FLOOD INSURANCE STUDY

VOLUME 1 OF 6

BERGEN COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

COMMUNITY NAME	COMMUNITY NUMBER
ALLENDALE, BOROUGH OF	340019
ALPINE, BOROUGH OF*	340581
BERGENFIELD, BOROUGH OF	340020
BOGOTA, BOROUGH OF	340021
CARLSTADT, BOROUGH OF	340022
CLIFFSIDE PARK, BOROUGH OF*	340582
CLOSTER, BOROUGH OF	340023
CRESSKILL, BOROUGH OF	340024
DEMAREST, BOROUGH OF	340025
DUMONT, BOROUGH OF	340026
EAST RUTHERFORD, BOROUGH OF	340028
EDGEWATER, BOROUGH OF	340029
ELMWOOD PARK, BOROUGH OF	340500
EMERSON, BOROUGH OF	340030
ENGLEWOOD, CITY OF	340031
ENGLEWOOD CLIFFS, BOROUGH OF*	340580
FAIR LAWN, BOROUGH OF	340033
FAIRVIEW, BOROUGH OF	340034
FORT LEE, BOROUGH OF*	340035
FRANKLIN LAKES, BOROUGH OF	340036
GARFIELD, CITY OF	340037
GLEN ROCK, BOROUGH OF	340038
HACKENSACK, CITY OF	340039
HARRINGTON PARK, BOROUGH OF	340040
HASBROUCK HEIGHTS, BOROUGH OF	340041
HAWORTH, BOROUGH OF	340042
HILLSDALE, BOROUGH OF	340043
HO-HO-KUS, BOROUGH OF	340044
LEONIA, BOROUGH OF	340045
LITTLE FERRY, BOROUGH OF	340046
LODI, BOROUGH OF	340047
LYNDHURST, TOWNSHIP OF	340048
MAHWAH, TOWNSHIP OF	340049
MAYWOOD, BOROUGH OF	340050
MIDLAND PARK, BOROUGH OF	340051
MONTVALE, BOROUGH OF	340052
MOONACHIE, BOROUGH OF	340053
NEW JERSEY MEADOWLANDS COMMISSION	340570
NEW MILFORD, BOROUGH OF	340054
NORTH ARLINGTON, BOROUGH OF	340055
NORTHVALE, BOROUGH OF	340056
NORWOOD, BOROUGH OF	340057
OAKLAND, BOROUGH OF	345309
OLD TAPPAN, BOROUGH OF	340059
ORADELL, BOROUGH OF	340060
PALISADES PARK, BOROUGH OF	340061
PARAMUS, BOROUGH OF	340062
PARK RIDGE, BOROUGH OF	340063
RAMSEY, BOROUGH OF	340064
RIDGEFIELD, BOROUGH OF	340065
RIDGEFIELD PARK, VILLAGE OF	340066
RIDGEWOOD, VILLAGE OF	340067
RIVER EDGE, BOROUGH OF	340068
RIVER VALE, TOWNSHIP OF	340069
ROCHELLE PARK, TOWNSHIP OF	340070
ROCKLEIGH, BOROUGH OF	340071
RUTHERFORD, BOROUGH OF	340072
SADDLE BROOK, TOWNSHIP OF	340074
SADDLE RIVER, BOROUGH OF	340073
SOUTH HACKENSACK, TOWNSHIP OF	340515
TEANECK, TOWNSHIP OF	340075
TENAFLY, BOROUGH OF	340076
TETERBORO, BOROUGH OF*	340537
UPPER SADDLE RIVER, BOROUGH OF	340077
WALDWICK, BOROUGH OF	340078
WALLINGTON, BOROUGH OF	340079
WASHINGTON, TOWNSHIP OF	340080
WESTWOOD, BOROUGH OF	340081
WOODCLIFF LAKE, BOROUGH OF	340082
WOOD-RIDGE, BOROUGH OF	340083
WYCKOFF, TOWNSHIP OF	340084

*No Special Flood Hazard Areas

REVISED:
AUGUST 28, 2019

FLOOD INSURANCE STUDY NUMBER
34003CV001B

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 available data. It is advisable to contact the FEMA Library 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 or the FEMA Map Service Center to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 20, 1995

Revised Countywide FIS Dates:

December 8, 1998 - to add Base Flood Elevations and Special Flood Hazard Areas; and to update Base Flood elevations, Special Flood Hazard Areas, and zone designations.

September 30, 2005 - to update Base Flood Elevations and Special Flood Hazard Areas; and to reflect updated topographic information.

August 28, 2019 – to update Base Flood Elevations and Special Flood Hazard Areas; and to change vertical datum to NAVD88.

REVISED:
AUGUST 28, 2019

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FLOOD INSURANCE STUDY
BERGEN COUNTY, NEW JERSEY (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates the previous FIS and Flood Insurance Rate Map (FIRM) for the geographic area of Bergen County, New Jersey, including: the Boroughs of Allendale, Bergenfield, Bogota, Carlstadt, Closter, Cresskill, Demarest, Dumont, East Rutherford, Edgewater, Elmwood Park, Emerson, Fair Lawn, Fairview, Franklin Lakes, Glen Rock, Harrington Park, Hasbrouck Heights, Haworth, Hillsdale, Ho-Ho-Kus, Leonia, Little Ferry, Lodi, Maywood, Midland Park, Montvale, Moonachie, New Milford, North Arlington, Northvale, Norwood, Oakland, Old Tappan, Oradell, Palisades Park, Paramus, Park Ridge, Ramsey, Ridgefield, River Edge, Rockleigh, Rutherford, Saddle River, Tenafly, Upper Saddle River, Waldwick, Wallington, Westwood, Woodcliff Lake, and Wood-Ridge; the Cities of Englewood, Garfield, and Hackensack; the Townships of Lyndhurst, Mahwah, River Vale, Rochelle Park, Saddle Brook, South Hackensack, Teaneck, Washington, and Wyckoff; the Villages of Ridgefield Park and Ridgewood; and the New Jersey Meadowlands Commission[1] (hereinafter referred to collectively as Bergen County). Please note that the New Jersey Meadowlands Commission (NJMC) is geographically located in Bergen and Hudson Counties but is included in its entirety in the Bergen County FIS. Hudson County communities within the NJMC include Secaucus, Kearny, Jersey City, and North Bergen.

Please note that on the effective date of this study, the Boroughs of Alpine, Cliffside Park, Englewood Cliffs, Fort Lee, and Teterboro have no Special Flood Hazard Areas (SFHAs). This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e. annexation of new lands) or availability of new scientific or technical data about flood hazards.

This FIS aids in the administration of the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, and the Flood Insurance Reform Act of 2012. This study 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 Bergen County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and

[1] On August 27, 2001, the Hackensack Meadowlands Commission was renamed the New Jersey Meadowlands Commission.

regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in Title 44 of the Code of Federal Regulations (CFR) § 60.3.

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.

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 original September 20, 1995, countywide FIS was prepared to include incorporated communities within Bergen County into a countywide FIS format. Information on the authority and acknowledgments for each jurisdiction prior to the countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Allendale, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated January 1979 was prepared by Parsons, Brinckerhoff, Quade, and Douglas for the Federal Emergency Management Agency (FEMA) under Contract No. H-3774. That work was completed in November 1975. The analysis for the FIS report dated August 18, 1992, was prepared by Dewberry & Davis in coordination with FEMA and was based on the hydraulic analysis that was completed in July 1981.
Bergenfield, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated June 1, 1977, was prepared by McPhee, Smith, Rosenstein Engineers for FEMA under Contract No. H-3723. That work was completed in September 1975. For the FIRM dated October 10, 1979, the 1% annual chance flood boundaries for Hirschfeld Brook Tributary and French's Creek were revised using updated aerial topographic maps. That work was completed in October 1979. The hydraulic analysis for

	the FIS report dated May 17, 1988, was prepared by the New Jersey Department of Environmental Protection (NJDEP). That work was completed in November 1986.
Bogota, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated October 1, 1981, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Closter, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated October 18, 1982, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for FEMA under Contract No. H-4623. That work was completed in January 1980.
Cresskill, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated December 1, 1981, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for FEMA under Contract No. H-4623. That work was completed in January 1980. The FIS report and FIRM dated September 18, 1986, were updated by Dewberry & Davis. That work was completed in July 1985.
Demarest, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated March 30, 1981, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for the Federal Insurance Administration (FIA) under Contract No. H-4623. That work was completed in January 1980.
Dumont, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated September 15, 1977, was prepared by McPhee, Smith, Rosenstein Engineers for FEMA under Contract No. H-3723. That work was completed in March 1976. For the May 5, 1978, FIRM, the 1% annual chance special flood hazard areas

	were revised along Hirschfeld Brook Tributary and Tributary to Oradell Reservoir. The hydrologic and hydraulic analysis for the FIS report dated June 15, 1988, was prepared by Anderson-Nichols & Co., Inc., under subcontract to the NJDEP. That work was completed in December 1986.
East Rutherford, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated June 1980 was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in January 1978.
Edgewater, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 1, 1983, was prepared by Camp Dresser & McKee, under subcontract to the New York State Department of Environmental Conservation, for FEMA during the preparation of the FIS for the City of New York.
Elmwood Park, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated November 15, 1979, was prepared by Tippetts-Abbett-McCarthy-Stratton, Engineers and Architects (TAMS) for the FIA under Contract No. H-3733. That work was completed in June 1975.
Emerson, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated March 1980 was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.
Englewood, City of:	For the FIS report dated February 19, 1986, the hydrologic and hydraulic analysis for Flat Rock Brook and Tributary to Overpeck Creek was prepared by the NJDEP for FEMA under Contract No. H-4546. That work was completed in November 1979. The analysis for Overpeck Creek was prepared by Dewberry & Davis, under agreement with

	FEMA. That work was completed in March 1984.
Fair Lawn, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated January 2, 1981, was prepared by the NJDEP for the FIA under Contract No. H-3855. That work was completed in February 1979. For the FIS report dated July 2, 1991, the hydraulic analysis for Jordan Brook was prepared by Rigg Associated, P.A., and was completed in January 1987.
Fairview, Borough of	The hydrologic and hydraulic analysis for the FIS report dated February 2, 1982, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Franklin Lakes, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated February 15, 1984, was prepared by URS Company, Inc., under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in May 1982.
Garfield, City of:	The hydrologic and hydraulic analysis for the FIS report dated May 1, 1984, was prepared by URS Company, Inc., for FEMA under Contract No. H-6808. That work was completed in April 1982.
Glen Rock, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated January 2, 1981, was prepared by the NJDEP for the FIA under Contract No. H-3855. That work was completed in February 1979.
Hackensack, City of:	The hydrologic and hydraulic analyses for the FIS report dated June 1, 1982, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under

	Contract No. H-4546. That work was completed in November 1979.
Harrington Park, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated April 15, 1981, was prepared by the NJDEP for FEMA under Contract No. H-3959. For the FIS report dated March 15, 1984, the hydrologic and hydraulic analysis was prepared by the NJDEP under agreement with FEMA. That work was completed in April 1983.
Haworth, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated April 15, 1981, was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.
Hillsdale, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated June 15, 1981, was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.
Ho-Ho-Kus, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated June 1, 1977, was prepared by McPhee, Smith, Rosenstein Engineers for the FIA under Contract No. H-3723. That work was completed in August 1976. The updated analysis for the FIS report dated January 3, 1986, was prepared by The RBA Group for FEMA under Contract No. EMW-C-1195. That work was completed in July 1984.
Leonia, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated January 5, 1982, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979. The hydrologic and hydraulic analysis for the FIS report dated March 4, 1991, was prepared by John E. Collazuol and Associates and was completed in November 1989.

Little Ferry, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 15, 1981, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Lodi, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated June 4, 1984, was prepared by URS Company, Inc., for FEMA under Contract No. H-6808. That work was completed in April 1982.
Lyndhurst, Township of:	The hydrologic and hydraulic analysis for the FIS report dated December 1977 was prepared by the NJDEP, for the FIA under Contract No. H-3855. That work was completed in June 1977.
Mahwah, Township of:	The hydrologic and hydraulic analysis for the FIRM dated November 3, 1982, was prepared by the U.S. Army Corps of Engineers (USACE) for FEMA under Inter-Agency Agreement No. IAA-H-19-74, Project Order Nos. 18 and 23; No. IAA-H-16-75, Project Order No. 22; and No. IAA-H-10-77, Project Order No. 23. That work was completed in May 1978.
Midland Park, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated September 1977 was prepared by Parsons, Brinckerhoff, Quade & Douglas for the FIA under Contract No. H-3774. That work was completed in October 1975.
Montvale, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 15, 1980, was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.

New Jersey Meadowlands Commission:	The hydrologic and hydraulic analysis for the FIS report dated June 15, 1982, was prepared by TAMS for FEMA under Contract No. H-4626. That work was completed in May 1981. At the time of those analyses, this commission was called the Hackensack Meadowlands Development Commission.
New Milford, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated April 1, 1977, was prepared by McPhee, Smith, Rosenstein Engineers for FEMA under Contract No. H-3723. The FIRM dated January 3, 1985, was prepared by Dewberry & Davis under agreement with FEMA. The analysis was based on information provided by the NJDEP. That work was completed in March 1980. The FIS report dated February 19, 1987, was based on information supplied by the NJDEP. That work was completed in March 1980.
North Arlington, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated June 1977 was prepared by the NJDEP for the FIA under Contract No. H-3855. That work was completed in March 1977.
Northvale, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated July 20, 1981, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for FEMA under Contract No. H-4623. That work was completed in January 1980.
Norwood, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated October 18, 1982, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for FEMA under Contract No. H-4623. That work was completed in January 1980.
Oakland, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated July 1, 1970, was prepared by

	the USACE. The analysis for the FIS report dated November 1, 1985, was prepared by O'Brien & Gere Engineers, Inc., under subcontract to the NJDEP, for FEMA under Contract No. H-3959. That work was completed in December 1983.
Old Tappan, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated October 1976, was prepared by the USACE for the FIA under Inter-Agency Agreement Nos. IAA-H-2-73 and IAA-H-19-74, Project Order Nos. 14 and 15, respectively. That work was completed in April 1975.
Oradell, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated February 1, 1980, was prepared by the USACE for FEMA under Inter-Agency Agreement Nos. IAA-H-2-73 and IAA-H-19-74. That work was completed in September 1976. The analysis for the FIS report dated April 15, 1986, was prepared by Anderson-Nichols & Co., Inc., under subcontract to the NJDEP. That work was completed in August 1984.
Palisades Park, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 1, 1981, was prepared by the NJDEP for FEMA under Contract No. H-4546. That work was completed in November 1979.
Paramus, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 1, 1983, was prepared by the NJDEP and the URS Company, Inc., for FEMA under Contract No. H-4808. That work was completed in September 1981.
Park Ridge, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated November 5, 1980, was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.

Ramsey, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated September 2, 1981, was prepared by the NJDEP for FEMA under Contract No. H-3855. That work was completed in November 1977. The hydrologic analysis for Valentine Brook Tributary No. 2 for the FIS report dated November 15, 1989, was prepared by Dewberry & Davis for FEMA. That work was completed in August 1988.
Ridgefield, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated September 1976 was prepared by McPhee, Smith, Rosenstein Engineers for FEMA under Contract No. H-3723. The analysis for Overpeck Creek in the FIS report dated May 18, 1992, was prepared by John E. Collazuol and Associates for FEMA, and was completed in November 1989.
Ridgefield Park, Village of:	The hydrologic and hydraulic analysis for the FIS report dated April 15, 1982, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Ridgewood, Village of:	The hydrologic analysis for the FIS report dated June 15, 1983, was prepared by the NJDEP and URS Company, Inc. The hydraulic analysis was prepared by URS Company, Inc., for FEMA under Contract No. H-4808. That work was completed in September 1981.
River Edge, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated August 1, 1983, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.

River Vale, Township of:	The hydrologic and hydraulic analysis for the FIS report dated April 15, 1981, was prepared by the NJDEP, for the FIA under Contract No. H-3959. That work was completed in October 1977.
Rochelle Park, Township of:	The hydrologic and hydraulic analysis for the FIS report dated September, 1979, was prepared by the NJDEP, for the FIA under Contract No. H-3855. That work was completed in November 1977. The analysis for Sprout Brook for the FIS report dated June 16, 1993, was reviewed and revised by Leonard Jackson Associates for FEMA under Contract No. EMW-90-C-3127. That work was completed in January 1993.
Rockleigh, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated November 17, 1981, was prepared by Leonard Jackson Associates, under subcontract to the NJDEP, for FEMA under Contract No. H-4623. That work was completed in January 1980.
Rutherford, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 1977 was prepared by TAMS and the NJDEP, for the FIA under Contract No. H-3855. That work was completed in April 1977.
Saddle Brook, Township of:	The hydrologic and hydraulic analysis for the FIS report dated October 15, 1981, was prepared by the NJDEP, for FEMA under Contract No. H-3855. That work was completed in October 1977. For the FIS report dated June 16, 1993, the hydrologic and hydraulic analysis was reviewed and revised by Leonard Jackson Associates, for FEMA under Contract No. EMW-90-C-3127. That work was completed in January 1993.
Saddle River, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated November 1976 was

	prepared by Parsons, Brinckerhoff, Quade & Douglas for the FIA under Contract No. H-3774. That work was completed in November 1975.
South Hackensack, Township of:	The hydrologic and hydraulic analysis for the FIS report dated September 2, 1982, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Teaneck, Township of:	The hydrologic and hydraulic analysis for the FIS report dated April 16, 1984, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979. A portion of Teaneck Creek was revised using information prepared for the original April 16, 1984, FIS for the Township of Teaneck.
Tenafly, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated August 17, 1981, was prepared by URS/MSR Engineers, under subcontract to the NJDEP, for FEMA under Contract No. H-4546. That work was completed in November 1979.
Upper Saddle River, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated September 1977 was prepared by Parsons, Brinckerhoff, Quade & Douglas for the FIA under Contract No. H-3774. That work was completed in February 1976.
Waldwick, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated September 1978 was prepared by the USACE for FEMA under Inter-Agency Agreement No. IAA-H-2-73, Project Order No. 4. That work was completed in June 1973.

Wallington, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated December 1979, was prepared by TAMS, under subcontract to the NJDEP, under Contract No. H-3855. That work was completed in February 1977.
Washington, Township of:	The hydrologic and hydraulic analysis for the FIS report dated May 1980, was prepared by the NJDEP, under Contract No. H-3959. That work was completed in October 1977.
Westwood, Borough of:	The hydrologic and hydraulic analysis for the FIRM dated February 4, 1981, was prepared by the NJDEP for FEMA under Contract No. H-3959. That work was completed in October 1977. The hydrologic and hydraulic analysis for the FIS report dated March 1, 1984, was prepared by the NJDEP under agreement with FEMA. That work was completed in October 1982.
Woodcliff Lake, Borough of:	The hydrologic and hydraulic analysis for the FIS report dated March 2, 1981, was prepared by the NJDEP for the FIA under Contract No. H-3959. That work was completed in October 1977.
Wyckoff, Township of:	The hydrologic and hydraulic analysis for the FIS report dated December 26, 1980, was prepared by Parsons, Brinckerhoff, Quade & Douglas Engineers for the FIA under Contract No. H-3744. That work was completed in May 1976.

There were no previous individual FIS Reports published for Boroughs of Carlstadt, Hasbrouck Heights, Moonachie and Wood-Ridge.

For the September 20, 1995 FIS, the flooding sources for which a revised hydrologic and/or hydraulic analysis was performed are listed in Table 1, "Revised Analyses Authority and Acknowledgements for September 20, 1995, FIS." The study contractors, Natural and Technological Hazards Management Consulting, Inc. (NTHMC), and Leonard Jackson Associates (LJA), the contract numbers, and the completion dates of the work are also included.

TABLE 1 - REVISED ANALYSES AUTHORITY AND ACKNOWLEDGMENTS FOR THE SEPTEMBER 20, 1995, FIS

Flooding Source	Revision Contractor (Contract No.)	Completion Date(s)
Allendale Brook	NTHMC (EMW-92-C-3802)	December 1992 May 1993
Deep Voll Brook	NTHMC (EMW-92-C-3802)	February 1993
Demarest Avenue Tributary	NTHMC (EMW-92-C-3802)	February 1993
Ho-Ho-Kus Brook Tributary	NTHMC (EMW-92-C-3802)	February 1993
Saddle Brook	LJA (EMW-90-R-3127)	March 1993
Valentine Brook	NTHMC (EMW-92-C-3802)	May 1993

For the December 8, 1998, countywide revision, the following streams were studied by Edwards and Kelcey, Inc., under Contract No. EMW-93-C-4193: Diamond Brook, East Branch Saddle River, West Branch Saddle River, Goffle Brook, Goffle Brook Tributary, Kroner's Brook, Oost Val Brook, Pleasant Brook, Pleasant Brook Tributary, and Sparrow Bush Brook. This work was completed in October 1995.

For the September 30, 2005, countywide revision Musquapsink Brook and Musquapsink Brook By-Pass were studied by Dewberry and Davis, LLC under Contract No. EMW-2000-CO-0003. Additionally, backwater-controlled flooding areas for tributaries of Musquapsink Brook were revised to reflect the new analysis. This work was completed in November 2002. Pond Brook, known as Allerman Brook within the Borough of Oakland, was restudied by Howard Needles Tammen & Bergendoff (HNTB) for the New Jersey Department of Transportation in conjunction with a channel realignment project for the construction of Interstate Route 287. Floodplains along the West Branch Saddle River in the Borough of Upper Saddle River was redelineated for this revision based on topographic data provided by the Borough of Upper Saddle River.

For the August 28, 2019 countywide revision, the flooding sources for which a revised hydrologic and hydraulic analysis was performed are listed in Table 2, "Revised Analyses Authority and Acknowledgments for the August 28, 2019 Revision" The study contractors, NJDEP, URS, AECOM, Sun Engineers, NTHMC and the Risk Assessment, Mapping, and Planning Partners (RAMPP), the contract numbers, and the completion dates of the work are also included. Sun Engineers updated the floodplain boundaries based on NTHMC hydraulic models of Saddle River, Ho-Ho-Kus Brook and Ramsey Brook under subcontract with RAMPP. The FIS Report was updated by URS under contract to NJDEP as a Cooperating

Technical Partner (CTP) with FEMA. The vertical datum for all streams studied by detailed methods was changed to the North American Vertical Datum of 1988 (NAVD88).

TABLE 2 - REVISED ANALYSES
AUTHORITY AND ACKNOWLEDGMENTS FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION

Flooding Source	Revision Contractor (Contract No.)	Completion Date(s)
Bear Brook	NJDEP-CTP (Sun Eng.)	March 2013
Coles Brook	NJDEP-CTP (NJDEP)	March 2013
Dorotockey's Run	NJDEP-CTP (NJDEP)	March 2013
East Branch Saddle River	NTHMC, RAMPP, AECOM	2005/October 2016[1]
Hackensack River	NJDEP-CTP (URS)	March 2013
Ho-Ho-Kus Brook	NTHMC, RAMPP, AECOM	2005/October 2016[1]
Mahwah River	NJDEP-CTP (AECOM)	March 2013
Masonicus Brook	NJDEP-CTP (AECOM)	March 2013
Metzlers Creek	NJDEP-CTP (URS)	March 2013
Mill Brook	NJDEP-CTP (Sun Eng.)	March 2013
Pascack Brook	NJDEP-CTP (Sun Eng.)	March 2013
Passaic River	RAMPP (Dewberry; HSFEHQ-09-D-0369)	March 2013
Ramapo River	NJDEP-CTP (AECOM)	March 2013
Ramsey Brook	NTHMC, RAMPP, AECOM	2005/October 2016[1]
Saddle River	NTHMC, RAMPP, AECOM	2005/October 2016[1]
Sparkill Creek	NYSDEC-CTP (URS)	March 2011[2], May 2014[2]
Wolf Creek	NJDEP-CTP (URS)	March 2013

[1] Initial hydraulic modeling was completed in 2005 by NTHMC. Under RAMPP (HSFEHQ-09-D-0369), independent QA/QC of the models was conducted, which identified the need for revisions. The models for East Branch Saddle River, Ho-Ho-Kus Brook, Ramsey Brook and Saddle River were revised in October 2016.

[2] Hydraulic modeling of Sparkill Creek was completed in March 2011 as part of the New York State Department of Environmental Conservation (NYSDEC) CTP, Rockland County, New York countywide FIS, which became effective on March 3, 2014 (FEMA, 2014). A portion of Sparkill Creek crosses into and out of Bergen County in the Borough of Northvale. The floodway within New Jersey was revised in May 2014 to reflect a maximum 0.2 foot surcharge.

For the August 28, 2019 countywide revision, base map information shown on the 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 collected in 2012.

The projection used in the preparation of this map was New Jersey State Plane 2900 zone. The horizontal datum was North American Datum of 1983 (NAD83). Differences in datum, spheroid projection or State Planes 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 the FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held with representatives from 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 with representatives from FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for all jurisdictions within Bergen County prior to the September 20, 1995, countywide FIS are shown in Table 3, "Initial and Final CCO Meetings Prior to September 20, 1995."

TABLE 3 – INITIAL AND FINAL CCO MEETINGS PRIOR TO SEPTEMBER 20, 1995

Community Name	Initial CCO Date	Final CCO Date
Borough of Allendale	January 8, 1992	*
Borough of Bergenfield	*	May 12, 1975
Borough of Bogota	May 1979	May 12, 1981
Borough of Closter	November 22, 1977	May 22, 1980
Borough of Cresskill	November 2, 1977	May 29, 1980
Borough of Demarest	November 29, 1977	May 29, 1980
Borough of Dumont	July 8, 1974	May 5, 1975
Borough of East Rutherford	March 9, 1976	April 16, 1979
Borough of Edgewater	*	June 30, 1983
Borough of Elmwood Park	*	March 25, 1976
Borough of Emerson	March 18, 1976	November 8, 1978
City of Englewood	*	May 14, 1981
Borough of Fair Lawn	May 7, 1975	February 6, 1979
Borough of Fairview	May 1979	September 2, 1981
Borough of Franklin Lakes	May 25, 1977	February 9, 1983
City of Garfield	May 1979	December14, 1983
Borough of Glen Rock	May 7, 1975	April 30, 1979
City of Hackensack	*	January 6, 1982
Township of Mahwah	October 17, 1974	November 13, 1980

* Data not available.

TABLE 3 – INITIAL AND FINAL CCO MEETINGS PRIOR TO SEPTEMBER 20, 1995 – continued

Community Name	Initial CCO Date	Final CCO Date
Borough of Midland Park	June 26, 1975	October 14, 1975
Borough of Montvale	March 18, 1976	November 16, 1978
New Jersey Meadowlands Commission	December 5, 1978	February 3, 1982
Borough of New Milford	*	April 24, 1975
Borough of North Arlington	May 16, 1975	March 14, 1977
Borough of Northvale	November 22, 1977	May 29, 1980
Borough of Norwood	November 22, 1977	May 28, 1980
Borough of Oakland	March 11, 1976	October 2, 1984
Borough of Old Tappan	*	January 19, 1976
Borough of Oradell	April 7, 1983	*
Borough of Palisades Park	*	July 14, 1981
Borough of Paramus	May 17, 1979	December 2, 1982
Borough of Park Ridge	March 18, 1976	November 13, 1978
Borough of Ramsey	May 7, 1975	May 24, 1979
Borough of Ridgefield	*	March 31, 1976
Village of Ridgefield Park	*	September 25, 1981
Village of Ridgewood	May 17, 1979	July 19, 1982
Borough of River Edge	*	September 27, 1982
Township of River Vale	March 18, 1976	November 9, 1978
Township of Rochelle Park	July 16, 1992[1]	
Borough of Rockleigh	November 29, 1977	May 28, 1980
Borough of Rutherford	May 16, 1976	April 5, 1977
Township of Saddle Brook	July 16, 1992[1]	
Borough of Saddle River	*	January 29, 1979
Township of South Hackensack	May 1979	January 27, 1982
Township of Teaneck	*	February 17, 1982
Borough of Tenafly	*	March 24, 1981
Borough of Upper Saddle River	June 17, 1975	March 31, 1976
Borough of Waldwick	January 9, 1992	
Borough of Wallington	May 7, 1975	May 10, 1979
Township of Washington	March 18, 1976	April 1979
Borough of Westwood	*	November 16, 1978
Borough of Woodcliff Lake	March 18, 1976	October 16, 1978
Township of Wyckoff	January 16, 1992	

* Data not available.
[1] Date of the letter notifying the community of the initiation of a revision.

For the September 20, 1995, countywide FIS, final CCO meetings were held with representatives of FEMA, the communities, the State, Dewberry & Davis, and the Bergen County Department of Planning on February 2, 1994, February 3, 1994, and March 19, 1994.

For the 1998 countywide revision, Bergen County was notified by FEMA in a letter dated March 6, 1996, that its FIS would be revised using the analysis prepared by Edwards and Kelcey, Inc.

For the 2005 countywide revision, an initial meeting was held on November 20, 2000 in the Township of Washington with representatives of FEMA, the communities, and Dewberry & Davis to discuss the scope of work. Bergen County was notified by FEMA in a letter dated November 12, 2002, that its FIS would be revised using the analyses prepared by Dewberry & Davis. A final CCO meeting was held on October 2, 2003.

For the August 28, 2019 countywide revision, an Introduction to RiskMAP presentation for affected communities was conducted via a webinar on June 9, 2010. A follow-up coordination call was conducted on June 28, 2011. Initial CCO meetings for communities in the coastal areas of Bergen County were held on September 3, 2014 and October 9, 2014. An initial CCO meeting for communities in areas with riverine SFHAs was held on January 6, 2015. A final CCO meeting was held on June 20, 2017.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS Report covers the geographic area of Bergen County, New Jersey, and the jurisdictional area covered by the New Jersey Meadowlands Commission.

All or portions of the flooding sources listed in Table 4, "Streams Studied by Detailed Methods Prior to the August 28, 2019 Countywide Revision," were studied by detailed methods prior to this countywide revision. Flooding sources studied as part of this countywide revision are not listed in Table 4. Limits of detailed studies are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2)

All or portions of additional flooding sources in the county were studied by limited detailed or approximate methods. Limited detailed or 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 Bergen County.

TABLE 4 – STREAMS STUDIED BY DETAILED METHODS PRIOR TO THE AUGUST 28, 2019 COUNTYWIDE REVISION

Allendale Brook
Allerman Brook
Beaver Dam Brook
Behnke Brook
Blanch Brook
Charlies Creek
Cherry Brook
Coalberg Brook
Coalberg Brook Tributary
Cresskill Brook
Darlington Brook Tributary 1
Deep Voll Brook
Demarest Avenue Tributary
Demarest Brook
Diamond Brook
Dwars Kill
Echo Glen Brook
Fairview Brook
Fieldstone Brook
Flat Rock Brook
Fleischer Brook
French's Creek
Goffle Brook
Goffle Brook Tributary
Haunsmans Ditch
Henderson Brook
Herring Brook
Hillsdale Brook
Hirschfeld Brook
Hirschfeld Brook Tributary
Ho-Ho-Kus Brook Tributary
Holdrum Brook
Jordan Brook
Kips Brook
Kroner's Brook
Laurel Brook
Mannings Brook
Muddy Creek
Musquapsink Brook
Musquapsink Brook By-pass
Norwood Brook
Oost Val Brook
Overpeck Creek
Pine Brook
Pleasant Brook
Pleasant Brook Tributary
Pond Brook
Tributary 1 to Ramapo River
Tributary 2 to Ramapo River
Tributary 3 to Ramapo River
Reservoir Brook
Rivervale Brook
Saddle Brook
Sparkill Brook
Sparrow Bush Brook
Sprout Brook
Stateline Brook
Steinals Ditch
Tandy Brook
Tappan Run
Teaneck Creek
Tenakill Brook
Township Brook
Tributary to Overpeck Creek
Valentine Brook
Valentine Brook Tributary No. 1
Valentine Brook Tributary No. 2
Van Saun Mill Brook
West Branch Saddle River
Westdale Brook

As part of the August 28, 2019 countywide revision, new or updated analyses were included for the flooding sources shown in Table 5, "Limits of Detailed Study for the August 28, 2019 Countywide Revision."

TABLE 5 - LIMITS OF DETAILED STUDY FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION

Stream	Limits of Detailed Study
Bear Brook	From approximately 890 feet downstream of Pascack Road to approximately 980 feet upstream of Grand Avenue

TABLE 5 - LIMITS OF DETAILED STUDY FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Stream	Limits of Revised or New Detailed Study
Coles Brook	From approximately 1,120 feet downstream of Spring Valley Avenue to approximately 750 feet upstream of Old Rail road
Dorotockey's Run	From the confluence with Oradell Reservoir to approximately 90 feet upstream of Old Tappan Road
East Branch Saddle River	From the confluence with Saddle River to the county boundary
Hackensack River	From 96,300 feet upstream of New York Bay to the State Boundary
Ho-Ho-Kus Brook	From the confluence with Saddle River to approximately 135 feet upstream of Old Mill Road
Hudson River	County limits
Mahwah River	From confluence with Ramapo River to the county boundary
Masonicus Brook	From confluence with Mahwah River to approximately 2,800 feet upstream of Armount Road
Metzlers Creek	From confluence with Overpeck Creek to approximately 1,030 feet upstream of Lantana Avenue
Mill Brook	From approximately 590 feet downstream of Pascack Road to approximately 100 feet upstream of Summit Avenue
Pascack Brook	From Broadway Railroad and culvert to the County Boundary
Passaic River	From approximately 3,280 feet downstream of State Route 7 to approximately 5,300 feet upstream of confluence of Rockaway River
Ramapo River	From county boundary to approximately 3,125 feet upstream of the confluence of Mahwah River

TABLE 5 - LIMITS OF DETAILED STUDY FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Stream	Limits of Revised or New Detailed Study
Ramapo River Left Diversion Channel	From the confluence with the Ramapo River to approximately1,600 feet upstream
Ramapo River Right Diversion Channel	From the confluence with the Ramapo River to approximately 3,300 feet upstream
Ramsey Brook	From the confluence with Ho-Ho-Kus Brook to the county boundary
Saddle River	From the confluence with Passaic River to the confluence of the East and West Branches of the Saddle River
Sparkill Creek	From county/state boundary to county/state boundary, as shown in Figure 1*

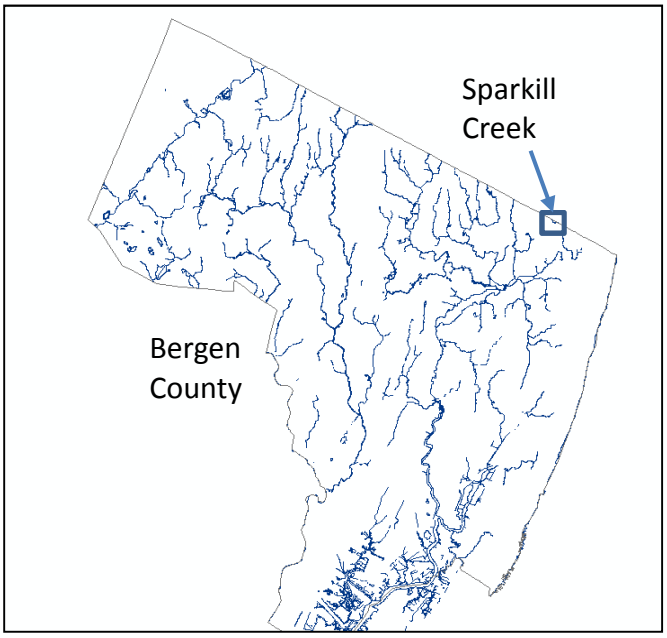

FIGURE 1 – SPARKILL CREEK LOCATION

*Sparkill Creek was studied from the confluence with the Hudson River to Erie Street in Orangetown within Rockland County, New York as part of the March 3, 2014, Rockland County countywide FIS (FEMA, 2014). A portion of the creek modeled as part of that study, shown in Figure 1, passes through Bergen County.

TABLE 5 - LIMITS OF DETAILED STUDY FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Stream	Limits of Revised or New Detailed Study
Wolf Creek	From the confluence with Bellman's Creek to approximately 11,000 feet upstream of the confluence

In addition, 34 streams were studied by limited detailed methods. Section 3.2 provides a comprehensive definition of limited detailed flood hazard designations.

Some flood sources have been renamed in this countywide study. Golf Course Creek in the Borough of Leonia and City of Englewood has been changed to Flat Rock Brook Tributary 1.

This FIS also incorporated 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 Amendment [LOMA]). Within the Borough of Allendale, revisions to the Special Flood Hazard Area and floodway along Allendale Brook as described in FEMA LOMR 07-02-0297P, issued February 26, 2007, were incorporated into the FIRM.

2.2 Community Description

Bergen County is located in the northeastern corner of New Jersey. It is bordered by Rockland County, New York to the north; Hudson County, New Jersey to the south; Westchester, Bronx, and New York Counties, New York to the east; and Passaic and Essex Counties, New Jersey to the west. The eastern border of Bergen County lies on the Hudson River; much of the shoreline is in Palisades Interstate Park. Bergen County's population was 905,116 in 2010 (2010 United States Census).

Bergen County lies within two physiographic provinces; the Piedmont Province and the Highlands Province. The Piedmont Province in New Jersey is a rolling plain underlain by soft shale and sandstone interrupted to the east by the Palisades Igneous sill, and to the west near Franklin Lakes by the basaltic First and Second Watchung Mountains. The Watchung Mountains are approximately 750 feet above sea level near Franklin Lakes. In Bergen County, the Palisades range in height from 150 feet at Cliffside Park to a high of 550 feet above sea level at Closter. The general level of the plain and crests of the ridges gently slopes towards the southeast. North of Paterson and Hackensack the plain is approximately 300 feet above sea level and along the lower course of the Hackensack River it dips below sea level. South of Englewood, extending into the southern portion of Bergen

County, where the plain is below sea level, large areas are covered by tidal marshes which are a part of the New Jersey Meadowlands.

The New Jersey Highlands are a portion of the Reading Prong of the New England Physiographic Province. The Highlands consist of a series of ridges, one of which is located in the northwestern part of the county and is called Ramapo Mountain. The mountains are composed of hard, crystalline, resistant Precambrian Igneous and metamorphic rocks. The highest elevation of the county is found in this region at Bald Mountain, 1,164 feet above sea level (NJDEP, 1971).

Bergen County's location puts it on the edge of New Jersey's northern climates, characterized by elevated highlands and valleys which are part of the Appalachian Uplands, but subject to coastal influences in the low lying areas of the New Jersey Meadowlands, near New York-New Jersey Harbor, and the Hudson River.

The northwest part of the county normally exhibits a colder temperature regime than other parts of the county. This difference is most dramatic in winter when average temperatures can be more than ten degrees Fahrenheit cooler than along the coastal areas. Annual snowfall averages 40 to 50 inches. Due to its proximity to the ocean, continental and oceanic influences battle for dominance on daily to weekly bases. In autumn and early winter, when the ocean is warmer than the land surface, the county may experience warmer temperatures than interior regions of the state. In the spring months, ocean breezes keep temperatures cooler.

During the warm season, thunderstorms are responsible for most of the rainfall. Cyclones and frontal passages are less frequent during this time. Thunderstorms spawned in Pennsylvania and New York State often move into Bergen County, where they often reach maximum development in the evening.

Prevailing winds are from the southwest in summer and from the northwest in winter, and sea breezes play a major role in the coastal Bergen County climate. When the land is warmed by the sun, heated air rises, allowing cooler air at the ocean surface to spread inland. Sea breezes often penetrate 5-10 miles inland. They are most common in spring and summer.

Bergen County is subject to impacts from coastal storms, often characterized as nor'easters, which are most frequent between October and April. These storms track over the coastal plain or up to several hundred miles offshore, bringing strong winds and heavy rains. Rarely does a winter go by without at least one significant coastal storm and some years see upwards of five to ten. Tropical storms and hurricanes are also a special concern along the coast. In some years, they contribute a significant amount to the precipitation totals of the region. Damage during times of high tide can be severe when tropical storms or nor'easters affect the region (ONJSC, 2014).

2.3 Principal Flood Problems

Flooding in Bergen County can occur during any season of the year since New Jersey lies within the major storm tracks of North America. The worst storms have occurred in late summer or early fall when tropical disturbances (hurricanes) are most prevalent. Recent tropical events include Tropical Storm Floyd, Hurricane Irene, and Hurricane Sandy.

Hurricane Floyd originally made landfall in Cape Fear, North Carolina as a Category 2 hurricane on September 16, 1999. The storm crossed over North Carolina and southeastern Virginia before briefly entering the western Atlantic Ocean. The storm reached New Jersey on September 17, 1999 as a tropical storm. Record breaking flooding from rainfall exceeding 14 inches was recorded throughout the State of New Jersey. Some locations in Bergen County experienced rainfall amounts up to 10 inches. A Federal Emergency Declaration was issued on September 17, 1999. Overall damage estimates for Hurricane Floyd in Bergen County were estimated at over $100 million.

Having earlier been downgraded to a tropical storm, Hurricane Irene came ashore in 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 25th, with President Obama reaffirming the declaration on August 27th. Mandatory evacuations were ordered throughout the State of New Jersey. Wind speeds were recorded at 75 mph and rainfall totals reached over 10 inches in many parts of the state. Extensive flooding throughout Bergen County caused damage to homes, businesses, and public infrastructure. The flooding was exacerbated by high water levels in reservoirs and wetlands as a result of previous heavy rains. Over 1 million customers lost power during the storm. Overall damage estimates for the State of New Jersey came to over $1 billion, with over 200,000 homes and buildings being damaged. The county received more than $48 million in federal loans and grants to cover the storm damages (Bergen Beat, 2012).

Hurricane Sandy came ashore as an immense tropical storm in Brigantine, New Jersey, on October 29, 2012. Although rainfall was limited to less than 2 inches within Bergen County, wind gusts were recorded up to 76 mph. 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. Seaside communities were damaged and destroyed up and down the coastline. Although protected from severe waves, the Bergen County shoreline within New York-New Jersey Harbor experienced record storm surge elevations. Some 2.7 million households within New Jersey lost power. Initial reports suggest that 72,000 homes and businesses statewide were damaged or destroyed by the storm. Governor Chris Christy declared a state of

emergency on October 31. Hurricane Sandy was estimated to cost the State of New Jersey over $36 billion.

Flooding is generally the result of heavy rainfall produced by hurricanes moving up the coast, large frontal storms from the west and south, and local thunderstorms. In September 1999, floods of unprecedented magnitude were caused by Hurricane Floyd in the highly urbanized basins of northeastern New Jersey. The storm resulted in a record discharge on Ho-Ho-Kus Brook of 4,670 cubic feet per second (cfs) at the U.S. Geological Survey (USGS) gauge No. 01391000 located at Ho-Ho-Kus, New Jersey. The second highest discharge on record was caused by a Hurricane Irene on August 28, 2011 with a discharge of 4,230 cfs.

The flood of record on the Hackensack River occurred on April 16, 2007. The USGS gauge located on the Hackensack River at New Milford, New Jersey (01378500) recorded a flow of 11,600 cfs with an associated gauge height of 12.36 feet. This flow of record is much higher than the estimated 1% annual chance of exceedance peak flow on the Hackensack River at this location. The next highest discharge of 10,500 cfs occurred during Hurricane Irene. The discharge measured following Tropical Storm Floyd in September 1999 was 9,760 cfs.

The September 16, 1999, flood destroyed the USGS gauge house on Pascack Brook in the Borough of Westwood (01377500). The best estimated flow peak for the event was 9,630 cfs, which is much higher than the estimated flood peak with a 1% annual chance of exceedance rate. That flow was affected by upstream dam failure. The second largest flood recorded at the gauge occurred during Hurricane Irene on August 28, 2011, with a peak flow of 4,630 cfs.

Serious flooding along the main stem of the Passaic River has occurred in the highly developed business, industrial and residential areas in the lower river valley from Newark, New Jersey, to Little Falls, New Jersey. Severe flooding has occurred along the Passaic River almost 24 times in the past 200 years; four of the ten highest floods have occurred since 1999: in 1999 following Tropical Storm Floyd, April 2007, March 2010, and during Hurricane Irene in August 2011. The 1903 flood remains the maximum flood of record on the Passaic River with an estimated peak discharge of 39,800 cfs at the mouth.

The USGS gauge on the Ramapo River at the Township of Mahwah (01387500) recorded a discharge 15,000 cfs on August 28, 2011 during Hurricane Irene. The April 5, 1984, flood is the second highest peak of record with 12,100 cfs.

The USGS gauge on the Saddle River at the Village of Ridgewood (01390500) recorded a peak discharge of 6,800 cfs in July, 1945, which is approximately a

1% annual chance of exceedance rate flood. The August 28, 2011 flood is the second highest since 1936, when the gauge was installed, with a peak discharge of 6,770 cfs. Other major recorded flood events at this location are the September 16, 1999 flood (5,380 cfs) and a November 8, 1977 flood (4,650 cfs).

The lower portions of the Hackensack River, Pascack Brook, Haunsmans Ditch, and Dorotockey's Run flood when Oradell Reservoir is at a high stage. Oradell Reservoir has a spillway crest elevation of 22.7 feet and has had several high stages in recent years. On September 17, 1999, the Oradell Reservoir recorded a peak elevation of 26.2 feet, surpassing the previous record of 25.0 feet by more than one foot. In addition to the September 1999 stage, four other recorded stages have exceeded the 24-foot elevation: 24.20 feet on September 27, 1975; 24.15 feet on June 19, 1972; 24.14 feet on May 29, 1968; and 24.02 feet on December 21, 1973.

Lake Tappan's water surface is controlled by a series of bascule gates and a sluice gate and has been in operation since 1967, with a normal lake level at 55.0 feet. Its level reached 55.67 feet on September 17, 1999. Other high stages experienced include: 55.50 feet on May 29, 1968; 55.30 feet on April 4, 1970; 55.26 feet on January 28, 1976; and 55.22 feet on May 13, 1974.

Woodcliff Lake, with a crest elevation of 94.0 feet (NAVD88), has experienced four stages equaling or exceeding elevation 97.00 feet (NAVD88): 97.65 feet (NAVD88) on February 2, 1973; 97.20 feet on September 12, 1971 (NAVD88); and 97.00 feet (NAVD88) on July 1, 1976; and again on August 21, 1973. The February 2, 1973, stage of 97.65 feet (NAVD88) is the highest recorded to date.

The incidence of high reservoir stage and local stream flooding does not normally occur coincidentally. The small local streams will peak and recede rapidly, whereas the reservoir levels will typically lag behind these peaks and be dependent upon the water supply regulation in effect at the time

The principal flooding in southern Bergen County results from the tidal stages of Newark Bay which affect the Hackensack River and Passaic River, and in turn Bellman's Creek, Overpeck Creek and Wolf Creek. The tidal influence is negated on Wolf Creek by a tidal barrier located approximately 1,000 feet upstream of the confluence of Wolf Creek and Bellman's Creek.

The largest historical tide was produced by the hurricane of September 3, 1821. On the basis of old street maps and newspaper accounts, it has been concluded that the surge produced by that hurricane was approximately 10 to 11 feet. However, the surge peak occurred at the time of a low astronomical tide, and mean sea level for September 1821 was approximately 1.5 feet below present mean sea level for August. Consequently, such a hurricane surge on a high astronomic tide would

now produce a tide of approximately 14 feet in elevation. Although the 1821 hurricane was weaker than other historic storms, its track, just inland from the Atlantic shore, and its forward speed were conducive to critical storm surge conditions.

Previous studies of the records have shown that the most important hurricane surges of interest in the study area are those of 1821, 1938, 1944, 1954, 1955 (Connie), 1960 (Donna), 1971 (Doria), and Hurricane Sandy in 2012. Hurricane Diane in 1955 and Tropical Storm Agnes in 1972 failed to produce major surges, although they resulted in heavy rainfall in several eastern states.

Important hurricane surges at the Battery, New York, from 1926 to 2012 are presented below:

Date	Surge Height (feet)*
October 2012	9.4
September 1960	5.3
September 1944	5.0
August 1971	4.2
September 1938	4.1
August 1954	3.1
August 1955	3.1

*Net surge, exclusive of predicted tide

Extratropical cyclones or northeasters are far more frequent in the area than hurricanes and may produce severe surges. Winds in the northeasters blow in a direction that is conducive to surge generation along the 80 or 90 miles of continental shelf off of New York Bight. Important northeaster surges at the Battery, New York, from 1926 to 1976 are presented below:

Date	Surge Height (feet)*
November 1950	8.5
November 1953	5.4
November 1932	5.3
December 1974	5.2
November 1968	5.0
February 1927	4.6
March 1962	4.3
January 1944	4.2

*Net surge, exclusive of predicted tide.

Storm-tide flooding in the area depends not only on the storm-tide elevation, but also on the location of the area. Flooding of areas located near the mouth of the Hackensack and Passaic Rivers depends on the tide crest elevation. Flooding of

areas located further inland depends not only on the tide crest elevation at Newark Bay, but also on the duration of the storm surge, as the tide propagates through the river and its system of tidal streams. Due primarily to the storage available in the system, a high storm-tide elevation created by a hurricane may be less critical to tidal flooding than a comparatively lower storm-tide of longer duration, such as those produced by northeasters. Therefore, the frequency distribution of high tide elevations in the New Jersey Meadowlands must be obtained through separate routing of tides of either kind, with prescribed frequencies of occurrence at the mouth. The elevations thus obtained for each area are then used in a joint frequency analysis.

2.4 Flood Protection Measures

In the City of Englewood and the Township of Teaneck, a flood control project exists on Overpeck Creek from State Route 4 to West Forest Avenue. This project included channelization of the creek and construction of concrete retaining walls originally designed to contain the 1% annual chance flood. The project now provides limited protection from frequent flood events but is not shown as providing protection from the 1% annual chance flood. Potential flooding along State Route 4 has been reduced; however, flooding along West Forest Avenue can still be a problem.

A tide gate is located on Wolf Creek in the Boroughs of Fairview and Ridgefield.

Channel improvements have been completed along Fleischer Brook by the Bergen County Department of Engineering and along Schroeders Brook by the City of Garfield. These improvements reduce localized flooding experienced during relatively minor storms.

In the Borough of Little Ferry, a tide gate and pumping station are located on Losen Slote, located near Birch Street. The pump station has a maximum capacity of 27 cfs. The adjacent berm along the Hackensack River at the southern corporate boundary is not of uniform height, nor is it continuous. This allows the tidal stages of the river to flood the characteristically low topographic areas of the borough.

In the Borough of Lodi, some local channel improvements were effected on the Saddle River in 1954. Additional local improvements were made in August and September 1971 following floods. Late in 1973 channel improvements were also made on Lodi Creek by the borough and the Bergen County Mosquito Control Commission.

The system of water management berms, and highway and railroad embankments around the area of Kearny are barriers to low level tidal flooding. There are gaps in

the berms and road crossings at different levels, which allow flooding from the extreme tide events in the Hackensack River.

Numerous earthen berms in the study area provide several of communities with some limited protection against low level flooding. However, these berms are unlikely to protect the communities from rare events such as the 1% annual chance flood.

In the Borough of New Milford, a natural dike and berm system exists along the Hackensack River Bypass. The dike was created by excavation away from the river edge. The dike does not have a continuous elevation and is subject to overtopping from the 1% annual chance flood.

There are no existing flood protection works on streams in the Borough of Oakland. Pompton Lake provides a limited amount of storage to reduce the effect of flood flows from upstream sources. The U.S. Army Corps of Engineers constructed tainter gates on the dam for the lake, which are operated to lower the lake elevation, reducing tailwater elevations for the upstream channels, which in turn help to reduce flooding upstream of the lake.

The Borough of Paramus has undertaken extensive channel improvements along the Saddle River and Sprout Brook. Dredging and straightening of the Saddle River began in the late 1960's, and major portions of the stream are now channelized. In addition, hydraulic structures have been enlarged to safely pass flood flows. A similar program for Sprout Brook was initiated in 1974. In addition, two vehicular bridges at East Ridgewood Avenue and Grove Street, which had insufficient capacity to convey flood flows, were replaced by the county.

In the Township of Rochelle Park, the Borough of Saddle River and the Village of Ridgewood, flood protection measures include the purchase of land within flood hazard areas for recreational purposes. Purchases by the Village of Ridgewood and the County Park Commission account for 241.5 acres within the village devoted to passive and active recreation. The village has acquired 35 acres of flood-prone land, which is devoted to passive recreation and is to be kept in its natural state. The remaining undeveloped land in the flood hazard area has been designated as parkland, which gives the village first option to purchase this property to prevent further development in the floodplain.

Part of the southern parcel of the Township of South Hackensack is partially protected from tidal flooding from the Hackensack River and Losen Slote by a discontinuous dike, which does allow some flooding. The Township also maintains a pumping station at State Route 46 and Huyler Street in the northern parcel of the township. In addition, the Saddle River Avenue bridge was replaced by Bergen County.

The Hackensack Water Company constructed a dam on the lower end of Hirschfeld Brook to create an impoundment that would divert flow to the Oradell Reservoir for potable water supply. There is another impoundment along the brook known as Cooper Pond, located in Bergenfield. The lake has a surface area of approximately 10 acres and excess discharges flow to the brook over a concrete spillway and through three manually operated flood gates. Although peak flows may be slightly suppressed, as floodwaters are routed through the lake, its primary purpose is to serve as a local recreational facility.

Woodcliff Lake, located on Pascack Brook in the Borough of Hillsdale, and Lake Tappan, located on the Hackensack River in the Borough of Old Tappan, serve to stabilize Oradell Reservoir stages. Both reservoirs are owned and operated by United Water for public water supply and are not designed or used for flood control; however, due to the 835,000 gallon capacity and 200 acre-foot surface storage area of Woodcliff Lake and the 3.38 million gallon capacity and 550 acre-foot surface storage area of Lake Tappan, the reservoirs have a natural attenuating effect on most flood peaks.

Several flood protection measures have accompanied the development of the New Jersey Meadowlands Commission area. The dense network of highways and railroads creates a complex system of partial barriers that limit low level tidal flooding. The Sports Complex is bounded by Patterson Plank Road on the north, State Route 3 on the south, Berry's Creek on the east, and the New Jersey Turnpike on the west.

Previous studies of the New Jersey Meadowlands Commission were based on results from routing historic hurricane tidal surges through the area, and as a consequence, computed flood elevations at Moonachie and Little Ferry were below the crest of many of the dikes and roads along the Hackensack River. This study included a suite of recent storms in the coastal analysis and resulted in higher elevations that would overtop these dikes and berms.

In an effort to minimize flood damage, the Division of Water Resources of the New Jersey Department of Environmental Protection, under authority of NJSA 58:16:-50 and others, has adopted rules, regulations, and minimum standards concerning development and use of land within the floodplain.

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%, 2%, 1%, or 0.2% annual chance

period have been selected as having special significance for floodplain management and for flood insurance rates. These events have a 10%, 2%, 1%, and 0.2% 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 a 1-percent chance of annual exceedance 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 study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting Bergen County. Information on the methods used to determine peak discharge-frequency relationships for the streams studied by detailed methods is shown below.

In previous hydrologic analyses, each community within Bergen County, with the exception of the Boroughs of Alpine, Cliffside Park, Englewood Cliffs, Fort Lee and Teterboro has a previously printed FIS report narrative.

Hydrology for the following streams, in which the drainage area was approximately one square mile or less, was developed using the Rational Method:

Blanch Brook
Charlies Creek
Echo Glen Brook
Fairview Brook
Fieldstone Brook
French's Creek
Haunsmans Ditch
Hillsdale Brook
Hirschfeld Brook Tributary
Holdrum Brook (upstream of confluence of Hillsdale Brook)
Kips Brook
Laurel Brook
Losen Slote
Pine Brook
Reservoir Brook
Rivervale Brook
Stateline Brook
Steinals Ditch
Tandy Brook
Township Brook
Westdale Brook

The Rational Method involves the formula Q = CiA where:

Q = discharge in cfs,
C = runoff coefficient depending on drainage-basin characteristics,
i = rainfall intensity in inches per hour, and
A = drainage area in acres.

Hydrology for the following streams was based on Special Report No. 38, a method developed through a cooperative program between the NJDEP, Division of Water Resources and the USGS (State of New Jersey, 1974):

Allerman Brook
Pond Brook
Beaver Dam Brook
Behnke Brook
Cherry Brook
Coalberg Brook
Coalberg Brook Tributary
Cresskill Brook
Darlington Brook Tributary
Demarest Brook
Diamond Brook
Dwars Kill
Flat Rock Brook
Henderson Brook
Herring Brook
Holdrum Brook (downstream of confluence of Hillsdale Brook)
Mannings Brook
Jordan Brook
Muddy Creek
Norwood Brook
Overpeck Creek (in Ridgefield)
Tributary to Overpeck Creek
Tributary 1 to Ramapo River
Tributary 2 to Ramapo River
Schroeder Brook
Sparkill Brook*
Sprout Brook
Tappan Run
Teaneck Creek
Tenakill Brook
Van Saun Mill Brook

*Sparkill Brook flows at the unnamed tributary (drainage area of 2.20 sq. mi.) increase in the upstream direction. The flood flows were developed from Special Report 38 as part of a previous study; the basis of the increase is unclear.

This method is based on a multiple regression analysis used to develop mathematical relationships between flood discharges at the various recurrence intervals (50%, 10%, 2%, and 1% annual chance of exceedance) obtained from gaging station data and hydrologic characteristics. Flood information from 103 gauges was used in making the analysis (Water Resources Council, 1976). Hydrologic parameters included stream drainage area, main channel slope, surface storage area, and an index of manmade impervious cover based on basin population and development conditions. The 0.2% annual chance discharge was extrapolated from the lower frequency floods (Richard P. Browne Associates 1975 & 1976)

As a result of interbasin transfer of floodwater between Dwars Kill and Norwood Brook, it was necessary to balance discharges between the two streams. Hand backwater calculations supplied by Leonard Jackson Associates were used in determining the water-surface elevations and the discharge distribution between the two streams.

For Tenakill Brook, the analysis utilizing USGS Special Report No. 38 was compared against a log-Pearson Type III analysis of USGS gauges on Tenakill Brook located in Closter and Cresskill. The results of both analyses were weighted and coordinated at a meeting including representatives of the NJDEP, USGS, and Leonard Jackson Associates.

The gauge information used in this analysis is summarized in Table 6, “Stream Gauge Information,” below. Table 7, "Stream Studied Using Log-Pearson Type III and Gauges Used," lists the streams studied by this method and the gauges used.

TABLE 6 - STREAM GAUGE INFORMATION

Gauged Stream	Gauge Number	Location of Gauge	Years of Record
Hackensack River	01377000	Township of River Vale	34
	01378500	Borough of New Milford	81
Ho-Ho-Kus Brook	01390810	Brookside Avenue in Borough of Allendale	6
	01391000	Approximately 500 feet upstream of Maple Avenue in Borough of Ho-Ho-Kus	48
Metzlers Creek	01378590	City of Englewood	37

TABLE 6 - STREAM GAUGE INFORMATION – continued

Gauged Stream	Gauge Number	Location of Gauge	Years of Record
Musquapsink Brook	01377475	near Borough of Westwood	21
	01377490	Borough of Westwood	24
Pascack Brook	01377500	Borough of Westwood	41
Passaic River	01389800	Paterson, New Jersey	58
	01389500	Little Falls, New Jersey	119
Ramapo River	01388000	Pompton Lakes, New Jersey	78
	01387500	Near Township of Mahwah	77
Ramsey Brook	01390900	Borough of Allendale	40
Saddle River	01391500	Borough of Lodi	92
	01390450	Lake Street in Borough of Upper Saddle River	12
	01391110	Dunkerhook Road in Borough of Paramus	9
	01390500	State Route 17 in Village of Ridgewood	55
Weasel Brook	01392000	Clifton, New Jersey	25

TABLE 7- STREAMS STUDIED USING
LOG-PEARSON TYPE III AND GAUGES USED

Stream(s) Studied	Gauge Number(s)*
Deep Voll Brook, Demarest Avenue Tributary, Goffle Brook in Township of Wyckoff, Valentine Brook in Township of Mahwah	01390450, 01391110 01390500, 01390810 01391000
East Branch Saddle River, Goffle Brook, Goffle Brook Tributary, Valentine Brook in Township of Mahwah, West Branch Saddle River	01390450, 01391110, 01390500, 01390810, 01391000
Valentine Brook in Borough of Allendale	01391000

*See Table 6 for stream gauge information

The flows from the gauges were transferred to specific locations downstream and upstream in proportion to the discharge-drainage area formula:

$$Q_s / Q_g = (A_s / A_g)^n$$

where:

Q_s = Discharge at a site
A_s = Drainage area at that site
Q_g = Discharge at the gauge
A_g = Drainage area at the gauge
n = Transfer exponent

The following is a list of known transfer exponents used according to stream: for Fleischer Brook, n = 0.75.

Discharges for Goffle Brook in Ridgewood were taken from the FIS for the Borough of Hawthorne, New Jersey (FEMA, March 17, 1981).

The hydrologic analysis for Golf Course Creek in Leonia was carried out using methods outlined in the Soil Conservation Service Technical Release No. 55 (US Department of Agriculture, 1975).

Frequency-discharge data for Hirschfeld Brook were developed by correlation with the Second River, Weasel Brook, and Ho-Ho-Kus Brook (US Department of Interior, 1968). Discharges adopted in backwater computations were obtained by comparison with Ho-Ho-Kus Brook in New Jersey, which has the most similar drainage basin characteristics.

The USACE HEC-1 computer program was used for the following streams (USACE, 1998): Valentine Brook Tributary No. 2; and Overpeck Creek in the Boroughs of Leonia and Palisades Park, the Village of Ridgefield Park, and the Township of Teaneck. In the Township of Teaneck, the discharge-frequency relationships for Overpeck Creek were tied into the values as developed by the New York District of the USACE upstream of Metzlers Creek and agreed with the values from the FIS for the Borough of Ridgefield at the mouth of Overpeck Creek. In the City of Englewood, the Overpeck Creek hydrology was computed to reflect the changing drainage area along the stream. A graphical relationship of discharges to drainage area was compiled. The data were derived from three USGS gauges with drainage basin characteristics similar to Overpeck Creek. Discharges for specific drainage area locations were taken from the graph.

Hydrologic analyses for Allendale Brook, Ho-Ho-Kus Brook Tributary, and Saddle Brook were obtained using USGS Special Report No. 38, as discussed above (State of New Jersey, 1974). In addition, hydrology for portions of Ho-Ho-Kus Brook

Tributary, in which the drainage area was approximately one square mile or less, was developed using the Rational Method, as described above (US Department of Agriculture, 1974).

Discharges for the 0.2% annual chance floods on the following streams were determined by straight-line extrapolation of log-probability graphs of flood discharges computed for frequencies up to 100 years: Allendale Brook, Deep Voll Brook, Demarest Avenue Tributary, Goffle Brook, and Ho-Ho-Kus Brook Tributary.

The hydrology for Goffle Brook Tributary, Kroner's Brook, Pleasant Brook Tributary, and Sparrow Bush Brook were determined by using the method described in Special Report No. 38 (State of New Jersey, 1974).

The hydrology for Diamond Brook, West Branch Saddle River, Oost Val Brook, and Pleasant Brook were also determined by the multiple regression method described in Special Report No. 38 (Richard P. Browne Associates, 1975 & 1976).

Flood-flow data for Goffle Brook in the Borough of Midland Park were transferred by using the discharge from the downstream corporate limits of the Village of Ridgewood. The exponents in the transfer equation used were 0.658 (1% annual chance) and 0.579 (0.2% annual chance).

For Musquapsink Brook ratios of weighted discharges to regression discharges were developed at each stream gaging station location. Discharges at other locations along the brook were developed by multiplying the regression discharge by these ratios. For Musquapsink Brook, the ratios obtained for the gauge located near Westwood (Station No. 01377475) represented the area upstream of Washington Lake, and the ratios obtained for the gauge at Westwood (Station No. 01377490) represented the area downstream the gauge. Between the two gauges a USACE HEC-1 model was developed to determine the flow rates by routing the 1% annual chance hydrograph (USACE, 1998). This hydrograph was developed for Station No. 01377475 as well as for 3 sub-watersheds located downstream of the gauge, using the NFF program (U.S. Department of the Interior, 1996). Ratios between the routed and unrouted 1% annual chance discharge were used to estimate the discharges for the 10%, 2% and 0.2% annual chance discharges. The flows for Musquapsink Brook By-Pass were determined by balancing the energy grade lines and water-surface elevations at the confluence with Musquapsink Brook and at Washington Lake.

For Allerman Brook/Pond Brook, between the confluence with Crystal Lake in the Borough of Oakland and 850 feet upstream of Colonial Road in the Borough of Franklin Lakes, revised discharges were obtained from a study performed by HNTB, Inc., for the State of New Jersey Department of Transportation (NJDOT). These discharges were based on an analysis at the gauge located at Oakland

(Station No. 01387880) and were approved by the New Jersey Department of Environmental Protection (NJDEP).

Revised analyses for the August 28, 2019 countywide revision are discussed below.

Discharges for detailed studies of Bear Brook, Dorotockey's Run, Masonicus Brook, Metzlers Creek, and Wolf Creek; and limited detailed studies of Darlington Brook and Tributaries, Deep Voll Brook Tributary, Dorotockey's Run, Flat Rock Brook, Franklin Lake, French's Creek, Herring Brook and Tributaries, Hirschfeld Brook, Ho-Ho-Kus Brook Tributaries, Overpeck Creek and Tributaries, Pond Brook Tributary, Ramapo River Tributary, Ramsey Brook and Tributary, Sprout Brook Tributary, Suraci Pond Brook, Tenakill Brook, Valentine Brook and Tributary, and Van Saun Mill Brook were computed by USGS Regional Regression equations (2009) for the state of New Jersey (http://water.usgs.gov/osw/streamstats/new_jersey.html).

HEC-HMS (version 3.4) was used to develop peak discharge frequency relationships for Coles Brook. Rainfall data for different recurrence intervals were obtained from NOAA Atlas 14 (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=nj) and land use data was obtained from NJDEP (http://www.state.nj.us/dep/gis/lulc07shp.html). Soils data were obtained from NRCS (http://soildatamart.nrcs.usda.gov/). NRCS curve number method was used to estimate loss and SCS unit hydrograph was used for flow transformation. Routing was performed by Modified pulse method. Base flow was not considered.

Discharges for the Hackensack River were based on a statistical analysis of USGS gauge data of gauge 01387500 in New Milford using a record of 89 years and USGS gauge data of gauge 01377000 at Rivervale using a record of 69 years. All procedures were performed in accordance with the USGS "Methodology for Estimation of Flood Magnitude and Frequency for New Jersey Streams" Scientific Investigations Report 2009-5167 (SIR 2009-5167) (USGS, 2010), by Watson and Schopp. Bergen County is located in the non-Coastal Plain Region; therefore, the generalized skew and standard error were 0.41 and 0.53, respectively. SIR 2009-5167 indicates this portion of Bergen County to be located in the Glaciated Valley and Ridge flood-frequency region, so an exponent, b, of 0.68 was used for estimating flood frequencies for ungauged sites along the stream.

Discharges for the Mahwah River were based on a statistical analysis of USGS gauge data of gauge 01387450 near Suffern, NY using a record of 51 years. All procedures were performed in accordance with the USGS SIR 2009-5167. The generalized skew and standard error used were 0.41 and 0.53, respectively. The exponent, b, of 0.59 was used for estimating flood frequencies for ungauged sites along the stream.

Discharges for Mill Brook were unchanged from the previous effective flood insurance study. These were calculated using log-Pearson Type III equations.

Discharges for Pascack Brook downstream of the Woodcliff Lake were based on a statistical analysis of USGS gauge data (gauge no. 01377500) at Westwood using a record of 77 years. At the time of the study, USGS data for gauge 01377370 at Park Ridge had only 9 years of record. Therefore, the discharges for Pascack Brook upstream of the Woodcliff Lake up to the corporate limits of Bergen and Rockland Counties were based on the Urban Regression analysis. The analysis was performed using National Streamflow Statistics (NSS) program, version 5.0 (http://water.usgs.gov/software/NSS).

Flood flow frequencies for the Passaic River was developed using a calibrated rainfall-runoff model. The Rainfall-Runoff model was developed using HEC-HMS 3.5 computer model (USACE, 2010). Hypothetical rainfall data (frequency storm) are used to develop peak flow hydrographs for the four return intervals scoped for the project. The frequencies considered for this study are 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations . The hypothetical rainfall used in this study was based on NOAA Atlas 14 data and was obtained from the Hydrometeorological Design Studies Center of NOAA's National Weather Service. The duration chosen for the frequency storm is 96-hour and the type of distribution chosen is frequency storm. Hydrologic losses were based on NRCS's Curve Number method, rainfall-runoff transformations were based on NRCS (unit hydrograph) procedures, and reach routing was based on three methods: Modified Plus, Muskingum Cunge and hydraulic routing using an unsteady HEC-RAS model. The model calibration and verification were performed by simulating historic flood events. Calibration and verification were performed for the September 2009 and September 2010 events, respectively.

Flood flow frequencies for the East Branch Saddle River, Saddle River, Ho-Ho-Kus Brook and Ramsey Brook were based on a Log-Pearson Type III distribution for the gages on each stream, weighted using data from regional regression results as outlined in USGS SIR 2009-5167 (USGS, 2010). Peak discharges were transferred from the appropriate gage to the hydrologic node using the equation:

$$Q2 = Q1\ (A2/A1)^c$$

Where Q2 and Q1 are the discharges at the desired site and the known site, respectively, A2 and A1 are the drainage area at these points, "c" is an empirical variable used to correlate data between drainage basins. For the Saddle River and Ho-Ho-Kus Brook, data from multiple gages on each stream, combined with regulation may result in significant changes in flood flows along those streams.

Discharges at the Upper Shadow Lake Dam and Shadow Lake Dam on Ho-Ho-Kus Brook were developed from a HEC-1 routing of dam discharges on the brook. Immediately downstream of the dam at the confluence with an unnamed tributary, the previous FIS discharge was used.

Flood flow frequencies for Ramapo River were based on a statistical analysis of USGS gauge data of gauge 01387500 near Mahwah using a record of 100 years.

All procedures were performed in accordance with SIR 2009-5167. The generalized skew and standard error used were 0.41 and 0.53, respectively. The exponent, b, of 0.59 was used for estimating flood frequencies for ungauged sites along the stream.

The New Jersey Flood Hazard Area Design Flood (NJFHADF) is equal to the 1-percent-annual-chance flood plus an additional 25% in flow, and should not exceed the 0.2-percent-annual-chance flood. The NJFHADF boundary is used to regulate disturbance to the land and vegetation within the 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. Flooding sources for which NJFHADF flows were determined are noted in Table 8, "Summary of Discharges".

A summary of the drainage area-peak discharge relationships for all of the streams studied by detailed methods is shown in Table 8, "Summary of Discharges." Discharge data is not available for the following streams: Beaver Dam Brook and Tributary 3 to Ramapo River.

TABLE 8 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
ALLENDALE BROOK					
At confluence with Ho-Ho-Kus Brook	1.40	430	620	680	1,015
At upstream corporate limits of the Borough of Waldwick	1.30	405	585	645	960
At Franklin Turnpike	0.95	320	465	510	760
At upstream corporate limits of the Borough of Allendale	0.21	115	155	165	210
ALLERMAN BROOK					
At confluence with Crystal Lake	7.30	*	*	1410	*

*Data not available.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
BEAR BROOK					
At confluence with Woodcliff Lake reservoir	2.36	520	773	888/ 1,110[1]	1,170
At Spring Valley Road (Glen Road)	1.39	310	458	526/658[1]	687
At corporate limits between Montvale & Park Ridge	0.93	249	380	440/550[1]	589
At Garden State Parkway	0.21	86	131	151/189[1]	200
BEAVER DAM BROOK	*	*	*	*	*
BEHNKE BROOK					
At confluence with Herring Brook	1.43	370	600	735	1,105
BLANCH BROOK					
At confluence with Hackensack River	0.44	147	257	327	533
CHARLIES CREEK					
Approximately 160 feet downstream of Morris Avenue	0.35	140	235	306	495
At Madison Avenue	0.20	123	210	266	435
CHERRY BROOK					
At confluence with Hackensack River	2.02	239	396	485	741
At Orangeburg Road	1.58	182	305	375	575
At state line	0.86	126	216	266	415
COALBERG BROOK					
At confluence with Saddle River	0.75	251	400	470	600

*Data not available.

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
COALBERG BROOK TRIBUTARY					
At confluence with Coalberg Brook	0.18	79	125	146	201
COLES BROOK					
At the confluence with Hackensack River	7.27	1,020	1,585	1,900	2,745
At the confluence with Van Saun Mill Brook	1.96	435	685	959	1,215
At Fairmont Avenue	0.93	317	617	767/ 1,053[1]	1,187
Downstream of Grove Avenue	0.73	314	571	722/992[1]	1,118
Downstream of Passaic Street	0.64	314	571	708/972[1]	1,096
At Central Avenue	0.49	280	512	637/877[1]	990
Downstream of Essex Street	0.04	54	77	89/112[1]	122
CRESSKILL BROOK					
At confluence with Tenakill Brook	2.20	500	810	1,000	1,500
DARLINGTON BROOK TRIBUTARY					
Approximately 3,200 feet downstream of Shadyside Road	1.22	95	148	170	235
Approximately 430 feet upstream of Alida Place	0.65	88	136	160	220
DEEP VOLL BROOK					
Approximately 3,130 feet downstream of Grandview Avenue	1.70	430	710	970	1,580
At State Route 208	0.80	260	420	580	970

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
DEEP VOLL BROOK (continued)					
Approximately 1,000 feet upstream of Sicomac Avenue	0.17	120	160	170	220
DEMAREST AVENUE TRIBUTARY					
Upstream of confluence with Goffle Brook	0.57	200	320	440	750
Approximately 100 feet upstream of Jacqueline Drive	0.39	145	235	330	560
DEMAREST BROOK					
At confluence with Tenakill Brook	2.20	500	810	1,000	1,500
DIAMOND BROOK					
At Harristown Road	2.90	*	*	1,323	1,920
At Rock Road	1.80	510	820	980	1,450
Approximately 2,300 feet upstream of Rutland Road	1.10	400	620	770	1,180
DOROTOCKEY'S RUN					
At Harrington Avenue (Oradell Reservoir)	4.28	501	814	992	1,509
At Swim Club Drive	3.58	451	736	900	1,371
At Blanch Avenue	2.36	304	506	622	962
Approximately 200 feet upstream of First Street	2.03	282	471	580	899

*Data not available.

[1] A new detailed study was conducted in the Borough of Old Tappan, upstream of First Street in the Borough of Harrington Park. The flows for this node were applied to that reach. Flows downstream of the Old Tappan/Harrington Park corporate boundary were not changed.

[2] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
DOROTOCKEY'S RUN (continued)					
Approximately 70 feet upstream of Old Tappan Road[1]	1.91	407	618	715/894[2]	955
DWARS KILL					
At confluence with Oradell Reservoir	3.60	1,043/400[1]	1,658	2,030/465[1]	3,038
Upstream of Conrail	3.60	1,043/1,043[1]	1,658	2,030/640[1]	3,038
At Blanch Avenue	3.20	1,009	1,604	1,966	2,943
Above unnamed tributary above Blanche Avenue	1.40	563	914	1,129	1,709
EAST BRANCH SADDLE RIVER					
At confluence with Saddle River	6.56	1,310	2,030	2,380/ 2,975[2]	3,240
Upstream of confluence with Oost Val Brook	2.78	863	1,380	1,630/ 2,038[2]	2,270
ECHO GLEN BROOK					
At confluence with Mill Brook	0.22	102	165	212	338
At West Grand Avenue	0.08	60	99	125	200
FAIRVIEW BROOK					
At confluence with Pascack Brook	0.01	15	17	21	34
FIELDSTONE BROOK					
At confluence with Pascack Brook	0.23	87	154	193	315

[1] Discharge determined using Special Report No. 38/Discharge calculated considering interbasin flow transfer. The second value reflects the percent chance flood flow in the stream.

[2] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
FLAT ROCK BROOK					
At confluence with Overpeck Creek	2.50	665	1,075	1,315	1,980
FLEISCHER BROOK					
At Garden State Parkway	2.50	197	291	566	908
At Jan Court	0.50	126	186	354	567
FRENCH'S CREEK					
At confluence with Hackensack River	0.82	315	465	546	780
GOFFLE BROOK					
Approximately 100 feet downstream of Conrail	4.60	850	1,450	1,840	2,840
Approximately 150 feet downstream of Lake Avenue	4.35	*	*	1,774	2,750
At confluence of Goffle Brook Tributary	2.44	*	*	1,212	1,967
Downstream of confluence with Demarest Avenue Tributary	2.25	520	860	1,150	1,850
Upstream of confluence with Demarest Avenue Tributary	1.67	430	700	950	1,550
Downstream of confluence with Unnamed Tributary	1.20	340	560	770	1,300
Upstream of confluence with Unnamed Tributary	0.73	235	380	540	920
Approximately 150 feet upstream of Carlton Road	0.24	100	160	220	370
GOFFLE BROOK TRIBUTARY					
At confluence with Goffle Brook	0.83	*	*	526	630
At unnamed tributary	0.15	*	*	120	140

*Data not available.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
HACKENSACK RIVER					
Upstream of Interstate 80	132.1	4,794	7,675	9,088/ 11,360[1]	12,844
Upstream of confluence with Van Saun Mill Brook (Coles Brook)	120.1	4,493	7,194	8,518/ 10,648[1]	12,039
At USGS gauge no. 01378500 (New Milford)	113.0	4,311	6,902	8,172/ 10,215[1]	11,550
At confluence of Oradell Reservoir	58.0	2,252	3,802	4,561/ 5,701[1]	6,606
At downstream corporate limits of Old Tappan	57.1	2,229	3,763	4,515/ 5,644[1]	6,541
At USGS gauge no. 01377000 (Rivervale)	56.3	2,222	3,752	4,501/ 5,626[1]	6,518
At Old Tappan Road	52.5	2,116	3,578	4,291/ 5,364[1]	6,213
At Lake Tappan Reservoir spillway	50.00	2,051	3,470	4,160/	6,021
HAUNSMANS DITCH					
At mouth	0.42	168	282	367	594
At Ridgewood Road	0.10	70	115	150	241
HENDERSON BROOK					
At mouth	1.25	420	640	790	1,200
HERRING BROOK					
At confluence of Behnke Brook	2.76	440	715	870	1,290
Upstream of confluence of Behnke Brook	1.33	170	280	345	520

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
HILLSDALE BROOK					
At confluence with Holdrum Brook	1.59	173	291	382	611
At Piermont Avenue	1.30	170	285	375	600
At Prospect Avenue	0.61	152	259	335	548
At Park Avenue	0.19	90	156	195	315
HIRSCHFELD BROOK					
At the confluence with Hackensack River By-pass	4.60	615	970	1,145	1,585
Approximately 300 feet downstream of Prospect Avenue	3.30	490	770	910	1,260
Approximately 35 feet downstream of West Central Avenue	2.31	335	530	670	1,000
HIRSCHFELD BROOK TRIBUTARY					
At confluence with Hirschfeld Brook	1.00	390	620	760	1,150
Approximately 60 feet downstream of New York Avenue	0.99	320	485	580	840
Approximately 50 feet upstream of Madison Avenue	0.59	210	315	380	550
Approximately 230 feet upstream of Cresskill Avenue	0.24	105	155	190	270
HO-HO-KUS BROOK					
At confluence with Saddle River	20.39	2,552	3,997	4,744/ 5,930[1]	6,656

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
HO-HO-KUS BROOK (continued)					
At Spillway downstream of Warren Avenue	16.40	2,241	3,567	4,248/ 5,310[1]	6,049
At Whites Pond Dam	14.90	1,910	3,021	3,608/ 4,511[1]	5,146
Upstream of confluence of Allendale Brook	12.70	1,524	2,461	2,969/ 3,711[1]	4,345
Upstream of confluence of Ramsey Brook	9.9	1,084	1,807	2,210/ 2,762[1]	3,348
Approximately 800 feet downstream of Brookside Avenue	9.11	980	1,679	2,075/ 2,594[1]	3,259
Downstream of confluence of Valentine Brook	6.39	757	1,261	1,544/ 1,930[1]	2,333
Downstream of confluence of Ho-Ho-Kus Brook Trib.	5.31	661	1,090	1,332/ 1,664[1]	1,989
Approximately 960 feet upstream of Woodside Avenue	4.94	588	937	1,104/ 1,380[1]	1,729
At Old Mill Road	2.97	505	808	970/ 1,213[1]	1,438
HO-HO-KUS BROOK TRIBUTARY					
Upstream of confluence with Ho-Ho-Kus Brook	1.00	120	205	255	385
Approximately 20 feet upstream of Clinton Avenue	0.32	120	190	215	320
HOLDRUM BROOK					
At confluence with Hackensack River	3.00	329	537	654	979

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
HOLDRUM BROOK (continued)					
At Piermont Avenue	1.04	273	459	589	959
At Prospect Avenue	0.64	230	384	492	787
Approximately 450 feet upstream of Rolling Hill Drive	0.11	91	154	196	318
JORDAN BROOK					
At mouth	1.08	269	410	474	632
KIPS BROOK					
At confluence with Oradell Reservoir	0.61	215	363	478	770
At Haworth Avenue	0.21	126	209	272	441
KRONER'S BROOK					
At confluence with Saddle River	0.56	*	*	321	390
LAUREL BROOK					
At USGS gauge no. 01387450	12.4	1,240	2,050	2,470/ 3,088[1]	3,655
At confluence with Mill Brook	0.34	119	209	261	422
MAHWAH RIVER					
At the confluence with the Ramapo River	26.0	3,309	5,005	5,800/ 7,250[1]	7,583
At NY-NJ boundary	21.2	2,098	3,753	4,631/ 5,789[1]	7,167
MANNINGS BROOK					
At confluence with Sprout Brook	1.30	110	185	230	350

*Data not available.

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	02-Percent
MASONICUS BROOK					
At mouth	4.56	669	1,070	1,260/ 1,575[1]	1,750
Approx. 40 feet upstream of East Ramapo Avenue	3.77	598	953	1,130/ 1,413[1]	1,560
Immediately upstream of West Airmount Road	2.94	506	805	953/ 1,191[1]	1,320
Immediately upstream of North Central Avenue	1.52	340	541	639/799[1]	883
Immediately upstream of North Franklin Turnpike	0.80	177	278	327/409[1]	446
Approximately 690 feet upstream of Airmount Road	0.42	92	145	170/213[1]	232
METZLERS CREEK					
At confluence with Overpeck Creek	2.29	536	792	908/ 1,135[1]	1,180
MILL BROOK					
At confluence with Pascack Brook	1.42	372	618	805/ 1,006[1]	1,360
Below confluence of Echo Glen Brook	1.11	290	510	637/ 796[1]	1,060
At Spring Valley Road	0.82	208	358	460/ 575[1]	750
Upstream confluence with Laurel Brook	0.36	141	217	252/315[1]	338
At Summit Avenue	0.17	74	122	157/ 196[1]	253
MUDDY CREEK					
At mouth	2.29	536	792	908	1,180

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	02-Percent
MUSQUAPSINK BROOK					
At confluence with Pascack Brook	7.00	390	570	660	880
At USGS gauge No. 01377490 (Bogert Pond)	6.40	390	560	650	870
At Lafayette Avenue	5.57	560	810	940	1,260
Washington Lake Dam	*	550	890	1,080	1,730
At USGS gauge No. 01377475 (Pascack Road)	2.19	710	1,160	1,410	2,280
Approximately 1,500 feet downstream of Hillsdale Av.	*	690	1,130	1,370	2,220
Approximately 1,800 feet upstream of Werimus Rd.	*	390	650	790	1,310
MUSQUAPSINK BROOK BY-PASS					
At Woodfield Road	2.66	261	430	544	688
NORWOOD BROOK					
At confluence with Oradell Reservoir	1.90	243/926[2]	406	499/2,002[1]	753
Upstream of CONRAIL bridge	1.60	215/858[2]	360	444/1,750[1]	671
OOST VAL BROOK					
At confluence with East Branch Saddle River	3.63	*	*	839	1,200
OVERPECK CREEK					
At confluence with Hackensack River	17.30	1,810	2,240	2,665	4,000
Upstream of confluence of Teaneck Creek	12.00	1,635	2,030	2,390	3,500

*Data not available.

[1] Discharge determined using Special Report No. 38/Discharge calculated considering interbasin flow transfer. The second value reflects the 1% chance flood flow in the stream.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
OVERPECK CREEK (continued)					
Upstream of confluence of Flat Rock Brook	8.40	1,215	1,520	1,775	2,700
Upstream of confluence of Tributary to Overpeck Creek	5.70	760	1,090	1,200	1,600
Upstream of confluence of Metzlers Creek	3.00	530	750	830	1,100
PASCACK BROOK					
At USGS gauge No. 01377500 (Westwood)	29.6	2,126	3,937	4,969/ 6,211[1]	8,152
At confluence of Musquapsink Brook	20.7	1,742	3,224	4,037/ 5,046[1]	6,418
Start of detailed study-ConRail crossing	19.9	1,703	3,152	3,944/ 4,930[1]	6,258
At Woodcliff Lake Reservoir Spillway	18.2	1,620	3,003	3,753/ 4,691[1]	5,927
Approximately 1,800 feet Upstream of Grand Avenue	10.7	2,640	3,850	4,510	5,600
At corporate limits Bergen & Rockland Counties	9.77	2,510	3,680	4,310	5,370
PASSAIC RIVER					
Passaic River above Second River	905.9	17,746	26,401	30,772/ 38,465[1]	43,185
Passaic River above Third River	888.6	14,945	21,718	25,184/ 31,480[1]	35,952

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
PASSAIC RIVER (continued)					
Passaic River above Saddle River	820.5	11,437	17,903	21,469/ 26,836[1]	30,008
PINE BROOK					
At mouth	0.54	175	311	411	666
At Pascack Road	0.45	121	218	291	472
At Ridgewood Road	0.41	111	192	258	418
PLEASANT BROOK					
At confluence with Saddle River	1.82	*	*	573	820
Upstream of confluence of Pleasant Brook Tributary	1.11	*	*	480	690
PLEASANT BROOK TRIBUTARY					
Upstream of Park Way	*	*	*	203	245
At confluence with Pleasant Brook	0.33	*	*	148	153
POND BROOK					
Approximately 110 feet downstream of High Mountain Road	5.06	287	484	594	912
Above confluence with unnamed Tributary	3.42	167	286	352	546
Above confluence with unnamed Tributary	3.16	140	242	299	465
Above confluence with unnamed Tributary	2.10	78	138	171	270
At Franklin Lake Dam	1.76	75	132	164	258

*Data not available.

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
RAMAPO RIVER					
Approx. 240 feet downstream of I-287	149	8,057	14,659	18,533/ 23,166[1]	30,034
Approximately 2, 900 feet upstream of Patriots Way	139	7,742	14,103	17,835/ 22,294[1]	28,931
Approximately 2.2 miles downstream of Interstate-287	125	7,282	13,286	16,806/ 21,008[1]	27,294
At USGS gauge no. 01387500	120	7,205	13,372	16,978/ 21,223[1]	28,049
Approximately 2,300 feet upstream of NJ-17	120	7,117	12,996	16,442/ 20,553[1]	26,721
At State Boundary	93.7	6,083	11,008	13,911/ 17,389[1]	22,448
RAMAPO RIVER LEFT DIVERSION CHANNEL					
At confluence with Ramapo River	n/a	859	1,360	1,636/ 2,022[1]	2,703
RAMAPO RIVER RIGHT DIVERSION CHANNEL					
At confluence with Ramapo River	n/a	904	1584	1,925/ 2,387[1]	3,769
RAMSEY BROOK					
At confluence with Ho-Ho-Kus Brook	2.73	629	990	1,173/ 1,466[1]	1,639
At upstream side of Brookside Avenue	2.65	609	976	1,161/ 1,451[1]	1,651
Upstream of Crystal Spring Lake Dam	1.70	446	694	819/ 1,024[1]	1,132
Approximately 125 feet down-Stream of State Route 17	1.38	390	606	714/893[1]	983
Upstream of McIntosh Drive	0.15	210	317	366/458[1]	485

[1]1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
RESERVOIR BROOK					
At confluence with Woodcliff Lake Reservoir	0.19	90	156	195	315
At Woodcliff Avenue	0.09	54	93	116	189
RIVERVALE BROOK					
At confluence with the Hackensack River	0.24	122	203	264	427
At Prospect Avenue	0.08	43	70	90	144
SADDLE BROOK					
At confluence with the Saddle River	1.35	215	365	450	700
SADDLE RIVER					
At confluence with the Passaic River	60.60	3,851	5,344	6,019/ 7,524[1]	7,679
At Outwater Lane	58.90	3,770	5,201	5,849/ 7,311[1]	7,432
At Garden State Parkway	48.00	3,711	5,697	6,744/ 8,430[1]	9,704
Upstream of State Route 4	46.80	3,700	5,737	6,822/ 8,528[1]	9,911
Upstream of confluence of Ho-Ho-Kus Brook	23.20	2,533	4,716	6,016/ 7,520[1]	10,026
Upstream of State Route 17	21.60	2,419	4,637	5,982/ 7,478[1]	10,325
Upstream of confluence of Saddle Brook	19.90	2,672	4,693	5,860/ 7,326[1]	9,323

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
SADDLE RIVER (continued)					
Upstream of confluence of Pleasant Brook	11.80	2,850	4,378	5,168/ 6,460[1]	7,197
At Lake Street	10.90	2,796	4,297	5,047/ 6,309[1]	6,976
SPARKILL BROOK					
At confluence with Sparkill Creek	3.20	480	800	980	1,510
At Sewage Plant Drive	2.80	450	740	920	1,420
At Paris Avenue	2.40	420	700	870	1,340
At confluence of unnamed tributary	2.20	460	770	950	1,460
SPARKILL CREEK					
Upstream of confluence of Sparkill Brook	5.70	974	1,566	1,888	2,716
SPARROW BUSH BROOK					
At confluence with West Branch Saddle River	0.59	*	*	365	440
SPROUT BROOK					
At confluence with the Saddle River	5.90	445	720	870	1,295
Upstream of West Century Road	4.89	410	665	805	1,190
STATELINE BROOK					
At confluence with Pascack Brook	0.18	77	137	172	281

*Data not available

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
STEINALS DITCH					
At confluence with Oradell Reservoir	0.79	244	417	540	880
At Haworth Avenue	0.46	179	300	391	636
Approximately 620 feet upstream of Sunset Avenue	0.27	137	228	297	480
TANDY BROOK					
At confluence with Pascack Brook	0.44	192	315	406	643
At Pascack Road	0.18	117	191	241	386
TAPPAN RUN					
At confluence with Dorotockey's Run	1.22	308	506	622	948
Approximately 850 feet downstream of Blanche Avenue	1.20	300	490	610	920
TEANECK CREEK					
At confluence with Overpeck Creek	1.50	515	815	985	1,430
Upstream of DeGraw Avenue	1.10	440	700	850	1,235
TENAKILL BROOK					
At confluence with Oradell Reservoir	8.60	904	1,420	1,700	2,510
Above confluence of Demarest Brook	4.90	600	940	1,120	1,660
Above confluence of Cresskill Brook	3.00	260	380	440	650
TOWNSHIP BROOK					
At confluence with Pascack Brook	0.41	187	310	403	653
Approximately 440 feet upstream of Fernwood Avenue	0.26	16	289	372	593

TABLE 8 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-Percent	2-Percent	1-Percent	0.2-Percent
TRIBUTARY TO OVERPECK CREEK					
At confluence with Overpeck Creek	1.00	275	445	545	810
TRIBUTARY 1 TO RAMAPO RIVER					
At confluence with the Ramapo River	1.12	187	315	390	574
TRIBUTARY 2 TO RAMAPO RIVER					
Approximately 440 feet upstream of Andrew Avenue	0.66	132	222	275	407
VALENTINE BROOK					
At confluence with Ho-Ho-Kus Brook	2.90	545	965	1,200	1,925
At Borough of Allendale upstream corporate limits	2.06	425	745	930	1,490
Downstream of confluence of Valentine Brook Tributary No. 2	2.06	490	820	1,100	1,750
VALENTINE BROOK TRIBUTARY NO. 1					
At confluence with Valentine Brook	0.80	250	420	580	980
VALENTINE BROOK TRIBUTARY NO. 2					
At confluence with Valentine Brook	1.02	218	277	349	600

TABLE 8 - 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 SAUN MILL BROOK					
At confluence with Coles Brook	5.31	665	1,060	1,280	1,895
Upstream of confluence of Herring Brook	1.21	240	395	485	735
Approximately 1,100 feet upstream of Continental Avenue Bridge	0.97	195	320	395	600
WEST BRANCH SADDLE RIVER					
At confluence with Saddle River	3.54	*	*	1,160	1,620
Upstream of confluence of Sparrow Bush Creek	2.70	*	*	864	1,250
WESTDALE BROOK					
At confluence with Pascack Brook	0.40	150	253	322	529
WOLF CREEK					
At confluence with Bellman's Creek	2.07	650	973	1,120/ 1,400[1]	1,470

*Data not available

[1] 1-percent annual chance discharge / New Jersey Flood Hazard Area Design Flood (NJFHADF) discharge; the NJFHADF discharge is equal to the 1-percent annual chance flow plus an additional 25% in flow, and not to exceed the 0.2-percent annual chance flow.

The stillwater elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance flood for the following sources studied by detailed methods and are summarized in Table 9, "Summary of Lake Stillwater Elevations."

TABLE 9 - SUMMARY OF LAKE STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD88) 10-Percent	2-Percent	1-Percent	0.2-Percent
LAKE TAPPAN Township of River Vale and Borough of Old Tappan	54.3	54.7	55.1	55.6
ORADELL RESERVOIR Boroughs of Oradell, Haworth, Emerson, Harrington Park, Closter, and Norwood	24.8	25.4	25.7	26.4
WOODCLIFF LAKE* Boroughs of Hillsdale and Woodcliff Lake	94.0	94.0	94.0	94.0

*Woodcliff Lake was set at a controlling elevation of 94.0 Feet NAVD88 for hydraulic modeling.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources 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 the FIS in conjunction with the data shown on the FIRM.

Each community within Bergen County, with the exception of the Boroughs of Carlstadt, Hasbrouck Heights, Moonachie, and Wood-Ridge, had a previously printed FIS report narrative. The hydraulic analyses described in those narratives prior to the September 20, 1995 countywide FIS as well as the hydraulic analyses prior to the August 28, 2019 countywide revision have been compiled and are summarized below.

Cross sections for the following streams were obtained from photogrammetric surveys, and the below-water portions of the cross sections were obtained by field survey: Cherry Brook; Echo Glen Brook; Fairview Brook; Fieldstone Brook; Haunsmans Ditch; Hillsdale Brook in the Boroughs of Park Ridge, Woodcliff Lake, and the Township of River Vale; Holdrum Brook; Laurel Brook; Reservoir Brook; Rivervale Brook; Stateline Brook; and Westdale Brook.

Channel cross sections and partial overbank cross sections for the following streams were obtained from field surveys, and the overbanks were extended using topographic maps: Beaver Dam Brook; Behnke Brook; Cresskill Brook; Darlington Brook Tributary 1; Demarest Brook; Dwars Kill in the Borough of Closter; Flat Rock Brook in the Borough of Leonia; French's Creek; Henderson Brook; Herring Brook; Jordan Brook; Losen Slote in the Borough of Little Ferry; Mannings Brook; Overpeck Creek; Tributary to Overpeck Creek; Sprout Brook in the Borough of Paramus; Teaneck Creek; Tenakill Brook; Van Saun Mill Brook, Blanch Brook; Charlies Creek; Hillsdale Brook in the Borough of Hillsdale; Kips Brook; Tributary 1 to Ramapo River; Tributary 2 to Ramapo River; Steinways Ditch; Tandy Brook; Tappan Run in the Borough of Harrington Park; and Township Brook. In areas where aerial photographs did not indicate the most recent land development, full cross sections of the streams were taken.

Cross-section data for the following streams were obtained from topographic maps compiled from aerial photographs: Dwars Kill in the Borough of Norwood, Norwood Brook, Sparkill Brook, and Tappan Run in the Borough of Norwood.

Cross-section data for the following stream was obtained using a HEC-2 model obtained from the USACE and developed as part of a previous flood-control study: Muddy Brook in the Borough of Montvale.

For the remaining streams, cross-section data for the backwater analyses were field surveyed. Cross sections for all the streams were located at close intervals above or below bridges and culverts in order to compute the significant backwater effects of these structures. All bridges and culverts were surveyed to obtain elevation data and structural geometry. The baselines used for horizontal control were obtained by field survey.

Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (USACE, 1984) or HEC-RAS.

On Charlies Creek, it was determined that once the flow overtops the Morris Avenue culvert, the entire weir flow will not continue on downstream, but instead a portion will be diverted east down Morris Avenue to join Tenakill Brook Tributary 2. The amount of flow diverted was estimated to be approximately 20, 40, 60, and 100 cfs for the 10%, 2%, 1%, and 0.2% annual chance flows, respectively.

Water-surface elevations for Coalberg Brook, Coalberg Brook Tributary, and Schroeder Brook in the Township of Saddle Brook were computed using the USACE HEC-2 and USGS E-431 step-backwater computer programs.

During flooding there is a transfer of water from the Dwars Kill watershed to the Norwood Brook watershed. This independent flow condition is reflected in the

USACE HEC-2 modeling of the floodway. The multiple profiles for both streams reflect existing conditions. These profiles were prepared by distributing the flow and determining the water-surface elevations of Dwars Kill and Norwood Brook. Backwater computations and flow distribution calculations were supplied by Leonard Jackson Associates. For the shallow flooding area between Dwars Kill and Norwood Brook, the depth of flooding, 2 feet, was determined during the hydraulic analyses.

On Kips Brook, it was found that the high CONRAIL embankment crosses a very inadequately sized culvert and results in significant storage upstream plus a reduction of flow downstream of the culvert. The upstream storage depths and downstream flows were determined by performing a storage-routing analysis. The flows downstream of the culvert were substantially reduced; the reduction was estimated to be approximately 110, 215, 290, and 500 cfs for the 10%, 2%, 1%, and 0.2% annual chance flows, respectively.

On Steinals Ditch, it was found that some of the flow would be diverted from the stream into a low-lying floodplain area and that this low-lying area would drain only after the peak discharge had passed. The area where this occurs is located approximately 500 feet downstream of Haworth Avenue on the western side. The amount of flow diverted was estimated to be approximately 15, 40, and 160 cfs for the 2%, 1%, and 0.2% annual chance flows, respectively. There was no diversion for the 10% flow.

Elevations for the shallow flooding in the Borough of Emerson along Forest Avenue were determined by using past flood elevations and engineering judgment.

In the Borough of Fair Lawn, the area of shallow flooding along McBridge Avenue is caused by inadequate containment at a culvert. The hydraulic analyses for this area were based on surveyed and topographic map elevations, field investigations by engineers, and hand-computed hydraulic calculations.

Starting water-surface elevations were calculated using the slope/area method for the following streams: Beaver Dam Brook; Behnke Brook; Blanch Brook; Charlies Creek; Cherry Brook; Echo Glen Brook; Fairview Brook; Fieldstone Brook; French's Creek; Henderson Brook; Herring Brook; Hillsdale Brook; Hirschfeld Brook in the Borough of Dumont; Hirschfeld Brook Tributary in the Borough of Dumont; Holdrum Brook; Jordan Brook; Mannings Brook; Muddy Creek; Tributary 1 to Ramapo River; Tributary 2 to Ramapo River; Rivervale Brook; Sprout Brook; Stateline Brook; Tandy Brook; Tappan Run in the Borough of Harrington Park; Teaneck Creek; Township Brook; and Westdale Brook.

Starting water-surface elevations for the following streams were calculated using a rating curve developed at specific locations: Coalberg Brook at the junction with the Saddle River, Darlington Brook Tributary at Darlington Lake, and Goffle Brook

in the Borough of Midland Park. Starting water-surface elevations for Overpeck Creek were obtained from the rating curve developed on the basis of the USACE HEC-1 Flood Hydrograph Package analysis.

Starting water-surface elevations for the following streams were based on critical depth, assuming non-coincidental flooding conditions: Cresskill Brook, Demarest Brook, Sparkill Brook in the Boroughs of Norwood and Rockleigh, and Tappan Run in the Borough of Norwood. It was found that Sparkill Brook is submerged by backwater from Sparkill Creek for a distance of 0.5 mile into Rockleigh.

The starting water-surface elevations for Flat Rock Brook and Tributary to Overpeck Creek were calculated using normal depth.

The starting water-surface elevations for Dwars Kill were taken from the computed backwater elevations at Oradell Reservoir at the time of peak flow on Dwars Kill. Starting water-surface elevations on Norwood Brook were determined utilizing the same method used for Dwars Kill. It was subsequently determined that the backwater elevations from Oradell Reservoir submerge all fluvial elevations computed on Norwood Brook.

The starting water-surface elevations for Fleischer Brook were taken from normal depth computed at the diversion spillway at Lanza Avenue in the City of Garfield.

The starting water-surface elevations for the 10% flow on Haunsmans Ditch and Steinals Ditch, and the 10% and 2% flows on Kips Branch, were determined from the Oradell Reservoir spillway crest elevation. The slope/area method was used to determine the starting water-surface elevations for all other flows on Haunsmans Ditch, Steinmans Ditch, and Kips Brook.

The starting water-surface elevations for Hirschfeld Brook in the Borough of Bergenfield were obtained from the FIS for the Borough of Dumont. In the Borough of New Milford, the starting water-surface elevations for Hirschfeld Brook were developed using a one-year recurrence interval discharge, with the Hackensack River peak backwater effects as a control.

The starting water-surface elevations for Hirschfeld Brook Tributary were determined as follows: in the Borough of Bergenfield they were obtained using the computed water-surface elevation for Hirschfeld Brook; in the Borough of Dumont by the slope/area method.

Starting water-surface elevation for Valentine Brook in the Borough of Ramsey was obtained from the FIS for the Borough of Allendale.

For Reservoir Brook, the starting water-surface elevations were determined by a manual hydraulic analysis of the capacity of the grated inlet on the west side of Pascack Road.

The starting water-surface elevations for Tenakill Brook were taken at its mouth, at the Oradell Reservoir.

The starting water-surface elevations for Valentine Brook Tributary No. 1 and Valentine Brook Tributary No. 2 were taken from computed water-surface elevations for Valentine Brook.

For Van Saun Mill Brook, the starting water-surface elevations were taken from computed water-surface elevations for Coles Brook.

In the Borough of Allendale, starting water-surface elevations for Allendale Brook were taken from the previously printed FIS for the Borough of Waldwick. The starting water-surface elevations for Valentine Brook were established using the slope/area method.

In the Borough of Waldwick, starting water-surface elevations for Allendale Brook were established using the White Pond elevations.

In the Township of Washington, starting water-surface elevations for a portion of Pine Brook were obtained from the FIS for the Township of Washington.

In the Township of Wyckoff, starting water-surface elevations for Deep Voll Brook were obtained from the FIS for the Borough of Hawthorne. Starting water-surface elevations for Demarest Avenue Tributary were obtained from Goffle Brook. Starting water-surface elevations for Goffle Brook were taken from the FIS for the Borough of Midland. For Ho-Ho-Kus Brook Tributary, starting water-surface elevations were obtained using the slope/area method.

Starting water-surface elevations for Diamond Brook were obtained from the Borough of Fair Lawn FIS report.

Starting water-surface elevations for Goffle Brook were obtained from the Village of Ridgewood FIS report. On Goffle Brook in the Borough of Midland Park, the flow overtops the Greenwood Avenue and railroad crossings, both of which are located on the right overbank. This flow is diverted downstream along Greenwood Avenue until it rejoins Goffle Brook at the pond. The starting water-surface elevations for Goffle Brook Tributary were determined by using the slope/area method.

The starting water-surface elevations for Kroner's Brook, Oost Val Brook, Pleasant Brook, Pleasant Brook Tributary, and Sparrow Bush Brook were determined using the slope/area method.

Starting water-surface elevations for Musquapsink Brook and Allerman Brook were determined by using the slope/area method.

The Manning roughness coefficient "n" and the expansion and contraction coefficients were developed from field observation and photographic interpretation. Channel roughness factors used in the hydraulic computations are listed in Table 10, "Summary of Roughness Coefficients in Previous Studies."

TABLE 10 - SUMMARY OF ROUGHNESS COEFFICIENTS IN PREVIOUS STUDIES

Stream	Channel "n"	Overbank "n"
Allendale Brook	0.030-0.050	0.050-0.150
Allerman Brook	0.013-0.080	0.050-0.200
Pond Brook	0.033-0.035	0.070-0.125
Beaver Dam Brook	0.035-0.045	0.050-0.080
Behnke Brook	0.030-0.037	0.040-0.090
Blanch Brook	0.035	0.060-0.070
Charlies Creek	0.030	0.050-0.070
Cherry Brook	0.040	0.060-0.080
Coalberg Brook	0.030-0.040	0.060-0.120
Cresskill Brook	0.020-0.030	0.050
Darlington Brook Tributary 1	0.060	0.090
Deep Voll Brook	0.035-0.045	0.070-0.150
Demarest Avenue Tributary	0.035-0.040	0.080-0.150
Demarest Brook	0.015-0.030	0.050
Diamond Brook	0.035-0.045	0.015-0.080
Dwars Kill	0.020-0.050	0.030-0.050
East Branch Saddle River	0.035-0.040	0.040-0.080
Echo Glen Brook	0.030	0.080
Fairview Brook	*	*
Fieldstone Brook	0.045	0.070
Flat Rock Brook	0.015-0.034	0.060-0.140
Fleischer Brook	*	*
French's Creek	0.028-0.035	0.080-0.090
Goffle Brook	0.025-0.045	0.015-0.150

*Data not available

TABLE 10 - SUMMARY OF ROUGHNESS COEFFICIENTS IN PREVIOUS STUDIES - continued

Stream	Channel "n"	Overbank "n"
Goffle Brook Tributary	0.035-0.050	0.015-0.060
Haunsmans Ditch	0.030	0.060
Henderson Brook	0.035-0.045	0.050-0.080
Herring Brook	0.025-0.033	0.035-0.080
Hillsdale Brook	0.024-0.045	0.030-0.080
Hirschfeld Brook	0.025	0.200
Hirschfeld Brook Tributary	0.025	0.200
Ho-Ho-Kus Brook Tributary	0.030-0.035	0.080-0.100
Holdrum Brook	0.035-0.045	0.060-0.100
Jordan Brook	0.035-0.045	0.050-0.080
Kips Brook	0.030	0.050-0.070
Kroner's Brook	0.040	0.050-0.080
Laurel Brook	0.040	0.090
Losen Slote	0.028	0.070-0.090
Mannings Brook	0.022-0.030	0.040-0.060
Muddy Creek	0.030-0.040	0.070-0.090
Musquapsink Brook	0.020-0.046	0.043-0.130
Musquapsink Brook By-pass	0.040	0.070
Norwood Brook	0.020-0.030	0.015-0.020
Oost Val Brook	0.030-0.040	0.040-0.090
Overpeck Creek	0.020-0.180	0.050-0.100
Tributary to Overpeck Creek	0.033	0.060-0.080
Pleasant Brook	0.030-0.045	0.060-0.070
Pleasant Brook Tributary	0.015-0.060	0.015-0.070
Pine Brook	0.040	0.070
Tributary 1 to Ramapo River	0.025-0.060	0.040-0.100
Tributary 2 to Ramapo River	0.030-0.080	0.080-0.200
Reservoir Brook	0.040	0.070
Rivervale Brook	0.030	0.075
Saddle Brook	0.035	0.060-0.100
Sparkill Brook	0.030-0.050	0.030-0.050
Sparkill Creek	0.030-0.050	0.030-0.050
Sparrow Bush Brook	0.036-0.070	0.060-0.080
Sprout Brook	0.030-0.050	0.020-0.120
Stateline Brook	0.045	0.080
Steinals Ditch	0.030-0.035	0.035-0.090
Tandy Brook	0.030	0.050-0.070
Tappan Run	0.020-0.035	0.050

TABLE 10 - SUMMARY OF ROUGHNESS COEFFICIENTS IN PREVIOUS STUDIES - continued

Stream	Channel "n"	Overbank "n"
Teaneck Creek	0.028	0.014
Tenakill Brook	0.015-0.033	0.030-0.070
Township Brook	0.030-0.040	0.060
Valentine Brook	0.035-0.045	0.060-0.100
Valentine Brook Tributary No. 1	0.015-0.045	0.030-0.060
Valentine Brook Tributary No. 2	0.045	0.060
Van Saun Mill Brook	0.022-0.033	0.050-0.090
West Branch Saddle River	0.035	0.040-0.080
Westdale Brook	0.030	0.070

For the August 28, 2019 countywide revision, the following flooding sources were studied by detailed methods: Bear Brook, Coles Brook, Dorotockey's Run, East Branch Saddle River, Hackensack River, Ho-Ho-Kus Brook, Mahwah River, Masonicus Brook, Metzlers Creek, Mill Brook, Pascack Brook, Passaic River, Ramapo River, Ramsey Brook, Saddle River, Sparkill Creek and Wolf Creek. For Pompton Lake and the lower portion of the Ramapo River, an unsteady flow analysis was performed from the downstream county boundary to approximately 200 feet downstream of Interstate 287. The rest of the flooding sources, and the Ramapo River from a point approximately 200 feet downstream of Interstate 287 to the upstream county boundary, were studied using a steady flow analysis.

Cross section geometries for the flooding sources studied by detailed methods were obtained from a combination of Light Detection and Ranging (LiDAR) data and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. The channel sections were located at close intervals upstream and downstream of structures. 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).

The hydraulic model used for the most recent hydraulic analyses was the USACE Hydraulic Engineering Center River Analysis Stream, version 4.1 (HEC-RAS 4.1) (http://www.hec.usace.army.mil/software/hec-ras/). The models were developed using recently acquired LiDAR land data, field measurements of hydraulic structure information, and updated hydrologic data. The models were run for the peak 10%, 2%, 1%, and 0.2% annual chance frequency storm discharges.

Starting conditions for the hydraulic models were set to normal depth using starting slopes calculated from water surface elevation values taken from the LiDAR data or downstream backwater, as appropriate.

For the unsteady flow analysis of the Ramapo River, the USACE HEC-RAS version 4.1 was used. The unsteady option within HEC-RAS was chosen for its

ability to solve the full dynamic, Saint-Venant equations using the implicit finite difference method. Under unsteady flow, a discharge hydrograph is applied at the upstream boundary, and a discharge-stage rating (rating curve) at the downstream boundary. The unsteady methodology allows the program to calculate both stages and discharges throughout the studied reach. Due to the operation of the Pompton Lake Dam floodgates, the water surface elevation and flow both upstream and downstream of the dam have the potential to change. Therefore, the use of the dynamic wave (discharge and stage vary over time) approach allows for the attenuation of the water as it moves downstream.

Within the unsteady HEC-RAS model, inflow hydrographs were used as inputs into the model. The hydrographs were obtained from a calibrated HEC-HMS model. For all model runs, a downstream boundary condition of a rating curve was used. The rating curve was constructed for USGS Gauge No. 01388500 near Jackson Avenue.

The rule curve data for Pompton Lake Dam was extracted from the Pompton Lake Dam, NJ, Appendix C, NY OMRR and R Manual as supplied by the USACE – NY District and coded into HEC-RAS user-defined Rule Operation boundary condition. The rule curve operation was coded in such a way to determine the simulated water surface elevation for each unsteady simulation at every fifteenth minute. The water surface elevation reading was taken at the first cross-section just upstream of Pompton Lake Dam. This elevation was then used to calculate the difference in relation to the set point (target) elevation which in turn, determined the gate opening so as to mimic the rule curve data.

For those detailed study streams which used a steady flow analysis, water-surface elevations of the selected recurrence intervals were computed using HEC-RAS version 4.1.0. The hydraulic analyses were based on unobstructed flow. The computed flood elevations are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. Cross section geometries were developed by extracting cross section topographic data directly from a digital elevation model, and supplemented with field survey data. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Starting water-surface elevations were based on normal depth using channel invert slopes, or where applicable known water-surface elevations.

Bear Brook was modeled from approximately 890 feet downstream of Pascack Road to approximately 980 feet upstream of Grand Avenue.

The Hackensack River was modeled from approximately NJ Route 4 to the Lake Tappan Dam. This reach included the Oradell Reservoir. The Hackensack River Bypass, modeled separately in earlier studies, was included in the HEC-RAS model as an overbank channel due to inundation during the 1% annual chance event. No separate modeling was necessary.

On Metzlers Creek, Base Flood Elevations along the 1,430 foot Glenbrook Parkway culvert were modeled using a separate, overland flow HEC-RAS model. Discharges were estimated from weir flow at the upstream end of the culvert.

Mill Brook was modeled from approximately 590 feet downstream of Pascack Road to approximately 100 feet upstream of Summit Avenue. No special modeling was required.

Pascack Brook was modeled from Fairview Ave (Borough of Westwood) to the New York – New Jersey state boundary. Known water surface elevation of 94 feet was used at Woodcliff Lake to maintain permanent pool elevations based on Dam Safety guidance from NJDEP.

Roughness coefficients (Manning's "n") used in the steady-state hydraulic computations were chosen based on field observation. Table 11, "Summary of Roughness Coefficients for the August 28, 2019 Countywide Revision" provides a summary of the Manning's roughness coefficients used for the detailed studies.

TABLE 11 - SUMMARY OF ROUGHNESS COEFFICIENTS FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION

Stream	Channel "n"	Overbank "n"
Bear Brook	0.040-0.070	0.020-0.120
Coles Brook	0.015-0.040	0.024-0.150
Dorotockey's Run	0.015-0.040	0.024-0.150
East Branch Saddle River	0.030-0.035	0.020-0.080
Hackensack River	0.035-0.080	0.035-0.120
Ho-Ho-Kus Brook	0.025-0.045	0.040-0.150
Hudson River	*	*
Mahwah River	0.015-0.040	0.024-0.150
Masoniscus Brook	0.015-0.040	0.024-0.150
Metzlers Creek	0.040-0.060	0.040-0.120
Mill Brook	0.015-0.080	0.020-0.120
Pascack Brook	0.020-0.049	0.020-0.120
Passaic River	0.030-0.103	0.035-0.140
Ramapo River	0.024-0.035	0.030-0.150
Ramsey Brook	0.030-0.045	0.050-0.150
Saddle River	0.025-0.035	0.020-0.100
Wolf Creek	0.030-0.040	0.040-0.120

*Hudson River flood data is based on coastal surge modeling

At some locations along study streams, hydraulic conditions may create a situation of supercritical flow. Because of the inherent instability of such a condition, an assumption of critical flow has been adopted for the hydraulic analyses.

Limited Detailed Studies - "Enhanced Approximate Floodplains": This category is assigned to certain areas previously designated as approximate Zone A flood zones where communities have requested upgraded flood hazard analyses or no

flood hazard analyses existed, but due to the low level of projected development or budget limitations, a detailed study was not performed. It is also applied to lakes that do not have level gauge data. These enhanced zones were created using the following data and methodologies: digital orthophotos, LiDAR, limited survey of structures, nomination of flow rates, and the development of HEC-RAS hydraulic models.

The term "limited survey" refers to the survey of man-made hydraulic obstructions, such as dams, bridges and culverts, and to the survey of outlet channels of lakes with natural outlet controls. The purpose of collecting limited survey is to enhance the accuracy of the hydraulic model thus allowing the development of 1% annual chance flood elevations at selected cross sections. Engineering drawing plans and Department of Transportation (DOT) hydraulic studies may have been substituted for limited survey, where appropriate and available.

Floodways and flood profiles were not developed for streams studied using limited detailed methods; however, the 1% annual chance flood elevations for selected modeled cross-sections are provided in Table 12, "Limited Detailed Flood Hazard Data for the August 28, 2019 Countywide Revision." These cross-section locations will also be shown on the FIRM. Because the base flood elevations are advisory, the published values need not be used to enforce floodplain management ordinances as outlined in 44 CFR 60.3(c)(10), but should be used as base flood elevation data according to 44 CFR 60.3(b)(4). Development in Special Flood Hazard Areas that are designated as Zone A but which have advisory flood elevations should comply with the elevation standards, but may not have to develop an analysis of increases in water surface elevations, unless required by the local community.

The following flooding sources were studied by limited detailed methods: Darlington Brook, Darlington Brook Tributary 1, Darlington Brook Tributary 2, Deep Voll Brook Tributary, Deep Voll Brook Tributary Overflow, Flat Rock Brook, Flat Rock Brook South, Flat Rock Brook Tributary 1, Franklin Swamp, French's Creek, Haledon Reservoir, Herring Brook, Hirschfeld Brook, Ho-Ho-Kus Brook Tributary 1, Ho-Ho-Kus Brook Tributary 2, Ho-Ho-Kus Brook Tributary 4, Overpeck Creek, Overpeck Creek Tributary 1, Overpeck Creek Tributary 2, Overpeck Creek Tributary 2 South, Pond Brook, Pond Brook Tributary 2, Ramapo River Tributary 1, Ramsey Brook Tributary, Sprout Brook Tributary, Suraci Pond Brook. Tenakill Brook, Tributary 1 to Herring Brook, Tributary 2 to Herring Brook, Tributary 1 to Ramapo River, Valentine Brook, Valentine Brook Tributary 1, and Van Saun Mill Brook. Water-surface elevations of the 1% annual chance flood were computed through using HEC-RAS, version 4.1.0. The hydraulic analyses were based on unobstructed flow. The computed flood elevations are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. Models were developed by extracting cross section topographic data directly from a digital elevation model, and supplemented with field measurements for the structures. Starting water-surface elevations were based on normal depth using channel invert slopes, or

where applicable (where limited detail studies extend effective detailed studies), known water-surface elevations. Manning's "n" values were based on regional assessment and adjusted based on land cover determined by aerial photography, and range from 0.012 to 0.048 for channels, and 0.024 to 0.15 for overbanks.

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION

Cross Section	Flood Discharge (CFS)	1% Annual Chance Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
DARLINGTON BROOK			
1	536	249.0[(1)]	0058
2	536	250.5	0058
3	536	253.0	0058
4	536	255.1	0058
5	536	263.2	0058
6	536	272.0	0058
7	536	282.4	0058
8	503	287.1	0058
9	503	293.0	0058
10	503	297.1	0058
11	503	310.7	0058
12	239	323.5	0058
13	239	323.5	0066
14	239	325.4	0066
15	239	327.4	0066
16	239	328.6	0066
17	165	328.9	0066
18	165	331.4	0066
19	165	336.7	0066
20	165	340.5	0066
21	98	343.2	0066
22	98	350.2	0066
23	68	354.5	0066

[(1)]Backwater from Ramapo River

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
DARLINGTON BROOK TRIBUTARY 1			
1	277	328.6[(2)]	0066
2	277	328.6[(2)]	0066
3	277	328.6[(2)]	0066
[(2)]Backwater Darlington Brook			
DARLINGTON BROOK TRIBUTARY 2			
1	74	337.2	0066
2	74	338.2	0066
3	65	342.4	0066
4	65	347.0	0066
5	65	349.0	0066
6	49	353.3	0066
7	49	354.9	0066
8	49	354.9	0058
DEEP VOLL BROOK TRIBUTARY			
1	224	329.8[(3)]	0156
2	224	334.8	0156
3	224	340.8	0156
4	224	367.6	0156
5	213	383.3	0156
6	213	403.2	0156
7	213	415.8	0156
DEEP VOLL BROOK TRIBUTARY OVERFLOW			
1	155	327.0[(3)]	0156
2	155	328.5	0156
3	155	344.5	0156
[(3)]Backwater from Deep Voll Brook			
FLAT ROCK BROOK			
1	624	129.0	0213
2	624	134.8	0214
3	624	154.6	0214

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
4	624	208.8	0214
FLAT ROCK BROOK (continued)			
5	624	222.6	0214
6	312	235.2	0214
7	312	257.7	0214
8	312	284.7	0214
9	312	294.8	0214
FLAT ROCK BROOK TRIBUTARY 1			
1	302	35.4	0276
2	232	42.9	0276
3	232	70.2	0276
4	107	87.2	0276
5	104	93.5	0276
6	104	108.4	0276
FRANKLIN SWAMP			
1	358	417.3	0151
2	358	421.4	0151
3	358	421.4	0151
4	328	421.4	0151
5	328	421.4	0151
6	219	421.4	0151
7	223	421.4	0151
FRENCH'S CREEK			
1	104	55.0[(4)]	0192
2	104	56.7	0192
3	104	63.3	0192

[(4)]Backwater from French's Creek Detailed Study

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
HALEDON RESERVOIR			
1	776	415.2	0152
2	776	415.2	0152
HERRING BROOK			
1	367	37.5	0187
2	367	37.7	0187
3	367	48.9	0187
HERRING BROOK (continued)			
4	367	49.3	0187
5	269	49.4	0187
6	269	50.7	0191
7	265	51.0	0191
8	265	51.7	0191
HIRSCHFELD BROOK			
1	466	71.8	0192
2	466	71.9	0192
3	466	71.9	0192
HO-HO-KUS BROOK TRIBUTARY 1			
1	210	320.0[(5)]	0068
2	210	324.2	0068
3	210	326.7	0068
4	210	330.0	0066
5	210	336.9	0066
6	152	341.8	0066
7	152	349.7	0066
[(5)]Backwater from Ho-Ho-Kus Brook			
HO-HO-KUS BROOK TRIBUTARY 2			
1	100	346.4	0066
2	100	348.9	0066
3	43	351.9	0066
4	28	351.9	0066

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
5	28	354.2	0066
HO-HO-KUS BROOK TRIBUTARY 4			
1	243	351.2	0062
2	243	354.8	0062
3	243	356.1	0066
4	202	361.3	0066
5	202	366.4	0066
6	180	373.7	0066
7	114	382.4	0066
8	114	393.0	0062
OVERPECK CREEK			
1	526	84.0[(6)]	0212
2	526	91.0	0212
3	526	105.3	0212
4	526	114.0	0212
5	330	119.2	0212
6	330	127.4	0212
7	330	133.5	0212
8	330	146.0	0212
9	330	156.5	0212
10	330	164.3	0212
11	330	172.9	0212
OVERPECK CREEK TRIBUTARY 1			
1	332	9.7	0213
2	343	10.1	0213
3	509	12.4	0213
OVERPECK CREEK TRIBUTARY 2			
1	855	58.5[(7)]	0214
2	855	66.8	0214
3	210	77.8	0214
4	210	95.2	0214

[(6)]Backwater from Overpeck Creek (Detailed Study portion)

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
[7]Backwater from Overpeck Creek			
OVERPECK CREEK TRIBUTARY 2 (continued)			
5	210	133.6	0214
6	210	161.2	0214
7	210	188.4	0214
8	210	227.8	0214
9	210	257.5	0214
10	60	285.8	0214
11	60	316.6	0214
12	60	338.0	0214
13	60	353.4	0214
14	60	380.9	0214
15	60	389.9	0214
16	60	394.2	0214
OVERPECK CREEK TRIBUTARY 2 SOUTH			
1	495	67.6	0214
2	495	72.7	0214
POND BROOK			
1	390	417.1	0152
2	390	417.2	0151
3	390	417.2	0151
4	390	417.2	0151
5	362	417.2	0151
6	193	417.7	0151
POND BROOK TRIBUTARY 2			
1	646	410.3	0152
2	646	415.1	0152
3	646	423.4	0152
4	646	434.2	0152
5	587	454.7	0152
6	587	460.6	0152
7	587	463.8	0064
8	587	476.7	0064

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
RAMAPO RIVER TRIBUTARY 1			
1	344	240.0	0062
2	344	248.2	0062
3	344	263.7	0062
4	344	275.0	0062
5	273	302.2	0062
6	273	314.0	0062
7	273	326.8	0062
8	273	335.2	0062
9	273	351.7	0062
10	273	375.1	0062
11	181	403.2	0062
12	181	433.3	0062
13	121	468.9	0062
14	121	505.5	0062
15	74	531.2	0062
16	74	545.6	0062
17	74	556.0	0062
18	74	561.6	0062
RAMSEY BROOK TRIBUTARY			
1	126	407.0[8]	0078
2	126	422.1	0078
3	126	448.1	0078
4	126	457.4	0078
5	112	464.4	0078
6	112	480.9	0078
SPROUT BROOK TRIBUTARY			
1	195	52.0[9]	0179
2	50	52.0[9]	0179
3	50	52.0[9]	0179

[8]Backwater from Ramsey Brook

[9]Backwater from Sprout Brook

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	1% Annual Chance Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
SURACI POND BROOK			
1	98	340.0	0066
2	98	342.1	0066
3	98	343.3	0066
4	70	343.9	0066
5	70	346.6	0066
6	70	348.3	0066
7	36	350.2	0066
TENAKILL BROOK			
1	1,162	40.3	0211
2	1,162	45.0	0211
3	1,162	46.4	0211
4	1,162	48.0	0211
TRIBUTARY 1 TO HERRING BROOK			
1	145	42.6	0187
2	145	47.6	0187
3	135	47.9	0187
TRIBUTARY 2 TO HERRING BROOK			
1	296	44.7	0187
2	296	48.3	0187
TRIBUTARY 1 TO RAMAPO RIVER			
1	120	238.1	0044
2	120	256.2	0044
3	120	278.4	0044
4	120	300.2	0044
5	120	319.7	0044
6	111	333.9	0044
7	93	348.4	0044
8	79	358.2	0044
9	79	369.5	0044
10	79	376.3	0044

TABLE 12 - LIMITED DETAILED FLOOD HAZARD DATA FOR THE AUGUST 28, 2019 COUNTYWIDE REVISION - continued

Cross Section	Flood Discharge (CFS)	1% Annual Chance Advisory Base Flood Elevation (Feet NAVD88)	FIRM Panel Number
VALENTINE BROOK			
2[(10)]	214	348.1	0067
3	214	348.2	0059
4	183	348.5	0059
5	183	348.6	0059
[(10)]No cross-section '1' on Valentine Brook.			
VALENTINE BROOK TRIBUTARY 1			
1	144	345.6	0067
2	144	346.3	0067
3	122	347.6	0059
VAN SAUN MILL BROOK			
1	302	46.3	0183
2	302	48.1	0183
3	302	50.1	0183
4	301	53.8	0183
5	301	56.3	0183
6	301	59.0	0183

Approximate flood elevations within the County were determined using historical flood data, hydraulic and hydrologic data for the area, and engineering judgment.

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 Analyses for the September 20, 1995, Countywide FIS

For a portion of the Hudson River, a stage-frequency analysis was performed to develop flood elevations for the selected recurrence intervals. Stage-frequencies curves for Albany, Catskill, and Spuyten Duyvill, New York were provided by the USACE, New York District (Hudson River Tidal-Frequency Curves for Albany, Spuyten Duyvill, and Catskill, New York, USACE). Stage-frequencies curves for points between Spuyten Duyvill and Catskill were developed by establishing the maximum and minimum possible slopes of the profiles between Spuyten Duyvill and Catskill for each recurrence interval and estimating the position of the final profile between these envelope profiles. An attempt was made to take into account both the magnitude of the recurrence interval and variations in the mean high tide. For instance, the 0.2-percent chance profile, while positioned to follow the mean high-tide profile, does not conform to it as closely as the 10-percent chance profile, because the high stages would tend to eliminate minor fluctuations of the tidal profile. A tidal gage for the Hudson River (USGS Gage No. 88; period of record 1926-present) located approximately

seven miles south of the Village of Spuyten Duyvill has been analyzed by the USACE and a stage-frequency relationship established. The private engineering firm of Camp Dresser and McKee, Inc., in the FIS for Briarcliff Manor, New York, has determined stage-frequency relationships for the Hudson River at a point approximately 10 miles north of Hastings-on-Hudson (US Department of Housing and Urban Development, August 1977). The adopted stage-frequency relationship for the Hudson River at Hastings-on-Hudson is the average between the stages determined for these two locations.

In addition, an analysis of the Hudson River was taken from the 2001 FIS for the City of New York, New York (FEMA, May 21, 2001). In the FIS for the City of New York, surge depths were determined independently of the astronomic tide by the application of a synthetic storm to generate surges. The propagation of surges through the entire waterway system is simulated by use of mathematical models that dissipate the surge waves in a manner consistent with the physical and hydraulic properties of the waterway system and determine elevations at any selected location along the coast. An offshore surge generation model was used to generate surges from hurricanes over the continental shelf. An embedded link-node network model was used to propagate the surge inland through the New York Bight and into the harbor and bays. The second model enables a finer spatial resolution for computing storm surges at all coastal locations in the city. A different set of models was developed which included a northeaster wind field algorithm to properly simulate the surge producing mechanisms of northeasters.
The two models were calibrated to astronomic tidal conditions to establish the hydrodynamic characteristics of the study area. The models were then calibrated to Hurricane Carol (1954) and verified against Hurricanes Edna (1954) and Donna (1960), and the hurricane of 1938. The northeastern wind algorithms were calibrated and verified using 13 historical northeasters.

Observed historical data were used to develop discrete distributions of storm surge events that have the potential to occur. Total stillwater elevations were determined by combining each stillwater elevation with the complete range of local tidal conditions also based on historical data and accounting for non-linearities in the combination.

The Joint Probability Method was used to determine the stillwater elevations at specific recurrence intervals (US Department of Commerce, 1970). Application of the Joint Probability Method consisted of assigning annual probabilities of occurrence to each synthetic storm based on the probabilities of its characteristics. The resulting peak tide levels from each synthetic storm were summed in half-foot increments from 0 to 20 feet at each selected point. Cumulative annual exceedance probabilities at each point were obtained by summing the annual occurrence probabilities from high to low elevations. Finally, hurricane and northeaster frequency curves were combined by summing annual exceedance probabilities.

The stillwater elevations do not include the contributions from wave action effects such as the wave crest height and wave run-up. Nonetheless, this additional hazard due to wave action effects should be considered in the planning of future development.

The stillwater elevations for the 10, 2, 1, and 0.2 percent chance floods have been determined and are summarized in Table 13, "Summary of Coastal Stillwater Elevations."

TABLE 13 - SUMMARY OF COASTAL STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD) 10-Percent	2-Percent	1-Percent	0.2-Percent
BELLMANS CREEK				
At Node 16	5.6	7.0	7.6	8.1
At Node 43	5.6	7.0	7.6	8.1
At Node 44	5.6	7.0	7.6	8.1
At Node 45	5.7	7.0	7.7	8.1
At Node 36	5.7	7.0	7.7	8.1
BERRYS CREEK				
At Node 11	5.6	7.1	7.7	8.3
At Node 65	5.5	7.0	7.6	8.1
At Node 66	5.5	7.0	7.6	8.0
At Node 58	5.5	6.9	7.5	8.0
At Node 59	5.3	6.7	7.4	7.8
At Node 60	5.2	6.6	7.2	7.7
At Node 62	5.2	6.6	7.2	7.7
At Node 63	3.7	4.0	4.3	5.4
BERRYS CREEK CANAL				
At Node 12	5.6	7.0	7.7	8.2
At Node 57	5.5	7.0	7.6	8.1
At Node 58	5.5	6.9	7.5	8.0
COLES BROOK				
At confluence with the Hackensack River	5.9	7.3	7.9	8.4
CROMAKILL CREEK				
At Node 15	5.6	7.0	7.6	8.1
At Node 46	5.6	7.0	7.7	8.1
At Node 48	5.6	7.0	7.7	8.2

TABLE 13 - SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD) 10-Percent	2-Percent	1-Percent	0.2-Percent
FLAT ROCK BROOK				
At confluence with Overpeck Creek	*	*	5.7	*
FRENCH BROOK				
At confluence with the Hackensack River	5.9	7.3	7.9	8.4
HACKENSACK RIVER				
At Node 5	6.3	7.9	8.8	9.6
At Node 6	6.2	7.8	8.6	9.3
At Node 7	6.1	7.6	8.4	9.1
At Node 8	5.9	7.5	8.2	8.9
At Node 9	5.8	7.3	8.1	8.7
At Borough of Bogota corporate limits	5.8	7.2	7.8	8.3
At Node 10	5.7	7.2	7.9	8.5
At Node 11	5.6	7.1	7.7	8.3
At Node 12	5.6	7.0	7.7	8.2
At Node 13	5.6	7.0	7.7	8.2
At Node 14	5.6	7.0	7.6	8.1
At Node 15	5.6	7.0	7.6	8.1
At Node 16	5.6	7.0	7.6	8.1
At Node 17	5.6	7.0	7.6	8.1
At Node 18	5.6	7.0	7.6	8.1
At Node 19	5.7	7.0	7.7	8.1
At Node 20	5.7	7.1	7.7	8.1
HUDSON RIVER				
At George Washington Bridge	6.3	7.8	8.6	10.7
At upstream corporate limits of the City of New York	5.9	7.4	8.2	10.6
At Yonkers, New York	5.2	6.2	6.7	8.0
KINGSLAND CREEK				
At Node 10	5.7	7.2	7.9	8.5
At Node 69	5.2	6.9	7.6	8.2
At Node 70	4.7	6.6	7.4	8.0

*Data not available

TABLE 13 - SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD) 10-Percent	2-Percent	1-Percent	0.2-Percent
LOSEN SLOTE				
At Node 17	5.6	7.0	7.6	8.1
At Node 76	5.6	7.0	7.7	8.1
MILL CREEK				
At Node 15	5.6	7.0	7.6	8.1
At Node 49	5.6	7.0	7.6	8.1
MOONACHIE CREEK				
At Node 14	5.6	7.0	7.6	8.1
At Node 55	4.3	5.8	6.5	7.2
At Node 56	2.8	3.7	4.1	4.5
NEWARK BAY				
On the Hackensack River at the downstream corporate limits of Borough of River Edge	5.9	7.3	7.9	8.4
On Coles Brook at confluence with the Hackensack River	5.9	7.3	7.9	8.4
OVERPECK CREEK				
At Node 20	5.7	7.1	7.7	8.1
At Node 99	5.7	7.0	7.7	8.2
At Node 36	5.7	7.0	7.7	8.1
At downstream tide gates at the New Jersey Turnpike	5.7	7.0	7.7	8.1
At upstream tide gates at the New Jersey Turnpike	*	*	5.7	*
At the City of Englewood downstream corporate limits	3.7	5.1	5.7	8.1
Downstream of State Route 4	5.2	6.1	6.6	9.1
PASSAIC RIVER				
At East Newark gage	6.5	8.3	9.2	11.8
PEACH ISLAND CREEK				
At Node 60	5.2	6.6	7.2	7.7
At Node 61	6.2	6.6	7.3	7.7

*Data not available

TABLE 13 - SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD) 10-Percent	2-Percent	1-Percent	0.2-Percent
PENHORN CREEK				
At Node 7	6.1	7.6	8.4	9.1
At Node 52	3.6	4.8	5.3	5.8
At Node 53	2.7	3.9	4.4	4.9
At Node 54	2.3	3.4	3.9	4.3
SAWMILL CREEK				
At Node 9	5.8	7.3	8.1	8.7
At Node 71	5.8	7.4	8.1	8.7
At Node 72	5.8	7.4	8.1	8.6
TEANECK CREEK				
At confluence with Overpeck Creek	*	*	5.7	*
WEST RISER DITCH				
At the Township of South Hackensack corporate limits	3.7	4.0	4.3	5.4

*Data not available

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 in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the County must, therefore, be referenced to NAVD88. It is important to note that adjacent counties may be referenced to NGVD29. This may result in difference in BFEs across the county boundaries between the counties.

As noted above, the elevations shown on the FIS report and on the FIRM for Bergen County are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a standard conversion factor. The county-wide average conversion factor of -1.0 foot was determined using the National Geodetic Survey (NGS) VERTCON conversion program (NAVD88 = NGVD29 – 1.0) as shown in Table 14.

TABLE 14 – COUNTYWIDE VERTICAL DATUM CONVERSION

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
Ramsey	SW	41.000	-74.250	-0.955
Ramsey	SE	41.000	-74.125	-0.971
Nyack	SW	41.000	-74.000	-0.988
Hackensack	SE	40.875	-74.000	-1.004

Average Conversion from NGVD29 to NAVD88 = -0.979 feet; rounded to -1.0 feet

Users who wish to convert to the elevations in this FIS to NVGD29 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 more information regarding conversion between the NGVD29 and on NAVD88, visit the National Geodetic Survey website at 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
(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 provides 1% annual chance floodplain data, which may include a combination of the following: 10%, 2%, 1% and 0.2% annual chance flood elevations; delineations of the 1% annual chance and 0.2% annual chance floodplains; and 1% annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevations tables. Users should reference the data presented in the

FIS 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% annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2% annual chance flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 1% and 0.2% annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For the streams studied prior to the August 28, 2019 countywide revision and listed in Table 4, "Streams Studied by Detailed Methods Prior to the August 28, 2019 Countywide Revision", between cross sections, the boundaries were interpolated using topographic maps, aerial photographs, maps provided by the NJDEP, sanitary sewer maps, storm sewer maps, and updated topographic maps provided by the New Jersey Meadowlands Commission.

For the streams studied by approximate methods, the 1% annual chance floodplain boundaries were delineated using previously printed FISs and FHBMs, USGS flood-prone area maps, topographic maps, depth-discharge-frequency relationships, and information furnished by local officials.

For several communities, field reconnaissance provided data that were used in verifying the limits of flooding delineated.

For the streams studies by detailed or limited detailed methods for the August 28, 2019 countywide revision and listed in Tables 5, "Limits of Detailed Study for the August 28, 2019 Countywide Revision" and Table 12, "Limited Detailed Flood Hazard Data for the August 28, 2019 Countywide Revision", between cross sections, the boundaries were interpolated using a Digital Elevation Model prepared from LiDAR data provided by the NJDEP.

The 1% and 0.2% annual chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1% annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones VE, A, AE, AH, and AO), and the 0.2% annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% 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.

Along numerous streams studied as part of the August 28, 2019 countywide analysis, the New Jersey Flood Hazard Area Design Flood (NJFHADF) floodplain is also shown as a separate line type. The NJFHADF is equal to the 1% flood in tidal areas and the 1% flood plus an added factor of safety in non-tidal areas (NJ flood hazard area design flood = 125% of 1% discharge in non-tidal areas), not to exceed the 0.2% annual chance flood. A separate NJFHADF line is not shown in areas subject to tidal inundation.

The State of New Jersey, Department of Environmental Protection (NJDEP) 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.

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% 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 1% annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study.

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 (Table 14). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1% annual chance floodplain boundaries are either very close together or collinear, only the floodway boundary is shown.

On Metzlers Creek, the floodway in the vicinity of the Glenbrook culvert does not follow the culvert, which runs directly under the road. The floodway location resulting from flow over and around the culvert runs through a low area adjacent to the Glenbrook culvert.

The floodway on Valentine Brook Tributary No. 2 between the CONRAIL embankment and Prospect Street has been delineated to coincide with the 1% annual chance floodplain boundary. This delineation of the floodway is appropriate because the base flood elevation upstream of the railroad was determined from a routing of the 1% annual chance flood hydrograph through the railroad embankment culverts using available flood storage volume data. Encroachment in this area is not appropriate unless the culverts under the railroad are enlarged to allow greater flow capacity.

The floodways for Electric Lake, the Oradell Reservoir, the Lake Tappan Reservoir, and Washington Lake were delineated at the shoreline rather than using equal conveyance reduction.

Floodways were not computed for Coalberg Brook upstream of cross section D, Coalberg Brook Tributary, and Coles Brook upstream of a point approximately 850 feet downstream of Spring Valley Avenue.

Portions of the floodways for the Mahwah River, the Passaic River, and Sparkill Creek extend beyond the county boundary.

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 14, “Floodway Data” for certain downstream cross sections are lower than the regulatory flood elevations in that area, which must take into account the 1% annual chance flooding due to backwater from other sources.

No floodways have been computed for streams studied by limited detailed methods. Information pertaining to the flood discharges and 1% annual chance water surface elevations for selected cross-sections along streams studied by limited detailed methods is shown in Table 12, “Limited Detailed Flood Hazard Data for the August 28, 2019 Countywide Revision.”

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 15, "Floodway Data." In order 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.

The area between the floodway and 1% 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 water-surface elevation of the 1% annual chance flood by 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 2, "Floodway Schematic."

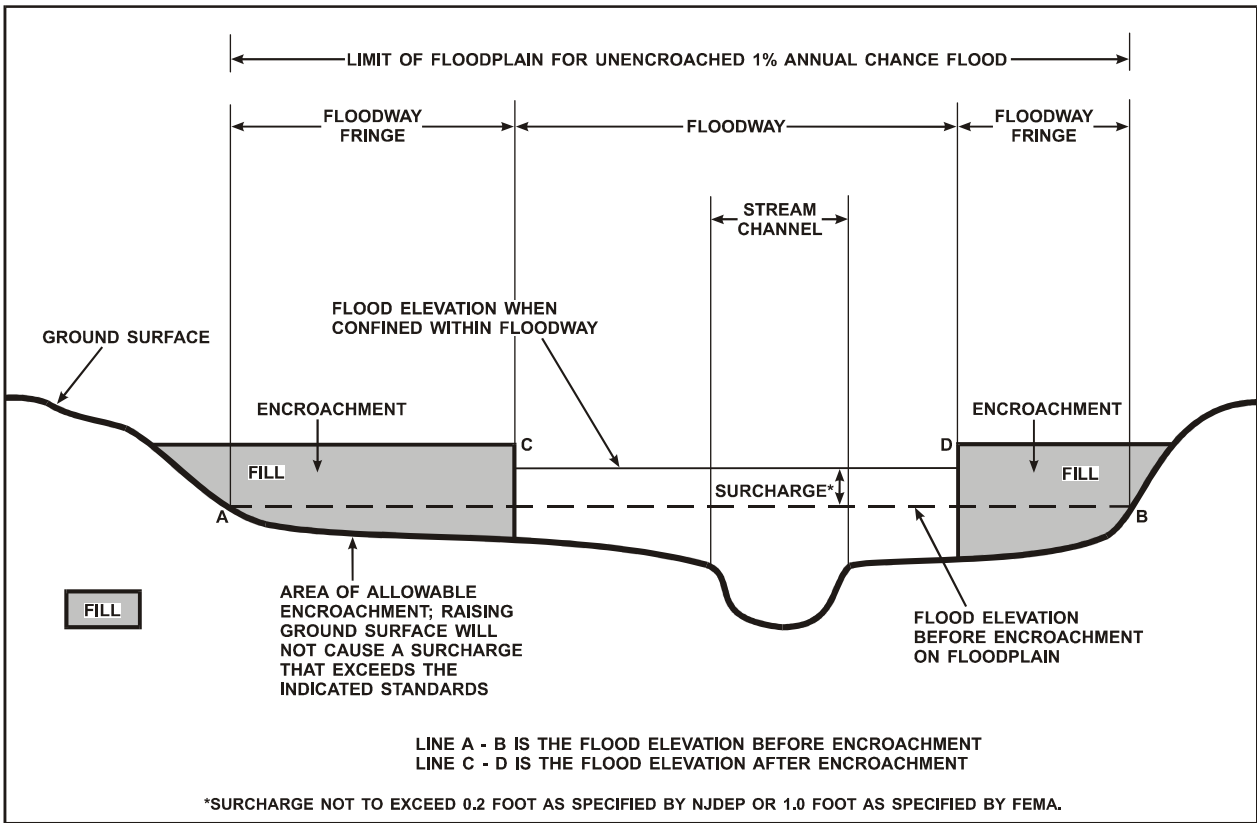

FIGURE 2 – FLOODWAY SCHEMATIC