Weston & Sampson

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MEMORANDUM

TO: Kristen Wilson, City of Kingston

FROM: Norman Ward, Project Manager/ Senior Landscape Architect

DATE: February 19, 2019

SUBJECT: RONDOUT RIVERPORT SHORELINE STABILIZATION AND PUBLIC ACCESS
Re: Sea Level Rise and Design Elevation Standards

Weston & Sampson, PE, LS, LA, PC (Weston & Sampson) is providing design and engineering consulting services to the City of Kingston (City) for the Rondout Riverport Shoreline Stabilization and Public Access project (project). As part of this project, the team is working towards creating an enduring design to revitalize the waterfront space along Rondout Creek and the Hudson River that responds to climatic conditions.

We understand that an elevation has been selected for the Rondout Riverport Phase I project due to various considerations, this memo is intended to summarize our understanding of the selected design criteria for the project, as well as identify the concerns, potential issues and recommendations to be considered.

The design criteria selected by the City for this project includes an increase in elevation up to El. 6.5 feet (North American Vertical Datum of 1988 (NAVD88)) and a 35-year design life. These criteria are also being used at an adjacent site for a project by the McLaren Engineering Group. However, this elevation is below the elevation of the current 1% Annual Chance Flood at the project site, which is approximately El. 8 feet NAVD88 as documented by FEMA on the effective Flood Insurance Rate Map (FIRM).

Additionally, sea level rise (SLR) is projected to impact the annual chance flood elevation within the design life of the project. A comparison of climate research for the City and NYS shows that the area may experience up to 36 inches of SLR by 2060, which is roughly the requested 35-year design life of the project. Therefore, a design elevation of 6.5 feet NAVD88 is inadequate to address current flood levels and/or prepare for future flood levels within the intended design life of the project. We have provided additional information and recommendations in the following sections.

FEMA 100-YEAR FLOODPLAIN

The Rondout Riverport Shoreline Stabilization and Public Access project site falls within FEMA Zone AE. This zone is included within the Special Flood Hazard Area (SFHA), which shows the extent of the 100-year flood, otherwise known as the 1% Annual Chance Flood. Zone AE also includes Base Flood Elevations (BFEs) showing the anticipated height of the 1% Annual Chance Flood. The FEMA-defined BFE indicated for the project site is 8 feet NAVD88. Please refer to **Figure 1** for a copy of the FEMA FIRM and BFEs near the project site.

Additionally, the 2015 "Tidal Rondout Creek Watershed Management Plan" prepared by Milone & MacBroom identifies the current (2014) 100-year flood elevation as 8.2 feet NAVD88. New York State (NYS) floodplain construction requirements for new structures in Zone AE require building to the BFE plus an additional 2 feet of freeboard, resulting in an elevation of roughly El. 10 feet NAVD88 for the site. We have reached out to the NYS Department of Environmental Conservation (NYSDEC) to request additional information related to design standards to satisfy requirements for the community's continued participation in the National Flood Insurance Program. Please refer to the NYSDEC webpage on Floodplain Construction Requirements for more information.

SEA LEVEL RISE PROJECTIONS

The team reviewed available climate research and sea level rise (SLR) projections for the City of Kingston and New York State (NYS). Please refer to **Figure 2** for a comparison of climate research related to the project site. Since the intended design life of the project is 35-years, we identified projections for the 2050- and 2060-time horizons. These projections are summarized in the table below, shown as ranges.

Time Horizon	SLR Projections (inches)
2050 [A]	5 to 27
2060 [B]	20 to 36

A: Climate Projections for the Hudson Valley, 2019 and Working Towards Climate Resilience, 2018
B: Planning for Rising Waters, 2013

Please refer to **Figure 3** for a map of "Central Range" flooding and **Figure 4** for a map of "Rapid Ice Melt" flooding in Kingston. These maps show the 1% Annual Chance Flood Event with SLR, and include a ribbon showing the approximate location of El. 6.5 feet NAVD88, based on the 2-foot contour data provided by Ulster County.

The 2016 City of Kingston Comprehensive Plan also recommended designing with SLR in mind. Strategy 10.1.4 suggested the following requirement:

> "…that any proposed new public structures or infrastructure or major renovations be construction to withstand flood elevations of 14 feet above 2014 mean sea level. Current (2014) 100-year flood elevation is 8.2 feet. High range projections for sea level rise for 2100 are for 5 to 6 feet. Long-term planning for public infrastructure and facilities should be designed and located in a manner that will not subject them to future flood risk, based on high-range projections" (City of Kingston 2016, page 88).

Although the project has a shorter proposed design life than the end of the century, this strategy from the Comprehensive Plan reinforces the goal that climate resilient projects in this area should design with both current and future flooding in mind. A related 2017 memo from the *Climate Smart Kingston Commission* and *Kingston Conservation Advisory Council* suggests planning for 36 inches of sea level rise by 2060, and references the Kingston Zoning Code and the Flood Hazard Overlay District. This design standard is in line with the climate research reviewed for this project and falls within the proposed 35-year design life of the project.

RECOMMENDATIONS

Flooding due to rising sea levels will impact properties, transportation networks, sewer outfalls, and other infrastructure and utilities. Rising sea levels will also impact areas of the Rondout Riverport that provide habitat, as locations that were once tidal may become permanently submerged.

Incorporating climate resilience into design can help mitigate these impacts. ***At a minimum, it is recommended that the project should be desigedn to El. 10 NAVD88 (the current BFE plus 2 feet of freeboard). We recommend incorporating 36 inches of SLR into the design to achieve a design life of 35 years based on currently available data.***

There are opportunities to design the site to protect the community from SLR impacts.

- Grades increase sharply north of the shoreline, and it may be feasible to design to a higher elevation and tie into existing grades.
- Lower lying areas may be designed to accommodate flood waters.
- Incremental adaptation concepts may be feasible, for example planning for future increasing grades and/or migrating living shorelines.

This project is an opportunity for the City of Kingston to take action in preparing for climate change. Designing to an elevation above 6.5 feet NAVD88 can provide a resilient example and standard for future development. Existing lower adjacent infrastructure and properties may be able to tie into this site in the future, and the City may be able to use this project to enact neighborhood protection while creating public value and access to the waterfront.

We acknowledge that designing to a higher grade adds additional cost to the project, but research has found that every $1 spent on mitigation can save $6 in disaster recovery (National Institute of Building Sciences 2017). We welcome the opportunity to continue the conversation regarding our recommendations to address current flood risk and future climate impacts.

Attachments:

Figure 1: FEMA FIRM

Figure 2: Comparison of Climate Projections

Figure 3: “Central Range” Flooding in Kingston

Figure 4: “Rapid Ice Melt” Flooding in Kingston

FIGURE 1

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 18. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC–3, #9202
1315 East–West Highway
Silver Spring, MD 20910–3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713–3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from digital orthophotography provided by the NY Office of Cyber Security & Critical Infrastructure Coordination from photography dated April 2004.

This map reflects more detailed and up–to–date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de–annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

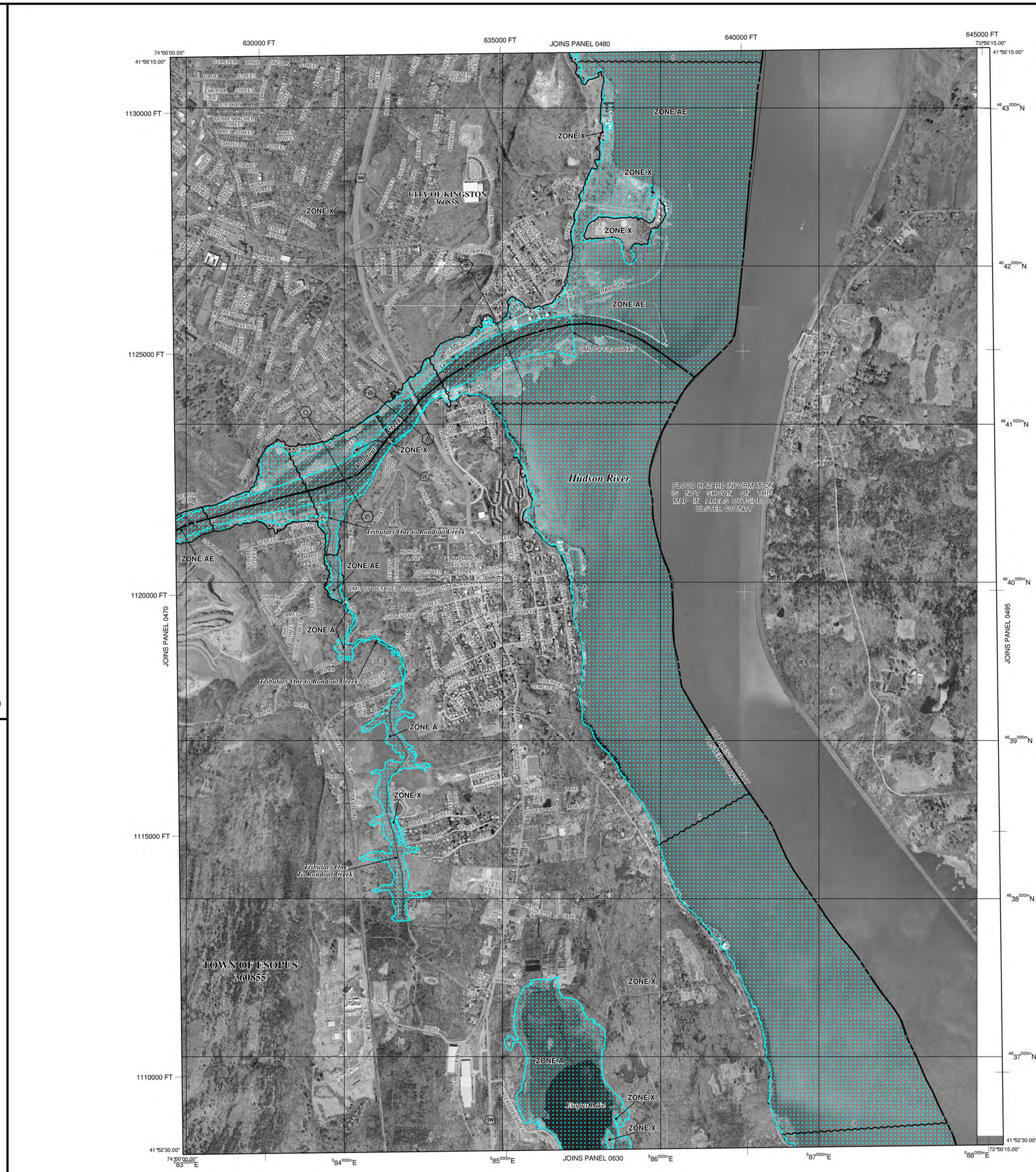
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1–800–358–9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report,* and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1–800–358–9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1–877–FEMA MAP** (1–877–336–2627) or visit the FEMA website at http://www.fema.gov/.

CTP Cooperating Technical Partners

This digital FIRM was produced through a unique cooperative partnership between the New York State Department of Environmental Conservation (NYSDEC) and FEMA. As part of the effort, NYSDEC has joined in a Cooperative Technical Partnership agreement to produce and maintain FEMA's digital FIRM.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid values, zone 18
6000000 FT	5000-foot grid ticks: New York State Plane coordinate system, east zone (FIPSZONE 3101), Transverse Mercator
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1–800–638–6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0490E

FIRM
FLOOD INSURANCE RATE MAP

ULSTER COUNTY,
NEW YORK
(ALL JURISDICTIONS)

PANEL 490 OF 910
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ESOPUS, TOWN OF	360855	0490	E
KINGSTON, CITY OF	360858	0490	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
36111C0490E

EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

FIGURE 2

Projections and Scenarios used in New York Climate Change Research & Planning					
Source	**Author**	**Date**	**Time Horizons**		**SLR Projections**
Climate Projections for the Hudson Valley	Cornell College of Agriculture and Life Sciences (CALS), New York State Water Resources Institute	2019	2020s		1-9"
			2050s		5-27"
			2080s		10-54"
			2100		11-71"
Working Toward Climate Resilience: General Climate Information Prepared for Hudson Valley Communities	New York State Hudson River Estuary Program	2018	2020s		1, 3, 5, 7, 9"
			2050s		5, 9, 14, 19, 27"
			2080s		10, 14, 25, 36, 54"
			2100		11, 18, 32, 46, 71"
Climate Change in New York State	New York State Energy Research and Development Authority (NYSERDA)	2014	2020s		3-8"
			2050s		9-21"
			2080s		14-39"
Planning for Rising Waters: Final Report of the City of Kingston Tidal Waterfront Flooding Task Force	City of Kingston	2013	SLR (Central Range)	2060s	20"
				2100	33"
			SLR with rapid ice-melt scenario	2060s	36"
				2100	68"
City of Kingston Climate Action Plan	Rich Schiafo, Climate Analyst, City of Kingston	2012	SLR (Central Range)	2020s	1-4"
				2050s	5-9"
				2080s	8-18"
			SLR with rapid ice-melt scenario	2020s	4-9"
				2050s	17-26"
				2080s	37-50"
Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State	New York State Energy Research and Development Authority (NYSERDA)	2011	Global Climate Model-based	2020s	1-4"
				2050s	5-9"
				2080s	8-18"
			Rapid ice-melt scenario	2020s	4-9"
				2050s	17-26"
				2080s	37-50"

FIGURE 3

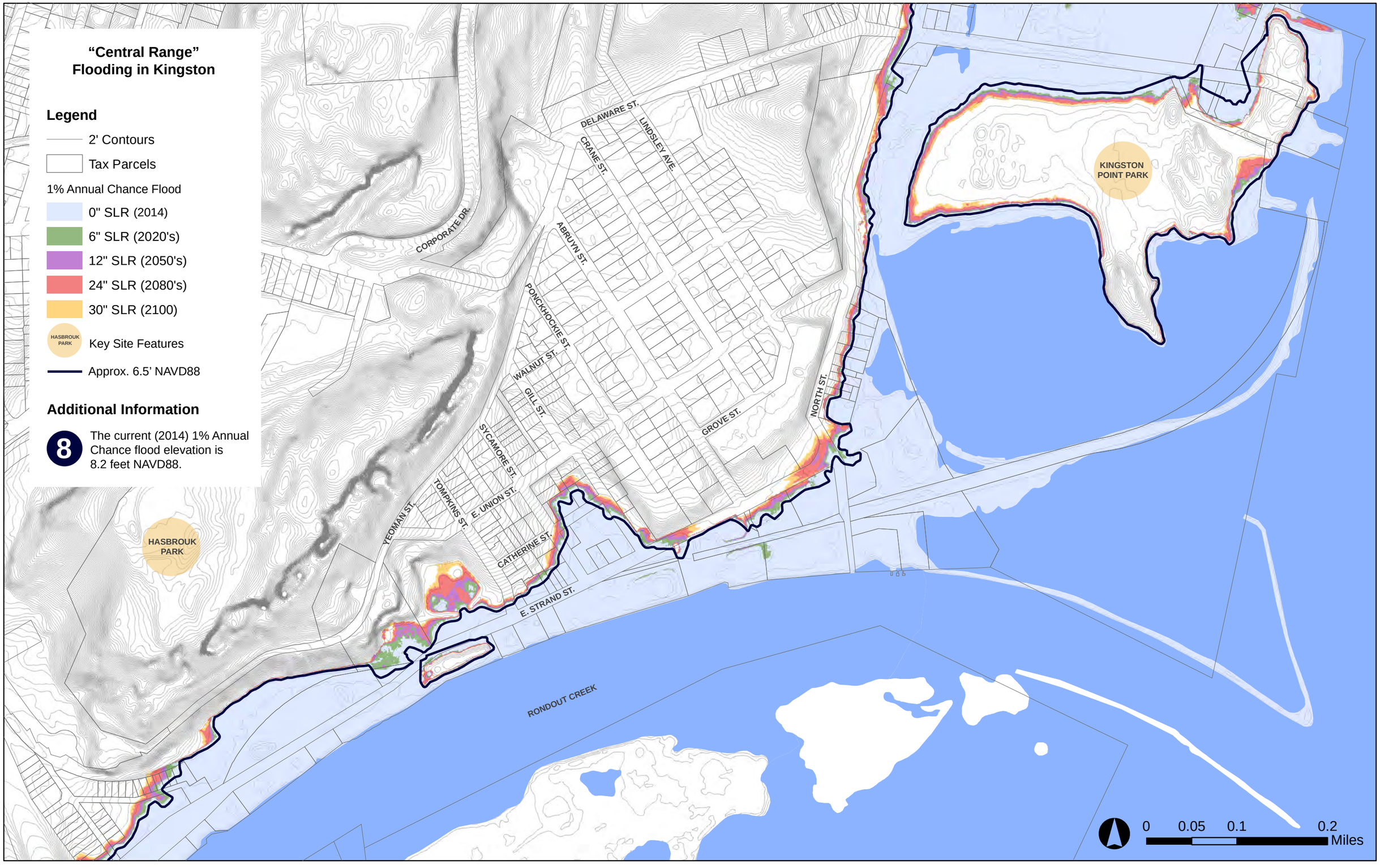
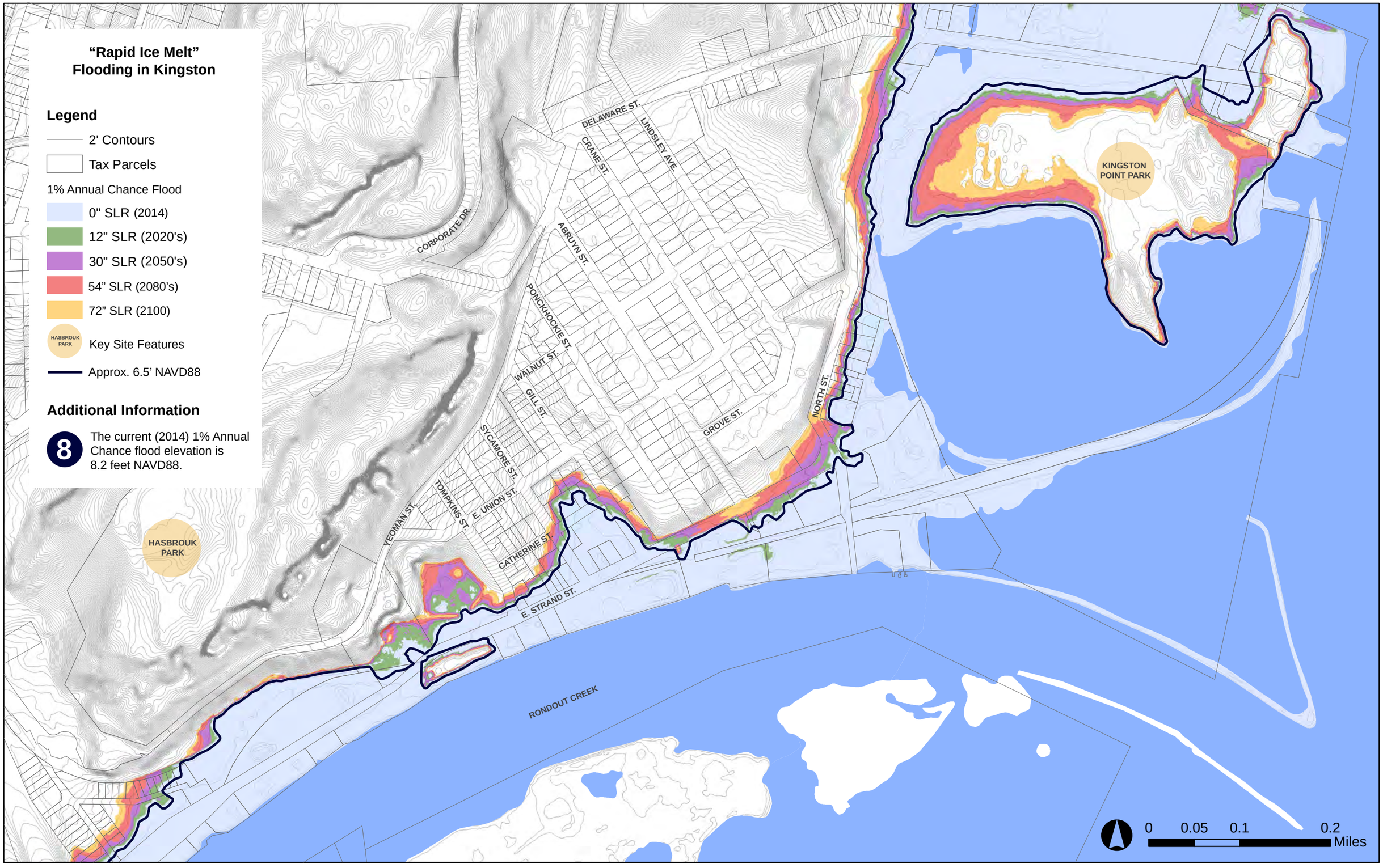

"Central Range"
Flooding in Kingston
Legend
2' Contours
Tax Parcels
1% Annual Chance Flood
0" SLR (2014)
6" SLR (2020's)
12" SLR (2050's)
24" SLR (2080's)
30" SLR (2100)
HASBROUK PARK
Key Site Features
Approx. 6.5' NAVD88
Additional Information
8
The current (2014) 1% Annual Chance flood elevation is 8.2 feet NAVD88.
DELAWARE ST.
LINDSLEY AVE.
CRANE ST.
CORPORATE DR.
ABRUYN ST.
PONCKHOCKIE ST.
WALNUT ST.
GILL ST.
SYCAMORE ST.
GROVE ST.
NORTH ST.
TOMPKINS ST.
E. UNION ST.
YEOMAN ST.
CATHERINE ST.
E. STRAND ST.
KINGSTON POINT PARK
HASBROUK PARK
RONDOUT CREEK
0
0.05
0.1
0.2
Miles

FIGURE 4


"Rapid Ice Melt"
Flooding in Kingston
Legend
2' Contours
Tax Parcels
1% Annual Chance Flood
0" SLR (2014)
12" SLR (2020's)
30" SLR (2050's)
54" SLR (2080's)
72" SLR (2100)
HASBROUK PARK
Key Site Features
Approx. 6.5' NAVD88
Additional Information
8
The current (2014) 1% Annual Chance flood elevation is 8.2 feet NAVD88.
DELAWARE ST.
LINDSLEY AVE.
CRANE ST.
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ABRUYN ST.
PONCKHOCKIE ST.
WALNUT ST.
GILL ST.
SYCAMORE ST.
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KINGSTON POINT PARK
TOMPKINS ST.
E. UNION ST.
YEOMAN ST.
CATHERINE ST.
E. STRAND ST.
HASBROUK PARK
RONDOUT CREEK
0
0.05
0.1
0.2
Miles