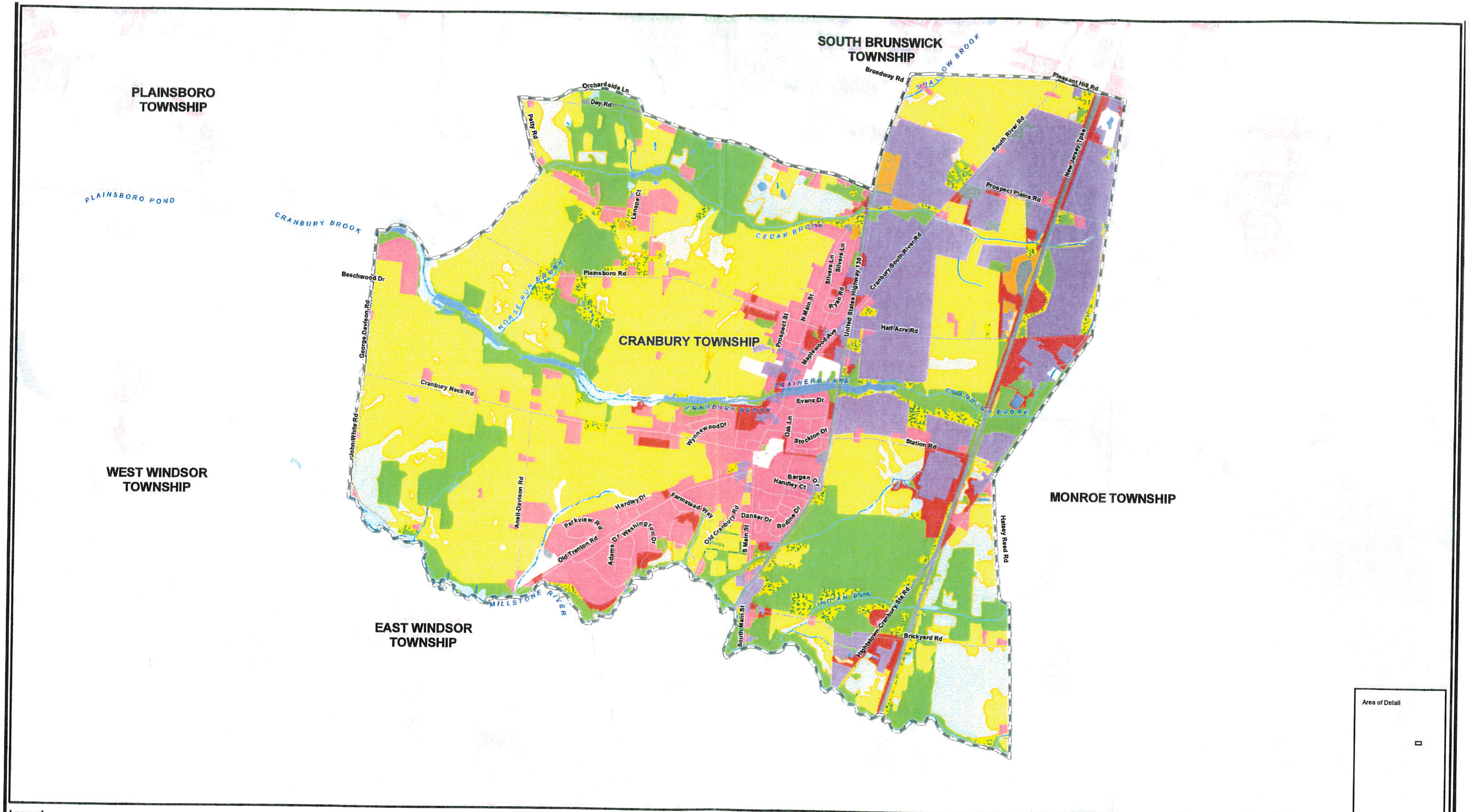
Millburn, New Jersey 07041

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 5 - ZONING

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		02/16/2005

P:\219182\GIS\Projects\Figure5_Zoning.mxd



Legend

Road
Rivers & Streams
Lakes & Ponds
Municipal Boundary

Land Cover / Land Use

Residential
Commercial/Industrial
Transportation/Communications/Utilities
Mixed Urban
Recreational Land
Agriculture
Forest
Brush/Shrubland
Open Water
Wooded Wetland
Herbaceous Wetland
Modified Wetlands
Barren Lands

0 3,000 6,000 Feet

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.

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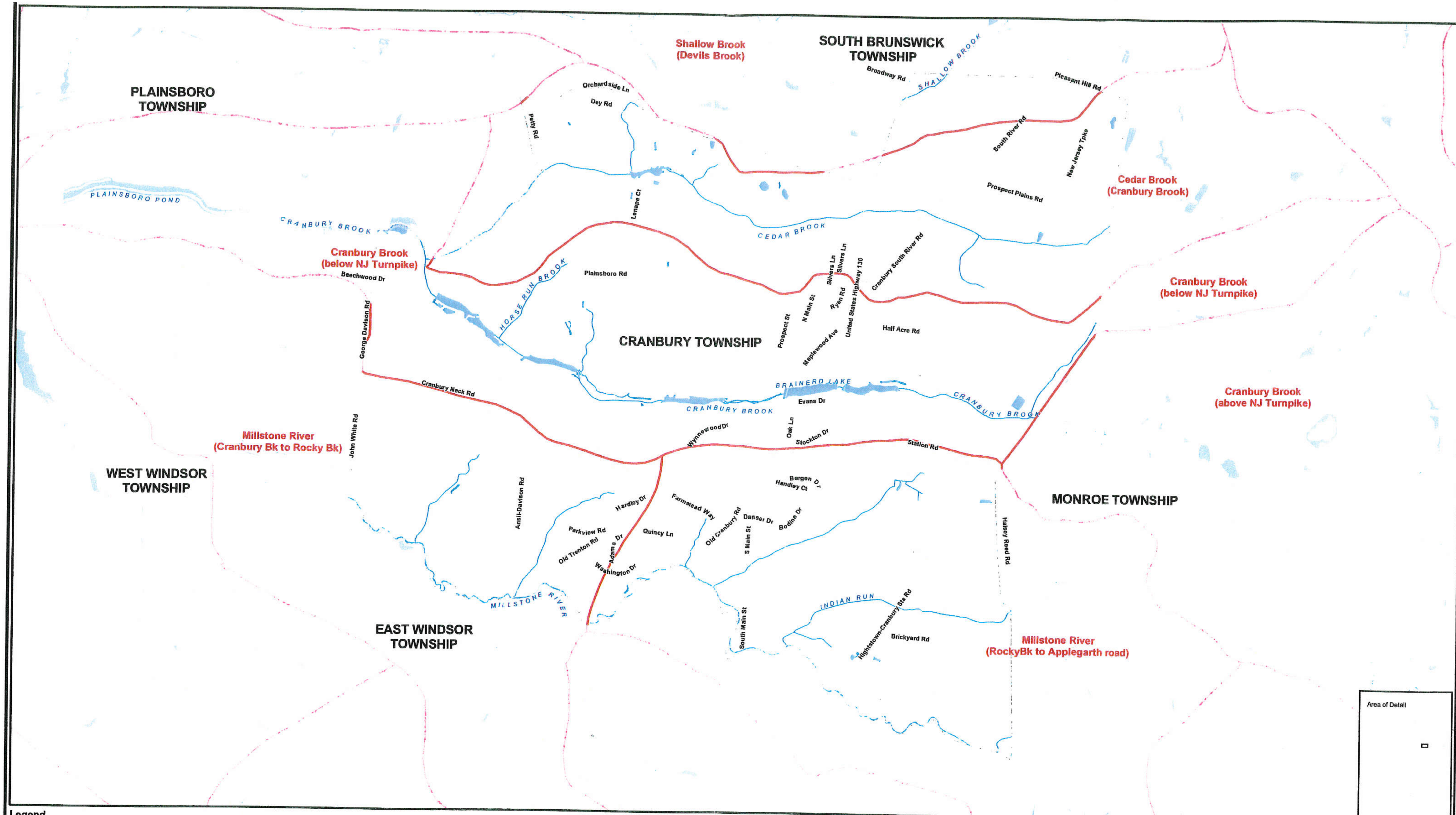
TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 6 - EXISTING LAND COVER / LAND USE (1995)

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		05/31/2005



Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Watershed Boundary (HUC14)
- Municipal Boundary

N W E S

0 3,000 6,000 Feet

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.

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Millburn, New Jersey 07041

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 7 - HUC14 SUB-WATERSHEDS

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		02/16/2005

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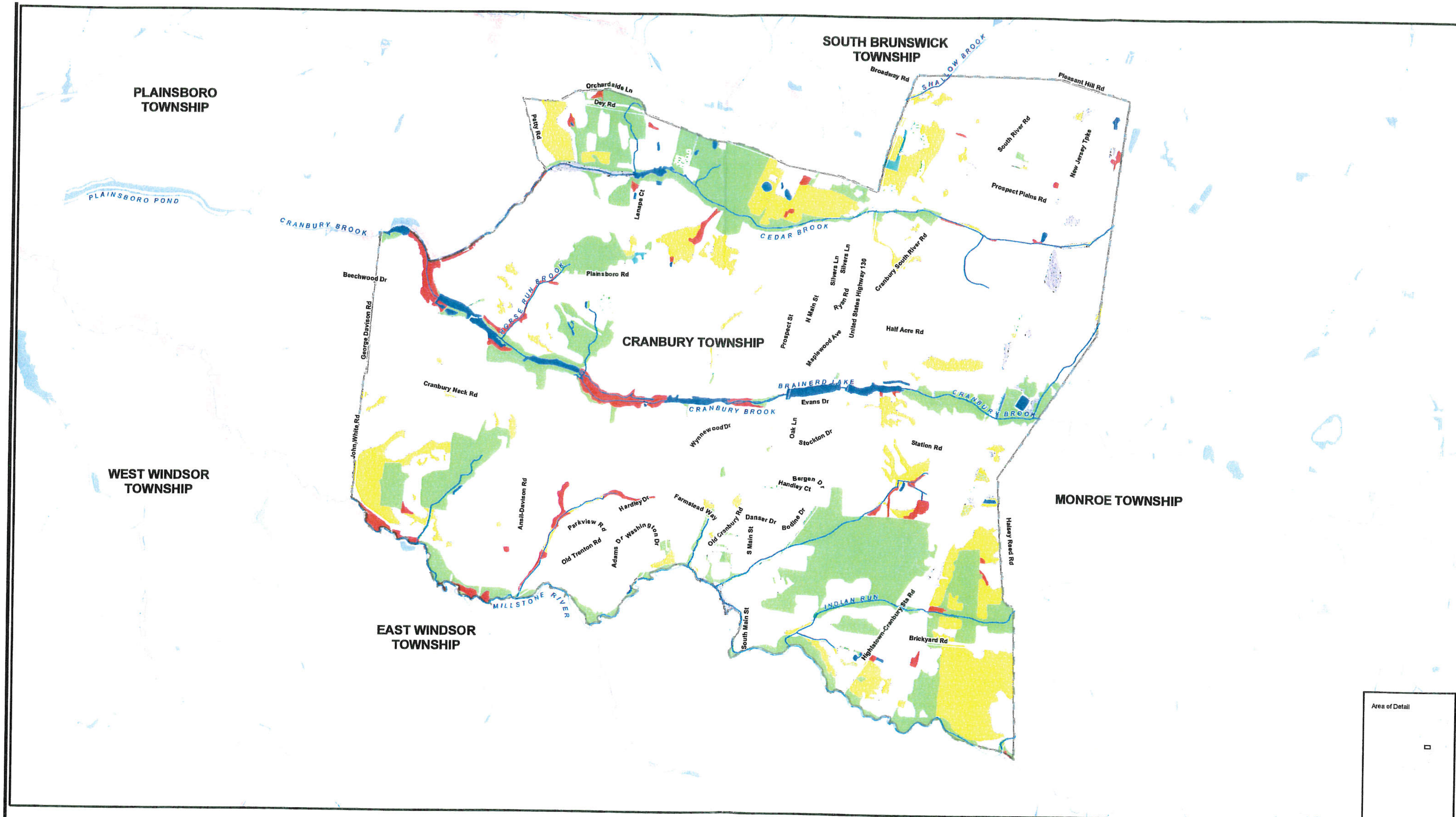

Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Municipal Boundary

Wetlands *

- Agricultural Wetlands (Modified)
- Deciduous Scrub/Shrub Wetlands
- Deciduous Wooded Wetlands
- Disturbed Wetlands (Modified)
- Former Agricultural Wetland (Becoming shrubby, not built-up)
- Herbaceous Wetlands
- Managed Wetland
- Mixed Scrub/Shrub Wetlands (Deciduous Dom.)
- Wetland Rights-of-Way (Modified)

* Wetland delineations provided by New Jersey DEP GIS 1995/97 Landuse/Landcover - Millstone (WMA 10) database. Discrepancies exist between areas mapped as wetlands on Figure 3.

0 3,000 6,000 Feet

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.

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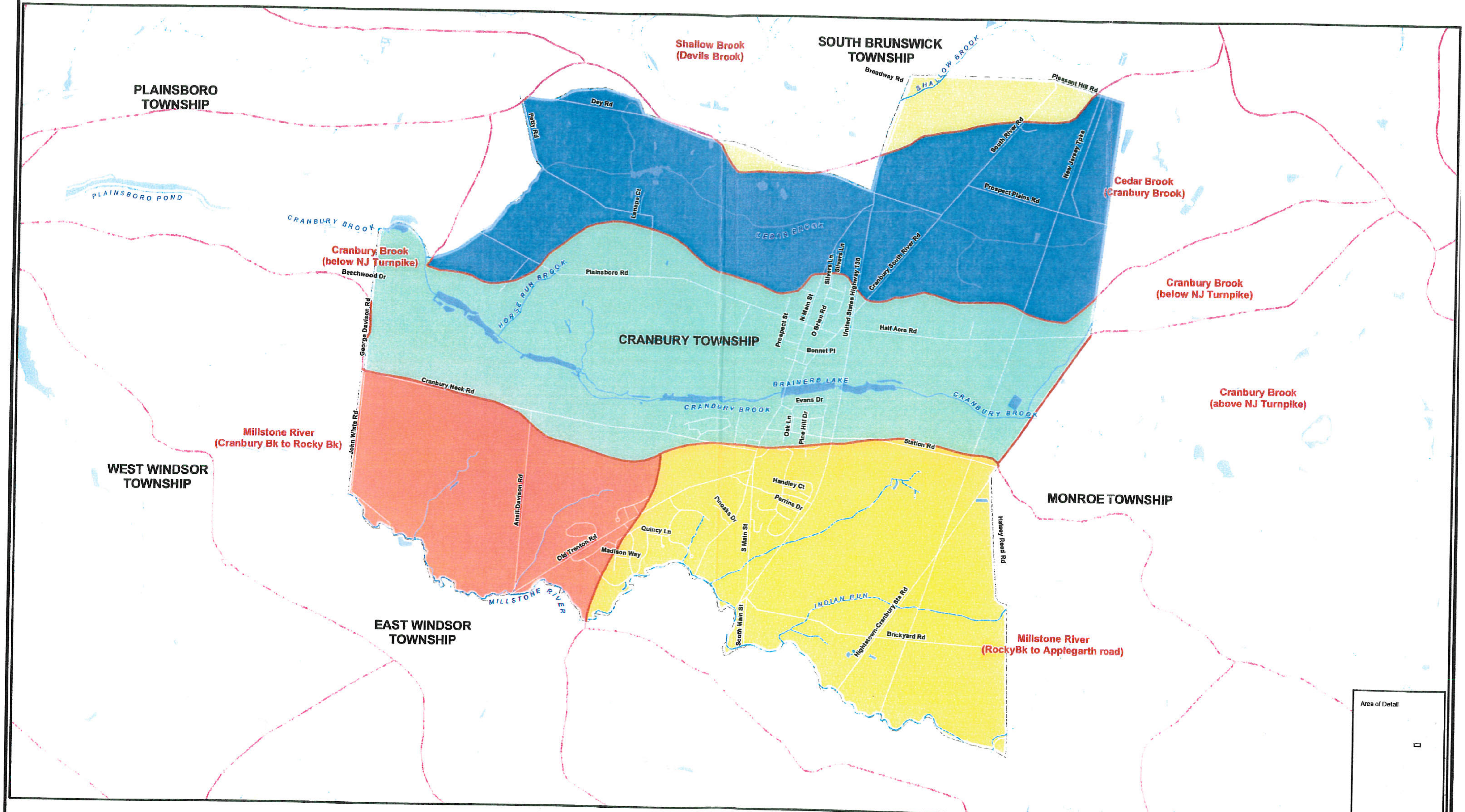
Millburn, New Jersey 07041

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 8 - CONSTRAINED LANDS: WETLANDS AND WATER BODIES

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		05/31/2005



Legend

- Road
- Rivers & Streams
- Lakes & Ponds
- Watershed Boundary (HUC14)
- Municipal Boundary

Percent Impervious (by Watershed) Within Township

- 2.84
- 8.73
- 10.23
- 11.98
- 19.98

0 3,000 6,000 Feet

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.

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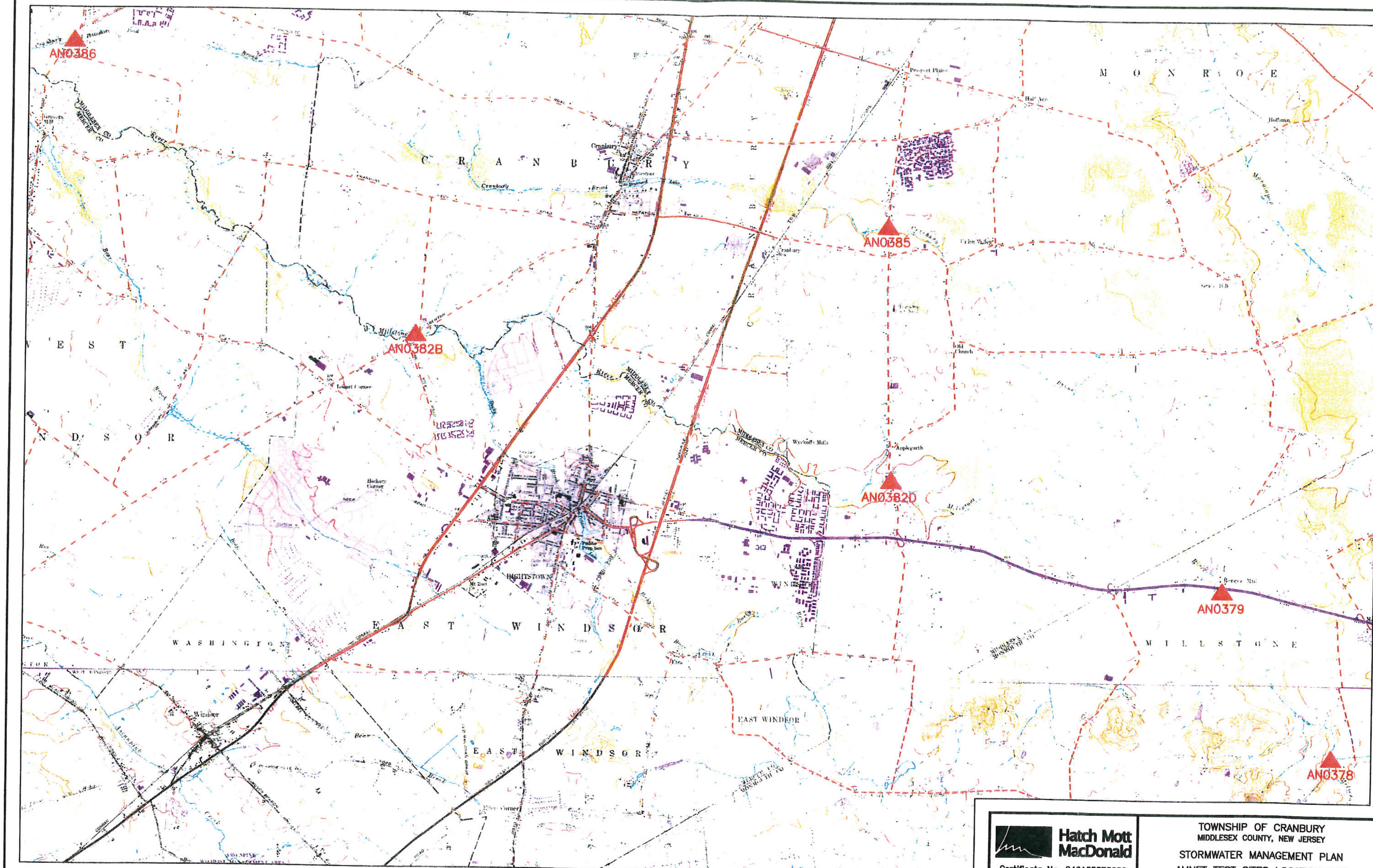
Millburn, New Jersey 07041

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY
STORMWATER MANAGEMENT PLAN
FIGURE 9 - PRESENT PERCENT IMPERVIOUS COVER

Designed	Drawn	Checked	Approved	Date
RLB	RLB	DSC		02/16/2005



▲ Ambient Biomonitoring Network (AMNET) Program Test Station

Hatch Mott MacDonald

Certificate No. 24GA28075000

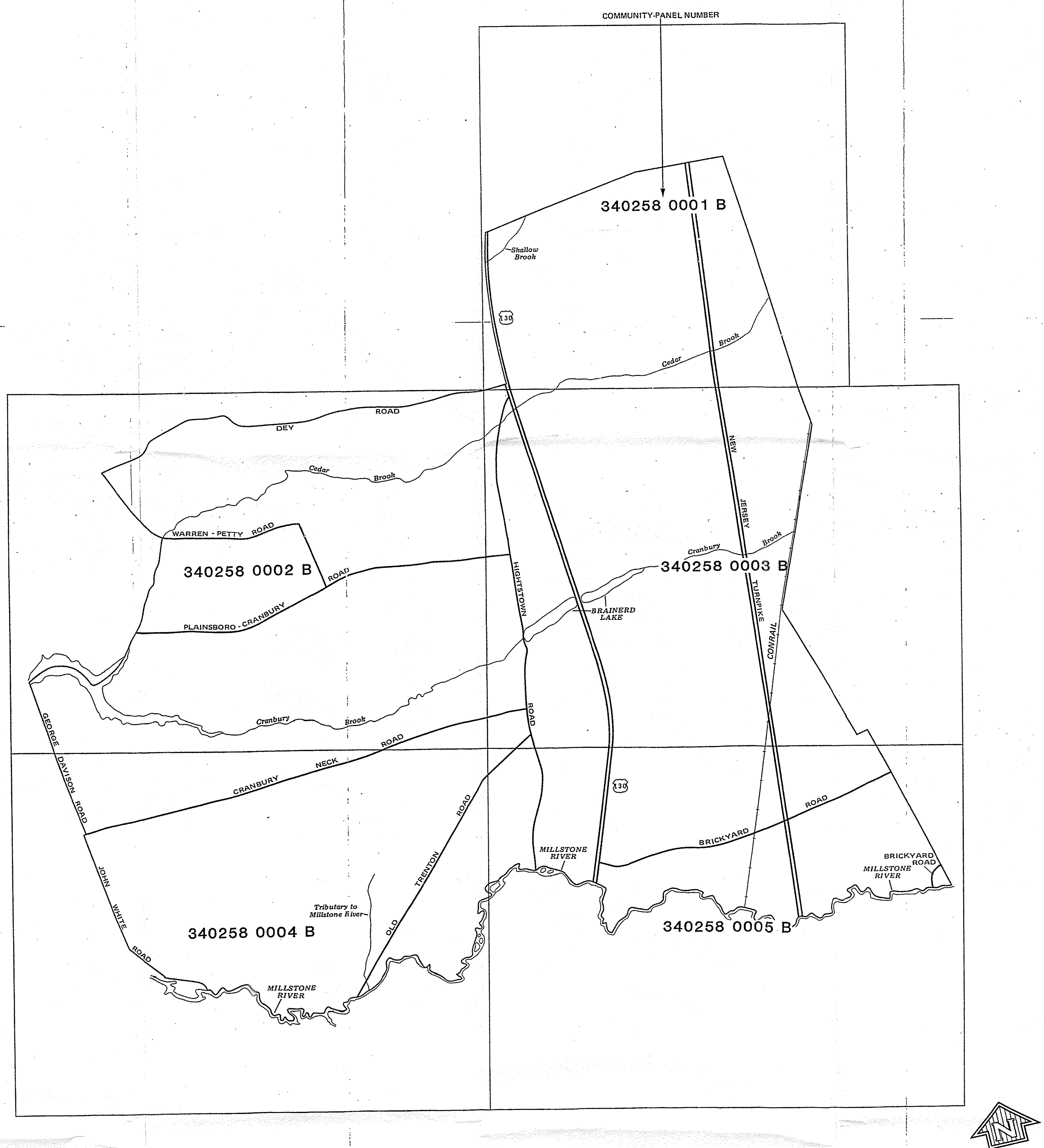
100 Willowbrook Road
Freehold, New Jersey 07728

TOWNSHIP OF CRANBURY
MIDDLESEX COUNTY, NEW JERSEY

STORMWATER MANAGEMENT PLAN
AMNET TEST SITES LOCATION MAP

FIGURE 10

Designed	Drawn	Checked	Approved	Date
L.P.	L.P.	L.P.		



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

TOWNSHIP OF
CRANBURY,
NEW JERSEY
MIDDLESEX COUNTY

MAP INDEX
PANELS PRINTED: 1, 2, 3, 4, 5

COMMUNITY-PANEL NUMBERS
340258 0001–0005

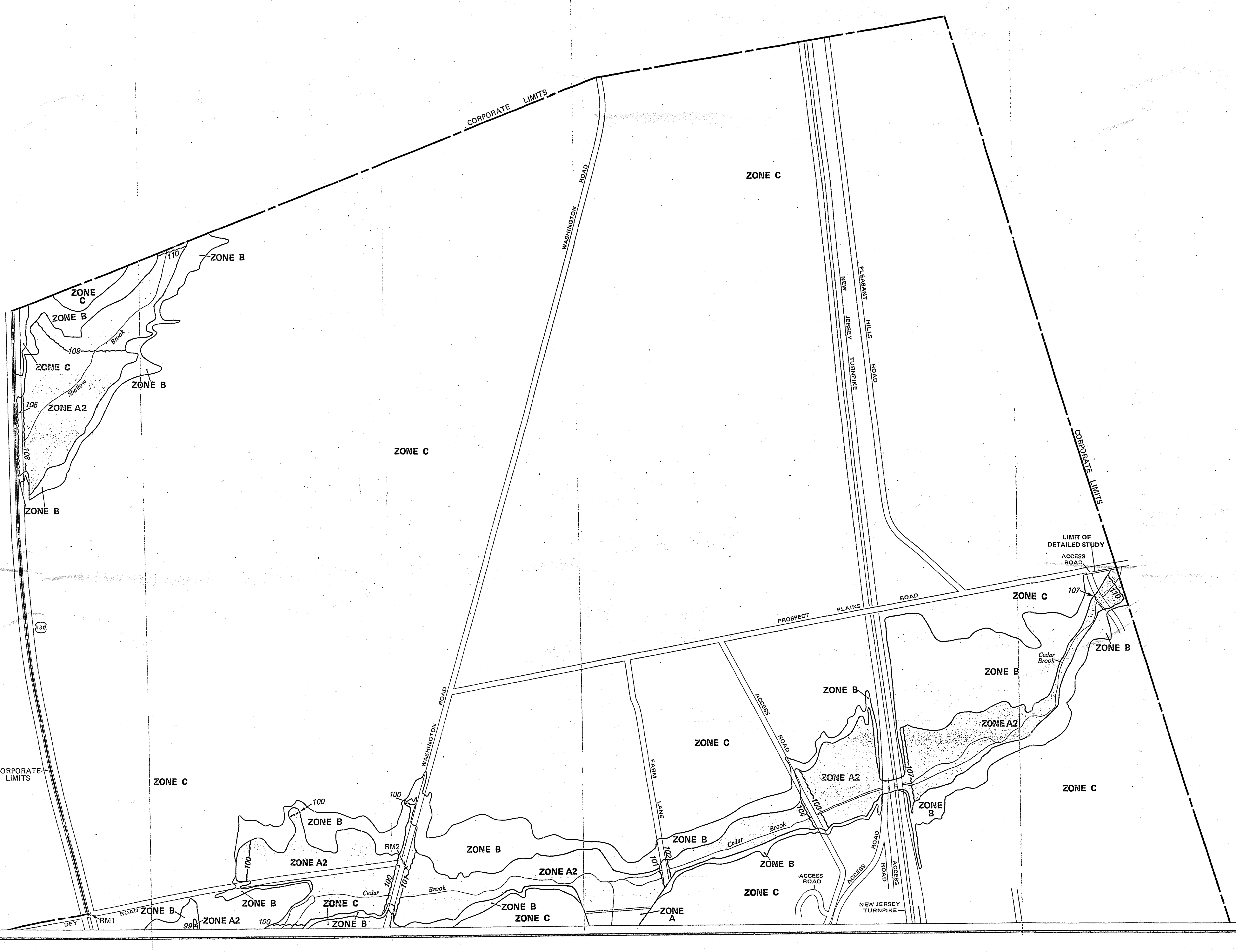
EFFECTIVE DATE:
MAY 17, 1982

Federal Emergency Management Agency

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 1	101.35	Standard NJGCS disk, set in pavement at intersection of US Route 130 and Dey Road; located approximately 15.1 feet west of centerline of northbound lanes of US Route 130 and on centerline of Dey Road.
RM 2	98.27	Standard USC&GS disk set in concrete, on Washington Road and opposite Dey Road (leading to US Route 130) on southeast side of road, opposite a 2-story frame dwelling and flush with ground.

[1] National Geodetic Vertical Datum of 1929



KEY TO MAP

500-Year Flood Boundary — ZONE B
100-Year Flood Boundary
Zone Designations* — ZONE A1 / ZONE A5
100-Year Flood Boundary
500-Year Flood Boundary — ZONE B

Base Flood Elevation Line With Elevation In Feet** — 513

Base Flood Elevation in Feet Where Uniform Within Zone** — (EL 987)

Elevation Reference Mark — RM7×

Zone D Boundary

River Mile — •M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
MAY 10, 1974
FLOOD HAZARD BOUNDARY MAP REVISIONS:
DECEMBER 27, 1974

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 17, 1982
FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRA

FIRM
FLOOD INSURANCE RATE MAI

TOWNSHIP OF CRANBURY, NEW JERSEY MIDDLESEX COUNTY

PANEL 1 OF 5
(SEE MAP INDEX FOR PANELS NOT PRINTE

COMMUNITY-PANEL NUMBEI
340258 0001 E

EFFECTIVE DATE
MAY 17, 1982

Federal Emergency Management Agen

ELEVATION REFERENCE MARK

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 3	101.2	Pavement surface at centerline of Warren-Petty Road, located approximately 2300 feet southeast of Cedar Brook.
RM 4	74.8	Pavement surface at centerline of Plainsboro-Cranbury Road bridge over centerline of Cedar Brook.
RM 5	69.8	Pavement surface at centerline of George Davison Road bridge over centerline of Cranbury Brook.
RM 6	96.0	Pavement surface at centerline of Cranbury Neck Road, located approximately 2100 feet southeast of intersection of Wynnewood Drive and Cranbury Neck Road.
RM 7	106.8	Pavement surface at intersection of centerlines of Wynnewood Drive and Cranbury Neck Road.

[1] National Geodetic Vertical Datum of 1929

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE A!
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations a flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where dept are between one (1) and three (3) feet; average dept of inundation are shown, but no flood hazard fact are determined.
AH	Areas of 100-year shallow flooding where dep are between one (1) and three (3) feet; base flo elevations are shown, but no flood hazard fact are determined.
A1-A30	Areas of 100-year flood; base flood elevations a flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flo protection system under construction; base flo elevations and flood hazard factors not determin
B	Areas between limits of the 100-year flood and 5(year flood; or certain areas subject to 100-year floo ing with average depths less than one (1) foot or wh the contributing drainage area is less than one squ mile; or areas protected by levees from the base flo (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazar
V	Areas of 100-year coastal flood with velocity (w action); base flood elevations and flood hazard fact not determined.
V1-V30	Areas of 100-year coastal flood with velocity (w action); base flood elevations and flood hazard fact determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and may be protected by flood control structures.

This map is for flood insurance purposes only; it does not nec sarily show all areas subject to flooding in the community all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To M Panels.

INITIAL IDENTIFICATION:
MAY 10, 1974
FLOOD HAZARD BOUNDARY MAP REVISIONS:
DECEMBER 27, 1974

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 17, 1982
FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE d shown on this map to determine when actuarial rates apply structures in the zones where elevations or depths have been est lished.

To determine if flood insurance is available in this communi contact your insurance agent, or call the National Flood Insura Program, at (800) 638-6620.

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROG

FIRM
FLOOD INSURANCE RATE M

TOWNSHIP OF
CRANBURY,
NEW JERSEY
MIDDLESEX COUNTY

PANEL 2 OF 5
(SEE MAP INDEX FOR PANELS NOT PRIN

COMMUNITY-PANEL NUMB
340258 0002

EFFECTIVE DA
MAY 17, 198

Federal Emergency Management Ag

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 8	100.7	Pavement surface at centerline of access road along CONRAIL tracks and opposite end of factory guardrail.
RM 9	102.9	Standard USC&GS disk, set in concrete, on southwest corner of intersection of North Main Street and Plainsboro-Cranbury Road; located approximately 30.9 feet west of North Main Street and approximately 19 feet south of Plainsboro-Cranbury Road.
RM 10	93.9	Pavement surface at centerline of south-bound lanes of US Route 130 bridge over centerline of Cranbury Brook.

[1] National Geodetic Vertical Datum of 1929

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE A5
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
MAY 10, 1974
FLOOD HAZARD BOUNDARY MAP REVISIONS:
DECEMBER 27, 1974

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 17, 1982
FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRA

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FLOOD INSURANCE RATE MAF

TOWNSHIP OF
CRANBURY,
NEW JERSEY
MIDDLESEX COUNTY

PANEL 3 OF 5
(SEE MAP INDEX FOR PANELS NOT PRINTE

COMMUNITY-PANEL NUMBEF
340258 0003 B

EFFECTIVE DATE
MAY 17, 1982

Federal Emergency Management Agenc

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 11	76.0	Pavement surface at centerline of Ancil Davison Road bridge over Millstone River at corporate limits.

[1]National Geodetic Vertical Datum of 1929

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE
100-Year Flood Boundary	
500-Year Flood Boundary	ZONE B
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation In Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations a flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where dep are between one (1) and three (3) feet; average dep of inundation are shown, but no flood hazard fact are determined.
AH	Areas of 100-year shallow flooding where dep are between one (1) and three (3) feet; base flo elevations are shown, but no flood hazard fact are determined.
A1-A30	Areas of 100-year flood; base flood elevations a flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flo protection system under construction; base flo elevations and flood hazard factors not determin
B	Areas between limits of the 100-year flood and 5 year flood; or certain areas subject to 100-year flo ing with average depths less than one (1) foot or wh the contributing drainage area is less than one squ mile; or areas protected by levees from the base flo (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazar
V	Areas of 100-year coastal flood with velocity (wa action); base flood elevations and flood hazard fact not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wa action); base flood elevations and flood hazard fact determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and may be protected by flood control structures.

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For adjoining map panels, see separately printed Index To M Panels.

INITIAL IDENTIFICATION:
MAY 10, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:
DECEMBER 27, 1974

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 17, 1982

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE da shown on this map to determine when actuarial rates apply structures in the zones where elevations or depths have been esta lished.

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APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROG

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FLOOD INSURANCE RATE M

TOWNSHIP OF
CRANBURY,
NEW JERSEY
MIDDLESEX COUNTY

PANEL 4 OF 5
(SEE MAP INDEX FOR PANELS NOT PRIN

COMMUNITY-PANEL NUM
340258 0004

EFFECTIVE DA
MAY 17, 19

Federal Emergency Management A

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 12	93.36	Standard NGCS disk, set flush with ground, on US Route 130, in center of traffic circle at intersection with Hightstown and Brickyard Roads.

[1]National Geodetic Vertical Datum of 1929

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE A5
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations an flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depth are between one (1) and three (3) feet; average depth of inundation are shown, but no flood hazard factor are determined.
AH	Areas of 100-year shallow flooding where depth are between one (1) and three (3) feet; base floo elevations are shown, but no flood hazard factor are determined.
A1-A30	Areas of 100-year flood; base flood elevations an flood hazard factors determined.
A99	Areas of 100-year flood to be protected by floo protection system under construction; base floo elevations and flood hazard factors not determinec
B	Areas between limits of the 100-year flood and 50(year flood; or certain areas subject to 100-year flooc ing with average depths less than one (1) foot or wher the contributing drainage area is less than one squar mile; or areas protected by levees from the base flooc (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazard
V	Areas of 100-year coastal flood with velocity (wav action); base flood elevations and flood hazard facto not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wav action); base flood elevations and flood hazard facto determined.

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For adjoining map panels, see separately printed Index To Ma Panels.

INITIAL IDENTIFICATION:
MAY 10, 1974
FLOOD HAZARD BOUNDARY MAP REVISIONS:
DECEMBER 27, 1974

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 17, 1982
FLOOD INSURANCE RATE MAP REVISIONS:

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APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROG

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FLOOD INSURANCE RATE M

TOWNSHIP OF
CRANBURY,
NEW JERSEY
MIDDLESEX COUNTY

PANEL 5 OF 5
(SEE MAP INDEX FOR PANELS NOT PRIN

COMMUNITY-PANEL NUMB
340258 0005

EFFECTIVE DA
MAY 17, 198

Federal Emergency Management Ag