Levee Analysis and Mapping Plan
Kingston Flood Protection Project

City of Kingston, New York

April 2018

FEMA

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Acronyms

BFE	Base Flood Elevation
CERC	Community Engagement and Risk Communication
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
LLPT	Local Levee Partnership Team
LOMR	Letter of Map Revision
NAVD 88	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NGVD 29	National Geodetic Vertical Datum of 1929
NYSDEC	New York State Department of Environmental Conservation
SFHA	Special Flood Hazard Area
STARR II	Strategic Alliance for Risk Reduction
USACE	U.S. Army Corps of Engineers

Definitions

The terms below have been used in this document. Additional terms are provided in FEMA's *Analysis and Mapping Procedures for Non-Accredited Levee Systems* (July 2013) in the Glossary of Levee Terms. This document is available from the FEMA Library at https://www.fema.gov/media-library-data/20130726-1922-25045-4455/20130703_approachdocument_508.pdf.

Base Flood Elevation (BFE) – The elevation of a flood having a 1-percent chance of being equaled or exceeded in any given year.

Levee Analysis and Mapping Procedures* – Levee Analysis and Mapping Procedures include Sound Reach, Freeboard Deficient, Overtopping Analysis, Structural-Based Inundation, and Natural Valley. Details on these approaches can be found in FEMA's *Analysis and Mapping Procedures for Non-Accredited Levee Systems* (July 2013).

Leveed Area* – A spatial feature in the NLD defined by the lands from which flood water is excluded by the levee system.

Levee Reach – Any continuous section of a levee system to which a single analysis and mapping procedure may be applied.

Levee System – A flood hazard-reduction system that consists of a levee, or levees, and associated structures, such as closures, pumps and drainage devices, which are constructed and operated in accordance with sound engineering practices**.**

Local Levee Partnership Team (LLPT) – A work group that can be facilitated by FEMA when a non-accredited levee system in a community or project area will be analyzed and the areas landward of the levee system will be mapped. The primary function of this group is to share information/data and identify options based on stakeholder roles and knowledge.

Non-Accredited Levee System – A levee system that does not meet the requirements spelled out in the National Flood Insurance Program (NFIP) regulations at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR§65.10), *Mapping of Areas Protected by Levee Systems*, and is not shown on a FIRM as reducing the flood hazards posed by a 1-percent-annual-chance or greater flood.

Zone A – An area inundated by 1-percent-annual-chance flooding, for which no BFEs have been determined.

Zone D – Area of undetermined but possible flood hazard.

*All definitions on this page except for this one are from FEMA's Analysis and Mapping Procedures for Non-Accredited Levee Systems (July 2013)

0 Executive Summary

The Federal Emergency Management Agency's (FEMA's) Flood Insurance Study (FIS) report and Flood Insurance Rate Map (FIRM) for the City of Kingston (City), Ulster County, New York depict the leveed area of the non-accredited Kingston Flood Protection Project (Kingston Levee) as high risk Special Flood Hazard Area (SFHA). FEMA's guidance was revised in 2013 to incorporate a new Levee Analysis and Mapping Procedure which provides a suite of flexible procedures to perform flood hazard analysis and mapping (see Section 1 of this report). The City has a levee discovery project where the levee system is being studied using the Levee Analysis and Mapping Procedures (see Section 2). This study will help identify potential options the City may have to show the levee as providing reduced flood hazard on the FIRM.

In February of 2017, FEMA Region II partnered with stakeholders in the City to form a collaborative Local Levee Partnership Team (LLPT) and worked to determine potential Levee Analysis and Mapping Procedures for the Kingston Levee (see Sections 3 and 4 respectively). The process involved the collection and group evaluation of available data, creation and evaluation of an initial data analysis (see Section 5), and detailed discussions on mapping needs.

The information gained through the extensive coordination of the LLPT and the initial data analysis performed, supports the development of this document — a plan outlining potential reach analysis procedures. This document informs the potential paths forward for the City (see Section 6). The City is currently weighing the benefits and costs of considering the Freeboard Deficient Procedure for the Kingston Levee and the Sound Reach Procedure for Interstate 587 (I-587) to depict the flood hazard for leveed areas of the Kingston Levee. The effective FIRM dated November 16, 2016 depicts the leveed area of the non-accredited Kington Levee as high risk Special Flood Hazard Area (SFHA). Should the City elect to revise the FIRM in the future through the Freeboard Deficient and Sound Reach Procedures or accreditation, the City may pursue a Letter of Map Revision (LOMR) instead of waiting for the FEMA Regional Office to incorporate updates into future mapping studies.

1 Introduction

Under FEMA's prior levee approach, a levee system that did not meet the National Flood Insurance Program (NFIP) requirements outlined in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44CFR§65.10) was analyzed and mapped as if it provided no protection during a base (1-percent-annual-chance) flood. This was known as the "without levee" approach.

Some stakeholders expressed concern about the "without levee" approach. Members of both the U.S. House of Representatives and the U.S. Senate echoed this concern and asked FEMA to consider discontinuing the "without levee" approach. Accordingly, FEMA drew on current modeling techniques to refine the identification of flood hazard reduction that non-accredited levee systems provide. This process recognizes the uncertainty associated with hazard identification of leveed areas.

FEMA, its Production and Technical Services contractor Strategic Alliance for Risk Reduction (STARR II) and Community Engagement and Risk Communication contractor (CERC) initiated the Levee Analysis and Mapping Procedures process for the levee in the City. Recent technological

advances in data collection methods and hydrologic and hydraulic modeling were leveraged as part of this process. FEMA's Levee Analysis and Mapping Procedures for non-accredited levees is a more refined approach to mapping flood hazards in leveed areas.

The Levee Analysis and Mapping Procedures process also:

- Leverages local knowledge and data, with proactive stakeholder engagement in LLPTs;
- Aligns available resources for engineering analyses and mapping commensurate with the level of risk in leveed areas; and
- Considers the unique characteristics of each levee system from an engineering perspective.

The levee system in the City is non-accredited. At the request of the community, FEMA is using the Levee Analysis and Mapping Procedures process to develop refined flood hazard mapping in leveed areas. This will inform the City's decision on how they would like to depict the levee-related flood hazards in the City.

This report is the result of the collaboration between FEMA, the City, Ulster County, New York State Department of Environmental Conservation (NYSDEC), U.S. Army Corps of Engineers (USACE), and other stakeholders. This report documents the evaluation of data, initial data analysis, as well as the community's preferred Levee Analysis and Mapping Procedure.

2 Levee System Description

2.1 Flood Protection Measures in the City of Kingston

The Kingston Levee is a USACE designed and constructed project comprised of approximately 1,600 feet of earthen levee, 950 feet of concrete flood wall, along with retaining walls, two pump stations, and other drainage appurtenances designed to reduce the flood risk on the right bank of the Esopus Creek Reach 1[1]. The levee system is located between Washington Avenue and Interstate 587 (I-587) in the City, Ulster County, New York as shown in Figure 1.

[1] Esopus Creek Reach 1 as identified in the FIS report for Ulster County, New York (All Jurisdictions) revised November 18, 2016.

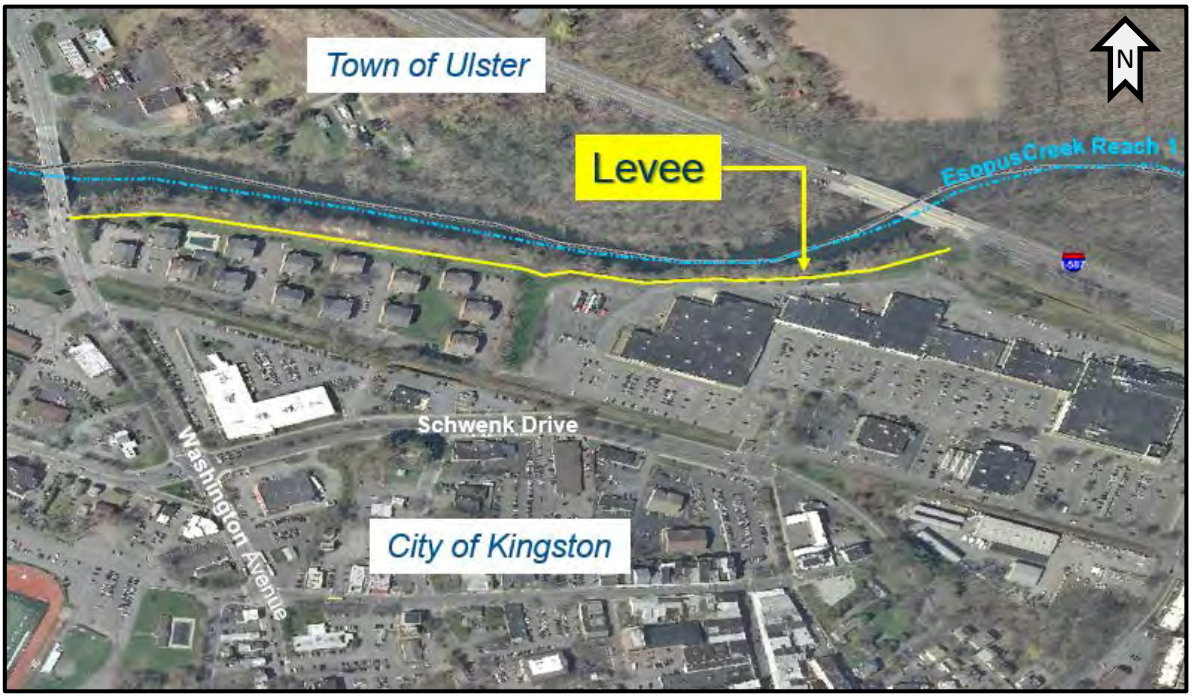

Figure 1: General Location Map

2.2 Pump Stations

One pump station house and one over the wall pump station are part of the Kingston Levee. According to the Operation and Maintenance Plan for the Kingston Levee, the pump station house consists of two identical pumps with capacity ranging from 11 to 16 cfs. The over-the-wall pump station is comprised of one 12-inch diameter pipe with two 8-inch diameter quick connects built to discharge flow over the floodwall from the interior drainage pond. The location of the pump stations and the over-the-wall pump station connection are shown in Figure 2.

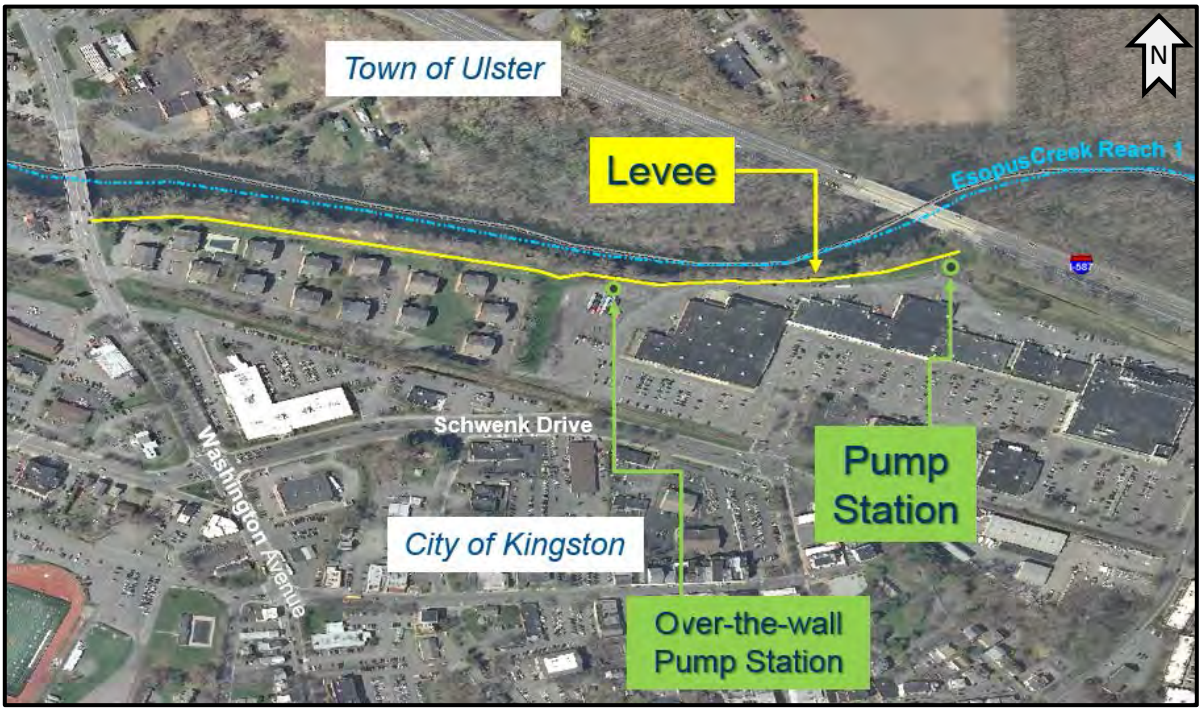

Figure 2: Pump Stations

2.3 Community NFIP and FIRM History

Tables 1 and 2 summarize the communities' NFIP and FIRM history.

Table 1. Summary of Project Area

County	Community	Participating in the NFIP?	Estimated Number of Potentially Impacted Structures in Leveed Area[2]
Ulster County	City of Kingston	Yes	14 Apartment Structures, 1 Utility Substation, 18 Commercial Structures (including 1 shopping center), Wiltwyck Fire Station

[2] Levee protected area from 1-percent-annual-chance flood hazard from November 16, 2016 FIRM.

Table 2. Community Map History

Community Name	Initial Identification	Flood Hazard Boundary Map Revision Date(s)	FIRM Effective Date	FIRM Revision Date(s)
City of Kingston	May 17, 1974	November 28, 1975 January 18, 1980	May 1, 1985	November 18, 2016

A countywide FIS report was issued for Ulster County, New York on November 18, 2016. According to the FIS report, "Documentation provided by the NYSDEC indicates the Kingston Levee does not meet the freeboard requirements of 44 CFR 65.10 of the NFIP Regulations. Accordingly, the levee has been mapped as not providing protection against the 1-percent-annual-chance flood."

3 Local Levee Partnership Team

The LLPT was formed to provide FEMA with data and input, including feedback on the procedures to be used for analyzing and mapping the levee reach, based on local levee conditions. The stakeholders who participated in the LLPT for this project are listed in Table 3.

Table 3. LLPT Participants

LLPT Member	Contact Information
Steve Noble	Mayor, City of Kingston 845-334-3902; snoble@kingston-ny.gov
Ralph Swenson	City of Kingston 845-334-3967; rswenson@kingston-ny.gov
Joe Chenier	City of Kingston 845-331-0682; jchenier@kingston-ny.gov
Alan Adin	City of Kingston 845-334-3968; aadin@kingston-ny.gov
Aaron Bennet	Ulster County 845-688-3047; aben@co.ulster.ny.us
Kathy Fallon	Office of Congressman John Faso 845-514-2322; kathy.fallon@mail.house.gov
Bill Nechamen*	NYSDEC**Since this meeting, Bill Nechamen has retired. Alan Fuchs will assume his roles.*
Brad Wenskoski	NYSDEC 518-402-8082; Brad.wenskoski@dec.ny.gov
Alan Fuchs**	NYSDEC 518-402-8185; Alan.fuchs@dec.ny.gov ***Took over for Bill Nechamen when Bill retired.*
Arvind Goswami	NYSDEC 518-402-8186; Arvind.goswami@dec.ny.gov
John Harrington	NYSDEC 845-256-3055; John.harrington@dec.ny.gov
Lynn Meeker	NYSDEC Lynn.meeker@dec.ny.gov
Ali Buchowski***	USACE ****Since meeting left NY District USACE, Encer Schaefer now covering.*
Anna Servidone	NYSDEC 518-402-8147; Anna.servidone@dec.ny.gov
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Thomas Song	CERC, FEMA Outreach Consultant 914-343-6696; thomas.song@mbakerintl.com

4 Stakeholder Engagement

4.1 LLPT Meeting 1

A FEMA-led project team engaged the Kingston Levee stakeholders at the LLPT Meeting 1 held at City Hall on February 21, 2017. The overall intent of the meeting was to gain local insight on the status and data available for the levee system, introduce the Levee Analysis and Mapping Procedures concepts with respect to the levee system, and begin to establish the stakeholders who would like to participate in the LLPT.

An overview of the methods available to depict flood risks of leveed areas under current Levee Analysis and Mapping Procedures guidance was also discussed during the meeting along with a timeline for the levee project. Additional details regarding the LLPT 1 meeting are provided in Appendix A.

4.2 LLPT Meeting 2

On September 12, 2017, the LLPT Meeting 2 was held to review the Initial Data Analysis and discuss outcomes from the data collection process. During the meeting, the FEMA project team discussed the results of the Initial Data Analysis for the Natural Valley Procedure, Structural-Based Inundation Procedure, and the Freeboard Deficient Procedure. The Sound Reach Procedure and the Overtopping Procedure were not applicable due to the levee crest elevations being elevated above the BFE but not meeting minimum freeboard requirements. Additional details regarding the LLPT 2 meeting are provided in Appendix B and information from the data collection are provided in Appendices C through F.

4.3 LLPT Meeting 3

A LLPT Meeting 3 was held on January 22, 2018 to review the draft levee analysis and mapping plan with the LLPT prior to it being finalized.

5 Initial Data Analysis

FEMA project team members of STARR II developed an Initial Data Analysis, which is an approximate analysis using available data to approximate the floodplain boundary for each relevant Levee Analysis and Mapping Procedures approach. This informed the discussions in LLPT Meeting

2 and the touchpoint call prior to LLPT Meeting 3. Details of the reach analysis and application of reach analysis procedures are provided below. Supporting data is provided in Appendix G.

5.1 Reach Analysis

Topographic data and top of levee survey data were reviewed to define the levee system and identify if the levee system should be evaluated as separate reaches for application of the reach analysis procedures. A levee reach is any continuous section of a levee system to which a single reach analysis procedure may be applied.

The Kingston Levee is located riverside of a low area in the topography between Washington Avenue and I-587. A breach or failure at any point along the levee could cause inundation of the low area landside of the levee. For hydraulic modeling purposes, there is no reason to evaluate the levee system as separate reaches because it would not refine the flood risk analysis of the leveed area.

It should be noted; however, that the Kingston Levee system ties-in to high ground at the upstream end near Washington Avenue and ties-in to the I-587 embankment as high ground at the downstream end. The existing ground at the upstream end of the levee system near Washington Avenue appears to be approximately at or above the elevation of the 1-percent-annual-chance flood; however, it should be further investigated if the high ground is part of the roadway embankment or could be considered natural high ground. For the purposes of the reach analysis, the upstream end of the levee is considered to tie-in to natural high ground.

The downstream end of the levee system ties-in to the I-587 embankment. The interstate embankment would be considered a non-levee reach, as it was not originally designed as a levee, but serves as an extension of the levee as the levee ties-into it. Because non-levee reaches are not recognized as levees, they cannot be mapped as reducing flood risk on a FIRM. FEMA conservatively maps the flood risk associated with non-levee features, such as stream crossings and associated embankments, as existing conditions instead of using the Natural Valley procedure (without levee condition). The flood risk associated with existing condition may be more conservative due to the ponding of floodwaters that can occur upstream of restrictive stream crossings.

A non-levee reach could be considered a levee (subject to accreditation or reach analysis procedures) if it can be certified to meet the minimum requirements of 44CFR§65.10, including that it is operated, and maintained as a levee. The burden of proof may fall on the stakeholder seeking recognition of the embankment as a levee, as the Federal Highway Administration (FHWA) issued a September 10, 2008 memorandum stating that “the FHWA discourages DOTs in certifying highway embankments as levee or allowing any such certification by any entity.”

For the purposes of the Initial Data Analysis, the I-587 embankment was considered an existing condition except for one reach analysis procedure described under Section 5.4.

5.2 Natural Valley Procedure

The Natural Valley Procedure is completed for all levee systems to identify the potential leveed area associated with the 1-percent-annual-chance flood. This is completed through hydraulic

modeling of the levee system as though it is not reducing flood risk by allowing flow to be conveyed on both sides of the levee. For the Natural Valley Procedure, only the Kingston Levee reach was evaluated. The I-587 embankment was included in the model as existing condition.

5.3 Structural-Based Inundation Procedure

For the Structural-Based Inundation Procedure, a hypothetical breach analysis was completed using HEC-RAS 5.0.3 (2-Dimensional, unsteady flow) at 3 locations along the Kingston Levee (upstream, central, and downstream). The breach locations were developed for modeling purposes only and not indicate historic or future breach development at these locations. The I-587 embankment was included in the model as existing condition.

5.4 Freeboard Deficient Procedures

For the purposes of the initial data analysis of the Freeboard Deficient Procedure, the Kingston Levee crest elevations were assumed to be elevated at or above the BFE. The levee crest data from multiple sources, including the USACE National Levee Database, NYSDEC survey, and City survey were compared to the 44CFR§65.10 required freeboard profile for the levee system. The profile comparison is included in Appendix C. The I-587 embankment was assessed under two conditions: as a Sound Reach (recognized as a levee) and Natural Valley.

5.5 Review of Initial Data Analyses

It should be noted that the findings of the Initial Data Analysis are non-regulatory and are intended to inform the path forward for identification of flood risk associated with the levee system. The findings may be used for emergency planning purposes; however, they are subject to change and due process, and should not be used outside of this levee stakeholder group for any regulatory activities. The flood risk due to interior drainage in the leveed area associated with the Freeboard Deficient and Sound Reach Procedures is also <u>not</u> depicted. Evaluation of interior drainage in the leveed area is part of the 44CFR§65.10 requirements that must be submitted to FEMA prior to updating the FIRM to depict Freeboard Deficient and Sound Reach Procedure.

The effective FIRM currently shows the flood risk of the leveed area as Zone A SFHA. The Natural Valley procedure yielded similar results to the effective HEC-2 hydraulic analysis which also depicts the levee system as not reducing flood risk. Figure 3 illustrates the approximate inundation area for the 1-percent-annual-chance flood for the Natural Valley Procedure using HEC-RAS 5.0.3 (1-Dimensional, steady-state flow). Figure 4 shows the approximate depth grid for the Natural Valley Procedure.

Figure 3: Natural Valley Procedure

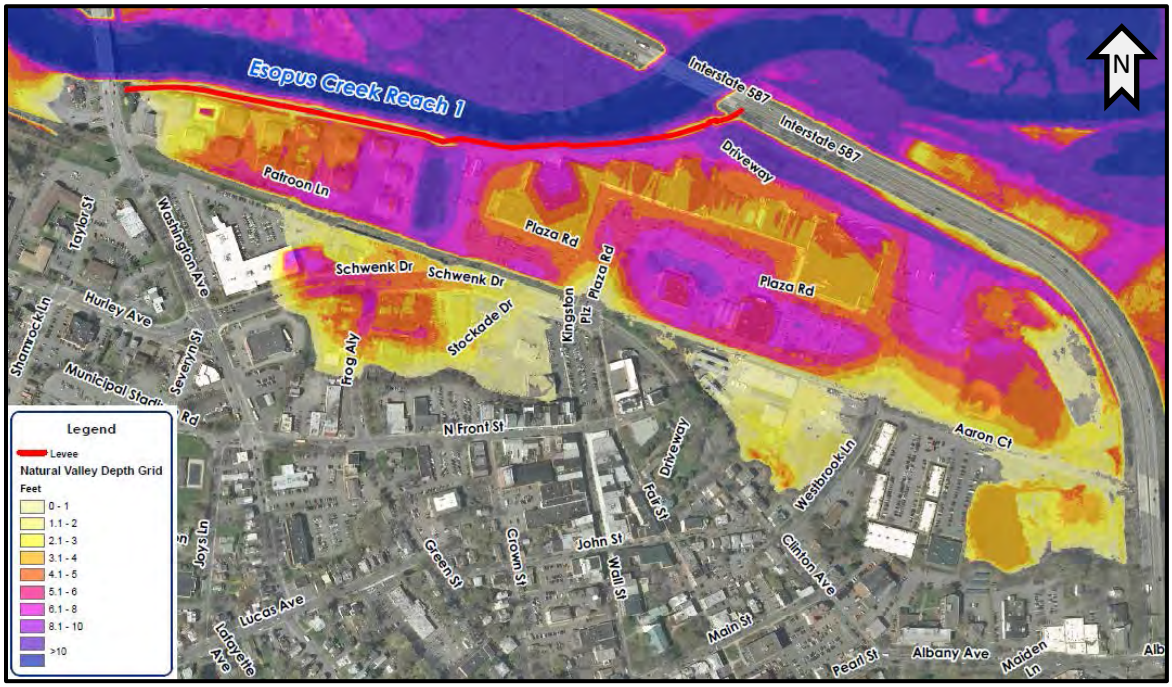

Figure 4: Natural Valley Procedure Flood Depth Grid

The Structural-Based Inundation Procedure yields a slightly larger inundation area compared to the Natural Valley analysis. This analysis is more conservative than the Natural Valley analysis and could be used by the community for emergency planning purposes. Figure 5 shows the composite

inundation area resulting from these analyses completed using HEC-RAS 5.0.3 (2-Dimensional, unsteady flow). Figure 6 shows the approximate depth grid for the Structural-Based Inundation Procedure.

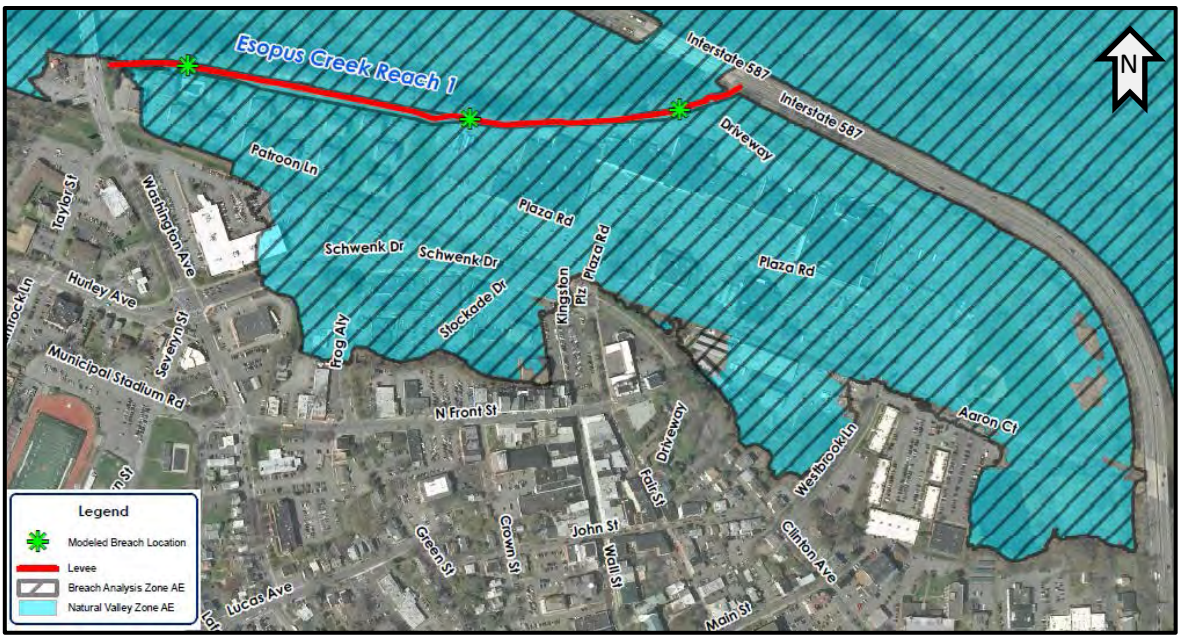

Figure 5: Structural-Based Inundation Procedure

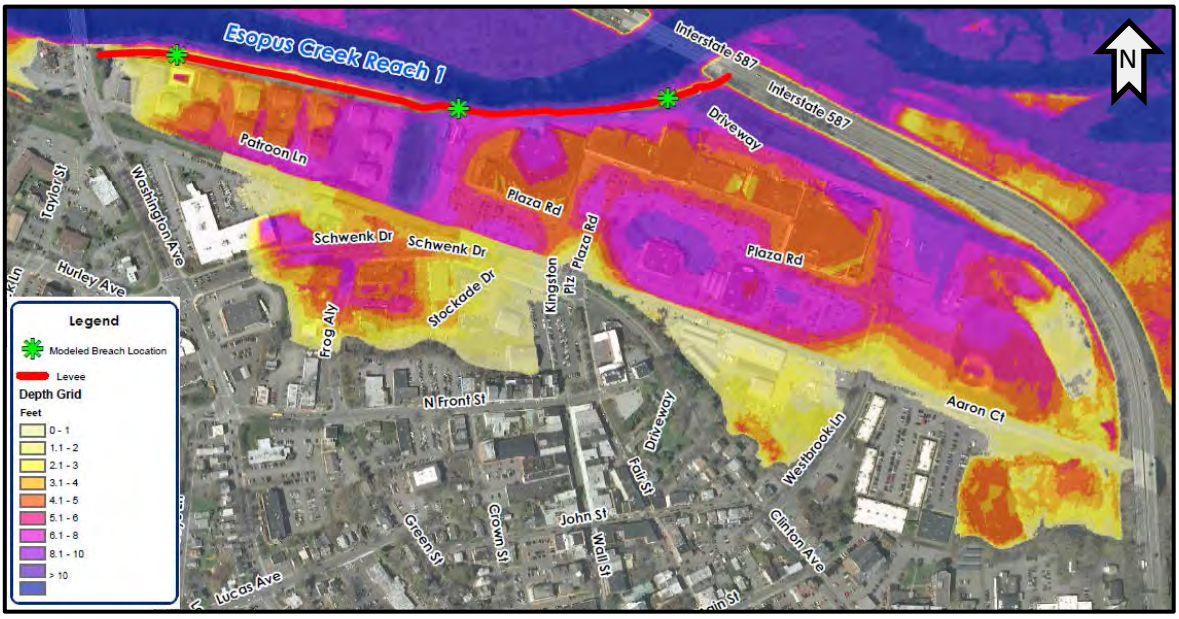

Figure 6: Structural-Based Inundation Procedure Flood Depth Grid

To revise the FIRM to reflect the Freeboard Deficient Procedure for the Kingston Levee reach, 44CFR§65.10 compliant data would need to be received and accepted by FEMA showing the minimum levee crest elevations at or above the BFE for Esopus Creek Reach 1.

As noted above, the I-587 embankment was evaluated under two reach analysis procedures: as a Sound Reach (recognized as a levee) and Natural Valley (without levee) conditions.

Figure 7 shows the resulting flood risk should I-587 be recognized and certified as a levee and the Kingston Levee certified as Freeboard Deficient. The flood risk of the leveed area was conservatively estimated to be equal to that of the Natural Valley Procedure; however, a more detailed analysis could be part of future studies. The resulting flood risk of the leveed area could be depicted as Zone D.

Zone D is defined by FEMA as unidentified, but possible flood risk and could require flood insurance at rates estimated to be similar to Zone A. Zone D, however, is not considered SFHA and does not have mandatory flood insurance purchase for federally back mortgages and has minimal floodplain management requirements.

Figure 8 shows the resulting flood risk should I-587 be evaluated as Natural Valley and the Kingston Levee certified as Freeboard Deficient. The resulting flood risk associated with the Natural Valley inundation of I-587 could be shown as Zone AE SFHA and the residual inundation area could be shown as Zone D. No additional data requirements are associated with the Natural Valley evaluation of I-587; however, the Kingston Levee reach would still need to be certified as Freeboard Deficient.

Summary results from the Initial Data Analysis are included in Table 4.

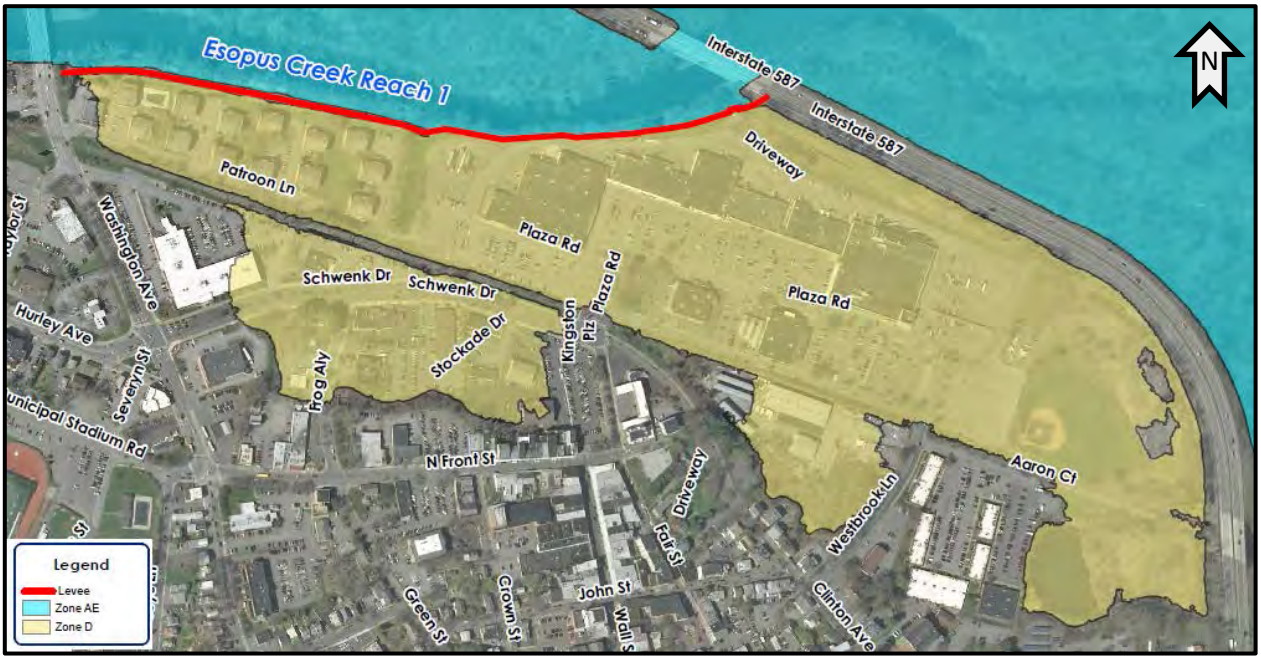

Figure 7: Freeboard Deficient and Sound Reach Procedures

Figure 8: Freeboard Deficient and Natural Valley Procedures

Table 4. Results from the Initial Data Analysis

Approximate Length of Levee Segment (ft)	Approximate # Structures Impacted	Comments: Natural Valley Procedure	Comments: Structural-Based Inundation Procedure	Comments: Freeboard Deficient Procedures	Comments: General
2,550	14 Apartment Structures, 1 Utility Substation, 18 Commercial Structures (including 1 shopping center)	• Similar results to effective analysis that depicts levee system and not reducing flood risk.	• More conservative results than Natural Valley Procedure. May be utilized for emergency planning.	• There is insufficient freeboard for the majority of the Kingston Levee. • I-587 is a non-levee feature and would mapped using the Natural Valley procedure. For I-587 to be recognized as a levee, it would need to be owned, operated, and maintained as a levee and meet the minimum requirements of 44CFR§65.10.	• It may be difficult for I-587 to be recognized as a levee.

6 Path Forward

6.1 Levee Analysis and Mapping Procedures

The Kingston Levee included in this study is shown as non-accredited on the effective FIRM, which depicts the Natural Valley condition based on the effective HEC-2 hydraulic model. At the request of the City, FEMA engaged the community through the Levee Analysis and Mapping Procedures process to help identify potential options to evaluate the flood risk for the leveed area. The community is considering moving forward with the Freeboard Deficient Procedure that could map the flood risk of the leveed area as Zone D; however, they are currently weighing the costs and benefits prior to moving forward.

Should the community be able to provide 44 CFR§65.10 compliant data for I-587 and for all but freeboard criteria (Freeboard Deficient Procedure) and the levee crest is certified to be at or above the 1-percent-annual-chance flood elevation, the flood risk of the leveed area could be shown as a combination of Zone AE and Zone D as shown in Figure 8. If the community also provides 44 CFR§65.10 compliant data for I-587, including that I-587 is operated, and maintained as a levee, the flood risk of the leveed area could be shown as Zone D as shown in Figure 7. If the community does not provide 44 CFR§65.10 compliant data, the effective FIRM dated November 17, 2017 will remain unchanged.

Due to the recent flood risk mapping for the levee system becoming effective November 18, 2016, FEMA does not anticipate updating the flood risk maps in the near future; however, the 44 CFR§65.10 compliant levee data in support of the Freeboard Deficient Procedure may be submitted at any time through the LOMR process to update the FIRM. It is recommended that the community coordinate with FEMA Region II in advance of any submittal to keep the Region apprised of the levee status. FEMA's Levee Accreditation Checklist has been included in Appendix F for reference.

7 References

FEMA: Non-Accredited Levee Analysis and Mapping Guidance, September 2013

USACE, National Levee Database (GeoDatabase Version 3.0 dated 07-28-2015), 2015.

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