CITY OF ELIZABETH

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City of Elizabeth
Hazard Mitigation Plan – Natural Hazards

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Elizabeth, New Jersey

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1.0 INTRODUCTION

The Hazard Mitigation Plan (the Plan) for the City of Elizabeth (Elizabeth or the City), Union County, New Jersey, is a single jurisdiction Plan that has been developed through a cooperative effort with local members and its governing bodies. The current update effort for this Plan represents a comprehensive effort by the City to continue pre-disaster mitigation planning and implementing actions to reduce vulnerability and potential losses from future disasters.

From the October 2010 "*Local Mitigation Plan Review Guide*":

"Hazard mitigation *is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards (44 CFR 201.2). Hazard mitigation activities may be implemented prior to, during, or after an event. However, it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs."*

Therefore, hazard mitigation would be any cost-effective and sustained action(s) that reduces long-term risk to human life, property, and infrastructure from hazards. While hazard mitigation activities are usually implemented before a disaster occurs, it is often after a disaster that repair and reconstruction are completed by simply restoring damaged areas to pre-disaster conditions. The implementation of this Plan would lead to, and continue to build stronger, safer and smarter developments prior to and after any disaster. Being prepared and proactive before and after any disaster will lead to long-term sustainability.

1.1 BACKGROUND

The City of Elizabeth is located in the eastern corner of Union County. It is bordered by the City of Newark in Essex County to the north; the City of Bayonne in Hudson County to the northeast; Staten Island in Richmond County, New York to the southeast; Roselle Park Borough in Union County to the west, Roselle Borough in Union County to the southwest, the City of Linden in Union County to the south; and Hillside Township and Union Township to the northwest. Elizabeth encompasses approximately 12.32 land square miles. Figure 1-1 provides the location of Elizabeth within Union County and within the State of New Jersey; Figure 1-2 provides a recent Aerial Map of the City.

Elizabeth is characterized by a mix of suburban and urban areas and has a well-developed local transportation system with both residential, commercial and industrial businesses. Elizabeth has experienced varying disasters, including Presidential-declared disasters, in recent years ranging from significant snowstorms, to hurricanes/flooding, to industrial hazardous materials incidents. Given the geographic location and character of Elizabeth, it is vulnerable to natural disasters and hazards, specifically flooding from large storms. Any disasters or hazard events would have the potential for loss of life as well as to cause economic hardship to the City and ajoining neighbors. As a result, Elizabeth, independent from Union County and other municipalities, has developed and adopted its own Plan. An approved Plan would also allow the City to be eligible for future FEMA funding. Please note that although the City is independent of Union County, the City will make efforts to be involved with the County and adjoining neighbors.

Figure 1-1 City of Elizabeth – State and County View
Source: Wikipedia

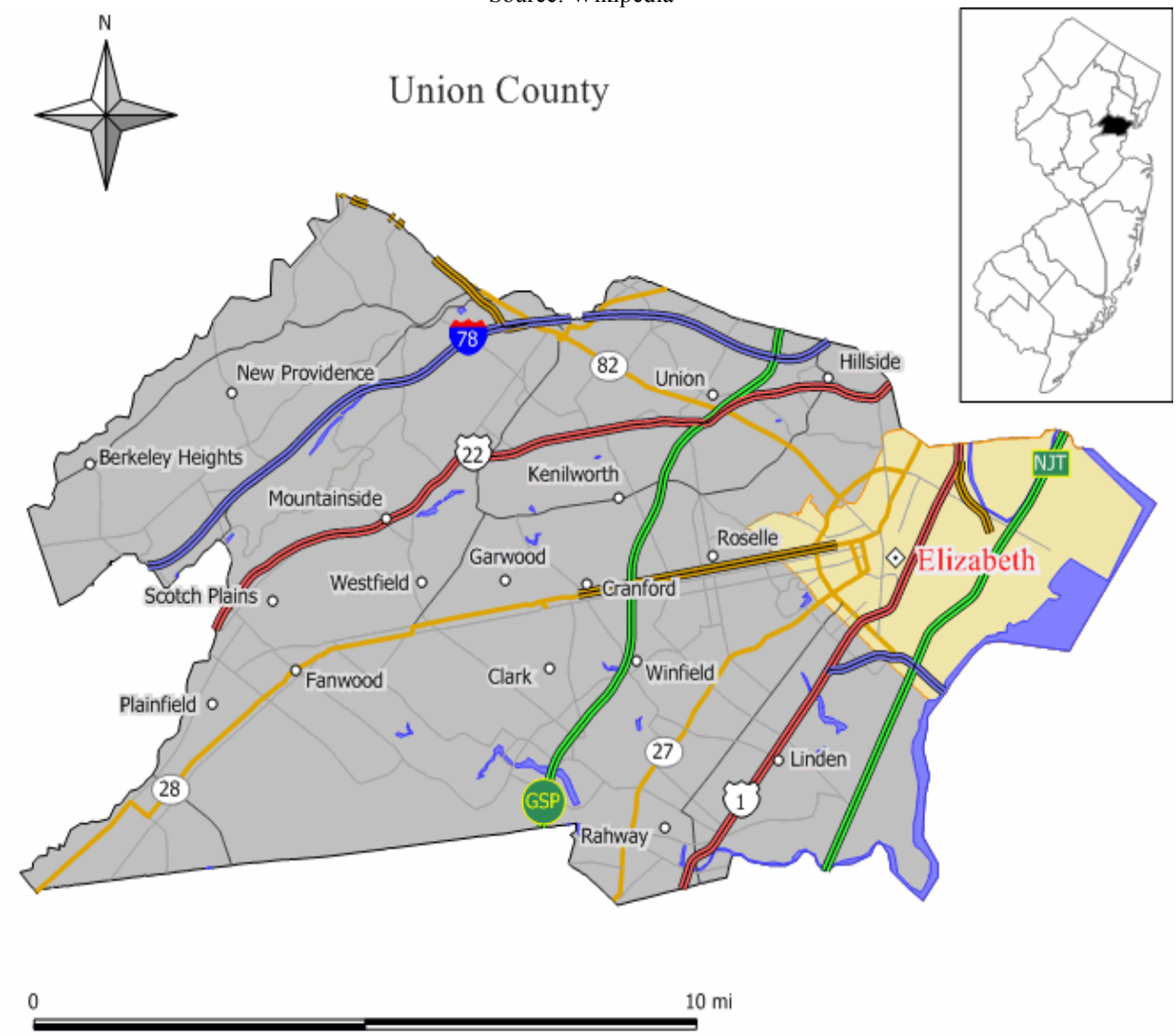


Figure 1-2 Aerial Map of Elizabeth
Source: 2015 Google Earth Pro

Hazard mitigation is defined as any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Thus, hazard mitigation can include a wide-range of actions such as retro-fitting transportation elements (e.g., roads, bridges and tunnels), structures and buildings; modify or adopt new buildings codes, administer sound land development strategies; and develop and implement preparedness planning. Most importantly, hazard mitigation is performed prior to the occurrence of a potential disaster and represents a proactive approach to disaster and overall emergency management. The development, adoption and continual update of this Plan establishes a broad vision with clear objectives to eliminate or reduce risk and vulnerabilities specific to the City's entire vulnerable population.

1.2 PURPOSE

The purpose of this Hazard Mitigation Plan is to provide a tool and proactive living document to reduce risk and vulnerability from potential natural diasters. Proactive mitigation actions and natural diaster preparedness will increase the City's resiliency and sustainability, thereby allowing the City to recover faster and with less ecomonic damage and loss. Through the use of this document with other internal planning documents, the City will demonstrate their continual efforts to provide and increase public safety, health and welfare. The City continuals to assess, prepare, and implement Citywide mitigation actions that will comntinue to protect human life and property and reduce future expenditures and hardships in the event of any natural disaster. This Plan incorporates hazard mitigation principles and practices into local government policies and functions of the City. The City is committed to reduce risk and hazard vulnerability by adopting, updating and implementing this Plan. Since the Plan is a living document, it shall be updated on an as needed basis and on a 5-year FEMA update schedule, as specified in the Plan Maintenance Program. The primary objectives of the Plan are:

- To protect human life, safety and property by reducing potential future harm caused by natural hazards;
- To reduce and minimize future damages and economic losses resulting from natural hazards;
- To increase resiliency and sustainability, therefore, hastening recovery and redevelopment following every disaster or natural hazard event;
- To maintain critical facilities (i.e., hospitals and bridges), power infrastructures, and traffic circulation in functioning order during and after a disaster or hazard event; and
- To obtain funding in both pre-disaster and post-disaster situations to continue serving and protecting the City's vulnerable population from natural hazards.

The City provides practical information within this document to achieve resiliency and sustainability, therefore, striving towards a more stable community before, during and after any natural hazard event. FEMA, in their document entitled "*Integrating Hazard Mitigation Into Local Planning",* has noted that "*Resilience is the ability to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption. Sustainability is the capability to equitably meet the vital human needs of the present without compromising the ability of future generations to meet their own needs*." and "*The goal of Safe Growth is to build environments that are safe for current and future generations and to protect buildings, transportation, utilities, and the natural environment from damage.*" The City's ultimate goal with this document is to develop and maintain preparedness to any natural hazard, but specifically flooding from inland and coastal storms. Implementing and updating this Plan will help reduce risk and vulnerability Citywide based on the most up to date information available for natural hazard mitigation, planning and for prioritizing funding to protect the citizen of the City.

1.3 AUTHORITY

FEMA has been authorized by Congress to make grants available to states for mitigating natural disasters pursuant to the provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 USC 5121, et seq. (Stafford Act), as amended, and, with reference to the planning process, as enacted by Section

104 of the Disaster Management Act (DMA) of 2000 (DMA 2000). The New Jersey Office of Emergency Management (NJ OEM) has been awarded grant funds in support of that goal and, as the duly designated Grantee, NJ OEM has the authority to receive, administer and disburse FEMA mitigation funds for local government mitigation projects. Once this updated Plan is approved by FEMA, Elizabeth will be eligible for project funding going forward.

This Plan has been developed in accordance with FEMA regulations and in cooperation with both FEMA and NJ OEM. FEMA's regulations and procedures require a full evaluation of natural hazards which are to be assessed within the Plan and updated as necessary to accomplish current and future projects to mitigate potential natural hazards. This updated Plan shall be adopted once approved and the corresponding municipal resolution adopting the updated Plan shall be provided in Appendix A.

2.0 ORGANIZATION OF DOCUMENT

This Hazard Mitigation Plan (the Plan) developed on behalf of the City of Elizabeth, New Jersey, is organized into ten (10) Sections. The Plan includes an Executive Summary, which provides a summary of the comprehensive planning process and effort undertaken by Elizabeth. The Executive Summary also sets forth a series of goals, objectives and mitigation actions, which results from the collaborative planning effort and commitment to this endeavor.

Section 1 provides the background and the basis for the preparation and update of this Plan. Further, Section 1 documents the participation of Elizabeth and the approval of the updated Plan by the municipality.

Section 2 explains the organization of the Plan and provides a brief summary of the type of information presented in each Section. This Section is intended to facilitate review and/or consultation of this document by a wide-variety of readers.

Section 3 provides a description of the overall planning process, including public/community involvements and a list of current stakeholders. This Section provides a discussion of the 2014/2015 community public notices and meetings that did not draw any comments. Because of this, the City will establish future efforts to be undertaken to draw out more participation from the community and neighborhoods and new stakeholders. For example, the City now provides a dedicated web page (http://elizabethnj.org/hazard-mitigation-plan) that can be accessed for submitting ongoing public comments.

Section 4 presents a profile of Elizabeth to establish existing conditions. This Section provides information ranging from history to demographics, to existing land use and infrastructure, and provides a full characterization of Elizabeth as a whole as well as the individual nature of each district/community within the City.

Section 5 identifies and describes the potential natural hazards, which are likely to impact all or part of Elizabeth as the whole population is considered vulnerable to natural hazards. The hazard identification forms are the foundation for the risk assessment element of the Plan and allows for the development of an appropriate mitigation strategy. This Section documents the sources used to identify hazards, and discusses the hazard ranking process, which was used to eliminate and rank hazards. This Section also provides information related to past occurrences of hazard events and the geographical locations of past hazard events and potential hazards and areas within Elizabeth as well as a discussion of the severity of each hazard.

Section 6 describes the vulnerability of the entire City to each identified hazards through an assessment of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas. The future conditions described in this Section are based upon development trends, as established by Elizabeth. As appropriate, the Section distinguishes between the vulnerability of different areas within Elizabeth and notes if certain areas are more vulnerable to specific hazards, noting that some secondary impacts are also very serious. This Section assesses vulnerability related to existing conditions as well as likely future conditions and, as possible, identifies special populations at risk, such as the elderly, disabled, or others with special needs, which may be at increased risk. To the extent possible, the updated Plan describes potential financial impacts to identified vulnerable structures and facilities.

Section 7 presents and discusses the capabilities of Elizabeth to implement actions before, during and after any natural hazard to include mitigation actions completed and planned. The Capability Assessment included the assessment of internal City departments unifying to provide the overall natural hazard preparedness and to ensure the development of a comprehensive mitigation strategy moving forward. As per FEMA's guidance, the Capability Assessment includes the identification of existing municipal mitigation activities, regulatory standards and planned projects, resulting in the integration of mitigation strategies with comprehensive planning and capital improvement programs ongoing and proposed.

Section 8 presents the mitigation strategies developed through the risk and vulnerability assessments. The strategies set forth the goals and objectives of Elizabeth and establishes the methods to be used to avoid or reduce vulnerabilities to identified hazards. This section describes the selection process and re-identifies the list of potential mitigation efforts with an overall planning strategy. The strategy outlines the logistics of implementation, based on available funding source(s) and the responsible entity for implementation each mitigation effort planned. From this initial list generated for the 2009 Plan, only 4 "Exisitng" projects remain and 30 new projects have been added to ensure hazard mitigation is a priority.

Section 9 sets forth the Plan Maintenance Program, which includes both an annual review and a five-year review. The Plan Maintenance Program is established to ensure that the Plan remains relevant and addresses changing conditions as well as to facilitate incorporation of the Plan into municipal planning documents and strategies. In addition to the annual and five-year review, this Section also establishes a montioring, evaluating and updating review system, which will be utilized subsequent to the occurrence of a federal or state "declared disaster". Each of the established maintenance programs (annual, five-year and post-disaster) includes actions to ensure continued public participation.

Section 10 documents the Plan adoption process.

3.0 PLANNING PROCESS

This Section provides a description of the overall planning process consisting of the following primary elements: continual assessment of the Plan and planning area; the implementation of identified resiliency upgrades and schedules for upgrades based on identified rankings and available funding; and updating any new or replacement members of the Hazard Mitigation Planning Committee (Planning Committee – current 2015 members are listed in Table 3-1 below). The Plan maintenance process will continue to include public announcements on the City's new dedicated website encouraging public participation, involvement, and commenting as the entire community is considered a vunerable population unit, especially for flooding which would impact to all social and econimic populations within the City. At a minimum, the local communities, along with adjoining municipalities and County will be given opportunities to comment on the City's website with a link to the updated Plan. The City will also increase outreach efforts to communicate to the public and neighboring communties.

The City continues maintenance and planning of their comprehensive hazard mitigation program that would include enhanced education efforts, review new policies and programs to increase resiliency, and improve planning processes that may include revised evacuation and notification procedures (i.e., broadcast emails and/or phone calls with emergency messages) or other methods to reduce the vulnerability of individuals, families, households, businesses, infrastructure and critical facilities from adverse impacts from potential natural hazards. Planning may include:

- Education and Outreach
- Re-assess Planning and Review New Studies
- Implement New and/or Revise Policy Development
- Implement Projects Involving Flood Mitigation
- Implement Projects Involving Structural Mitigation
- Add New or Revise Stormwater and Wastewater Policies and Projects
- Continue Training within the City and possibly with Neighbors (Municipalities and Counties)
- Develop Effective Communication with Public and adjacent Communities.

The City's planning process included a pre-Plan update Committee Meeting on December 9, 2014. The meeting consisted of members of the Department of Public Works, Engineering, Planning, Police, Fire, Health, Housing and Construction. Pre-designed questionnaires were used to draw out concerns, comments and rankings of hazards and to identify potential project needs/upgrades by various departments prior to the meeting. During the meeting, members of the various departments discussed issues they felt were important to hazard mitigation and the Plan. A list of mitigation projects and measures were developed and recorded and updated in the Plan. As a result, all of the locations listed in this 2015 updated Plan are current proposed and ranked Mitigation Projects (refer to Table 8-1) specific to minimizing flood, loss of power, and storm surge damages. FEMA's Planning Process Worksheets are also located in Appendix C for the City to reference or utilize.

3.1 THE PLANNING AREA AND COMMUNITY SUPPORT

The planning area has been defined as the entire political jurisdiction of the City of Elizabeth, New Jersey. Based on several Rutgers University publications, the entire City is considered to be vulnerable to various impacts from potential natural hazards and therefore the entire City is the Planning Area.

A publication entitled, "*Strategies for Flood Risk Reduction for Vulnerable Coastal Populations along Arthur Kill at Elizabeth, Linden, Rahway, Carteret and Woodbridge*", Final Report, August 2014, indicates the City is a vulnerable population due to direct and indirect impacts to the whole population. These impacts may consist of loss and/or deterioration of power supply (e.g., gas and electric), loss of traffic circulation/control, inability to obtain food and water and other necessary supplies, and even loss of residency due to flooding events.

In another Rutgers University publication entitled "*Vulnerable Populations to Climate Change in New Jersey",* by Kelly M. Bickers (updated in February 2014), the study narrowly focused on social vulnerability using the Social Vulnerability Index 2006-2010 (SoVI), Hazards & Vulnerability Research Institute, 2013 method to assess and idenifiy characteristics of socially vulnerable groups . This publication indentified high vunerable populations which are specific to New Jersey. The study identified three significant factors 1) Family Structure; Race and Socioeconomic Status; 2) Linguistic Isolation; Ethnicity and Population Density; and 3) Age. High vulnerability to these populations would be "*a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and is adaptive capacity (Intergovernmental Panel on Climate Change, 2007, p.6)*" and expressed by tracts that fall within the top 20% of any one of the three significant factors identified above or having an unique vulnerable variable.

The results indicated that Union County had 32 census tracts out of 108 (~30%) with 2 or more vulnerable factors or unique vulnerable variables catergorizing populations as having "*High Social Vulnerability*". Extrapulating from "*Figure 7. Summary of High Social Vulnerability Areas in New Jersey*", the City is entirely mapped within at least one identifed significant factor for having high social vulnerability to a natural hazard. The publication included studying Superstorm Sandy and the impacts of flooding on socially vulnerable groups in New Jersey. The areas of likely flooding coincided with concentrations of Factor 2, Linguistic Isolation; Ethnicity and Population Density. Factor 2 is the predominant significant factor affecting the majority of the City's vulnerable population, with Factor 1, Family Structure; Race and Socioeconomic Status nearly a co-dominant factor, and Factor 3, Age, is a minor to moderate vulnerabilty factor for the City. Factors 1 and 2 were also dominant factors in the "*Sandy Surge Extent"* and "*Floodprone Land*" assessments for vulnerable populations impacted using the Social Vulnerability Index method of study.

As stated throughout this Plan, the City utilizes available technical documents to evaluate risks and vulnerable populations with public outreach actions such as public meetings. Elizabeth has established planning priorities and schedules based on upcoming maintenance years that may include scheduling meetings with the Chamber of Commerce, meetings with local and adjacent residents (including Union County) , and public informative workshops at the library, senior centers and recreation centers. Also, the Plan would be available for public review from the dedicated Plan Internet site and at the public Library.

Notices will also be posted throughout the City's public areas letting the public know of the new approved Plan and a process for the public to comment on the Plan at any time. The following link will allow public access to the current Hazard Mitigation Plan:

http://www.elizabethnj.org/sites/default/files/pdf/HazardMitigationPlan_4June2015_Elizabeth(6.04.15).pdf

Currently, community support is marginal and the City is aware that active outreach strategies will have to be implemented to attain stronger community participation and support. In Section 3.4 below, some methods of outreach are outlined and the City will review FEMA's "*Local Mitigation Handbook*", specifically the section entitled *"Task 3 –Create an Outreach Strategy",* for discussions in future Planning Team meetings so that over time, community participation and support will strengthen within the City.

3.2 THE CITY OF ELIZABETH PLANNING TEAM

Table 3-1 below identifies the 2015 City of Elizabeth Planning Team members along with governmental departments and titles within the coresponding individual departments. The various City agencies listed below have been updated and have the authorities to regulate policies/programs, administer resilency activities and make decisions to improve on future developments, policies and programs.

Table 3-1 The Planning Team

Name	Title	Department
John F. Papetti Jr.	Director	Public Works
Daniel J. Loomis	City Engineer	Public Works - Engineering
Albeiro Hincapie Jr.	Assistant to the City Engineer	Public Works - Engineering
Steven P. Rinaldi	City Land Surveyor	Public Works - Engineering
Eduardo Rodriguez	Director	Planning and Community Development
Bridget Zellner	Business Administrator	Administration
Raywant Sarran	Floodplain Manager/Construction Code Official	Housing and Construction
Randy Moscaritolo	Assistant Health Department Official	Department of Health
Mark Colicchio	Health Department Official	Department of Health

Patrick Shannon	Chief of Police and Emergency Operations Coordinator	Police Department
James Cosgrove	Police Director	Police Department
Alexander Sofianakos	Deputy Chief	Police Department
Onofrio Vitullo	Director	Fire Department
Dan Campbell	Deputy Chief	Fire Department

The Planning Team established the following action items to continue Plan maintenance processes:

- Planning meeting schedules on a pro-active as-needed basis beginning in 2016 at City Hall;
- Identify and update projects completed from those listed in the current Plan and those projects that are in the pipe line and new projects proposed to continual hazard mitigation planning; and
- Process information gathered from handouts/questionnaires, responses by municipality departments and public and summarizes responses/comments for meeting discussions. Action items will be noted and implemented by corresponding Team member and reviewed during future Planning Committee meetings. Public meetings were held and will continue to be scheduled as part of the maintenance and ongoing planning process. Continuing efforts will be made to increase public attendances and commenting. Surveys may be developed and handed out to the public in various City events, such as annual festivals, parades, expos and carnivals.

3.3 PLAN PREPARATION AND UPDATES

The Hazard Mitigation Plan as updated is a community specific effort by the City of Elizabeth and its success rests on the decisions and directions set by the Planning Team representatives through Plan preparations, implementations and maintenance. The Planning Team continues to review the status of past and current mitigation actions, identify alternatives and ultimately select and prioritize mitigation projects that maximizes the money spent to reduce risk and improve diaster resiliency for the entire population.

Hatch Mott MacDonald (HMM) has identified and profiled natural hazards using HAZUS 2.2 (updated event runs in 2015 using 2010 current Census data). HMM also identified and characterized existing and potential future probabilistic risk to help the City to identify vulnerabilities; identify/modify land uses and to identify development trends located in flooding areas. The City guides the Planning Committee in terms of selection of goals, objectives, actions, and prioritization of strategies; resulting in this updated Hazard Mitigation Plan. Within the City limits, priorities are focused on reducing the magintude and duration of flooding, thereby reducing damages and recovery efforts/time. Flooding causes other major damages such as electric and gas power outages, water and wastewater impacts, road and bridge damages and other infrasture damages such as utility structures. This flood minimization priorty is unlikely to change since

flooding in the City is the core hazard, however, depending on future hazard impacts and available funding, project prorities may change or be shuffled to maximize the City's overall hazard mitigation efforts.

As part of the Plan preparation and update process, the City has identified past (completed), current and future flood mitigation projects below. There are projects in the list have have stalled due to funding and priority re-evaluations over the past years. All listed projects would decrease flood risk and population vulnerabilty if the planned improvements are completed. All new construction over the past 5 years were built in accordance with the Flood Damage Prevention ordinance which requires the use of FEMA's best available data for construction within SFHAs. Floodplain and building code enforcement is handled through the issuance of construction permits. Though the City has not participated in any Blue Acres initiatives to remove houses from flood prone areas, there may be opportunities to do this in future years. Also, future hazard events may dictate funding allocation.

The City has completed a large number of mitigation projects improving the City's resiliency to flooding and decreasing the City's vulnerability to natural diasters. The past, current and future flood mitigation projects are identifed below:

I. <u>Completed Hazard Mitigation Projects:</u>

- ***Harding Road Improvements (2007)***

  This project generally consists of improvements to the existing combined sewer, construction of a new 36" diameter combined sewer and other drainage improvements on Harding Road between Browning Avenue and Park Avenue.

- ***Great Ditch Dredging Project (2008)***

  This project involved the dredging within Great Ditch to provide improved drainage storage along a highly industrial section of the City of Elizabeth near Dowd Avenue, Newark Liberty International Airport (EWR) and Interchange 13A of the New Jersey Turnpike.

- ***Verona Avenue Storm Sewer and Pump Station (2009)***

  This project generally consists of the construction of a stormwater collection system, pump station and other drainage improvements to alleviate localized flooding in the area of Verona Avenue and Gebhardt Avenue near the City Line with Union Township/Kean University.

- ***Summer Street Storm Drainage Improvements (2010)***

  Project consists of construction of approximately 50 LF of 42", 1,590 LF of 30", 170 LF of 16" and 240 LF of 10" storm sewers to alleviate flooding along Summer Street.

- ***Midtown Infrastructure Improvements CSO Abatement (2011)***

  This project will construct and or reconstruct the storm and sanitary sewer system including sewer separation within the Midtown area on portions of the following streets:

Murray Street, Sterling Place, Price Street, Union Street, West Grand Street, Crane Street, Julian Place, Harrison Street, West Jersey Street and Westfield Avenue.

- ***South Street Bridge Flood Control Project (2012)***

  This project consists of drainage improvements for the low area of South Avenue

- ***North Avenue Flood Control Project (2012)***

  This project consists of drainage improvements for the low area of North Avenue beneath the railroad bridge between Pennsylvania Avenue and Jefferson Avenue. The installation of drainage pipe will extend along Madison Avenue to Fanny Street.

- ***Westfield Avenue/Elmora Avenue Sewer Improvements (2012)***

  The scope of work included the replacement of approximately 2,500 linear feet of brick combined sewer with 54" and 48" diameter fiberglass reinforced sewer along Westfield Avenue, Park Avenue and through McPherson Park. Work in the intersection of Westfield Avenue and Elmora Avenue included open cut excavation and support of an active 100 year old 42" brick interceptor sewer owned by Joint Meeting of Essex and Union Counties. Approximately 262 linear feet of the 42" brick sewer received a cured in place structural liner. Additional work included drainage improvements on Park Avenue and Bellwood Place.

- ***Third Avenue Flood Control Project – Phase I (2013)***

  Phased flood modifications to city sewer lines along Third Avenue to improve flood risk.

- ***Fairmont Avenue Sewer Project (2014)***

  This project consisted of the construction of a dedicated storm sewer and other stormwater improvements along Fairmount Avenue between Spring Street (U.S. Routes 1 and 9) and Division Street. The construction cost was $2,038,169.

- ***Park Avenue Sewer Flow Metering (2014)***

  The scope of services will provide for the installation of three (3) flow velocity meters along Park Avenue in the existing 48 inch brick sewer for a period of four (4) weeks. The meters will be installed near the intersections of Palisade Road, Harding Road and Galloping Hill Road. The objective of this project is to gauge the flow upstream of the recently completed Park Avenue / Westfield Avenue sewer project as well as potential inflow and infiltration from Roselle Park storm sewer.

- ***Westerly Inceptor Cleaning (2015)***

  This project will increase the conveyance capacity of the Western Interceptor through the Mid-Town area with the design of replacement sewers as well as correction of hydraulic restrictions at the Bridge Street Siphon and along Elizabeth Avenue, Pearl Street, South Pearl Street and Clarkson Avenue. This project will also increase sewer flow to the

Trenton Avenue pump station and reduce CSO overflows in the Midtown Area and is necessary to ensure adequate capacity for the anticipated development within of the midtown redevelopment area. The City is awaiting a final permit from the Army Corps of Engineers and will then bid the project.

II. Hazard Mitigation Project Still In Progress (or on hold)

- ***Elizabeth River Flood Control Project Maintenance Contracts Nos. 06-14, 01E-13, 01-15***

  This project generally consists of the modifications and improvements to the existing flood control facilities and drainage structures along the Elizabeth River from Trotters Lane to Trenton Avenue. Work includes maintenance on earthen levees, demolition, removal and construction of new concrete headwalls, sluice gates, inlet/outlet pipes, control manholes, tide gate valves, flexible check valves, flood gate structures and other drainage structures.

- ***Three Major Flood Control Pump Stations***

  Restoration and Flood Mitigation for Mattano Park Pump Station, Kapkowski Road Pump Station and Trenton Avenue Pump Station

- ***Atalanta Sea Wall Flood Control Project***

  This proposed project consists of the construction of a new sea wall and associated stormwater improvements to assist in mitigating and minimizing coastal flooding from the Arthur Kill/Newark Bay for commercial and industrial properties situated along Atalanta Place, Slater Drive and Puleo Plaza. This type of coastal seawall had been identified as having the potential of large coastal storm impact reductions and good storm resiliency but at a large construction cost. Currently, a concept plan had been completed and FEMA grant money was requested for funding further work but no progress in obtaining any funding so the project is on indefinite hold as other viable flood mitigation project take priority.

- ***Dowd Avenue Pump Station Project***

  This project consisted of the construction of a stormwater pump station and other associated surface drainage improvements in an industrialized area of Dowd Avenue near North Avenue East and Interchange 13A of the New Jersey Turnpike that is consistently affected by localized flooding during heavy rain events. The stormwater pump station would connect to an existing 84" diameter reinforced concrete pipe that connects to an outfall located on the Peripheral Ditch situated in Newark Liberty International Airport (EWR). Currently, this project has no funding and has not been designed as other project took priority.

III. Projects In Final Design (projected construction in 2016 or later)

- ***South Street Flood Control Project***

  This project consists of repairs, renovations, and upgrades to the South Street Stormwater Pump Station, restoration of the ponding storage areas and outlet structures, and repairs to sewers and drainage structures located in the study area. Work within the pump station includes replacement and upgrades to the pumps and motors, stand-by emergency generator, sluice gates, flap gates, sump pump, electric controls and instrumentation. The study will alleviate storm related flooding that occurs in the vicinity of South Street, Fourth Avenue and South Spring Street during heavy rainfall events.

- ***Trumbull Street Flood Control Project***

  The proposed repairs for the intersection of Trumbull Street and Sixth Street are intended to limit roadway flooding and to maintain passable travel lanes. Inlets will be installed at the intersection allowing the drainage system to function during smaller storms. When the capacity of the existing storm inlets is exceeded, the excess stormwater will flow into the new inlets. Piping connecting the inlets will direct flow to a watertight 1.5 million gallon concrete vault which will store the flow below grade, thereby minimizing surface flooding. The concrete vault will consist of modular precast concrete unit to maximize the volume the entire structure will be wrapped in an impermeable pond liner. The vault will extend under Bond Street and the business on Block 7 Lot 1227 will be acquired and demolished for this structure. The vault will be equipped with a small pumping station. A level sensor will be installed in the combined sewer. The pump is capable of dewatering the vault in one day and it is intended that the tank will be emptied within two days of a storm event allowing one day for the water level in the combined sewer to recede. Block 7 Lot 1227 will be converted into a passive neighborhood park. This project will also serve as a test case for installing Green Stormwater Infrastructure. A bioswale will be installed on the northeast side of Trumbull Street a rain garden will be installed in the proposed park and if possible tree boxes will be installed along Bond Street.

- ***Progress Street Flood Control Project***

  The preferred alternative isolates the flooding areas from the CSO outfall by rerouting the existing outfall through an industrial property to Progress Street and reconnecting to the existing outfall on Progress Street. The local drainage that connected to the outfall will be connected to an existing storm sewer on Dowd Avenue. Additional protection against high water levels in the great ditch will be provided by using box culverts in the Progress Street right-of-way to provide storage for excess runoff low areas. Flow into the box culverts will be controlled by a weir and tide gates which will allow stormwater to drain until the tail water becomes too high at which point the stormwater will overtop the weir and enter the storage conduit. The netting facility adjacent to Dowd Avenue will have its walls extended vertically to contain any potential overflows. The cost of the recommended plan is $3.3M and greatly reduces the frequency of flooding matching the temporary condition that allowed for reasonable operation of the local businesses.

- ***New Police Headquarters Emergency Generator***
- ***Peterstown Community Center Emergency Generator***
- ***Sampson Senior Center Emergency Generator***
- ***Mickey Walker Community Center Emergency Generator***

IV. <u>Mitigation Project In Planning</u>

- ***Western Interceptor Improvements***
- ***Third Avenue Flood Control Project – Phase II***

An enormous amount of planning, coordination and funding was required to complete the flood mitigation projects noted above. Other projects planned and anticipated would be based on the City's priorities and available funding during each fiscal cycle. The initial Plan priorities and the current Plan priorities remain the same since the first Plan approval in that the City makes every effort to reduce vulnerability and risk due to potential flooding and continues to increase resiliency and sustainability for the entire population living in Elizabeth.

Should funding not be available for a proposed high cost mitigation project/study/assessment (e.g., coastal seawalls), then the City would prioritize the use of available mitigation funds during any fiscal cycle to maximized completion of other planned hazard mitigation projects as identified in this Plan. As each hazard mitigation project is completed, the City reduces its vulnerability and lowers social and economic risk to future natural hazard. Also, in doing so within the City's limits, it would also have secondary and cumulative impacts to neighboring municipalities and to Union County

3.4 PUBLIC/COMMUNITY INVOLVEMENT

The public plays a vital role in the overall planning process and in recognition of the essential nature of public consensus, the Planning Committee will make concerted efforts to provide the general public with information on the planning process as well as to inform the public on the actions being undertaken by the Planning Committee. In addition, the Planning Committee, with the assistance of branches of Elizabeth's government, will provide opportunities for the public (to include neighboring communities and Counties) to voice opinions and to provide input throughout the planning, maintenance and update processes. The City acknowledges that past public meetings did not gather many public participants and more regular meetings would need to be planned in future years and not just meetings prior to the Plan update. The City in the future years will attempt to establish better and more frequent communication with the public and schedule meetings on a more regular basis.

To improve public relations, the City will prominantly display the Plan on its website. The website would inform the public of the current Plan status and activities. The public will also be able to download a copy of the approved Plan to review and comment. This would allow for public commentting at any stage of the

Plan's life by inviting public comments through emails to the City. And as such,all comments can be documented and addressed in throughtout the Plan maintenance process.

For this Plan update, the City had provided two (2) public meetings for this Plan update. The public meetings were held at the City of Elizabeth Municipal building (City Hall), Council Chambers in October 2014 and February 2015. The Planning Committee elected to publicize all meetings in the regional newspaper (Star Ledger), available local newspapers, and, given area demographics, a foreign language newspaper (La Voz). Meetings were also publicized on a City's website as well as the website used for the Elizabeth Public Library System. Notifications appeared in the identified newspapers approximately ten (10) days prior to each public meeting. Public Meeting #1 was held on October 30, 2014, and Public Meeting #2 was held on February 4, 2015. Both meetings were located at the City of Elizabeth's Council Chambers located in City Hall. Both public meetings were designed to provide participants with an overview of the planning process and overall planning effort. Hatch Mott MacDonald prepared an updated PowerPoint presentation for each meeting to inform participants, answer questions, and to obtain public comments. Both meetings were designed to provide the community with an update and draft copies of the Plan was available for review and comments. Unfortunately, participation was weak and the City will try to improve public participation as it has been difficult to draw the public into this Natural Hazards arena. Elizabeth will establish a planning timeframe and meeting schedules for upcoming maintenance years that may include local meetings with the Chamber of Commerce, local and adjacent residents, and at various senior centers and recreation centers.

Copies of the public announcements and sign-in sheets from the two Public Meetings are provided in Appendix B. Letters inviting stakeholder to the second public meeting are also provided in Appendix B.

The City will have to brainstorm about improving outreach activties and determine what public objectives are needed moving forward. A strategy should be developed and methods to implement appropriate outreach would be needed. From the FEMA Local Mitigation Handbook, the City may implement any of the outreach methods listed below:

Example of Outreach Methods for Mitigation Planning

Outreach Method	Community Examples
Community Events	At the annual fair in Howard County, Maryland, the Office of Emergency Management has a booth to educate residents on preparing for natural hazards. Brochures and fliers on related topics are distributed to visitors.
Interviews	The focus of the hazard mitigation planning process for Oakland County, Michigan was a series of structured discussions with County officials, municipal officials, affected stakeholders, and the general public. This broad outreach effort included telephone and face-to-face interviews with leaders and representatives from each of

the County's 62 communities, 28 public schools districts, and 2 public universities to identify hazards of concern and potential mitigation measures.

News Media

The mitigation planning process in Mecklenburg County, North Carolina included extensive outreach to local media outlets. In response, the local television, radio and print media partners prepared stories to help promote widespread public involvement. Through the City of Charlotte's Corporate Communications & Marketing Office, "e-blasts" soliciting input on draft plan documents as well as public meeting attendance were sent out using distribution lists that included government agencies, businesses, and civic organizations. Public meeting information was sent to all City and County employees, posted to the community's online public events calendar, added to live tickers that scrolled across the bottom of the local government access television channel, and shared through C-Mail (bi-weekly e-newsletter for City of Charlotte news and events). In addition, live television coverage of public input meetings was provided with the ability for citizens to submit their questions or comments by e-mail.

Presentations to Governing Bodies

During the development of a Multi-jurisdictional Natural Hazards Mitigation Plan for Garfield County, Colorado the Steering Committee made several presentations to the Board of County Commissioners about the status of the plan. These meetings were public and announcement of the plan agenda item was included along with the announcement of the public meeting.

Questionnaires/ Surveys

In completing its first hazard mitigation plan, Catawba County, North Carolina used a survey to capture information from people who might not have been able to attend the public meetings or participate through other means in the mitigation planning process. Copies of the survey were distributed by local officials and made available for residents to complete at local county and municipal offices, and an electronic version was posted on their websites. Nearly 250 respondents to the survey provided input for the County's planning team to consider in developing their mitigation strategy.

Roundtables/Forums

In order to solicit ideas from citizens on how to reduce the risk of natural hazards, the City of Everett, Washington sponsored a public forum titled the "Safe and Sound Summit: Help Everett Master Disaster." Attended by more than 80 residents of the community, this was the primary public event designed to both educate the public and to empower citizens to contribute to the hazard mitigation plan's action items. The resulting ideas helped the City's planning team to identify risks, strengths, weaknesses, and opportunities in Everett.

Social Media

Clark County, Kansas (population 1,950) used computer technology to obtain public input by creating the Clark County, Kansas Hazard Mitigation Plan Facebook page. Additionally, the Facebook page was used to hold a drawing for an Apple iPod Shuffle 2GB MP3 Player posting that *"all those that participate and provide feedback via this Facebook page will be entered in the drawing."*

Area-specific Meetings

The City of Tulsa, Oklahoma holds small, area-specific meetings on a semi-annual basis at public libraries and other public venues. These meetings are used to distribute literature and educate citizens on actions they can take to mitigate natural hazards, save lives, and prevent property damage. Input also is solicited about how the mitigation process can be more effective.

3.5 STAKEHOLDERS INVOLVEMENT

The Planning Committee and Team members tried to involve stakeholders in the overall planning update process of the Plan. With the exception of the internal Planning Committee meetings, all other meetings were advertised in advance as being open to the public and stakeholders, including representatives from neighborhood organizations, private agencies, businesses, academia, nonprofits, and other interested parties who might wish to be involved in the planning and updating process. While these opportunities were made available, stakeholder turnout from entities beyond those already represented on the Planning Committee was minimal.

As the City continues to monitor, update, and maintain the Plan on an as-need-basis, major revisions during the 5-year cycle will involve informing the public and stakeholders with new and increased outreach efforts.

The following identified list of stakeholders is current and will be sent invitation letters (as also sent in 2014) for upcoming Plan discussion meetings. It is possible that the City may present small workshop opportunties for stakeholder in 2016. The following is the current list of stakeholders the Committee has identified:

- Trinitas Hospital (Critical Care Facility)
- NJ Transit
- The Port Authority of New York and New Jersey
- PSE&G
- Verizon
- New Jersey American/Liberty Water
- Elizabeth Development Company
- Elizabeth Board of Education
- Elizabethtown Gas
- Kean University
- Union County College

The City also believes that it would be more beneficial to be added to the County's future stakeholders meeting schedule and will discuss this with the County. This dual meeting/information exchange process would be best for both entities and as the County Seat, it makes sense that they would also be included in future Hazard Mitigation Plan meetings.

Lastly, all listed stakeholders will be included in future Plan meetings to discuss development and actions going forward. The City will invite the Chamber of Commerce, residents at the various senior centers, health care centers and will continue to invite Trinitas management staff and all stakeholders, even though, to date the Trinitas management staff have not provided any input to the City.

3.6 USE OF EXISTING INFORMATION IN PLAN PREPARATION AND PLANNING PROCESS

44 CFR Part 201.6(b) states that the planning process shall include the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information. The Planning Committee has utilized substantial existing information either in its entirety or as a basis for review of individual occurrences and conditions. The City would on an as-needed basis, keep this Plan updated annually.

The following represents a list of pertinent information that may have been reviewed and presents an extensive updated resources list. Please note, additional source information is provided (hazard-specific basis) in Section 5, Risk Assessment.

- FEMA, "*Local Mitigation Handbook",* March 2013- http://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf
- FEMA, "*Comprehensive Preparedness Guide (CPG) 201: Threat and Hazard Identification and Risk Assessment Guide",* Second Edition, August 29, 2013 - https://www.fema.gov/media-library/assets/documents/26335
- FEMA, *"Integrating Hazard Mitigation Into Local Planning*" Case Studies and Tools for Community Officials – March 1, 2013 - http://www.fema.gov/media-library/assets/documents/31372
- FEMA, *"Mitigation Ideas",* A Resource for Reducing Risk to Natural Hazards, January 2013 - http://www.fema.gov/library/viewRecord.do?id=6938 or http://www.fema.gov/media-library-data/20130726-1904-25045-2423/fema_mitigation_ideas_final_01252013.pdf
- FEMA, *"Comprehensive Preparedness Guide (CPG) 201: Threat and Hazard Identification and Risk Assessment Guide",* Second Edition, August 29, 2013 - https://www.fema.gov/media-library/assets/documents/26335
- FEMA, "*Mitigation Planning Laws, Regulations, and Guidance*", October 2011 - http://www.fema.gov/preparedness.pdf
- FEMA, *"Local Mitigation Plan Review Guide"*, Ocober 1, 2011 - http://www.fema.gov/library/viewRecord.do?id=4988
- FEMA, *"Mitigation Planning Fact Sheet",* March 2010 - http://www.fema.gov/library/viewRecord.do?id=2066
- FEMA*"Hazard Mitigation: Integrating Best Practices into Planning*", James C. Schwab, Editor Report Number 560 Published by APA Planning Advisory Service, 2010 (May be purchased - https://www.planning.org/store/product/?ProductCode=BOOK_P560)
- FEMA *"Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects: State and Local Mitigation Planning How-To Guide*", FEMA 386-9. August 2008 - http://www.fema.gov/library/viewRecord.do?id=3388
- FEMA, *"National Flood Insurance Program (NFIP) Community Rating System (CRS) Coordinator's Manual*" FIA-15/2007 - http://www.fema.gov/library/

- *"Strategies for Flood Risk Reduction for Vulnerable Coastal Populations along Arthur Kill at Elizabeth, Linden, Rahway, Carteret and Woodbridge"*, Final Report, Rutgers University,August 2014
- "*Vulnerable Populations to Climate Change in New Jersey",* Bickers, Kelly M., February 2014
- NJADAPT (online tool to visualize how climate change impacts an area) http://www.njadapt.org/
- NJADAPT Coastal Hazard Profiler - http://sugar.rutgers.edu/latest/#/configure
- Rutgers University – NJFloodMapper (interactive website to visualize coastal flooding and sea level rise): http://njfloodmapper.org/
- NOAA – Sea Level Rise Tool - http://oceanservice.noaa.gov/news/features/aug13/sandy-sir-tool.html
- State of New Jersey 2014 State Hazard Mitigation Plan
- Union County, New Jersey – Multi-Jurisdictional Hazard Mitigation Plan, December 2010 (2015 updated version will replace the 2010 version when availabe)
- New Jersey Office of Emergency Management (NJOEM)
- The National Drought Mitigation Center
- New Jersey Department of Environmental Protection
- U.S. Army Corps of Engineers (USACE)
- National Oceanic and Atmospheric Administration (NOAA)
- National Weather Service (NWS) Eastern Region Headquarters
- Northeast States Emergency Consortium (NESEC) - website for specific hazards. The website includes information pertaining to earthquakes, fire, floods, hazardous materials, hurricanes, ice jams tornadoes, winter storms and terrorism
- "*StormReady*," National Weather Service, 2012, http://www.stormready.noaa.gov/
- United States Geological Survey (USGS), Natural Hazards Database includes Natural Hazard Fact Sheets (also provided on the website) and the Natural Hazards Support System (real time data provided through the website)
- New Jersey Geological Survey (NJGS) website
- Other Documents and Resources:
    - Master Plan for the City of Elizabeth (currently being updated)
    - City of Elizabeth Emergency Operations Plan
    - City of Elizabeth Land Development Code

4.0 CITY OF ELIZABETH

The City of Elizabeth Planning Area consists of six (6) sections known as Wards, encompassing a total of 12.32 square miles with a total population of 127,558 (United States Census, 2013). Elizabeth is New Jersey's fourth most densely populated City with approximately 10,354 persons per square mile. Elizabeth's economy continues to grow due to an incentive sales tax cut pulling in over 1,000 businesses, including retail giants like IKEA. The UEZ (Urban Enterprise Zone) Program is responsible for over 1.5 billion dollars in new economic development since its incorporation into Elizabeth. In addition to the City's corporate giants and growing economy, the Port Authority Marine Terminal is the largest container port on the east coast, the local mall known as "The Mills At Jersey Gardens" is the largest outlet mall in New Jersey and Newark Liberty International Airport, despite its small size (currently being renovated), is the fifth busiest international air gateway.

The City's changes in development trends year to year is minor as the City is predominantly a developed urban environment with minmal open spaces for new developments unless the older structures are removed. With each flood minimization/ protection project implemented throughout the City (see project list on Page 3-5 thru Page 3-9), the City become less vurnerable and more sustainable/resilient to future natural diasters.

The City regulates new construction and reconstruction within the floodplain in accordance with the City Code Chapter 17.44 – Flood Damage Prevention. Redevelopment would have to meet all new flood codes. The City recently adopted the Best Available Flood Hazard Data NJDEP model ordinance (City Ordinance No. 4457) for Flood Damage Prevention on April 8, 2014 which was signed by the Mayor on April 9, 2014 and effective 20 days thereafter. This Ordinance allows the City to use the best available data provided by FEMA during the transition period from the current effective maps to the new FIRM maps. A subsequent ordinance will be prepared to adopt the new FIRM maps once finalized.

4.1 HISTORY

The history of Elizabeth dates back to 1664, when a group of Englishmen formed the Elizabethtown Associates and purchased a land area west of Newark Bay from the Indians of Staten Island. This area included the area of current day Elizabeth.

Elizabethtown was named in honor of the wife of Sir George Carteret and was established on the banks of the Elizabeth River in 1665. Elizabethtown thrived with a population of 700 and the City became the first capital of New Jersey. In 1665, Phillip Carteret became the first Governor of New Jersey and in 1668 the first assembly meeting took place. In 1706, Rev. Jonathan Dickinson, a graduate of Yale College, became pastor of an old Congregational Church, which he eventually persuaded to join the Philadelphia Presbyterian council in 1717. His church would be known as First Presbyterian Church of Elizabethtown. In 1746 at Dickinson's request, the Governor of New Jersey granted the City of Elizabeth a charter for a classical school which would eventually become Princeton University.

In 1804 the Morris Turnpike was completed, improving travel on the old road between Elizabeth and Morristown and in 1836 the first railroad passed through Elizabeth opening up new means of development to the interior farmlands. In the 1850's the Elizabeth Water Company and the Elizabethtown Gas Company received charters furthering developments.

In the early 1900's, Newark developed a plan which proposed annexation of much of Essex and Hudson Counties and parts of Bergen and Union Counties, including the City of Elizabeth. Newark sought to become the fourth largest city in the United States, ahead of St. Louis in population, manufacturing, banking and property valuation. The reason for annexing Elizabeth was based on the relative sophistication and maturity of the targeted town's infrastructure. Elizabeth's Water Company drew on the Elizabeth River to fill two reservoirs and in 1889 the company operated forty-six miles of water mains, serving 35,000 individuals. Its capacity was sufficient for foreseeable future development. A strong city infrastructure was the key to the city's independence and progressive spirit in the early years of the 20th century and a defense against Newark's annexation.

Today Elizabeth's diverse population represents more than 50 countries and 37 language groups. With its close proximity to Newark Liberty International Airport, which is partially located in the City, the New Jersey Turnpike, the Garden State Parkway, Routes 1 & 9, and Manhattan, Elizabeth has become a regional hub for the East Coast. Elizabeth also has two (2) New Jersey Transit (NJT) train stations that connect to New York City and to other areas of the State. The Port Newark/Elizabeth's 2,000 acre marina terminal hosts over 150,000 jobs and is one of the world's largest containership port and the largest foreign trade zone in the United States.

4.2 WARDS

Elizabeth is divided into six (6) Wards:

- The First Ward is located on the eastern side of the City bordering Newark Bay and the Arthur Kill inlet. A large percentage of the First Ward is occupied by the Port Authority Marine Terminal, which is the largest container port on the east coast and the third largest in the country. Located off the New Jersey Turnpike, The Mills At Jersey Gardens is the largest outlet mall in New Jersey, occupying the majority of the commercial section in the First Ward. Surrounding this commercial area are many high rise apartment buildings.
- The Second Ward is located just to the southwest of the First Ward and is mainly comprised of two-family residential, multifamily residential, light to medium industrial and light to medium commercial.
- The Third Ward is located directly west of the Second Ward and consists of mostly single-family residential houses and community commercial.
- The Fourth Ward is located directly north of the Second and Third Wards. This area has single family, two-family and multifamily residential dwellings along with community and some central commercial uses.
- The Fifth Ward is located in the northeast section of Elizabeth. Newark Liberty International Airport occupies the majority of the Fifth Ward and is the tenth busiest airport in the United States and the nation's fifth busiest international air gateway (as of 2010). The Fifth Ward contains a dense area of manufacturing and research facilities. This Ward also has some single family, two-family and multifamily residential dwellings.
- The Sixth Ward is located in the center of Elizabeth. It is surrounded by the other Wards and has a greater percentage of commercial land use as compared to residential uses.

4.3 GEOGRAPHY AND DEMOGRAPHICS

Elizabeth is bordered to the north by the City of Newark, to the east by Newark Bay and further east by Staten Island, New York, to the south by the Arthur Kill, to the southwest by the City of Linden, to the west by Roselle Borough and Roselle Park Borough, to the northwest by Union Township and Hillside Township. According to the United States Census Bureau, the City has a total area of 13.72 square miles consisting of 12.32 square miles of land and 1.4 square miles of water. Elizabeth's average topographical elevation is sixteen (16) feet above mean sea level. Elizabeth is located in the Piedmont which lies northeast of the Atlantic Coastal Plain. About twenty (20) miles wide, this area covers only about 1/5 of the State of New Jersey and includes the industrial cities of Elizabeth, Paterson, Jersey City and Newark. New Jersey's major rivers (Hudson River, Passaic River, Ramapo River, and Raritan River) are found in the Piedmont area, supporting the areas' industrial development.

Elizabeth is split into eight (8) districts; Midtown, Elizabeth Avenue/Union Square, North Elizabeth, Westminster, Elizabethport, Elmora, Elmora Hills and Peterstown. Midtown is the main commercial district as well as the main historic section, and includes the First Presbyterian Church founded in the 1700's. Elizabeth Avenue/Union Square is a vibrant and mainly Hispanic immigrant neighborhood, and is situated just east of Midtown. North Elizabeth is a diverse working-class neighborhood. Morris Avenue, a main thoroughfare extends northwest to southeast. Many Colombian stores and restaurants front Morris Avenue and this area is sometimes given the nickname "Little Colombia". Westminster is one of the more affluent and historic areas of Elizabeth, located between North Avenue and Elizabeth's border with Hillside. Elizabethport, which is dominated by industrial uses, has been an impoverished part of Elizabeth for many decades. Recent redevelopment efforts have been focused on this area. The population of Elizabethport is mainly Black/African American, Puerto Rican, Dominican, Cuban and Portuguese. Elmora is a middle/working-class neighborhood in the western part of Elizabeth with a large Colombian and Jewish population. Elmora Hills is the northwestern part of Elizabeth just north of Elmora and is characterized by a strong middle- to upper-middle class neighborhood, largely Jewish population. Peterstown is a middle/working-class neighborhood in the southeast part of the City. It is heavily industrialized and ethnically diverse. The western terminus of the Goethals Bridge, which spans the Arthur Kill to Staten Island, is also located in this part of the City.

4.4 CLIMATE

Elizabeth experiences a temperate climate with four seasons. The average annual temperature is approximately 54.9°F. The average annual high temperatures is 63.3°F and average annual low temperature is 46.5°F. The average rainfall for Elizabeth is 46.24 inches per year and the average snowfall is 28 inches per year (U.S. Climate Data from Newark International Airport from 1981-2010).

4.5 POPULATION OVERVIEW

The 1990, 2000 and 2010 census shows that Elizabeth is constantly growing with approximately 2,589 person increases between 2010 and 2013. Compared to other cities in New Jersey it ranks as the fourth largest by population and largest in Union County. Table 4-1 is below.

Table 4-1 Population Trend
Source: U.S. Census Bureau, Census 2010, 2000, 1990 Census

Municipality	2010	2000	1990	Population Change	2010% Growth
Elizabeth	124,969*	120,568	110,002	14,967	3.7%
Union County	536,499	522,541	493,819	42,680	2.7%
New Jersey	8,899,339	8,414,350	7,730,188	1,169,151	5.8%
*The City has the largest municipal population (~23%) of Union County and more than two times the next largest municipality (Union Township with 56,642 people). The entire County in 2014 Census has a population of 552,939.					

4.6 DEMOGRAPHIC DATA

The majority of the total population of Elizabeth identifies themselves as one (1) race, thus insight in racial composition have been obtained by reviewing race data from the 2010 US Census Bureau. Please see Table 4-2 below.

Table 4-2 Population by Race and Ethnicity, 2010
Source: US Census Bureau, 2010 Census

Categories for Race and Ethnicity	2010 Total	% Share of City Total
White	69,983	54.6%
Black/African American	26,368	21.1%
Native American	1,037	0.83%
Asian	2,604	2.1%
Pacific Islander	*Z	<
Two or More Races	5,749	4.6%
Hispanic Origin*	74,357	59.50%

*Z = Value greater than zero but less than half unit of measure shown.
*Hispanics may be of any race, also are included in applicable race categories, so may not be representative to the total 2010 population of 124,969.

4.6.1 Gender and Age Groups

Per the 2010 Census, Elizabeth's population is generally split equally between genders. Amongst the approximate 124,969 citizens living in Elizabeth in 2010, 49.6% of the total population are males and 50.4% of the total population are females.

The median age of the population in Elizabeth was 33.2 years in 2010. In 2010, Elizabeth's largest age group was 30-39, followed by the 20-29 age groups.

4.6.2 Education

The City's public schools are operated by Elizabeth Public Schools, serving students in kindergarten through 12th grade. The district is one (1) of thirty-one (31) Abbott districts statewide, which are now referred to as "SDA Districts" based on the requirement for the state to cover all costs for school building and renovation projects in these districts under the supervision of the New Jersey Schools Development Authority

As of the 2010–11 school year, the district's 34 schools had an enrollment of 24,258 students and 1,890.0 classroom teachers (on an FTE basis), for a student–teacher ratio of 12.83:1

With 5,300 students, Elizabeth High School was the largest high school in the state of New Jersey and one of the largest in the United States, and underwent a split that created five new academies and a smaller Elizabeth High School under a transformation program that began in the 2009–10 school year.[99] The school was the 294th-ranked public high school in New Jersey out of 322 schools statewide, in New Jersey Monthly magazine's September 2010 cover story on the state's "*Top Public High Schools*", after being ranked 302nd in 2008 out of 316 schools. Before the 2008-09 school years, all of the district's schools (except high schools) became K–8 schools, replacing the middle schools and elementary schools. SchoolDigger.com, which maintains detailed profiles for over 136,000 schools in every state in the US, ranked Elizabeth 431st of 559 districts evaluated in New Jersey.

Elizabeth is also home to several private schools. The Roman Catholic Archdiocese of Newark oversees the coeducational St. Mary of the Assumption High School and the all-girls Benedictine Academy. The Newark Archdiocese also operates the K–8 schools Our Lady of Guadalupe Academy, St. Genevieve School.

Following the closure of Saint Patrick's High School by the Newark Archdiocese in June 2012 in the face of increasing costs and declining enrollment, administrators and parents affiliated with the defunct school opened an independent non-denominational school located on Morris Avenue in Elizabeth called "*The Patrick School*" in September 2012.

The Jewish Educational Center comprises the Yeshiva of Elizabeth (nursery through sixth grades), the Rav Teitz Mesivta Academy (boys, seventh through twelfth grades), and Bruriah High School (girls, seventh through twelfth grades).

The 2010 census indicates that 72.8% of the residents have a high school diploma; whereas, 12.1% of the population have a Bachelor's degree or higher.

4.6.3 Employment

There are six (6) major occupational categories: 1) management and professional; 2) service occupations; 3) sales and office support; 4) farming, fishing and forestry; 5) natural resources, construction and maintenance; and 6) production, transportation and material. The civilian labor force consists of the population 16 years old and over who are classified as employed or unemployed. Excluded from the employed category are people whose only activity consists of work around the house or unpaid volunteer work for charitable, religious or similar organizations. Also, people on active duty in the United States Armed Forces are excluded from this census category.

In Elizabeth, the greatest percent of civilians 16 years and older were employed by businesses in the production, transportation and material category. The second major occupation sector in Elizabeth was sales

and office support. The percentage of employed population for the remaining categories in descending order are as follows: 1) management and professional service; 2) natural resources, construction and maintenance; and 3) farming, fishing and forestry.

4.6.4 Households

There were 41,596 households of which 37.0% had children under the age of 18 living with them, 39.2% were married couples living together, 22.0% had a female householder with no husband present, and 29.5% were non-families. 23.5% of all households were made up of individuals and 7.2% had someone living alone who was 65 years of age or older. The average household size was 2.94 and the average family size was 3.43.

In the city, 25.6% of the population were under the age of 18, 10.6% from 18 to 24, 31.3% from 25 to 44, 23.3% from 45 to 64, and 9.2% who were 65 years of age or older. The median age was 33.2 years. For every 100 females there were 98.6 males. For every 100 females age 18 and over, there were 96.8 males.

The Census Bureau's 2006-2010 American Community Survey showed that (in 2010 inflation-adjusted dollars) median household income was $43,770 (with a margin of error of +/- $1,488) and the median family income was $46,891 (+/- $1,873). Males had a median income of $32,268 (+/- $1,205) versus $27,228 (+/- $1,427) for females. The per capita income for the City was $19,196 (+/- $604). About 14.7% of families and 16.7% of the population were below the poverty line, including 23.5% of those under age 18 and 18.5% of those ages 65 or over.

4.7 ECONOMY

There are twelve (12) sectors of employment: manufacturing; wholesale trade; retail trade; information; real estate and rental and leasing; professional, scientific and technical services; administrative and support, and waste management and remediation services; educational services; healthcare and social assistance; arts, entertainment and recreation; accommodation and food services; and other services (except public administration). The largest sector is maintained by Retail Trade, which has 526 establishments within the City and also the largest number of employees.

4.7.1 Household Income

The Census Bureau's for data collected between 2009-2013 shows that the median household income was $44,110. Males had a median income of $32,268 (+/- $1,205) versus $27,228 (+/- $1,427) for females. The per capita income for the City was $19,196 (+/- $604). About 14.7% of families and 16.7% of the population were below the poverty line, including 23.5% of those under age 18 and 18.5% of those ages 65 or over.

4.8 SERVICES

4.8.1 Police, Fire and Hospital

The Elizabeth Fire Department has seven (7) stations within the City and retains approximately 213 career employees. The City has only one critical care facility hospital that was formed from the merger of St. Elizabeth and Elizabeth General Hospital; currently known as the Trinitas Hospital, it is a critical care

facility located near the center of the City. Trinitas Hospital is a Catholic community teaching hospital sponsored by the Sisters of Charity of Saint Elizabeth in partnership with Elizabethtown Healthcare Foundation. Emergency Medical Services (EMS) are provided by the City's Fire Department. The Police Department was established in 1858 and has approximately 288 officers in 4 stations.

4.8.2 Transportation

Several major roadways run through Elizabeth including the New Jersey Turnpik, Routes 1 and 9, Route 27, Route 28, Route 81, Route 82, and Route 439. Elizabeth also has two train stations which service New Jersey Transit's North Jersey Coast Line and the Northeast Corridor Line. Broad Street Elizabeth is the southern station in Midtown Elizabeth and the other train station in Elizabeth is North Elizabeth Station. NJ Transit is considering several bus rapid transit systems (BRT) under the banner Next Generation Bus as recommended by NJT, NJDOT and the Metropolitan Planning Organization (MPO) of New Jersey. The only specifically designed BRT system, the go bus, runs through Newark, the state's largest city, to Newark Liberty Airport and adjacent communities.

4.8.3 Utilities

A number of utility providers supply various services throughout the City as noted in Table 4-3 below. Based on a table top review of the State of New Jersey 2014 Hazard Mitigation Plan (Section 5 – Risk Assessment), all of the local utility companies were required to have their own vulnerability assessment and analysis for power failure events. Many utilities have identified a need for and implemented their own back-up plan (e.g., installing back-up generators) to keep their services intact during and after a natural disaster. The City will continue to review data from the State's HMP and use the information to complement this updated Plan.

Table 4-3 Utility Service Providers

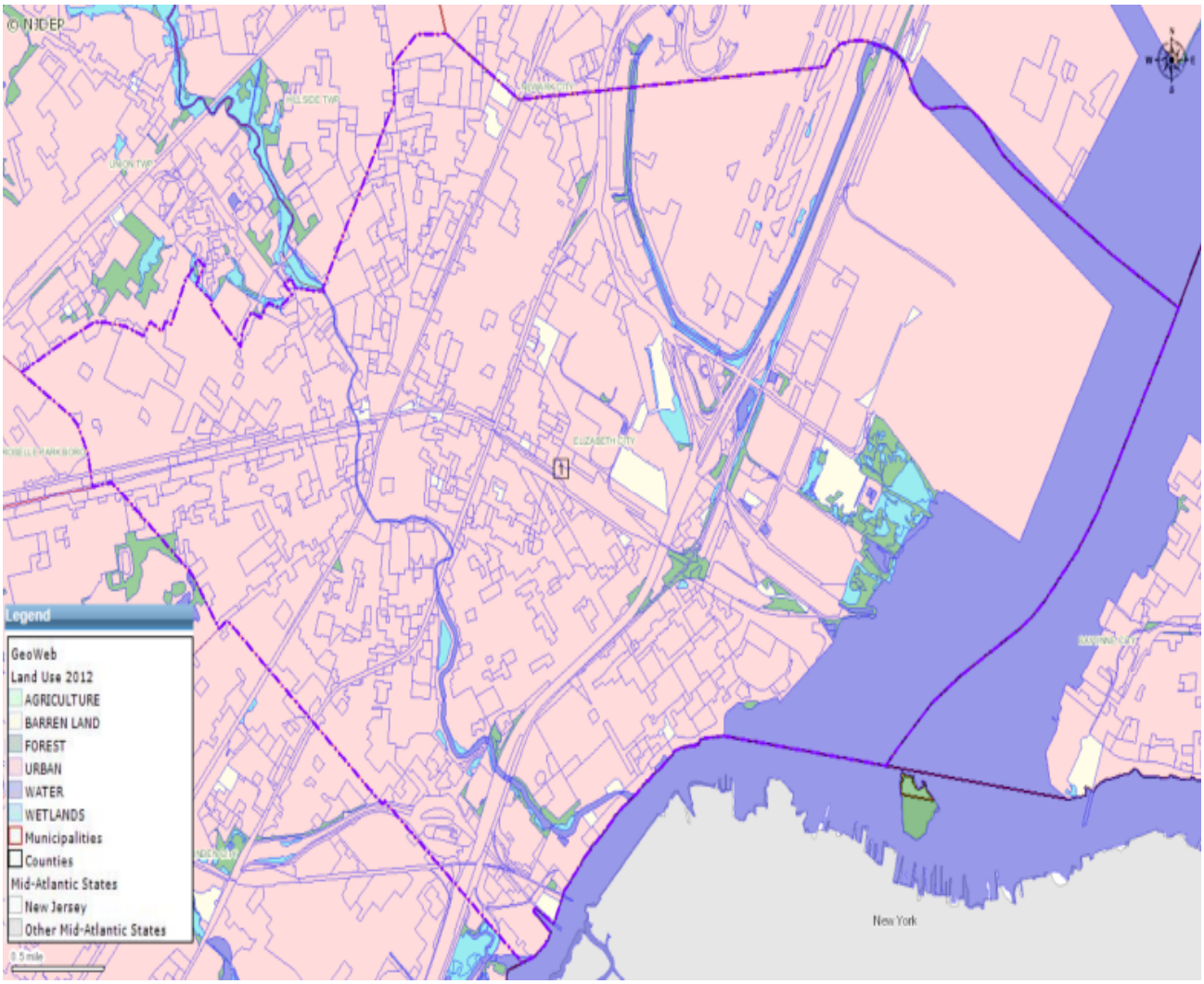
Utility Company	Service
Joint Meeting of Essex and Union County	Sewer
New Jersey American/Liberty Water	Water
Newark Liberty International Airport	Airport
NJ Transit	Train, Bus, Light Rail, Subway
Port Authority of NY and NJ	Airport, Bus, Train, PATH, Tunnels, Bridges
Public Service Electric and Gas	Natural Gas, Electricity
Elizabethtown Gas	Natural Gas
Comcast	Cable Television, Internet, Telephone
Cablevision	Cable Television, Internet, Telephone
Verizon	Communications
AT&T	Communications
Sprint	Communications
IDT	Communications

4.9 LAND USE AND INFRASTRUCTURE

The majority of the City is urban and continues to be built upon. Aside from a few small wetland areas located along the Elizabeth River, the entire City is urban. Elizabeth is located in the east-northeast corner of Union County and had the most building permits issues over the period of 2000-2012 (data from the Union County 2015 Hazard Mitigation Plan Update). The City had 4,844 building permits issued in the 13 year period, which is the most permits issued in the County. Rahway and Springfield with the next two largest issued buidling permits had only 1,501 and 1,030 permits, respectively. The total number of building permits issued for the entire County in the 13 years was 11,837 building permit. The City had approximately 41 percent of all building permits and this reflects the development and building trends.

The land use mapping for Elizabeth is obtained from the 2012 Land Use Land Cover (LULC) dataset provided by the State of New Jersey, Department of Environmental Protection, (NJDEP), Bureau of Geographical Information Systems (BGIS) and as shown in Figure 4-1 below.

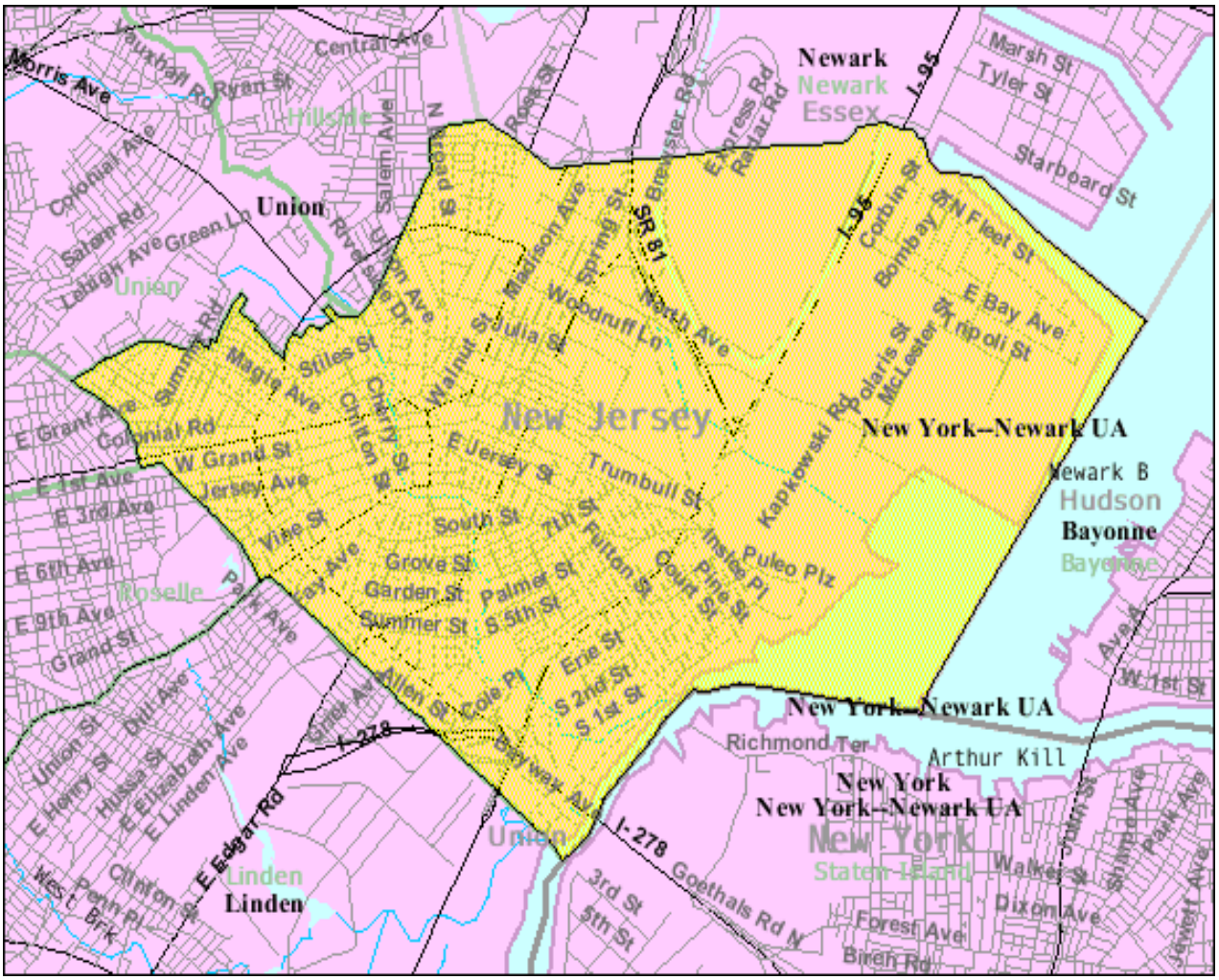
Figure 4-1 - NJDEP 2012 Land Use Map
NJDEP Geo-Web



4.10 ADJOINING NEIGHBORS

Elizabeth is located on the eastern side of Union County, bordering Linden, Roselle, Roselle Park, Union, Hillside and Newark. The City Elizabeth is divided from Bayonne in Hudson County by Newark Bay and from Staten Island, New York by the Arthur Kill Inlet. The City has an area of 13.7 square miles within the aforementioned population and population density reported above from the 2010 census. However, HAZUS model uses an approximate 12 square mile area in their area data base for the City of Elizabeth. Figure 4-2, Adjoining Neighbors, shows the directly adjacent municipalities.

Figure 4-2 - Adjoining Neighbors
Source: Google Maps



5.0 RISK ASSESSMENT

This Section addresses the Risk Assessment portion of the Plan, which has been performed in a manner consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 2001). This section is intended to meet FEMA requirements outlined in CFR Part 201.6(c)(2)(i). The following steps are used when assessing hazard risk:

- **Step 1→** Identify Hazards
- **Step 2→** Profile and Rank Hazards
- **Step 3→** Inventory Assets
- **Step 4→** Estimated Losses
- **FINAL** Risk Assessment Outputs Inputs for Hazard Mitigation Strategy

The Risk Assessment process includes both hazard identification and hazard profiling/ranking and ultimately considers the assets that are at risk in the community and what assets could be damaged or lost due to the occurrence of a hazard event. This analysis allows the City of Elizabeth to make informed decisions related to hazard assessment as well as to develop an appropriate mitigation strategy. Section 5.1 provides a general overview of identified hazards including a description of destructive characteristics as well as the location and extent of hazard events.

The information presented in Section 5.1 is utilized to identify hazards which are considered priority for Elizabeth. Section 5.2, Hazard Analysis, presents the methodology utilized to profile and rank the identified hazards with respect to Elizabeth and the findings of the overall analysis.

5.1 HAZARD IDENTIFICATION

The City of Elizabeth is vulnerable to a wide array of natural hazards that threaten life and property. Some hazards are interrelated (i.e., hurricanes may cause flooding and wind), and some contain elements that are not listed separately (i.e., severe thunderstorms can cause lightning; tropical storms can cause coastal erosion). Some hazards, such as a thunderstorm, may impact a large area without causing much damage, but other hazards, such as a tornado, may impact only a small area but cause extensive damage in that area. This section provides a general description of the hazards listed above, including a discussion of their destructive characteristics.

Such statistics are usually available on a national or state level, but seldom on the local level. Information shown on Tables 5-1a, 5-1b and 5-1c, were obtained from the FEMA website and identifies New Jersey's disaster declaration history.

Specific descriptions of risk (predominantly flooding within the City), street locations of vunerability,and types of improvements recommended increase the City's resiliency in those hazard prone areas and are documented in Table 8-1, Mitigation Projects.

These potential natural hazards include:

- Avalanche
- Coastal Erosion
- Coastal Storm, Nor'easter and Hurricane
- Drought
- Earthquake
- Expansive Soil
- Extreme Heat
- Extreme Cold
- Flood
- Hailstorm
- Ice Jams
- Landslide
- Land Subsidence
- Mosquito-Borne Disease
- Severe Winter Storm
- Thunderstorms
- Tornado
- Tsunami
- Volcano
- Wildfire
- Wind

Table 5-1a New Jersey Disaster History - Major Disaster Declarations
Source: FEMA

Year	Date	Disaster Types	Disaster Number
2012	10/30	Hurricane Sandy	4086
2012	7/19	Severe Storms and Straight-Line Winds	4070
2011	11/30	Severe Storm	4048
2011	10/14	Remnants of Tropical Storm Lee	4039
2011	9/15	Severe Storms and Flooding	4033
2011	8/31	Hurricane Irene	4021
2011	2/4	Severe Winter Storm and Snowstorm	1954
2010	4/2	Severe Storms and Flooding	1897
2010	3/23	Severe Winter Storm and Snowstorm	1889
2010	2/5	Snowstorm	1873
2009	12/22	Severe Storms and Flooding associated with Tropical Depression Ida and a Nor'easter	1867
2007	4/26	Severe Storms and Inland and Coastal Flooding	1694
2006	7/7	Severe Storms and Flooding	1653
2005	4/19	Severe Storms and Flooding	1588
2004	10/1	Tropical Depression Ivan	1563
2004	7/16	Severe Storms and Flooding	1530
2000	8/17	Severe Storms, Flooding And Mudslides	1337
1999	9/18	Hurricane Floyd	1295
1998	3/3	Coastal Storm	1206
1997	9/23	Flooding	1189
1996	11/19	Severe Storms/Flooding	1145
1996	1/13	Blizzard	1088

Table 5-1a (continued) New Jersey Disaster History - Major Disaster Declarations
Source: FEMA

Year	Date	Disaster Types	Disaster Number
1992	3/3	Severe Coastal Storm	936
1985	10/15	Hurricane Gloria	749
1984	4/12	Coastal Storms, Flooding	701
1977	2/8	Ice Conditions	528
1976	8/21	Severe Storms, High Winds, Flooding	519
1975	7/23	Heavy Rains, High Winds, Hail, Tornadoes	477
1973	8/7	Severe Storms, Flooding	402
1971	9/4	Heavy Rains, Flooding	310
1968	6/18	Heavy Rains, Flooding	245
1965	8/18	Water Shortage	205
1962	3/9	Severe Storms, High Tides, Flooding	124
1955	8/20	Hurricane, Floods	41

Table 5-1b New Jersey Disaster History - Emergency Declarations
Source: FEMA

Year	Date	Disaster Types	Disaster Number
2012	10/28	Hurricane Sandy ** ***- Active Disaster No.***	3354
2011	8/27	Hurricane Irene	3332
2005	9/19	Hurricane Katrina Evacuation	3257
2003	9/23	Power Outage	3188
2003	3/20	Snowstorm	3181
2001	9/19	Terrorist Attack Emergency Declaration	3169
2000	11/1	Virus Threat	3156
1999	9/17	Hurricane Floyd	3148
1980	10/19	Water Shortage	3083
1974	12/24	Severe Winter Storm, High Winds and Tides	3005

Table 5-1c: New Jersey Disaster History - Fire Management Assistance Declarations

Source: FEMA

Year	Date	Incident	Disaster Number
2007	5/16	Warren Grove Fire	2695
2002	6/2	Double Trouble Fire	2411

Data Sources:

- ***American Society of Civil Engineers (ASCE), "Facts About Windstorms"***
  Web site: www.windhazards.org/facts.cfm
- ***Bureau of Reclamation, U.S. Department of the Interior***
  Web site: www.usbr.gov
- ***Federal Emergency Management Agency (FEMA)***
  Web site: www.fema.gov
- ***National Climatic Data Center (NCDC),*** U.S. Department of Commerce, National Oceanic and Atmospheric Administration
  Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html
- ***National Drought Mitigation Center***, University of Nebraska-Lincoln
  Web site: www.drought.unl.edu/index.htm
- ***National Severe Storms Laboratory (NSSL),*** U.S. Department of Commerce, National Oceanic and Atmospheric Administration
  Web site: www.nssl.noaa.gov
- ***National Weather Service (NWS),*** U.S. Department of Commerce, National Oceanic and Atmospheric Administration
  Web site: www.nws.noaa.gov
- ***Storm Prediction Center (SPC***), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
  Web site: www.spc.noaa.gov
- ***The Tornado Project***, St. Johnsbury, Vermont
  Web site: www.tornadoproject.com
- ***United States Department of Energy (DOE)***
  Web site: www.energy.gov
- ***United States Geological Survey (USGS),*** U.S. Department of the Interior
  Web site: www.usgs.gov
- ***United States Army Corps of Engineers***
  Web site: http://www.usace.army.mil
- ***Other Sources:***
  - http://www.flooddamagedata.org/
  - http://www.avalanche.org/%7enac/
  - http://www.haznet.org
  - http://www.cdc.gov/ncidod/diseases/insects/diseases.htm

- http://www.cdc.gov/ncidod/dvbid/
- http://diseasemaps.usgs.gov/
- http://www.cdc.gov/ncidod/dvbid/arbor/pdf/SLEDOC07132006.pdf
- http://lwf.ncdc.noaa.gov/o/climate/research/snow-nesis/
- http://www.disastercenter.com/newjersy/newjersy.htm

The City of Elizabeth Planning Area consists of six (6) sections known as Wards, encompassing a total of 12.32 square miles with a total population of 127,558 (United States Census, 2013). Elizabeth is New Jersey's fourth most densely populated City with approximately 10,354 persons per square mile. Elizabeth's economy continues to grow due to an incentive sales tax cut pulling in over 1,000 businesses, including retail giants like IKEA. The UEZ (Urban Enterprise Zone) Program is responsible for over 1.5 billion dollars in new economic development since its incorporation into Elizabeth. As mentioned previously, in addition to the City's corporate giants and growing economy, the Port Authority Marine Terminal is the largest container port on the east coast, The Mills At Jersey Gardens is the largest outlet mall in New Jersey and Newark Liberty International Airport is the fifth busiest international air gateway.

5.2 NATURAL HAZARDS

A natural hazard is an unexpected or uncontrollable natural event of unusual magnitude that threatens the activities of people or people themselves. A natural disaster is a natural hazard event that actually resulted in widespread destruction of property or caused injury and/or death. Natural hazards are usually classified based on where they occur on the Earth. Atmospheric hazards are most often weather-related events, while geologic hazards happen on or within the Earth's surface. However, it is important to understand that atmospheric hazards can trigger geologic hazards (such as a thunderstorm producing flooding), and geologic hazards can trigger atmospheric hazards (such as a volcanic eruption producing thunderstorms). For the purpose of this Plan, a natural hazard is defined as natural events that threaten lives, property, and other assets. This Section of the Plan will discuss the natural hazards identified earlier in this Section as well as a discussion of the hazards probable impact to Elizabeth.

5.2.1 Avalanche

Using its simplest definition, an avalanche is a fall or slide of a large mass down a mountainside. In areas where snow pack can build up to considerable thickness, the snow pack can fail and cause a massive slide of snow, ice, mud and other debris. A slope failure can also be triggered in the absence of snow, causing a slide of rock and soil known as a landslide. Large piles of material such as slag and coal, can also exhibit avalanches. Heavy rains can cause a massive flow of mud, called a mudslide.

Generally snow avalanches originate in areas where a blanket of old snow mantles ground obstructions so that a layer of new snow can easily slide across the top. The United States Forest Service National Avalanche Center uses a two-foot depth of old snow and a minimum of 12 inches of new snow as precursor requirements to precipitate a potentially dangerous avalanche above the tree-line. The projection of trees above the snow surface helps to anchor snow pack in place. Elizabeth does not typically receive enough snowfall during the winter months for snow avalanches to be a problem, nor are there any elevations in the City above the tree-line.

Landslides present a threat to human life, and the safety of public and private property. Substantial landslides would likely result in disruption of everyday services, including the delay of emergency response, and blockage of transportation routes. The debris could also dam streams, and contaminate water supplies.

Avalanches and landslides can be triggered by an earth tremor, extreme precipitation, freeze thaw cycles, or man-made disturbances such as blasting at a construction site. An avalanche can reach speeds of over 100 miles per hour. The impact of the flowing material and the air blast that precedes the flow can cause extensive damage to anything in its path. Landslides in the United States cause over $1.5 billion in damages, and an average of about 25 deaths per year.

No avalanches or landslides have been documented in Elizabeth and the topography of the City does not indicate that an avalanche and/or landslides present any potential hazard.

5.2.2 Coastal Erosion

Coastal Erosion is the gradual breakdown and removal of land material into a sea or lake due to physical and chemical, natural processes such as wind, wave and tide action, with contributions from man-made interferences. Coastal erosion can be thought of as taking place at two different rates: gradual erosion which occurs on a daily basis along all coastlines; and sudden or catastrophic events, primarily due to storms, which can result in changes to coasts over very short time periods. The former mechanisms are fairly steady state, but the latter mechanisms are sporadic and not as predictable.

There are numerous natural factors that influence the coastline. Constant wave action, ocean currents, daily tides, and wind are the primary energy sources for erosion. Sources of sand, which can range in size from very fine sand to small pebbles, include continental shelf deposits, rivers, eroding cliffs, sand dunes, and other beaches that are losing sand due to the action of long shore currents. Sinks that accept the removed sand include continental shelf deposits and deep ocean canyons. If these deposits are below depths of approximately 45 feet they will be too deep to be lifted by wave action and re-deposited on the land. The geologic characteristics of the shore will also affect erosion rates. For instance, a resistant rock type will erode more slowly than a sedimentary shoreline. There is typically movement of sand between three areas: the beach, inland sand dunes, and offshore sand bars. Transfer of sand between these areas does not represent sand loss, but can affect the shape of the coastline. The offshore bathymetry of the sea bottom also has an effect on coastal erosion. In shallow water, waves will have less energy when they hit the shore, but deep water close to shore allows strong waves to strike the coast with more energy, causing more erosion.

The construction of artificial structures by humans, such as piers and jetties, as well as activities like beach sand mining, dredging, and the damming of rivers are all factors in coastal erosion. Groins and breakwaters serve to build up beachfront land in isolated areas, but at the expense of other areas that then face greater erosional rates.

Elizabeth has a limited coastline along the Newark Bay. This area has been developed and reinforced with bulkheads and other structural walls to prevent erosion. However, since this coastal area does experience tidal influence, coastal erosion is regarded as a potential hazard for Elizabeth. After Hurricane Sandy in October 2012, there was measurable coastal erosion and future planning may consist of additional shoreline

protection with living shore designs and/or additional hard armoring. However, coastal erosion is not currently assessed as a high risk for the City.

5.2.3 Coastal Storm/Nor'easter/Hurricane

Hurricanes, tropical storms, nor'easters and typhoons, are all different varieties of a cyclone, which is the generic term for a low-pressure system that generally forms in the tropics, and features closed circulation. A typical cyclone is accompanied by thunderstorms, and in the Northern Hemisphere, a counterclockwise rotation of winds near the earth's surface, around the low-pressure core.

Storms develop as a "Tropical Depression", which is a system of clouds and thunderstorms with a defined circulation and maximum sustained winds of 38 mph (33 knots) or less. If sustained storm winds increase to 39 to 73 mph (34-63 knots), the system is designated as a "Tropical Storm", given a name by the National Weather Service, and is closely monitored by the National Hurricane Center in Miami, Florida. Once sustained winds reach or exceed 74 miles per hour, the storm is classified as a "Hurricane." In the western Pacific, hurricanes are called "typhoons," and similar storms in the Indian Ocean are called "cyclones."

All Atlantic and Gulf of Mexico coastal areas are subject to hurricanes and tropical storms. The Atlantic hurricane season lasts from June to November, with the peak season from mid-August to late October. On average, approximately six (6) storms reach hurricane intensity per year.

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating system based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures. The Saffir- Simpson Scale is shown in Table 5-2, below.

Table 5-2 Saffir-Simpson Scale
Source: NOAA

Saffir-Simpson Hurricane Scale			
Scale Number (Category)	**Sustained Winds (MPH)**	**Damage**	**Storm Surge**
1	74-95	Minimal: Unanchored mobile homes, vegetation and signs.	4-5 feet
2	96-110	Moderate: All mobile homes, roofs, small crafts, are flooding.	6-8 feet
3	111-130	Extensive: Small buildings, low-lying roads cut off.	9-12 feet
4	131-155	Extreme: Roofs destroyed, trees down, roads cut off, mobile homes	13-18 feet

		destroyed. Beach homes flooded.	
5	More than 155	Catastrophic: Most buildings destroyed. Vegetation destroyed. Major roads cut off. Homes flooded.	Greater than 18 feet

Hurricanes can cause catastrophic damage up to several hundred miles inland from the coastline. There are three major mechanisms by which hurricanes can cause damage: storm surge, high winds, and heavy rains/floods.

One major cause of hurricane damage, particularly along the coastline, is storm surge. Storm surge occurs when sea level rises locally due to the low pressure, high winds, and high waves associated with a hurricane as it makes landfall. Storm Surge can vary from 4 feet in a Class 1 hurricane, to over 18 feet in a class 5 hurricane. The bulge of water in a storm surge can be between 50 to 150 miles wide. These temporary increases in sea level can cause catastrophic flooding. Coastal towns adjacent to large bays or areas with shallow water are especially susceptible to damage by the storm surge. A phenomenon known as "Storm Tide" can act in concert with, and worsen storm surge. Storm tide is the combination of the storm surge and the normal astronomical tide. Areas that might not otherwise flood due to storm surge at low tide may flood during a storm tide combination of high tide plus storm surge.

Hurricane-force winds, which can exceed 155 miles per hour, can destroy poorly constructed buildings. Loose debris, such as outdoor furniture, and any other small items left outside, can become missiles in hurricanes. High winds can uproot trees, knock over traffic signals and street lights, pluck signs out of the ground, peel off roofing and siding material, any of which in turn can also become airborne missiles. Tornadoes and microbursts can be caused by hurricanes and tropical storms, although the localized destruction caused by these features can be overwritten by the overall damage caused by the main storm.

Heavy rainfall causes both flash and long term flooding. Hurricanes and tropical storms can deluge an area with several feet of rain in a period of days. This can cause severe inland flooding from runoff, endangering residents who believe they are safe because they do not live near the coast. Although hurricanes begin to deteriorate and degrade in strength after making landfall, they can still produce a lot of rainfall. Even storms as weak as a tropical depression is still a very strong storm when compared to average thunderstorms. Flooding, through either storm surge or caused by excessive rainfall, has been the number one cause of death from hurricanes in the United States.

Similar to hurricanes, nor'easters are ocean storms that form as extra-tropical cyclones off the North American coast. When the low-pressure core remains off-shore the winds affecting the land come from the northeast. Nor'easters are named for these winds.

Nor'easters can cause substantial damage to coastal areas in the Eastern United States due to their strong winds and heavy surf. These storms tend to track up the East Coast along the warm water of the Gulf Stream, which lies off the Atlantic coast. Nor'easters generally occur during the fall and winter months when both sufficient moisture and cold air are present in the atmosphere. Nor'easters are known for creating high surf that can cause severe coastal flooding and erosion, and for dumping heavy amounts of rain and snow, while sometimes producing hurricane-force winds.

Due to the location of Elizabeth, coastal storms, nor'easters and hurricanes are potential hazards and the historical occurrences documented these types of hazard events impacting the City of Elizabeth. Significant hurricanes to impact Elizabeth was Hurricane Floyd in September, 1999 and Superstorm Sandy in October 2012. An April 2007 nor'easter also caused significant damage to locations within twelve counties in Northeast New Jersey including the City of Elizabeth and all twelve counties received a Presidential Disaster Declaration. Given the history of impacts by these types of storms on the City, coastal storms, nor'easters and hurricanes would be continuing potential hazards for Elizabeth. Such events are considered to have potential high risk with significant impacts to the City predominantly due to heavy rain and high winds that cause flooding, loss of power, and damage to prperties and environments.

5.2.4 Drought

Drought is a natural climatic condition resulting from an extended period of below normal precipitation caused by variations in local or regional weather patterns. Weather patterns can be altered for varying lengths of time by factors such as changes in ocean temperatures and currents, changes in local or regional wind patterns, and abnormal temperatures due to solar variation.

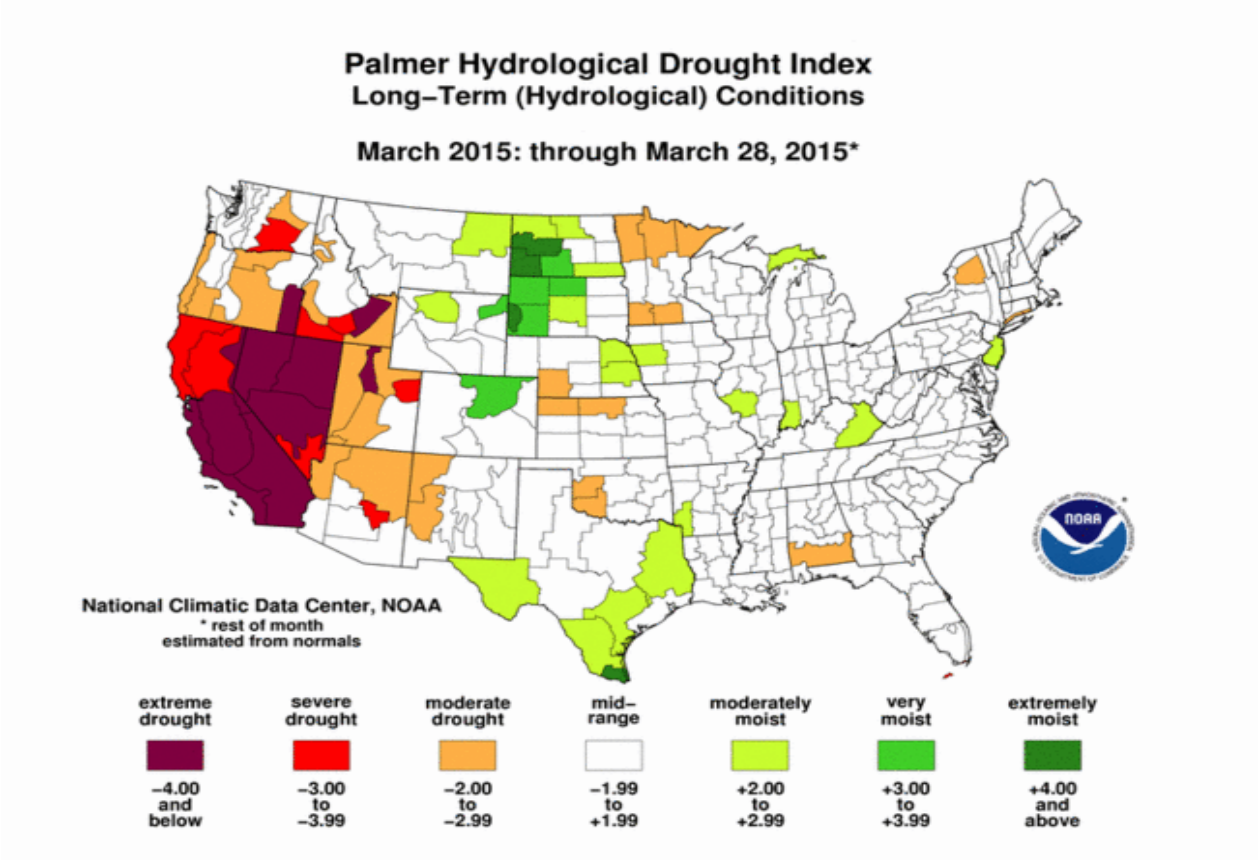
Extreme climate conditions (high wind, high temperature, low humidity, etc.) as well as increased human demands and actions can worsen drought conditions, and can make areas more susceptible to the negative impacts of the precipitation deficiency.

Droughts are classified into four major categories: meteorological, agricultural, hydrological, or socioeconomic.

- Meteorological droughts are defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time.
- Agricultural droughts are based on specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels.
- Hydrological drought is due to precipitation shortfalls on surface and groundwater supplies. Changes in land use, and other human factors, can alter the hydrologic characteristics of a basin.
- Socioeconomic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

The drought hazard can be monitored on a NOAA website that utilizes the Palmer Drought Index. Based review of the current Palmer Index map as shown below, New Jersey and Elizabeth does not appear to have any current significant drought hazard issues. The City geographic zone also does not appear to be sensitve to short-term or long-term drought scenarios, and as such does not currently pose a likely risk to the City. The City shall be watchful and continue to monitor for dought when those conditions arise and plan accordingly should the potenial for drought become significant. Figure 5-1 is an example of the Palmer Hydrological Drought Index ane Weekly Palmer Indexes can be reviewed at the following link: http://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/

Figure 5-1



5.2.5 Earthquakes

An earthquake is the sudden motion or trembling of the earth caused by a sudden release of accumulated strain within the earth's crust. In New Jersey, earthquakes usually occur when strain is released by the sudden displacement of rock along a fault, although earthquakes can also be caused by volcanism, landslides, or the collapse of caverns. An earthquake's "epicenter" is the point on the Earth's surface that is directly above the point where the earthquake originates. Depending on geologic conditions and the amount of energy released, earthquakes can be felt, and cause damage, quite far from their epicenters.

Most earthquakes originate along the active borders of the Earth's tectonic plates. The eastern coast of the United States sits near the middle of the North American tectonic plate. This position isolates it somewhat from the more active seismic sources at the edges of the plate, which are along the west coast, and near the center of the Atlantic Ocean. Never-the-less, both crustal strain and faults exist in New Jersey, and earthquakes do occur. New Jersey does not experience as many earthquakes as do the states west of the Rocky Mountains. However, earthquakes have occurred in New Jersey, mostly on a small scale and a few New Jersey earthquakes, and several that originated outside the state, have produced minor damage within New Jersey.

An earthquake's strength is expressed as "magnitude". An instrument called a seismograph is used to determine magnitude. The most widely known magnitude scale is the Richter Scale, designed by C.F. Richter in 1935 for west coast earthquakes. Magnitude increases of 1 represent a 10-fold increase in amplitude of the seismic wave; this corresponds to a 32-fold increase in energy.

An earthquake's "intensity" describes effects at a particular place on the Earth's surface. Intensity is dependent upon an earthquake's magnitude, its distance from the epicenter, and local geology. Intensity scales are based on reports of people experiencing felt movements, sounds, and visible effects on structures and landscapes. The most commonly used scale in the United States is the Modified Mercalli Intensity Scale (MMI) as presented in Table 5-3 below. Values on the MMI scale are usually reported in Roman numerals to distinguish them from magnitudes. Nnote that there have been earthquakes with epicenters not originating in New Jersey but felt by the City of Elizabeth.

Table 5-3 Modified Mercalli Intensity Scale
Source: NJ Geological Survey (http://earthquake.usgs.gov/learn/topics/mercalli.php)

Mercalli Intensity	Equivalent Magnitude[1]	Effects
I	Not Felt	Not felt except by a very few under especially favorable condition.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of building. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone, many awakened. Some dishes, windows broken. ; Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

1. Abridged from The Severity of an Earthquake, a U. S. Geological Survey General Interest Publication. U.S. GOVERNMENT PRINTING OFFICE: 1989-288-913.

Tables 5-4 presents additional information pertaining to damaging earthquakes in New Jersey from 1737 to present day. Please refer to Appendix D for the City of Elizabeth HAZ-US: Earthquake Event Report (Probabilistic 100yr-Mag5 and 500yrMag5). Please note that all HAZ-US run data utilizes 2010 Census Data.

Table 5-4 Damaging Earthquakes Felt in New Jersey

Source: NJ Geological Survey

Location	Year	Magnitude (Richter)	Intensity (Mercalli) Max. in NJ	Comments
New York City	1737	Not Recorded	VII / VII	Chimneys down in New York City. Felt in Boston, Massachusetts and Philadelphia, Pennsylvania.
Cape Ann, Massachusetts	1755	6.0	VIII / IV	Chimneys and brick buildings down in Boston. Its tsunami grounded boats in the West Indies
West of New York City	1783	5.3	VII / VII	Felt from New Hampshire to Pennsylvania.
New Madrid, Missouri	1811-1812	8.0-8.8	XII / IV-V	Four great earthquakes. Changed course of Mississippi River. Town of New Madrid destroyed. Loss of life low due to sparse settlement. Damage in Chicago.
New York City	1884	5.5	VII / VII	Toppled chimneys in New York City and New Jersey. Cracked masonry from Hartford, Connecticut to West Chester, Pennsylvania. Felt from Maine to Virginia, and eastern Ohio.
Charleston, South Carolina	1886	7.7	X / IV	Sixty killed. Over 10,000 chimneys down.
High Bridge, New Jersey	9/1/1895	Unknown	VI	Felt in the northeast and southwest from Maine to Virginia. Articles fell from shelves and building rocked in Hunterdon County, New Jersey. Broken windows and overturned crockery reported in Philadelphia, Pennsylvania.
New Jersey Coast	1927	Unknown	VII / VII	Several chimneys down from Asbury Park to Long Branch.
West-central New Jersey	3/23/1957	Unknown	VI	Cracked chimneys, windows/dishes broken and fallen pictures. Near the site of the 9/1/1895 earthquake.
New Jersey	8/23/2011	5.8	III-IV	Epicenter was northwest of Richmond, VA

Review of the above table (Damaging Earthquakes Felt in New Jersey) reveals the time spans between the intensity VII earthquakes were 46, 101, and 43 years. As stated by the New Jersey Geological Survey, this data plus information from other smaller-intensity quakes, implies a return period of 100 years or less, and suggests New Jersey is overdue for a moderate earthquake.

Most property damage and earthquake-related deaths are not caused directly by the shaking of an earthquake, but rather by the failure and collapse of structures due to ground shaking. Other damaging effects include landslides, and liquefaction of unconsolidated, saturated soils. Liquified soils exhibit fluid-like properties, and can flow, much like quick sand. Therefore, structures relying on liquefied soil for support can be damaged, shift, or collapse during an earthquake. In addition to destroying buildings, ground shaking, landslides, and liquefaction can disrupt utilities (i.e., gas, electric, phone, water), and the destruction of or impact to these assets can sometimes trigger fires.

The survival of a building in a strong earthquake can be correlated to the soundness of its construction. Newer buildings, built to higher construction standards, are more likely to withstand earthquakes. New Jersey's building codes include some provisions for earthquake-resistant design, but current codes do not include requirements for upgrading existing buildings. In particular, non-reinforced masonry structures appear to be most vulnerable to earthquake damage, and housing of this construction is common in New Jersey's crowded urban areas. According to the New Jersey Geological Survey, an earthquake the size of New York City's 1884 quake (magnitude 5.5) would cause severe property and asset damage and would likely include fatalities.

Despite the low likelihood of an earthquake occurring in New Jersey, the U.S. Geological Survey earthquake hazard maps show that northern New Jersey communities should identify earthquakes as a potential hazard. The map below shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years of 5-6% g for northern NJ. According to FEMA How-To Guidance, Understanding Your Risks, FEMA 386-2 earthquakes should be identified as a hazard if the pga is greater than 2% g.

There have been no recorded earthquake related deaths in New Jersey. Damage in New Jersey from earthquakes has been minor, with the most severe damage reported being fallen chimneys, articles falling from shelves and buildings being rocked. The City of Elizabeth is identified as being situated in a 5% g area. Given Elizabeth's location within the 5% g area, earthquakes are considered a potential hazard for the City with potential high damage should an large earthquake occur. However, based on historic natural hazard events, the likelihood of a major earthquake event impacting the City is low.

5.2.6 Sea Level Rise

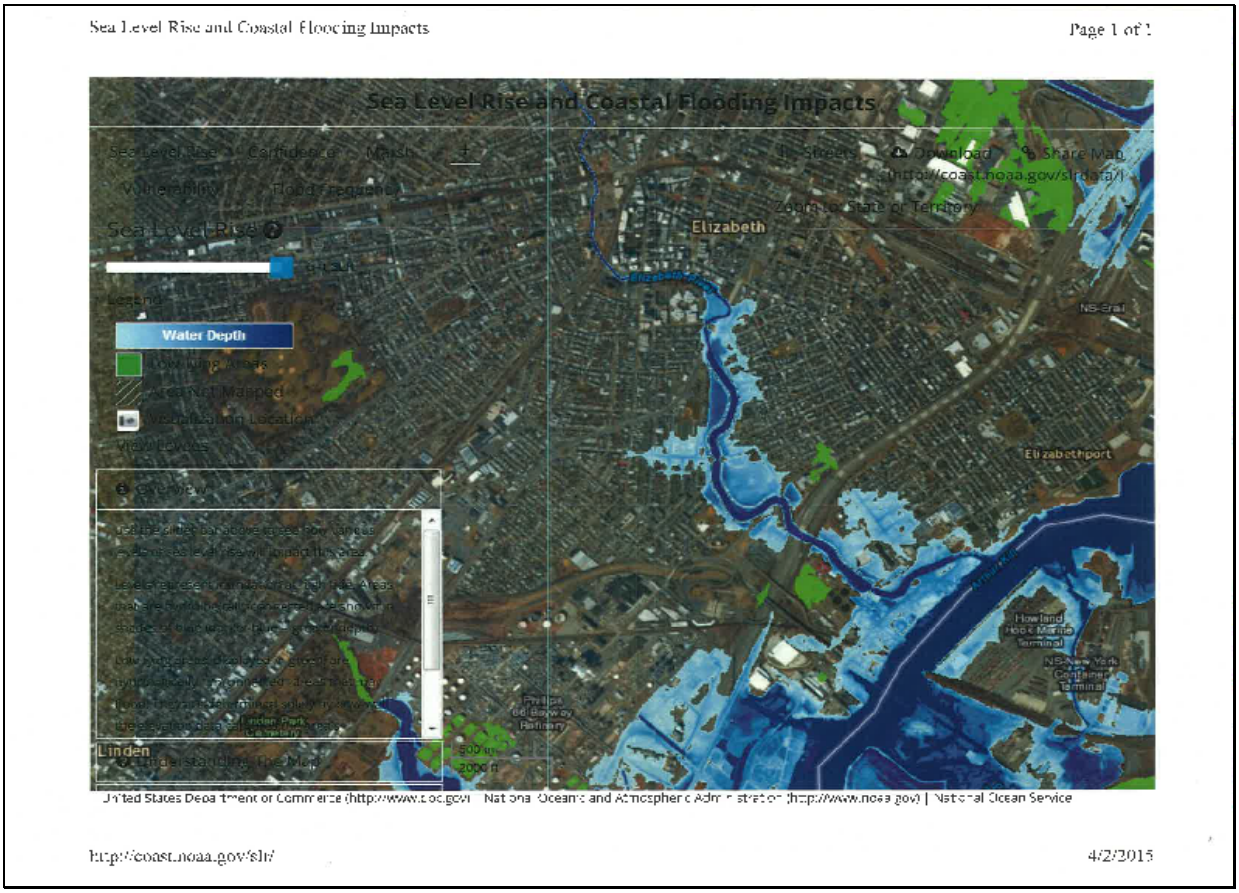
Sea Level Rise as defined by NASA Global Climate Change (Vital Signs of the Planet) *"is caused primarily by two factors related to global warming: the added water coming from the melting of land ice and the expansion of sea water as it warms."* This rise of sea water also directly affects the coastal tides with ground data at tide gauges showing a change of about 200mm from 1870 to year 2000 (http://climate.nasa.gov/vital-signs/sea-level/).

According to NOAA, "*By 2050, a majority of U.S. coastal areas are likely to be threatened by 30 or more days of flooding each year due to dramatically accelerating impacts from sea level rise, according to a*

new NOAA study, published today in the American Geophysical Union's online peer-reviewed journal Earth's Future." The current rate of rise is 3.19mm per year and is expected to accelerate.

The City of Elizabeth is a coastal city and impacts from sea level rise may be significant in futures years or during extreme tidal storm surge events. Figure 5-2 below show affected areas in a hypothetical 6-foot sea level rise above the current highest tidal range is shown below:

Figure 5-2: 6' Sea Level Rise Map



The NOAA Digital Coast viewer was used to simulate the 6' sea level rise scenario above and the viewer can simulate sea level rise from 1 to 6 feet above the average highest tides in the corresponding areas of the United States. The City may use the following link to estimate sea level rise in future years: http://coast.noaa.gov/digitalcoast/tools/slr

5.2.7 Extreme Heat

According to the FEMA, "extreme heat" is defined as a period of abnormally high temperature (>10° F above average regional temperatures) that lasts for several weeks. Humid or muggy conditions occur when a "dome" of high pressure, humid air remains near the ground. The increased water vapor in the air traps solar radiation near the surface of the earth raising temperatures. Humidity prevents the evaporation of sweat and the associated cooling effects on the human body. In general, urban areas tend to suffer more from extreme heat due to the "urban heat island effect" in which heat stored in asphalt and concrete is slowly released after dark, resulting in higher nighttime temperatures. Additionally, air tends to stagnate more in urban areas as tall buildings can block wind.

The NOAA NWS Heat Index Program is used to alert the public of hazardous heat/humidity conditions. The "Heat Index" represents the cumulative effects of heat and humidity on the human body. Minor health effects associated with extreme heat (namely, fatigue) can begin with heat indices as low as 80 to 90 degrees Fahrenheit (that is, an air temperature as low as 80 degrees with a relative humidity of at least 40 percent).

The negative effects of extreme heat include but are not limited to:

- Heat-related illnesses such as sunburn, fatigue, and heat cramps, heat exhaustion, and heat stroke;
- Health concerns created by stagnant atmospheric conditions trapping pollutants;
- Excessively dry and hot conditions can provoke dust storms resulting low visibility and respiratory problems;
- Power shortages/outages caused by increased energy demands;
- Increased demand on health care facilities by individuals suffering from various heat related health effects;
- Disruption of commerce as a result of increased energy demand;
- Disruption of municipal services (e.g. waste collection) as a result of decreased human productivity or increased energy demands; and,
- Damage to structures and infrastructure due to softening, (e.g. asphalt).

According to the National Weather Service (NWS) website, approximately 175 Americans die from extreme heat annually. Young children, elderly people, and those who are ill or overweight and people without access to air conditioning are more likely to become victims. Because men sweat more than women, men are more susceptible to heat illness because they become more quickly dehydrated. People living in urban areas may be at a greater risk from the effects of a prolonged heat wave than people living in rural regions. Technical sources do not identify frequent occurrences of extreme heat in New Jersey. However, given the City's geographic location and history of extensive heating events, extreme heat is considered a potential hazard to the City, especially for the elderly, homeless, poor and those whom may not have air conditioning at the time of an extreme heat event. The NWS Heat Index Chart is presented below in Figure 5-3:

Figure 5-3: NWS Heat Index Chart

NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

5.2.8 Extreme Cold

Prolonged periods of extremely cold weather can be caused by abnormal wind patterns that bring arctic air masses from northern latitudes, below normal humidity levels which allow solar radiation to escape from the atmosphere, and variations in the amount of solar energy reaching the surface of the Earth.

Generally, weather forecasts will provide advance notice of extreme cold events allowing individuals, governments, and industries to prepare for the onset of such temperatures. There are many potential effects of prolonged periods of cold weather. These effects to the City include:

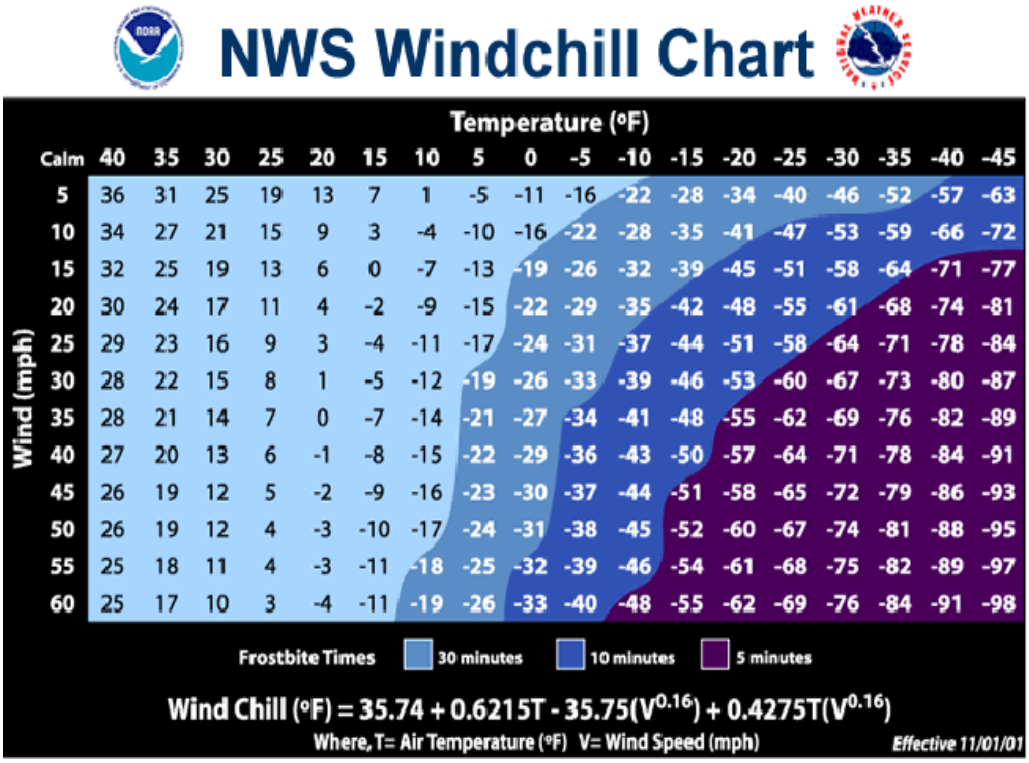
- Human injury and death due to exposure (frostbite, hypothermia);
- Fire caused by an increased usage of space heaters and/or fireplaces;
- Carbon Monoxide poisoning caused by an increased usage of space heaters and/or fireplaces;
- Flooding due to ice jams in rivers;

- Crop damage if cold weather comes during local growing seasons;
- Loss of commerce caused by freezing of ports and rivers;
- Loss of commerce caused by failure of automobiles/buses to start;
- Potential for water lines and sewers of insufficient burial depth (i.e. above the frost-line) to become damaged due to freezing; and,
- Damage to structures and infrastructure due to brittleness.

Other meteorological conditions can exacerbate the effects of cold temperatures. High winds can increase risks for exposure, and allow fires caused by the use of heaters and fireplaces to spread more rapidly. Low humidity creates ideal conditions for fires to start and spread. Sharp increases in temperature or rainfall following extremely cold weather can cause snow to melt rapidly and flood areas upstream from ice jams.

The elderly, homeless and people living in poverty are at the greatest risk for injury or death caused by the effects of extreme cold events. Extreme cold can also lead to additional slips/fall injuries, many that may be serious to the elderly. Technical sources do not identify frequent occurrences of extreme cold in New Jersey. Given the City's geographic location, extreme cold is considered a potential hazard with respect to the entire jurisdiction, but was not identified as a significant potential hazard. The NOAA NWS Windchill Chart is presented below in Figure 5-4:

Figure 5-4: NOAA NWS Windchill Chart



Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

5.2.9 Flooding

On August 4, 2004, FEMA released a statement declaring that flooding is New Jersey's #1 natural hazard. This statement holds true for the City of Elizabeth and is identified as a highly likely and continual potential hazard for the City. According to NOAA, the term "flooding" is defined as "the inundation of a normally dry area caused by high flow, or overflow of water in an established watercourse, such as a river, stream, or drainage ditch; or ponding of water at or near the point where the rain fell." Commonly, the term flooding refers to a duration type event, with an onset that is greater than six hours from the start of rainfall. The term "flash flooding" refers to a flood which occurs within six hours or less of the causative event. Flash floods are usually the product of heavy, localized precipitation falling in a short time period. General flood such as involve precipitation over a wider area, typically a given river basin.

Besides precipitation and weather patterns, other characteristics such as river basin topography; recent soil moisture conditions; and the degree of vegetative land cover in the basin, can affect the severity of floods. Flooding can be common in urbanized areas where a high percentage of the ground is covered by impervious surfaces, which decreases the ability of the soil to absorb and retain surface water runoff. The problem is often exacerbated by development, which obstructs the natural flow of water.

It is normal and inevitable for lands adjacent to rivers, streams, and shorelines to experience periodic flooding as a natural occurrence. Floods are typically described in terms of their statistical frequency. The recurrence interval of flooding is defined as the average time interval, in years, that is expected between a flood event of a particular magnitude and an equal or larger flood. Larger, more severe floods are expected to occur less frequently.

Floodplains are designated by the frequency of the flood that is large enough to cover them: for example, a 10-year flood will define the 10-year floodplain, and the 100-year flood will define the 100-year floodplain. Flood frequencies are determined by graphically plotting the size of all known floods for an area and determining how often floods of a particular size occur. A 100-year flood is defined as having a 1% chance of occurring in any given year. A 50-year flood will have 2% chance of occurring in any given year.

The NOAA NWS Flood Categories are shown below:

Minor Flooding is defined to have minimal or no property damage, but possibly some public threat. A Flood Advisory product is issued to advise the public of flood events that are expected not to exceed the minor flood category. Examples of conditions that would be considered minor flooding include:

- water over banks and in yards
- no building flooded, but some water may be under buildings built on stilts (elevated)
- personal property in low lying areas needs to be moved or it will get wet
- water overtopping roads, but not very deep or fast flowing
- water in campgrounds or on bike paths
- inconvenience or nuisance flooding
- small part of the airstrip flooded, and aircraft can still land
- one or two homes in the lowest parts of town may be cut off or get a little water in the crawl spaces or homes themselves if they are not elevated

In remote areas with few specific impacts, floods with 5-10 year recurrence interval would be assumed to be causing minor flooding on streams in the area.

Moderate Flooding is defined to have some inundation of structures and roads near the stream. Some evacuations of people and/or transfer of property to higher elevations may be necessary. A Flood Warning is issued if moderate flooding is expected during the event. Examples of conditions that would be considered moderate flooding include:

- several buildings flooded with minor or moderate damage
- various types of infrastructure rendered temporarily useless (i.e. fuel tanks cannot be reached due to high water, roads flooded that have no alternates, generator station flooded)
- elders and those living in the lowest parts of the village are evacuated to higher ground
- access to the airstrip is cut off or requires a boat
- water over the road is deep enough to make driving unsafe
- gravel roads likely eroded due to current moving over them
- widespread flooding, but not deep enough to float ice chunks through town
- water deep enough to make life difficult, normal life is disrupted and some hardship is endured
- airstrip closed
- travel is most likely restricted to boats

In remote areas with few specific impacts, floods with 15-40 year recurrence interval would be assumed to be causing moderate flooding on streams in the area

Major Flooding is defined to have extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary. A Flood Warning is issued if major flooding is expected during the event. Examples of conditions that would be considered major flooding include:

- many buildings flooded, some with substantial damage or destruction
- infrastructure destroyed or rendered useless for an extended period of time
- multiple homes are flooded or moved off foundations
- everyone in threatened area is asked to evacuate
- National Guard units assist in evacuation efforts
- erosion problems are extreme
- the airstrip, fuel tanks, and the generator station are likely flooded
- loss of transportation access, communication, power and/or fuel spills are likely
- fuel tanks may float and spill and possibly float downstream
- ice chunks floating through town that could cause structural damage
- high damage estimates and high degree of danger to residents

In remote areas with few specific impacts, floods with 50-100 year recurrence interval would be assumed to be causing major flooding on streams in the area.

Because floodplains are mapped, the limit of a 100-year flood is commonly used in the compilation of floodplain mitigation programs to identify areas where the risk of flooding may be significant. Flood areas have been documented within the City of Elizabeth, and 100-year and 500-year flood zones are identified and mapped in this section and by the Flood Manager. Flooding is considered to be a major and predominantnatural hazard that is highly likely to occur across the densely populated jurisdcition and especially within the mapped 100-year and 500-year flood zones.

5.2.10 Hailstorms

Hail is a form of frozen precipitation consisting of balls or irregular lumps of ice (hailstones), typically from the size of a pea to a golf ball in diameter, though much larger hail has been reported from severe thunderstorms. Hail forms when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice.

Hail can fall from heights of 30,000 feet, and reach speeds of 120 miles per hour. Hailstorms can cause damage to human life, property (i.e., roofs, cars, landscaping), and crops. NOAA estimates that hail causes $1 billion in damage to crops and property each year in the United States. If severe enough, fallen hail can also temporarily disrupt transportation by icing roadways. Hailstorms are a potential hazard for the City, however, only a few past events had cause any damage to properties (e.g., eaxposed cars during hail events). Hail storms but are not identified as a significant potential hazard that is likely to occur with any regularity.

5.2.11 Ice Jams

An ice jam is a formation of ice over a body of water that limits the flow of the water. The primary hazard associated with ice jams is flooding. Ice jam flooding typically originates when heavy rain, or warm temperatures, cause snow to melt rapidly, overflowing frozen rivers or lakes. When impacted by the rising water, the ice cover breaks into pieces of varying sizes. These pieces of ice, which can include large chunks, will float downstream and can pile up on obstructions, such as bridge abutments and dam spillways. This accumulation can directly cause flooding upstream, but can also affect the integrity of the structures, possibly inducing failure. Ice jams along the stream and rivers within the City limits are not identified as a significant potential hazard that is likely to occur with any regularity.

5.2.12 Land Subsidence

Subsidence is the sinking of the land surface in an area. Subsidence can occur gradually or suddenly. It can be caused by different factors in different parts of the world, but the general cause is that that subsurface support is removed, causing a collapse of the overlying ground surface. They are similar to sinkholes (sinkholes are a form of localized subsidence) but generally speaking, subsidence affects a larger area than sinkholes.

The main causes of subsidence are due to human activities. Mining, groundwater usage and subsequent compaction of the aquifer and removal of organic materials are some of the most common human-induced causes of subsidence. Human-placed fill can also cause subsidence due to poor compaction or the use of inappropriate, degradable materials, such as refuse or wood that can breakdown and leave void space and collapse.

Natural forces can also cause subsidence: natural compaction of sediments, thawing permafrost, deterioration of organic material, and movement along faults can all cause subsidence. Collapse of soluble rock or compression of weak rock, as is found in karst landscapes, is a cause of subsidence.

Subsidence poses more danger to property and the economy than to human life. It can damage buildings, highways, bridges and dams. Subsidence can damage and change gradients in stream channels and utilities (e.g. gravity-drained sewers). Subsidence can also have secondary effects. In coastal areas it can worsen

floods, erosion and storm surge. Upland areas that have subsided can be subjected to floods. Subsidence can also contribute to the pollution of ground water supplies by allowing surface pollutants to enter aquifers through fissures and other conduits. In 1991, the Ground Failure Hazard Committee of the National Research Council estimated the total annual losses due to subsidence in the United States at greater than $125 million. However, such impacts and associated losses are not documented in the City of Elizabeth and the information gained through the review of technical information sources does not indicate that subsidence is a likely potential hazard for this jurisdiction.

5.2.13 Mosquito-Borne Disease and Ticks

Some diseases can be spread through the "bite" of a mosquito. Though strictly speaking, the bite is actually a piercing of the skin by a mosquito's proboscis during feeding. Female mosquitoes require a blood enzyme to complete their egg production cycle. If a bite-victim's blood contains disease-causing organisms, the organisms can survive in the mosquito and could be injected into the next victim's bloodstream when the mosquito feeds again. Mosquitoes can spread disease from animal to animal, animal to man, and from person to person in this manner. Another type of blood-feeding arthropod, the tick, is also common in North America, and can spread disease in the same manner.

The National Center for Disease Control lists six arthropod-borne viruses (a.k.a. "arboviruses") found globally that are encephalitic. Of the several arboviral encephalitides that are known to occur in the United States, there are four that have been known to occur in New Jersey: West Nile Virus (WNV), Eastern Equine Encephalitis (EEE), St. Louis Encephalitis (SLE), and La Crosse (LAC) Encephalitis.

Common symptoms to the various arboviral encephalitides are similar to nonspecific flu-like syndrome. Onset may be gradual or sudden with fever, headache, general malaise and occasionally prostration. Infection may lead to encephalitis (inflammation of the brain), meningitis (inflammation of the membrane around the brain and the spinal cord), or both, which can yield a fatal outcome or permanent neurological damage. Usually, only a small proportion of infected persons progress to the severe stage of these diseases.

Because these are viral diseases, antibiotics are not effective treatment, and to date, the medical community has not identified any effective antiviral drugs. Treatment is supportive, and tends to deal more with the symptomatic problems such as swelling of the brain, and other treatable complications like bacterial pneumonia, and controlling fever. The Center for Disease Control (CDC) estimated costs for arboviral encephalitides are $150 million, which includes the costs of vector (mosquito) control and surveillance/testing activities.

WNV was first isolated in 1937. Human and animal infections were not documented in the Western Hemisphere until 1999. Outbreaks of WNV encephalitis in 1999 and 2000 were reported in persons living in the New York City metropolitan area, New Jersey, and Connecticut. In these two years, 83 human cases of West Nile illness were reported; 9 with fatalities. By 2002, WNV had spread to most eastern and mid-western states, with 4,156 cases and 285 deaths.

Less than 1% of people who become infected with WNV will develop severe illness. In fact, most people who get infected do not develop any disease at all. Among those with severe illness due to WNV, case-fatality rates range from 3% to 15% with the highest rates among the elderly. With respect to reported cases of WNV in New Jersey: there were no human cases, only avian, animal or mosquito cases in 1999; six human cases in 2000; twelve in 2001; twenty-four in 2002; thirty-four in 2003; one in 2004; six in 2005;

five human cases in 2006; and one in 2007. No case of human WNV has been documented within the City of Elizabeth.

EEE is also mosquito-borne viral disease, found in New Jersey. EEE virus occurs in the eastern half of the United States where it causes disease in humans, horses, and some bird species. Because of its high mortality rate of about one-third, EEE is regarded as one of the most serious mosquito-borne diseases in the United States. There were 20 reported human cases in New Jersey from 1965 through 2005, which accounts for about 10% of the 220 cases reported nationally during that time period.

SLE has had 4,478 reported human cases in the United States, since 1964, with an average of 128 cases reported annually. The last major episode of SLE in the United States was in 1975 when 1,815 cases and 142 deaths were reported. Case fatality rates estimates range from 4% to 20%. There were 131 human cases of SLE in New Jersey in 1965 through 2005. The last reported New Jersey case was in 1974.

LCE can progress to seizures or coma, though a majority of infections result only in mild illness; this disease has a fatality rate of <1%. Detailed historic statistics were not readily available for LCE, but the CDC fact sheet identifies approximately 70 cases nationally per year. There were no reported cases of LCE in New Jersey during 2006.

Most cases of arboviral encephalitis and other insect-borne diseases occur from June through September, when arthropods are most active. In warmer parts of the country arthropods are active late into the year, and cases can occur into the winter months.

There are other diseases that are known to be carried by mosquitoes worldwide, but are essentially non-existent in the continental United States: Dengue fever occasionally occurs in some of the US territories, Puerto Rico, for instance; Malaria was a common disease in the southeastern United States until the CDC classified it as eradicated due to control efforts in 1951; Rift Valley Fever only occurs in Africa; and Yellow Fever only occurs in South America and Africa. While cases of these diseases do exist within the country, they are typically contracted by persons traveling outside the United States.

Another arthropod commonly known to be a disease vector is the tick, which has been known to spread Lyme disease across the whole of New Jersey. Lyme disease is an inflammatory disease, characterized by a distinctive skin lesion, and flu-like symptoms, with possible cardiac and neurologic disorders. This disease can be treated with antibiotics and usually leads to complete recovery. Rocky Mountain Spotted Fever, though less prevalent than Lyme in New Jersey, does occur in New Jersey. Rocky Mountain Spotted Fever has similar symptoms, treatment and outcome as Lyme disease. Different tick species transmit each disease.

The deadly tick-borne Powassan virus that currenlty has no known cure has been reported in northwest New Jersey. Unlike Lyme disease, Powassen virus can cause death and can be transimtted to humans after a bite within hours (http://www.fios1news.com/newjersey/powassan-tick-virus).

Human (non-infectious) disease outbreaks are primarily limited to effects on human health, and therefore, such an outbreak would not affect structures, utilities or infrastructure. However, an outbreak could cause economic losses associated with work absences or decreased in productivity; human losses due to fatality; adverse impacts on health care facilities and staff; and the fear and anxiety associated with a severe outbreak. Given the above information and based on the City's history, mosquito-borne and tick related diseases would not beconsidered a potential or likely natural hazard for the City.

5.2.14 Severe Winter Storms

There is some overlap between this particular hazard and several others being considered by this Plan, namely Extreme Cold and Hailstorms. Severe winter storms can also combine the effects of hurricane-force winds, and coastal flooding while simultaneously paralyzing an entire region with heavy snow or ice accumulations. Winter storms can be large enough to affect several states, but may affect individual communities more than others. Winter storms may include snow, sleet, freezing rain, or a mix of precipitation types. In recent years, winter storms have had significant impacts to the City and are a likely natural hazard in all future years.

Snow is white or translucent ice crystals that fall in soft, white flakes. NOAA classifies snowfalls as follows:

- Flurries - Light snow falling for short durations. No accumulation or light dusting is expected.
- Showers - Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Squalls - Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant. Snow squalls most frequently occur in the Great Lakes region.
- Blowing Snow - Wind-driven snow that reduces visibility and causes significant drifts. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.
- Blizzard - Winds over 35 mph with snow and blowing snow which reduces visibility to near zero.

Even though the City will continue to persevere through severe winter storms, it would be unlikely that a severe winter storm by itself would cause any real damage or threaten lives. However, the City would have to monitor extreme cold cycles, nor'easters and hailstorms that may coincide with a severe winter storm and/or severe winter storms that stack on top of each other causing cumulative impacts, such as dangerous travel and roof collapses, and put together would become a high risk with large impacts to the City. In general, a severe winter storm is very likely to occur each year, but may not pose a real risk unless combined with other natural hazards.

5.2.15 Thunderstorms

A thunderstorm is a form of weather characterized by the presence of lightning and associated thunder. Thunderstorms are usually produced from a cumulonimbus cloud and typically produce heavy precipitation. Thunderstorms frequently produce strong winds, and can also spawn hail and tornadoes. Thunderstorms form when three ingredients are present: 1) significant atmospheric moisture, 2) a mass of warm unstable air, and 3) a source of energy to lift the warm, moist air mass rapidly upward. Lifting can be caused by the following: unequal warming of the Earth's surface; orographic lifting due to a topographic obstruction, such as when an air mass is forced up the slope of a mountain range; and, mechanical lifting along a frontal zone.

The NWS identifies four main types of thunderstorms: single-cell, multi-cell, squall line and super-cell. The storm type depends on the instability and relative wind conditions at different layers of the atmosphere ("wind shear").

Single-cell storms form in unstable atmospheres with little or no wind shear. This means precipitation falls back down through the updraft that led to it, cooling it and eventually destroying the cell. Typically these storms are short lived, and last for less than an hour after becoming strong enough to produce lightning.

Multi-cell storms are groups of cells in different stages of development which have merged into a larger system. The cloud is divided into different updraft and downdraft sections, which are separated by a "gust front," which is the leading edge of gusty surface winds from thunderstorm downdraft. The storm itself will have different portions sequentially going through the various thunderstorm stages. Sometimes immature cells develop along a flanking line.

Squall line storms are formed as a linear arrangement of multi-cell storms, frequently with a gust front along or ahead of a cold front. They often arise from convective updrafts in or near mountain ranges and linear weather boundaries, such as strong cold fronts. Occasionally, squall lines are also formed near the outer rain band of tropical cyclones. The squall line is moved by its own outflow, which reinforces continuous development of updrafts along the leading edge. Squall lines tend to be hundreds of miles long, sometimes stretching across an entire region of the country, covering multiple states at a time.

Super-cell storms are large, quasi-steady-state storms which form when the wind speed and direction vary with height ("wind shear") separates downdrafts from updrafts (i.e., precipitation is not falling through the updraft) and contain a strong, rotating updraft. These storms normally have such powerful updrafts that the top of the cloud (or "anvil," named for its flat-topped shape) can reach miles into the air and can be 15 miles wide. These storms produce destructive tornadoes, extremely large hailstones (4 inch diameter), winds in excess of 80 mph (130 km/h), and flash floods.

The NWS describes high winds as:

- Strong, dangerous, or damaging: equal or greater than 40mph
- Very Windy: 30-40mph
- Windy: 20-30mph
- Breezy, brisk, blustery: 15-25mph
- Light or variable wind: 5-15mph or 10-20mph, respectively; and
- No wind: 0-5mph.

A severe thunderstorm is a generic term that is typically taken to mean a thunderstorm with damaging winds (58 mph or greater), ¾ inch or larger hail, or one which may generate funnel clouds or tornadoes. These storms may contain frequent cloud-to-ground lightning and heavy downpours which can lead to localized flooding.

According to the NWS, approximately 25 million cloud-to-ground lightning strikes occur in the United States each year. Nationally, lightning kills about 100 people each year making it the number two weather killer in the United States. According to NOAA, 84 thunderstorm and/or high wind events have occurred in Union County from 1957 to 2007.

Based on the past meteorological records, there is a high potential for future damages caused by thunderstorms. As such, thunderstorms are a potential likely natural hazard to the City where rain, snow, high winds, lightening may cause flooding and power outages. As such all thunderstorm would have a risk to be evaluated by the City on a case-by-case basis.

5.2.16 Tornadoes

The American Meteorological Society defines a tornado as a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind

speeds ranging from as low as 40 mph to higher than 300 mph. Tornadoes are often generated by thunderstorms, but can also result from hurricanes and other coastal storms. Anytime cool, dry air overrides a layer of warm, moist air forces the warm air to rise rapidly, and can tornadoes can form.

Tornado damage is a result of the high wind velocity and wind-blown debris. Lightning and large hail can accompany tornadoes. The Enhanced Fujita Tornado Scale (or the "F Scale"), described in Table 5-5 below, has become the commonly used scale for estimating wind speeds of tornadoes based upon the damage done to structures. The National Weather Service uses it in investigating tornadoes (all tornadoes are now assigned an EF scale number).

Table 5-5 Enhanced Fujita Tornado Scale
Source: NOAA

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

Tornado season is generally during the spring and early summer months of March through August, though tornadoes can occur at any time of year. Tornadoes can also occur at any time of day, but they tend to form mostly in the afternoons and evenings. The highest concentration of tornadoes in the United States occurs in the central plains states and southeastern states. The area commonly referred to as "Tornado Alley" is a north-south oriented zone in the Great Plains region of the United States and includes north Texas, Oklahoma, Kansas, and Nebraska.

Most tornadoes are only dozens of yards wide but can cause enormous damage even though they may only touchdown briefly. Highly destructive tornadoes may cause damage over a much wider area. Waterspouts are weak tornadoes that form over warm water. Waterspouts can move inland, and become tornadoes that can cause damage and injury. Waterspouts have been reported off the New Jersey Coast, but they are most common along the Gulf Coast and southeastern states.

According to NOAA's National Climatic Data Center (NCDC 2013), there is about 2 tornadoes recorded in New Jersey between 1991 and 2010. While the potential for any future tornadoes exists in Union County and the City of Elizabeth, given past meteorological history, the likelihood of a direct path of a tornado passing through the City in any given year is unlikely,and the expected likelihood of future damages caused by this type of hazard is low as well. As such, tornadoes are considered a potential hazard but are not a significant risk to the City.

5.2.17 Tsunami

A tsunami is a series of waves generated by an undersea disturbance, typically an earthquake, volcanic eruption, or landslide. Tsunamis have been historically referred to as "tidal waves" because they take on the characteristics of a violent onrushing tide as they approach the coast, rather than the typical wind-driven, crested, ocean waves. The time between successive waves may be five to 90 minutes. The speed of a tsunami can range from about 20 miles per hour in shallow water, up to 500 miles per hour in deep water. The wave front of a tsunami is different from regular ocean waves in that their currents travel the full depth of the water column down to the sea floor. Wave amplitudes in deep water are typically less than one meter and are sometimes imperceptible to the human eye, but wave height increases dramatically in shallow water, which can be devastating to coastlines.

Tsunamis can originate hundreds or even thousands of miles away from coastal areas. Areas at greatest risk are typically less than 50 feet above sea level and within one mile of the shoreline in relatively flat topographic areas. Short-term changes in the ocean water level may indicate that a tsunami is approaching. Most deaths during a tsunami are the result of drowning. Besides death and injury, associated risks include flooding, polluted water supplies, damaged utilities and other property damage.

A rare tsunami-type wave hit the New Jersey shore on June 13, 2013 and the last major tsunami hit Japan in 2011. Based on NOAA's website a tsunami on October 11, 1918 hit Atlantic City, New Jersey and origiated by an earthquake off the coast of Puerto Rico. On May 19, 1964, a east coast earthquake generated a tsunami hitting the northeast.

In general, tsumani waves are rare and even rarer for the coast of New Jesery. It would be rare and unlikely that a tsunami would impact the City. The City is already implementing resilent and sustainable improvements that would minimize any future tsunami event should it occur.

5.2.18 Volcano

USGS defines a volcano as a vent in the Earth's crust that emits molten rock and gas. Volcanoes erupt when pressure from gases and the molten rock at depth exceeds the downward pressure of the overlying rock. According to the Michigan Technological University website, there are two types of volcanic eruptions: effusive (e.g. Hawaii) and explosive (e.g. Mount St. Helens).

The Union County area has experienced volcanic activity in the distant past. The Watchung Mountains are composed of 200 million year old volcanic lava rock. As indicated by the USGS, volcanic hazards and ash fall hazards (based on activity in the last 15,000 years) are clustered within the western portion of the United States.

There are no active volcanoes in the region and there is little or no evidence (earthquakes, hydrothermal activity, etc.) of any volcanic activity in the City of Elizabeth reginal area. While some hazards of volcanism (ash fall, acid rain, tsunami, and climate change) can have wide reaching or even global effects, these hazards are likely to leave the City and New Jersey unaffected and are not considered to be a likely natural hazard.

5.2.19 USACE Dam/Levee System

The City is partially protected by an USACE dam/levee system built around 1975. After Hurricane Sandy, three sections of the levee were deemed "unacceptable" as noted in Section 5.3 of the 2014 State of New Jersey Hazard Mitigation Plan. Based on the State Plan, the four sections have been identified as follows:

- Elizabeth River Right Bank South (Unacceptable)
- Elizabeth River Right Bank North (Unacceptable)
- Elizabeth River Left Bank South (Unacceptable)
- Elizabeth River Left Bank North (Minimally Acceptable)

The City of Elizabeth worked diligently with the US Army Corps of Engineers (USACE) to implement levee maintenance repair along a 2.25 mile stretch of the Elizabeth River (Rahway Ave to South 1st Street). The primary work involves two parts, emergency and non-emergency maintenance: 1) Nine drainage structures/outfalls and directly adjacent areas have been deemed as "*Emergency Rehabilitation"* and 2) fourteen remaining drainage structures/outfalls within the levee system were deemed non-emergency.

Repair of the proposed outfalls noted above will also require earthen levee repairs within the existing embankments and including maintenance work (woody vegetation removal, grubbing of soil and seeding) within pond structures to improve flood storage capacity. These ponds currently no longer function as built as years of sedimentation and siltation has filled them in. All the work required will make the whole levee protection system function at full capacity to minimize damage to properties and human welfare during large storm events.

As part of the levee drainage structure/outfall work, the USACE has requested that asphalt pathways, fencing/railings and light pole footings be removed from the ponding areas since those structures have shown over the years to be a detriment to the overall flood proofing system. However, these structures will be reinstalled along the levee as part of the City's public access program. Some of these ponded areas

were initially designed as small parks as part of the original USACE levee system but the gradual failures of sluice gates over the years flooded these parks with uncontrolled tidal inflows. Many of these small parks have developed into wetlands behind the levee system, compromising drainage into the Elizabeth River. These low overgrown areas and other man-made features have been identified by the Army Corps as obstacles for unobstructed to overland flow and trapping large amounts debris during severe storms. These man-made wetlands have been permitted by the Corps and NJDEP as a maintenance project that began in early 2015. Once the man-made features are removed and the pond areas restored to original grade, it would be seeded with appropriate seeds/plants.

5.2.20 Current Flood Control Mitigation

In addition to the Army Corps levee work noted above that consumed and will consume much of the City's flood control contract efforts through 2017, the City has been aggressively implementing flood control projects to mitigate against flooding. Projects include the Verona Avenue/Gebhardt Avenue Storm Sewer Improvement Project, Westfield Avenue/Elmora Avenue Sewer Modification Project, Midtown Sewer Separation Project, Third Avenue Flood Control Project, Summer Street CSO Flood Relief Project, South Street Flood Control Project, North Avenue Flood Control Project, Harding Road Flood Control Project, and the Dredging of the Great Ditch. The City also has traffic signal improvement projects, with one currently under construction, and is being fitted with quick disconnects for connection of gas powered generators during loss of power.

The majority of the Flood Control Projects listed above, including but not limited to, Verona Avenue/Gebhardt Avenue Storm Sewer Improvement Project, Westfield Avenue/Elmora Avenue Sewer Modification Project, Third Avenue Flood Control Project, Summer Street CSO Flood Relief Project, Harding Road Flood Control Project, and the Dredging of the Great Ditch have substantially reduced the flooding risk for existing and proposed buildings within the project areas. Repairs to the waterfront parks and pumping stations as a result of Superstorm Sandy also include mitigation measures to protect these facilities from future damage as a result of flooding or storm surge. Vulnerable equipment is being replaced in higher elevations and flood walls are being installed at the various pumping stations based on having the most impact to the local region. Reinforcement of the boardwalk using hurricane straps and concrete ballasts as well as additional revetment of the shoreline with rip-rap was performed at the waterfront parks amongst other things.

Once the levee system with restored pond storage is completed, the City will greatly reduce its vulnerability and minimize future economic and social impacts for natural hazards. It is evident that the City has accomplished many actions to reduce risk to building and infrastructures as well as limit risk to redeveloped/repaired areas to the maximum extent possible. The City continues to maintain improve its resiliency to future natural hazards.

6.0 VULNERABILITY ASSESSMENT

The purpose of the Vulnerability Assessment is to examine built environments, populations and economic sectors to identify elements which are susceptible to damage from natural hazards. This Section of the Plan presents the methodology and findings of the Vulnerability Assessment for the City and ultimately provides essential information regarded to prioritize mitigation actions and direct disaster response and mitigation planning. The Section is organized as follows: Section 6.1 provides the Overview of the Vulnerability Assessment; Section 6.2 provides the Methodology; Section 6.3 provides the Estimated Costs and Losses; Section 6.4 provides Land Use and Development Trends; Section 6.5 discusses Relationship of the City's Master Plan to Other Plans, Section 6.6 discusses Hazard Vulnerabilities; and Section 6.7 provides a Summary of Hazard Vulnerabilities.

6.1 Overview

As previously discussed in Section 5 – Risk Assessment, a series of natural hazards were addressed as potential occurrences within the City. The risk assessment process included both hazard identification and hazard profiling/ranking and through consideration of hazards and assets, identified those assets that are at risk in the community. This includes assets that could be damaged or lost due to the occurrence of a hazard event. As part of the Vulnerability Assessment, each City department ranked each identified natural hazard and provided an assessment of the likely severity of impact. Assessments were limited to direct impacts and not induced impacts. All hazards previously discussed in Section 5 were ranked based on a scale of 1-5 with 5 being the most likely to impact the City. Impact assessment was based on a scale of High, Medium and Low with regard to the extent of damage in the event of the hazard's occurrence. Table 6-1 presents the findings of the Hazard Ranking Vulnerability Assessment as prepared by the City departments; Table 6-1 is organized by hazards.

6.1.1 Assessment of Previous Natural Hazard Events

The City reviews and assesses past vulnerabilities/hazard events and considers community/economic risks to develop updated mitigation strategies. The City's largest risk comes from the deteriorating levee system (as described Section 5.2.19) which has consumed much of the City's efforts in 2015. Previous occurances of natural hazard events also shape the decision making process for prioritizing action for mitigating future natural hazard events. This would include analyzing regular/severe flooding events and severe winter weather that occurs on a fairly regular seasonal basis and is not specifically documented.

Since the development of the original Plan, no tornadoes have been documented. The 2014 to 2015 winter season was an extremely cold winter (4th coldest on record in New Jersey) and the previous winter season had the 7th highest total snow fall amount (54.3" or 28.4" above average), so numerous emergency Code Blue warnings were issued over the last two winter seasons. Extreme heat is difficult to document but periods consistent with heat waves have occurred.

For Disaster Declaration #1954, the City had three (3) FEMA Public Assistance projects with an eligible amount of $302,262.55 for emergency protective measures. For Disaster Declaration #4048, the City had

four (4) FEMA Public Assistance projects with an eligible amount of $292,528.60 for debris removal and emergency protective measures.

The City also experiences area-wide of flooding and damage to it sewer system as a result of Hurricane Irene. The City sustained a sewer collapse on Fanny Street that cost approximately $390,000 to repair and a sewer collapse on Fairmount Avenue that cost approximately $90,000 to repair. Areas listed in the Mitigation Projects (Table 8-1) experienced flooding as a result of Hurricane Irene. The sewer repair costs were partially recovered through FEMA Public Assistance. For Irene, Disaster #4021, the City had eight (8) FEMA Public Assistance Projects with an eligible amount of $976,517.53. These were for the sewer repairs, emergency protective measure, pump station repairs, debris removal and flood damage to 7 City Buildings.

For Superstorm Sandy, Disaster #4086, the City sustained massive amounts of damage along the Arthur Kill Waterfront and the lower reaches of the Elizabeth River as a result of the storm surge. The City has ten (10) FEMA Public Assistance Projects with an eligible amount of over $17 million dollars. The surge caused almost $16 million dollars' worth of damage to the City's waterfront park system alone. The flooding cause by the surge also caused damage to 3 of the City's pumping stations and 2 of their sewer netting facilities. There was damage to a number of City Buildings as a result of the wind. Debris removal and emergency protective measures were also large impacts as a result of the storm. Many parts of the City were without power for up to 10 days increasing the need for emergency shelters.

Lastly, the City has a combined sewer system constructed prior to 1920 that is inadequately sized to address stormwater runoff for the fully developed community. The broadest and most frequent impact the City faces is localized flooding due to moderated to heavy precipitation events. In addition to the general impacts of flooding, the fact that these are combined sewers (storm and sanitary) creates additional health concerns for human contact with these flood waters. Flood control and mitigation is a specific and primary priority based on the risks, vulnerabilities and social and economic impacts.

Table 6.1 Hazard Ranking Vulnerability Assessment by Hazard

Department	Avalanche		Coastal Erosion		Coastal Storm/ Nor'easter/ Hurricane		Drought		Earthquake		Expansive Soil		Extreme Heat	
	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact
Public Works & Engineering	1	Low	4	Medium	5	High	3	Low	2	Medium	3	Medium	3	Medium
Planning & Community Development	1	Low	3	Medium	5	High	3	Low	2	Medium	3	Medium	3	Medium
Business Administrator	1	Low	3	Medium	4	Medium	3	Low	1	Low	2	Low	4	High
Fire	1	Low	2	High	5	High	5	High	4	High	1	Medium	5	High
Police	0	Low	0	Low	5	High	0	Low	0	Low	0	Low	0	Low
Health & Human Resources	1	Low	2	High	4	High	3	Medium	2	High	2	Medium	5	High
Average Rank/Average Impact Assessment	1	Low	2.3	Medium	4.7	High	2.3	Low	1.8	Medium	1.8	Medium	3.3	Medium
City's Overall Probability of Impacts from Hazard	0-10% (Very Unlikely)		33-66% (About as Likely As Not)*		90-100% (Very Likely)*		0-33% (Unlikely)		0-33% (Unlikely)		0-33% (Unlikely)		33-66% (About as Likely As Not)*	

Table 6-1 Hazard Ranking Vulnerability Assessment by Hazard (continued)

Department	Extreme Cold		Flood		Hailstorm		Ice Jams		Land Subsidence		Mosquito-borne Illnesses	
	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact
Public Works and Engineering	3	Medium	5	High	2	Medium	2	Low	2	Low	2	Low
Planning & Community Development	3	Medium	5	Medium	2	Low	1	Low	1	Low	3	Medium
Business Administrator	2-3	Medium	5	Medium	3	Medium	1	Low	2	Low	3	Medium
Fire	3	High	5	High	4	Medium	2	Medium	2	Medium	3	Medium
Police	1	Low	3	Medium	0	None	0	None	0	None	0	None
Health & Human Resources	5	Medium	4	High	3	Medium	5	High	0	0	3	Medium
Average Rank / Average Impact Assessment	3	Medium	4.5	High	2.3	Medium	1.8	Low	1.2	Low	2.3	Medium
City's Overall Probability of Impacts from Hazard	33-66% (About as Likely As Not)		90-100% (Very Likely)*		0-33% (Unlikely)		0-10% (Very Unlikely)		0-10% (Very Unlikely)		0-10% (Very Unlikely)	

Notes for Table 6-1:

Rank: 1-5 with 5 being the most likely to impact a municipality. Likelihood Scale is based on the International Panel on Climate Change (IPCC) Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties, July 2010.

*Increasing probability as sea level rises and climate changes.

Table 6-1 Hazard Ranking Vulnerability Assessment by Hazard (continued)

Department	Severe Winter Storm		Thunderstorms		Tornado		Tsunami		Volcano		Wildfire	
	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact	Rank	Impact
Public Works and Engineering	5	High	4	High	1	Low	1	Low	1	Low	1	Low
Planning & Community Development	5	High	3	Medium	1	Low	1	Low	1	Low	1	Low
Business Administrator	5	Medium	5	Medium	3	Low	1	Low	1	Low	2	Medium
Fire	5	High	5	2	1	Medium	1	Medium	1	Low	1	Low
Police	0	Low	4	Medium	0	Low	0	Low	0	Low	0	Low
Health & Human Resources	4	High	5	Medium	2	High	1	High	1	High	1	High
Average Rank / Average Impact Assessment	4	High	4.3	Medium	1.3	Low	1.6	Low	1	Low	1	Low
City's Overall Probability of Impacts from Hazard	90-100% (Very Likely)		90-100% (Very Likely)		0-33% (Unlikely)		0-1% (Exceptionally Unlikely)		0-1% (Exceptionally Unlikely)		0-10% (Very Unlikely)	

Notes for Table 6-1:
Rank: 1-5 with 5 being the most likely to impact a municipality. Likelihood Scale is based on the International Panel on Climate Change (IPCC) Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties, July 2010.
*Increasing probability as sea level rises and climate changes.

As a result of the Hazard Ranking Vulnerability Assessment completed by the various City departments, those hazards with high averages and/or high impact potential were analyzed further to assess the City's overall vulnerability/risk in these areas. The remaining natural hazards reviewed and described in the risk assessment (Section 5), were mo longer considered for further assessment as they have low potentials for occurrence and/or low potential impacts with respect to the City. Based on the City's knowledge of natural hazard occurances, as well as information provided through technical information sources, the following natural hazards with either a low history of occurrence and/or low risk of of impacts were removed from futher risk assessments within the City of Elizabeth Planning Area: avalanche, drought, expansive soil, hailstorm, ice jams, land subsidence, mosquito-borne disease, tornado, tsunami, volcano and wildfire. The low or lack of occurrence is attributed to the geographic location, climatology, land form conditions, topographic features and/or other physical conditions/features.

This section of the Plan provides detailed vulnerability assessments for the following natural hazards:

Natural Hazards:

- Earthquakes;
- Flooding;
- Coastal Storm/Nor'Easter/Hurricane;
- Thunderstorms;
- Severe Winter Storm; and
- Extreme Heat/Extreme Cold

These hazards were chosen for detailed analysis due to the higher level of risk for these hazards when compared to other potential hazards in the City of Elizabeth Planning Area. The potential impact of these hazards was reviewed with respect to both existing and "planned (i.e., future development)" structures and infrastructure to the extent practical. The "planned" or future structures and infrastructure were identified/determined through Planning Committee discussions, as well as during individual meetings and conference calls between municipal representatives and Hatch Mott MacDonald. The loss estimates provided in this Section were developed using available data and the methodologies applied have resulted in an "approximation" of risk. These estimates should be used to understand relative risk from hazards and potential losses. However, it is important to understand that uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects in the built environment. This includes unforeseen circumstances that are the result of unpredictable climate and weather conditions, such as Sandy in 2012 and snow/ice storms between 2013 and 2014. Uncertainties also result from approximations and simplifications that are necessary for the comprehensive analysis such as abbreviated inventories, demographics or economic parameters. Further, the Planning Committee concluded that it was not possible to determine specific losses of structures for the following hazards since the likelihood of occurrence of these hazards are difficult to predict, tend to be uniformly distributed across the jurisdiction or impossible to geo-locate with any level of accuracy: thunderstorms, severe winter storms and extreme heat. To the extent practical, the Planning Committee has attempted to provide qualitative loss information for the above listed hazards. It should be noted that New Jersey has a well-developed body of land use regulation which prohibits and/or limits development in designated floodplains, steep slopes, wetlands and other environmentally sensitive areas. The primary

purpose of the land use regulations is to preserve and minimize developmental impacts to natural resources. It is worth noting that the State of New Jersey has revised a substantial body of regulation relating to stormwater management and limited allowable development adjacent to certain waterways and in designated flood and wetland areas. These regulations further strengthen development controls and will assist with hazard mitigation by minimizing or eliminating future construction of structures in hazard prone areas. This does not account for developments that occurred prior to the implementation/updates of the regulations by the State of New Jersey.

6.2 Methodology

Hatch Mott MacDonald, in concert with the Elizabeth Planning Committee, further assessed risk utilizing two (2) methodologies: HAZUS 2.2 (FEMA's Loss Estimation Software) and a statistical risk assessment methodology. Both approaches provide estimates for potential impact by using a systematic framework for evaluation.

HAZUS 2.2 (HAZUS) is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale.

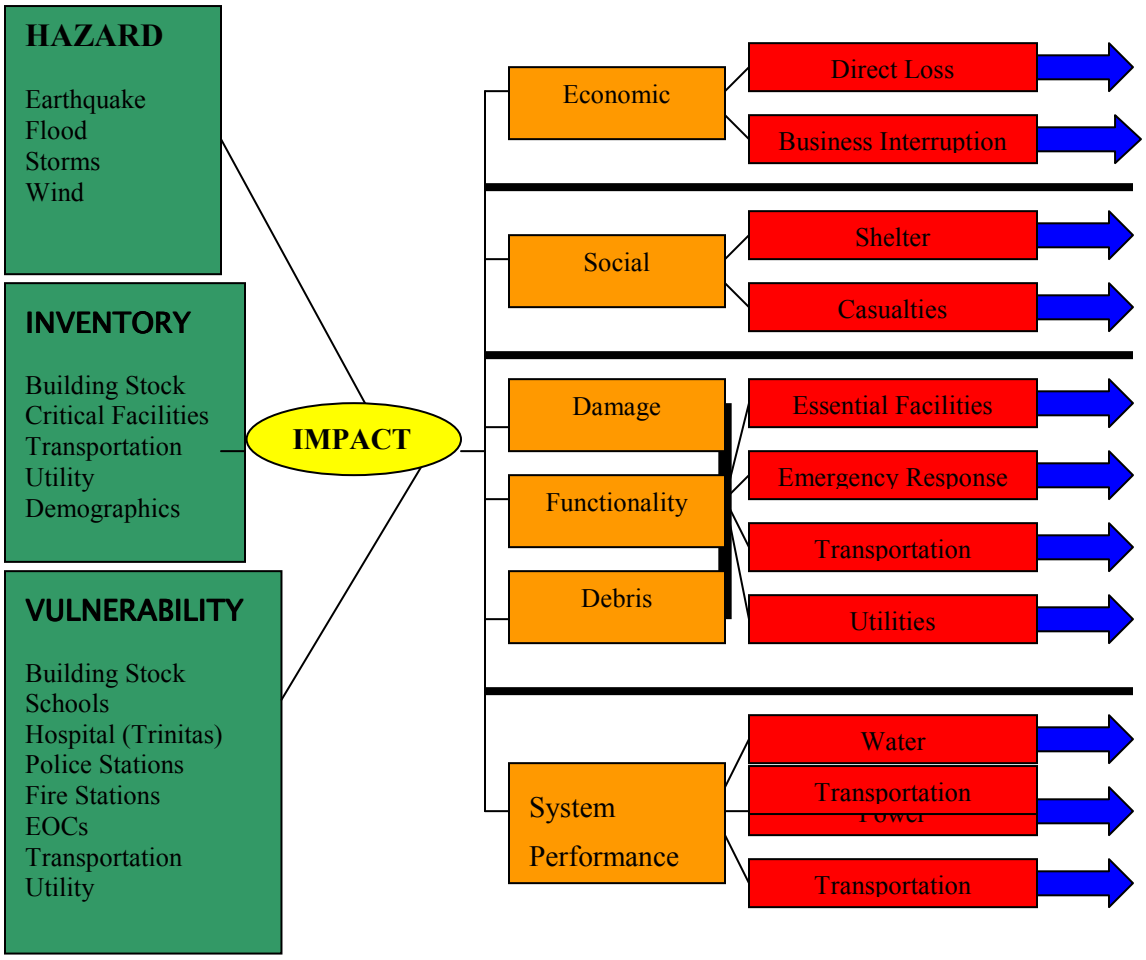
For all data sets generated in this report, HAZUS has pre-determined that the geographical size of the region is approximately12 square miles. The region would contain over 42 thousand households and has a total population of 124,969 people (2010 Census Bureau data).

HAZUS also estimates 19,522 buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95.27% of the buildings (and 67.30% of the building value) are associated with residential housing. Please note, all statistics and tables generated herein are replicated from the probabilistic reports run for the various elements. The numbers in these charts do not always add up to the exact same number in the HAZUS summaries, but are presented as-is. The back-up to the data generated can all be found in Appendix D (Earthquake Event Report), Appendix E (RiverineCoastal Flood Event Report) and Appendix F (Hurricane (Wind) Event Report).

6.2.1 Explanation of HAZUS Risk Assessment Methodology

HAZUS is FEMA's standardized loss estimation software program, built upon an integrated GIS platform. HAZUS software is a powerful risk assessment methodology for analyzing potential losses from floods, hurricanes and earthquakes. This risk assessment applied HAZUS to produce regional profiles and estimate losses for hazards addressed in this Section of the Plan regarding flooding and high winds. Figure 6-1 presents the conceptual model of HAZUS.

FIGURE 6-1 Conceptual Model of HAZUS

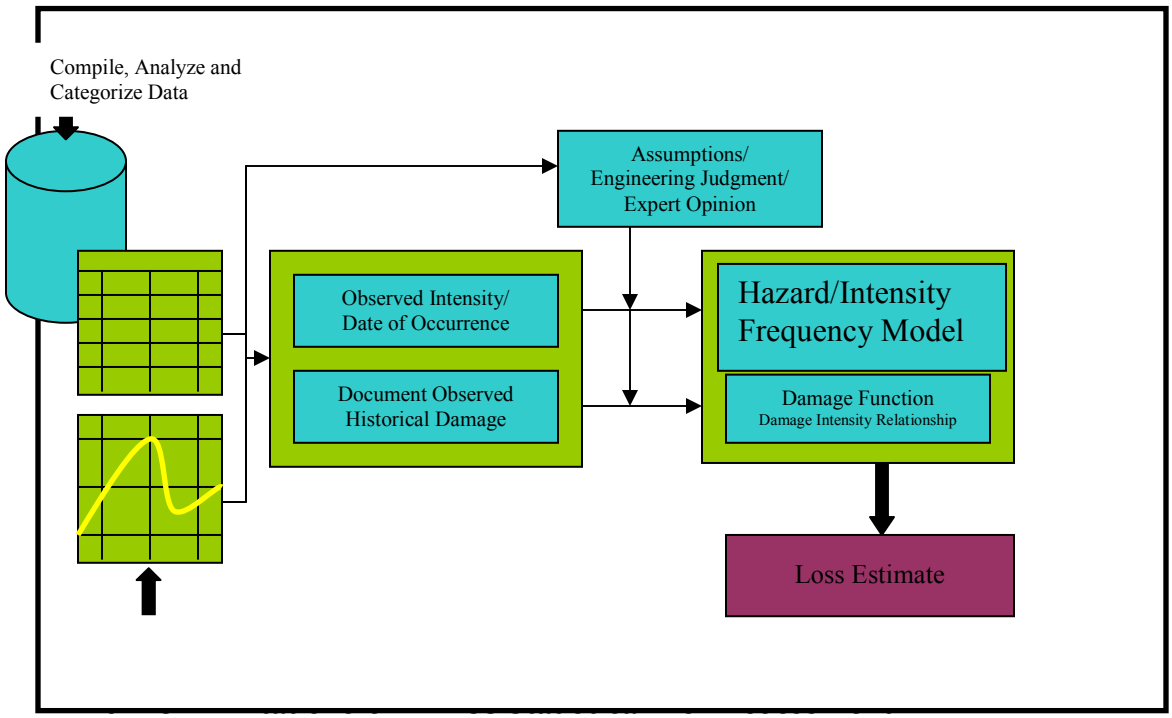


6.2.2 Explanation of Statistical Risk Assessment Methodology

Risks associated with other natural hazards were analyzed using a statistical assessment methodology developed and used specifically for this effort. This approach is based on the same principals as HAZUS, but does not rely on readily-available automated software. Rather, historical data for each hazard are used and statistical evaluations are performed using manual calculations. Figure 6-2 is the HAZUS Conceptual Model of the Statistical Assessemtn Methodology. The general steps used in the statistical risk assessment methodology are summarized below:

- Compile data from national and local sources;
- Conduct statistical analysis of data to relate historical patterns within data to existing hazard models (minimum, maximum, average, and standard deviation);
- Categorize parameters for each hazard to be modeled;
- Develop model parameters based on an analysis of data, existing hazard models, and risk engineering judgment; and
- Apply hazard model using the following criteria:
    - Analysis of frequency of hazard occurrence
    - Analysis of intensity and damage parameters of hazard occurrence
    - Development of intensity and frequency tables and curves based on observed data
    - Development of simple damage functions to relate hazard intensity to a level of estimated damages *(for example, one flood = $ in estimated damages)*
    - Development of exceedance and frequency curves relating a level of damage for each hazard to an annual probability of occurrence
    - Development of loss estimate.

Figure 6-2
Conceptual Model of the Statistical Risk Assessment Methodology



The information gathered by FEMA for the use in the HAZUS 2.2 program was acquired from several sources including United States Census records as well as state, county and municipal inventories. Although some inventory numbers may be inaccurate as of 2010, for the purpose of the Plan, the existing data would deemed accurate for the data reporting period. The HAZUS modeling interpretations is based on the knowledge of the data's age at the time of the models' conception. It should be noted that the HAZUS program is capable of creating data specific models based on individual information provided by the user. This means that the City could run the model based on more accurate information when available and/or if provided directly by the HAZUS program user at a later date.

HAZUS (HAZards U.S.) is geographic information system (GIS) based, standardized, and nationally applicablie multi-hazard loss estimation methodology and sofeware. Because HAZUS was intended to facilitate natural hazard risk assessment on a consistent basis nationwide, the software is provided with a significant amount of default data to allow users to run a simplified "Level 1" analysis "straight from the box" (The Shake Out Scenario Supplemental Study: HAZUS Enhancements and Implementation for the ShakeOut Scenario by Hope Seligson, MMI Engineering) withourt any additional data. For the purpose of this Plan analysis, only Level 1 analysis was implemented. Please be advised there are built-in limitiations and generalizations of a level 1 analysis for the following HAZUS hazards. These limitations can be found in the HAZUS program.

6.3 Estimated Costs and Losses

The economic loss results are presented in this Section using two (2) interrelated risk indicators:

1) Annualized Loss (AL), which is the estimated long-term value of losses to the general building stock in any single year in a specified geographic area (i.e., county);
2) Annualized Loss Ratio (ALR), which expresses estimated annualized loss as a fraction of the building inventory replacement value.

The estimated Annualized Loss (AL) addresses the two (2) key components of risk: the probability of the hazard occurring in the study area and the consequences of the hazard, largely a function of building construction type and quality, and of the intensity of the hazard event. By annualizing estimated losses, the AL factors in historic patterns of frequent smaller events with infrequent but larger events to provide a balanced assessment of risk. The ALR represents the AL as a fraction of the replacement value of the local building inventory. This ratio is calculated using the following formula:

"ALR = ANNUALIZED LOSSES / TOTAL EXPOSURE AT RISK"

The ALR gauges the relationship between average AL and building replacement value. This ratio can be used as a measure of relative risk between areas and, since it is normalized by replacement value, it can be directly compared across different geographic units such as metropolitan areas or counties. It is important to note that HAZUS–MH was used to produce "worst case scenario" results. The outputs in this document are considered to be the result of a worst-case scenario event for each hazard, and it is understood that any smaller events which could occur would most likely create fewer losses than those calculated for the purpose of this assessment. The use of the annualized losses approach has three (3) primary benefits: (1) the ability to assess potential losses from all future disasters, (2) results across

different hazards are readily comparable and are, therefore, easier to rank, and (3) the annualized losses method provides an objective means to evaluate mitigation alternatives. To help assess the significance of losses across the City, it is important to identify the areas of the City with higher populations which would receive elevated levels of loss due to their density.

HAZUS estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2010 dollars). These numbers are derived from HAZUS using 2010 Census data and forms the basis of the the City's vulnerability and risk assessment presented in Section 6.0 for the HAZUS analysis for earthquake, flood (coastal and riverine) and hurricane events (including wind damage).

Table 6-2 below represents the Building Exposure by Occupancy Type for the Study Region. This table is representative for all HAZUS natural hazards (i.e., earthquakes, riverine and coastal flooding, and hurricanes/wind storms). Table 6-2a represents Building Value by Residential and Non-Residential.

Table 6-2 Building Exposure by Occupancy Type For Study Region

Sources: HAZUS (run on April 21, 2015)

Occupancy	Exposure ($1000)	Percent of Total
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religious	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.0%**

Table 6-2a Building Value (thousands of dollars)

Sources: HAZUS (run on April 21, 2015)

Population in Study Region	Residential	Non-Residential	Total
124,949	$7,946,754	$3,861,385	$11,808,139

6.4 Land Use and Development Trends

A general analysis of land uses and development trends within the planning area is an important factor when determining the overall vulnerability of the region, predicting areas of future vulnerability and formulating mitigation options that influence future land use decisions. General land uses and development trends for the City are discussed below and more detailed land use information is provided in Section 4.9 of this Plan.

6.4.1 City of Elizabeth – Existing Land Use

Land use in Elizabeth is predominantly residential in character, both in number of parcels and the total area of parcels. Elizabeth has historically provided both housing and industry; however, the City is experiencing a trend toward an increasing number of residential parcels, and a decrease in the number of commercial and industrial parcels. Table 6-3 represents Land Use by Number of Tax Parcels.

Table 6-3 Land Use by Number of Tax Parcels – 1990 v. 2005
Source: City of Elizabeth Master Plan, Land Use Element – October 2005

Land Use	Number of Parcels			
	From 1990 Master Plan	Year 2005	# Change	% Change
Vacant	786	790	4	0.5
Residential	13,927	14,358	431	3.1
Apartment	569	589	20	3.5
Commercial	2,027	1,954	-73	-3.6
Industrial	223	197	-26	-11.7
Exempt	N/A*	334	N/A	N/A
Public	N/A*	505	N/A	N/A

*N/A = non-applicable

Table 6-4 Land Use by Parcel Area – 2005
Source: City of Elizabeth Master Plan, Land Use Element

Land Use	Lot Acreage*	% of Total Parcel Area
Vacant	58,300	7.7
Residential	358,010	47.0
Apartment	83,167	10.9
Commercial	137,972	18.1
Industrial	91,747	12.1
Exempt	10,833	1.4
Public	21,088	2.8
Total Parcel Area	761,117	100.0

* Lot Acreage from Tax Assessor Records and data from City's Master Plan

6.4.2 Urban Enterprise Zone (UEZ)

The designation of most of the City's commercial zoning districts as an Urban Enterprise Zone (UEZ) has had a significant positive impact on land use in the City, particularly in the Kapkowski Road area. The City's UEZ was originally designated in the mid-1980s, which allowed for the establishment of such Elizabeth icons as IKEA Elizabeth Center and The Mills AT Jersey Gardens on top of a former landfill. Location in the UEZ provides commercial enterprises opportunities to participate in UEZ programs. The level of involvement in the programs is generally based on varying qualifying factors such as what percentage of employees are Elizabeth residents and whether on-the-job training is provided by the business entity. Enterprises such as IKEA and The Mills At Jersey Gardens qualify for the 3.5 percent sales tax program wherein they charge customers a 3.5 percent sales tax, which is funneled into the UEZ fund that uses the proceeds to finance additional UEZ programs. UEZ programs are administered by the Elizabeth Development Company (EDC), a non-profit entity retained by the City to run the UEZ program. Some highlights from the EDC's 2001 Five Year Plan include the stabilization of the Midtown Special Improvement District, the completion of a parking garage in the Midtown Redevelopment Area, infrastructure improvements in E-port, streetscape design work at the UEZ gateway, and The Mills At Jersey Gardens. The current goals include the continued stabilization of UEZ shopping districts, the improvement of infrastructure in targeted UEZ areas, the encouragement of gateway development, the completion of the Midtown Redevelopment Project, and the redevelopment of Trumbull Street (rail yards). The Elizabeth UEZ Program expiration date has been renewed for another 16 years. Figure 6-3 represents the Urban Enterprise Zone Map for the City.

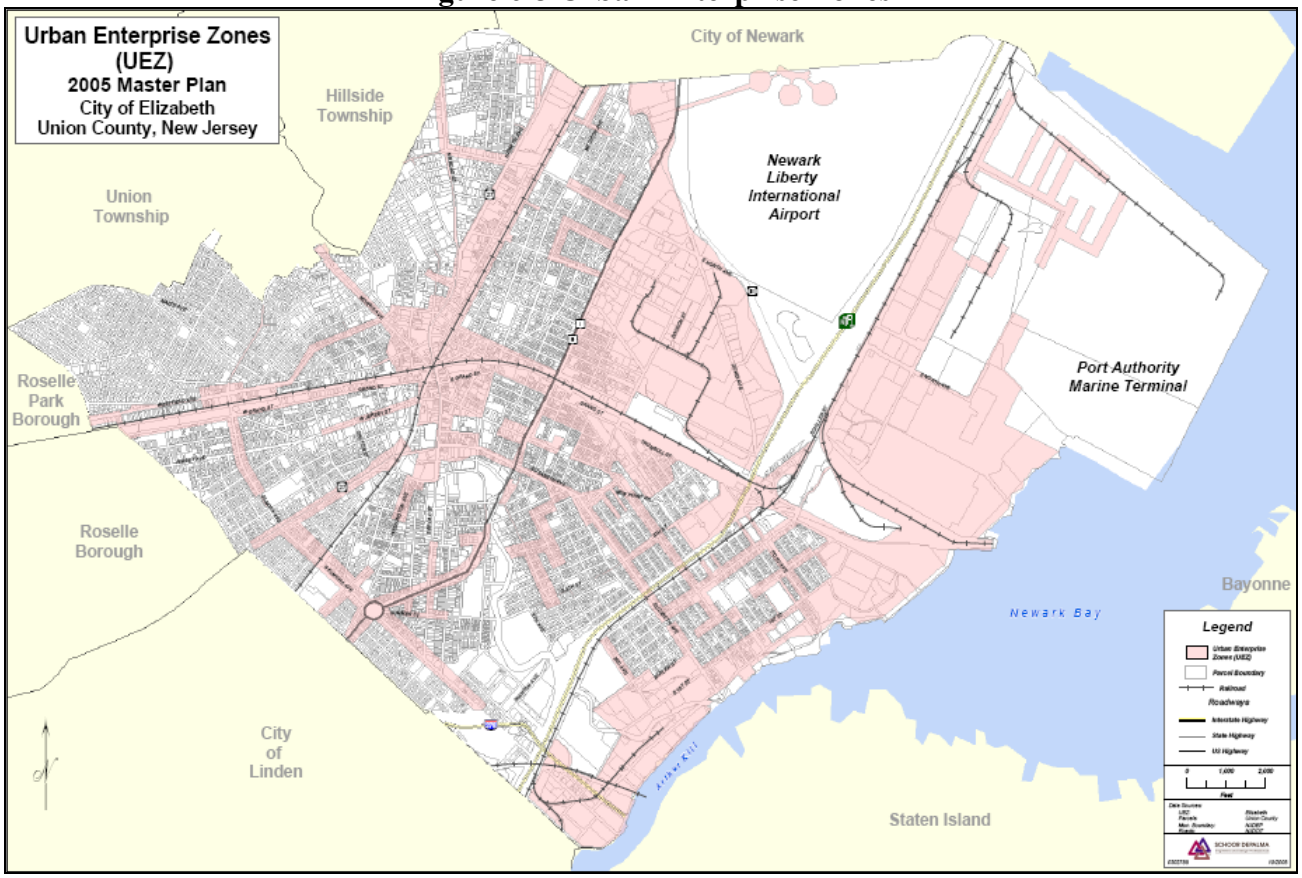
6.4.3 Changing Development Trends

The City exhibits only minor changes in development trends due to the fully developed urban community structure. Also, most development is really redevelopment as open space is minimal. On the residential side, the development trend in the City over the past 10 years has moved away from two-family houses towards higher density, multi-family residential developments. Most of these recent developments utilize elevated structures maximize on-site parking at grade level below the units. While parking is driving factor in this residential construction trend, it also provides a level of flood protection.

On the commercial side, the development trend has been towards large climate controlled distribution warehouses due to the proximity to Newark Airport and the various major highways. These developments have been focused in the area adjacent to Newark Airport between Route 1&9 and the Turnpike.

All developments are reviewed for compliance with the City's Flood Damage Prevention Ordinance. These are all typically redevelopment projects as the City is already fully developed and footprints of disturbances would be considered redevelopment rather than new developments.

Figure 6-3 Urban Enterprise Zones



6.4.4 Zoning

In addition to the many redevelopment areas in the City, the City contains residential, commercial and industrial zoning districts that also regulate land use and building layout. These zoning districts are reflected on the Land Use Plan Map, which sets forth the basis for the Zoning Map. Limited modifications have been recommended for the Zoning Map itself; the bulk of recommendations herein relate to the standards within the zoning ordinance. Figure 6-4 represents the February 2000 Zoning Map for the City. Figures 6-5, 6-6 and 6-7 present the existing land use for the City. Figures 6-8, 6-9 and 6-10 represent the land use plan as per the 2005 City Master Plan (still current in 2015). The City is currently in the process of updating the 2005 Master Plan. This Master Plan update will incorporate this Hazard Mitigation Plan to develop new/revised local planning guidance as the City moves forward into the next 5 years of planning. The updated Master Plan will emphasize, where appropriate, the City's prioriy in mitigating against the vulnerability of flooding.

Figure 6-4 City of Elizabeth Zoning Map

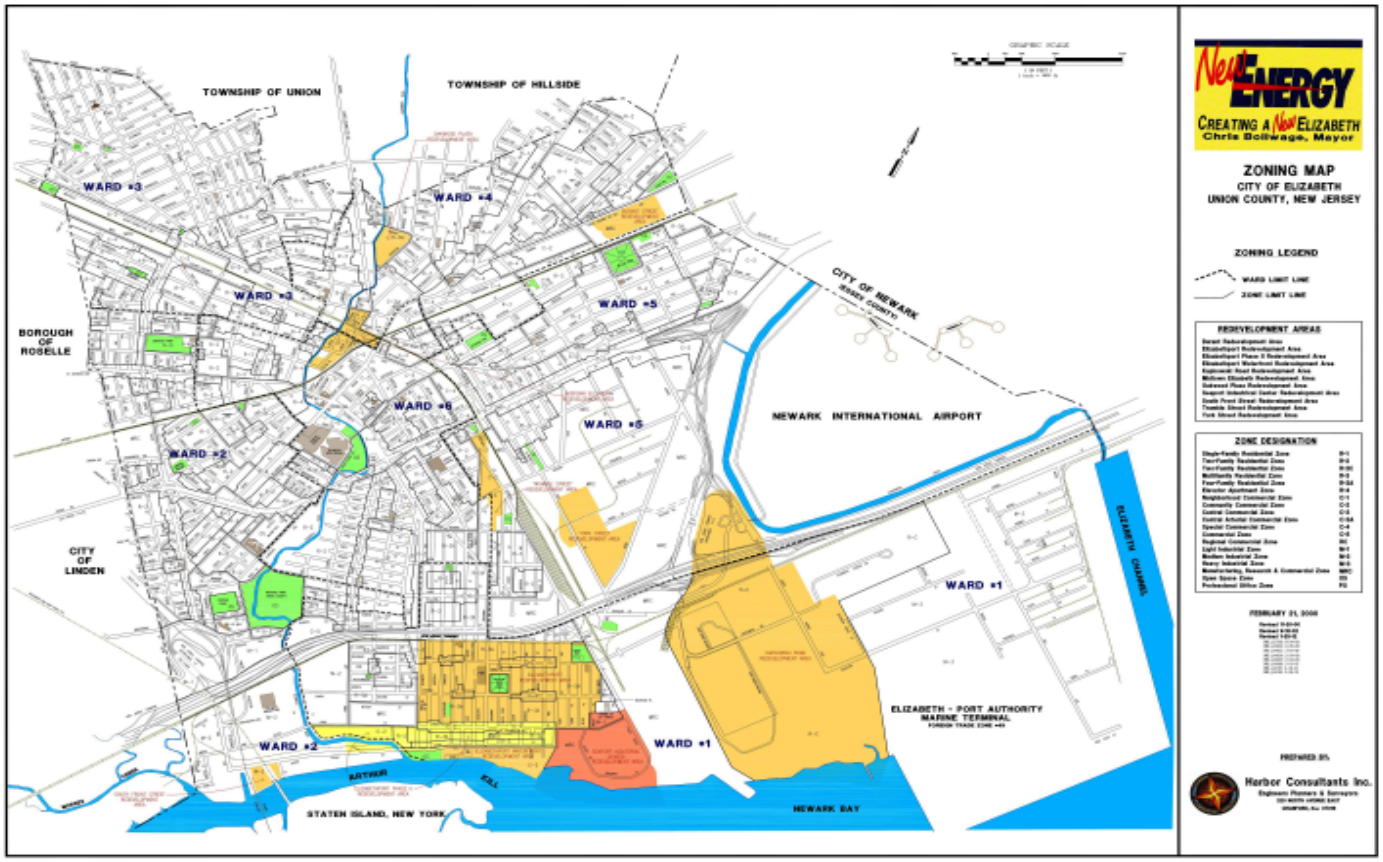


Figure 6-5 Existing Land Use Section 1

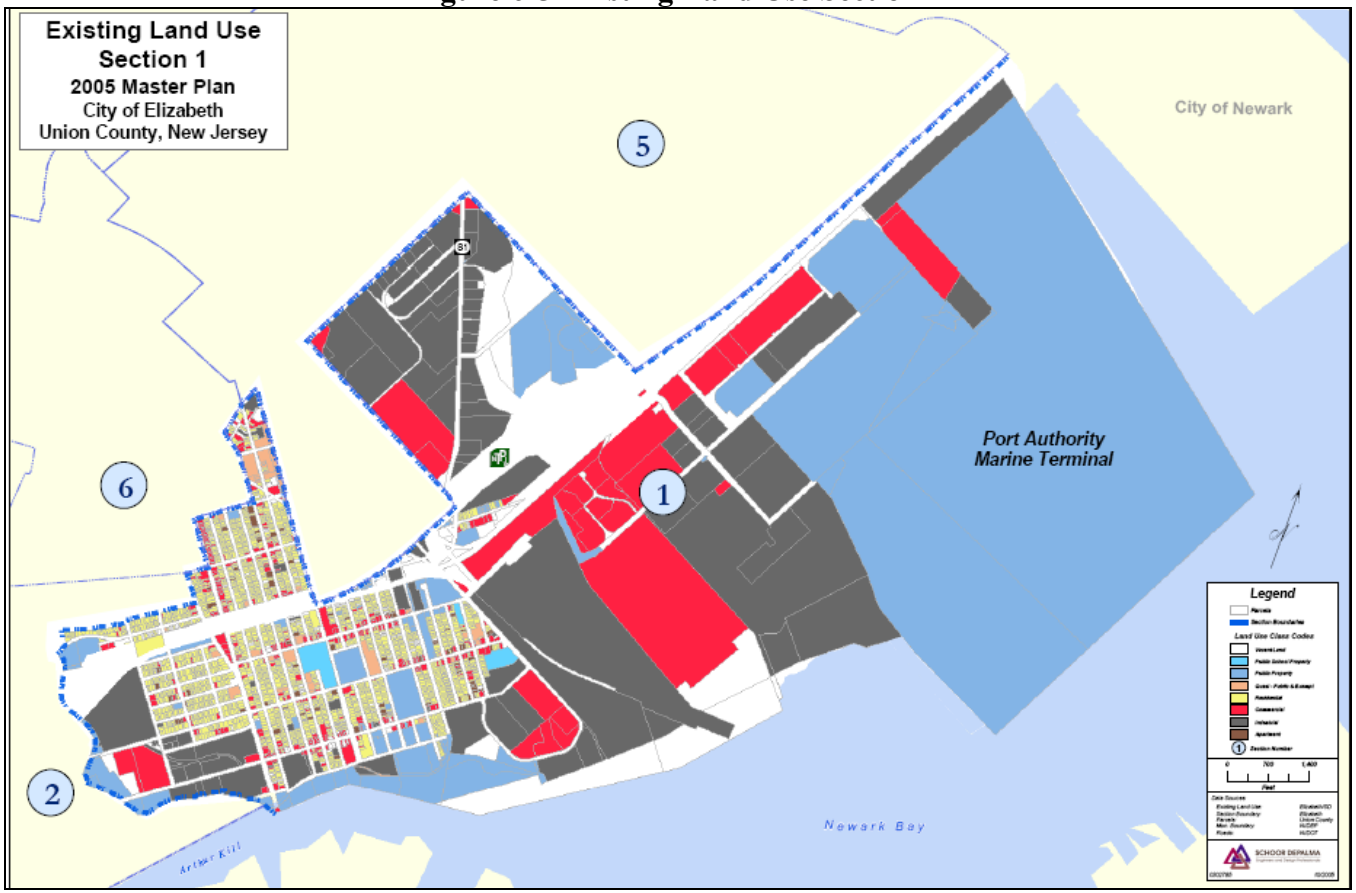


Figure 6-6 Existing Land Use Section 5

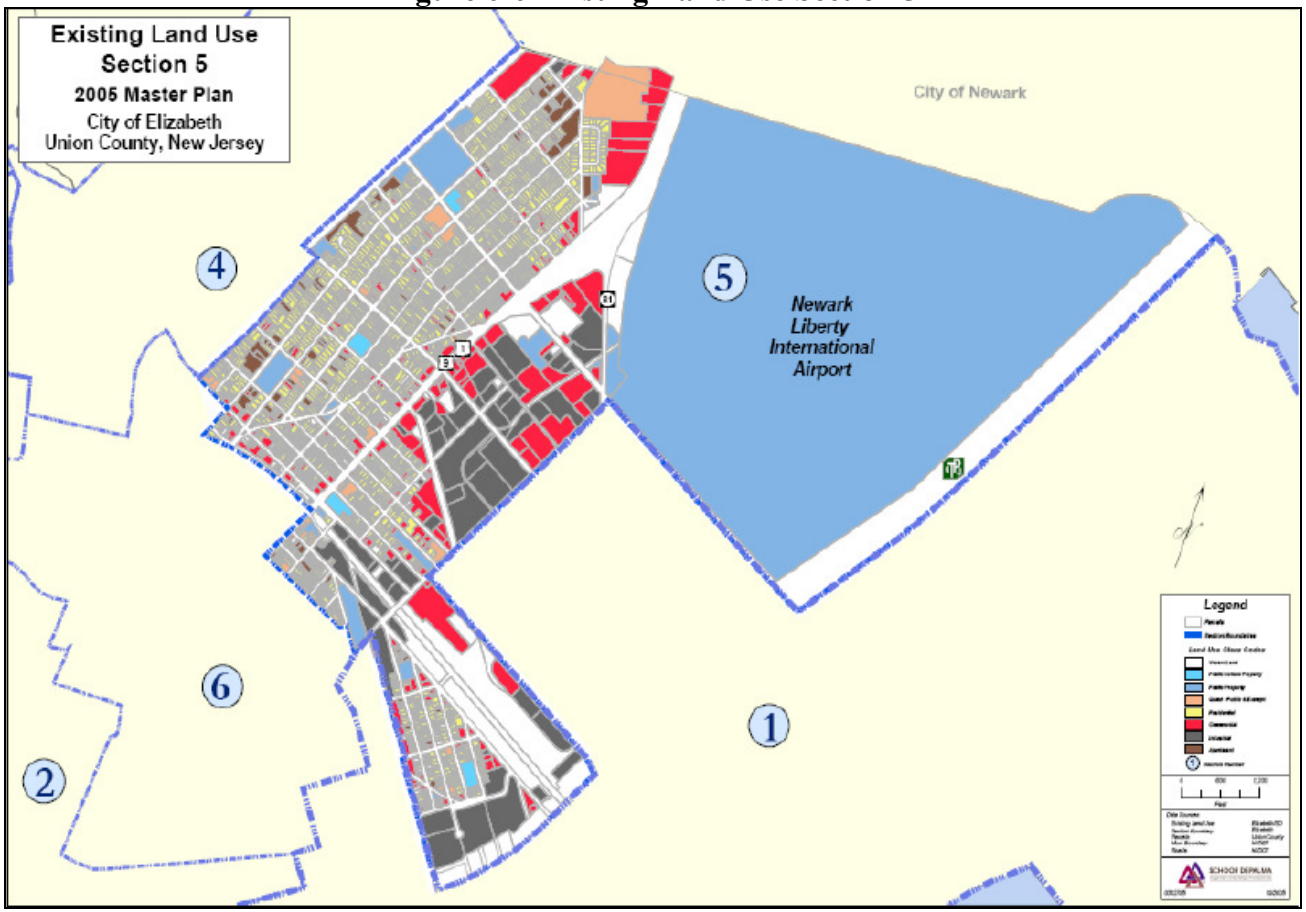


Figure 6-7 Existing Land Use Sections 2, 3, 4 & 6

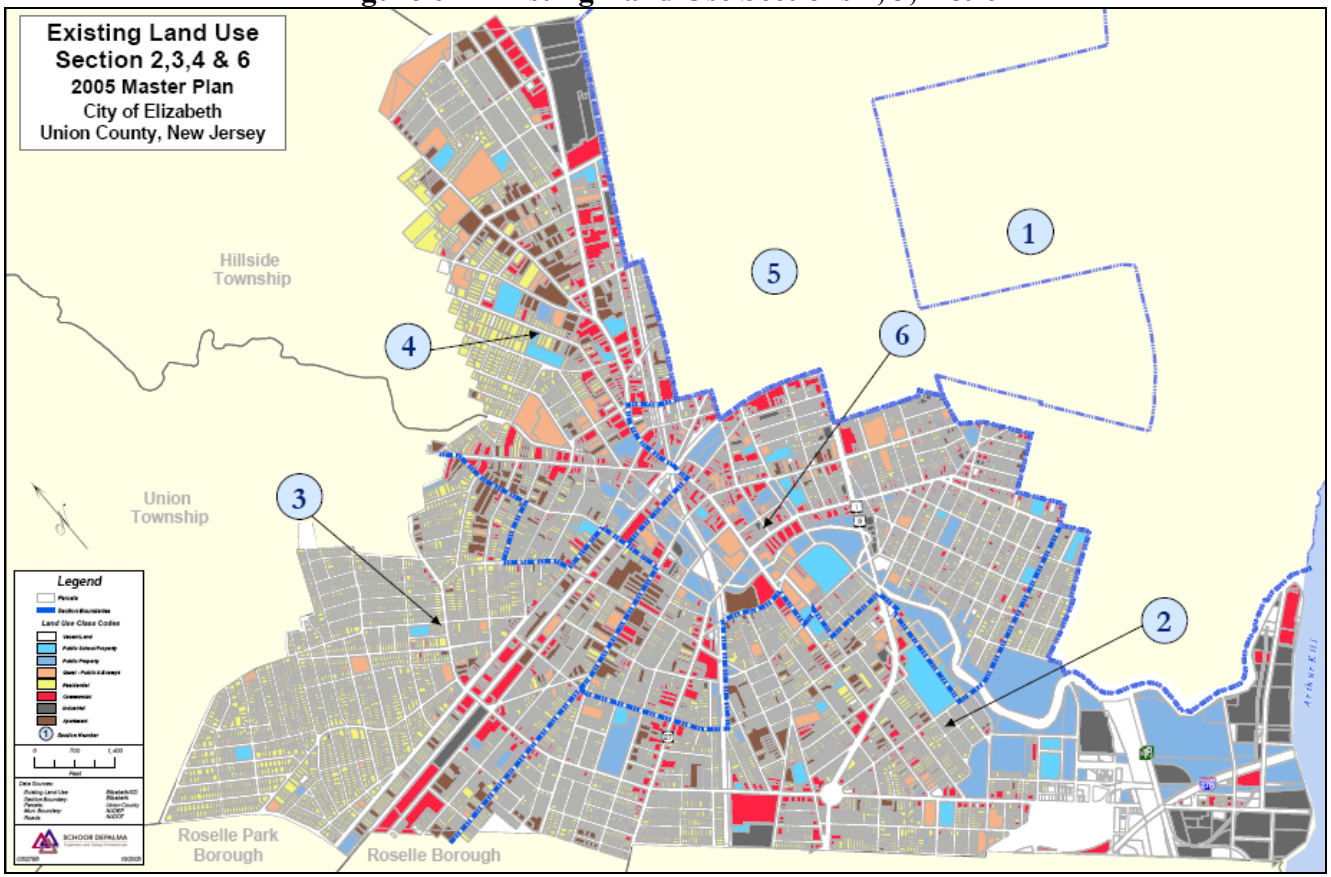


Figure 6-8 Land Use Plan Section 1

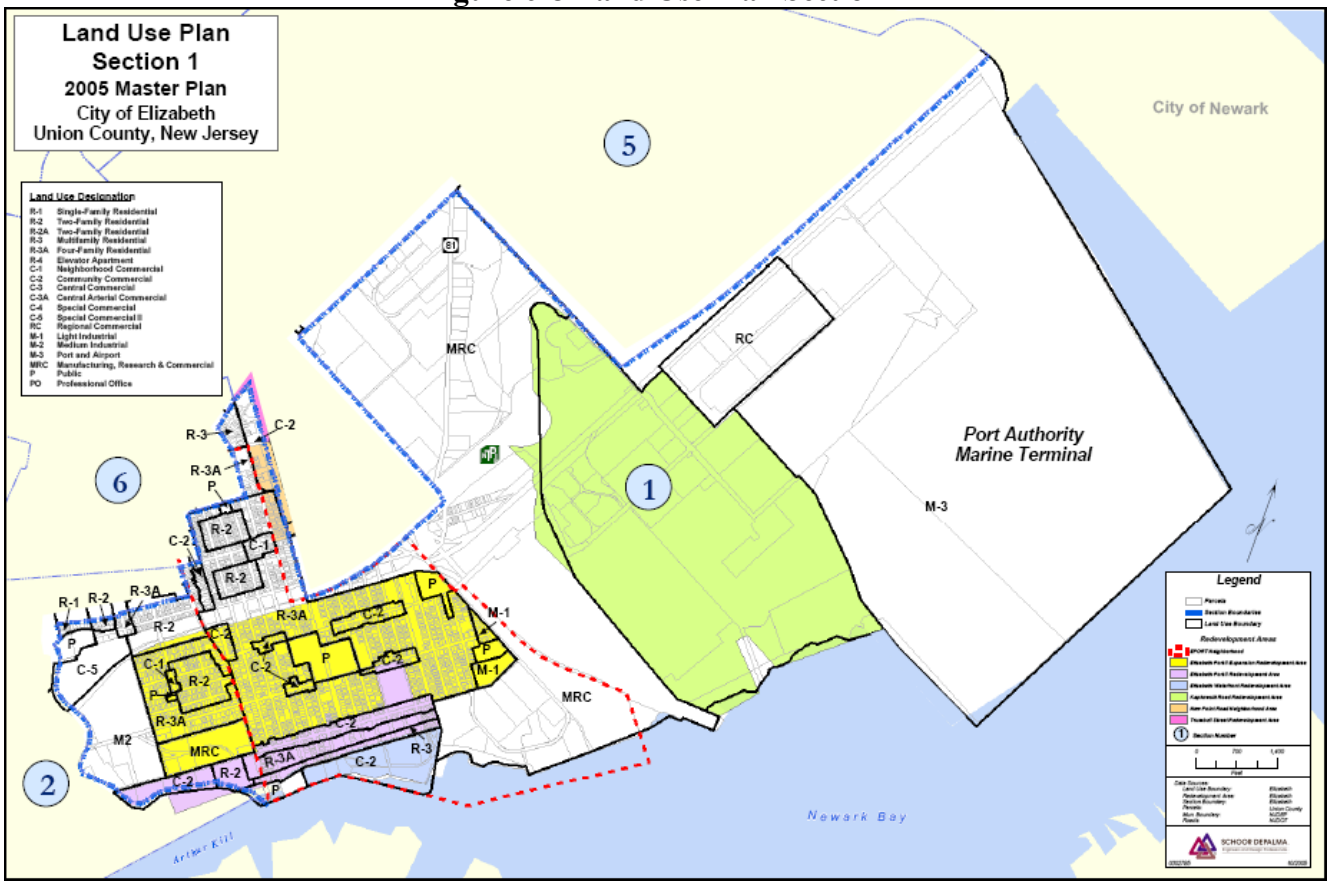


Figure 6-9 Land Use Plan Section 5

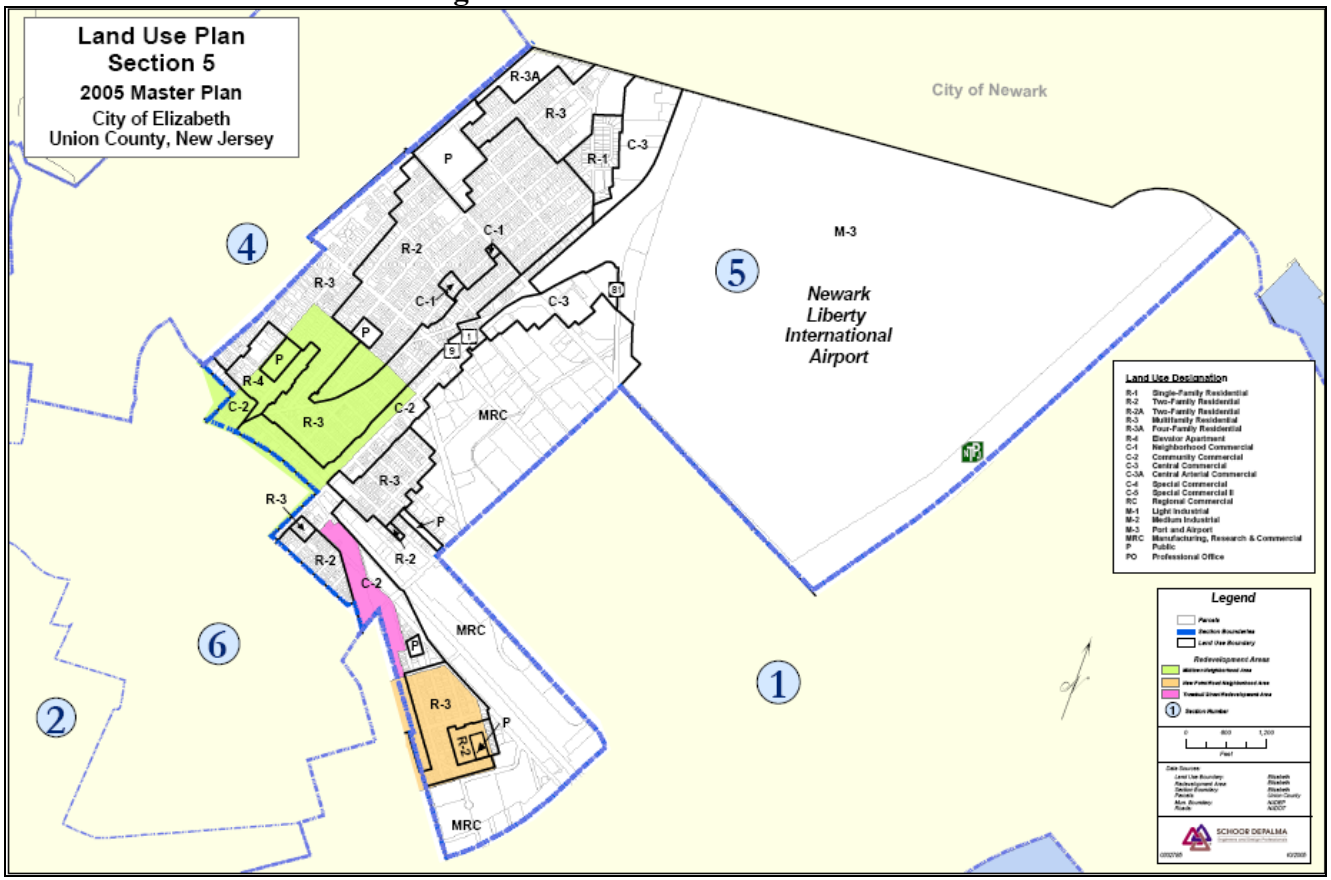
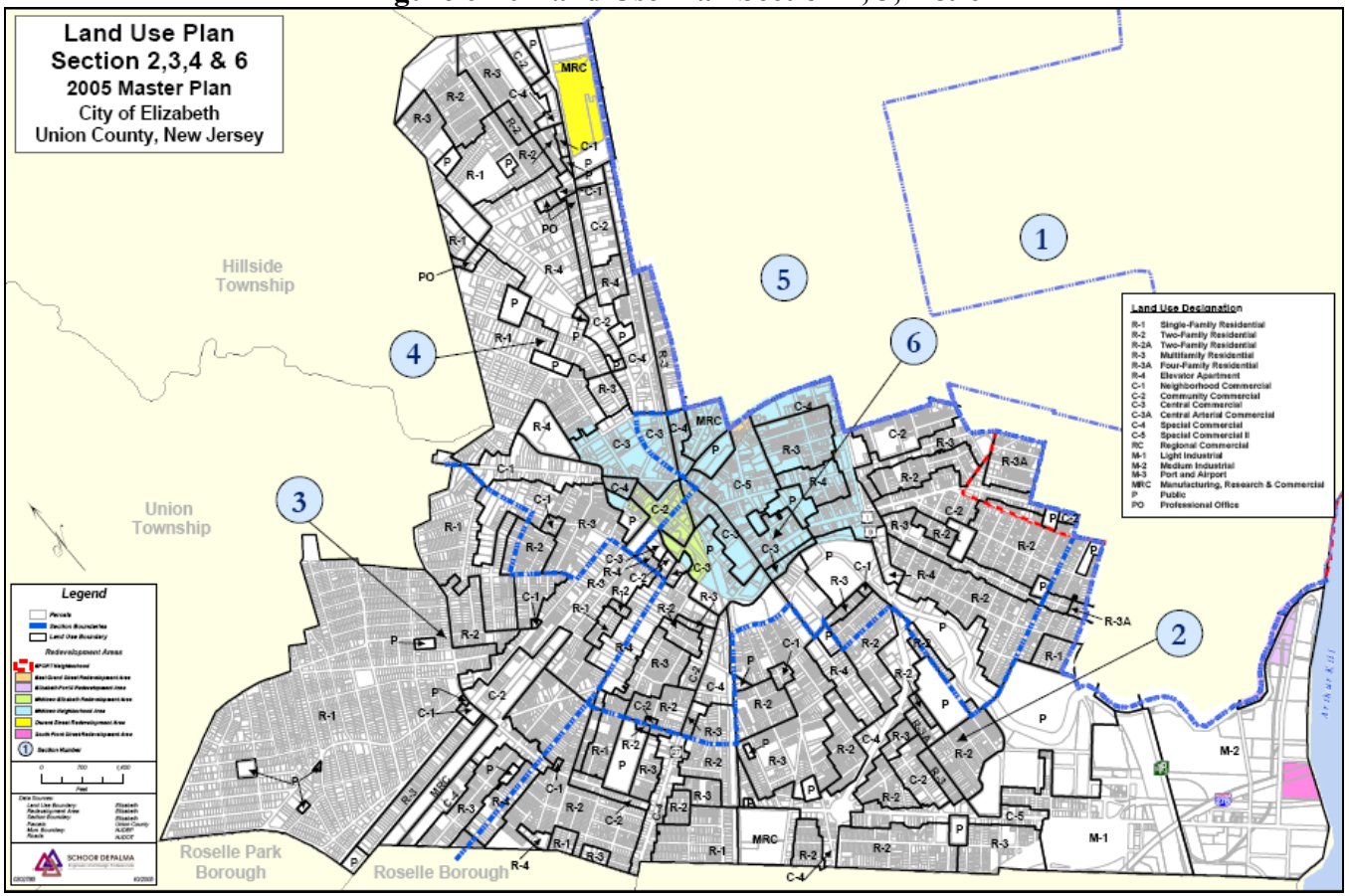


Figure 6-10 Land Use Plan Section 2, 3, 4 & 6



6.5 Relationship of the City's Master Plan to Other Plans

The Municipal Land Use Law requires that all municipal Master Plans consider the relationship of the Master Plan to Plans of contiguous municipalities, county plans and the New Jersey State Development and Redevelopment Plan (SDRP). The intent is to coordinate planning and land use activities among communities and to reduce potential conflicts. This section provides a summary of the review the master plans of the municipalities bordering the City of Elizabeth, as well as Union County, the Port Authority of New York and New Jersey (PANYNJ) and the SDRP.

6.5.1 Adjacent Municipalities

To the north of Elizabeth is Newark, the State's largest city and the seat of Essex County. To the south lies Linden, which like Elizabeth, is an older industrial city. To the west and southwest lie the suburban municipalities of Roselle Park, Union, and Roselle. These municipalities are generally residential in character. To the east is the Arthur Kill, which connects Newark Bay with Raritan Bay and the industrialized areas of Middlesex County. For the development of the the 2005 SDRP Cross-Acceptance (III) process, the City reached out to the surrounding municipalities to determine whether there were any planning or land use conflicts across borders, and whether there were any regional planning issues that required study or discussion, particularly with respect to the policies and intent of the SDRP. Following are comments received from Elizabeth's adjoining municipalities, as well as a comparison of plans. Discussion on the City's large, quasi-governmental agency, the PANYNJ is also included. In general, it was determined that elements of the City's 2005 Master Plan are substantially consistent with the Master Plans of adjacent municipalities, the County and the SDRP.

Based on previous discussions with adjacent municipalities and/or the PANYNJ, there are possibilities for joint effort projects with Elizabeth to improve infrastructure and for future redevelopment. These include, but are not limited to:

Township of Hillside: During Cross-Acceptance, the Township's Planning Board Secretary expressed interest for a closer relationship with Elizabeth relative to major projects in proximity to Hillside and/or along major corridors. Hillside would like to pursue joint planning efforts with Elizabeth for its input and comments.

City of Linden: Linden's designated SDRP Cross-Acceptance representative supports and would like to have a closer relationship with Elizabeth concerning major planning projects that occur near Linden in the future.

City of Newark: Newark's designated SDRP Cross-Acceptance representative supports any efforts made towards a working relationship with Elizabeth, including transportation projects, such as improvements to State Highway Route 27 that runs through both towns.

Borough of Roselle: The Borough's designated SDRP Cross-Acceptance representative also supported any type of regional planning in coordination with Elizabeth. The Borough stated because Elizabeth is so large, any type of planning and/or development that would occur in the City would affect its surrounding towns.

Township of Union: The Township's SDRP Cross-Acceptance representative supports a cooperative relationship with regard to regional planning with Elizabeth.

PANYNJ: The PANYNJ plays an important role in the City due to the presence of Newark Liberty International Airport and Port Elizabeth/Newark Marine Terminal. The City reports a good working relationship with the PANYNJ and would like to continue working together on expansion, intensification and reuse issues that affect Elizabeth.

6.6 Hazard Vulnerabilities

The following section of the Vulnerability Assessment reviews each of the high impact hazards identified as high potential/impact by the City during the hazard ranking process. The analysis considers both historical and potential impacts from disasters related to each hazard. HASUZ modeling is incorporated into the assessment, when possible. The analysis also utilizes impact assessment and other vulnerability information provided in technical reports from a variety of regulatory and government agencies.

As discussed in Section 6.1, the results of the Hazard Ranking Vulnerability Assessment completed by the City, identifies the following hazards with high averages and/or high impact levels:

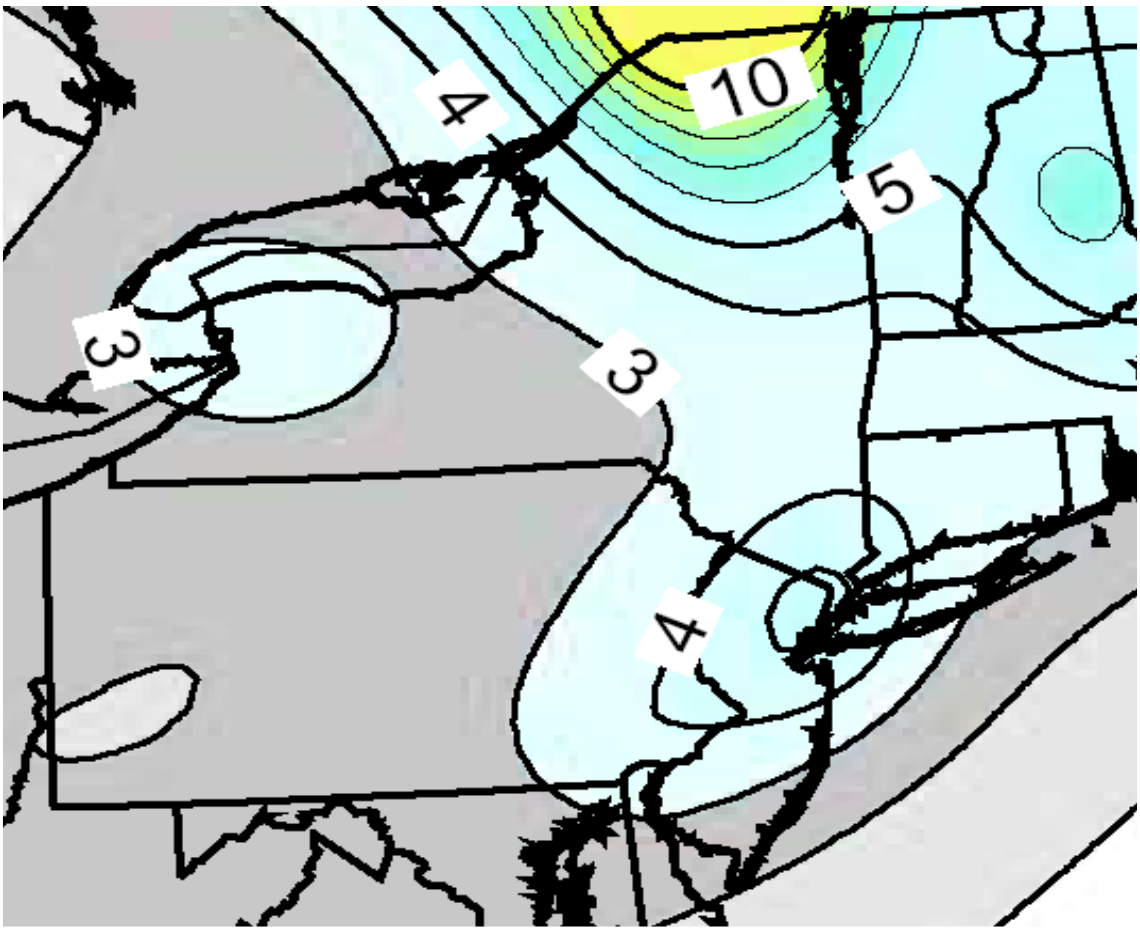
Natural Hazards

- Earthquakes
- Flooding;
- Coastal Storm/Nor'Easter/Hurricane;
- Thunderstorms;
- Severe Winter Storm; and
- Extreme Heat/Extreme Cold

6.6.1 Earthquakes

Although the likelihood of an earthquake affecting the City was ranked with a score of just less than 2 – Medium in the Hazard Ranking Vulnerability Assessment (Table 6-1), the resulting potential impact of such an event is still considered to be "high" and could result in millions of dollars in damages from a single, significant occurrence. In addition, according to FEMA How-To guidance, Understanding Your Risks, FEMA 386-2, p. 1-7, earthquakes should be profiled as a hazard if the pga is greater than 3%g. The USGS earthquake hazard map presented as Figure 6-11 shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years as highest in northeastern NJ (6%g) and decreasing to the south (2%g). As such, a vulnerability analysis for earthquakes was completed using Census 2010 Data.

Figure 6-11 USGS Earthquake Hazard Map
Source: USGS



A HAZUS analysis performed by NJGS produced significant changes in both the spatial distribution of damage and the total damage estimates compared to default geology. The results from the analysis upgraded also produced greater building damage in the Newark Bay and Arthur Kill areas of the County, where Class E (salt-marsh) soils are softer and more liquefiable then the default soils. The entire City of Elizabeth is identified within this Class E soils geology area. In contrast, the analysis identified less building damage on the most upland areas of the County, where till and weathered-bedrock soils are stronger then the default. Because the uplands comprise most of the area of Union County, the upgrade analysis indicted a 10% to 20% reduction in the total economic loss prediction is comprised with output using the default data at all magnitudes. However, the economic loss estimated for Elizabeth was greater than the County average given the geologic conditions within the City. Adding liquefaction increases building damage about 10% in susceptible census tracts such as Elizabeth, especially at magnitudes less then 7, but results in less than a 5% increase in total loss of the entire County. Structures that are particularly susceptible to damage from permanent ground displacement, such as pipelines and bridges, show significantly increased breakage when liquefaction is added to the analysis.

The report provides additional detail on building and property damage, business interruption, total economic loss and casualties under different scenarios based on earthquake magnitude. Those projected losses are not further described herein but rather are included by reference. Given the area-wide nature of this hazard, it is difficult to assess any changes to the loss estimates provided in the above referenced report due to future development of structures and infrastructure. However, increased losses would be anticipated based upon projected population growth within the City.

6.6.1.1 General Building Stock Damage 100-Year Mag5

General building stock is defined as all buildings located within the model area without specification as to use. HAZUS estimates that no buildings will be at least slightly, moderately, extensivly or completely damaged in a 100yr-Mag5 earthquake event. Table 6-5, 6-6 and 6-7 below summarizes the expected damage by occupancy, general building type and to essential facilities.

Table 6-5 Expected Building Damage by Occupancy
100-Year Mag5 Event
Source: HAZUS (run on April 16, 2015)

	None		Slight		Moderate		Extensive		Complete	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Other Residential	9,710	49.74	0	0	0	0	0	0	0	0
Single Family	8,888	45.53	0	0	0	0	0	0	0	0
Commercial	696	3.5	0	0	0	0	0	0	0	0
Industrial	126	0.64	0	0	0	0	0	0	0	0
Agricultural	0	0.00	0	0	0	0		0	0	0
Religious	63	0.32	0	0	0	0	0	0	0	0
Government	30	0.15	0	0	0	0	0	0	0	0
Educational	9	0.05	0	0	0	00	0	0	0	0
Total	**19,522**		0		0		0		0	

Percent: Of the buildings which will be impacted during the earthquake event, the number of buildings which will incur a specific percentage of over-all damage

Table 6-6 Expected Building Damage by Building Type (All Design Levels)
100-Year Mag5 Event
Source: HAZUS (run on April 16, 2015)

Building Type	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	458	2.35	0	0	0	0	0	0	0	0
RM	969	4.96	0	0	0	0	0	0	0	0
URM	3,082	15.79	0	0	0	0	0	0	0	0
MH	77	0.39	0	0	0	0	0	0	1	0
Pre-Cast	38	0.20	0	0	0	0	0	0	0	0
Steel	722	3.70	0	0	0	0	0	0	0	0
Wood	14,175	72.61	0	0	0	0	0	0	0	0
Total	**19,522**		0		0		0			

Table 6-7 Expected Damage to Essential Facilities
100-Year Mag5 Event
Source: HAZUS (run on April 16, 2015)

Essential Facilities				
Classification	**Total in Model Area**	**Probability of at Least Moderate Damage >50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 Day**
Fire Stations	7	0	0	7
Hospital (Trinitas–a critical care facility)	1	0	0	1
Police Stations	4	0	0	4
Schools	41	0	0	41

Other HAZUS generated data such as Transportation System Lifeline Inventory (Table 1), Utility System Lifeline Inventory (Table 2), Expected Damage to the Transportation System (Table 6), Expected Utility System Facility Damage (Table 7), Expected Utility System Pipeline Damage (Table 8), Expected Potable Water and Electric Power System Performance (Table 9), Casualty Estimates (Table 10), Building-Related Economic Loss Estimates (Table 11), Transportation System Economic Loss (Table 12), and Utility System Economic Loss (Table 13) can be reviewed in the corresponding tables in Appendix D - HAZUS: Earthquake Event Report (Probabilistic 100yr-Mag5 and 500yrMag5).

6.6.1.2 General Building Stock Damage 500-Year Mag5

General building stock is defined as all buildings located within the model area without specification as to use. HAZUS estimates that about 113 buildings will be at least moderately damaged in a 500yr-Mag5 earthquake event. This is over 1% of the buildings in the region. There are an estimated 1 building that would be damaged beyond repair. Table 6-8 below summarizes the expected building damage by occupancy. Table 6-9 below summarizes the expected damage by general building type.

Table 6-8 Expected Building Damage by Occupancy
500-Year Mag5 Event
Source: HAZUS (run on April 16, 1015

	None		Slight		Moderate		Extensive		Complete	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Other Residential	9,431	49.52	207	56.86	63	63.04	8	63.44	1	62.06
Single Family	8,726	45.82	130	35.69	28	28.05	3	27.31	0	31.91
Commercial	667	3.5	21	5.73	7	6.68	1	7.15	0	4.58
Industrial	121	0.64	3	0.93	1	1.09	0	1.06	0	0.57
Agricultural	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	60	0.32	2	0.50	1	0.66	0	0.74	0	0.68
Government	29	0.15	1	0.21	0	0.24	0	0.23	0	0.13
Educational	9	0.05	0	0.07	0	0.08	0	0.08	0	0.06
Total	**19,044**		**364**		**100**		**12**		**1**	

Percent: Of the buildings which will be impacted during the earthquake event, the number of buildings which will incur a specific percentage of over-all damage

Table 6-9 Expected Building Damage by Building Type (All Design Levels)
500-Year Mag5 Event
Source: HAZUS (run on April 16, 2015)

Building Type	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	444	2.33	11	3.13	3	2.82	0	2.52	0	0
RM	937	4.92	21	5.83	10	9.85	1	9.58	0	0
URM	2,830	4.92	171	46.89	69	69.20	11	85.23	1	100.00
MH	71	0.37	5	1.27	2	1.62	0	0.27	0	0
Pre-Cast	36	0.19	1	0.39	1	0.82	0	1.11	0	0
Steel	703	3.69	15	4.03	4	4.10	0	2.52	0	0
Wood	14,024	73.64	140	38.46	12	11.58	0	0	0	0
Total	**19,044**		**364**		**101**		**12**		**1**	

Essential Facility Damage 500-Year Mag5 Event

Essential facilities are defined as police stations, fire stations, hospitals and schools. The essential facility damage model is based on the after-effects of a flood event and, as such, the verbiage used to discuss the damage is provided in the present tense as if a storm has recently occurred. Because of the likelihood of shared critical facility usage within the model region by multiple counties and communities, specific numbers related to the City were not distinguished from the model output.

Before the earthquake, the region had 886 hospital beds available for use. On the day of the earthquake, the model estimates that only 770 hospital beds (87.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 95.00% of the beds will be back in service. By 30 days, 99.00% will be operational. Table 6-10 shows the Expected Damage to Essential Facilities in a 500-year Mag5 Event.

Table 6-10 Expected Damage to Essential Facilities
500-Year Mag5 Event
Source: HAZUS (run on April 16, 2015)

Essential Facilities				
Classification	**Total in Model Area**	**Probability of at Least Moderate Damage >50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 Day**
Fire Stations	7	0	0	7
Hospital (Trinitas - a critical care facility)	1	1	0	1
Police Stations	4	0	0	4
Schools	41	0	0	41

Other data generated with HAZUS for earthquakes include the Transportation System Lifeline Inventory, Utility System Lifeline Inventory, Expected Damage to the Transportation System , Expected Utility System Facility Damage, Expected Utility System Pipeline Damage, Expected Potable Water and Electric Power System Performance, Casualty Estimates, Building-Related Economic Loss Estimates, Transportation System Economic Loss, and Utility System Economic Loss can all be reviewed in Appendix D - HAZUS: Earthquake Event Report for Probabilistic 100yr-Mag5 and 500yrMag5 Probabilistic Global Summary.

6.6.2 Flooding

Flooding may be divided into two (2) categories; Riverine flooding and Coastal flooding. The City experiences both forms of flooding and the severity/extent of flooding can be influenced by tidal cycles/elevations along the coast. The eastern border of the City is defined by the Newark Bay and the Arthur Kill. The Elizabeth River, which is tidally influenced for a dominant section of the river, enters the City at its northwestern border with Hillside and empties into the Arthur Kill near the City's southern corner. In addition to these water sources, a series of ditches have been created in the City to help alleviate the effects of excess stormwater runoff including the Great Ditch and the Peripheral Ditch. HAZUS currently generates data for the 100/500-year RiverineCoastal combination data set which provides probabalistic data for flooding vulnerability and potential extent of damage/cost to properties.

6.6.2.1 Riverine Flooding

Riverine flooding poses a serious threat to the City. Heavy rainfall events can cause flash flooding which closes roads, damages infrastructure and endangers lives. Riverine flooding can be influenced by tidal elevations (i.e., high tide cycles) from the coast during heavy rain fall and coastal storm events. Water rescues from homes and vehicles are frequently required during flash flood events. As a result, the City must divert municipal resources to evacuation and rescue efforts.

6.6.2.2 Coastal Flooding

FEMA defines a coastal zone as any coastal area that includes coastal waters extending to the outer limit of state submerged land title and ownership, adjacent shorelines and land extending inward to the extent necessary to control shorelines. A coastal zone includes islands, beaches, transitional and intertidal areas, and salt marshes. The effects of coastal flooding during significant storm events can affect the coastal zone of the City, as well as the other inland neighborhoods which share a boundary with the Elizabeth River. The head waters from the Elizabeth River empty into the Arthur Kill and also experience tidal fluctuations. Newark Liberty International Airport is located less than two (2) miles from the defined coast line. In addition, many of the large industrial storage facilities associated with marine businesses are located in or adjacent to the City's coastal area including Port Elizabeth.

6.6.2.3 Flood Modeling

Using FEMA Q3 Digital Flood Data (Digitized Flood Insurance Rate Maps [DFIRM]) where available, along with the modeling approach as described earlier, losses were estimated using return period events for 100-year and 500-year storm events. Using this approach, annualized losses were calculated by accounting for the losses from different return period events and their respective annual probabilities of occurrence. For example, the annual probability of observing a 100-year flood in any given year is 1 percent. The annual probability of observing a 500-year flood in any given year is 0.2 percent.

6.6.2.4 100-Year Riverine/Coastal Storm Event

The following section presents the planning area vulnerability and estimated exposure, and potential annualized losses, respectively, caused by a 100-year riverine/coastal flooding event through figures and tables. Due to the complexity of analyzing detailed flood risk for the City, it is important to note that this risk assessment is based on aggregated data and represents a base-level assessment for the region as a whole. The City as well as any areas outside of the City used as part of the modeling is considered the model region.

From the riverine/coastal event report, HAZUS estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2010 dollars). The geographical size of the study region (City of Elizabeth) is 12 square miles and contains 1,003 census blocks. The region

contains over 42 thousand households and has a total population of 124,969 people (2010 Census Bureau data).

Table 6-11 presents the relative distribution of the value with respect to the general occupancy by Study Region. Table 6-12 is the same distribution of the value with respect to the general occupancy but by a Scenario for the 100-yr flood event. From comparing the two data sets, the percentage of total for each occupancy type (i.e., Residential, Commercial and etc.) is very similar. One can expect that from any natural hazard scenario event for the City, residential and commercial exposure would consist of 80-90% of the value of potential damages. Figure 6-12 below shows the 100-Year Riverine/Coastal Flood (Water Depths with Roads).

Table 6-11 Building Exposure by Occupancy Type
For the Study Region

Source: HAZUS Riverine/Coastal Flood Event Report (run on April 27, 2015)

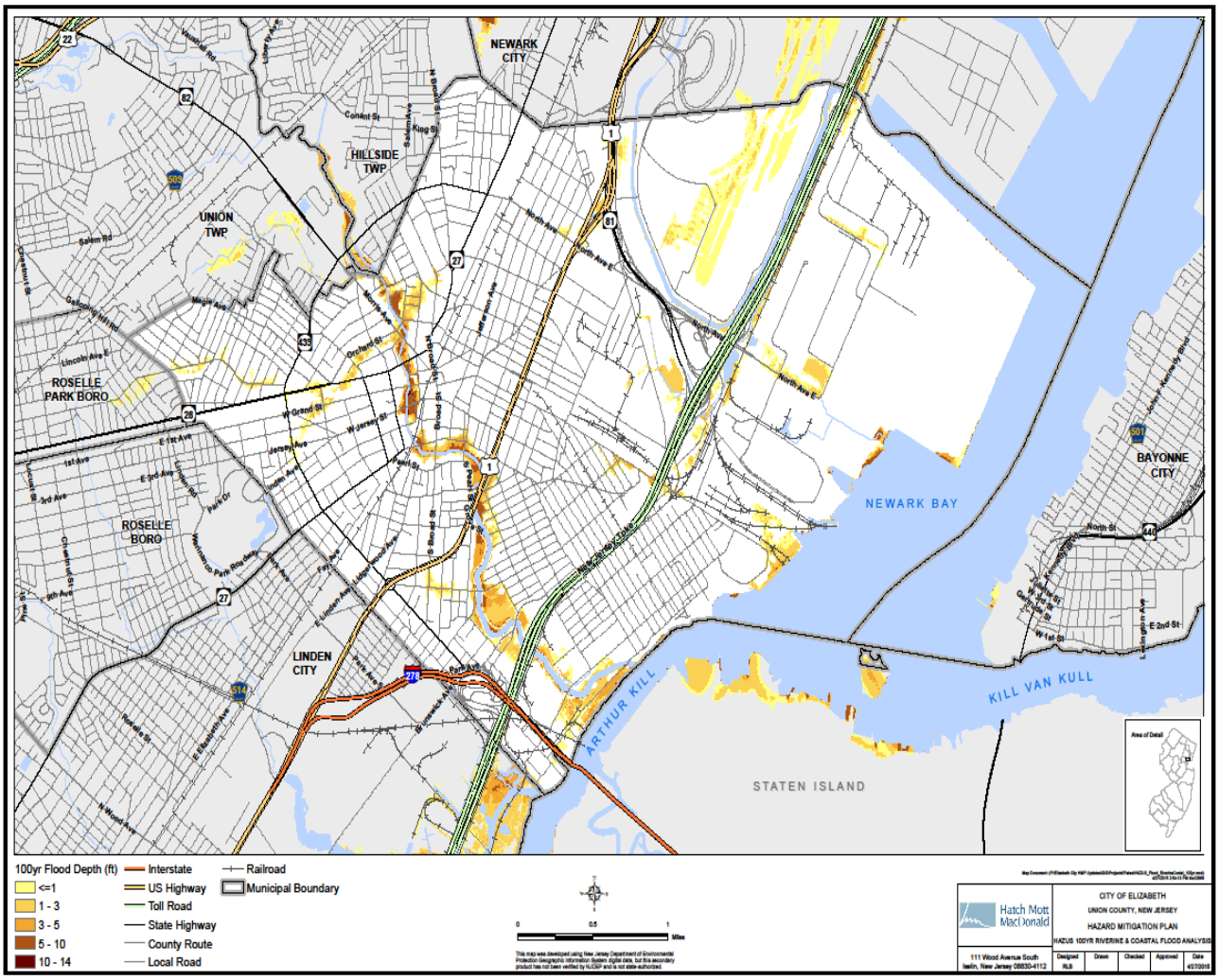
Occupancy	Exposure ($1000)	Percent of Total
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religion	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.0%**

Table 6-12 Building Exposure by Occupancy Type For A Scenario

Source: HAZUS Riverine/Coastal 100-Year Flood Event Report (run on April 27, 2015)

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,032,482	53.6%
Commercial	1,263,420	33.3%
Industrial	365,319	9.6%
Agricultural	1,747	0.0%
Religion	51,564	1.4%
Government	33,288	0.9%
Education	43,603	1.2%
Total	**3,791,423**	**100.0%**

Figure 6-12
100 Year Riverine/Coastal Flood (Water Depths with Roads)
HAZUS Source: HAZUS Riverine/Coastal Flood Event Report (run on April 27, 2015)



6.6.2.4.1 General Building Stock Damage 100-Year Riverine/Coastal

General building stock is defined as all buildings located within the model area without specification as to use. From the 100-year report, HAZUS estimates that 2 buildings will be completely destroyed.

Table 6-13 summarizes the Expected Building Damage by Occupancy in a 100-Year Event and Table 6-14 below summarizes the Expected Building Damage by Building Type in a 100-Year Event.

Table 6-13
Expected Building Damage by Occupancy 100-Year Event
Source: HAZUS Riverine/Coastal Flood Event Report (run on April 27, 2015

Percent Building Damage	1-10		11-20		21-30	
Occupancy	**Model Counts**	**Model %**	**Model Counts**	**Model %**	**Model Counts**	**Model %**
Residential	0	0.00	4	10.00	10	25.00
Commercial	0	0.00	1	100.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00
Government	0	0.00	2	100.00	0	0.00
Educational	0	0.00	0	0.00	0	0.00
Total	**0**		**7**		**10**	
Percent Building Damage	**31-40**		**41-50**		**Substantially**	
Occupancy	**Model Counts**	**Model %**	**Model Counts**	**Model %**	**Model Counts**	**Model %**
Residential	11	27.50	13	32.50	2	5.00
Commercial	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00
Educational	0	0.00	0	0.00	0	0.00
Total	**11**		**13**		**2**	

Percent Building Damage: Of the buildings which will be impacted during the 100-year storm event, the number of buildings which will incur a specific percentage of over-all damage

Table 6-14 Expected Building Damage by Building Type
100-Year Event
Source: HAZUS Riverine/Coastal Flood Event Report (run on April 27, 2015)

% Building Damage	1-10		11-20		21-30	
Building Type	Count	Count %	Count	Count %	Count	Count %
Concrete	0	0	1	100.00	0	0
Manufactured Housing	0	0	0	0	0	0
Masonry	0	0	1	33.33	0	0
Steel	0	0	2	100.00	0	0
Wood	0	0	3	8.11	10	27.03
% Building Damage	**31-40**		**41-50**		**Substantially**	
Building Type	**Count**	**Count %**	**Count**	**Count %**	**Count**	**Count %**
Concrete	0	0	0	0	0	0.00
Manufactured Housing	0	0	0	0	0	0.00
Masonry	1	33.33	1	33.33	0	0.00
Steel	0	0	0	0.00	0	0.00
Wood	10	27.03	12	32.43	2	5.41

Percent Building Damage: Of the buildings which will be impacted during the 100-year storm event, the number of buildings which will incur a specific percentage of over-all damage

Essential Facility Damage

Essential facilities are defined as police stations, fire stations, hospitals and schools. The essential facility damage model is based on the after-effects of a flood event and, as such, the verbiage used to discuss the damage is provided in the present tense as if a storm has recently occurred.

Before the flood analyzed in this scenario, the region had 886 hospital beds available for use. On the day of the flood event, the model estimates that 886 hospital beds are available in the region. No other documentation regarding the duration of hospital bed availability is provided in the modeling. Table 6-15 presents the Expected Damage to Essential Facilities in a 100-year riverine/coastal flood event.

Table 6-15 Expected Damage to Essential Facilities 100-Year Event
Source: HAZUS Riverine/Coastal Flood Event Report (run on April 27, 2015)

Essential Facilities				
Classification	**Total in Model Area**	**Probability of at Least Moderate Damage**	**Probability of at Least Substantial**	**Loss of Use**
Fire Stations	7	2	0	2
Hospital (Trinitas – a critical care facility)	1	0	0	0
Police Stations	4	0	0	0
Schools	41	1	0	1

6.6.2.4.2 Induced Flood Damage/Debris Generation

HAZUS estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). The model provided a distinction between the debris types because different types of material handling equipment will be required to handle each type of debris.

The model estimates that a total of 3,360 tons of debris will be generated. Of the total amount, Finishes comprise 99% of the total, Structural comprises of 1% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 135 truckloads (at 25 tons/truck) to remove the debris generated by the 100-year flood event.

6.6.2.4.3 Social Impact

Social Impact is defined as the effects of the storm event on the model area's population. HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood event and the number of displaced people that will require accommodations in temporary public shelters.

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,182 households will be displaced due to the 100-year flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5,895 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

6.6.2.4.4 Economic Loss

Economic loss is defined as financial losses due to loss of buildings and loss of business while a building is unusable due to damages. The total economic loss estimated for a 100-year flood event is 213.23 million dollars, which represents 5.62% of the total replacement value of the damaged study case buildings.

Building-Related Losses

The model also provides losses which are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to buildings and contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses estimated for a 100-year flood event is 211.89 million dollars. One percent of the estimated losses were related to business interuptions of the region. The residential occupanices made up 31.63% of the total loss. Table 6-16 below provides the Building Related Economic Loss Estimates (Millions) in a 100-Year Event.

Table 6-16
Building Related Economic Loss Estimates (Millions) 100-Year Event
Source: HAZUS: RiverineCoastal 100-Year Flood Event Report (run on April 27, 2015)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	39.08	25.15	7.22	2.88	74.33
	Content	28.29	68.95	20.97	15.63	133.83
	Inventory	0.00	1.76	1.97	0.00	3.73
	Subtotal	**67.37**	**95.86**	**30.15**	**18.51**	**211.89**
Business Interruption Loss						
	Income	0.01	0.30	0.00	0.02	0.33
	Relocation	0.02	0.11	0.00	0.02	0.14
	Rental Income	0.04	0.07	0.00	0.00	0.11
	Wage	0.02	0.32	0.00	0.42	0.76
	Subtotal	**0.07**	**0.80**	**0.01**	**0.46**	**1.34**
Total	**Total**	**67.45**	**99.66**	**30.16**	**18.97**	**213.23**

6.6.2.5 500-Year Riverine/Coastal Storm Event

The following section presents the planning area vulnerability, estimated exposure, and potential annualized losses, respectively, caused by a 500-year riverine/coastal storm event through figures and tables. Due to the complexity of analyzing detailed flood risk for the Planning Area, it is important to note that this risk assessment is based on aggregated data and represents a base-level assessment for the region as a whole. As such, additional adjacent communities outside of the City of Elizabeth Planning Area have been included in the flood modeling due to the requirements of the DEM.

HAZUS estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2010 dollars). The geographical size of the study region

(City of Elizabeth) is 12 square miles and contains 1,003 census blocks. The region contains over 42 thousand households and has a total population of 124,969 people (2010 Census Bureau data).

Table 6-17 shows the Building Exposure by Occupancy Type in a Riverine/Coastal 500-year Flood Event for a large Study Region. Table 6-18 runs the same Riverine/Coastal 500-year flood event but for a Scenario (i.e., smaller sub-set). Comparing the two proposed data sets run in HAZUS, it shows that the percentage of total for each occupancy type (i.e., Residential, Commercial and etc.) is very similar in this region. From these two tables, one can expect that from any natural hazard scenario event for the City, residential and commercial exposure would consist of 80-90% of the value of potential damages, based on the current HAZUS 2.2.

Table 6-17 Building Exposure by Occupancy Type for the Study Region

Source: HAZUS Riverine/Coastal 500-Year Flood Event Report (run on April 27, 2015)

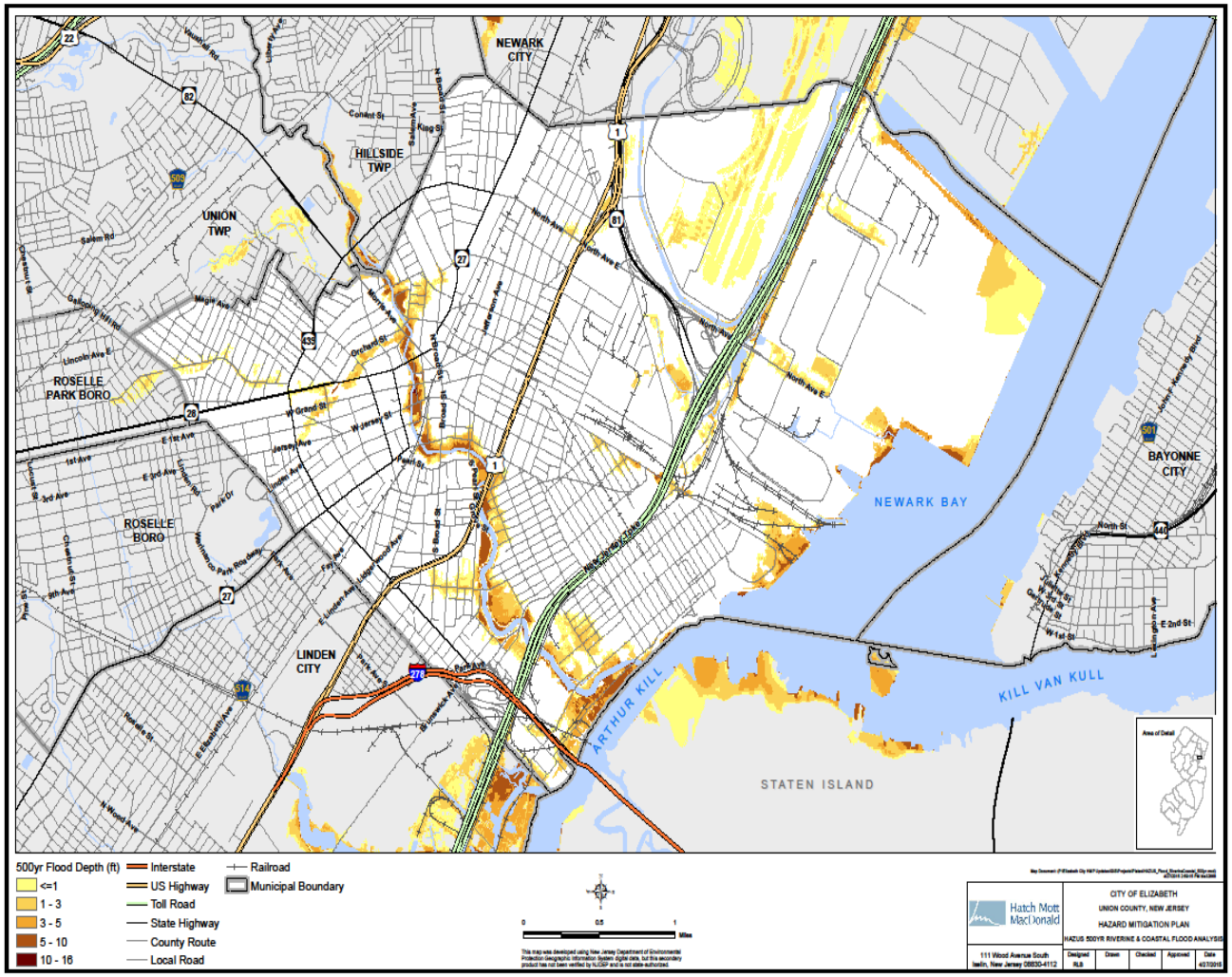
Occupancy	Exposure ($1000)	Percent of Total
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religious	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.0%**

Table 6-18
Building Exposure by Occupancy Type for a Scenario
Source: HAZUS Riverine/Coastal 500-Year Flood Event Report (run on April 27, 2015)

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,097,339	52.3%
Commercial	1,332,647	33.2%
Industrial	428,925	10.7
Agricultural	1,802	0.0%
Religious	71,856	1.8%
Government	34,784	0.9%
Education	43,441	1.1%
Total	**4,010,794**	**100.0%**

Figure 6-13 below shows the HAZUS 500-Year Riverine / Coastal Flood scenario with local road mapping.

Figure 6-13
500-Year Riverine/Coastal Flood (Water Depth with Roads)
HAZUS Source: Riverine/Coastal Flood (April 27, 2015)



6.6.2.5.1 General Building Stock Damage 500-Year Riverine/Coastal

General building stock is defined as all buildings located within the model area without specification as to use. HAZUS estimates that about 83 buildings will be at least moderately damaged in a 500-year storm by hurricane forces. There are an estimated 5 buildings that will be completely destroyed.

Table 6-19 below summarizes the Expected Building Damage by General Occupancy. Table 6-20 below represents Building Damage by Type.

Table 6-19 Expected Building Damage by Occupancy
500-Year Event
Source: HAZUS (run on April 27, 2015)

Percent Building Damage	1-10		11-20		21-30	
Occupancy	**Model Counts**	**Model %**	**Model Counts**	**Model %**	**Model Counts**	**Model %**
Residential	0	0.00	10	10.53	26	35.62
Commercial	0	0.00	8	100.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00
Government	0	0.00	2	0.00	0	0.00
Educational	0	0.00	0	0.00	0	0.00
Total	**1**		**20**		**26**	
Percent Building Damage	**31-40**		**41-50**		**Substantially**	
Occupancy	**Model Counts**	**Model %**	**Model Counts**	**Model %**	**Model Counts**	**Model %**
Residential	14	19.18	18	24.66	5	6.85
Commercial	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00
Educational	0	0.00	0	0.00	0	0.00
Total	**14**		**18**		**5**	

Table 6-20 Expected Building Damage by Building Type
500-Year Event
Source: HAZUS Riverine/Coastal 500-Year Flood Event Report (run on April 27, 2015)

% Building Damage	1-10		11-20		21-30	
Building Type	Count	Count %	Count	Count %	Count	Count %
Concrete	0	0	1	100.00	0	0
Manufactured Housing	0	0	0	0	0	0
Masonry	0	0	1	12.50	5	62.50
Steel	1	14.29	6	85.71	0	0
Wood	0	0	8	12.90	20	32.26
% Building Damage	31-40		41-50		Substantially	
Building Type	Count	Count %	Count	Count %	Count	Count %
Concrete	0	0	0	0	0	0.00
Manufactured Housing	0	0	0	0	0	0.00
Masonry	1	12.50	1	12.50	0	0.00
Steel	0	0	0	0.00	0	0.00
Wood	13	20.97	16	25.81	5	8.06

Percent Building Damage: Of the buildings which will be impacted during the 100-year storm event, the number of buildings which will incur a specific percentage of over-all damage

Essential Facility Damage

Essential facilities are defined as police stations, fire stations, hospitals and schools. The essential facility damage model is based on the after-effects of a flood event and, as such, the verbiage used to discuss the damage is provided in the present tense as if a storm has recently occurred. Because of the likelihood of shared critical facility usage within the model region by multiple counties and communities, specific numbers related to the City of Elizabeth were not distinguished from the model output.

Before flood event analyzed in this scenario, the flood model region has 886 hospital beds available. On the day of the scenario flood event, the model estimates that 866 hospital beds are available for in the region. No other documentation regarding the duration of hospital bed availability is provided in the modeling. Table 6-21 presents the number of essential facilities potentially damaged during a 500-year event.

Table 6-21 Expected Damage to Essential Facilities
500-Year Event
Source: HAZUS Riverine/Coastal 500-Year Flood Event Report (run on April 27, 2015)

Essential Facilities (same result as 100-year)				
Classification	**Total in Model Area**	**At Least Moderate**	**At Least Substantial**	**Loss of Use**
Fire Stations	7	2	0	2
Hospital (Trinitas-a critical care facility)	1	0	0	0
Police Stations	4	0	0	0
Schools	41	1	0	1

6.6.2.5.2 Induced

Flood Damage/Debris Generation

HAZUS estimates the amount of debris that will be generated by the flood and breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). The model provided a distinction between the debris types because different types of material handling equipment will be required to handle each type of debris.

The model estimates that a total of 5,190 tons of debris will be generated. Of the total amount, Finishes comprises 91% of the total, Structures conprises of 7% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 208 truckloads (at 25 tons/truck) to remove the debris generated by the flood event.

6.6.2.5.3 Social Impact

Social HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,878 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 7,977 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

6.6.2.5.4 Economic Loss

Economic loss is defined as financial losses due to loss of buildings and loss of business while a building is unusable due to damages. The total economic loss estimated for a 500-year flood event is 323.48 million dollars, which represents 8.07% of the total replacement value of the damaged study case buildings.

Building-Related Losses

The model also provides losses which are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to buildings and contents. The business interruption losses are the losses associated with inability

to operate a business because of the damage sustained during the flood. Business interruption losses also include temporary living expenses for those people displaced from their homes because of the flood.

The total building-related loss estimated for the 500-year riverine/coastal flood event is 321.10 million dollars, One percent of the estimated losses related directly to business interruption within the region. The residential occupancies of the impacted buildings account for 28.20% of the total loss. Table 6-22 provides a summary of the losses associated with the estimated Building Related Ecomonic Loss.

Table 6-22

Building Related Economic Loss Estimates (Millions) 500-Year Flood Event

Source: HAZUS: Riverine 500-Year Flood Event Report (run on April 27, 2015)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	53.22	44.97	10.92	3.85	112.95
	Content	37.91	112.25	31.79	20.45	202.40
	Inventory	0.00	2.81	2.94	0.00	5.75
	Subtotal	**91.13**	**160.03**	**45.65**	**24.30**	**321.10**
Business Interruption Loss						
	Income	0.01	0.71	0.00	0.03	0.75
	Relocation	0.03	0.24	0.01	0.02	0.29
	Rental Income	0.05	0.17	0.00	0.00	0.22
	Wage	0.02	0.57	0.00	0.53	1.13
	Subtotal	**0.07**	**0.80**	**0.01**	**0.46**	**1.34**
Total	**Total**	**91.22**	**161.72**	**45.65**	**24.89**	**323.48**

6.6.2.7 History of Flooding Events and Occurrences

The City of Elizabeth experiences flooding during both major and minor weather events. As noted in the FEMA Risk Assessment Summary for New Jersey, flooding in Union County occurs at a high frequency with extensive severity, implying that the probability of future events with extensive damage is inevitable. Because of the age of the City, many of the City's stormwater utilities are unable to capture and dispose of flood waters before rising waters cause damage to the City's structures, roadways and properties. Most of the costly flooding events which have affected the City are not equated to hurricane events or Nor'easters. Six of the eight events with recorded property damage values were due to low pressure systems which brought extensive rainfall to the area causing flash flood and urban flooding.

Evidence of the frequent flooding in areas of the City prompted the Planning Committee to identify several flood mitigation actions to address previous flooding issues. Each of these mitigation actions were specifically designed to alleviate the damage to properties cause by frequent flood events in these areas of the City, thereby reducing the potential hazard of flooding, including monetary damages to public and private property. For additional information regarding the proposed mitigation actions, please see Section 8 of the Hazard Mitigation Plan. Please refer to Section 5.2.19 to read discussion on how the City is currently working on the USACE dam/levees to reduce flooding impacts.

6.6.2.8 National Flood Insurance Program

The Mitigation Division, a component of FEMA, manages the National Flood Insurance Program (NFIP). The three (3) components of the NFIP are as follows: flood insurance, floodplain management and flood hazard mapping. Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. The City of Elizabeth has been a participant in the program since May 7, 1971.

Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year as a result of community implemented floodplain management systems and by property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance with those standards.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

National Flood Insurance Program (NFIP)

As mentioned above, the City joined the National Flood Insurance Program (NFIP) in 1971. Pursuant to the City's Flood Damage Prevention Ordinance, Raywant Sarran, the Construction Code Official is also designated as the Floodplain Administrator by City Code, Chapter 17.44.040.B. As a member of NFIP, Mr. Sarran reviews construction projects for conformance to the local flood plain management ordinance in addition other building code issues. The City provides education to the public about their floodplain management program and provides information about the importance of these building codes and how ordinances help reduce future flood damages.

Raywant Sarran regulates construction and reconstruction within the floodplain in accordance with the City Code Chapter 17.44 – Flood Damage Prevention. The ordinance framework was developed by the NJDEP to fully comply with federal requirements for continued participation in the NFIP program. Preliminary Firm Maps were issued by FEMA in February 2015 and are currently being used by the City to identify and regulate construction in flood hazard areas as identified on the FEMA mapping. These Preliminary Firm Maps are located in Appendix H for review. The Construction Code Official/Floodplain Manager is involved in the planning process and will make effort to meet with and discuss flooding issues with the County and adjoining neighbors. As the Construction Code Official/Floodplain Manager, he is exploring ways to get the City into the Community Rating System (CRS), which would help participants receive a discount on their flood insurance. Once in the CRS, the City will implement additional annual public outreach project, such as the Repetitive Loss Outreach Program. The Program would identify the repetitive loss areas and then advise homeowners that they live in a repetitive loss areas subject to flooding. The City would then provide the homeowners appropriate FEMA property protection guidelines and lastly, make the homeowner aware of the basic facts about flood insurance. Currently, only one property has been identified as having repetitive loss issues and the City is working with them under NFIP Program.

The City adopted the new Best Available Flood Hazard Data NJDEP model ordinance (City Ordinance No. 4457) for Flood Damage Prevention on April 8, 2014 which was signed by the Mayor on April 9, 2014 and effective 20 days thereafter. This Ordinance allows the City to use the best available data provided by FEMA during the transition period from the current effective maps to the new FIRM maps. A subsequent ordinance will be prepared to adopt the new FIRM maps once finalized.

6.6.2.9 Repetitive Loss (RL) Properties

Another way to gauge flood hazard risk is to identify and analyze the number of properties that have filed multiple flood insurance claims. Properties that meet these criterions are typically referred to as "repetitive loss" (RL) properties. The NFIP definition of repetitive loss is, (definition provided by NFIP and FEMA), "any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property." For the purposes of the Community Rating System (CRS) the definition of repetitive loss is, "a property for which two or more NFIP losses of at least $1,000 each have been paid within any 10-year rolling period since 1978." For planning purposes, information on repetitive loss properties in the City of Elizabeth Planning Area has been researched. FEMA's RL Properties Strategy is used to provide a frame of reference for this review; FEMA's RL Properties Strategy which is aimed at eliminating or reducing the damage to property and the disruption of life caused by repeated flooding of the same properties. Through this federal initiative, 14 repetitive loss properties have been identified across the City as "target" RL properties.

NFIP Data for Elizabeth was provided by FEMA showing target properties within the City of Elizabeth Planning Area, including the total number of properties on FEMA's target list, number of claims, total payments made, average payments made, payments made for building related claims, payments made for content related claims, and the percent of RL claims per number of NFIP policies. Local officials maintain specific property information for these repetitive loss properties; however, details are not included in this Plan due to privacy restrictions. Based on the NFIP for Elizabeth up to March 2015, the total "RESIDENTIAL" loss for the City is $982,885. The total "COMMERCIAL" loss for the City is $2,424,486.

6.6.2.10 Severe Repetitive Loss (SRL) Properties

In addition to RL properties, NFIP maintains a category of RL identified as Severe Repetitive Loss (SRL). The definition of severe repetitive loss, as established in section 1361A of the National Flood Insurance Act, and as amended (NFIA), 42 U.S.C. 4102a, is defined as a residential property that is covered under an NFIP flood insurance policy and: (a)That has at least four (4) NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or (b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both (a) and (b) above, at least two (2) of the referenced claims must have occurred within any ten-year period, and must be greater than ten (10) days apart. There are no SRL properties within the City of Elizabeth Planning Area. Below are other Riverine Flood Maps that were recently (2015) generated by the HAZUS program for the City of Elizabeth.

Figure 6-14
100 and 500 Year Flood Zones (without roads)
Source: HAZUS Riverine 100 and 500-Yr Flood Event Report (April 21, 2015)

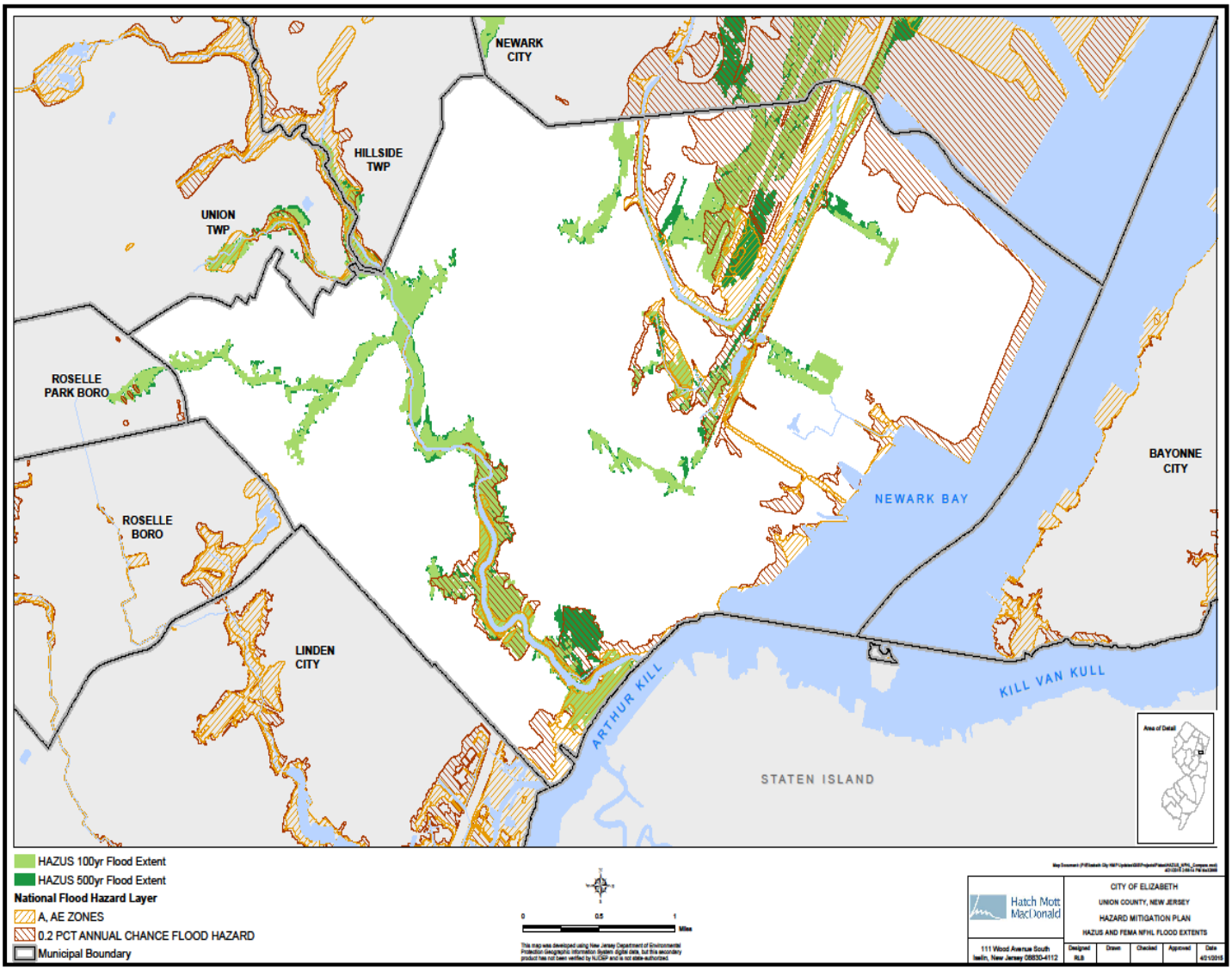
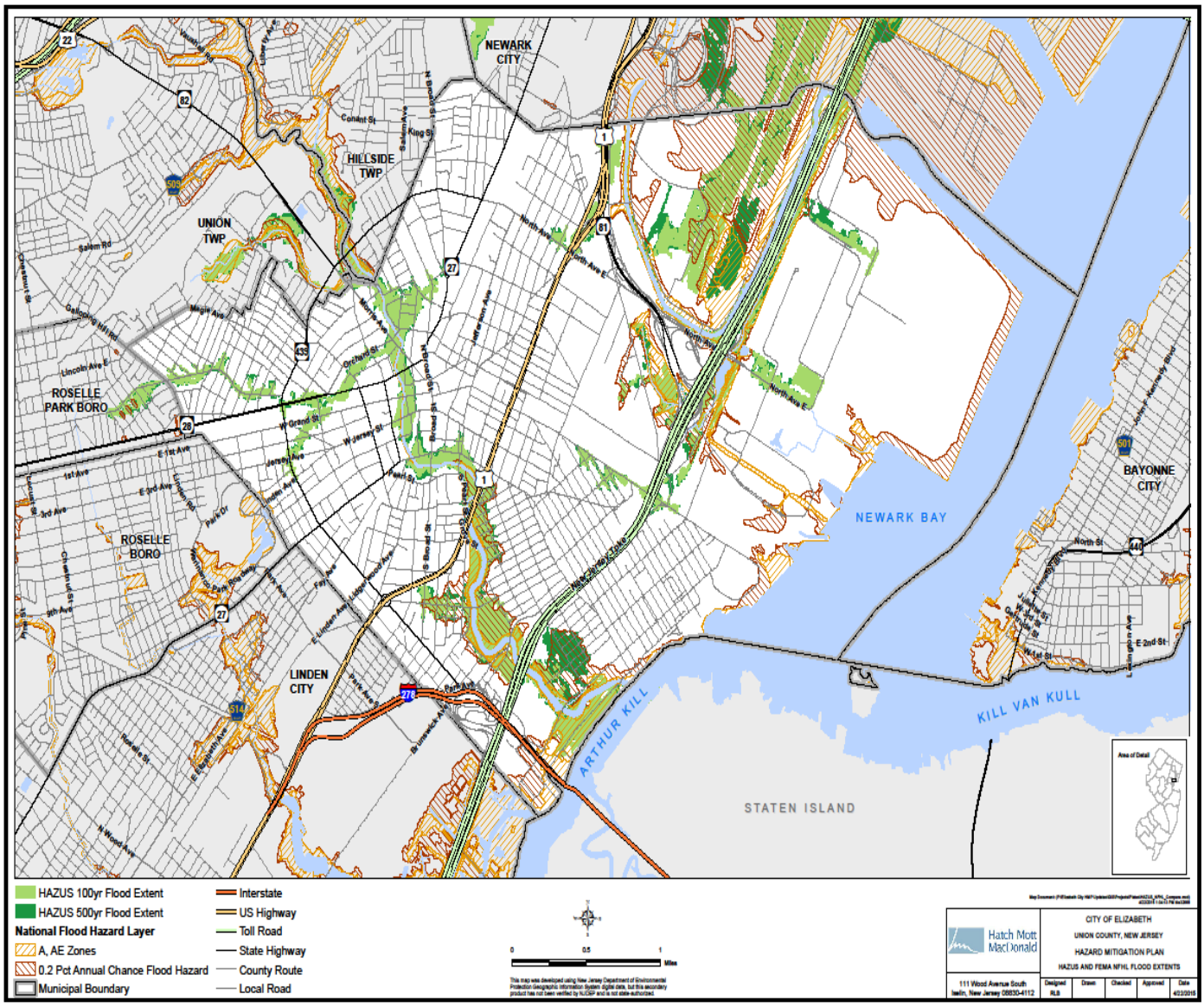


Figure 6-15
100 and 500 Year Flood Zones (with roads)
Source: HAZUS Riverine 100 and 500-Yr Flood Event Report (April 21, 2015)



6.6.3 Coastal Storm, Nor'easter, and Hurricane

In addition to flooding, coastal storms, nor'easters, and hurricanes, all have a potential for strong wind(s) which can affect both the coastal zone and more inland portions of the City.

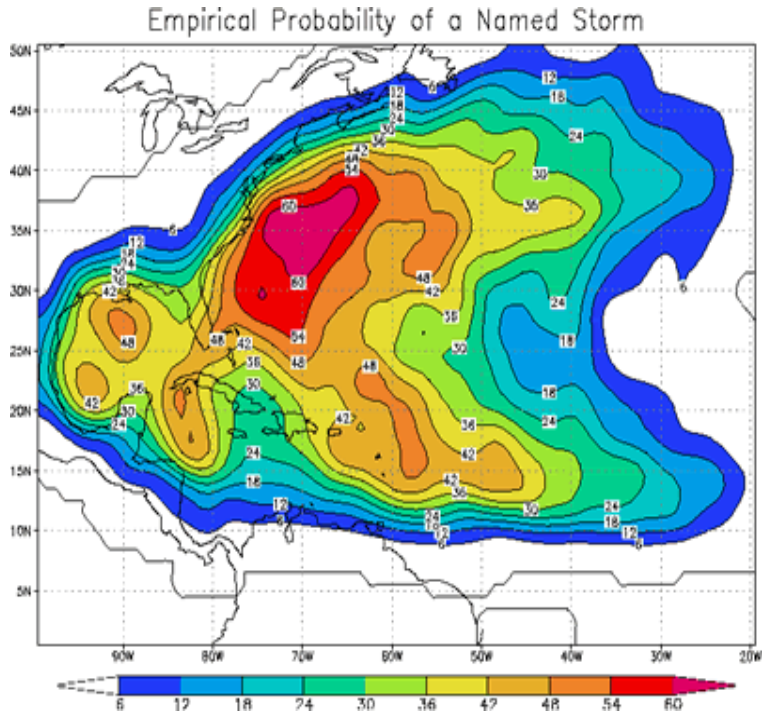
For this HAZUS data set, the model uses a geographical size of the region of 12.43 square miles (instead of 12 square miles) and contains 26 census tracts (instead of 1,003 census blocks as in the riverine/coastal data). There are over 41 thousand households in this data region and has a total population of 124,969 people (2010 Census Bureau data). There are still an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95% of the buildings (and 67% of the building value) are associated with residential housing.

6.6.3.1 Coastal Storms and Hurricanes

Hurricane or tropical storm probability analysis for any particular location with the chance of a hurricane or tropical storm that may affect a regional area during the June to November hurricane season is predicted using Empirical Probablility by the Atlantic Oceanographyic and Meteorological Laboratory. Data is used from 1944 to present in the analysis and counted hits when such storms or hurricanes were within about 100 miles (165 km) of the City. The map in Figure 6-16 was created by the Atlantic Oceanographic and Meteorological Laboratory and indicates that the City has about a 12-18% chance (the light blue color) per year of experiencing a strike by a hurricane or tropical storm forces.

Figure 6-16 Hurricane or Tropical Storm Probability

Source: The Atlantic Oceanographic and Meteorological Laboratory



Historically, the City has been on the edge of several hurricane paths from 1888 to present. In 2012, Elizabeth was impacted by Superstorm Sandy and then impacted by large snow and ice storms during the winter season beginning in 2013 through 2014.

A HAZUS loss estimation model for a hurricane event was created and utilized to estimate the effects of hurricane force winds on the City in the event of a direct hit. The model was designed to interpret the effects of a 100-year storm impact and a 500-year wind storm impact on the City. The 100-year and 500-year wind modeling data is specific to the affects from winds and was selected to incorporate with the flood modeling data used most often by both NFIP and FEMA when interpreting the effects of natural hazard events on communities. The specific impacts under the wind event are based on aggregated data and represent a base-level (Level 1) assessment for the Planning Area as a whole. As previously stated, the Committee recommends that efforts be undertaken (on an ongoing basis) to enhance, expand and further improve the accuracy of the baseline established here and enhance the level of detail provided in future plan updates.

6.6.3.1.1 100-Year Storm Event

The following section presents the planning area vulnerability and estimated exposure, and potential annualized losses, respectively, caused by a 100-year wind storm event . Due to the complexity of analyzing detailed flood risk for the City, it is important to note that this risk assessment is based on aggregated data and represents a base-level assessment for the region as a whole. As such, additional adjacent communities outside of the City of Elizabeth Planning Area have been included in the modeling due to the requirements of the DPM. The Planning Committee recommends the performance of additional work (on an ongoing basis) to enhance, expand and further improve the accuracy of the baseline established here and enhance the level of detail provided in future plan updates.

6.6.3.1.1.1 General Building Stock Damage 100-Year Storm Event

General building stock is defined as all buildings located within the model area without specification as to use. HAZUS estimates that 12 buildings will be at least moderately damaged by wind in a 100-year storm event brought on by a hurricane within the study area. It is estimated that no buildings would be completely destroyed. Table 6-23 below summarizes the Expected Building Damage by Occupancy for the buildings in the study area. Table 6-24 summarizes the Expected Building Damage by Type.

Table 6-23 Expected Building Damage by Occupancy: 100-Year Event
Source: HAZUS (run on April 16, 2015)

	None		Minor		Moderate		Severe		Destructive	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Residential	18,472	99.32	114	0.61	11	0.06	1	0.00	0	0.00
Commercial	691	99.28	5	0.68	0	0.04	0	0.00	0	0.00
Industrial	125	99.12	1	0.87	0	0.00	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Religion	63	99.47	0	0.53	0	0.00	0	0.00	0	0.00
Government	30	99.27	0	0.73	0	0.00	0	0.00	0	0.00
Education	9	99.31	0	0.00	0	0.00	0	0.00	0	0.00
Total	**19,390**		**120**		**11**		**1**		**0**	

Table 6-24 Expected Building Damage by Type 100-Year Event
Source: HAZUS (run on April 16, 2015)

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	%	Count	%	Count	%	Count	%	Count	%
Concrete	389	99.06	4	0.94	0	0.01	0	0.00	0	0.00
Masonry	3,765	98.32	56	1.45	8	0.21	1	0.01	0	0.00
Manufactured Homes	70	100	0	0.00	0	0.00	0	0.00	0	0.04
Steel	654	99.16	5	0.81	0	0.03	0	0.00	0	0.00
Wood	14,095	99.76	33	0.24	0	0.00	0	0.01	0	0.01

Essential Facility Damage

Essential facilities are defined as police station, fire stations, hospitals and schools. As with flooding, the essential facility damage model is based on the after-effects of a hurricane and as such, the verbiage used is in the present tense as if a storm has recently occurred.

Before the hurricane, the region had 886 hospital beds available for use. On the day of the hurricane, the model estimates that 886 are available for use. After one week, 100% of the beds will be in servicee. By 30 days, 100% will be operational. Table 6-25 presents the Expected Damage to Essential Facilities during a 100-year event.

Table 6-25 Expected Damage to Essential Facilities– 100-Year Event
Source: HAZUS (run on April 16, 2015)

Facilities				
Classification	**Total**	**Probability of at Least Moderate Damage >50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 Day**
Fire Stations	7	2	0	7
Hospital (Trinitas – Critical Care Facility)	1	1	0	1
Police Stations	4	0	0	4
Schools	41	1	0	41

6.6.3.1.1.2 Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane and breaks the debris into four (4) general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris and d) Other Tree Debris. This distinction is made because different types of material handling equipment will be required to handle each type of debris.

The model estimates that 1,686 tons of debris will be generated. Of the total amount, 110 tons (7%) is Other Tree Debris. Of the remaining 1,576 tons, Brick/Wood comprise 83% of the total, Reinforced Concrete/Steel comprises of 0% of the total and the remainder is Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 52 truckloads (at 25 tons/truck) to remove the debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 275 tons of Eligible Tree Debris are collected and processed. The

volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, un-compacted debris.

6.6.3.1.1.3 Social Impact

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates no households would be displaced due to the hurricane. Therefore, no people would be expected to be seeking shelter from a 100-yr hurricane storm.

6.6.3.1.1.4 Economic Loss

Economic loss is defined as financial losses due to loss of buildings and loss of business while a building is unusable due to damages. The total economic loss estimated for the hurricane is 8.6 million dollars, which represents 0.07 % of the total replacement value of the region's buildings.

Building-Related Losses

The model also provides losses which are broken into two (2) categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to buildings and contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during high winds. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the wind damage.

The total property damage losses were 9 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 6-26 provides a summary of the losses associated with Building-related Economic Loss Estimates.

Table 6-26: Building-Related Economic Loss Estimates (Thousands of Dollars) – 100 – Year Hurricane Event

Source: HAZUS (run on April 16, 2015)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	6,829.17	437.49	139.45	67.37	**7,473.48**
	Content	28.29	68.95	20.97	15.63	**133.83**
	Inventory	0.00	1.76	1.97	0.00	**3.73**
	Subtotal	**7,506.69**	**437.49**	**139.45**	**67.37**	**8,151.00**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	**0.00**
	Relocation	177.66	8.13	0.04	0.01	**185.83**
	Rental	254.93	0.00	0.00	0.00	**254.93**
	Wage	0.02	0.32	0.00	0.42	**0.76**
	Subtotal	**432.58**	**8.13**	**0.04**	**0.01**	**1.34**
Total	**Total**	**7,939.28**	**445.62**	**139.48**	**67.37**	**8,591.75**

6.6.3.1.2 500-Year Storm Event

The following section presents the planning area vulnerability and estimated exposure, and potential annualized losses, respectively, caused by a 500-year Hurricane storm event through figures and tables. Due to the complexity of analyzing detailed flood risk for the City, it is important to note that this risk assessment is based on aggregated data and represents a base-level assessment for the region as a whole. As such, additional adjacent communities outside of the City of Elizabeth Planning Area have been included in the flood modeling due to the requirements of the DEM.

For this HAZUS data set, the model uses a geographical size of the region of 12.43 square miles (instead of 12 square miles as noted in previous sections) and contains 26 census tracts (instead of 1,003 census blocks as in the riverine/coastal data). There are over 41 thousand households in this dats region and has a total population of 124,969 people (2010 Census Bureau data). There are still an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95% of the buildings (and 67% of the building value) are associated with residential housing.

6.6.3.1.2.1 General Building Stock Damage 500-Year Storm Event

General building stock is defined as all buildings located within the model area without specification as to use. HAZUS estimates that about 217buildings will be at least moderately damaged by wind in a 500-year storm event brought on by a hurricane within the study area. This is over 1% of the total number of buildings in the study area. Per the model, an estimated zero building will be completely destroyed by a

500-year wind event. Table 6-27 below summarizes the Expected Damage by Occupancy for the buildings in the study area. Table 6-28 summarizes the Expected Damage by Building Type.

Table 6-27 Expected Building Damage by Occupancy: 500-Year Event
Source: HAZUS (run on April 16, 2015)

	None		Minor		Moderate		Severe		Destructive	
Occupancy	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Residential	17,132	92.12	1,258	6.77	201	1.08	6	0.03	0	0.00
Commercial	652	93.73	36	5.10	7	1.00	1	0.17	0	0.00
Industrial	117	93.13	7	5.70	1	0.32	0	0.00	0	0.00
Agricultural	0	0.00	0	0.00	0	0.01	0	0.00	0	0.00
Religion	60	99.47	3	4.85	0	0.27	0	0.00	0	0.00
Government	29	95.15	1	4.52	0	0.00	0	0.00	0	0.00
Education	9	95.06	0	4.60	0	0.00	0	0.00	0	0.00
Total	**17,999**		**1,307**		**209**		**7**		**0**	

Table 6-28 Expected Building Damage by Type 500-Year Event
Source: HAZUS (run on April 16, 2015)

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Concrete	368	93.73	22	5.69	2	0.57	0	0.01	0	0.00
Masonry	3,427	89.51	279	7.29	18	3.08	5	0.12	0	0.00
Manufactured Homes	70	99.79	0	0.17	0	0.04	0	0.00	0	0.04
Steel	620	93.87	33	4.85	7	1.01	1	0.17	0	0.00
Wood	13.184	93.31	911	6,45	34	0.24	0	0.01	1	0.01

Essential Facility Damage

Essential facilities are defined as police station, fire stations, hospitals and schools. As with flooding, the essential facility damage model is based on the after-effects of a hurricane and as such, the verbiage used is in the present tense as if a storm has recently occurred.

Before the hurricane, the region had 886 hospital beds available for use. On the day of the hurricane, the model estimates that 886 hospital beds are available for use. After one week, 100% of the beds will be in service. By 30 days, 100% will be operational. Table 6-29 presents the Expected Damage to Essential Facilities during a 500-year event.

Table 6-29 Expected Damage to Essential Facilities 500-Year Event
Source: HAZUS (run on April 16, 2015)

Facilities				
Classification	**Total**	**Probability of at Least Moderate Damage >50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 Day**
Fire Stations	7	0	0	7
Hospital (Trinitas – Critical Care Facility)	1	1	0	1
Police Stations	4	0	0	4
Schools	41	0	0	38

6.6.3.1.2.2 Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane and breaks the debris into four (4) general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, and c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because different types of material handling equipment will be required to handle each type of debris.

The model estimates that 12,026 tons of debris will be generated. Of the total amount, 442 tons (4%) is Other Tree Debris. Of the remaining 11,584 tons, Brick/Wood comprise 91% of the total, Reinforced Concrete/Steel comprises of 0% of the total and the remainder is Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 420 truckloads (at 25 tons/truck) to remove the debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,087 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, un-compacted debris.

6.6.3.1.2.3 Social Impact

Social Impact is defined as the effects of the storm event on the model area's population. HAZUS estimates the number of people that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates zero people (out of 124,969) will be displaced due to the hurricane.

6.6.3.1.2.4 Economic Loss

Economic loss is defined as financial losses due to loss of buildings and loss of business while a building is unusable due to damages. The total economic loss estimated for a 500-year hurricane event is 73.4 million dollars, which represents 0.62 % of the total replacement value of the region's buildings.

The model also provides losses which are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to buildings and contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the wind damage.

The total building-related losses for the 500-year hurricane event were 73 million dollars, with 1% of the estimated losses related directly to business interruption of the region. By far, the residential occupancies owhich made up over 87% of the total loss. Table 6-30 provides a summary of the losses associated with the estimated building damage.

Table 6-30 Building Related Economic Loss Estimates (Thousands of Dollars) 500-Year Event

Source: HAZUS (run on April 16, 2015)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	53,881.96	4,297.03	1,393.44	471.43	60,043.86
	Content	4,984.46	830.83	613.39	32.20	6,460.88
	Inventory	0.00	29.36	86.52	5.47	4,632.73
	Subtotal	680,417.02	112,908.77	41,760.70	0.35	116.23
Business Interruption Loss						
	Income	0.00	428.46	12.14	33.61	474.21
	Relocation	2,400.06	530.98	46.58	31.69	3,009.31
	Rental	2,775.52	226.43	8.54	2.59	3,013.31
	Wage	0.00	220.75	17.29	84.32	322.37
	Subtotal	5,175.57	1,406.62	17.29	84.32	322.37
Total	**Total**	**64,041.99**	**6,563.84**	**2,177.90**	**152.22**	**73,439.93**

6.6.3.2 Nor'easter

In addition to coastal storms and hurricanes, the City is also vulnerable to Nor'easters. Nor'easters, named for the strong northeasterly winds blowing in ahead of the storm, are also referred to as extratropical cyclones, mid-latitude storms, or Great Lake storms. Mid-latitude cyclones are characterized by having a low pressure system with associated warm, cold, and occluded fronts. Nor'easters are a type of mid-latitude cyclone that occur off the east coast of North America. The storms can occur at any time of the year, but are most frequent and most violent between September and April because of the temperature differences of the converging air masses: the cold air is colder, and the warm air drawn up from the south and from the ocean is still quite warm. The storms usually develop where the Gulf Stream comes closest to the continent of North America within 100 miles east or west of the coastline and progress generally northward to northeastward typically attaining maximum intensity near New England and the Maritime Provinces. Nor'easters generally include precipitation, winds of gale force, rough seas, and coastal flooding to the affected regions. Impacts from a nor'easter can include the following: flooding, high winds, damage to utility lines, building damage from flood waters and wind-driven water, business interruption, emergency personal dispatch, vehicular and transit corridor disruptions.

Elizabeth recently sustained significant wind and flooding damage due to the nor'easter event which occurred during the period of April 14 through April 20, 2007. Twelve (12) counties in New Jersey, including Union County, were significantly impacted by the storm. All twelve counties received a Presidential Disaster Declaration.

6.6.4 Coastal Erosion

Coastal Erosion affects a very specific part of the City of Elizabeth; its eastern and south-southeastern border. The eastern border of Elizabeth is defined by Newark Bay and the south-southeast border by the Arthur Kill. Both water bodies experience tidal influence which is the main cause of shore line erosion or shoreline change. However, causes of shoreline erosion can be both natural and human-induced. The primary natural causes of erosion along the Elizabeth shoreline is relative sea-level rising, which is approximately one vertical foot every 100 years, and immediate and culmulative impacts from coastal storms. The primary human-induced coastal erosion factor is interruption of sediment sources and sediment transport. Examples include the improper or unnecessary armoring of sediment sources along natural coastal bluffs (banks) with revetments, seawalls, and bulkheads. Thereby interrupting natural sediment transport by the construction of jetties and groins. In many cases, hard armoring would prevent erosion control but living shorelines should be first considered where natural processes are essential to the longevity of the entire coastal system.

The area of the City vulnerable to coastal erosion is primarily used for industrial and commercial purposes. The shoreline is currently improved by bulk heads in areas with development along the water. Areas along the water which are not developed and contain no structures do not maintain bulkheads or any other coastal barriers. These undeveloped areas are identified in the City's Master Plan as vacant areas.

Most of the industry and commercial businesses within this area of the City rely on the waterways as a method of shipping products and receiving goods. Most notably, the PANYNJ maintains a large marine terminal in the northeast corner of the City on Newark Bay. As such, these businesses maintain the bulkheads to protect not only human life, but to protect the business interest; thus, coastal erosion is considered an area of vulnerability.

The probability of future, naturally occurring, coastal erosion events is highly likely due to the meteorological cycles of the Earth. However, advancements in technology are aiding the City in mitigating the potential effects such as redesigned construction materials and building techniques. In addition, regulations set forth by the State of New Jersey and the City help mitigate human-induced coastal erosion, thereby minimizing the probability of future events. Regulations have been developed in coastal areas to prevent the loss of coastal land due to erosion. These regulations include buffer zones, permitting regulations, the construction of seawalls and implementation of other erosion reducing strategies.

6.6.5 Thunderstorms

Thunderstorms affect relatively small areas when compared with hurricanes, Nor'easters and winter storms. Despite their small size, thunderstorms are dangerous. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. NWS defines severe weather as any weather event that can and does pose a threat to life and property including but not limited to heavy snow, freezing rain, high winds, flash flooding, river flooding, thunderstorms, tornadoes, tropical storms, and hurricanes. Thunderstorms carry a multiple vulnerability threat as they can produce a series of primary hazards to life and property including flash flooding, tornadoes, lightning, high winds and hail.

Despite the severity of these possible hazards, New Jersey is ranked 22nd in the number of lightning injuries from 1959 to present with only 118 injuries reportedly caused by lightning and 29th in the number of lightning related deaths from 1959 to present with 27 lightning related deaths. According to NOAA, 136 tornadoes have been reported in New Jersey from 1959 to present yet only one (1) tornado related death was recorded during this time frame.

6.6.6 Severe Winter Storms

Severe Winter Storms are a combination of snow and ice accumulations with strong winds. These conditions are most significant during the following three types of winter storms: Blizzards, Heavy Snowstorms, and Ice Storms

Blizzard: The NWS defines a blizzard as a snow event with winds in excess of 35 mph and visibilities of 1/4 mile or less, for an extended period of time (i.e. > 3 hours). A blizzard is also the most dangerous of all winter storms because it combines the three main factors in gauging a storm's severity: snow fall amounts, wind and duration.

Heavy Snowstorm: A snowstorm is defined by the NWS as a snow event that drops four or more inches of snow in a twelve-hour period or less. This type of winter storm can down trees, causes power outages, damage property, lead to injuries, and cause fatalities and injuries to human life.

Ice Storm: An ice storm occurs when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures and roads, for example. Ice loads are the result of the storm and oftentimes, the weight of the ice on a communications tower line can cause power outages and other damages. In addition, ice storms present hazard issues for transportation systems – both on the roads, rail lines, and air travel.

The impacts experienced by the City during sever winter storms include the following: immobility on roadways and through high-traffic corridors, decreased ability to initiate mobile emergency plans such as police, fire or ambulance due to impassible roads, loss of utilities and lack of heat in homes.

During an ice storm, two (2) types of ice can be produced due to the weather conditions: black ice and freezing rain.

- Black Ice: A thin layer of ice forms on all surfaces and is virtually impossible to detect. It contributes to traffic fatalities and injuries.
- Freezing Rain (Drizzle): Temperatures drop to near freezing and the liquid precipitation cools as it falls through the colder air then freezing on trees, power lines, roads and structures, primarily causing slippery conditions on untreated roadways.

New Jersey's middle latitude location results in snow falling in all portions of the state each winter. There have been several unusual winters in the past century when measurable snow (greater than or equal to 0.1 inch) has failed to fall or been almost absent over southern portions of the state. On average, seasonal snowfall totals 10-20 inches per season in the southern third of the state, 20-30 inches per season in the central third and 30-40 inches per season in the lower elevations of the northern third. The higher northern locations receive 40-60 inches per season. These averages are not particularly meaningful, as inter-annual variations may be on the order of feet. Two winters within the past decade exemplify the variability.

Recently, New Jersey, as of 2013/2014, has experienced significant snow fall and ice storms that has resulted in, at least, fourteen (14) storms. From these fourteen (14) storm events, there has been impact to infrastructure with respect freeze/thaw episodes creating pot holes and vehicle damage, effect of overhead catenary lines for electric rail services that cause delays to inter-mobile transport by rail, delayed openings of offices and schools, etc.

The potential for future events is highly likely given the City's geographic location and history of previous severe winter storm events. As a result, it is not possible to determine the type and number of existing or future structures within the hazard area. Further, without the benefit of a defined "hazard area" it is not feasible to assess damage to future structures and/or infrastructure from severe winter storms given the area-wide nature of this hazard. However, it is reasonable to assume that the cost of damage will rise incrementally based upon any increase in development and population density across the City, as well as the City's response to these weather/climate occurrences.

6.6.7 Extreme Heat

Because of New Jersey's geographic location, temperatures can vary greatly throughout the calendar year. Excessive summer heat is often denoted through counts of days with maximum temperatures greater than or equal to 90°F and greater than or equal to 100°F. Interior lowlands of the state have the largest number of such days; on average these areas have 20-30 days of greater than or equal to 90°F. Fewer than 10 such days occur each summer along the coast and at higher elevations. Days with temperatures above 100°F are rare throughout New Jersey, averaging one (1) day or less per year statewide. However, the best chance of experiencing such a day lies in urban locations such as the City of Elizabeth.

According to the NOAA, 158 heat-related fatalities were reported in the United States as of 2005. Of the 158, two (2) heat-related fatalities were reported in New Jersey, accounting for 1.27% of all heat-related fatalities in the United States in 2005. This number is expected to increase over time.

Extreme heat events impact the entire City. Often times, extreme temperature events can be directly related to other hazard events such as drought. An increased hazard risk caused by extreme temperature events often has the most significance effect on cities like Elizabeth with large urban areas that maintain multi-floor office buildings and residential structures. A municipality's ability to supply a moderating temperature to a multi-floor structure filled with occupants becomes significantly multiplied by the number of persons located within each building. The City has developed extreme heat plans within their local programming, which supply the public with available resource during an extreme heat event. However, these extreme heat plans are only a successful practice when the public is aware of the program and the availability of assistance and resources.

Due to the lack of historical information, no specific dollar damages have been calculated for the hazard. With respect to future development, it is reasonable to assume that the cost of damage will rise incrementally based upon any increase in development and population density across the City.

6.7 Summary of Hazard Vulnerabilities

Table 6-31 (below) provides a summary of vulnerability by the City. The City's vulnerability to each hazard has been summarized by a High, Medium or Low ranking. These rankings are based upon the following factors:

High: Indicates that a jurisdiction is highly vulnerable to the hazard based upon previous occurrences of the hazard in the jurisdiction, local knowledge of hazard areas and the qualitative analysis of the hazards.

Medium: Indicates that a jurisdiction is moderately vulnerable to the hazard based upon previous occurrences of the hazard in the jurisdiction, local knowledge of hazard areas and the qualitative analysis of the hazards.

Low: Indicates that a jurisdiction is not very vulnerable to the hazard based upon previous occurrences of the hazard in the jurisdiction, local knowledge of hazard areas and the qualitative analysis of the hazards. Where applicable, the rankings have also taken into consideration the quantitative analyses that have been developed as part of the Planning process.

Table 6-31 Hazard Ranking Vulnerability Assessment

RANKING	OVERVIEW OF VULNERABILITY
HIGH	High vulnerability to Earthquake, Flooding, Coastal Storms/Nor'easter/Hurricanes, Coastal Erosion, Thunderstorms, Severe Winter Storm, Extreme Heat, Extreme Cold
MEDIUM	Medium vulnerability to Drought, Hailstorm, and Mosquito-Borne Illness.
LOW	Low vulnerability to Avalanche, Expansive Soil, Ice-Jams, Land Subsidence, Tornado, Tsunami, Volcanoes, Wildfires

Citywide Social Vulnerability

The entire City is considered a socially vulnerable population. The Rutgers University publication entitled "*Vulnerable Populations to Climate Change in New Jersey",* by Kelly M. Bickers (updated in February 2014), indicated that the City has 3 major factor groups that attribute to the Citywide social vulnerability to natural hazards. They are 1) Family Structure; Race and Socioeconomic Status; 2) Linguistic Isolation; Ethnicity and Population Density; and 3) Age, being the smallest factor of the three indicated groups influencing social vulnerability. A detailed summary of the City's social vulnerability was described in Section 3.1, The Planning Area and Community Support section.

The City is densely populated, ethnically diverse, typically a poorer population, and aging that all contributes to not have the appropriate means to face an emergency situation and handle the resulting damages after a major storm/event. The City offers services to assist residents based on the type of hazard being faced (e.g. hot, cold, loss of power, etc.). The City also has a home improvement program that can assist disadvantaged residents with repairs due to damage or mitigation measures on a preventative basis.

The City has awareness programs for Cold, Heat, Disease, and etcetera, especially for the vulnerable population. In addition to some discussions of social and economic impacts, the City also performs free vaccinations for residents throughout the year. The City sets up warming stations, cooling stations, power stations at various public buildings when situations warrant it. The City provides spray fountains in most of its parks for cooling in the summer. The City's Health Department provides transportation to the elderly. The City is in the process of establishing official energy independent emergency shelters for use during emergencies. Every hazard mitigation project that gets completed will reduce risk and vulnerability to future hazards and increase resiliency, thereby reducing losses.

7.0 Capability Assessment

This Section addresses the Capability Assessment portion of the Plan, which has been performed in a manner consistent with FEMA's goals and objectives . A CapabilityAssessment is considered an essential step in the development of a meaningful mitigation strategy that meets the needs of the City while taking into account their own unique abilities. Specifically, the Rule states that a community's mitigation strategy should be *"based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools*" (44 CFR, Part 201.6(c) (3)).

The Planning Committee considers individual community goals and limitations, and where possible, attempt to identify local and more regional mitigation measures that have the potential to enhance existing planning tools and mechanisms. Further, the performance of the Capability Assessment is to identify the existence of several planning programs and tools which are in place throughout the City.

7.1 Capability Assessment for City Of Elizabeth

The Capability Assessment is a review of the City's resources in order to identify, review, and analyse what the City is currently doing to reduce vulnerability (and therefore reduce losses), and to identify the framework that is in place for the implementation of identified hazard mitigation activities. This section of the Plan acknowledges working relationships with the New Jersey State Office of Emergency Management (NJOEM), FEMA and with federal/state agencies and resources. In addition, this assessment is useful in evaluating how the current Plan may be improved. Additionally, many of the most critical and effective hazard mitigation strategies and programs, including enforcement of floodplain management, building codes, and land-use planning, require a strong local role to achieve effective implementation.

Each Planning Team member (and Departments) establishes their own technical and/or administrative capabilities. Capability Assessment worksheets were submitted to each of the City's departments and those that reponded can be found in Appendix G: Below is a brief description of the primary responsibility for the Department of Public Works and Engineering, the Police Department, and the Department of Administration.

Department of Public Works and Engineering

The Department of Public Works handles many services including services to sewer and stormwater services. During any hazard that involves the movement of local vehicles, the Department of Public Works will organize and implement temporary road closures for public safety and for the effectiveness of the police and fire departments activities. Coordination is usually through the engineering department.

Police Department

The fundamental objective of the Elizabeth Police Department in respect to hazard mitigation is to protect and serve the citizens of the community and ensuring a high quality of life. This is accomplished by ensuring continued access to all services. This includes making sure that police, medical, food, shelter, utilities, communications, etc., are still available after a natural hazard and that all avenues of ingress and egress are operable and accessible in order to carry out the aforementioned objectives. The Elizabeth

Police Department mitigates hazards with the coordination and partnership of FEMA and its programs, and also through working relationships with the County and State Emergency Management Offices.

Department of Administration

The Department of Administration is responsible for the daily municipal operations of the City .This includes personnel, employee benefits and city-wide purchasing. The Business Administrator oversees the Directors of each City Department and meets twice a month to discuss programs and activities occurring throughout the municipality, to include hazards that may occur before and after the event. The Business Administrator also responds to requests for information from City Council as they pertain to initiatives, opportunities and projects submitted for consideration and approval, to include hazard mitigation actions and construction items.

According to the Emergency Operations Plan (EOP), the Division of Purchasing located in the Department of Administration is tasked with the development and operation of a viable resource management program during any emergency or disaster situation. This effort is to ensure completion of required emergency actions.

Also, according to the EOP, the City of Elizabeth routinely maintains a stock of the following items: generators, blankets, cots, medical supplies, construction supplies and equipment, printing and sign-making supplies, automobiles and larger vehicles, self-contained breathing apparatus and oxygen.

Resource Management empowers the Police Department, Fire Department, Department of Public Works and various other departments involved in an emergency to make necessary emergency purchases on a 24-hour basis. The Resource Management representative will be the Purchasing Agent, who reports to the Emergency Operations Committee during an emergency. • Emergency purchases may be specifically authorized when a situation affects the public health, safety or welfare requiring the immediate delivery of the article or the performance of the service, provided that the awarding or making of such purchases, contracts or agreements are made in accordance with the guidelines outlined within the EOP.

FEMA's library provides a vast amount of Emergency Preparedness Materials on the importance of emergency preparedness, before, during and after a disaster. Information are for families, pets, seniors, disabled, and businesses: https://www.fema.gov/media-library/resources-documents/collections/344

The Internet link above can be provided on the City's web page and some of these documents cam be printed for discussion or handouts during public events.

For example, the Capability Assessment Tool (dated March 17, 2015 and found at https://www.fema.gov/media-library/assets/documents/103649) provides forms to assist faith-based organizations in performing their capability aassessment. Using these forms may assist the City when preparing for a storm and may expediate recovery after a storm event.

Conclusion

Overall, the Capability Assessment has determined that planning is widely applied to response-related activities using the Master Plan (being currently updated) and Emergency Operations Plan. Therefore, an important consideration in this Plan is that the City is able to apply the planning experience and opportunity to decide how to implement hazard mitigation project for the City, thereby increasing sustainability and resiliency each year going forward. This Plan will assist in obtaining consensus and

long-term success by identifying mitigation projects and actions focused on policy, program and technical documentation development as outlined in Section 8.

In conclusion, there are several areas which may be investigated further to determine the relevance of developing hazard mitigation strategies and to fill gaps or shortcomings that may be discovered in future years. Particularly these areas include: staffing, resources, and coordination.

As noted, there is often limited staffing available at the local level to devote to hazard mitigation related activities. This includes mitigation project identification, public outreach, and survey/data gathering; grant writing and application submittals. There is also subsequent project management that follows an award of a grant or funding event. Therefore, it is envisioned that more education and training programs for current staff regarding hazard mitigation be available to local governments which would help reduce future risk to vulnerable populations.

8.0 Mitigation Strategy

The purpose of a Mitigation Strategy is to set forth mitigation goals, objectives and strategies for prioritizing proposed projects based on all of the information collected during the Planning Process. This Section of the Plan is the mitigation plan section that drives current and future courses of action. The City intends to follow their Mitigation Plan to reduce vulnerability from future natural hazard events. The Mitigation plan is a living document that will guide action but is expected to be fluid and change based on updated strategies, priorities and funding sources. This Section is organized as follows: Section 8.1 provides an overview of the overall Mitigation Strategy; Section 8.2 provides the City's goals and objectives with respect to proposed mitigation; Section 8.3 provides the discussion of the range of mitigation actions identified through the Planning Process; and, Section 8.4 describes the Mitigation Action Plan for the City of Elizabeth Planning Area.

It should be noted that a comprehensive approach to mitigation planning is established and recognizes that the proposed actions identified as most critical in one area of the City may not be the same as those identified in another area. As a result, this Section has organized mitigation actions by priority levels as well as by type of mitigation to achieve the resiliency goals, reduce overall vulneribility, and to improve overall mitigation planning effectiveness by enhancing efforts first at the local (municipal) level and with regional (county/state) level cooperation.

8.1 OVERVIEW

This mitigation strategy provides the City with the basis for action. Based on the findings of the Risk Assessment, the Capability Assessment and the Vulnerability Assessment, the City of Elizabeth Planning Committee developed a broad-based mission statement supported by goals and actions, which is intended to guide both the day-to-day operations and the long-term approach taken by the City to reduce the impacts of hazards. To achieve these aims, this Section was organized into the following components:

- Mitigation Goals and Objectives;
- Identification and Analysis of Mitigation Measures; and
- Mitigation Action Plan

The Plan (City of Elizabeth Hazard Mitigation Plan) has been designed to be both comprehensive and strategic in nature. The Plan was created to provide a comprehensive review of hazards and identify short-term and long-term, far-reaching policies and projects intended to not only reduce the future impacts of hazards, but also to assist the City in achieving compatible economic, environmental and social goals. In addition, the Plan is strategic, in that all policies and projects were linked to agencies or departments responsible for future implementation.

When possible, funding sources were and will be identified that could be used to assist in mitigation project implementation. The foundation for mitigation action has been developed through the Planning Process, which has evolved from the prior efforts and lessons learned by the City. This Section includes the overall Mitigation Action Plan (MAP). The MAP lists specific actions, a general description of the actions, those responsible for implementation, potential funding sources that may be used, and an estimated target date for completion. The MAP is comprised of those actions identified by the City such that the overall MAP is formed by the compilation of all identified projects, proritization, and implementation. Updates are always

necessary at the MAP is a living document and completed projects would be noted and remaining projects would be re-prioritized. The approach undertaken by the Planning Committee and described herein provides those in charge of the Plan's overall implementation with a clear roadmap that will serve as an important monitoring tool. The collection of actions also serves as an easily understood menu of policies and projects for those decision makers who want to quickly review the mitigation aspect of the Plan.

8.2 GOALS AND OBJECTIVES

To guide the actions of those charged with implementation, the Plan follows a traditional planning approach, beginning with the development of a mission statement that provides the overall guiding principle for goals and objectives. Next, the Planning Committee identified goals which will enable the City to meet the intent of the mission statement and implement mitigation actions including policies or projects designed to reduce the impacts of future hazard events. Each hierarchical step is intended to provide a clearly defined set of policies and projects based on a rational framework for action. The components of the planning framework are explained in greater detail below.

Mission Statement:	Provides guiding principles of the Hazard Mitigation Plan.
Goals:	Goals represent broad statements that provide the framework for achieving the intent of the mission statement.
Hazard Mitigation Policies:	Policies are defined as a course of action agreed to by members of the Planning Team.
Hazard Mitigation Projects:	Projects are defined as specific actions taken to address defined vulnerabilities to existing buildings or systems.
Mitigation Action Plan:	Prioritized listing of actions (policies and projects), including a categorization of mitigation technique, hazards addressed, individual or organization responsible for implementation, estimated timeline for completion, and potential funding source(s).

8.2.1 Mission Statement

The Planning Committee sets forth the following mission statement.

To update and maintain a comprehensive pre-disaster hazard mitigation (PDM) program guided by enhanced education and outreach efforts, new policies and programs, to improve planning processes based on study findings, and improved evacuation procedures leading to the creation of policies and projects designed to reduce the vulnerability of individuals, families, households, businesses, infrastructure and critical facilities from the adverse impacts of natural hazards.

8.2.2 Mitigation Goals

The goals listed below are the result of an inclusive planning process described in Section 3. The goals were developed where Committee members representing the City and its departments agreed upon broad mitigation categories that provided the basis for the formulation of regional mitigation goals. The mitigation categories and goal statements developed through the City of Elizabeth Planning process are listed below (in alphabetical order):

Mitigation Categories:

- Education and Outreach
- Planning and Study
- Policy Development
- Projects/Flooding Mitigation
- Projects/Structural Mitigation
- Stormwater and Wastewater Policies/Projects
- Training

Mitigation Goals:

Goal 1 Develop hazard mitigation policies and programs designed to reduce the impact of natural and man-made hazards on people and property.

Goal 2 Identify and implement hazard mitigation projects to reduce the impact from hazard events and disasters.

Goal 3 Conduct studies and implements planning processes to foster and increase the understanding of local hazard vulnerability and to protect the natural environment.

Goal 4 Improve education and outreach efforts regarding preparedness and mitigation actions that can be implemented by citizens, businesses and county and municipal government officials.

Goal 5 Improve evacuation procedures for natural hazards.

The goals of this Plan reflect similar goals to those set forth in the State of New Jersey Hazard Mitigation Plan. This similarity is not intentional, and it should be noted that the goals of the New Jersey Plan were not presented to members of the City of Elizabeth Planning Committee. This approach was purposeful in fostering an environment that did not manipulate the goal-making process in any particular direction based on preceding determinations. It is, however understandable that the goals established through these two (2) separate efforts are similar because of the similar purposes of the State of New Jersey and City of Elizabeth Plans.

State of New Jersey Hazard Mitigation Plan Goals:

Goal 1 – Protect Life
Goal 2 - Protect Property
Goal 3 – Promote Sustainable Economy
Goal 4 – Protect the Environment
Goal 5 – Increase Public Preparedness

8.3 RANGE OF IDENTIFIED MITIGATION ACTIONS

In formulating this mitigation strategy, the City of Elizabeth Planning Committee considered a wide range of activities to help achieve the goals of the City. Table 8-1 lists the mitigation actions that were identified by participants in the planning process. Mitigation actions identified by the City address both existing building and infrastructure located within hazard areas, as well as addressing new infrastructure in hazard areas prior to their development. The majority of the mitigation actions identified are focuses on existing buildings and infrastructure.

However, in some cases, the City would like to develop pro-active mitigation actions to prevent any losses due to hazards in the future. The locations of the identified mitigation projects (exisitng and new) are presented on Table 8-1 below. In addition, the majority of the mitigation actions presented identifies projects related to flood hazards. The City considered all hazard vulnerabilities when identifying potential mitigation actions, yet at the time of updating the Plan, many City departments focused on flooding hazards as it is the predominate hazard for their departments and the City. At least one (1) mitigation action was identified for each identified hazard vulnerability and discussed in Section 6 of the Plan.

As described in Section 4.9, Land Use and Infrastructure, and Section 6.4, Land Use and Development Trends, new development and redevelopment is slated for both the suburban portions of the City as well as the commercial and industrial zones. Some urban areas have been characterized for redevelopment including Brownfield properties/sites with a wider range of end uses. The areas currently zoned for commercial and industrial use are characterized by potential new development and redevelopment for commercial and industrial usage as well as residential along the waterfront as part of a potential revitilization in the future. As part of the planning process, Elizabeth considered land development trends and identified new development or redevelopment projects. Because of these conditions, the Planning Committee includes new development and redevelopment into the mitigation planning aspect of the Plan.

Please note the mitigation categories listed in Table 8-1 are selected from those identified in Section 8.2. Table 8-1 represents the updated mitgation projects and its rankings. Many projects ares still ongong as decribed within this document while other projects from the original Plan approval have been completed, such as the Verona Avenue/Gebhardt Avenue Storm Sewer Improvement, and Westfield Avenue/Elmora Avenue Sewer Modification Projects that have been completed. The Dowd Avenue and Trumbull Street projects are very large projects which are currently outside of the City's funding ability although elements of these two projects that are within the City's means are currently being designed and should be bid for construction this summer. New equipment has been purchased over the past five years to combat winter weather and additional staging areas are still being sought since not all properties are owned by the City.

Other identifed items on this list remain unchanged or undeveloped, however, may have been re-assessed and re-ranked based on current needs and funding abilities.

Table 8-1 Mitigation Projects

Action or Issue	Category	New or Existing	Specific Hazard(s) Addressed
Dowd Avenue Pump Station	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	Existing	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Trumbull Street Regional Stormwater Management Project	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	Existing	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Monmouth Road Flood Control (JMEUC Issues)	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Park Avenue and Summit Road Flood Control	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Maple Avenue/Route 1&9 Flooding	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Route 1&9/Railroad Flooding	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Cherry Street/West Jersey Street Sewer Separation/Pump Station Upgrades and Generators/Installation	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Ursino Dam Repairs	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Portable Generators and Transfer Switches at Key Traffic Signals	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms

Table 8-1 Mitigation Projects - Continued

Action or Issue	Category	New or Existing	Specific Hazard(s) Addressed
Elizabeth River and Arthur Kill Shoreline Stabilization	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Miscellaneous Generators and Electrical Upgrades at Critical Care Facility (e.g., Police HQ, Emergency Shelters and etc.)	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects; Supply of Fuel	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Salt and Storage Facilities Upgrades.	Projects/ Structural Mitigation	New	Severe Winter Storm
Extreme Heat Education and Awareness Outreach	Education and Outreach; Training	Existing	Extreme Heat
Earthquake Awareness Outreach	Education and Outreach; Training	Existing	Earthquakes
Third Avenue and Atlantic Street Facility with Generator for Flood Control	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
South Second Street Pump Station and Flood Control with Generator	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
South Street Flood Control and Pump Station Upgrades with Generator	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Progress Street Flood Control	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Bayway Area Sewer Separation	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Trumbull Street Flood Control Project (at 6th Street)	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms

Table 8-1 Mitigation Projects - Continued

Action or Issue	Category	New or Existing	Specific Hazard(s) Addressed
Broad Street Firehouse Engine #1	Flood Mitigation Project; Flood Proofing Firehouse	New	Flooding, Coastal Storms, Nor'easter, hurricane;

			Thunderstorms
Kapkowski Road Pump Station upgrades and Generator	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Trenton Avenue Pump Station upgrades and Generator	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects Project	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Mattano Park Pump Station upgrades and Generator	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Decker Avenue Sewer (Backups)	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Pennington Street Sewer Surcharge	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms
Marina Generator for Emergency Fueling Station	Respond to fueling public vehicles	New	Fueling emergency and public vehicles to respond to site in the case of an emergency
Elizabeth River Flood Control Project – Maintenance and Upgrades	Maintain and upgrade the levy for floor water management	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms
City Wide Emergency Overhead Signs	Public Notification	New	Notify the Public of Hazardous and locations of Muster Points
City Wide Solar Power Disconnects	Public Notification	New	Transfer main electrical power to solar for continuous electricity
Infectious Disease Control	Public Notification	New	Notify the public of critical stations to receive vaccinations.
New Fire House Construction	Flood mitigation project	New	Improve Emergency Response

8.3.1 Mitigation Techniques

The Planning Committee evaluated a wide-selection of techniques to achieve the mitigation goals of the Plan. The techniques range from prevention to an expansion or enhancement of emergency services to increased public awareness. The techniques discussed and integrated into the overall mitigation strategy are further described below.

1. **Prevention**

Prevention is particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and Zoning
- Hazard Mapping
- Open Space Preservation
- Floodplain Regulations
- Stormwater Management
- Drainage System Maintenance
- Capital Improvements Programming
- Shoreline/ Riverine/ Fault Zone Setbacks

2. Property Protection

Property protection measures enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses. Examples include:

- Acquisition
- Relocation
- Building Elevation
- Critical Facilities Protection
- Retrofitting (i.e. wind proofing, flood proofing, seismic design standards)
- Insurance
- Safe Room Construction

3. Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the functions of natural systems. Examples of natural systems that can be classified as high hazard areas include floodplains, wetlands and barrier islands. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation, or conservation agencies and organizations often implement these measures. Examples include:

- Floodplain Protection
- Beach and Dune Preservation
- Riparian Buffers
- Fire Resistant Landscaping
- Erosion and Sediment Control
- Wetland Restoration
- Habitat Preservation
- Slope Stabilization

4. Structural Projects

Structural mitigation projects are intended to lessen the impact of hazards by modifying the environment or hardening structures. Structural projects are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Levees, Dikes, Floodwalls or Seawalls
- Detention and Retention Basins
- Channel Modification

- Storm Sewer Construction

5. Emergency Services

Although not typically considered a mitigation technique, emergency services minimize the impact of a hazard on people and property. Actions taken immediately prior to, during, or in response to a hazard event include:

- Warning Systems
- Search and Rescue
- Evacuation Planning and Management
- Flood Fighting Techniques

6. Public Information and Awareness

Public Information and Awareness activities are used to advise residents, business owners, potential property buyers and visitors about hazards and mitigation techniques they can use to protect themselves and their property. Examples of measures used to educate and inform the public include:

- Outreach and Education
- Training
- Speaker Series, Demonstration Events
- Real Estate Disclosure
- Hazard Expositions

8.3.2 Mitigation Techniques in the Planning Area

The Planning Committee reviewed the updated findings of the Risk Assessment, Capability Assessment and Vulnerability Assessment to determine feasible and effective mitigation techniques. The DMA 2000 specifies that state and local governments should prioritize actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. The Mitigation Matrix – Natural Hazards is provided in Table 8-2 and was used as a general guide to ensure that the hazards identified through this planning process were addressed utilizing appropriate mitigation techniques.

Table 8-2 Mitigation Matrix – Natural Hazards

Mitigation Technique	Natural Hazards				
	Flooding	Costal Storm/ Nor'easter/ Hurricane	Thunderstorm	Severe Winter Storm	Extreme Heat
Prevention	X	X	X	X	
Property Protection	X	X	X		
Natural Resource Protection	X	X	X		
Structural Projects	X	X	X	X	X

Emergency Services	**X**	**X**	**X**	**X**	**X**
Public Information and Awareness	**X**	**X**	**X**	**X**	**X**

8.3.3 Alternative Mitigation Actions

To further the development of a comprehensive range of specific mitigation actions and projects, other then those identified in Table 8-2 above, which would reduce the effects of the City's vulnerability to hazards, the Planning Committee reviewed the FEMA Alternative Mitigation Action By Hazard worksheet provided in FEMA guidance document "Developing the Mitigation Plan". Using the hazards identified and discussed in detail in Section 6 of this Plan, the Planning Committee discussed ideas presented in the worksheet and identified possible actions which could be successful. The information generated from the worksheet will be used in the future as guidance to assist the City in the development of new mitigation project to add to the City's mitigation action/project list. Table 8-3 below presents a summary of the Planning Committee's findings.

Table 8-3 Alternative Mitigation Actions

	ALTERNATIVE MITIGATION ACTIONS BY HAZARD (Adapted from FEMA, 386-3, App D, Worksheet Job Aid #1)	**Flood**	**Earth-quake**	**Coastal Storm/ Nor'easter/ Hurricane**	**Thunderstorm**	**Severe Winter Storm**	**Extreme Heat**
Prevention	Building codes	x	x	x	x	x	x
	Coastal zone management regulations	x		x		x	
	Density controls	x	x	x	x	x	
	Design review standards	x	x	x	x	x	x
	Easements	x	x	x	x	x	
	Environmental review standards	x	x	x	x	x	x
	Floodplain development regulations	x		x	x		
	Floodplain zoning	x		x	x		
	Forest fire fuel reduction						
	Hillside development regulations		x				
	Open space preservation	x	x	x	x	x	
	Performance standards	x	x	x	x	x	x
	Shoreline setback regulations	x		x	x	x	
	Special use permits	x	x	x	x	x	x
	Stormwater management regulations	x		x	x	x	
	Subdivision and development regulations	x	x	x	x	x	x
	Transfer of development rights	x	x	x	x	x	
op ert y Pr ote cti	Acquisition of hazard-prone structures	x	x	x	x	x	

	Construction of barriers around structures	x		x			
	Elevation of structures	x		x	x		
	Relocation out of hazard areas	x	x	x			
	Structural retrofits (e.g., reinforcement, flood proofing, storm shutters, bracing, etc.)	x	x	x	x	x	x
Public Education	Hazard information centers	x	x	x	x	x	x
	Public education and outreach programs	x	x	x	x	x	x
	Real estate disclosure	x	x	x	x	x	x
Natural Resources Protection	Best Management Practices (BMPs)	x	x	x	x	x	x
	Dune and beach restoration			x			
	Forest and vegetation management	x					
	Sediment and erosion control regulations	x		x	x	x	
	Stream corridor restoration	x		x	x	x	
	Stream dumping regulations	x		x	x	x	
	Urban forestry and landscape management	x					
	Wetlands development regulations	x					

Table 8-3 Alternative Mitigations Actions - continued

	ALTERNATIVE MITIGATION ACTIONS BY HAZARD (Adapted from FEMA, 386-3, App D, Worksheet Job Aid #1)	**Flood**	**Earth-quake**	**Coastal Storm/ Nor'easter/ Hurricane**	**Thunderstorm**	**Severe Winter Storm**	**Extreme Heat**
Emergency Services	Critical facilities protection	x	x	x	x	x	x
	Emergency response services	x	x	x	x	x	x
	Hazard threat recognition	x	x	x	x	x	x
	Hazard warning systems (community sirens, NOAA weather radio)	x	x	x	x	x	x
	Health and safety maintenance	x	x	x	x	x	x
	Post-disaster mitigation	x	x	x	x	x	x
Structural Projects	Channel maintenance	x		x	x	x	
	Dams/ Reservoirs	x		x	x	x	
	Levees and floodwalls	x		x	x	x	
	Safe room/ shelter				x		x
	Seawalls/bulk-heads			x			

8.4 MITIGATION ACTION PLAN

The mitigation actions developments are dynamic and Table 8-3 above represents the general format in which each mitigation action was recorded. Each action has been designed to achieve the goals identified in the Mitigation Strategy and the compilation of all the mitigation actions forms the MAP for this Plan. By identifying specific projects and policies, the MAP laid the framework for the City to engage in distinct actions that will reduce their exposure to future hazard events and disasters. Table 8-4 below represent a typical Mitigation Action Worksheet for the City to implement.

Table 8-4 Mitigation Action Worksheet

Mitigation Action	
A. Municipal Department:	
B. Action Item (Describe):	
C. Hazard(s):	
D. Lead Agency/Department Responsible	
E. Estimated Cost	
F. Funding Method:	
G. Implementation Schedule	
H. Priority:	

Notes:

A. **Municipal Department:** Be sure to identify your department.
B. **Action Item:** Identify specific actions that, if accomplished, will reduce vulnerability and risk in the impact area. Actions should match mitigation goals.
C. **Hazard(s):** The hazard(s) the action attempts to mitigate.
D. **Lead Agency/ Department Responsible:** Identify the local agency, department or organization that is best suited to accomplish this action.
E. **Estimated Cost:** If applicable, indicate the cost to accomplish the mitigation action. This amount should be estimated until a final dollar amount can be determined.
F. **Funding Method:** If applicable, indicate how the cost to complete the action will be funded. For example, funds may be provided from existing operating budgets (General Revenue), a previously established contingency fund (Contingency/ Bonds), or a federal or state grant (External Sources).
G. **Implementation Schedule:** Indicate when the action will begin, and when the action is expected to be completed. Remember that some actions will require only a minimum amount of time, while others may require a long-term continuing effort.
H. **Priority:** Indicate whether the action is a 1) High priority – short-term immediate – reducing overall risk to life and property; 2) Moderate priority – an action that should be implemented in the near future due to political or community support or ease of implementation; 3) Low priority – an action that should be implemented over the long term that may depend on the availability of funds.

The MAP includes an element of prioritization for the mitigation actions set forth herein. The mitigation actions for Elizabeth were prioritized based on the following five (5) factors: (1) effect on overall risk to life and property; (2); ease of implementation; (3) political and community support; (4) special emphasis on a general economic cost/benefit review; and (5) funding availability. An overall ranking of High, Moderate or Low was given to each action based on analysis of the action in terms of the five factors listed above. The criteria above (items a. through h.) were also used by the City to evaluate the feasibility of identified actions. If the action was determined not to be cost feasible, it was eliminated from consideration. Generally, cost feasibility was performed in a qualitative manner as part of discussions during the Planning Committee meetings. Cost determinations for potential projects was based upon information from a variety of sources including actual costs from prior similar projects within the City or adjacent jurisdictions and, review of readily available engineering/construction estimation manuals/documents as well as from technical knowledge and/or experience of engineering, building and other professionals participating in the overall planning process. Potential loss values were based upon documentation pertaining to municipal, land values, population density information as well as from cost estimates incurred from prior incidents. Projects were determined to be "not feasible" when estimated losses were significantly below the estimated project costs. With regard to prioritization, the City of Elizabeth Planning Committee anticipates that projects will be implemented based on the availability of resources and findings of cost/benefit analysis, as appropriate. In particular, cost/benefit analysis will be the guiding element for grant funded projects as that is an essential component of funding through programs such as FEMA and HMGP. Although prioritization has been considered, the MAP included in this Plan should be regarded as a comprehensive listing of projects which may be pursued simultaneously as resources are available. This perspective is cognizant of the fact that the listed projects call for diverse actions and may not be competing for the same types of funds or may involve internal re-organization or program integration, which do not require accessing external funding sources. As such, a project with a lower risk priority but with limited funding requirements may proceed prior to a project with a higher risk priority that lacks a viable funding source or local match. This comprehensive philosophy will allow the Planning Process and the action plan developed by the City of Elizabeth Planning Committee to move forward despite ever present funding constraints.

Again, it is important to note that these mitigation actions are specific measures to be undertaken by the City. It is expected that this component of the Plan will be the most dynamic as it will be used as the primary indicator to measure the Plan's progress over time. As outlined in Section 9, the mitigation actions set forth in this Plan will be routinely updated and/or revised based on the completion of actions/projects and changing natural conditions in the City of Elizabeth Planning Area.

Table 8-5 Mitigation Action Matrix below presents a City wide matrix identifying current project requiring mitigation actions as well as priority project ranking for the top 11 projects going forward in 2015. It should be noted that an estimated cost for each the project/action is shown. Many of the identified projects/actions would likely be divided up into phases such that the amount requested through grant programs will be less then that identified total cost of the project/action. Please note, the action identification numbers may not be in order from highest to lowest priority but the ranking colunm will identify the City's project/action priority. Some City departments felt the need to have discretion of implementation for an action based on the necessity to implement an action at any given time and funding resources which may become available. As such, the identification numbers are not intentionally listed by priority ranking.

8.4.1 MAP and NFIP Compliance

Mitigation actions identified in this Section include strategies to identify and analyze actions related to continued compliance with the NFIP. As previously discussed in Section 6, the City of Elizabeth has been a participant in the NFIP since May 7, 1971 and has adopted and enforced floodplain management ordinances to reduce future flood damage. All new construction or redevelopment must meet these ordinances requirements and provided documentation of such prior to Municipal approval. However, several areas of the City are still affected by flooding because of development which preceded the NFIP guidance. Raywant Sarran, the Floodplain manager would continue compliance and administration of the NFIP.

Table 8-5 Mitigation Action Matrix

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#1	**Dowd Avenue Pump Station**	**Area Specific**	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	Existing	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~25 Million
#2	**Trumbull Street Regional Stormwater Management Project**	**Area Specific**	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	Existing	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~30 Million
#3	**Monmouth Road Flood Control (JMEUC Issues)**	**Area Specific**	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~3 Million
#4	**Park Avenue and Summit Road Flood Control**	**Area Specific**	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#10	Yes	Department of Public Works/City Engineering	~4 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#5	**Maple Avenue/Route 1&9 Flooding**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~3 Million
#6	**Route 1&9/ Railroad Flooding**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~3 Million
#7	**Cherry Street/West Jersey Street Sewer Separation/Pump Station Upgrades and Generator**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#8	Yes	Department of Public Works/City Engineering	~4 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#8	**Ursino Dam Repairs**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~1 Million
#9	**Portable Generators and Transfer Switches at Key Traffic Signals**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~.5 Million
#10	**Elizabeth River and Arthur Kill Shoreline Stabilization**	Area Specific to Waterway	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~20 Million
#11	**Miscellaneous Generators and Electrical Upgrades at Critical Facilities (e.g., Police HQ, Emergency Shelters and Etc.)**	Area Specific	Flood Mitigation Project; Structural Mitigation; Stormwater and Wastewater Policies/Projects; Supply of Fuel	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~6 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#12	**Salt and Storage Facilities Upgrades**	Area Specific	Projects/ Structural Mitigation	New	Severe Winter Storm	#9	No	Department of Public Works/City Engineering	.5 Million
#13	**Extreme Heat Education and Awareness Outreach**	Area Specific	Education and Outreach; Training	Existing	Extreme Heat	Not Ranked	No	Department of Public Works/City Engineering	~$100,000
#14	**Earthquake Awareness Outreach**	Area Wide	Education and Outreach; Training	Existing	Earthquakes	Not Ranked	No	Department of Public Works/City Engineering	~$100,000
#15	**Third Avenue and Atlantic Street Flood Control Facility and Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#7	Yes	Department of Public Works/City Engineering	~8 Million
#16	**South Second Pump Station and Flood Control and Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#4	Yes	Department of Public Works/City Engineering	~4 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#17	**South Street Flood Control and Pump Station Upgrades with Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#3	Yes	Department of Public Works/City Engineering	~4 Million
#18	**Progress Street Flood Control**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#2	Yes	Department of Public Works/City Engineering	~5 Million
#19	**Bayway Area Sewer Separation**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~ 6 Million
#20	**Trumbull Street Flood Control Project (at 6th Street)**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#1	Yes	Department of Public Works/City Engineering	~5 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#21	**Broad Street Firehouse Engine #1**	Area Specific	Flood Mitigation Project; Flood Proofing Firehouse	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~7 Million
#22	**Kapkowski Road Pump Station Upgrades and Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#11	Yes	Department of Public Works/City Engineering	~2 Million
#23	**Trenton Avenue Pump Station Upgrades and Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects Project	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~4 Million
#24	**Mattano Park Pump Station Upgrades and Generator**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	#6	Yes	Department of Public Works/City Engineering	~.75 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#25	**Decker Avenue Sewer (Backups)**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~2 Million
#26	**Pennington Street Sewer Surcharge**	Area Specific	Flood Mitigation Project; Stormwater and Wastewater Policies/Projects	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~2 Million
#27	**Marina Generator For Emergency Fueling Station**	Area Specific	Responding to fueling of public and emergency vehicles to respond to emergencies	New	Flooding, Coastal Storms, Nor'easter, hurricane; Thunderstorms	Not Ranked	Yes	Department of Public Works/City Engineering	~.5 Million
#28	**Elizabeth River Flood Control Project – Maintenance and Upgrades**	Area Specific	Maintain and upgrade the levy for floor water management	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms	#5	Yes	Department of Public Works/City Engineering	~20 Million
#29	**City Wide Emergency Overhead Signs**	Area Wide	Notify the Public of Hazardous and Locations of Muster Points	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~.5 Million

Table 8-5 Mitigation Action Matrix - Continued

ID #	Action or Issue	Action Area	Category	New or Existing	Specific Hazard(s)	Priority	NFIP*	Lead Agency	Estimated Cost
#30	**City Wide Solar Power Disconnects**	Area Wide	Transfer main electrical power to solar for continuous electricity	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~.5 Million
#31	**Infectious Disease Control**	Area Wide	Notify the public of critical stations to receive vaccinations.	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~$100,000
#32	**New Fire House Construction**	Area Specific	Flood Mitigation Project and Improve Emergency Response	New	Flooding, Coastal Storms, Nor'easter, Hurricane; Thunderstorms	Not Ranked	No	Department of Public Works/City Engineering	~6 Million

NFIP* - Mitigation actions which relate to the continued compliance with the National Flood Insurance Program

9.0 Plan Maintenance Procedures

In accordance with 44 CFR Part 201.6 (c)(4)(i), this Section describes how the City will implement, evaluate and enhance the Plan over time. This Section also will discuss how the participating entities and the public will continue to be involved with pre-disaster mitigation planning. The three following subsections are provided to fully meet the requirements related to Plan maintenance:

- Implementation
- Evaluation, Monitoring and Enhancement
- Public Involvement

A brief discussion on integrating the Plan into other Planning Mechanisms is also provided in this Section.

44 CFR Part 201.6 (c) (4) (i) states that the Plan shall set forth a maintenance process describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

9.1 IMPLEMENTATION

Mitigation objectives and actions derived through this Planning Process are described in Section 8. These objectives and actions are organized on a City department basis such that each department has the ability and responsibility to update department specific mitigation strategies without altering the broader focus of the Plan. Further, under this approach Elizabeth has the authority and responsibility to expand objectives and to implement procedures, as appropriate, beyond those specified herein. The City and its departments will take on the responsibility of integrating their objectives and actions into other municipal plans, where appropriate. The City Engineer, Dan Loomis, is the person identified as the main contact person responsible for identifying how, when and by whom this Plan would be monitored and updated.

Each department will have their own internal responsibility of integrating requirements of this Plan into other local relevant documents and processes including Master Plans, Strategic Plans, Capital Improvement Plans, Continuity of Operations Plans, Ordinances/Resolutions/Regulations. For example, if a mitigation goal for the City included a reduction in building density along the Elizabeth River, the City planner would review zoning designations along the Elizabeth River in future master plan updates. As for the Master Plan, it is in the beginning process of being updated in 2015 and 2016.

It should be noted that this Plan does not set forth a regulatory obligation or mandate any update or review of existing municipal plans or processes but does convey information which would be useful for the City to incorporate, as appropriate and feasible. Opportunities for the City to integrate the requirements of this Plan into other local planning documents/processes will continue to be identified as part of the Plan review process.

The designated members of the Planning Committee will take on the lead role in each department for informing their departments of the Plan's goals and objectives such that updates and changes to municipal plans and processes do not contribute to increased hazard vulnerability in the City.

9.2 CITY OF ELIZABETH PLANNING COMMITTEE

The Planning Committee shall remain an active entity to monitor, evaluate and oversee the Plan's progress through updates. The Planning Committee is comprised of individuals with mixed academic and professional knowledge and skills which has resulted in a well-rounded and comprehensive Plan. As such, the Committee shall make a full faith effort to retain this multi-disciplined perspective going forward. During updates or revisions to the Plan, the Committee shall continue to involve the community and all local/regional stakeholders with their input. The Planning Committee members will change through the Plan's life and changes revisions will be made as needed or identified as new members are added or removed.

9.3 MONITORING, EVALUATION, AND ENHANCEMENT

An essential component of any mitigation planning is the development of a viable process/method to monitor, evaluated and enhance the Plan, especially during update cycles. It is also essential to document the established process throughout the five-year implementatuin cycle. The periodic review, revision/update by the City will ensure that the Plan reflects current information, remains up-to-date and continues to meet the goals of the City. As part of the planning process, the Planning Committee discussed and evaluated various methods to ensure comprehensive Plan monitoring and maintenance. As a starting point, the Planning Committee annually (starting in 2016) would complete a handout/worksheet addressing evaluation and effectiveness of the current Plan as part of the montioring procedures. This annual process would ensure that the initial mitigation strategeis have been or would be implemented as planned. The Planning Committee annually may address new ideas and debate/re-prioritize mitigation agendas. The specifics of the discussions involved the following: composition of the Planning Team (currently the Planning Committee) including identification of the Committee leader (City Engineer); other Planning Team review/update meetings that may be needed during the fiscal year; and potential tools/publications that should be reviewed and integrated into the Plan as an update. These discussions form the basis for the Plan's maintenance and effectiveness evaluation strategy.

The Plan will be reviewed, updated and submitted to the New Jersey State Hazard Mitigation Officer every five-years in accordance with 44 CFR, Section 201.6. The update cycle will be based upon the date of adoption of the initial Plan and will commence on the fourth anniversary of the Plan adoption date to ensure that the revised Plan will be approved within the five-year cycle. As described below, the Planning Committee has established an annual review process within the five-year cycle, thus, the timely review of the Plan will be coordinated as part of the continual informal review process.

- The Planning Committee has determined that an informal annual review should occur such that the Plan reflects current conditions and identifies new issues and priorities, especially should a natural had disaster. The primary focus of the annual review will be to evaluate progress and effectiveness of mitigation implemented and proposed and to discuss the effectiveness of current members, stakeholders and outreach effectiveness with the public sector. In particular, the Committee would discuss reviewing pertinent chapters of existing FEMA guidance documents and any new documents that could be used for better Plan guidance. The Planning Committee may want to review or re-review the latest guidance documents, such as:
- FEMA, "Local Mitigation Planning Handbook", March 2013 - http://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf

- FEMA, "Mitigation Planning Laws, Regulations, and Guidance", October 2011 - http://www.fema.gov/preparedness.pdf
- FEMA's "Mitigation Ideas", A Resource for Reducing Risk to Natural Hazards, January 2013; http://www.fema.gov/media-library-data/20130726-1904-25045-2423/fema_mitigation_ideas_final_01252013.pdf and
- FEMA, "Comprehensive Preparedness Guide (CPG) 201: Threat and Hazard Identification and Risk Assessment Guide", Second Edition, August 29, 2013 - https://www.fema.gov/media-library/assets/documents/26335

As a result of these discussions, the Planning Committee evaluations and discussions will include the following:

- Identification of any changes in State or Federal regulations, including in particular, any modification to FEMA rules and guidance that could impact elements of the Plan;
- Identification of any natural hazard events which occurred during the year;
- Discussion of the impact(s) of any recent (generally occurring within the review year) hazard events in the City of Elizabeth Planning Area;
- Review of initiated and completed mitigation measures identified in the Plan
- Evaluation of the success of initiated and completed mitigation measures identified in the Plan;
- Identification of any new mitigation measures that should be added or removed mitigation measures that are no longer a priority or modified any mitigation measures based on the most recent funding round or in terms of new importance as compared to that which was provided in the Plan;
- Identification or modification of funding options for mitigation measures;
- Identification of any changes in GIS or data acquisition and management technologies that would be useful or meaningful in Plan updates; and,
- Identification of any new Planning members or stakeholders that should be included in the Planning Process.

Also, as stated in Section 3, the Planning Committee determined that it would attempt to obtain input from stakeholder groups including but not limited to utility and transportation authorities/companies as well as from adjoining municipalities and counties as part of the Plan maintenance and update efforts. At this point, it is anticipated that the Planning Committee will identify new stakeholder groups and the appropriate representatives from adjoining Counties during annual work-session and will solicit information from the identified entities through written correspondence. The Chairman (or its designated person) of the Planning Committee will take the lead for this action and will maintain responses for inclusion in the Plan update.

The Committee members will take on the responsibility of evaluating the Plan within the context of their individual departments and may provide input to updates and address revisions to the Plan as needed.. As part of Plan maintenance, each City department will prepare an annual Progress Report documenting any mitigation actions completed or proposed for inclusion to the Plan. However, the collection of relevant project information is considered the paramount goal of the Progress Report and, as such the Committee is amenable to modifying the Progress Report format as needed. The Progress Report used in the Plan maintenance procedure can be placed in a folder for documentation/review and updates during the 5-year cycles. In addition, each member of the Planning Committee may forward a copy of annual generated Progress Reports to the Planning Committee Chairperson such that the documents can be retained officially

with the most current copy of the Plan. The Planning Committee member from each City department will have the responsibility of ensuring that all completed mitigation actions are documented in a Progress Report and that the completed Reports are provided to the Planning Committee Chairman for annual reviews and for discussion prior to annual meetings.. The Planning Committee will review the Progress Reports as part of the annual meeting to determine if modifications are required for the Plan and provide input on such changes during the meeting.

The Planning Committee will prepare minutes documenting annual meetings and any updates, revisions or deletions to the Plan. A copy of the minutes will be distributed to each member of the Committee and the Chairman will retain a copy along with other updated documentation such as Progress Reports along with the most current version of the Plan.

In addition, the Planning Committee has determined that it will convene for the purposes of discussion within 60 days following a major disaster warranting a Presidential Disaster Declaration for the City (or the County). As appropriate, the Chairman of the City of Elizabeth Planning Committee will have the ability to convene a work-session following the occurrence of any smaller disaster event, which has impacted the City or the County. As described above, the Planning Committee will prepare minutes documenting post-disaster meetings and noting any required modification to the Plan as a result of the disaster. A copy of the minutes will be distributed to each member of the Committee and the Chairman will retain a copy along with other updated documentation such as Progress Reports along with the most current version of the Plan.

9.4 PUBLIC INVOLVEMENT

With respect to providing information to the public and improving public involvement, the Planning Committee during annual meetings would determine the appropriate methods to disseminate natural hazard planning information. To improve public involvment, the City may publish and hand out small brochures throughout the year during various public events. The brochure can define Natural Hazard Mitigation and present various local, State and Federal Internet links to find more information on topics addressed in the Plan. The public notification process may include public presentations, workshops, special natural hazard topic discussions before and after a natural hazard. Open public discussions can be offered during Council or Board meetings and special meetings can be scheduled at the library – the City has 4 libraries. The Coty may also post information on public boards and on the municipal website or even set up a Natural Hazard Information booth/table during several of the annual events held in Elizabeth. The City currently has a direct link to the Hazard Mitigation Plan on the bottom of the City's Internet page and the brochure and ask the public to review and comment on the Plan. Some of the public opportunities areas are listed below:

- Free Vaccination Programs
- Josephine's Place Events
- Free Flu Shot Programs
- Hispanic Heritage Celebration Day
- Italian Flag Raising Day
- Dominican Day Parade
- Citywide Back-to-School Day
- African Heritage Day Parade
- Game Night at the Public Library

- Annual Historical Reenactment
- Taste of Elizabeth – Annual Food Tasting Extravaganza
- Fall Concert Series at the Library
- Annual Independent Authors Expo
- Annual Breast Cancer Awareness Walk
- Marriott Halloween Bash
- Anime Club at the Library
- Holiday Tree Lighting Events
- At Any Block Watch Meetings

As described above, the Planning Committee will continue to inform the public of any changes to the Plan and announce when and where hazard mitigation information would be disseminated. With respect to the full five-year review, the Planning Committee will discuss a public involvement strategy at the onset of the nest review process in early 2016. The strategy will be based upon the needs and capabilities of the City. At a minimum, the City will take the lead in providing public notification of the Plan update process, and will post notice of the Plan approval on its website and on a bulletin board at a designated location in a City building, assumed to be City Hall and/or through the City library system (of 4 libraries). The notice will provide the location where copies of the Plan can be reviewed (City Hall, libraries, and on the Internet) and will clearly identify one or more methods for the public to provide input/comment to the Plan.

9.5 INTEGRATION OF THE PLAN INTO PLANNING MECHANISMS

The City of Elizabeth and the Planning Committee have provided up to date information on identified potential hazards, reviewed hazard scenarios, assessed risk and vulnerability to the City's population and reviewed and implemented mitigation measures over the past 5 years. Readily available updated information was used during the Plan update. The information contained herein represents the latest source of information and a current planning tool for the City planning process that would integrate with the capital improvement program, funding and budgeting, local planning entities (land use, environmental commission, and planning board), utility master planning, zoning/growth management, mapping (including GIS) and critical areas/open space management. The City maintains both a Master Plan (currently being updated) and an Emergency Operations Plan (EOP). As such, these two planning documents represent the most appropriate local planning mechanisms for incorporation with this Plan. Once this updated Plan has been approved, the City will evaluate which element of the Plan would be appropriate for inclusion into individual EOP and the revised Master Plan. Further, according to Municipal Land Use Law, each municipality in New Jersey is required to re-examine its Master Plan and develop regulations at least once every six years. Thus, the incorporation of applicable pre-disaster mitigation tasks, actions and recommendations can be incorporated during in the near future.

Additionally, updated information from each planning mechanisms, including each Department's team member's inputs would be integrated into this Plan as an ongoing basis, since the Plan is a living document that can be modified and updated interimly. The intergration process will enhance the overall City mitigation planning that will incrementally reduce vulnerability/risk to the population going into a more resilient future.

10.0 Plan Adoption

The City will adopt the updated Plan in accordance with 44 CFR Part 201.6 (c)(4)(i) once approved by FEMA. The Plan was submitted to the NJ OEM and local FEMA on January 18th via email and then hardcopies delivered on January 20, 2015. Subsequent conversations in April 2015 led to further updates and revisions. On April 28, 2015, the City requested from the NJ OEM/FEMA that the requirement for an active Hazard Mitigation Plan be waived in light of extraordinary circumstances as a result of the on-going Plan update review process. A revised Plan was re-submitted for review in May 2015. The revised Plan was then sent to the NY FEMA office for review and FEMA provided additional comments in August 2015.

The City has addressed the most recent series of comments provided by NJ OEM and FEMA Region II in this updated Plan to the extent practical. Upon completion of required revisions from FEMA's final comments, a copy of the approved Updated Plan will be adopted by The City of Elizabeth put in safekeeping at various locations (e.g., public library) available for public review. A copy of the adopting resolution will the be placed in Appendix A.

Appendix A
City of Elizabeth Resolution(s) – Updated Plan Approval Resolution (2015)

Appendix B
Meeting Documentation – Planning Committee Meetings and Public Meetings

Public Notice

Municipality: City of Elizabeth
Printed On: October 7, 2014

Public Notice:

PUBLIC NOTICE The City of Elizabeth is updating the jurisdictional All-Hazard Mitigation Plan that complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000). The All-Hazard Mitigation Plan provides the framework for state and local governments to evaluate and mitigate all hazards as a condition of receiving Federal disaster assistance. The All-Hazard Mitigation Plan identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks. As part of the process the City will be holding a series of public meetings to obtain public input on potential natural hazards, which may threaten your community as well as to identify potential mitigation measures that would minimize the impact/effect of such hazards. The City will also be seeking information on the impact of past disasters in your community.

The first Public Meeting will be held as follows:
Thursday, October 30, 2014
City of Elizabeth
City Hall Council Chambers, 3rd Floor
50 Winfield Scott Plaza
Elizabeth, NJ 07201
4:00 PM - 6:00 PM

All inquiries should be directed to the City Of Elizabeth, Department of Public Works, Director John Papetti Jr., at 908-820-4101.

Aviso Público

Municipio: Ciudad de Elizabeth
Impreso el: 7 de octubre de 2.014

Aviso Público:

AVISO PÚBLICO, La Ciudad de Elizabeth está actualizando en su totalidad el Plan de Mitigación de Riesgo Jurisdiccional, de acuerdo con la Ley Federal de mitigación de desastres de 2.000 (DMA 2000) –Por sus siglas en inglés-. El Plan de mitigación de riesgo proporciona un marco legal para gobiernos estatales y locales con el fin de evaluar y mitigar los desastres como condición para recibir ayuda Federal en caso de desastre. El Plan de Mitigación de Riesgo identifica y prioriza toda probabilidad de daño a la vida y a la propiedad debido a desastres naturales y desarrolla una estrategia para minimizar los riesgos identificados. Como parte del proceso, la ciudad llevará a cabo una serie de reuniones públicas para obtener acceso público en la identificación de peligros naturales, que pueden amenazar a su comunidad, así como identificar posibles medidas de mitigación, las que minimizarían el impacto/efecto de tales peligros. La ciudad también recopilará información sobre el impacto de desastres pasados en su comunidad.

La primera reunión pública se realizará de la siguiente manera:
Jueves, 30 de octubre de 2.014
Ciudad de Elizabeth
Salón de Cámaras del Consejo de la Alcaldía, 3° piso
50 Winfield Scott Plaza
Elizabeth, NJ 07201
4:00 p.m. - 6:00 p.m.

Todas las preguntas e inquietudes deben dirigirse a la ciudad de Elizabeth, Departamento de Obras Públicas, Director John Papetti Jr., al 908-820-4101.

J. Christian Bollwage, Mayor

City of Elizabeth
Update of
Hazard Mitigation Plan - Natural Hazards

John F. Papetti, Jr., Director

October 30, 2014
City Hall Council Chambers, 3rd Floor
50 Winfield Scott Plaza

Name (print)	Signature	Company/Affiliation	Address/Phone number/E-mail
Kevin E. Koch	Kevin E. Koch	Hatch Mott MacDonald	111 Wood Ave South Iselin NJ 08830 973-912-2490 Kevin.Koch@HatchMott.com
Daniel J. Loomis		City of Elizabeth	50 Winfield Scott Plaza Elizabeth, NJ (908) 820-4269 DLoomis@ElizabethNJ.org
Steven P. Rinaldi	Steven P. Rinaldi	City of Elizabeth City Land Surveyor	50 Winfield Scott Plaza Elizabeth, NJ 908-820-4278 SRinaldi@ElizabethNJ.org
David Reis	David Reis	City of Elizabeth	50 Winfield Scott Plaza Elizabeth NJ 908 820 4271 DReis@Elizabethnj.org
Susan McKeown	Susan McKeown	City of Elizabeth	50 Winfield Scott Plaza Elizabeth, NJ 07201 908-820-4177 smckeown@elizabethnj.org

J. Christian Bollwage, Mayor

City of Elizabeth
Update of
Hazard Mitigation Plan - Natural Hazards

John F. Papetti, Jr., Director

October 30, 2014
City Hall Council Chambers, 3rd Floor
50 Winfield Scott Plaza

Name (print)	Signature	Company/Affiliation	Address/Phone number/E-mail
ALBEIRO HINCAPIE JR		CITY OF ELIZABETH, DPW, DIVISION OF ENGINEERING	50 WINFIELD SCOTT PLAZA ELIZABETH, NJ 07201 (908) 820-4289 ahincapie@elizabethnj.org
Kelly Vence		City of Elizabeth Public Information	50 Winfield Scott Pl. Elizabeth, NJ 07201 908-820-4124 Kvence@elizabethnj.org

Public Notice

Municipality: City of Elizabeth
Printed On: January 15, 2015

Public Notice:

PUBLIC NOTICE The City of Elizabeth is updating the jurisdictional Hazard Mitigation Plan – Natural Hazards that complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000). The Hazard Mitigation Plan – Natural Hazards provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks. As part of the process the City will be holding a series of public meetings to obtain public input on potential natural hazards, which may threaten your community as well as to identify potential mitigation measures that would minimize the impact/effect of such hazards. The City will also be seeking information on the impact of past disasters in your community.

The second Public Meeting will be held as follows:
Wednesday, February 4, 2015
City of Elizabeth
City Hall Council Chambers, 3rd Floor
50 Winfield Scott Plaza
Elizabeth, NJ 07201
4:00 PM - 6:00 PM

All inquiries should be directed to the City Of Elizabeth, Department of Public Works, Director John Papetti Jr., at 908-820-4101.

Aviso Público

Municipalidad: Ciudad de Elizabeth
Impreso en: Enero 15, 2015

Aviso Público:

AVISO PÚBLICO La Ciudad de Elizabeth está actualizando el Plan jurisdiccional de Mitigación de Riesgos - Riesgos Naturales que cumple con la Ley Federal de Mitigación de Desastres del 2000 (DMA 2000). El Plan de Mitigación de Riesgos - Riesgos Naturales proporciona el marco para que los gobiernos estatales y locales evalúen y mitiguen los riesgos naturales como condición para recibir asistencia federal por desastre. El Plan de Mitigación de Riesgos - Riesgos Naturales identifica y prioriza la probabilidad de daño a la vida y a la propiedad por desastres naturales y desarrolla una estrategia para minimizar los riesgos identificados. Como parte del proceso la Ciudad llevará a cabo una serie de reuniones públicas para obtener la opinión del público sobre los posibles riesgos naturales que pueden poner en peligro a su comunidad, así como para identificar posibles medidas de mitigación que reduzcan al mínimo el impacto / efecto de tales peligros. La ciudad también buscará información sobre el impacto de los desastres del pasado en su comunidad.

La segunda Reunión Pública se llevará a cabo de la siguiente manera:
Miércoles, 4 de febrero, 2015
Ciudad de Elizabeth
City Hall – Cámara del Concilio, 3er piso
50 Winfield Scott Plaza
Elizabeth, NJ 07201
4:00 PM - 6:00 PM

Todas las preguntas deben dirigirse al Director del Departamento de Obras Públicas de la Ciudad de Elizabeth, Mr. John Papetti Jr., al 908-820-4101.

Hazard Mitigation Plan - Natural Hazards

Public Meeting #2 – City's Council Chambers, City Hall

CITY OF ELIZABETH
50 Winfield Scott Plaza
Elizabeth, NJ 07201

February 4, 2015 4:00PM - 6:00PM

SIGN-IN SHEET

Name	Company	Phone #	Email Address
Kevin Koch	Hatch Mott MacDonald	201-247-4292	Kevin.Koch@hatchmott.com
Alex Sofianwnkos	Eliz Police Dept	908 558-2000	ASofianwnkos@elizabethnj.org
MIKE LYONS	KEAN U	908-358-9764	mlyons@exchange.kean.edu
DAN LOOMIS	CITY OF ELIZABETH	908 820 4269	DLOOMIS@ELIZABETHNJ.ORG
ALBEIRO HINCAPIE JR	CITY OF ELIZABETH	908 820-4289	AHINCAPIE@ELIZABETHNJ.ORG
STEVEN P. RINALDI	CITY OF ELIZABETH	908-820-4278	SRINALDI@ELIZABETHNJ.ORG
Jorge Chavez	Elizabeth Fire	908-820-2805	jchavez@elizabethnj.org
JOSEPH SHERRER	ELIZ. FIRE	908-820-2807	JSHERRER1@verizon.net
Christopher Sinclair	Eliz Fire Dept	908 820 2813	CSinclair5000@yahoo.com
Christopher Clarke	Eliz Fire Dept.	908 820 2800	wineisgreat@yahoo.com

CITY OF ELIZABETH, NEW JERSEY

DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE CITY ENGINEER
50 WINFIELD SCOTT PLAZA, ELIZABETH, NEW JERSEY 07201-2462
(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8360
RETURN RECEIPT REQUEST

Sheridan Balmeo
Public Service Electric & Gas
Union, Somerset & Hunterdon Counties
472 Weston Canal Road
Mail Code: 442
Somerset, NJ 08873

Dear Mr. Balmeo:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

As part of the public process, the City invites stakeholders and the public to attend public meetings through a series of published advertisements/notices. The first public meeting was held on October 30, 2014. As with the first public meeting announcement in October 2014, the second public meeting announcement was advertised in the Star-ledger, Union County Local Source and La Voz on January 15, 2015. The public notice is also posted on the City's website as well as the Elizabeth Public Library's website. During the first meeting, a PowerPoint presentation was used to inform the public and obtain public comments about known or potential natural hazards (e.g., hurricanes and large storms).

This letter is specifically sent to invite identified local stakeholders, like you, to participate and comment on the City's Hazard Mitigation Plan.

Your input in this public commenting process is extremely important as we attempt to create a better process for all stakeholders within and adjacent to the City. Please attend the public meeting if possible; and if not, please submit any comments you may have to Daniel Loomis at his email address (dloomis@elizabethnj.org). You may also mail the comments to:

Daniel J. Loomis, PE
City Engineer
City of Elizabeth
50 Winfield Scott Plaza
Elizabeth, NJ 07201

If you would like to attend this public meeting, it will be held on Wednesday, February 4, 2015 in the City's Council Chambers located on the 3rd Floor of City Hall. The meeting address is the same as the mailing address above. The meeting will take place in between 4:00PM and 6:00PM.

Thank you for your interest in the City's Hazard Mitigation Plan. We look forward to hearing your comments or suggestions.

Sincerely,

Daniel J. Loomis, PE
City Engineer

CITY OF ELIZABETH, NEW JERSEY

DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE CITY ENGINEER
50 WINFIELD SCOTT PLAZA, ELIZABETH, NEW JERSEY 07201-2462
(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8377
RETURN RECEIPT REQUEST

Mark Bocchieri
Director, External Affairs
Verizon
25 Main Street
Hackensack, NJ 07601

Dear Mr. Bocchieri:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

As part of the public process, the City invites stakeholders and the public to attend public meetings through a series of published advertisements/notices. The first public meeting was held on October 30, 2014. As with the first public meeting announcement in October 2014, the second public meeting announcement was advertised in the Star-ledger, Union County Local Source and La Voz on January 15, 2015. The public notice is also posted on the City's website as well as the Elizabeth Public Library's website. During the first meeting, a PowerPoint presentation was used to inform the public and obtain public comments about known or potential natural hazards (e.g., hurricanes and large storms).

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Your input in this public commenting process is extremely important as we attempt to create a better process for all stakeholders within and adjacent to the City. Please attend the public meeting if possible; and if not, please submit any comments you may have to Daniel Loomis at his email address (dloomis@elizabethnj.org). You may also mail the comments to:

Daniel J. Loomis, PE
City Engineer
City of Elizabeth
50 Winfield Scott Plaza
Elizabeth, NJ 07201

If you would like to attend this public meeting, it will be held on Wednesday, February 4, 2015 in the City's Council Chambers located on the 3rd Floor of City Hall. The meeting address is the same as the mailing address above. The meeting will take place in between 4:00PM and 6:00PM.

Thank you for your interest in the City's Hazard Mitigation Plan. We look forward to hearing your comments or suggestions.

Sincerely,

Daniel J. Loomis, PE
City Engineer

CITY OF ELIZABETH, NEW JERSEY

DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE CITY ENGINEER
50 WINFIELD SCOTT PLAZA, ELIZABETH, NEW JERSEY 07201-2462
(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8421
RETURN RECEIPT REQUEST

Dr. Dawood Farahi
President
Kean University
1000 Morris Avenue
Union, NJ 07083

Dear Mr. Farahi:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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Daniel J. Loomis, PE
City Engineer
City of Elizabeth
50 Winfield Scott Plaza
Elizabeth, NJ 07201

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Thank you for your interest in the City's Hazard Mitigation Plan. We look forward to hearing your comments or suggestions.

Sincerely,

Daniel J. Loomis, PE
City Engineer

CITY OF ELIZABETH, NEW JERSEY

DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE CITY ENGINEER
50 WINFIELD SCOTT PLAZA, ELIZABETH, NEW JERSEY 07201-2462
(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTITIED MAIL 7010 1870 0000 1303 8384
RETURN RECEIPT REQUEST

Dee Gillespie
Director of NJ Contracts/Projects
New Jersey American Water
P.O. Box 102
Bound Brook, NJ 08805

Dear Mr. Gillespie:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8339
RETURN RECEIPT REQUEST

Gary S. Horan
President/CEO
Trinitas Regional Medical Center
225 Williamson Street
Elizabeth, NJ 07202

Dear Mr. Horan:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8407
RETURN RECEIPT REQUEST

Olga Hugelmeyer
Superintendent
Elizabeth Board of Education
500 North Broad Street
Elizabeth, NJ 07208-3302

Dear Mr. Hugelmeyer:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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City Engineer

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OFFICE OF THE CITY ENGINEER
50 WINFIELD SCOTT PLAZA, ELIZABETH, NEW JERSEY 07201-2462
(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8414
RETURN RECEIPT REQUEST

Jim Kibler
AGL Resources
10 Peachtree Place
Dept 1461
Atlanta, Ga 303091

Dear Mr. Kibler:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8346
RETURN RECEIPT REQUEST

John C. Leon
Senior Director - Government & Community Relations
NJ Transit
One Penn Plaza East
Newark, NJ 07105-2246

Dear Mr. Leon:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8438
RETURN RECEIPT REQUEST

Dr. Stephen D. Nacco
Vice President
Administrative Services & Executive Assistant to the President
Union County College
1033 Springfield Avenue
Cranford, NJ 07016

Dear Mr. Nacco:

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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(908) 820-4270

DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8391
RETURN RECEIPT REQUEST

Bill O'Dea
Executive Director
Elizabeth Development Company
205 First Street, Suite 114
Elizabeth, NJ 07207

Dear Mr. O' Dea :

The purpose of this letter is to inform you of an opportunity to provide comments on the ongoing efforts by the City of Elizabeth (City) to update their jurisdictional Hazard Mitigation Plan - Natural Hazards. The Hazard Mitigation Plan – Natural Hazards complies with the Federal Disaster Mitigation Act of 2000 (DMA 2000) and provides the framework for state and local governments to evaluate and mitigate natural hazards as a condition of receiving Federal disaster assistance. The Hazard Mitigation Plan – Natural Hazards identifies and prioritizes the likelihood of damage to life and property from natural disasters and develops a strategy to minimize identified risks.

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DANIEL J. LOOMIS, PE
City Engineer

J. CHRISTIAN BOLLWAGE
Mayor

January 23, 2015

CERTIFIED MAIL 7010 1870 0000 1303 8353
RETURN RECEIPT REQUEST

Bill Young
Client Manager, Tunnels - Bridges & Terminals
Port Authority of New York and New Jersey
2 Montgomery Avenue, 4th. Floor
Jersey City, NJ 07302

Dear Mr. Young:

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Daniel J. Loomis, PE
City Engineer

Appendix C
Copy of FEMA Planning Process Worksheets
(March 2013)

List of Planning Process Worksheets

Task 1: Determine the Planning Area and Resources

Worksheet 1.1 – Comparison of Multi-Hazard Mitigation and CRS Planning Requirements

Worksheet 1.2 – Sample Memorandum of Agreement for a Multi-Jurisdictional Planning Team

Task 2: Build the Planning Team

Worksheet 2.1 – Mitigation Planning Team Worksheet

Worksheet 2.2 – Sample Schedule of Tasks

Task 3: Create an Outreach Strategy

Worksheet 3.1 – Sample Public Opinion Survey

Task 4: Review Community Capabilities

Worksheet 4.1 – Capability Assessment Worksheet

Worksheet 4.2 – Safe Growth Audit

Worksheet 4.3 – National Flood Insurance Program Worksheet

Task 5: Conduct a Risk Assessment

Worksheet 5.1 – Hazards Summary Worksheet

Task 6: Develop a Mitigation Strategy

Worksheet 6.1 – Mitigation Action Evaluation Worksheet

Worksheet 6.2 – Mitigation Action Implementation Worksheet

Task 7: Keep the Plan Current

Worksheet 7.1 – Mitigation Action Progress Report Form

Worksheet 7.2 – Plan Update Evaluation Worksheet

Task 8: Review and Adopt the Plan

Worksheet 8.1 – Example Adoption Resolution

Comparison of Multi-Hazard Mitigation and CRS Planning Requirements

One of the activities that communities can take to improve their Community Rating System (CRS) rating (and subsequently lower National Flood Insurance Program [NFIP] premiums) is to develop a CRS plan. The CRS 10-step planning process is consistent with the multi-hazard planning regulations under 44 CFR Part 201. Use this worksheet to compare how the local mitigation planning requirements at 44 CFR Part 201 relate to the CRS planning steps.

More detailed information on CRS plans can be found in Activity 510 of the CRS Coordinator's Manual at http://www.fema.gov/national-flood-insurance-program/community-rating-system.

Check ✓ if You Meet Both CRS & Part 201	Community Rating System (CRS) Planning Steps (Activity 510)	Local Mitigation Planning Handbook Tasks (44 CFR Part 201)
	Step 1. Organize	**Task 1:** Determine the Planning Area and Resources **Task 2:** Build the Planning Team 44 CFR 201.6(c)(1)
	Step 2. Involve the public	**Task 3:** Create an Outreach Strategy 44 CFR 201.6(b)(1)
	Step 3. Coordinate	**Task 4:** Review Community Capabilities 44 CFR 201.6(b)(2) & (3)
	Step 4. Assess the hazard	**Task 5:** Conduct a Risk Assessment 44 CFR 201.6(c)(2)(i) 44 CFR 201.6(c)(2)(ii) & (iii)
	Step 5. Assess the problem	
	Step 6. Set goals	**Task 6:** Develop a Mitigation Strategy 44 CFR 201.6(c)(3)(i) 44 CFR 201.6(c)(3)(ii) 44 CFR 201.6(c)(3)(iii)
	Step 7. Review possible activities	
	Step 8. Draft an action plan	
	Step 9. Adopt the plan	**Task 8:** Review and Adopt the Plan 44 CFR 201.6(c)(5)
	Step 10. Implement, evaluate, revise	**Task 7:** Keep the Plan Current **Task 9:** Create a Safe and Resilient Community 44 CFR 201.6(c)(4)

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Sample Memorandum of Agreement for a Multi-Jurisdictional Planning Team[1]

I. Purpose

A Memorandum of Agreement (MOA) is hereby executed between the participating jurisdictions in the [Insert Title of Plan]. "Participating jurisdictions" in this MOA are as follows:

- [insert Lead Community name]
- [insert Community A name]
- [insert Community B name]

The purpose of this MOA is to establish commitment from and a cooperative working relationship between all Participating Jurisdictions in the development and implementation of the [Insert Title of Plan]. In addition, the intent of this MOA is to ensure that the multi-jurisdictional hazard mitigation plan is developed in accordance with Title 44 of the Federal Code of Regulations (CFR) Part 201.6; that the planning process is conducted in an open manner involving community stakeholders; that it is consistent with each participating jurisdiction's policies, programs and authorities; and it is an accurate reflection of the community's values.

This MOA sets out the responsibilities of all parties. The MOA identifies the work to be performed by each participating jurisdiction. Planning tasks, schedules, and finished products are identified in the Work Program and Schedule. The plan created as a result of this MOA will be presented to the governing body (Planning Commission, City Council and or Board of Commissioners) of each participating jurisdiction for adoption.

II. Background

Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The Participating Jurisdictions in a mitigation planning process would benefit by:

- identifying cost effective actions for risk reduction;
- directing resources on the greatest risks and vulnerabilities;
- building partnerships by involving people, organizations, and businesses;
- increasing education and awareness of hazards and risk;
- aligning risk reduction with other community objectives; and
- providing eligibility to receive federal hazard mitigation grant funding.

The [insert Lead Community name] has received a grant from the Federal Emergency Management Agency to prepare a multi-jurisdictional hazard mitigation plan in accordance with 44 FEMA requirements at 44.C.F.R. 201.6.

III. Planning Team Responsibilities

[Insert Lead Community name] will act as the Lead Community, and will assign a Chairperson of the Planning Team for the [Insert Title of Plan]. The Participating Jurisdictions authorize the Lead Community to manage and facilitate the planning process in accordance with the Work Program and Schedule.

1 The language provided in this Sample Memorandum of Agreement does not impose legally enforceable rights and obligations, but provides information that may be suitable for your community in entering a partnership agreement with other jurisdictions. It is recommended that you consult an attorney prior to executing any legal instruments.

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

IV. Planning Team

The following points of contacts and alternatives are authorized on behalf of the governing bodies to participate as members of the Planning Team for the [Insert Title of Plan]:

[Insert Points of Contact for the Lead Jurisdiction and for each Participating Jurisdiction, and any alternative POCs, including, at a minimum:]

Name

Title

Office/Agency

Name of Participating Jurisdiction

Address

Phone number

Email address

V. MOA Implementation

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

[Insert signature block for each Participating Jurisdiction, or attach resolutions]

Signature: _____

Name of Authorized Government Official

Title (City Manager, Mayor, County Emergency Management Director, etc.)

Name of Lead Jurisdiction

Office/Agency

Date: _____

Signature: _____

Name of Authorized Government Official

Title (City Manager, Mayor, County Emergency Management Director, etc.)

Name of Jurisdiction A

Office/Agency

Date: _____

VI. Attachments

Plan Work Program and Schedule

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Mitigation Planning Team Worksheet

Use this worksheet to identify partner organizations to invite to participate on the planning team. Some organizations do not need to be involved in every decision of the planning process but are stakeholders that require outreach and involvement during the planning process. Revise the list of general partners below to reflect the organizations in your community. Mark which organizations will be invited to participate on the planning team and which will be involved through stakeholder outreach activities.

Planning Team – The core group responsible for making decisions, guiding the planning process, and agreeing upon the final contents of the plan

Stakeholders – Individuals or groups that affect or can be affected by a mitigation action or policy

Partner Organization	Planning Team	Stakeholder	Notes
Local Agencies			
Building Code Enforcement			
City Management/County Administration			
Emergency Management			
Fire Department/District			
Floodplain Administration			
Geographic Information Systems			
Parks and Recreation			
Planning/Community Development			
Public Works			
Stormwater Management			
Transportation (Roads and Bridges)			
City Council/Board of Commissioners			
Planning Commission			
Planning/Community Development			
Regional/Metropolitan Planning Organization(s)			
City/County Attorney's Office			
Economic Development Agency			
Local Emergency Planning Committee			
Police/Sheriff's Department			
Sanitation Department			
Tax Assessor's Office			
Special Districts and Authorities			
Airport, Seaport Authorities			
Fire Control District			
Flood Control District			
School District(s)			
Transit Authority			
Utility Districts			

Worksheet 2.1

Mitigation Planning Team Worksheet

Partner Organization	Planning Team	Stakeholder	Notes
Non-Governmental Organizations			
American Red Cross			
Chamber of Commerce			
Community/Faith-Based Organizations			
Environmental Organizations			
Homeowners Associations			
Neighborhood/Community Organizations			
Utility Companies			
State Agencies			
State Emergency Management Agency			
State Dam Safety			
State Department of Transportation			
State Fire and Forestry Agency			
State Geological Survey			
State Water Resources Agency			
State National Flood Insurance Program Coordinator			
State Planning Office			
Federal Agencies			
Federal Emergency Management Agency			
Land Management Agencies (USFS/NPS/BLM)			
National Weather Service			
US Army Corps of Engineers			
US Department of Housing and Urban Development			
US Department of Transportation			
US Environmental Protection Agency			
US Geological Survey			
Other			
Tribal Officials			
Colleges/Universities			
Land Developers and Real Estate Agencies			
Major Employers and Businesses			
Professional Associations			
Neighboring Jurisdictions			

Note: Multi-jurisdictional planning teams require at least one representative for each participating jurisdiction. This worksheet can be used by each jurisdiction to identify their local sub-team.

Worksheet 2.2

Sample Schedule of Tasks

Sample Schedule of Tasks

	September	October	November	December	January	February	March	April	May	June	July
Project Tasks											
Organize Resources and Convene Planning Team											
Create Outreach Strategy											
Review Community Capabilities											
Conduct Risk Assessment											
Identify Mitigation Goals and Actions											
Develop Action Plan for Implementation											
Identify Plan Maintenance Procedures											
Review Final Draft											
Submit Plan to State and FEMA											
Adopt Plan											
Meetings											
Planning Team											
Jurisdictional Sub-team											
Stakeholder/Public Outreach											

Worksheet 2.2

Sample Schedule of Tasks

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Sample Mitigation Public Opinion Survey

Mid-Columbia Region Natural Hazard Mitigation Public Opinion Survey

Your household has been randomly selected to participate in this survey about public perceptions and opinions regarding natural hazards in your county. In addition, we would like information regarding the methods and techniques you prefer for reducing the risks and losses associated with these hazards. The questionnaire should be completed by an adult, preferably the head of household. The information you provide will be used to help improve public/private coordination, mitigation, and risk reduction efforts in your county. The survey should take less than 30 minutes to complete.

This is a public opinion survey, the results of which will inform local natural hazard mitigation planning in Oregon. Your returned, completed survey indicates your willingness to take part in the study. Participation in this study is voluntary. The survey is not intended to contribute to "generalizable knowledge" and none of the information you provide will be attributed to you directly. If you have questions regarding your rights as a research participant, please contact the Office for Protection of Human Subjects, 1600 Millrace Drive, Suite 105, University of Oregon, Eugene, OR 97403-5219, or call (541) 346-2510.

NATURAL HAZARD INFORMATION

First we would like to know about your experiences involving natural hazards and your exposure to preparedness information.

1. During the past five years in the county you currently reside in, have you or someone in your household directly experienced a natural disaster such as an earthquake, severe windstorm, flood, wildfire, or other type of natural disaster?
   - ☐ Yes
   - ☐ No (***IF NO Skip to Question 2***)

   If "YES", which of these natural disasters have you or someone in your household experienced in the past five years?
   (***Please check all that apply***)
   - ☐ Drought
   - ☐ Dust Storm
   - ☐ Earthquake
   - ☐ Flood
   - ☐ Landslide / Debris Flow
   - ☐ Wildfire
   - ☐ Windstorm
   - ☐ Volcanic Eruption
   - ☐ Severe Winter Storm
   - ☐ Other (specify): _____

2. How concerned are you about the following natural disasters affecting your county?
   (***Check the corresponding box for each hazard***)

Natural Disaster	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
Drought	☐	☐	☐	☐	☐
Dust Storm	☐	☐	☐	☐	☐
Earthquake	☐	☐	☐	☐	☐
Flood	☐	☐	☐	☐	☐
Landslide / Debris Flow	☐	☐	☐	☐	☐
Wildfire	☐	☐	☐	☐	☐
Volcanic Eruption	☐	☐	☐	☐	☐
Wind Storm	☐	☐	☐	☐	☐
Severe Winter Storm	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

3. Have you ever received information about how to make members of your household and your home safer from natural disasters?
   - ☐ Yes
   - ☐ No (***IF NO Skip to Question 5***)

   If "YES", how recently?
   - ☐ Within the last 6 months
   - ☐ Between 6 and 12 months
   - ☐ Between 1 and 2 years
   - ☐ Between 2 and 5 years
   - ☐ 5 years or more

4. From whom did you **last** receive information about how to make members of your household and your home safer from natural disasters?
   (***Please check only one***)
   - ☐ News media
   - ☐ Government agency
   - ☐ Insurance agent or company
   - ☐ Utility company
   - ☐ University or research institution
   - ☐ Neighbor / friend / family member
   - ☐ Elected official
   - ☐ American Red Cross
   - ☐ Other non-profit organization
   - ☐ Social media (e.g. Facebook)
   - ☐ Not sure
   - ☐ Other:_____

5. Whom would you <u>most trust</u> to provide you with information about how to make your household and home safer from natural disasters?
   (***Please check up to three***)
   - ☐ News media
   - ☐ Government agency
   - ☐ Insurance agent or company
   - ☐ Utility company
   - ☐ University or research institution
   - ☐ Neighbor / friend / family member
   - ☐ Elected official
   - ☐ American Red Cross
   - ☐ Other non-profit organization
   - ☐ Social media (e.g. Facebook)
   - ☐ Not sure
   - ☐ Other:_____

6. What is the <u>most effective</u> way for you to receive information about how to make your household and home safer from natural disasters?
   (***Please check up to three***)

   Newspapers:
   - ☐ Newspaper stories
   - ☐ Newspaper ads

   Television:
   - ☐ Television news
   - ☐ Television ads

   Radio:
   - ☐ Radio news
   - ☐ Radio ads

   Internet:
   - ☐ Email newsletters
   - ☐ Online news outlets
   - ☐ Social media (e.g. Facebook)

   Other methods:
   - ☐ Schools
   - ☐ Outdoor advertisements (billboards, etc.)
   - ☐ Books
   - ☐ Mail
   - ☐ Fire Department/Rescue
   - ☐ Fact sheet/brochure
   - ☐ Chamber of Commerce
   - ☐ Public workshops/meetings
   - ☐ Magazine
   - ☐ University or research institution
   - ☐ Other: _____

7. Prior to receiving this survey, were you aware of your county's Natural Hazard Mitigation Plan (NHMP)?
   - ☐ Yes
   - ☐ No

8. Prior to receiving this survey, were you aware that the Federal Emergency Management Agency (FEMA) requires your county to update the NHMP every five years in order for your county to be eligible for federal pre- and post-disaster hazard mitigation funds?
   - ☐ Yes
   - ☐ No

COMMUNITY VULNERABILITIES AND HAZARD MITIGATION STRATEGIES

In order to assess community risk, we need to understand which community assets may be vulnerable to natural hazards in the region. Vulnerable assets are those community features, characteristics, or resources that may be impacted by natural hazards (e.g. populations with functional needs, economic components, environmental resources, etc.). The next set of questions will focus on vulnerable assets in your community and your preferred strategies to mitigate risk to those assets.

9. Community assets are features, characteristics, or resources that either make a community unique or allow the community to function. In your opinion, which of the following *categories* are most susceptible to the impacts caused by natural hazards in your county?
   (Please rank the community assets in order of vulnerability, 1 being most vulnerable and 6 being least vulnerable)

Community Assets	Potential Natural Hazard Impact	Order of Vulnerability
Human	Loss of life and/or injuries	_____
Economic	Business closures and/or job losses	_____
Infrastructure	Damage or loss of bridges, utilities, schools, etc.	_____
Cultural/Historic	Damage or loss of libraries, museums, fairgrounds, etc.	_____
Environmental	Damage or loss of forests, rangeland, waterways, etc.	_____
Governance	Ability to maintain order and/or provide public amenities and services	_____

10. Next we would like to know what specific types of community assets are most important to you.
    (Check the corresponding box for each asset)

Community Assets	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Elder-care facilities	☐	☐	☐	☐	☐
Schools (K-12)	☐	☐	☐	☐	☐
Hospitals	☐	☐	☐	☐	☐
Major bridges	☐	☐	☐	☐	☐
Fire/Police Stations	☐	☐	☐	☐	☐
Museums/Historic buildings	☐	☐	☐	☐	☐
Major employers	☐	☐	☐	☐	☐
Small businesses	☐	☐	☐	☐	☐
College / University	☐	☐	☐	☐	☐
City Hall / Courthouse	☐	☐	☐	☐	☐
Parks	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐

11. A number of activities can reduce your community's risk from natural hazards. These activities can be both regulatory and non-regulatory. **Please check the box that best represents your opinion of the following strategies to reduce the risk and loss associated with natural disasters.**

Community-wide Strategies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Sure
I support a regulatory approach to reducing risk	☐	☐	☐	☐	☐	☐
I support a non-regulatory approach to reducing risk	☐	☐	☐	☐	☐	☐
I support a mix of both regulatory and non-regulatory approaches to reducing risk	☐	☐	☐	☐	☐	☐
I support policies to prohibit development in areas subject to natural hazards	☐	☐	☐	☐	☐	☐
I support the use of tax dollars (federal and/or local) to compensate land owners for not developing in areas subject to natural hazards	☐	☐	☐	☐	☐	☐
I support the use of local tax dollars to reduce risks and losses from natural disasters	☐	☐	☐	☐	☐	☐
I support protecting historical and cultural structures	☐	☐	☐	☐	☐	☐
I would be willing to make my home more disaster-resistant	☐	☐	☐	☐	☐	☐
I support steps to safeguard the local economy following a disaster event	☐	☐	☐	☐	☐	☐
I support improving the disaster preparedness of local schools	☐	☐	☐	☐	☐	☐
I support a local inventory of at-risk buildings and infrastructure	☐	☐	☐	☐	☐	☐
I support the disclosure of natural hazard risks during real estate transactions	☐	☐	☐	☐	☐	☐

12. Natural hazards can have a significant impact on a community, but planning for these events can help lessen the impacts. The following statements will help determine citizen priorities regarding planning for natural hazards in your county. **Please tell us how important each one is to you.**

Statements	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property	☐	☐	☐	☐	☐
Protecting critical facilities (e.g. transportation networks, hospitals, fire stations)	☐	☐	☐	☐	☐
Preventing development in hazard areas	☐	☐	☐	☐	☐
Enhancing the function of natural features (e.g. streams, wetlands)	☐	☐	☐	☐	☐
Protecting historical and cultural landmarks	☐	☐	☐	☐	☐
Protecting and reducing damage to utilities	☐	☐	☐	☐	☐
Strengthening emergency services (e.g.- police, fire, ambulance)	☐	☐	☐	☐	☐
Disclosing natural hazard risks during real estate transactions	☐	☐	☐	☐	☐
Promoting cooperation among public agencies, citizens, non-profit organizations, and businesses	☐	☐	☐	☐	☐

MITIGATION AND PREPAREDNESS ACTIVITIES IN YOUR HOUSEHOLD

Households can mitigate and prepare for natural hazards in order to prevent damage to property, injuries, and loss of life. The precautions you take and training you receive can make a big difference in your ability to recover from a natural disaster or emergency. Access to basic services, such as electricity, gas, water, telephones and emergency care may be cut off temporarily, or you may have to evacuate at a moment's notice. The following questions focus on your household's preparedness for disaster events.

13. In the following list, please check those activities that you have done in your household, plan to do in the near future, have not done, or are unable to do.
    (Please check one answer for each preparedness activity)

In your household, have you or someone in your household:	Have Done	Plan To Do	Not Done	Unable To Do
Attended meetings or received written information on natural disasters or emergency preparedness?	☐	☐	☐	☐
Talked with members in your household about what to do in case of a natural disaster or emergency?	☐	☐	☐	☐
Developed a "Household/Family Emergency Plan" in order to decide what everyone would do in the event of a disaster?	☐	☐	☐	☐
Prepared a "Disaster Supply Kit" (stored extra food, water, batteries, or other emergency supplies)?	☐	☐	☐	☐
In the last year, has anyone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR)?	☐	☐	☐	☐
Prepared your home by having smoke detectors on each level of the house	☐	☐	☐	☐
Discussed or created a utility shutoff procedure in the event of a natural disaster?	☐	☐	☐	☐

GENERAL HOUSEHOLD INFORMATION

Finally, we would appreciate any information you are willing to share with us about you and your household. This information will remain confidential and is for survey comparison purposes only.

14. Please indicate your age: _____

15. Gender: ☐ Male ☐ Female

16. Please indicate your level of education:
    - ☐ High school graduate/GED
    - ☐ Some college/trade school
    - ☐ College degree
    - ☐ Postgraduate degree
    - ☐ Other (please specify): _____

17. What is your total household income?
    - ☐ Less than $10,000
    - ☐ $10,000 - $19,999
    - ☐ $20,000 - $29,999
    - ☐ $30,000 - $39,999
    - ☐ $40,000 - $49,999
    - ☐ $50,000 - $59,999
    - ☐ $60,000 - $69,999
    - ☐ $70,000 - $79,999
    - ☐ $80,000 - $89,999
    - ☐ $90,000 - $99,999
    - ☐ $100,000 - $149,999
    - ☐ More than $150,000

18. Zip code *(optional)*: _____

19. County:
    - ☐ Clackamas County
    - ☐ Hood River County
    - ☐ Gilliam County
    - ☐ Morrow County
    - ☐ Sherman County
    - ☐ Umatilla County
    - ☐ Wasco County
    - ☐ Wheeler County

20. Please specify your race:
    - ☐ American Indian or Alaska Native
    - ☐ Asian
    - ☐ Black or African American
    - ☐ Native Hawaiian or Other Pacific Islander
    - ☐ White

21. Please specify your ethnicity:
    - ☐ Hispanic or Latino
    - ☐ Not Hispanic or Latino

22. How long have you lived in Oregon?
    - ☐ Less than one year
    - ☐ 1-5 years
    - ☐ 5-9 years
    - ☐ 10-19 years
    - ☐ 20 years or more

23. Do you own or rent your home? ☐ Own ☐ Rent

24. Do you own/rent a:
    - ☐ Single-family home
    - ☐ Duplex
    - ☐ Apartment (3-4 units in structure)
    - ☐ Apartment (5 or more units in structure)
    - ☐ Condominium / townhouse
    - ☐ Manufactured home
    - ☐ Other: _____

Please feel free to provide any additional comments in the space provided:

THANK YOU VERY MUCH FOR PROVIDING THIS INFORMATION

The Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center prepared this survey. Implementation of this survey has been made possible by funding from the Federal Emergency Management Agency and the Oregon Emergency Management.
For more information, please contact the Oregon Partnership for Disaster Resilience at 1209 University of Oregon, Eugene, OR 97403-1209, call (541) 346-3588, or visit ***http://csc.uoregon.edu/opdr/***

Capability Assessment Worksheet

Jurisdiction: _____

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the tables and questions in the worksheet as completely as possible. Complete one worksheet for each jurisdiction.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Please indicate which of the following your jurisdiction has in place.

Plans	Yes/No Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan		
Capital Improvements Plan		
Economic Development Plan		
Local Emergency Operations Plan		
Continuity of Operations Plan		
Transportation Plan		
Stormwater Management Plan		
Community Wildfire Protection Plan		
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		

Worksheet 4.1

Capability Assessment Worksheet

Building Code, Permitting, and Inspections	Yes/No	Are codes adequately enforced?
Building Code		Version/Year:
Building Code Effectiveness Grading Schedule (BCEGS) Score		Score:
Fire department ISO rating		Rating:
Site plan review requirements		
Land Use Planning and Ordinances	**Yes/No**	**Is the ordinance an effective measure for reducing hazard impacts?** **Is the ordinance adequately administered and enforced?**
Zoning ordinance		
Subdivision ordinance		
Floodplain ordinance		
Natural hazard specific ordinance (stormwater, steep slope, wildfire)		
Flood insurance rate maps		
Acquisition of land for open space and public recreation uses		
Other		

How can these capabilities be expanded and improved to reduce risk?

Administrative and Technical

Identify whether your community has the following administrative and technical capabilities. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level government that can provide technical assistance, indicate so in your comments.

Administration	Yes/No	Describe capability Is coordination effective?
Planning Commission		
Mitigation Planning Committee		
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)		
Mutual aid agreements		
Staff	**Yes/No FT/PT[1]**	**Is staffing adequate to enforce regulations?** **Is staff trained on hazards and mitigation?** **Is coordination between agencies and staff effective?**
Chief Building Official		
Floodplain Administrator		
Emergency Manager		
Community Planner		
Civil Engineer		
GIS Coordinator		
Other		

1 Full-time (FT) or part-time (PT) position

Worksheet 4.1

Capability Assessment Worksheet

Technical	Yes/No	Describe capability Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)		
Hazard data and information		
Grant writing		
Hazus analysis		
Other		

How can these capabilities be expanded and improved to reduce risk?

Financial

Identify whether your jurisdiction has access to or is eligible to use the following funding resources for hazard mitigation.

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding		
Authority to levy taxes for specific purposes		
Fees for water, sewer, gas, or electric services		
Impact fees for new development		
Storm water utility fee		
Incur debt through general obligation bonds and/or special tax bonds		
Incur debt through private activities		
Community Development Block Grant		
Other federal funding programs		
State funding programs		
Other		

How can these capabilities be expanded and improved to reduce risk?

Worksheet 4.1

Capability Assessment Worksheet

Education and Outreach

Identify education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.		
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)		
Natural disaster or safety related school programs		
StormReady certification		
Firewise Communities certification		
Public-private partnership initiatives addressing disaster-related issues		
Other		

How can these capabilities be expanded and improved to reduce risk?

Safe Growth Audit

Use this worksheet to identify gaps in your community's growth guidance instruments and improvements that could be made to reduce vulnerability to future development.

Comprehensive Plan	Yes	No
Land Use		
1. Does the future land-use map clearly identify natural hazard areas?		
2. Do the land-use policies discourage development or redevelopment within natural hazard areas?		
3. Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?		
Transportation		
1. Does the transportation plan limit access to hazard areas?		
2. Is transportation policy used to guide growth to safe locations?		
3. Are movement systems designed to function under disaster conditions (e.g., evacuation)?		

Worksheet 4.2
Safe Growth Audit

Comprehensive Plan (continued)	Yes	No
Environmental Management		
1. Are environmental systems that protect development from hazards identified and mapped?		
2. Do environmental policies maintain and restore protective ecosystems?		
3. Do environmental policies provide incentives to development that is located outside protective ecosystems?		
Public Safety		
1. Are the goals and policies of the comprehensive plan related to those of the FEMA Local Hazard Mitigation Plan?		
2. Is safety explicitly included in the plan's growth and development policies?		
3. Does the monitoring and implementation section of the plan cover safe growth objectives?		

Worksheet 4.2
Safe Growth Audit

Zoning Ordinance	Yes	No
1. Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?		
2. Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?		
3. Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?		
4. Does the ordinance prohibit development within, or filling of, wetlands, floodways, and floodplains?		

Subdivision Regulations	Yes	No
1. Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?		
2. Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?		
3. Do the regulations allow density transfers where hazard areas exist?		

Worksheet 4.2

Safe Growth Audit

Capital Improvement Program and Infrastructure Policies	Yes	No
1. Does the capital improvement program limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?		
2. Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?		
3. Does the capital improvement program provide funding for hazard mitigation projects identified in the FEMA Mitigation Plan?		
Other	**Yes**	**No**
1. Do small area or corridor plans recognize the need to avoid or mitigation natural hazards?		
2. Does the building code contain provisions to strengthen or elevate construction to withstand hazard forces?		
3. Do economic development or redevelopment strategies include provisions for mitigation natural hazards?		
4. Is there an adopted evacuation and shelter plan to deal with emergencies from natural hazards?		

Questions adapted from Godschalk, David R. Practice Safe Growth Audits, *Zoning Practice*, Issue Number 10, October 2009, American Planning Association. http://www.planning.org/zoningpractice/open/pdf/oct09.pdf.

National Flood Insurance Program (NFIP) Worksheet

Use this worksheet to collect information on your community's participation in and continued compliance with the NFIP, as well as identify areas for improvement that could be potential mitigation actions. Indicate the source of information, if different from the one included.

NFIP Topic	Source of Information	Comments
Insurance Summary		
How many NFIP policies are in the community? What is the total premium and coverage?	State NFIP Coordinator or FEMA NFIP Specialist	
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were for substantial damage?	FEMA NFIP or Insurance Specialist	
How many structures are exposed to flood risk within the community?	Community Floodplain Administrator (FPA)	
Describe any areas of flood risk with limited NFIP policy coverage	Community FPA and FEMA Insurance Specialist	
Staff Resources		
Is the Community FPA or NFIP Coordinator certified?	Community FPA	
Is floodplain management an auxiliary function?	Community FPA	
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	Community FPA	
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	
Compliance History		
Is the community in good standing with the NFIP?	State NFIP Coordinator, FEMA NFIP Specialist, community records	
Are there any outstanding compliance issues (i.e., current violations)?		
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?		
Is a CAV or CAC scheduled or needed?		

Worksheet 4.3

National Flood Insurance Program (NFIP)

NFIP Topic	Source of Information	Comments
Regulation		
When did the community enter the NFIP?	Community Status Book http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book	
Are the FIRMs digital or paper?	Community FPA	
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	Community FPA	
Provide an explanation of the permitting process.	Community FPA, State, FEMA NFIP Flood Insurance Manual http://www.fema.gov/flood-insurance-manual Community FPA, FEMA CRS Coordinator, ISO representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	
Community Rating System (CRS)		
Does the community participate in CRS?	Community FPA, State, FEMA NFIP	
What is the community's CRS Class Ranking?	Flood Insurance Manual http://www.fema.gov/flood-insurance-manual	
What categories and activities provide CRS points and how can the class be improved?		
Does the plan include CRS planning requirements	Community FPA, FEMA CRS Coordinator, ISO representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	

Hazards Summary Worksheet

Use this worksheet to summarize hazard description information and identify which hazards are most significant to the planning area. The definitions provided on the following page can be modified to meet local needs and methods.

Hazard	Location (Geographic Area Affected)	Maximum Probable Extent (Magnitude/Strength)	Probability of Future Events	Overall Significance Ranking
Avalanche				
Dam Failure				
Drought				
Earthquake				
Erosion				
Expansive Soils				
Extreme Cold				
Extreme Heat				
Flood				
Hail				
Hurricane				
Landslide				
Lightning				
Sea Level Rise				
Severe Wind				
Severe Winter Weather				
Storm Surge				
Subsidence				
Tornado				
Tsunami				
Wildfire				

Worksheet 5.1

Hazard Summary Worksheet

Definitions for Classifications

Location (Geographic Area Affected)

- **Negligible:** Less than 10 percent of planning area or isolated single-point occurrences
- **Limited:** 10 to 25 percent of the planning area or limited single-point occurrences
- **Significant:** 25 to 75 percent of planning area or frequent single-point occurrences
- **Extensive:** 75 to 100 percent of planning area or consistent single-point occurrences

Maximum Probable Extent (Magnitude/Strength based on historic events or future probability)

- **Weak:** Limited classification on scientific scale, slow speed of onset or short duration of event, resulting in little to no damage
- **Moderate:** Moderate classification on scientific scale, moderate speed of onset or moderate duration of event, resulting in some damage and loss of services for days
- **Severe:** Severe classification on scientific scale, fast speed of onset or long duration of event, resulting in devastating damage and loss of services for weeks or months
- **Extreme:** Extreme classification on scientific scale, immediate onset or extended duration of event, resulting in catastrophic damage and uninhabitable conditions

Hazard	Scale / Index	Weak	Moderate	Severe	Extreme
Drought	Palmer Drought Severity Index[3]	-1.99 to +1.99	-2.00 to -2.99	-3.00 to -3.99	-4.00 and below
Earthquake	Modified Mercalli Scale[4]	I to IV	V to VII	VII	IX to XII
	Richter Magnitude[5]	2, 3	4, 5	6	7, 8
Hurricane Wind	Saffir-Simpson Hurricane Wind Scale[6]	1	2	3	4, 5
Tornado	Fujita Tornado Damage Scale[7]	F0	F1, F2	F3	F4, F5

Probability of Future Events

- **Unlikely:** Less than 1 percent probability of occurrence in the next year or a recurrence interval of greater than every 100 years.
- **Occasional:** 1 to 10 percent probability of occurrence in the next year or a recurrence interval of 11 to 100 years.
- **Likely:** 10 to 90 percent probability of occurrence in the next year or a recurrence interval of 1 to 10 years
- **Highly Likely:** 90 to 100 percent probability of occurrence in the next year or a recurrence interval of less than 1 year.

Overall Significance

- **Low:** Two or more criteria fall in lower classifications or the event has a minimal impact on the planning area. This rating is sometimes used for hazards with a minimal or unknown record of occurrences or for hazards with minimal mitigation potential.
- **Medium:** The criteria fall mostly in the middle ranges of classifications and the event's impacts on the planning area are noticeable but not devastating. This rating is sometimes used for hazards with a high extent rating but very low probability rating.
- **High:** The criteria consistently fall in the high classifications and the event is likely/highly likely to occur with severe strength over a significant to extensive portion of the planning area.

3 Cumulative meteorological drought and wet conditions: http://ncdc.noaa.gov/

4 Earthquake intensity and effect on population and structures: http://earthquake.usgs.gov

5 Earthquake magnitude as a logarithmic scale, measured by a seismograph: http://earthquake.usgs.gov

6 Hurricane rating based on sustained wind speed: http://nhc.noaa.gov

7 Tornado rating based on wind speed and associated damage: http://spc.noaa.gov

Mitigation Action Evaluation Worksheet

Use this worksheet to help evaluate and prioritize each mitigation action being considered by the planning team. For each action, evaluate the potential benefits and/or likelihood of successful implementation for the criteria defined below.

Rank each of the criteria with a -1, 0 or 1 using the following scale:

- 1 = Highly effective or feasible
- 0 = Neutral
- -1 = Ineffective or not feasible

Example Evaluation Criteria

Life Safety – How effective will the action be at protecting lives and preventing injuries?

Property Protection – How significant will the action be at eliminating or reducing damage to structures and infrastructure?

Technical – Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.

Political – Is there overall public support for the mitigation action? Is there the political will to support it?

Legal – Does the community have the authority to implement the action?

Environmental – What are the potential environmental impacts of the action? Will it comply with environmental regulations?

Social – Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

Administrative – Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?

Local Champion – Is there a strong advocate for the action or project among local departments and agencies that will support the action's implementation?

Other Community Objectives – Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of the comprehensive plan?

Worksheet 6.1

Mitigation Action Evaluation Worksheet

Mitigation Action	Life Safety	Property Protection	Technical	Political	Legal	Environmental	Social	Administrative	Local Champion	Other Community Objectives	Total Score
Local Plans and Regulations											
Structure and Infrastructure Projects											
Natural Systems Protection											
Education and Awareness Programs											

Mitigation Action Implementation Worksheet

Complete a mitigation action implementation worksheet for each identified mitigation action.

Jurisdiction:	
Mitigation Action/Project Title:	
Background/Issue:	
Ideas for Integration:	
Responsible Agency:	
Partners:	
Potential Funding:	
Cost Estimate:	
Benefits: (Losses Avoided)	
Timeline:	
Priority:	
Worksheet Completed by:	(Name/Department)

Worksheet 6.2

Mitigation Action Implementation Worksheet

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Mitigation Action Progress Report Form

Progress Report Period	From Date:	To Date:
Action/Project Title		
Responsible Agency		
Contact Name		
Contact Phone/Email		
Project Status	❑ Project completed ❑ Project canceled ❑ Project on schedule ❑ Anticipated completion date:_____ ❑ Project delayed Explain _____	

Summary of Project Progress for this Report Period

1. What was accomplished for this project during this reporting period?

2. What obstacles, problems, or delays did the project encounter?

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments

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Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?	
	Have any internal or external agencies been invaluable to the mitigation strategy?	
	Can any procedures (e.g., meeting announcements, plan updates) be done differently or more efficiently?	
	Has the Planning Team undertaken any public outreach activities?	
	How can public participation be improved?	
	Have there been any changes in public support and/or decision- maker priorities related to hazard mitigation?	
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?	
	Are there different or additional administrative, human, technical, and financial resources available for mitigation planning?	
	Are there different or new education and outreach programs and resources available for mitigation activities?	
	Has NFIP participation changed in the participating jurisdictions?	
Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?	
	Should the list of hazards addressed in the plan be modified?	
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?	
	Do any new critical facilities or infrastructure need to be added to the asset lists?	
	Have any changes in development trends occurred that could create additional risks?	
	Are there repetitive losses and/or severe repetitive losses to document?	

Worksheet 7.2

Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimates accurate?	
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or eliminated from the plan?	
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?	
	Are there new funding sources to consider?	
	Have elements of the plan been incorporated into other planning mechanisms?	
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?	
	What are needed improvements to the procedures?	

Example Adoption Resolution

(LOCAL COMMUNITY)

(STATE)

RESOLUTION NO. _____

A RESOLUTION OF THE (LOCAL COMMUNITY) ADOPTING THE

(TITLE AND DATE OF MITIGATION PLAN)

WHEREAS the (local governing body) recognizes the threat that natural hazards pose to people and property within (local community); and

WHEREAS the (local community) has prepared a multi-hazard mitigation plan, hereby known as (title and date of mitigation plan) in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS (title and date of mitigation plan) identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in (local community) from the impacts of future hazards and disasters; and

WHEREAS adoption by the (local governing body) demonstrates their commitment to the hazard mitigation and achieving the goals outlined in the (title and date of mitigation plan).

NOW THEREFORE, BE IT RESOLVED BY THE (LOCAL COMMUNITY), (STATE), THAT:

Section 1. In accordance with (local rule for adopting resolutions), the (local governing body) adopts the (title and date of mitigation plan).

ADOPTED by a vote of ____ in favor and ____ against, and ____ abstaining, this _____ day of

_____, _____.

By: _____

(print name)

ATTEST:

By: _____

(print name)

APPROVED AS TO FORM:

By: _____

(print name)

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Appendix D
HAZUS: Earthquake Event Report

Hazus-MH: Earthquake Event Report

Region Name: Elizabeth_FHE

Earthquake Scenario: Probabilistic-100yr-Mag5

Print Date: April 16, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12.43 square miles and contains 26 census tracts. There are over 41 thousand households in the region which has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 (millions of dollars). Approximately 95.00 % of the buildings (and 67.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 3,845 and 158 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 11,808 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds. There are 41 schools, 7 fire stations, 4 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 17 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 4,003.00 (millions of dollars). This inventory includes over 60 kilometers of highways, 114 bridges, 9,495 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	114	3,235.60
	Segments	65	460.10
	Tunnels	0	0.00
		Subtotal	**3,695.70**
Railways	Bridges	6	1.20
	Facilities	9	24.00
	Segments	51	42.20
	Tunnels	0	0.00
		Subtotal	**67.30**
Light Rail	Bridges	0	0.00
	Facilities	2	5.30
	Segments	3	6.90
	Tunnels	0	0.00
		Subtotal	**12.20**
Bus	Facilities	3	3.90
		Subtotal	**3.90**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	14	28.00
		Subtotal	**28.00**
Airport	Facilities	0	0.00
	Runways	1	38.00
		Subtotal	**38.00**
		Total	**3,845.10**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	95.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**95.00**
Waste Water	Distribution Lines	NA	57.00
	Facilities	2	158.50
	Pipelines	0	0.00
		Subtotal	**215.50**
Natural Gas	Distribution Lines	NA	38.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**38.00**
Oil Systems	Facilities	2	0.20
	Pipelines	0	0.00
		Subtotal	**0.20**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**348.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Probabilistic-100yr-Mag5
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	696	3.57	0	0.00	0	0.00	0	0.00	0	0.00
Education	9	0.05	0	0.00	0	0.00	0	0.00	0	0.00
Government	30	0.15	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	126	0.65	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	9,710	49.74	0	0.00	0	0.00	0	0.00	0	0.00
Religion	63	0.32	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	8,888	45.53	0	0.00	0	0.00	0	0.00	0	0.00
Total	**19,522**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	14,175	72.61	0	0.00	0	0.00	0	0.00	0	0.00
Steel	722	3.70	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	458	2.35	0	0.00	0	0.00	0	0.00	0	0.00
Precast	38	0.20	0	0.00	0	0.00	0	0.00	0	0.00
RM	969	4.96	0	0.00	0	0.00	0	0.00	0	0.00
URM	3,082	15.79	0	0.00	0	0.00	0	0.00	0	0.00
MH	77	0.39	0	0.00	0	0.00	0	0.00	0	0.00
Total	**19,522**		**0**		**0**		**0**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 886 hospital beds available for use. On the day of the earthquake, the model estimates that only 874 hospital beds (99.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	3	0	0	3
Schools	41	0	0	41
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	7	0	0	7

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	65	0	0	65	65
	Bridges	114	0	0	114	114
	Tunnels	0	0	0	0	0
Railways	Segments	51	0	0	51	51
	Bridges	6	0	0	6	6
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
Light Rail	Segments	3	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Bus	Facilities	3	0	0	3	3
Ferry	Facilities	0	0	0	0	0
Port	Facilities	14	0	0	14	14
Airport	Facilities	0	0	0	0	0
	Runways	1	0	0	1	1

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	2	0	0	2	2
Natural Gas	0	0	0	0	0
Oil Systems	2	0	0	2	2
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,748	0	0
Waste Water	2,849	0	0
Natural Gas	1,899	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	41,596	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 0.03 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.00	0.00	0.00	0.00
	Capital-Related	0.00	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital Stock Losses							
	Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Non_Structural	0.00	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	460.10	$0.00	0.00
	Bridges	3,235.63	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**3695.70**	**0.00**	
Railways	Segments	42.19	$0.00	0.00
	Bridges	1.18	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	23.97	$0.01	0.04
	Subtotal	**67.30**	**0.00**	
Light Rail	Segments	6.86	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.00	0.04
	Subtotal	**12.20**	**0.00**	
Bus	Facilities	3.89	$0.00	0.04
	Subtotal	**3.90**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	27.96	$0.01	0.04
	Subtotal	**28.00**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	37.96	$0.00	0.00
	Subtotal	**38.00**	**0.00**	
	Total	**3845.10**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	95.00	$0.00	0.00
	Subtotal	**94.95**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	158.50	$0.00	0.00
	Distribution Lines	57.00	$0.00	0.00
	Subtotal	**215.48**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	38.00	$0.00	0.00
	Subtotal	**37.98**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.20	$0.00	0.00
	Subtotal	**0.24**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**348.65**	**$0.00**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Union,NJ

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Jersey					
	Union	124,969	7,946	3,861	11,808
Total State		**124,969**	**7,946**	**3,861**	**11,808**
Total Region		**124,969**	**7,946**	**3,861**	**11,808**

Hazus-MH: Earthquake Event Report

Region Name: Elizabeth_FHE

Earthquake Scenario: Probabilistic-500yr-Mag5

Print Date: April 16, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12.43 square miles and contains 26 census tracts. There are over 41 thousand households in the region which has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 (millions of dollars). Approximately 95.00 % of the buildings (and 67.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 3,845 and 158 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 19 thousand buildings in the region which have an aggregate total replacement value of 11,808 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 73% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds. There are 41 schools, 7 fire stations, 4 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 17 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 4,003.00 (millions of dollars). This inventory includes over 60 kilometers of highways, 114 bridges, 9,495 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	114	3,235.60
	Segments	65	460.10
	Tunnels	0	0.00
		Subtotal	**3,695.70**
Railways	Bridges	6	1.20
	Facilities	9	24.00
	Segments	51	42.20
	Tunnels	0	0.00
		Subtotal	**67.30**
Light Rail	Bridges	0	0.00
	Facilities	2	5.30
	Segments	3	6.90
	Tunnels	0	0.00
		Subtotal	**12.20**
Bus	Facilities	3	3.90
		Subtotal	**3.90**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	14	28.00
		Subtotal	**28.00**
Airport	Facilities	0	0.00
	Runways	1	38.00
		Subtotal	**38.00**
		Total	**3,845.10**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	95.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**95.00**
Waste Water	Distribution Lines	NA	57.00
	Facilities	2	158.50
	Pipelines	0	0.00
		Subtotal	**215.50**
Natural Gas	Distribution Lines	NA	38.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**38.00**
Oil Systems	Facilities	2	0.20
	Pipelines	0	0.00
		Subtotal	**0.20**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**348.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Probabilistic-500yr-Mag5
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (Km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Hazus estimates that about 113 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 1 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	667	3.50	21	5.73	7	6.84	1	7.15	0	4.58
Education	9	0.05	0	0.07	0	0.08	0	0.08	0	0.06
Government	29	0.15	1	0.21	0	0.24	0	0.23	0	0.13
Industrial	121	0.64	3	0.93	1	1.09	0	1.06	0	0.57
Other Residential	9,431	49.52	207	56.86	63	63.04	8	63.44	1	62.06
Religion	60	0.32	2	0.50	1	0.66	0	0.74	0	0.68
Single Family	8,726	45.82	130	35.69	28	28.05	3	27.31	0	31.91
Total	**19,044**		**364**		**100**		**12**		**1**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	14,024	73.64	140	38.46	12	11.58	0	0.00	0	0.00
Steel	703	3.69	15	4.03	4	4.10	0	2.52	0	0.00
Concrete	444	2.33	11	3.13	3	2.82	0	1.28	0	0.00
Precast	36	0.19	1	0.39	1	0.82	0	1.11	0	0.00
RM	937	4.92	21	5.83	10	9.85	1	9.58	0	0.00
URM	2,830	14.86	171	46.89	69	69.20	11	85.23	1	100.00
MH	71	0.37	5	1.27	2	1.62	0	0.27	0	0.00
Total	**19,044**		**364**		**100**		**12**		**1**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 886 hospital beds available for use. On the day of the earthquake, the model estimates that only 770 hospital beds (87.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 95.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	3	0	0	3
Schools	41	0	0	41
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	7	0	0	7

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	65	0	0	65	65
	Bridges	114	0	0	114	114
	Tunnels	0	0	0	0	0
Railways	Segments	51	0	0	51	51
	Bridges	6	0	0	6	6
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
Light Rail	Segments	3	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Bus	Facilities	3	0	0	3	3
Ferry	Facilities	0	0	0	0	0
Port	Facilities	14	0	0	14	14
Airport	Facilities	0	0	0	0	0
	Runways	1	0	0	1	1

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	2	0	0	2	2
Natural Gas	0	0	0	0	0
Oil Systems	2	0	0	2	2
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,748	3	1
Waste Water	2,849	2	1
Natural Gas	1,899	1	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	41,596	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.01 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 75.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 320 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 28 households to be displaced due to the earthquake. Of these, 25 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	5	1	0	0
	Single Family	1	0	0	0
	Total	**6**	**1**	**0**	**0**
2 PM	Commercial	3	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	0	0	0	0
	Total	**6**	**1**	**0**	**0**
5 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	2	0	0	0
	Single Family	0	0	0	0
	Total	**5**	**1**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 23.30 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 19.71 (millions of dollars); 21 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 54 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.07	0.59	0.02	0.04	0.72
	Capital-Related	0.00	0.03	0.47	0.01	0.01	0.52
	Rental	0.04	0.77	0.47	0.01	0.01	1.30
	Relocation	0.14	0.56	0.64	0.06	0.12	1.52
	Subtotal	**0.18**	**1.42**	**2.17**	**0.11**	**0.18**	**4.06**
Capital Stock Losses							
	Structural	0.36	1.41	1.24	0.24	0.17	3.42
	Non_Structural	1.01	4.94	2.19	0.61	0.36	9.12
	Content	0.28	1.08	1.09	0.41	0.16	3.02
	Inventory	0.00	0.00	0.03	0.06	0.00	0.09
	Subtotal	**1.65**	**7.43**	**4.55**	**1.32**	**0.69**	**15.65**
	Total	**1.83**	**8.85**	**6.72**	**1.43**	**0.88**	**19.71**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	460.10	$0.00	0.00
	Bridges	3,235.63	$0.28	0.01
	Tunnels	0.00	$0.00	0.00
	Subtotal	**3695.70**	**0.30**	
Railways	Segments	42.19	$0.00	0.00
	Bridges	1.18	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	23.97	$0.85	3.56
	Subtotal	**67.30**	**0.90**	
Light Rail	Segments	6.86	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	5.33	$0.19	3.59
	Subtotal	**12.20**	**0.20**	
Bus	Facilities	3.89	$0.14	3.58
	Subtotal	**3.90**	**0.10**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	27.96	$1.00	3.58
	Subtotal	**28.00**	**1.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	37.96	$0.00	0.00
	Subtotal	**38.00**	**0.00**	
	Total	**3845.10**	**2.50**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	95.00	$0.02	0.02
	Subtotal	**94.95**	**$0.02**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	158.50	$1.10	0.69
	Distribution Lines	57.00	$0.01	0.02
	Subtotal	**215.48**	**$1.11**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	38.00	$0.00	0.01
	Subtotal	**37.98**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.20	$0.00	0.67
	Subtotal	**0.24**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**348.65**	**$1.13**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS	Total	%

Appendix A: County Listing for the Region

Union,NJ

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
New Jersey					
	Union	124,969	7,946	3,861	11,808
Total State		**124,969**	**7,946**	**3,861**	**11,808**
Total Region		**124,969**	**7,946**	**3,861**	**11,808**

Appendix E
HAZUS: Riverine/Coastal Flood Event Report

Hazus-MH: Flood Event Report

Region Name: Elizabeth_F_CoastalRiverine

Flood Scenario: ElizabethRiverineCoastal100yr

Print Date: Monday, April 27, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12 square miles and contains 1,003 census blocks. The region contains over 42 thousand households and has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 19,522 buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95.27% of the buildings (and 67.30% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2010 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religion	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,032,482	53.6%
Commercial	1,263,420	33.3%
Industrial	365,319	9.6%
Agricultural	1,747	0.0%
Religion	51,564	1.4%
Government	33,288	0.9%
Education	43,603	1.2%
Total	**3,791,423**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds.
There are 41 schools, 7 fire stations, 4 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Elizabeth_F_CoastalRiverine
Scenario Name:	ElizabethRiverineCoastal100yr
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 43 buildings will be at least moderately damaged. This is over 4% of the total number of buildings in the scenario. There are an estimated 2 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	4	10.00	10	25.00	11	27.50	13	32.50	2	5.00
Total	**0**		**7**		**10**		**11**		**13**		**2**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	1	33.33	0	0.00	1	33.33	1	33.33	0	0.00
Steel	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	3	8.11	10	27.03	10	27.03	12	32.43	2	5.41

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 886 hospital beds available for use. On the day of the scenario flood event, the model estimates that 886 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	7	2	0	2
Hospitals	3	0	0	0
Police Stations	4	0	0	0
Schools	41	1	0	1

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3,360 tons of debris will be generated. Of the total amount, Finishes comprises 99% of the total, Structure comprises 1% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 134 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,182 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5,895 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 213.23 million dollars, which represents 5.62 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 211.89 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 31.63% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	39.08	25.15	7.22	2.88	74.33
	Content	28.29	68.95	20.97	15.63	133.83
	Inventory	0.00	1.76	1.97	0.00	3.73
	Subtotal	**67.37**	**95.86**	**30.15**	**18.51**	**211.89**
Business Interruption						
	Income	0.01	0.30	0.00	0.02	0.33
	Relocation	0.02	0.11	0.00	0.02	0.14
	Rental Income	0.04	0.07	0.00	0.00	0.11
	Wage	0.02	0.32	0.00	0.42	0.76
	Subtotal	**0.07**	**0.80**	**0.01**	**0.46**	**1.34**
ALL	**Total**	**67.45**	**96.66**	**30.16**	**18.97**	**213.23**

Appendix A: County Listing for the Region

New Jersey

- Union

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
New Jersey				
Union	124,969	7,946,754	3,861,385	11,808,139
Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**
Total Study Region	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**

Hazus-MH: Flood Event Report

Region Name: Elizabeth_F_CoastalRiverine

Flood Scenario: ElizabethRiverineCoastal500yr

Print Date: Monday, April 27, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12 square miles and contains 1,003 census blocks. The region contains over 42 thousand households and has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 19,522 buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95.27% of the buildings (and 67.30% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2010 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religion	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,097,339	52.3%
Commercial	1,332,647	33.2%
Industrial	428,925	10.7%
Agricultural	1,802	0.0%
Religion	71,856	1.8%
Government	34,784	0.9%
Education	43,441	1.1%
Total	**4,010,794**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds.
There are 41 schools, 7 fire stations, 4 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Elizabeth_F_CoastalRiverine
Scenario Name:	ElizabethRiverineCoastal500yr
Return Period Analyzed:	500
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 83 buildings will be at least moderately damaged. This is over 7% of the total number of buildings in the scenario. There are an estimated 5 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	1	11.11	8	88.89	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	10	13.70	26	35.62	14	19.18	18	24.66	5	6.85
Total	**1**		**20**		**26**		**14**		**18**		**5**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	1	12.50	5	62.50	1	12.50	1	12.50	0	0.00
Steel	1	14.29	6	85.71	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	8	12.90	20	32.26	13	20.97	16	25.81	5	8.06

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 886 hospital beds available for use. On the day of the scenario flood event, the model estimates that 886 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	7	2	0	2
Hospitals	3	0	0	0
Police Stations	4	0	0	0
Schools	41	1	0	1

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 5,190 tons of debris will be generated. Of the total amount, Finishes comprises 91% of the total, Structure comprises 7% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 208 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,878 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 7,977 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 323.48 million dollars, which represents 8.07 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 321.10 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 28.20% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	53.22	44.97	10.91	3.85	112.95
	Content	37.91	112.25	31.79	20.45	202.40
	Inventory	0.00	2.81	2.94	0.00	5.75
	Subtotal	**91.13**	**160.03**	**45.64**	**24.31**	**321.10**
Business Interruption						
	Income	0.01	0.71	0.00	0.03	0.75
	Relocation	0.03	0.24	0.01	0.02	0.29
	Rental Income	0.05	0.17	0.00	0.00	0.22
	Wage	0.02	0.57	0.00	0.53	1.13
	Subtotal	**0.10**	**1.69**	**0.01**	**0.59**	**2.39**
ALL	**Total**	**91.22**	**161.72**	**45.65**	**24.89**	**323.48**

Appendix A: County Listing for the Region

New Jersey

- Union

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
New Jersey				
Union	124,969	7,946,754	3,861,385	11,808,139
Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**
Total Study Region	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**

Appendix F
HAZUS: Hurricane (Wind) Event Report

Hazus-MH: Hurricane Event Report

Region Name: Elizabeth_FHE

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, April 16, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12.43 square miles and contains 26 census tracts. There are over 41 thousand households in the region and has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95% of the buildings (and 67% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religious	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds. There are 41 schools, 7 fire stations, 4 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 12 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	691	99.28	5	0.68	0	0.04	0	0.00	0	0.00
Education	9	99.31	0	0.69	0	0.00	0	0.00	0	0.00
Government	30	99.27	0	0.73	0	0.00	0	0.00	0	0.00
Industrial	125	99.12	1	0.87	0	0.01	0	0.00	0	0.00
Religion	63	99.47	0	0.53	0	0.00	0	0.00	0	0.00
Residential	18,472	99.32	114	0.61	11	0.06	1	0.00	0	0.00
Total	**19,390**		**120**		**11**		**1**		**0**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	389	99.06	4	0.94	0	0.01	0	0.00	0	0.00
Masonry	3,765	98.32	56	1.45	8	0.21	1	0.01	0	0.00
MH	70	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	654	99.16	5	0.81	0	0.03	0	0.00	0	0.00
Wood	14,095	99.76	33	0.24	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 886 hospital beds available for use. On the day of the hurricane, the model estimates that 886 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	7	0	0	7
Hospitals	3	3	0	3
Police Stations	4	0	0	4
Schools	41	0	0	41

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1,686 tons of debris will be generated. Of the total amount, 110 tons (7%) is Other Tree Debris. Of the remaining 1,576 tons, Brick/Wood comprises 83% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 52 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 275 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 8.6 million dollars, which represents 0.07 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 9 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	6,829.17	437.49	139.45	67.37	7,473.48
	Content	677.52	0.00	0.00	0.00	677.52
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**7,506.69**	**437.49**	**139.45**	**67.37**	**8,151.00**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	177.66	8.13	0.04	0.01	185.83
	Rental	254.93	0.00	0.00	0.00	254.93
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**432.58**	**8.13**	**0.04**	**0.01**	**440.76**
Total						
	Total	**7,939.28**	**445.62**	**139.48**	**67.37**	**8,591.75**

Appendix A: County Listing for the Region

New Jersey

- Union

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
New Jersey				
Union	124,969	7,946,754	3,861,385	11,808,139
Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**
Study Region Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**

Hazus-MH: Hurricane Event Report

Region Name: Elizabeth_FHE

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Thursday, April 16, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- New Jersey

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 12.43 square miles and contains 26 census tracts. There are over 41 thousand households in the region and has a total population of 124,969 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 19 thousand buildings in the region with a total building replacement value (excluding contents) of 11,808 million dollars (2010 dollars). Approximately 95% of the buildings (and 67% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 19,522 buildings in the region which have an aggregate total replacement value of 11,808 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	7,946,754	67.3%
Commercial	2,692,590	22.8%
Industrial	754,202	6.4%
Agricultural	3,758	0.0%
Religious	202,432	1.7%
Government	55,870	0.5%
Education	152,533	1.3%
Total	**11,808,139**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 886 beds. There are 41 schools, 7 fire stations, 4 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 217 buildings will be at least moderately damaged. This is over 1% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	652	93.73	36	5.10	7	1.00	1	0.17	0	0.00
Education	9	95.06	0	4.60	0	0.33	0	0.00	0	0.00
Government	29	95.15	1	4.52	0	0.32	0	0.00	0	0.00
Industrial	117	93.13	7	5.70	1	0.91	0	0.24	0	0.01
Religion	60	94.87	3	4.85	0	0.27	0	0.00	0	0.00
Residential	17,132	92.12	1,259	6.77	201	1.08	6	0.03	0	0.00
Total	**17,998**		**1,307**		**209**		**7**		**0**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	368	93.73	22	5.69	2	0.57	0	0.01	0	0.00
Masonry	3,427	89.51	279	7.29	118	3.08	5	0.12	0	0.00
MH	70	99.79	0	0.17	0	0.04	0	0.00	0	0.00
Steel	620	93.87	33	4.95	7	1.01	1	0.17	0	0.00
Wood	13,184	93.31	911	6.45	34	0.24	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 886 hospital beds available for use. On the day of the hurricane, the model estimates that 886 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	7	0	0	7
Hospitals	3	3	0	3
Police Stations	4	0	0	4
Schools	41	0	0	38

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 12,026 tons of debris will be generated. Of the total amount, 442 tons (4%) is Other Tree Debris. Of the remaining 11,584 tons, Brick/Wood comprises 91% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 420 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,087 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 124,969) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 73.4 million dollars, which represents 0.62 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 73 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	53,881.96	4,297.03	1,393.44	471.43	60,043.86
	Content	4,984.46	830.83	613.39	32.20	6,460.88
	Inventory	0.00	29.36	86.52	0.35	116.23
	Subtotal	**58,866.42**	**5,157.22**	**2,093.35**	**503.98**	**66,620.96**
Business Interruption Loss						
	Income	0.00	428.46	12.14	33.61	474.21
	Relocation	2,400.06	530.98	46.58	31.69	3,009.31
	Rental	2,775.52	226.43	8.54	2.59	3,013.08
	Wage	0.00	220.75	17.29	84.32	322.37
	Subtotal	**5,175.57**	**1,406.62**	**84.55**	**152.22**	**6,818.96**
Total						
	Total	**64,041.99**	**6,563.84**	**2,177.90**	**656.20**	**73,439.93**

Appendix A: County Listing for the Region

New Jersey

- Union

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
New Jersey				
Union	124,969	7,946,754	3,861,385	11,808,139
Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**
Study Region Total	**124,969**	**7,946,754**	**3,861,385**	**11,808,139**

Appendix G
Capability Assessment Worksheets

Name of Department:	
Description of Department Functions in Respect to Hazard Mitigation (e.g., flooding)	The fundamental objective of the Elizabeth Police Department in respect to hazard mitigation is to protect and serve the citizens of the community and ensuring a high quality of life. This is accomplished by ensuring continued access to all services i.e., police, medical, food, shelter, utilities, communications, etc., are still available, and that all avenues of ingress and egress are operable and accessible in order to carry out the aforementioned objectives.
Point of Contact	Name/Title: Deputy Chief Alexander Sofianakos Email:asofianakos@elizabethnj.org Phone:908 558-2022 Address:1 Police Plaza, Elizabeth, N.J. 07201 Website link to Department if available:
Effectiveness and/or function before, during and after a disaster event	The Elizabeth Police Department mitigates hazards with the coordination and partnership of FEMA and its programs, and also through working relationships with the County and State Emergency Management Offices.
Contribution to Loss Reduction Y/N (If Yes, please describe how or what contributes to Loss Reduction)	The City of Elizabeth through its engineering department has examined and addressed mitigation issues due to natural disasters, while the police department Emergency Management Division and Emergency Services Division have addressed human caused issues such as terrorism and the like.
Available Funding? Y/N (If Yes, please describe the types of funding available to Department)	The Elizabeth Police Department through the City of Elizabeth applies and receives grants and funding from FEMA.
Provides Technical Assistance to public and private sectors? Y/N (If yes, describe type of assistance)	The Elizabeth Police Department generates risk/vulnerability and mitigation/action data only for its own use. It does not participate or assist other bordering territories or agencies.
Mitigation Integration in existing Plans/Policies/ Documents? (If yes, describe	Police Emergency Management Manual and Engineering Department data.

type of integration)	
Mitigation Training (e.g., seminars/ conferences and internal training)	Internal training, seminars and conferences
NJOEM/FEMA Mitigation partnership/coordination? Y/N	Y
Funding Offered? Y/N (If yes, please provide description)	Y / FEMA
Hazards addressed by your organization (e.g. Multiple hazards, natural hazards, flooding, etc.)	Flooding, power failures, terrorism and other man caused disasters.
New capabilities? (e.g. responsibilities, programs, initiatives in near future) Y/N (If yes, please describe).	N

1. Description of Department Functions in Respect to Hazard Mitigation:

- The Department of Administration is responsible for the daily municipal operations of the City .This includes personnel, employee benefits and city-wide purchasing. The Business Administrator oversees the Directors of each City Department and meets twice a month to discuss programs and activities occurring throughout the municipality. The Business Administrator also responds to requests for information from City Council as they pertain to initiatives, opportunities and projects submitted for consideration and approval.

- According to the Emergency Operations Plan (EOP), the Division of Purchasing located in the Department of Administration is tasked with the development and operation of a viable resource management program during any emergency or disaster situation. This effort is to ensure completion of required emergency actions.

- According to the EOP, the City of Elizabeth routinely maintains a stock of the following items: generators, blankets, cots, medical supplies, construction supplies and equipment, printing and sign-making supplies, automobiles and larger vehicles, self contained breathing apparatus and oxygen.

- Resource Management empowers the Police Department, Fire Department, Department of Public Works and various other departments involved in an emergency to make necessary emergency purchases on a 24-hour basis.

- The Resource Management representative will be the Purchasing Agent, who reports to the Emergency Operations Committee during an emergency.

- Emergency purchases may be specifically authorized when a situation affects the public health, safety or welfare requiring the immediate delivery of the article or the performance of the service, provided that the awarding or making of such purchases, contracts or agreements are made in accordance with the guidelines outlined within the EOP.

2. Point of Contact:

Name/Title: Marie T. Krupinski, Assistant Business Administrator

E-mail: mkrupinski@elizabethnj.org

Phone: (908) 820-4277

Address: City Hall, 50 Winfield Scott Plaza, Elizabeth, NJ 07201

Website link to Department: www.elizabethnj.org

3. Effectiveness and/or function before/during and after a disaster event:

As indicated above, the Department of Administration contains the Division of Purchasing, which would act as the Resource Management Center during an event. The Business Administrator would remain in constant contact with all Department Directors and be provided with status updates in regard to activities and progress.

Name of Department:	
Description of Department Functions in Respect to Hazard Mitigation (e.g., flooding)	N/A , ETOWN SERVICES HANDLE SEWER AND STORM WATER
Point of Contact	Name/Title: CARLOS CARVALHO / SUPT. PUBLIC WORKS Email: CCARVALHO@ELIZABETHNJ.ORG Phone: 9088204173 Address: 400 ATLANTIC STREET Website link to Department if available:
Effectiveness and/or function before, during and after a disaster event	TEMPORARY ROAD CLOSURES SAFETY OF ROADWAY
Contribution to Loss Reduction Y/N (If Yes, please describe how or what contributes to Loss Reduction)	NO
Available Funding? Y/N (If Yes, please describe the types of funding available to Department)	N/A
Provides Technical Assistance to public and private sectors? Y/N (If yes, describe type of assistance)	NO
Mitigation Integration in existing Plans/Policies/ Documents? (If yes, describe	POLICY AND MITIGATION THROUGH ENGINEERING DEPT.

type of integration)	
Mitigation Training (e.g., seminars/ conferences and internal training)	NO
NJOEM/FEMA Mitigation partnership/coordination? Y/N	NO
Funding Offered? Y/N (If yes, please provide description)	N/A
Hazards addressed by your organization (e.g. Multiple hazards, natural hazards, flooding, etc.)	LIST AVAILABLE THROUGH ENGINEERING DEPT.
New capabilities? (e.g. responsibilities, programs, initiatives in near future) Y/N (If yes, please describe).	N/A

Appendix H
Preliminary FEMA/FIRM Maps (February 2015)

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2

UNION COUNTY, NEW JERSEY

(ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
BOROUGH OF FANWOOD	340463	CITY OF SUMMIT	340476
BOROUGH OF GARWOOD	340464	TOWN OF WESTFIELD	340478
BOROUGH OF KENILWORTH	340466	TOWNSHIP OF BERKELEY HEIGHTS	340459
BOROUGH OF MOUNTAINSIDE	340468	TOWNSHIP OF CLARK	345290
BOROUGH OF NEW PROVIDENCE	345306	TOWNSHIP OF CRANFORD	345291
BOROUGH OF ROSELLE	340472	TOWNSHIP OF HILLSIDE	340465
BOROUGH OF ROSELLE PARK	340473	TOWNSHIP OF SCOTCH PLAINS	340474
CITY OF ELIZABETH	345523	TOWNSHIP OF SPRINGFIELD	345321
CITY OF LINDEN	340467	TOWNSHIP OF UNION	340477
CITY OF PLAINFIELD	345312	TOWNSHIP OF WINFIELD[1]	340479
CITY OF RAHWAY	345314		

[1] No Special Flood Hazard Areas Identified

This Preliminary FIS report only includes revised Flood Profiles and Floodway Data tables. The unrevised Flood Profiles and Floodway Data tables will appear in the final FIS report.

REVISED: **PRELIMINARY FEBRUARY 3, 2015**

FLOOD INSURANCE STUDY NUMBER
34039CV001B
Version Number 2.2.2.2

FEMA

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 20, 2006

Revised Countywide FIS Date: [TBD] – to change Base Flood Elevations, Special Flood Hazard Areas and zone designations; to update the effects of wave actions, roads and road names; and to reflect revised shoreline and updated topographic information.

This Preliminary FIS report only includes revised Flood Profiles and Floodway Data tables. The unrevised Flood Profiles and Floodway Data tables will appear in the final FIS report.

ATTENTION: On FIRM panels 34039C0024G and 34039C035G the Elizabeth River levee and on FIRM panels 34039C0043G and 34039C0044G the Rahway River levee have not been demonstrated by the community or levee owner(s) to meet the requirements of Section 65.10 of the NFIP regulations in 44 CFR as it relates to the levee's capacity to provide 1-percent annual chance flood protection. The subject areas are identified on FIRM panels (with notes and bounding lines) and in the FIS report as potential areas of flood hazard data changes based on further review.

FEMA has updated the levee analysis and mapping procedures for non-accredited levees. Until such time as FEMA is able to initiate a new flood risk project to apply the new procedures, the flood hazard information on the aforementioned FIRM panel(s) that are affected by the Elizabeth River and Rahway River levees are being added as a snapshot of the prior previously effective information presented on the FIRMs and FIS reports dated September 20, 2006. As indicated above, it is expected that affected flood hazard data within the subject area could be significantly revised. This may result in

floodplain boundary changes, 1-percent annual chance flood elevation changes, and/or changes to flood hazard zone designations.

The effective FIRM panels (and the FIS report) will again be revised at a later date to update the flood hazard information associated with the Elizabeth River and Rahway River levees when FEMA is able to initiate and complete a new flood risk project to apply the new levee analysis and mapping procedures.

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Branch 10-34	Panel	09P
Branch 22	Panels	10P-12P
Branch 22-11	Panels	13P-14P
Branch Blue Brook	Panel	15P
Branch Green Brook	Panels	16P-17P
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College Branch	Panel	32P
Drainage Ditch	Panels	33P-34P
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Exhibit 2 – Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
UNION COUNTY, NEW JERSEY (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Union County, including: the Boroughs of Fanwood, Garwood, Kenilworth, Mountainside, New Providence, Roselle, and Roselle Park; the Cities of Elizabeth, Linden, Plainfield, Rahway, and Summit; the Town of Westfield; and the Townships of Berkeley Heights, Clark, Cranford, Hillside, Scotch Plains, Springfield, Union, and Winfield (hereinafter referred to collectively as Union County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Union County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations (CFR) at 44 CFR, 60. 3.

Please note that on the effective date of this FIS, the Township of Winfield has no Special Flood Hazard Areas (SFHAs) identified. This does not precluded future determinations of SFHAs that could be necessitated by changes conditions affecting the community (i.e. annexation of new lands) or the availability of new scientific or technical data about flood hazards.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

Please also note that FEMA has identified one or more levees in this jurisdiction that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44 CFR Part 65.10 of the NFIP regulations (44CFR65.10) as it relates to the levee's capacity to provide 1-percent annual chance flood protection. As such, temporary actions being taken until such time as FEMA is able to initiate a new flood risk project to apply new levee analysis and mapping

procedures. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The September 20, 2006, the countywide FIS was prepared to include all the incorporated communities within Union County into a single countywide FIS.

Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed precountywide FIS reports, is shown below.

Berkeley Heights, Township of: the hydrologic and hydraulic analyses for the original October 1977 FIS report and March 1, 1978, FIRM were prepared by Pfisterer, Tor, and Associates for the Federal Emergency Management Agency (FEMA), under Contract No. H-3737. That work was completed in November 1975.

In the February 19, 1992, FIS revision, a portion of Snyder Avenue Brook was revised to reflect updated hydraulic analyses performed by Dewberry and Davis for FEMA and to reflect updated topographic information. That work was completed in June 1990. In addition, new hydrologic and hydraulic analyses for a portion of Blue Brook were taken from the January 19, 2001, FIS for the Township of Scotch Plains.

In the January 6, 1999, FIS revision, the hydrologic and hydraulic analyses for Blue Brook and Green Brook were prepared by Leonard Jackson and Associates for FEMA, under Contract No. EMW-90-R-3127. That work was completed in March 1993.

In the November 21, 2001, FIS revision, the hydrologic and hydraulic analyses for the Passaic River were prepared by Leonard Jackson and Associates for FEMA, under

Contract No. EMN 96-C0-0026. That work was completed in November 1998.

Clark, Township of: the hydrologic and hydraulic analyses for the FIS report dated March 2, 1982, represented a revision of the original analyses by the U. S. Army Corps of Engineers (USACE), New York District, for FEMA. The updated version was prepared by the State of New Jersey, Department of Environmental Protection (NJDEP), Division of Water Resources under agreement with FEMA. That study, which was completed in January 1979, covered all significant flooding sources in the Township of Clark. The hydrologic and hydraulic analyses in the updated study were computed by Richard Browne Associates.

Cranford, Township of: the hydrologic and hydraulic analyses for the FIS report dated August 16, 1982, represented a revision of the original analyses by the USACE, New York District, for FEMA, under an Inter-Agency Agreement. The updated version was prepared by the NJDEP, Division of Water Resources, under agreement with FEMA. That study, which was completed in May 1979, covered all significant flooding sources in the Township of Cranford. The hydrologic and hydraulic analyses in the updated study were computed by Richard Browne Associates.

Elizabeth, City of: the hydrologic and hydraulic analyses for the FIS report dated November 1, 1985, represented a revision of the original analyses. The updated version was prepared by the RBA Group for FEMA, under Contract No. EMW-C-1195. That work was completed in November 1984.

Garwood, Borough of: the hydrologic and hydraulic analyses for the FIS report dated May 17, 1988, represented a revision of the original analyses prepared by Pfisterer, Tor and

Associates for FEMA, under Contract No. H-3737. In the revised study, the hydraulic analysis for Garwood Brook was performed by Dewberry and Davis based on data prepared by Keller and Kirkpatrick, Inc., for the Borough of Garwood. That work was completed in April 1987.

Hillside, Township of: the hydrologic and hydraulic analyses for the FIS report dated March 1979 were performed by the NJDEP, Division of Water Resources, for FEMA, formerly the Federal Insurance Administration (FIA), under Contract No. H-3855. That work, which covered all significant flooding sources affecting the Township of Hillside, was completed in November 1977.

Kenilworth, Borough of: the hydrologic and hydraulic analyses for the FIS report dated September 2, 1982, were prepared by the NJDEP, Division of Water Resources, for FEMA, under Contract No. S-90024. The hydrologic and hydraulic analyses were conducted by URS Corporation, Inc., under subcontract to the NJDEP. That work was completed in November 1980.

Linden, City of: for the original May 24, 1976, FIS report and November 24, 1976, FIRM, the hydrologic and hydraulic analyses for Morses Creek, Peach Orchard Brook, West Brook, Kings Creek, and the Arthur Kill-Rahway River tidal floodplain were prepared by the USACE, New York District, for FEMA, under Inter-Agency Agreement No. IAA-H- 19-74, Project Order Nos. 17, 18, and 23.

In the March 2, 1994, FIS revision, the hydrologic and hydraulic analyses for Peach Orchard Brook and West Brook were prepared by Leonard Jackson and Associates for FEMA, under Contract No. EMW- 90-3127. That work was completed in December 1991. Tidal flooding along

	Arthur Kill (including backwater effects on the Rahway River, Kings Creek, Piles Creek, Marshes Creek, and Morses Creek) was taken from the information used July 5, 1994, FIS for the City of New York City, New York.
Mountainside, Borough of:	the hydrologic and hydraulic analyses for the FIS report dated August 1976 were performed by Pfisterer, Tor and Associates for FEMA, formerly the FIA, under Contract No. H-3737.
New Providence, Borough of:	for the November 23, 1973, FIRM, the hydrologic and hydraulic analyses were prepared by the Soil Conservation Service (SCS) for FEMA, under Inter-Agency Agreement No. IAA-H-16-72, Project Order No. 10. That work was completed in November 1971. For the May 16, 1994, FIS revision, the hydrologic and hydraulic analyses for the Passaic River, Salt Brook, and West Branch of Salt Brook were prepared by the NJDEP. That work was completed in September 1982. For the December 20, 2001, FIS revision, the hydrologic and hydraulic analyses for the Passaic River was prepared by Leonard Jackson and Associates for FEMA, under Contract No. EMN-96-C0-0026. That work was completed in November 1998.
Plainfield, City of:	the hydrologic and hydraulic analyses for the FIS report dated January 18, 1983, represented a revision of the original analyses by the U.S. Geological Survey (USGS), for FEMA, under Inter-Agency Agreement No. IAA-H- 19-71. The updated version was prepared by the NJDEP, Division of Water Resources, under Contract No. H-4623. The hydrologic and hydraulic analyses in the updated study were prepared by URS Corporation, Inc.,

subcontractors to the State of New Jersey under Contract No. S-90024, Project "Y". That work was completed in November 1980, and covered all significant flooding sources in the City of Plainfield.

Rahway, City of: the hydrologic and hydraulic analyses in the February 2, 1982, FIS and August 2, 1982, FIRM represented a revision of the original analyses by the USACE, New York District, for FEMA. The updated version was prepared by the NJDEP, Division of Water Resources, under agreement with FEMA. That study was completed in January 1979. The hydrologic and hydraulic analyses in updated study were computed by Richard Browne Associates.

For the December 20, 2002, FIS revision, the hydrologic and hydraulic analyses were derived from the City of Linden, Union County, New Jersey, FIS, dated March 2, 1994.

Roselle, Borough of: the hydrologic and hydraulic analyses for the FIS report dated January 1978, were performed by Pfisterer, Tor and Associates for FEMA, formerly the FIA, under Contract No. H-3737. That work was completed in February 1975, and covered all significant flooding sources affecting the Borough of Roselle.

Scotch Plains, Township of: in the original September 30, 1977, FIS report, the hydrologic and hydraulic analyses were prepared by Anderson-Nichols and Co. Inc., for FEMA, formerly the FIA, under Contract No. H-3715. That work was completed in April 1976.

For the January 19, 2001, FIS revision, the hydrologic and hydraulic analyses for Green and Blue Brooks were prepared by Leonard Jackson and Associates for FEMA, under Contract No. EMW- 90-R-3127. That work was completed in March 1993. Further

revisions were made to the hydraulic analyses for Green and Blue Brooks by Leonard Jackson and Associates, that work was completed in March 2000.

Springfield, Township of: the hydrologic and hydraulic analyses for the FIS report dated February 2, 1982, represented a revision of the original analyses by the USACE, New York District, for FEMA. The updated revision was prepared by the NJDEP, Division of Water Resources, under agreement with FEMA. That study, which was completed in May 1979, covered all significant flooding sources in the Township of Springfield. The hydrologic and hydraulic analyses in the updated study were computed by Richard Browne Associates.

Summit, City of: for the original August 1976 FIS report and February 2, 1977, FIRM, the hydrologic and hydraulic analyses were prepared by the USGS, Water Resources Division, Trenton, New Jersey, for FEMA, formerly the FIA, under Inter-Agency Agreement No. IAA-H-20- 74, Project Order No. 16. That work was completed on July 7, 1975.

For the May 2, 2002, FIS revision, the hydrologic and hydraulic analyses for the Passaic River was prepared by Leonard Jackson and Associates for FEMA, under Contract No. EMN-96-C0-0026. That work was completed in November 1998.

Union, Township of: the hydrologic and hydraulic analyses for the FIS report dated February 1978, were performed by Pfister, Tor and Associates for FEMA, formerly the FIA, under Contract No. H-3737. That work was completed in November 1975, and covered all significant flooding sources affecting the community.

Westfield, Town of: the hydrologic and hydraulic analyses for the FIS report dated June 1979, were performed by the NJDEP, for FEMA,

formerly the FIA, under Contract No. H-385.5. That work was completed in November 1977, and covered all significant flooding sources affecting the community.

The authority and acknowledgments for the Borough of Fanwood and the Township of Winfield are not available because no community-based FIS reports were ever published for these communities.

For September 20, 2006, FIS, revised hydrologic and hydraulic analyses for the Rahway River were conducted by Dewberry and Davis, LLC under Contract No. EMW-2000-C0-0003. That work was completed in March 2006. In addition, updated hydraulic information for the Elizabeth River in the Township of Hillside, developed by the USACE, New York District, was incorporated into that study.

For the September 20, 2006, FIS, the digital base map files used in the revision were obtained from the Union County Bureau of Geographic Information Systems (GIS), and were produced at a scale of 1"=100' from photography dated 1999 or later.

For the [TBD], FIS revision, coastal storm surge elevations were updated and revised within the states of New York and New Jersey for the Atlantic Ocean, including Newark Bay and Arthur Kill. The study replaces outdated coastal analysis, for approximately 7.5 miles of coastline in Union County, as well as previously published storm surge stillwater elevations for all FIS Reports in the study area, including Union County, New Jersey, and serves as the basis for updated FIRMs. The coastal study for the New Jersey Atlantic Ocean coast and New York City coast was conducted for FEMA by the Risk Assessment, Mapping, and Planning Partners (RAMPP) under contract HSFEHQ-09-D-0369 task order HSFE02-09-J-0001. This work was completed in December 2012.

In addition for the [TBD], FIS revision, RAMPP performed approximately 3.9 miles of detailed hydraulic analyses along the Elizabeth River in the City of Elizabeth. Also, Flood Profiles for the streams falling on revised panels, 34039C0014G, 34039C0015G, 34039C0023G, 34039C0024G, 34039C0025G, 34039C0026G, 34039C0033G, 34039C0034G, 34039C0035G, 34039C0036G, 34039C0043G, 34039C0044G, 34039C0045G, 34039C0046G, 34039C0047G, and 34039C0048G, were updated to the North American Vertical Datum of 1988 (NAVD88). The new detailed analyses along the Elizabeth River and the Flood Profile update were conducted for FEMA under contract HSFEHQ-09-D-0369 task order HSFE02-09-J-0001. This work was completed in December 2014.

For the [TBD], FIS revision, the basemap files were provided in digital format by the State of New Jersey Office of Information Technology. This information was derived from digital orthophotos produced at a scale of 1:24,000 with a 1-foot

pixel resolution from photography dated 2012.

The digital FIRM was produced in New Jersey State Plane projection, FIPZONE 2900. The horizontal datum used was North American Datum of 1983 (NAD 83), GRS80 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the New Jersey State Plane projection, NAD 83. Differences in the datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held prior to the September 20, 2006, FIS for all jurisdictions within Union County are shown in Table 1, "Initial and Final Precountywide CCO Meetings."

Table 1 – Initial and Final Precountywide CCO Meetings

Community Name	Initial CCO Date	Final CCO Date
Berkeley Heights, Township of	*	June 16, 2000
Clark, Township of	November 16, 1976	November 2, 1981
Cranford, Township of	November 16, 1976	October 27, 1981
Elizabeth, City of	April 12, 1983	April 24, 1985
Garwood, Borough of	*	April 1, 1975
Hillside, Township of	*	September 5, 1978
Kenilworth, Borough of	*	April 13, 1982
Linden, City of	*	November 30, 1992
Mountainside, Borough of	November 19, 1974	August 19, 1975
New Providence, Borough of	*	May 30, 2000
Plainfield, City of	*	July 22, 1982
Rahway, City of	*	November 28, 2001
Roselle, Borough of	*	June 30, 1975
Roselle Park, Borough of	*	*
Scotch Plains, Township of	*	*

*Data not available

Table 1 – Initial and Final Precontywide CCO Meetings – continued

Community Name	Initial CCO Date	Final CCO Date
Springfield, Township of	November 9, 1979	August 10, 1981
Summit, City of	*	June 6, 2000
Union, Township of	May 9, 1975	February 3, 1976
Westfield, Town of	May 5, 1975	November 18, 1978

*Data not available

There are no precountywide initial and final CCO meeting dates for the Borough of Fanwood and the Township of Winfield because no community-based FIS reports were ever published for these communities.

For the September 20, 2006, FIS, final CCO meetings were held April 21, 2004, and April 23, 2004. These meetings were attended by representatives from the Boroughs of Fanwood, Kenilworth, New Providence; Cities of Elizabeth, Linden, Plainfield, Rahway, and Summit; Town of Westfield; Townships of Berkeley Heights, Clark, Cranford, Hillside, Springfield; Union County, the State of New Jersey, FEMA, and the study contractor.

The results of the [TBD] FIS revision, were reviewed at the final CCO meeting held on [TBD date], and attended by representatives of [insert attendee list]. All of the concerns and/or issues raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the entire geographic area of Union County, New Jersey.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

Table 2 – Flooding Sources Studied by Detailed Methods

Arthur Kill	Morses Creek
Black Brook	Newark Bay
Blue Brook	Nomahegan Brook
Branch 1, Nomahegan Brook	Nomahegan Brook – Echo Lake
Branch 3, Nomahegan Brook	Orchard Creek
Branch 7, Nomahegan Brook	Passaic River
Branch 10-24	Peach Orchard Brook
Branch 10-30-1	Piles Creek
Branch 10-34	Pumpkin Patch Brook
Branch 22	Rahway River
Branch 22-11	Robinsons Branch

Table 2 – Flooding Sources Studied by Detailed Methods – continued

Branch Blue Brook	Robinsons Branch 15
Branch Green Brook	Robinsons Branch 15-1
Branch West Brook	Robinsons Branch 15-2
Bryant Brook	Salt Brook
Bryant Brook Branch	Snyder Avenue Brook
Cedar Brook	South Branch Rahway River
College Branch	Southwest Branch
Drainage Ditch	Stream 10-30
East Branch Rahway River	Sub-Branch, Branch 2, Nomahegan Brook
East Branch Green Brook	Tributary A
Elizabeth River	Tributary B
Gallows Hill Road Branch	Tributary C
Garwood Brook	Trotter Lane Branch
Green Brook	Van Winkles Branch
Irvington Branch	Vauxhall Branch
Jouet Brook	Vauxhall Subbranch
Kings Creek	West Branch
Lehigh Valley Branch	West Branch of Salt Brook
Lightning Brook	West Branch West Brook
Maplewood Branch	West Brook
Macro Creek Tributary 9-1-7-1	Winans Creek
Marshes Creek	Winding Brook

For the September 20, 2006, FIS, the Rahway River was restudied by detailed methods.

For the [TBD], FIS revision, Table 3, "[TBD], Scope of Revision" describes the limits of the updated analysis for the Elizabeth River. Flood Profiles (Exhibit 1) for the streams on the revised FIRM panels, 34039C0014G, 34039C0015G, 34039C0023G, 34039C0024G, 34039C0025G, 34039C0026G, 34039C0033G, 34039C0034G, 34039C0035G, 34039C0036G, 34039C0043G, 34039C0044G, 34039C0045G, 34039C0046G, 34039C0047G, and 34039C0048G were updated to NAVD88. All other profiles will be converted to NAVD88 in an upcoming issuance of the FIS.

Table 3 – [TBD], Scope of Revision

Stream Name	Limits of Revised or New Detailed Study
Elizabeth River	From the confluence with Arthur Kill to approximately 340 feet upstream of Trotter Lane

Riverine flooding sources throughout Union County have been studied by detailed methods at different times and prior to the September 20, 2006, FIS, often on a community-by-community basis. Table 4, "Model Dates for Riverine

Flooding Sources" represents the hydraulic modeling dates for the detailed study flooding sources in the county.

Table 4 – Model Dates for Riverine Flooding Sources

Stream Name	Community	Most Recent Model Date
Black Brook	Borough of Kenilworth	November 1982
	Township of Union	November 1975
Blue Brook	Township of Berkeley Heights	March 2000
	Borough of Mountainside	August 1976
	Township of Scotch Pines	March 2000
Branch 10-24	Township of Union	November 1975
Branch 10-30-1	Borough of Kenilworth	November 1980
Branch 10-34	Township of Union	November 1975
Branch 22	Township of Scotch Pines	March 1993
Branch 22-11	Township of Scotch Pines	March 1993
Branch Blue Brook	Township of Scotch Pines	March 1993
Branch Green Brook	Township of Berkeley Heights	March 2000
Branch 1, Nomahegan Brook	Borough of Mountainside	August 1976
Branch 2, Nomahegan Brook	Borough of Mountainside	August 1976
Branch 3, Nomahegan Brook	Borough of Mountainside	August 1976
Branch 7, Nomahegan Brook	Borough of Mountainside	August 1976
Branch West Brook	Borough of Roselle	February 1975
Bryant Brook	Township of Springfield	May 1979
Bryant Brook Branch	Township of Springfield	May 1979
Cedar Brook	City of Plainfield	November 1980
	Township of Berkeley Heights	March 2000
College Branch	Township of Cranford	May 1979
Drainage Ditch	Borough of Kenilworth	November 1980
	Township of Cranford	November 1980
	Township of Springfield	November 1980
	Township of Union	November 1980
East Branch Rahway River	Township of Union	December 1991
East Branch Green Brook	Township of Scotch Pines	March 1993
Elizabeth River	City of Elizabeth	December 2014
	Township of Hillside	November 1977
Gallow Hill Road Branch	Township of Cranford	November 1980
Garwood Brook	Township of Cranford	November 1980
	Borough of Garwood	April 1987
Green Brook	Township of Berkeley Heights	March 2000
	Township of Scotch Plains	March 1993
	City of Plainfied	November 1980
Irvington Branch	Township of Union	November 1980
Jouet Brook	Borough of Roselle	February 1975
Kings Creek	City of Linden	July 1994

Table 4 – Model Dates for Riverine Flooding Sources – continued

Stream Name	Community	Most Recent Model Date
Lehigh Valley Branch	Township of Union	November 1980
Lightning Brook	Township of Union	November 1980
Maplewood Branch	Township of Union	November 1980
Nomahegan Brook	Borough of Mountainside	August 1976
Nomahegan Brook – Echo Lake	Borough of Mountainside	August 1976
Orchard Creek	City of Rahway	December 1991
Passaic River	Township of Berkeley Heights	November 1998
	Borough of New Providence	November 1998
	City of Summit	November 1998
Peach Orchard Brook	City of Linden	December 1991
	Borough of Roselle	February 1975
Pumpkin Patch Brook	Township of Clark	January 1979
Rahway River	Its Entirety in Union County	September 2006
Robinsons Branch	Township of Clark	January 1979
	City of Rahway	
	Township of Scotch Plains	April 1976
Robinsons Branch 15	Town of Westfield	November 1977
Robinsons Branch 15-1	Town of Westfield	November 1977
Robinsons Branch 15-2	Town of Westfield	November 1977
Salt Brook	Borough of New Providence	September 1982
Snyder Avenue Brook	Township of Berkeley Heights	November 1998
South Branch Rahway River	City of Rahway	December 1991
Southwest Branch	Township of Union	November 1980
Stream 10-30	Borough of Kenilworth	November 1980
Sub-Branch, Branch 2, Nomahegan Brook	Borough of Mountainside	August 1976
Tributary A	Township of Scotch Plains	April 1976
Tributary B	Township of Scotch Plains	April 1976
Tributary C	Township of Scotch Plains	April 1976
Trotters Lane Branch	Township of Union	November 1980
Van Winkles Branch	Township of Springfield	May 1979
Vauxhaull Branch	Township of Union	November 1980
Vauxhaull Subbranch	Township of Union	November 1980
West Branch	Township of Union	November 1980
West Branch of Salt Brook	Borough of New Providence	September 1982
West Branch West Brook	Borough of Roselle	February 1975
West Brook	Township of Cranford	May 1979
	Borough of Kenilworth	November 1980
	City of Linden	December 1991
	Borough of Roselle	February 1975
Winding Brook	Township of Scotch Plains	April 1976

The following tabulation lists streams that have names in this countywide FIS other than those used in the previously printed pre-countywide FISs for the communities in which they are located:

Community	Old Name	New Name
Cranford, Township of	Orchard Street Branch	Garwood Brook
Westfield, Township	Tributary to Rahway River	Gallows Hill Road Branch
Union, Township of	East Branch	East Branch Rahway River
Rahway, City of	South Branch	South Branch Rahway River

The September 20, 2006, countywide FIS incorporated the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision – based on Fill [LOMR-F], and Letter of Map Amendement [LOMA]) as shown in the tabulation below.

Community	Flooding Source(s)/Project Identifier	Effective Date	Type
Berkeley Heights, Township of	Passaic River Tributaries	April 23,2003	LOMR
	Snyder Avenue Brook/ Berkeley Heights Convalescent Center	May 12, 2003	LOMR
Garwood, Borough of	Garwood Brook	May 12, 2003	LOMR
Kenilworth, Borough of	To correct road configuration	June 17, 1994	LOMR
	West Brook/Channelization & Detention Basin	April 3, 1996	LOMR
Linden, City of	Jouet Brook/Jouet Brook Flood Control Project	August 10, 1999	LOMR
	West Brook/West Brook Phase 3 Channel Improvements	August 10, 1999	LOMR
Roselle, Borough of	West Brook/Channelization & Detention Basin	April 2, 1996	LOMR
	Jouet Brook/Jouet Brook Flood Control Project	August 10, 1999	LOMR
	West Brook/West Brook Phase 3 Channel Improvements	August 10, 1999	LOMR
	Branch West Brook and West Branch West Brook	February 20, 2004	LOMR
Scotch Plains, Township of	Green Brook/The Reserve at Scotch Plains	December 12, 2003	LOMR
Union, Township of	Irvington Branch/Channel Improvements	August 10, 2000	LOMR

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Union County.

2.2 Community Description

Union County is located in northeastern New Jersey, centered approximately 20 miles southwest of New York City and is a part of the New York metropolitan area. There are 21 communities in Union County. The Boroughs of Mountainside and New Providence, the City of Summit, and the Townships of Berkeley Heights and Springfield are located in the northwest portion of the county. The Borough of Fanwood, the City of Plainfield, the Town of Westfield, and the Township of Scotch Plains are located in the southwestern section of the county. The Boroughs of Garwood, Kenilworth, Roselle, and Roselle Park, and the Townships of Cranford and Winfield comprise the central portion of the county. The northeastern part of the county consists of the Cities of Elizabeth and the Townships of Hillside and Union. The Cities of Linden and Rahway, and the Township of Clark make up the southeastern portion of Union County.

Union County is bordered to the east and northeast by the City of Bayonne, in Hudson County, New Jersey. To the north, the county is bordered by the following communities of Essex County: the City of Newark, the Town of Irvington, and the Townships of Maplewood and Millburn. To the northwest, the county is bordered by the following communities of Morris County: the Borough of Chatham, the City of Passaic, and the Township of Chatham. It is bordered to the southwest by communities of Somerset County: the Borough of Watchung, the City of North Plainfield, and the Townships of Green Brook and Warren. The following communities of Middlesex County border Union County to the south: the Boroughs of Carteret, Dunellen, Metuchen, and South Plainfield, and the Townships of Piscataway and Woodbridge. It is bordered to the east by Staten Island, in the City of New York, New York.

According to the United States (U.S.) Census Bureau, at the 2000 U.S. Census, the population was 522,541 in Union County (U.S. Census Bureau, 2010). At the 2010 U.S. Census the population was 536,499, an increase of 13,958 (2.7-percent) from the 2000 Census (U.S. Census Bureau, 2010). According to the 2010 U.S. Census, Union County had a population density of 4,955 people per square mile (water excluded) making it the 15th-most densely populated county in the U.S., and the third-densest in New Jersey, behind Hudson County and Essex County.

The topography of the county is generally flat to gently rolling, with elevations increasing gradually from east to west, marked by low parallel ridges generally running in a northeast direction. The Watchung Mountains, in the extreme western portion of the county, comprise the largest of these ridges. Elevations in Union County range from less than 10 feet in the marshes of the east, along Arthur Kill, to greater than 500 feet in the Watchung Mountains.

A very high percentage of the land in Union County has been developed. The county consists primarily of established residential communities with small, interspersed commercial and industrial zones. More intense commercial development exists in the eastern part of the county. The land along the eastern shoreline of the county is characterized by industrial development and port activity.

The climate of the county is mostly continental, due to the predominance of winds from the interior. The temperatures for the area average approximately 31 degrees Fahrenheit (°F) during the winter months and approximately 75°F in the summer months. The average rainfall is approximately 42 to 50 inches per year.

2.3 Principal Flood Problems

Flooding in Union County can occur during any season of the year, since New Jersey lies within the major storm tracks of North America. The worst storms, however, have occurred in late summer or early fall when tropical disturbances such as hurricanes are most prevalent.

For the [date] countywide FIS revision, special consideration was given to storms which caused damages to the area in recent years, including Hurricane Sandy in 2012 and Hurricane Irene in 2011 (FEMA, 2013).

Hurricane Sandy ("Superstorm Sandy") came ashore as an immense tropical storm in Brigantine, New Jersey, on October 29, 2012. On October 30, 2012, President Obama approved a Major Disaster Declaration (FEMA-4086-DR-NJ) for the State of New Jersey. Rainfall amounts associated with Hurricane Sandy in New Jersey were between 2 to 4 inches, while the storm produced almost a foot of rain in states to the south. A full moon made the high tides 20 percent higher than normal and amplified the storm surge. The New Jersey shore suffered the most damage, battered by 14-foot waves at the shoreline, while 32-foot waves were recorded at National Oceanic and Atmospheric Administration (NOAA) Buoy 44065, and wind gusts up to 88 miles per hour. Governor Chris Christy declared a state of emergency on October 31, 2013. The New Jersey shore suffered the most damage. Some barrier island communities suffered severe "wash over" including the creation of two temporary inlets. Seaside communities were damaged and destroyed along the coastline. Approximately 2.7 million

households had lost power. In Union County, residents coped with downed power lines, trees and flooding as Hurricane Sandy hit the area (Union County, 2012). In the Town of Westfield, dozens of homes were left uninhabitable in the wake of Hurricane Sandy (Mustac, 2012). In the Township of Cranford, local authorities reported major damage from wind and widespread power outages, however no flooding was reported within the entire Township (Rybolt, 2012). This is in sharp contrast to the Township of Cranford's experience during Hurricane Irene in August 2011 when there was significant flooding experienced.

Having earlier been downgraded to a tropical storm, Hurricane Irene came ashore at Little Egg Inlet in southern New Jersey; on August 28, 2011. In anticipation of the storm, Governor Chris Christy declared a state of emergency on August 25, 2011. Mandatory evacuations were ordered throughout the State of New Jersey. Wind Speeds were recorded at 75 mph and rain totals reached over 10 inches in many parts of the state. 1.46 million customers lost power during the storm. Overall damage estimates, for the State of New Jersey, came to over $1 billion dollars (in 2011 dollars); with over 200,000 homes and buildings being damaged.

In Union County, flooding impacts from Hurricane Irene amounted to $15 million in residential (392 homes) and businesses (30) losses; $560,000 spent in emergency response actions during the storm, followed by an additional $775,000 in restoration work (Mayors Council Rahway River Watershed Flood Control, Date Unknown). The Mayors Council Rahway River Watershed Flood Control reported it was estimated that there were $31.8 million worth of private insurance claims by homeowners in Union County due to Hurricane Irene. In the Township of Cranford over $4 million in damages to Brookside Avenue School and Cranford Highschool; the 1st floor of the Cranford Municipal Building was damaged and deemed unusable; 1600 homes were impacted with 300 first floors damaged with FEMA estimating homeowners losses at approximately $16.5 million. Over 70,000 tons of damaged household debris was removed from the Township of Cranford and there were significant safety and public works expenses to manage the storm and its aftermath.

In the City of Rahway, Hurricane Irene cost almost $700,000 of municipal public safety and public works expense to response to the storm and left homes severely damaged, including several with serious foundation problems, heavily damaged commercial properties and the church on West Grande damaged (Mayors Council Rahway River Watershed Flood Control, Date Unknown).

In the Township of Springfield over 80 homes had severe flooding with damages estimated at $8 million; 70 homes and 40 businesses has basement flooding with damages estimated at $2.3 million; and the township spent over $400,000 in public safety and public works costs (Mayors Council Rahway River Watershed Flood Control, Date Unknown).

The main stem of the Rahway River conveys storm water runoff from an area of

25 square miles as it cross U. S. Route 22 in the Township of Springfield and has a total drainage area of 41 square miles before it discharges into Arthur Kill in the Carteret. Increased storm water runoff due to construction of impervious areas has strained the limited capacity of stream channels and man-made restrictions, including bridges, resulting in floodwaters leaving the channels of the river and its branches and inundating signification developed areas of Millburn, Union, Springfield, Kenilworth, Cranford and Rahway and to a lesser degree in other municipalities (Mayors Council Rahway River Watershed Flood Control, Date Unknown).

Prior to the September 20, 2006, FIS the most serious and widespread flooding in the county occurred in August 1971, as a result of tropical storm Doria. Other major floods of record occurred in September 1960, September 1966, May 1968, August 1973, July 1975, and September 1999.

Township of Berkeley Heights

In the Township of Berkeley Heights, the Passaic River flows along the northern corporate limits in a relatively flat valley. Although the channel is well defined for low and normal flows, the stream floods the adjacent plain during high stages, and flooding becomes especially widespread at the junction points with the four tributaries in the township area. The Passaic River tributaries run in narrow channels, and overbank flooding is common at medium- to low-frequency flood flows because backwater from the Passaic River tends to build up sediment in the downstream portions of the tributaries. The upper reaches of these tributaries are appreciably sloped because they are located on the steeper portions of the Second Watchung Mountain ground slope. These steep slopes reduce the time of concentration of storm waters during severe storms and increase the discharge volumes expected during storms.

The Green Brook segment south of Horseshoe Road to Plainfield Avenue has flooded in the past and has caused property damage. Another area subject to flooding extends from Oak Way to Valley Road.

Blue Brook itself is well channelized up to where it crosses Valley Road, at which point it enters a broader-bottomed valley. Branch Blue Brook is very steeply sloped and causes flooding at its confluence with the main channel. Part of the flooding is caused by an inadequate culvert (Elson T. Killam Associates, 1971).

Township of Clark

Areas in the Township of Clark periodically inundated, as a result of heavy rainfall, lie primarily along Robinsons Branch upstream of the Middlesex Reservoir and along Pumpkin Patch Brook. Robinsons Branch and the Rahway River affect a large number of communities in Union County. Stream flows on both the Rahway River and Robinsons Branch are gaged. The Rahway River has

a gage upstream of St. Georges Avenue in the City of Rahway (USGS gage No. 01395000) at which a systematic record has been kept since 1922. There is also a gage located at U.S. Route 22 in Springfield, New Jersey, (USGS gage No. 01394500) that has been operating since 1938. The gage on Robinsons Branch is located at Milton Lake in Rahway (USGS gage No. 01396000) and has been in operation since 1940.

The September 1999 storm was the most severe on record at the time along the Rahway River with the peak discharge reaching 5,590 cubic feet per second (cfs), the equivalent to a 60-year recurrence interval flood. On Robinsons Branch, the September 1999 storm was more severe than the 1975 storm. The peak discharge was 4,800 cfs.

Township of Cranford

In the Township of Cranford, the Rahway River, Garwood Branch and Gallows Hill Road Branch have caused flooding. The Riverside Drive and Balmiere Parkway areas are the most seriously flooded areas in the Township of Cranford. The Union County Park Commission dike along Riverside Drive has been overtopped many times in recent memory, with flood waters nearly 7 feet deep recorded along Riverside Drive.

Cranford Engineering Department records show that during the August 1973 flood, 350 acres of the township were flooded and approximately 450 homes were damaged by floodwaters.

The City of Elizabeth

The City of Elizabeth has experienced flooding from riverine flows in the Elizabeth River and from tidal flooding along Newark Bay and Arthur Kill. The most severe floods to affect the area were tidal floods associated with hurricanes. During Hurricane Donna on September 12, 1960, the water level at East Newark (applicable to Newark Bay) reached 8.4 feet at high tide, a level of 5.5 feet above the normal high tide.

Areas along the Elizabeth River which show approximate 1-percent annual chance flooding on the landward side of the levee between the New Jersey Turnpike and Bridge Street are not caused by overtopping of the levee. It is interior drainage areas which flood as a result of the levee system interior drainage system.

Township of Hillside

The Township of Hillside has experienced flooding problems along the East Branch Rahway River. Flooding along the East Branch Rahway River is caused by an inadequate culvert and the inability of the main stream to carry the

floodwaters. The stream's hydraulic inadequacy creates a backwater which inundates the 6-foot by 16-foot culvert along Central Avenue. During the August 1971 storm, heavy damage occurred along Central, Long, Silver, Boston, Baltimore, and St. Louis Avenues and along Baker, State, South State, and Acme Streets.

Borough of Kenilworth

The residential and industrial areas in the Borough of Kenilworth that border the Rahway River and its tributaries are all low-lying with respect to the channel bottoms of the streams. As a result, during severe storms such as those experienced in 1971 and 1973, yards, roads, basements, and other residential and industrial structures sustained flooding. The floodplain was extremely wide, encompassing whole blocks in certain instances. Although the depth of the floodwater was minimal, it advanced due to the extremely flat terrain.

Past flooding caused by backwater from the Rahway River has been severe. On August 18, 1971, a high-water mark of 71.5 was recorded. As a result of the August 1973 storm, floodwaters from the Rahway River extended as far as Willshire Drive in the southwestern section of Kenilworth.

The flooding problem is aggravated by various factors. The stream channels are confined and undersized due to excessive floodplain development in the past. Also, most hydraulic structures are undersize and incapable of handling flows generated by large storms.

City of Linden

The City of Linden is subject to both tidal and fluvial flooding, although tidal wave velocities are dampened by the meanders of the stream channels. This tidal influence is less severe than the fluvial flooding along these waterways. The city is subject to fluvial flooding along Peach Orchard Brook, West Brook, and Kings Creek.

The fluvial floods are usually the result of coastal storms. The intense antecedent rainfall with the passage of tropical storm Doria caused widespread flooding in the central and northeastern communities of New Jersey. Flooding caused severe damage to dwellings and commercial establishments along Peach Orchard Brook and West Brook.

Borough of Mountainside

Flooding of considerable magnitude occurred in the Borough of Mountainside during tropical storm Doria in August 1971 and from a rainstorm on August 2 and 3, 1973. The latter caused considerable damage within Echo Lake Park when an abutment of the dam was breached, causing the collapse of two bridges on the

main channel of Nomahegan Brook and the collapse of a bridge on Branch 2. The water level of Echo Lake has remained low since that time as a result of this failure. There was extensive flooding outside the park area along Nomahegan Brook at New Providence Road and at Mountain Avenue. Other areas which were inundated were the culvert crossings of Branch 2 and 3 at U. S. Route 22 and areas along Charles Street where Branch 1 crosses into Springfield. There were several other locations that experienced local flooding due to inadequate storm sewer capacity and inadequate inlet capacity. In addition, some of the culverts crossing Nomahegan Brook and its branches were identified as being inadequate (Elson T. Killam Associates, Inc., 1971).

Although the volume of flow in Blue Brook was very high during the August 1973 rainstorm, very little damage occurred within the borough limits due to the undeveloped character of the Watchung Reservoir.

Borough of New Providence

In the Borough of New Providence, the Passaic River floods the low-lying areas along its banks. Salt Brook causes most of the borough's damage as water runs off quickly from the steep areas and inundates the low-lying flatter areas.

City of Plainfield

Within the City of Plainfield, most of the flooding problems which occur are a result of water which flows out of Green Brook in Scotch Plains and in the area of Leland Avenue in Plainfield and flows through the streets across the basin divide into Cedar Brook. This diversion leads to a condition where flood depths are deeper at a distance from the stream than they are in the immediate area. This occurs because after water tops the basin divide (roughly defined by East Front Street) it backs up behind the CONRAIL embankment which has only two openings (Richmond and Berkman Streets) leading to Cedar Brook. This results in a large floodplain throughout the northern portion of the city even though the majority of Green Brook flows are contained within and adjacent to its banks.

City of Rahway

Areas in the City of Rahway periodically inundated as a result of heavy rainfall lie along the Rahway River downstream of St. Georges Avenue, along Robinsons Branch downstream of Maple Avenue, and along the entire length of the South Branch Rahway River and Orchard Creek. Flooding along the Rahway River downstream of Monroe Street and along South Branch Rahway River downstream of East Inman Avenue is caused by both riverine and tidal flooding.

Borough of Roselle

The Borough of Roselle experienced considerable flooding during tropical storm

Doria in August 1971. Flooded areas included portions along West Brook, from St. Georges Avenue to Raritan Road; along Branch West Brook, north of the Staten Island Rapid Transit embankment; along Jouet Brook, from St. Georges Avenue to Grand Street; along Peach Orchard Brook, from St. Georges Avenue to Park Drive in Warinanco Park. There was also local flooding in the area of Branch West Brook, which is enclosed in pipe from Sixth Avenue to First Avenue. The widest point of this inundation centered at Third Avenue and Vine Street. Damage caused by tropical storm Doria included basement flooding; flooding of low-lying first floors of dwellings adjacent to West Brook, Jouet Brook, and Peach Orchard Brook; and damages to a light footbridge over the Branch West Brook.

Borough of Roselle Park

In the Borough of Roselle Park, the only major flood problems occur along Morses Creek during severe storms. A detention basin, box culverts, and riprap has been constructed for Morses Creek. Major floods have occurred on Morses Creek in 1968, 1971, 1973, and 1975. Frequencies are unavailable because no gages are located on this stream.

Township of Scotch Plains

The floodplains of the streams that run through the Township of Scotch Plains support much residential and commercial development, and structures on the floodplains have been damaged by floods in the past.

Flooding along Robinsons Branch-Rahway River is aggravated by low-lying stream banks and wide floodplains. The backwater effect of high water stages on Robinsons Branch-Rahway River causes much of the flooding along the lower reaches of Winding Brook and Branch 22.

On the north side of Scotch Plains, widespread flooding occurs along Green Brook, East Branch Green Brook, and Cedar Brook. During the 100-year flood, waters from Green Brook inundate Front Street in the vicinity of Terrill Road and Farley Avenue, and along Mountain Avenue at Park Street. These waters then overflow into the Cedar Brook watershed, flooding several streets. This overflow is in the form of water flowing down the streets to Cedar Brook, with an estimated depth of 6 inches during the base flood. During the 500-year flood, a similar overflow occurs along East Branch Green Brook on Mountain Avenue in the vicinity of Westfield Avenue and Mountainview Avenue.

Flood elevations along the lower portion of East Branch Green Brook are affected by the backwater from the main branch of Green Brook. Further upstream on East Branch Green Brook, much of the flooding that inundates U. S. Route 22 near Mountainview Avenue results from an inadequate 36-inch diameter pipe upstream of Mountainview Avenue.

On Cedar Brook, flooding in the Terrill Road area is aggravated by twin 72-inch diameter pipes which are inadequate to carry the flood flow.

Township of Springfield

Flooding in the Township of Springfield occurs along the Rahway River, the lower sections of Van Winkles Brook, and between Bryant Brook and Bryant Brook Branch.

City of Summit

In the City of Summit, the Passaic River is the major source of flooding. Major floods have occurred along the Passaic River in 1903, 1905, 1907, 1936, 1971, and 1973. The flood of August 1973 was the worst flood recorded at that time at the gaging station on the Passaic River in Chatham in 45 years; this flood had a peak discharge of 3,380 cfs. The banks of the Passaic River are relatively steep and cause the water-surface elevation to rise significantly during the periods of intense rainfall. Salt Brook and several other small tributaries to the Passaic River in the corporate area experience minor flooding.

Township of Union

One of the important features of the Township of Union that lessens damages during high and medium frequency flooding events is the fact that the overbank of the Rahway River is located in Union County parklands. As a consequence, very little flooding problems have been noted on the Township of Union side of the Rahway River downstream of Morris Avenue (New Jersey Route 82), although the Springfield bank has had extensive levees built to protect adjoining residential areas. The Morris Avenue bridge has been described as inadequate to pass medium-to-low frequency stream discharges, because it causes high stream stages upstream (Union County, New Jersey, Date Unknown).

Along the upstream reaches of the East Branch Rahway River, flooding has been frequently reported at the intersection of Valley Street and Springfield Avenue, and along parts of Franklin Street downstream of Vauxhall Road.

Flooding along the Vauxhall Branch has been reported in the open area between Carol Drive and Audrey Terrace. This high-water condition is caused by the backwater effects of Rahway River above Morris Avenue.

Further upstream on the Vauxhall Branch, frequent flooding has been caused mainly by inadequate channel and culvert capacities in the open stream section between Burnet Avenue and Vauxhall Road. The subbranch of the Vauxhall Branch north and upstream of I-78 has also contributed to the flooding problems experienced at the Springfield Avenue intersection with Valley Street, where the capacity of the relocated channel of this subbranch has proven to be inadequate

during severe rainstorms. This is caused mainly by the inadequate culvert capacity under the main roadway of I-78 and the adjoining access ramp.

Flooding along Branch 10-34 west of Springfield Road is caused by backwater effects of high stream stages in the main channel.

Flooding along the main channel of the Elizabeth River is also lessened by the fact that the Township of Union overbank is situated in Union County parklands. Areas frequently inundated in the past include the Trotters Lane bridge at the Township Line, and at the North Avenue bridge, which cuts through the Ursino Lake Detention Basin. Further upstream along the main channel, flooding during severe storms has affected residences along Roberts Street, and has caused local damage to residences downstream of Union Avenue.

Along Trotters Lane Branch, severe flooding has been reported on many occasions at Morris Avenue due to the inadequate capacity of the Trotters Lane storm sewer. Flooding in the upstream reaches of this stream has been lessened by the construction of a detention basin in the area west of Woodland Avenue; however, low-lying parts of the Keane College grounds were inundated during the flood of 1973 when the detention basin was not yet in operation.

The Lehigh Valley Branch has reported flooding due to backwater effects at its confluence with the main channel and at Morris and Huguenot Avenues upstream, due to inadequate culvert capacity.

The West Branch of the Elizabeth River has had reports of flooding in the vicinity of its confluence with the main stem up to Vauxhall Road. The upstream portions have had only isolated and local flooding reports during severe storm events.

Lightning Brook has been a source of severe local flooding. The main stem of the brook has had flooding reported at Stuyvesant Avenue. The Maplewood and Southwest Branches have flooded Morrison, Stecher, Bahmoral Avenues, and Tyler Street, due to inadequate culvert and channel capacity. The Irvington Branch has flooded Stuyvesant Avenue and properties along Myrtle Street upstream of I-78, which has inadequate culvert capacity. Ostwood Terrace has been severely inundated at the channel crossing, due to inadequate culvert capacity.

2.4 Flood Protection Measures

Within the this jurisdiction, there are one or more levees that have not been demonstrated by the communities or levee owner(s) to meet the requirements of 44 CFR Part 65.10 of the NFIP regulations as they relates to the levee's capacity to provide 1-percent-annual-chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

Communities enlist a variety of strategies to protect their residents from flood hazards, from structural measures to mitigation strategies and ordinances. FIS Report users are encouraged to visit the community's local website for the most recent information on flood protection measures.

Additionally there are groups and organizations active in Union County. For example, the Mayor's Council Rahway River Watershed Flood Control has published a Flood Risk Management Needs Statement outline flood protection measures needed in the Rahway River Watershed.

Prior to the September 20, 2006, FIS the flood protection measures identified are summarized below.

Township of Berkeley Heights

Within the Township of Berkeley Heights, the flooding problems along the main stream of the Passaic River have long been recognized and studied. Various proposals have been put forward to alleviate flooding during high stages in the stream reach adjacent to the Township of Berkeley Heights.

The Union County Park Commission has a program of land acquisition along the Passaic River which has had a beneficial impact on floodplain encroachment and flood drainage for adjacent improved properties.

The upper reaches of the four Passaic River tributaries are steeply sloped; recommendations have been made to place these fast-flowing reaches in piped sewers. Some of these recommendations have been carried out.

There are several bridges and culverts within the Township of Berkeley Heights that have been identified as being marginal or inadequate (NJDEP, 1974).

Township of Cranford

The Township of Cranford has put great effort into trying to alleviate flooding within the township. Funds were expended for engineering survey and feasibility studies for all streams in the Township of Cranford. As a result of these reports, the Rahway River was dredged to increase its flow capacity, the old Public Service Dam upstream of South Avenue was removed, and various dikes were extended and raised. Union County built a stormwater retention basin on the Rahway River in Lenape Park, located at the Cranford-Springfield corporate limits. This retention basin has increased the natural detention of the park through the use of a control structure located approximately 100 feet upstream of Kenilworth Boulevard, and the construction of dikes around the perimeter of the park. Two tributaries located in the Borough of Kenilworth which had previously discharged into the Rahway River now discharge into the Drainage Ditch, located outside the dikes on the northeastern corporate limits. The Drainage Ditch flows

into the Rahway River just below the retention basin.

Other flood protection measures include early warning telemetry equipment tied in to the USGS gage in Springfield. The equipment was placed in operation in December 1973 to enable township officials to monitor flows on a continuous basis during a major storm. Two pumps were acquired to drain the area behind the Riverside Drive Dike. Channel improvements have been made along the lower 5,400 feet of Gallows Hill Road Branch, and two stormwater retention basins have been constructed further upstream. One basin is located in the Fairview Cemetery in Westfield, and the other is located upstream of Brookside Place Road in Cranford. The stormwater retention basins and stream improvements provide protection for 100-year flooding along Gallows Hill Road Branch.

While there is no question that all of these improvements have had a beneficial effect on reducing flooding, wide-spread flooding during a 100-year storm can be expected because the Riverside Drive dikes will be overtopped and floodwaters will back up behind bridges. The Riverside Drive dikes would be overtopped by a flood with a 20-year recurrence interval.

City of Elizabeth

Within the City of Elizabeth, the USACE has completed a flood control project along the Elizabeth River which consists of levees, channelization, and the reconstruction of bridges. FEMA specifies that all levees must have a minimum of three feet freeboard against 1-percent annual chance flood to be considered a safe flood protection structure. The levee system on the Elizabeth River does meet the FEMA freeboard requirement.

Residents and businesses within the city depend on warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the Flood Forecasting Center of NOAA, located at Trenton, New Jersey.

Borough of Garwood

In the Borough of Garwood, channel modifications have taken place along Garwood Brook in order to limit the potential for flood damage.

Township of Hillside

In the Township of Hillside, flood control measures along the Elizabeth River have consisted of levee construction and channel improvements. An earthen levee with interior flood control facilities has been constructed along the left bank of the river from just downstream of the U.S. Route 22 bridge to the vicinity of Harvard Avenue. This levee has been certified by the USACE and provides

protection from the 1-percent annual chance flood. The North Avenue bridge was widened and raised further controlling flooding from the Elizabeth River in the township.

City of Linden

Within the City of Linden, flood control measures in the study area have consisted of channel improvements and removal of restrictions. Two partially state-funded flood control projects were granted to Union County to improve the channel of West Brook from Eleventh Street to St. Georges Avenue (State Route 27). The county also has improved the West Brook channel from Clinton to Winans Avenues. Concrete flumes, trapezoidal channels, and new bridges were constructed at these locations, thus lowering fluvial flood elevations in this area and reducing upstream backwater effects. In addition, an extensive piped storm relief system was constructed in the areas to the east of West Brook, providing good interior drainage in the project area, and reducing the frequency of flooding along West Brook.

Borough of Mountainside

Within the Borough of Mountainside, although the impoundment of Nomahegan Brook and Blue Brook is mainly for recreation purposes, it affords some minor protection from floods.

Following a 1962 report on storm drainage facilities for Mountainside, the borough has carried out a program of improving storm water drainage in line with the recommendations of that report (Elson T. Killam Associates, 1962). The report identified a number of problem areas along Branches 2, 3, and 7 of Nomahegan Brook. The storm drainage improvements have substantially decreased the flooding which occurs in those areas where the pipes have been installed. Storms of medium to high frequency can be handled by these new pipes.

Borough of New Providence

Extensive channel work on Salt Brook and its tributaries has been done within the Borough of New Providence. Some of the smaller upland streams were piped as development took place. Many of the downstream channels have been modified to carry larger flows.

City of Rahway

The USACE has completed two flood control projects within the City of Rahway, one on the Rahway River and one on South Branch Rahway River. Earthen dikes were constructed along the western bank of the Rahway River between Monroe Street and its confluence with South Branch Rahway River, and along both banks

of South Branch Rahway River for a distance of approximately 0.5 mile upstream from the mouth. The Rahway River project includes moveable flood gates across East Milton and East Hazelwood Avenues. The South Branch Rahway River project includes a moveable flood gate across Main Street near East Hazelwood Avenue and a pumping station on Main Street for interior drainage.

The USACE has also planned projects along Robinsons Branch, and along the South Branch Rahway River upstream of the existing project, both of which include channel improvements and flood impoundments. However, the South Branch Rahway River project was abandoned because of the cost while the Robinsons Branch project is awaiting funding; therefore, its effects were not considered in the December 2, 2002, FIS for the City of Rahway.

The City of Rahway has completed channel improvements along Orchard Creek between Orchard Street and Bramhall Road. These improvements were intended to reduce erosion of the channel banks and have only a minimal effect on reducing flooding from a 100-year storm. The storm water retention basin on the Rahway River in Lenape Park was designed to reduce the peak flow for the 100-year storm by 20 percent in Rahway, which would result in approximately a 1.0-foot drop in the 1-percent annual chance flood level. Peak flood elevations downstream of Monroe Street are controlled by tidal flooding from the Arthur Kill, so the reduction in flow has a negligible effect on the flood levels.

Borough of Roselle Park

Within the Borough of Roselle Park, because of a general drainage study conducted by the consulting engineering firm of Luster and Guariello Associates, Inc., a number of flood protection improvements have been implemented along Morses Creek Tributary 9-1-7-1 (Luster and Guariello Associates, 1974). The most notable of these improvements are as follows:

- Replacement of a box culvert in the Central Railroad right-of-way. The existing structure was inadequate for the drainage area served and was replaced with a 54-inch diameter reinforced concrete pipe;
- Construction of a detention basin at the Hawthorne Street playground area. The basin was designed to impound surface runoff for controlled discharge downstream thereby reducing drainage structure requirements downstream and alleviating flooding problems.
- A number of other improvements, generally in terms of pipe and culverts, were recommended in the aforementioned report.
- The Carpenter Place Detention basin has been constructed to limit flood damage in the Borough of Roselle Park. The channel for Morses Creek has been modified also, including installation of circular and box concrete culverts and a trapezoidal channel with riprap.

Township of Scotch Plains

Within the Township of Scotch Plains, a stream improvement project was completed on the lower portion of East Branch Green Brook, consisting of a diversion chamber and a 78-inch diameter relief pipe, located on the north side of

U.S. Route 22 and extending downstream from the 36-inch diameter pipe near Montainview Avenue, emptying into an improved channel. The reinforced concrete-lined, improved channel begins near Scotland Street and continues downstream to the confluence with Green Brook.

Winding Brook's channel also has a section of improved channel that extends upstream from the confluence with Robinson's Branch-Rahway River for approximately 0.5 mile.

Inundation on the south side of the Township of Scotch Plains generally occurs along Robinson's Branch-Rahway River and the lower portion of Winding Brook and Branch 22. A large portion of these areas consists of undeveloped swamps and lowlands. By providing flood retention areas, these swamps and lowlands reduce some flooding. NOAA in cooperation with the New Jersey Division of Water Resources, has installed a flood stage sensing device on Green Brook.

The Civil Defense Department, assisted by the Scotch Plains Police Department and the City Manager's Office, is responsible for local flood warnings and evacuations.

Township of Springfield

Within the Township of Springfield, a dike is located near Marion Avenue and Interstate Route 78. Although the dike is built high enough to retain the 100-year storm, there is a low-lying section on the ramp from Springfield Avenue to Interstate Route 78 over which the water can flow. The 500-year storm overtops all the dikes in Springfield.

The Township of Springfield has also constructed a dike along the Rahway River between Morris Avenue and Springfield Avenue. This dike does not meet the FEMA freeboard requirement.

In 1976, the Township of Springfield channelized and realigned Van Winkles Brook from Mountain Avenue downstream to CONRAIL. In addition, a dike was constructed along Garden Oval. About 350 feet of Van Winkles Brook downstream of Morris Avenue has been improved with a concrete lining.

Both Bryant Brook and Bryant Brook Branch were realigned between Mountain Avenue and Interstate Route 78. In addition to replacing the major bridges and culverts, Bryant Brook was improved with a concrete channel lining and Bryant

Brook Branch was improved with a combination concrete and earthen channel.

Township of Union

Within the Township of Union, the headwaters of Trotters Lane Branch have been developed as a detention basin by the Township of Union and help the flooding problem downstream at Keane College.

Parts of the Lehigh Valley Branch between Minute Arms and Huguenot Avenue have been channelized, and the Huguenot Avenue culvert has been rebuilt; however, the area still experiences flooding problems during severe storms.

Along Lightning Brook, the Union Avenue bridge was reconstructed and the channel was flumed between Oakland and Stuyvesant Avenues and at the point where the Irvington and Maplewood Branches join. None of these improvements has prevented flooding of Stuyvesant Avenue during heavy rainfalls. The Southwest Branch channel was walled and paved between Tyler Street and Morrison Avenue, but still experiences flooding during heavy storms. The Irvington Branch was flumed upstream of Stanley Terrace and the Stanley Terrace bridge was rebuilt to allow greater channel conveyance.

The upper part of the Vauxhall Branch between Liberty and Burnet Avenues is in culvert and pipe, but this improvement was not designed to fully alleviate flooding problems related to low-frequency flooding events. The Vauxhall Subbranch was relocated extensively at the point where it crosses Interstate-78 (I-78) and upstream of I-78, where it was relocated on the north side of the roadway. The relocation and the culverts under I-78 did not solve the flooding problems during medium- and low-frequency storms, which have noticeably affected this area.

Township of Westfield

The Town of Westfield has experienced very few problems with flooding, and only a small number of flood protection measures have been undertaken. A retention basin along Gallows Hill Road Branch was constructed at the Fairview Cemetery to alleviate flooding problems in this area. The basin was originally designed for a storm frequency of 50 years and a storage capacity of 2.92 acre-feet. Discharge is controlled by an outlet structure at the upstream end of two 48-inch pipes at Gallows Hill Road. Calculations indicate that the basin will be adequate to deter floods of the 50-year frequency.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on

the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent annual chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

Note: Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner to meet the requirements of 44CFR 65.10 as it relates to the levee's capacity to provide 1-percent annual chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Information on the methods used to determine peak discharge-frequency relationships for the streams studied by detailed methods is shown below.

For each community within Union County that has a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

For the February 19, 1992, Township of Berkeley Heights FIS, the hydrologic analyses for Blue Brook was taken from the Township of Scotch Plains (FEMA, 1977). For Snyder Avenue Brook, peak discharges were determined using the USACE Hydrologic Engineering Center's (HEC) HEC-1 Flood Hydrograph Computer Package (USACE, 1985).

For the Drainage Ditch, flows obtained from Stream 10-30 and Branch 10-30-1 using Technical Paper 40 were transferred by using a drainage area proportion and an approved coefficient.

The interpolated values for Garwood Brook at the Rahway River were obtained from a log-log plot of discharge versus drainage area for the 10-, 2-, 1-, and 0.2-percent chance recurrence intervals. Discharges for subareas above the mouth of

Garwood Brook were computed assuming that the ratio of discharge to that at the mouth is equal to the ratio of the respective areas with an exponent of 0.75.

For the Borough of New Providence, hydrologic analyses were carried out to establish the peak discharge-frequency relationships for Passaic River, Salt Brook, and West Branch Salt Brook studied in detail affecting the community. With the exception of Central Branch of Salt Brook and South Fork, the regional regression formulas for this area were used to compute the 1-percent annual chance discharges for all other streams included in this study.

The SCS Technical Release No. 20 computer program was used to determine routed peak discharges on Salt Brook and West Branch Salt Brook for the 10-, 2-, 1-percent annual chance flood events (U.S. Department of Agriculture, 1983).

The hydrologic analyses employed in the City of Plainfield are based on work presented in the USACE Feasibility Report on Flood Control for the Green Brook Subbasin (URS Corporation, Inc., 1980). The analysis is complicated by the fact that, for certain storms, water diverts out of the Green Brook basin and flows into Cedar Brook. Discharge-frequency relationships were developed at both the upstream (Union Avenue in Scotch Plains) and the downstream (Norwood Avenue in Plainfield) limits of the diversion.

The initial step in the analysis was to derive an "actual" unit hydrograph at the USGS gage (No. 01403500) in the City of Plainfield. Based in this hydrograph, synthetic hydrographs were developed upstream and downstream of the gage along Green Brook. Next, peak discharge-frequency relationships at the gage were determined which could then be transposed using drainage area relationships.

The discharge-frequency relationship for the City of Plainfield gaging station is based on the natural, annual flood series for the gage because the series is non-homogeneous. It includes some events which are not true flood peaks but are residuals of larger, partially diverted floods. Rather, the discharge-frequency relationship is based on an adjusted series in which estimates of what would have happened if no diversion flow has occurred, replace the natural residual flows.

The overflow area was divided into eight portions, and the diversion for each was evaluated using a trial and error methodology based on balancing an assumed stage with the resulting stage developed from a subsequent backwater analysis. The amount of diversion at each point was estimated by treating the Green Brook-Cedar Brook divide as a broaded-crested weir. A check was made by running backwater computations to match historic flood marks using flows incremented (as the flow line progressed upstream) to reflect the diversion. This accounts for the reduction in peak discharges upstream of the USGS gage.

A final verification of the synthetic relations was done by generating flood

hydrographs using rainfall data from Technical Paper No. 40 (U.S. Department of Commerce, 1963). These discharges were then augmented with flows diverting from the Green Brook basin, resulting in final peak discharges for the portion of Cedar Brook studied in detail.

Peak flows for the South Branch Rahway River were determined using relationships developed through a statistical regression analysis of data collected at over 100 gages across the State of New Jersey (U.S. Department of the Interior, 1974). This analysis accounts for urban development, natural retention created by lakes and swamps, stream slope, and drainage area.

The Morses Creek Drainage Basin, encompassing the entire Borough of Roselle, is ungaged. Basic hydrologic data consists of isohyetal mappings of rainfall data during storms such as tropical storm Doria in 1971 and the flood of August 2 and 3, 1973 (New Jersey Department of Environmental Protection, 1971; U.S. Department of the Interior, 1974).

Within the Borough of Roselle, the flood discharge-frequency relationships for West Brook and its branch (drainage area 3.55 square miles), Peach Orchard Brook (drainage area 0.76 square mile), and Jouet Brook (drainage area 1.14 square miles) were patterned on relationships developed by the USACE, New York District, for downstream reaches of West Brook and Peach Orchard Brook in the City of Linden. All drainage areas referred to are measured at the southern boundary of the Borough of Roselle.

Flood discharge values for reaches upstream from the southern boundary of Roselle were determined by applying ratios of drainage areas, with an exponent of 0.75, to the discharge values at the boundary.

Preliminary routing of the flood resulting from tropical storm Doria in 1971 indicated that stream controls in the upstream reach of West Brook were instrumental in regulating discharges to lower values. The ratio of actual to unregulated flows for tropical storm Doria, estimated by the USACE to have a 70- year frequency, was assumed to apply to floods of greater and lower frequency.

For Robinson's Branch, peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods were based on data previously developed by the USACE.

The flow distribution between Bryant Brook and Bryant Brook Branch was obtained by balancing the energy grade lines of the separate hydraulic computer models. Discharge-frequency estimates for Lightning Brook at the confluence with Elizabeth River (drainage area 3.13 square miles) were determined by adjusting estimates for Elizabeth River (drainage area 18.0 square miles), assuming that the discharge varies with (A) 0.75. Discharge-frequency estimates for the upstream reaches of Lightning Brook, Irvington Branch, Maplewood

Branch, and Southwest Branch were computed assuming a relationship (A) 0.75 as related to the discharge of Lightning Brook at its confluence.

For the Town of Westfield, the discharge-frequency relationships for the Gallows Hill Road Branch were calculated by multiplying values obtained from the FIS for Garwood, New Jersey (FEMA, 1976), by the ratio of drainage areas, with an exponent of 0.75. This method was also used to establish discharges for the Fairview Cemetery retention basin and basin overflow calculations.

For Cedar Brook, peak discharges for the 10-, 2-, 1-, and 0.2-percent chance recurrence intervals were developed using Special Report 38 (State of New Jersey, Department of Environmental Protection, 1974). These discharges were then augmented with flows for diverting from the Green Brook Basin, resulting in final peak discharges for the portion of Cedar Brook studied in detail.

The 1-percent annual chance discharge at the mouth of Blue Brook, where it flows into Green Brook, was obtained from flood-discharge frequency relationships developed by the USACE. The USACE determined the values for Blue Brook by applying the ratio of peak flows for synthetic unit hydrographs to the flood discharge frequency values for Green Brook at U.S. Route 22. For Blue Brook, at the borough corporate limits, the 1-percent annual chance discharge value was obtained by applying the ratio of drainage areas with an exponent of 0.75 to the value at the mouth.

Peak discharges for the four tributaries of the Passaic River and for Branch Blue and Branch Green Brooks were determined by the rational method for 10-year and 1-percent annual chance recurrence intervals, with rainfall-duration relationships estimated by the USACE for Plainfield (Water Resources Council, 1967). The 2-percent annual chance peak discharge was determined by interpolation. Peak discharges for the 0.2-percent annual chance recurrence interval were estimated at twice 1-percent annual chance values, based on relationships for West Brook and Peach Orchard Brook in Roselle, New Jersey.

Peak discharges for Gallows Hill Road Branch were taken from the FIS for the Town of Westfield (FEMA, 1979). These flows were determined taking into account the Fairview Cemetery retention basin in Westfield and the Brookside Retention Basin in Cranford. The methodology used involved calculating the peak discharges to the point in question by the rational formula, disregarding the drainage area tributary to the Fairview Cemetery. The peak flows resulting from routing through the retention basins were then added to local channel drainage to obtain the final flows.

For College Branch, peak discharges were determined using the rational formula, since the drainage area is less than 1.0 square mile. Runoff coefficients were estimated by field observation based on published values for different land uses (Ven Te Chow, 1959). The 0.2-percent annual chance discharge values were

based on synthetic unit hydrographs and the standard project rainfall for the region. The 1-percent annual chance discharge values were estimated by the rational formula, with rainfall intensity obtained by dividing the 1-percent annual chance depth for Rahway, New Jersey, by the unit hydro graph lag time. Discharges for 2-, and 10-percent annual chance return intervals were determined by extending a plot of the log-Pearson Type III distribution based on logarithmic mean and standard deviation of discharge values for Saddle River at Lodi, New Jersey.

Two methods for determining peak frequency-discharge relationships were used in the Borough of Roselle Park FIS. For the section of the streams where the drainage basin is approximately 1.0 square mile or larger, USGS Special Report 38, was used to determine peak discharges (U.S. Department of the Interior, 1974). For the sections of streams where the drainage basins are less than 1.0 square mile, the Rational Method was used to determine peak discharges. The Rational Method is based on a determination of the intensity of rainfall (I), the runoff coefficient (C), and the drainage area (A). This is equated to discharge by the use of the formula Q = CIA.

Because of the criteria set forth above, the Morses Creek Tributary 9-1-7-1 peak discharges were determined by the Rational Method. Consideration was also given to storage along stream 9-1-7-1 through a routing analysis as described in Section 3.2 “Hydraulic Analyses.” The Morses Creek peak discharges were determined by USGS Special Report 38 (U.S. Department of the Interior, 1974).

Discharges for Morses Creek were determined using the methodology described above, except that the analyses were modified at the newly installed detention basin in the Borough of Roselle Park FIS. Routing at the detention basin was performed using the USACE HEC-1 computer program (USACE, 1985).

Discharge-frequency estimates for Vauxhall Branch (drainage area 1.51 square miles) and Vauxhall Subbranch (drainage area 0.56 square mile) were obtained by using the rational method.

Discharge-frequency estimates for Branch 10-34 at its confluence with the Rahway River (drainage area 0.32 square mile) were obtained by the rational method.

Discharge-frequency estimates for Lehigh Valley Branch above the confluence with Elizabeth River (drainage area 0.84 square mile) were obtained by the rational method.

Discharge-frequency estimates for Trotters Lane Branch at its confluence with Elizabeth River (drainage area 0.95 square mile) were obtained by the rational method.

Peak discharges for Robinsons Branch 15 were determined using USGS Special Report 38 (U.S. Department of the Interior, 1974). Peak discharges for Robinsons Branch 15-1 and Robinsons Branch 15-2 were determined by the Rational Method. Consideration was also given to storage along the Tributary to Rahway River through a routing analysis.

Discharges for Stream 10-30, Branch 10-30-1, and Branch 10-24 were developed through the application of hypothetical rainfall patterns based on Technical Paper No. 40 and distributed on the basis of the Standard Project Flood. These runoff distributions were then applied to synthetic unit hydrographs to develop the flood discharges. For the Drainage Ditch discharges, flows obtained from Stream 10-30 and Branch 10-30-1 using Technical Paper 40 were transferred by employing a drainage area proportion and an approved coefficient. Due to the natural detention area upstream of the restrictive Springfield Road bridge, flows for Black Brook obtained by the Technical Paper No. 40 method were then routed using the Modified Puls method. For West Brook, discharges were obtained using the Rational Method.

Peak discharges for Orchard Creek were determined using the rational formula since the drainage area was less than 1.0 square mile. Runoff coefficients were estimated by field observation based on published values for different land uses.

For Branch West Brook and West Branch West Brook, peak discharges were determined using New Jersey Special Report 38 (U.S. Department of the Interior, 1974).

Peak flows for Pumpkin Patch Brook were determined using the relationships contained in a report developed by the USGS in cooperation with the State of New Jersey Department of Environmental Protection (U.S. Department of the Interior, 1974). A statistical regression analysis was performed using data collected at over 100 gages across the State of New Jersey. This analysis accounts for urban development, natural retention created by lakes and swamps, stream slope, and drainage area.

The hydrologic analyses for West Brook were prepared by M. Disko Associates of Union, New Jersey, using the procedure described in the state publication, Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization (U.S. Department of the Interior, 1974).

The hydrologic analyses for Peach Orchard Brook were prepared utilizing the SCS unit hydrograph. The peak discharge of each hydrograph was determined by the procedure used in Special Report No. 38 (U.S. Department of the Interior, 1974). The hydrograph calculations, routing, lagging, and summations were prepared using the USACE HEC-1 program (USACE, 1985). The construction of the Jouet Brook detention basin and channel improvements were incorporated in the analyses of the Peach Orchard Brook and Jouet Brook flood peak discharges.

For Winding Brook, Tributary A, Branch 22, Branch 22-11, Tributary B, East Branch Green Brook, Tributary C, and Cedar Brook, hydrologic analyses were based upon the method for estimating flood-peak magnitudes developed under a cooperative program between the State of New Jersey Division of Water Resources and the USGS in Special Report 38 (U.S. Department of the Interior, 1974). Through a series of mathematical and graphical relations, various hydrologic parameters were used to estimate the peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods. The parameters included stream drainage area, main channel slope, surface storage area, and an index of manmade impervious cover based upon basin population and development. The 0.2-percent annual chance discharge value was extrapolated from the lower frequency floods.

Frequency-discharge drainage area curves were prepared from these data for Robinson's Branch-Rahway River, Winding Brook, Tributary A, Branch 22, Branch 22-11, Tributary B, East Branch Green Brook, Tributary C, and Cedar Brook.

Peak flows for Van Winkles Brook and Bryant Brook were determined using the relationships contained in Special Report 38, developed by the USGS in cooperation with the State of New Jersey, Department of Environmental Protection (U.S. Department of the Interior, 1974). These relationships were developed through a statistical regression analysis of data collected at over 100 gages across the State of New Jersey. This analysis accounts for urban development, natural retention created by lakes and swamps, stream slope and drainage area.

Discharge-frequency estimates for West Branch (drainage area 3.08 square miles) above confluence with Elizabeth River, were based on the method outlined in New Jersey Department of Environmental Protection, Report No. 38 (U.S. Department of the Interior, 1974).

Within the Township of Berkeley Heights, the hydrology for the Passaic River was determined using a log-Pearson Type III analysis based on USGS gage data in the Township of Chatham at station No. 1379500.

The peak discharges for Green Brook and Blue Brook were based on the results of a technical coordination meeting with Anderson-Nichols Co., Inc., which reflect changes in the drainage area for both streams. Peak discharges were determined by use of the frequency-discharge relationships described in Special Report No.38 to reflect the significant hydrologic events of August 1973 (U.S. Department of the Interior, 1975; U.S. Department of the Interior, 1974). The results of this methodology were compared to the USACE's log-Pearson Type III studies made for Green Brook above the Plainfield gage which was not considered in the original USACE computations. The frequency-discharge relationships as derived by both methods were considered comparable, and the use of the newly developed hydrology by the USGS was accepted for use in this

study (U.S. Department of the Interior, 1975). Flows for partial drainage area of Green Brook and Blue Brook were estimated by applying a ratio of drainage areas to the 0.75 power to discharges at locations derived by the methods described above.

The discharge-frequency relationships for the Elizabeth River were determined for the FIS for the Township of Union, New Jersey (FEMA, 1975). These peak discharges were obtained by log-Pearson Type III analyses (Water Resources Council, 1977) of data from the USACE gaging station on the Elizabeth River, at Elizabeth, New Jersey. At the time of the pre-countywide analyses, this gaging station had 38 years of record. The gaging station was originally located 85 feet upstream from the Westfield Avenue bridge, in the City of Elizabeth. On December 27, 1972, a new gaging station was established at Ursino Lake, Township of Hillside, 75 feet upstream from the Trotters Lane bridge. Peak discharge records for 1973-1974 at the new gaging station at Ursino Lake were adjusted by the USACE to correlate with the records from the old gaging station site. The discharges associated with the Township of Hillside were then computed by assuming that flows would vary according to drainage areas as

$$(A_1/A_2)^{0.75}$$

Where: A = Drainage Areas.

Peak discharges for Robinsons Branch were based on stream flow records at USGS gage No. 01396000 at Milton Lake. Values for the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were calculated using a log-Pearson Type III statistical distribution of the annual peak flows from 1940 through 1977, using a weighted gage skew coefficient (U.S. Department of the Interior, 1963-1976; Water Resources Council, 1977). These flows calculated at the gage were transposed to other specific sites along Robinsons Branch using the drainage area-discharge formula:

$$\frac{Q_1}{Q_2} = \frac{A_1{}^T}{A_2}$$

where: A_1 and A_2 are the drainage areas at the specific site and the gage, T is the transfer coefficient, Q_2 is the peak discharge at the gage for a particular flood, and Q_1 is the resulting peak discharge at the site. A transfer coefficient of 0.85 was used because the resulting peak discharges agreed well with those used in the Township of Scotch Plains FIS (FEMA, 1977).

Hydrologic analyses for Kings Creek were prepared by the USACE using the log-Pearson Type III analysis on the physically similar, gaged Saddle River at Lodi, New Jersey, and transferring this information to the study area, via areal comparisons (Water Resources Council, 1967).

The hydrology for the Passaic River was determined using a proportional adjustment based on log-Pearson Type III analyses using USGS gage data at Pine Brook.

Peak discharge-frequency relationships for the gage were developed in accordance with the methods of frequency analysis contained in "Guidelines for Determining Flood Flow Frequency" (Water Resources Council, 1977). The log-Pearson Type III distribution of flood data was used as the basic distribution for defining the annual flood series. This method assumes that the logarithms of the annual peak discharges are normally distributed and that statistical procedures apply.

For the Township of Scotch Plains, peak discharges for Green Brook and Blue Brook were based on the results of a technical coordination meeting with Anderson-Nichols & Co., Inc. Peak discharges were determined by use of the frequency-discharge relationships described in Special Report 38, adjusted to reflect the significant hydrologic events of August 1973 (U.S. Department of the Interior, 1974; U.S. Department of the Interior, 1975). The results of this methodology were compared to the USACE log-Pearson Type III studies made for Green Brook above the Plainfield gage which was not considered in the original USACE computations. The frequency-discharge relationships as derived by both methods were considered comparable, and the use of the newly developed hydrology by the USGS was accepted for use in this FIS (U.S. Department of the Interior, 1975). Flows for partial drainage areas of Green Brook and Blue Brook were estimated by applying a ratio of drainage areas to the 0.75 power to discharges at locations derived by the methods described above.

For the City of Summit, the hydrology for the Passaic River was determined using a proportional adjustment based on log-Pearson Type III analysis using USGS gage data at Pine Brook and a log-Pearson Type III analysis using USGS gage data at Chatham.

Discharge-frequency estimates for the East Branch Rahway River were obtained by log-Pearson Type III analyses (Water Resources Council, 1967) at the old confluence with West Branch of Rahway River (drainage area 9.1 square miles) using statistical parameters derived from the gaging station at Springfield, New Jersey (drainage area 25.5 square miles) on the basis of physical similarity between the two basins. The discharge-frequency relationships for the new confluence point of the East Branch (drainage area 7.6 square miles) and upstream reaches were obtained by assuming discharges vary with (A) 0.75.

For Nomahegan Brook at its mouth, flood flow-frequency data were based on statistical analysis of stage-discharge records for two gaging stations on the Rahway River, operated by the USGS. One gaging station is located at Springfield, New Jersey. Its drainage basin area is 25.5 square miles and the length of record used was from 1938 to 1973. The other gaging station is located

at Rahway, New Jersey, with a drainage basin area of 40.9 square miles. The length of record used was from 1908 to 1915 and from 1921 to 1973. This analysis followed the standard log-Pearson Type III method as outlined by the Water Resources Council (Water Resources Council, 1977), and was performed by the USACE, New York District.

For locations on Nomahegan Brook between the mouth and Echo Lake Dam, discharges were determined by multiplying the values at the mouth by the ratio of drainage areas, with an exponent of 0.75. This was done in accordance with a practice used by the USACE.

For locations on Nomahegan Brook upstream of Echo Lake, and for its branches, flood discharges up to the 1-percent annual chance value were computed using Special Report No. 38 (U.S. Department of the Interior, 1974). This method is in close agreement with the study techniques used at the mouth of Nomahegan Brook. For discharges for return periods between 1- and 0.2-percent annual chance, the flood-frequency curves were extended by comparing them with curves for stations downstream of Echo Lake.

For the September 20, 2006, FIS, an archived USACE HEC-1 flood hydrograph package computer model was used to verify and calibrate the September 16, 1999, Tropical Storm Floyd flood event in the Rahway River basin with the published hydrographs at the Springfield, New Jersey (01394500) and Rahway, New Jersey (01395000) USGS stream gages. For calibration, stage-storage relationships at Lenape Park were updated based on information provided by the Union County Department of Engineering. Also, stage-storage relationships at Nomahegan Park were calculated from topographic data provided by the Township of Cranford. For the analysis of the 10-, 2-, 1-, and 0.2-percent annual chance rainfall estimates were taken from NOAA Atlas 14, Volume 2, Version 2, for Springfield, New Jersey.

For [TBD], FIS revision hydrologic analyses were prepared for the Elizabeth River using gage data and New Jersey Regression Equations. The regional regression equations are used to improve the estimates of flood magnitude and frequency at gaged sites by weighting together the log-Pearson Type III data and the estimated data from the regression equations, according to their equivalent years of record.

The peak discharge computation procedure for using New Jersey Regression equations is presented in the publication "*Methodology for Estimation of Flood Magnitude and Frequency for New Jersey Streams*" (USGS, 2009). Based on physiography, soils, and precipitation, New Jersey is divided into five hydrologic regions. Union County falls within the Glaciated Portion of Piedmont Floodplain Region. The regression analysis indicated that flood discharge is related to the drainage area, main channel slope, percentage of lake and wetland areas in the basin, population density, and the flood-frequency region.

A summary of the drainage area-peak discharge relationships for all of the streams studied by detailed methods is shown in Table 5, “Summary of Discharges.” Drainage area-peak discharge relationships not presented in Table 5 are presented in Figure 1, “Frequency-Discharge, Drainage Area Curves.”

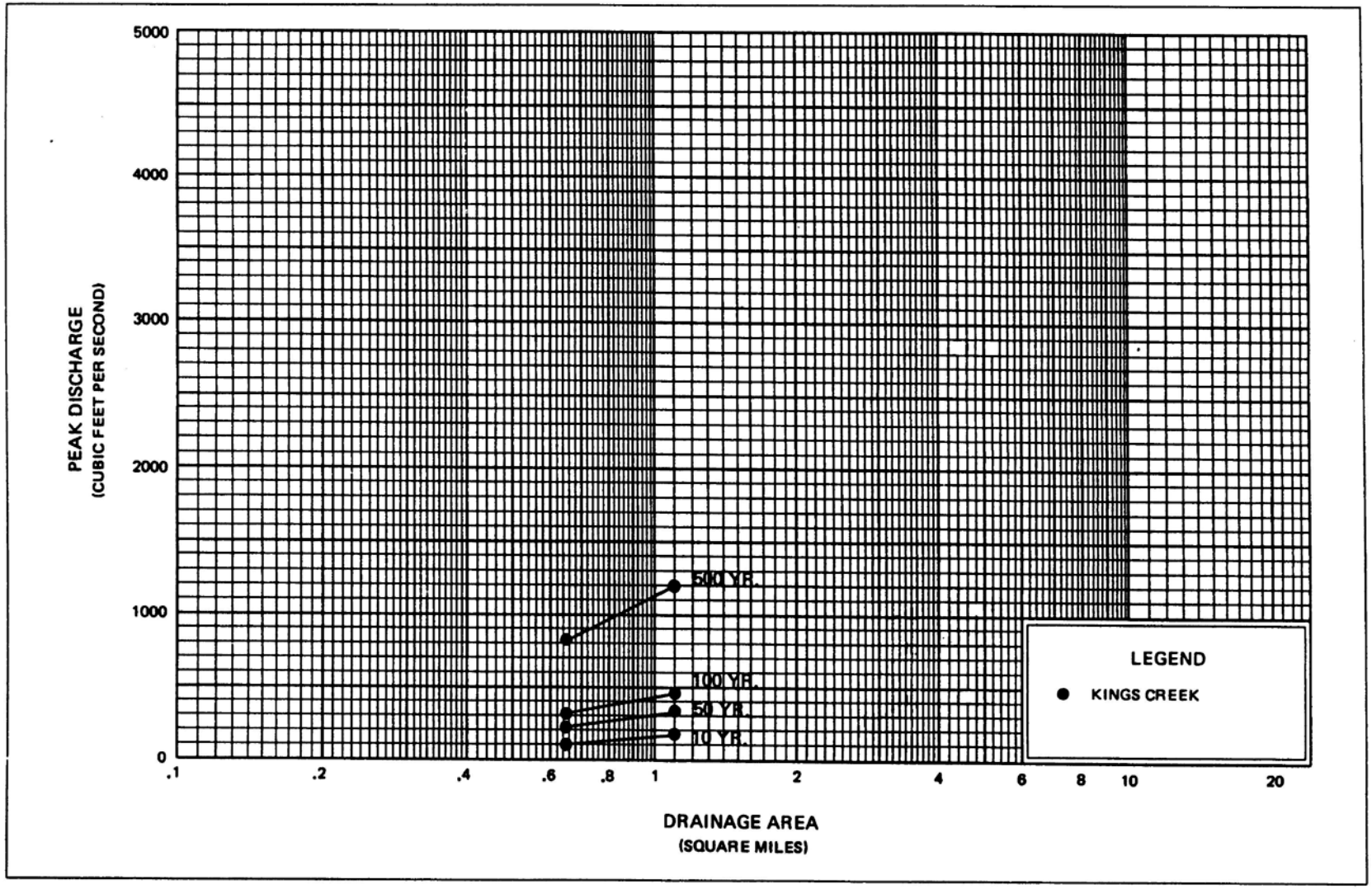

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ
(ALL JURISDICTIONS)

FREQUENCY DISCHARGE, DRAINAGE AREA CURVES

KINGS CREEK

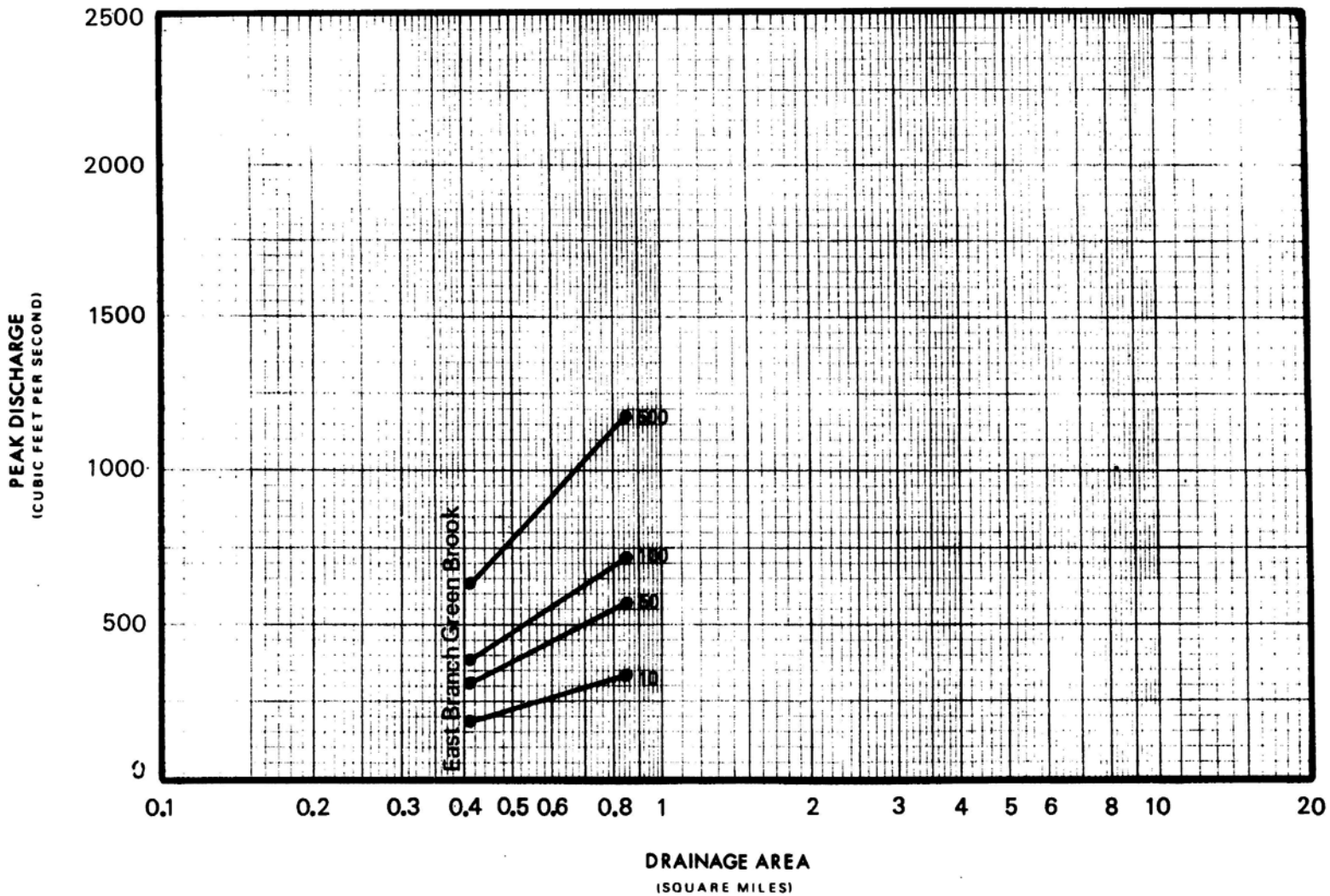

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

EAST BRANCH GREEN BROOK

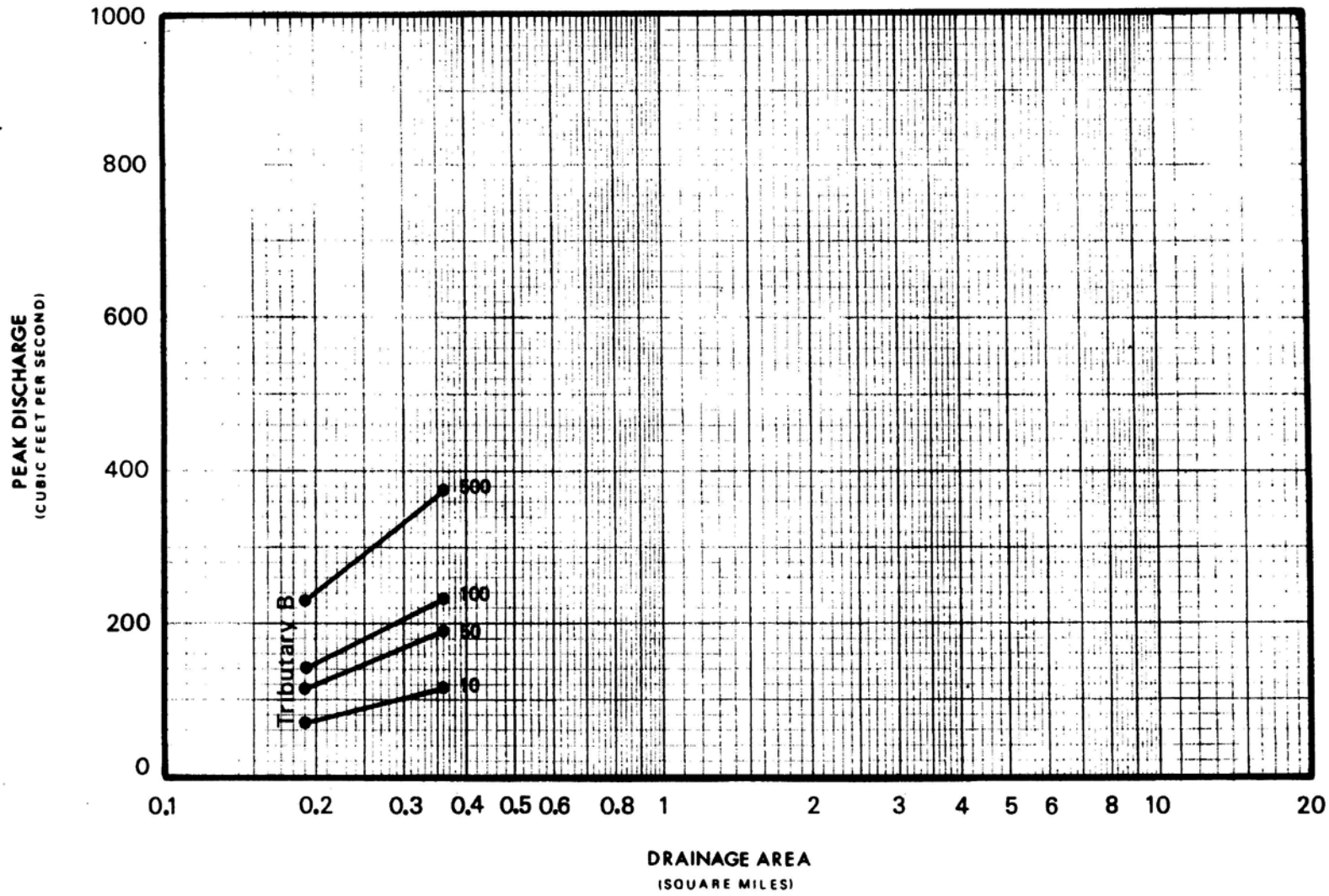

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

TRIBUTARY B

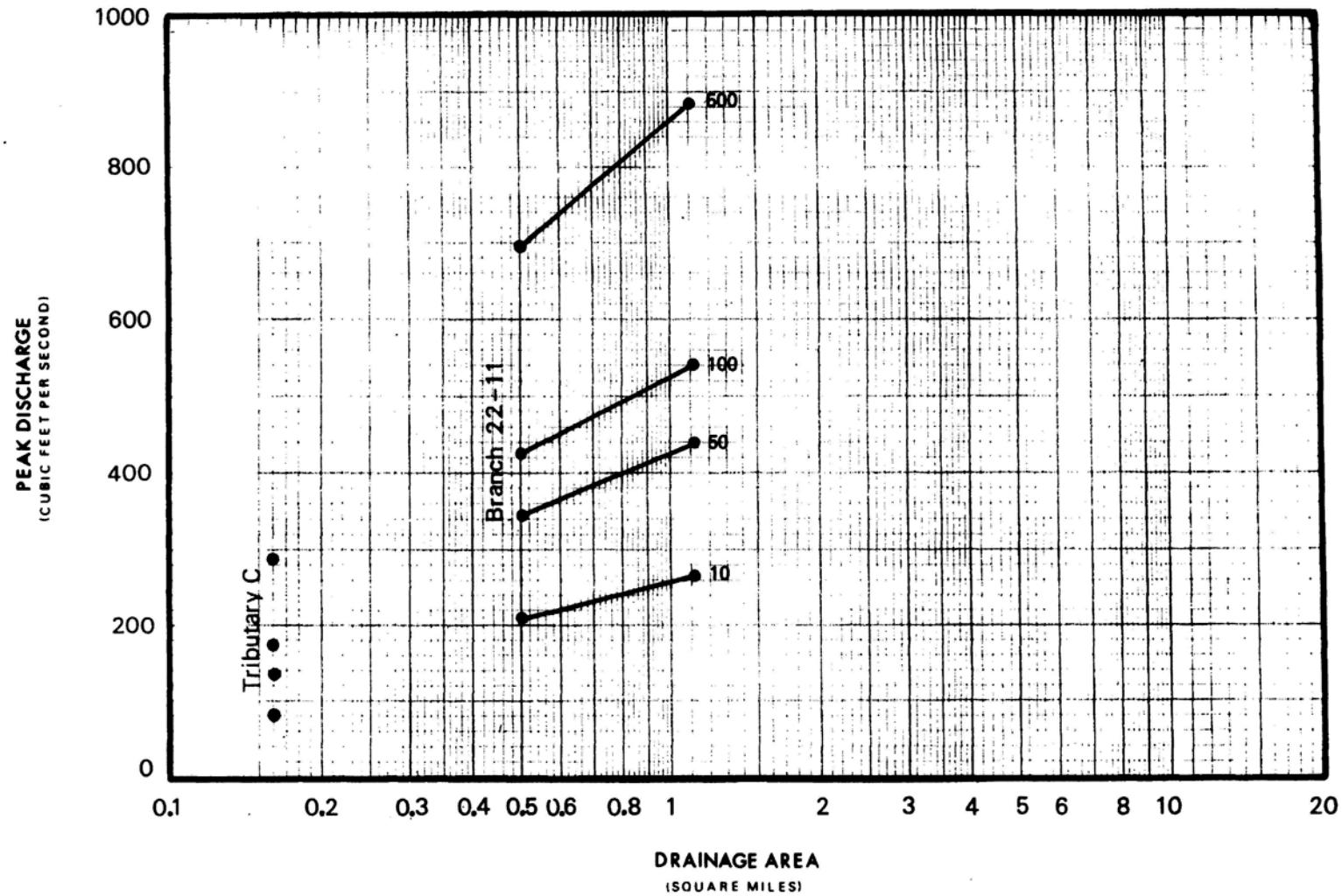

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

TRIBUTARY C, BRANCH 22–11

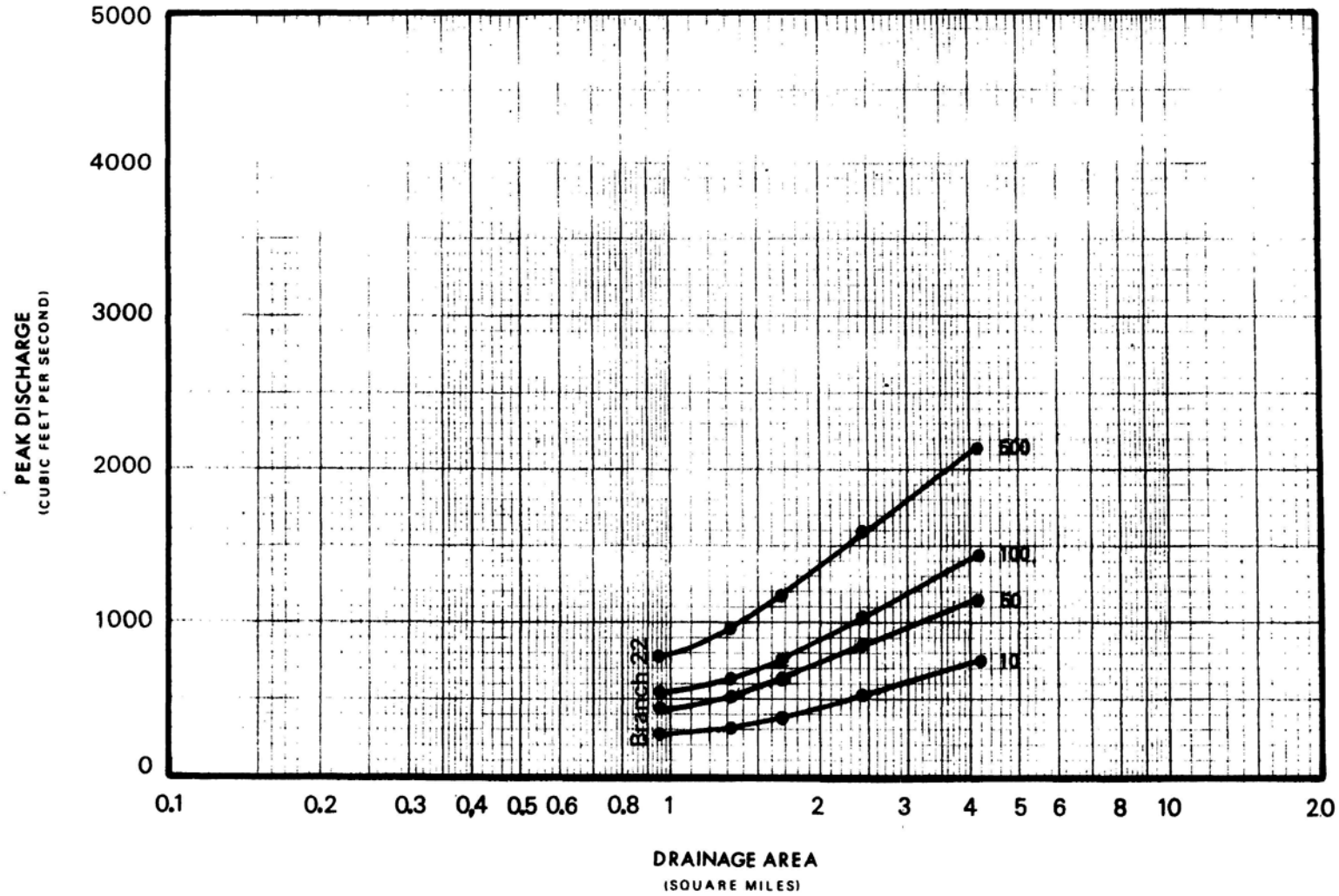

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

BRANCH 22

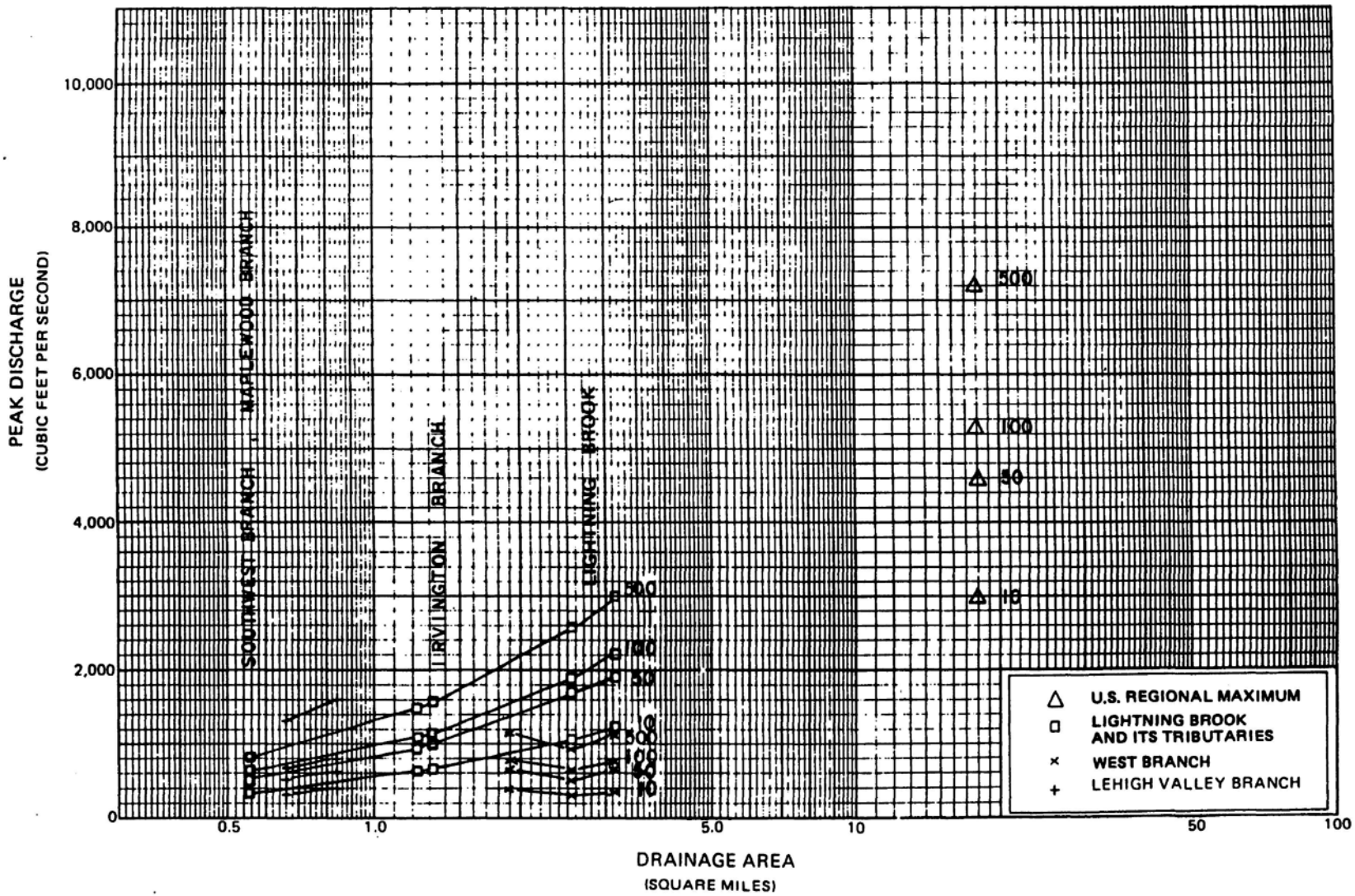

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ
(ALL JURISDICTIONS)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

LEHIGH VALLEY BRANCH-WEST BRANCH-LIGHTNING BROOK-IRVINGTON BRANCH-MAPLEWOOD BRANCH-SOUTHWEST BRANCH

Table 5 – Summary of Discharges

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BLACK BROOK					
At the confluence with the Rahway River	0.32	175	190	195	240
BLUE BROOK					
At confluence with Green Brook	6.30	1,380	2,480	3,240	5,200
Upstream of confluence with Green Brook	3.61	655	1,200	1,590	2,550
At Sky Top Drive	3.28	565	1,040	1,400	2,250
Approximately 3,140 feet upstream of Sky Top Drive	2.76	455	830	1,090	1,790
Approximately 1,040 feet downstream of Berkeley Heights-Summit corporate limits	2.55	382	710	949	1,582
BRANCH 10-24					
At the Cranford-Kenilworth corporate limits	0.19	200	250	275	400
At Bloomingdale Avenue	0.14	160	200	220	320
BRANCH 10-30-1					
At the confluence with Dranage Ditch	0.13	150	190	210	300
BRANCH WEST BROOK					
At confluence with West Brook	1.19	199	294	346	446
At Sixth Avenue	1.12	190	280	329	424
At Third Avenue	0.54	103	159	191	248
At Second Avenue	0.43	85	132	158	207
BRYANT BROOK					
At mouth	3.0	800	1,260	1,530	2,270
Upstream of the confluence of Bryant Brook Branch	2.1	550	880	1,070	1,590

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BRYANT BROOK BRANCH					
At confluence with Bryant Branch	0.5	190	290	360	530
CEDAR BROOK					
At county boundary	4.90	900	1,670	2,120	3,070
COLLEGE BRANCH					
At mouth	0.5	430	550	610	730
DRAINAGE DITCH					
At its confluence with the Rahway River	0.61	470	595	645	945
Upstream of Stream 10-30	0.19	200	250	280	400
ELIZABETH RIVER					
At its confluence with Arthur Kill, Downstream of South Front Street	23.1	3,513	4,434	4,811*	5,689
At Trotters Lane, Downstream of Ursino Lake	18.1	2,967	3,752	4,071	4,825
At the Elizabeth-Union-Hillside corporate limits	16.95	2,751	4,532	5,242	6,941
Just downstream of Liberty Avenue – below the confluence with Elizabeth River, West Branch	14.5	2,569	3,936	4,528	6,160
Just upstream of U.S. Route 22	9.9	1,918	2,939	3,381	4,600
Just upstream of Union Avenue	6.7	1,443	2,211	2,543	3,460
GALLOWS HILL ROAD BRANCH					
At mouth	1.1	275	339	365	402
At Brookside Place Road	0.9	105	133	140	203

*Peak discharge calculated for New Jersey Flood Hazard Area Design Flood (NJFHADF) is equal to the 1-percent annual chance flow plus an additional 25-percent in flow, and not to exceed the 0.2-percent annual chance flow – at this location the NJFHADF is equal to the 0.2-percent annual chance flood.

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
GARWOOD BROOK					
At mouth	1.4	450	700	940	1,460
GREEN BROOK					
Downstream of confluence of Stony Brook	18.20	3,650	6,100	7,900	15,200
Upstream of confluence of Stony Brook	10.30	2,040	2,500	2,850	4,150
At the Plainfield gage	9.75	1,815	1,950	2,100	2,635
At Norwood Avenue	9.00	1,750	1,780	1,850	2,135
From Leland Avenue to Netherwood Avenue	8.50	1,795	2,000	2,100	2,350
At Plainfield-Scotch Plains corporate limits	1*	1,730	2,550	2,630	3,060
Just downstream of U.S. Route 22	1*	1,620	2,480	2,700	3,100
Just downstream of Union Avenue	1*	1,450	2,600	3,370	5,410
At Terrill Road	4.90	900	1,670	2,120	3,070
Downstream of first crossing of New Providence Road	2.55	643	1,180	1,570	2,550
Approximately 400 feet downstream of first crossing of Bonnie Burn Road	1.60	475	870	1,160	1,890
Approximately 1,500 feet downstream of first crossing of Plainfield Avenue	0.77	256	465	620	1,010
Approximately 400 feet downstream of Plainfield Avenue	0.53	194	352	469	764
JOUET BROOK					
At St. Georges Avenue	1.03	141	215	251	328
At Rivington Street	0.98	128	194	227	296
At Frank Street	0.95	121	182	213	276
At Morris Street	0.92	113	170	190	257
At Warren Street	0.90	108	162	188	244
At Spruce Street	0.87	100	149	173	224
At Columbus Avenue	0.85	95	141	163	211

* Flow diversion between Green Brook and Cedar Brook watersheds – discharge-drainage area relationship inapplicable

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
JOUET BROOK (continued)					
At Spruce Street	0.76	85	104	119	152
At Warren Street	0.75	70	100	114	146
At Detention Pond	0.74	67	96	109	139
At Eighth Street	0.66	168	271	327	435
At Seventh Street	0.60	153	246	294	391
At Sixth Street	0.53	135	218	260	345
At Fifth Street	0.50	127	205	245	326
MORSES CREEK TRIBUTARY 9-1-7-1					
At Roselle-Roselle Park corporate limits, retained flow	0.38	43	61	68	87
At Roselle-Roselle Park corporate limits, unretained flow	0.38	175	250	285	390
NOMAHEGAN BROOK					
At Cranford-Westfield corporate limits	3.87	580	1,050	1,300	2,020
At Downstream end of Echo Lake	2.79	450	800	1,000	1,580
ORCHARD CREEK					
At mouth	1.4	661	865	930	1,100
At upstream corporate limits of Rahway	0.4	472	600	665	800
PASSAIC RIVER					
At confluence with Rockaway River	141.00	2,780	4,010	4,637	6,080
At Chatham gaga (No. 01379500)	100.00	2,182	3,030	3,414	4,190
PEACH ORCHARD BROOK					
Above confluence with West Brook	3.81	425	927	1,309	2,615
At CONRAIL	2.68	381	812	1,137	2,232
Above confluence of Jouet Brook	0.96	161	360	510	1,028

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
PUMPKIN PATCH BROOK					
At mouth	2.7	610	970	1,190	1,770
At county boundary	1.8	440	710	870	1,300
RAHWAY RIVER					
Downstream of confluence of South Branch Rahway River	77.4	4,874	8,175	9,932	14,984
Downstream of confluence of Robinsons Branch	64.8	3,498	6,127	7,404	11,904
At Rahway Gage (No. 01395000)	40.8	2,013	3,942	5,360	9,407
At Rahway Valley Railroad	36.3	1,962	3,877	5,207	9,195
At Kenilworth Boulevard (confluence of Nomahegan Brook)	30.9	1,765	3,586	4,808	8,412
Downstream of Lenape Park	30.8	1,810	4,775	6,825	11,796
At Springfield Gage (No. 01394500)	25.3	2,316	5,118	6,589	10,549
Downstream of the confluence of Van Winkles Brook	23.1	2,187	4,947	6,283	9,773
At Interstate 78	15.8	1,940	3,700	4,790	8,600
ROBINSONS BRANCH					
At mouth	22.9	1,980	3,280	4,000	6,125
At Rahway Gage No. 01396000	21.6	1,885	3,125	3,800	5,830
At Middlesex Reservoir Dam	20.5	1,800	2,990	3,640	5,575
Downstream of Winding Brook	15.8	1,400	2,150	2,500	3,580
Upstream of Winding Brook (mile 5.1)	12.6	1,170	1,850	2,120	3,020
At county boundary	5.8	1,000	1,600	1,820	2,600
ROBINSONS BRANCH 15					
At Scotch Plains-Westfield corporate limits	2.16	560	885	1,075	1,650

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
ROBINSONS BRANCH 15 (continued)					
Above confluence with Robinsons Branch 15-1	1.59	435	695	840	1,300
Above confluence with Robinsons Branch 15-2	1.02	303	492	600	920
ROBINSONS BRANCH 15-1					
At confluence with Robinsons Branch 15	0.46	318	442	486	620
ROBINSONS BRANCH 15-2					
At confluence with Robinsons Branch 15 (Lower)	0.39	240	314	344	450
At end of upper open channel portion near Tice Place	0.28	185	245	270	350
SALT BROOK					
At confluence with Passaic River	5.2	1,200	1,870	2,260	*
Upstream of confluence of West Branch of Salt Brook	4.1	1,000	1,570	1,900	*
SOUTH BRANCH RAHWAY RIVER					
At mouth	12.1	1,630	2,510	3,010	4,400
At county boundary	10.2	1,450	2,250	2,700	3,970
STREAM 10-30					
At the confluence with Drainage Ditch	0.40	350	440	480	700
TRIBUTARY TO RAHWAY RIVER					
At Cranford-Westfield corporate limits	0.53	160	195	210	270
Near Cranford Avenue	0.38	64	71	75	92

*Data Not Available

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
VAN WINKLES BROOK					
At mouth	5.4	1,180	1,840	2,230	3,260
Upstream of the confluence of Bryant Brook	2.1	610	980	1,190	1,770
At county boundary	1.2	410	670	860	1,230
WEST BRANCH OF SALT BROOK					
At confluence with Salt Brook	1.0	400	640	785	*
Upstream of Central Avenue	0.7	335	545	670	*
WEST BRANCH WEST BROOK					
At confluence with Branch West Brook	0.51	77	111	127	246
At Third Avenue	0.48	72	103	118	234
At Second Avenue	0.43	64	91	103	215
At First Avenue	0.42	62	88	100	210
WEST BROOK					
At the dam	9.71	1,036	1,799	2,440	4,650
Above confluence of Peach Orchard Brook	5.90	962	1,491	1,786	2,492
At Clinton Street	5.37	890	1,398	1,675	2,340
At U.S. Routes 1 and 9	4.99	845	1,315	1,577	2,206
At Munsell Avenue	4.39	752	1,175	1,411	1,975
At Linden Avenue	4.28	731	1,144	1,374	1,926
At Elizabeth Avenue	4.01	688	1,078	1,296	1,820
At Knopf Street	3.91	670	1,052	1,265	1,776
At Henry Street	3.83	651	1,023	1,230	1,729
At Wood Avenue	3.70	628	989	1,189	1,627
At St. Georges Avenue	3.54	637	1,004	1,209	1,527
At Brooklawn Avenue	3.39	600	947	1,141	1,481
At Raritan Road	2.97	533	846	1,020	1,344
At Roselle-Roselle Park corporate limits	0.97	141	174	181	271
At upstream corporate limit of Roselle Park	0.71	335	450	480	650

*Data Not Available

Table 5 – Summary of Discharges – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
WEST BROOK (continued)					
At the Kenilworth-Roselle Park corporate limits	0.48	280	350	405	585
At Michigan Avenue	0.43	258	322	373	539
At Market Street	0.38	235	294	340	491
At Sumner Avenue	0.34	216	270	313	453

For streams studied by approximate methods, depth-discharge-frequency relationships for non-coastal plain sites in New Jersey, based on the mean annual flood, were used to establish flows and boundaries.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM. Users of the FIRM should also be aware that coastal flood elevations are provided in the Summary of Stillwater Elevations table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2). Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For each community within Union County that has a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and

are summarized below.

For all flooding sources studied by detailed methods, water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program (USACE, 1991).

Starting elevations for the Vauxhall Branch above Burnet Avenue were based on computing a rating curve for the culvert inlet at that point, calibrated against a floodmark.

Starting elevations for the Lehigh Valley Branch, West Branch, and Lightning Brook tributaries were obtained from flood profile elevations computed for the Elizabeth River main channel at their respective confluence points. Starting elevations for the Trotters Lane Branch were obtained by means of a rating curve developed for the Trotters Lane storm drain at Morris Avenue.

Within the Township of Berkeley Heights, cross sections for Green Brook and Blue Brook were obtained from previous studies prepared by the NJDEP and were supplemented with field surveys. Cross sections for the Passaic River were obtained from existing topographic information used in the previous January 6, 1999, FIS (FEMA, 1999). For Branch Blue Brook, Branch Green Brook, and Snyder Avenue Brook, cross sections for the backwater analyses were field surveyed and were located at close intervals above and below bridges and culverts to compute the significant backwater effects of these structures in urbanized areas. Existing topographic maps were used to augment surveyed cross-section data in the overbank areas.

Within the Township of Clark, cross-section data and bridge and culvert geometry for Pumpkin Patch Brook were field-surveyed by the USACE for their studies in the basin (USACE, 1973a). The USACE cross sections were used on Robinsons Branch downstream of Featherbed Lane, while the data developed for the Township of Scotch Plains FIS were used upstream (FEMA, 1977).

The acceptability of all assumed hydraulic factors, cross sections, and hydraulic structure data was checked by computations that duplicated historic floodwater profiles.

Within the Township of Cranford, cross-section data and bridge and culvert geometry for Garwood Brook, Gallows Hill Road Branch and College Branch were based on plans prepared for the Cranford Engineering Department and supplemented where required by new field surveys.

Within the City of Plainfield, cross-section information for Green Brook was obtained from Flood Hazard Report No. 3, Green Brook (State of New Jersey, 1972). This report is based on topographic maps prepared from aerial photographs dated March 1968 (Quinn and Associates, Inc., 1968). The maps

were updated by field reconnaissance to include development in the floodplain areas. All bridges and culverts that were modified since these reports were surveyed to obtain elevation data and structural geometry.

For Cedar Brook, channel cross sections and partial overbank cross sections were obtained through field surveys. All bridges and culverts were surveyed to obtain elevation data and structural geometry. The overbanks were extended using topographic maps prepared from an aerial survey dated March 1979 (Topographic Data Consultants, Inc., 1979a). Cross sections for the backwater analyses of the streams studied by detailed methods were selected at close intervals above and below bridges and culverts in order to compute the significant backwater effects of those structures.

Within the Borough of Roselle, cross sections for the backwater analysis of West Brook and Branch West Brook, Jouet Brook, and Peach Orchard Brook were field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures in urbanized areas. An existing topographic map (Hudson, Franklin, Consulting Engineer, 1962) was used to augment surveyed cross-section data in the overbank areas.

Within the Township of Scotch Plains, cross sections for the backwater analyses of the streams studied by detailed methods were field-surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures in the developed areas. In long segment lengths between structures, approximate valley cross sections were also surveyed.

Cross sections for Blue Brook and Green Brook were taken from previous studies performed by the NJDEP and were supplemented by field inspections. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Starting water-surface elevations for Green Brook were taken from the City of Plainfield FIS (FEMA, 1983). The elevations were in agreement with a feasibility report prepared by the USACE (URS Corporation, Inc., 1980). Starting water surfaces for Blue Brook were taken from its confluence with Green Brook where their peaks were coincident at a point of combined flow.

Within the Township of Springfield, cross-section data and bridge and culvert geometry for Van Winkles Brook were obtained from field surveys by the USACE for their study of the Rahway River basin (USACE, 1973b).

Cross-section data and structural geometry for Bryant Brook and Bryant Brook Branch were obtained from channel improvement plans developed for the township, and construction plans for Interstate Route 78 developed for the New

Jersey Department of Transportation (Richard J. Jeske, Inc., 1972; State of New Jersey, 1978).

Within the Township of Union, cross sections for the backwater analysis of West Branch, Lehigh Valley Branch, Lightning Brook, Maplewood Branch, Irvington Branch, Southwest Branch, East Branch Rahway River, Branch 10-34, and Vauxhall Branch were field surveyed and were located at close intervals above and below bridges, culverts, and weirs in order to compute significant backwater effects of these structures in urbanized areas. Use was made of the cross-sectional channel survey on the main channel of the Rahway River previously surveyed by the USACE and of cross sections surveyed along the channel of parts of Lightning Brook surveyed by the township engineer. Existing sewer plates with street elevations, where available, were used to augment surveyed cross-section data in the overbank areas.

Within the Town of Westfield, channel cross sections and partial overbank cross sections were obtained through field surveys. The overbanks were extended using topographic maps derived from aerial photos (Westfield Aerial Survey, 1971). In areas where the maps did not indicate recent development, full cross sections of the streams were taken.

Starting water-surface elevations for the Passaic River were determined from the Township of Fairfield, New Jersey, FIS at the corporate limits for the Township of Fairfield and the Borough of West Caldwell (station 243,680). Starting water-surface elevations for the four tributaries of the Passaic River were determined from flood profile elevations of the Passaic River at their respective confluences.

For the Township of Berkeley Heights, the hydraulic analyses represent the conditions of culverts at the time of the original study and are based generally on unobstructed flow. Exceptions to this rule were made on Green Brook at Plainfield Avenue at Runnel's Hospital for the 0.2-percent annual chance flood which is expected to obstruct the bridge opening in the same manner as the August 1973 flood, both being of comparable discharge magnitude. The same premise applies to the Green Brook bridge crossing at Valley Road.

Normal depth from slope/area calculations was used as the starting water-surface elevation for Pumpkin Patch Brook.

Starting water-surface elevations for the Drainage Ditch, Garwood Brook, Gallows Hill Road Branch and College Branch were determined from normal depths taken from slope/area calculations.

Within the Borough of Garwood, the starting water-surface elevation for Garwood Brook at its confluence with the Rahway River was obtained from a study of the Rahway River. Water-surface profiles were developed by using USGS gage data at Springfield and Rahway, which are located upstream and

downstream, respectively, from the Rahway River confluence point. Additional detailed profile information as obtained from records kept by the Union County Park Commission from 1938 through 1973. Numerous flood marks for both the flood of August 3, 1973, and Tropical Storm Doria of August 28 and 29, 1971, were obtained from borough officials and local citizens. Many of these are documented with photographs, showing the actual flooding conditions. The HEC-2 backwater computer runs were calibrated by modeling the discharges of the flood of August 2, 1972, so that the computed stream profile for natural stream conditions matched six known flood mark points. The stream has been remodeled in this revised study to incorporate channel modifications.

Within the City of Linden, starting water-surface elevations for all streams except Arthur Kill were obtained from a known water-surface elevation from Arthur Kill were obtained from a known water-surface elevation from Arthur Kill. Starting water-surface elevations for Arthur Kill were obtained from the City of New York City, New York, FIS (FEMA, 1994).

Channel cross sections and partial overbank cross sections for Drainage Ditch, Branch 10-30, West Brook, Branch 10-24, Branch 10-30-1, and Black Brook were obtained through field surveys. The overbanks were extended using topographic maps compiled from aerial photographs (Topographic Data Consultants, 1979b).

Starting water-surface elevations for Branch 10-24, Black Brook, and the Drainage Ditch were determined using the slope/area method. For Stream 10-30 and Branch 10-30-1, starting water-surface elevations were established by considering their peak discharge on the peak discharge of the Drainage Ditch and selecting the corresponding stage elevation of the Drainage Ditch.

For Salt Brook and West Branch of Salt Brook, starting water-surface elevations were calculated using a known water-surface elevation.

Within the City of Rahway, starting water-surface elevations for South Branch Rahway River were obtained from a known water-surface elevation from Arthur Kill. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Hydraulic calculations on South Branch Rahway River were begun at a 10-percent annual chance recurrence interval tidal level. Calculations on Robinsons Branch were begun at coincident Rahway River flood elevations determined using the hydrograph analysis contained in the USACE report on flood control for Robinsons Branch (USACE, 1973a). For Orchard Creek, hydraulic calculations were begun at the upstream end of the railroad culvert using elevations resulting from a hydrologic routing through the culvert based on a tail water elevation equal to that of a 10-percent annual chance flood on the South Branch Rahway River.

The HEC-2 model used for the South Branch Rahway River was coded originally

in 1975 as part of a report, Special Flood Hazard Information Report, the South Branch of the Rahway River, prepared for the New York District USACE (USACE, 1975). This model was updated, where required, to reflect current conditions in the watershed and adjusted to allow the development of a valid floodway.

The Robinsons Branch model was calibrated to measured high water marks from the August 1971 storm.

The starting elevations for the water-surface profiles for West Brook and Peach Orchard Brook were obtained from the the City of Linden FIS and reconfirmed by flood mark data available along St. Georges Avenue. The starting elevations for Jouet Brook were obtained by computing a staged discharge curve based on flood mark elevation data for tropical storm Doria. Starting elevations for Branch West Brook were determined from computed stream profile elevations of West Brook and its confluence with the branch.

Within the Borough of Roselle Park, cross sections for the flooding sources studied by detailed methods were obtained from field surveys. The overbanks were extended using topographic maps supplied by the Borough of Roselle Park from an aerial survey (Borough of Roselle Park, 1970). In areas where the aerial photographs did not indicate recent development, full cross sections of the streams were taken. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry to compute the significant backwater effects of these structures.

Starting water-surface elevations for Morses Creek were taken from the FIS for the Borough of Roselle (FEMA, 1978). For Morses Creek Tributary 9-1-7-1, starting water-surface elevations were based on stage-discharge relationships for the retention basin at the Hawthorne Street playground area. Starting elevations for Morses Creek Tributary 9-1-7 were determined using the slope/area method. Starting water-surface elevations for Peach Orchard Creek were derived from headwater depths at the downstream box culvert with inlet controls.

Morses Creek Tributary 9-1-7-1 was analyzed for a detention basin. A standard inflow-outflow routing procedure based on an empirical hydrograph was used in the analysis. A separate analysis was performed by the borough engineer and results were comparable. Based upon these calculations, the retention basin design indicates that flooding will not occur along Morses Creek Tributary 9-1-7-1. Also, detailed analysis for the upstream and downstream drainage piping along Morses Creek Tributary 9-1-7-1 indicates that they are adequate to eliminate flooding in this area. Since all floods are contained in the basin and culverts, no profiles or floodway data have been developed.

Similarly, profiles and floodway data tables were not developed for Peach Orchard Brook and Morses Creek Tributary 9-1-7 since they are shallow flooding

areas within the Borough of Roselle Park. First, the streams were analyzed without external effects to establish flood elevations. The analyses indicated that Peach Orchard Brook should be designated as a shallow flooding area. Then the flood outlines based upon these elevations were evaluated. The resultant flood outlines are a combination of stream backwater and overland flow from Morses Creek Tributary 9-1-7.

The acceptability of all assumed hydraulic factors, cross sections and hydraulic structure data was checked by computations that duplicated historic flood-water profiles.

For Van Winkles and Bryant Brook, normal depth, developed from slope/area calculations, was used for starting water-surface elevations.

Bryant Brook and Bryant Brook Branch were modeled as a single stream system. The discharge entering the system was distributed into each channel by a trial and error procedures varying the flow split until the energy grade lines at the upstream end of each stream balanced.

No profile was shown for the Old Channel Rahway River as this information was taken from the FIS for the Township of Springfield, which contained no profile information (FEMA, 1982).

Starting elevations for Branch 10-34, Vauxhall Branch, East Branch Rahway River, and South Branch Rahway River were obtained from flood profile elevations computed for the main, or receiving, stream at their respective confluence points. Starting elevations for the Vauxhall Branch above Burnet Avenue were based on computing a rating curve for the culvert inlet at that point, calibrated against a flood mark.

Starting water surface elevations for the Lehigh Valley Branch, West Branch, and Lightning Brook tributaries were obtained from flood profile elevations computed for the Elizabeth River main channel at their respective confluence points. Starting water surface elevations for the Trotters Lane Branch were obtained by means of a rating curve developed for the Trotters Lane storm drain at Morris Avenue.

Gallows Hill Road Branch was analyzed for the retention basin along the stream. A standard inflow-outflow routing procedure based on an empirical hydrograph, was used in the analysis. These calculations indicate that the retention basin will be adequate to prevent flooding in the area.

Starting water-surface elevations were determined for Robinsons Branch 15 using the slope-energy method downstream of the corporate limits through bridge structures; for Robinsons Branch 15-1 and Robinsons Branch 15-2 at the points of confluence with Robinsons Branch 15; for Nomahegan Brook-Echo Lake via the

FIS for Mountainside, New Jersey (FEMA, 1976); and for Tributary to Rahway River using the slope/area method.

Within the Borough of Mountainside, cross sections for the backwater analysis of Nomahegan Brook and its four tributaries were field surveyed and were located at close intervals above and below bridges and culverts to compute the significant backwater effects of these structures in urbanized areas. Existing topographic maps were used to augment surveyed cross-section data in the overbank areas.

Channel and roughness factors (Manning's "n") for these computations were assigned on the basis of field reconnaissance of floodplain areas. The computer program was calibrated by routing floodflows of the August 1973 storm through floodmarks obtained from published sources and by interviewing local residents. Flood mark information obtained by interview was integrated with known elevations which were obtained during the survey phase.

The 1-percent annual chance flood for Blue Brook, from a point approximately 1.4 miles upstream of Seeley's Pond Dam to the upstream corporate limits, was approximated by the use of flood mark information obtained for the storm of August 2 and 3, 1973, adjusted to a 1-percent annual chance frequency.

Within the Township of Hillside, for the streams studied by approximate methods, depth-discharge-frequency relationships for non-coastal plain sites in New Jersey (based on the mean annual flood) were used, along with information supplied by the Township Engineer and field investigation; to establish flows and boundaries (State of New Jersey, 1964).

Historical flood limits combined with engineering judgment were used to define the extent of flooding in the area studied by approximate methods. These limits were then compared to approximate limits of flooding determined using curves established for non-coastal plain sites in New Jersey by the NJDEP. The curves use the mean annual flood discharge for a specific area to predict the depth of flow for a specific frequency.

Elevations, depths, and boundaries for AO and AH zones along Arlington Avenue, Randolph Road, and South Avenue were determined by historical information and engineering judgment.

In the Borough of Roselle, for the flooding sources studied by approximate methods, the extent of flooding was determined using information from the Borough of Roselle Park engineer and through field observation.

For the September 20, 2006, FIS, cross-section data for the Rahway River were obtained from photogrammetric surveys, field surveys, and existing HEC-2 models developed as part of previous FISs. All bridges, dams, and culverts were field surveyed or modeled using as-built plans to obtain elevation data and

structural geometry. Starting water-surface elevations for the Rahway River were determined by obtaining mean-higher high water on Arthur Kill. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-RAS computer program, version 3.1.2 (USACE, 2004). Water-surface profiles for the Elizabeth River within the Township of Hillside and Union were compiled based on HEC-2 input and output files obtained from and developed by the USACE, New York District, for flood control projects along the Elizabeth River. Starting water-surface elevations were taken from the FIS for the City of Elizabeth (FEMA, 1985).

For the [TBD], FIS, detailed hydraulic analyses were carried out using HEC-RAS, version 4.1 (USACE, 2010). Cross-sections were cut from the available topographic data using RAMPP's GEORAMPP toolset within an Environmental Systems Research Institute (ESRI) ArcMap Geographic Information Systems platform. Study methods studies utilized GeoRAS version 4.2 in conjunction with GeoRAMPP toolset. Light Detection and Ranging (LiDAR) data was obtained from the LiDAR acquisition iniittative led by the USGS in 2006 for the metropolitan New Jersey area. That LiDAR data was used to create the terrain model used. Field survey information was collected along natural channel cross-sections for the channels of detailed studied streams. The channel survey data were used as the terrain source for the channels and the topographic data were used as the terrain source for the overbanks for the detailed study streams. For cross-sections that were not surveyed, channel geometry was interpolated between surveyed cross-sections and extrapolated beyond channel cross-sections.

In some instances, the terrain model did not pick up the full depth or shape of the channel or the true height of the channel banks as noted in the field reconnaissance or field survey. For example, the terrain model may not pick up data within steep slopes or steep banks. For cases where there was a difference between the terrain model and the contour data, engineering judgment was used to determine the floodplain boundary based on the field survey and/or field reconnaissance and contour data.

For the Elizabeth River, Overbank Manning's "n" polygons were based on Chow's publication of Open Channel Hydraulics and the "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains" were used as a reference for "n" value selection (Chow, 1959).

Calibration for the Elizabeth River hydraulic model was carried out using stream gage data recorded at the USGS gage location at Ursino Lake in Elizabeth, NJ (01393450). The USGS gage data reported peak discharges and corresponding gage heights which were used for model calibration.

Starting water surface elevations for the Elizabeth River were obtained from the Arthur Kill, updated for this FIS revision as a part of the coastal analyses.

Roughness factors (Manning's "n") used in the hydraulic computations for all detailed streams were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 6, "Manning's "n" Values."

Table 6 – Manning's "n" Values

Stream	Channel "n"	Overbank "n"
Blue Brook	0.040	0.070
Branch 10-24	0.020-0.035	0.050-0.120
Branch 10-30-1	0.025-0.035	0.080-0.100
Bryant Brook	0.020	0.030-0.060
Bryant Brook Branch	0.040	0.030-0.060
Cedar Brook	0.025-0.035	0.060-0.080
College Branch	0.025-0.040	0.060
Drainage Ditch	0.030-0.035	0.060-0.100
East Branch Rahway River	*	*
Elizabeth River	0.020-0.030	0.035-0.140
Gallows Hill Road Branch	0.018	*
Garwood Brook	0.025-0.040	0.060
Green Brook	0.035-0.055	0.050-0.160
Morses Creek	0.012-0.035	0.050-0.150
Morses Creek Tributary 9-1-7-1	0.012-0.035	0.05-0.150
Nomahegan Brook	0.015-0.035	0.080-0.120
Nomahegan Brook-Echo Lake	0.015-0.035	0.080-0.120
Orchard Creek	0.040	0.020-0.060
Passaic River	0.025-0.055	0.025-0.080
Peach Orchard Brook	0.012-0.035	0.05-0.150
Pumpkin Patch Brook	0.040	0.050-0.080
Rahway River	0.018-0.050	0.015-0.080
Robinsons Branch	0.030-0.100	0.060-0.150
Robinsons Branch 15	0.015-0.035	0.080-0.120
Robinsons Branch 15-1	0.015-0.035	0.080-0.120
Robinsons Branch 15-2	0.015-0.035	0.080-0.120
Salt Brook	0.017-0.040	0.050-0.080
South Branch Rahway River	0.030-0.040	0.060-0.100
Tributary to Rahway River	0.015-0.035	0.080-0.120
Van Winkles Brook	0.040	0.060
West Branch of Salt Brook	0.017-0.048	0.060-0.080
West Brook	0.015-0.035	0.060-0.120

* Data Not Available

The channel and overbank "n" values are not available for the following streams studied by detailed methods:

Branch 10-34
Branch 22
Branch 22-11
Branch Blue Brook
Branch Green Brook
Branch West Brook
Branches 1, 2, 3, and 7 of Nomahegan Brook
East Branch Green Brook
Irvington Branch
Jouet Brook
Kings Creek
Lehigh Valley Branch
Lightning Brook
Maplewood Branch
Snyder Avenue Brook
Southwest Branch
Stream 10-30
Subbranch, Branch 2 Nomahegan Brook
Tributary A
Tributary B
Tributary C
Trotters Lane Branch
Vauxhall Branch
Vauxhall Sub-Branch
West Branch
West Branch West Brook
Winding Brook

All elevations for the updated coastal analyses and the Elizabeth River and corresponding FIRM panels (34039C0014G, 34039C0015G, 34039C0023G, 34039C0024G, 34039C0025G, 34039C0026G, 34039C0033G, 34039C0034G, 34039C0035G, 34039C0036G, 34039C0043G, 34039C0044G, 34039C0045G, 34039C0046G, 34039C0047G, and 34039C0048G) are referenced to NAVD88. All other FIRMs panels are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29) and will be updated in a future update.

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g.,

concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Coastal Analyses

Coastal storm surge analyses were performed for the Newark Bay and Arthur Kill and all the bays and inlets within these areas.

The extent of coastal flooding due to hurricanes and northeasters is determined by three factors: 1) the nature of the storm with respect to intensity, duration, and path; 2) astronomical tide conditions at the time the storm-surge wave reaches the shore; and 3) the physical geometry and bathymetry of a particular area, which affects the time and passage of the surge wave.

The FEMA, Region II office, initiated a study in 2009 to update the coastal storm surge elevations within the states of New York and New Jersey including the Atlantic Ocean, the Barnegat Bay, the Raritan Bay, the Jamaica Bay, the Long Island Sound and their tributaries. The study replaces outdated coastal analysis as well as previously published storm surge stillwater elevations for all FIS Reports in the study area, including Union County, New Jersey, and serves as the basis for updated FIRMs. The coastal study for the New Jersey Atlantic Ocean coast and New York City coast was conducted for FEMA by RAMPP under contract HSFEHQ-09-D-0369 task order HSFE02-09-J-0001.

The region wide, end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics. ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating Waves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (FEMA,

2013). The resulting model system is typically referred to as SWAN+ADCIRC (FEMA, 2013). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from five major flood events for the Region II domain: the 1938 hurricane, Hurricane Ethel, Hurricane Gloria, and two extra-tropical storms, from 1991 and 1992. Two of the more recent storm events, Hurricane Irene and Hurricane Sandy were not used in this study for validation. Both Hurricane Irene and Hurricane Sandy occurred during the study or after this storm surge was completed. Hurricane Irene was a major rainfall event and did not produce major coastal tidal flooding. The climatology of Hurricane Sandy, at this time, is not well studied.

Model skill was assessed by quantitative comparison of model output to wind, wave, and water level and high water mark observations. The model was then used to simulate 30 historical extra-tropical storms and 157 synthetic hurricanes to create a synthetic water elevation record from which the 10-, 2-, 1-, and 0.2-percent annual chance of exceedence elevations were determined.

Wave set up is the increase in mean water level above the still water level due to momentum transfer to the water column by waves that are breaking or otherwise dissipating their energy (Dean, 2010). For the New York and New Jersey surge study, wave setup was determined directly from the coupled wave and storm surge model. The total stillwater elevation (SWEL) with wave setup was then used for the wave modeling.

The stillwater elevations for the 10-, 2-, 1-, and 0.2- percent annual chance floods determined for the primary sources of flooding in Union County: Arthur Kill and Newark Bay are shown in Table 7, “Transect Data”. The analysis reported herein reflect the stillwater elevations due to tidal and wind setup effects. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

The Newark Bay and Arthur Kill are the primary flooding sources in Union County. Coastal flooding along Newark Bay and Arthur Kill along the eastern boundary of the county affects the municipalities along this shoreline including the City of Elizabeth and the Newark Airport. In Union the shoreline is primarily industrial and is protected by bulkheads.

The tidal surge in the Newark Bay and Arthur Kill affects approximately 7.5 miles (mi.) of Union County coastline, and all of the coastline was modeled for overland wave propagation. The fetch length across the Newark Bay varies from approximately 0.8 to 1.6 mi., and across the Arthur Kill varies from approximately 0.1 to 0.6 mi.

The coastal hydraulic analysis for this countywide FIS revision involved transect layout, field reconnaissance, and overland wave modeling including wave setup, wave height and wave run-up analysis.

Transects represent the locations where the overland wave height analysis was modeled and are placed with consideration given to topography, land use, shoreline features and orientation, and the available fetch distance. Each transect was placed to capture the dominant wave direction, typically perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights were computed considering the combined effects of changes in ground elevation, obstructions, and wind contributions. Transects were placed along the shoreline along all sources of primary flooding in Essex County, as illustrated on the FIRMs and Figure 2, "Transect Location Map". Transects also represent locations visited during field reconnaissance to assist in parameterizing obstructions and observing shore protection features.

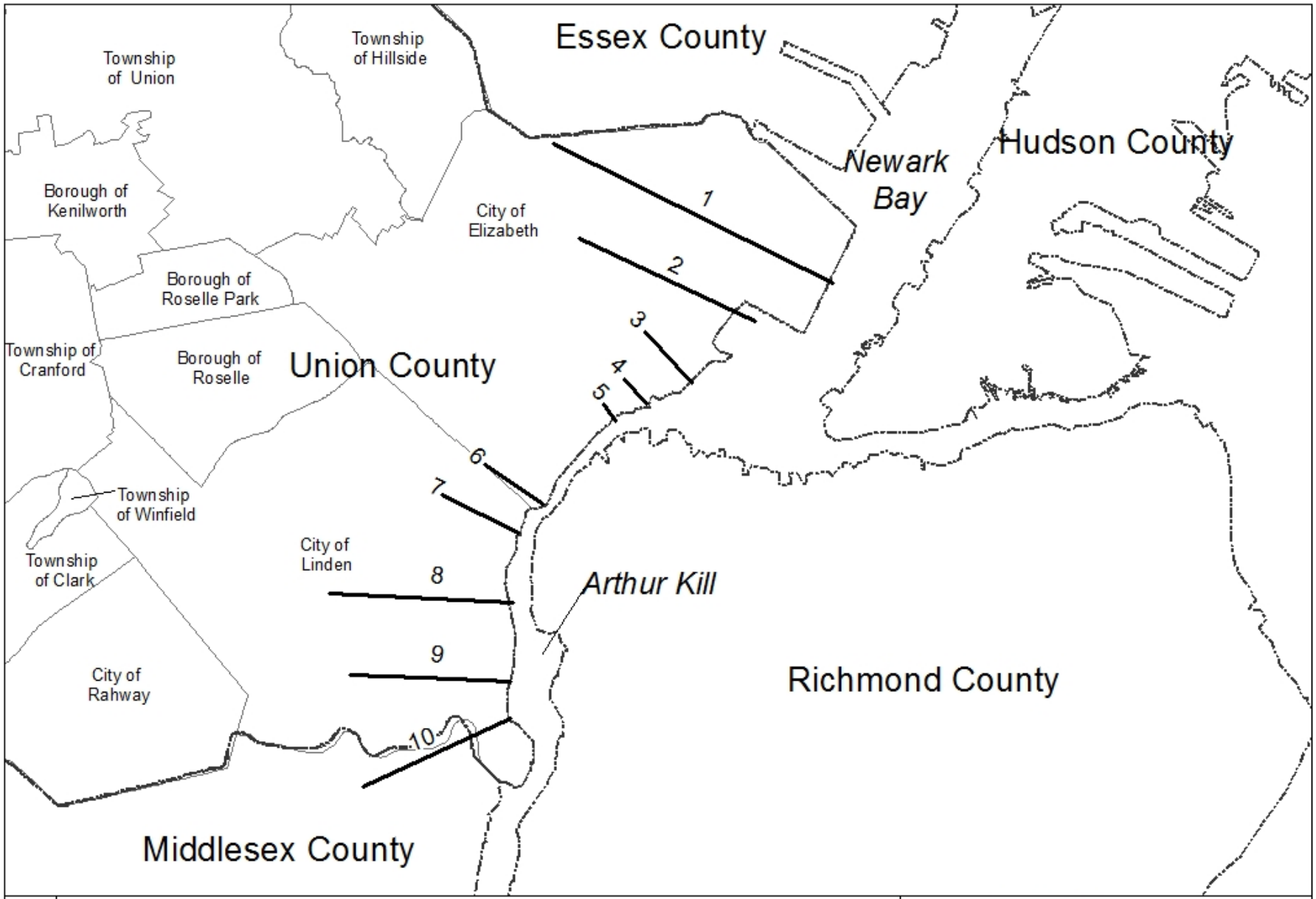

Figure 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NEW JERSEY (ALL JURISDICTIONS)

Approximate Scale

0 0.5 1 1.5 2 Miles

TRANSECT LOCATION MAP

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS) (NAS, 1977). This method is based on three major concepts. First, depth-limited waves in shallow water reach maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70-percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in NAS Report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Simulations of inland wave propagation were conducted using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model Version 4.0 (FEMA, 2007b). WHAFIS is a one-dimensional model that was applied to each transect in the study area. The model uses the total stillwater and starting wave information extracted from the coupled wave and storm surge model. In Table 7, "Transect Data," the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations for each transect are provided along with the starting wave height and period. Simulations of wave transformations were then conducted with WHAFIS taking into account the storm-induced erosion and overland features of each transect. The model outputs the combined flood elevation from the total SWEL and wave height along each cross-shore transect allowing for the establishment of base flood elevations (BFEs) and flood zones from the shoreline to points inland within the study area. Wave heights were calculated to the nearest 0.1 foot, and BFEs were determined at whole-foot increments along the transects.

Table 7 – Transect Data

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations*(ft NAVD88)			
		Coordinates	Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Newark Bay	1	N 40.665911 W 74.144472	3.23	3.43	7.0 7.0 – 7.1	9.7 9.1 – 9.8	10.8 10.5 - 12.7	13.8 13.6 – 15.3
Newark Bay	2	N 40.660539 W 74.159336	2.97	2.92	7.0 6.8 – 7.1	9.7 9.1 – 9.8	10.9 10.6 – 10.9	13.9 13.7 – 14.6
Newark Bay	3	N 40.651747 W 74.171237	2.49	3.18	7.1 6.6 – 7.1	9.8 9.4 – 9.8	11.0 10.9 – 11.2	13.9 13.9 – 14.0

Table 7 – Transect Data – continued

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations*(ft NAVD88)			
		Coordinates	Significant Wave Height H_s (ft)	Peak Wave Period T_p (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Newark Bay	4	N 40.648891 W 74.180046	2.12	2.91	7.2 7.1 – 7.2	9.9	11.1 11.0 – 11.1	14.0
Arthur Kill	5	N 40.646484 W 74.185803	1.82	2.59	7.2	9.9 9.9 – 10.0	11.1 11.1 – 11.7	14.1 13.9 – 14.1
Arthur Kill	6	N 40.634647 W 74.19972	1.69	2.32	7.3	10.2 9.6 – 10.2	11.5 11.2 - 11.5	14.6 14.6 – 14.9
Arthur Kill	7	N 40.630539 W 74.204308	1.29	2.17	7.5 4.7 – 7.6	10.3 9.8 – 10.3	11.6 11.4 – 11.6	14.8 14.7 - 15.0
Arthur Kill	8	N 40.620725 W 74.205306	1.58	2.32	7.4 2.7 – 7.6	10.4 9.5 - 10.4	11.6 11.2 - 12.8	14.9 14.8 – 15.4
Arthur Kill	9	N 40.609615 W 74.205865	1.16	2.02	7.5 7.5 – 8.4	10.4 9.9 - 10.8	11.7 11.5 - 12.8	14.9 14.8 – 15.5
Arthur Kill	10	N 40.604288 W 74.205772	1.28	2.01	7.5 7.5 - 7.6	10.4 10.4 - 10.5	11.7 11.6 - 11.8	14.9 14.9 - 15.2

Wave runup is defined as the maximum vertical extent of wave uprush on a beach or structure. FEMA's 2007 Guidelines and Specifications require the 2-percent wave runup level be computed for the coastal feature being evaluated (cliff, coastal bluff, dune, or structure) (FEMA, 2007a). The 2-percent runup level is the highest 2-percent of wave runup affecting the shoreline during the 1-percent-annual-chance flood event. Each transect defined within the Region II study area was evaluated for the applicability of wave runup, and if necessary, the appropriate runup methodology was selected and applied to each transect. Runup elevations were then compared to WHAFIS results to determine the dominant process affecting BFEs and associated flood hazard levels. Based on wave runup rates, wave overtopping was computed following the FEMA 2007 Guidelines and Specifications.

The results of the overland wave height and runup calculations are accurate until local topography, vegetation, or cultural development within the community undergoes major changes. Consequently between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the extent of coastal flood zones.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard area. The USACE has established the 3-foot breaking wave as the

criterion for identifying the limit of coastal high hazard area. The 3-foot wave has been determined to be the minimum size wave capable of causing major damage to conventional wood frame of brick veneer structures. The one exception to the 3-foot wave criteria is where a primary frontal dune exists. The limit of the coastal high hazard area then becomes the landward toe of the primary frontal dune or where a 3-foot or greater breaking wave exists, whichever is most landward. The coastal high hazard zone is depicted on the FIRMs as Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet. Zone AE is depicted on the FIRMs where the delineated flood hazard includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 3, “Transect Schematic”.

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area (FEMA, 2008). Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE, see Figure 3, "Transect Schematic".

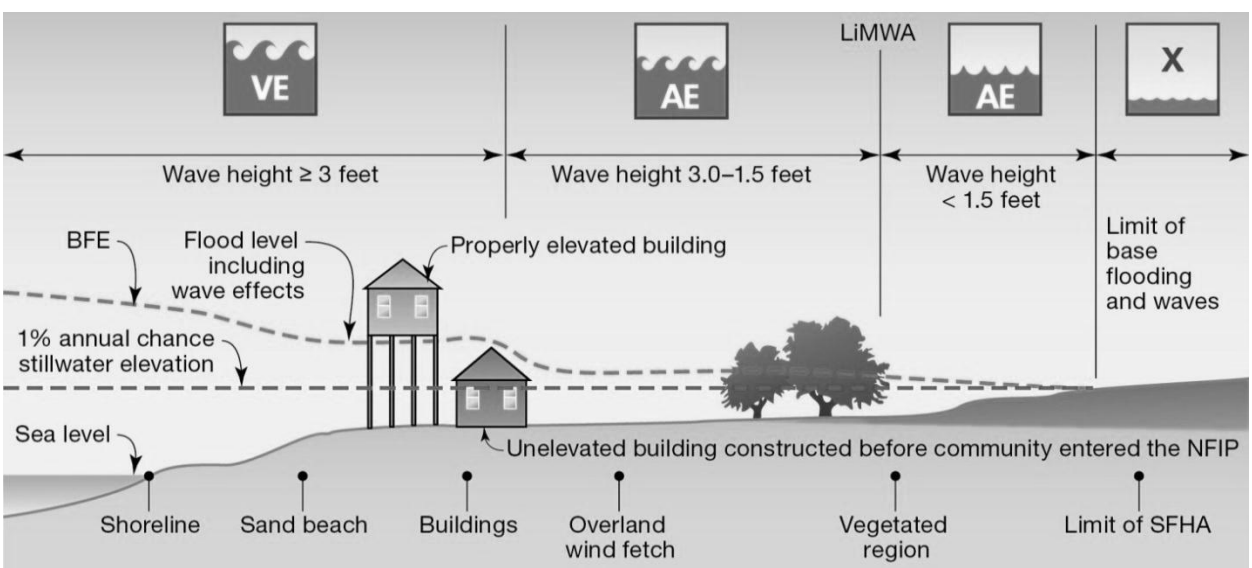

Figure 3 – Transect Schematic

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was NGVD 29. With the completion of the NAVD 88, many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

Not all of the flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. For FIRM panels and Flood Profiles not associated with this revision, flood elevations are referenced to NGVD 29 and will be updated in the near future. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

As noted above, the elevations shown in this FIS report and on the FIRM for the revised panels (34039C0014G, 34039C0015G, 34039C0023G, 34039C0024G, 34039C0025G, 34039C0026G, 34039C0033G, 34039C0034G, 34039C0035G, 34039C0036G, 34039C0043G, 34039C0044G, 34039C0045G, 34039C0046G, 34039C0047G, and 34039C0048G) in Union County are referenced to NAVD 88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor. The conversion factor to NGVD 29 is +1.03 foot. The conversion between datum may be expressed as an equation:

$$\text{NAVD 88} = \text{NGVD 29} - 1.03 \text{ foot}$$

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For information regarding conversion between the NGVD 29 and NAVD 88, visit the National Geodetic Survey (NGS) website at www.ngs.noaa.gov, or contact the NGS at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282
Fax: (301) 713-4172, or
Telephone: (301) 713-3242

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic and orthophoto topographic maps.

For the September 20, 2006, FIS, for each stream studied by detailed methods, the 1- and 0.2-percent annual chance floodplain boundaries were combined into a single countywide FIS. A description of how those floodplains were determined from the community based studies is described below.

For the Township of Berkeley Heights, in the 1978 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Aero Science Corporation, 1960). In the 1992 revision, the boundaries between cross sections were interpolated using topographic maps at a scale of 1"=100' with a contour interval of 2 feet (Aero Science Corporation, 1960; Robinson Aerial Surveys, Inc., March 1974). For the

1999 revision, the boundaries between cross sections were interpolated using topographic maps at a scale of 1"=200' with a contour interval of 1 foot and USGS topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (NJDEP, 1987; U.S. Department of Interior, 1981). In the 2001 revision, the boundaries between cross sections were interpolated using topographic maps at a scale of l "=200' with a contour interval of 2 feet (Aerial Reduction Associates, 1978).

For the Township of Clark, in the 1982 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (USACE, 1973c).

For the Township of Cranford, in the 1982 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 2 feet (Aerial Reduction Associates, 1973).

For the Borough of Garwood, in the 1988 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:200 with a contour interval of 2 feet and at a scale of 1:1,200 with a contour interval of 2 feet (Aerial Reduction Associates, 1973; Robinson Aerial Surveys, 1976).

For the Township of Hillside, in the 1979 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (Geod-Aerial Mapping, Inc., March 1976).

For the Borough of Kenilworth, in the 1982 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1"=200' with a contour interval of 5 feet (Topographic Data Consultants, Inc., March 1979b).

For the Borough of Mountainside, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Aero Sciences Corporation, April 1967).

For the Borough of New Providence, in the 1994 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (U.S. Department of the Interior, 1955; photorevised 1981). In the 2001 revision, the boundaries between cross sections were interpolated using topographic maps at a scale of l "=200', with a contour interval of 2 feet (Aerial Data Reduction Associates, April 1978).

For the City of Plainfield, in the 1983 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet for Green Brook and topographic maps at a scale of 1:2,400 with a contour interval of 2 feet for Cedar Brook (Topographic Data Consultants, Inc., March 1979a; Quinn and Associates, Inc., March 1968).

For the Borough of Roselle, in the 1978 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:6,000, with a contour interval of 2 feet (Hudson, Franklin, December 1962).

For the Borough of Roselle Park, in the 1980 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Borough of Roselle Park, 1970). In the 1997 revision, the boundaries between cross sections were interpolated using topographic maps at a scale of l "=100' with a contour interval of 2 feet (M. Disko Associates, Unpublished).

For the Township of Scotch Plains, in the 2001 FIS, the boundaries between cross sections were interpolated using topographic maps at scales of 1:4,800 and 1:6,000 with a contour interval of 2 feet (Township of Scotch Plains, 1967), using NJDEP Floodway and Flood Hazard Area Delineation maps at a scale of 1"=200' with a contour interval of 1 foot, and topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (NJDEP, 1987; U.S. Department of Interior, 1955; photorevised 1981).

For the Township of Springfield, in the 1982 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 2 feet (Township of Springfield Topographic Maps, Unpublished).

For the City of Summit, in the 1977 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (U.S. Department of the Interior, 7.5-Minute Series Topographic Maps). In the 2002 revision, the boundaries between cross sections were interpolated using USGS 15-Minute Series Topographic Maps at a scale of 1:24,000 with a contour interval of 10 feet (U.S. Department of the Interior, 1981).

For the Town of Westfield, in the 1979 FIS, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:1,200, with a contour interval of 2 feet, prepared by photogrammetric methods from aerial photographs (Westfield Aerial Survey, 1971).

In the Borough of Fanwood, boundaries were delineated using topographic maps at a scale of l"=100', with a contour interval of 2 feet (Borough of Fanwood, 1992).

For the Rahway River floodplain, the boundaries between cross sections were interpolated using topographic maps at a scale of 1:1,200, with a contour interval of 2 feet and at a scale of 1:2,400, with a contour interval of 5 feet (Topographic Data Consultants, 1979a). This delineation was supplemented by detailed survey information submitted by the Township of Cranford.

In cases where the 1- and 0.2-percent annual chance flood boundaries are close together, only the 1-percent annual chance flood boundary has been shown.

Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44CFR Part 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1-percent annual chance flood protection. As such, the floodplain boundaries in this area were taken directly from the previously effective FIRM and are subject to change. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information on how this may affect the floodplain boundaries shown on the FIRM.

For [TBD], FIS revision, the 1- and 0.2-percent annual chance floodplain boundaries for the Elizabeth River, from the confluence of Arthur Kill to approximately 340 feet upstream of Trotter Lane, were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using Geographic Information Software and LiDAR obtained from the LiDAR acquisition initiative led by the USGS in 2006 for the metropolitan New Jersey Area.

For the areas studied by approximate methods, the boundary of the 1-percent annual chance flood was delineated using maps from the USACE Elizabeth River Flood Control Project (USACE, July 1981). The approximate flood boundary was delineated around detention ponds at an elevation equivalent to the 1-percent annual chance flood on the Elizabeth River, information supplied by Borough of Garwood officials and from backwater effects from Garwood Brook, the boundary of the 1-percent annual chance flood was based on depth-discharge-frequency relationships for non-coastal plain sites in New Jersey for the mean annual flood and field investigations (State of New Jersey, 1964), using the Flood Hazard Boundary Map for the Borough of Kenilworth (FEMA, 1973), were delineated on the community street map at a scale of l "=600' (Plainfield, 1976), using information supplied by the borough engineer through field investigations, and delineated using topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Borough of Roselle Park, April 1970). For the section of East Branch Green Brook that was studied by approximate methods, the 100-year floodplain was estimated from field inspection of the floodplains and information supplied by Township of Scotch Plains officials.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 1). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AO, and VE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood

elevations, but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

New Jersey Flood Hazard Area Design Flood (NJFHADF)

The State of New Jersey, Department of Environmental Protection (the Department) is mandated to delineate and regulate flood hazard areas pursuant to N.J.S.A. 58:16A-50 et seq., the Flood Hazard Area Control Act. This Act authorizes the Department to adopt land use regulations for development within the flood hazard areas, to control stream encroachments and to integrate the flood control activities of the municipal, county, State and Federal Governments.

The State's Flood Hazard Area delineations are defined by the New Jersey Flood Hazard Area Design Flood. In 1974, the Water Policy and Supply Council passed a resolution stating that the New Jersey Flood Hazard Area Design Flood shall be equal to a design flood discharge 25-percent greater in flow than the 100 year or 1- percent annual chance flood. In addition, the floodway shall be based on encroachments that produce no more than a 0.2 foot water surface rise above the 100 year or 1-percent annual chance flood. These flood hazard area delineations must be adopted by NJDEP.

For the Elizabeth River, from the confluence with Arthur Kill to approximately 340 feet upstream of Trotter Lane, the NJFHADF floodplain boundary was delineated in addition to the 1- and 0.2-percent-annual-chance boundaries. The NJFHADF is equal to the 0.2-percent annual chance flood.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot and the State of New Jersey standards limit the increase to 0.2 feet, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be

adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (See Table 8, "Floodway Data"). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Please note that portions of the floodways for East Branch Rahway River, Green Brook, Rahway River, Passaic River, and Van Winkles Brook extend beyond the county boundary.

The areas of the Lenape Park Stormwater Retention Basin and Nomahegan Lake have been delineated as floodways to prevent encroachment in these valuable storage areas. For some portions of Gallows Hill Road Branch and for the entire length of the Drainage Ditch within Cranford, the floodway is coincident with the channel banks. The floodway for the Drainage Ditch was taken from the FIS for the Borough of Kenilworth.

Within the City of Elizabeth, since the 1-percent annual chance flood is always contained either within the Elizabeth River levee or within the channelization, the floodway presented in this study is shown on the land side toe of the levee when along the levee, and along the channel bank where the 1-percent chance annual flood is contained within the channel. This is to insure that no development will occur on the levee, on the river side of the levee, or within the channel. Since the floodway along the Elizabeth River was defined by regulatory constraints and not by encroachment, there are no surcharges, and no cross sections are shown on the FIRM or on the Flood Profiles.

For the Elizabeth River within the Townships of Hillside and Union, the floodway is not based on hydraulic modeling and is to be considered an administrative floodway. The floodway was taken from the previously effective FIRMs for the Townships of Hillside and Union, except in areas where the effective floodway boundaries were outside the revised 1-percent annual chance floodplain. In these areas, the floodway was made coincident with the 1-percent annual chance floodplain.

Within the City of Linden, no floodway was computed for Kings Creek. No floodway was computed for Arthur Kill, Rahway River, Morses Creek, Piles Creek, and Marshes Creek because they are tidal.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood

hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 8, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 8 for certain downstream cross sections of Black Brook, Branch 10-30-1, Branch 10-34, Bryant Brook, Bryant Brook Branch, College Branch, Drainage Ditch, Gallows Hill Road Branch, Garwood Brook, Lehigh Valley Branch, Lightning Brook, Pumpkin Patch Brook, Rahway River, Robinsons Branch, South Branch, Stream 10-30, Tributary A, Van Winkles Brook, Vauxhall Branch, and Vauxhall Subbranch are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

The following streams do not have any Floodway Data table information: Branch West Brook, Kings Creek, Nomahegan Brook-Echo Lake, Robinsons Branch 15-1, Robinsons 15-2, and West Branch West Brook.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the WSEL of the base flood more than 0.2 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4, "Floodway Schematic."

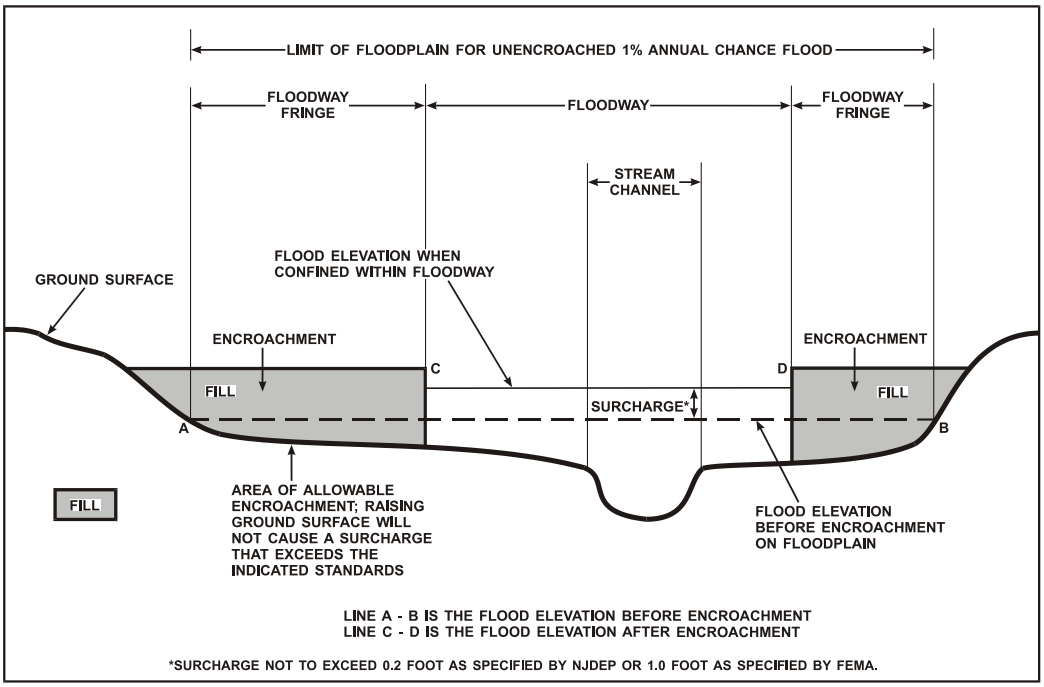

Figure 4 – Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Elizabeth River								
A	20,738	161	*	*	22.1	22.1	*	*
B	21,685	304	*	*	23.9	23.9	*	*
C	23,125	192	*	*	28.6	28.6	*	*
D	24,525	100	*	*	32.8	32.8	*	*
E	25,343	86	*	*	34.4	34.4	*	*
F	26,931	190	*	*	37.0	37.0	*	*
G	28,363	100	*	*	39.0	39.0	*	*
H	29,069	200	*	*	40.1	40.1	*	*
I	31,349	125	*	*	43.4	43.4	*	*
J	32,549	300	*	*	46.1	46.1	*	*
K	33,894	60	*	*	48.1	48.1	*	*
L	35,481	200	*	*	52.8	52.8	*	*
M	36,763	141	*	*	56.3	56.3	*	*
N	37,961	130	*	*	61.3	61.3	*	*
O	39,377	52	*	*	70.4	70.4	*	*

[1]Feet above confluence with Arthur Kill

*Data not available, administrative floodway, see Section 4.2 for detailed explanation

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

ELIZABETH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Irvington Branch								
A	280[1]	244	914	1.3	78.8	78.8	78.9	0.1
B	820[1]	25	101	11.5	80.3	80.3	80.3	0.0
C	995[1]	26	156	7.4	83.1	83.1	83.1	0.0
D	1,280[1]	300	862	1.3	89.4	89.4	89.4	0.0
E	1,525[1]	*	*	*	89.5	89.5	*	*
F	2,147[1]	*	*	*	96.6	96.6	*	*
G	2,338[1]	*	*	*	100.5	100.5	*	*
H	2,784[1]	*	*	*	106.6	106.6	*	*
I	3,069[1]	*	*	*	111.9	111.9	*	*
Jouet Brook								
A	2,025[2]	13	29	8.6	27.7	27.7	27.7	0.0
B	2,320[2]	13	37	6.7	27.7	27.7	27.7	0.0
C	2,690[2]	13	35	6.2	28.6	28.6	28.6	0.0
D	3,090[2]	13	45	4.2	30.3	30.3	30.3	0.0
E	3,380[2]	13	37	5.1	30.5	30.5	30.5	0.0
F	3,600[2]	12	32	5.4	31.2	31.2	31.2	0.0
G	4,360[2]	26	61	2.7	33.4	33.4	33.4	0.0
H	5,320[2]	22	43	2.8	34.9	34.9	34.9	0.0
I	5,580[2]	7	13	8.2	35.2	35.2	35.2	0.0
J	6,510[2]	7	19	5.8	38.4	38.4	38.4	0.0

[1]Feet above confluence with Lightning Brook
[2]Feet above confluence with Peach Orchard Brook
*Floodway contained in channel

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

IRVINGTON BRANCH
JOUET BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Jouet Brook (Cont'd)								
K	6,944[1]	24	80	4.1	40.8	40.8	40.8	0.0
L	7,465[1]	20	63	4.6	43.2	43.2	43.3	0.1
M	8,159[1]	18	59	4.4	49.0	49.0	49.0	0.0
N	8,526[1]	48	195	1.3	53.5	53.5	54.3	0.8
O	8,814[1]	31	102	2.4	54.1	54.1	54.8	0.7
Lehigh Valley Branch								
A	50[2]	698	5,137	0.2	38.5	38.5[3]	38.7	0.2
B	551[2]	513	2,218	0.4	38.5	38.5[3]	38.7	0.2
C	1,513[2]	24	78	10.4	39.6	39.6	39.6	0.0
D	1,935[2]	124	178	3.8	45.7	45.7	45.7	0.0
E	2,440[2]	63	114	6.0	48.2	48.2	48.2	0.0
F	3,081[2]	229	253	2.7	52.0	52.0	52.1	0.1
G	4,016[2]	10	52	13.1	58.1	58.1	58.1	0.0

[1]Feet above confluence with Peach Orchard Brook
[2]Feet above confluence with Elizabeth River
[3]Elevation computed without consideration of backwater effects from Elizabeth River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

JOUET BROOK
LEHIGH VALLEY BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Lightning Brook								
A	100[1]	812	5,159	0.4	54.2	54.2[4]	54.2	0.0
B	1,412[1]	52	301	7.3	55.0	55.0	55.2	0.2
C	2,460[1]	43	255	8.7	60.9	60.9	60.9	0.0
D	2,900[1]	51	290	7.6	62.4	62.4	62.5	0.1
E	3,966[1]	60	582	3.8	74.5	74.5	74.7	0.2
F	4,556[1]	58	522	4.2	75.1	75.1	75.3	0.2
G	4,942[1]	221	578	3.6	78.1	78.1	78.3	0.2
Maplewood Branch								
A	515[2]	77	367	3.0	78.4	78.4	78.4	0.0
B	1,880[2]	70	933	0.7	81.5	81.5	81.5	0.0
Orchard Creek								
A	980[3]	65	352	2.4	16.6	16.6	16.6	0.0
B	2,068[3]	90	438	2.0	17.5	17.5	17.5	0.0
C	2,440[3]	131	324	2.6	17.8	17.8	18.0	0.2
D	2,752[3]	120	339	2.5	18.7	18.7	18.8	0.1
E	3,736[3]	137	163	5.3	20.9	20.9	20.9	0.0
F	4,196[3]	143	368	2.3	21.9	21.9	22.0	0.1
G	4,660[3]	120	199	4.3	24.3	24.3	24.4	0.1
H	5,254[3]	69	136	6.3	29.8	29.8	29.8	0.0

[1]Feet above confluence with Elizabeth River
[2]Feet above confluence with Lightning Brook
[3]Feet above confluence with South Branch Rahway River
[4]Elevation computed without consideration of backwater effects from Elizabeth River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

LIGHTNING BROOK - MAPLEWOOD BRANCH ORCHARD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Peach Orchard Brook								
A	90	230	1,324	1.0	*	*	*	*
B	1,110	315	2,435	0.5	*	*	*	*
C	2,190	195	1,310	1.0	*	*	*	*
D	2,810	325	2,147	0.6	*	*	*	*
E	3,390	185	589	2.2	10.7	10.7	10.9	0.2
F	4,020	208	1,209	1.1	11.5	11.5	11.6	0.1
G	4,370	115	693	1.9	11.7	11.7	11.8	0.1
H	4,940	36	235	5.6	12.4	12.4	12.5	0.1
I	5,330	57	236	5.5	13.2	13.2	13.3	0.1
J	5,690	25	187	4.5	15.1	15.1	15.3	0.2
K	6,140	82	246	3.4	17.3	17.3	17.5	0.2
L	6,770	350	1,449	0.8	21.4	21.4	21.4	0.0
M	7,140	308	806	1.4	21.7	21.7	21.7	0.0
N	7,640	230	935	1.2	23.8	23.8	23.8	0.0
O	8,040	267	883	1.3	23.9	23.9	23.9	0.0
P	8,400	360	1,945	0.6	24.0	24.0	24.1	0.1
Q	8,820	185	851	1.3	24.0	24.0	24.1	0.1
R	9,080	31	157	3.2	25.1	25.1	25.2	0.1
S	9,530	34	134	3.8	26.4	26.4	26.4	0.0
T	9,710	208	372	1.2	27.5	27.5	27.7	0.2
U	10,830	531	2,506	0.2	31.9	31.9	32.1	0.2
V	11,330	330	1,816	0.3	31.9	31.9	32.1	0.2

[1]Feet above confluence with West Brook

*Coastal analyses supersedes riverine, floodway shown for administrative purposes

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

PEACH ORCHARD BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Rahway River								
A	4,268	205[2]	4,541	2.1	*	*	*	*
B	7,680	390[2]	4,735	2.0	*	*	*	*
C	9,632	218[2]	4,108	2.3	*	*	*	*
D	12,622	182[2]	2,567	3.6	*	*	*	*
E	15,524	300[2]	3,743	2.5	*	*	*	*
F	17,386	185[2]	3,317	2.8	*	*	*	*
G	20,292	350	2,481	3.8	*	*	*	*
H	22,337	279	2,064	4.5	*	*	*	*
I	22,939	194	1,824	5.1	*	*	*	*
J	25,144	214	1,893	4.4	*	*	*	*
K	26,541	132	1,030	8.1	*	*	*	*
L	28,089	355	1,885	3.3	13.3	13.3	13.3	0.0
M	29,899	538	4,274	1.4	14.9	14.9	15.0	0.1
N	32,259	131	880	7.0	17.7	17.7	17.8	0.1
O	34,300	344	2,461	2.5	21.9	21.9	22.1	0.2
P	36,463	249	1,435	4.3	22.8	22.8	23.0	0.2
Q	38,376	252	2,154	2.9	26.5	26.5	26.6	0.1
R	42,096	404	1,628	3.8	29.8	29.8	29.9	0.1
S	44,906	285	1,914	3.2	33.3	33.3	33.3	0.0
T	50,390	271	2,480	2.5	49.8	49.8	50.0	0.2
U	54,395	267	1,797	3.4	51.6	51.6	51.8	0.2

[1]Feet above confluence with Arthur Kill

[2]Width within Union County

*Coastal analyses supersedes riverine, floodway shown for administrative purposes

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RAHWAY RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Rahway River (Cont'd)								
V	55,841	131	1,039	5.9	52.0	52.0	52.2	0.2
W	60,138	285	2,070	3.0	60.9	60.9	61.1	0.2
X	62,142	227	1,384	4.5	63.2	63.2	63.3	0.1
Y	63,633	205	1,991	3.1	67.1	67.1	67.2	0.1
Z	66,160	262	1,679	3.7	68.8	68.8	69.0	0.2
AA	68,324	260	1,957	3.2	70.2	70.2	70.4	0.2
AB	70,227	255	2,509	2.5	70.7	70.7	70.9	0.2
AC	72,530	861	7,863	0.8	71.2	71.2	71.4	0.2
AD	74,930	461	3,821	1.7	71.8	71.8	72.0	0.2
AE	78,959	711	4,393	1.5	73.6	73.6	73.7	0.1
AF	81,879	203	2,103	3.1	79.6	79.6	79.8	0.2
AG	84,674	453	3,684	1.7	82.5	82.5	82.5	0.0
AH	88,894	386	4,223	1.1	85.2	85.2	85.4	0.2
AI	94,428	458	2,631	1.8	85.9	85.9	86.1	0.2
AJ	95,114	196	2,048	2.3	89.9	89.9	90.1	0.2
AK	95,721	112	1,476	3.2	90.2	90.2	90.4	0.2

[1]Feet above confluence with Arthur Kill

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RAHWAY RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Robinsons Brnach								
A	0.036	280	1,470	2.5	13.3	10.3[2]	10.5	0.2
B	0.119	59	554	6.8	13.3	11.0[2]	11.2	0.2
C	0.170	61	775	4.8	13.3	13.1[2]	13.2	0.1
D	0.277	186	1,238	3.0	15.0	15.0	15.1	0.1
E	0.374	234	1,882	2.0	15.5	15.5	15.6	0.1
F	0.488	60	656	5.7	15.8	15.8	16.0	0.2
G	0.623	470	3,812	1.0	16.9	16.9	17.0	0.1
H	0.807	167	642	5.8	17.3	17.3	17.3	0.0
I	0.854	350	1,728	2.2	18.0	18.0	18.2	0.2
J	0.955	404	1,572	2.4	18.8	18.8	19.0	0.2
K	1.184	480	1,424	2.6	20.6	20.6	20.7	0.1
L	1.384	342	1,997	1.8	22.5	22.5	22.6	0.1
M	1.521	450	2,200	1.6	22.9	22.9	23.0	0.1
N	1.733	297	1,406	2.5	25.2	25.2	25.2	0.0
O	1.902	297	1,406	2.5	25.9	25.9	25.9	0.0
P	2.241	41	287	12.3	29.6	29.6	29.6	0.0
Q	2.252	42	352	10.0	31.6	31.6	31.6	0.0
R	2.339	166	2,171	1.6	46.7	46.7	46.7	0.0
S	2.428	500	5,612	0.6	46.7	46.7	46.7	0.0
T	2.920	409	3,468	1.0	46.7	46.7	46.7	0.0
U	3.104	610	5,329	0.7	47.0	47.0	47.0	0.0

[1]Miles above confluence with Rahway River

[2]Elevation computed without consideration of backwater effects from Rahway River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

ROBINSONS BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Robinsons Branch (Cont'd)								
V	3.636	99	780	4.5	47.0	47.0	47.0	0.0
W	3.684	259	2,136	1.7	47.3	47.3	47.4	0.1
X	3.849	127	1,218	2.9	47.4	47.4	47.5	0.1
Y	4.083	190	1,042	2.4	48.5	48.5	48.7	0.2
Z	4.248	265	1,668	1.5	49.1	49.1	49.3	0.2
AA	4.437	435	2,466	1.0	49.5	49.5	49.7	0.2
AB	4.681	195	1,041	2.4	50.1	50.1	50.3	0.2
AC	4.933	115	788	3.1	51.4	51.4	51.5	0.1
AD	5.075	110	530	4.0	52.4	52.4	52.6	0.2
AE	5.202	209	656	3.2	54.6	54.6	54.7	0.1
AF	5.262	200	722	2.9	55.5	55.5	55.6	0.1
AG	5.364	200	1,719	1.2	56.0	56.0	56.2	0.2
AH	5.448	290	2,323	0.9	56.2	56.2	56.4	0.2
AI	5.565	885	6,668	0.3	56.3	56.3	56.5	0.2
AJ	5.728	995	8,222	0.3	56.3	56.3	56.5	0.2
AK	5.901	1,190	11,486	0.2	57.0	57.0	57.2	0.2
AL	6.082	1,430	13,952	0.1	57.0	57.0	57.2	0.2
AM	6.256	1,425	12,925	0.2	57.0	57.0	57.2	0.2
AN	6.764	150	6,361	0.3	57.0	57.0	57.2	0.2

[1]Miles above confluence with Rahway River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

ROBINSONS BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
South Branch Rahway River								
A	0.042[1]	122	711	3.9	*	*	*	*
B	0.100[1]	160	578	4.8	*	*	*	*
C	0.129[1]	170	702	3.9	*	*	*	*
D	0.263[1]	145	871	3.2	*	*	*	*
E	0.367[1]	180	885	3.1	*	*	*	*
F	0.487[1]	165	1,094	2.5	*	*	*	*
G	0.600[1]	125	528	5.2	*	*	*	*
H	0.693[1]	100	558	4.9	*	*	*	*
I	0.830[1]	46	450	6.1	*	*	*	*
J	0.850[1]	100	481	5.7	*	*	*	*
K	0.945[1]	200	1,795	1.5	12.4	12.4	12.5	0.1
L	1.091[1]	175	970	2.8	12.6	12.6	12.8	0.2
M	1.195[1]	325	2,165	1.3	13.3	13.3	13.5	0.2
Southwest Branch								
A	120[2]	143	416	1.5	78.8	78.8	79.0	0.2
B	537[2]	379	653	1.0	79.1	79.1	79.3	0.2
C	1,076[2]	131	176	3.5	80.9	80.9	80.9	0.0
D	1,473[2]	280	332	1.9	82.5	82.5	82.7	0.2
E	2,300[2]	150	317	2.0	86.3	86.3	86.3	0.0

[1]Miles above confluence with Rahway River

[2]Feet above confluence with Maplewood Branch

*Coastal analyses supersedes riverine, floodway shown for administrative purposes

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

SOUTH BRANCH RAHWAY RIVER
SOUTHWEST BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Trotters Lane Branch								
A	1,120[1]	245	1,078	0.7	26.2	26.2	26.4	0.2
B	2,035[1]	31	80	9.1	27.0	27.0	27.0	0.0
C	3,145[1]	14	39	9.6	37.0	37.0	37.0	0.0
D	3,799[1]	114	259	1.3	42.7	42.7	42.9	0.2
E	4,561[1]	240	565	0.7	47.8	47.8	48.0	0.2
F	5,104[1]	19	32	7.3	48.5	48.5	48.5	0.0
G	5,225[1]	10	27	8.7	49.3	49.3	49.4	0.1
Vauxhall Branch								
A	430[2]	181	2,414	0.5	89.7	88.5[3]	88.7	0.2
B	1,500[2]	846	7,502	0.1	89.7	88.7[3]	88.7	0.0
C	2,520[2]	755	3,158	0.1	89.7	88.7[3]	88.7	0.0
D	5,430[2]	240	1,354	0.3	102.7	102.7	102.7	0.0
E	6,010[2]	10	37	11.1	109.7	109.7	109.7	0.0
F	6,390[2]	86	160	2.6	114.8	114.8	114.8	0.0
G	7,640[2]	46	72	5.7	128.3	128.3	128.3	0.0

[1]Feet above mouth
[2]Feet above confluence with Rahway River
[3]Elevation computed without consideration of backwater effects from the Rahway River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

TROTTERS LANE BRANCH
VAUXHALL BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
West Branch Elizabeth River								
A	900	344	1,550	0.5	41.7	41.7	41.9	0.2
B	1,573	151	210	3.6	43.3	43.3	43.3	0.0
C	2,900	42	90	8.4	49.3	49.3	49.3	0.0
D	3,764	29	119	6.4	53.0	53.0	53.0	0.0
E	4,650	154	565	1.4	54.3	54.3	54.3	0.0
F	5,170	42	202	3.8	54.4	54.4	54.5	0.1
G	5,970	11	61	10.5	54.2	54.2	54.4	0.2
H	7,100	719	7,059	0.1	57.5	57.5	57.5	0.0
I	7,950	800	8,393	0.1	57.5	57.5	57.5	0.0
J	8,650	645	2,295	0.3	57.5	57.5	57.5	0.0
K	9,046	47	239	2.7	57.5	57.5	57.5	0.0
L	9,668	67	286	2.8	58.4	58.4	58.4	0.0
M	10,290	46	282	2.8	58.9	58.9	59.0	0.1
N	11,500	247	1,308	0.6	58.9	58.9	59.0	0.1

[1]Feet above confluence with Elizabeth River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

WEST BRANCH ELIZABETH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
West Brook								
A	440	550	5,558	0.4	*	*	*	*
B	1,600	442	3,961	0.5	*	*	*	*
C	2,800	563	4,606	0.4	*	*	*	*
D	3,510	330	1,462	1.2	*	*	*	*
E	4,540	80	638	2.8	*	*	*	*
F	5,050	68	547	3.1	*	*	*	*
G	5,500	82	669	2.5	*	*	*	*
H	5,970	90	516	3.2	*	*	*	*
I	6,370	95	712	2.4	*	*	*	*
J	6,725	50	382	4.4	*	*	*	*
K	7,210	46	295	5.3	*	*	*	*
L	7,910	54	297	5.3	*	*	*	*
M	8,515	53	278	5.7	12.7	12.7	12.8	0.1
N	9,000	55	271	5.8	13.8	13.8	13.9	0.1
O	9,440	60	189	7.5	14.6	14.6	14.7	0.1
P	10,050	30	180	7.8	15.7	15.7	15.7	0.0
Q	10,680	24	192	7.2	18.9	18.9	18.9	0.0
R	10,970	24	194	6.7	19.6	19.6	19.6	0.0
S	11,500	24	166	7.8	19.9	19.9	19.9	0.0
T	12,060	24	135	9.6	20.2	20.2	20.2	0.0
U	12,880	24	115	11.0	22.1	22.1	22.1	0.0

[1]Feet above confluence with Morses Creek

*Coastal analyses supersedes riverine, floodway shown for administrative purposes

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

WEST BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
West Brook (Cont'd)								
V	13,710	23	143	8.6	25.3	25.3	25.3	0.0
W	14,270	23	102	12.0	26.5	26.5	26.5	0.0
X	15,130	22	112	10.6	29.9	29.9	29.9	0.0
Y	15,700	22	98	12.1	31.3	31.3	31.4	0.1
Z	16,120	50	113	10.7	33.3	33.3	33.3	0.0
AA	16,320	22	109	11.1	33.7	33.7	33.7	0.0
AB	18,140	22	111	10.3	38.8	38.8	38.8	0.0
AC	18,650	28	162	7.0	41.2	41.2	41.2	0.0
AD	19,390	25	136	7.5	43.2	43.2	43.2	0.0
AE	19,900	51	256	3.8	47.3	47.3	47.3	0.0
AF	20,960	90	701	1.3	49.0	49.0	49.1	0.1
AG	21,630	150	546	1.7	49.6	49.6	49.7	0.1
AH	22,730	49	171	3.0	53.3	53.3	53.4	0.1
AI	23,480	33	134	3.9	55.6	55.6	55.7	0.1
AJ	24,050	145	234	2.2	57.7	57.7	57.7	0.0
AK	24,910	55	106	4.9	59.3	59.3	59.3	0.0
AL	25,570	57	231	2.3	61.5	61.5	61.6	0.1
AM	25,890	49	239	1.7	62.1	62.1	62.2	0.1
AN	26,110	90	681	3.2	63.9	63.9	64.1	0.2
AO	26,380	150	243	1.7	64.6	64.6	64.8	0.2
AP	27,700	33	99	3.1	65.0	65.0	65.2	0.2

[1]Feet above mouth confluence with Morses Creek

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

WEST BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
West Brook (Cont'd)								
AQ	30,860	335	1,735	0.3	72.4	72.4	72.6	0.2
AR	32,423	65	104	3.9	73.5	73.5	73.6	0.1
AS	32,681	31	110	3.7	74.2	74.2	74.3	0.1
AT	33,689	60	116	3.5	76.5	76.5	76.5	0.0
AU	34,520	24	85	4.4	79.9	79.9	80.0	0.1
AV	34,980	33	81	4.6	80.6	80.6	80.7	0.1
AW	36,640	33	181	1.7	86.7	86.7	86.9	0.2
AX	37,130	18	108	2.9	86.8	86.8	86.9	0.1

[1]Feet above confluence with Morses Creek

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY
UNION COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

WEST BROOK

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analysis. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the one percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analysis is not performed for such areas, no BFEs or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the one percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analysis is shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of one percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analysis is shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of one percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analysis is shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the one annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the one percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the one percent annual chance floodplain that will be protected by a Federal flood

protection system where construction has reached specified statutory milestones. No BFEs or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the one percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analysis is performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the one percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analysis is shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2 percent annual chance floodplain, areas within the 0.2 percent annual chance floodplain, and areas of one percent annual chance flooding where average depths are less than 1 foot, areas of one percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the one percent annual chance flood by levees. No BFEs or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

Within this jurisdiction there are one or more levees that have not been demonstrated by the community or levee owner(s) to meet the requirements of 44CFR Part 65.10 of the NFIP regulations as it relates to the levee's capacity to provide 1-percent annual chance flood protection. Please refer to the Notice to Flood Insurance Study Users page at the front of this FIS report for more information on how this may affect the FIRM.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use zones and BFEs in conjunction with information on structures and

their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analysis and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Union County. Historical data relating to the FIRMs prepared for each community, prior to the September 20, 2006, initial countywide FIS, are presented in Table 9, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Berkeley Heights, Township of	May 24, 1974	None	March 1, 1987	February 19, 1992 January 6, 1999 November 21, 2001
Clark, Township of	December 23, 1971	None	December 23, 1971	July 1, 1974 May 14, 1976 September 2, 1982
Cranford, Township of	September 2, 1970	None	June 25, 1971	July 1, 1974 January 30, 1976 February 16, 1983
Elizabeth, City of	May 22, 1970	None	May 8, 1971	July 1, 1974 December 26, 1975 August 27, 1976 December 1, 1978 November 1, 1985
Fanwood, Borough of[1]	N/A	N/A	N/A	
Garwood, Borough of	February 1, 1977	None	February 1, 1977	May 17, 1988
Hillside, Township of	January 9, 1974	None	September 14, 1979	
Kenilworth, Borough of	October 26, 1973	June 18, 1976	March 2, 1983	

[1] This community does not have map history prior to the first countywide mapping

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ (ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Linden, City of	June 7, 1974	July 16, 1976	November 24, 1976	March 2, 1994
Mountainside, Borough of	February 16, 1977	None	February 16, 1977	
New Providence, Borough of	November 23, 1973	None	November 23, 1973	July 1, 1974 February 6, 1976 September 3, 1976 May 16, 1994 December 20, 2001
Plainfield, City of	June 26, 1971	None	June 26, 1971	July 1, 1974 June 13, 1975 July 18, 1983 July 16, 1997
Rahway, City of	December 23, 1971	None	December 23, 1971	July 1, 1974 September 5, 1976 August 2, 1982 December 20, 2002
Roselle, Borough of	July 17, 1978	None	July 17, 1978	
Roselle Park, Borough of	April 22, 1977	None	June 4, 1980	November 5, 1997

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Scotch Plains, Township of	January 9. 1974	None	September 30, 1977	July 18, 1980 January 19, 2001
Springfield, Township of	October 13, 1971	None	October 13, 1971	July 1, 1974 January 9, 1976 August 2, 1982
Summit, City of	March 16, 1973	None	February 2, 1977	May 2, 2002
Union, Township of	May 11, 1973	None	August 1, 1978	
Westfield, Town of	December 18, 1979	None	December 18, 1979	
Winfield, Township of [1,2]	N/A	N/A	N/A	

[1] No Special Flood Hazard Areas Identified
[2] This community does not have map history prior to the first countywide mapping

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdicition within Union County has been compiled into this FIS. Therefore, this FIS either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

This is a multi-volume FIS. Each volume may be revised separately, in which case it supersedes the previously printed volume. Users should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, FEMA Region II, 26 Federal Plaza, Room 1351, New York, New York, 10278.

9.0 BIBLIOGRAPHY AND REFERENCES

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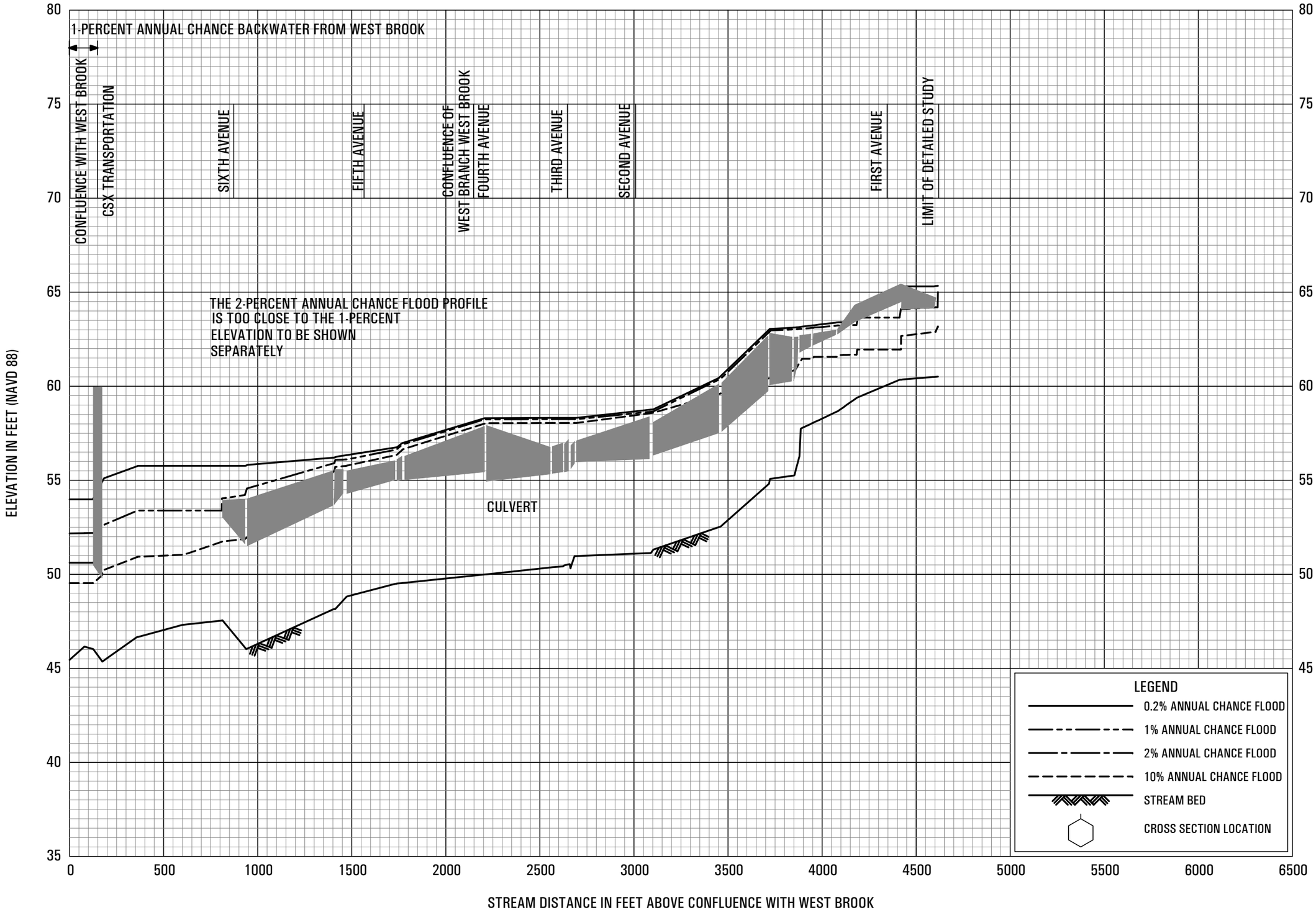


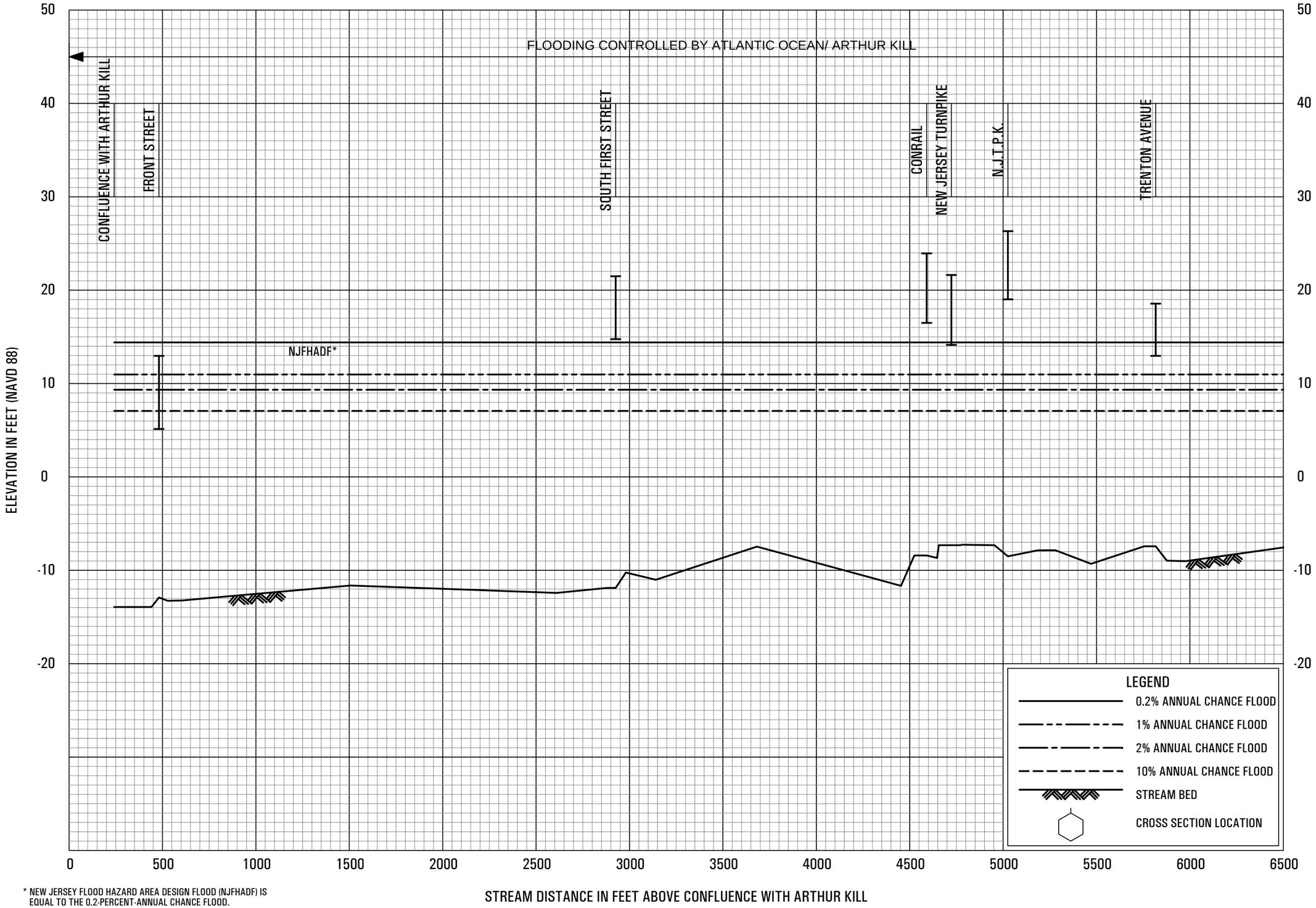
FLOOD PROFILES

BRANCH WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

AND INCORPORATED AREAS



* NEW JERSEY FLOOD HAZARD AREA DESIGN FLOOD (NJFHADF) IS EQUAL TO THE 0.2-PERCENT-ANNUAL CHANCE FLOOD.

FLOOD PROFILES

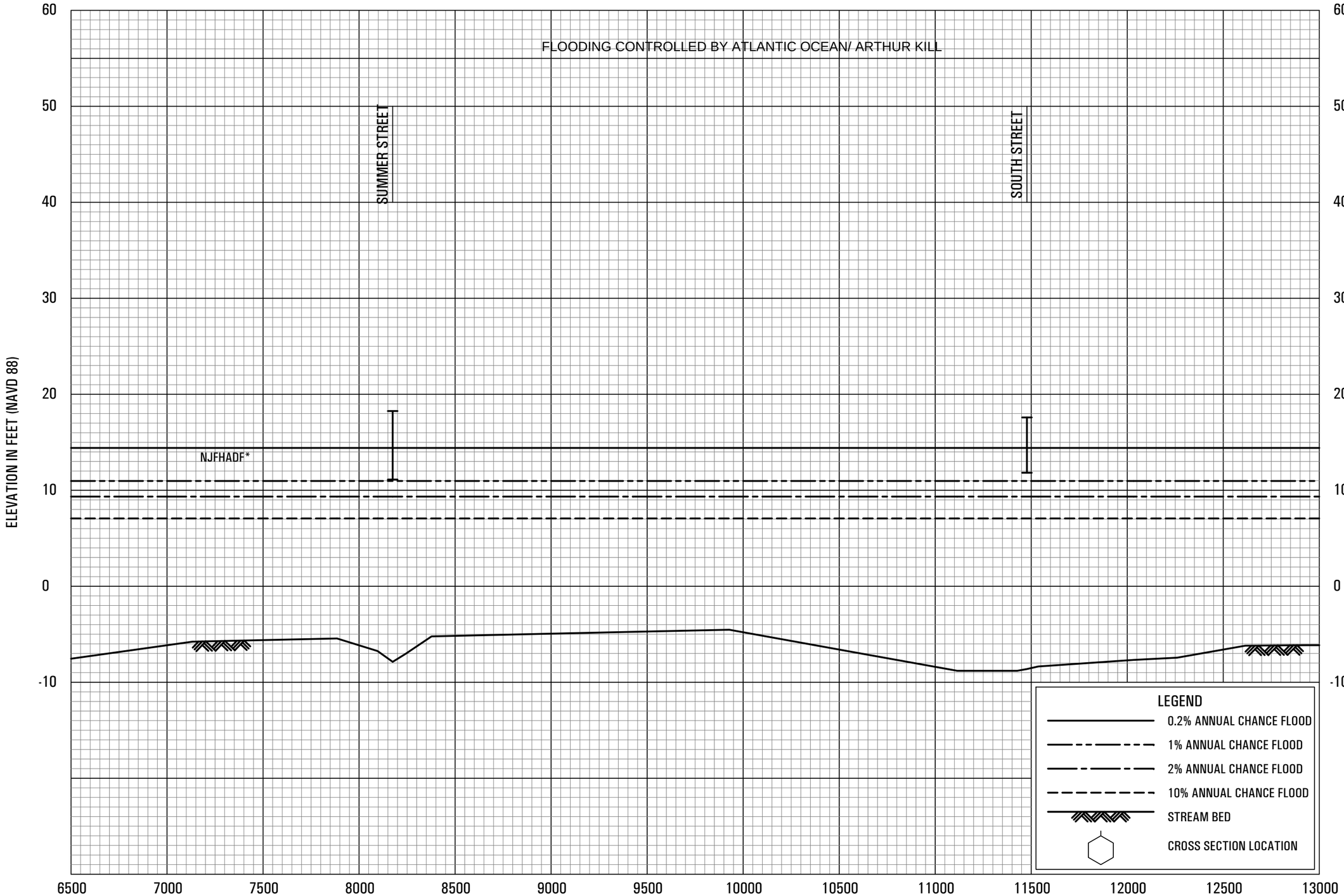
ELIZABETH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

38P



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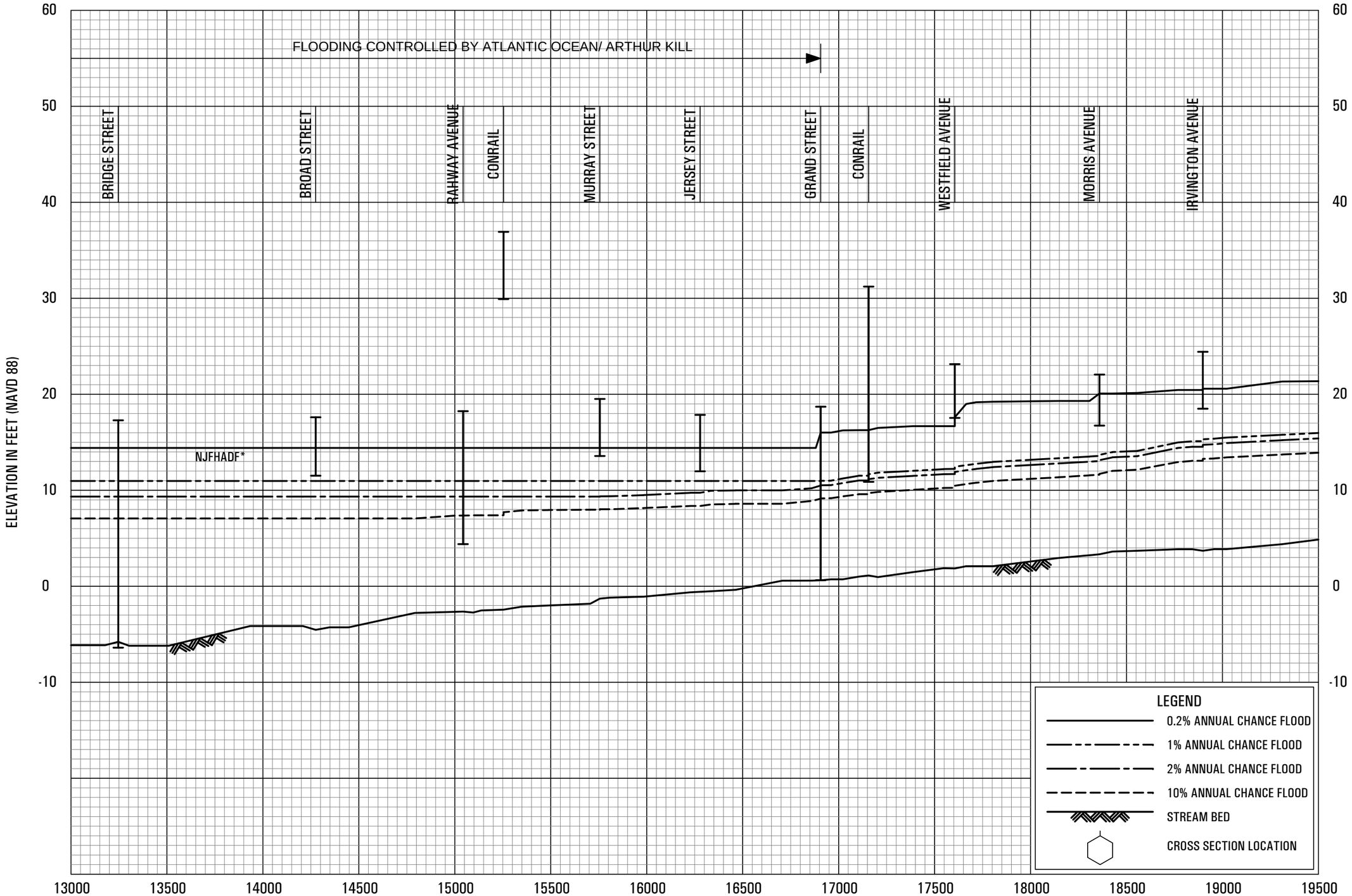
FLOOD PROFILES

ELIZABETH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



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FLOOD PROFILES

ELIZABETH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

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FLOOD PROFILES

ELIZABETH RIVER

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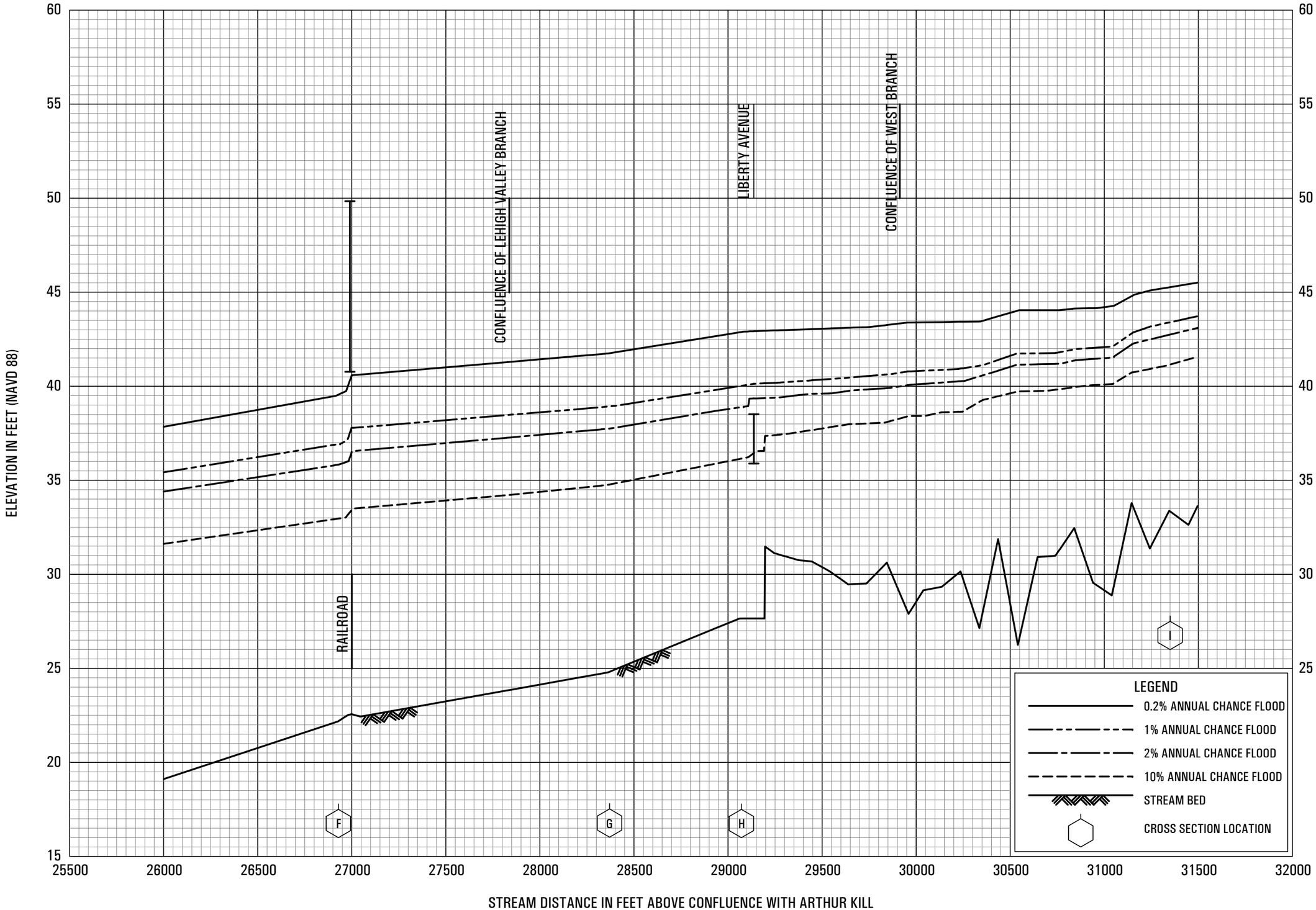
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

ELIZABETH RIVER

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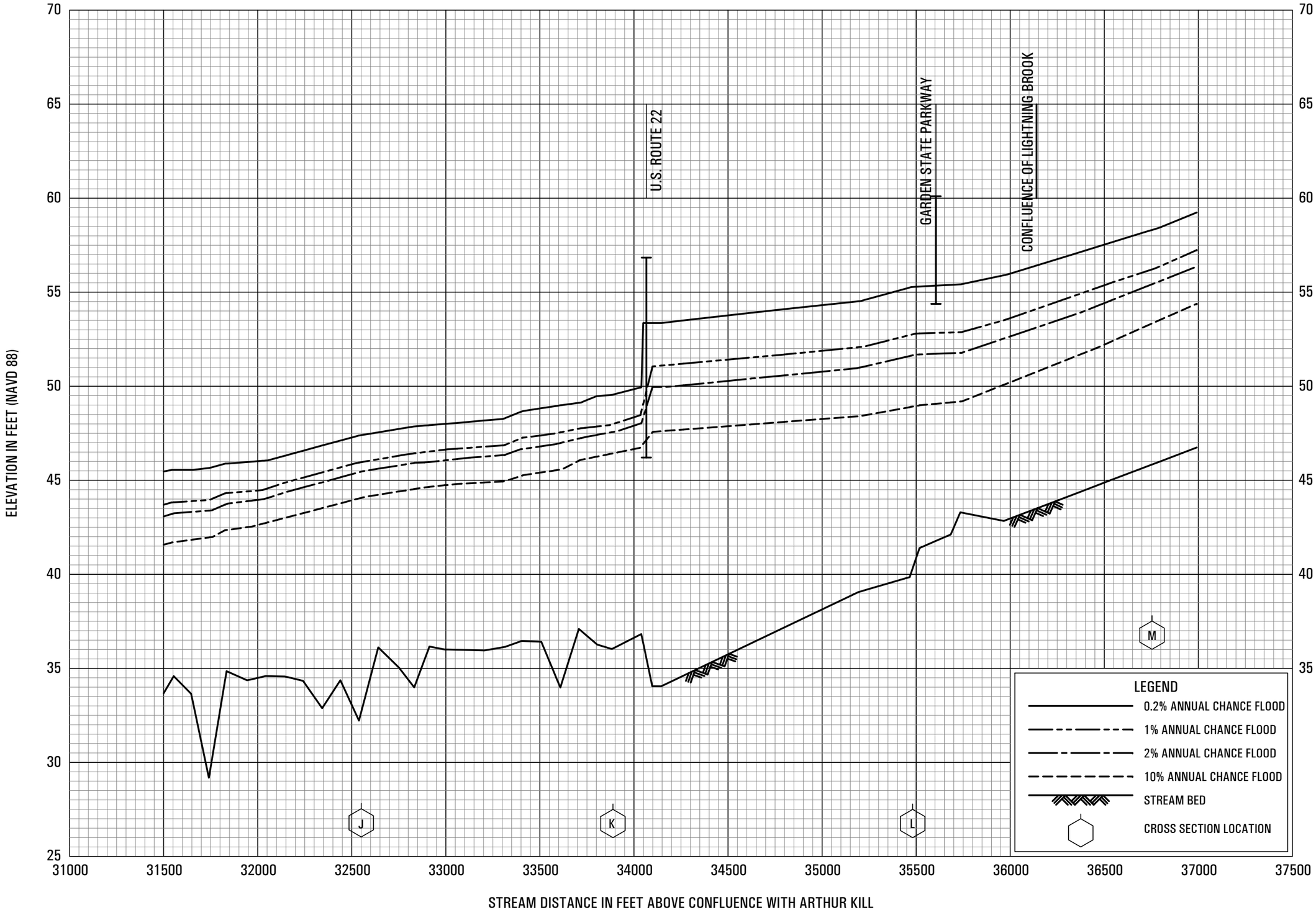
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

ELIZABETH RIVER

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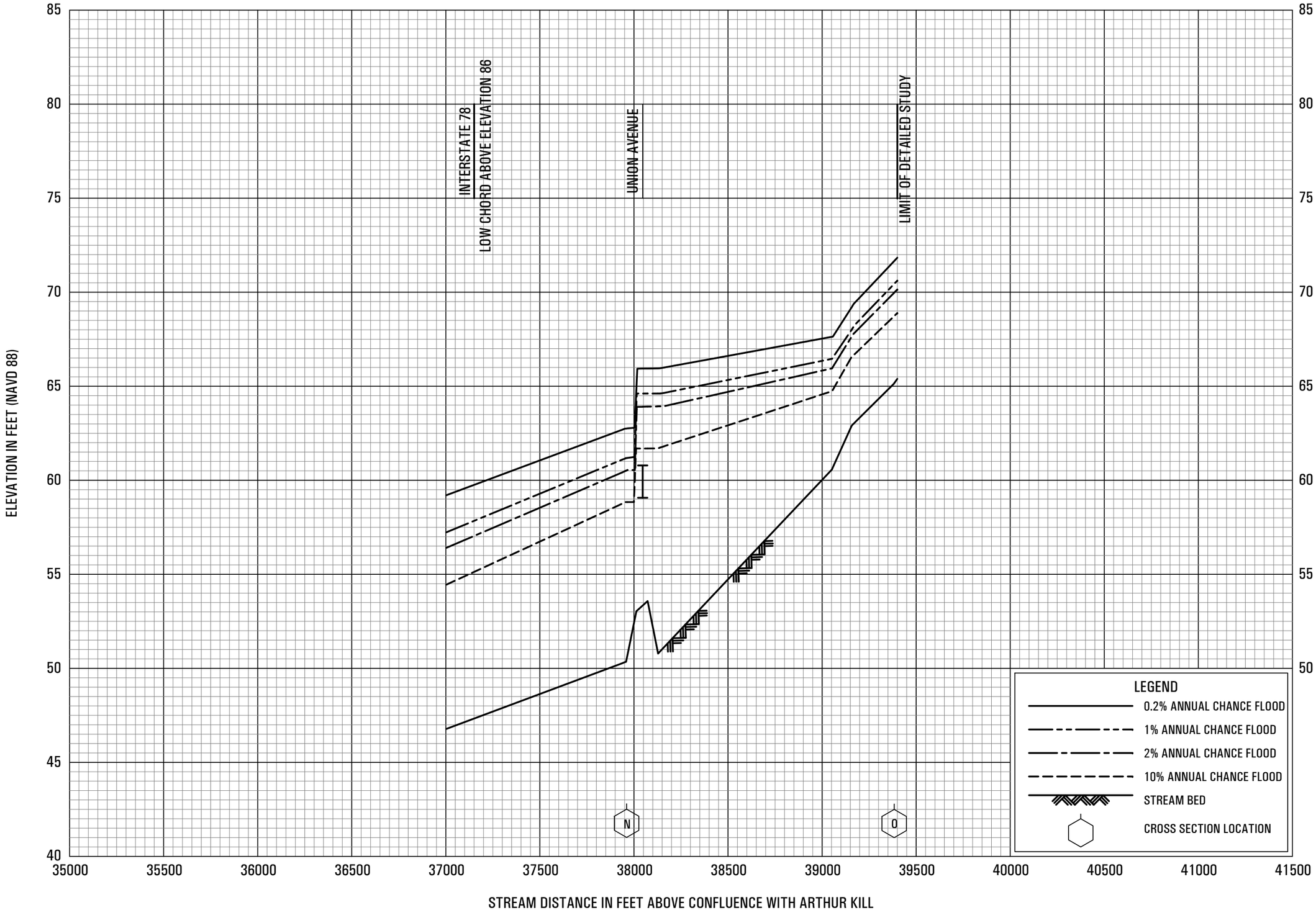
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

ELIZABETH RIVER

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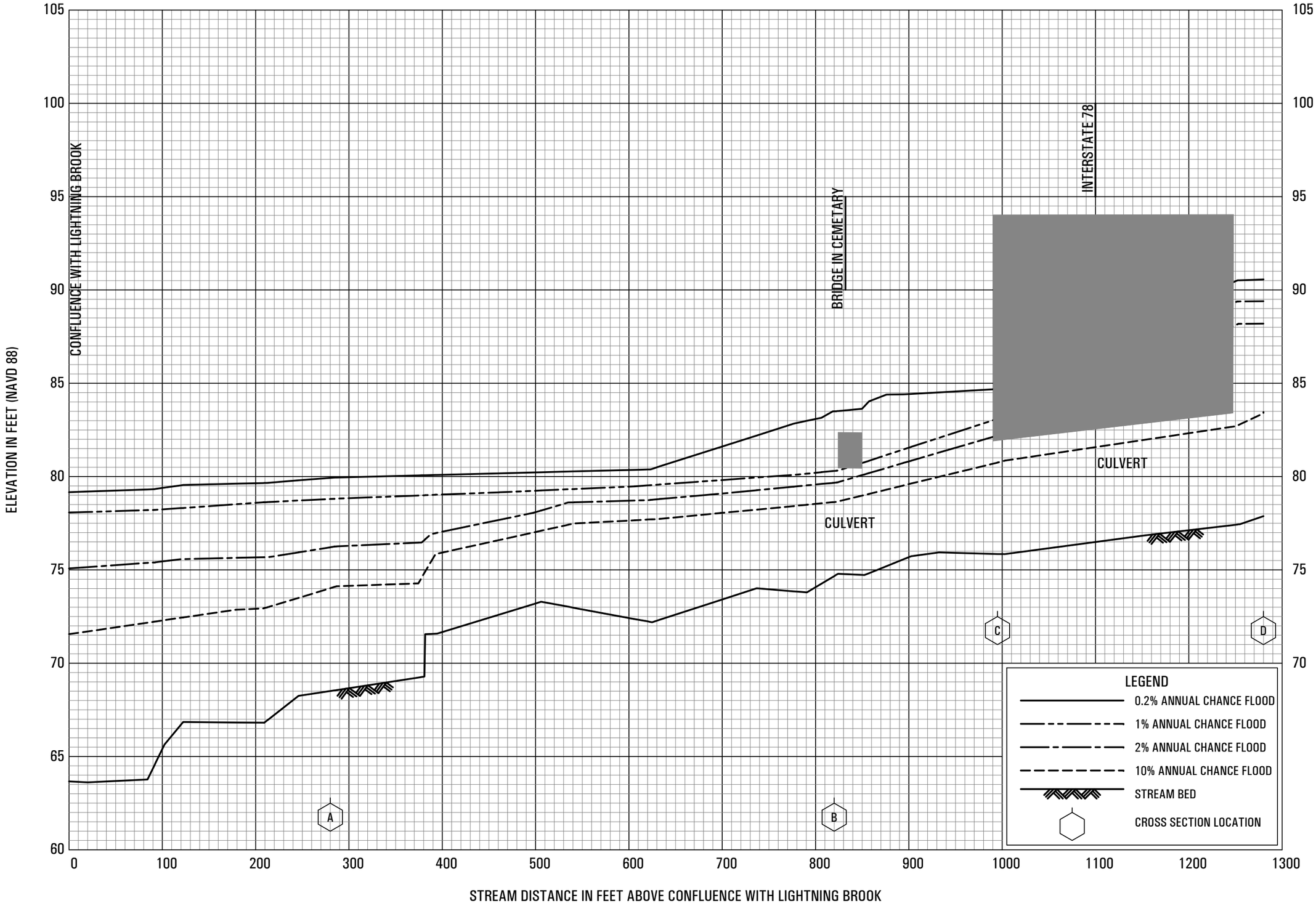
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

IRVINGTON BRANCH

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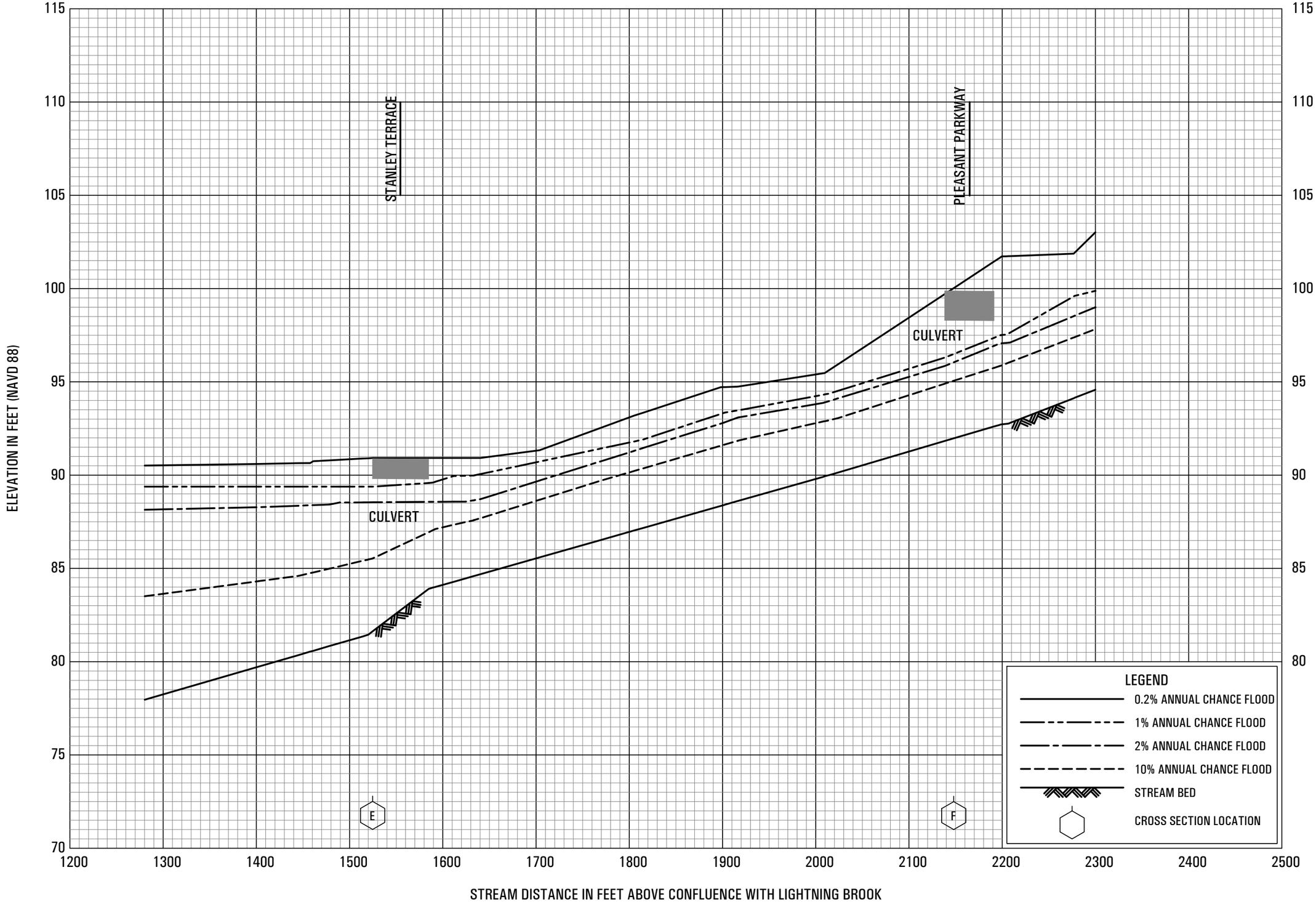
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

IRVINGTON BRANCH

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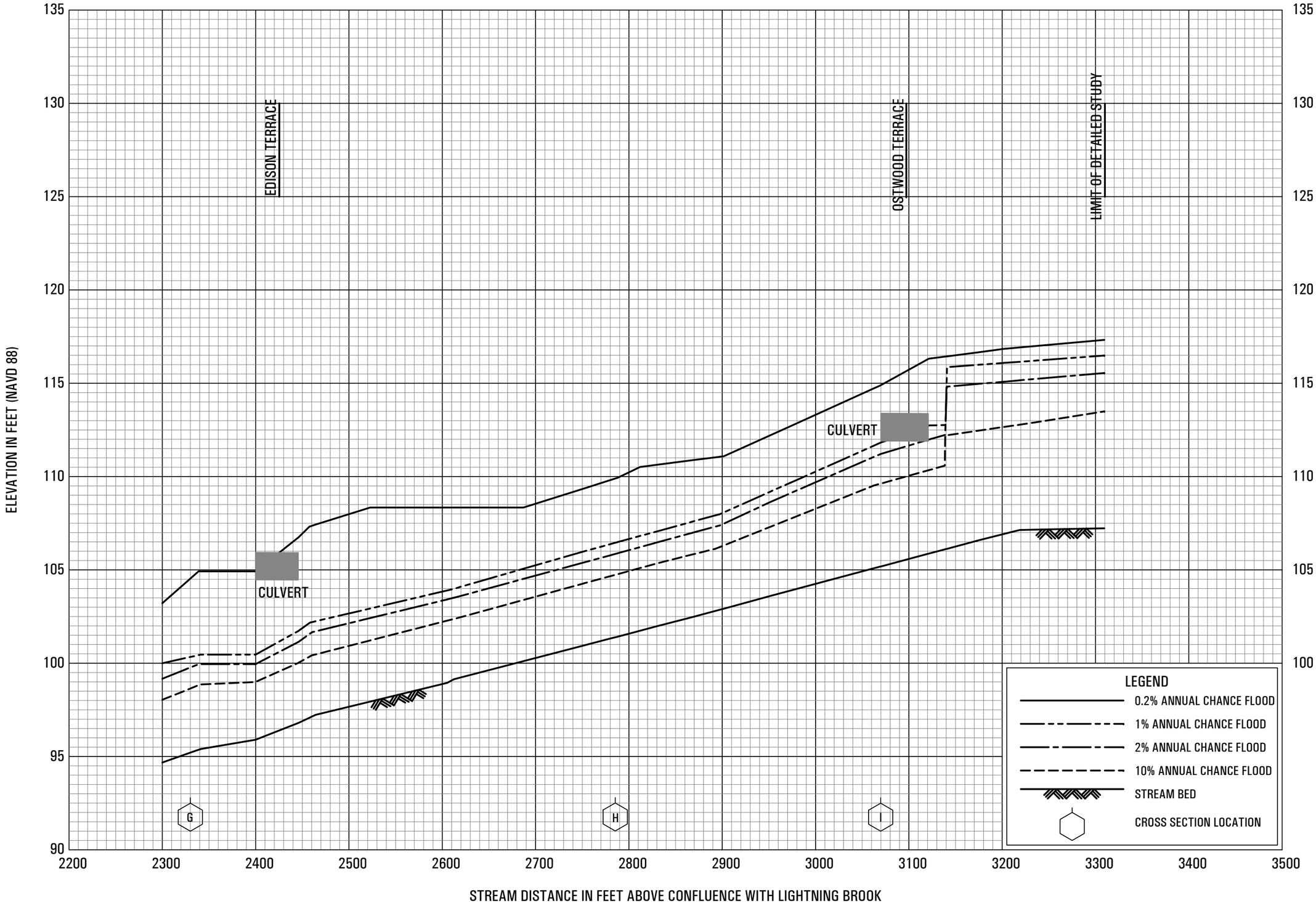
UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

IRVINGTON BRANCH

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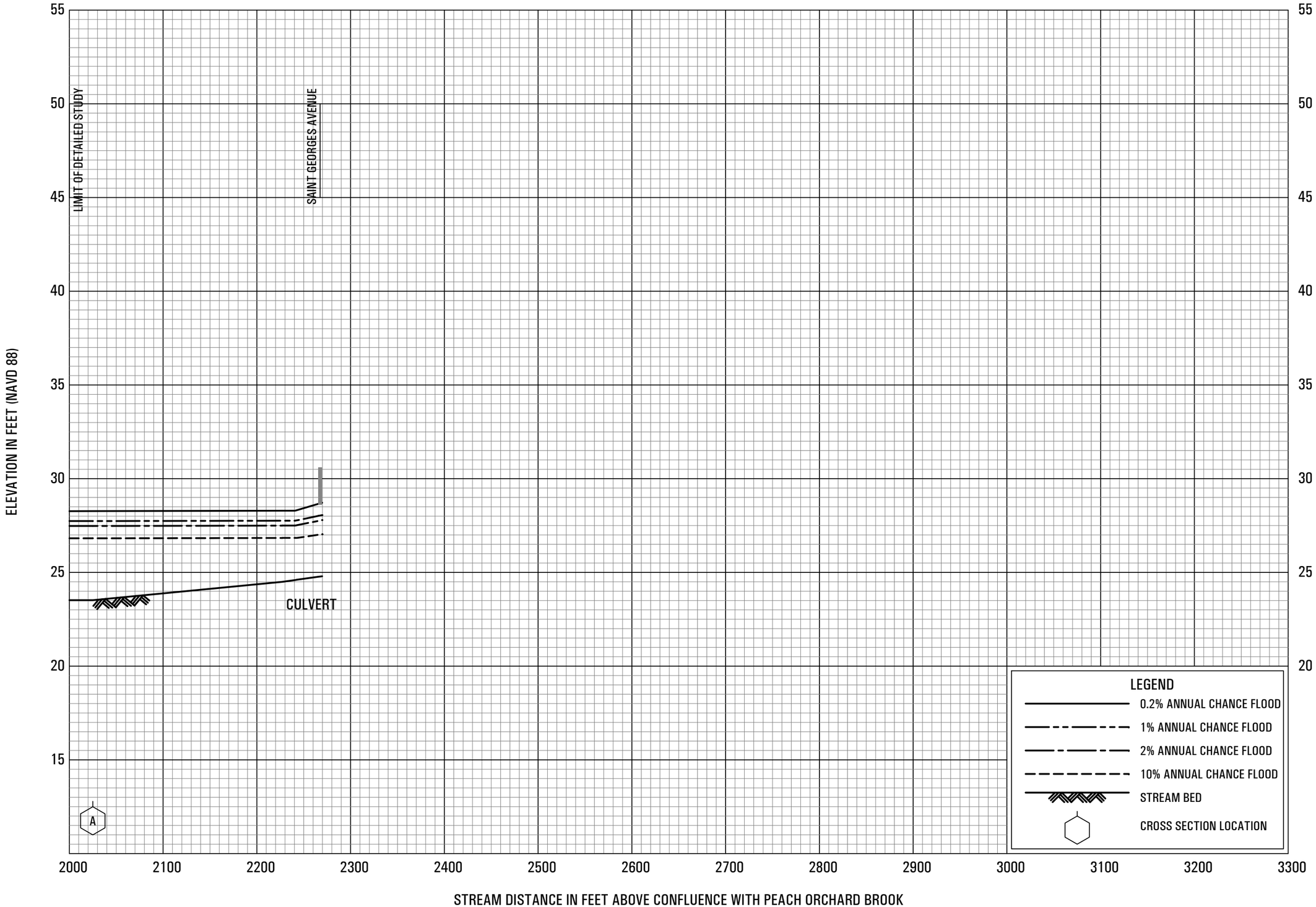

FLOOD PROFILES

JOUET BROOK

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UNION COUNTY, NJ

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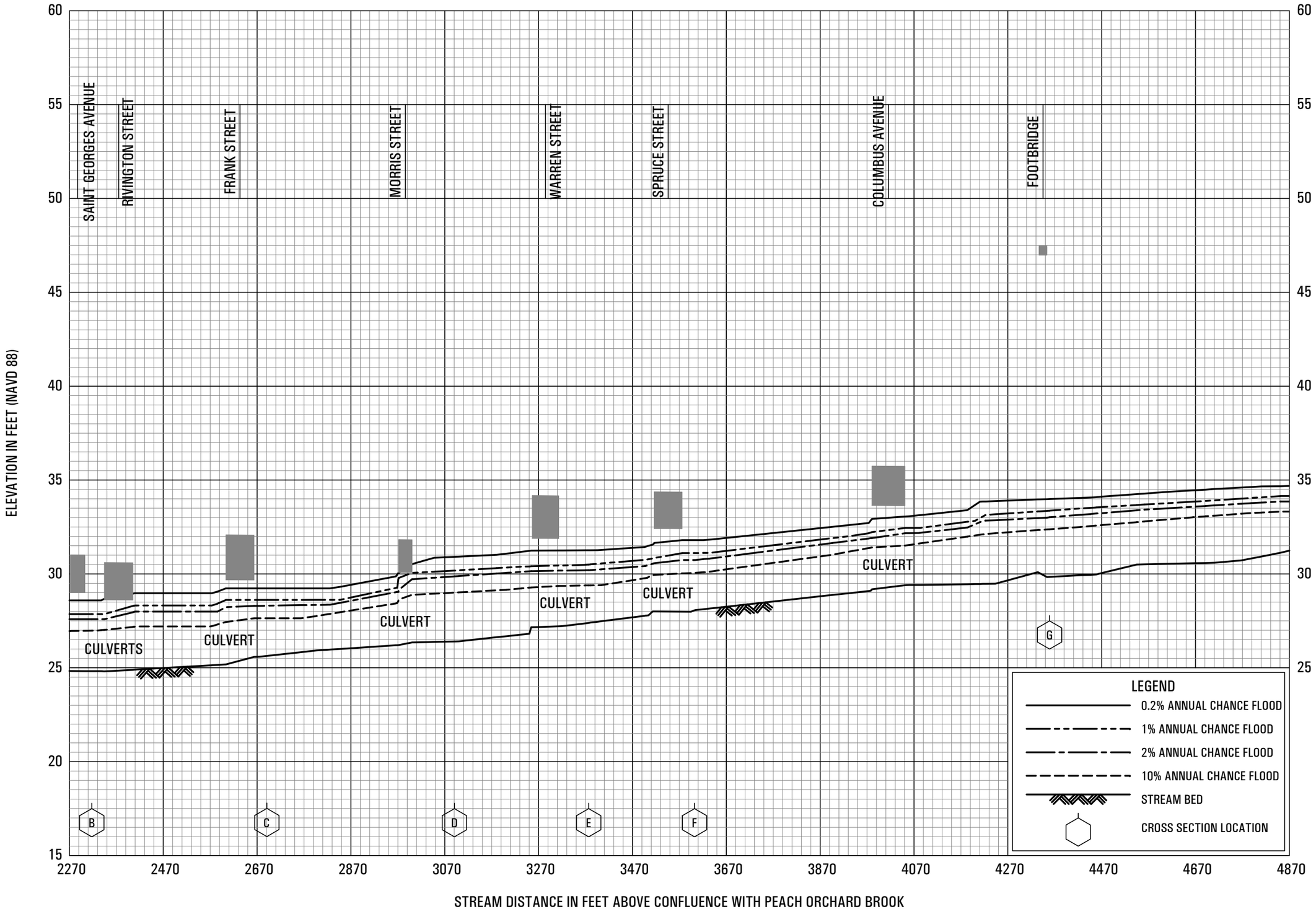

FLOOD PROFILES

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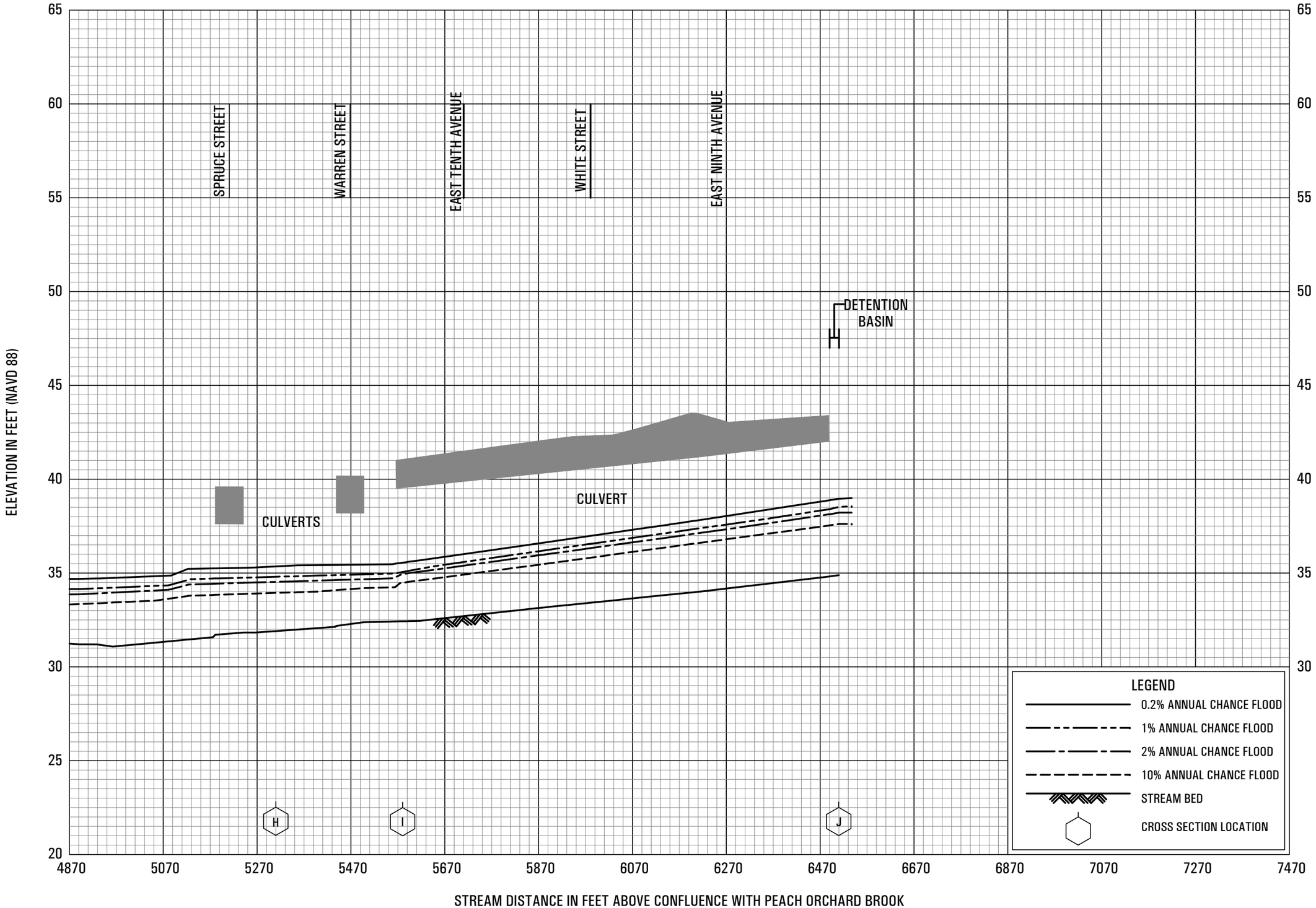

FLOOD PROFILES

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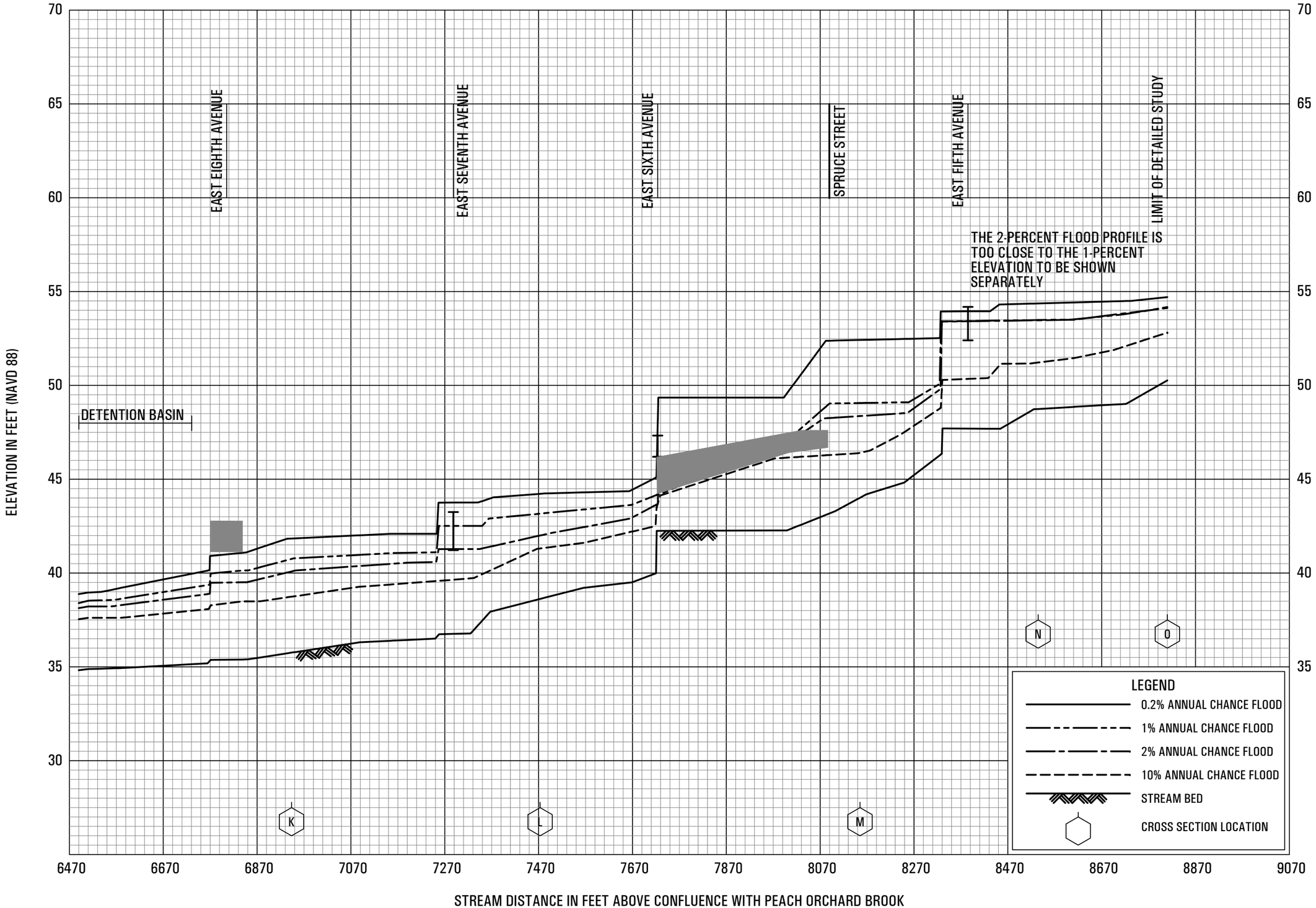

FLOOD PROFILES

JOUET BROOK

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UNION COUNTY, NJ

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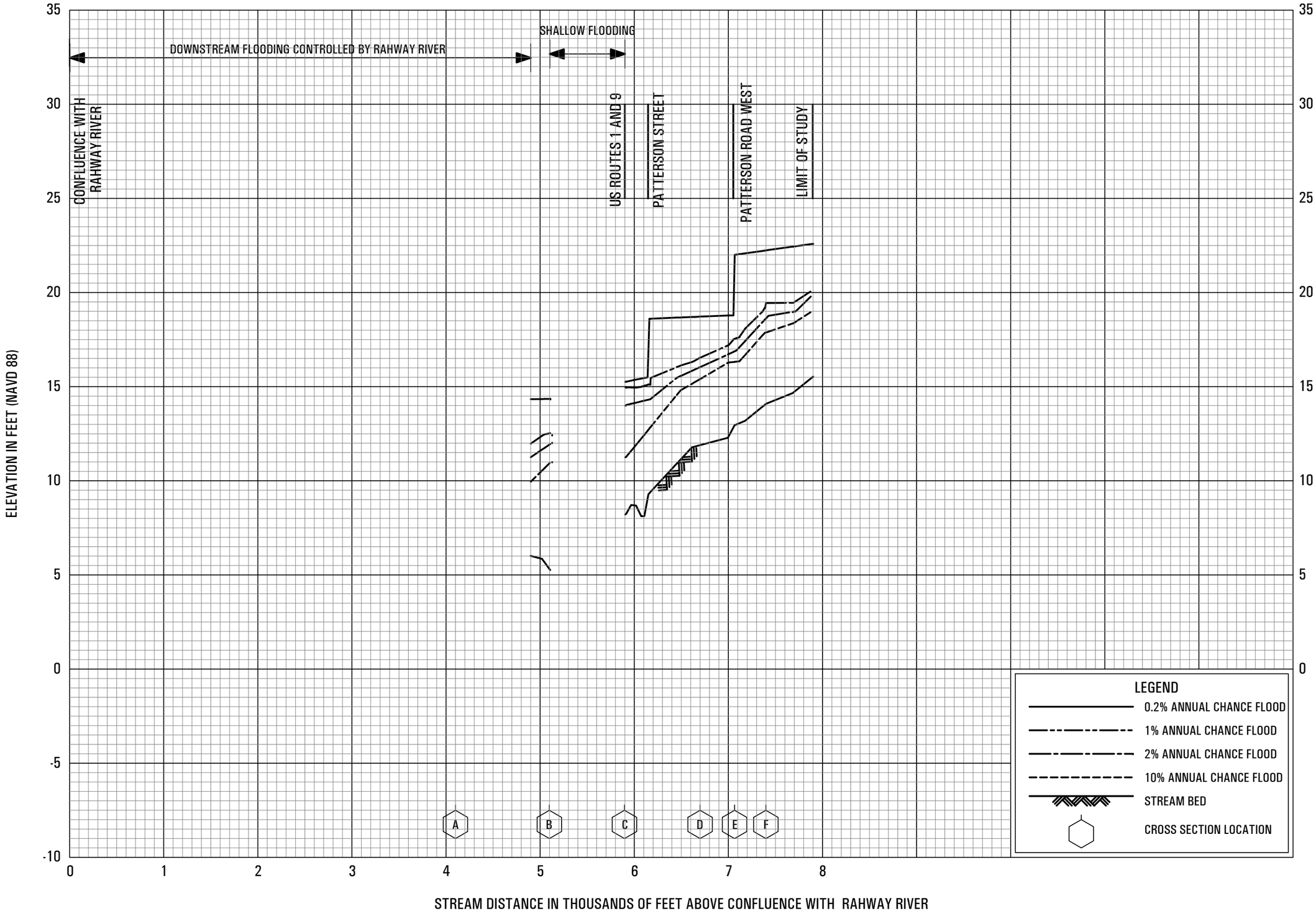


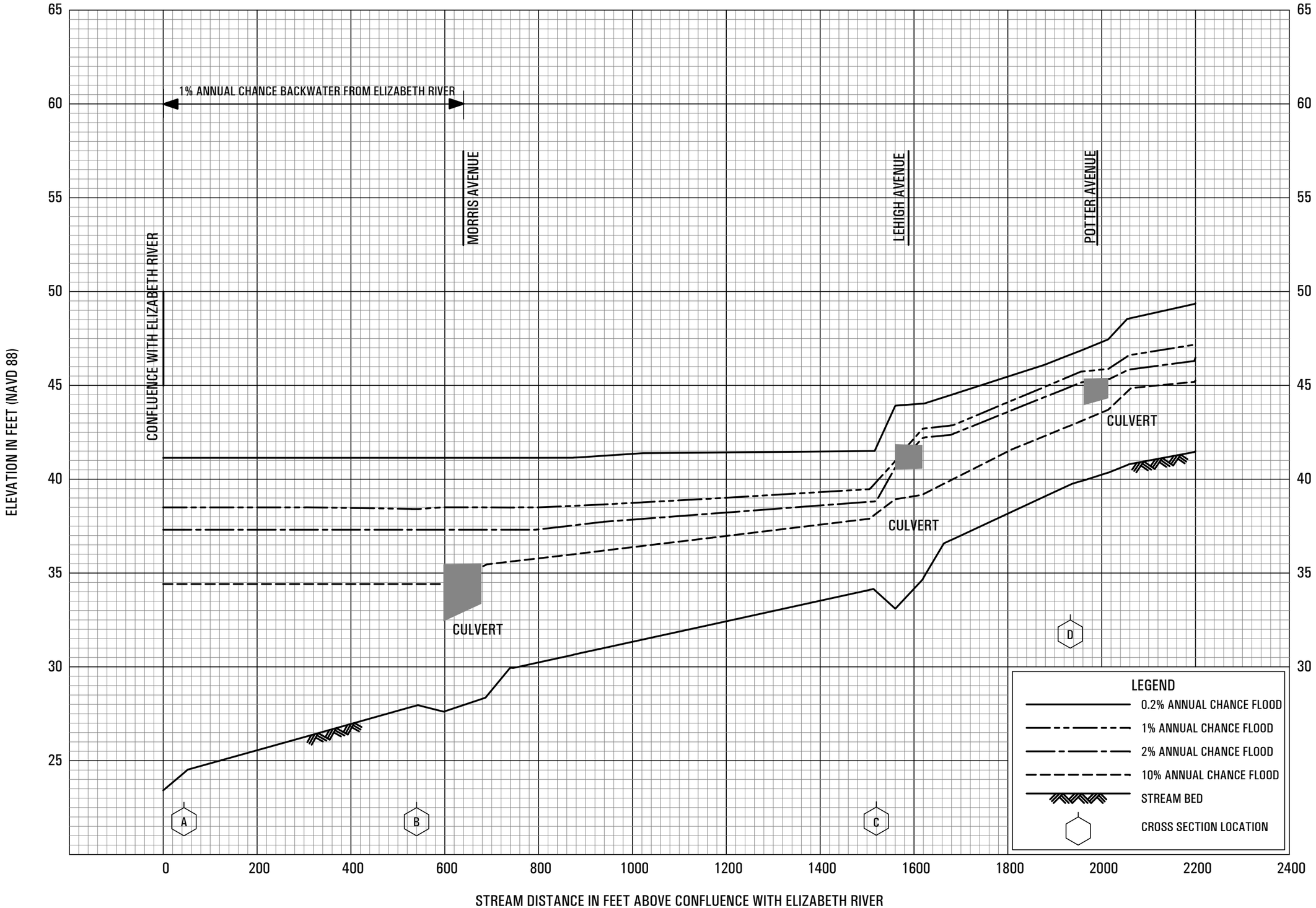
FLOOD PROFILES

KINGS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



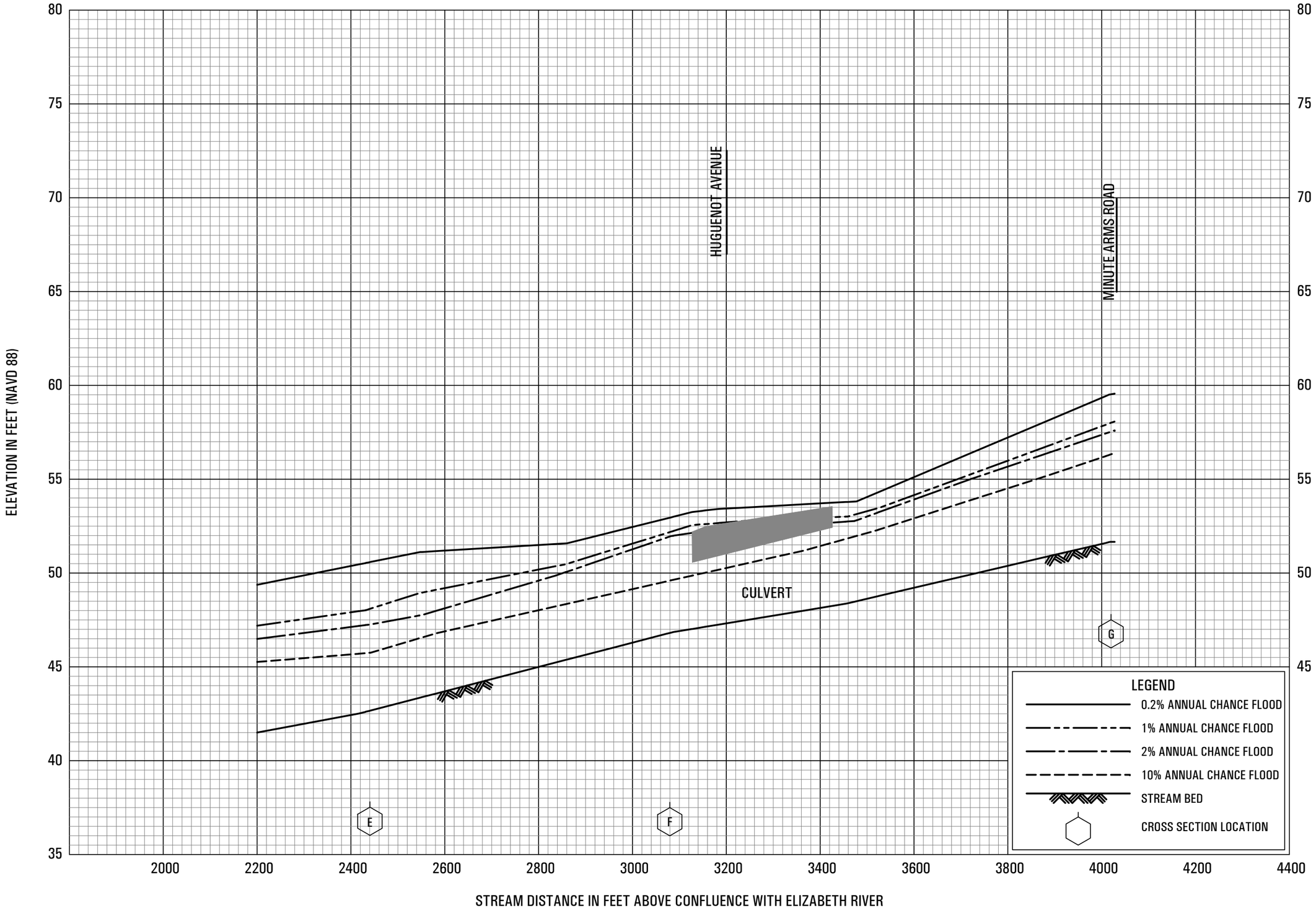
FLOOD PROFILES

LEHIGH VALLEY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

LEHIGH VALLEY BRANCH

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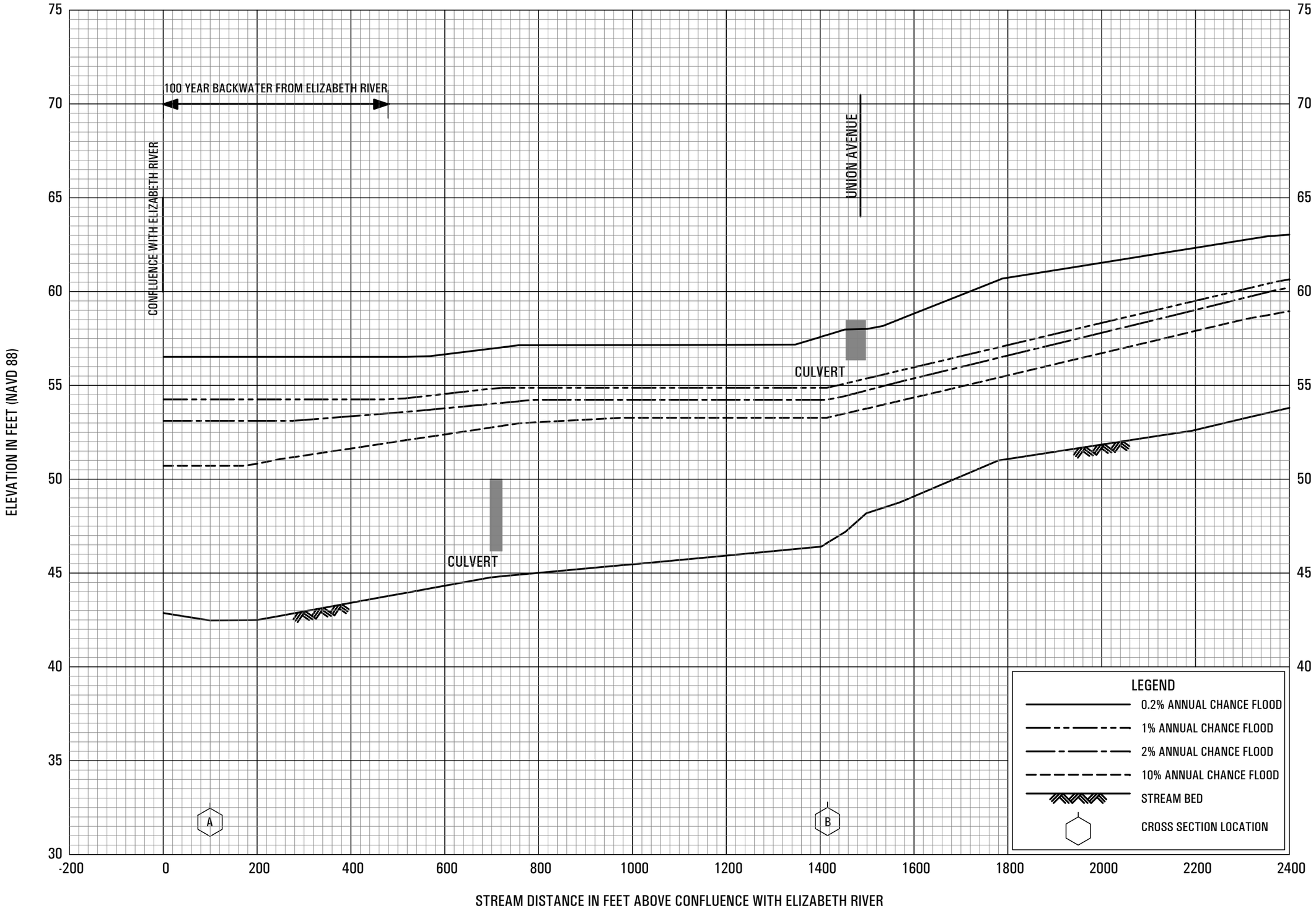

FLOOD PROFILES

LIGHTNING BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

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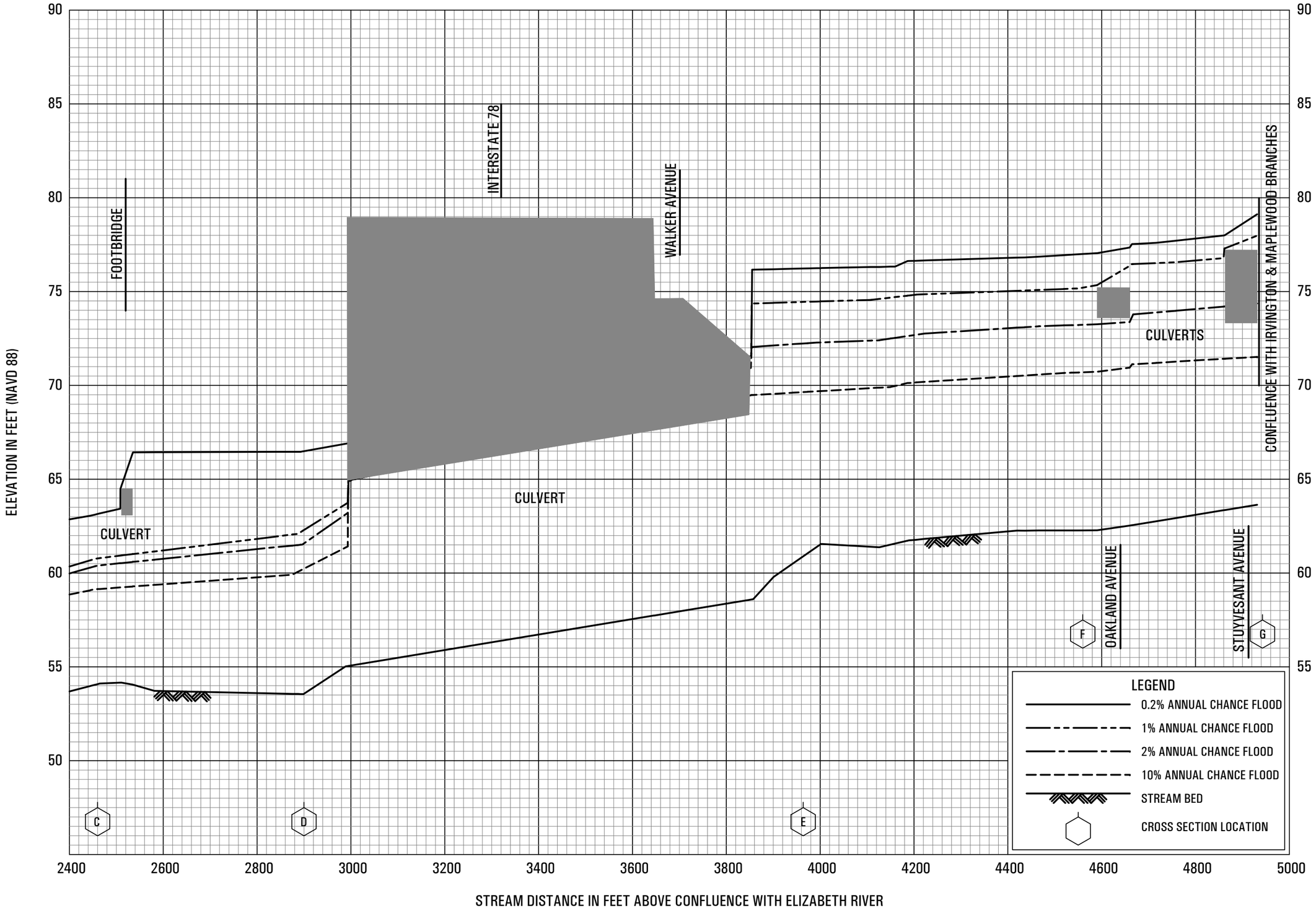

FLOOD PROFILES

LIGHTNING BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

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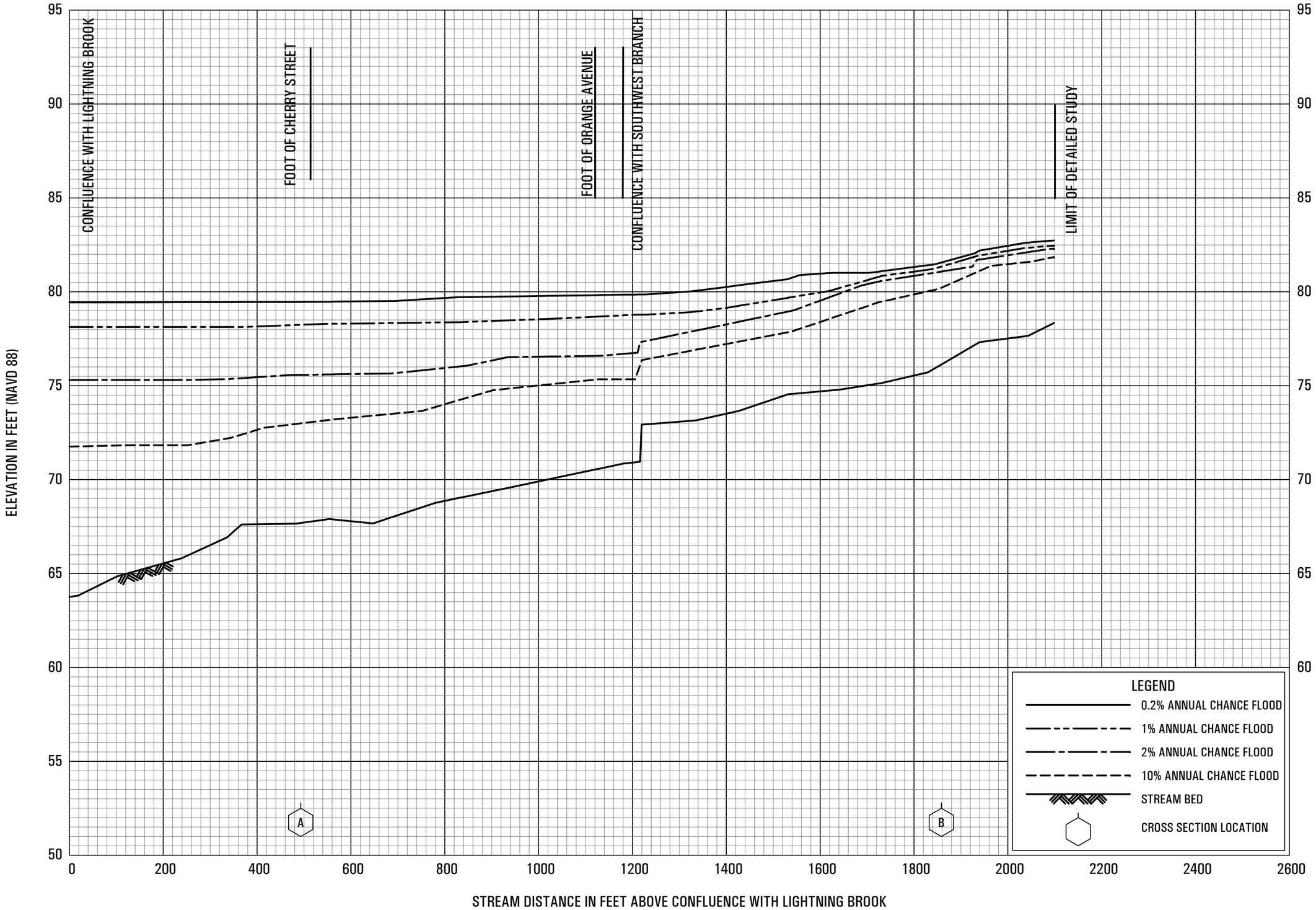

FLOOD PROFILES

MAPLEWOOD BRANCH

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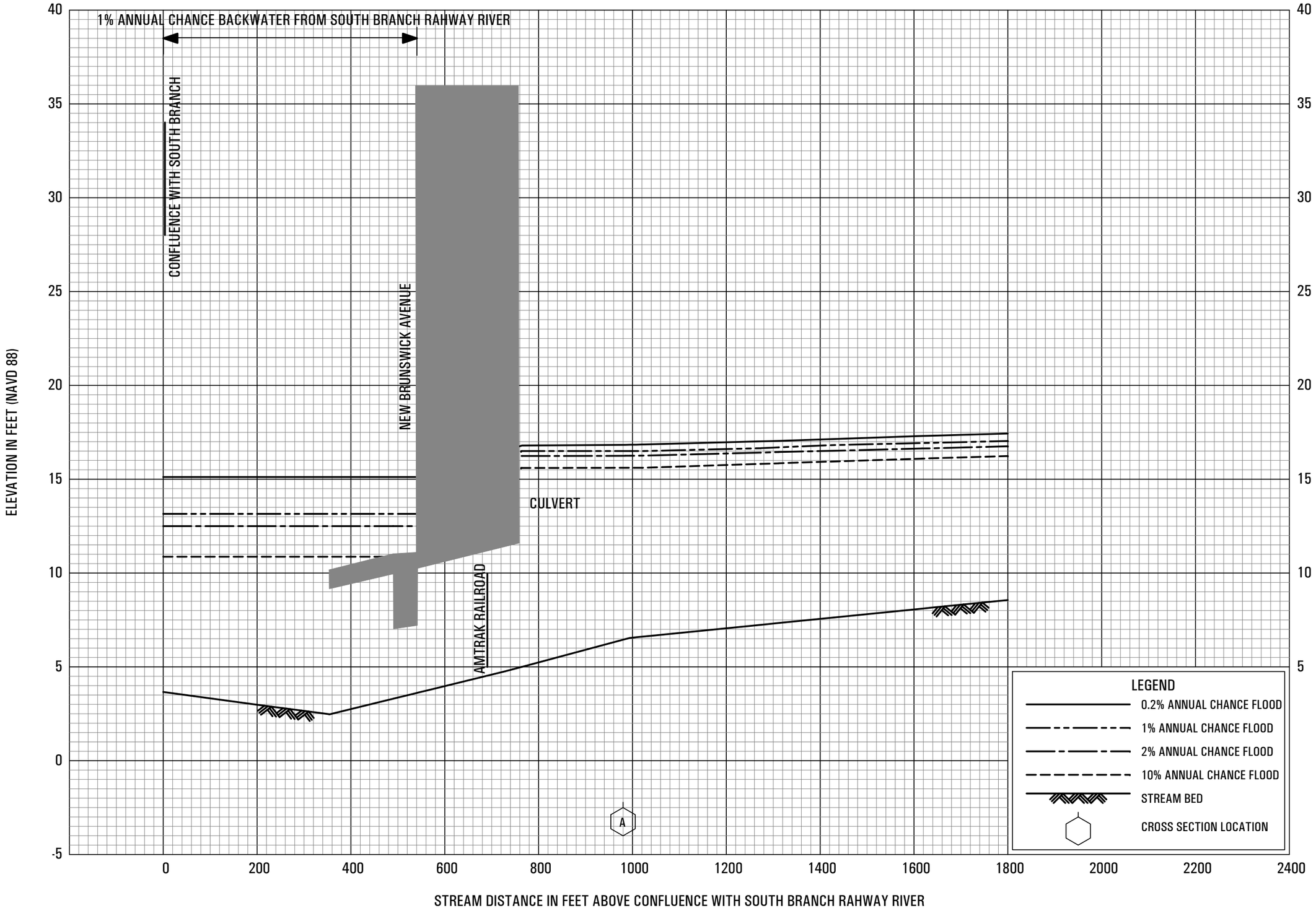


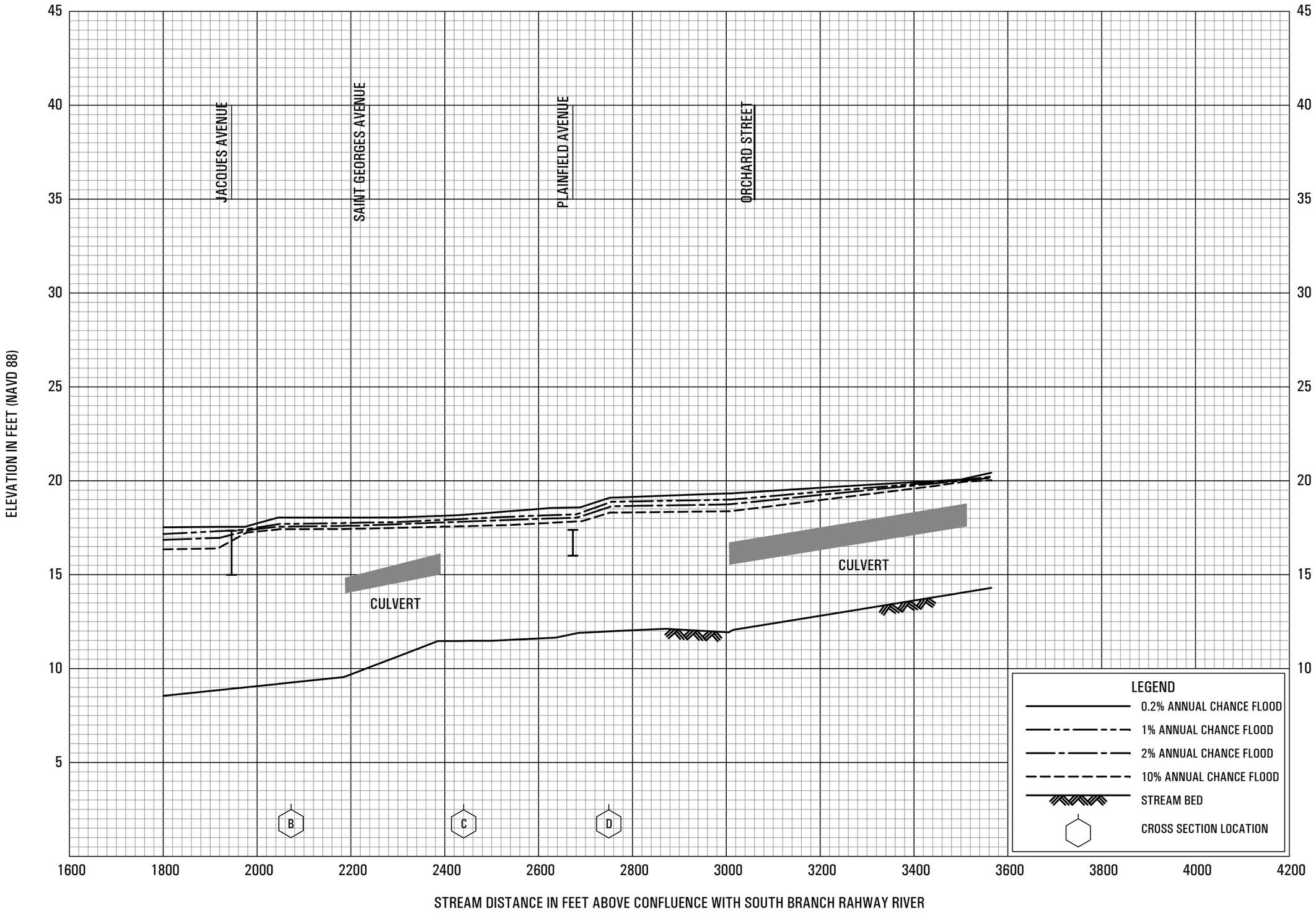
FLOOD PROFILES

ORCHARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

ORCHARD CREEK

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UNION COUNTY, NJ

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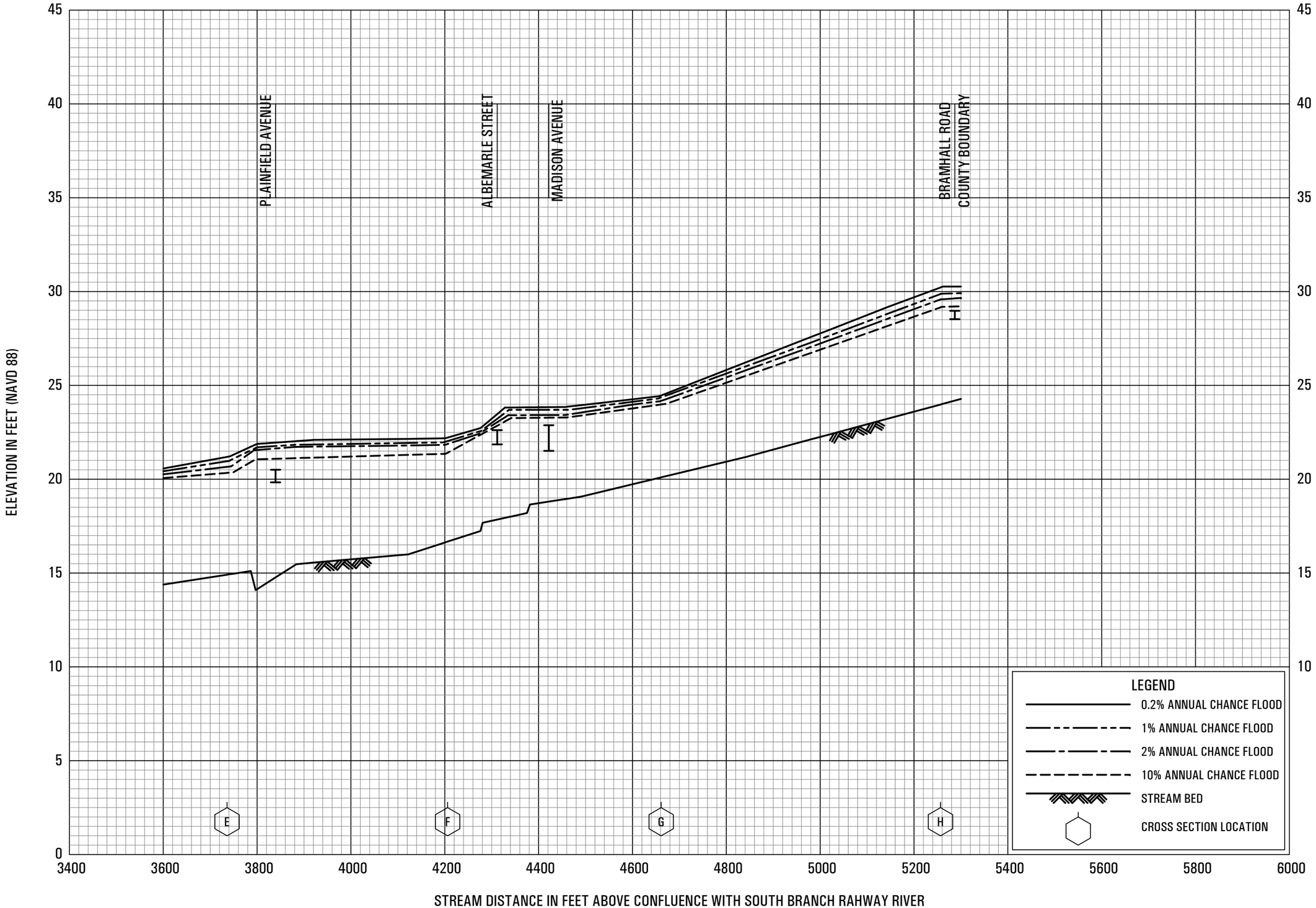

FLOOD PROFILES

ORCHARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 2 OF 2

UNION COUNTY, NEW JERSEY

(ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
BOROUGH OF FANWOOD	340463	CITY OF SUMMIT	340476
BOROUGH OF GARWOOD	340464	TOWN OF WESTFIELD	340478
BOROUGH OF KENILWORTH	340466	TOWNSHIP OF BERKELEY HEIGHTS	340459
BOROUGH OF MOUNTAINSIDE	340468	TOWNSHIP OF CLARK	345290
BOROUGH OF NEW PROVIDENCE	345306	TOWNSHIP OF CRANFORD	345291
BOROUGH OF ROSELLE	340472	TOWNSHIP OF HILLSIDE	340465
BOROUGH OF ROSELLE PARK	340473	TOWNSHIP OF SCOTCH PLAINS	340474
CITY OF ELIZABETH	345523	TOWNSHIP OF SPRINGFIELD	345321
CITY OF LINDEN	340467	TOWNSHIP OF UNION	340477
CITY OF PLAINFIELD	345312	TOWNSHIP OF WINFIELD[1]	340479
CITY OF RAHWAY	345314		

[1] No Special Flood Hazard Areas Identified

This Preliminary FIS report only includes revised Flood Profiles and Floodway Data tables. The unrevised Flood Profiles and Floodway Data tables will appear in the final FIS report.

REVISED: **PRELIMINARY FEBRUARY 3, 2015**

FLOOD INSURANCE STUDY NUMBER
34039CV002B
Version Number 2.2.2.2

FEMA

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 20, 2006

Revised Countywide FIS Date: [TBD] – to change Base Flood Elevations, Special Flood Hazard Areas and zone designations; to update the effects of wave actions, roads and road names; and to reflect revised shoreline and updated topographic information.

This Preliminary FIS report only includes revised Flood Profiles and Floodway Data tables. The unrevised Flood Profiles and Floodway Data tables will appear in the final FIS report.

ATTENTION: On FIRM panels 34039C0024G and 34039C035G the Elizabeth River levee and on FIRM panels 34039C0043G and 34039C0044G the Rahway River levee have not been demonstrated by the community or levee owner(s) to meet the requirements of Section 65.10 of the NFIP regulations in 44 CFR as it relates to the levee's capacity to provide 1-percent annual chance flood protection. The subject areas are identified on FIRM panels (with notes and bounding lines) and in the FIS report as potential areas of flood hazard data changes based on further review.

FEMA has updated the levee analysis and mapping procedures for non-accredited levees. Until such time as FEMA is able to initiate a new flood risk project to apply the new procedures, the flood hazard information on the aforementioned FIRM panel(s) that are affected by the Elizabeth River and Rahway River levees are being added as a snapshot of the prior previously effective information presented on the FIRMs and FIS reports dated September 20, 2006. As indicated above, it is expected that affected flood hazard data within the subject area could be significantly revised. This may result in

floodplain boundary changes, 1-percent annual chance flood elevation changes, and/or changes to flood hazard zone designations.

The effective FIRM panels (and the FIS report) will again be revised at a later date to update the flood hazard information associated with the Elizabeth River and Rahway River levees when FEMA is able to initiate and complete a new flood risk project to apply the new levee analysis and mapping procedures.

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Cedar Brook	Panels	29P-31P
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Lehigh Valley Branch	Panels	77P-78P
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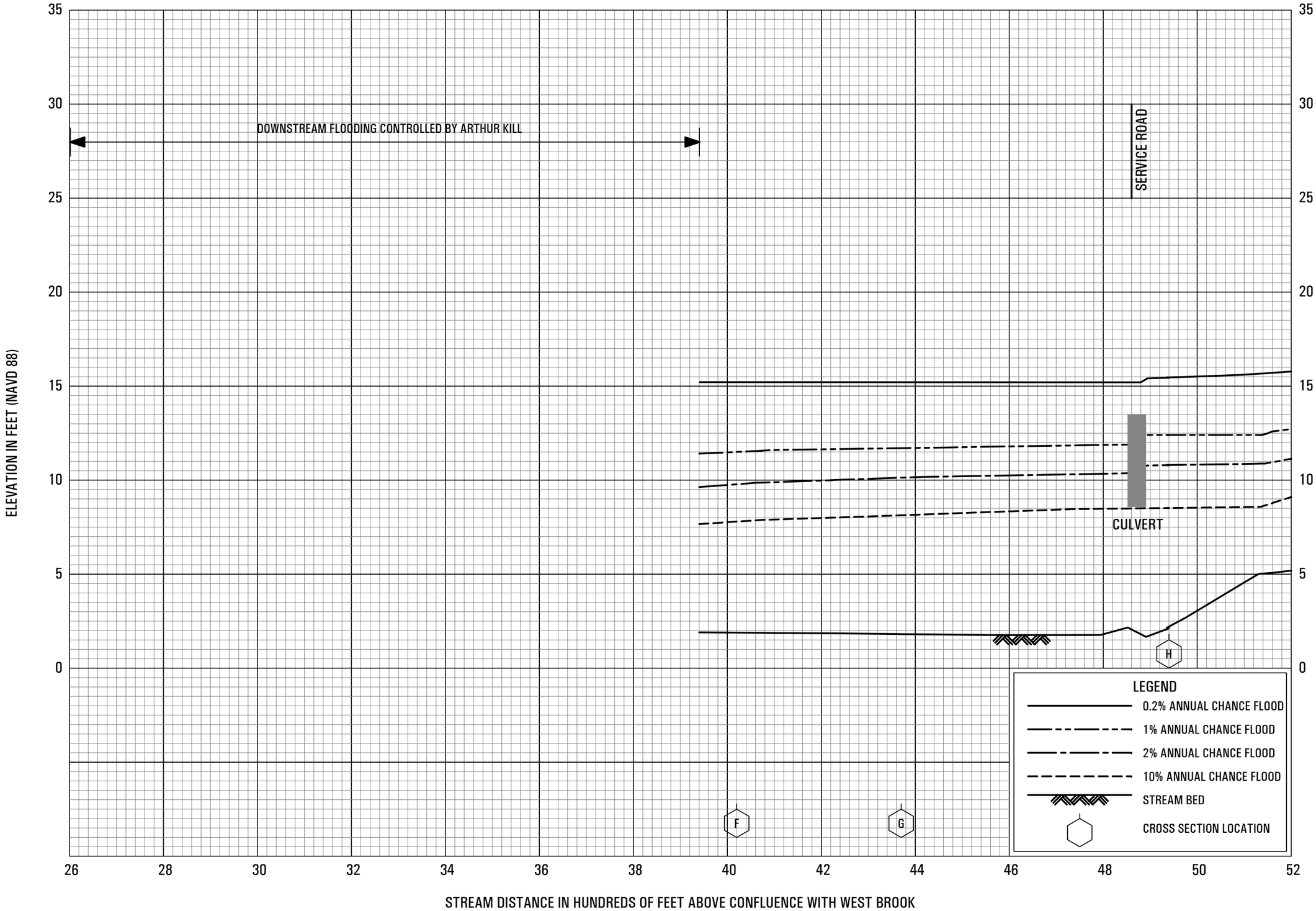
Flood Insurance Rate Map



FLOOD PROFILES

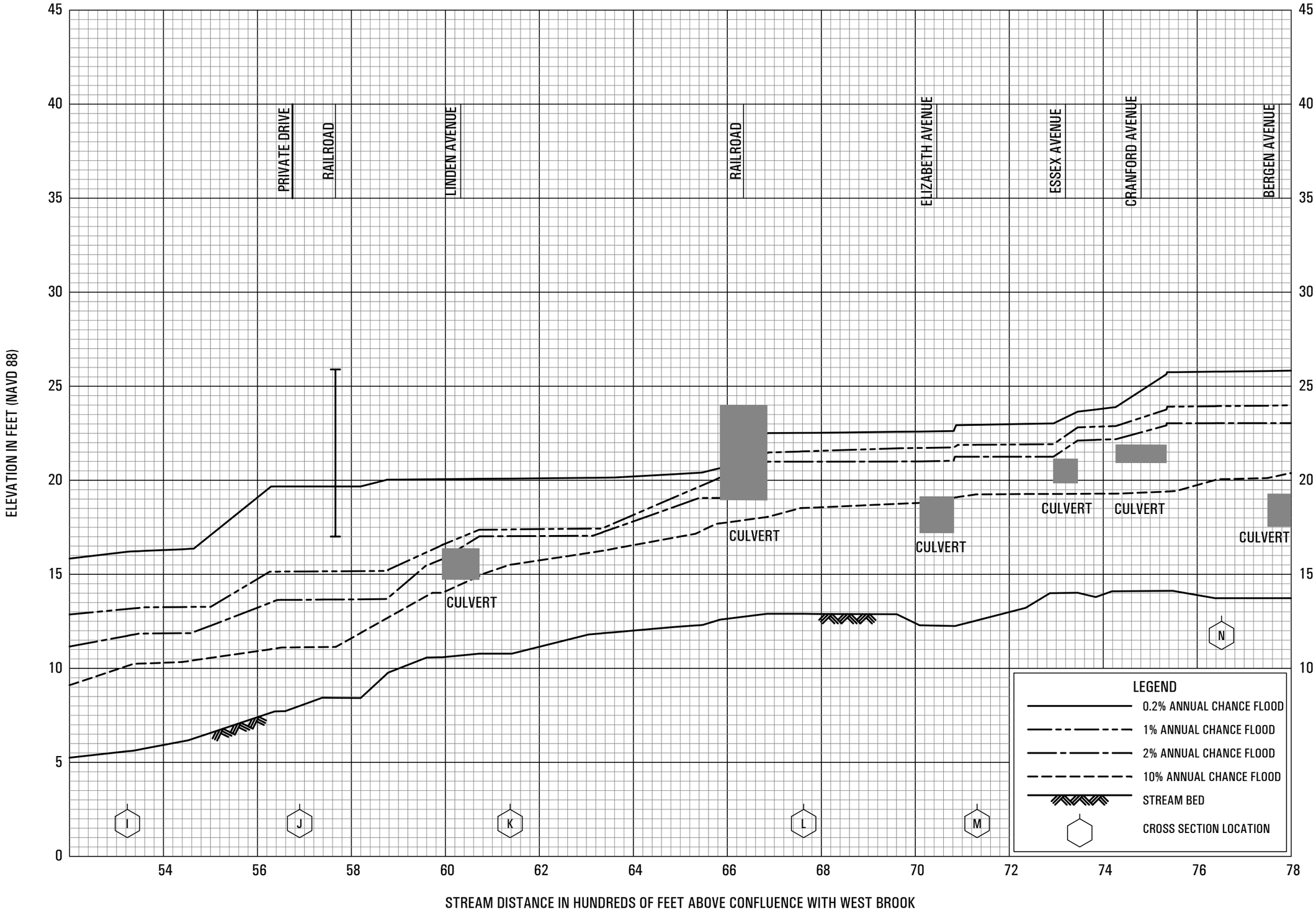
PEACH ORCHARD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

104P



FLOOD PROFILES

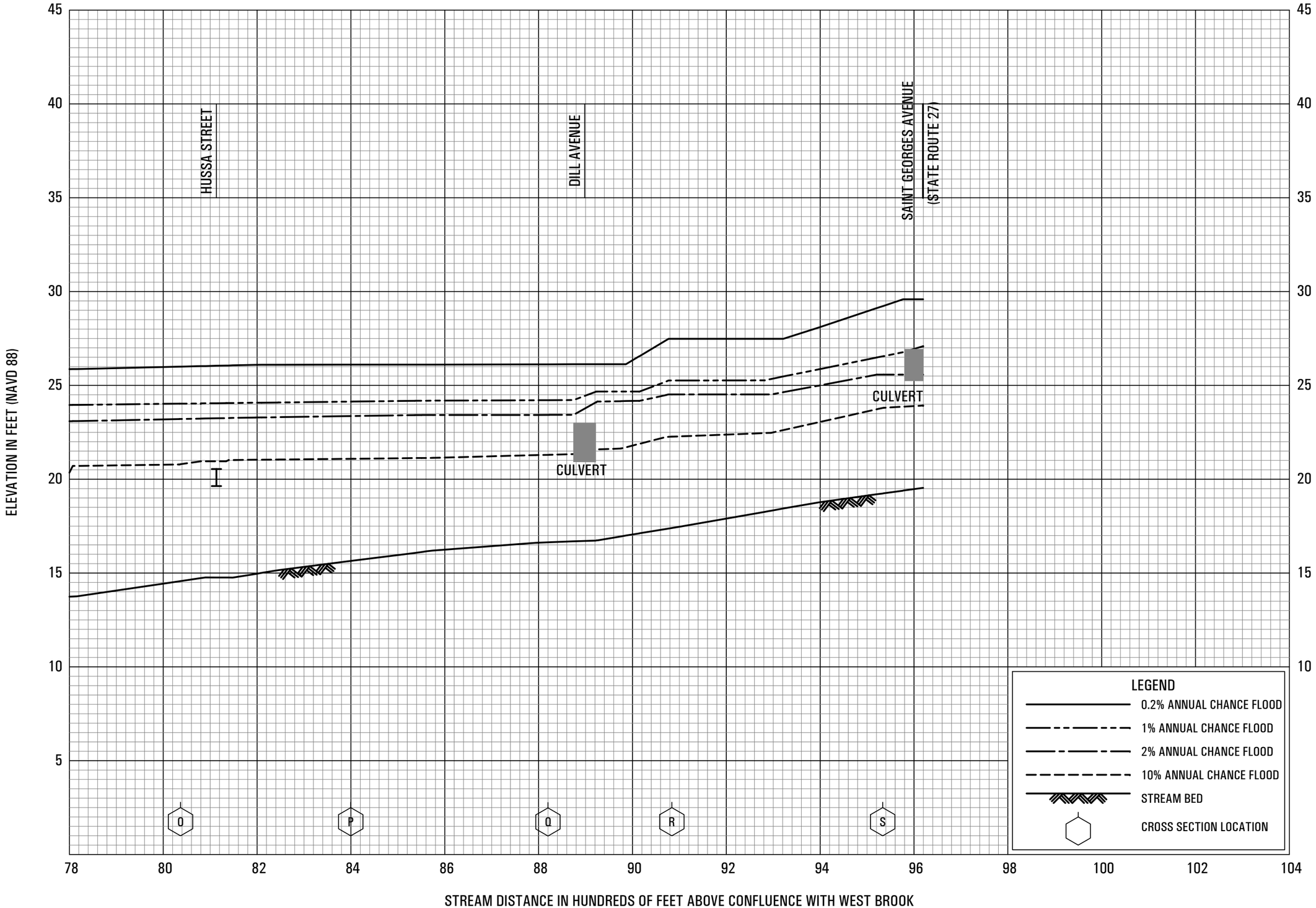
PEACH ORCHARD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

105P



FLOOD PROFILES

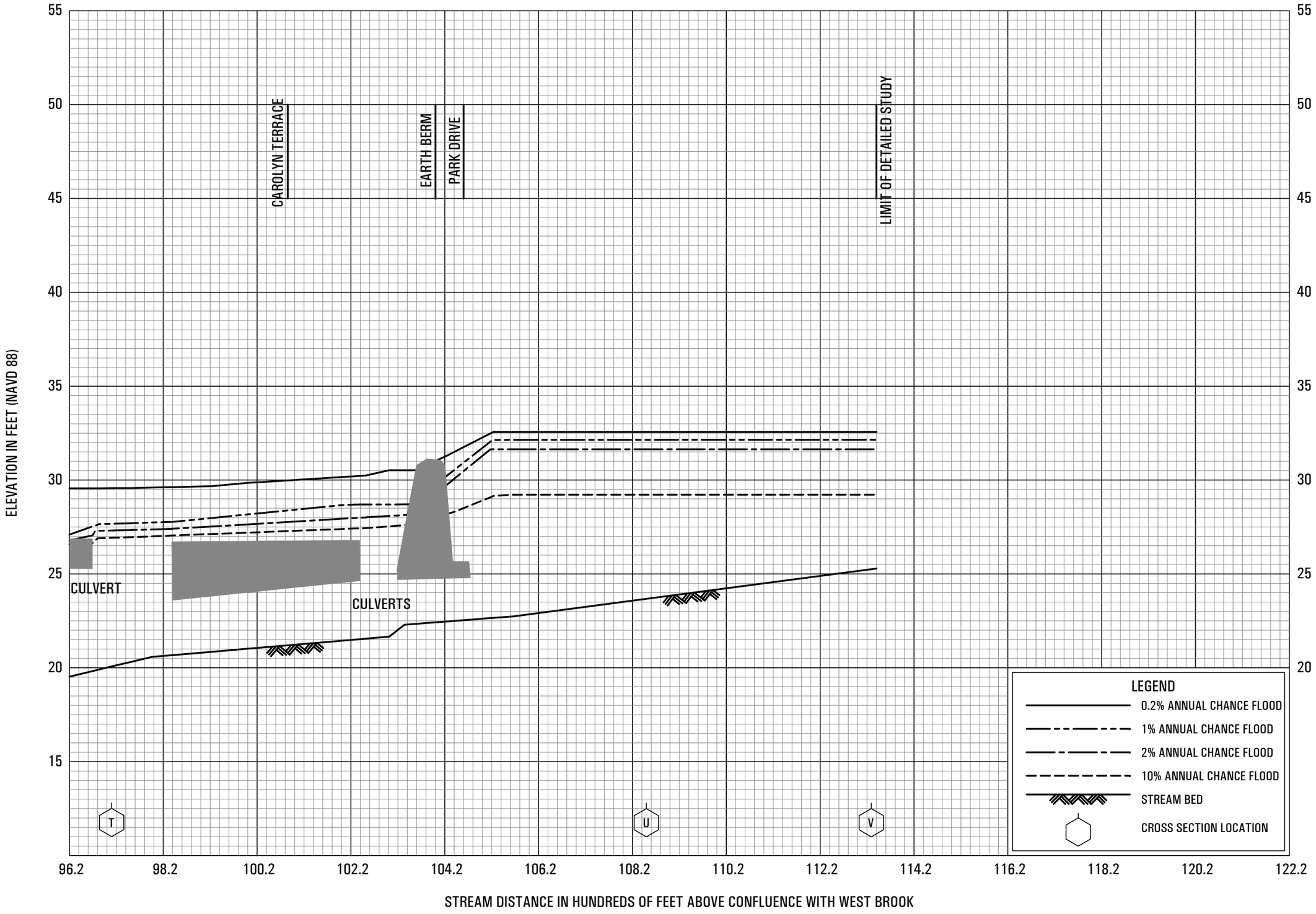
PEACH ORCHARD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

106P



FLOOD PROFILES

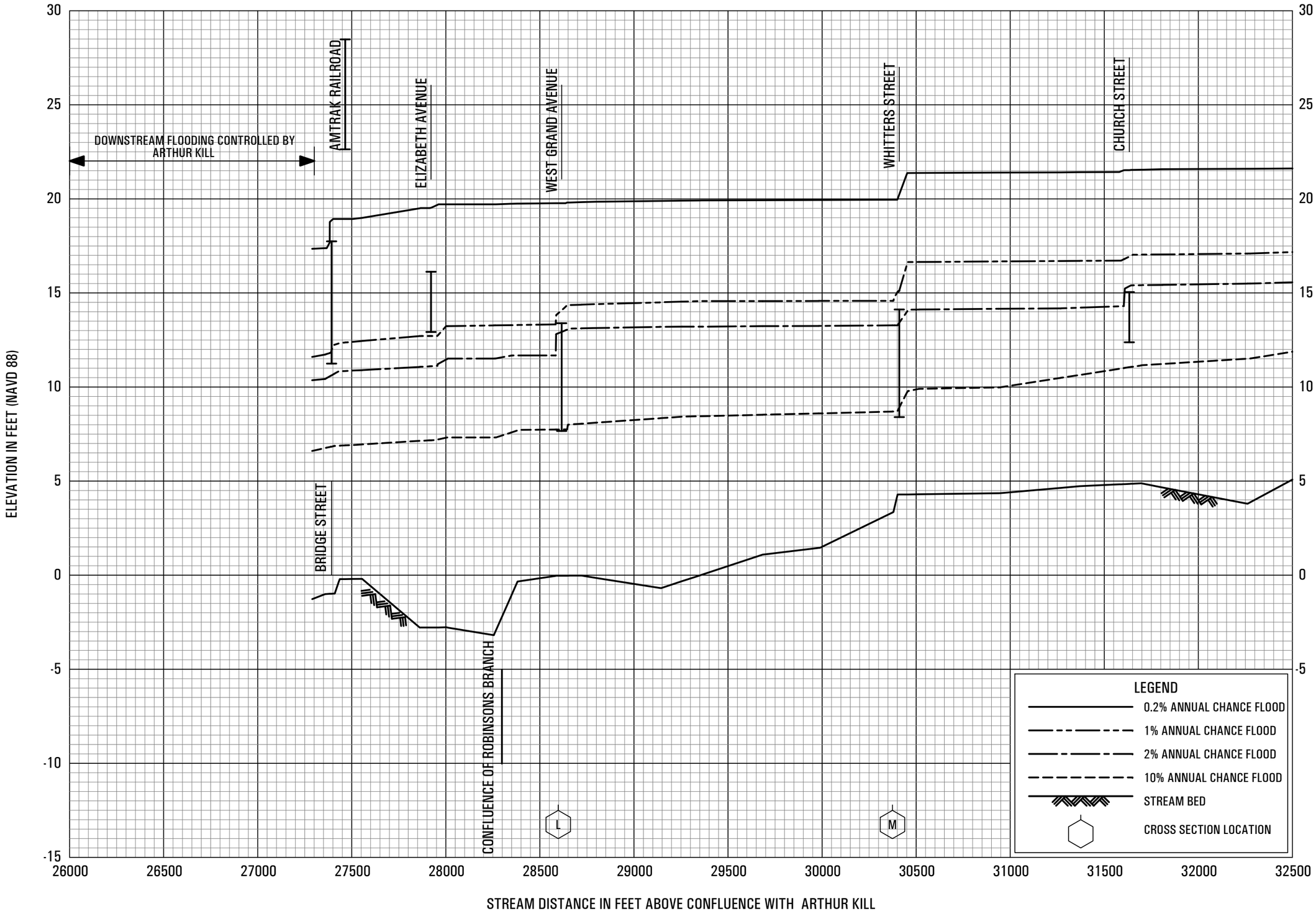
PEACH ORCHARD BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

107P



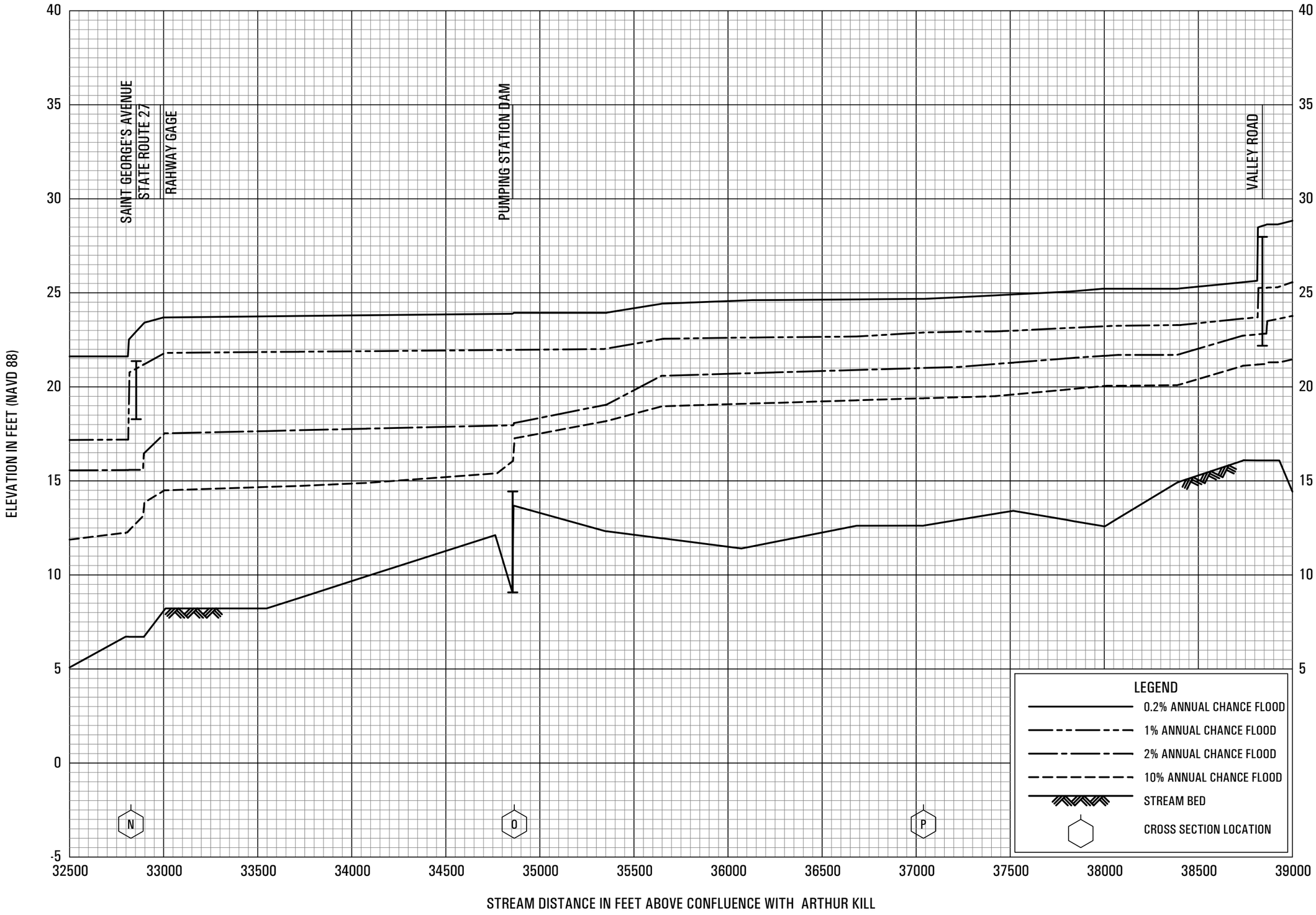
FLOOD PROFILES

RAHWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



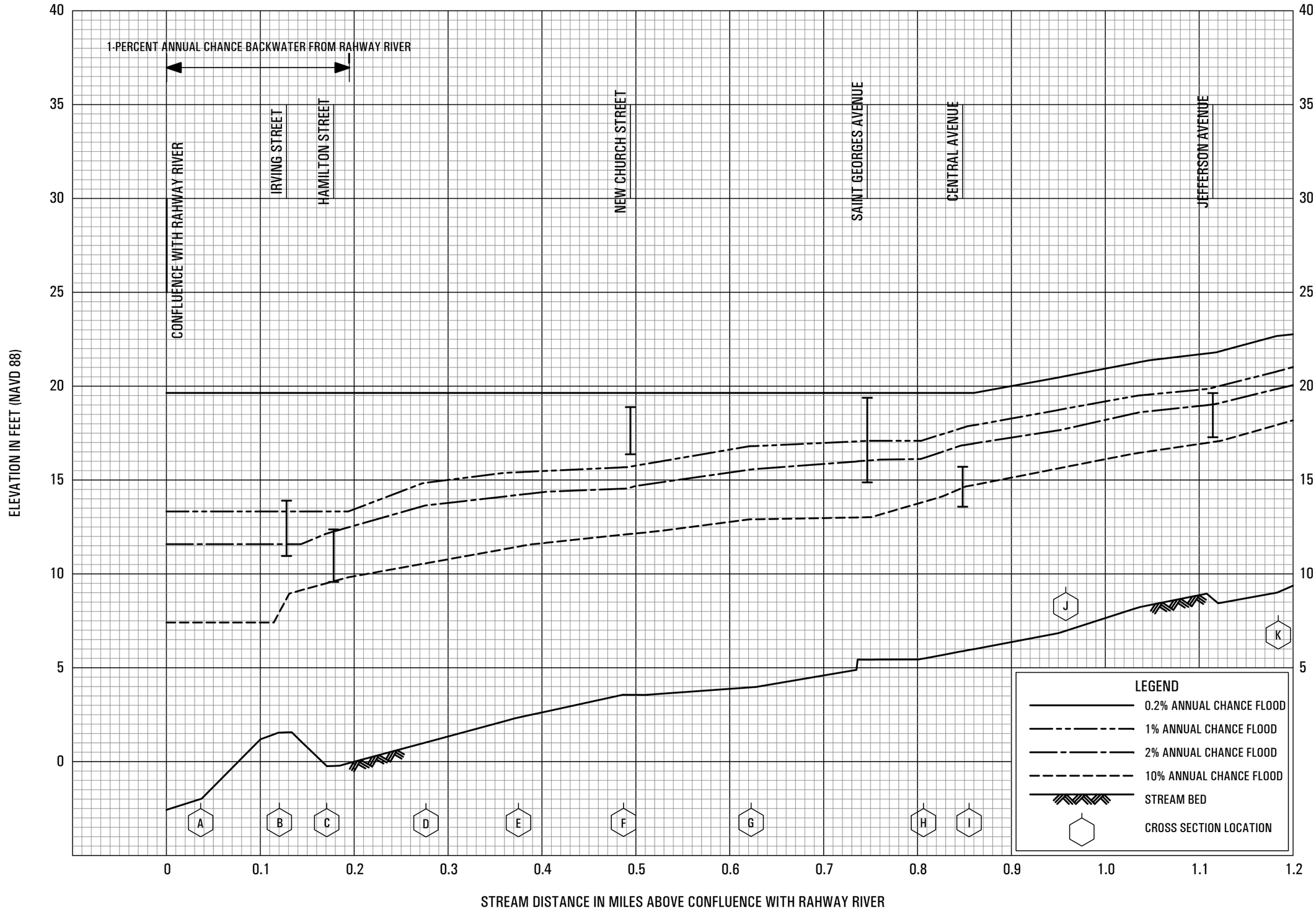
FLOOD PROFILES

RAHWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



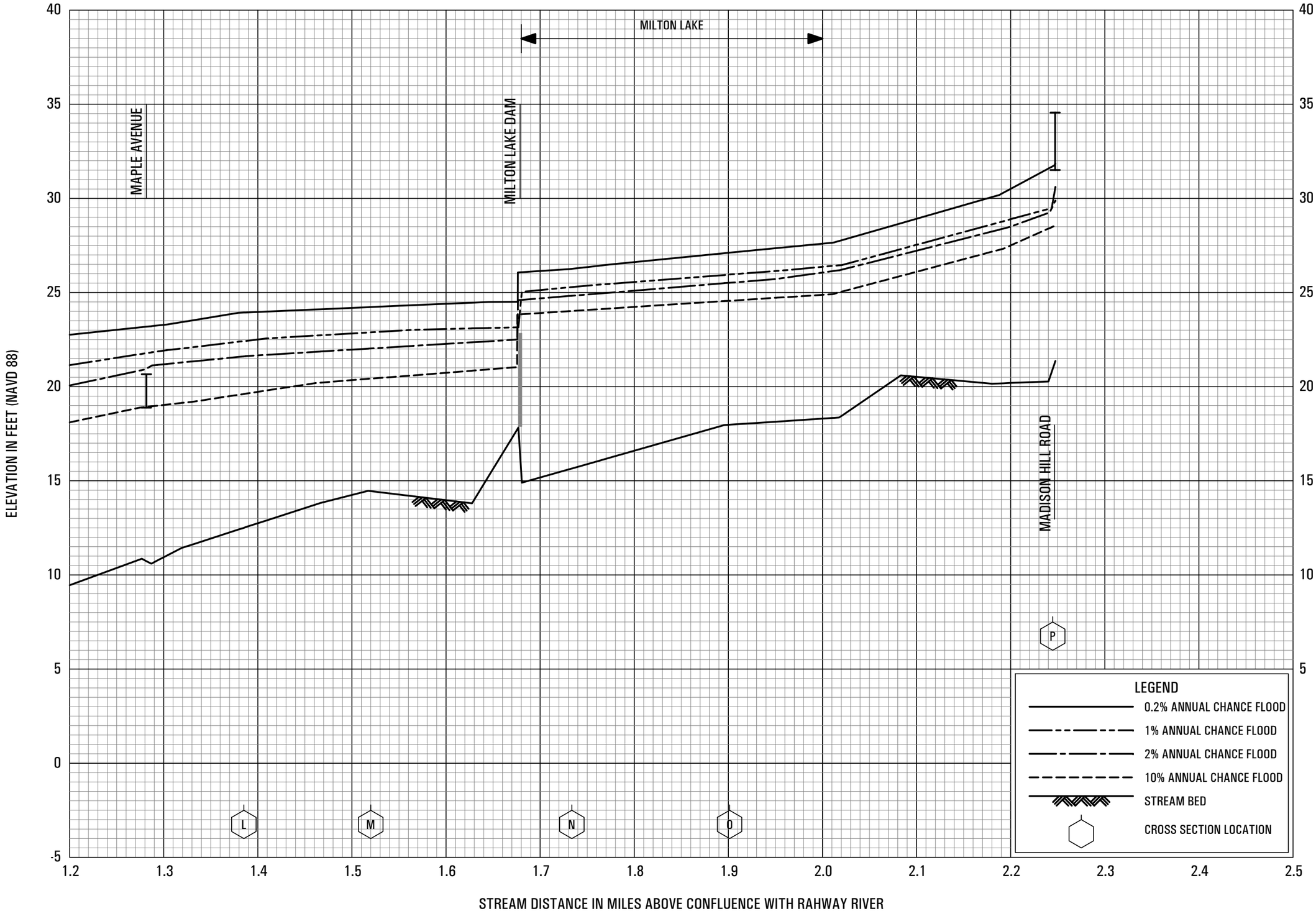
FLOOD PROFILES

ROBINSONS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



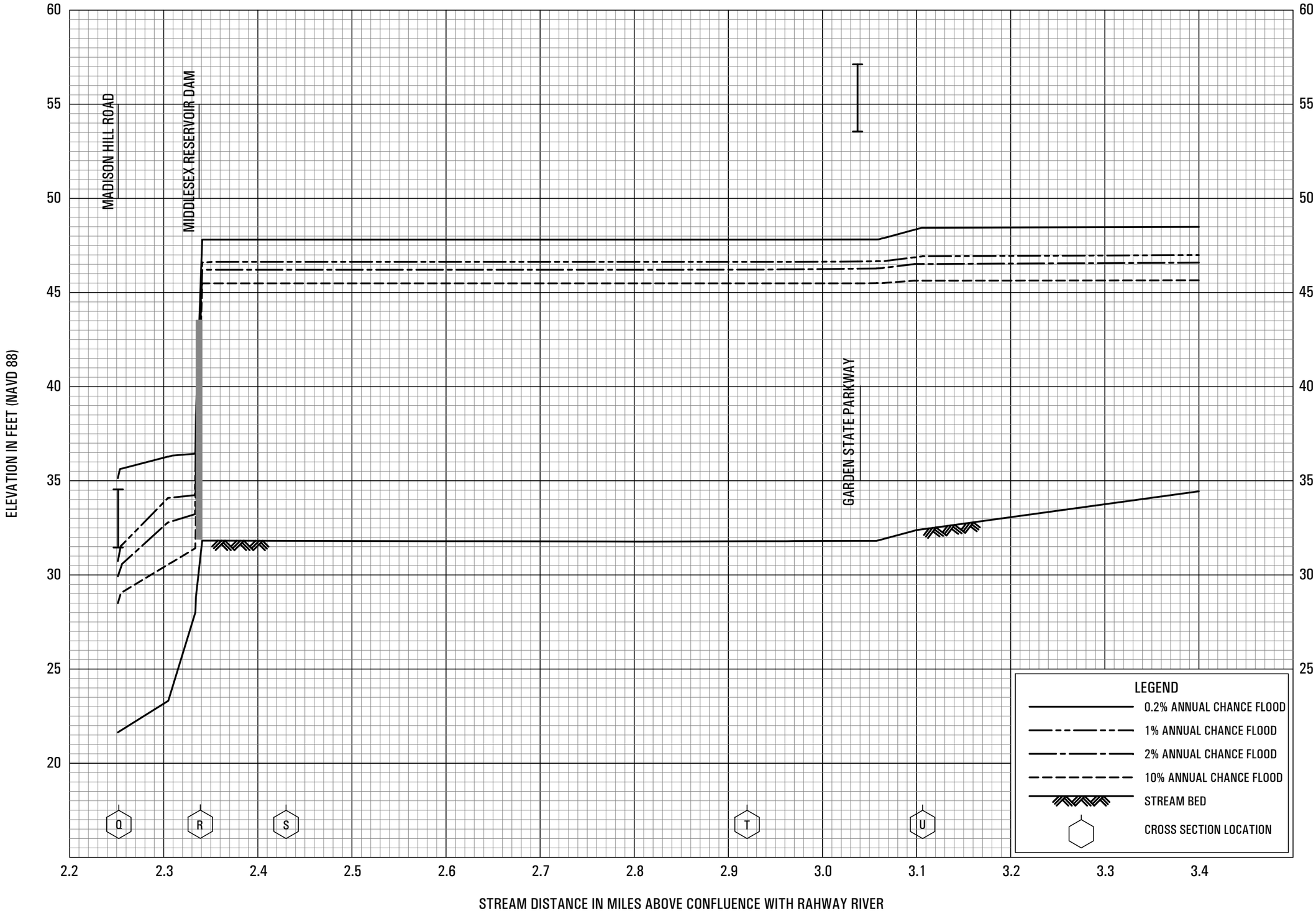
FLOOD PROFILES

ROBINSONS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



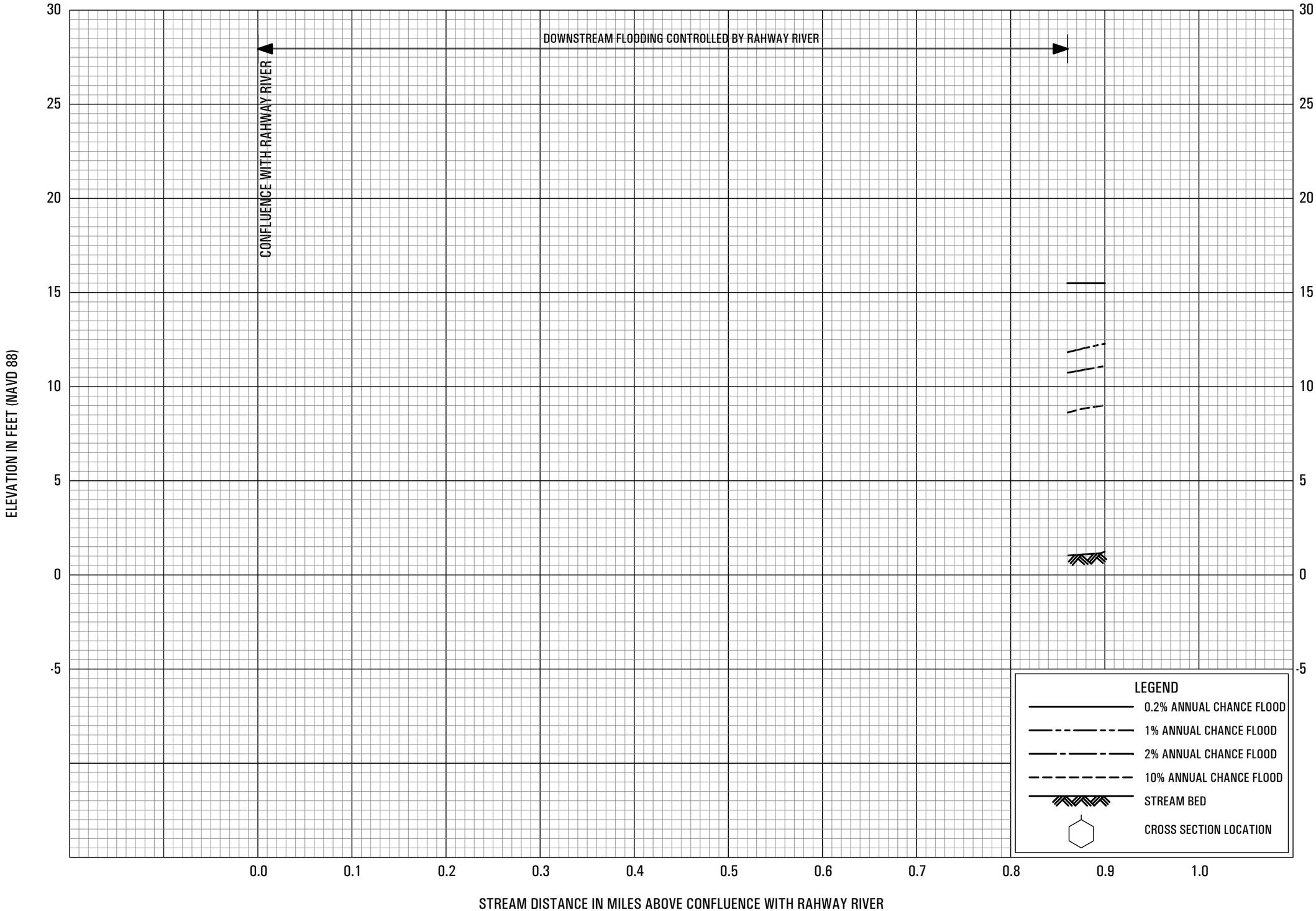
FLOOD PROFILES

ROBINSONS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

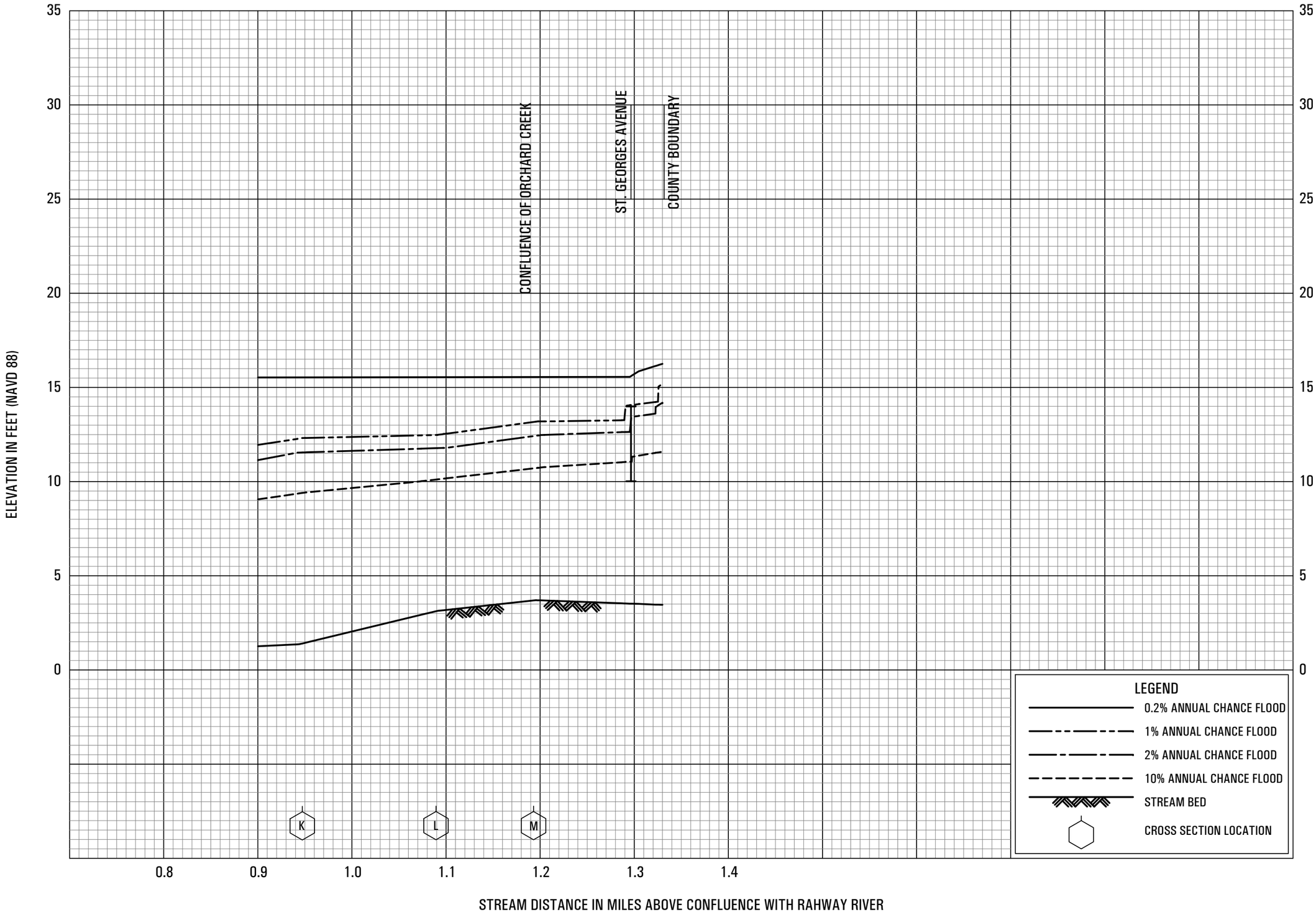
SOUTH BRANCH RAHWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS

147P



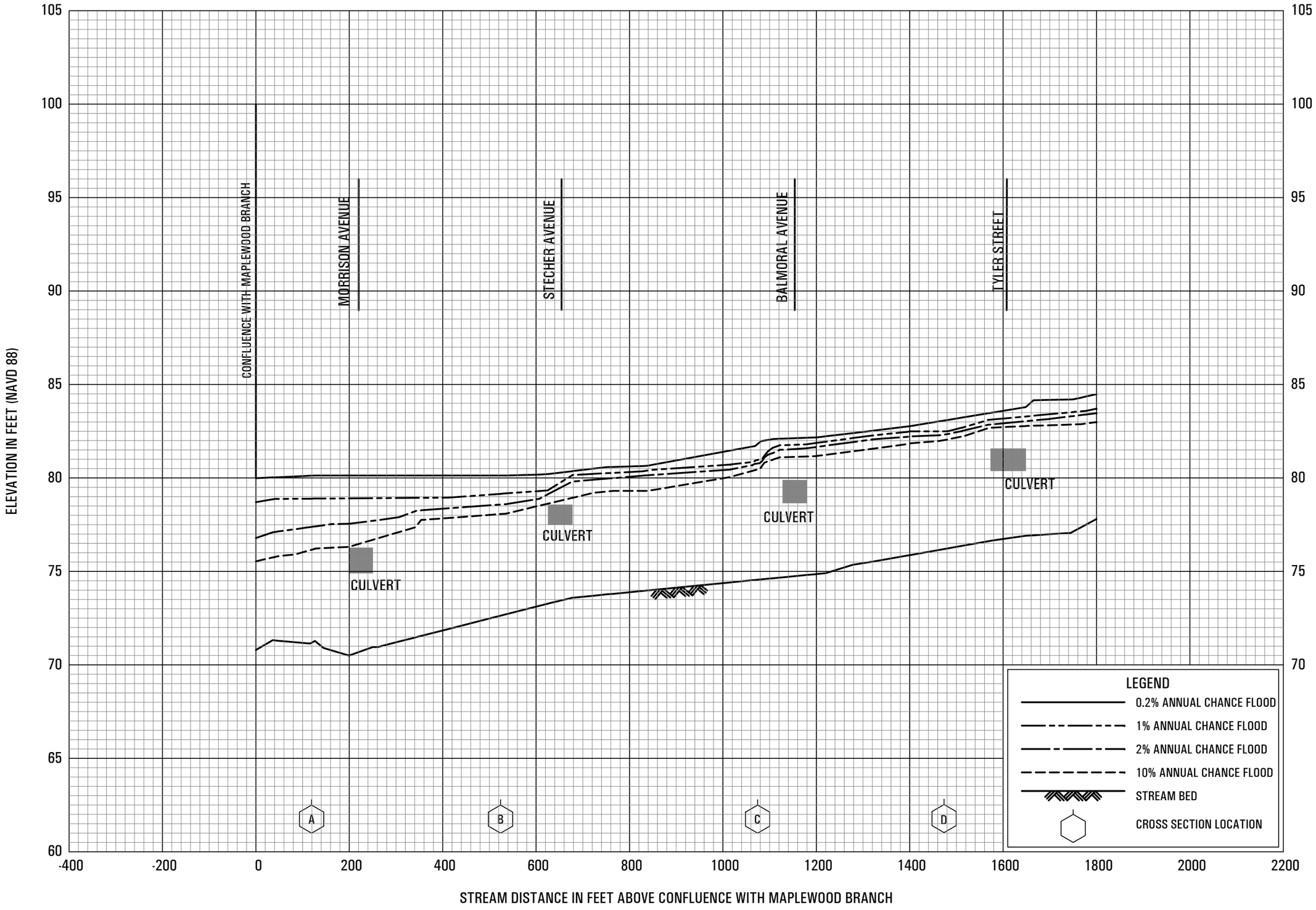
FLOOD PROFILES

SOUTH BRANCH RAHWAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

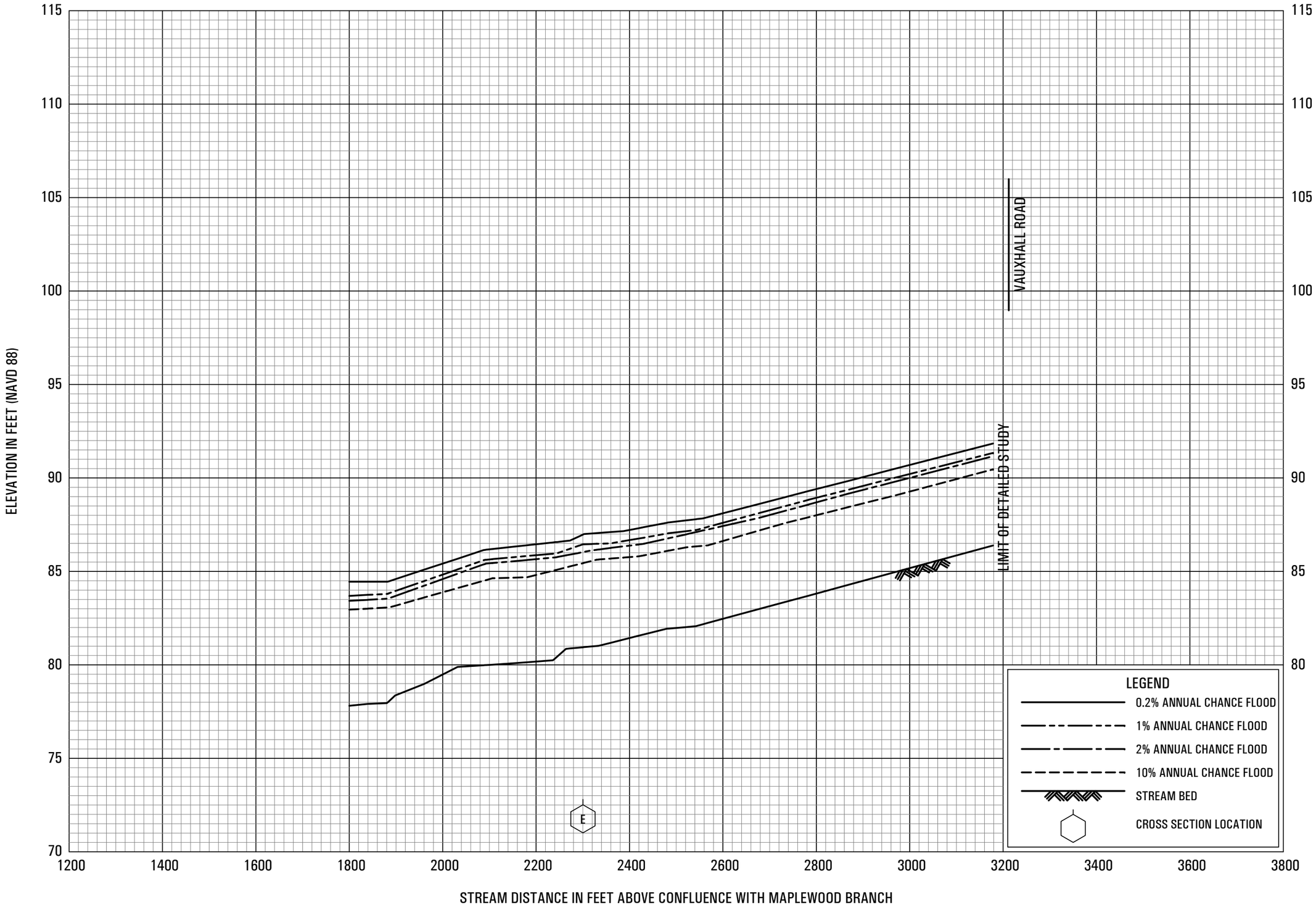
SOUTHWEST BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

149P



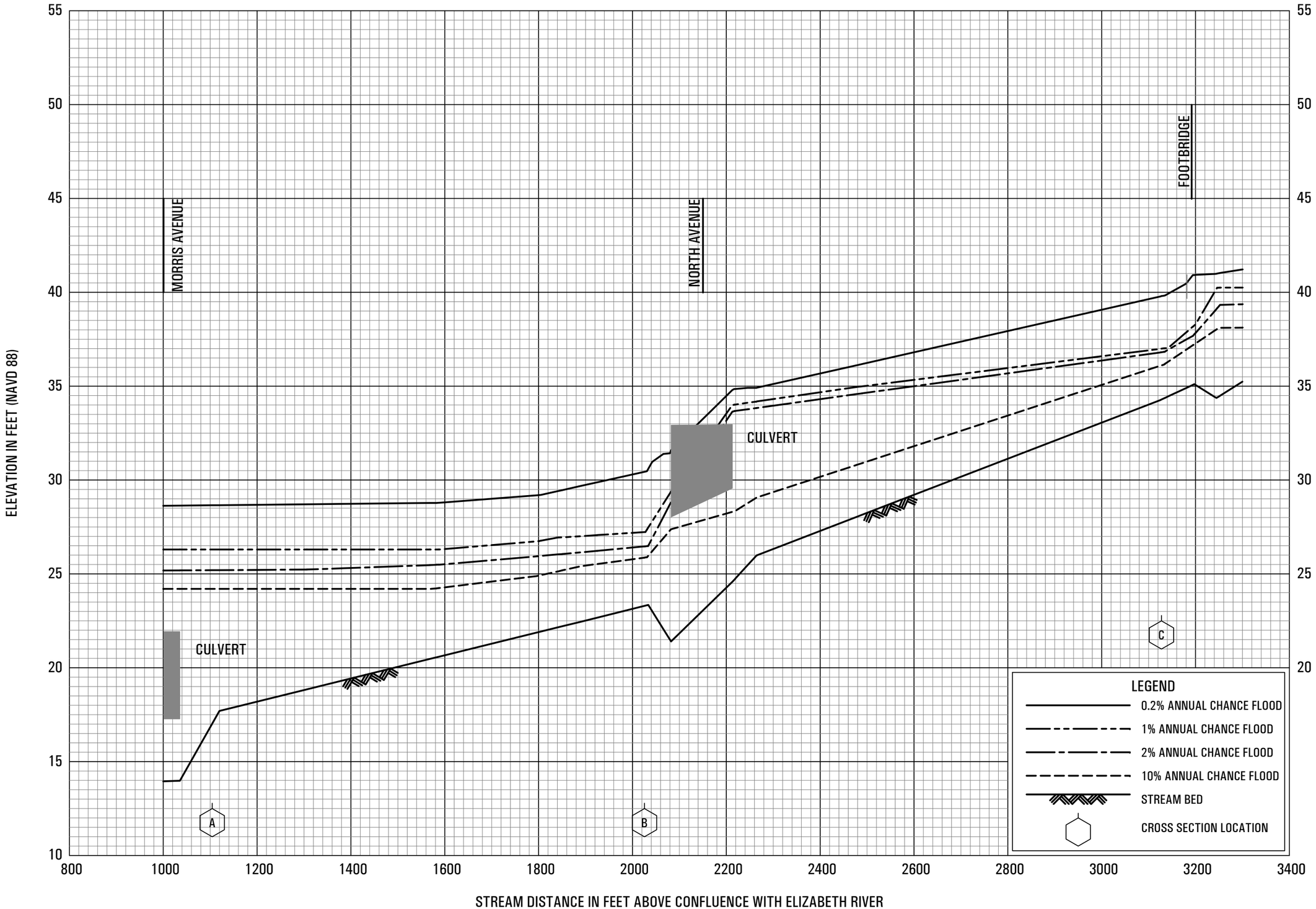
FLOOD PROFILES

SOUTHWEST BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

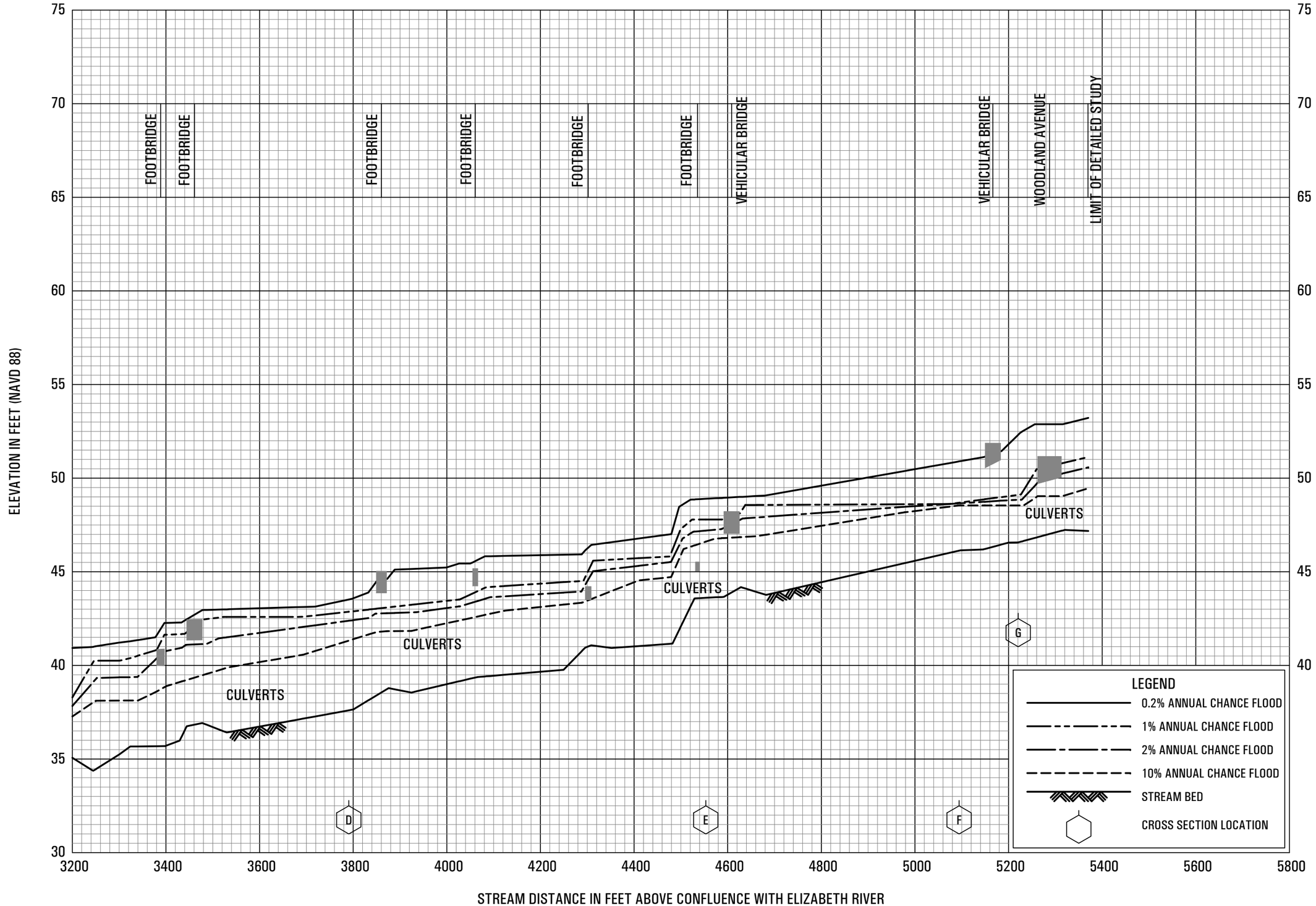
TROTTERS LANE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

156P



FLOOD PROFILES

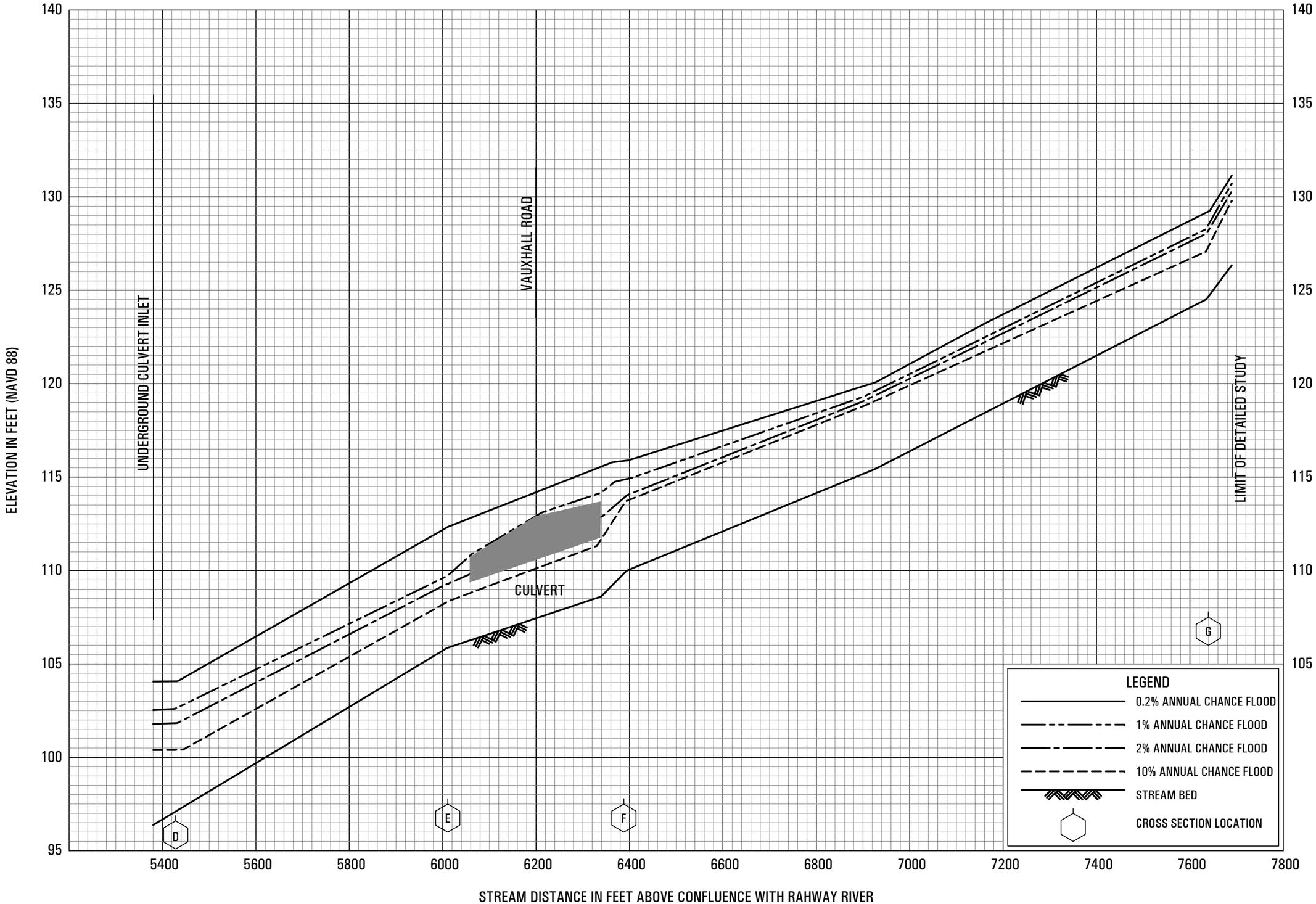
TROTTERS LANE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

157P



FLOOD PROFILES

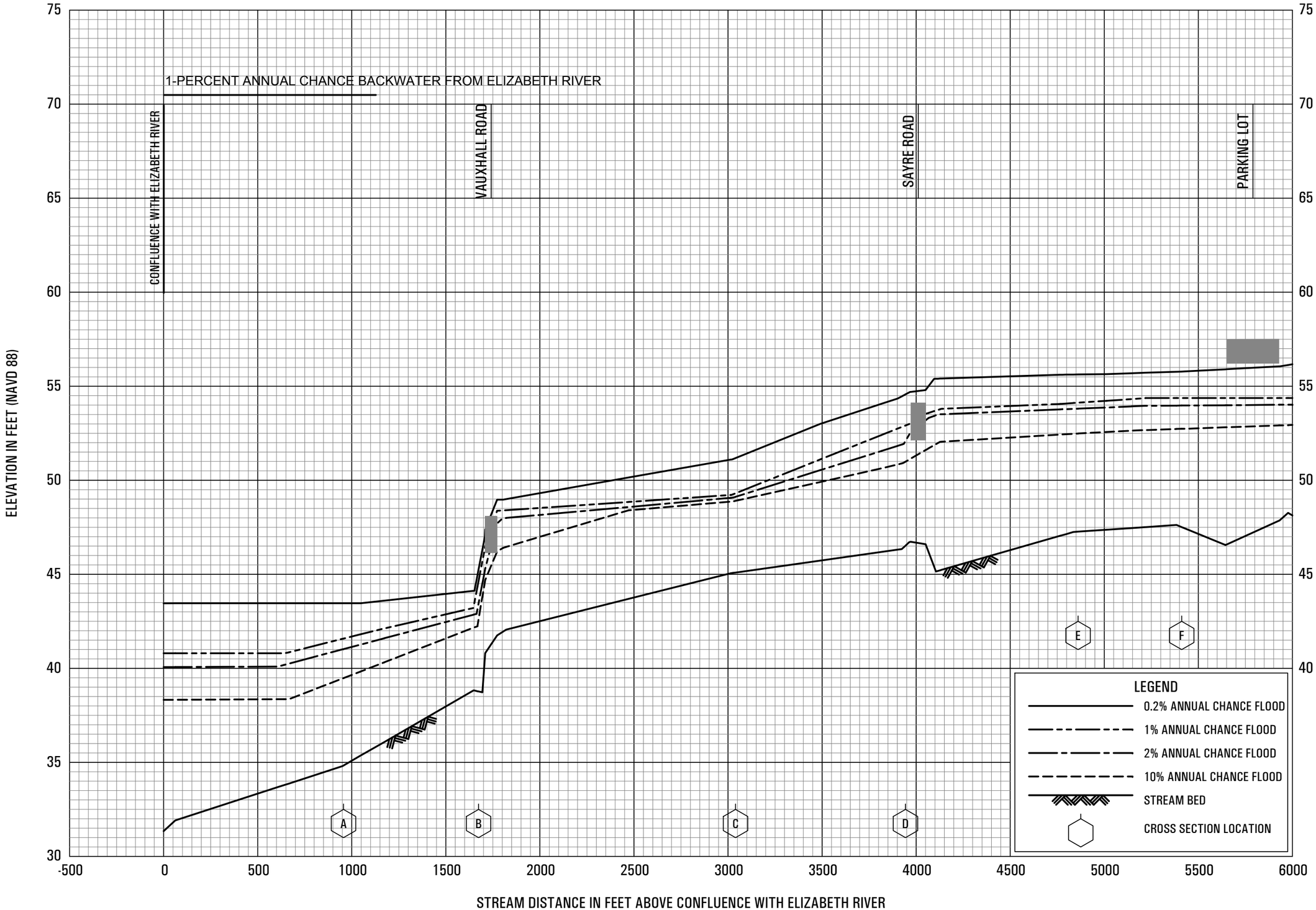
VAUXHALL BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

165P



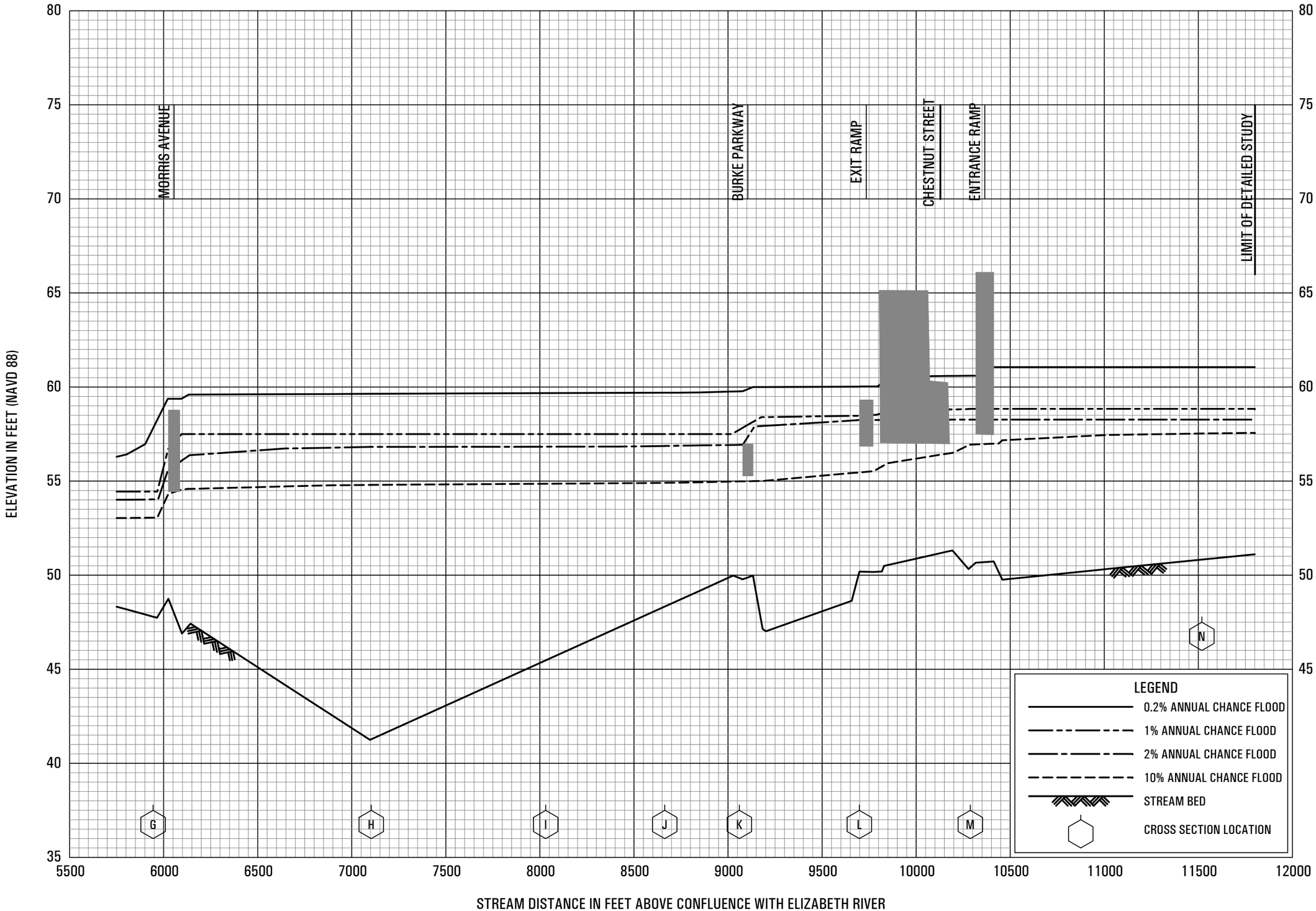
FLOOD PROFILES

WEST BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

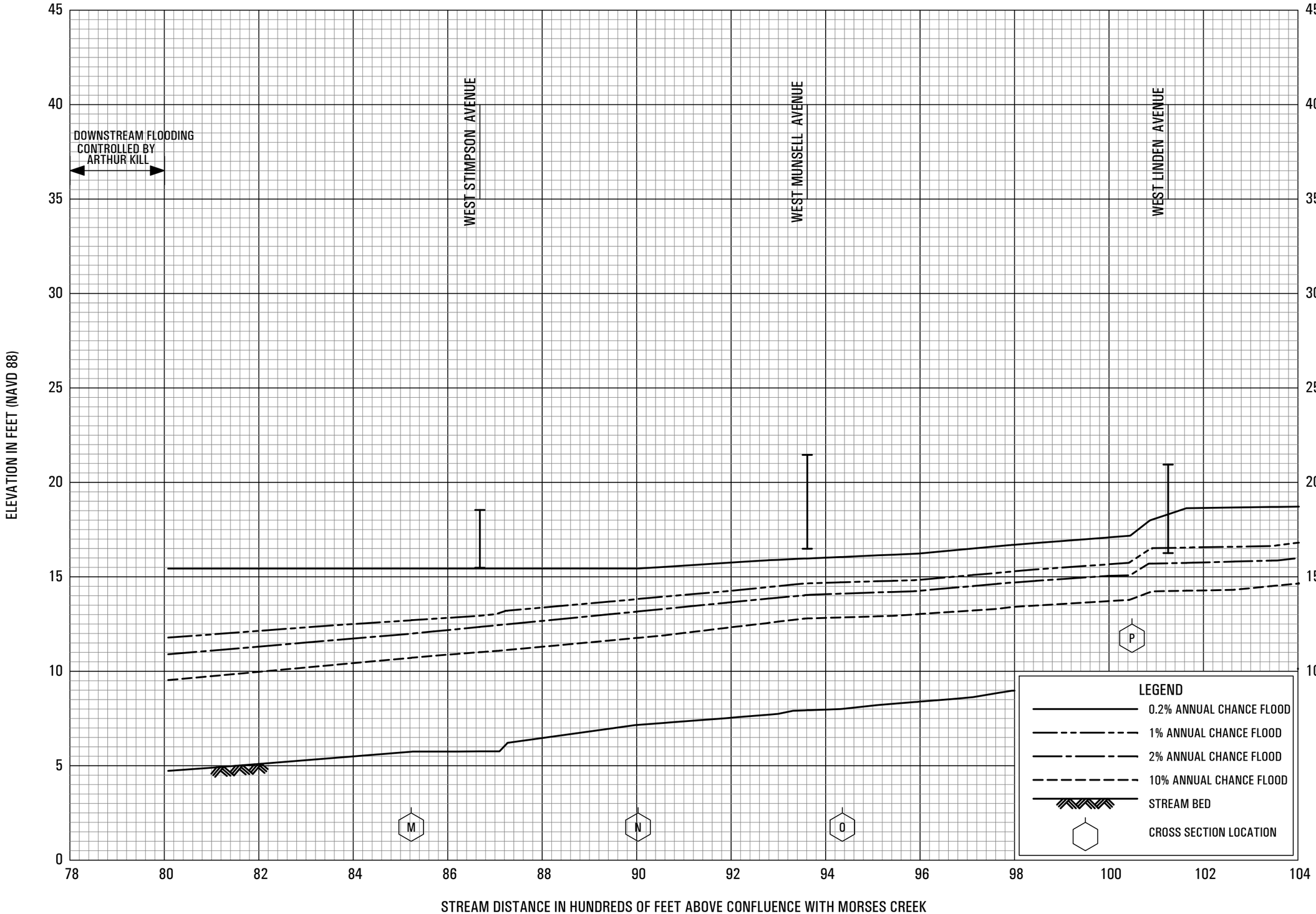
WEST BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

168P



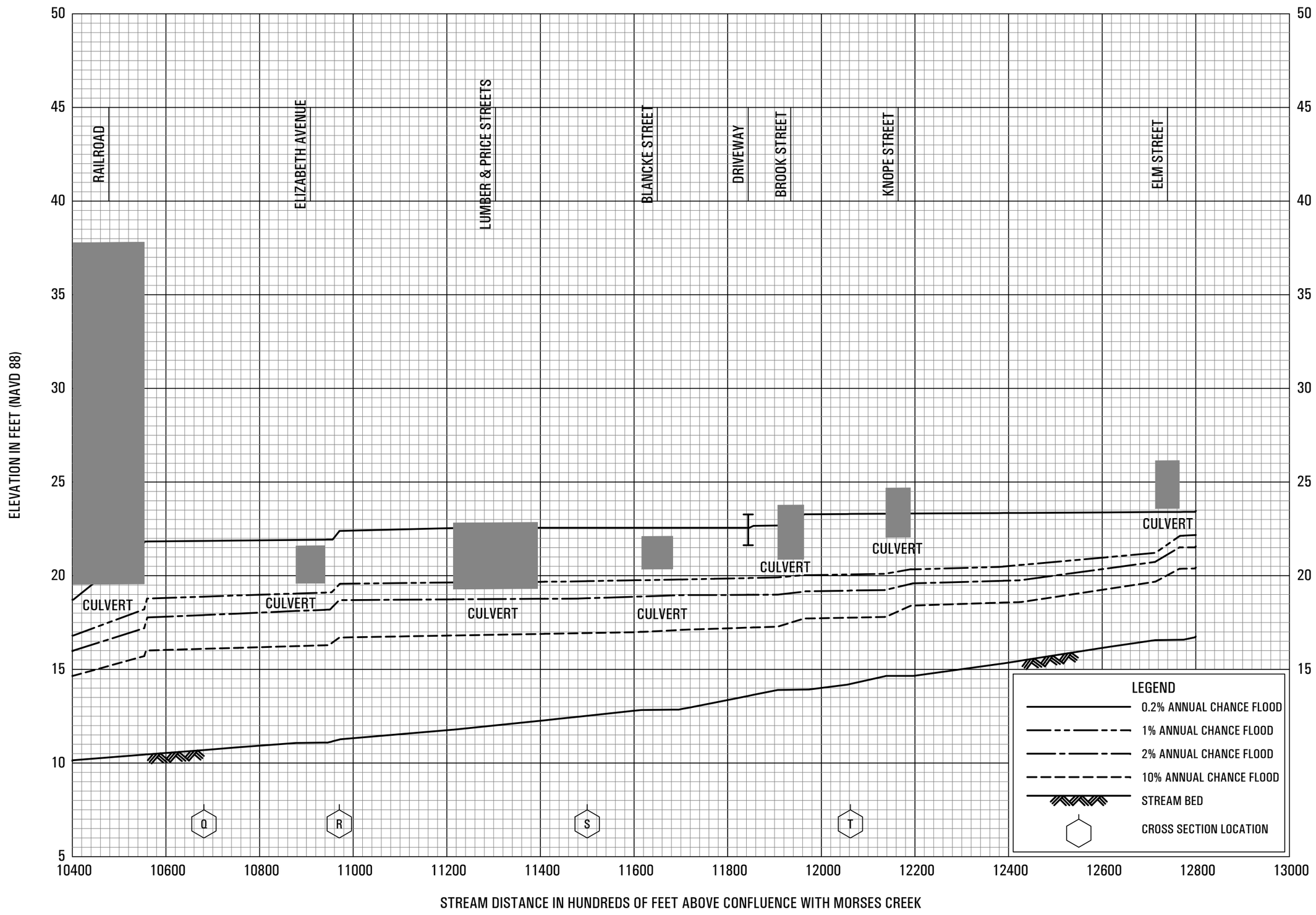
FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



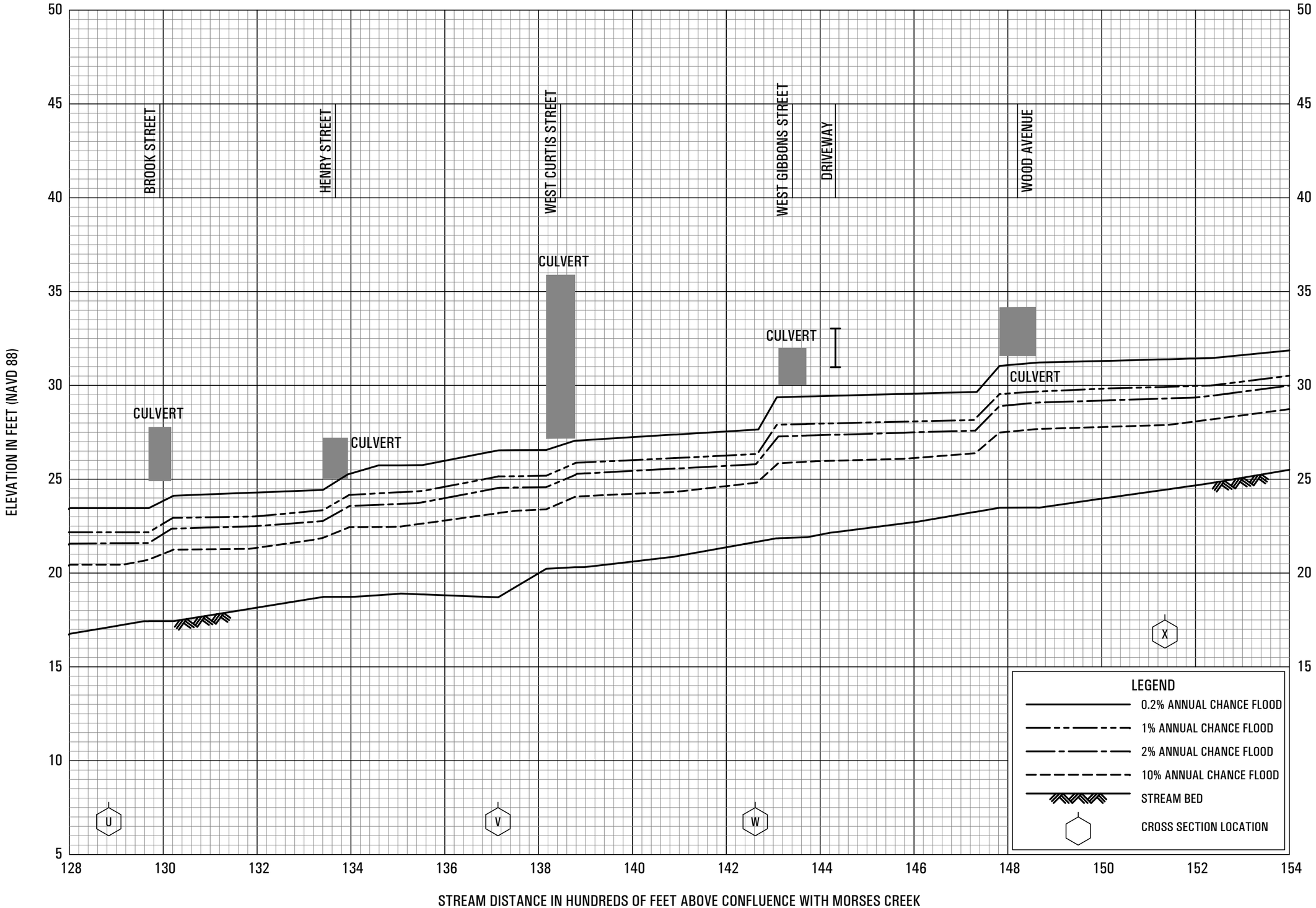
FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

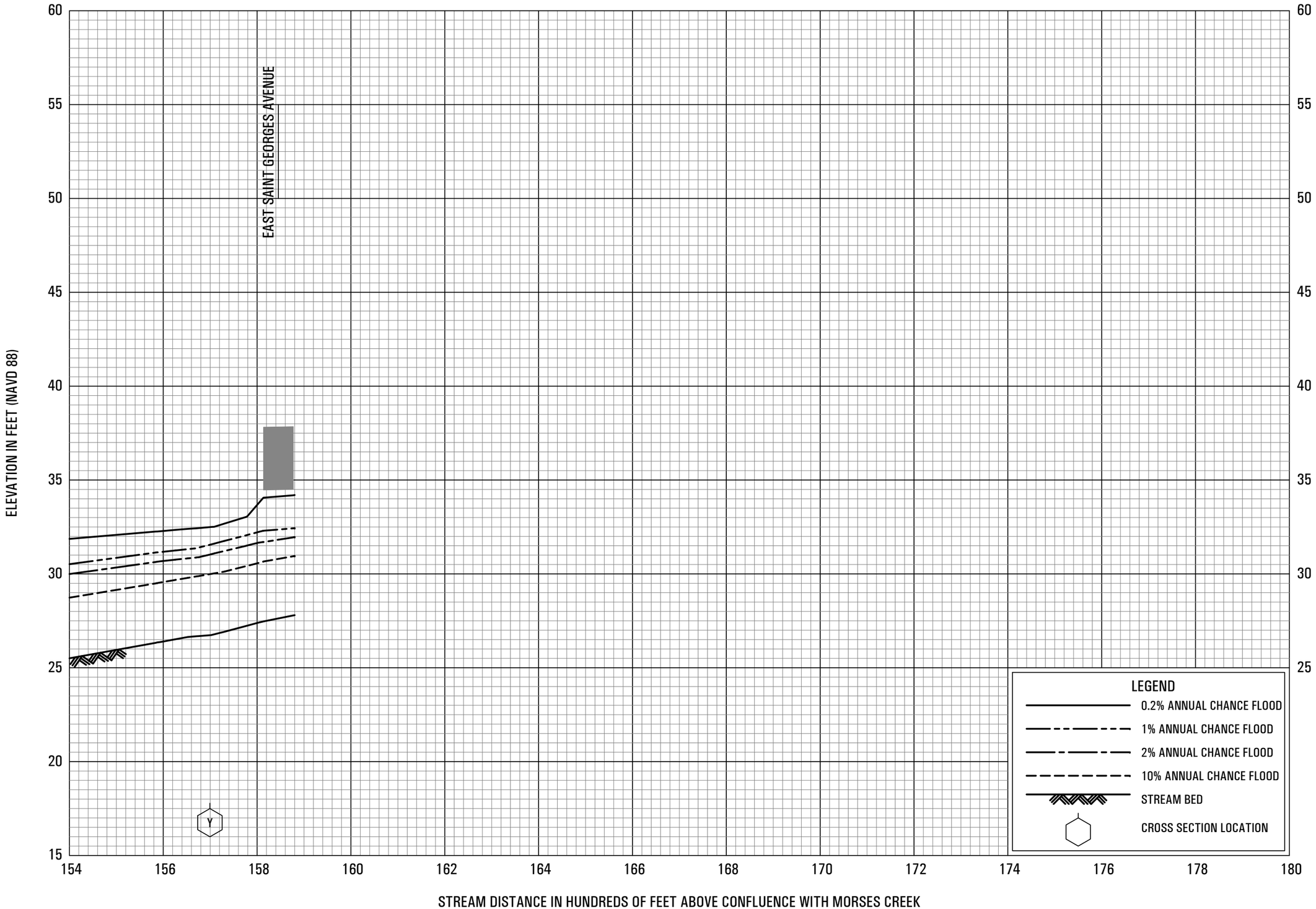
WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

178P



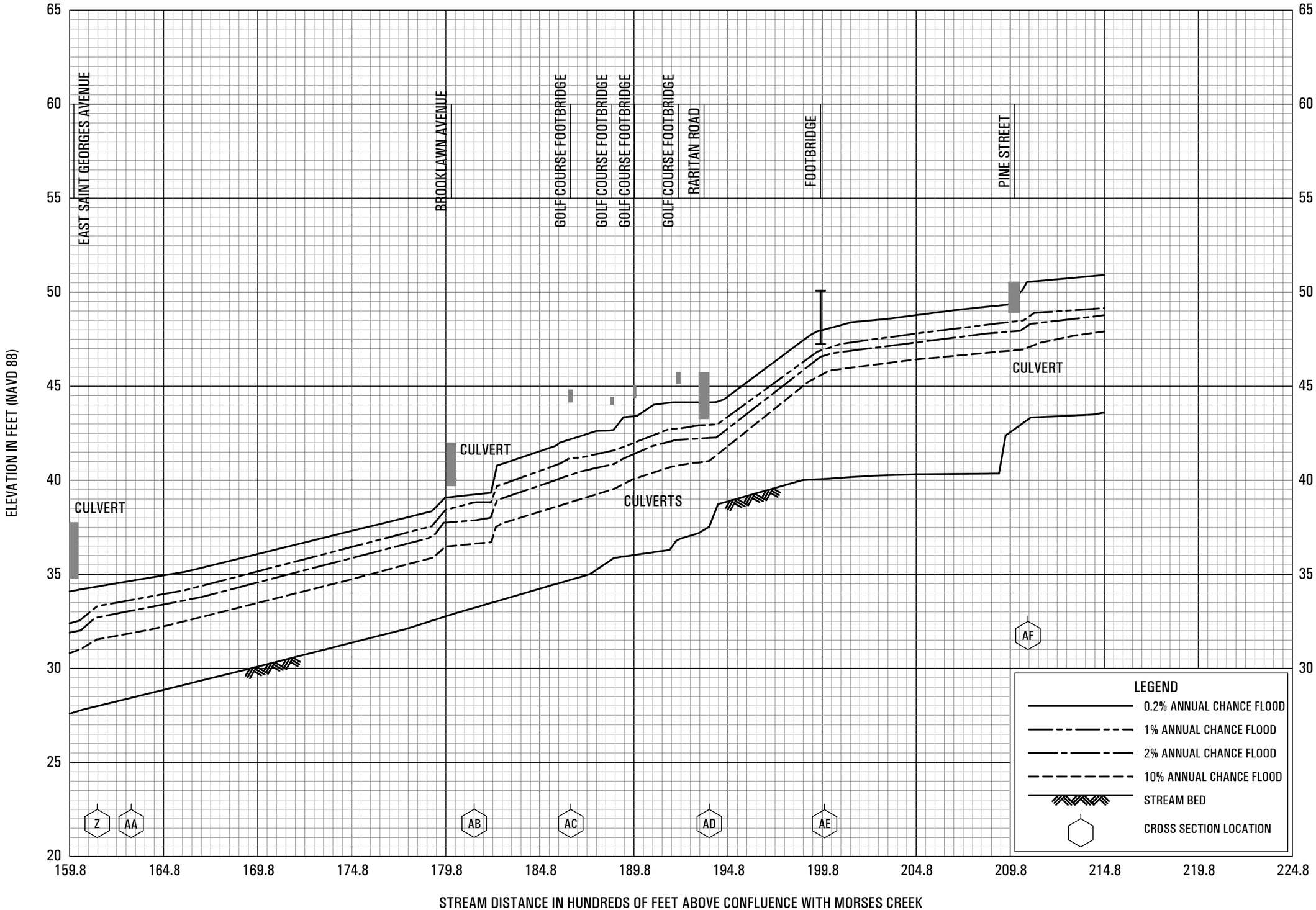
FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



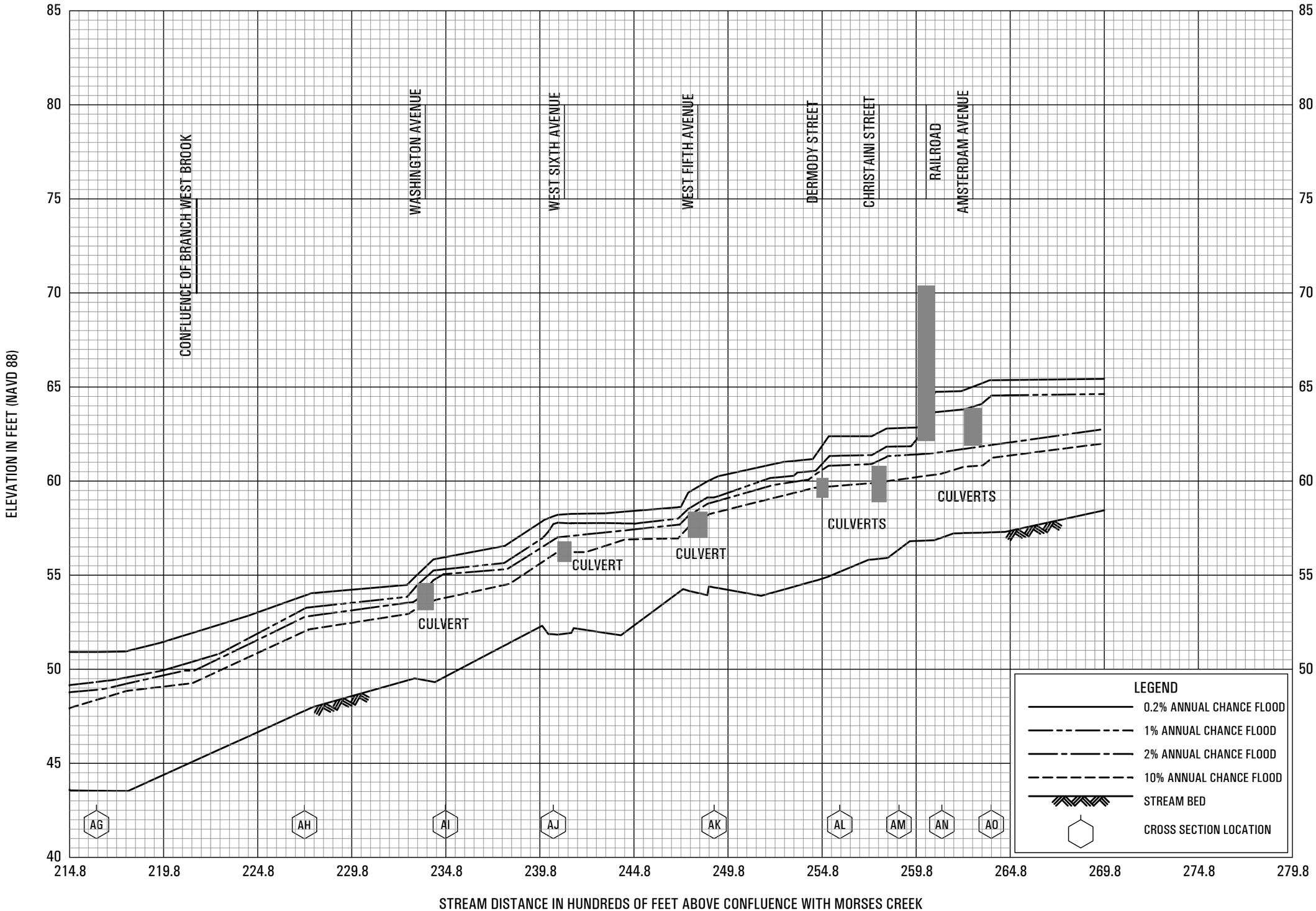
FLOOD PROFILES

WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

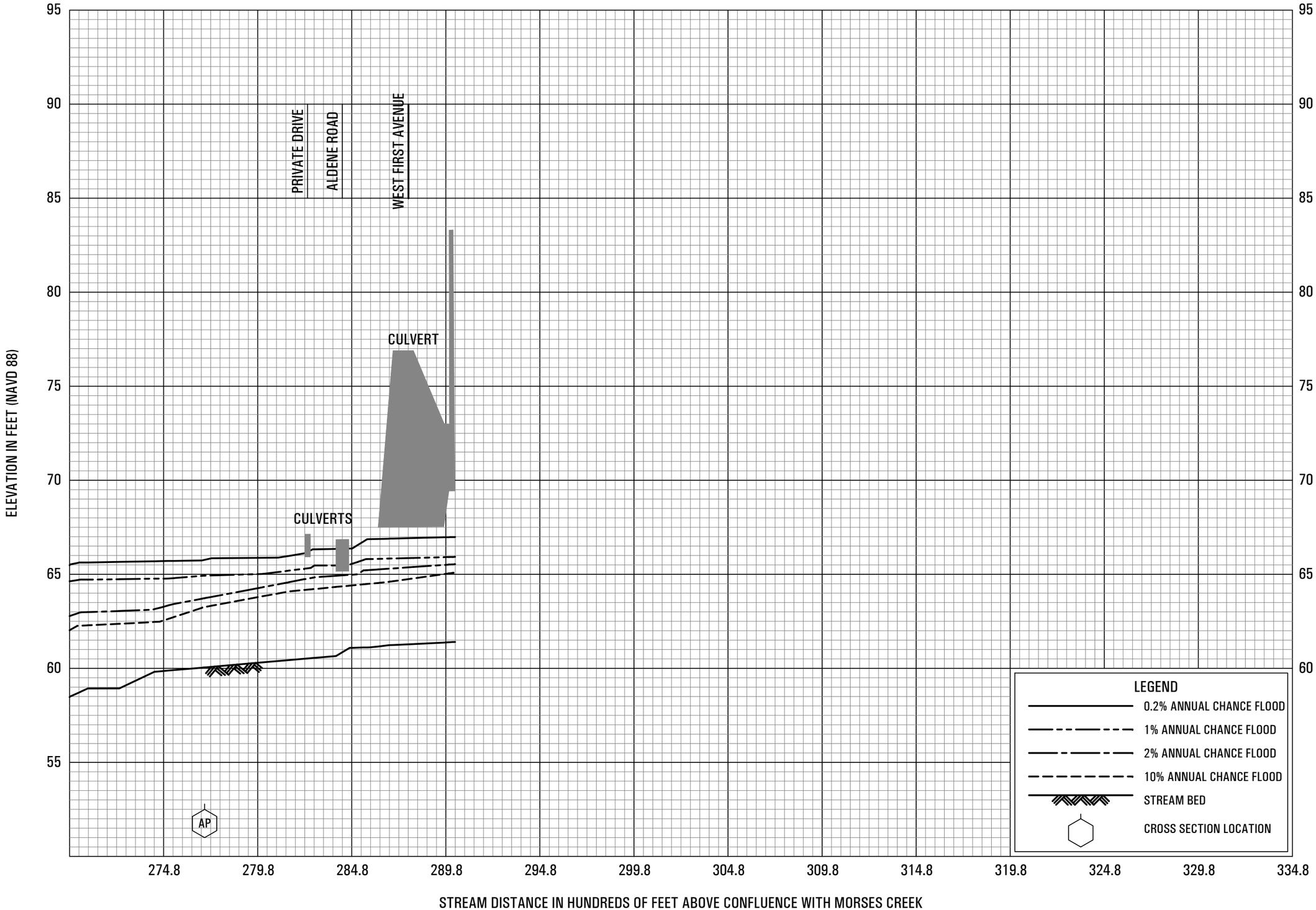
WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

181P



FLOOD PROFILES

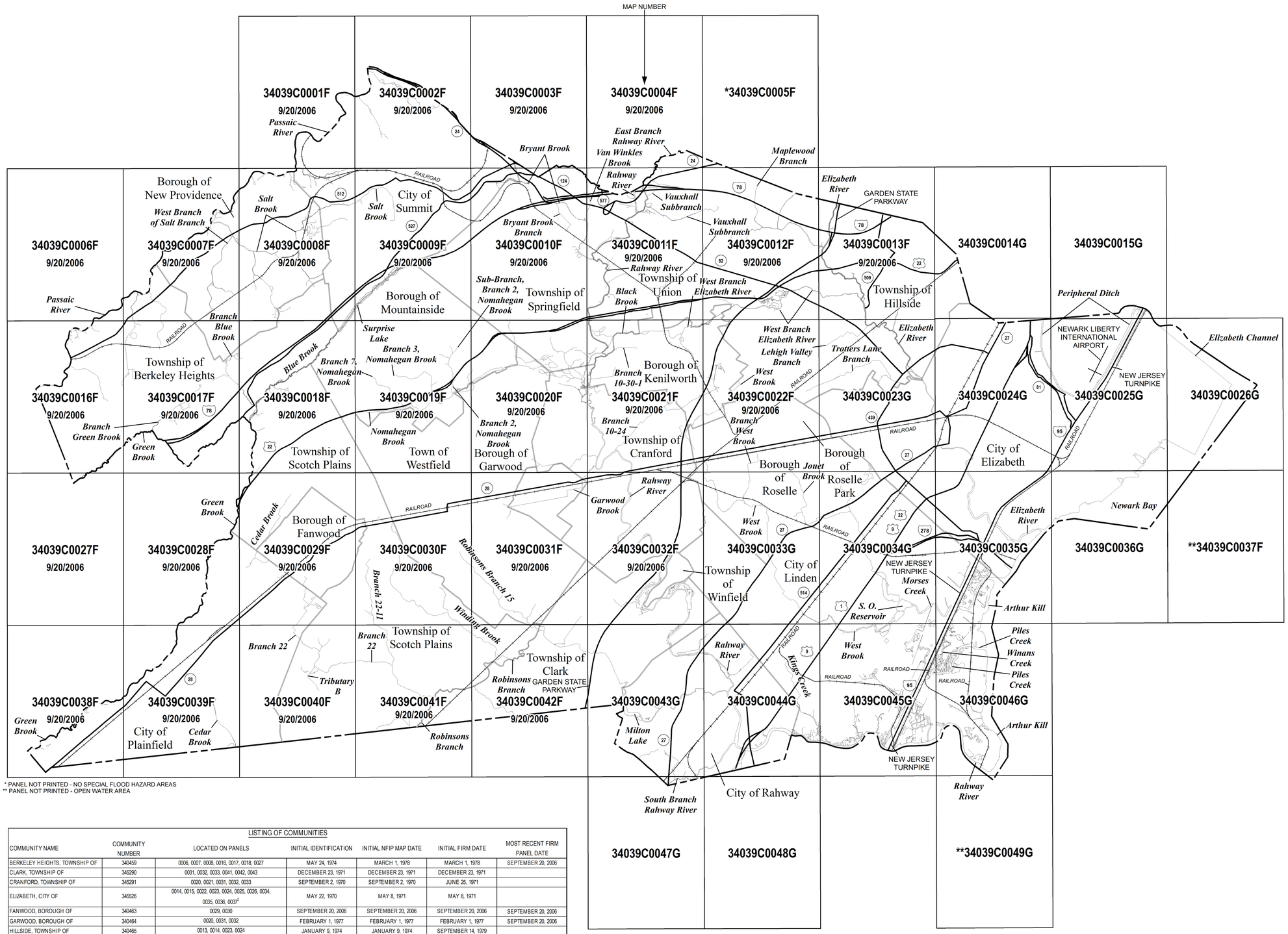
WEST BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

UNION COUNTY, NJ

(ALL JURISDICTIONS)

182P



* PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
** PANEL NOT PRINTED - OPEN WATER AREA

LISTING OF COMMUNITIES

COMMUNITY NAME	COMMUNITY NUMBER	LOCATED ON PANELS	INITIAL IDENTIFICATION	INITIAL NFIP MAP DATE	INITIAL FIRM DATE	MOST RECENT FIRM PANEL DATE
BERKELEY HEIGHTS, TOWNSHIP OF	340459	0006, 0007, 0008, 0016, 0017, 0018, 0027	MAY 24, 1974	MARCH 1, 1978	MARCH 1, 1978	SEPTEMBER 20, 2006
CLARK, TOWNSHIP OF	345290	0031, 0032, 0033, 0041, 0042, 0043	DECEMBER 23, 1971	DECEMBER 23, 1971	DECEMBER 23, 1971	
CRANFORD, TOWNSHIP OF	345291	0020, 0021, 0031, 0032, 0033	SEPTEMBER 2, 1970	SEPTEMBER 2, 1970	JUNE 25, 1971	
ELIZABETH, CITY OF	345526	0014, 0015, 0022, 0023, 0024, 0025, 0026, 0034, 0035, 0036, 0037[2]	MAY 22, 1970	MAY 8, 1971	MAY 8, 1971	
FANWOOD, BOROUGH OF	340463	0029, 0030	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006
GARWOOD, BOROUGH OF	340464	0020, 0031, 0032	FEBRUARY 1, 1977	FEBRUARY 1, 1977	FEBRUARY 1, 1977	SEPTEMBER 20, 2006
HILLSIDE, TOWNSHIP OF	340465	0013, 0014, 0023, 0024	JANUARY 9, 1974	JANUARY 9, 1974	SEPTEMBER 14, 1979	
KENILWORTH, BOROUGH OF	340466	0011, 0012, 0020, 0021, 0022	OCTOBER 26, 1973	OCTOBER 26, 1973	MARCH 2, 1983	
LINDEN, CITY OF	340467	0032, 0033, 0034, 0035, 0044, 0045, 0046, 0049[2]	JUNE 7, 1974	JUNE 7, 1974	NOVEMBER 24, 1976	
MOUNTAINSIDE, BOROUGH OF	340468	0008, 0009, 0010, 0018, 0019, 0020	FEBRUARY 16, 1977	FEBRUARY 16, 1977	FEBRUARY 16, 1977	SEPTEMBER 20, 2006
NEW PROVIDENCE, BOROUGH OF	345306	0007, 0008, 0017, 0018	NOVEMBER 23, 1973	NOVEMBER 23, 1973	NOVEMBER 23, 1973	SEPTEMBER 20, 2006
PLAINFIELD, CITY OF	345312	0028, 0029, 0038, 0039, 0040	JUNE 26, 1971	JUNE 26, 1971	JUNE 26, 1971	SEPTEMBER 20, 2006
RAHWAY, CITY OF	345314	0032, 0033, 0043, 0044, 0047, 0048	DECEMBER 23, 1971	DECEMBER 23, 1971	DECEMBER 23, 1971	
ROSELLE, BOROUGH OF	340472	0021, 0022, 0023, 0032, 0033, 0034	JULY 17, 1978	JULY 17, 1978	JULY 17, 1978	
ROSELLE PARK, BOROUGH OF	340473	0021, 0022, 0023	APRIL 22, 1977	APRIL 22, 1977	JUNE 4, 1980	
SCOTCH PLAINS, TOWNSHIP OF	340474	0018, 0019, 0028, 0029, 0030, 0031, 0040, 0041, 0042	JANUARY 9, 1974	JANUARY 9, 1974	SEPTEMBER 30, 1977	SEPTEMBER 20, 2006
SPRINGFIELD, TOWNSHIP OF	345321	0003, 0009, 0010, 0011, 0020, 0021	OCTOBER 13, 1971	OCTOBER 13, 1971	OCTOBER 13, 1971	SEPTEMBER 20, 2006
SUMMIT, CITY OF	340476	0001, 0002, 0003, 0008, 0009, 0010, 0018	MARCH 16, 1973	MARCH 16, 1973	FEBRUARY 2, 1977	SEPTEMBER 20, 2006
UNION, TOWNSHIP OF	340477	0004, 0005[2], 0011, 0012, 0013, 0021, 0022, 0023	MAY 11, 1973	MAY 11, 1973	AUGUST 1, 1978	
WESTFIELD, TOWN OF	340478	0018, 0019, 0020, 0030, 0031, 0042	DECEMBER 18, 1979	DECEMBER 18, 1979	DECEMBER 18, 1979	SEPTEMBER 20, 2006
WINFIELD, TOWNSHIP OF[1]	340479	0032	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006	SEPTEMBER 20, 2006

[1] NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED
[2] PANEL NOT PRINTED

MAP REPOSITORIES

(Maps available for reference only, not for distribution.)

BERKELEY HEIGHTS, TOWNSHIP OF:
Berkeley Heights Township Hall
29 Park Avenue
Berkeley Heights, New Jersey 07922

CLARK, TOWNSHIP OF:
Clark Township Municipal Building
430 Westfield Avenue
Clark, New Jersey 07066-1590

CRANFORD, TOWNSHIP OF:
Cranford Township Municipal Building
8 Springfield Avenue
Cranford, New Jersey 07016-2199

ELIZABETH, CITY OF:
Construction Department
Room 401
50 Winfield Scott Plaza
Elizabeth, New Jersey 07201

FANWOOD, BOROUGH OF:
Fanwood Municipal Building
75 Martin Avenue North
Fanwood, New Jersey 07023

GARWOOD, BOROUGH OF:
Garwood Borough Clerk's Office
403 South Avenue
Garwood, New Jersey 07027

HILLSIDE, TOWNSHIP OF:
Hillside Township Municipal Building
1409 Liberty Ave
Hillside, New Jersey 07205

KENILWORTH, BOROUGH OF:
Kenilworth Municipal Building
567 Boulevard
Kenilworth, New Jersey 07033

LINDEN, CITY OF:
Linden City Municipal Building
301 North Wood Avenue
Linden, New Jersey 07036

MOUNTAINSIDE, BOROUGH OF:
Mountainside Borough Hall
1385 Route 22
Mountainside, New Jersey 07092

NEW PROVIDENCE, BOROUGH OF:
New Providence Borough Hall
360 Elkwood Avenue
New Providence, New Jersey 07974-1834

PLAINFIELD, CITY OF:
Plainfield Municipal Building
515 Watchung Avenue
Plainfield, New Jersey 07061

RAHWAY, CITY OF:
Engineering Office
1 City Hall Plaza
Rahway, New Jersey 07065

ROSELLE, BOROUGH OF:
Engineering Office
210 Chestnut Street
Roselle, New Jersey 07203

ROSELLE PARK, BOROUGH OF:
Building Department - Department of Public Works
110 East Westfield Avenue
Roselle Park, New Jersey 07204

SCOTH PLAINS, TOWNSHIP OF:
Scotch Plains Municipal Building
430 Park Avenue
Scotch Plains, New Jersey 07076

SPRINGFIELD, TOWNSHIP OF:
Springfield Township Municipal Building
100 Mountain Avenue
Springfield, New Jersey 07081

SUMMIT, CITY OF:
Summit City Hall
512 Springfield Avenue
Summit, New Jersey 07901-2267

UNION, TOWNSHIP OF:
Engineering Department
1976 Morris Avenue
Union, New Jersey 07083-3579

WESTFIELD, TOWN OF:
Westfield Township Municipal Building
425 East Broad Street
Westfield, New Jersey 07090

WINFIELD, TOWNSHIP OF:
Winfield Township Municipal Building
12 Gulfstream Avenue
Winfield, New Jersey 07036

MAP DATES

This FIRM Index displays the map date for each FIRM panel at the time that this Index was printed. Because this Index may not be distributed to unaffected communities in subsequent revisions, users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center (MSC) website at http://msc.fema.gov, or by calling the FEMA Map Information eXchange (FMIX) at 1-877-336-2627.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index.These may be ordered directly from the Map Service Center at the number listed above.

NOTE TO USER

Future revisions to this FIRM Index will only be issued to communities that are located on FIRM panels being revised. This FIRM Index therefore remains valid for FIRM panels dated or earlier. Please refer to the "MOST RECENT FIRM PANEL DATE" column in the Listing of Communities table to determine the most recent FIRM Index date for each community.

NOTE TO USERS

FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise flood information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

MAP INDEX

FIRM
FLOOD INSURANCE RATE MAP
UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

MAP INDEX

PANELS PRINTED: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48

PRELIMINARY
FEBRUARY 3, 2015

MAP NUMBER
34039CIND0B

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Jersey State Plane 2900 zone. The **horizontal datum** was NAD 83. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the State of New Jersey Office of Information Technology. This information was derived from digital orthophotos produced at a scale of 1:2400 with a 1-foot pixel resolution from photography dated 2012.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

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LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
3 — 3	Limited detail cross section line
23 - - - - 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
2°76000'N	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0014G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 14 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0014	G
HILLSIDE, TOWNSHIP OF	340465	0014	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0014G

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

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To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Jersey State Plane 2900 zone. The **horizontal datum** was NAD 83. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA).** The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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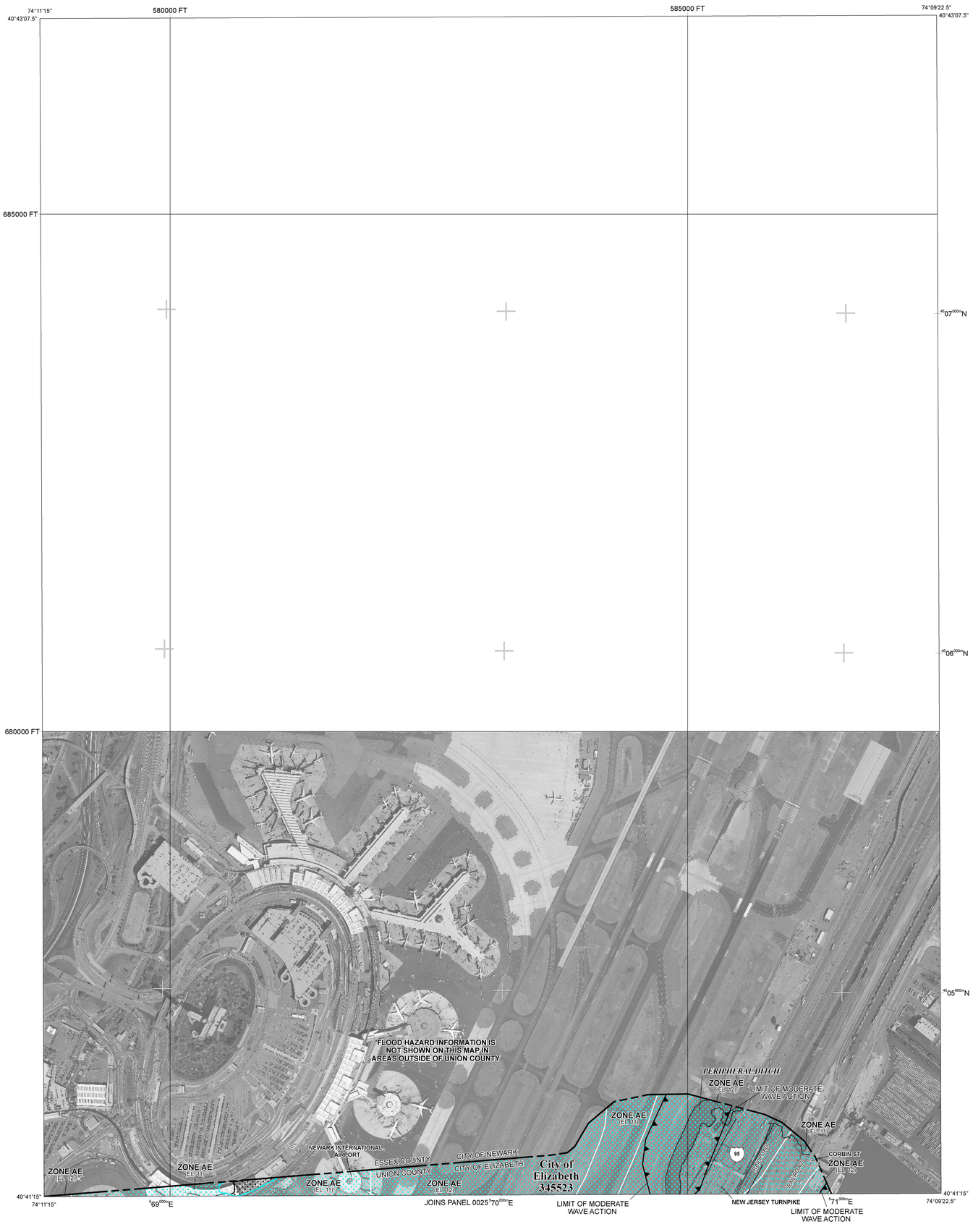

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
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23 - - - - 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
76000mN	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0015G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 15 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0015	G

PRELIMINARY
FEBRUARY 3, 2015

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MAP NUMBER
34039C0015G

MAP REVISED

Federal Emergency Management Agency

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

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NJFHADF is equal to the 1-percent-annual chance flood plus an additional 25% in flow, and not to exceed the 0.2-percent-annual chance flood. NJFHADF boundary is to regulate disturbance to the land and vegetation within flood hazard area of a water body. This regulation is set forth by the State of New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13, and is administered by New Jersey Department of Environmental Protection (NJDEP).

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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ZONE A	No Base Flood Elevations determined.
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ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)—(A) Cross section line

(3)—(3) Limited detail cross section line

(23)- - - -(23) Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{24}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT — 5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0023G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

PANEL 23 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0023	G
HILLSIDE, TOWNSHIP OF	340465	0023	G
ROSELLE PARK, BOROUGH OF	340473	0023	G
ROSELLE, BOROUGH OF	340472	0023	G
UNION, TOWNSHIP OF	340477	0023	G

PRELIMINARY
FEBRUARY 3, 2015

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MAP NUMBER
34039C0023G

MAP REVISED

Federal Emergency Management Agency

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NJFHADF is equal to the 1-percent-annual chance flood plus an additional 25% in flow, and not to exceed the 0.2-percent-annual chance flood. NJFHADF boundary is to regulate disturbance to the land and vegetation within flood hazard area of a water body. This regulation is set forth by the State of New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13, and is administered by New Jersey Department of Environmental Protection (NJDEP).

ATTENTION: The levee, dike, or other structure that impacts flood hazards inside this boundary has not been shown to comply with Section 65.10 of the NFIP Regulations. As such, this FIRM panel will be revised at a later date to update the flood hazard information associated with this structure.

The flood hazard data inside this boundary on the FIRM panel has been republished from the previous effective (historic) FIRM for this area, after being converted from NGVD 29 to NAVD 88.

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
3 — 3	Limited detail cross section line
23 - - - - 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
2 76 000m N	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0024G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

PANEL 24 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0024	G
HILLSIDE, TOWNSHIP OF	340465	0024	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0024G

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Jersey State Plane 2900 zone. The **horizontal datum** was NAD 83. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the State of New Jersey Office of Information Technology. This information was derived from digital orthophotos produced at a scale of 1:2400 with a 1-foot pixel resolution from photography dated 2012.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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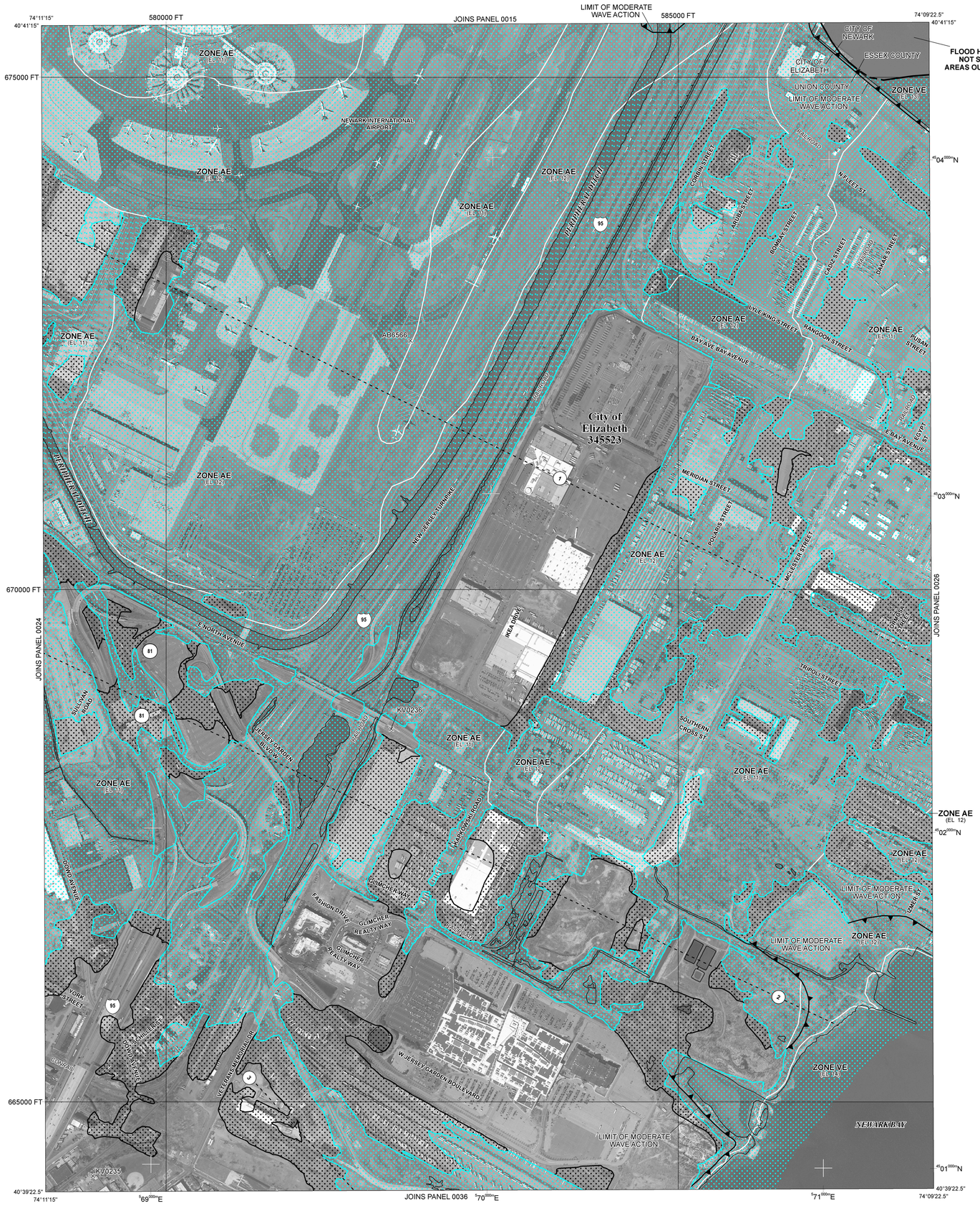

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)—(A) Cross section line

(3)- - - -(3) Limited detail cross section line

(23)- - - -(23) Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{24}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT — 5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0025G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

PANEL 25 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0025	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0025G

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Jersey State Plane 2900 zone. The **horizontal datum** was NAD 83. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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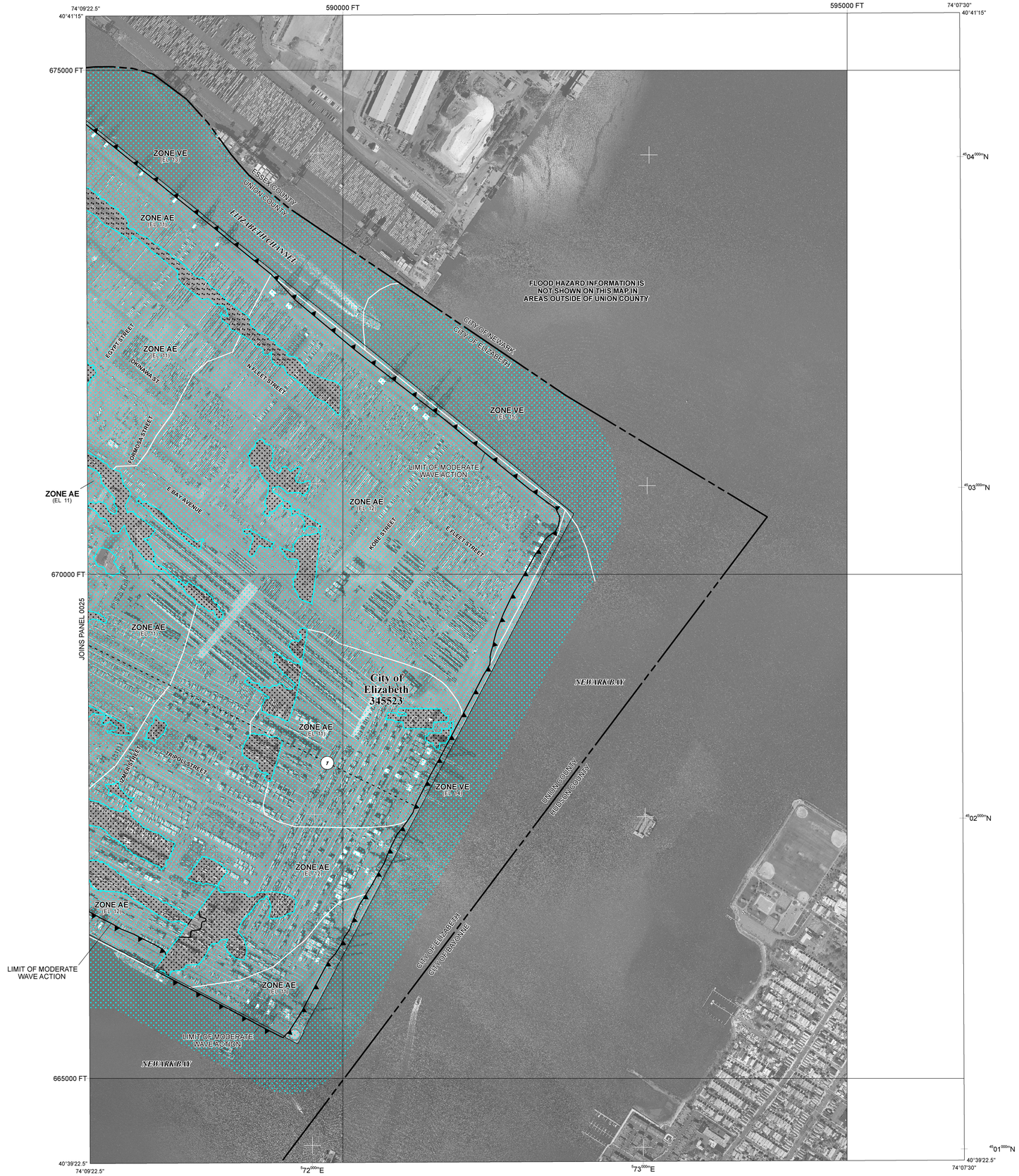

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
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ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(3)———(3)	Limited detail cross section line
(23)- - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4076000mN	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0026G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 26 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0026	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0026G

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

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1315 East-West Highway
Silver Spring, Maryland 20910-3282
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The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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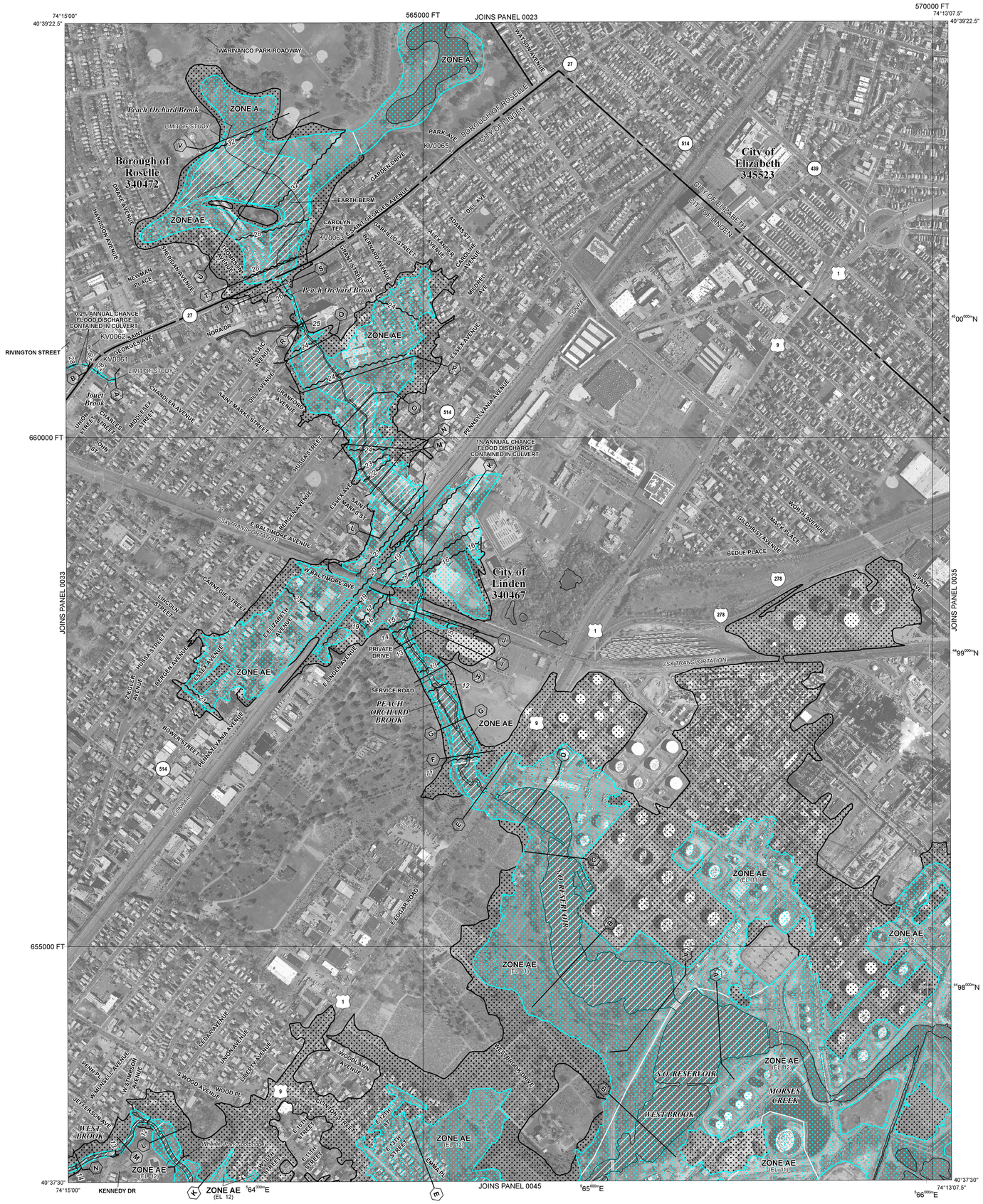

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A Cross section line

3 — 3 Limited detail cross section line

23 — 23 Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{27}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT — 5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0034G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 34 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0034	G
LINDEN, CITY OF	340467	0034	G
ROSELLE, BOROUGH OF	340472	0034	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0034G

MAP REVISED

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Jersey State Plane 2900 zone. The **horizontal datum** was NAD 83. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the State of New Jersey Office of Information Technology. This information was derived from digital orthophotos produced at a scale of 1:2400 with a 1-foot pixel resolution from photography dated 2012.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA).** The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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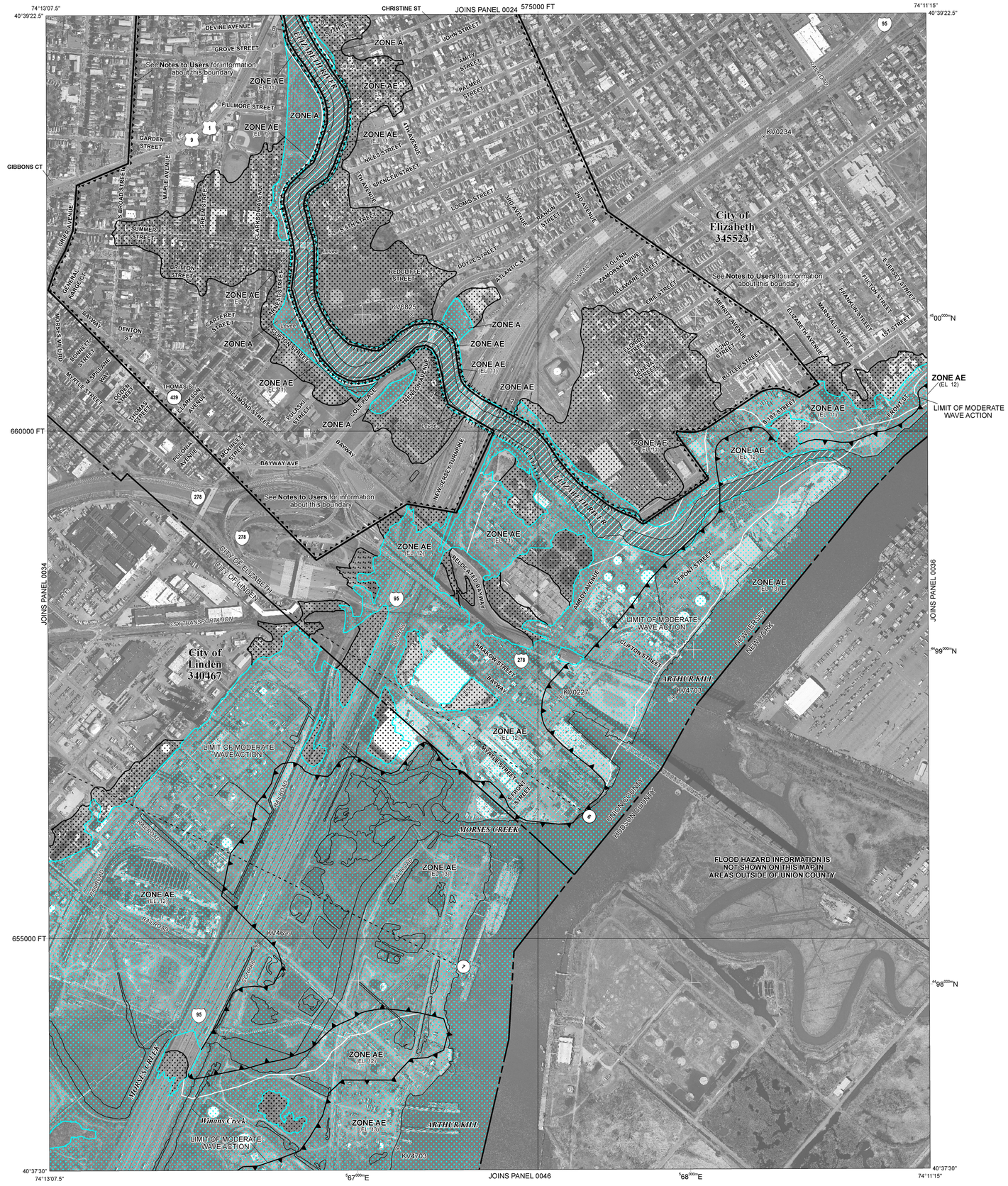
NJFHADF is equal to the 1-percent-annual chance flood plus an additional 25% in flow, and not to exceed the 0.2-percent-annual chance flood. NJFHADF boundary is to regulate disturbance to the land and vegetation within flood hazard area of a water body. This regulation is set forth by the State of New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13, and is administered by New Jersey Department of Environmental Protection (NJDEP).

ATTENTION: The levee, dike, or other structure that impacts flood hazards inside this boundary has not been shown to comply with Section 65.10 of the NFIP Regulations. As such, this FIRM panel will be revised at a later date to update the flood hazard information associated with this structure.

The flood hazard data inside this boundary on the FIRM panel has been republished from the previous effective (historic) FIRM for this area, after being converted from NGVD 29 to NAVD 88.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
3 — 3	Limited detail cross section line
23 - - - 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
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600000 FT	5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0035G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

PANEL 35 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0035	G
LINDEN, CITY OF	340467	0035	G

PRELIMINARY
FEBRUARY 3, 2015

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MAP NUMBER
34039C0035G

MAP REVISED

Federal Emergency Management Agency

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LEGEND

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ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

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1% annual chance floodplain boundary

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0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

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(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

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3 — 3 Limited detail cross section line

23 — 23 Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

4976000mN — 1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT — 5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
SEPTEMBER 20, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0036G

FIRM

FLOOD INSURANCE RATE MAP

UNION COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)

PANEL 36 OF 49

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ELIZABETH, CITY OF	345523	0036	G

PRELIMINARY
FEBRUARY 3, 2015

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
34039C0036G

MAP REVISED

Federal Emergency Management Agency