

# GREEN BROOK FLOOD CONTROL PROJECT FLOODPLAIN MANAGEMENT PLAN

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## **SECTION 1: INTRODUCTION**

### **1.1 Authority and Purpose**

Pursuant to Section 202 (c), Floodplain Management Plans, of the Water Resources Development Act of 1996 (WRDA 1996), prior to the construction of any flood control project that would lessen the impacts of flooding from storms and hurricanes involving assistance from the Secretary of the Army, the non-federal interest must: (1) agree to participate in and comply with applicable federal floodplain management and flood insurance programs, (2) prepare a Floodplain Management Plan designed to reduce the impacts of future flood events in the project area no later than one year after the date of signing the Project Cooperation Agreement (PCA), and (3) implement this plan within one year after project construction is complete.

In accordance with this requirement, the State of New Jersey Department of Environmental Protection (NJDEP), the project's non-federal sponsor has developed this Floodplain Management Plan (FPMP) for Segments R, T, and U of the Green Brook Flood Control Project. The project is co-sponsored by the US Army Corps of Engineers, the New Jersey Department of Environmental Protection, and Middlesex, Somerset and Union Counties.

The Green Brook Flood Control Project encompasses the 65 square-mile Green Brook sub-basin of the Raritan River basin as well as short reaches of the Raritan River itself and its Middle Brook tributary. The entire project area includes thirteen municipalities in three counties, consisting of the Boroughs of Dunellen, Middlesex, and South Plainfield, and the Township of Piscataway in Middlesex County; the Boroughs of Bound Brook, North Plainfield, and Watchung, and the Townships of Green Brook and Bridgewater in Somerset County; and the Borough of Fanwood, the Townships of Scotch Plains and Berkeley Heights, and the City of Plainfield in Union County. Segments R, T, and U of the project, which are the focus of this FPMP, are located mainly in the Borough of Bound Brook in Somerset County, and include a small portion of Bridgewater Township in Somerset County. Unless otherwise noted, all references in the FPMP to the "project" pertain only to Segments R, T, and U.

For the purposes of the FPMP, the project area for Segments R, T, and U have been divided into two sections. The Protected Area is located within or behind the various structural flood control measures in Segments R, T, and U that protect this area from riverine flooding from the Raritan River, Green Brook, and Middle Brook. The Unprotected Area consists of the remainder of the Green Brook Flood Control Project area as well as all other areas within the Raritan Basin (including areas of Hunterdon, Mercer, Middlesex, Monmouth and Morris Counties) that contribute to the flows and flood levels that cause flooding. This area also includes existing residences, businesses, and other structures that have received floodproofing by the project.

This FPMP implements measures, practices, and policies that will reduce the impacts of future flood events in the Segment R, T, and U project area as required by the Section 202 (c). The Plan does this by 1) preserving the level of protection, 2) maintaining the limits of residual flooding, and 3) preserving and enhancing natural floodplain values. Preservation of the project's level of protection are addressed through existing floodplain and stormwater management regulations at the federal, state, county, and municipal levels that pertain to both the Protected and Unprotected Areas of the project. Maintenance of the limits of residual flooding are addressed through a combination of existing and new state and municipal floodplain and stormwater management regulations that pertain to the Protected Areas of the project. Similarly, natural floodplain values are enhanced through a combination of existing and new state and municipal floodplain regulations and programs.

## **1.2 Format of the Plan**

Details of the FPMP for the Segment R, T, and U project area are presented in the following sections, beginning with a review of the project's background and the existing federal, state, county, and municipal floodplain and stormwater management regulations that pertain to the project area. This is followed by a description of existing emergency services available in the project area and ending with descriptions of the existing and new regulations and services that pertain to the project's Protected and Unprotected Areas.

It is noted that the contents of the FPMP may not necessarily be readily understood by ordinary citizens or lay persons. If the reader needs additional explanations on any particular item or clarification on the purpose of the plan, they should consult with an Attorney who practices in this field of specialization, and/or a Professional Engineer and/or a Professional Planner who practices in this field of specialization.

## **1.3 Project Background**

The Green Brook Flood Control Project is located in north central New Jersey in the Counties of Middlesex, Somerset, and Union. The Green Brook originates in the Watchung Mountains and upon reaching the base of the first Watchung Mountain flows in a southwesterly direction through a highly urbanized/industrialized floodplain to its confluence with the Raritan River. Flooding has been a longstanding problem in this sub-basin and has been studied extensively by numerous local, state, and federal agencies since the 1932 Report of the State Water Policy Commission. Weather events ranging from local thunderstorms to tropical storms have caused severe and often devastating flooding in this sub-basin.

In 1968 the Army Corps of Engineers conducted a reconnaissance investigation for small projects along the Ambrose, Bound, and Bonygutt Brooks. This report recommended further study at all three locations. Subsequent catastrophic flood events in the early 1970's prompted a comprehensive investigation of the entire Green Brook Sub-Basin. In 1980, the Army Corps of Engineers issued a feasibility report for various flood control plans designed to protect the Green Brook Sub-Basin. The Water Resources Development Act (WRDA) of 1986 authorized the implementation of a flood control project for the Green Brook Sub-Basin. Significant delays in project implementation were incurred because of an apparent conflict between the project authorization language and national economic development considerations. In 1994, a reevaluation study was initiated to refine and re-scale alternatives developed during the initial feasibility study (1980). The results of this investigation were reported in the General Reevaluation Report (GRR) of 1997. The recommended plan included a system of levees,

floodwalls, dams, channel improvements, bridge raisings, closure structures, and non-structural measures throughout the sub-basin.

The Flood Plain Management Plan is the non-structural component of the comprehensive flood control plan for the basin. Flood plain management can be summarized as the process of planning for flood damage prevention through the proper use of flood hazard areas. It seeks to minimize the threat of flood damage without significantly altering the natural function of the flood plain. This is done by keeping damage-prone property out of the floodway and regulating the use of the floodway fringe to minimize the damage when flooding occurs. Flood plain management emphasizes the use of nonstructural measures to achieve the following major goals:

- The prevention of further development that is incompatible with the flood hazard,
- The relief of persons who have unknowingly or unwisely located their residence or businesses in areas of flood hazard.

This FPMP focuses on Segments R, T, and U of the Green Brook Flood Control Project, as shown on Plate 1 at the end of this section. These segments are located in the Borough of Bound Brook and Township of Bridgewater, Somerset County. The line of protection provided by these segments begins at the East Street crossing over Vosseller Brook and continues along the right bank of Vosseller Brook (looking downstream) to Green Brook. It continues along the right bank of Green Brook (looking downstream) to the NJ Transit Railroad tracks. The line of protection continues west along the railroad just north of the Raritan River, then turns north up the left bank (looking downstream) of Middle Brook, terminating at Route 22. The layout of the project and the pre-project 100-year floodplain are shown on Figures 1 and 2. The line of protection includes levees, floodwalls, channel improvements, bridge raisings, closure structures, pump stations, and non-structural measures including floodproofing.

## **1.4 Flood Risks**

### **1.4.1 Before the Flood Protection Project**

Weather events ranging from local thunderstorms to tropical storms have caused severe and often devastating flooding in the project area. Flooding has been a longstanding problem in this area, resulting in over \$2.5 billion in damages over the last century. Without this FPMP major storms would continue to inflict significant flood damages which compromises the safety and health of the public. The pre-project 100-year flood plain boundary shown on Figures 1 and 2 serves to graphically illustrate the large and intensely developed area of downtown Bound Brook Borough which have experienced recurrent losses.

### **1.4.2 After the Flood Protection Project**

The levees and floodwall in this project are designed to provide protection up to a 150-year event (event that has less than 1 percent chance of occurring in a given year). Storms greater than the 150-year event may cause flooding in the Protected Area or result in levee overtopping. The line of protection is designed to overtop first in less developed areas. This should lessen damage to residential, commercial, and public development and provide residents with additional warning time to evacuate if the floodwaters rise above the level of protection.

Figures 1 & 2 illustrates the large and intensely developed area of downtown Bound Brook Borough which previous to the Project has been within the 100 year flood plain, but will be

protected after the Project is completed. This is graphically emphasized on these figures with a yellow color shading.

The completion of the Flood Protection Project will result in a very extensive and important improvement for all who live, work or own property in that very large area.

Insert PLATE 1: Green Brook Flood Control Project- Segments R, T, and U

## **SECTION 2: EXISTING REGULATORY REQUIREMENTS**

As noted in the introduction the purpose of the FPMP is to develop and implement programs and regulations in both the Protected and Unprotected Areas that will maintain the project's level of protection. There are several federal, state, and local agencies that have existing regulations that achieve this goal, particularly in the Unprotected Areas.

The following are summaries of applicable regulations that govern floodplains in the overall Green Brook Flood Control Project Area including Segments R, T, and U.

### **2.1 United States Army Corps of Engineers Regulations**

United States Army Corps of Engineers (USACE) Policy Guidance Letter No. 52 (PGL No. 52), Floodplain Management Plans (Dec 8, 1997) defines USACE policy on Section 202 (c) of WRDA 1996. It states that the non-federal sponsor of the project should develop a FPMP that: (1) implements measures, practices, and policies which will reduce loss of life, injuries, damages to property and facilities, public expenditures, and other adverse impacts associated with flooding, (2) preserves and enhances natural floodplain values, and (3) addresses measures which will help preserve levels of protection provided by the USACE flood damage reduction or hurricane or storm damage reduction project.

Enclosures to PGL No. 52 include "Guidance on the Development of Floodplain Management Plans (Nov 7, 1997)" which provides further clarification on the development of a FPMP in accordance with Section 202 (c) of WRDA 1996. It states that the primary focus of the plan should be to address potential measures (both structural and non-structural), practices, and policies which will reduce the impacts of future residual flooding, help preserve levels of protection provided by the USACE project, and preserve and enhance natural floodplain values. An element of the plan will include provisions related to post-storm activities following a catastrophic event.

USACE further requires communities receiving funding for flood protection projects to prepare a FPMP following procedures similar to the National Flood Insurance Program's (NFIP) minimum standards. Communities participating in the NFIP must adopt certain land use regulations for flood hazard areas. In exchange for adopting these regulations the federal government makes flood insurance available to those communities.

### **2.2 NFIP's Floodplain Management Regulations**

NFIP's regulations on Floodplain Management are located in the Code of Federal Regulations, Chapter 4 Parts 59 & 60. The NFIP is primarily concerned with the flood hazard area, which is the area of land that would be inundated by a flood having a one percent (1%) chance of occurring in any given year (also known as the base flood or 100-year flood). The base flood, constitutes a reasonable compromise between the need for building restrictions to minimize potential loss of life and property and the economic benefits to be derived from floodplain development. Development may take place within the flood hazard area provided that development complies with local floodplain management ordinances which must meet the minimum federal requirements.

Under the NFIP the adopted regulatory floodway must carry and discharge the waters of the base flood without increasing the water surface elevation of that flood by more than 0.2 foot in the



State of New Jersey. The floodplain management criteria for flood-prone areas states that “permits are required for all new construction and substantial improvements within the Special Flood Hazard Area (SFHA)”. All new construction must be anchored and constructed by methods that minimize flood damages. A list of definitions of SFHA zones is provided in Appendix A of this report.

When a final flood elevation for a flood hazard area has been determined, the community shall require that all new construction and substantial improvements of residential structures within certain zones elevate the lowest floor (including basement) to or above the base flood level. For the same zones, all new construction and substantial improvements of non-residential structures shall either elevate the lowest floor (including basement) to or above the base flood level, or together with attendant utility and sanitary facilities be designed so that the structure is watertight below the base flood level. This has to be certified by a registered professional engineer or architect.

### **2.3 Levee Certification**

The USACE certifies levees for protection against flooding. Once the USACE certifies a levee, the Federal Emergency Management Agency (FEMA) may recognize it as protecting against the 100-year flood. Property owners in the Protected Area are not required to purchase flood insurance but encouraged to do so. In most cases the flood insurance rates may be reduced.

### **2.4 State of New Jersey Regulations**

The New Jersey Department of Environmental Protection (NJDEP) existing regulations for flood hazard areas are found in Chapter 13 of the New Jersey Administrative Code (NJAC) titled Flood Hazard Area Control (7:13). For delineated watercourses the State defines the Flood Hazard Area as the area of land that would be inundated by the Flood Hazard Area Design Flood. This design flood has a peak discharge equal to the 100-year flood flow plus an additional 25% of the 100-year flow to take into account future development in the drainage basin. The Flood Hazard Area consists of the floodway and the flood fringe area of a delineated stream. It is also referred to as the channel and adjacent land areas that must be reserved in order to carry and discharge the base flood without cumulatively increasing the water surface elevation more than 0.2 foot above existing conditions. The floodway is the inner portion of the flood hazard area. This area has higher velocities and is at a higher risk for flood damage. Construction in this area is prohibited in most cases. Section 7:13-2.2(b) of the State regulations defines the specific conditions under which construction may be allowed. The flood fringe is the outer portion of the flood hazard area just outside of the floodway. This area has lower velocities and is at lower risk for flood damage. Construction is allowed within this area with certain restrictions. Green Brook and Raritan River are both delineated watercourses, while Middle Brook is a non-delineated watercourse. The 100-year peak flood flows along non-delineated watercourses should be calculated assuming that the entire contributory drainage area is fully developed in accordance with current zoning plan. For non-delineated watercourses the FEMA maps can only be used in areas where:

- it can be demonstrated that the FEMA study reflects full development in the drainage basin or
- it is viable that the basin-wide storm water management system in place will not increase the peak flows developed by the FEMA study.

The goals of the NJDEP in setting restrictions on development in the floodplain are to minimize the impacts to flooding and water quality. Preserving flood storage, protecting structures,

preventing obstructions, and controlling stormwater runoff in the floodplain minimize flooding impacts. Protecting existing near-stream vegetation and setting restrictions on stormwater runoff pollutants help to minimize water quality impacts.

NJDEP requirements in the floodway do not allow fill or any obstructions to flow. All bridges and culverts in the floodway must pass the design flood without increasing flood levels, and the structures must be stable.

NJDEP requirements in the flood fringe restrict the net fill to 20%. Buildings must be elevated or floodproofed, and certain buildings must have dry access (i.e. hospitals, schools, etc). For activities proposed in the flood fringe area, the volume of net fill to be placed on an applicant's property is limited to 20% of the total volume of flood storage on that portion of property. In addition all fill should be graded in such a way that slopes are not steeper than a ratio of two horizontal to one vertical.

According to NJDEP Flood Hazard Area Control Act Rules [NJAC 7:13-2.18 (a) (1)] flood control projects shall not increase the flood elevation upstream and downstream of the project limits by more than two tenths (0.2) of a foot. These rules, last updated February 2004, are applicable to the Green Brook Flood Control Project.

The State's guidelines for stormwater management are detailed under section NJAC 7:8 Stormwater Management Rules. If a regional stormwater management plan has been developed then the project needs to conform to this plan. These rules were also updated in February 2004 and are applicable to the Green Brook Flood Control Project.

The current requirements for soil erosion and sediment control stipulate that an erosion and sediment control plan be prepared in accordance with New Jersey Standards for Soil Erosion and Sediment Control. The Green Brook Flood Control Project Plans are submitted to the Somerset-Union Soil Conservation District before any land disturbance activity greater than 5,000 square feet can take place.

NJDEP regulations regarding wetlands are found under NJAC 7:7A, Freshwater Wetland Rules. The goal of NJDEP in setting rules on development in wetlands is to minimize impacts on wetlands. These rules are applicable to the Green Brook Flood Control Project.

## **2.5 County Regulations**

The project is located in Somerset County. Since the State possesses the authority to delineate and regulate floodplains, there are no separate county-level floodplain management regulations. The municipalities are responsible for developing and enforcing their own individual FPMP ordinances in accordance with NFIP. All of the counties have stormwater management regulations for new development and redevelopment in addition to the NJDEP Stormwater Management Rules. These regulations will help maintain the Project's level of protection.

Somerset County regulates all proposed land developments along county roads or which affect county drainage facilities through its 1995 Land Development Review Resolution. These regulations impose post-construction outflow requirements similar to those in NJDEP's Stormwater Management Rules that prevent peak runoff increases from development and redevelopment sites. In addition, the County has developed a regional stormwater management plan for the Middle Brook watershed that further prevents future peak flow increases in Middle Brook due to development. This plan includes the construction of a regional stormwater detention basin on the West Branch of Middle Brook at the Washington Valley Reservoir that was completed in 1989. This basin not only helps prevent increases in downstream peak discharges along the Main Branch of the Middle Brook but also reduces the existing 100-year flooding along the Main Branch to 25-year levels, further ensuring the Project's level of protection along its Middle Brook component.

## **2.6 Municipal Regulations**

All basin municipalities participating in NFIP have adopted flood damage prevention ordinances that embody the NFIP floodplain management regulations. In addition to their floodplain management requirements, all municipalities regulate land development in accordance with the Municipal Land Use Law (MLUL). This includes the State's Residential Site Improvement Standards administered by the NJ Department of Community Affairs (NJDECA). These regulations are identical to NJDEP Stormwater Management Rules regarding preventing peak runoff increases.

The Township of Bridgewater has adopted regulations identical to the State's. In addition to the State and NFIP regulations, the Borough of Bound Brook requires that the lowest floor in new construction and substantial improvements for both residential and non-residential structures in the flood hazard area, must be elevated at least one foot above the base flood elevation. In non-residential construction the structure may otherwise be floodproofed below the base flood level so that the structure is watertight with walls substantially impermeable to the passage of water. The additional foot above the base flood elevation is applied as a safety factor, and is called freeboard. The "freeboard" of one foot compensates for some of the unknown factors that contribute to flood heights greater than the base flood. These factors include obstructed bridge openings, debris and ice jams, and the effects of urbanization in a watershed.

All municipalities are required to comply with the new NJDEP Stormwater Management Rules (adopted February 2004) for all types of development.

### **SECTION 3: EMERGENCY SERVICES**

The emergency services for the project area involves three entities: the State, County and Municipality. It begins with the NJ Office of Emergency Management which is part of the NJ State Police and oversees the County's Office of Emergency Management (OEM). The County works directly with the Emergency Management Coordinator in each municipality. All levels work together during flood emergencies.

Somerset County operates the Somerset County Flood Information System (SCFIS). SCFIS is a county-wide monitoring system made up of 25 rain gages and 23 waterway gages, including 9 rain gages and 7 waterway gages in the Green Brook Flood Control Project Area. See Table 1 in Appendix A for information on the location of the gages. These gages report automatically by radio and telephone to the main SCFIS computers in Somerville, NJ. These computers also receive weather forecasts and flood bulletins, including Flood Watches and Flood Warnings from the National Weather Service at Mount Holly, NJ. The computers are continually monitored by SCFIS personnel in the County's Engineering Division and/or County OEM personnel in the Communication Center. SCFIS personnel also work with the County Public Works and municipal OEM personnel to disseminate rain and flood information via radio, telephone, and facsimile.

The Borough of Bound Brook has developed an Emergency Operations Plan that contains instructions for each department in the event of an approaching flooding weather event. In the event of an evacuation, police/fire/emergency management personnel can make use of vehicular public announcement systems or possible door-to-door notification.

The Township of Bridgewater has also developed an Emergency Operations Plan that contains instructions for each department in the event of an approaching flooding weather event. In the event of an evacuation, the township typically uses local media to notify the residents but police, fire, and emergency management personnel can use the vehicular Public Announcement (PA) systems if necessary. In the event of an impending emergency, the Emergency Operations Center is activated to serve as a centralized command center. The Township is in the process of setting up a reverse 911 system to use in localized areas for emergency notification.

## **SECTION 4: UNPROTECTED AREA MEASURES**

The following section discusses the regulations pertinent to the Unprotected Area of the project. The discussion includes the definition and identification of the Flood Hazard Areas, Floodways, and natural areas in the Unprotected Area. The discussion concludes with a summary of the regulations that govern the Unprotected Area. The following sections refer to Segments R, T and U of the project.

### **4.1 Flood Hazard Area**

The Flood Hazard Area is defined under NJDEP Flood Hazard Area Control Act Rules (NJAC 7:13) as the floodway and flood fringe area of a delineated stream. The Flood Hazard Area Design Flood is the 100-year storm in non-delineated area and 100-year storm plus 25% of the 100-year flow in delineated areas to take into account future development in the drainage basin. For Segment T and Segment R along the Raritan River the effect of levee and floodwall construction along the Raritan River and Green Brook is offset by the raising of Main Street Bridge over Green Brook and the removal of the abandoned Conrail Bridge over Raritan River. As a result of these improvements, the Flood Hazard Area is not affected by the project in the Unprotected Areas along Segment T and the portion of Segment R along the Raritan River.

Green Brook and Raritan River are delineated watercourses and, as such, the NJDEP has defined the limits of the Flood Hazard Areas. Middle Brook and Vosseller Brook are non-delineated waterways; therefore, the NJDEP has not delineated Flood Hazard Areas along these waterways.

One of the improvements of the Project includes the raising of the Talmage Avenue Bridge over Middle Brook to alleviate flooding conditions at the bridge. Despite this improvement the water surface elevation along Middle Brook increases by more than 0.2 feet for the 100 year Base Flood. Therefore, in the Unprotected Area west of Middle Brook, the post project 100-year floodplain increases slightly in portions of Segments U and R in comparison to the pre-project floodplain. See Figures 1 and 2 for delineation of the pre-project and post-project 100-year floodplains. At the locations where an increase in the floodplain area was unavoidable, flowage easements have been attained.

### **4.2 Floodway**

The floodway is defined as the channel and adjacent land areas that must be reserved in order to carry and discharge the base flood (100 year) without cumulatively increasing the water surface elevation more than 0.2 foot above existing conditions. The Green Brook and Raritan River are delineated watercourses, and NJDEP has defined the limits of the floodway. The limits of the floodway along the Raritan River are not changed by the project. At Green Brook, the limit of the floodway is not changed in the Unprotected Area, and the post-project floodway ties into the levee. Middle Brook is not a delineated waterway; therefore there is no NJDEP delineated floodway along this waterway. However, a floodway has been identified for Middle Brook by the NFIP Flood Insurance Study. See Figures 1 and 2 for floodway delineation along the Raritan River and Green Brook.

### **4.3 Identification and Description of Natural Areas**

The wetlands within the project have been delineated in the “Green Brook Flood Control Project, Wetland Delineation Report” dated March 2000. Wetlands are areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal conditions do support, a prevalence of vegetation typically adapted. The wetland located in the Unprotected Area encompasses the junction of Ambrose Brook with Green Brook, and extends northward up both sides of each of the streams to Union Avenue (NJ State Route 28). See Appendix C for delineation of wetlands.

### **4.4 Regulations**

Maintaining the integrity of the Project’s level of protection requires regulation of land development and floodplain activities within the Raritan River watershed. The Corps of Engineers, FEMA, the State of New Jersey, and the Counties and Municipalities within which the project is located, have existing floodplain and stormwater management regulations that control development and redevelopment within the entire watershed. These regulations are expressly intended to prevent increases in flood flows and floodplain levels. These limits in turn, will prevent activities in the project’s Unprotected Area from reducing the Project’s level of protection. These regulations have been addressed and summarized in previous sections of this plan. All of these regulations will continue to apply to the Unprotected Area. The Unprotected Area of the project shall comply with the following rules and regulations:

- USACE Floodplain Management Plan Policies (PGL No. 52)
- NFIP Floodplain Management Regulations (44 CFR Parts 59 & 60)
- NJDEP Flood Hazard Area Control Act Rules (NJAC 7:13)
- NJDEP Stormwater Management Rules (NJAC 7:8)
- NJDEP Freshwater Wetlands Rules (NJAC 7:7A)
- NJDCA Residential Site Improvement Standards (NJAC 5:21)
- County Stormwater Management Regulations and Plans
- Municipal Floodplain Management Ordinances
- Municipal Stormwater Management Ordinances
- Municipal Zoning Ordinances

All current regulations and rules regarding flood hazard area, floodway, stormwater, and wetlands will remain in force. There shall be no change in jurisdiction, and current authorities will continue to administer and enforce the provisions of the regulations.

### **4.5 Emergency Services**

Emergency services shall continue to be provided by the State, County, and municipalities.

## **SECTION 5: PROTECTED AREA MEASURES**

This section discusses the following areas within the project's Protected Area:

- Protected Contributory Area
- Interior Drainage System
- Residual Flood Hazard Area
- Floodway
- Levee Overtopping Areas
- Pre-Project 100-year Floodplain
- Natural Areas

A description of each of these areas is presented below. Current regulations governing activities within each of these portions of the Protected Area will need refinement to take into account the new line of protection. Maintaining the overall project's level of protection is dependant on activities permitted within the Protected Area as well as the Unprotected Area and areas that contribute to the runoff that will be stored behind the line of protection. Municipal and County officials and personnel involved with building and development design and review should become thoroughly familiar with the new rules and regulations for the Protected Area.

### **5.1 Protected Contributory Area**

The Protected Contributory Area is defined as the area that contributes runoff to the interior drainage systems behind flood control measures (line of protection). The limits of the Protected Contributory Area are shown on Figures 3 and 4. The Residual Flood Hazard Areas, Levee Overtopping Areas, and Pre-Project 100-Year Floodplain are part of the Protected Contributory Area.

### **5.2 Interior Drainage System in the Protected Area**

Interior drainage systems for Segments R, T, and U in the Protected Area have been designed to convey runoff from the Protected Contributory Area through the levees and floodwalls and into the Raritan River, Green Brook and Middle Brook. Each system consists of a network of swales, storm sewers, ponding areas, levee drainage structures, and, in the case of Segments R and T, pumping stations. Each system was designed using two mathematical models that simulated the rainfall-runoff response for a 150-Year recurrence interval storm in each system subarea as well as the operation of the systems themselves. These models, both of which were developed by the Hydrologic Engineering Center (HEC) of the Corps of Engineers, are the HEC-1 Flood Hydrograph Package and the HEC-IFH Interior Flood Hydrology.

The location and general details of the interior drainage systems within each Segment are shown on Figures 1 and 2, while the locations of each system's drainage subareas are shown on Figures 3 and 4. The drainage area, the NRCS Runoff Curve Number, and Time of Concentration for each sub-area are presented in Appendix A and shown on Figures 3 and 4.

In order to maintain the level of flood protection provided by these interior drainage systems, the flow paths to and along each system must remain unobstructed in order that runoff from the system's Protected Contributory Area can continue to drain to the system in a manner consistent with the system's design. In addition, design runoff rates and volumes as well as ponding area stage-storage and stage-discharge relationships must be preserved in order to maintain maximum



design storm water surface elevations in the ponding areas. Finally, system design features necessary for required operation, inspection, maintenance, and repair of both the interior drainage system and the project's flood protection measures must also be continued. Details of the proposed requirements within each system's drainage subarea are presented in the Protected Area requirements in Section 6.

### **5.3 Residual Flood Hazard Area**

In the Protected Area a new Flood Hazard Area, based on interior drainage analysis has been developed and is termed "FHA." This Residual Flood Hazard Area is the area that will continue to be inundated by the 100-year storm runoff after project construction. The 100-year storm was selected to be consistent with the frequency of storm used in the Unprotected Area for the National Flood Insurance Program. The additional 25% flow that the State requires for new development, was not included, since the implementation of Stormwater management rules and the regulations provided in this plan shall prevent increases from development or re-development. In the Protected Area, the Residual Flood Hazard Area is the area that will continue to be inundated by the 150-year storm runoff after project construction. In addition, the Residual Flood Hazard Area will continue to be inundated by the runoff from the 150-year flood event after project construction. These areas are used for storage of runoff from the Protected Contributory Area. The Residual Flood Hazard Areas in the Protected Area have been delineated and are shown on Figures 1 and 2. For each Residual Flood Hazard Area, both the 100-year base flood elevation and the 150-year flood elevations are shown on Figures 1 and 2. The 150-year flood elevations are shown on Figures 1 and 2. The 150-year level is shown for consistency with the overall project's level of protection. All information shown on these figures should be examined sufficiently so as to be fully understood, by all who live, work, own property or have an ownership and/or development interest in property in these areas.

### **5.4 Floodway**

There are no floodways within the Protected Area.

### **5.5 Levee Overtopping Hazard Analysis**

This analysis was performed to evaluate the areas that would have the least amount of damage if the levee were to overtop. The analysis identified the less developed areas at the most feasible downstream sections of the streams, including wetlands and parks where there would be the least amount of damage if flooding were to occur. Allowing the levee to overtop at these areas should decrease the amount of damage due to flooding and increase the warning time for evacuations. The overtopping areas have been identified on Figures 1 and 2 in Appendix B. All information shown on these figures should be examined sufficiently so as to be fully understood, by all who live, work, own property or have an ownership interest in property in the areas referred to.

### **5.6 Identification and Description of Natural Areas**

The natural areas behind the line of protection (on the protected side) include wetlands, parks, and open spaces. The wetlands have been delineated in the "Green Brook Flood Control Project, Wetland Delineation Report" dated March 2000. The wetland within the Protected Area consists of a narrow band along the eastern side of Middle Brook. At locations south of the Conrail Railroad (formerly Lehigh Valley Railroad) it widens to include a large floodplain extending from Interstate Route 287 and east along the Raritan River. Figures from the report above showing the wetland delineation are included in Appendix C.



Some of the other natural areas behind the levee include a park with a baseball field and playground. These natural areas need to be preserved in order to maintain the level of protection. These areas are important in reducing the risk of flood damage and supporting the natural habitats of species that are vital to this area. The levee would overtop first into these natural undeveloped areas prior to flooding the developed areas. Preserving these areas is essential to reducing flood damage.

## **SECTION 6: PROTECTED AREA REQUIREMENTS**

### **6.1 Floodplain Management**

In order to maintain the level of protection within the Protected Areas of Segments R, T, and U, various requirements for development and redevelopment projects within the Protected Area must be met. These requirements affect development and redevelopment projects within the following portions of the Protected Area:

- Protected Contributory Area
- Residual Flood Hazard Area
- Levee Overtopping Areas
- Pre-Project 100-Year Floodplain
- Interior Drainage Systems

The proposed requirements for land development and redevelopment projects within each of these areas are presented below. These requirements shall be adopted by each municipality and incorporated into existing or new land use, floodplain management, and/or stormwater management ordinances.

### **6.2 Protected Contributory Area**

Proposed land development and redevelopment projects within the Protected Contributory Area shown on Figures 3 and 4 must meet the following requirements:

- All flow paths to the various interior drainage system components must remain unobstructed for all flood events. These components include swales, storm sewers and inlets, ponding areas, levee and floodwall drainage structures, and pumping stations.
- Development and redevelopment activities within the Protected Contributory Area must not increase runoff rates or volumes to the project's interior drainage systems. Such increases can overload these systems and result in increased residual flooding levels and/or durations and a decrease in both the system's and the overall project's level of protection. Therefore, in addition to applicable stormwater management requirements promulgated by the State of New Jersey Departments of Environmental Protection (NJDEP) and Community Affairs (NJDC), no "major development" within the drainage subarea of a Segment's interior drainage system shall (a) increase subarea runoff rates or volumes or (b) decrease subarea Times of Concentration in such a way as to adversely impact the performance of the interior drainage system for all storm events up to and including the 150-Year storm. In accordance with the NJDEP's Stormwater Management Rules (NJAC 7:8), a "major development" is defined as any land development or redevelopment project that disturbs at least one acre of land or creates at least one quarter acre of new or additional impervious surface.

To insure compliance with this requirement, an applicant seeking approval of a major development within any Segment R, T, and U interior drainage system subarea must provide an engineering analysis performed by a licensed professional engineer that demonstrates such compliance to the Bound Brook Borough and/or Bridgewater Township Engineer or officially designated development application review engineer. This analysis may demonstrate compliance with the requirement through one of the following ways:

1. Demonstrate no change between pre- and post-development project conditions in the NRCS Curve Number (CN) and Time of Concentration (TC).
2. Demonstrate no change between pre- and post-development project conditions in the NRCS Curve Number (CN) and Time of Concentration (TC) of the interior drainage system subarea in which the development project is located. The existing subarea CNs and TCs used in the design of each interior drainage system are presented in Table 2 of Appendix A and on Figures 3 and 4.
3. Demonstrate through detailed computations and/or computer models that the proposed development project will have no adverse hydrologic and hydraulic impacts to the operation and performance of the interior drainage system to which the proposed development project drains. Data and models used in the original design of the interior drainage system may be obtained from the Bound Brook Borough or Bridgewater Township Engineer for use in such analyses. Where necessary and upon approval by the Bound Brook or Bridgewater Township Engineer, such analyses may also include proposed upgrades or expansions of the interior drainage system in order to offset or mitigate unavoidable increases in site runoff rate or volume adverse changes in subarea Time of Concentration (TC), adverse increases in residual flood levels, depths, or durations, and/or adverse impacts on interior drainage system operation, performance, or maintenance.

### **6.3 Residual Flood Hazard Areas**

The proposed requirements for development and redevelopment projects within the Residual Flood Hazard Areas address both residential and nonresidential structures and include the construction of new structures and the substantial improvements of existing structures. It should be noted that a substantial improvement is defined by current State and Federal regulations as any repair, reconstruction or improvement of a structure, where the cost exceeds or equals fifty (50 %) percent of the market value of the structure either before the improvement or repair is started or if the structure has been damaged and is being restored, before the damage occurred.

For the Residual Flood Hazard Areas, both the 100-year base flood and the 150-year flood water surface elevations are shown on Figures 1 and 2. It should be noted that the limits shown on the Figures are for information purposes only. In complying with the Residual Flood Hazard Area requirements presented below, the water surface elevations shown in the Figures shall be used in conjunction with a current topographic survey to determine the exact limits of the Residual Flood Hazard Area at a proposed development or redevelopment site.

With regards to the construction of new structures and the substantial improvement of existing structures within a Residual Flood Hazard Area, the following requirements must be met:

- For residential construction in Bridgewater Township, the lowest floor (including basement) must be at or above the base flood (100 year) elevation. This concurs with current Bridgewater Township floodplain management regulations.
- For residential construction in the Borough of Bound Brook the level of the lowest floor (including basement) must be one foot above the Residual Flood Hazard level which is the Residual Flood Hazard Area elevation shown on Figures 1 and 2. This concurs with current Borough of Bound Brook floodplain management regulations.

- For nonresidential structures in Bridgewater Township, the lowest floor (including basement) must be at or above the Residual Flood Hazard level or the structure, along with its attendant utility and sanitary facilities, must be floodproofed to the Residual Flood Hazard level.
- For nonresidential structures in the Borough of Bound Brook, the lowest floor (including basement) must be at least one foot above the Residual Flood Hazard elevation or the structure, along with its attendant utility and sanitary facilities, must be floodproofed to the Residual Flood Hazard level.
- For nonresidential structures in both municipalities, the floodproofing may include watertight doors or other devices at other openings and walls that are substantially impermeable to water. A registered professional engineer or architect may be required to certify the floodproofing. The floodproofing methods and certifications should be in compliance with the current National Flood Insurance Program, and Bridgewater Township and Borough of Bound Brook floodplain management regulations.

#### **6.4 Levee Overtopping Areas**

The Levee Overtopping Areas were established based on their location and land use. Wetlands, parks, and undeveloped areas were selected to receive the first impact in the event of the levee being overtopped. There are three designated overtopping areas.

The first designated overtopping area is an open space between Tea Street and the levee located along Middle Brook. It begins at approximately 150 feet north of the Dalay Place and Tea Street intersection, and extends 1200 feet southerly along the levee. (See Figure 2)

The second designated overtopping area is a designated wetland area in Segment R, along the Raritan River. This area coincides with the Flood Hazard Area in Segment R, and lies between the levee and the residences located to the north of the Raritan River. (See Figure 2)

The third designated overtopping area is Billian Legion Park located in Segment T. The overtopping begins at approximately the levee turning point at confluence of Vosseller Brook and Green Brook and extends 400 feet southerly along the levee. (See Figure 2)

No development shall be allowed within Levee Overtopping Areas with the exception of active and passive recreation and the enhancement of open space. All properties within the Levee Overtopping Areas shall be deed restricted to prevent any unallowable development or land use.

#### **6.5 Pre-Project 100-Year Floodplain**

For construction of new structures outside the Residual Flood Hazard Areas and Levee Overtopping Areas but within the limits of the Pre-Project 100-Year Floodplain shown on Figures 1 and 2, the following requirements must be met:

- The lowest elevation of all doorways and other exterior entrances to a structure floor (including basements) must be located at least one foot above the higher of the following: (a) ground surface measured immediately outside the doorway or other exterior openings, or (b) the elevation of the street located perpendicular to the opening.
- All first floor elevations (including basements) must either be located at least one foot above the lowest ground surface outside the exterior walls of that floor or the walls must be

floodproofed to an elevation at least one foot above that ground surface. Such floodproofing must render the exterior wall substantially impermeable to water. A registered professional engineer or architect must certify the floodproofing.

## **6.6 Interior Drainage Systems**

Interior drainage systems include 1) structural and operational components and appurtenances such as buildings, pumps, culverts, pipes, valves, swales, ponding areas, trash racks, linings, fences, and railings, and 2) features such as setbacks, buffers, access routes, and staging, storage, and operational areas needed for required system operation, inspection, maintenance, and repair.

The following requirements shall be met for any proposed activity affecting an interior drainage system, including land development and redevelopment projects, building construction, and substantial improvements of existing structures:

- Interior drainage system components and appurtenances as described above and system stage-storage-discharge relationships up to their maximum 150-Year flood levels should be preserved. If changes to these components, appurtenances, or relationships are proposed, it must be demonstrated through detailed analysis, computations, and/or computer models that the proposed changes will have no adverse impacts to the operation, performance, inspection, maintenance, and repair of the system. Interior drainage system design data and models are available from the Municipal Engineer for use in the analysis of such proposed changes. When preserving or proposing changes to an existing interior drainage system, the system's maximum 150-Year design water surface elevation shall be used in conjunction with a current topographic survey to determine the exact limits of the system's required runoff ponding area.
- Interior drainage system features as described above, for required system operation, inspection, maintenance, and repair, should be preserved. If changes to these features are proposed, it must be demonstrated that the proposed changes will have no adverse impacts to the operation, performance, inspection, maintenance, and repair of the system.

## **6.7 Soil Erosion and Sediment Control**

The current requirements for soil erosion and sediment control stipulate that an erosion and sediment control plan be prepared in accordance with New Jersey Standards for Soil Erosion and Sediment Control and submitted to the Somerset-Union Soil Conservation District before any land disturbance activities greater than 5,000 square feet take place. The current restrictions on soil erosion and sediment control will remain in place for the Protected Area, and any land disturbance activity will require approval from the Somerset-Union Soil Conservation District.

## **6.8 Preservation of Environmentally Sensitive Areas**

The new levee/floodwall system represents the most effective alternative for flood protection in the project impact area. Project elements have been designed with both the objectives of flood control and environmental protection in mind. New structures, and means of protecting them, were designed to minimize to the greatest extent possible any adverse affects upon the pre-construction character of the site, while providing the greatest degree of flood protection. While the implementation of this project has short-term negative impacts to the environment which

cannot be avoided or mitigated, the net positive impacts to public health, safety, and welfare in the long term are significant.

In addition to reducing the risk of flood damage, the Protected Area regulations, also help preserve environmentally sensitive areas by reducing pollutant and sediment loads and protecting the natural habitats of species that are vital to the environmental health of the region.

Freshwater wetland rules are described under NJDEP, NJAC 7:7A. These rules shall continue to be enforced by NJDEP in the Protected Area.

## **6.9 Emergency Services**

Emergency services currently provided for the project area shall continue to be provided by the State, County, and municipalities. In addition to the rain and waterway gages listed in Table 1 in Appendix A, the SCFIS computers also receive operating information from the Segment T and Segment R Pumping Stations in Bound Brook. This information, which includes wet well and receiving stream water levels as well as pump and slide gate operations, is used to remotely monitor pumping station operations and, in conjunction with rain and waterway information, to direct closure structure operation by County Public Works personnel. The Operation and Maintenance Manual developed for the project, addresses all drainage features, including pump stations and closure structures.

## **SECTION 7: ADMINISTRATION**

### **7.1 General**

NJDEP regulates flood hazard areas under the New Jersey Flood Hazard Area Control Act N.J.S.A. 58:16A 50 et seq. that is implemented by regulation NJAC 7:13 et seq. The affected municipalities are required to adopt this Floodplain Management Plan in its entirety and the provisions contained therein, by means of either amending existing land use, floodplain, or stormwater management ordinances or resolutions or by adopting new ones. Each municipality shall administer and enforce the provisions of the adopted floodplain management ordinances and resolutions.

The municipalities shall maintain for public inspection all records pertaining to the review of development and building permit applications to insure that the requirements of this Floodplain Management Plan have been satisfied. The municipalities shall also make sure that all necessary permits have been obtained from those Federal, State, County and local government agencies from which prior approval is required.

### **7.2 Variance and Exception Procedure**

Any person believing that the requirements of this Floodplain Management Plan would result in unnecessary hardship may file an application with the affected municipality for a variance. The municipalities and counties shall have the power to authorize, in specific cases conditional upon NJDEP approval, a variance from the requirements of this Floodplain Management Plan. The municipality and county shall approve or disapprove the variance request after examining the hardship request. Such variances shall not be inconsistent with Federal and State regulations, and will not be contrary to the public interest where, owing to special conditions of the lot or parcel, a literal enforcement of the provisions of the plan's requirements would result in unnecessary hardship.

## APPENDIX A

Definitions

Special Flood Hazard Zones

Abbreviations

Reference Documents

Table 1 - Somerset County Flood Information System (SCFIS)  
Gages in Project Area

Table 2 - Drainage Sub-Areas Parameters



## **DEFINITIONS**

**Base Flood** – The flood having a one percent (1%) chance of being equaled or exceeded in any given year.

**Delineated waterways** - A waterway or stream that has a delineated floodway officially adopted by the New Jersey Department of Environmental Protection and published in the New Jersey Register.

**Flood** – A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters and/or, the unusual and rapid accumulation or runoff of surface waters from any source.

**Flood Fringe** – The portion of the Flood Hazard Area not designated as the floodway.

**Flood Hazard Area (FHA)** – The floodway and the flood fringe area of a delineated stream.

**Flood Hazard Area Design Flood** – The 100-year storm in non-delineated areas and the 100-year storm plus 25 percent of the 100-year flow in the delineated areas.

**Flood Hazard Design Elevation** – The elevation of the Flood Hazard Area design flood.

**Flood Insurance Rate Map (FIRM)** – Official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

**Flood Insurance Study (FIS)** – Official report in which the Federal Insurance Administration has provided flood profiles, as well as the flood boundary and floodway map and the water surface elevation of the base flood.

**Floodplain Management Regulations** – Zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances and other applications of police power. The term describes such state or local regulations, which provide standards for the purpose of flood damage prevention and reduction.

**Floodplain** – same as Flood Hazard Area

**Floodproofing** – Any combination of structural and nonstructural design features, additions, changes or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

**Floodway** – The channel of a river or other water-course and the adjacent land areas that must be reserved in order to carry and discharge the base flood without cumulatively increasing the water surface elevation more than 0.2 foot.

**Levee Overtopping Area** - Area that will be flooded first if the River or Brooks overtop the flood control measures during floods that exceed the level of protection.

**Non-delineated watercourse** - Waterways or streams that have not been officially adopted by the State of New Jersey.

**Pre-project 100-year Floodplain** - Areas inundated by the 100-year flood prior to the construction of the Project that will be protected by the Project's flood control measures.

**Protected Area** – Area that is located within or behind the various structural flood control measures that protect this area from riverine flooding.

**Protected Contributory Area** - Area that contributes runoff to interior drainage systems behind the flood control measures.

**Unprotected Area** - Areas not protected by the flood control measures.

**Residual Flood Hazard Area** - Area that will continue to be inundated by 150-year storm runoff after project construction. Used for storage of runoff from Protected Contributory Area.

**Restricted Use** – Any flood fringe use which requires a restricted use permit from the municipality.

**Special Flood Hazard Area** – The land in the floodplain within the community subject to a one-percent or greater chance of flooding in any given year.

**Substantial improvement** – Any repair, reconstruction or improvement of a structure, where the cost exceeds or equals fifty (50 %) percent of the market value of the structure either before the improvement or repair is started or if the structure has been damaged and is being restored, before the damage occurred.

## **SPECIAL FLOOD HAZARD ZONES:**

### **Zone A**

Zone A is the flood insurance rate zone that corresponds to the Flood Hazard Areas that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations (BFE's) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

### **Zone AE and A1-A30**

Zones AE and A1-A30 are the flood insurance rate zones that correspond to the Flood Hazard Areas determined in the Flood Insurance Study by detailed methods. In most instances, BFEs derived from the detailed hydraulic analysis are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

### **Zones B, C, and X**

Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the Flood Hazard Areas, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No BFEs or depths are shown within this zone.

## ABBREVIATIONS

BFE	- Base Flood Elevation
CFR	- Code of Federal Regulations
CN	- Curve Number
CRS	- Community Rating System
DFIRM	- Digital Flood Insurance Rate Map
DMA	- Disaster Mitigation Act of 2000
FEMA	- Federal Emergency Management Agency
FHA	- Flood Hazard Area
FIA	- Federal Insurance Administration
FIMA	- Federal Insurance and Mitigation Administration
FIRM	- Flood Insurance Rate Map
FIS	- Flood Insurance Study
FMA	- Flood Mitigation Assistance program
FPMP	- Floodplain Management Plan
GRR	- General Reevaluation Report
HEC-IFH	- Hydrologic Engineering Center, Interior Flood Hydrology
HEC-1	- Hydrologic Engineering Center, Flood Hydrograph Package
HMGP	- Hazard Mitigation Grant Program
HUD	- Housing and Urban Development
LOMA	- Letter of Map Amendment
LOMR	- Letter of Map Revision
LOMR-F	- Letter of Map Revision based on Fill
NFIP	- National Flood Insurance Program
NFIRA	- National Flood Insurance Reform Act
NJAC	- New Jersey Administrative Code
NJDEP	- New Jersey Department of Environmental Protection
NRSCS	- National Resource Conservation Service
OEM	- Office of Emergency Management
OPAs	- Otherwise Protected Areas
PCA	- Project Cooperation Agreement
PGL	- Policy Guidance Letter
RSIS	- Residential Site Improvement Standards
SFHA	- Special Flood Hazard Area
SFIP	- Standard Flood Insurance Policy
SCFIS	- Somerset County Flood Information System
TB	- Technical Bulletin
TC	- Time of Concentration
USACE	- United States Army Corps of Engineers
WRDA	- Water Resources Development Act of 1996

## REFERENCE DOCUMENTS

The following documents were used as references in developing this Plan:

- USACE Floodplain Management Plan Policies (PGL No. 52)
- NFIP Floodplain Management Regulations (44 CFR Parts 59 & 60)
- NJDEP Flood Hazard Area Control Act Rules (NJAC 7:13)
- NJDEP Stormwater Management Rules (NJAC 7:8)
- NJDEP Freshwater Wetlands Rules (NJAC 7:7A)
- NJDCA Residential Site Improvement Standards (NJAC 5:21)
- County Stormwater Management Regulations and Plans
- Borough Bound Brook and Township of Bridgewater Floodplain Management Ordinances
- Borough Bound Brook and Township of Bridgewater Stormwater Management Ordinances
- Borough Bound Brook and Township of Bridgewater Zoning Ordinances
- Interviews with Borough Bound Brook and Township of Bridgewater Emergency Management Department.
- Project Information:
- <http://www.nan.usace.army.mil/business/prjlinks/flooding/greenbk/index.htm>
- Green Brook Flood Control Project - General Reevaluation Report (GRR), 1997
- Green Brook Flood Control Project - Wetland Delineation Report, March 2000

**Table 1 – Somerset County Flood Information System (SCFIS)  
Gages in Project Area**

Gage Type	Waterway	Location
Rain	Raritan River	Bound Brook
Rain	Middle Brook	Bridgewater
Rain	West Brook of Middle Brook	Bridgewater
Rain	Green Brook	Green Brook
Rain	Green Brook	Watchung
Rain	Green Brook	Mountainside
Rain	Stony Brook	North Plainfield
Rain	Stony Brook	Watchung
Rain	East Branch of Stony Brook	Watchung
Waterway	Raritan River	Bound Brook
Waterway	Middle Brook	Bound Brook
Waterway	Green Brook	Green Brook
Waterway	Green Brook	North Plainfield
Waterway	Green Brook	Watchung
Waterway	Stony Brook	North Plainfield
Waterway	Stony Brook	Watchung

**Table 2- Drainage Sub-Areas Parameters**

Sub-Area*	Area (Acres)	Overall CN	Tc (hours)
1ML3	26	71	0.32
2ML3	26	87	0.32
3ML3	14	86	0.19
4ML3	10	82	0.23
5ML3	17	85	0.71
1ML2	29	90	0.23
2ML2	28	82	0.82
1RL1	74	88	0.82
2RL1	76	86	0.41
3RL1	19	86	0.68
4RL1	58	85	0.51
1GR1	69	86	1.25
1GR1VOS	20	84	0.19

Notes:

- 1) Areas are based on HEC-1 hydrologic models, and are approximate.
  - 2) The actual HEC-1 models use Clark unit graphs. NRSCS unit graphs were developed based on the CN and Tc values in these tables and the two unit graphs were found to be consistently close.
  - 3) See abbreviation descriptions on Pg A-4
- \*See Figures 3 and 4 for Sub-Area designations.

## APPENDIX B

Figure 1 - FPMP-1: Floodplain Management Plan Residual Flood Hazard  
Area Pre-Project 100-yr floodplain

Figure 2 - FPMP-2: Floodplain Management Plan Residual Flood Hazard  
Area Pre-Project 100-yr floodplain

Figure 3 - FPMP-3: Floodplain Management Plan  
Contributory Area

Figure 4 - FPMP-4: Floodplain Management Plan  
Contributory Area



## APPENDIX C

### **WETLAND DELINEATION MAPS:**

WT-1: Green Brook Flood Control Project Segment T  
Borough of Bound Brook, New Jersey

WT-2: Green Brook Flood Control Project  
Borough of Bound Brook, New Jersey

WT-3: Green Brook Flood Control Project  
Borough of Bound Brook, New Jersey

WT-4: Green Brook Flood Control Project  
Borough of Bound Brook, New Jersey

WT-5: Green Brook Flood Control Project  
Borough of Bound Brook, New Jersey

WT-6: Green Brook Flood Control Project  
Borough of Bound Brook, New Jersey

## **Appendix C: Wetland Delineation Maps**

The Wetland Maps (WT-1 through WT-6) enclosed are the original maps prepared by the USACE in April 2000. These maps are subject to updates as the various segments of the project are permitted and completed.

Revisions to these maps will include the following:

1. Legend Updates
2. Miscellaneous Notes/Clarifications, including the Horizontal and Vertical Datum References.
3. Updates to the delineations as needed to reflect as-permitted conditions.

The updated wetlands maps, when completed, will be issued as an addendum to the Report.