Salmon River Flood & Ice Jam Mitigation & Resilience Report

Franklin County

New York State Department of Environmental Conservation, in cooperation with the New York State Office of General Services

Prepared by:

SLR Engineering, Landscape Architecture, and Land Surveying, P.C.

231 Main Street, Suite 102, New Paltz, New York, 12561

SLR Project No.: 142.16511.00021

Client Reference No: SD755

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Making Sustainability Happen

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SD 755

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Acronyms

AOP	Aquatic Organism Passage
APA	Adirondack Park Agency
BFE	Base Flood Elevation
BIN	Bridge Identification Number
BLE	Base-line Engineering
CBP	US Customs and Border Protection
CFS	Cubic Feet per Second
CRRA	Community Risk and Resiliency Act
CRREL	Cold Regions Research and Engineering Laboratory
DEC	Department of Environmental Conservation
DPW	Department of Public Works
EFC	Environmental Facilities Corporation
EPA	Environmental Protection Agency
EWP	Emergency Watershed Protection
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPMS	Floodplain Management Services (program)
FPS	Feet per second
GIGP	Green Innovation Grant Program
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center – *River Analysis System*
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HRA	High Risk Area
LiDAR	Light Detection and Ranging
LWRP	Local Waterfront Revitalization Program
MWRR	Municipal Waste Reduction and Recycling
NBI	National Bridge Inventory
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSOGS	New York State Office of General Services
PDM	Pre-Disaster Mitigation Program
RCP	Representative Concentration Pathway

RFC	Repetitive Flood Claims
SFHA	Special Flood Hazard Area
SLR	SLR Engineering, Landscape Architecture, and Land Surveying, P.C.
SRL	Severe Repetitive Loss
STA	Station (river)
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant

Summary

This analysis of the Salmon and Little Salmon Rivers was conducted as part of the Resilient New York Program, an initiative of the New York State Department of Environmental Conservation. The Salmon River watershed is located in Franklin County in northeastern New York State and falls within the Adirondack Mountains and St. Lawrence Lowlands physiographic regions. The Salmon River flows in generally a northwestern direction before crossing the Canadian border and discharging into the St. Lawrence River in Quebec, Canada. When measured at its outlet, the watershed is 413 square miles in size. Of this, 406 square miles, or just over 98 percent of the watershed, is located within New York State.

The Salmon River watershed has a history of potash production, logging, agriculture, and iron ore mining. Sawmills, tanneries, and carding mills were located along the Salmon River. Today, there are active hydroelectric dams and defunct industrial-era dams present along the river. The watershed has historically been impacted by hurricanes, tropical storms, thunderstorms and nor'easters, rain-on-snow events, and ice jams.

As part of this analysis, High Risk Areas within the Salmon River watershed are identified, and an analysis of flood mitigation considerations within each area is undertaken.

- High Risk Area 1 is located in the town of Fort Covington, extending up the Salmon River from the Canadian border to the border with the town of Westville, and along the Little Salmon River from its confluence with the Salmon River to the border with the town of Bombay.
- High Risk Area 2 is located in the town of Westville, where some areas are prone to riverine flooding from the Salmon River.
- High Risk Area 3 is located in the town and village of Malone, with riverine flooding associated with the Salmon River and Branch Brook, which joins Salmon River in the southern part of the village.
- High Risk Area 4 is located in the town of Bombay. Flooding in Bombay is associated with the Little Salmon River.

Flood mitigation recommendations are provided, either specific to High Risk Areas or as overarching recommendations that apply to the entire watershed or stream corridor. Flood mitigation scenarios such as floodplain enhancement and channel restoration, dam and building removal, road closures, and replacement of undersized bridges and culverts are investigated and are recommended where appropriate. Several funding sources may be available for the implementation of recommendation flood mitigation scenarios and are discussed in further detail in this report.

1.0 Introduction

1.1 Project Background and Overview

This work is a component of the Resilient New York Program, an initiative of the New York State Department of Environmental Conservation (NYSDEC), contracted through the New York State Office of General Services (NYSOGS). The goal of the Resilient New York Program is to make New York State more resilient to flooding and climate change. Through the program, flood studies are being conducted across the state, resulting in the development of flood and ice jam hazard mitigation alternatives to help guide implementation of mitigation projects.

1.2 Terminology

In this report, all references to right bank and left bank refer to "river right" and "river left," meaning the orientation assumes that the reader is standing in the river, looking downstream.

Stream stationing is used in the narrative and on maps as an address to identify specific points along the subject watercourses. Stationing on each watercourse is measured in feet, beginning at station (STA) 0+00 and continuing upstream. For the Salmon River, stationing begins at the USA-Canada border; for the Little Salmon River, stationing begins at its confluence with the Salmon River in Fort Covington.

The Federal Emergency Management Agency (FEMA) is an agency of the United States Department of Homeland Security. In order to provide a common standard, FEMA's National Flood Insurance Program (NFIP) has adopted a baseline probability called the base flood. The base flood has a 1 percent (one in 100) chance of occurring in any given year, and the base flood elevation (BFE) is the level floodwaters are expected to reach in this event. For the purpose of this report, the 1 percent annual chance of flooding is also referred to as the 100-year flood event. Other recurrence probabilities used in this report include the 2-year flood event (50 percent annual chance flood), the 10-year flood event (10 percent annual chance flood), the 25-year flood event (4 percent annual chance flood), the 50-year flood event (2 percent annual chance flood), and the 500-year flood event (0.2 percent annual chance flood).

The Special Flood Hazard Area (SFHA) is the area inundated by flooding during the 100-year flood event. Within the project area, FEMA has developed Flood Insurance Rate Mapping (FIRM), which indicates the location of the SFHA along the Salmon and Little Salmon Rivers and their tributaries.

2.0 Data Collection

Data were gathered from various sources related to the hydrology and hydraulics of Salmon and Little Salmon Rivers and their tributaries, watershed characteristics, recent and historical flooding in the affected communities, and factors that may contribute to flood hazards.

2.1 Salmon River Watershed Characteristics

The Salmon River watershed is located primarily in Franklin County in northeastern New York State. The watershed falls within the physiographic regions known as the Adirondack Mountains and St. Lawrence Lowlands (Figure 2-1). The Salmon River flows in generally a northwestern direction before crossing the Canadian border and exiting into the St. Lawrence River in Quebec, Canada. The Salmon River watershed drains the northern half of Franklin County and is oblong in shape, narrowing towards its outlet into the St. Lawrence River in Quebec. When measured at its outlet, the watershed is 413 square miles in size. An area of 406 square miles, or just over 98 percent of the watershed, is located within New York State (Figure 2-2).

The upper, southeastern portion of the Salmon River watershed falls within the Adirondack Mountains, a steep and mountainous area with peaks exceeding 3,000 feet in elevation. The lower or northwestern portion of the watershed is comparatively low and flat (Figure 2-3).

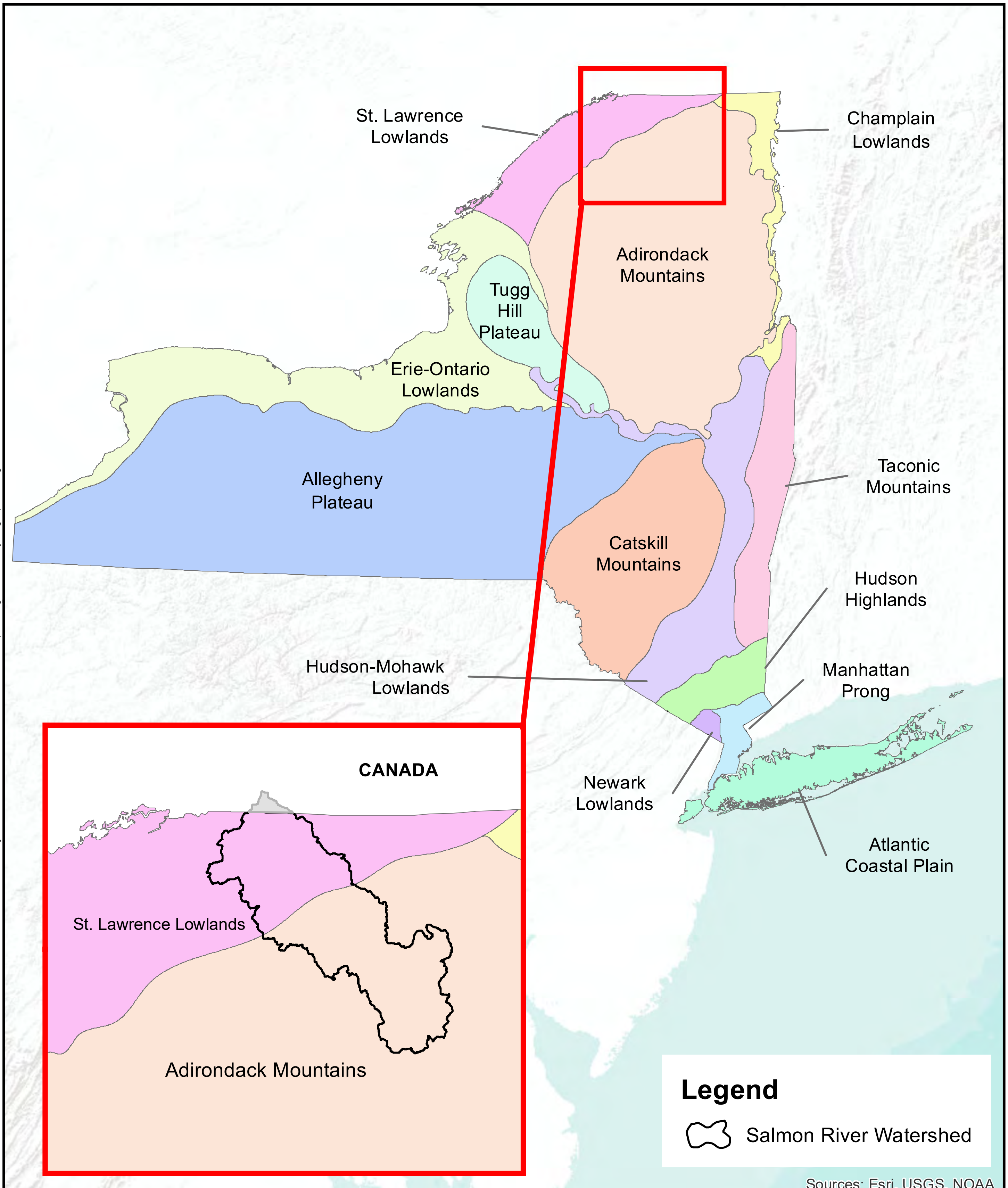
The Salmon River was called "Negentsiagoa" by the original Mohawk Indian inhabitants. This word translates to "the place where we catch large fish." Runs of Atlantic salmon no longer occur on the Salmon River.

The watershed has a history of potash production, logging, agriculture, and iron ore mining. Sawmills, tanneries, and carding mills were located along the Salmon River. Today, there are several hydroelectric dams present along the river, two of which are in operation.

The Adirondack Mountains is a circular massif, or a compact group of mountains, located in northeastern New York. Salmon River originates in the northern portion of the Adirondack Mountains within the Elbow Range, which sits at an elevation just above 2,500 feet. It flows between several other mountains of similar elevation before flowing onto the St. Lawrence Lowlands. On contrast to the Adirondack Mountains, the Lowlands consist of a broad terrain with level valley and plains scattered with low ridges. The Adirondack Mountains are composed of metamorphic rocks while the St. Lawrence Lowlands are composed of sedimentary rocks. More than 10 million years ago, sedimentary rock covered both regions until the Adirondack region uplifted. The easily erodible sedimentary rocks were worn away, and the more erosion-resistant metamorphic rocks were left.

The northwestern portion of the watershed, contained within the St. Lawrence Lowlands, is underlain by three different sedimentary formations: the Potsdam Sandstone, Theresa Formation, and the Ogdensburg Dolostone. The Potsdam Sandstone originates from the Late Cambrian Period to the Early Ordovician Period and consists of tiny quartz grains cemented together by quartz cement. It can range from gray to tan, rusty yellow, and pink to red. The Theresa Formation, which also originates from the Late Cambrian Period to the Early Ordovician Period, consists of both dolostone and sandstone. The dolostone is calcareous and sandy, with interbedded weak sandstones. Dolostone is a fine-grained sedimentary rock primarily composed of the mineral dolomite, and its color can range from medium to light gray. The Ogdensburg Dolostone is comprised of dolostone and originates from the Lower Ordovician Period. The southern half of the watershed, specifically in the Adirondack Mountain region, is underlain primarily by metamorphic rocks. Due to a mountain-building event called the Grenville Orogeny, these rocks have been subjected to high amounts of pressure and high temperatures. They have also been severely folded and sheared. Most of these rocks are a type of gneiss, with the exception of a small spot of metagabbro in the west central section of the watershed. Gneiss is a foliated metamorphic rock that contains granular minerals in an interlocking texture. Metagabbro is generally a medium- to coarse-grained, dark-colored mafic rock. Both gneiss and metagabbro are hard and resistant to erosion.

Surficial geology of the Salmon River watershed is predominantly comprised of glacial legacy sediments. Glacial till is mapped all throughout the watershed. In the northern half of the watershed, a complicated mix of lacustrine clay, glacial till, sand deposits, lacustrine silt, marine sand, and swamp deposits is mapped. Much of the surficial geology mapped within the Adirondack Mountains was deposited by water melting from a glacier ice sheet. The deltas and sandy beach deposits are derived from vanished glacial lakes. In the St. Lawrence Lowlands, both a glacial lake and a shallow sea existed in the area at some point in geologic history. As the glacier ice sheet was retreating, it left behind moraines and glacial lake deposits. On top of those deposits, sands, silts, and clay with marine fossils are found, which were sourced from the shallow sea that existed previously in the area. In addition, alluvium, deposited from rivers and streams, underlies the course of the Little Salmon and Salmon Rivers periodically. The swamp deposits consist of peat, clay, and sand. The southern half of the watershed is less complicated but similar in content to the northern half. Small spots of exposed bedrock, large quantities of glacial till, kame deposits (poorly sorted sand and gravel deposits), outwash gravel and sand, marine and lacustrine sand, and small sections of swamp deposits are mapped.



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NYS PHYSIOGRAPHIC REGIONS

Salmon River Flood & Ice Jam Study
SD755
Franklin County
New York

SCALE 1" = 300,000 '

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FIG. 2-1

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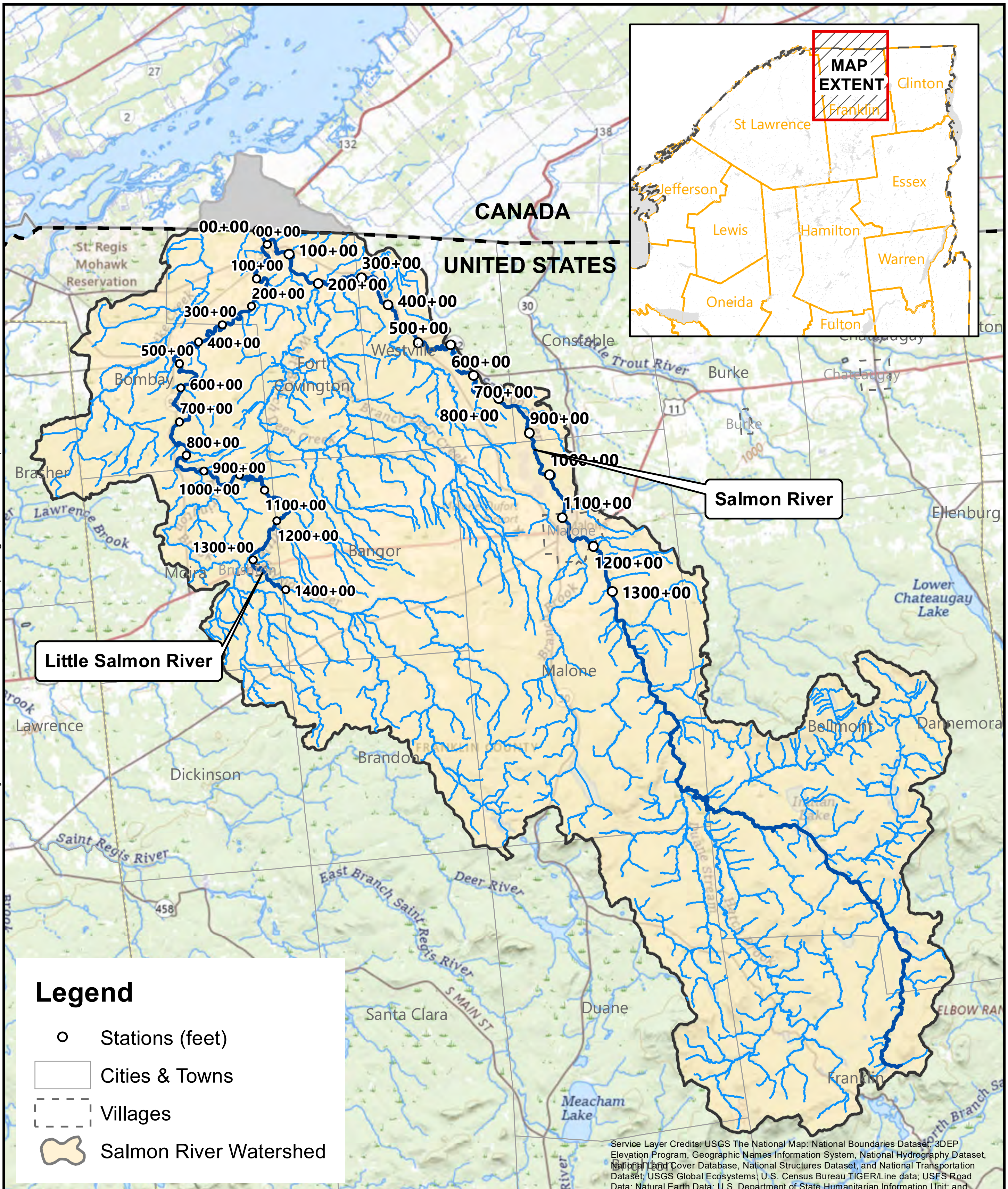

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SALMON RIVER WATERSHED

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FIG. 2-2

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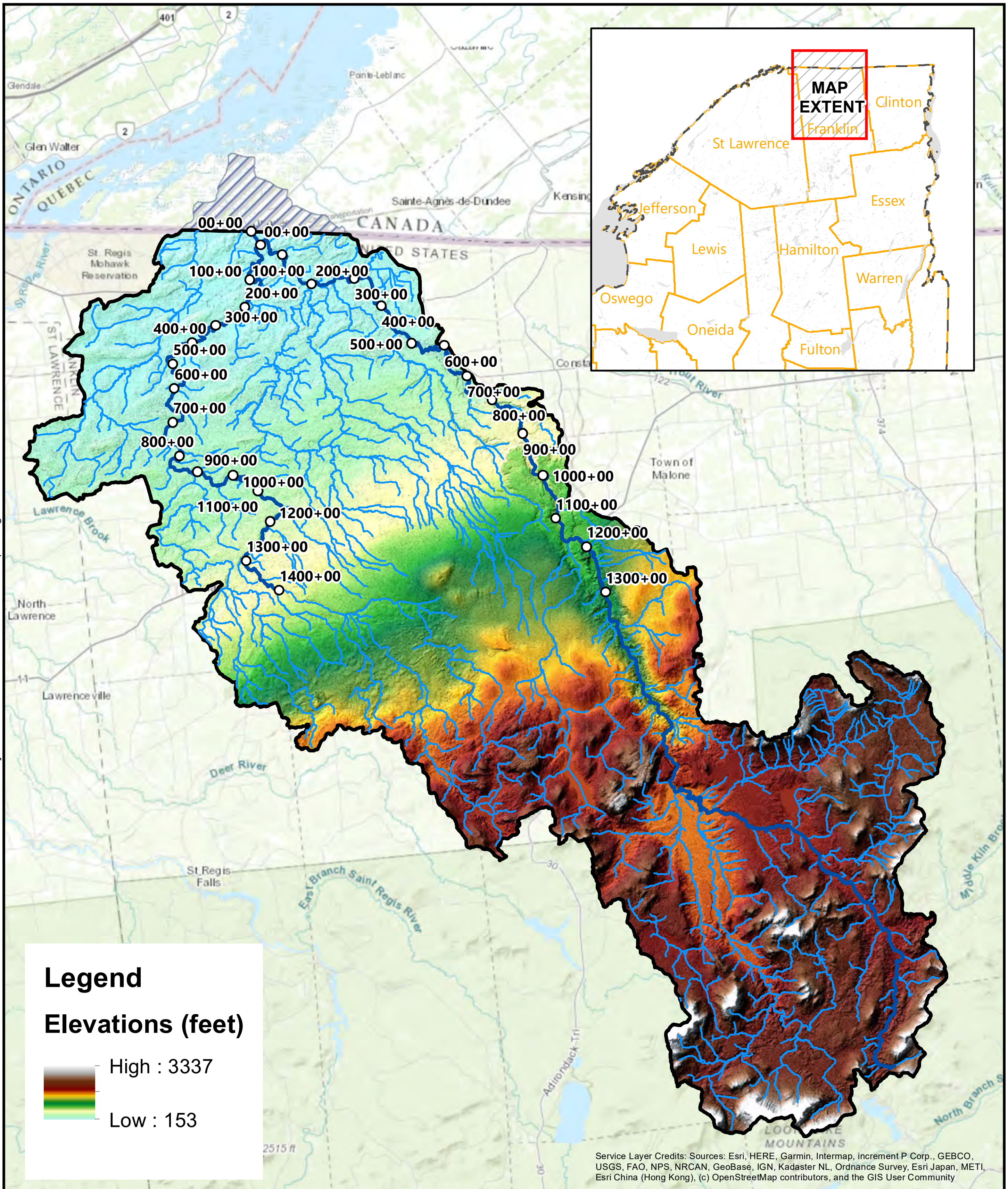

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RELIEF MAP

Salmon River Flood & Ice Jam Study

SD755

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FIG. 2-3

During a rainfall event, the proportion of rainfall that runs off directly into rivers and streams or that infiltrates into the ground is greatly influenced by the composition of soils within a watershed. Soils are assigned a hydrologic soil group identifier, which is a measure of the infiltration capacity of the soil. These are ranked A through D. A hydrologic soil group A soil is often very sandy, with a high infiltration capacity and a low tendency for runoff except in the most intense rainfall events; a D-ranked soil often has a high silt or clay content or is very shallow to bedrock and does not absorb much stormwater, which instead is prone to runoff even in small storms. A classification of B/D indicates that when dry the soil exhibits the properties of a B soil, but when saturated, it has the qualities of a D soil. Around 34 percent of the mapped soils in the Salmon River watershed are classified as hydrologic soil group C, C/D, or D, indicating a low capacity for infiltration and a high tendency for runoff (Figure 2-4). Another 39 percent of the soils are either A/D or B/D, which indicates a tendency for runoff in high-magnitude rainfall events. The remaining 26 percent consists of A and B hydrologic soil types.

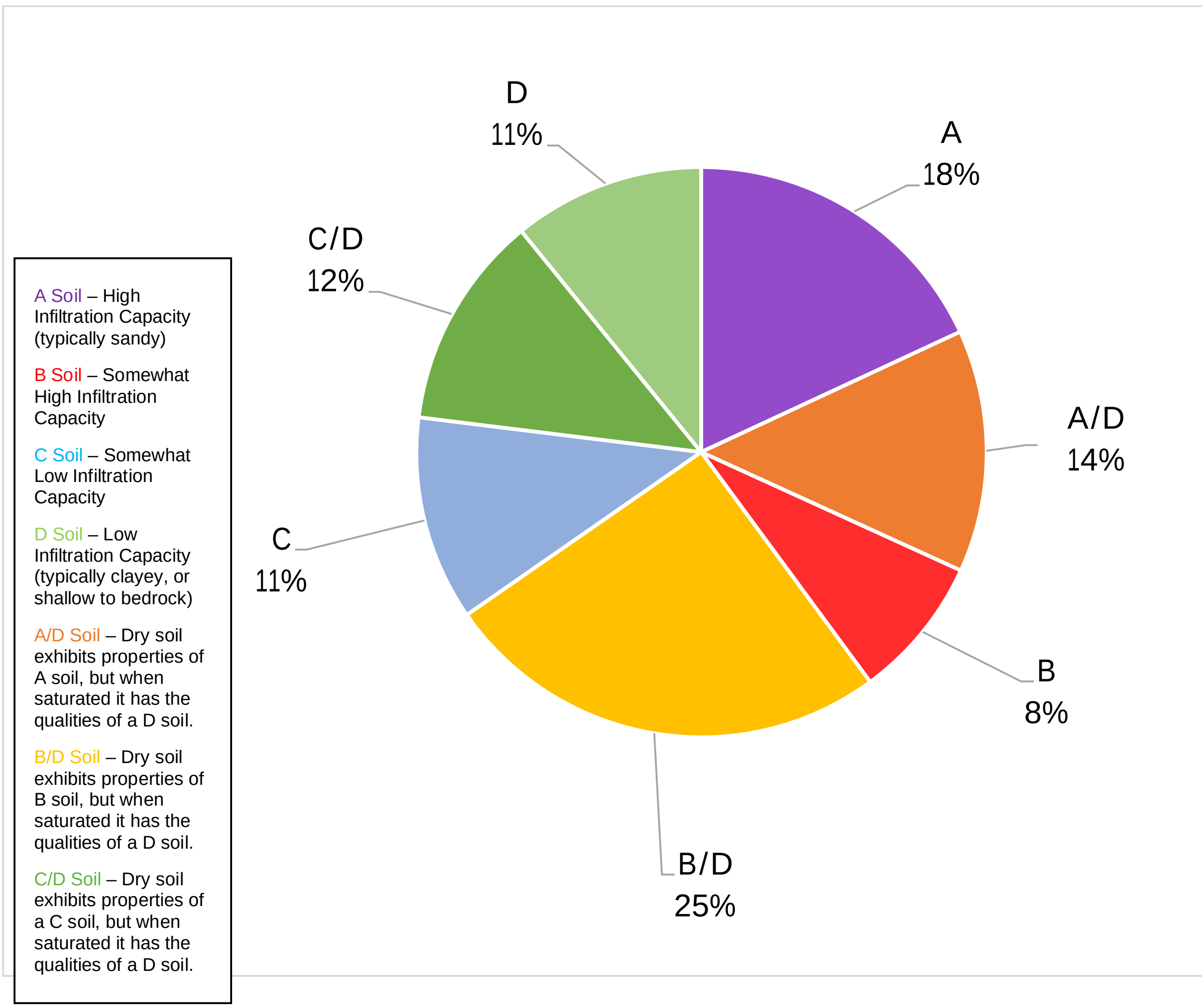

Figure 2-4: Hydrologic Grouping of Soils within the Salmon River Watershed

Land cover is another important factor influencing the runoff characteristics of a watershed. Land cover within the Salmon River watershed can be characterized using the 2016 Multi-Resolution Land Characteristics National Land Cover Database for Southeast New York State and is shown graphically in Figure 2-5.

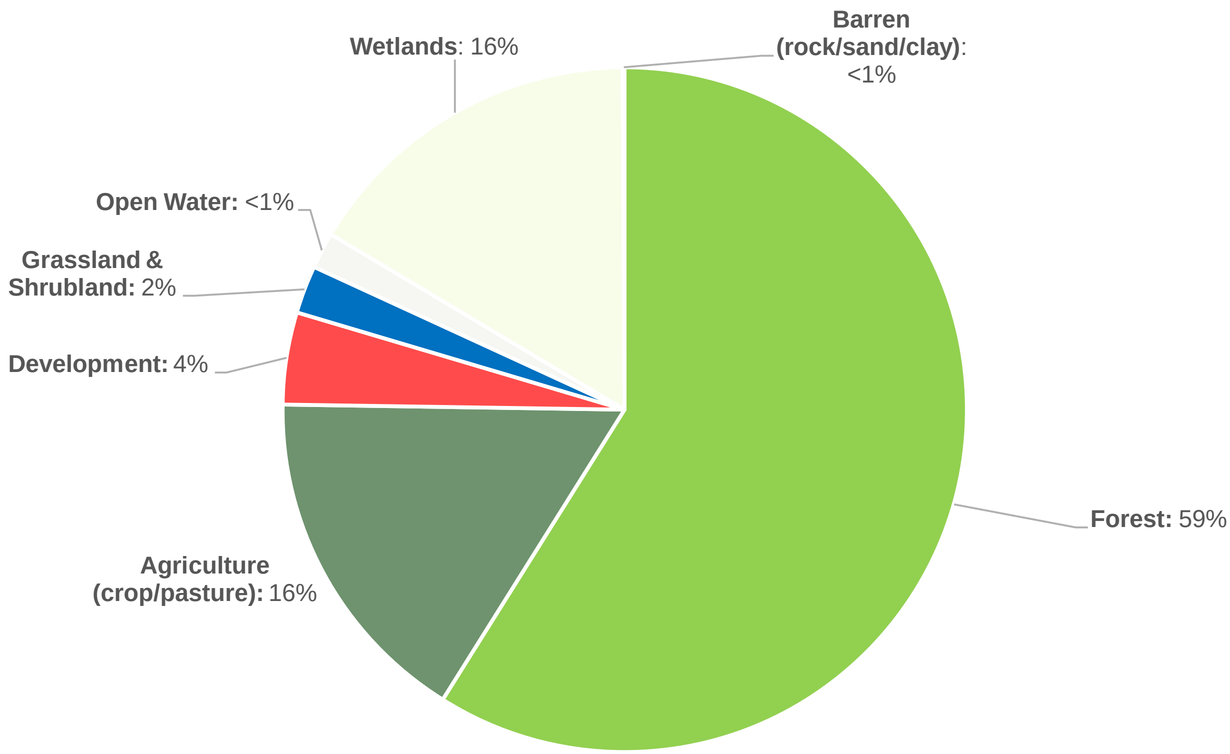

Figure 2-5: Land Cover within the Salmon River Watershed

> It is estimated that since colonial times approximately 50 to 60 percent of the wetlands in the state of New York have been lost through draining, filling, and other types of alteration.

Wetland cover was also examined using information available from the U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI). The NWI indicates that there are over 28,000 acres of wetlands within the Salmon River watershed, or approximately 11 percent of the watershed. This amount is slightly less than the estimate above based on land cover and includes the following types of wetland habitats: freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, lake, and riverine. Some of this acreage can be attributed to large waterbodies in the watershed, which include the Indian Lake, Mountain View, Ragged Lake, Lake Titus, Debar Pond, Weir Pond, Fishhole Pond, and Grass Pond. Wetlands play an important role in flood mitigation by storing water and attenuating peak flows. It is estimated since colonial times approximately 50 to 60 percent of the wetlands in the state of New York have been lost through draining, filling, and other types of alteration.

The southeast portion of the Salmon River watershed is within the Adirondack Park, accounting for approximately 30 percent, or 124 square miles, of the watershed area. The Adirondack Park is the largest publicly protected area in the contiguous United States, with an area of 6 million acres. Half of that is owned by New York State and is considered a “forever wild” forest preserve. Land management planning for municipalities located within Adirondack Park falls under the jurisdiction of the Adirondack Park Agency (APA). Please see About the Adirondack Park (ny.gov) for more information.

2.2 Salmon River Watercourse

Salmon River originates in northern Adirondack Park within the northern part of the town of Franklin. It flows generally northwestward into the town of Belmont, town of Malone and the village of Malone, and town of Westville. Salmon River then heads westward into Fort Covington where it is joined by the Little Salmon River. It then flows north into Canada, crosses through a wetland, and empties into the St. Lawrence River. When measured at the point where Salmon River crosses the Canadian border, it is approximately 57 miles in length. When measured at the point where Salmon River enters the St. Lawrence River, it is 61 miles in length. Named tributaries to Salmon River include the Little Salmon River, East Branch Deer Creek, West Branch Deer Creek, Cold Spring Brook, Branch Brook, Winslow Brook, Hatch Brook, Cold Brook, and Ingraham Stream.

The Little Salmon River's headwaters are near Catamount Peak within Adirondack Park in the southeast corner of the town of Malone. It then flows south briefly before turning north and crossing into the town of Brandon. From here, it flows generally northwestward through Adirondack Park into the town of Bangor, then the northeast corner of the town of Moira, and through the center of the town of Bombay before joining with the Salmon River in the town of Fort Covington. When measured at the point where the Little Salmon River joins with Salmon River, it is approximately 44 miles in length. Named tributaries to Little Salmon River include East Branch Limekiln Brook, Develin Brook, and Farrington Brook.

Stream order provides a measure of the relative size of streams by assigning a numeric order to each stream in a stream network. Water typically flows starting at stream order 1, with increasing stream orders until it reaches the mouth of a larger water body. The smallest tributaries are designated as first-order streams, and the designation increases as tributaries join. The main stem of Salmon River can be characterized as a fifth-order stream for the majority of its length and a sixth-order stream upon entering St. Lawrence River. Figure 2-6 is a map depicting stream order in the Salmon River watershed.

Characteristics of each order of stream (total length, average slope, and percentage of overall stream network) are summarized in Table 2-1. First- and second-order streams account for most of the overall stream length within the Salmon River watershed (73 percent). Stream slopes are typically shallower moving downstream in watershed. First-order streams are steeper in slope than second- and third-order streams.

Table 2-1 Stream Order Characteristics in the Salmon River Watershed

Stream Order	Total Length (Miles)	Percentage of Overall Network Length (%)	Average Slope (%)
1st	499.9	54	3.3
2nd	179.8	19	1.4
3rd	105.3	11	0.8
4th	90.2	10	0.7
5th	50.0	5	0.8
6th	7.9	1	0
Total	**933.1**	**100%**	

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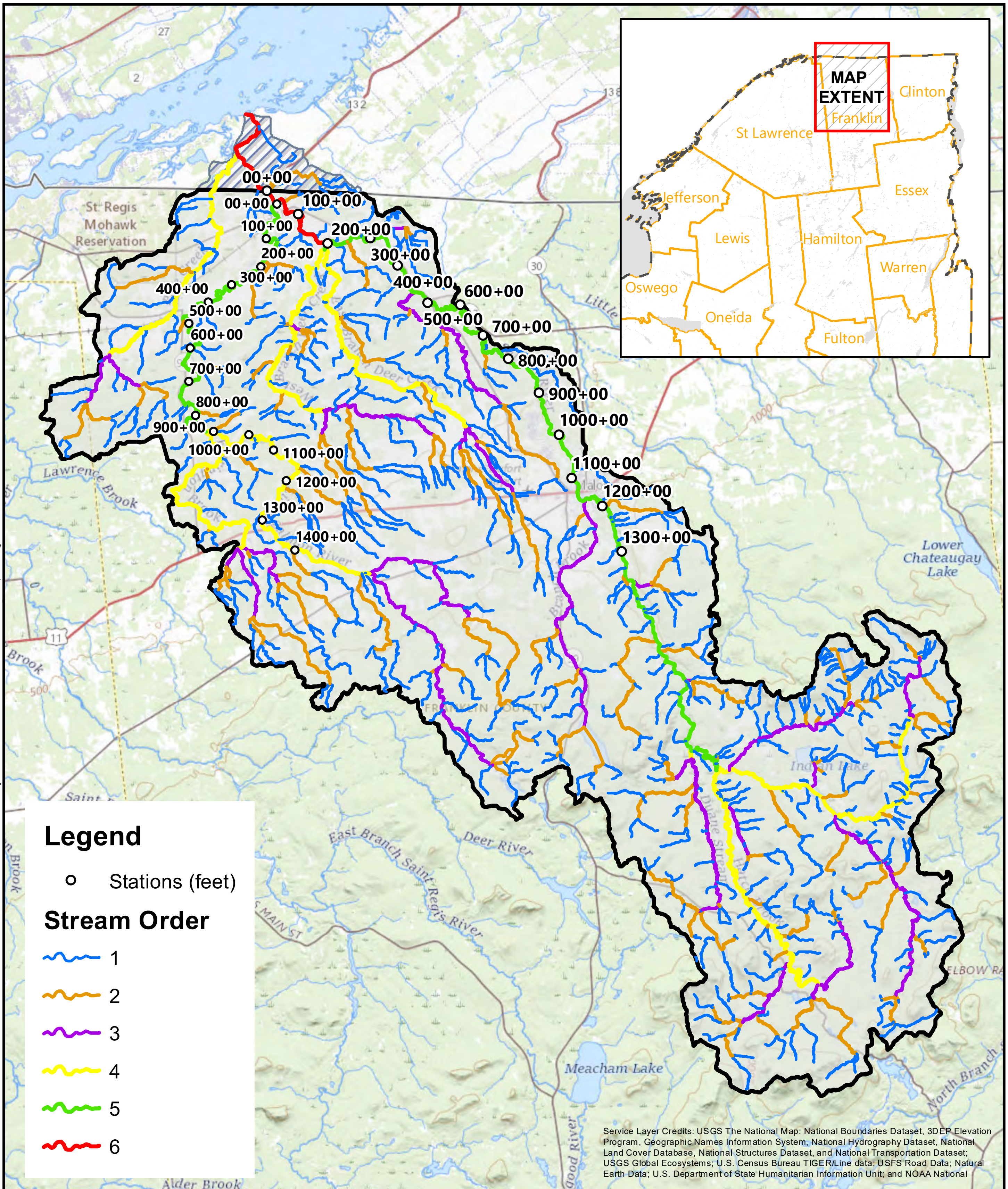

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STREAM ORDER

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FIG. 2-6

2.3 Hydrology

Hydrologic studies are conducted to understand historical, current, and potential future river flow rates, which are a critical input for hydraulic modeling software such as Hydrologic Engineering Center – *River Analysis System* (HEC-RAS). These often include statistical techniques to estimate the probability of a certain flow rate occurring within a certain period of time based on data from the past; these data are collected and maintained by the United States Geological Survey (USGS) at thousands of stream gauging stations around the country. For the streams without gauges, the USGS has developed region-specific regression equations that estimate flows based on watershed characteristics, such as drainage area and annual precipitation, as well as various techniques to account for the presence of nearby stream gauges or to improve analyses of gauges with limited records. These are based on the same watershed characteristics as gauged streams in that region so are certainly informative although not as accurate or reliable as a gauge due to the intricacies of each unique basin.

For the purposes of this study, we are primarily concerned with the more severe flood flows although hydrologic analyses may be conducted for the purposes of estimating low flows, high flows, or anywhere in between. The commonly termed "100-Year Flood" refers to the flow rate that is predicted to have a 1 percent, or 1 in 100, chance of occurring in any year. A "25-Year Flood" has a 1 in 25 chance of occurring (4 percent) every year. It is important to note that referring to a specific discharge as an "X-Year Flood" is a common and convenient way to express a statistical probability but can be misleading because it has no bearing whatsoever on when or how often such a flow actually occurs.

A simplified diagram of the hydrologic cycle is presented in Figure 2-7.

Along with the location, duration, and intensity of a storm, the flooding that may result from a rainfall event can vary widely depending on the unique hydrology of each basin. Characteristics of local topography, soils, vegetation cover and type, bedrock geology, land use and cover, river hydraulics and floodplain storage, ponding, wetland, and reservoir storage, combined with antecedent conditions in the watershed such as snow pack or soil saturation, can impact the timing, duration, and severity of flooding.

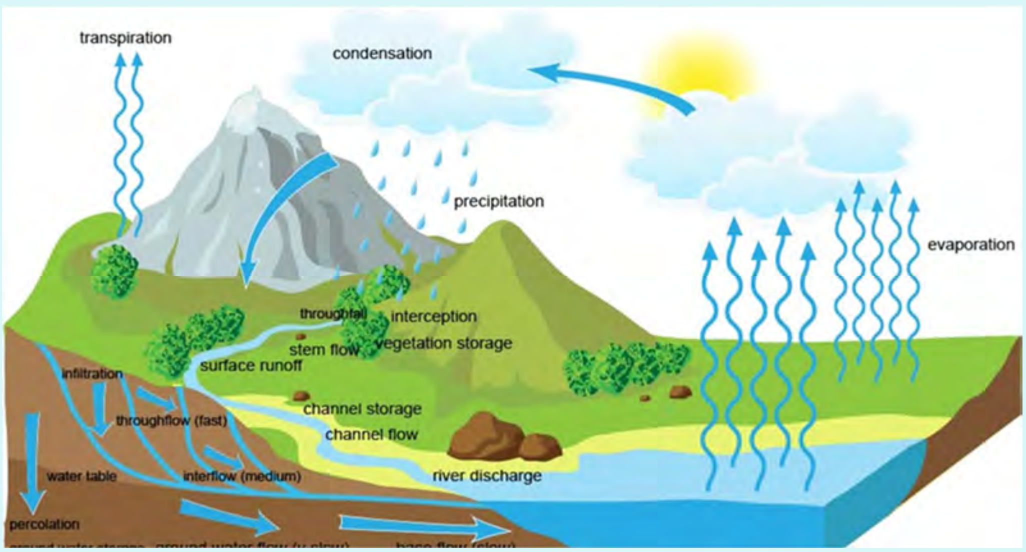


Figure 2-7: Diagram of Simplified Hydrologic Cycle

Flood hydrology for the Salmon River was developed using the USGS stream gauge at Chasm Falls (04270000), which was in operation from 1925 until 2013. A USWRC Bulletin 17B flood frequency analysis of the peak flow record at the gauge site was weighted with the results of regional regression equations (*StreamStats*) using Equation (3) described in USGS SIR 2006-5112. The weighted results at the Chasm Falls gauging station were scaled to ungauged sites along the Salmon River using Equation (5) in SIR 2006-5112. The Salmon River watershed falls within Hydrologic Region 1.

The same process was followed for the Little Salmon River, with a flood frequency analysis of the peak flow record at the USGS gauge in Bombay (04270200), which has been in operation since 1959. These results were weighted and scaled to ungauged locations along the Little Salmon River using Equations (3) and (5) in SIR 2006-5112, respectively.

Peak flood hydrology for Branch Brook in Malone was determined using regional regression equations (*StreamStats*).

Flood hydrology used in hydraulic modeling of the studied watercourses is presented in Table 2-2.

Table 2-2 Flood Hydrology for Salmon River Watershed

Watercourse	Location	River Station	Drainage Area (sq. mi.)	Peak Flood Discharge (cfs)					
				5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
Salmon River	Chasm Falls	1650+00	132	2,290	2,690	3,190	3,560	3,930	4,750
	Malone above Branch Brook	1180+00	161	2,690	3,150	3,740	4,170	4,590	5,540
	Malone below Branch Brook	1155+00	180	2,950	3,460	4,100	4,560	5,020	6,050
	Macomb Dam	1000+00	184	3,000	3,520	4,170	4,640	5,110	6,160
	Westville	400+00	205	3,280	3,850	4,550	5,060	5,570	6,700
	Fort Covington above Little Salmon River	100+00	275	4,180	4,880	5,750	6,390	7,020	8,420
	Fort Covington below Little Salmon River	30+00	376	5,400	6,300	7,400	8,200	8,990	10,740
Little Salmon River	Bombay	500+00	90	2,370	2,740	3,190	3,520	3,840	4,540
	Fort Covington	0+00	100	2,510	2,990	3,480	3,830	4,180	4,940
Branch Brook	Malone	0+00	19	780	950	1,180	1,350	1,540	1,980

To account for projected increases in peak flood flows due to climate change, estimated future flood hydrology was determined using the "National Climate Change Viewer," a web-based tool developed by the USGS (Alder and Hostetler, 2013) in conjunction with regional regression equations (Lumia et al., 2006). The climate change projections predict an increase in mean annual precipitation, which was applied to the regional regression equations and compared to the current results of the regressions. The percent increase in peak flood discharges was then applied to the hydrology developed for the Salmon River watershed. The results allow for modeling of flood conditions that may occur in future decades, enabling proactive flood mitigation measures.

Runoff data were evaluated for two future scenarios, termed "Representative Concentration Pathways" or RCPs, that provide estimates of the extent to which greenhouse gas concentrations in the atmosphere were likely to change through the 21st century. RCPs are based on potential future emissions trajectories of greenhouse gases such as carbon dioxide. RCP 4.5 is considered a midrange-emissions scenario, and RCP 8.5 is a high-emissions scenario. The future precipitation estimates are based on 20 different climate models, which have been scaled for Franklin County.

Flows based on the more moderate greenhouse gas scenarios (RCP 4.5) were used in the hydraulic models in this report. Proposed replacement stream crossings were assessed based on the 2075 to 2099 projections to account for anticipated bridge design lifetimes of 75 years or more.

Mean estimated increases for the 50- and 100-year floods based on the climate models are presented in Table 2-3. These are based on regressions for Flood Frequency Region 2 in New

York. Current and Predicted future flows for Salmon River and its tributaries at various locations along the watercourses are compared in Table 2-4.

Table 2-3 Projected Increases (percent) in Flood Flows on Salmon River

Mean Change in Discharge (%)	2025 to 2049		2050 to 2074		2075 to 2099	
Greenhouse Gas Scenario	50-Year Flood	100-Year Flood	50-Year Flood	100-Year Flood	50-Year Flood	100-Year Flood
RCP 4.5	5.1	5.0	7.3	7.1	8.0	7.8
RCP 8.5	6.0	5.9	9.2	9.0	12.8	12.5

Table 2-4 Current and Projected Future Flood Flows Used in Hydraulic Analyses in the Salmon River Watershed

Watercourse	Location	River Station	Peak-Flood Discharge (cfs)			
			Current		Projected Future (RCP 4.5, 2075-2099)	
			50-Year	100-Year	50-Year	100-Year
Salmon River	Chasm Falls	1650+00	3,560	3,930	3,850	4,240
	Malone above Branch Brook	1180+00	4,170	4,590	4,500	4,950
	Malone below Branch Brook	1155+00	4,560	5,020	4,930	5,420
	Macomb Dam	1000+00	4,640	5,110	5,010	5,510
	Westville	400+00	5,060	5,570	5,460	6,000
	Fort Covington above Little Salmon River	100+00	6,390	7,020	6,900	7,570
	Fort Covington below Little Salmon River	30+00	8,200	8,990	8,860	9,690
Little Salmon River	Bombay	500+00	3,520	3,840	3,800	4,140
	Fort Covington	0+00	3,830	4,180	4,140	4,500
Branch Brook	Malone	0+00	1,350	1,540	1,460	1,660

cfs = cubic feet per second

2.4 Hydraulics

Effective floodplain mapping within the corporate limits of the village of Malone is based on HEC-2 modeling of the Salmon River performed for the 1978 Flood Insurance Study (FIS) for the village (3602720001B). No other hydraulic modeling appears to have been conducted by FEMA for the purposes of flood insurance rate mapping within the identified HRAs.

A base-line engineering (BLE) HEC-RAS model of the Salmon River watershed that was developed by NYSDEC was obtained and truncated to the studied sources of riverine flooding: Salmon and Little Salmon Rivers and Branch Brook, a tributary to the Salmon River with confluence in the village of Malone. This model geometry is developed from 1-meter grid resolution light detection and ranging (LiDAR)-derived topographic mapping created as part of the New York FEMA 2016 QL2 LiDAR project (collected winter 2016 through spring 2017) and lacks bathymetric survey of the river channel as well as any hydraulic structures (bridges, culverts, dams).

Separately, survey has been collected by FEMA for a new countywide FIS for Franklin County that is currently in progress; this survey data was obtained through NYSDEC. These data consisted of raw survey points of hydraulic cross sections and structures along certain reaches of the Salmon and Little Salmon Rivers. Bathymetric cross section and structural survey data were provided for the Little Salmon River in Fort Covington from STA 0+00 to STA 60+00 and for the Salmon River in Fort Covington and Westville between STA 0+00 at the Canadian border and STA 660+00 and in the town of Malone from STA 1010+00 to STA 1205+00 and from STA 1482+00 to STA 1604+00.

The BLE model was modified to reflect the bathymetric and structural data where it was available. This included relocation of existing cross sections and addition of new cross sections to collocate with the FEMA survey data. Floodplain/overbank topography was cut (or re-cut) from the LiDAR surface and supplemented with the surveyed bathymetry. Structural survey was available for two bridges over the Little Salmon River and 14 bridges and two dams on the Salmon River, which were added to the respective model geometries. One bridge on the Salmon River and one on Branch Brook were field measured by SLR Engineering, Landscape Architecture, and Land Surveying, P.C. (SLR) staff for inclusion in the models.

2.5 Previous Studies of Salmon River

Several studies have previously been conducted on Salmon River and the Salmon River watershed. Table 2-5 contains a summary of studies that were reviewed as part of this analysis.

Table 2-5 Summary of Studies Conducted in the Salmon River Watershed

Study	Conducted By	Date
Town and Village of Malone Local Waterfront Revitalization Program	ELAN https://docs.dos.ny.gov/opd-lwrp/LWRP/Malone%20V&T/Index.html	2012
Salmon River Watershed Management Plan	Franklin County Soil & Water Conservation District	2016
Salmon River Sediment Study	Ramboll, Inc.	2019
Franklin County Multi-Jurisdictional Hazard Mitigation Plan (2020 Draft Updates)	Franklin County	2020

2.6 Stakeholder Engagement

An important component of the data gathering for this study took place through stakeholder engagement. A stakeholder meeting was held on June 6, 2023, by video conference call. In addition to the formal video meeting, multiple one-on-one conversations took place with representatives from the watershed municipalities and groups.

Documentation of past flood and ice jam events was provided by the Village of Malone and the Franklin County Soil & Water Conservation District, which included photos, videos, watershed studies, and after-action reports.

2.7 Infrastructure

A number of bridge crossings of the Salmon River and its tributaries are contained within identified high risk areas (HRAs) and, in certain cases, may contribute to flooding in these locations. These structures and summary details are listed below in Table 2-6. The span of the crossing and estimated bankfull width of the channel is provided for each crossing location. It should be noted that a crossing span that is narrower than the channel's bankfull width indicates that the crossing may be hydraulically undersized and may be prone to scour or contribute to flooding.

Several dams are also located along the studied watercourses. Two of these dams are active hydropower stations, one is used to create a recreation pond, and the remaining three are no longer in use. Summary details of these dams are presented in Table 2-7.

Table 2-6 Summary of Bridge Crossings of Salmon and Little Salmon Rivers

River	Roadway	River Station (feet)	Structure	NBI BIN* (Owner)	Year Built	Number of Spans	Total Span (feet)	Bankfull Width (feet) (Regional Regressions)
Salmon River: Fort Covington	CSX Railroad	51+25		N/A (CSX Transportation)		2	200	164
	Center Street	58+50	Steel Stringer/Multi-Beam or Girder Bridge	3337370 (Franklin County)	1974	2	170	164
	Chateaugay Street	67+60	Steel Stringer/Multi-Beam or Girder Bridge	1023970 (NYSDOT)	1998	1	143	164
Salmon River: Westville	Cushman Road	375+00	Concrete box beam/girder	3337500 (Franklin County)	1998	2	102	148
	CR-4 / Westville-Bombay Road	435+00	Concrete box beam/girder	3338130 (Franklin County)	1999	1	109	148
	CR-19 (Jewett Road)	503+50	Steel Multi-beam	3338190 (Franklin County)	1969	2	145	144
	NY-37	510+00	Steel Multi-Beam	1023980 (NYSDOT)	1994	2	245	144
Salmon River: Town of Malone	Upper Flat Rock Road	780+00	Concrete box beam/girder	3337450 (Franklin County)	1995	1	85	143
	Cargin Road	898+00	Concrete box beam/girder	3337620 (Franklin County)	2008	1	77	142
	Brand Road	1012+15	Steel Stringer/Multi-Beam or Girder Bridge	3336910 (Franklin County)	2008	1	170	142
	Lane Street	1081+00	Steel Stringer/Multi-Beam or Girder Bridge	3336900 (Franklin County)	1975	1	85	141
	US-11 (Main Street)	1132+00	Steel Stringer/Multi-Beam or Girder Bridge	1008940 (NYSDOT)	1947	1	112	141

River	Roadway	River Station (feet)	Structure	NBI BIN* (Owner)	**Year Built**	Number of Spans	Total Span (feet)	Bankfull Width (feet) (Regional Regressions)
	Pearl Street	1150+30	Prestressed Concrete Box Beam or Girder Bridge	3337490 (Franklin County)	2003	1	84	137
	Willow Street	1173+00	Prestressed Concrete Box Beam or Girder Bridge	3337480 (Franklin County)	1994	1	65	135
	River Road	1337+40	Prestressed Concrete Box Beam or Girder Bridge	3336950 (Franklin County)	1964	1	63	133
Branch Brook: Malone	College Avenue	3+50	Prestressed concrete box beam/girder	3336930 (Franklin County)	1994	1	27	63
Little Salmon River: Fort Covington	Drum Street	02+50	Steel Girder and Floorbeam System Bridge	3337380 (Franklin County)	1938	1	80	114
	Chateaugay Street	28+50	Prestressed Concrete Box Beam or Box Girder (Multiple) Bridge	1023960 (NYSDOT)	1977	1	99	114
	CSX Railroad	73+75		N/A (CSX Transportation)		1	80	113
	Foster Road	171+20	Prestressed Concrete Box Beam or Bix Girders (Multiple) Bridge	3337390 (Franklin County)	1995	1	73	113
Little Salmon River: Bombay	CR-4 / Westville-Bombay Road	438+50	Steel girder and floorbeam	3337840 (Franklin County)	1941	1	80	109
	River Road (Shirttail Road)	479+00	Steel multi-beam	3337320 (Franklin County)	1967	1	52	109

*NBI BIN = National Bridge Inventory Bridge Identification Number

Table 2-7 Summary NYSDEC Data for Dams on Salmon River and Tributaries

River	River Station (feet)	Name	Location	Purpose	Description	NYS Dam ID (Listed Owner)	Hazard Classification	Dam Height (Feet)	Dam Length (Feet)	Year Constructed	Last Inspection (NYSDEC)
Salmon River	1000+00	High Falls Dam / Macomb Dam	Town of Malone	Hydroelectric/ Recreation	Concrete Gravity	165-0134 (Erie Boulevard Hydropower)	A	35	72	1900	1998
	1132+70	“Main Street Weir”	Village of Malone	Unknown	Run-of-River Ogee Weir	Not in NYSDEC inventory					
	1140+00	Whittelsey Dam	Village of Malone	Hydroelectric – Inactive	Concrete Gravity	165-0148 (Village of Malone/Office of Commercial Development)	A	19	120	1925	1972
	1181+00	Ballards Dam	Village of Malone	Hydroelectric – Inactive	Timber Crib Rockfill	165-0149 (North Country Community College)	B	12	300	1901	1998
	1650+00	Chasm Falls Dam	Town of Malone	Hydroelectric	Concrete Gravity	182-0229 (Erie Boulevard Hydropower)	B	25	202	1913	1997
Branch Brook	28+00	Malone Recreation Dam	Village of Malone	Recreation	Concrete Gravity	165-1235 (Village of Malone)	B	19	250	1946	2021

In 2014, the Community Risk and Resiliency Act (CRRA) was signed into law to build New York's resilience to rising sea levels and extreme flooding. The Climate Leadership and Community Protection Act made modifications to the CRRA, expanding the scope of climate hazards and projects for consideration. These modifications became effective January 1, 2020. NYSDEC has provided guidelines for requirements under CRRA, which are summarized in a publication entitled *New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act.*

Based on guidance provided in the New York State Department of Transportation (NYSDOT) *Highway Design Manual* (NYSDOT, 2021) and *Bridge Design Manual* (NYSDOT, 2019), the design criteria for bridges and culverts are listed below. Culverts are classified as any stream crossings with a span of less than 20 feet (measured parallel to the roadway) while bridges have a span of 20 feet or greater.

- Culverts will be designed to pass the predicted 50-year storm event.
- Bridges will be designed to pass the 50-year storm event with 2 feet of freeboard below the bridge low chord and the 100-year storm event without touching the low chord.
- The structure will not raise the water surface elevations anywhere when compared to existing conditions for both the 50-year and 100-year flood events.
- The proposed bridge's low chord will not be lower than the existing low chord.
- Hydrologic analysis will include an evaluation of future predicted flows. The recommended design-flow multiplier for eastern New York State, which includes the Salmon River watershed, is 120 percent.
- The maximum skew of the bridge pier(s) to the flow shall not exceed 10 degrees.
- Headwater at culverts will be limited to an elevation that:
  - Would not result in damage to upland property,
  - Would not increase the water surface elevation allowed by floodplain regulations, and
  - Would result in a headwater depth-to-culvert height ratio of not greater than 1.0 for culverts with a height greater than 5 feet and not greater than 1.5 for culverts with a height of 5 feet or less.

NYSDEC stream crossing guidelines recommend, where possible, that the following best management guidelines be incorporated:

- Provide a minimum opening width of 1.25 times the bankfull width of the waterway in the vicinity of the crossing.
- Use open-bottom or embedded, closed-bottom structures, which allows for installation of natural streambed material through the length of the structure.
- Match the channel slope through the bridge or culvert to the natural channel slope.
- Install bridges or culverts perpendicularly to the direction of flow of the stream.
- Install new or replacement structures so that no inlet or outlet drop would restrict aquatic organism passage (AOP).

3.0 Identification of Flood and Ice Jam Hazards

3.1 Flooding and Ice Jam History

The Salmon River watershed has historically been impacted by hurricanes, tropical storms, thunderstorms and nor'easters, rain-on-snow events, and ice jams. According to the Franklin County Multi-Jurisdictional Hazard Mitigation Plan (Franklin County HMP), Franklin County had 50 reported floods between 1996 and 2017. According to the CRREL (Cold Regions Research and Engineering Laboratory) Ice Jam Database, 22 ice jam events have occurred on either the Salmon River or Little Salmon River since 1963. Ice jams typically occur in the springtime or during mid-winter thaw or rain-on-snow events, with the thaw producing higher flows and breaking up ice deposits. The broken-up ice can accumulate at obstructions or flow contractions such as undersized bridges and cause significant flooding and damage. Table 3-1 presents a summary of recent flood and ice jam events in the Salmon River watershed.

Table 3-1 Recent Flood History in Salmon River Watershed

Date	Flood Event	Notes	Source
January 19, 1996	Ice Jam	Ice jam on the Salmon River in the town of Malone.	CRREL Ice Jam Database
November 9, 1996	Flash Flood	$500,000 in property damages to Franklin County.	NOAA
June 27, 1998	Flash Flood	Extensive flooding occurred in the northern half of Franklin County. A state of emergency was declared. Numerous roads were washed out, especially in the town of Malone, town of Westville, hamlet of Whippleville, and town of Fort Covington. Bridges washed out in the town of Fort Covington and town of Bangor.	NOAA
July 1, 1998	Flash Flood	A storm system tracked across New England with steady rainfall. The soil conditions were saturated and allowed for high runoff. In the town of Malone, roads were flooded as well as road erosion and washouts. $500,000 in damages were reported across Franklin County.	NOAA
September 27, 1998	Flash Flood	Heavy rainfall caused flash flooding in the northern portions of Franklin County. Flooding occurred in the hamlet of Whippleville where some roads became closed. Some homes had garages and basements that were also flooded. Flooding also occurred in the town of Malone and town of Bombay. $100,000 in property damages occurred in Franklin County.	NOAA
January 19, 2000	Ice Jam	An ice jam on the Salmon River resulted in local flooding just south of the town of Malone. Route 25 near Chasm Falls was closed due to localized flooding.	NOAA

Date	Flood Event	Notes	Source
May 10, 2000	Flash Flood	A storm system moved across northern New York and dropped heavy rain across the region. Flash flooding occurred, specifically in the town of Malone area.	NOAA
January 28, 2003	Ice Jam	Ice jam on Salmon River in the town of Westville.	CRREL Ice Jam Database
January 14, 2004	Flood	An ice jam created flooding along the Salmon River in the town of Malone. Low areas were mostly flooded, and it impacted a few houses. Water damage to a few houses was reported.	NOAA
July 9, 2007	Flash Flood	Multiple thunderstorms moved across Franklin County, which resulted in localized flash flooding within the town of Malone, hamlet of Whippleville, and hamlet of Owls Head. Several roads along Salmon River were washed out, including Bull Run, Brick Church, and Kimpton Roads. Around $100,000 in property damages were recorded in the town of Malone.	NOAA, Franklin County HMP
January 27, 2010	Ice Jam	Heavy rain combined with multiple ice jams formed on the Salmon River, including in the town of Fort Covington and town of Westville, which created flooding in the area and resulted in several evacuations. Fifteen homes were impacted, and some basements were flooded in the town of Fort Covington.	NOAA and CRREL Ice Jam Database
September 30, 2010	Heavy Rain	Around 3 to 4 inches of rain fell over Saint Lawrence and Franklin Counties. This heavy rain caused flooding in the towns of Whippleville, Malone, and Bombay and the hamlet of Hogansburg. In the town of Malone, Moses Street was inundated, and basements were flooded. Around $100,000 in damages were reported in the town of Malone.	NOAA, Franklin County HMP
January 24, 2013	Ice Jam	Cold temperatures created a freeze-up ice jam on the Salmon River in Malone along Lower Park Street. Water rose overnight, and a state of emergency was declared. Multiple homes were evacuated, and seven homes had flooded basements or water into the first floor. Lower Park Street was inundated by several feet of water. The ice jam remained until January 31, when temperatures were low enough for ice melt to occur. $150,000 in damages were reported in the town of Malone.	NOAA, Frankling County HMP

Date	Flood Event	Notes	Source
June 11-12, 2013	Heavy Rain	Heavy rainfall, in excess of 3 inches, fell over northern Franklin County and western Clinton County. Soils were already saturated, and large amounts of runoff were produced. Several roads were closed throughout Franklin County in Duane Center, town of Bangor, town of Malone, town of Dickinson, town of Burke, hamlet of Hogansburg, and town of Bombay. Homes in the town of Fort Covington along the Salmon River were evacuated. Numerous state, county, and town highways were flooded.	NOAA, Franklin County HMP
April 8, 2014	Ice Jam	Ice jam on the Salmon River in the town of Fort Covington.	CRREL Ice Jam Database
April 16, 2014	Heavy Rain/ Snow Melt	Heavy rain combined with snowmelt created ample flooding conditions across northern New York. Approximately 4 to 6 inches of water fell over Franklin County. The Salmon River and its tributaries flooded the surrounding area and caused numerous road closures, washouts, and evacuations around the town of Malone and town of Fort Covington. In the town of Malone, College Avenue and Willow, Lafeyette, and Patnode Streets were flooded, and some residences were evacuated. At least four culverts were washed out. In the town of Fort Covington, Drum Street was closed due to flooding. In the town of Bombay, the Little Salmon River flooded additional roads.	NOAA, Franking County HMP
March 15, 2017	Ice Jam	Ice jam on the Salmon River in the town of Malone.	CRREL Ice Jam Database
January 12, 2018	Ice Jam	Rain, freezing rain, sleet, and snow was dropped across northern New York and Vermont from a storm system. Warm temperatures caused snowmelt and ice jams to form. These combined caused flooding along the Little Salmon River in the town of Fort Covington where dozens of residents were flooded and evacuated. $150,000 in damages were reported in the town of Fort Covington.	NOAA, Franklin County HMP
January 19, 2018	Ice Jam	Ice jam on the Little Salmon River in the town of Fort Covington.	CRREL Ice Jam Database
February 21, 2018	Ice Jam	An ice jam formed on the Little Salmon River in town of Fort Covington in January and remained in place until February. In February, snowmelt along with rainfall and warm temperatures caused the river to flood. Some homes were evacuated due to the flooding. $100,000 in damages were reported in the town of Fort Covington.	NOAA, Franklin County HMP

Date	Flood Event	Notes	Source
June 18, 2018	Flash Flood	Flash floods hit the town of Whippleville. $25,000 in damages were reported.	Franklin County HMP
January 18, 2019	Ice Jam	Ice jam on the Salmon River in the town of Malone.	CRREL Ice Jam Database
June 23, 2022	Flash Flood	Rain showers and thunderstorms dropped heavy rain over Franklin County. The hamlet of Whippleville was hit the hardest, with multiple roads flooded and one home evacuated.	NOAA

USGS stream gauges, both active and historic, have recorded peak streamflow in the Salmon River watershed. Table 3-2 lists active and historical gauges and the period that each was actively recording peak flow data.

Table 3-2 USGS Stream Gauging Stations in Salmon River Watershed

USGS Gauge No.	Gauged Watercourse	Location	River Station	Years of Operation
04270000	**Salmon River**	**Chasm Falls**	**1650+00**	**1925-2013**
04270200	**Little Salmon River**	**Bombay**	**440+00**	**1959-Present**
04270162	East Branch Little Salmon River	Skerry		1978-1998
04270180	Farrington Brook	Moira		1962-1969
04270150	East Branch Deer Creek	Fort Covington		1962-1986
04270100	West Branch Deer Creek	Fort Covington		1962-1986
04269859	Duane Stream	Duane		1995-Present

3.2 FEMA Mapping

As part of the NFIP, FEMA produces FIRMs that demarcate the regulatory floodplain boundaries. As part of an FIS, the extents of the 100-year and 500-year floods are computed or estimated as well as the regulatory floodway if one is established. The area inundated during the 100-year flood event is also known as the SFHA. In addition to establishing flood insurance rates for the NFIP, the SFHA and other regulatory flood zones are used to enforce local flood damage prevention codes related to development in floodplains.

> Over the period of a standard 30-year mortgage, a property located within the SFHA will have a 26 percent chance of experiencing a 100-year flood event. Structures falling within the SFHA may be at an even greater risk of flooding because if a house is low enough it may be subject to flooding during the 25-year or 10-year flood events. During the period of a 30-year mortgage, the chance of being hit by a 25-year flood event is 71 percent, and the chance of being hit by a 10-year flood event is 96 percent, which is a near certainty.

The FIS for the Village of Malone (360272V000) was made effective in 1978. The Salmon River was studied by detailed methods within the village corporate limits, and the Branch Brook floodplain was determined by approximate methods. For the Town of Malone (360271B), there does not appear to have been an FIS. FIRM panels reflect approximate floodplain delineations from 1974 to 1977, and the FIRMs were made effective in 1985. Similarly, the Towns of Westville (361123A), Bombay (360269B), and Fort Covington (360270) lack an FIS but have effective FIRM panels from the mid-1980s depicting approximate floodplain extents determined in the mid-1970s.

A modern countywide FIS for Franklin County is currently in progress. The updated study will include approximate and detailed analyses of many watercourses in Frankin County and may result in changes to the effective SFHA in the communities along the Salmon and Little Salmon Rivers.

It is important to note that flood hazard areas delineated by FEMA do not account for projected future flows. The flood hazard areas are assumed to be in a stationary climate rather than in a true representation of the nonstationary climate present today on earth.

Regulatory floodplains in the subject communities have not been digitized. Residents are encouraged to consult the most recent products available from the FEMA Flood Map Service Center (https://msc.fema.gov/portal/home) for a more complete understanding of the flood hazards that currently exist.

4.0 Flood Mitigation Analysis

In this section, flood-prone areas within the Salmon River watershed are identified, and an analysis of flood mitigation considerations within each HRA is undertaken. An overview map of the HRAs identified in the watershed is presented in Figure 4-1.

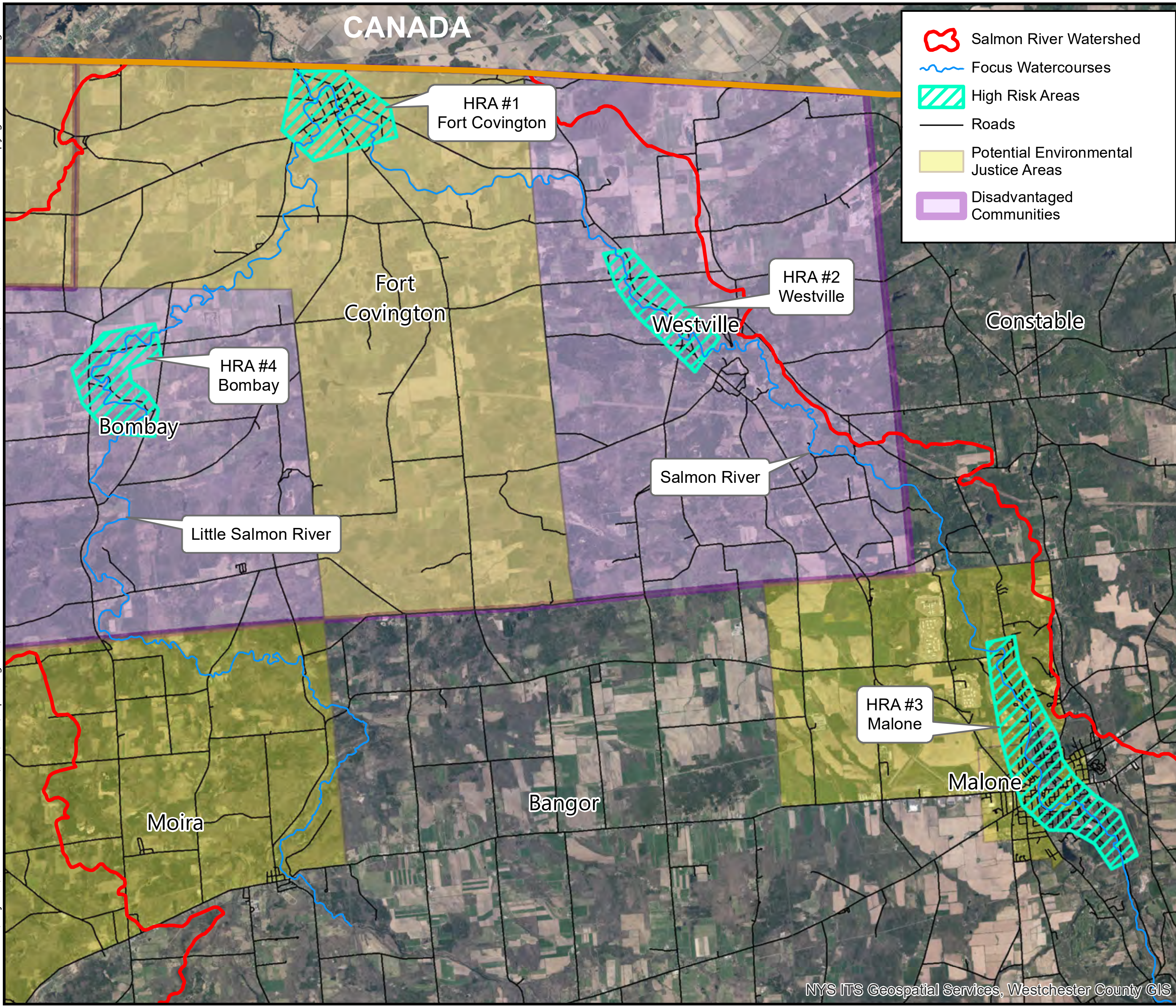
HRA 1 and portions of HRA 3 are located within Potential Environmental Justice Areas. Potential Environmental Justice Areas are U.S. Census block groups of 250 to 500 households each that, in the Census, had populations that met or exceeded at least one of the following statistical thresholds:

1. At least 52.42 percent of the population in an urban area reported themselves to be members of minority groups; or
2. At least 26.28 percent of the population in a rural area reported themselves to be members of minority groups; or
3. At least 22.82 percent of the population in an urban or rural area had household incomes below the federal poverty level.

The federal poverty level and urban/rural designations for census block groups are established by the U.S. Census Bureau. The thresholds are determined by a statistical analysis of the 2014-2018 American Community Survey data, which is the most recent data available as of the time of the analysis in 2020. See NYSDEC Commissioner Policy 29 on Environmental Justice and Permitting (CP-29) for more information. The following link provides a map to Potential Environmental Justice Areas throughout New York State:

https://www.arcgis.com/home/webmap/viewer.html?url=https://services6.arcgis.com/DZHaqZm9cxOD4CWM/ArcGIS/rest/services/Potential_Environmental_Justice_Area__PEJA__Communities/FeatureServer&source=sd.

New York State has released criteria developed by the Climate Justice Working Group for identifying disadvantaged communities. The criteria are intended to guide the equitable implementation of New York's Climate Leadership and Community Protection Act. Pursuant to the Climate Act's disadvantaged community provisions, an interactive map and a list of communities that criteria would cover is available, directing programs and projects to reduced air pollution and climate-altering greenhouse gas emissions, provide economic development opportunities, and target clean energy and energy efficiency investments. Portions of HRA 1, HRA 2, and HRA 4 have been identified as disadvantaged communities. The map can be viewed at the following link: https://www.nyserda.ny.gov/ny/disadvantaged-communities



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Feet

SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

SALMON RIVER WATERSHED HIGH RISK AREAS

Salmon River Flood & Ice Jam Study

SD755

Franklin County, NY

SCALE 1" = 10,000'

DATE 5/22/2024

142.16511.00021
PROJ. NO.

FIG. 4-1

Date Saved: 4/15/2024

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4.1 High Risk Area 1 – Fort Covington

HRA 1 is located in the town of Fort Covington, extending up the Salmon River from the Canadian border at STA 0+00 to the border with the town of Westville at STA 285+00, and along the Little Salmon River from its confluence with the Salmon River at STA 0+00 to the border with the town of Bombay near STA 300+00. HRA 1 is mapped in Figure 4-2.

Riverine flooding from both the Salmon and Little Salmon Rivers is modeled as affecting numerous properties in Fort Covington. Two roadway bridges span the Salmon River in Fort Covington: Center Street at STA 58+50 (county-owned) and NY Route 37/Chateaugay Street (state-owned) at STA 67+60. There are also three road crossings of the Little Salmon River: Drum Street (county-owned) at STA 2+50, NY-37/Chateaugay Street (state-owned) at STA 28+50, and Foster Road (county-owned) at STA 171+20. An elevated CSX railroad embankment passes through downtown, with bridge crossings of the Little Salmon River at STA 73+75 and the Salmon River at STA 51+25, which are owned by CSX Transportation.

The Fort Covington dam (NYSDEC 165-0012) was a 17-foot-high concrete and masonry gravity dam located at STA 64+00 and constructed in 1913 for hydroelectric power generation; it was removed in 2010. Ice jams had been reported at this location prior to removal of the dam.

Critical facilities in Fort Covington include the town highway garage, the town hall, the sewer plant, and the Adult Center, which the town uses as an emergency shelter. None of these four facilities are modeled as being directly impacted by flooding from the Salmon or Little Salmon Rivers. According to the Franklin County Multi-Jurisdictional Hazard Mitigation Plan, 41 parcels are substantially within the SFHA in Bombay; approximate floodplains of the Salmon and Little Salmon Rivers, East and West Branch Deer Creek, and Pike Creek are mapped on effective FIRM panels for Fort Covington.

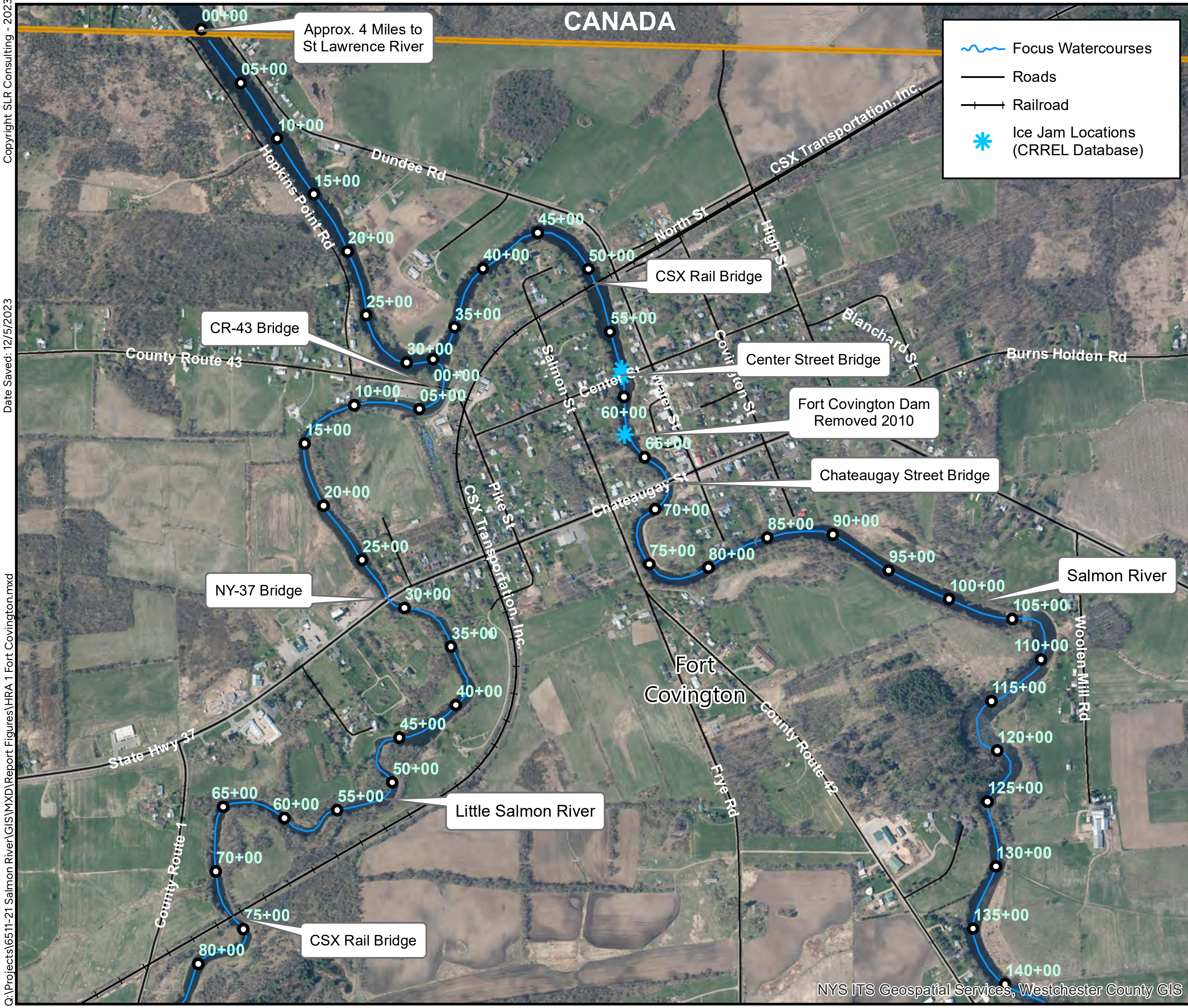
Many of the developed properties that experience flooding in Fort Covington are located north of Center Street. Figure 4-3A through E illustrate modeled inundation boundaries for the 10-, 25-, 50-, 100-, and 500-year floods in Fort Covington. Depth grid mapping and projected future inundation boundaries for the 50- and 100-year floods are presented in Figure 4-4 and Figure 4-5, respectively.

Fort Covington is situated in a relatively flat, low-lying area of the Saint Lawrence River valley, with up to about 25 feet of topographic relief in the developed sections of town, and many properties are at or only slightly above the natural floodplain elevation. As a result, portions of the downtown area are susceptible to flooding. Flooding in Fort Covington can be associated with ice jams, which are reported in the CRREL database as occurring in 2010, 2014, and 2018, although it is understood that numerous additional ice jams have occurred that are not in this database. The obstruction of the channel by ice in these events can generate severe and damaging flooding (Photo 4-1) and are often associated with river flows that would not cause flooding under free-flowing conditions.

The Salmon River joins the Saint Lawrence River in Quebec about 4 miles downstream of the USA-Canada border, which is just over a half mile downstream of the confluence of the Salmon and Little Salmon Rivers. The water surface profile is virtually flat over this approximately 4.5-mile reach of the Salmon River and into the Saint Lawrence River, which can have a significant influence on both clear water and ice jam flooding in Fort Covington. The Salmon River joins the Saint Lawrence River near the head of Lake Saint Francis, which is formed by dams associated with the Beauharnois Canal and locks between 25 and 40 miles downstream in Beauharnois-Salaberry, Quebec. As a result, the Saint Lawrence River water surface is relatively consistent at the Salmon River's confluence, creating a tailwater control that extends upstream into Fort Covington.

Photo 4-1 Ice jam flooding in Fort Covington, February 2018. Photo provided by Village of Malone.

Photo 4-2 Ice in the Salmon River downstream of Fort Covington, Saint Lawrence River in background. Photo provided by Village of Malone.



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0 500
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 1 - FORT COVINGTON
Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 1,000 '

DATE 12/5/2023

142.16511.00021
PROJ. NO.

FIG. 4-2

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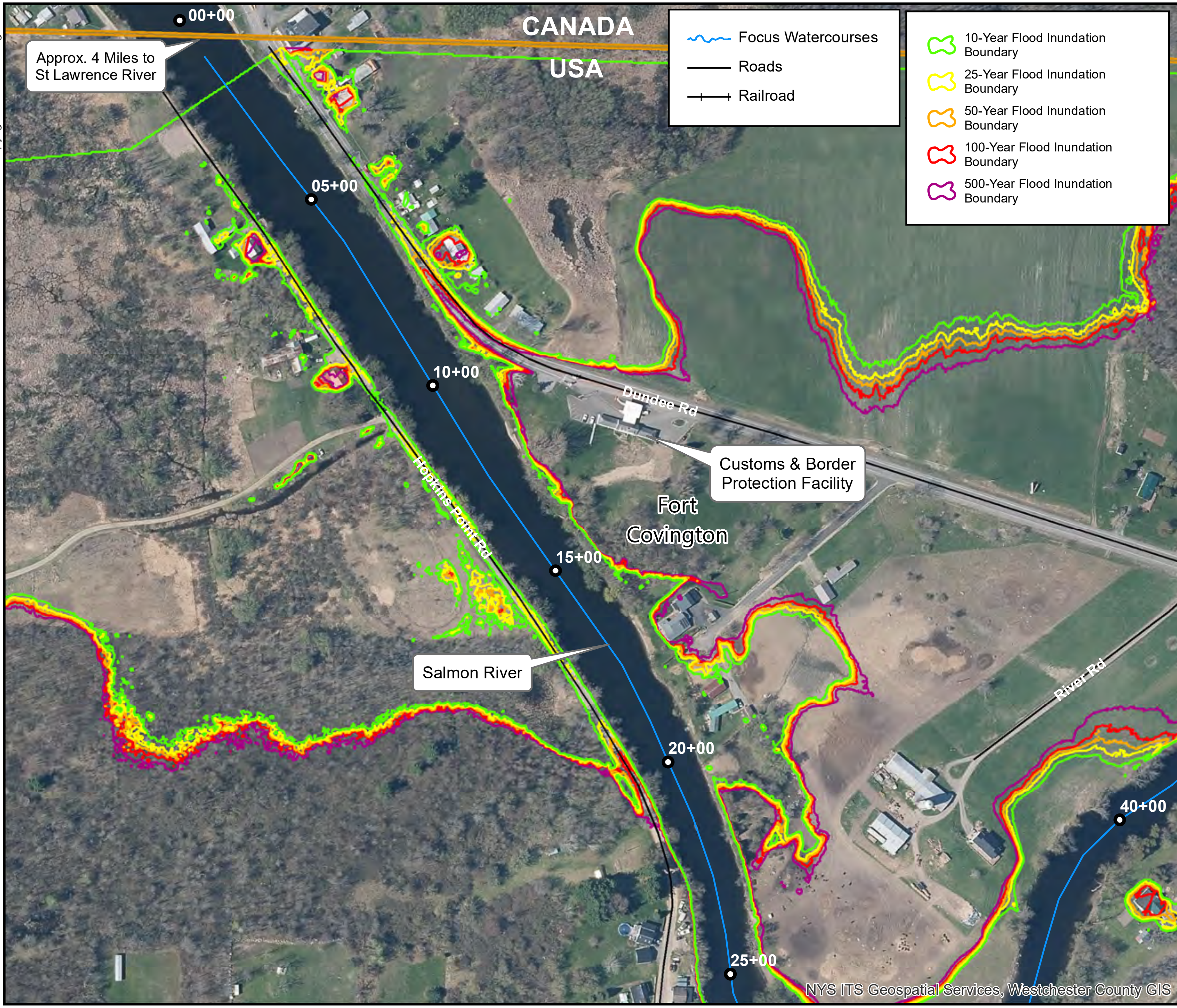

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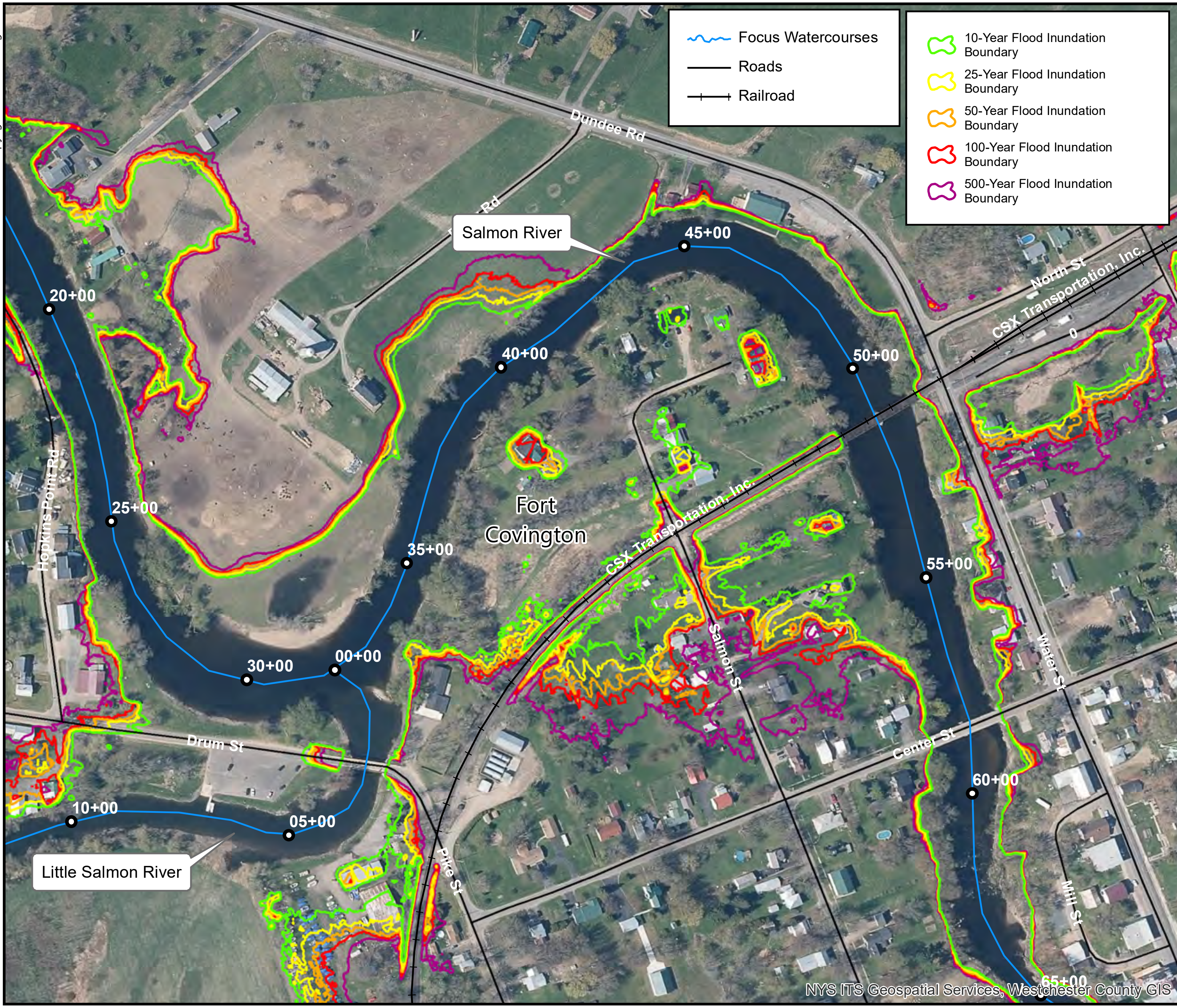
0 175
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 1 - Flooding Extents
Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 300'
DATE 5/23/2024
PROJ. NO. 142.16511.00021

FIG. 4-3A

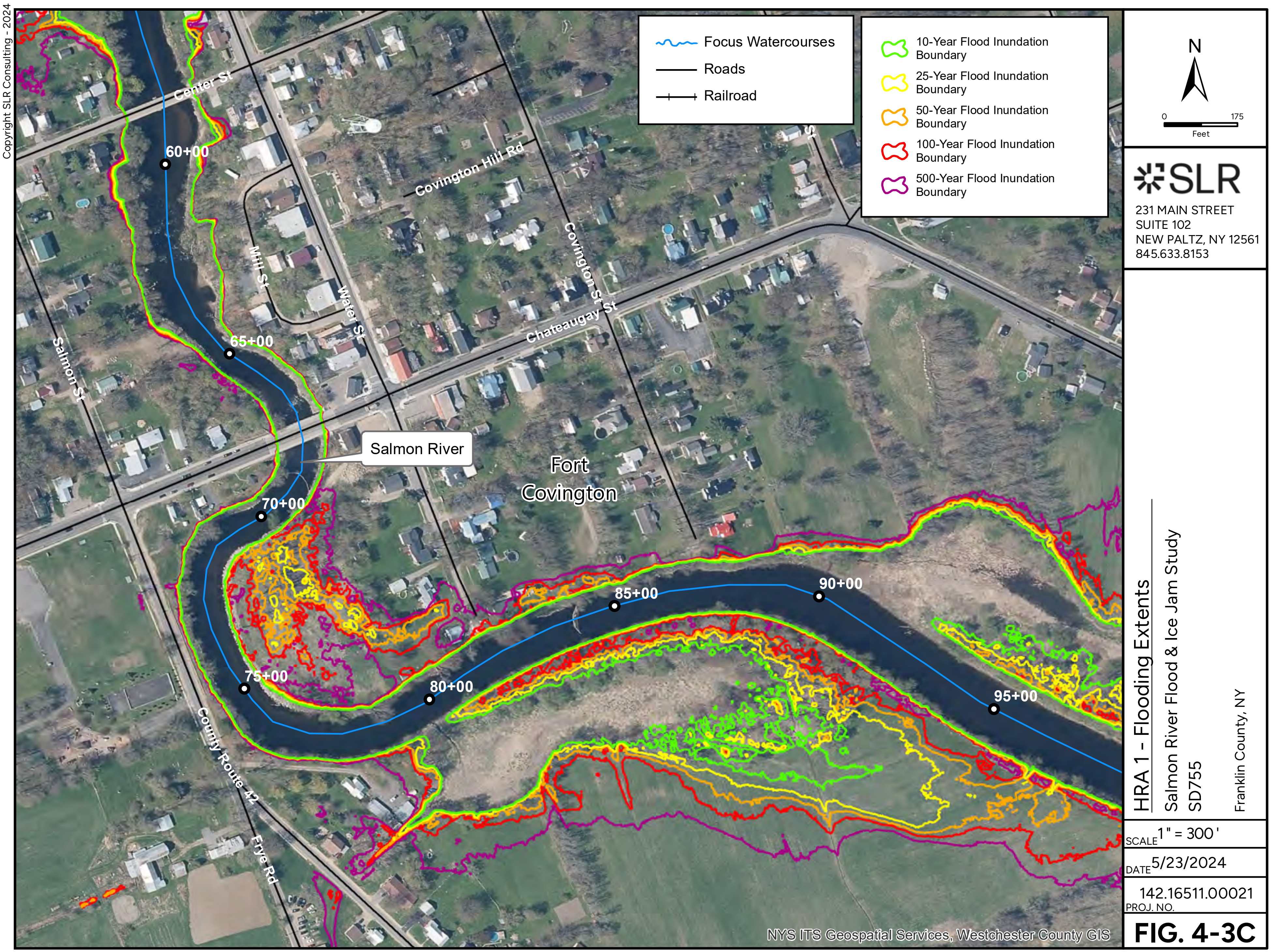


SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 1 - Flooding Extents
Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 300'
DATE 5/23/2024
142.16511.00021 PROJ. NO.

FIG. 4-3B



Copyright SLR Consulting - 2024
Focus Watercourses
Roads
Railroad
10-Year Flood Inundation Boundary
25-Year Flood Inundation Boundary
50-Year Flood Inundation Boundary
100-Year Flood Inundation Boundary
500-Year Flood Inundation Boundary
N
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Feet
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231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153
Center St
Covington Hill Rd
Mill St
Water St
Covington St
Chateaugay St
Salmon St
Salmon River
Fort Covington
County Route 42
Frye Rd
60+00
65+00
70+00
75+00
80+00
85+00
90+00
95+00
NYS ITS Geospatial Services, Westchester County GIS
HRA 1 - Flooding Extents
Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY
SCALE 1" = 300'
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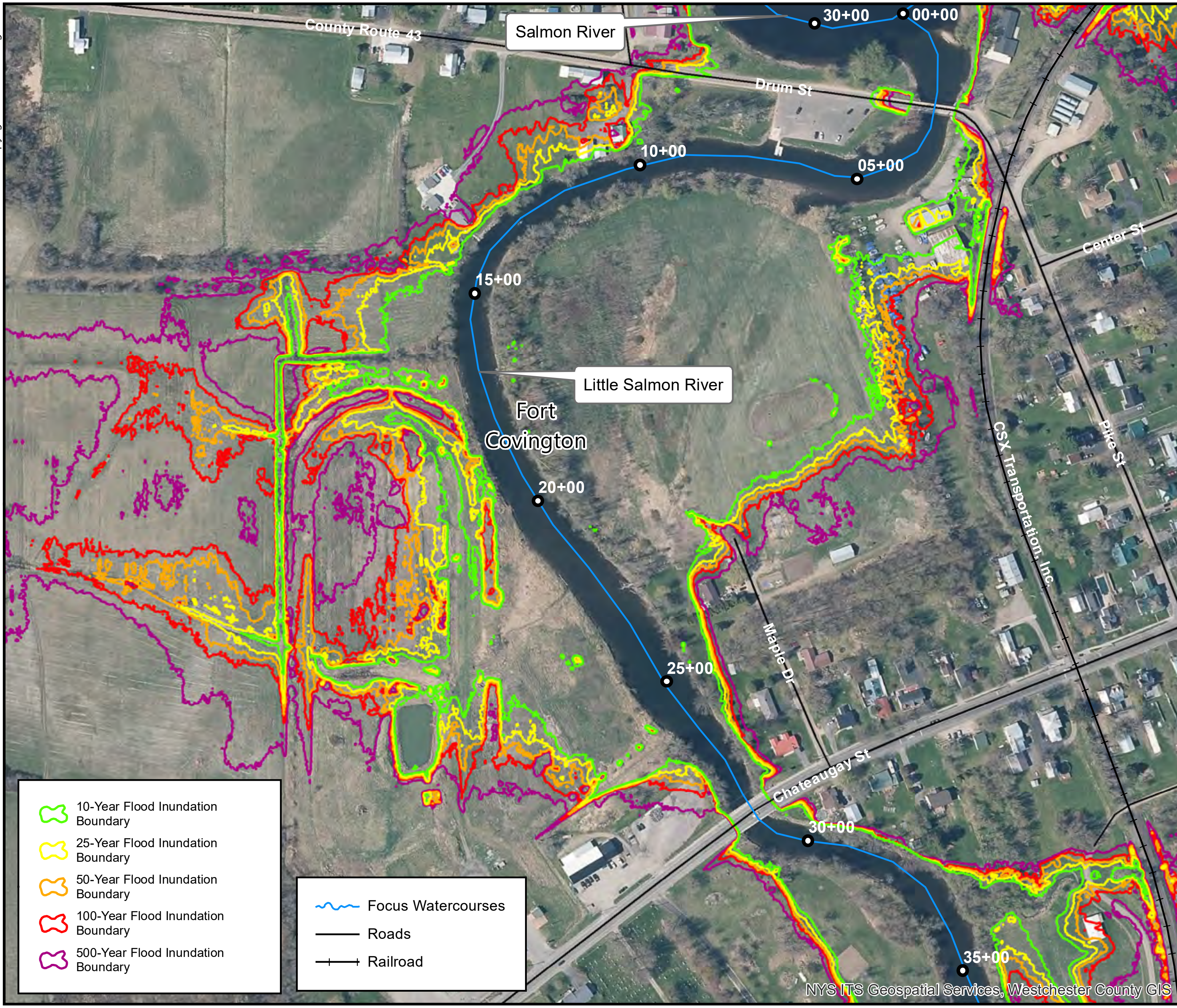
PROJ. NO.
FIG. 4-3C



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HRA 1 - Flooding Extents

Salmon River Flood & Ice Jam Study

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Franklin County, NY

SCALE 1" = 300'

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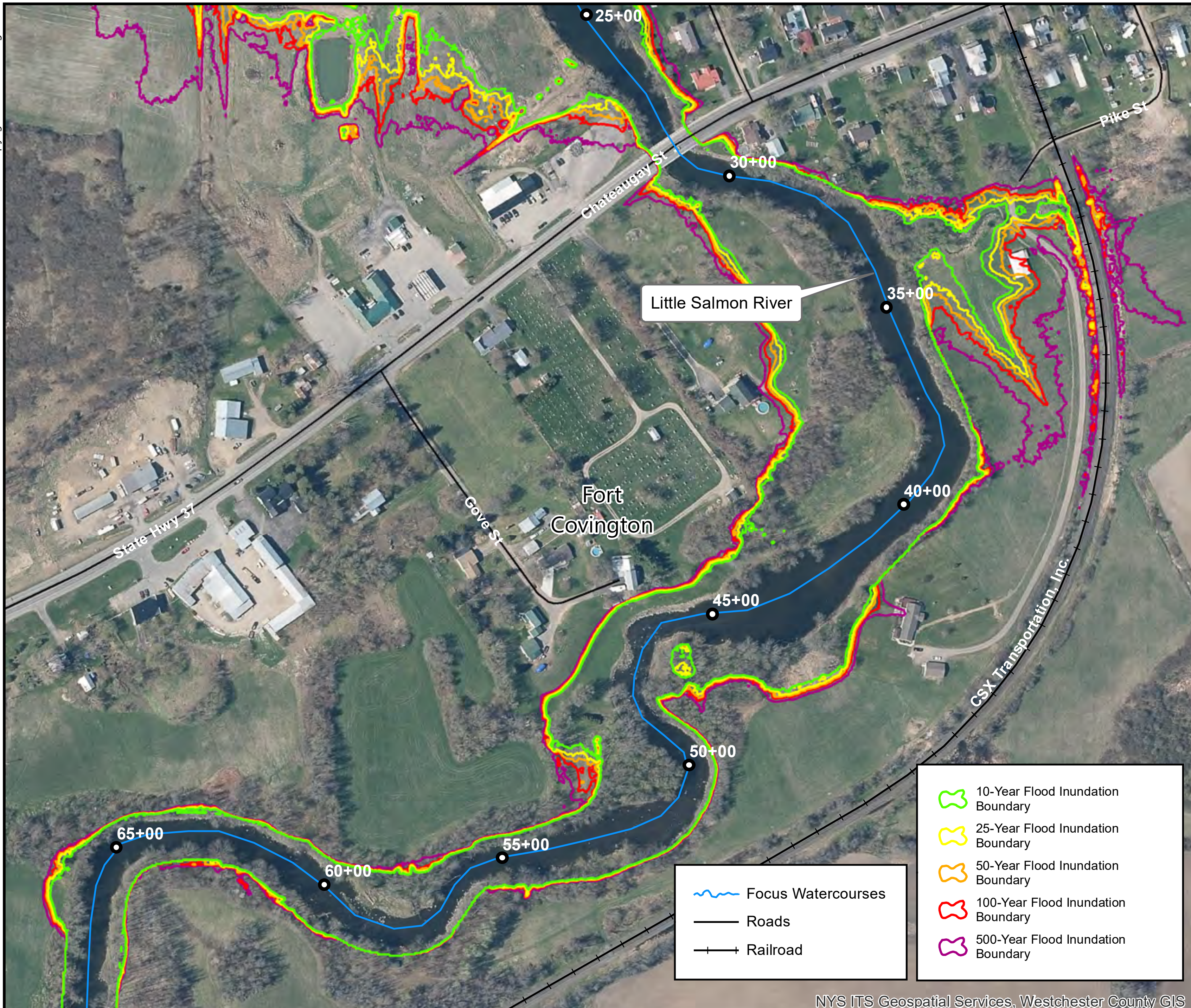
PROJ. NO.

FIG. 4-3D



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HRA 1 - Flooding Extents

Salmon River Flood & Ice Jam Study

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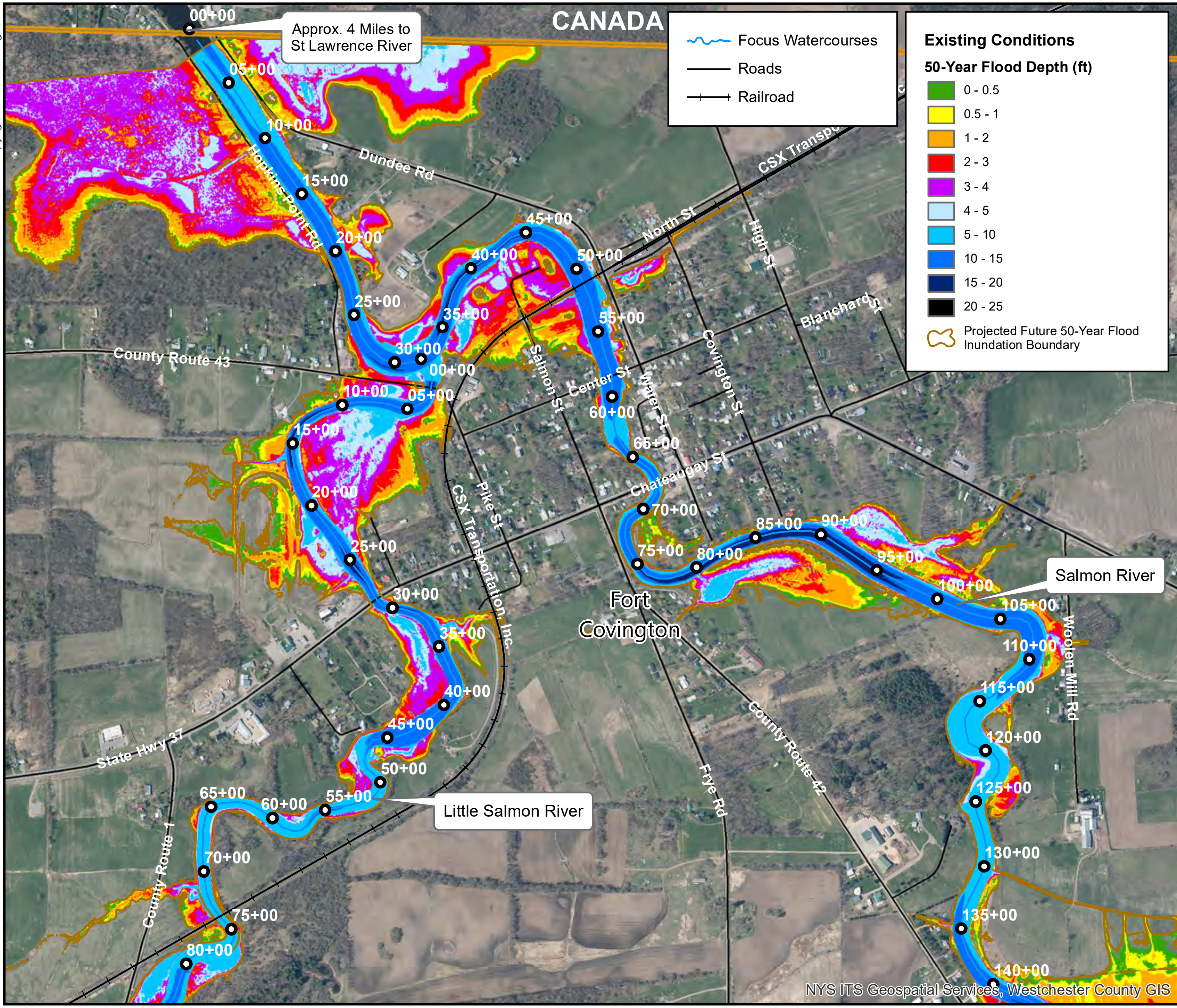
FIG. 4-3E



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0 500
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 1 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study

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Franklin County, NY

SCALE 1" = 1,000'

DATE 1/18/2024

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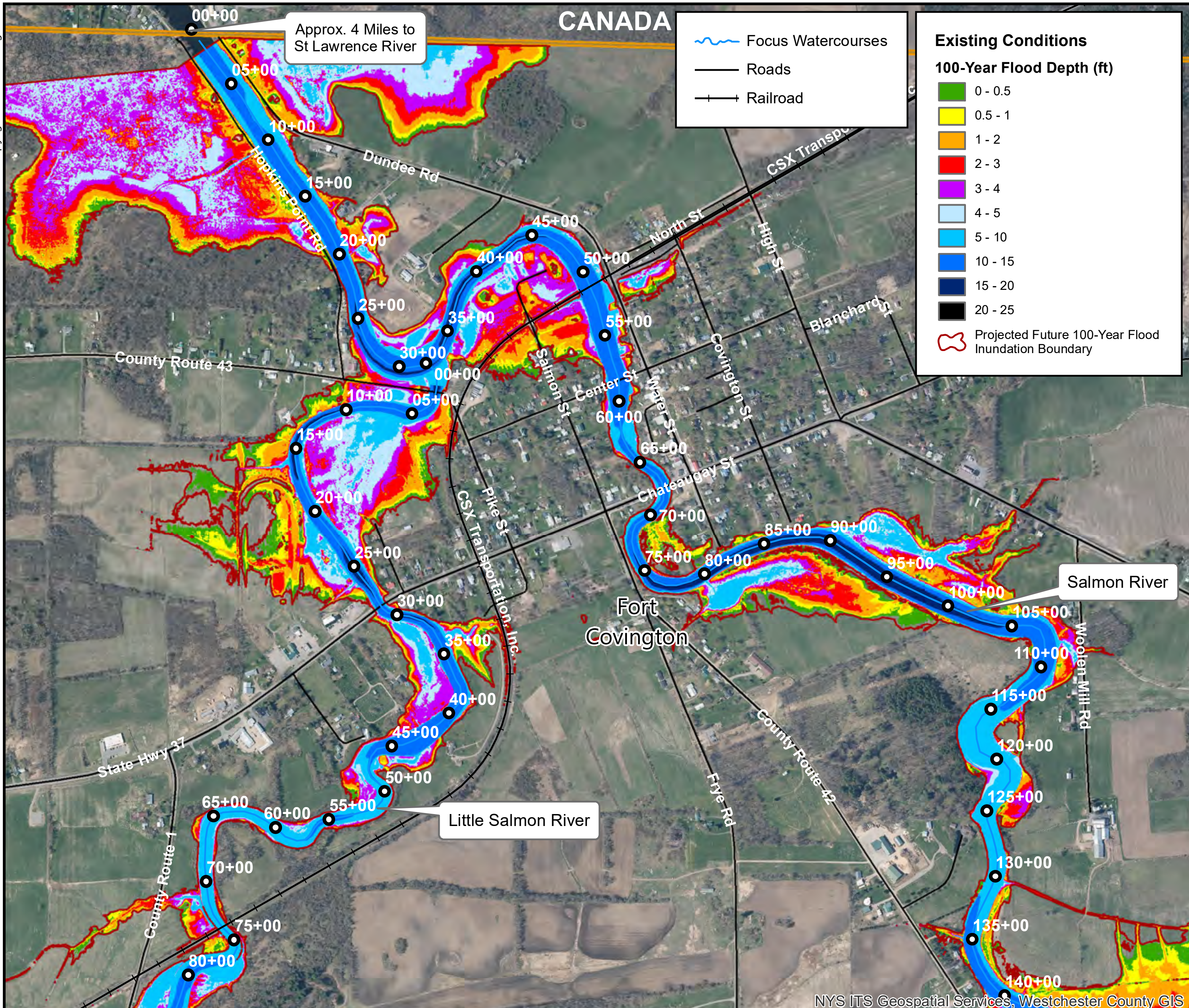
PROJ. NO.

FIG. 4-4



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0 500 Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 1 - Current & Projected Future 100-Year Flood

Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 1,000'

DATE 1/18/2024

PROJ. NO. 142.16511.00021

FIG. 4-5

Due to the Salmon River's shallow slope downstream of Fort Covington and the tailwater control from the Saint Lawrence River, the river ice that forms in the calm waters in and downstream of Fort Covington can be relatively thick and solid (Photo 4-2). This stronger ice is less prone to breakup during thaw events, and fragmented ice that travels from upstream reaches of the Salmon and Little Salmon Rivers accumulates when it encounters the intact ice. Because formation of solid ice in the downstream reaches of the Salmon River is possible during most winters, the conditions for breakup ice jamming in Fort Covington occur regularly. Bridge constrictions may exacerbate ice jam flooding, especially in cases where the bridge low chord is impacted by ice. The fairly sharp meander bend on the Salmon River between STA 35+00 and STA 50+00 also appears to contribute to accumulations of breakup ice even without intact ice farther downstream.

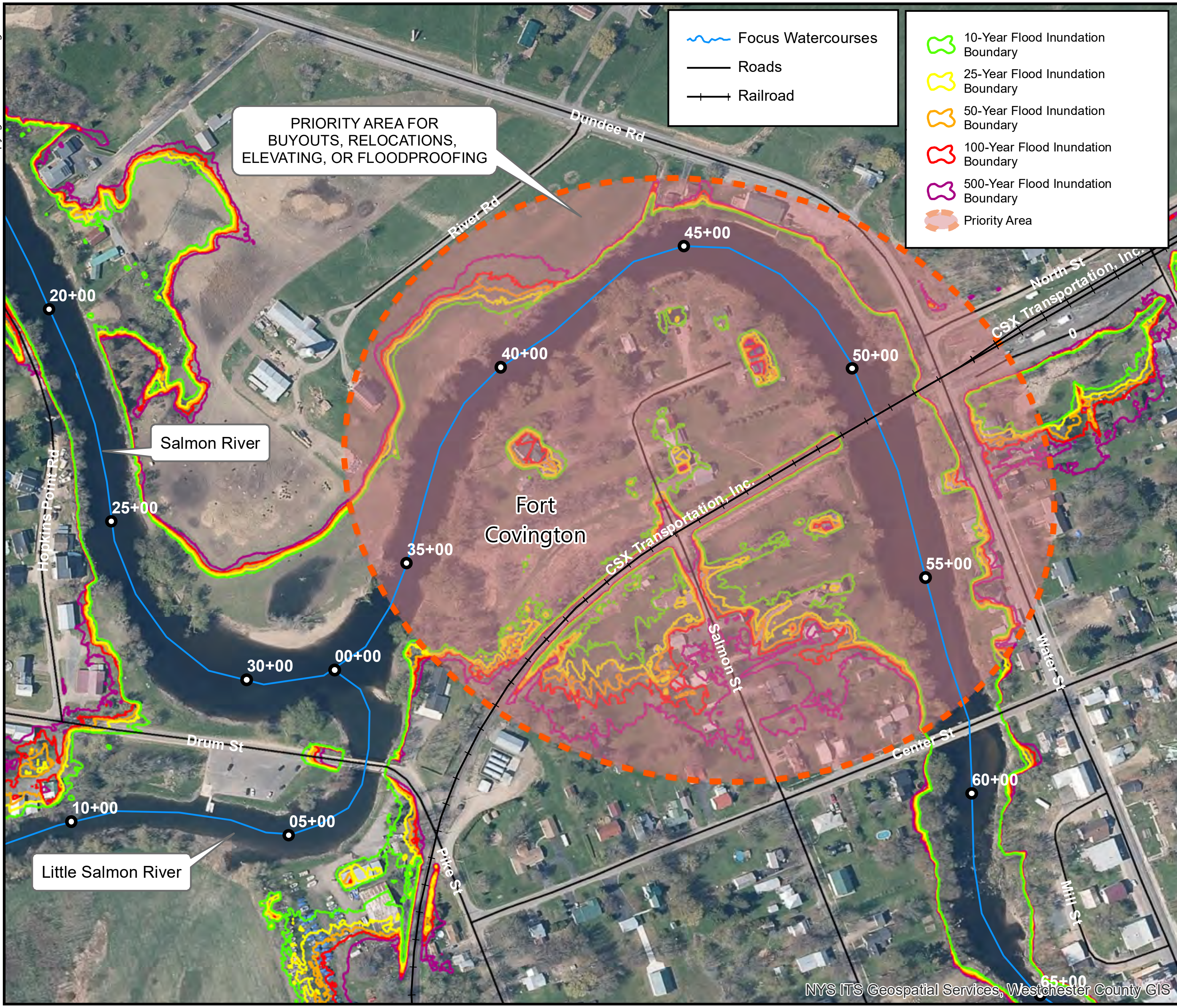
Ice jamming that occurred in February 2018 was well documented by local agencies and municipalities. This event was replicated in the HEC-RAS model based on recorded discharges at the Macomb dam and the Little Salmon River USGS gauge in Bombay and photographic observations. This scenario was simulated under natural conditions, with all bridge crossings and embankments removed from the model, which did not meaningfully reduce flooding. Floodplain enhancements were also modeled in the areas prone to jamming downstream of the Center Street bridge. The purpose of these floodplain enhancements would be to provide accessible overbank areas where breakup ice can accumulate without damaging properties or infrastructure, and decreasing flood depths by reducing the volume of ice that obstructs the flow of liquid water in the channel.

Ice jamming was modeled with floodplain benching from STA 25+00 to just downstream of the CSX rail bridge at STA 51+00. The floodplain enhancement was modeled on both the left and right overbank areas and varies from about 100 feet to 300 feet in width and would require buyouts of two to three flood-prone properties. Results indicate that up to about 2 feet of reductions in ice jam flooding on the Salmon River are possible downstream of the CSX railway and about 1 foot upstream of the railroad bridge. Extending the floodplain bench upstream to STA 57+00 was modeled as well, which would require an additional one to two flood-prone property buyouts and replacement of the rail bridge with a roughly 400-foot span that would accommodate continuous floodplain benching. This reduces ice jam flooding upstream of the railroad bridge by about another 1 foot. Similar reductions were modeled in the 2- and 5-year flood discharges coincident with ice jamming.

While the modeled floodplain benching can reduce flooding depths and damages in ice jam events, the remaining properties on the left bank of the Salmon River between STA 35+00 and STA 55+00 and on the right bank between STA 52+00 and STA 58+00 would remain susceptible to ice jam-related flooding. Depending on the discharges associated with ice jamming and the volume of breakup ice that accumulates, there are between 8 and 12 properties that are modeled as being the most vulnerable to ice jam flooding under existing conditions. Voluntary buyout or relocation of these residents is likely to be a more cost effective and reliable mitigation strategy than the extensive floodplain benching and railway bridge replacement that was modeled. These properties are also flood prone in clear water flood events. Because of tailwater controls on the Salmon River downstream of Fort Covington, the floodplain enhancements that may mitigate ice jamming would not have significant benefits in clear water flood conditions. Voluntary buyout or relocation, elevation, or floodproofing of flood and ice jam-prone properties on Pike, Salmon, and Water Streets north of Center Street is recommended. This area is mapped in Figure 4-6.

The CR-43 (Drum Street Road) bridge crossing of the Little Salmon River has an approximately 74-foot hydraulic opening, and modeling indicates that more than 500 feet of the roadway to the west is overtopped in the 100-year flood by depths of up to about 3 feet. The bridge is about 150 feet upstream of the confluence with the Salmon River, and flooding of the roadway to the west is influenced by both rivers. Elevation of this section of roadway may be a viable solution to keep the route in service during flood events, but this should be accompanied by a replacement bridge that provides an increase in conveyance commensurate with what would be lost by obstruction of overtopping flows on the floodplain. Due to the complex hydrodynamics of floodplain flows at the rivers' confluence, two-dimensional hydraulic modeling would be recommended for assessment of feasible alternatives to alleviate flooding of CR-43. Estimated bankfull width at this location on the Little Salmon River is 114 feet. This bridge was constructed in 1938 and is likely due for replacement in the near future. To meet NYSDEC stream crossing guidance, a minimum replacement bridge span of 142 feet would be recommended; however, a longer span may be necessary if roadway elevation is pursued.

Modeling indicates that the US Customs and Border Protection (CBP) facility on Dundee Road on the east bank of the Salmon River at STA 12+50 is not subject to flooding in assessed events. However, the station would be inaccessible from the north due to inundation of Dundee Road between the CBP station and the Canadian border in the 10-year and greater magnitude floods. Properties on Hopkins Point in Quebec are only accessible to vehicles via Hopkins Point Road in Fort Covington, which crosses into Canada on the west bank of the Salmon River. This road is modeled as becoming inundated beginning in the 5-year flood. County Route 43 (Drum Street Road) is subject to flooding just to the west of its crossing of the Little Salmon River in the 5-year and greater floods. Preparation of adequate road closure, detour, and evacuation routes in the event of forecast flooding or ice jamming conditions is recommended.



N
0 175
Feet

SLR
231 MAIN STREET
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NEW PALTZ, NY 12561
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HRA 1 - Flood-Prone Development

Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 300'
DATE 6/5/2024
PROJ. NO. 142.16511.00021

FIG. 4-6

4.2 High Risk Area 2 – Westville

HRA 2 is located in the town of Westville, where some areas are prone to riverine flooding from the Salmon River. HRA 2 is mapped in Figure 4-7. There are four bridge crossings of the Salmon River in Westville: Cushman Road (county-owned) at STA 375+00, County Route 4/Bombay-Westville Road/Coggin Bridge-Bombay Road (county-owned) at STA 435+00, County Route 19/Jewett Road (county-owned) at STA 503+50, and NY Route 37 (state-owned) at STA 510+00. The Westville Fire Department is located just south of the NY-37 bridge crossing at STA 510+00 but is modeled as being outside the flood-prone area.

According to the Franklin County Multi-Jurisdictional HMP, five parcels are substantially within the SFHA in the town of Westville. Approximate floodplains of the Salmon River, an unnamed tributary along Mary Riley Road, and Deer Creek are mapped on effective FIRM panels for Westville.

All four bridge crossings of the Salmon River in Westville are modeled as being hydraulically adequate for current conditions and meeting NYSDOT freeboard requirements for the projected future 50- and 100-year floods. The bridges' constrictions can generate minor backwaters, although the additional upstream flooding does not appear to impact any development. When these bridges are due for replacement, detailed hydrologic and hydraulic assessments are recommended, and new bridges should adhere to applicable NYSDEC guidance and NYSDOT standards.

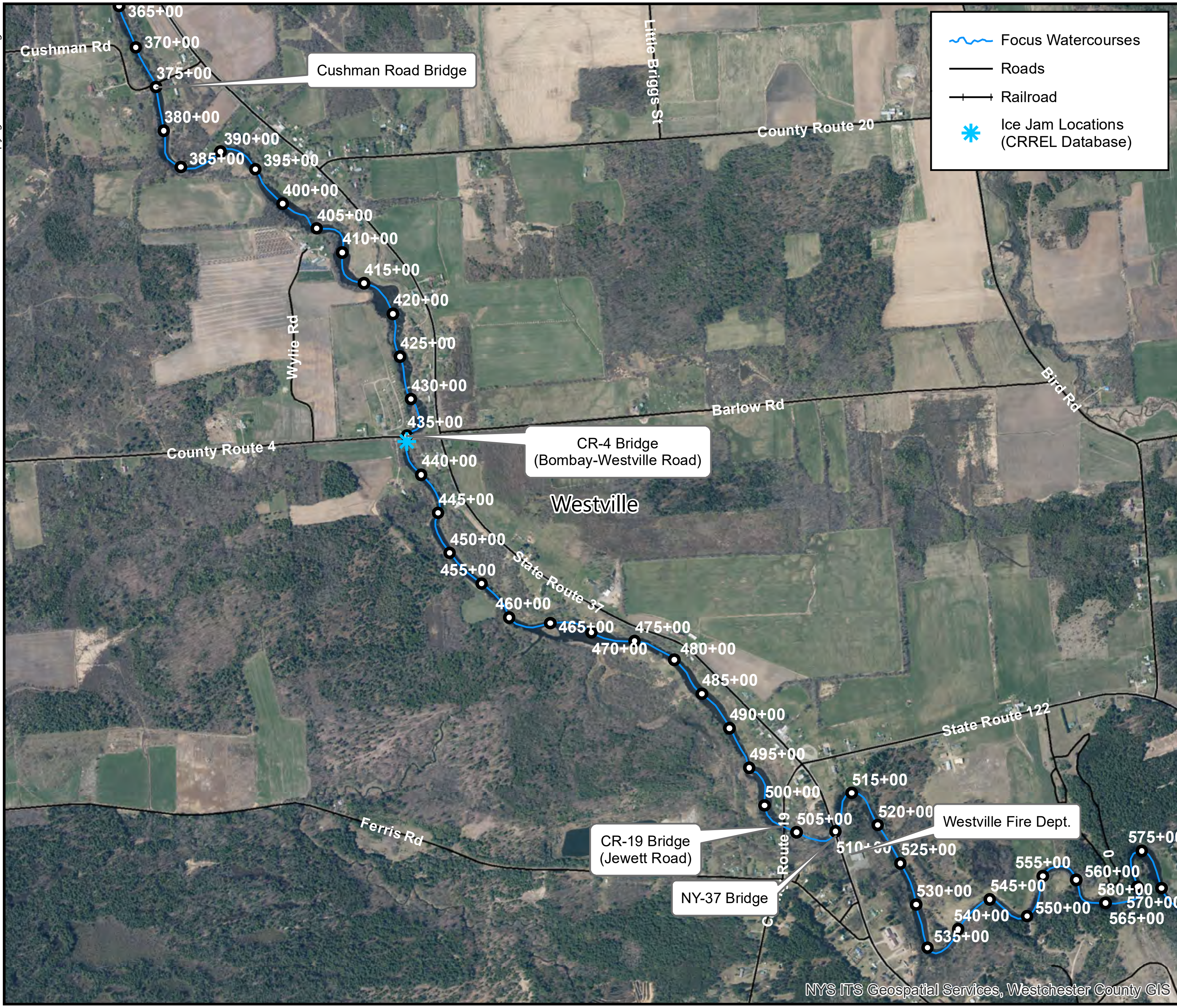
Ice jamming at the Coggin Bridge-Bombay Road bridge at STA 435+00 is reported in the CRREL database. Modeling indicates that ice jam conditions can cause flooding of the Babbling Brook RV Park campground downstream of the bridge and at least two properties upstream, depending on the river discharge associated with the ice jam event. Ice jamming in this area can produce greater flood depths than the free-flowing 100-year flood and appears to result from the relatively broad, shallow reach of stream between the bridge and a bedrock cascade approximately 500 feet downstream. This reach, from roughly STA 430+00 to STA 435+00, includes a sharp dogleg bend at about STA 433+50 and a bifurcation around an island in the channel at STA 431+50. The bend and the island can inhibit the transport of ice, and large rafts of breakup ice may become grounded in the shallow waters of this reach. The constriction of the Coggin Bridge-Bombay Road bridge may contribute to ice jamming at this location, although, other than in cases where the bridge low chord is impacted by ice, removal of the bridge and embankment from the hydraulic model did not produce any meaningful flood depth reductions in cases where ice accumulates due to the channel geometry.

It is recommended that any guests or residents at the Babbling Brook campground be located at campsites away from the river during winter months.

Ice jamming on the Salmon River has also occurred upstream of the Coggin Bridge-Bombay Road bridge, extending to the CR-19 bridge at STA 503+50 (Photo 4-3) as well as upstream of an anabranching reach near STA 620+00 and a sharp meander just downstream of the Fireman's Memorial Park and training grounds near STA 650+00 (Photo 4-4). There is limited development along these reaches, although nearby residents in low-lying areas adjacent to the river should make preparations when ice jamming occurs or is forecast in case evacuation becomes necessary.

Photo 4-3 Ice jamming downstream of CR-19 bridge, January 2018. Photo provided by Village of Malone.

Photo 4-4 Ice jamming near Fireman's park and training grounds. Photo provided by Village of Malone.



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NEW PALTZ, NY 12561
845.633.8153

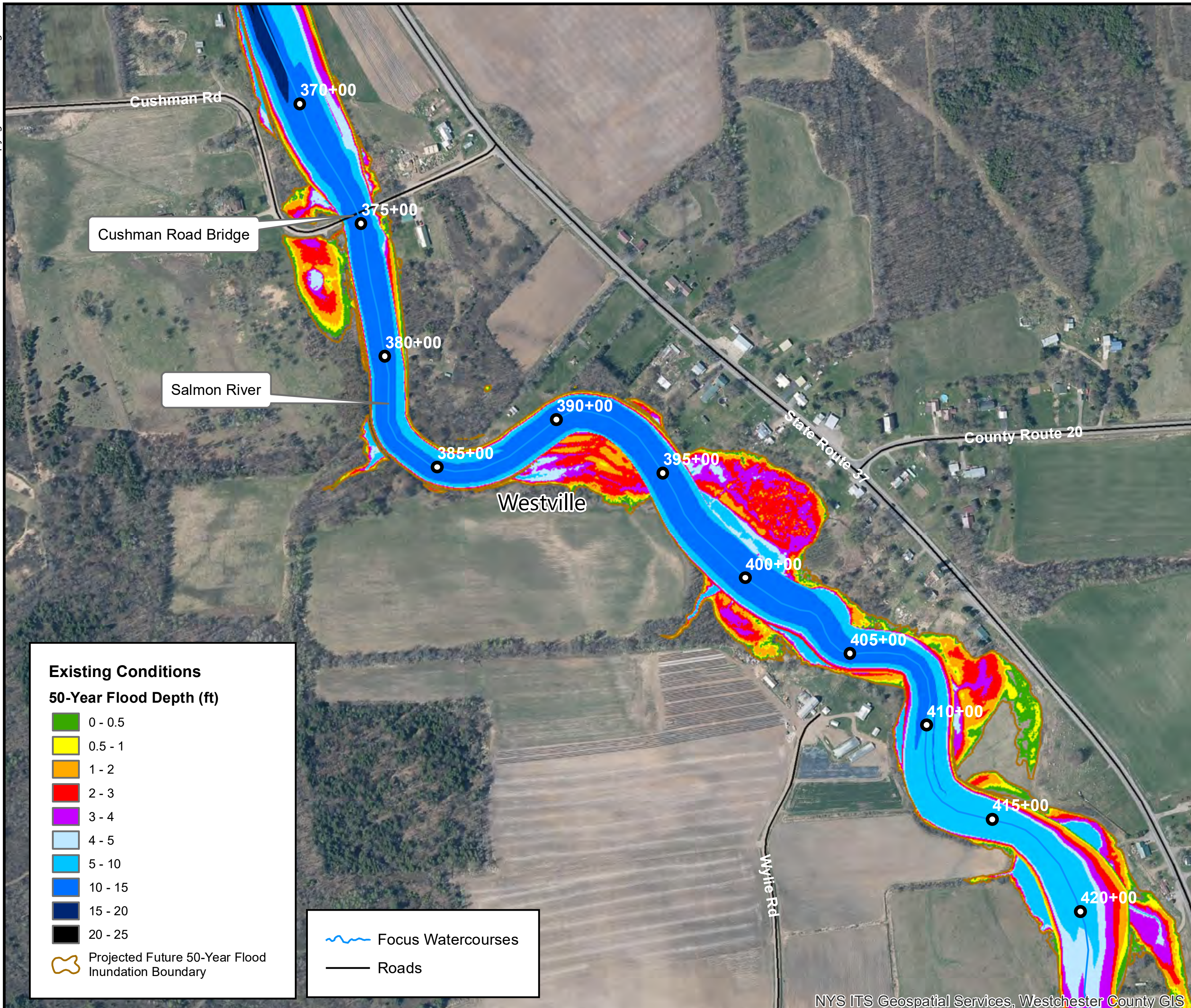
HRA 2
Salmon River Flood & Ice Jam Study
SD755
Franklin County, NY

SCALE 1" = 1,500'

DATE 1/26/2024

142.16511.00021
PROJ. NO.

FIG. 4-7



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HRA 2 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study

SD755

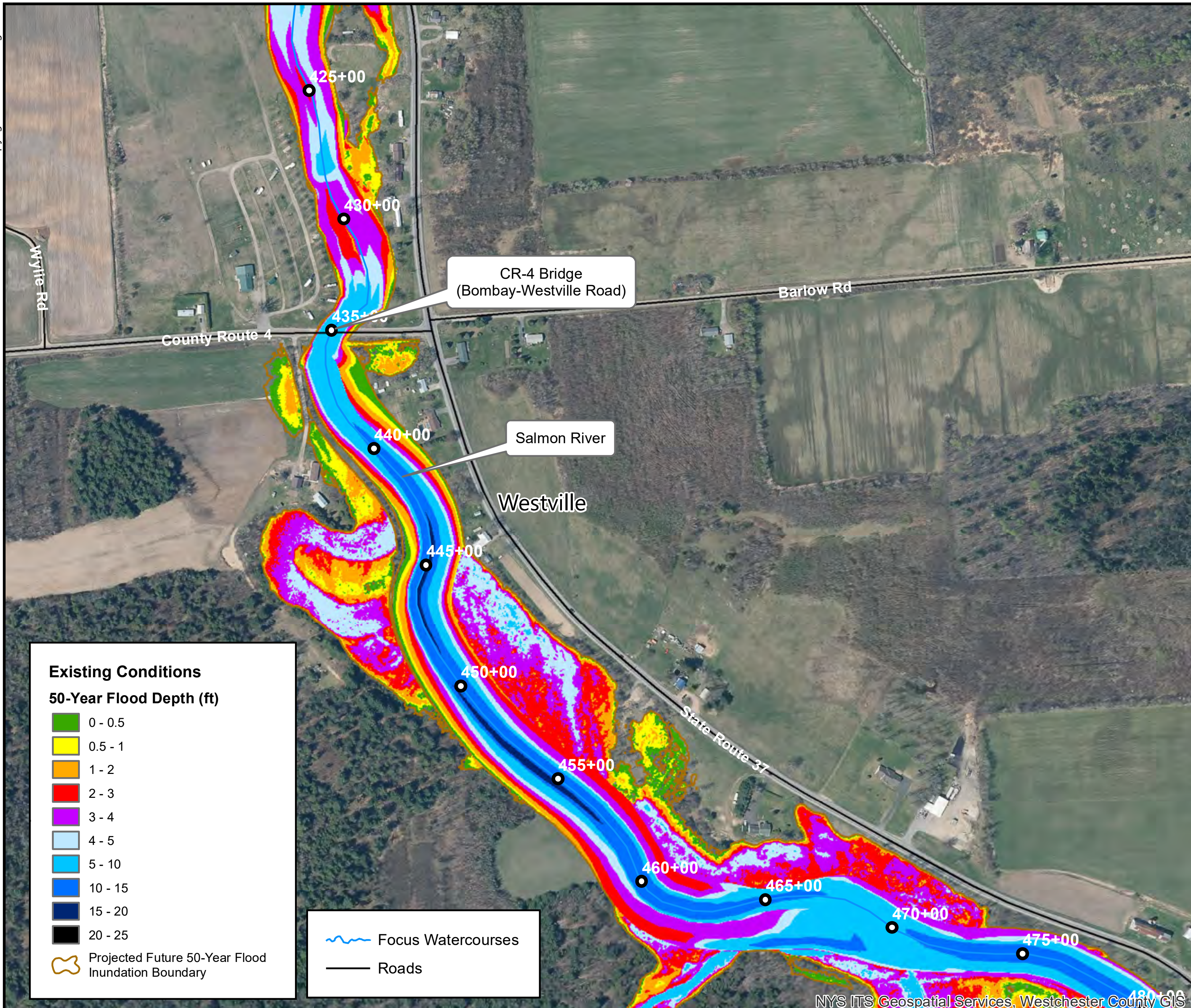
Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

142.16511.00021
PROJ. NO.

FIG. 4-8A



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231 MAIN STREET
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NEW PALTZ, NY 12561
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HRA 2 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study

SD755

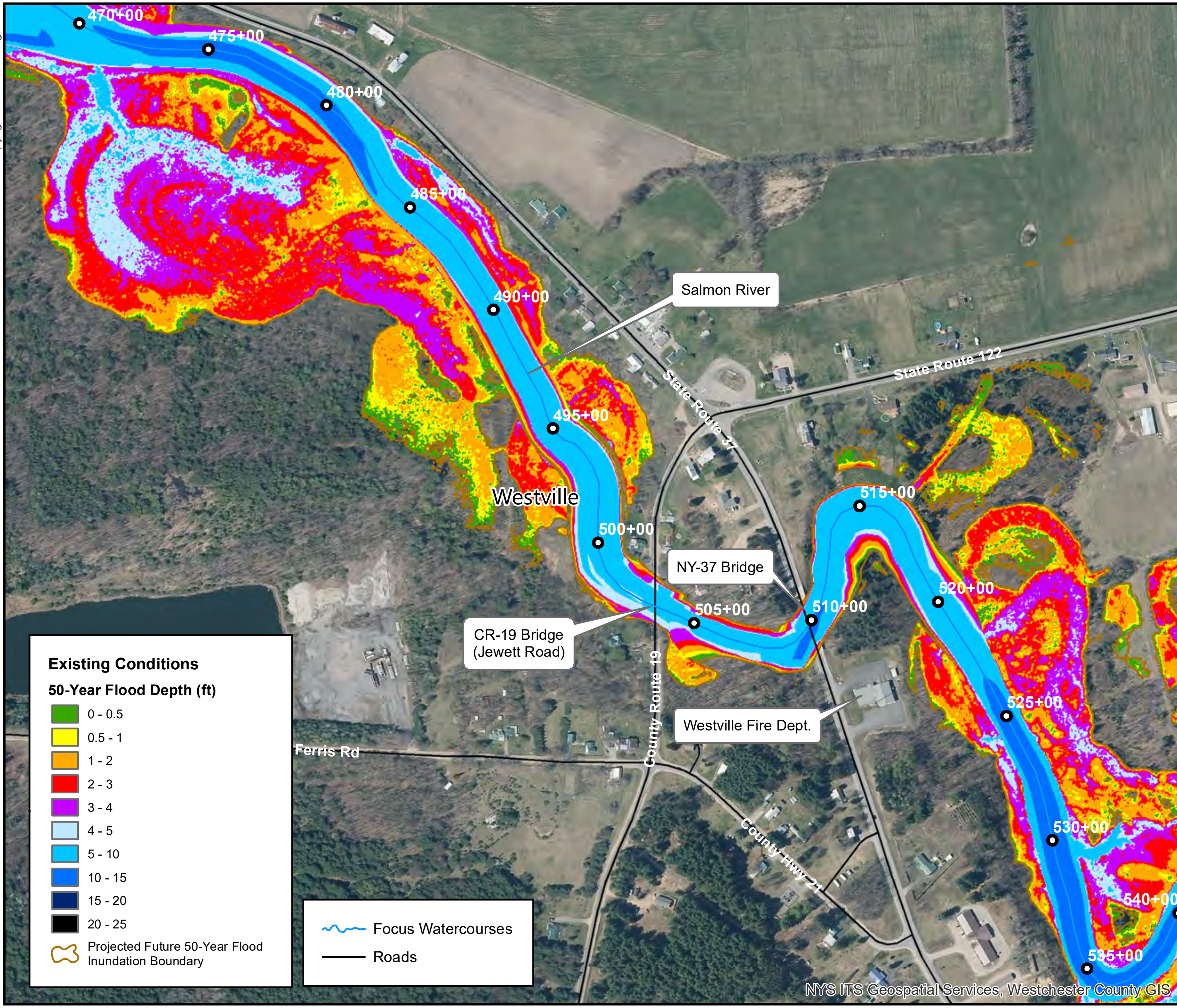
Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

142.16511.00021
PROJ. NO.

FIG. 4-8B



N

0 300
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 2 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study

SD755

Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

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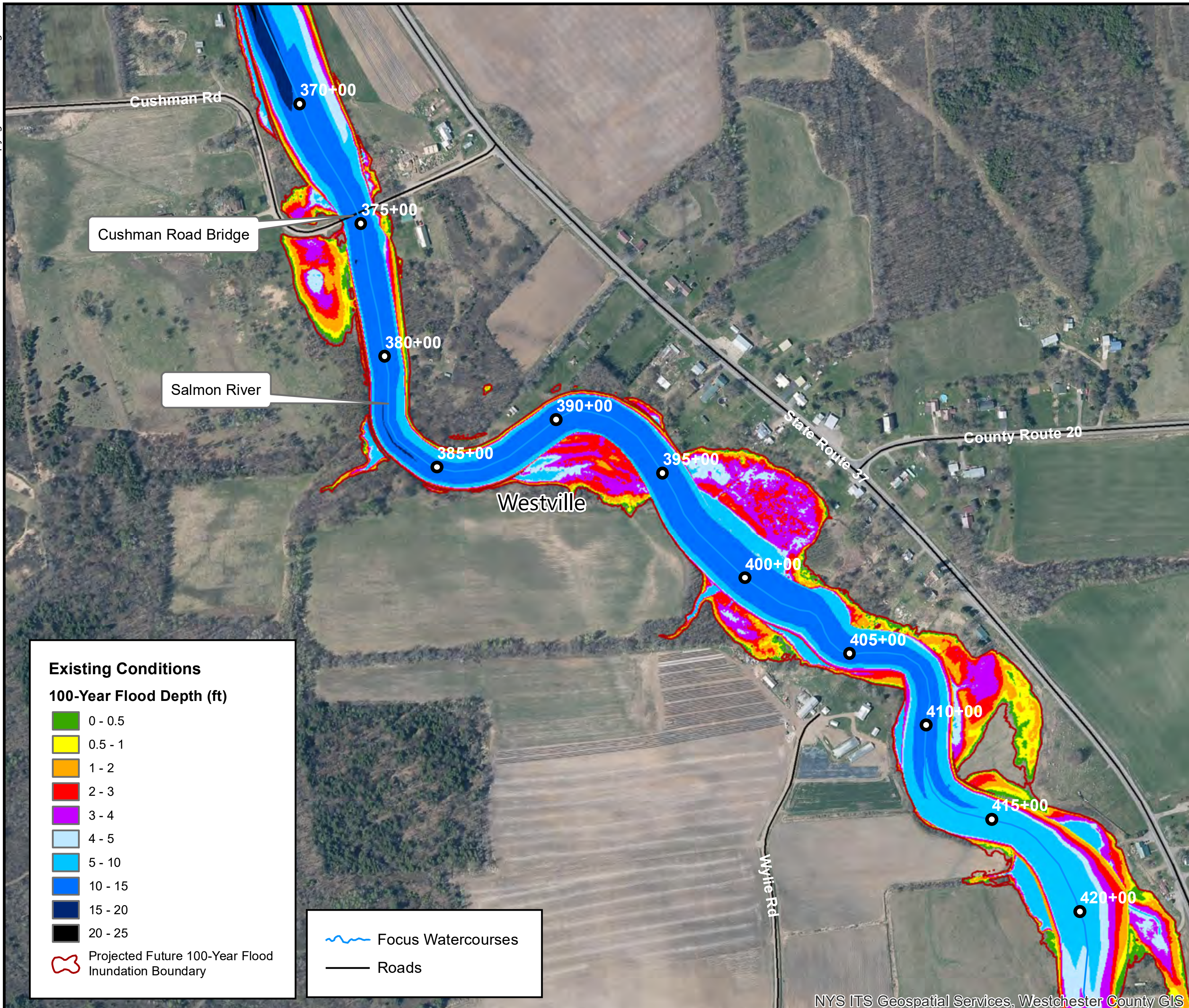
PROJ. NO.

FIG. 4-8C



N

0 300
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 2 - Current & Projected Future 100-Year Flood

Salmon River Flood & Ice Jam Study

SD755

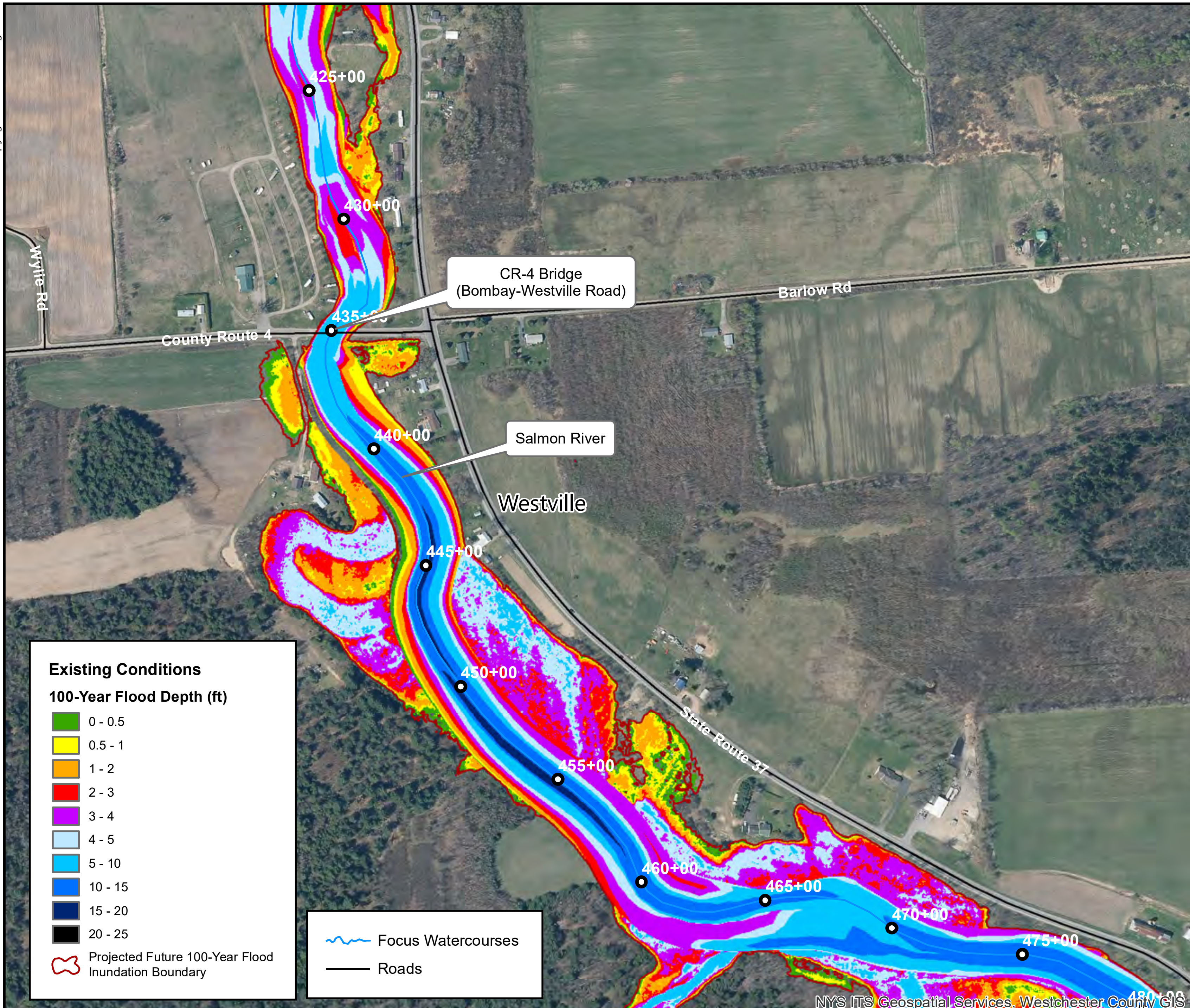
Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

142.16511.00021
PROJ. NO.

FIG. 4-9A



N

0 300
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 2 - Current & Projected Future 100-Year Flood

Salmon River Flood & Ice Jam Study

SD755

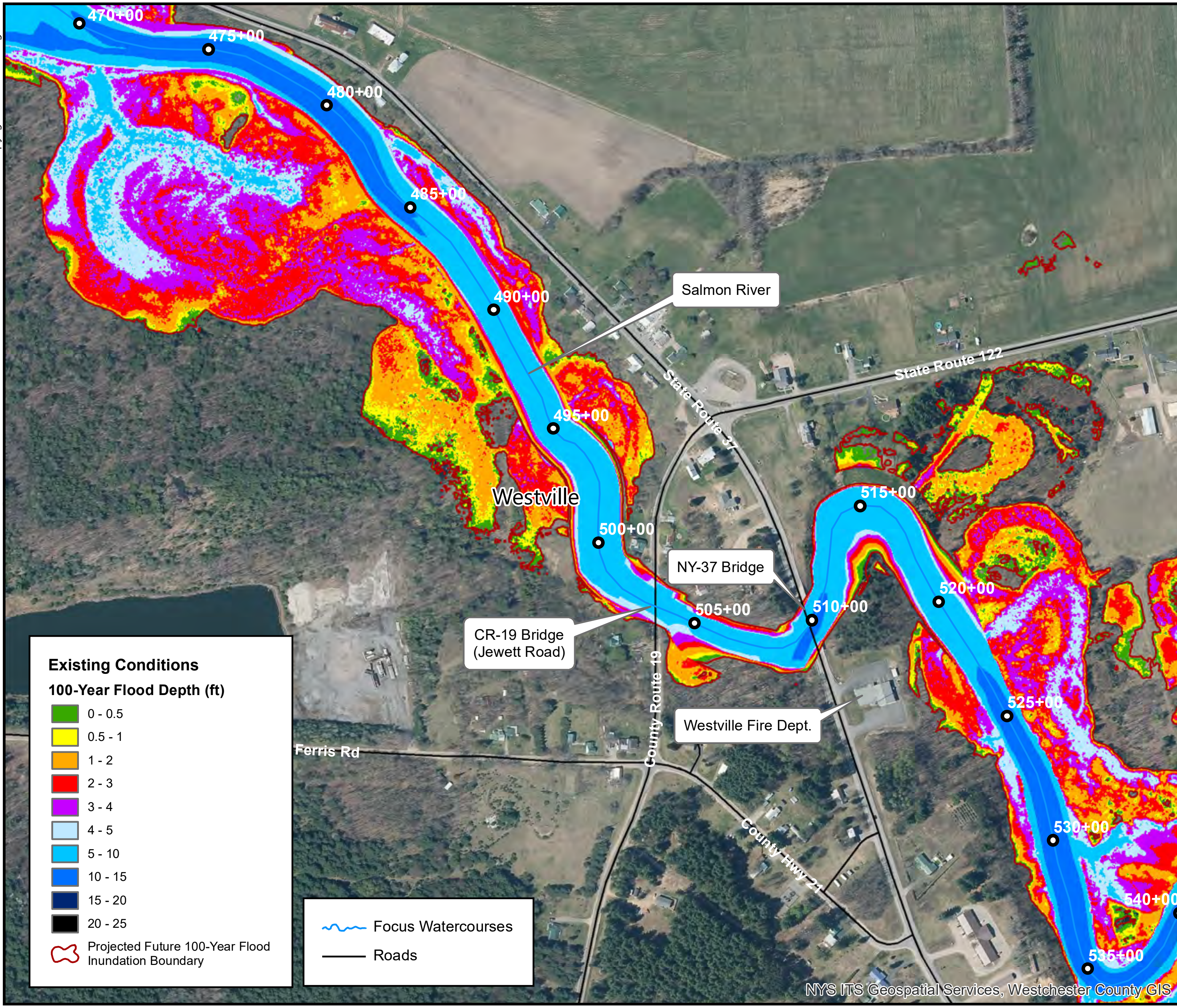
Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

142.16511.00021
PROJ. NO.

FIG. 4-9B



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NEW PALTZ, NY 12561
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HRA 2 - Current & Projected Future 100-Year Flood

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

SCALE 1" = 500'

DATE 5/23/2024

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PROJ. NO.

FIG. 4-9C

4.3 High Risk Area 3 – Malone

HRA 3 is located in the town and village of Malone, with riverine flooding associated with the Salmon River and Branch Brook, which joins Salmon River in the southern part of the village. HRA 3 extends from the Macomb dam (High Falls dam/Lamica Lake dam) at STA 1000+00 to the Ballards dam at STA 1181+00. Bridge crossings of the Salmon River in HRA 3 include Brand Road (county-owned) at STA 1012+00, Lane Street (county-owned) at STA 1081+00, US Route 11/Main Street (state-owned) at STA 1132+00, Pearl Street (county-owned) at STA 1150+00, and Willow Street (county-owned) at STA 1173+00. HRA 3 is mapped in Figure 4-10.

Critical facilities in HRA 3 that may be indirectly impacted by flooding include the Malone Wastewater Treatment Plant (WWTP) near STA 1065+00 and the Malone Village Department of Public Works (DPW) garage just downstream near STA 1060+00. Portions of the WWTP parcel are within the 100- and 500-year floodplains, but the facility does not appear to be inundated under clear water conditions. Modeling indicates that the DPW garage is also not directly impacted by flooding. However, about 600 feet of West and Lane Streets, which provide access to the garage and the WWTP, are submerged by up to 1.3 feet in the modeled 100-year flood, which may render both facilities inaccessible to most vehicles during such an event. Aerial imagery indicates that there are gravel access roads to the west of both the WWTP and the DPW garage that reach Brand Road to the north through a series of village-owned parcels. These roads are recommended to be improved if necessary and formalized for reliable emergency access to the two facilities in flood events.

Additional critical facilities that are not modeled as being impacted by flooding include the Malone Fire Department, three correctional facilities, the Franklin County Sherriff's Department, the village water treatment plant, and the Alice Center hospital. In addition to the fire department, the Malone YMCA and the Malone Adult Center are identified as emergency shelters. These are not located within modeled floodplains.

Portions of the reach of the Salmon River between Ballards dam at STA 1181+00 and the Macomb (High Falls) dam at STA 1000+00 were cleared and dredged by the USACE in 1959 to reduce the threat of ice and debris jams in the town and village of Malone. The town and village are currently exploring options for additional dredging of the Salmon River upstream of the Macomb dam and near the WWTP.

According to the Franklin County Multi-Jurisdictional HMP, 64 parcels are substantially within the SFHA in the town of Malone and 61 parcels in the village. In the town of Malone, approximate floodplains of the Salmon River, Collins Brook, Limekiln Brook, Branch Brook, Winslow Brook, Fishpole Outlet, Duane Stream, Townline Brook, Tamarack Brook, and several unnamed tributaries are mapped on effective FIRM panels. In the village, the Salmon River has detailed mapping, and Branch Brook is mapped by approximate methods.

Date Saved: 1/26/2024
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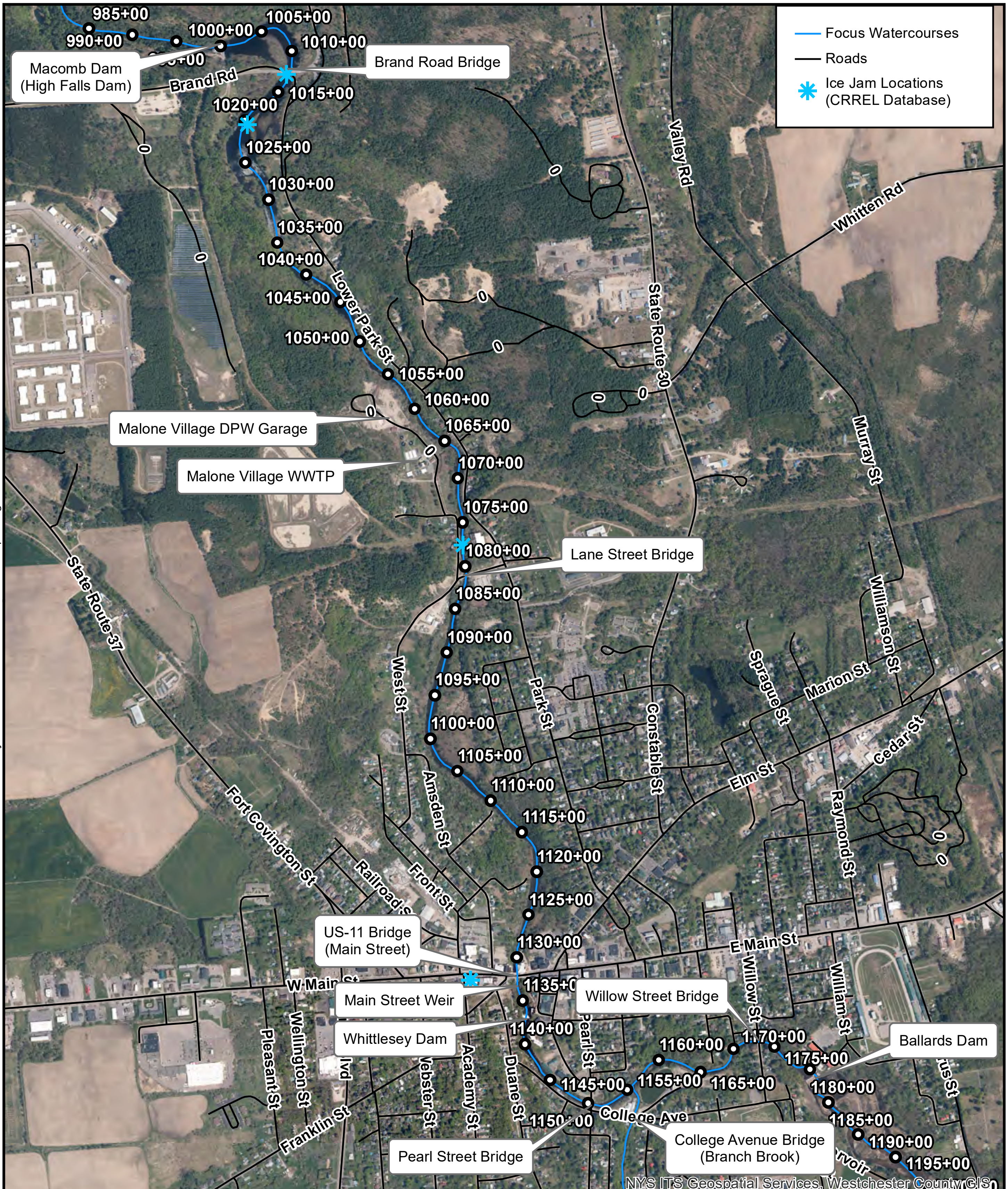

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SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Malone

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

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Feet

SCALE 1" = 1,500 '
DATE 1/26/2024
142.16511.00021
PROJ. NO.

FIG. 4-10

4.3.1 Dams in HRA 3

Five dams are located on the Salmon River in the town and village of Malone; four of these are located within HRA 3. Three dams are within the village: the Main Street weir at STA 1132+70 just upstream of the US-11 bridge, the Whittlesey dam (adjacent to the Horton Grist Mill) at STA 1137+00, and the Ballards dam at STA 1181+00. Two dams are within the town of Malone: the Macomb dam at STA 1000+00 and the Chasm Falls dam, which is outside of HRA 3 at STA 1650+00. Branch Brook is dammed at the Malone Recreation Park near the southern corporate limits of the village.

The Main Street weir at STA 1132+70 is not in the NYSDEC dam inventory and is roughly 6 feet high. The structure is referred to as the “Main Street Weir” in the 1977 FIS for the Village of Malone (360272V000). The dam does not serve any known purpose and is recommended to be removed to decrease upstream floodwater elevations and restore aquatic organism passage.

The Whittlesey dam (NYSDEC 165-0148) at STA 1137+00 is a 19-foot-high concrete gravity dam that was constructed in 1925 for hydroelectric power generation but is no longer active. The listed owner of the dam is the Village of Malone Office of Commercial Development. The dam is rated as a Class A, Low Hazard dam, and was last inspected in 1972. A penstock travels downstream from the dam on the right bank approximately 600 feet into a powerhouse building immediately adjacent to the US-11 bridge. During a site visit, a leak at the top of the penstock indicated that it is charged with water, which is generally not advisable for a non-operational dam due to the risks of uncontrolled releases and damage from water freezing in the pipe. The powerhouse building at 399 East Main Street was observed to be in a deteriorating structural condition, with elements of missing masonry, visible bulging, and apparent separation of southern wall, and the building also severely restricts the effective hydraulic opening of the US-11 bridge.

Hydraulic modeling indicates that the Whittlesey dam raises upstream water surface elevations in the 100-year flood by as much as approximately 14 feet. The 100-year flood backwaters behind this dam extend for approximately 1,000 feet upstream, causing flooding of adjacent properties, including the Malone Housing Authority Riverside Haven facility, and exacerbates flooding of several buildings on two other properties on the right bank of the Salmon River. On the left bank, five properties are impacted by the 100-year flood backwaters upstream of the Whittlesey dam. Many of these properties are also flooded in the 50-year event. Under existing conditions, the 100-year flood inundates approximately 375 feet of College Avenue with depths of up to nearly 3 feet near STA 1145+00. Removal of the dam from the model reduces this to depths of up to about 1.8 feet over 250 feet of the roadway and alleviates 100-year flooding at five homes along this section of College Avenue. Dam removal would also alleviate 100-year flooding at the Riverside Haven facility buildings and reduces flood depths by about 1 foot at businesses on the right bank farther upstream. Removal of the dam, penstock, and powerhouse buildings is recommended. Existing and proposed conditions flood depth mapping for the 50- and 100-year floods is depicted in Figure 4-11 through Figure 4-14. It is recommended that the penstock be decommissioned and closed at the upstream end (at the dam) as soon as practical.

The Ballards dam (NYSDEC 165-0149) is a Class B, Intermediate Hazard, 12-foot-high timber crib and rock fill dam constructed in 1901 for hydroelectric power generation, although the dam no longer serves this purpose. The North County Community College is listed as the dam’s owner in the NYSDEC inventory, which also notes the last inspection as occurring in 1998. Ice formation and accumulation in the impoundment has occurred in the past (Photo 4-6).

Outside of the village, two hydroelectric power dams operate in the town of Malone under active Federal Energy Regulatory Commission (FERC) licences: the Macomb dam, also known as the High Falls dam or Lamica Lake dam, at STA 1000+00 (NYSDEC 165-0134); and the Chasm Falls dam at STA 1650+00 (NYSDEC 182-0229). Both facilities are owned and operated by Erie Boulevard Hydropower/Brookfield Renewable.

These two hydropower dams conduct sediment management programs wherein release of accumulated sediment in their respective impoundments by operation of their low-level outlets is permitted under certain hydrologic conditions. The criteria for sediment release are based on the ability of the Salmon River to effectively transport the sediments downstream and are associated with geomorphologically significant discharges over a specified duration. Sediment flushing at Chasm dam may be initiated when flows exceed 700 cfs at the dam and are projected to remain above this level for at least 24 hours, and flows of at least 500 cfs are projected or able to be maintained by traditional releases for another 24 hours after the cessation of sediment flushing. At Macomb dam, flushing may begin 8 hours after the 700-cfs threshold is met at Chasm dam, with the same requirements for the duration of flows.

The three disused dams in the village of Malone, especially the upstream-most Ballards dam, interfere with the continuity of the sediment management plans for the Chasm and Macomb dams. The sediment released as prescribed from the Chasm dam becomes trapped in the Ballards dam impoundment, which does not have a sediment management plan and appears to be experiencing severe aggradation, shown in Photo 4-5. In addition to flood mitigation, safety, and AOP considerations, removal of the three disused dams is recommended to allow for continuity of sediment transport under prescribed releases from the two active hydroelectric dams.

Branch Brook is dammed in the village at the Memorial Recreation Pond dam (NYSDEC 165-1235), a 19-foot-high earth and concrete dam that creates a pond at the Malone Recreation Park. The Class B, Intermediate Hazard dam was constructed in 1946 and is owned by the Village of Malone. The dam’s condition is rated as deficiently maintained in the NYSDEC dam inventory database. Regular inspections and timely completion of any necessary repairs are recommended.

The Macomb dam impoundment, known as Lamica Lake, extends for roughly 4,000 feet upstream of the dam. In the 100-year flood, backwater from the Macomb dam causes about 1,000 feet of Lower Park Road, between STA 1017+00 and STA 1031+00, to be submerged by up to about 3 feet. Over the past decade, about 10 properties on Lower Park Road between STA 1025+00 and STA 1040+00 that would be inundated in this scenario have been bought out and demolished. The remaining structures in this area are modeled as being outside the 100-year floodplain, but portions of the associated parcels may be subject to flooding. Due to inundation of Lower Park Road, access to these properties may be restricted during flood and ice jam events.

Modeling indicates that without the dam, upstream 100-year flood depths can be reduced by between 3 feet and 4 feet, alleviating flooding of Lower Park Road. However, because of its active operation as a hydroelectric facility, removal of the Macomb dam is not a practical recommendation at this time. It may be possible to modify the dam to increase spillway capacity in flood events without impacting power generation, which could result in minor reductions in upstream flooding. Early evacuation of affected residents and preparation of adequate road closure and detour signage for Lower Park Road is a more viable strategy.

Ice jamming has been reported upstream of the Macomb dam and the Brand Road bridge at STA 1012+15. Because solid ice can form in the slack waters of Lamica Lake, incoming breakup ice can accumulate upstream of the intact ice. Ice jamming may also occur at the Brand Road bridge constriction. Modeled ice jamming in this area can produce flood depths comparable to the free-flowing 100-year flood. Fortunately, the properties that would be most severely impacted by ice jam flooding in this area have been bought out, although inundation of Lower Park Road can occur during ice jams.

Photo 4-5 2020 NYS orthophoto showing sediment aggradation at Ballards dam

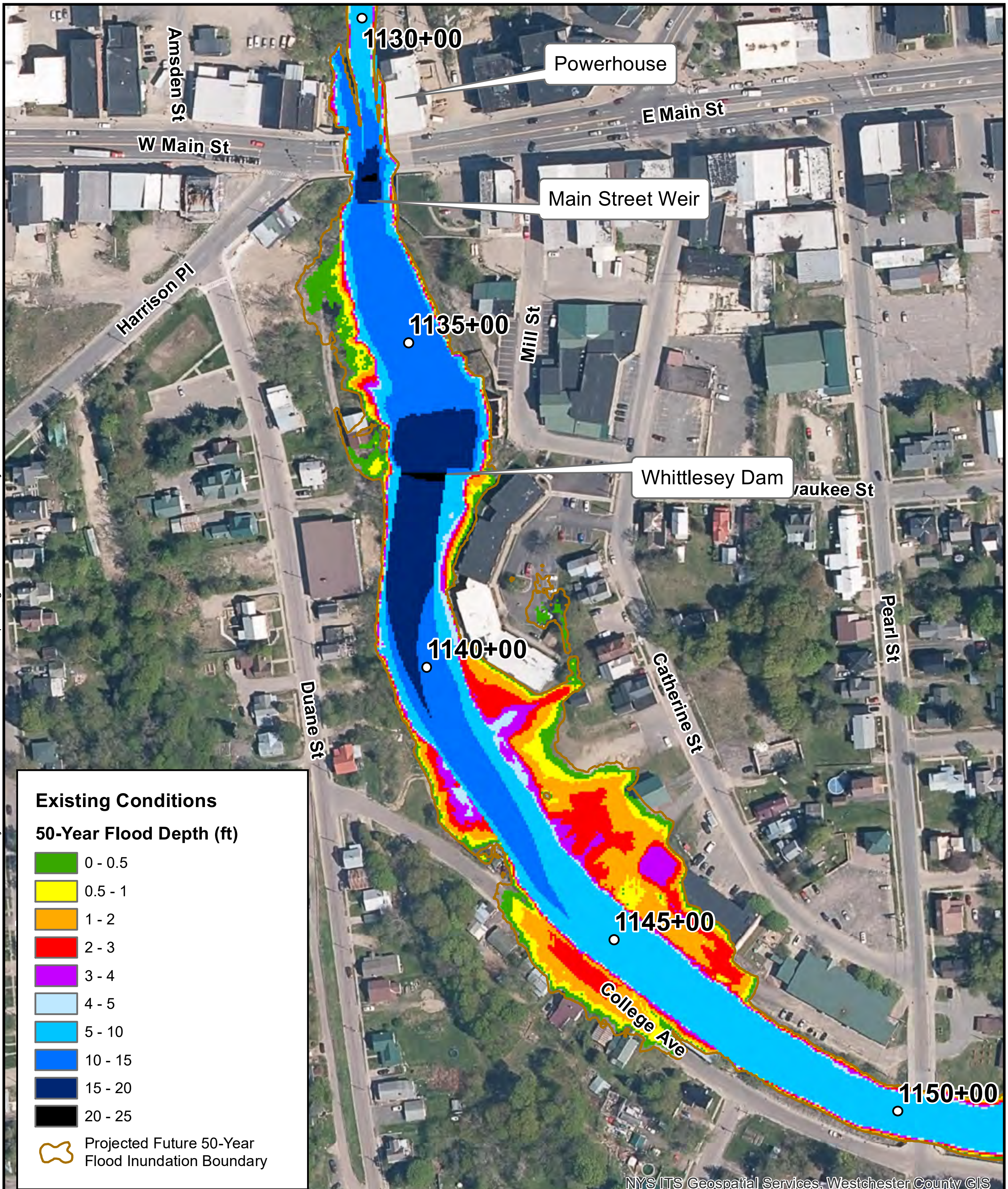
Photo 4-6 Ice formation and accumulation at Ballards dam. Photo provided by Village of Malone.

Photo 4-7 View of Whittlesey dam and penstock

Photo 4-8 View of 399 Main Street building and Whittlesey dam penstock. US-11 bridge at top of image. The building significantly reduces the effective hydraulic opening of the bridge; note visible bulging of the structure along the left side.

Photo 4-9 Whittlesey dam penstock entering powerhouse building beneath US-11 bridge, abutment at left. The majority of the bridge opening is obstructed.

Photo 4-10 Main Street weir viewed from downstream, US-11 bridge left (west) abutment at right of image, Whittlesey dam penstock at left.



1

SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Whittlesey Dam - Existing Conditions 50-Yr Flood

Salmon River Flood & Ice Jam Study
SD 755

Franklin County, NY

N

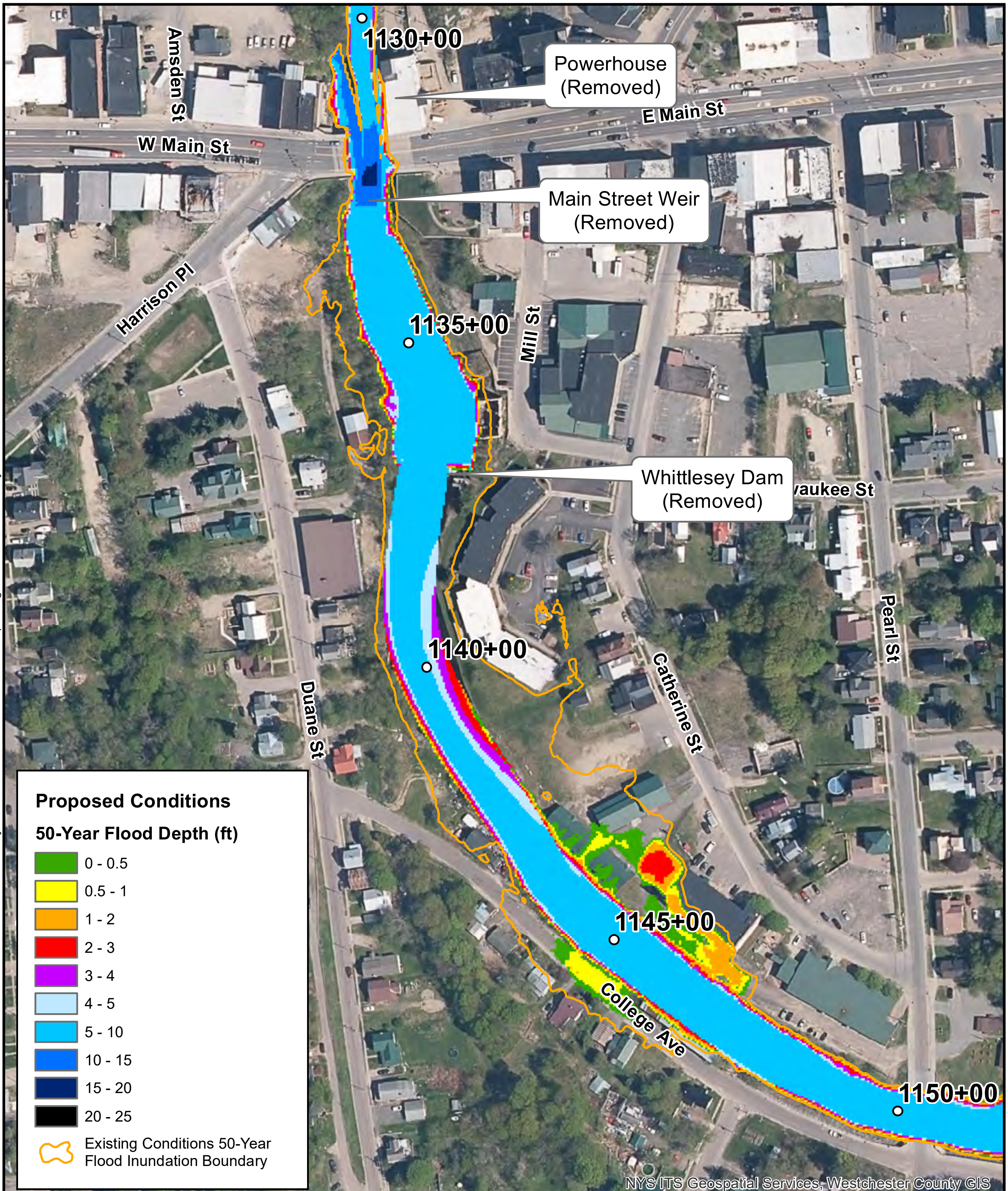
0 200
Feet

SCALE 1" = 200'

DATE 1/22/2024

142.16511.00021
PROJ. NO.

FIG. 4-11



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1

SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Whittlesey Dam - Proposed Conditions 50-Yr Flood

Salmon River Flood & Ice Jam Study

SD 755

Franklin County, NY

N

0 200 Feet

SCALE 1" = 200 '

DATE 1/22/2024

142.16511.00021
PROJ. NO.

FIG. 4-12

Date Saved: 11/22/2023
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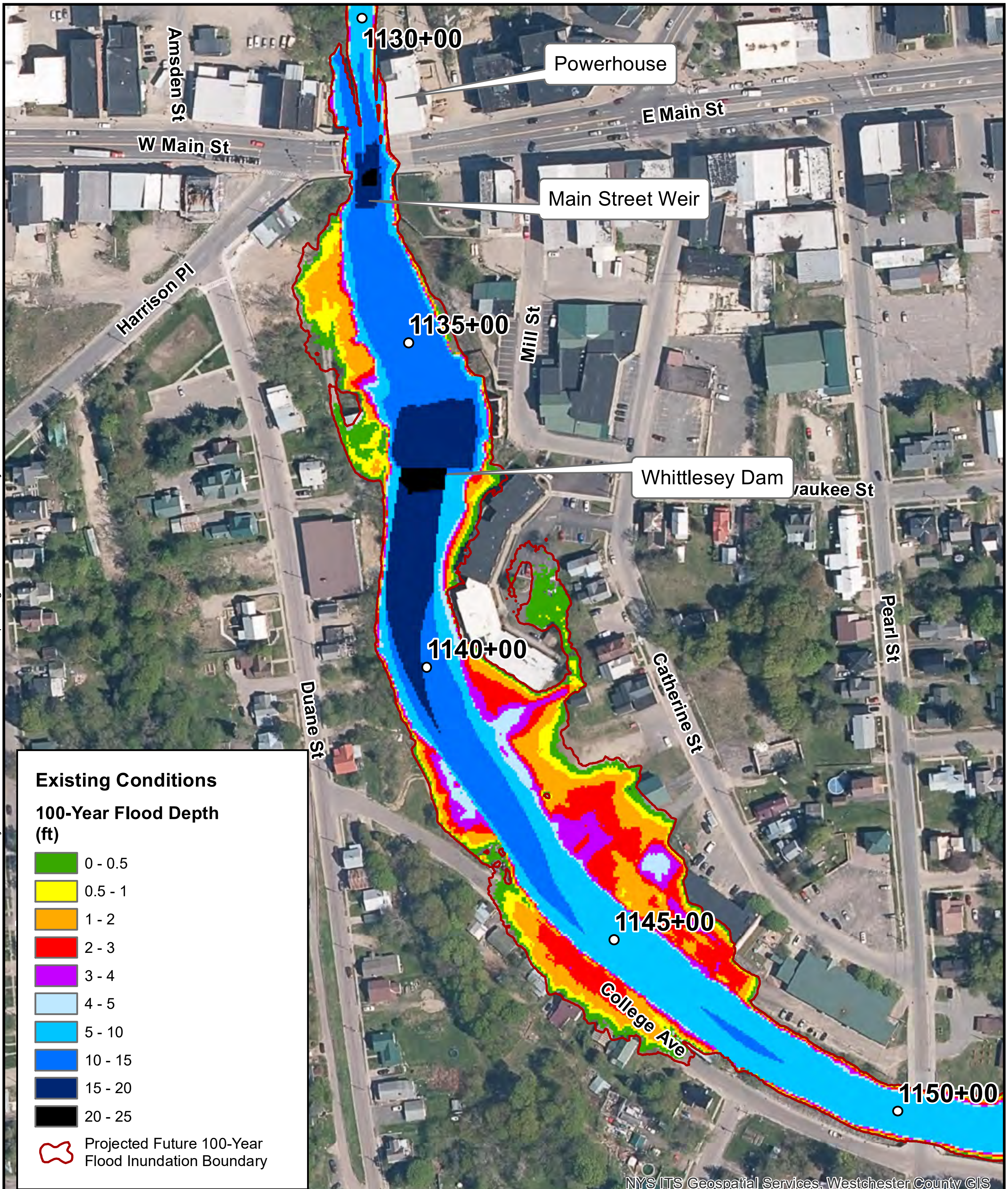


SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Whittlesey Dam - Existing Conditions 100-Yr Flood

Salmon River Flood & Ice Jam Study
SD 755

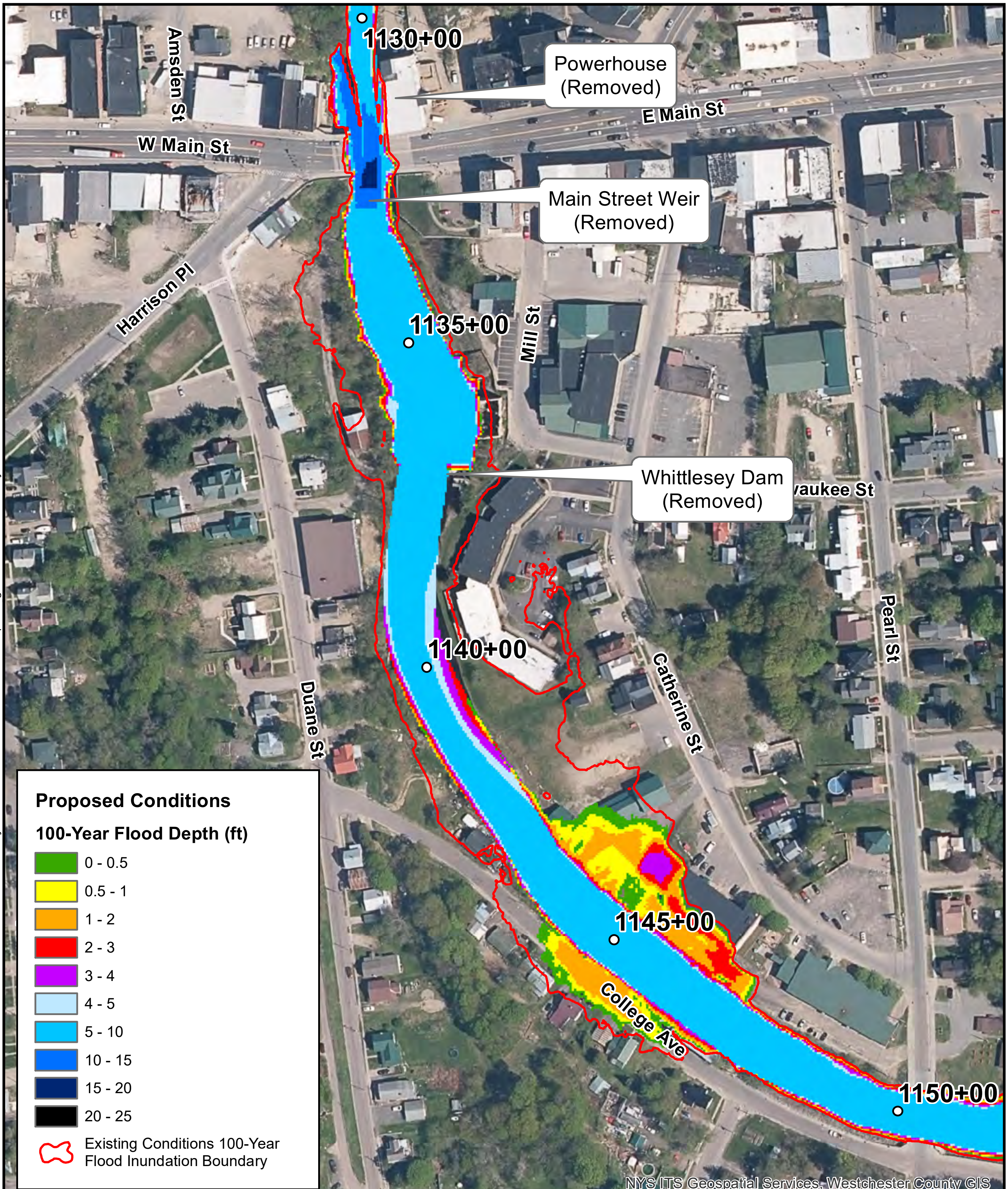
Franklin County, NY

N

0 200
Feet

SCALE	1" = 200'
DATE	1/22/2024
PROJ. NO.	142.16511.00021

FIG. 4-13



Date Saved: 11/22/2023

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SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Whittlesey Dam - Proposed Conditions 100-Yr Flood

Salmon River Flood & Ice Jam Study

SD 755

Franklin County, NY

N

0 200 Feet

SCALE 1" = 200'

DATE 1/22/2024

142.16511.00021
PROJ. NO.

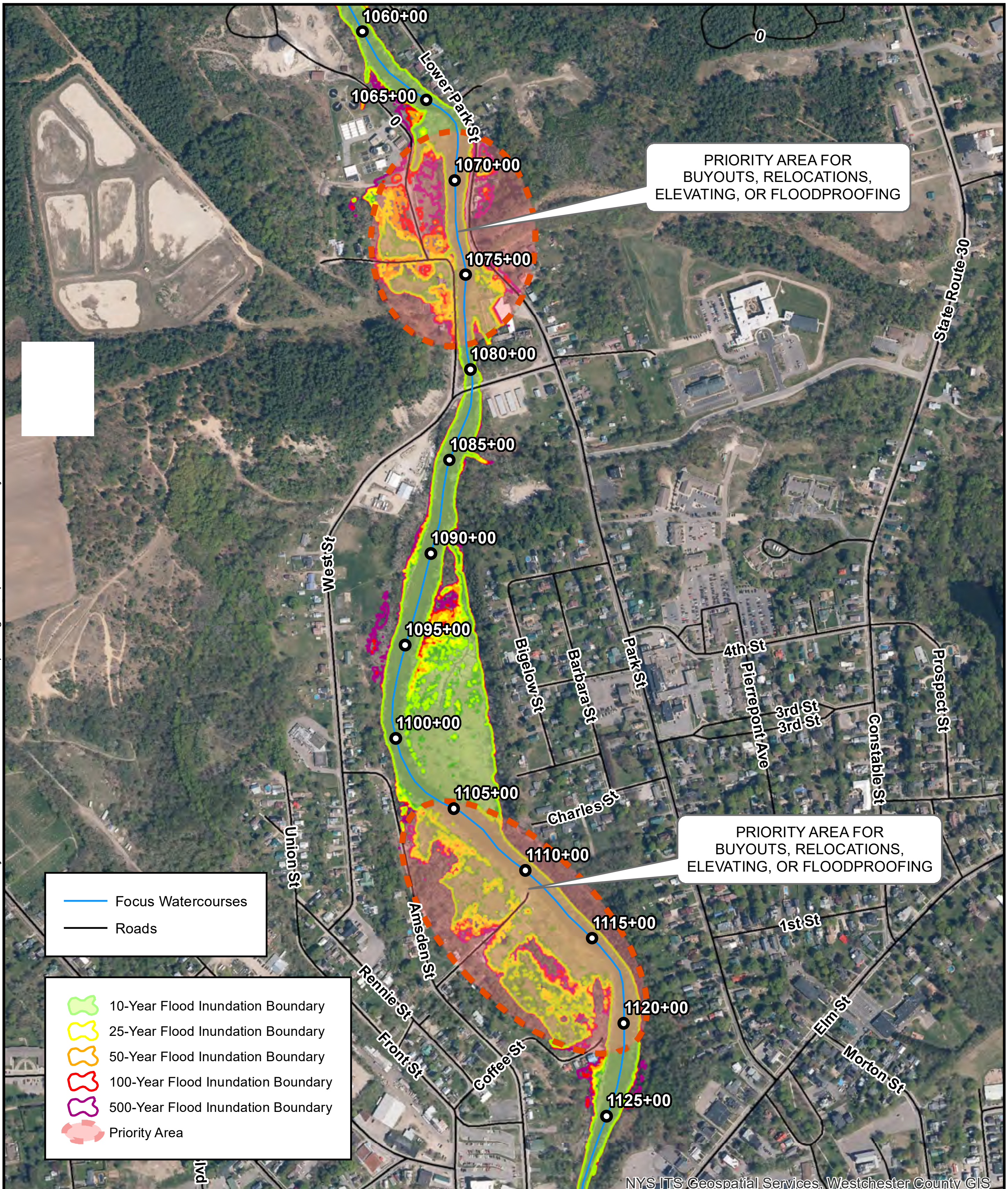
FIG. 4-14

4.3.2 Naturally Flood-Prone Areas in HRA 3

Some naturally flood-prone areas are sparsely developed, and depending on the severity of flooding and landowner preferences, floodproofing or elevating structures or buyout or relocation may be the most practical mitigation alternatives.

Between STA 1073+00 and STA 1080+00, one business on Lower Park Road on the right bank of the Salmon River is flood prone. On the left bank, four homes along West Street and two homes on Lane Street are impacted by flooding on Salmon River. 100-year flood depths of up to 2.5 feet are modeled in this area. Lower Park Road, West Street, and Lane Street are all susceptible to inundation. This area has also been impacted by ice jams, which can generate flood depths greater than the 100-year flood under clear water conditions.

Between STA 1105+00 and STA 1113+00, flooding along Salmon River impacts one home on Amsden Street and four homes on Factory Street. This is a low-lying area of the floodplain, and these properties are also modeled as being vulnerable to flooding under natural conditions scenarios as well as existing conditions. Voluntary buyout or relocation, elevation or floodproofing of flood-prone properties in these areas shown in Figure 4-15 is recommended.



SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Flood-Prone Development

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

0 500 Feet

SCALE 1" = 700'

DATE 6/6/2024

142.16511.00021
PROJ. NO.

FIG. 4-15

4.3.3 Bridge Crossings in HRA 3

The Brand Road, Lane Street, US-11 (Main Street), and Pearl Street bridges over the Salmon River are modeled as meeting NYSDOT standards for freeboard in projected future flood scenarios. The Willow Street bridge is modeled as undersized for projected future floods and is discussed in the next section.

The US-11 (Main Street) bridge crossing of the Salmon River is elevated about 50 feet above the channel bed and has ample freeboard in modeled flood events. However, the Salmon River channel is severely constricted at the bridge crossing. Although the bridge has a clear span of 108 feet, the effective hydraulic opening is only about 32 feet. On the right (east) bank, the buildings at 399 and 403 East Main Street obstruct roughly 60 feet of the bridge opening (Photo 4-8) while what appears to be a massive concrete buttress supporting the western abutment occupies nearly 20 feet of the opening (Photo 4-9). This constriction generates excess backwaters of up to 5 feet in the 50- and 100-year floods, is prone to ice jamming, which is reported at this location in the CRREL database, and also generates extreme velocities in flood events. 10-year flood velocities exceed 20 feet per second (fps) through the bridge and alongside the Whittlesey powerhouse, with velocities approaching 25 fps in the 100-year flood. These powerful flows may pose a risk to the adjacent building. Demolition and removal of the building at 399 East Main Street is recommended, and in the short term, inspection of the building by a qualified structural engineer is recommended. The US-11 bridge was constructed in 1947 and rehabilitated in 1991; when it is due for replacement, the existing span appears to be adequate; however, the left (west) abutment should be reconfigured such that it does not encroach on the channel.

The College Avenue bridge crossing of Branch Brook (county-owned) has inadequate hydraulic capacity due to a utility crossing immediately upstream, which is situated below the low chord of the bridge and supported on a steel girder (Photo 4-11). This reduces the effective vertical hydraulic opening of the bridge by more than 2 feet. In the modeled 100-year flood, the two homes on either bank just upstream of the bridge are flooded by up to about 3 feet. Relocating the utility crossing such that it does not obstruct flows would reduce upstream 100-year flood depths by between 3 feet and 4 feet at the two affected properties. This is a comparable reduction to a natural conditions scenario, indicating that without the utility crossing the bridge itself would be hydraulically adequate to convey flood flows. Relocating the utility crossing is recommended. Modeling indicates that with the utility crossing removed, the College Avenue bridge can convey the projected future 100-year flood without flows impacting the bridge low chord; however, the existing bridge would not have the 2 feet of freeboard in the projected future 50-year flood required by NYSDOT standards. This bridge is relatively new (constructed in 1994), but when it is due for replacement, a detailed, up-to-date hydrologic and hydraulic analysis should accompany design.

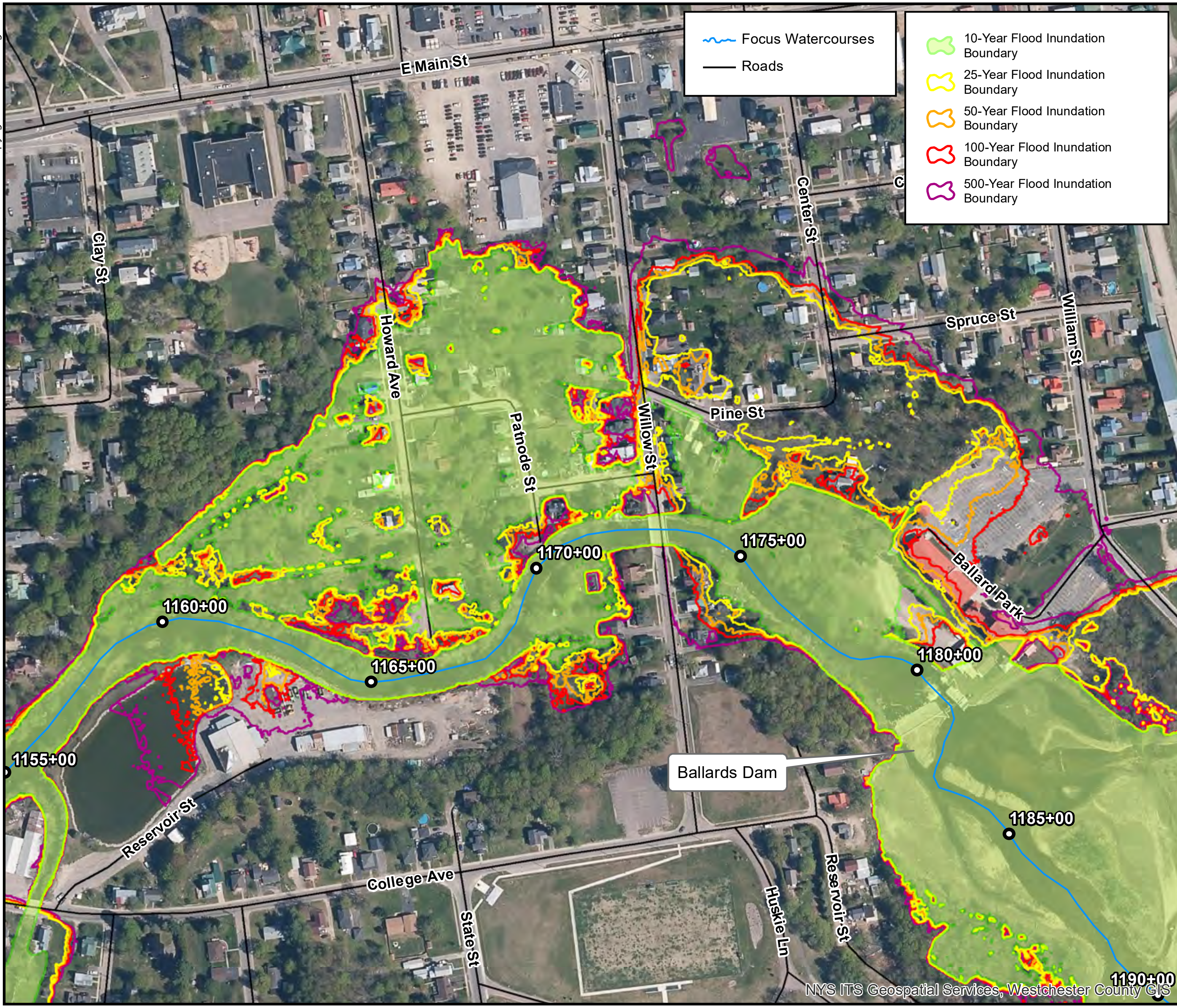
Photo 4-11 College Avenue crossing of Branch Brook, with utility crossing and supporting steel girder situated below the bridge low chord

4.3.4 Willow Street Neighborhood

Many flood-prone properties are located between STA 1160+00 and STA 1180+00 along Howard Avenue and Center, Pine, Willow, Lafayette, and Patnode Streets. At least 50 developed properties are within the modeled 100-year floodplain along this reach, most of which are on the right (north) side of the Salmon River. Floodwater depths at the affected buildings are generally between 1 foot and 4 feet in this event. Large portions of this area are also subject to flooding in the 10-, 25-, and 50-year floods. This flooding does not appear to be influenced by the Pearl Street bridge, although some excess backwater flooding upstream of the Willow Street bridge constriction is modeled under current conditions. The Willow Street bridge is modeled as being undersized for the projected future flood flows and would cause about 2 feet of additional backwater depths in the future 100-year flood scenario. Existing conditions flood extents in this area are mapped in Figure 4-16.

To reduce flooding in these neighborhoods on the right bank of the Salmon River and several properties on the left bank, floodplain benching was modeled along a roughly 2,000-foot reach of the Salmon River, from STA 1158+50 (about 300 feet upstream of the confluence of Branch Brook) to STA 1178+00 (about 200 feet downstream of Ballards dam). The floodplain enhancement includes an approximately 200-foot-wide floodplain on the right bank of Salmon River, where the floodplain elevation is reduced by between about 4 feet and 5 feet. This requires excavation of about 60,000 cubic yards of material, buyout of at least 12 and as many as 15 flood-prone properties adjacent to the river, and removal of Lafayette Street. A more modest, 80- to 100-foot-wide floodplain bench was also modeled along this reach, which would have reduced flood mitigation benefits but would only require buyout of six flood-prone properties and does not require removal of Lafayette Street. Conceptual layouts of the two floodplain bench alternatives are mapped in Figure 4-17. In either case, removal or replacement of the Willow Street bridge with a span that accommodates a longitudinally continuous floodplain bench would maximize flood mitigation benefits. Because this bridge is hydraulically inadequate for projected future flood scenarios, bridge replacement is also recommended independently of the proposed floodplain bench.

Modeling shows that the proposed 200-foot-wide floodplain enhancement and Willow Street bridge removal (or replacement with an accommodating span) reduces flood depths in the adjacent neighborhoods by between 2 feet and 4 feet along this reach in both the current and future 50- and 100-year floods, alleviating flooding at dozens of properties. The 100-foot-wide floodplain bench would reduce flooding depths by between about 1.5 feet and 3 feet. Existing and proposed conditions depth grid mapping for the 200-foot-wide floodplain bench for the 50- and 100-year floods are presented in Figure 4-18 through Figure 4-21.



N

0 210
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Existing Conditions Flood Extents

Salmon River Flood & Ice Jam Study
SD755

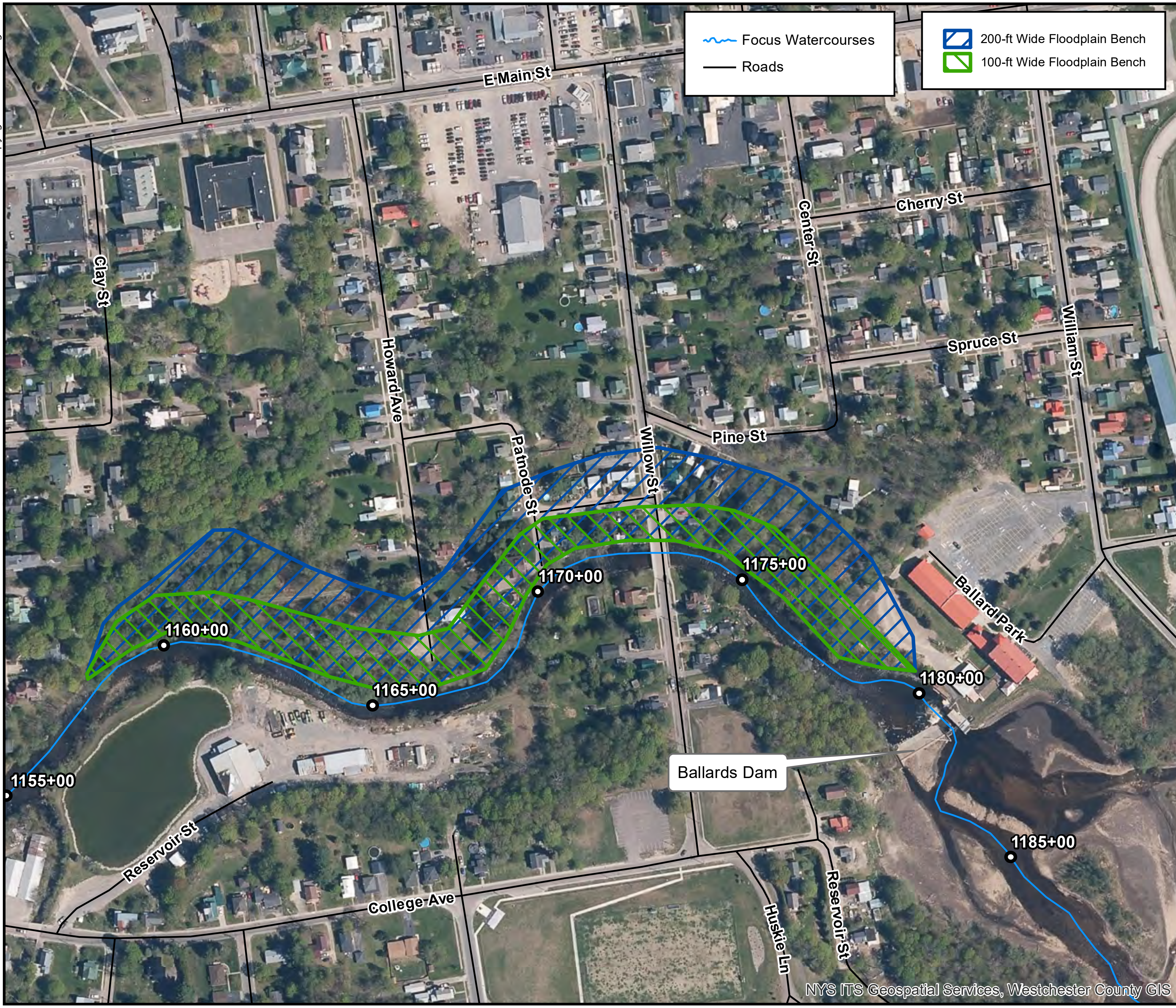
Franklin County, NY

SCALE 1" = 300'

DATE 6/5/2024

142.16511.00021
PROJ. NO.

FIG. 4-16



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0 175
Feet

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Proposed Floodplain Bench Alternatives

Salmon River Flood & Ice Jam Study

SD755

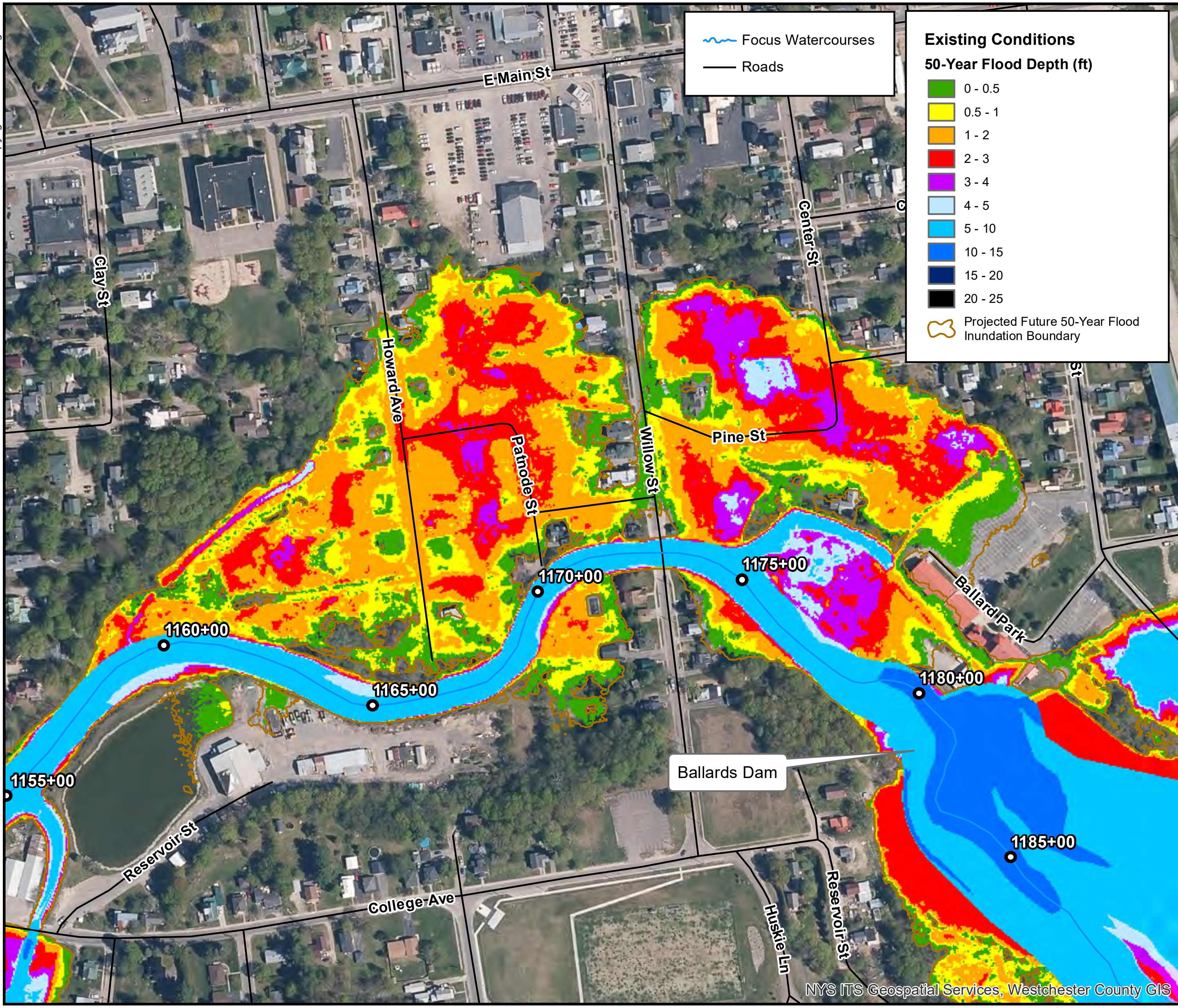
Franklin County, NY

SCALE 1" = 300'

DATE 1/22/2024

PROJ. NO. 142.16511.00021

FIG. 4-17



SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Existing Conditions 50-Year Flood

Salmon River Flood & Ice Jam Study

SD755

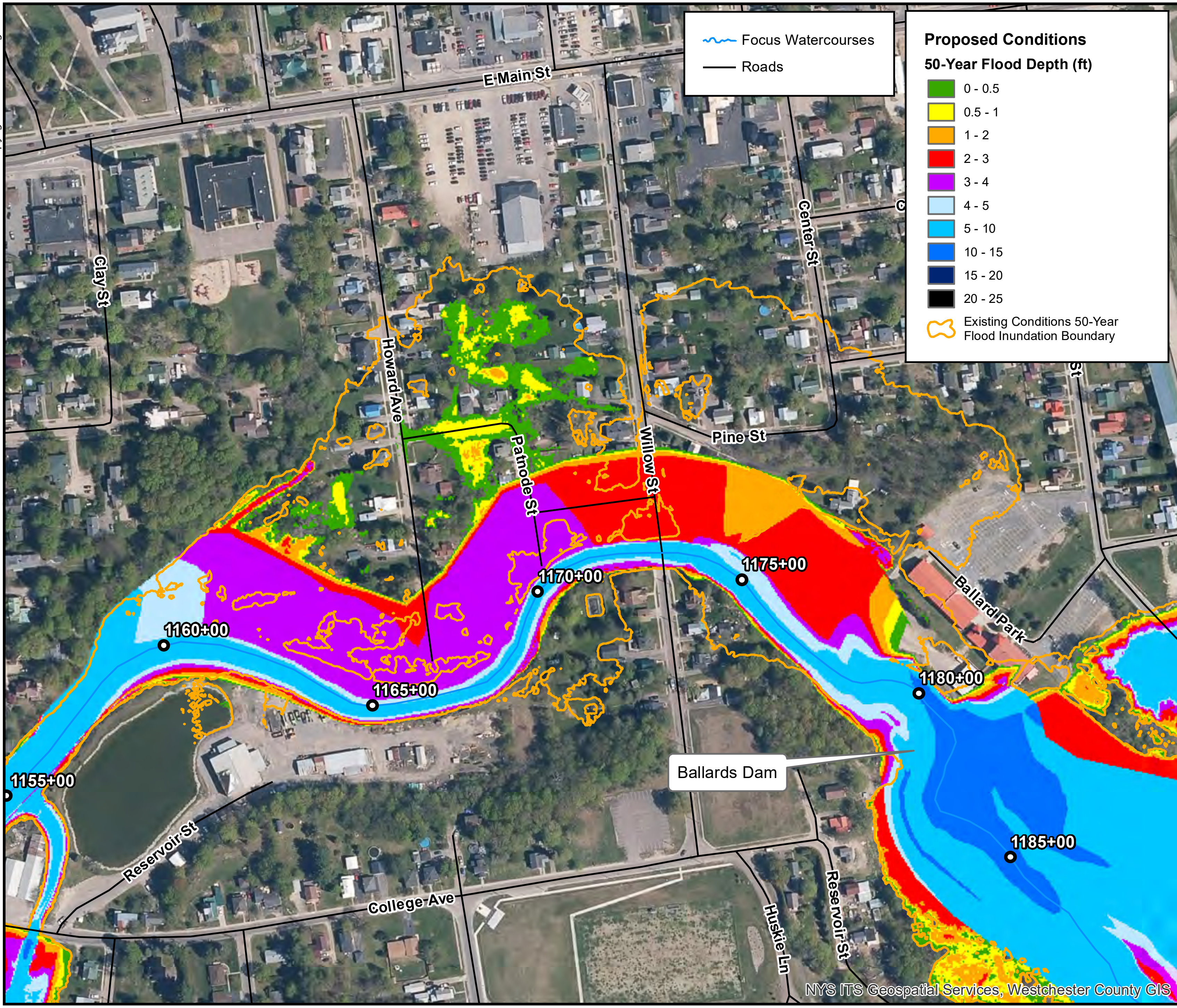
Franklin County, NY

SCALE 1" = 300'

DATE 1/22/2024

PROJ. NO. 142.16511.00021

FIG. 4-18



SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Proposed Floodplain Bench 50-Year Flood

Salmon River Flood & Ice Jam Study

SD755

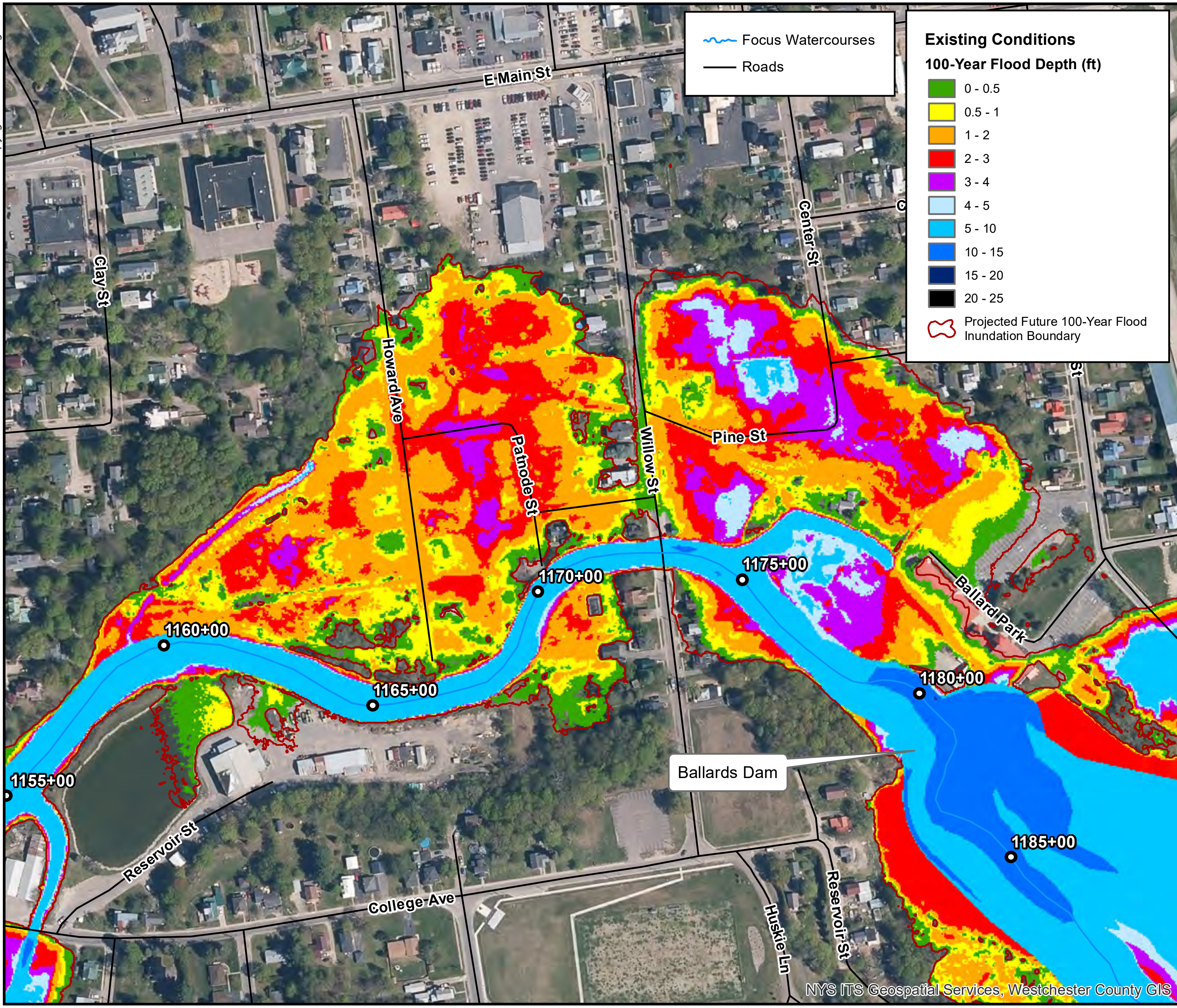
Franklin County, NY

SCALE 1" = 300'

DATE 1/22/2024

142.16511.00021
PROJ. NO.

FIG. 4-19



SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Existing Conditions 100-Year Flood

Salmon River Flood & Ice Jam Study

SD755

Franklin County, NY

SCALE 1" = 300'

DATE 1/22/2024

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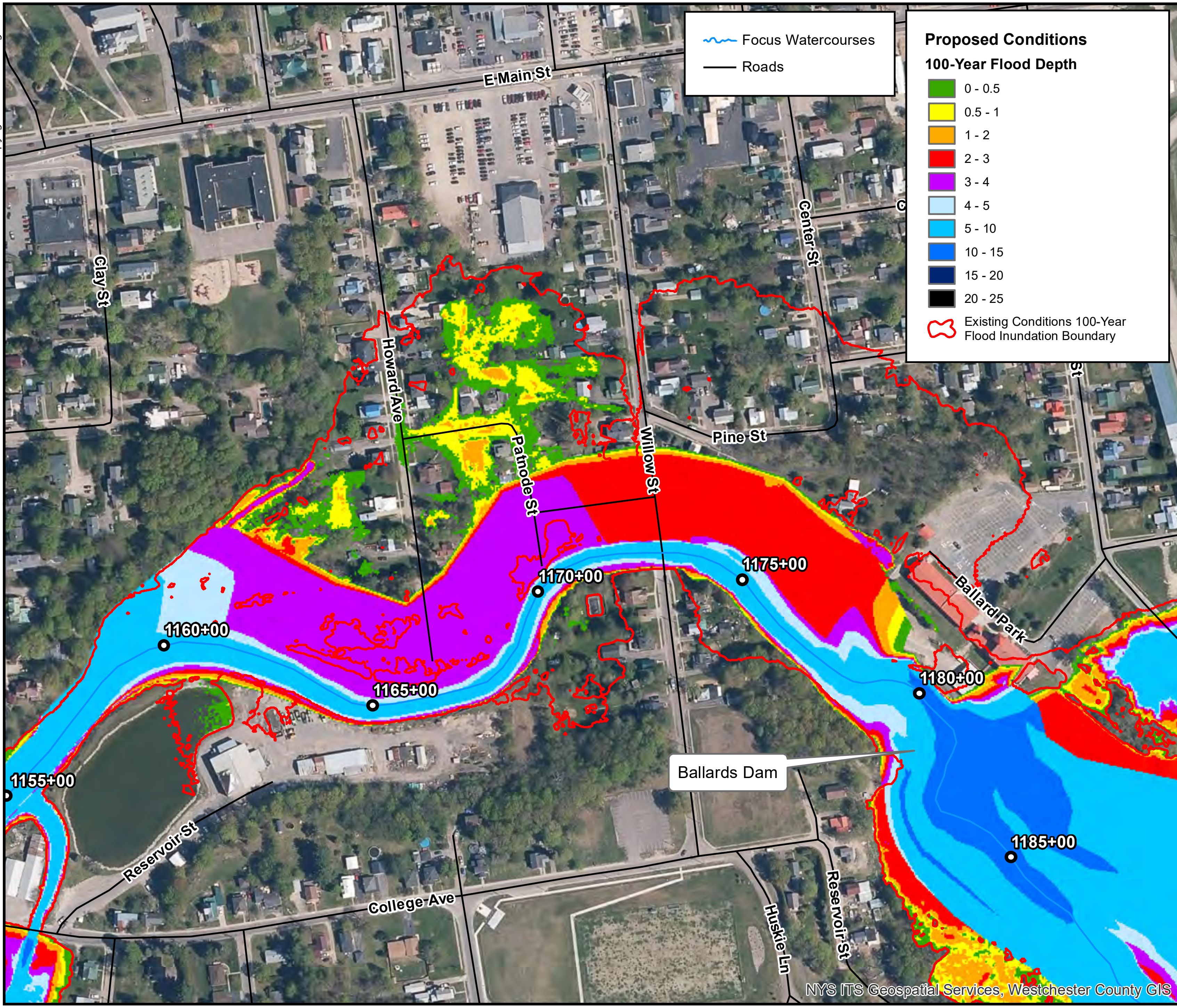
PROJ. NO.

FIG. 4-20



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231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 3 - Proposed Floodplain Bench 100-Year Flood

Salmon River Flood & Ice Jam Study

SD755

Franklin County, NY

SCALE 1" = 300'

DATE 1/22/2024

PROJ. NO. 142.16511.00021

FIG. 4-21

4.4 High Risk Area 4 – Bombay

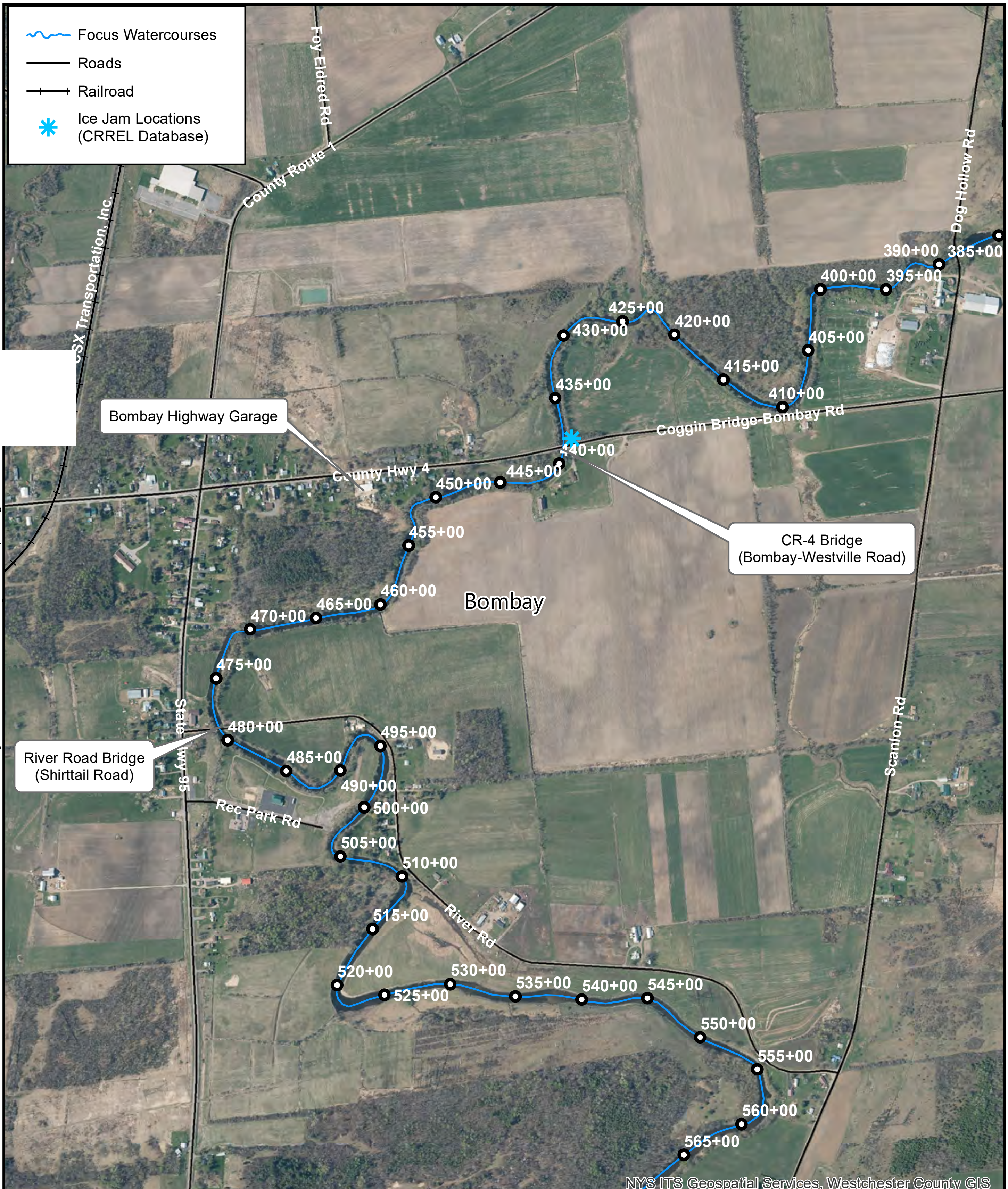
HRA 4 is located in the town of Bombay, shown in Figure 4-22. Flooding in Bombay is associated with the Little Salmon River, which modeling indicates may impact several properties and inundate roadways in town. Bridge crossings of the Little Salmon River in HRA 4 include Bombay-Westville Road/County Route 4/Coggin Bridge-Bombay Road (county-owned) at STA 438+50 and River Road/Shirttail Road (county-owned) at STA 479+00. Current flood depth mapping and projected future flood inundation extents for the 50- and 100-year floods are presented in Figure 4-23 and Figure 4-24, respectively.

Critical facilities in Bombay include the town hall, the Community Food Pantry and Shelter, the Town Highway Garage, and the Bombay Fire Department. Modeling indicates that these facilities are not directly impacted by flooding on the Little Salmon River. Portions of the Bombay Recreation Park are subject to flooding. According to the Franklin County Multi-Jurisdictional HMP, 11 parcels are substantially within the SFHA in Bombay; approximate floodplains of the Little Salmon River and Pike Creek are mapped on effective FIRM panels.

Since 1963, nine ice jams have been recorded in the CRREL database as occurring at the Bombay-Westville Road bridge crossing. Modeling indicates that partial flooding of the roadway to the west of the bridge begins in the 10-year flood, and the road is overtopped in the 25-year and greater floods. 100-year flood depths of up to about 1.5 feet are modeled at the saddle point of the Bombay-Westville Road about 600 feet to the west of the bridge. Natural conditions modeling indicates that flood depths along this section of the roadway can be reduced by about 1 foot with a hydraulically unobtrusive bridge.

The existing Bombay-Westville Road bridge has an approximately 80-foot-wide hydraulic opening. The bridge was constructed in 1941 and is likely due for replacement in the near future. The estimated bankfull width at this location is 109 feet; to adhere to NYSDEC stream crossing guidance, replacement of this bridge with a 136-foot span is recommended. Modeling indicates that the bridge low chord may be impacted in the 25-year and greater flood events, and the replacement bridge superstructure should be elevated to meet NYSDOT freeboard standards in the projected future 50- and 100-year floods. A detailed hydraulic analysis is recommended to accompany bridge replacement.

The River Road bridge is perched several feet above the adjacent floodplain elevation and does not appear to be impacted by floodwaters in modeled events. However, the bridge hydraulic opening is only about 52 feet wide, and this constriction contributes to flooding of upstream properties and the Bombay Recreation Park. Similar to the Bombay-Westville Road bridge, the estimated bankfull width at the River Road bridge is 109 feet, and replacement of the River Road bridge with a 136-foot span is recommended along with a detailed hydraulic analysis to assess conformance to NYSDOT standards.



1

SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 4

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

0 500
Feet

SCALE 1 " = 1,000 '

DATE 1/26/2024

142.16511.00021
PROJ. NO.

FIG. 4-22

Date Saved: 6/6/2024
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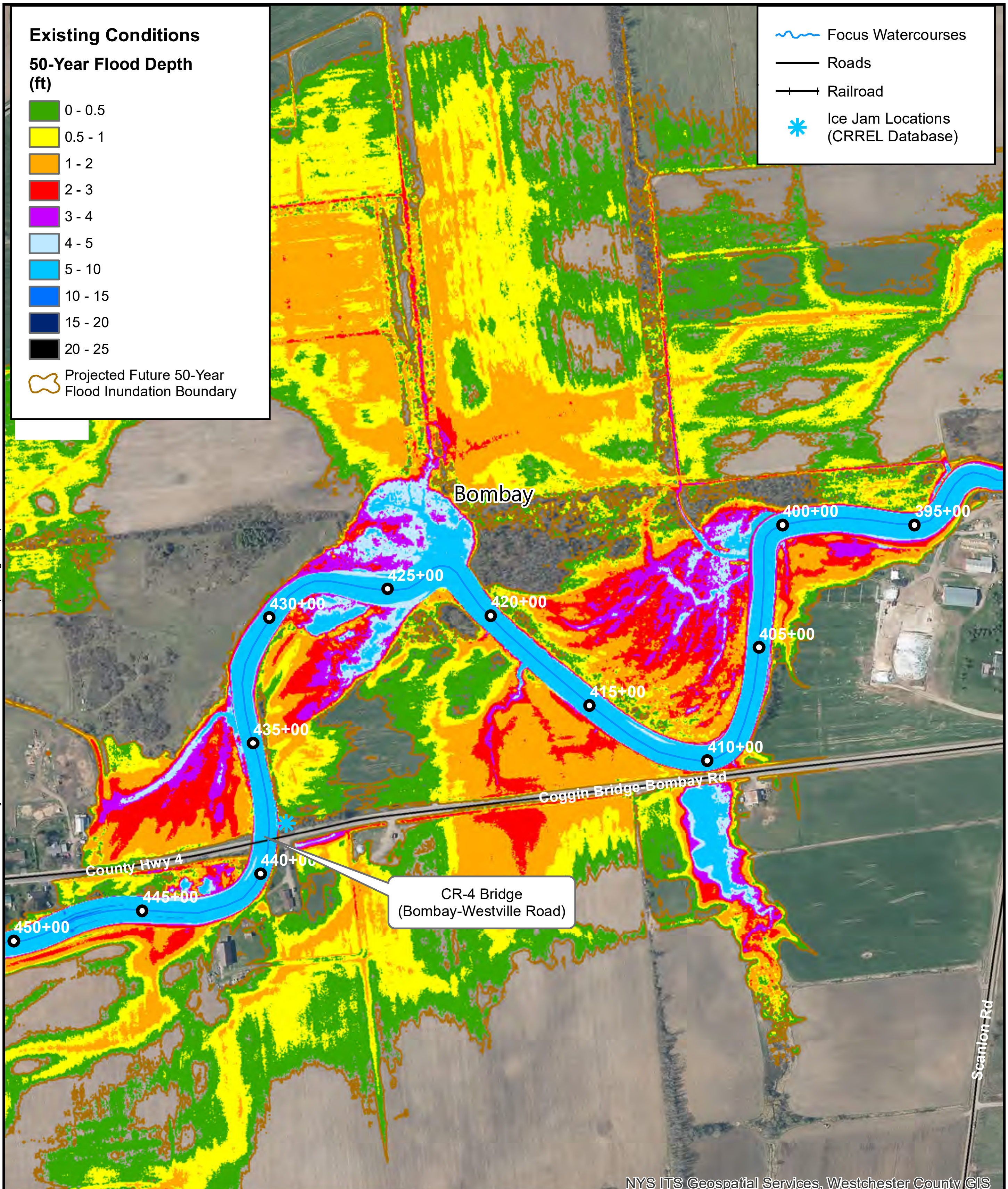


1

SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 4 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

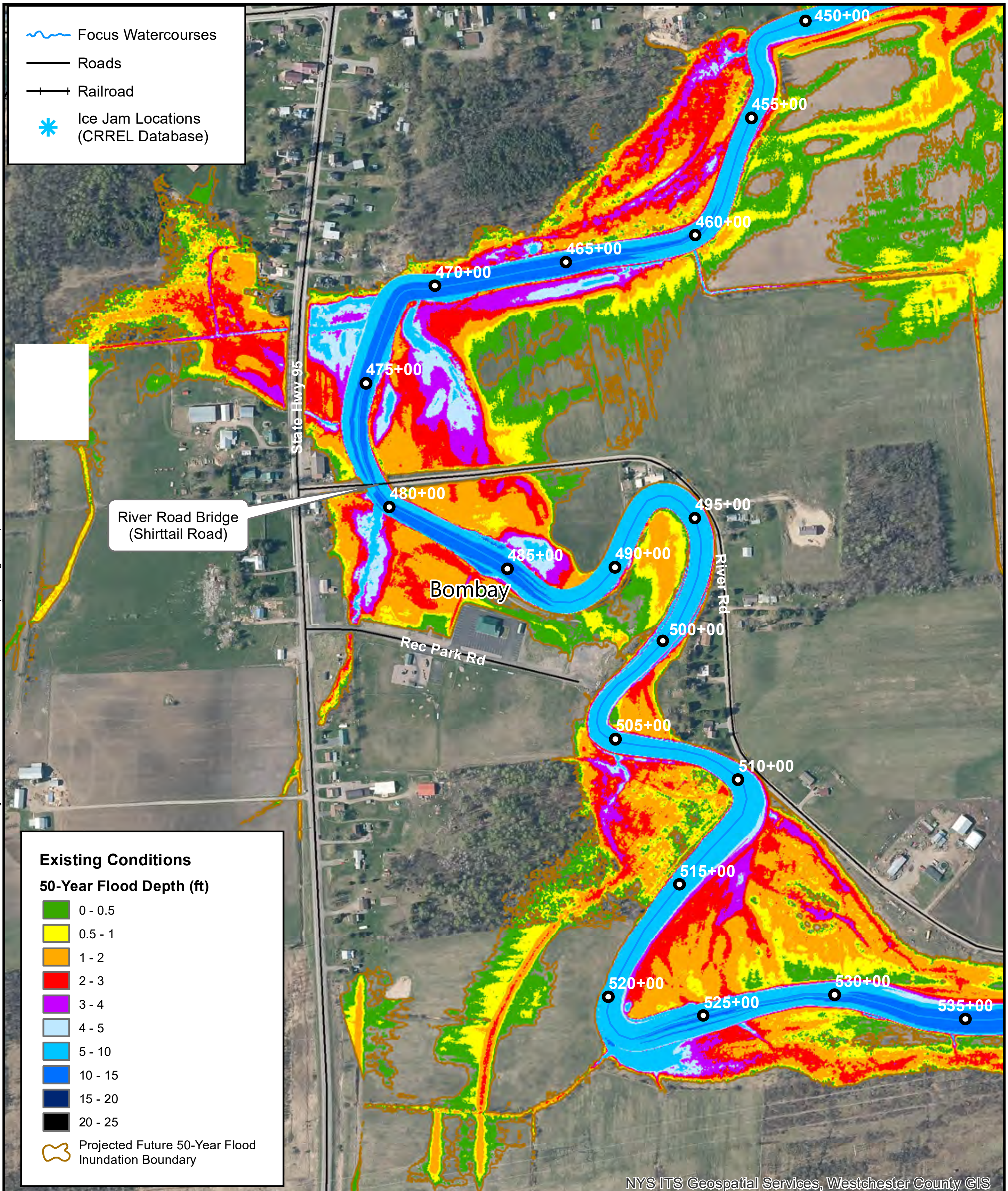
0 500
Feet

SCALE 1" = 500'

DATE 6/6/2024

142.16511.00021
PROJ. NO.

FIG. 4-23A



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SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 4 - Current & Projected Future 50-Year Flood

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

0 500 Feet

SCALE 1" = 500'

DATE 6/6/2024

142.16511.00021
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FIG. 4-23B

Date Saved: 6/6/2024
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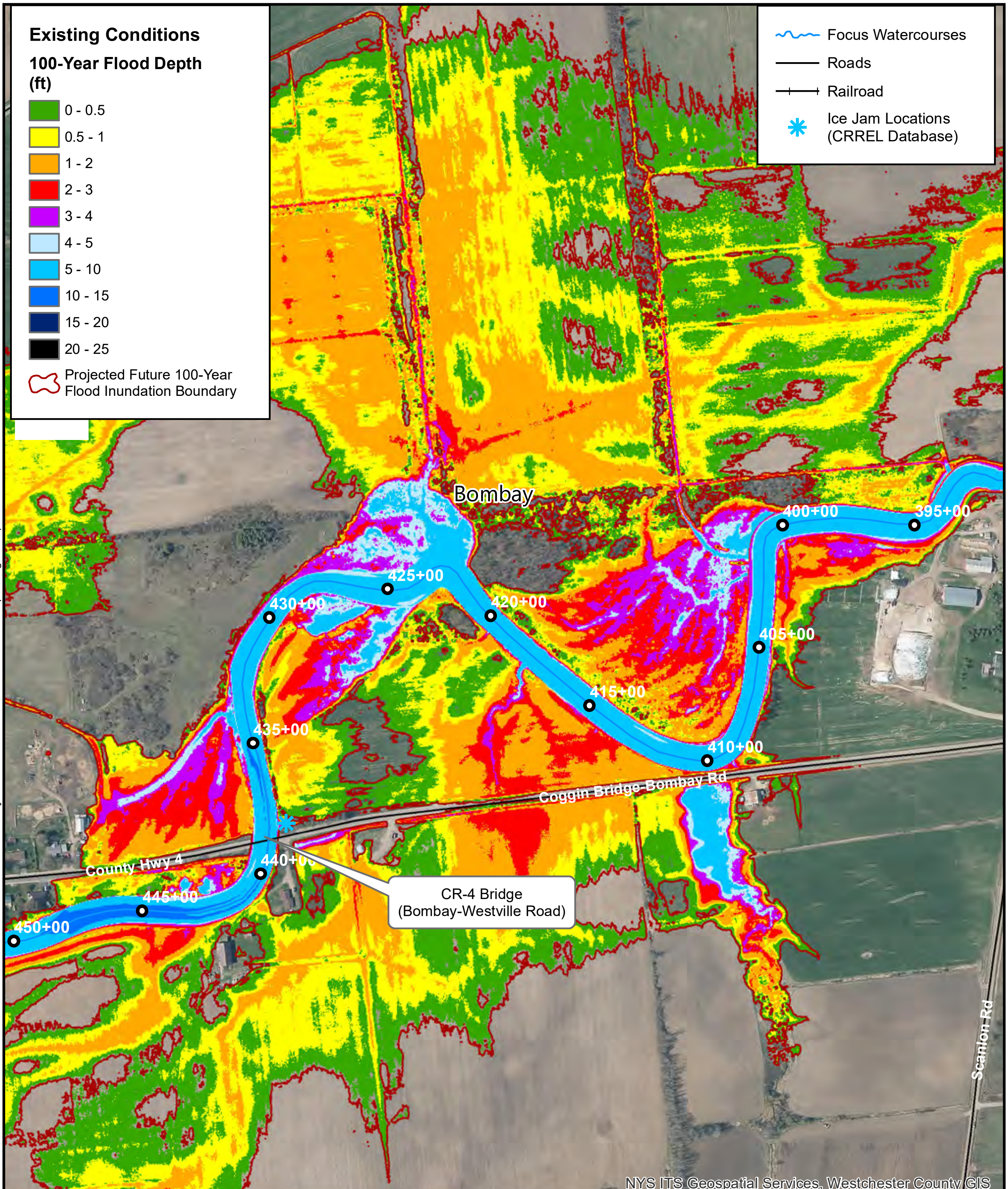


1

SLR

231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 4 - Current & Projected Future 100-Year Flood

Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

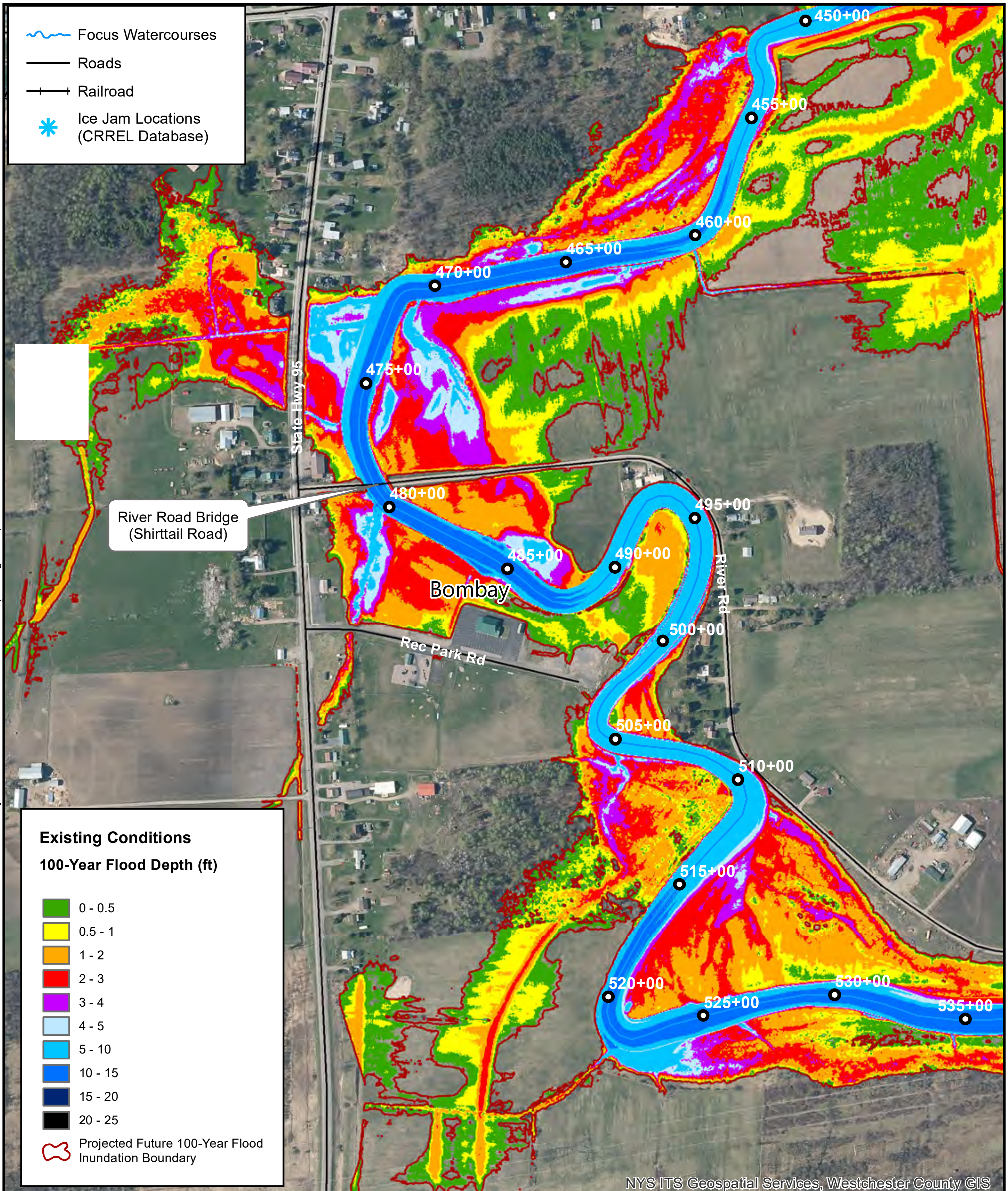
0 500
Feet

SCALE 1" = 500'

DATE 6/6/2024

142.16511.00021
PROJ. NO.

FIG. 4-24A



SLR
231 MAIN STREET
SUITE 102
NEW PALTZ, NY 12561
845.633.8153

HRA 4 - Current & Projected Future 100-Year Flood
Salmon River Flood & Ice Jam Study
SD755

Franklin County, NY

N

0 500 Feet

SCALE 1" = 500'
DATE 6/6/2024
142.16511.00021
PROJ. NO.
FIG. 4-24B

5.0 Recommendations

This report identifies HRAs within the Salmon River watershed. Flood mitigation recommendations are provided either as HRA-specific recommendations or as overarching recommendations that apply to the entire watershed or stream corridor. Flood mitigation scenarios such as floodplain enhancement and channel restoration, dam and building removal, road closures, and replacement of undersized bridges and culverts are investigated and are recommended where appropriate.

5.1 HRA 1 Recommendations

The following recommendations are provided for HRA 1:

- Voluntary relocation or buyout, elevation, or floodproofing of flood and ice jam-prone properties on Pike, Salmon, and Water Streets north of Center Street.
- Elevation of the flood-prone section of CR-43 (Drum Street Road) west of the bridge over the Little Salmon River may be a viable solution to keep the route in service during flood events. Elevation of the roadway would need to be accompanied by a replacement bridge that provides an increase in conveyance to make up for what would be lost by obstruction of overtopping flows on the floodplain. The bridge is owned by Franklin County. Due to the complex hydrodynamics of floodplain flows at the confluence, two-dimensional hydraulic modeling is recommended for assessment of feasible alternatives to alleviate flooding of CR-43. A minimum replacement bridge span of 142 feet would be recommended; however, a longer span may be necessary if roadway elevation is pursued.
- Preparation of adequate detour and road closure signage and evacuation plans for residents who are likely to become stranded in flood and ice jam events.

5.2 HRA 2 Recommendations

The following recommendations are provided for HRA 2:

- Locate any guests at the Babbling Brook RV Park farther from the river during winter months and prepare for evacuation if flooding or ice jamming occurs or is forecast.
- Residents in low-lying areas near Salmon River should be prepared to evacuate if flooding or ice jamming occurs or is forecast.
- When due for replacement, bridges should be designed to meet NYSDOT guidance for hydraulic performance and NYSDEC stream crossing guidelines.

5.3 HRA 3 Recommendations

The following recommendations are provided for HRA 3:

- Improvement of roads that provide alternative access to both the WWTP and the DPW garage for reliable emergency access to the two facilities in flood events.
- Include the Main Street weir and any other unregistered dams in the NYSDEC dam inventory.
- Removal of the Main Street weir.

- Removal of the Whittlesey dam, penstock, and powerhouse buildings.
- Decommission Whittlesey dam penstock as soon as is practical.
- Demolition and removal of the building at 399 East Main Street. When due for replacement, relocation of the left (west) abutment of the US-11/Main Street bridge (state-owned) so that it does not impinge on the Salmon River channel.
- Removal of the Ballards dam.
- Maintain Malone Memorial Recreation Pond dam on Branch Brook in a safe condition.
- The proposed floodplain bench and Willow Street bridge replacement can provide significant flood mitigation benefits to a large number of properties in HRA 3, but the two projects would require coordination.
    - Feasibility study to determine optimal configuration of a floodplain bench along approximately 2,000 linear feet along the Salmon River between STA 1158+50 and STA 1178+00 and Willow Street bridge at STA 1173+00. Based on conceptual modeling, a 200-foot-wide floodplain is recommended to maximize flood mitigation benefits. A 100-foot-wide floodplain would provide less reduction in flood depths in the adjacent neighborhoods but would be less disruptive to existing properties and infrastructure.
    - Removal or replacement of the Willow Street bridge (owned by Franklin County) with a span that accommodates the proposed floodplain benching in the area.
- Buyout or relocation, elevation, or floodproofing of flood-prone homes and businesses on Lower Park Road, West Street, Lane Street, Amsden Street, and Factory Street.
- Relocation of the utility crossing immediately upstream of the College Avenue bridge crossing of Branch Brook (owned by Franklin County).

5.4 HRA 4 Recommendations

The following recommendations are provided for HRA 4:

- Replacement of the county-owned Bombay-Westville Road (Coggin Bridge-Bombay Road) bridge at STA 438+50 with a 136-foot span.
- Replacement of the county-owned River Road (Shirttail Road) bridge at STA 479+00 with a 136-foot span.
- Both bridge replacements should be accompanied by detailed and up-to-date hydrologic and hydraulic analyses and should adhere to current NYSDEC stream crossing guidance and NYSDOT bridge standards at the time of replacement.

5.5 Replacement of Undersized Stream Crossings

Hydraulically undersized stream crossings contribute to flooding and washout of roadways. In addition to the recommendations for the replacement of stream crossings within the HRAs described above, it is recommended that undersized stream crossings elsewhere in the Salmon River watershed be identified and prioritized for replacement. Guidance for this prioritization should be based on capacity modeling and on available information regarding the physical condition of the crossing and its impact to AOP connectivity. Where multiple stream crossings are slated for replacement along a reach of watercourse, it is recommended that replacements begin at the downstream end and progress sequentially in an upstream direction.

5.6 Installation and Monitoring of Stream Gauge

The USGS discharge gauging station on the Salmon River at Chasm Falls (04270000) was deactivated in 2013. While flows are monitored at the Chasm dam as part of the facility's FERC license settlement agreement, these data are not subject to the USGS's quality review processes and are not necessarily an equivalent substitute for the gauging station. The gauge had been in operation since 1925 and, therefore, represents a valuable long-term record of historical hydrologic conditions on the Salmon River. Maintenance of such long-term stream gauging stations into the future provides irreplaceable data for understanding the effects of a changing climate. Resuming operation of the USGS gauging station at Chasm Falls is recommended.

5.7 Updated FEMA Modeling and Mapping

The majority of the Salmon River watershed study area has not been studied by FEMA, and floodplain mapping is based on approximate delineations. An FIS was conducted in the village of Malone in 1978, which included HEC-2 hydraulic modeling of the Salmon River within the village. These antiquated products are in the process of being updated by FEMA. Adoption of the new studies is recommended.

5.8 Dam Modifications

It is recommended that certain dams along the Salmon River and its tributaries that have compelling active use but also contribute to flooding of nearby property and infrastructure explore the feasibility of increasing spillway capacity to better accommodate flood flows or other modifications that may mitigate upstream flooding.

Archaic, unnecessary, breached, or abandoned dams should be considered for removal as a cost-effective and ecological long-term flood mitigation solution. Feasibility studies should be conducted for removal of such dams as a first step to determine the cost and level of effort required.

All dams should be regularly inspected and maintained in sound condition in accordance with 6 NYCRR Part 673 and Environmental Conservation Law (ECL) § 15-0507.

5.9 Individual Property Flood Protection

A variety of measures is available to protect existing public and private properties from flood damage. While broader mitigation efforts are most desirable, they often take time and money to implement. On a case-by-case basis where structures are at risk, individual floodproofing should be explored. Property owners within FEMA-delineated floodplains should also be encouraged to purchase flood insurance under the NFIP and to make claims when damage occurs. Potential measures for property protection include the following:

<u>Elevation of the structure</u> – Home elevation involves the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located at least 2 feet above the level of the 100-year flood event. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement

must be relocated to the first-floor level or suspended from basement joists or similar mechanism.

Construction of property improvements such as barriers, floodwalls, and earthen berms – Such structural projects can be used to prevent shallow flooding. There may be properties within the basin where implementation of such measures will serve to protect structures.

Dry floodproofing of the structure to keep floodwaters from entering – Dry floodproofing refers to the act of making areas below the flood level watertight and is typically implemented for commercial buildings that would be unoccupied during a flood event. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents can be either permanently closed or covered with removable shields. Flood protection should extend only 2 to 3 feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water.

Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded – Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures. Wet floodproofing should only be used as a last resort. If considered, furniture and electrical appliances should be moved away or elevated above the 100-year flood elevation.

Performing other home improvements to mitigate damage from flooding – The following measures can be undertaken to protect home utilities and belongings:

- Relocate valuable belongings above the 100-year flood elevation to reduce the amount of damage caused during a flood event.
- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the BFE (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
- Anchor the fuel tank to the wall or floor with noncorrosive metal strapping and lag bolts.
- Install a backflow valve to prevent sewer backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor and elevate electric outlets.

Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs – While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. Property owners should be encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

5.10 Road Closures

Approximately 75 percent of all flood fatalities occur in vehicles. Shallow water flowing across a flooded roadway can be deceptively swift and wash a vehicle off the road. Water over a roadway can conceal a washed-out section of roadway or bridge. When a roadway is flooded, travelers should not take the chance of attempting to cross the flooded area. It is not possible to tell if a flooded road is safe to cross just by looking at it.

One way to reduce the risks associated with the flooding of roadways is their closure during flooding events, which requires effective signage, road closure barriers, and consideration of alternative routes.

According to hydraulic modeling and anecdotal reporting, flood-prone roads exist within the Salmon River watershed. In some cases, small, unnamed tributaries and even roadside drainage ditches can cause washouts or other significant damage to roadways, culverts, and bridges. Drainage issues and flooding of smaller tributary streams are generally not reflected in FEMA modeling, so local public works and highway departments are often the best resource for identifying priority areas and repetitively damaged infrastructure.

5.11 Rough Order of Magnitude Cost Range of Key Recommendations

To assist with prioritization of the above recommendations, Table 5-1 provides an estimated cost range for key recommendations. Due to the conceptual nature of recommended actions and significant amount of data required to produce a reasonable rough order of magnitude cost, it is not feasible to further quantify the costs of all actions. Costs of land acquisition or easements are not included in the costs.

Table 5-1 Cost Range of Recommended Actions

Recommendation	< $100k	$100k - $500k	$500k - $1M	$1M - $5M	> $5M
HRA 1 – Elevation of a section of CR-43 (Drum Street Road) and replacement of the bridge over Little Salmon River					X
HRA 3 – Removal of the Main Street weir		X			
HRA 3 – Removal of the Whittlesey dam, penstock, and powerhouse buildings				X	
HRA 3 – Demolition and removal of building at 399 East Main Street			X		
HRA 3 – Removal of the Ballards dam			X		
HRA 3 – Construction of a floodplain bench along approximately 2,000 linear feet along the Salmon River				X	

Recommendation	< $100k	$100k - $500k	$500k - $1M	$1M - $5M	> $5M
HRA 3 – Replacement of Willow Street bridge with a span that accommodates the proposed floodplain benching					X
HRA 3 – Relocation of utility crossing at College Avenue bridge crossing of Branch Brook	X				
HRA 4 – Replacement of Bombay-Westville Road (Coggin Bridge-Bombay Road) bridge					X
HRA 4 – Replacement of River Road (Shirttail Road) bridge					X

5.12 Funding Sources

Several funding sources may be available for the implementation of recommendations made in this report. These and other potential funding sources are discussed in further detail below. Note that these may evolve over time as grants expire or are introduced.

Emergency Watershed Protection Program (EWP)

Through the EWP program, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) can help communities address watershed impairments that pose imminent threats to lives and property. Most EWP work is for the protection of threatened infrastructure from continued stream erosion. NRCS may pay up to 75 percent of the construction costs of emergency measures. The remaining costs must come from local sources and can be made in cash or in-kind services. EWP projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.

https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection

FEMA Pre-Disaster Mitigation (PDM) Program

The PDM program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through PDM planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. The PDM program is subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

https://www.fema.gov/pre-disaster-mitigation-grant-program

FEMA Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.

The HMGP is one of the FEMA programs with the greatest possible fit to potential projects recommended in this report. However, it is available only in the months subsequent to a federal disaster declaration in the State of New York. Because the state administers the HMGP directly, application cycles will need to be closely monitored after disasters are declared in New York.

https://www.fema.gov/hazard-mitigation-grant-program

FEMA Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and SRL properties have been modified.
- Cost-share requirements have changed to allow more federal funds for properties with RFC and SRL properties.
- There is no longer a limit on in-kind contributions for the nonfederal cost share.

One limitation of the FMA program is that it is used to provide mitigation for *structures* that are insured or located in SFHAs. Therefore, the individual property mitigation options are best suited for FMA funds. Like PDM, FMA programs are subject to the availability of appropriation funding as well as any program-specific directive or restriction made with respect to such funds.

http://www.fema.gov/flood-mitigation-assistance-grant-program

NYS Department of State

The NYS Department of State (NYSDOS) may be able to fund some of the projects described in this report. In order to be eligible, a project should link water quality improvement to economic benefits.

NYS Department of Environmental Conservation – Municipal Waste Reduction and Recycling (MWRR) Program

The NYS Department of Environmental Conservation (DEC) administers MWRR funding to local government entities for waste reduction and recycling projects. The overall goal of this funding program is to assist municipalities in expanding or improving local waste reduction and recycling programs and to increase participation in those programs.

The MWRR state assistance program can help fund the costs of the following:

- Capital Investment in Facilities and Equipment

Eligible projects are expected to enhance municipal capacity to collect, aggregate, sort, and process recyclable materials. Recycling equipment includes structures, machinery, or devices providing for the environmentally sound recovery of recyclables, including source separation equipment and recyclables recovery equipment.

https://dec.ny.gov/environmental-protection/waste-management/grants

U.S. Army Corps of Engineers (USACE)

The USACE provides 100 percent funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services (FPMS) Program. Specific programs used by the USACE for mitigation are listed below.

- Section 205 – Small Flood Damage Reduction Projects: This section of the 1948 Flood Control Act authorizes the USACE to study, design, and construct small flood control projects in partnership with nonfederal government agencies. Feasibility studies are 100 percent federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent nonfederal match. In certain cases, the nonfederal share for construction could be as high as 50 percent. The maximum federal expenditure for any project is $7 million.
- Section 14 – Emergency Stream Bank and Shoreline Protection: This section of the 1946 Flood Control Act authorizes the USACE to construct emergency shoreline and stream bank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and nonprofit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.
- Section 208 – Clearing and Snagging Projects: This section of the 1954 Flood Control Act authorizes the USACE to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- Section 206 – Floodplain Management Services: This section of the 1960 Flood Control Act, as amended, authorizes the USACE to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of flood-prone structures. When funding is available, this work is 100 percent federally funded.

In addition, the USACE provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and postflood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

https://www.nae.usace.army.mil/Missions/Public-Services/Flood-Plain-Management-Services/

New York State Grants

All New York State grants are now announced on the NYS Grants Gateway. The Grants Gateway is designed to allow grant applicants to browse all NYS agency anticipated and available grant opportunities, providing a one-stop location that streamlines the way grants are administered by the State of New York.

https://grantsmanagement.ny.gov/

Environmental Facilities Corporation

The Environmental Facilities Corporation (EFC) helps local governments and eligible organizations undertake water infrastructure projects. EFC provides grants and financing to help ensure projects are affordable while safeguarding essential water resources. EFC administers state and federal grants as well as interest-free and low-cost financing to help minimize the tax burden for communities.

https://efc.ny.gov

The EFC's Green Innovation Grant Program (GIGP) supports projects across New York State that utilize unique Environmental Protection Agency (EPA)-designated green stormwater infrastructure design and creates cutting-edge green technologies. Competitive grants are awarded annually to projects that improve water quality and mitigate the effects of climate change through the implementation of one or more of the following green practices: Green Stormwater Infrastructure, Energy Efficiency, and Water Efficiency.

https://efc.ny.gov/gigp

Bridge NY Program

The Bridge NY program, administered by NYSDOT, is open to all municipal owners of bridges and culverts. Projects are awarded through a competitive process and support all phases of project development. Projects selected for funding are evaluated based on the resiliency of the structure, including such factors as hydraulic vulnerability and structural resiliency; the significance and importance of the bridge, including traffic volumes, detour considerations, number and types of businesses served, and impacts on commerce; and the current bridge and culvert structural conditions.

https://www.dot.ny.gov/BRIDGENY.

Private Foundations

Private entities such as foundations are potential funding sources in many communities. Communities will need to identify the foundations that are potentially appropriate for some of the actions proposed in this report.

In addition to the funding sources listed above, other resources are available for technical assistance, planning, and information. While the following sources do not provide direct funding, they offer other services that may be useful for proposed flood mitigation projects.

Land Trust and Conservation Groups

These groups play an important role in the protection of watersheds, including forests, open space, aquatic ecosystems, and water resources.

Communities will need to work closely with potential funders to ensure that the best combinations of funds are secured for the proposed alternatives and for the property-specific mitigation such as floodproofing, elevations, and relocations. It will be advantageous for the communities to identify combinations of funding sources in order to reduce their own requirement to provide matching funds.

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