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APPENDIX A

Mohawk River Basin – Report Abstracts and Summaries

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UPSTATE FLOOD MITIGATION TASK FORCE

Mohawk River Basin Report Abstracts & Summaries

FEBRUARY 2023

Appendix A Mohawk River Basin Abstracts & Summaries
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REPORT TITLE /DATE/REF	Reservoir System Analysis Final Report	Dec 30, 2008	000
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The principal focus was on water supply for the Erie Canal as opposed to flooding. The Northern and Southern Reservoir Systems include the enlarged Erie Canal (1854) that consists of the Butternut, Limestone, and Chittenango Feeders; portions of the Black River Canal; the Forestport Feeder; the Nine Mile Feeder; and portions of the Chenango Canal system which included the Chenango Feeder and the Madison Feeder.

This analysis was prepared in response to Recommendations No. 3 and No. 7 of the Hinckley Reservoir Working Group's Report to the Governor, dated April 30, 2008:

- No. 3 – The Canal Corporation should consider using other sources, including Delta Reservoir, for water needed in the Rome summit section when Hinckley Reservoir water levels are below normal and declining.
- No. 7 – The Canal Corporation should consider assessing and upgrading infrastructure to assist other canal system reservoirs to augment flow to the Rom summit. Assessment should include a long-term study to identify capital improvements and funding mechanisms for modernizing canal capital facilities and related operational systems

The purpose of the report was to determine: the extent of canal systems' physical deterioration, capability to reliably store and convey water for canal purposes, the costs needed to upgrade the canal systems' infrastructure, and to compare the costs of upgrading these systems to the cost of constructing a new and single storage facility.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Findings were focused on Canal water supply:

<u>General</u>

1. The condition and hydraulic conveyance capacity of the Northern and Southern Reservoir Systems are limited and incapable of delivering sufficient water to satisfy the Erie Canal navigational needs in the Rome summit section.
2. Although the NYSCC has the primary jurisdictional authority to utilize and regulate the reservoirs of the Northern and Southern Reservoir Systems, they have not been operated to meet canal navigation needs in over two decades. Their use as storage reservoirs, solely for canal navigation needs would have adverse effects on waterfront property owners.

<u>Northern Reservoir System</u>

Capital improvements required at Sand Lake Reservoir and Woodhull Lake Reservoir to correct safety deficiencies. Upgrade Forestport Feeder/Black River Canal to increase conveyance from 100 cfs to original capacity of 267 cfs. No additional storage provided but would increase supply capacity to Delta Reservoir that could provide flexibility to manage it for downstream flood reduction.

REPORT TITLE /DATE/REF	Reservoir System Analysis Final Report	Dec 30, 2008	000
REVIEWER	Wayne Gannett, PE, CFM		

Nine Mile Feeder System

Upgrade Ninemile Feeder to increase conveyance from 80 cfs to original capacity of 267 cfs. No additional storage provided.

Southern (East) Reservoir System

Incapable of providing water to the Rome summit section because the system discharge point is east of (below) the summit section. Hatch Lake, Bradley Brook and Kingsley Brook reservoirs are no longer connected to the system and cannot provide water to the Erie Canal. Capital improvements would not result in any increase in conveyance capacity or storage.

Southern (West) Reservoir System

Capable of providing water to the Rome summit section at its discharge at New London. However, capacity is currently limited and cannot deliver sufficient water to satisfy canal navigation needs presently met with regulation of Hinckley and Delta Reservoirs. A complete upgrade of the Southern (West) Reservoir System would increase conveyance capacity from 98 cfs to 150 cfs, but no additional storage.

Increase Storage in Hinckley Watershed

Reconstruction of the Gray Reservoir Dam to store 3.1 billion gallons and managing it solely for low flow augmentation during drought, would meet existing potable water supply, hydroelectric generation, and canal navigation needs. Reconstruction of the Gray Reservoir Dam to store 6.0 billion gallons would meet future potable water supply, hydroelectric generation, and canal navigation needs .Reconstructing this dam would eliminate the need for diversion of water from other watershed into the Canal system.

Preliminary cost estimates (2008 dollars) to restore the reservoir systems were presented in Section 4:

Northern Reservoir System	$34.5 million
Nine Mile Feeder System	$6.0 million
Southern (East) Reservoir System	$14.6 million
Southern (West) Reservoir System	$103.9 million
Increase Storage in Hinckley Watershed	$23.6 to 40.9 million

REPORT TITLE /DATE/REF	Reservoir System Analysis Final Report	Dec 30, 2008	000
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?
Agencies not specified.
WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?
Hydrologic and reservoir management analysis of the Northern Reservoir System should be done to obtain annual watershed yield and flow vs. duration relationships for the individual reservoirs and for the combination at Forestport Reservoir, controlling flow to the Forestport Feeder. The evaluation would determine if reservoirs could store and regulate a significant amount of water for navigational purposes during times of drought. The analysis also would include an evaluation of the potential for increasing low-flow outlet works capacity, providing remote monitoring and controls on the low-flow outlet works, and increasing reservoir capacity.
WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?
Rehabilitate Forestport Feeder to restore capacity to original 267 cfs, upgrade Ninemile Feeder to restore capacity to original 267 cfs, upgrade Southern (West) Reservoir System to allow conveyance of up to 150 cfs to the Erie Canal at New London, and reconstruct the Gray Reservoir Dam to increase storage in the Hinckley watershed.

BIBLIOGRAPHY	Bergmann Associates (December 30, 2008) *New York State Canal Corporation: Reservoir System Analysis Final Report* I:\NYSCC\6715.17 NYSCC Reservoir System Evaluation\2.0 Design\2.8 Reports\Final Report\Combined Report for Posting\NYCC Reservoir System Analysis Final Report.pdf

REPORT NAME/DATE/REF	**Final Design Report Rev02 MD4 to MD11**	Aug 17, 2012	001A
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

Movable Dams 4 thru 11 were constructed early in the twentieth century to create stable pools in the Mohawk River for navigation along the Barge Canal. They consist of gates that can be lowered into the river along frames (uprights) which may also be raised and lowered from overhead steel bridge superstructures (trusses) during the navigation season. Both the gates and uprights are operated by "mules" – traveling hoists – that move along rails supported on the truss floor beams. The structures at Dams 5 and 8 also support public roadways.

Hurricane Irene and Tropical Storm Lee caused damages to movable dams in 2011, and subsequently, the New York State Canal Corporation (NYSCC) planned changes in the operation of the movable dams between Scotia and Fort Plain. The former operations plan included raising only the upper gates during or in anticipation of high water events. The proposed changes include lifting the lower gates and raising the uprights in some or all spans during, or in advance of, high water events. The benefit of lifting upper and lower gates and uprights prior to flood events will be a reduction in flood elevations upstream of each movable dam.

To accomplish this modification, the lower gates and the uprights need to be raised with headwater elevations higher than 2.5 feet above the top of the lower gates, a change from the current practice. These changes result in potentially higher forces on the supporting structural elements. Existing conditions were evaluated, and hydraulic and structural calculations performed to determine factors of safety, which critical elements limit capacity, and necessary improvements to structures and mechanisms.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The movable dams consist of two or three steel truss spans, each of which supports several 30-foot wide upper and lower gate panels. The shorter upper gate panels rest on top of the taller lower gate panels, which in turn are seated on concrete aprons along the riverbed. The gates are inclined at 1H:8V and each gate is held in position by two supports (uprights) that are spaced 15 feet on center across the full length of the dam (Fig 2). The uprights can be rotated up and out of the water after both gate panels have been raised. During the navigation season, the uprights and lower and upper gate panels are in the lowered positions to create level pools between locks to allow navigation. During the non-navigation season, the lower and upper gate panels and uprights are pulled from the water (Fig 4).

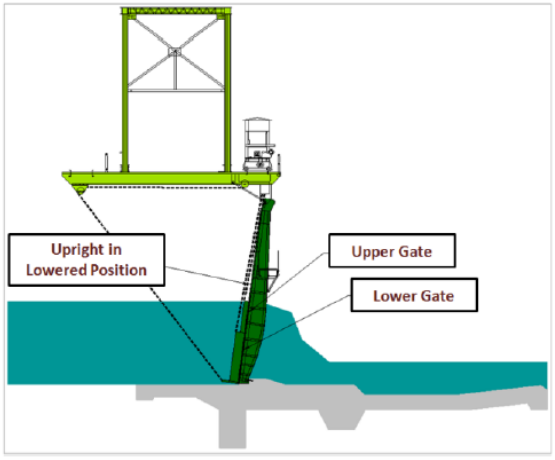

Figure 2 – Movable Dam with Both Gate Panels Lowered

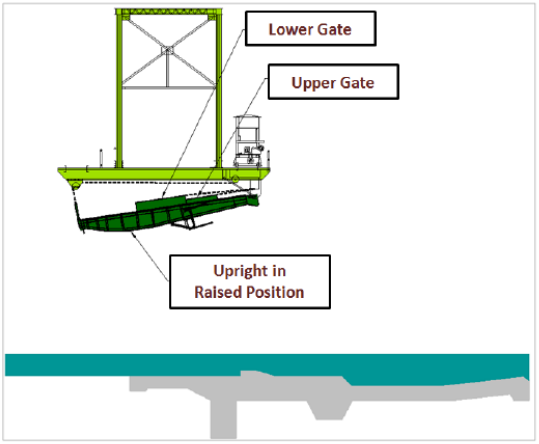

Figure 4 – Movable Dam with Upper and Lower Gate Panels and Uprights Raised

REPORT NAME/DATE/REF	**Final Design Report Rev02 MD4 to MD11**	Aug 17, 2012	001A
REVIEWER	Wayne Gannett, PE, CFM		

During the Hurricane Irene and Tropical Storm Lee floods, significant damage was caused at Movable Dams 4, 5 and 6 due to debris and hydraulic forces. With debris accumulation, the difference between upstream and downstream WSEL was significant (5.7 ft at MD 6) and caused damaging flow in the overbanks.
Improvements to the dams include: strengthening uprights, replacing roller bushings to decrease required hoisting loads, providing under bridge lighting and modifying gate machinery to increase safe lifting capacity so that lower gates and uprights can be pulled depending on velocity and depth of water. When this is done, the chance of debris capture on the gates is eliminated.

Design Criteria
Design codes included the AASHTO *Standard Specifications for Highway Bridges* and related standards. For existing steel where records did not show yield strength F_y 32 ksi was used. In general, structure load combinations were in accordance with AASHTO *Standard Specifications*. Hydraulic forces were verified by means of lifting tests conducted at Dam 10 with instrumented lifting equipment to measure lifting forces over time and gate position. Initial tests resulted in damage to one of the Dam 10 uprights due to skewed flow. It was concluded that gates would be raised in an alternating pattern to mitigate asymmetric crossflow through the openings, and uprights would not be lifted until all upper and lower gates in a span had been raised.

Hydraulic Analysis
Velocities and depths at the movable dams when the uprights are being raised were developed using the USACE HEC RAS model. Orthoimagery and the NYS 10 meter Digital Elevation Model (DEM) were imported into ESRI Arc Map and the land-water interface digitized to represent the channel banks. Boundary conditions were set to normal depth with a slope of 0.01 ft/ft for both the upstream and downstream limits. Multiple gate configurations were modeled at each dam to determine flow depth and velocity at the uprights.

Gate Lifting
The upper gates are significantly lighter and subjected to much lower forces than the lower gates, and are regularly operated by the NYSCC. Operation of the lower gates and uprights were evaluated. In calculating force to raise the lower gates it was determined that wheel (roller) friction and gate weight were the two largest components. With these improvements to the gates, the average chain tension required for lifting the lower gate is approximately 19.5 kips. To reduce wheel friction for lifting, the existing lower gate wheel bushings will be replaced with self-lubricating non-metallic bushings to obtain of coefficient of friction of 0.15. Seating-in will be required in the shop prior to bushing installation to reduce an initial higher coefficient of friction.

Uprights
Upright assemblies are comprised primarily of two uprights, sway bracing and a lower strut, In the lowered position, guide angles at the base of the upright prevent the upright from deflecting laterally off the shoe. Uprights were analyzed for two loading conditions: uprights resting on shoes, and uprights just lifting off the shoes. Some members were determined to be overstressed, and new welded steel uprights with increased capacity will be provided.

Mule Rails and Floor Beams
The mule rails are located on the downstream side of the dam superstructures and span longitudinally between transverse floor beams. They consist of channels supported by angle ledge brackets and lateral web support angles. The rails support not only the traveling hoists (mules), but also the chain boxes and locks, downstream upright chain sheaves, and upper catwalks. The existing rails were determined to be adequate.
The floor beams span transversely between the superstructure trusses and consist of fabricated I-sections. They were determined to be adequate.

Hangers to support floor beams were determined to be adequate provided that upstream hanger rivets are replaced with high strength bolts. Existing chain lock tab plates are ¼ inch thick on some dams and ½ inch on others. It is recommended that the ¼ inch tab plates be replaced with ½ inch tab plates.

Superstructure

The bridge superstructure is comprised of upstream and downstream trusses, connected along the top and bottom chords by X-bracing. The truss panel length is 15 ft, with panel points corresponding with the upright spacing. 3-D analysis of the trusses determined that Movable Dams 4 thru 11 have the capacity to safely sustain loads from gate lifting operations (exclusive of traffic on Dams 5 and 8). Vehicular traffic (HS-20) can be present on Dams 5 and 8 during lifting operations only if just one mule is present on a span at a time.

Lower gate and Upright Lifting Rule Curves

In the analysis, all of the loads imparted to the structure were based on a single set of headwater and tailwater values at each dam. The values used a conservatively low tailwater with a simultaneous high headwater to give the maximum realistic expected load. The loads imparted on the structure depend on not only the headwater and tailwater values but, in the case of the uprights, also on the water velocity. It is desirable to have specific rules for when lifting operations are permitted at the different dams to account for water conditions.

In all cases, it is assumed that the worst case loading of the uprights occurs during the removal of the uprights in the first span to be lifted during a high water event. Once the first span of gates and uprights is lifted out of the river the pool differential is expected to drop and subsequent spans of lifting will decrease the load on the gates and uprights. Because the chain force during gate lifting is directly related to the headwater and tailwater levels, and not water velocity, a relationship of allowable headwater and tailwater elevations was developed for each dam based on the target chain tensions. Figure 26 is an example of a lower gate lifting rule curve. It is permissible to lift the lower gate when the headwater and tailwater values are below and to the right of the curve and it is not safe to lift when the water levels are left and above the curve.

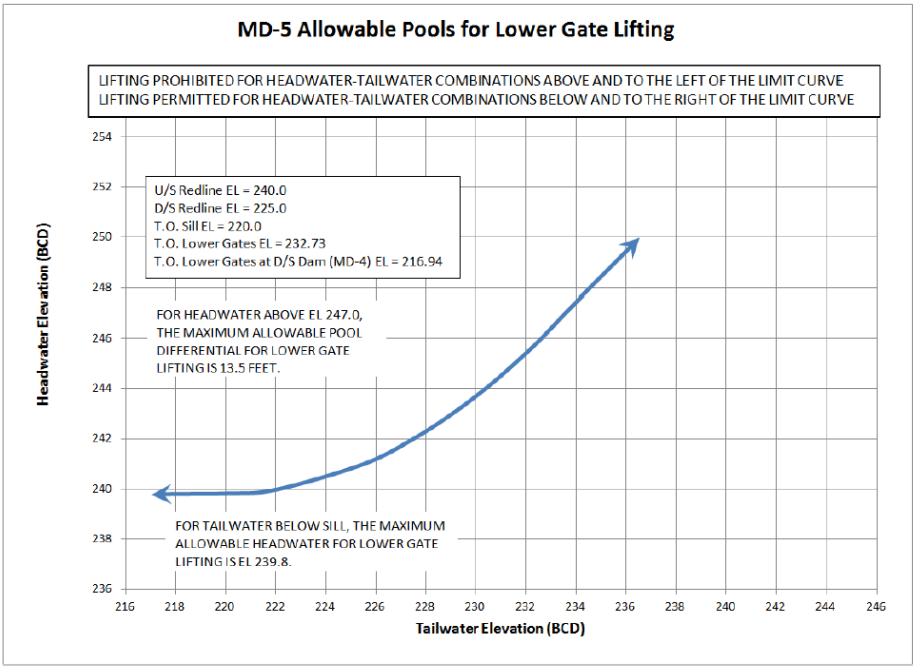

Figure 26 - Example Gate Lifting Rule Curve

For upright lifting, the headwater and tailwaters from depth and velocities were used to create the "step function" shaped curve for upright lifting shown in Figure 28. Similar to the lower gate lifting, it is permissible to lift the

uprights when the headwater and tailwater values are below and to the right of the curve and it is not safe to lift the uprights when the water levels are left and above the curve

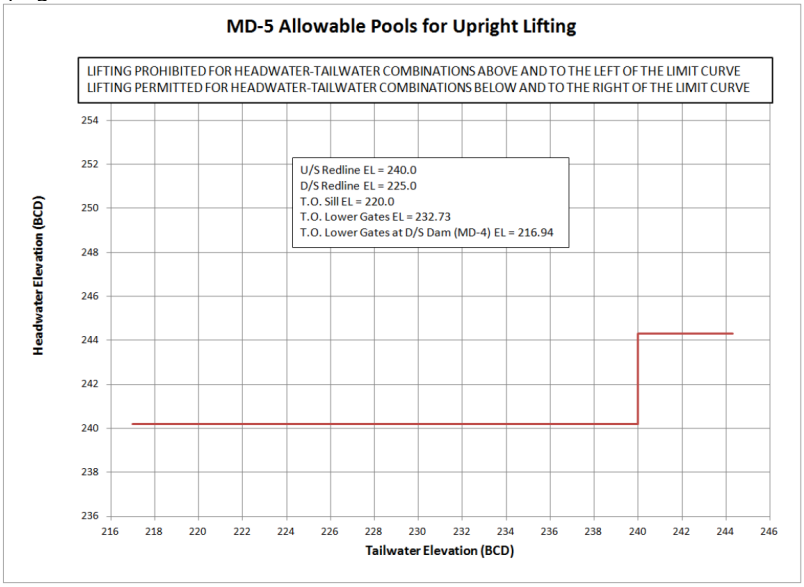

Figure 28 - Example Upright Lifting Rule Curve

Structural Improvements

Existing uprights are to be replaced by new units with increased structural capacity, except at MD 4 where no improvements are needed. Lower gate rollers will be replaced with synthetic bushings and hardened stainless steel axles or pins. Existing chains and floor beams are adequate for continued use.

Proposed Operating Procedures

Table 20 summarizes the operational procedures for lower gates and uprights.

Table 20 – Summary of Operational Procedures[1]

Movable Dam	4	5	6	7	8	9	10	11
All Gates and Uprights Fully Raised in Truss Span (Winter Condition)	A	A	A	A	C G	A	C	A
Adjusting Lower Gates	C D E	B D	C D E	C D E	B D G	C D E	C D E	C D E
Adjusting Uprights	C E F	B F	C E F	C E F	B F G	C E F	C E F	C E F

[1] This table summarizes the operational restrictions for movement of lower gates and uprights only. Procedures and restrictions regarding adjustment of upper gates or operations with all upright and lower gates in fully down positions are not included in this evaluation.

A. No restrictions on location of mules, assumes no active use of mule for lifting.
B. Limit one mule per truss span with simultaneous vehicular traffic on bridge. If the bridge is closed to traffic, the rules C & E apply.
C. A minimum of 15' clear space is required between mules in the same truss span.
D. Gate lifting is restricted to headwater and tailwater elevations provided in lifting charts in Appendix B.
E. Limit one mule lifting in a truss span. Second mule may be present but may not be lifting simultaneously in the same span.
F. Upright lifting is restricted to headwater and tailwater elevations provided in lifting charts in Appendix B.
G. The historic upstream mule must be centered over a pier or abutment to limit the load on the truss superstructure.

REPORT NAME/DATE/REF	**Final Design Report Rev02 MD4 to MD11**	Aug 17, 2012	001A
REVIEWER	Wayne Gannett, PE, CFM		

Recommended limits on upper and lower pool elevations are presented in Appendix B for raising lower gates and uprights at each dam. Lower gates may be raised in advance of a high water event to increase the effective hydraulic opening at the dams and to prevent accumulation of debris on the upstream side of the dams. When lower gates have been raised above the upper pool elevation, the uprights are subject to increased lateral loading. The uprights should be removed from the flow as soon as hydraulic conditions permit (but only after all lower gates in the span have been raised).

Cost breakdowns were not provided in the report.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Operate in accordance with Movable Dam Lifting Procedure (K118-EMP-0006). Perform the repairs to MD 4 through MD 11. These modifications have been constructed.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Provide similar removal capabilities at MD 13 and 14. These were not included in the original study.

BIBLIOGRAPHY

Bergmann Associates (Aug 17, 2012) *NYS Canal Corporation: Movable Dams 4-11 Design Report* I:\NYSCC\8839.04 Post-Irene Improvements to MD-4\3.0 Design\3.8 Reports\Design Report\2012-08-17 FINAL Design Report\Final Design Report Rev02 - Combined.pdf

REPORT NAME/DATE/REF	**Movable Dam Lifting Procedure**	Aug 13, 2018	001C
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This procedure (K118-EMP-0006) "the procedure," establishes the framework for lifting the New York State Canal Corporation's Movable Dams (MDs) in advance of a forecasted storm or major flood Incident.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The procedure applies to lifting MDs during navigation season, including MD-4 through MD-11 at Locks E-8 through E-15, and MD-12 at Rocky Rift Dam and MD-14 at Herkimer Dam. It also includes closing Guard Gates 1 through 5 and lowering Herkimer Crest Gates 1,2,3.

Responsibility for oversight of the procedure resides with the Director of Emergency Management. All Canal Corporation employees are responsible for compliance as applicable to their duties. The Water Management Engineer (WME) is responsible for monitoring weather and hydrologic observations and forecasts throughout the Canal system, including NWS forecasts. Internal communications are managed at the Emergency Operations Center (EOC) with the Deputy Director of Engineering and Maintenance (DDEM) as Incident Commander. When an NWS forecast triggers the major flood Incident criteria or the WME believes a flooding Incident threatens the safety of personnel, mariners, and/or communities along the canal, then the DDEM, Division Canal Engineer (DCE) and WME will make the decision to lift the dams, and comply with the procedure to conduct communications with dock permittees, railroads, marinas as well as notifications to vessels via Notice to Mariners (NTM). The decision to lift dams must be made at least 24 hours in advance of the lifting to ensure proper staffing, debris removal and safety. Preferably the lift will be done in daylight and favorable weather.

The Advanced Hydrologic Prediction Service (AHPS) provides a 2-3 day forecast which will be used to identify potential flooding events that are more than 24 hours ahead of current time and to establish Preliminary Dam Lifting Time (PDLT) for simultaneous movable dam lifting. Incident monitoring will utilize USGS Gages Mohawk River at Little Falls (USGS Gage 01347000), Mohawk River at Cohoes (USGS Gage 01357500) and Schoharie Creek at Burtonsville (USGS Gage 01351500).

If the AHPS forecast indicates flows will be in excess of 82,500 cfs at Cohoes or in excess of 26,100 cfs at Little Falls, all movable dams will be lifted.

If the AHPS forecast indicates that flows will be in excess of 82,500 cfs at Cohoes, in excess of 36,300 cfs at Burtonsville and less than 26,100 cfs at Little Falls movable dams MD-4 through MD-8 downstream of Schoharie Creek will be lifted.

The time required to fully lift lower gates and uprights varies from 1.5 hr. to 6 hr. Charts have been prepared (attached to the procedure manual) for each movable dam showing safe lifting criteria, where the difference between headwater and tailwater elevation does not exceed certain values. If headwater/tailwater conditions indicate safe lifting is not possible, EOC staff, in coordination with site staff, will determine if steps can be implemented that will allow for safe lifting.

At each MD, the Site Supervisor (SS) ensures that sufficient staff are present, the Safety Meeting has been held, and all staff are at assigned locations. Then the DCE contacts all Site Supervisors to begin simultaneous lifting operations:

- Close Guard Gates
- Lift upper gates in linear sequence, re-verify water levels allow safe lifting
- Lift lower gates in prescribed sequence, re-verify water levels allow safe lifting
- Lift uprights in linear sequence

REPORT NAME/DATE/REF	**Movable Dam Lifting Procedure**	Aug 13, 2018	001C
REVIEWER	Wayne Gannett, PE, CFM		

If the SS believes that continuing with lifting operations would create a safety hazard, the DCE shall be notified, and a determination made if the lifting operation should be aborted at the site.
Once water conditions allow safe access, a visual inspection will be conducted to assess the condition of the MD and its components, as per the Post-Incident Inspection Procedure (K118-EMP-0012). After the inspection confirms that the movable dams may safely be re-installed, this operation will be done as soon as feasible.
No cost estimates are provided in this operating procedure.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None, document is an operating procedure.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Operate in accordance the procedure (K118-EMP-0006).

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Continue operations, incorporated improvements based on operating experience, and provide similar removal capabilities at MD 12 and 14.

BIBLIOGRAPHY

NYS Canal Corporation (Aug 13, 2018) *Movable Dam Lifting Procedure (Procedure No. K118-EMP-0006)*

REPORT NAME/DATE/REF	**Supplemental Vischer Ferry Dam Memo**	Dec 18, 2019	004
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The Vischer Ferry Dam is a 1,900 foot long fixed crest ogee spillway dam. Flows on the north side of the dam are regulated through the NYPA Vischer Ferry Hydroelectric Project. River discharge exceeding the 21,000 cfs capacity of the power plant flows over the spillway. The NYPA hydroelectric license specifies the minimum water level at the spillway crest during non-navigation season and the minimum water level at the top of 27-inch high flashboards during navigation season, which prohibit drawing down the reservoir elevation in anticipation of a flood event. The area potentially affected extends along the Mohawk River between Vischer Ferry Dam at Lock E-7, Crescent, NY and Lock E-13 near Yosts, NY.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The intervention involves reducing the water level at Vischer Ferry Dam by either 2.5 feet, 4 feet, or 6 feet below the spillway crest in anticipation of major flood events to evaluate flood mitigation. Once the flood levels have subsided, reservoir water level would be restored to the normal level by raising the crest gates.

Evaluation of Effectiveness

The FEMA approved hydraulic model, based in Mike 11 (a flood software package), was updated to mimic the proposed interventions. The 100 and 500-yearr discharges from Lock E-13 to Vischer Ferry Dam were developed, based on the FEMA effective 100-and 500-year flood peaks. Then the HEC RAS steady state model was run between Lock E-13 and the Vischer Ferry Dam for existing non-navigation season conditions, and the pool level lowered 2.5 feet, 4 feet and 6 feet below spillway crest elevation. For all runs flood depths were developed as depth grids and depth grid polygons. Those results were used to calculate flood damages for each alternative. Property damage was determined through seven individual depth-damage curves acquired through the USACE HEC-FIA. Each depth-damage curve represented a property type (i.e. residential, industrial, mobile home, etc.) and therefore a different curve equation. The damage in the curve was represented as a percentage of the assessed value of the building based on the water depth at that specific building.

Results

Table 1 summarizes the benefits of potential interventions for the 100-year flood limits

Table 1 – Summary of Benefits of Potential Interventions for 100-Year Flood

Vischer Ferry Dam Potential Intervention Description[1]	Reduction in Flood Damages ($M)	Number of Parcels in 100-yr. Flood Limits for Existing Conditions	Number Removed from 100-year Floodplain	
			Parcels	Critical Facilities
Vischer Ferry Dam Operated at 2.5 ft. below spillway crest	14.4	478	130	2
Vischer Ferry Dam Operated at 4 ft. below spillway crest	20.8	478	145	2
Vischer Ferry Dam Operated at 6 ft. below spillway crest	25.8	478	153	3

Notes:

(1) Reductions in flood damages and parcels removed for these potential interventions include only the area along the Mohawk River upstream of Vischer Ferry Dam and Lock E13 near Yosts, NY.

The estimated reduction in FEMA flood insurance premiums for the combined potential interventions is presented in Table 3.

REPORT NAME/DATE/REF	**Supplemental Vischer Ferry Dam Memo**	Dec 18, 2019	004
REVIEWER	Wayne Gannett, PE, CFM		

Table 3 – Summary of Reduction in FEMA Residential Flood Insurance Premiums

Flood Insurance Premiums[1]	Pre-1980 Residential ($/per yr)	No. of Residential Parcels	Post-1980 Residential ($/per yr)	No. of Residential Parcels	Total Residential ($/per yr)	Total No. of Residential Parcels
Existing	$242,100	270	$24,400	14	$266,500	284
With Vischer Ferry Dam operated at 2.5 ft., below spillway crest	$66,700	89	$5,100	3	$71,800	92
With Vischer Ferry Dam operated at 4 ft. below spillway crest	$66,700	89	$5,100	3	$71,800	92
With Vischer Ferry Dam operated at 6 ft. below spillway crest	$60,400	85	$7,700	4	$68,100	89

Notes:
(1) Reductions in flood insurance premiums for these potential interventions include only the area along the Mohawk River upstream of Vischer Ferry Dam and Lock E13 near Yosts, NY.

Capital Cost

The cost of the crest gate construction for the full length of the Vischer Ferry Dam have been forecast at a high level. Benefits and capital costs of the potential interventions are summarized in Table 5 below.

Table 5 – Summary of Benefits and Costs of Capital and Operations Costs of Potential Interventions

Vischer Ferry Dam Potential Intervention Description	Reduction in 100-yr Flood Damages ($M)	Reduction in 500-yr Flood Damages ($M)	Reduction in Residential Flood Insurance Annual Premiums ($1000)	Costs of Crest Gates ($M)
Vischer Ferry Operated at 2.5 ft. below spillway crest	$14.4	$19.0	$71.8	$9.0
Vischer Ferry Operated at 4 ft. below spillway crest	$20.8	$22.7	$71.8	$14.0
Vischer Ferry Operated at 6 ft. below spillway crest	$25.8	$27.7	$68.10	$20.0

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

These interventions could have significant positive and negative impacts in areas not related to flood reduction such as navigation and current operations of the canal, changes in water quality and the broader ecosystem, and economic development associated with canalside properties. These impacts warrant further study; specific state agencies not identified.

REPORT NAME/DATE/REF	**Supplemental Vischer Ferry Dam Memo**	Dec 18, 2019	004
REVIEWER	Wayne Gannett, PE, CFM		

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

These findings are preliminary and require further in-depth evaluations in the areas of hydraulic performance, flood damage reduction benefits and both operational and capital costs.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Conduct pre-design studies of Vischer Ferry Dam crest gate alternatives to evaluate and develop recommendations for dam modifications to reduce flooding.

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Bergmann Associates (December 18, 2019) *New York Power Authority: Reimagine the Erie Canal – Mohawk Flood Assessment – Supplemental Vischer Ferry Dam Memo* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\Task 8 Deliverables\Mohawk Interventions Supplemental Memo Vischer Ferry Updated.pdf

REPORT NAME/DATE/REF	**Vischer Ferry Dam Crest Gates Confirmation Study Memo**	Feb 16, 2021	005
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The report has several components:

- Replacement of the below water portion of the MIKE-11 hydraulic model with 2019 bathymetric survey prepared by H2H Associates, which makes the bathymetry in the model similar to that for the ice jam model prepared by Clarkson University.
- Incorporation of the Clarkson University Vischer Ferry Dam crest modifications based on the ice jam modeling results. Those results include 27" flashboards on Dams E and F that fail during a flood event, and alternative modifications of Dam D that include 27" high crest gates, 48" crest gates and 72" crest gates.
- Updating the stage vs. damage relationship in this reach of the Mohawk River for the seven highest value properties: GE South and North Properties, Wastewater Treatment Plant, Casion, Community College Apartments and Apartment Complex Village.
- Review of April 17 2018, Gomez and Sullivan Engineers (GSE) Memo to NYPA. That study and others have shown that flood damage reduction benefits cannot be provided in the Stockade Historic District for the 100-year flood for crest lowerings of Vischer Ferry Dam less than 6 ft.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Interventions

The Vischer Ferry Dam is a 1,900 foot long fixed crest ogee spillway dam. There are three distinct dam segments - Dam D crest length 735 feet, Dam E crest length 682 feet and Dam F crest length 502 feet. The alternatives include:

- Baseline – all three dam segments have 27 inch high flashboards that do not fail in floods.
- Option A – all three dam segments have 27 inch high flashboards that fail in flood events.
- Option B – Dams E and F have 27 in. high flashboards that fail in flood events, and Dam D has 48 inch high crest gates, lowered during flood events.
- Option C - Dams E and F have 27 in. high flashboards that fail in flood events, and Dam D has 72 inch high crest gates, lowered during flood events.

All heights represent distances below the existing top of flashboards at el. 211.67 NAVD88. The benefits represent sum of all flood damage losses potentially avoided by the Vischer Ferry dam options. Reductions in flood insurance premiums are not considered.

Updating Stage vs. Damage for High Value Parcels

The seven high value parcels were examined in detail to refine flood damage estimates. Schenectady and Saratoga County Effective FIS maps were examined to determine if any of the seven high value properties are included in the 100-year floodplain (Special Flood Hazard Area, SFHA), the 500-year flood plain, or had been removed due to a property specific flood protection system or Letter of Map Revision (LOMR). The parcel centroid point (used as zero-damage point) was moved to a location that representatively captures the initiation of structure flooding damages.

Review of GSE Vischer Ferry Dam Memorandum

GSE developed a synthetic hydrograph from the 2011 Hurricane Irene hydrograph at Cohoes Falls, USGS 01357500. The ordinates of the synthetic hydrographs were adjusted by drainage area ratio to a power to Vischer Ferry Dam. This adjustment resulted in a 100-year flood event hydrograph with a peak of 153,175 cfs at Vischer Ferry Dam. The corresponding FIS 100-year peak (Mohawk River confluence with Alplaus Kill) is 149,600 cfs.
The GSE hydraulic analysis evaluated six options: Dam D lowered 2 feet, 4 feet, and 6 feet, and Dams D and F lowered 2 feet, 4 feet, and 6 feet. Dam E was not modified in any of the options. Modified crest elevations studied were 2 feet, 4 feet or 6 feet lower than top of flashboard elevations. At a 6 foot lowering, the modified dam crest

el. = 205.67. The Reimagine the Canals Task Force Report Supplemental Vischer Ferry Dam Memo, (December 18, 2019), established a 6 foot lowering from the top of the fixed dam crest, for a modified dam crest el. = 203.3. Minor reductions in WSEL resulted for all 6 GSE options as compared with the baseline case. Greater WSEL reductions occurred with lower flows, and with greater reductions in dam height. At a cross section in the Stockade District in Schenectady, the GSE determined that locations are inundated at least 5.9 feet in the baseline condition for the 100-year but are provided with maximum WSEL reductions of 0.12 foot for 6 foot dam lowering.

Evaluating Effectiveness of Intervention Options A, B and C

The Mike 11 hydraulic model with updated bathymetry was used to model the proposed interventions. Steady state flood peaks of 149,600 cfs (100-year) and 186,200 cfs (500-year) are used, consistent with the Reimagine the Canals study and the Effective Schenectady County FIS. The model was run for Options A, B and C to obtain peak WSEL from the Vischer Ferry Dam to Lock E-8. For all runs flood depths were developed as depth grids and depth grid polygons, with results used to calculate flood damages. Property damage was determined through seven different depth-damage curves acquired through the USACE HEC-FIA. Each depth-damage curve represented a different property type (i.e. residential, industrial, mobile home, etc.) and therefore a different curve equation. The damage in the curve was represented as a percentage of the assessed value of the building based on the water depth at that specific building.

Measures used to assess the benefits included reduction in flood damages for the 100-year and 500-year floods as determined from comparison of the depth-damage curves for existing conditions vs. proposed options, in non-navigation season. The number of parcels was determined for floodable structures and number of critical facilities removed from the floodplain.

Results

Table 2 and 3 summarize the benefits of potential interventions for the 100-year and 500-year flood limits, respectively, between the Vischer Ferry Dam and Lock E-8.

Table 2 – Summary of Damages for Baseline and Options for 100-Year Flood

Potential Intervention Option (1)	**Flood Damages**	**Number of Parcels in 100-yr. Flood Limits**	**Number of Critical Facilities in 100-yr Flood Limits**	**Number Removed from 100-year Floodplain from Baseline**	
				Parcels	**Critical Facilities**
Baseline	$15,230,404	498	19	N/A	N/A
Option A	$10,315,444	470	19	28	0
Option B	$9,212,152	461	19	37	0
Option C	$8,809,222	454	19	44	0

Table 3 – Summary of Benefits of Potential Interventions for 500-Year Flood

Potential Intervention Option (1)	**Flood Damages**	**Number of Parcels in 500-yr Flood Limits**	**Number of Critical Facilities in 500-yr Flood Limits**	**Number Removed from 500-year Floodplain from Baseline**	
				Parcels	**Critical Facilities**

REPORT NAME/DATE/REF	**Vischer Ferry Dam Crest Gates Confirmation Study Memo**	Feb 16, 2021	005
REVIEWER	Wayne Gannett, PE, CFM		

Baseline	$79,413,000	728	25	N/A	N/A
Option A	$74,807,081	689	25	39	0
Option B	$72,804,694	684	25	44	0
Option C	$71,838,398	679	25	49	0

Capital Cost

The cost of the crest gate construction at Vischer Ferry Dam have been forecast at a high level. Benefits and capital costs of the interventions are summarized in Table 5

Table 5 – Summary of Benefits and Capital Costs of Potential Intervention Options

Potential Intervention Option	Reduction in 100-yr Flood Damages from Baseline Configuration($M)	Reduction in 500-yr Flood Damages from Baseline Configuration ($M)	Capital Cost Potential Intervention Option ($M)
Option A	$4.9	$4.6	$9.0
Option B	$6.0	$6.6	$10.9
Option C	$6.4	$7.6	$13.2

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

These interventions could have significant positive and negative impacts in areas not related to flood reduction such as navigation and current operations of the canal, changes in water quality and the broader ecosystem, and economic development associated with canalside properties. These impacts warrant further study; specific state agencies not identified.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

These findings are preliminary and require further in-depth evaluations in the areas of hydraulic performance, flood damage reduction benefits and both operational and capital costs.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Conduct pre-design studies of Vischer Ferry Dam crest gate alternatives to evaluate and develop recommendations for dam modifications to reduce flooding.

BIBLIOGRAPHY

Bergmann Associates (February 16, 2021) *New York Power Authority: Reimagine the Erie Canal – Mohawk Flood Assessment – Vischer Ferry Dam Crest Gates Potential Interventions Confirmation Study Memo* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\Task 10 Deliverables\Mohawk Interventions Supplemental Memo Vischer Ferry Updated + VFD Comparison Study Working.docx

REPORT NAME/DATE/REF	**Guy Park Manor FEMA SFHA Evaluation**	Jul 15,2020	007A
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

Following Hurricane Irene and Tropical Storm Lee floods in 2011, the NYSCC designed repairs to moveable dam gates, uprights, and hoisting machinery so that lower gate panels and uprights could be raised under flowing water conditions. These repairs led to development of a procedure for lifting lower gates and uprights between Lock E-8 (MD-4) and Lock E-15 (MD-11) in advance of flood events, as documented in NYCC procedure K118-EMP-0006.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Analysis

Hydraulic modeling and boundary conditions were based on the effective 2018 Flood Insurance Study (FIS) for Montgomery County. Water-surface elevations and cross-section geometry were computed for the Mohawk River using the Danish Hydraulic Institute (DHI) hydrodynamic modeling software MIKE 11. In comparison to the 2018 FIS, which represents conditions in which lower gates for all the locks are in place, upper gates are lifted and there is no obstruction due to debris, MIKE 11 can account for moveable dams and locks.

Therefore, as part of the analysis, the hydraulic model was updated by removing the lower gates and uprights of MD-7. This means that both upper and lower gates and uprights of MD-7 are not part of the hydraulic structures and do not impact high flow conditions. This is the condition analyzed in the LOMR study.

Results

Model were transferred to the Inundation Mapping Tool (IMAP) to develop flood inundation maps. With access to the National Flood Hazard Layer (NFHL) on IMAP, the flood inundation maps were compared to the 2018 FEMA Study. All data was reported in NAD83 UTM-18N NAVD88.

- BFE (FEMA study) at upstream side of Lock 11 is **274.93 ft**
- BFE (LOMR study) with lower gates removed at upstream side of Lock 11 is **271.98 ft**
- The impact of lowering is **2.95 ft.**
- The extent of the regulatory floodplain decreased by approximately 30 ft.
- The regulatory floodway width decreased by approximately 55 ft, and it is confined to the channel banks.

No cost estimates were developed for this study.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Prepare a LOMR submission to FEMA reflecting operational change at Lock E-11.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Hydraulic analysis and LOMR preparation at other Movable Dams to reflect modified operating procedure for lower gate and upright removal prior to flood events.

BIBLIOGRAPHY

Bo Juza Aquatrend/Bergmann Associates (July 15, 2020) *Guy Park Manor FEMA SFHA Evaluation* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\Task 11 Guy Park Manor\20200715 Deliverables\GuyManor_Memo_ver05.docx

REPORT NAME/DATE/REF	Guy Park Manor LOMR	Apr 29, 2021	007B
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

This Letter of Map Revision (LOMR) documents to FEMA changes in Base Flood Elevations (BFE) and Floodway (FW) for the effective FEMA Study for the Mohawk River between the downstream side of Lock E-10 / Movable Dam 6 and the upstream side of Lock E-12 / Movable Dam 8 and for changed operations where the lower gates and uprights for Movable Dams 7 (Lock E-11) and 6 (Lock E-10) for the Mohawk River Erie Canal system are removed.

Flooding Problems Identified

The focus of the study is in the area of Guy Park Manor, adjacent to Lock E-11.

Flood Mitigation Measures Recommended and Estimated Capital Cost

- Analysis

Guy Park Manor is located on FIRM panel 36057C0204E. The LOMR submission revised the reach of the Mohawk River between the downstream side of Lock E-10 and the upstream side of Lock E-12, including a total of 7 FIRM panels.

The existing effective FEMA Study hydraulic model was updated at Moveable Dam 6 (at Lock E-10) and Movable Dam 7 (at Lock E-11) by removing all the lower gates and uprights above BFE. The remaining hydraulic structures in the model were not changed. This means that both upper and lower gates and uprights are not part of the hydraulic structures at Lock E-10 and E-11 and that only the fixed piers of the movable truss bridge structures have any effect on high flow conditions in the Erie Canal/Mohawk River system.

The floodway was developed by removing both (left and right) floodplain areas by adjusting the modeled cross section. In Mike 11, the cross sections were modified by adjusting the model mark representing the right and left bank (1 and 3) to confine flow to the bankfull cross section. The floodway model water levels were compared against the Q100 BFEs. The increases were all less than 1.0 feet and most increases are less than 0.7 feett. Based on the findings, the resulting floodway delineation for the LOMR is confined within the limits of the Mohawk River/Erie Canal channel for most of the revised reach.

- Results

Modeling results from 1D model were transferred to GIS tools and flood zones were establish based on results from Mike11 water levels. GIS tools were used to develop flood inundation maps for Q100 Q500 and the Floodway. All data are in NAD83 UTM-18N NAVD88.

REPORT NAME/DATE/REF	Guy Park Manor LOMR	Apr 29, 2021	007B
REVIEWER	Wayne Gannett, PE, CFM		

Revisions were made to affected FIRM maps, the floodway tables and river profiles to reflect the changed operating conditions. The Guy Park Manor is removed from the 100-year floodplain.

The LOMR package was submitted to FEMA April 29, 2021 by the NYCC on behalf of the municipalities within the mapped areas: City of Amsterdam, Town of Amsterdam, Town of Florida, Town of Mohawk and Village of Fort Johnson. The LOMR was approved by FEMA on June 1, 2022 and became effective 6 months later on December 1, 2022.

Investigations and actions recommended by each agency

None

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Hydraulic analysis and LOMR preparation at other Movable Dams to reflect modified operating procedure for lower gate and upright removal prior to flood events. This will be undertaken in the upcoming FEMA map update for Montgomery County.

BIBLIOGRAPHY	Bergmann Associates (April 29, 2021) *Guy Park Manor LOMR* I:\NYSCC\014344.09 NYSCC- Guy Park Manor LOMR\3.0 Design\3.4 Calcs\1-Submission Files\Working Docs\2021-04-29 GuyParkManor_LOMR_Technical Memorandum.pdf

REPORT NAME/DATE/REF	**Mohawk River Flooding Impact Evaluation: Bridges between Vischer Ferry Dam and Lock E8**	Aug 31, 2021	008
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The focus area of this study is between the Vischer Ferry Dam and Lock E-8, including the City of Schenectady, where existing bridges impact flooding of the Erie Canal and Mohawk River.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

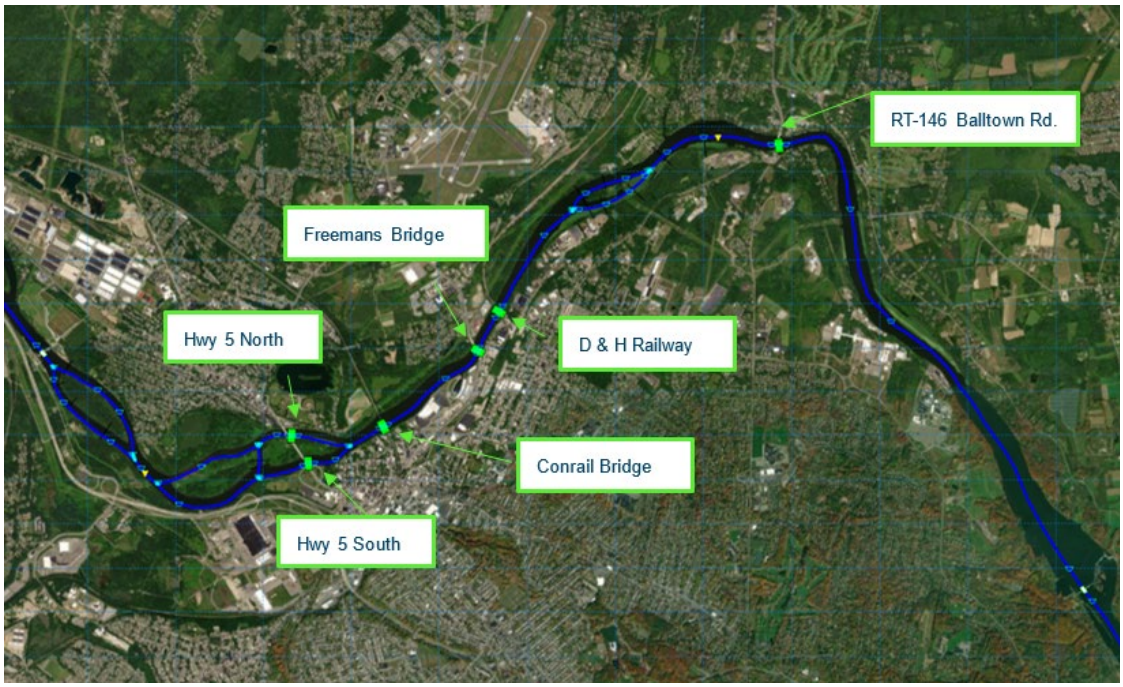
Analysis

The 2019 Baseline hydraulic model was updated to incorporate the NY Route 5 Bridge, which was omitted from the flood forecasting model, additional across sections, and new bathymetric survey (2019 H2H bathymetric survey) to improve the overall riverine system schematization. Water-surface elevations were computed for the Mohawk River (Erie Canal) for Q100 and Q500 FEMA recurrence intervals. Modeling was performed using the Danish Hydraulic Institute (DHI) hydrodynamic modeling software MIKE 11. Cross-section geometry was updated using sounding point cloud data provided by (H2H).

The report presented a comparison of this model with the 2010 Reference Model used in the FEMA Map Modernization Project for Schenectady County, which was based on previous topographic data.

Results

Modeling results were provided at the following bridges: RT-146 Balltown Rd., D & H Railway, Freeman Bridge, Conrail, Route 5 South Span and Route 5 North Span bridge, Ingersoll Avenue and Downstream of Lock E-8 Locations, which are depicted below.



Results are summarized in Table 8 and 9 of the report. Removal of railroad bridges and approach embankments would lower the Q100 WSEL by a maximum of 1.3 ft at the Conrail Bridge (Q100). Removal of highway bridges and approach embankments would lower the Q100 WSEL by a maximum of 1.64 ft at the Rt 146 Balltown Rd. bridge. Lowered WSEL would also be seen upstream of removed bridges. The Q100 WSEL would be lowered by 1.3 ft at

REPORT NAME/DATE/REF	**Mohawk River Flooding Impact Evaluation: Bridges between Vischer Ferry Dam and Lock E8**	Aug 31, 2021	008
REVIEWER	Wayne Gannett, PE, CFM		

Ingersoll Ave in the Stockade District for railroad bridge removal, and 1.75 ft at that location for highway bridge removal.

Baseline Model 2019 (RR Bridges and Embankments removed)				Q100		Q500	
Bridge Name	**River Name**	**Model chainage (m)**	**Model chainage (ft)**	**Difference with Baseline model for U/S WL (ft)**	**Difference with Baseline model for D/S WL (ft)**	**Difference with Baseline model for U/S WL (ft)**	**Difference with Baseline model for D/S WL (ft)**
RT-146 Balltown Rd.	Erie Canal	27357	89754	0.00	0.00	0.00	0.0
D & H Railway Bridge	Erie Canal	31425	103100	-0.43	0.03	-1.14	0.0
Freemanns Bridge	Erie Canal	31930	104757	-0.21	-0.46	-0.72	-1.0
Conrail Bridge	Erie Canal	33330	109350	-1.31	-0.19	-2.05	-0.6
Ingensoll Avenue	Erie Canal		109514	-1.31		-2.06	
Route 5 South Span	Erie Canal	34315	112582	-1.27	-1.30	-1.85	-2.0
Route 5 North Span	Isle of the Onondaga	1645	5397	-1.27	-1.31	-2.19	-2.0
Downstream of Lock E-8	Erie Canal		124508	-1.20		-1.93	

Table 1 Water Levels comparison between Baseline (2019) and RR Bridges and Embankments removal models

Baseline Model 2019 (Hwy Bridges and Embankments removed)				Q100		Q500	
Bridge Name	**River Name**	**Model chainage (m)**	**Model chainage (ft)**	**Difference with Baseline model for U/S WL (ft)**	**Difference with Baseline model for D/S WL (ft)**	**Difference with Baseline model for U/S WL (ft)**	**Difference with Baseline model for D/S WL (ft)**
RT-146 Balltown Rd.	Erie Canal	27357	89754	-1.64	-0.04	-1.95	-0.0
D & H Railway Bridge	Erie Canal	31425	103100	-1.22	-1.15	-1.36	-1.3
Freemanns Bridge	Erie Canal	31930	104757	-2.18	-1.14	-1.58	-1.2
Conrail Bridge	Erie Canal	33330	109350	-1.75	-1.84	-1.22	-1.3
Ingensoll Avenue	Erie Canal		109514	-1.75		-1.23	
Route 5 South Span	Erie Canal	34315	112582	-1.78	-1.70	-1.10	-1.1
Route 5 North Span	Isle of the Onondaga	1645	5397	-1.75	-1.75	-1.40	-1.2
Downstream of Lock E-8	Erie Canal		124508	-1.66		-1.20	

Table 2 Water Levels comparison between Baseline (2019) and Highway Bridges and Embankments removal models

No considerations for debris or ice flows are included in this evaluation, which is similar to the FEMA FIS for the City of Schenectady. It could be stated (based on past experience) that removal of bridge piers from the channel will further reduce flood risk from debris and ice jamming in this reach of the Mohawk River / Erie Canal.

Significant changes in the channel bathymetry between the 2010 and 2019 channel surveys were observed by comparing the 2010 FIS below water cross sections with below water channel cross sections taken using the 2019 H2H bathymetry at five cross section locations. The Mohawk River and its tributaries have a significant sediment load as observed after many recent flood events impacting channel morphology. As a result, hydraulic capacity of the channel has decreased.

No cost estimates were provided.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Further investigation/calibration of channel bathymetry data.

REPORT NAME/DATE/REF	**Mohawk River Flooding Impact Evaluation: Bridges between Vischer Ferry Dam and Lock E8**	Aug 31, 2021	008
REVIEWER	Wayne Gannett, PE, CFM		

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?
Further investigation flood damage reduction in this location of the Mohawk River including bridge replacement/removal.

BIBLIOGRAPHY	Bergmann Associates (Aug 31, 2021) *Mohawk River Flooding Impact Evaluation: Bridges between Vischer Ferry Dam and Lock E8* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\Task 13 - Mohawk River Bridges\VFD-E8_BridgesEvaluation_BathyUpdate_ver04.docx

REPORT NAME/DATE/REF	**Effect of VFD Modifications on Ice Jam Flooding Damages for January 2018 Ice Jam Event**	Jun 3, 2022	009
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

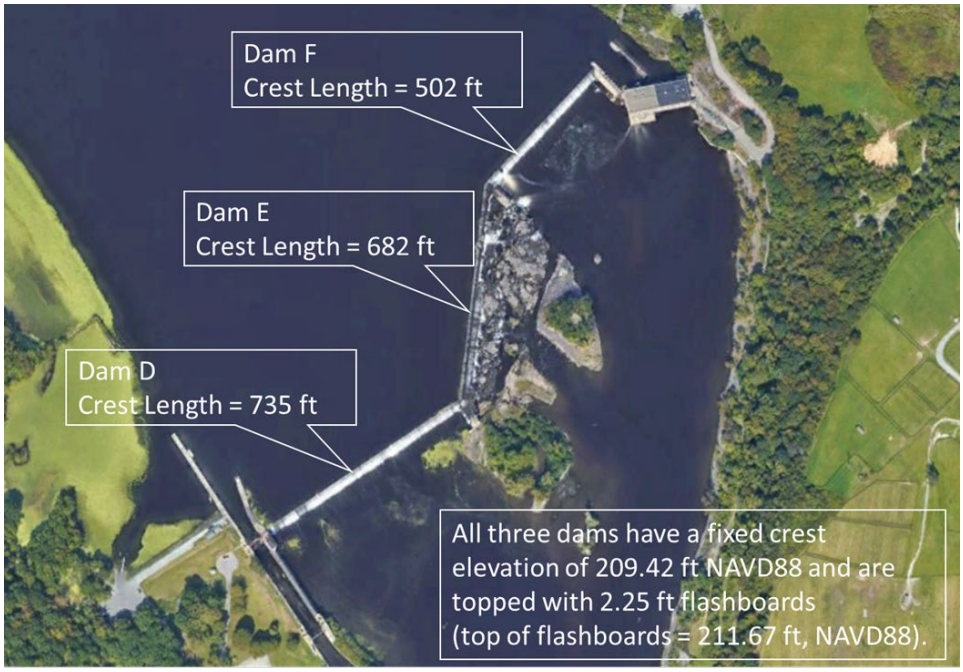
The focus of the study is in the between the Vischer Ferry Dam and Lock E-8, including the City of Schenectady and its Stockade District.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Analysis

The Vischer Ferry Dam (VFD) located adjacent to Lock E-7 is a 1,900-foot long fixed crest ogee spillway dam. Flows are regulated on the northern side of the dam through the New York Power Authority's (NYPA) Vischer Ferry Hydroelectric Project. The combined hydraulic capacity of the four hydroelectric generation units and associated bypass gates is 21,000 cfs. Flows exceeding the hydraulic capacity of the generation facilities and bypass flow over the fixed crest spillway.

Figure 1 - Vischer Ferry Dam Existing Crest Conditions



Previous studies included:

- ***Reimagine the Erie Canal – Mohawk Flood Assessment* – Vischer Ferry Dam CrestGates Potential interventions Confirmation Study Memo,** dated February 16, 2021. New river bathymetry, modify VFD interventions to be consistent with Clarkson University ice jam modeling study, and review 2018 Gomez and Sullivan study.
- ***Reimagine the Canals Task Force Report* Supplemental Vischer Ferry Dam Memo**, dated December 18, 2019. Evaluated VFD interventions of crest lowerings by 2.5 ft, 4 ft and 6 ft.
- ***Reimagine the Canals Mohawk Flooding Task Force Report* Summary Memo**, dated October 4, 2019. Estimates of flood damage reduction with lowering entire VFD spillway crest by 6 ft.

REPORT NAME/DATE/REF	**Effect of VFD Modifications on Ice Jam Flooding Damages for January 2018 Ice Jam Event**	Jun 3, 2022	009
REVIEWER	Wayne Gannett, PE, CFM		

Interventions

There are three distinct dam segments - Dam D crest length 735 ft, Dam E crest length 682 ft. and Dam F crest length 502 ft. The alternatives include:

- Baseline – all three dam segments have 27 in high flashboards that do not fail in floods.
- Option A – all three dam segments have 27 in. high flashboards that fail in flood events.
- Option B – Dams E and F have 27 in. high flashboards that fail in flood events, and Dam D has 48 in. high crest gates, lowered during flood events.
- Option C - Dams E and F have 27 in. high flashboards that fail in flood events, and Dam D has 72 in. high crest gates, lowered during flood events.

All heights represent distances below the existing top of flashboards at el. 211.67 NAVD88. Modification Options A, B and C and Dam E and F flashboards will remain in place throughout the winter and during ice flow runs, thus remaining at the top elevation of the existing flashboards. However, the Dam D flashboards will be lowered fully during ice flow runs. (Dam D, Dam E, and Dam F flashboards will be fully lowered during summer flood events.) Clarkson University provided the datasets for baseline conditions and the modification options. The variables in the dataset gave the index nodal number, X, Y, Z (bed elevation), WSE(water surface elevation), and HW (water depth above the riverbed or ground). The river bottom and overbank elevations in the Stockade and Scotia areas used geometric data from the MIKE 2D study. The floodplain elevations were the DEM data from NYS LiDAR data.

Depth grids in the form of GeoTIFF were developed to provide coordinates for data points at elevations; Z(bed elevation), WSE(water surface elevation), and HW(water depth above the riverbed).. All depth of water measurements for parcels (with structures) in areas projected to be impacted were recorded in Excel. The recorded measurements were imported into a developed damage curve to estimate flooding damage reductions to structures within areas affected for each potential intervention.

Property damage was determined through seven individual depth-damage curves that were acquired through the USACE HEC-FIA. Each depth-damage curve represented a property type (i.e. residential, industrial, mobile home, etc.) and therefore a different curve equation. The damage in the curve was represented as a percentage of the assessed value of the building based on the water depth at that specific building. The damage was summed for each model, and the difference was taken from the existing model to identify the reduction in flood damages according to each intervention. A vertical offset of 1 foot was assumed from ground elevation to first floor elevation for all structure types to account for a typical elevated first floor from ground surface.

Results

Reduction in flood damages for the January 2018 ice jam breakup event were determined from comparison of the summation of the depth-damage data for each of the modification options, compared to the baseline condition. The number of parcels with floodable structures and number of critical facilities entirely removed from the inundation limits of the January 2018 ice jam breakup event were determined. Results are summarized in Table 1.

REPORT NAME/DATE/REF	**Effect of VFD Modifications on Ice Jam Flooding Damages for January 2018 Ice Jam Event**	Jun 3, 2022	009
REVIEWER	Wayne Gannett, PE, CFM		

Table 1 – Summary of Damages for Baseline and Modification Options for January 2018 Ice Jam Breakup Event

Potential Modification Option [1]	Flooding Damages ($Million)	Number of Parcels in Event Flood Limits	Number of Critical Facilities in Event Flood Limits	Number Removed from Flooding Compared to Baseline		
				Parcels	Flooding Benefits ($Million)	Critical Facilities
Baseline	$119.2	240	4	N/A	N/A	N/A
Option A	$118.0	196	4	44	$1.2	0
Option B	$114.3	194	4	46	$4.9	0
Option C	$113.4	184	4	56	$5.8	0

Capital costs were not developed for this analysis.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Further investigation of VFD spillway crest interventions.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Further investigation of VFD spillway crest interventions and associated benefits for flooding reduction during ice jam events.

BIBLIOGRAPHY

Bergmann Associates (June 3, 2022) *Effect of VFD Modifications on Ice Jam Flooding Damages for January 2018 Ice Jam Event* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\DR 4480 HMGP Support\Task 1 - January 2018 Ice Jam Event Damages\DR 4480 Support - January 2018 Event - Existing and Alts Damages.docx

REPORT NAME/DATE/REF	Mitigation Measures to Reduce Flooding in the Historic Stockade	April, 2019	010
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

Shumaker reviewed literature on flood risk and historic flood events associated with the Mohawk River in the vicinity of the historic Stockade District in Schenectady. A hydraulic analysis was completed to quantify the frequency and magnitude of flooding for existing conditions of the Mohawk River adjacent to the Stockade. These flood elevations and frequencies, paired together in stage-frequency curves, were used by to inform the development of project alternatives.

Flooding Problems Identified

From 1910 to 1979, the flood stage in the Stockade was exceeded a total of 22 times. Recently, the Stockade has been subject to six damage-causing flood events: a rain-on-snow event in April 2005, a continental storm in June 2006, Tropical Storm Irene in August 2011, Tropical Storm Lee in September 2011, and ice jams in March 2007 and February 2018. High water during these events damaged public infrastructure, damaged private residences, and caused the closure of several City roads. Damage to some residences resulting from Tropical Storms Irene and Lee left some residents of the Stockade unable to return to their homes for six to nine months and led other residents to sell their home at a loss or abandon it entirely.

Flood Mitigation Measures Recommended and Estimated Capital Cost

- Analysis

Review of historic records and annual peak discharges at USGS Stream Gage No. 01357500 (Mohawk River at Cohoes, NY), showed that flooding can, and has, occurred in every month of the year on the Mohawk River and can be caused by a variety of causative factors including tropical storms/hurricanes, continental storms, rain-on-snow events, and ice jams. However, the most frequent cause of flooding is ice jams. Of the 54 flood events reviewed for this analysis, at least 36 of the recorded flood events were documented to be due to ice jams. This is consistent with research at Union College that identified that 80 percent of floods in the Stockade are due to ice jams (Lederer and Garver, 2000).

The straight alignment and low gradient of the Mohawk River promote ice cover development. When this ice cover is rapidly broken up, as may occur during sudden warm-ups or rapid increases in flow due to rainfall, large ice flows are conveyed downstream and may jam. The most frequent jam points are constrictions in the river or solid ice covers. Jam locations affecting the Stockade are at the Rexford Knolls, a bedrock gorge between the Rexford Bridge and Vischer Ferry Dam. The Rexford Knolls is were where the toe of the ice jams formed during 1914, 1936, 2007, and 2018 were located.

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The effective hydrology for the Mohawk River in the City was developed in 2007 by Baker Engineering NY. Since the effective hydrology was developed, there has been an additional 11 years of annual peak discharge data recorded by the USGS, including Hurricane Irene, which was the fourth-largest flood recorded at the USGS's Mohawk River at Cohoes, NY (USGS Gage #01357500) gage. To update the hydrology, Shumaker conducted analyses using procedures recommended in USGS's Bulletin 17C: *Guidelines for Determining Flood Flow Frequency.*

For the Mohawk River near Little Falls, NY gage, Shumaker included only those historic peaks recorded after construction of Delta and Hinckley Reservoirs in 1912 and 1914, respectively (USACE, 2019a). While neither reservoir is operated for flood control purposes, both provide a passive flood control benefit. For the Cohoes, NY gage, Shumaker included only those historic peaks recorded after construction of Schoharie Reservoir and the Blenheim-Gilboa Power Project in 1926 and 1974, respectively. While neither reservoir is explicitly operated for flood control, these reservoirs were reported to attenuate Hurricane Irene peaks approximately 19 and 8 percent, respectively (Milone and MacBroom, 2017).

Table 4-3 summarizes the Adopted discharge developed for this study, compared to the Effective Discharge developed in 1976.

Table 4-3
Summary of Hydrology Used in Corrected Effective Model

ACE (RI)	Discharge (cfs)					
	At Confluence with Kromme Kill		Upstream of Confluence with Alplaus Kill		Upstream of Vischer Ferry Dam [a]	
	Effective	Adopted	Effective [b]	Adopted	Effective [b]	Adopted
50 (2)	N/E	60,200	N/E	61,300	N/E	61,500
20 (5)	N/E	80,200	N/E	81,800	N/E	82,200
10 (10)	88,596	88,596	82,700	89,700	82,700	91,200
4 (25)	N/E	108,100	N/E	110,500	N/E	110,900
2 (50)	116,041	116,041	131,000	117,000	131,000	119,000
1 (100)	126,545	126,545	149,600	129,000	149,600	131,000
0.2 (500)	153,055	153,055	186,200	155,000	186,200	158,000

N/E = No estimate

For the hydraulic analysis, Shumaker identified the 2009 HEC RAS model used to develop the Flood Insurance Study (FIS) for Schenectady County (FEMA, 2014) as the best available model. Shumaker made the following changes to develop a Corrected Effective Model:

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- Extend the model to downstream to the Vischer Ferry Dam (VFD) with newer cross sections.
- Incorporate the VFD as an inline structure
- Change weir equation at the VFD to ogee weir and provide for 15,000 cfs through gates.

To validate the model, Shumaker compared measured water surface elevations of past high flow events to modeled water surface elevations for those same events. The annual peak discharges of 2011 (Tropical Storm Irene), 2015, and 2017 were selected to bound the typical range of flood flows expected. In general, the Corrected Effective Model was able to reproduce most measured high-water marks within several inches. With FEMA guidance recommending modeled water surface elevations match observed high-water marks within six inches, the hydraulic model performed well to reproduce observed high water marks at locations of uniform, gradually-varied flow and was thus considered valid for use in the study.

Differences in the Base Flood Elevation (BFE) between the Duplicate Effective Model and Corrected Effective Model ranged from a seven-inch increase near the Schenectady wastewater treatment plant to a nine-inch decrease near General Electric. These changes are largely due to improved modeling of the Mohawk River in the Town of Niskayuna and reduction in hydraulic losses at bridges resulting from the revised bridge modeling approach.

The Existing Conditions Model is a term used by DEC and FEMA to denote changes to the Corrected Effective Model that account for new development since the Duplicate Effective Model was created. In the case of this study, this new development includes the replacement new Rexford Bridge, development at Water's Edge, and development of the Mohawk Harbor / casino.

At the Q100 discharge, the Existing Conditions model indicate a reduction in flood stage of 0.6 ft at the Stockade, compared with the Duplicate Effective model.

- <u>Interventions</u>

No interventions were studied.

- <u>Results</u>

To examine ice jam events the concept of joint probability is used. To consider an example where flooding may occur as the result of both free-flow flooding and ice jams:

- The probability of an ice jam occurring in any given year and causing water to rise to or above the flood stage is one percent.

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- The probability of a free-flow event occurring in any given year and causing water to rise to or above the flood stage is two percent.

In such a scenario, where either an ice jam or a free-flow could occur during the year and cause water to rise above flood stage, the probability of the flood stage occurring is greater than the probability of the flood stage occurring as the result of just one of the events alone.

To obtain ice jam high-water marks, numerous primary and secondary data sources were reviewed. Each of these observations were recorded and adjusted to the project datum of NAVD88. Only ice jam events since 1913 were included, the year in which Vischer Ferry was constructed and flow dynamics in the Mohawk River substantially changed.

From the review of available records, peak water surface elevations were identified for 19 ice jam events in the 106-year record. The peak water surface elevations resulting from ice jams were used to develop a stage-frequency curve for the 19 recorded ice jam events assuming a systematic record in accordance with the FEMA (2018) procedures. The maximum water surface elevation estimated from this distribution was limited to elevation 232.4, the historic flood of record due to ice jams, to account for the fact that ice jams have a physical upper limit before they blow out. Due to the complex processes associated with their formation and break-up, standard practice is to not extrapolate statistical regressions beyond the ice jam flood of record.

Table 6-2 provides the resultant combined stage-frequency curve using the method described above; compared to results of the Duplicate Effective Model. The joint probability events result in higher WSEL at the Stockade for all events except the 0.2% annual probability (Q500) event.

Table 6-2
Joint Stage-Frequency Curve for Ice Jam and Free-Flow Induced Floods in the Stockade

ACE (RI)	Water Surface Elevation (ft, NAVD88)		
	Duplicate Effective Model	Joint Probability	Difference
50 (2)	N/E	220.7	N/A
20 (5)	N/E	223.9	N/A
10 (10)	223.41	226.2	+ 2.79
4 (25)	N/E	228.4	N/A
2 (50)	228.23	229.9	+ 1.67
1 (100)	230.18	231.4	+ 1.22
0.2 (500)	233.42	232.4	- 1.02

N/A = Not applicable; N/E = No estimate

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Capital costs were not developed for this analysis

Investigations and actions recommended by each agency

1. The prevalence of ice jams impacting the magnitude and frequency of flooding in the Stockade complicates, and most likely limits, the feasibility of "hydraulic" alternatives to reduce flood elevations of the Mohawk River as a means to mitigate flooding. Ice jams affecting the Stockade have occurred at numerous locations along the Mohawk River, suggesting that a hydraulic solution focused on one area may not mitigate ice-jam induced flooding at other locations.
2. The effective FIS underestimates flood risk in the Stockade.
3. Mitigation of ice jam-induced flooding is difficult to quantify due to the complex processes associated with the formation of ice jams.

The City of Schenectady, in collaboration with other interested in parties such as NYPA, would conduct appropriate studies.

Actions recommended to be undertaken by the NYSCC

Utilize this hydrology and hydraulics of ice jam probable flood stages to continue to assess interventions such as VFD modification.

Actions from this study can be adopted as an USFMTF recommendation

Conduct detailed modeling studies based on this hydraulic analysis of ice jam probable flood stages to investigate VFD spillway crest interventions and other possible interventions to reduce flooding during ice jam events.

BIBLIOGRAPHY	Shumaker Consulting Engineering and Land Surveying (with support from USACE Cold Regions Research and Engineering Laboratory) (April 2019) *Mitigation Measures to Reduce Flooding in the Historic Stockade* I:\Buro Happold Consulting Engineers\014193.00 Buro Happold - Mohawk River Flood Assess\3.0 Design\3.8 Reports\DR 4480 HMGP Support\Task 2 - Review of Shumaker Joint Probability Document\Shumaker_Stockade_H+H+IceJamAnalysis_201904-draft.pdf

REPORT NAME/DATE/REF	**Hazard Classification Review Memos Lock E-9 thru E-16 and E-18**	April – July 2016	015A - 015I
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

Removal of the upper and lower gates has been an operating procedure since 2018 to mitigate flooding along the Mohawk River. The hazard reclassification studies were similar for all the movable dams listed above. Under Part 673.5 (e) of NYSDECs Dam Safety Regulations, a dam owner may contest the Department's assignment of a Hazard Classification by providing a written request for Hazard Classification review to the department's Dam Safety Section. Documentation may include results of a dam break analysis, inundation mapping, and other relevant information in order to support the request for reclassification of the dam.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Hydrology

The Sunny Day flow of 3,400 cfs is the downstream discharge at the next downstream dam, Movable Dam 4 (MD-4) at Lock E-8, and was used as the initial conditions flow at the Lock E-9 dam. Standard practices allow for a more conservative approach by using a downstream discharge as the initial starting discharge in a hydraulic mode. Sunny Day flows at dams further upstream are lower as tributary drainage area decreases, for example 3,100 cfs at Lock E-12, 2,100 cfs at Lock E-14, and 700 cfs at Lock E-18.

Hydraulics

The Sunny Day with and without dam breaching runs were routed using the unsteady modeling routines in HEC-RAS. Cross section orientation and placement was developed using the HEC-GeoRAS extension for ESRI ArcGIS. The volume of water contained between each lock and the next upstream lock was represented in the model using cross sections developed from a hydraulically enforced DEM.

For the Spillway Design Flood (SDF) it was determined that a SDF breach analysis was unnecessary for the movable dams, for these reasons:

- New York State Canal Corporation (NYSCC) adopted changes to the operating procedures at the movable dams, where now gate panels as well as the vertical uprights will be raised completely out of the water, as they are during the non-navigation season, in anticipation of a major flood event (an event equal to or greater than a 10% annual chance flood event forecasted by the National Weather Service (NWS) Northeast River Forecast System). By raising the gate panels and the vertical uprights, the dam height is reduced to zero
- A 6-person crew (5 operators and a supervisor) is required at each movable dam to lift the gates and uprights for their lifting procedures. This staff is all on call during the navigation season ready to mobilize and implement the lifting procedures
- During the fall 2015 shutdown, the 6-person crews performing the gate and upright lifting were timed at 4 of the dams to provide data to verify that the operating procedure can be performed within the prediction interval. Including mobilization, the time required to complete lifting operations is estimated at 12.5 hour, will within the projected 24 hour forecast range.
- NYSCC operates gates and uprights of every movable dam at least twice in any year

Results

The peak flow resulting from the Sunny Day breach at each lock was calculated. The results of the Sunny Day dam breaching analysis show a maximum rise in water surface elevation just downstream of the dam, dissipating further at the next downstream dam. Since the maximum rise in water surface elevation does not extend to flood any structures, in accordance with the DOW TOGS 3.1.5 – Guidance for Dam Hazard Classification, a Low (Class A) Hazard is implied.

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REVIEWER	Wayne Gannett, PE, CFM		

Location	Movable Dam	Sunny Day Breach Peak Flow (cfs)	WSEL rise Downstream of Dam (ft)	WSEL at Next Downstream Lock (ft)
Lock E-9 Dam at Rotterdam Jct	MD-5	27,870	4.6	2.8
Lock E-10 Dam at Cranesville	MD-6	38,200	4.0	2.7
Lock E-11 Dam at Amsterdam	MD-7	36,400	3.5	2.9
Lock E-12 Dam at Tribes Hill	MD-8	25,800	2.6	2.2
Lock E-13 Dam at Fonda - Fultonville	MD-9	23,100	2.3	1.4
Lock E-14 Dam at Canajoharie	MD-10	20,600	2.8	1.7
Lock E-15 Dam at Fort Plain	MD-11	23,500	3.3	1.9
Lock E-16 Dam at Rocky Rift	MD-12	3700	0.8	0.3
Lock E-18 Dam at Herkimer	MD-14	5600	4.6	1.3

In addition, a cascade failure is not considered likely for the relatively small and short-lived rise in WSEL at the next downstream dam. Since the maximum rise in water surface elevation does not extend to flood any structures, in accordance with the DOW TOGS 3.1.5 – Guidance for Dam Hazard Classification, a Low (Class A) Hazard is implied.

Additionally, a review of the potential downstream inundation area was performed in accordance with the NYSDEC *Guidance for Dam Hazard Classification* and indicates that the maximum rise in the normal conditions water surface elevation, due to a breach event during the mean daily flow does not present a risk for the loss of human life, overtopping of roads and bridges, interruption of or reduced access to emergency services, interruption of utility services, or substantial environmental damages. Furthermore, the Erie Canal system is a recreational resource with little commercial traffic and does not provide transportation for critical resources, nor would a breach of the dam cause the interruption of any critical facilities.

Therefore, in accordance with NYSDEC Section IV.D of TOGS 3.1.5 - the Guidance for Dam Hazard Classification and Part 673.5 (e), it was recommended that the New York State Canal Corporation request that NYSDEC reduce the Hazard Class from Intermediate (Class B) to Low (Class A) for the studied dams.
Capital costs were not developed for this analysis.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

Approval of the Hazard Reclassification by NYSDED Dam Safety Division.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

None, hazard reclassification was the study purpose.

BIBLIOGRAPHY Bergmann Associates Hazard Classification Review memos:

REPORT NAME/DATE/REF	**Hazard Classification Review Memos Lock E-9 thru E-16 and E-18**	April – July 2016	015A - 015I
REVIEWER	Wayne Gannett, PE, CFM		

	July 6, 2016 Lock E-9 Dam at Rotterdam Jct Aug 29, 2016 Lock E-10 Dam at Cranesville Aug 29, 2016 Lock E-11 Dam at Amsterdam Aug 29, 2016 Lock E-12 Dam at Tribes Hill Aug 29, 2016 Lock E-13 Dam at Fonda - Fultonville Aug 29, 2016 Lock E-14 Dam at Canajoharie Aug 29, 2016 Lock E-15 Dam at Fort Plain Sep 15, 2016 Lock E-16 Dam at Rocky Rift Sep 15, 2016 Lock E-18 Dam at Herkimer All reports filed *I:\NYSCC\009619.18 NYSTA-HAZARD RECLASS LOCK E-8- E-16 & 18*

REPORT NAME/DATE/REF	**Supplemental Hydraulic Analysis Hazard Classification Review Memos Lock E-8**	April 1, 2016	018
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

Existing flooding issues on the canalized section of the Mohawk River will be mitigated by the NYSCC policy of removing upper and lower gates prior to a major flood event. The policy has been in place since 2018.
Based on a meeting held on in December 2015 at the NYSDEC main office, and follow-up conversations, the NYSCC agreed to perform supplemental hydraulic analyses (specifically three rainy day events) to further support obtaining approval to reclassify MD-4 from Class B to Class A. The original hazard reclassification review was issued to the NYSDEC DSS in March 2013, with supporting documentation.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

As an operating procedure since 2018 to mitigate flooding along the Mohawk River, the NYSCC has removed the upper and lower gates at Movable Dam 4 at Lock E-8. Under Part 673.5 (e) of NYSDECs Dam Safety Regulations, a dam owner may contest the Department's assignment of a Hazard Classification by providing a written request for Hazard Classification review to the department's Dam Safety Section. Documentation may include results of a dam break analysis, inundation mapping, and other relevant information in order to support the request for reclassification of the dam.

Hydrology

The three precipitation conditions that result in dam breaching events as specified by NYSDEC DSS were: 50% of the 100-year; 100-year; and 150% of the 100-year. Similar to the March 7, 2013 analyses, Bergmann performed the supplemental hydraulic analyses, using HECRAS to evaluate the potential downstream impacts of the breach scenarios. The March 2013 model was refined and calibrated as new information became available during this process.

Hydraulics

The additional three rainy day dam breach events assume the highly unlikely occurrence that all 17 of the lower gates could not be raised out of the water ahead of the flood event peak (contrary to the NYSCCs Movable Dam Gate Lifting Procedures, dated August 2018).

Table 1 provides a summary of the three dam analyses runs, with and without breach conditions.

Table 1 – Summary of Supplemental Hydraulic Analyses

Event	Number of Structures With 1st Floor Inundated		Number of Inundated 1st Floors With an Increase in Flooding		Change in Danger or Risk	NYSDEC Hazard Class Recommendation
	W/O Breach Event	With Breach Event	W/O Breach Event	With Breach Event		
Sunny Day	**0**	**0**	**0[1]**	**0[1]**	**None**	**Class A**
50% of 100 Year Storm	**0**	**0**	**0[1]**	**0[1]**	**None**	**Class A**
100 Year Storm	**3**	**3**	**0[1]**	**0[1]**	**None**	**Class A**
150% of 100 Year Storm	**14**	**14**	**0[1]**	**0[1]**	**None**	**Class A**

[1] Depth of inundation of downstream inundated structures does not increase due to the breach event as compared to the non-breach event, therefore, breaching of the Dam MD-4 at Lock E-8 does not increase the danger as defined by ACER-11.

In addition, an SDF breach analysis was not considered necessary for these reasons:

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REVIEWER	Wayne Gannett, PE, CFM		

- NYSCC adopted changes to the operating procedures at the movable dams, where now gate panels as well as the vertical uprights will be raised completely out of the water, as they are during the non-navigation season, in anticipation of a major flood event (an event equal to or greater than a 10% annual chance flood event forecasted)by the National Weather Service (NWS) Northeast River Forecast System). By raising the gate panels and the vertical uprights, the dam height is reduced to zero.
- A 6-person crew (5 operators and a supervisor) is required at each movable dam to lift the gates and uprights for their lifting procedures. This staff is all on call during the navigation season ready to mobilize and implement the lifting procedures
- During the fall 2015 shutdown, the 6-person crews performing the gate and upright lifting were timed at 4 of the dams to provide data to verify that the operating procedure can be performed within the prediction interval. Including mobilization, the time required to complete lifting operations is estimated at 12.5 hr, will within the projected 24 hr forecast range.
- NYCC operates gates and uprights of every movable dam at least twice in any year.

Results

The results of the supplemental hydraulic analyses show that there is no increase in the flood levels from a breach event at any of the lowest elevation structures in the downstream inundation zone for any of the three flood events that were evaluated.

Therefore, in accordance with NYSDEC Section IV.D of TOGS 3.1.5 - the Guidance for Dam HazardClassification and Part 673.5 (e), it was recommended that the New York State Canal Corporation request that NYSDEC reduce the Hazard Class from Intermediate (Class B) to Low (Class A) for MD-4.

Capital costs were not developed for this analysis

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

Approval of the Hazard Reclassification by NYSDED Dam Safety Division.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

None, hazard reclassification was the study purpose.

BIBLIOGRAPHY

Bergmann Associates Hazard Classification Review memo:
April 1, 2016 Lock E-8 Dam at Scotia

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B

REPORT NAME/DATE/REF	**Hydraulic Assessment Report Mohawk River Lock E-7 to Montgomery/ Herkimer County Line**	Aug 10, 2012	019
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

With movable dam lower gates in place across the Mohawk River, the lower gate panels (which range in height from 7.9 to 12.7 feet) act as a sill to trap debris during flooding events.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Movable dam structures have upper and lower gates that are used to control the water levels during navigation and non-navigation seasons. During the non-navigation season (November 16 to April 30), the movable dams are completely raised out of the water. During the navigation season (May 1 to November 15) the uprights, upper gates, and lower gates are lowered to impound water for navigation. The upper gates are raised as necessary to adjust pool levels for navigation, and are completely raised out of the water during periods of high flow. Presently, the lower gates are not adjusted during the navigation season, as they provide stability to the uprights against flowing water and debris.

Analysis

Several operating condition scenarios at each of the movable dams were selected for hydraulic evaluation. Each scenario was evaluated for the FEMA 10-, 50-, 100-, and 500-year flood events, and the resulting water surface elevations (in NAVD88 datum) and profiles were compared. The evaluations provide the peak water surface elevations at the upstream and downstream ends of each lock chamber. The modeled conditions are:

- Condition 1: Unobstructed flow (no debris), Baseline (upper gates removed)
- Condition 2: Unobstructed flow (no debris), One Span Fully Open
- Condition 3: Unobstructed flow (no debris), All Spans Fully Open
- Condition 4: Debris blockage on all spans for Baseline (upper gates removed)
- Condition 5: One Span Fully Open, remaining spans debris blockage same as Condition

An assessment was performed of the potential for debris accumulation during the navigation season downstream of Lock E-8.

A HEC RAS hydraulic model was developed. Cross section geometry data for the Mohawk River was obtained through multiple sources:

- Countywide LiDAR data existed for Schenectady County, which was used to define the overbank areas primarily
- Record drawings at structures existed at some of the bridge crossings, which were used to refine main channel and structure geometry
- Bathymetry existed at select locations collected from a recent FEMA flood mapping study within the county
- Typical canal section in areas not otherwise specified

Five bridges that had record plans available were modeled: CSX Hoffman Bridge upstream of Lock E-9, NY Rt. 5 Wester Gateway Bridge, Conrail and D&H Railroad Bridge, Freemans Road Bridge and Delaware and Hudson RR Bridge.

The downstream boundary condition was based on a rating curve calculated off the Vischer Ferry Dam, adjacent to the Lock E-7 structure.

Results

By opening one span of each moveable dam during the 1% annual chance flood event, the actual existing conditions water surface elevations would be lowered significantly - by up to 5.0 feet on the upstream side of moveable dams in Schenectady County, and by up to 3.2 feet in Montgomery County.

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REVIEWER	Wayne Gannett, PE, CFM		

By opening all spans of each moveable dam during the 1% annual chance flood event, the actual existing conditions water surface elevations would lowered even more significantly – by up to 7.5 feet on the upstream side of moveable dams in Schenectady County, and by up to 7.6 feet in Montgomery County.

The Condition 1 modeling for the 1% annual chance flood should theoretically match the FEMA published values because each was based on the same movable dam conditions: no debris loading, and lower gates in place. Due to modifications in the FEMA analysis, Condition 1 does not completely match FEMA, but is used as a baseline comparison.

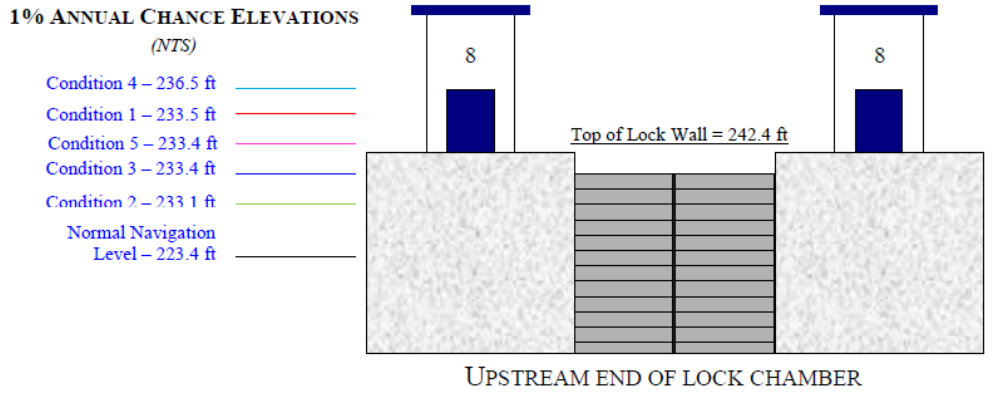
The actual existing conditions, with all lower gates in place and debris blockage occurring, are represented by Condition 4. For this condition, the peak water surface elevations for the 1% annual chance flood are as high as 4.5 feet above the corresponding FIS water surface elevations at Lock E-15 (MD-11), and on average 2.2 feet above the corresponding FIS water surface elevations at all moveable dams.

By opening one span of each moveable dam during the 1% annual chance flood event, the actual existing conditions water surface elevations would be lowered significantly - by up to 5.0 feet on the upstream side of the moveable dams in Schenectady County, and by up to 3.2 feet in Montgomery County. This is shown by comparing Conditions 5 and 4.

By opening all spans of each moveable dam during the 1% annual chance flood event, the actual existing conditions water surface elevations would lowered even more significantly – by up to 7.5 feet on the upstream side of the moveable dams in Schenectady County, and by up to 7.6 feet in Montgomery County. This is shown by comparing Conditions 3 and 4.

The assessment showed that none of the downstream bridges are nearly as prone to collecting debris as the movable dams currently are with the lower gates in place across the entire Mohawk River, during flooding events.

Water surface elevations were developed in tables and diagrams for each Lock and each operation condition, for each flow analyzed. Below is the WSEL diagram for Lock E-9 at the 1% annual chance (100-year) flood event.



Capital costs were not developed for this analysis

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

REPORT NAME/DATE/REF	**Hydraulic Assessment Report Mohawk River Lock E-7 to Montgomery/ Herkimer County Line**	Aug 10, 2012	019
REVIEWER	Wayne Gannett, PE, CFM		

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?
Further investigation of movable dam operating changes.
WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?
The movable dam operations were modified since 2018 to implement raising the lower gates in advance of a predicted flood event.

BIBLIOGRAPHY	Bergmann Associates (Aug 10, 2012) *Hydraulic Assessment Report Mohawk River Lock E-7 to Montgomery/ Herkimer County Line* I:\NYSCC\008839.13 NYSTA - D214049 ASSIGNMENT #13\3.0 Design\3.8 Reports\2012-08-17 Post Final Submission\2012-08-21-Final Hydraulic Report (Complete).pdf

B

REPORT NAME/DATE/REF	**Hydraulic & Structural Stability Analysis of Movable Dam 6 at Lock E-10**	December 2010	021
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

As a result of ongoing discussions between the NYSCC and the NYSDEC, Bergmann was commissioned by the NYSCC to conduct hydraulic and structural stability analyses of MD-6.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The dam is constructed like a steel bridge with steel gates suspended below the deck. There are three steel truss superstructures supported on concrete piers and abutments. Under each truss there is a series of paired steel uprights suspended above a concrete apron. Each pair of uprights provides the lateral support for a pair of steel slide gates that, in turn, create the impoundment of water for canal operation. The piers, abutments and aprons are founded either directly on soil or on timber piles. Wooden and steel sheet piles provide seepage control beneath the dam.

The movable dams are completely raised out of the water for each non-navigation season. During the navigation season (currently May 1 to November 15), the uprights and lower gates are lowered to impound water. These elements are left in place for the entire navigation season, since the uprights cannot be safely installed in deep water or high flow conditions. The lower gates are also left in place to provide stability to the uprights against flowing water and debris. Only the upper gates are raised as necessary to adjust pool levels for navigation, and are completely raised out of the water during periods of high flow. Figure 2 is a typical dam section.

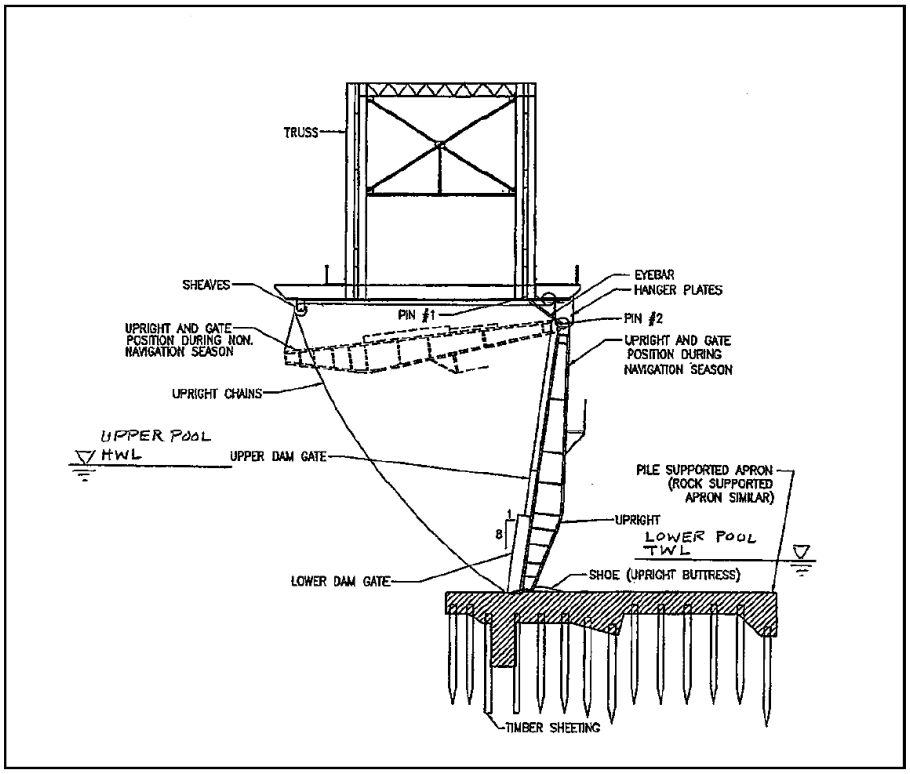


Figure 2 – Typical Section through Movable Dam

REPORT NAME/DATE/REF	**Hydraulic & Structural Stability Analysis of Movable Dam 6 at Lock E-10**	December 2010	021
REVIEWER	Wayne Gannett, PE, CFM		

Analysis

According to Sections 5.3 and 6.5.4 of the NYSDEC Guidelines, rehabilitated dams with a Hazard Classification "B" should have adequate spillway capacity (service spillway – auxiliary spillway combined) to convey the Spillway Design Flood (SDF, or 150% of 100-Year discharge) without overtopping. Since Movable Dam 6 (MD-6) is a Mohawk-style dam structure, it is designed to overtop, and thus a different interpretation is required. For application to these Mohawk-style structures. The NYSDEC criterion is interpreted as follows: the structure must be able to convey the SDF without causing failure to the structure or critical component parts.

Hydraulic and scour analyses were performed in connection with the design of the E-10 replacement auxiliary spillway (Bergmann Associates, 2007). As a part of the analyses, it was determined that the capacity of the service spillway-auxiliary spillway combination corresponds to a Mohawk River discharge of 96,000 cfs or approximately a 15-year recurrence interval event. Therefore, the service spillway-auxiliary spillway combination does not have sufficient hydraulic capacity to convey the SDF of 224,400 cfs. For this reason, the E-10 replacement auxiliary spillway was designed to withstand velocities and depths associated with the SDF.

Bergmann Associates performed structural stability evaluations of the various dam structures. Seven (7) sections were selected for evaluation (Figure 1). the structural stability of a dam structure was investigated for five loading conditions:

- Case 1 – Normal Loading (water surface at normal reservoir level)
- Case 2 – Ice Loading (water surface at normal reservoir level, plus ice loading)
- Case 3 – Design Loading (water surface at spillway design flood level)
- Case 3A – Maximum Hydrostatic Loading (maximum differential head between headwater and tailwater levels)
- Case 4 – Seismic Loading (water surface at normal reservoir level, plus seismic loading)

In addition to the above five cases, this project analyzed two other cases for their potential impact on the structure:

- Case 5a – Debris Loading (water surface at spillway design flood level, plus debris loading), whereas a continuous debris raft of 10-ft uniform thickness is impinged on the chains
- Case 5b – Debris Loading (water surface at spillway design flood level, plus debris loading, whereas a continuous debris raft of 10-ft uniform thickness impinged on both the chains and uprights, transmitting half the drag force to each.
- Case 6 – Wind Loading (water surface at normal reservoir level, plus wind loading)

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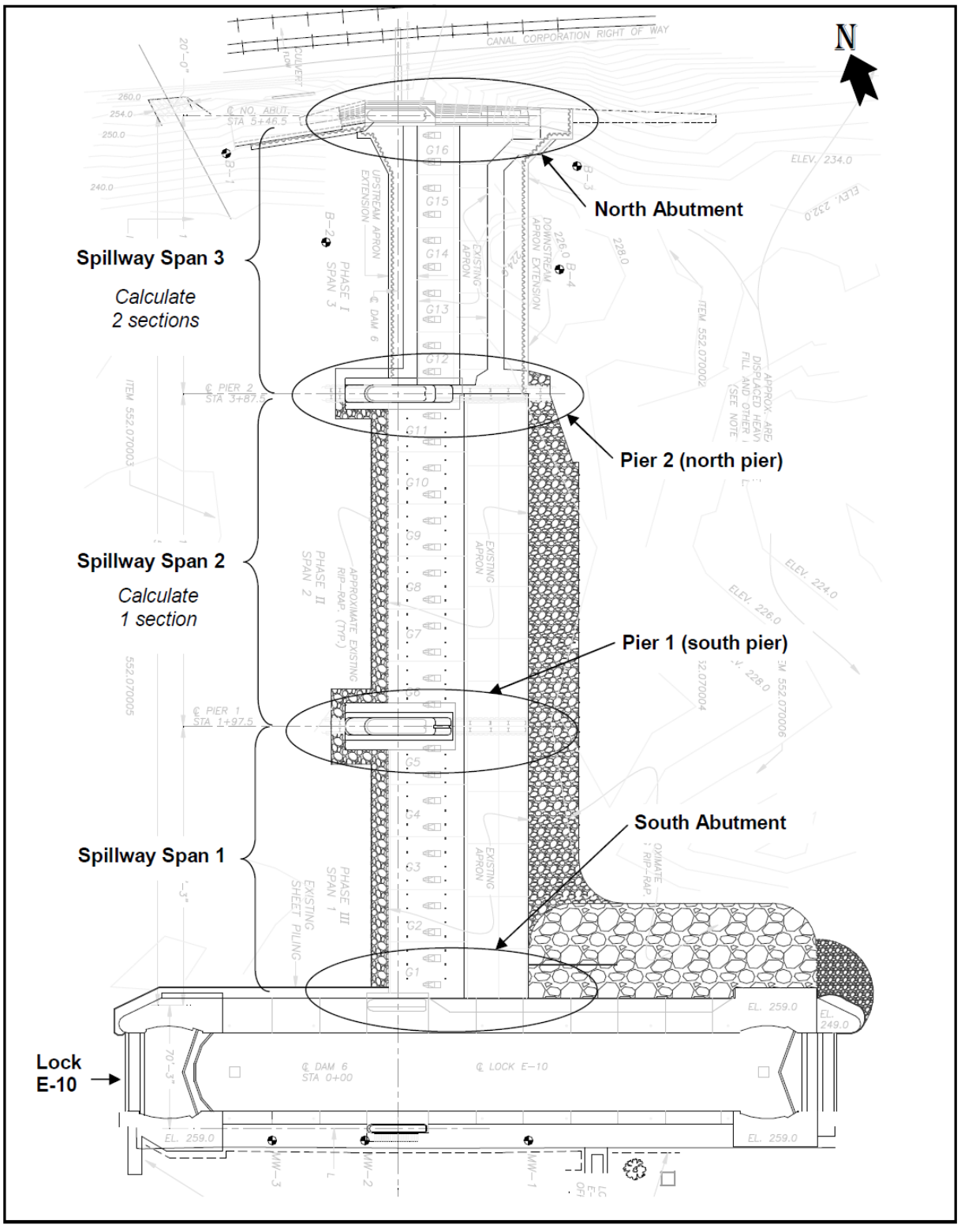

Figure 1B – Plan of Movable Dam 6 at Lock E-10

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REVIEWER	Wayne Gannett, PE, CFM		

Results

The MD-6 structure (and auxiliary spillway) does not have sufficient hydraulic capacity to convey the Spillway Design Flood (SDF) without overtopping. Because of this, the replacement auxiliary spillway and right overbank area, reconstructed following the June 2006 flood which washed it out, have been constructed and armored to protect the facilities from failure by scour from the SDF.

Additional hydraulic modeling was performed to evaluate the potential for a dam break scenario, also known as, "Sunny Day Failure." The findings indicate a maximum rise in water surface elevation of 4.5 feet (above normal pool elevation) from the breach wave. This maximum rise would occur near the structure, and as the wave propagates downstream it would gradually dissipate. This maximum rise is equivalent to the effects from a theoretical storm event less than the 2-year recurrence interval.

In general most, but not all, of the structural features of MD-6 were found to satisfy applicable safety criteria. One of the assumptions used in the analysis was that the existing timber piles are in good condition. This assumption is based on the evidence that continually submerged wooden structures do not degrade rapidly over time. Furthermore, the dam (and other like dams along the Mohawk River for that matter) has performed satisfactorily to date. Although the piles are approaching 100 years of age, it was concluded that the piles should retain their original strength characteristics.

Capital costs were not developed for this analysis

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The movable dam operations were modified since 2018 to implement raising the lower gates in advance of a predicted flood event. This analysis provided hydraulic and structural background for subsequent design work associated with the movable dams.

BIBLIOGRAPHY	Bergmann Associates (December 2010 *Hydraulic & Structural Stability Analysis of Movable Dam 6 at Lock E-10* I:\NYSCC\6715.15 Hydraulic & Structural Stability of MD-6\2.0 Design\2.8 Reports\2010-12 Final Technical Report\Report\1-Final Technical Report (Main Text).pdf

REPORT NAME/DATE/REF	**Spillway Design Report Lock E-10**	Mar 1, 2007	022B
REVIEWER	Wayne Gannett, PE, CFM		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The original concrete Spillway abutted the downstream end of the lower guide wall of Lock E-10 and extended 100 feet south, perpendicular to the lock chamber. The apron and spillway slabs were constructed of 12" thick concrete, lightly reinforced with 6" square wire mesh reinforcement. During the June 2006 flood event, the Spillway was washed away. The loss of the E-10 spillway steepened the hydraulic gradient between the downstream and upstream ends of the E-10 lock chamber and increased flows and velocities in the southern overbank. This resulted in scouring of the surface materials and underlying fill and alluvial soils, the loss of the frame buildings, shifting and settlement of the Lock Office Building, and loss of miscellaneous New York State Canal Corporation (NYSCC) facilities.

Figure 6: Flow over Spillway

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

- Analysis

The flood event of 150% of the 100-Year flood corresponds to the NYSDEC's *Guidelines for Design of Dams* for existing spillways of Hazard Classification "B" (NYSDEC, 1989). In terms of recurrence interval, this flood is greater than the 500-Year flood. Design discharges are listed below:

Table 1: Design Discharges for Replacement Spillway

Flood Event	River Discharge (cfs)	Corresponding Spillway Discharge (cfs)	Corresponding Spillway Unit Discharge (cfs/ft)
50-Year	131,300	5,400	54
100-Year	149,600	7,500	75
150% of 100-Year	224,400	14,100	141

Water surface elevations along a cross section of the Spillway taken parallel to the flow were calculated using HEC-RAS. It was assumed that all upper gates of MD-6 were raised to their highest position, and that the lower gates were obstructing flow, which represents navigation season operating conditions. The resulting water depths and velocities are used as input to develop structural design loadings for the Spillway and sheet piling, verify the ability of the surfacing material to resist the calculated velocities and determine the length and extent of new reinforced concrete Spillway.

Results

The replacement Spillway is integral with existing grade adjacent to Lock E-10, and functions only in the event that floodwaters flow overland around the lock structure. The Spillway is comprised of an upper concrete apron, 2H:1V sloping concrete slab, and lower concrete apron. The Spillway is oriented perpendicular to the landward lock wall, with the crest aligned just downstream of the lower miter gates and following the slope of the lower apron access

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stairs. The upper apron is level with the top of the lock walls and extends upstream of the crest approximately 68 feet. The lower apron extends 30 feett downstream of the end of the 2H:1V sloping slab and is level with the lower lock approach wall. The landside (south) abutment was set to meet the site geometry and includes a concrete haunch that rises 4 feet above the upper apron and 6 feet above the lower apron. Two lines of PZ 27 steel sheet piling are provided, including a 100 foot long section along the crest of the 2H:1V slope, transverse to the flow, and a 138 foot long section near the right side of the Spillway, parallel to the flow. The replacement Spillway was designed to be hydraulically equivalent to the original Spillway so that it did not increase upstream flooding.

The replacement Spillway is hydraulically and structurally designed for a range of discharges and flow conditions. One of the Spillway design conditions uses 150% of the 100-year flood, consistent with recommendations for existing dams with Hazard Classification "B", from NYSDEC's *Guidelines for Design of Dams* (NYSDEC, 1989).

Therefore, the replacement Spillway includes designed (either buried or surface) stone filling at the upstream and downstream perimeter of the reinforced concrete apron that withstand maximum calculated velocities for all return period flood events. The riprap protection will include a key at the perimeter of the protection.

A line of sheet piles will be installed along the replacement Spillway crest, extending from the face of the lock wall south to the south end of the Spillway. Those sheets will terminate at another row of sheet piles aligned orthogonally to the Spillway crest and that extend from the upstream edge of the upper apron to the downstream edge of the lower apron. The primary function of the sheet piles will be to provide a second line of defense against undermining of the Spillway and aprons, rather than to form a cutoff against water seepage. The sheet pile walls will be designed to sustain differential earth loading that could result from the unlikely erosion of the south Spillway abutment.

The replacement Spillway lower concrete apron forms the primary protection against undermining of the Spillway by turbulent high-velocity flows. As described Section 3C of this report, the apron length is established based on open-channel hydraulics. The downstream edge of the Spillway apron will extend below grade at least to the depth of the stone filling described above.

Medium or heavy stone filling will be designed for these regions of turbulent flow adjacent to the replacement spillway and on all surfaces that are steeper than 10% grade. The riprap protection will include a key at the perimeter of the protection.

Capital costs were not developed for this analysis.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Complete replacement of Lock E-10 spillway.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The Lock E-10 spillway was replaced in accordance with the engineering analysis and design. A similar approach can be used to guide similar replacements or upgrades at other movable dams.

BIBLIOGRAPHY

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REPORT NAME/DATE/REF	**Flood Mitigation Study Schoharie Creek**	April 2017	023
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

The Schoharie County Soil and Water Conservation District (SCSWCD) retained Milone & MacBroom, Inc. (MMI) to complete a Flood Mitigation Study for the Lower Schoharie Creek. The study is part of Phase 1 of the Mohawk River Watershed Management Plan Implementation. Public input has been a key element of this study. The public was engaged in an effort to inform them about the Schoharie flood study, its goals, and intended outcomes, and gather information on floodprone areas and flooding problems.

Flooding Problems Identified

With a watershed of approximately 930 square miles, Schoharie Creek drains the northwestern Catskill Mountains. A tributary to the Mohawk River, Schoharie Creek flows through Schoharie County from south to north. The terrain within the watershed is a mix of mountainous landscapes and flat, narrow valleys. Ground elevations range from an average of about 1,200 feet in the northern limestone plateau section of the county to approximately 2,000 feet in the higher plateaus in the southern part of Schoharie County, with the headwaters in Greene County at an elevation of 4,000 feet. Figure ES-1 shows the watershed study area of the lower basin.

The Schoharie Creek basin is particularly prone to flooding due to a number of factors, including the location of the headwaters in the Catskill Mountains; the low permeability of the mountainous landscape; the lack of wetland habitats or lakes within the watershed to retain stormwaters; and the prevalent winds, which during coastal storms push storm air masses up and over the mountains, causing cooling and subsequently high amounts of precipitation.

By far the largest storm on record occurred on August 28, 2011, as Tropical Storm Irene dumped up to 14 inches of rain within the Schoharie basin, resulting in a peak flow rate in Schoharie Creek of 128,000 cubic feet per second (cfs). This catastrophic flooding was followed by additional precipitation on September 7, 2011, as Tropical Storm Lee dropped a reported 2 to 7 inches of additional rain. Flows in Schoharie Creek exceeded the predicted 500-year flood in some locations, resulting in well over $100 million in estimated damages.

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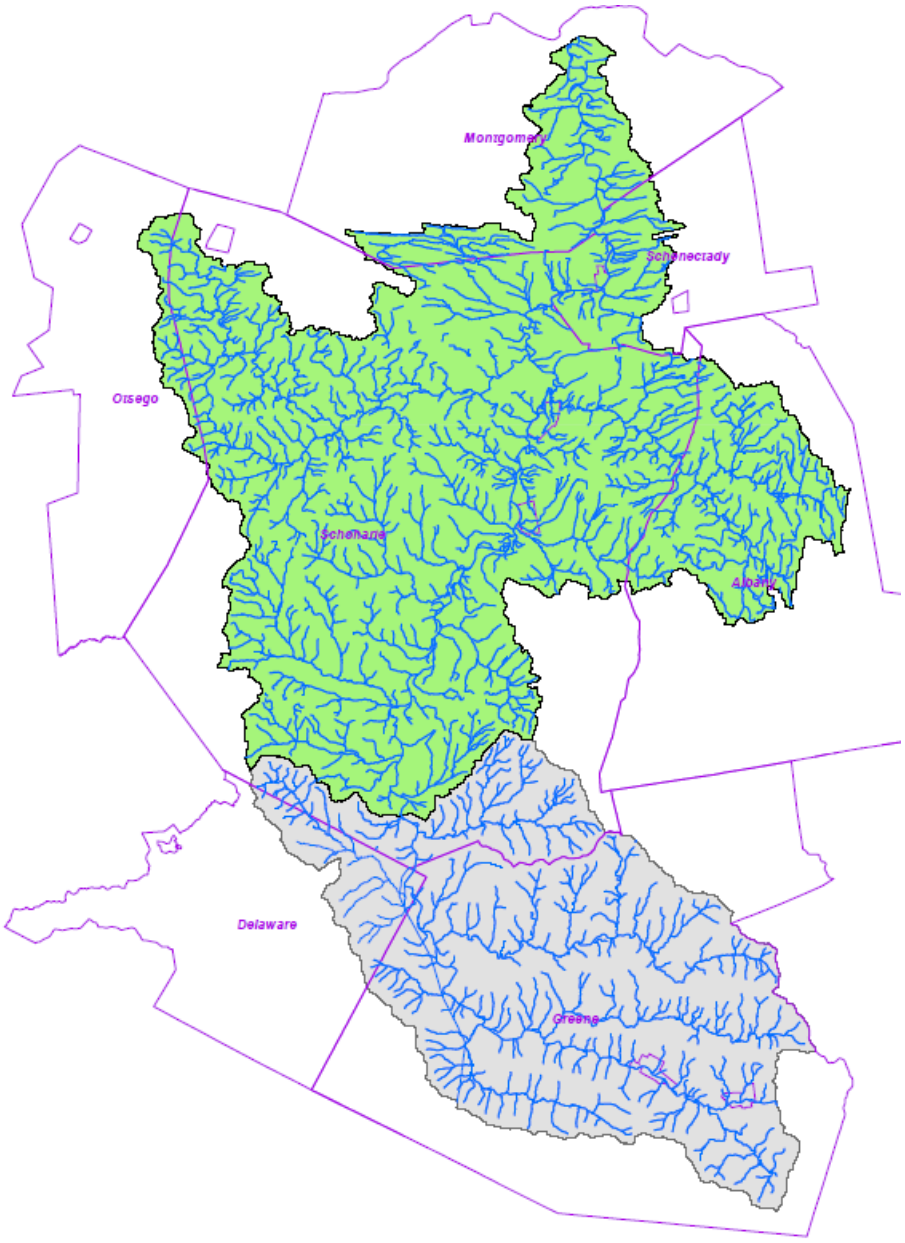

Figure 1 Schoharie Creek Watershed

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Flood Mitigation Measures Recommended and Estimated Capital Cost

The Lower Schoharie Creek basin was selected by the SCSWCD for analysis as a result of the highly floodprone nature of the region that has sustained extensive damage due to flooding, particularly in the recent past. While the entire Schoharie Creek basin is highly floodprone, the upper basin in Greene County has already been the subject of flood analyses funded by the NYCDEP through a number of Local Flood Hazard Mitigation Analyses (LFHMAs) and Local Flood Analyses (LFAs).

For the purposes of this assessment, 18 focus areas were identified within the Lower Schoharie Creek watershed (downstream of the Schoharie Reservoir). 15 of the focus areas are specific locations, while the remaining three areas can be applied throughout the watershed. The focus areas are listed below in Table ES-1.

TABLE ES-1
Summary of Floodprone Focus Areas

Focus Area #	*Reference Name*
1	North Blenheim
2	Bear Ladder Road
3	West Fulton Hamlet
4	Village of Middleburgh
5	Christmas Tree Lane Culvert
6	Route 145 Culvert
7	Village of Schoharie
8	Fox Creek
9	Gallupville
10	Railroad Bridge in Esperance
11	Cobleskill Creek Confluence
12	Fly Creek
13	Colyer Road, Burtonsville
14	Warnerville Cutoff
15	Flood Attenuation in Upper Watershed
16	Berms along Farm Fields
17	Flood Attenuation in Reservoirs
18	Protection of Wetlands, Floodplains, and Green Infrastructure

Within each focus area, on-the-ground assessments and visual inspections were made, including identification of land uses and low-lying structures, assessment of bank and channel conditions, measurements of valley confinement, measurements of bridge and culvert openings, and assessment of vegetation along the stream corridors. For each focus area, a range of flood

mitigation alternatives was developed and evaluated, and hydraulic modeling was conducted where appropriate. Recommendations were made for those alternatives that were found to provide substantial flood mitigation benefit at a cost that would justify their implementation.

- Analysis

Numerous public outreach meetings were held in the affected communities. Field assessments were conducted and land use and geomorphology were evaluated. Bridges and culverts were examined, though it was found that many do not span the bankfull width of their streams.

For the purpose of the subject study, peak flow rates determined by FEMA were used where available. For analysis within portions of the watershed where no FEMA flows have been determined, USGS StreamStats was used to estimate peak flow rates.

The flood history of Schoharie Creek was reviewed, and 42 flood events were documented since the first in 1784, up to the 2013 flooding. In March 1940, a USGS stream gauging station on the Schoharie Creek at Burtonsville (gauge #01351500) was installed to record discharge levels (peak stream flow) and other parameters. The largest flow recorded at Burtonsville was 128,000 cfs during Tropical Storm Irene in 2011. Of the 11 largest events on record, all but three were influenced by snowmelt. Other floods were due to hurricanes in October 1955 and two November rainstorms.

- Results

Multiple recommendations have been provided throughout this analysis. A summary of recommendations by specific focus area is presented in Table 5-1. Table 5-2 is a summary of cost opinions for implementation of the recommended flood mitigation alternatives. It should be noted that some types of mitigation alternatives such as the replacement of a bridge or culvert or the construction of an enhanced floodplain will have a quantifiable cost for design, permitting, and construction. For certain alternatives, such as the relocation of a home or the floodproofing of a business, the cost of implementation will vary widely depending on which and how many measures are being implemented and on the size and value of the home or business. Alternatives that emphasize the protection of watersheds, wetlands, and floodplains or that rely on changing local floodplain zoning codes or enforcing NFIP regulations are programmatic in nature, and the cost of implementation can be difficult to quantify.

Possible funding sources to localities include NYS Department of State, NY Grants, Community Development Block Grants, Empire State Development, Mohawk Rive Watershed Grants, FEMA Flood Mitigation Assistance, and FEMA Floodplain Management Planning. Potential funding sources were listed in Table 5-3.

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With reference to flood attenuation at reservoirs, the study examined Schoharie Reservoir and Blenheim-Gilboa Lower Reservoir. The Schoharie Reservoir, located in the towns of Gilboa and Conesville, is owned and operated by the NYCDEP and is used as a diversion reservoir to route water through the Shandaken tunnel into Esopus Creek. NYCDEP has submitted a proposed operating protocol to NYSDEC that seeks to operate Schoharie Reservoir against a conditional seasonal storage objective (CSSO) similar to how NYCDEP operates the Ashokan, Cannonsville, Neversink, and Pepacton reservoirs. The CSSO seeks to maintain the reservoir at 90 percent storage through regular releases during the fall tropical storm and winter rainfall snowmelt seasons while returning the reservoir to 100 percent storage in the late spring to meet water supply needs. The resultant 10 percent storage will provide additional peak flow attenuation.

The Blenheim-Gilboa Hydroelectric Facility is operated by the NYPA. A lower reservoir is used in conjunction with an upper, offline reservoir as part of a hydroelectric facility. Water is captured in this lower reservoir and pumped to the offline, upper reservoir for storage and subsequent power generation. During storm events, the lower reservoir is operated to reduce outflow as much as possible within operating limits. The dam is designed for a maximum outflow of approximately 178,000 cfs. From discussions with NYPA, it can be determined that during Tropical Storm Irene the storage within the NYPA lower reservoir reduced peak flows by 10,541 cfs, or 8.2 percent of the peak flow, which otherwise would have been discharged downstream. According to NYPA, peak shaving and pumping have been utilized in numerous past high water events, including during Tropical Storm Irene. According to NYPA, the storage capacity of the lower and upper reservoirs cannot be increased in any feasible manner.

In conclusion, reservoir storage during Tropical Storm Irene mitigated a moderate to substantial amount of downstream flooding. Storage in Schoharie Reservoir resulted in a reduction in peak flows of nearly 20 percent. Measures currently being implemented by the NYCDEP will result in the potential for additional peak flow attenuation. Storage in the Blenheim-Gilboa Lower Reservoir reduced peak flows by 8.2 percent. Neither reservoir is designed to operate in a flood-control capacity. Flood-control dams located in the upper Schoharie Creek watershed on the Batavia Kill performed as designed and further reduced peak flows.

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TABLE 5-1
Summary of Alternatives

Alternative	Recommended for Implementation?
Focus Area #1 – North Blenheim	
Alternative 1-1: Analysis of Historic Covered Bridge	M
Alternative 1-2a: Floodplain Enhancement	N
Alternative 1-2b: Floodplain Enhancement	N
Alternative 1-2c: Floodplain Enhancement	Y
Alternative 1-3: Sediment Removal	N
Focus Area #2 – Bear Ladder Road	
Alternative 2-1: Floodplain Modifications	N
Alternative 2-2: Raise Roadway	N
Alternative 2-3: Roadway Signage and Closure	Y
Focus Area #3 – West Fulton Hamlet	
Alternative 3-1: Replace Patria Road Bridge over House Creek	In future
Alternative 3-2: Replace West Fulton Road Bridge over Panther Creek	In future
Alternative 3-3: Create Compound Channel with Floodplain along Panther Creek	Y
Focus Area #4– Village of Middleburgh	
Alternative 4-1: Modify/Replace NYS Route 30 Bridge	N
Alternative 4-2: Floodplain Enhancement	N
Alternative 4-3: Right Bank Floodplain Enhancement	N
Alternative 4-4: Dredging	N
Alternatives 4-5a and 4-5b: Flood Control Levee and Wall	N
Alternative 4-6: Individual Building Relocation, Elevation, Floodproofing	Y
Focus Area #5 – Christmas Tree Lane Culvert	
Alternative 5-1: Increase Culvert Capacity	N
Alternative 5-2: Raise Roadway	N
Alternative 5-3: Relocate Roadway	N
Alternative 5-4: NYS Route 30 Roadway Signage and Closure	Y
Focus Area #6 – Route 145 Culvert	
Alternative 6-1: Replace Culvert	M
Alternative 6-2: Program of Debris Management	Y
Focus Area #7 – Village of Schoharie	
Alternative 7-1: Floodplain Enhancement	N
Alternative 7-2: Dredging	N
Alternatives 7-3a and 7-3b: Levee Scenarios	N
Alternative 7-4: Individual Building Relocation, Elevation, Floodproofing	Y
Focus Area #8 – Fox Creek	
Alternative 8-1: Modification/Replacement of the State Route 443 Bridge (Upper)	N
Alternative 8-2: Modification/Removal of Abutments at Schell Road Bridge	M
Alternative 8-3: Modification/Replacement of Schoonmaker Road	In future
Alternative 8-4: Modification/Replacement of Zimmer Road Bridge	Y
Alternative 8-5: Modification/Replacement of Sholtes Road Bridge	Y
Alternative 8-6: Modification/Replacement of the State Route 443 Bridge (Lower)	In future
Alternative 8-7: Development of Sediment Management Plan	Y
Alternative 8-8: Bank Erosion Repairs	Y
Focus Area #9 – Gallupville	
Alternative 9-1: Modification/Replacement of School Street Bridge	N
Alternative 9-2: Floodplain Enhancement	N
Alternative 9-3: Individual Building Relocation, Elevation, Floodproofing	Y

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TABLE 5-1 (continued)
Summary of Alternatives

Alternative	Recommended for Implementation?
Focus Area #10 – Railroad Bridge over Schoharie Creek	
Alternative 10-1: Modification/Replacement of Canadian Pacific Railroad Bridge	N
Alternative 10-2: Compliance with and Enforcement of NFIP Criteria	Y
Focus Area #11 – Cobleskill Creek Confluence	
Alternative 11-1: Modify/Replace Church Street Bridge	N
Alternative 11-2: Modify/Replace Route 30A Bridge and Roadway	N
Alternative 11-3: Individual Building Relocation, Elevation, Floodproofing	Y
Alternative 11-4: Roadway Signage and Closure	Y
Focus Area #12 – Fly Creek	
Alternative 12-1: SCSWCD Natural Channel Design Scenario #1	N
Alternative 12-2: SCSWCD Natural Channel Design Scenario #2	Y
Alternative 12-3: Develop a Sediment Management Plan	Y
Focus Area #13 – Colyer Road, Burtonsville	
Alternative 13-1: Modification or Enhancement of Channel or Floodplain	N
Alternative 13-2: Individual Building Relocation, Elevation, Floodproofing	Y
Focus Area #14 - Warnerville Cutoff	
Alternative 14-1: Elevation of the Roadway	N
Alternative 14-2: Elevation of Roadway and Installation of Bypass Culvert	N
Alternative 14-3: Elevation of Roadway and Installation of Bypass Bridge	N
Alternative 14-4: Warnerville Cutoff Roadway Signage and Closure	Y
Focus Area #15 – Potential for Flood Attenuation in Upper Watershed	
Alternative 15-1: Potential for Flood Storage at Warner Lake	N
Alternative 15-2: Potential for Flood Storage at Onderdonk Lake	N
Alternative 15-3: Potential for Flood Storage at Other Lakes, Ponds, and Wetlands	Conserve wetlands
Focus Area #16 – Review of Berms along Farm Fields	
Alternative 16-1: Removal of Agricultural Berms	Where possible
Focus Area #17 – Review of Potential for Flood Attenuation in Reservoirs	
Focus Area #18 - Recommendations for Protection of Watersheds, Wetlands, Floodplains	
Use green infrastructure and best management practices.	Y
Establish and maintain vegetated buffers.	Y
Protect forests and open space.	Y
Protect and reconnect floodplains.	Y
Develop guidelines to limit impervious surfaces.	Y
Implement watershedwide wetland, stream, and buffer protection.	Y

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TABLE 5-2
Cost Opinions for Recommended Alternatives

Alternative	Recommended for Implementation?	Cost Opinion Design/Study/ Permitting	Cost Opinion Construction
Focus Area #1 – North Blenheim			
Alternative 1-2c: Floodplain Enhancement	Y	$68,000	$800,000 - $1M
Focus Area #2 – Bear Ladder Road			
Alternative 2-3: Roadway Signage and Closure	Y	see note 1	Costs will vary depending on what measures are implemented.
Focus Area #3 – West Fulton Hamlet			
Alternative 3-1: Replace Patria Road Bridge over House Creek	In future	$150,000	$600,000 - $1M
Alternative 3-2: Replace West Fulton Road Bridge over Panther Creek	In future	$150,000	$600,000 - $1M
Alternative 3-3: Create Compound Channel with Floodplain along Panther Creek	Y	$60,000-$75,000	$150,000 -$ 200,000
Focus Area #4– Village of Middleburgh			
Alternative 4-6: Individual Building Relocation, Elevation, Floodproofing	Y	see note 2	Costs will vary depending on what measures are implemented.
Focus Area #5 – Christmas Tree Lane Culvert			
Alternative 5-4: NYS Route 30 Roadway Signage and Closure	Y	see note 1	Costs will vary depending on what measures are implemented.
Focus Area #6 – Route 145 Culvert			
Alternative 6-1: Replace Culvert	M	$150,000	$1M - $1.5M
Alternative 6-2: Program of Debris Management	Y		
Focus Area #7 – Village of Schoharie			
Alternative 7-4: Individual Building Relocation, Elevation, Floodproofing	Y	see note 2	Costs will vary depending on what measures are implemented.
Focus Area #8 – Fox Creek			
Alternate 8-2: Modification/Removal of Abutments at Schell Road Bridge	M	$5,000	Costs will vary depending on results of structural assessment.
Alternate 8-3: Modification/Replacement of Schoonmaker Road	In future	$150,000	$1.5M - $2M
Alternative 8-4: Modification/Replacement of Zimmer Road Bridge	Y	$150,000	$1.4M - $1.8M
Alternative 8-5: Modification/Replacement of Sholtes Road Bridge	Y	$150,000	$1.4M - $1.8M
Alternative 8-7: Development of Sediment Management Plan	Y		
Alternative 8-8: Bank Erosion Repairs	Y		
Focus Area #9 – Gallupville			
Alternative 9-3: Individual Building Relocation, Elevation, Floodproofing	Y	see note 2	Costs will vary depending on what measures are implemented.

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TABLE 5-2 (continued)
Cost Opinions for Recommended Alternatives

Alternative	Recommended for Implementation?	Cost Opinion Design/Study/ Permitting	Cost Opinion Construction
Focus Area #10 – Railroad Bridge over Schoharie Creek			
Alternative 10-2: Compliance with and Enforcement of NFIP Criteria	Y		
Focus Area #11 – Cobleskill Creek Confluence			
Alternative 11-3: Individual Building Relocation, Elevation, Floodproofing	Y	see note 2	Costs will vary depending on what measures are implemented.
Alternative 11-4: Roadway Signage and Closure	Y	see note 1	Costs will vary depending on what measures are implemented.
Focus Area #12 – Fly Creek			
Alternative 12-2: SCSWCD Natural Channel Design Scenario #2	Y	$40k - $50k	$400k - $500k
Alternative 12-3: Develop a Sediment Management Plan	Y		
Focus Area #13 – Colyer Road, Burtonsville			
Alternative 13-2: Individual Building Relocation, Elevation, Floodproofing	Y	see note 2	Costs will vary depending on what measures are implemented.
Focus Area #14 - Warnerville Cutoff			
Alternative 14-4: Warnerville Cutoff Roadway Signage and Closure	Y	see note 1	Costs will vary depending on what measures are implemented.
Focus Area #15 – Potential for Flood Attenuation in Upper Watershed			
Focus Area #16 – Review of Berms along Farm Fields			
Alternative 16-1: Removal of Agricultural Berms	M		
Focus Area #17 – Review of Potential for Flood Attenuation in Reservoirs			
Focus Area #18 - Recommendations for Protection of Watersheds, Wetlands, Floodplains			
Use green infrastructure and best management practices.	Y		
Establish and maintain vegetated buffers.	Y		
Protect forests and open space.	Y		
Protect and reconnect floodplains.	Y		
Develop guidelines to limit impervious surfaces.	Y		
Implement watershedwide wetland, stream, and buffer protection.	Y		

Investigations and actions recommended by each agency

REPORT NAME/DATE/REF	**Flood Mitigation Study Schoharie Creek**	April 2017	023
REVIEWER	Wayne Gannett, PE, CFM		

The report contains detailed recommendations, which could be implemented locally or with assistance from Schoharie County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

Overall watershed recommendations may be appropriate for NYSCC involvement.

Actions from this study can be adopted as an USFMTF recommendation

Measures for protection of watershed, wetlands and floodplains could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2017) *Flood Mitigation Study Schoharie Creek* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Schoharie-Basin-Flood-Mitigation-Study-Final-Report-web.pdf

REPORT NAME/DATE/REF	**USACE - Mohawk River and Catskill Creek, New York - Review of Reports for Flood Control**	April 1975	024
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

The purpose of this report was to compare flood event damage and flood protection costs in the Mohawk River Basin to determine if flood protection was economically justified.

Flooding Problems Identified

Major floods occurred in the Mohawk River basin in March 1914, March 1936, October 1945, October 1955 and September 1960. Average annual damages in the Mohawk River basin that would be caused by a recurrence of the maximum flood of record (March 1914) would amount to $2.5 million (1975) of which $1.6 million would be along the main stem of the Mohawk and the remainder along tributaries. Major areas of flooding are described in Table 10 below:

TABLE 10 - AREA FLOODED AND ESTIMATED REAL VALUE OF PROPERTY IN PRINCIPAL COMMUNITIES, MOHAWK RIVER BASIN, N.Y.
(December 1974 Price Level)

Community	Streams Causing Damage	Major Flood of Record	Area Inundated (acres) Developed	Area Inundated (acres) Undeveloped	Area Inundated (acres) Total	Estimated Real Value of Property in Flood Area (dollars)
Rome	Mohawk River	Oct 1945	13	12	25	1,277,000
Utica	Mohawk River	Oct 1945	200	200	400	21,935,000
Ilion	Mohawk River & Steele Creek	June 1922	225	35	260	3,274,000
Mohawk	Mohawk River & Fulmer Creek	Jan 1962	120	30	150	1,309,000
Herkimer	Mohawk River, Bellinger Brook & West Canada Creek	Oct 1945	50	100	150	3,143,000
Little Falls	Mohawk River	Oct 1945	15	-	15	-
Fort Plain	Mohawk River & Otsquago Creek	Mar 1936	10	15	25	2,195,000
Fonda	Mohawk River, Cayadutta Creek & Midway Alley Creek	Mar 1936	-	-	130	1,472,000
Amsterdam (north)	Mohawk River	Feb 1938	-	-	-	1,408,000
So.Amsterdam	Mohawk River & South Chuctanunda Creek	Feb 1938	30	-	30	5,177,000
Schenectady	Mohawk River	Mar 1914	100	20	120	20,952,000
Cohoes	Mohawk River	Mar 1936	4	16	20	622,000
Green Island	Mohawk River	Mar 1936				1,472,000
Waterford	Mohawk River	Mar 1936	55	--	55	3,470,000
Dolgeville	East Canada Creek	Oct 1945	4	-	4	1,309,000
Middleburg	Schoharie Creek	Oct 1955	90	130	220	-
Schoharie	Schoharie Creek	Oct 1955	70	600	670	-
Windham	Batavia Kill & Mad Brook	Sept 1960	30	15	45	6,235,000

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Existing USACE flood control projects include levees in the Village of Herkimer, floodwalls in South Amsterdam, and levees in Waterford. Floodwalls and levees in Rome were authorized but not constructed.

Local interests have constructed various flood protection measures in Schenectady, Mohawk, Utica, Windham, and Dolgeville.

At a hearing in Albany in February 1962, representatives from Rome, Utica, Schenectady, Mohawk, Schoharie County, Wright, Windham, Prattsville, Hunter and the Albany County Airport expressed the need for flood control projects.

Flood Mitigation Measures Recommended and Estimated Capital Cost

- Analysis

Previous studies in 1940 and 1955 concluded that a comprehensive flood control basin for the watershed was not warranted, and that local flood protection projects were the most feasible method to reduce flood damages.

Specific areas where local flood protection was considered include:

Mohawk River

- Rome – flood prone areas in the city are in the vicinity of the Dominick St. bridge. A plan for levees, flood walls, channel dredging and bridge replacement was authorized, but did not receive commitments for the local share of the cost. The estimated cost was $2.1 million (1974).
- Downstream of Rome to upstream of Utica – farmlands are flooded annually. Flooding could be reduced by excavating the Mohawk River channel from the mouth of Oriskayn Creek to Utica, but the annual costs would be far greater than the annual benefits.
- Upstream of Utica to upstream of Frankfort – flood control measures in the City of Utica are not economically justified.
- Upstream of Frankfort to upstream of Mohawk – previous flood protection in Frankfort and Ilion was done by others. Further flood control measures would be uneconomic.
- Mohawk – a system of levees and channel excavation was investigated in 1968 and found to be economically unfeasible. Subsequent to the ice jam flood in 1971, the area is being restudied.
- Herkimer – local protection completed 1964.

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- Downstream of Herkimer to upstream of Fort Plain – Little Falls is the only area of concentrated damage. A flood wall would be technically feasible but uneconomic.
- Fort Plain to downstream of Amsterdam – in the vicinity of Otsquago Creek, an embankment or flood wall plan, or a system of channel excavation, flood walls and check dams (to reduce debris quantities) were considered. Neither alternative was economically justified.
- Fonda – local flood protection was determined to be uneconomic.
- Amsterdam – a local protection project was completed in 1965 and further measures are considered uneconomic.
- Schenectady – most flooding has been associated with floating ice collecting on the edge of the ice sheet located from Lock 7 to the Rexford Knolls. Flood protection consisting of levees , walls and drainage facilities were recommended in 1968. The City of Schenectady did not support his plan and requested further study. Plans considered included:

  Non-structural – 58 structures would be flood proofed and 34 structures would be raised. Non-structural work would reduce flood damages by 70%. This would disrupt the historic Stockade District.

  Lowering Lock 7 Dam Spillway – this alternative was considered unwise and uneconomic as a means to prevent ice jam or fluvial flooding, and was eliminated.

  Snagging and Clearing – the old trolley car bridge piers would be removed along with the old Erie Canal towpath and widening the channel at the river bend in Rexford. A study of ice jams found that only a small number of jams, such as December 1973, occurred as a result of floating ice collecting at the Rexford river bend. The remaining ice jams result from floating ice collecting on the ice sheet that extends from Lock 7 to the Knolls. This alternative is not economically justified.

  Levees and Walls – although feasible and economically justified, this alternative was not supported by the City of Schenectady
- Downstream of Schenectady to upstream of Cohoes – low annual damages.
- Cohoes and Green Island – a levee paralleling Dyke Ave was considered and found to be economically unfeasible.
- Waterford – a plan for flood control was authorized but is inactive.

Schoharie Creek and tributaries

- Headwaters to upstream of Prattsville – flood control measures not economically justified.
- Prattsville – flood control is not economically warranted.
- Gilboa Dam to upstream of Middleburgh – average annual damages are insufficient to justify flood control works.

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- Middleburgh – this community had the largest flood damages of any on Schoharie Creek. Any plan of protection would result in average annual charges greater than annual benefits.
- Schoharie – flood control measures are not justified.
- Upstream of Burtonsville to mouth - flood control measures are not justified.
- Batavia Kill – Windham – Windham was subject to major flooding in Hurricane Donna in 1960. A project including a concrete chute and stilling basin on Mad Brook and levees on Batavia Kill was found to be economicallyjustified, but did not have local support. Separately the Soil Conservation Service determined that a system of 4 reservoirs upstream of Windham would be economically feasible. The level of protection would be the same as the Corps plan, for the September 1960 flood. The reservoirs were 60% complete in 1975.
- Batavia Kill – Hensonville, Ashland and Maplecrest – local flood protection measures not economically justified.

Other tributaries

- Shakers Creek – this stream flows along the west edge of the Albany County Airport and causes flooding of airport drainage. However flood control protection is not economical.
- Fox Creek – low annual damages do not justify flood control works.
- Cobleskill Creek - low annual damages do not justify flood control works
- Ninemile Creek – Holland Patent – levees and a diversion channel were found to be economically feasible and were completed in 1975

Alternative Measures of Flood Control information was provided for local agencies, but not authorized for Federal action in the 1975 study. These include floodplain mapping, implementing flood plain regulations, structural flood proofing, evacuation of the flood plain, development of a flood warning system, and the National Flood Insurance Program.

Coordination meetings were held with State and local interests in 1962, and again with State and local officials for the Schenectady and Windham studies.

- Results

The Corps concluded that flood protection, structural or non-structural for the Mohawk Basin, including the City of Schenectady, are not economically feasible at this time. Local interests should pursue alternative measures including flood insurance.

Capital costs were provided for the Schenectady evaluation of alternatives in Table 14.

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TABLE 14 - ECONOMIC EVALUATION OF FLOOD CONTROL ALTERNATIVES
CONSIDERED FOR THE MOHAWK RIVER AT SCHENECTADY, NEW YORK
(December 1974 Price Levels, 100 Year Project Life at 5-7/8% Interest Rate)

Alternative	Area to be Protected	First Cost	Annual Cost(2)	Annual Benefits(2)	Benefit-Cost Ratio
Non-Structural(1)	Residential	$6,264,000	$391,000	$173,000	0.44
	Industrial	3,291,000	205,000	166,700	0.81
	Residential & Industrial	9,555,000	596,000	339,700	0.57
Levees and Walls	Peninsula(3)	$1,914,000	$115,400	$ 51,200	0.44
	Residential	892,000	54,700	247,200	4.52
	Industrial	5,038,000	302,100	238,200	0.79
	Residential & Industrial	5,930,000	356,800	485,400	1.36
	Peninsula(3), Residential & Industrial	7,844,000	472,200	536,600	1.14
Snagging & Clearing	Peninsula(3), Residential & Industrial	$7,600,000	$448,000	$ 48,600	0.11

(1) Non-structural protection was not considered for the Peninsula because the area is undeveloped.

(2) Annual costs and benefits for the non-structural alternative are based on a 50-year project life.

(3) Benefits as a result of protecting the peninsula are based on land enhancement.

Investigations and actions recommended by each agency

General recommendation for State and/or local interests to pursue alternative measures.

Actions recommended to be undertaken by the NYSCC

For locations within the jurisdiction of the NYSCC, alternative measures may be considered.

Actions from this study can be adopted as an USFMTF recommendation

Portions of flood protection measures along the main stem of the Mohawk River which may not have been feasible in the Corps studies may be appropriate for NYSCC within areas it controls.

BIBLIOGRAPHY	US Army Corps of Engineers (April 1975) *Mohawk River and Catskill Creek, New York - Review of Reports for Flood Control* I:\NYSCC\22013187G\3.0 Design\3.1

REPORT NAME/DATE/REF	**USACE - Mohawk River 905_b Reconnaissance Study**	August 2009	025
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

By Congressional Resolution in September 2006, Secretary of the Army was requested to review the report of the Chief of Engineers on the Mohawk River and Tributaries, New York, published as House Document No. 172, 85th Congress, 1st Session, and other pertinent reports, to determine whether modifications of the recommendations therein are advisable at the present time in the interest of navigation, streambank stabilization, flood damage reduction, floodplain management, environment preservation and restoration, and other related purposes in the Mohawk River Watershed, New York.

The purpose of the reconnaissance phase study is to determine whether there is a Federal (Corps) interest in participating in a cost shared feasibility phase study and to identify a potential non-Federal partner to sponsor that study. The feasibility study will determine whether there is a Federal interest in a watershed management program that may authorize specific projects that provide flood damage risk reduction, ecosystem restoration, navigation improvements or other allied purposes to the Mohawk River Watershed.

Flooding Problems Identified

Flooding damages in the Mohawk River and tributaries include significant economic losses due to damages incurred in villages, towns, cities and private property, and loss of farmland. Channel and bank erosion has resulted in loss of natural stream meandering, active channel down cutting in some areas, channel bank erosion, and increased sedimentation resulting in a loss of native plant, fish, and wildlife species. Agricultural and urban development has resulted in a hydrologic modification and fill activities leading to invasive species, and loss of wetlands, aquatic and riparian habitat and flood storage. Flood damage has also caused extreme erosion, destroyed utilities, debris blocking the channel, displaced Lock Houses with structural damage, and sedimentation in the navigation channel.

Planning objectives are to implement one or more watershed scale solutions formulated based on specific sites for improvements for a comprehensive approach to flood damage reduction, ecosystem restoration and navigation improvements and protection. Solutions should also reduce flood damage to homes and public property, reduce the threat of loss of life, mitigate financial losses due to flooding, provide ecosystem and environmental restoration and improve land use withing the floodplains.

Planning Constraints

- Flood damage and ecosystem degradation areas in the basin are often located on private property
- The Schoharie Reservoir is a major feature in the eastern portion of the watershed

and its sole purpose is water supply for NYC

- Feasibility studies should generally focus on a watershed area no greater than 200 sq. miles. The Mohawk River watershed is 3,460 square miles
- Portions of the Mohawk River watershed are located in the Adirondack Park. Any construction or modification will require a Special Permit
- Adirondack Park open space consideration, environmental restoration and other programs
- NYSDEC Flood Mitigation Task Force considerations and programs
- Historic Properties, including prehistoric archaeological sites, are known to be located in the area. Investigation will be required during the feasibility phase

No Action Alternative

The Corps is required to consider the option of "No Action" as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). If "No Action" is taken, flood damage, ecosystem degradation, and threats to the New York State Canal System will continue within the Mohawk River, its tributaries, and the watershed. Sediment and associated debris will continue to fill channels throughout the watershed, reducing the capacity for high water and high velocity events, increasing flood related damages to property and infrastructure

Non-Structural Flood Damage Reduction

Removal of physical constrictions to flow will prevent high waters from becoming "backed up" in certain reaches. Removing large debris from creek channels will improve the flow of water through the creek. A regular debris removal program, including the removal of the debris adjacent to the streams before it washes in and becomes an obstruction, will allow the stream to flow more normally and begin to flush sediment resulting in a more natural channel. Where streambanks are being restored, opportunities may exist to build a floodplain in conjunction with the improved streambank. Reconnection of original floodplains to their streams and creation of new floodplain will improve flood water retention and enhance and create additional fish and wildlife habitat.

Structural Flood Damage Reduction

Construction of a structural feature such as a levee or floodwall along a portion of the Canal that is not yet protected and that experience the worst flood damages will serve to prevent waters from reaching people, businesses and roads. Levees and floodwalls may be difficult to justify in most areas in the basin because of low population density (i.e., lack of economic benefits in relation to cost).

REPORT NAME/DATE/REF	**USACE - Mohawk River 905_b Reconnaissance Study**	August 2009	025
REVIEWER	Wayne Gannett, PE, CFM		

The primary purpose of a breakup ice control structure (ICS) is to retain a breakup ice run upstream of a traditional ice jam problem area and thereby mitigate ice-jam flooding. By controlling ice-jam location, breakup ICSs also can prevent ice-related scour associated with dam removals or contaminated sediment remediation projects.

Environmental Restoration Opportunities

Wetlands provide critical flood storage as well as filter for sediment, pollutants, nutrients and pathogens that contribute to water quality degradation. Wetland restoration and creation include reestablishing topography and hydrologic connections with the river, and replanting with native species. Important wetlands along the Mohawk River include the Vischer Ferry Nature Preserve in Clifton Park, Utica Marsh in Utica, and the Oriskany Wildlife Management Area in Oriskany.

Streambank restoration and stabilization methods will prevent further erosion of banks thereby protecting private and public property and infrastructure located adjacent to the creek. In-stream methods to stabilize the creek and its banks, such as longitudinal peak stone toe protection, have been shown to be effective to restore a more natural stream bank, recreate riparian habitat and reconnect the stream to a floodplain. Areas identified as potential candidates for restoration and stabilization measures include several areas along the Sauquoit Creek in Utica, and several locations along Oriskany Creek in Oneida County. River restoration techniques including redirective and resistive methods will improve the overall health of the river system by reducing streambank erosion and providing fish habitat. Redirective methods such as Bendway Weirs and rock revetments could focus the stream flow and flush out depositional areas within the channel over time allowing for greater channel capacity when needed. Resistive methods such as longitudinal peak stone toe protection (LPSTP) will achieve streambank stabilization and direct the highest velocity flows away from vulnerable banks. Native vegetation can be incorporated into streambank stabilization projects.

Dredging

Dredging to restore hydrologic connections to wetlands, improve stream hydraulics, and provide flood storage may be needed in some reaches of the Canal System and some tributaries of the Mohawk River where the most accretion of sediment has taken place.

Watershed Management Approach

REPORT NAME/DATE/REF	**USACE - Mohawk River 905_b Reconnaissance Study**	August 2009	025
REVIEWER	Wayne Gannett, PE, CFM		

Management plans and programs aimed at improving and protecting the ecological resources within the Mohawk River Basin have been developed for segments of the Mohawk and its tributaries by different local, State and Federal agencies, including:

- New York City Department of Environmental Protection and Greene County Soil and Water Conservation District have developed a Stream Management Program for the Schoharie Creek watershed.
- Town of Colonie *Mohawk River Waterfront Revitalization Strategy and Action Plan*
- Adirondack Park Agency *Watershed Protection of the Mohawk River Watershed, Phase 1*, for the portion of the Mohawk watershed that lies within the Adirondack State Park
- Herkimer-Oneida Counties Comprehensive Planning Program has prepared multiple documents and has established several projects such as the Mohawk Greenway Project

In a watershed feasibility study, a "Watershed Program", featuring multiple projects, may be recommended to contribute to the overall improvement of the watershed system, including environmental river restoration and flood damage reduction. The Watershed Management Plan (an appendix to the Watershed Feasibility Study) would serve as the one, comprehensive document that identifies the various initiatives and programs aimed at maintaining or enhancing water quality and overall ecosystem sustainability that have been developed throughout the watershed.

Preliminary Plans

Preliminary plans are comprised of one or more management measures considered in the Reconnaissance Study. For a watershed of this size, the reconnaissance study does not specifically identify preliminary plans. Management measures are identified as possible solutions, alone or in combination with other measures, for future consideration and analysis during a feasibility study.

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REVIEWER	Wayne Gannett, PE, CFM		

Flood Mitigation Measures Recommended and Estimated Capital Cost

- Analysis – Preliminary Screening

The preliminary screening indicates that the types of management measures identified for further consideration have the greatest potential for implementation following a watershed feasibility report for the study area. The overall watershed improvements will include improved ecosystem function, improved habitat, stable streambanks, stable channels, and more consistent flow, temperature and depth. The potential ecosystem benefits (in habitat units) from a system of projects as recommended by the watershed feasibility study would likely be cost effective when applying the Corps formulation process for environmental restoration projects.

A decrease in damages due to flooding may be an ancillary benefit of a river restoration project. No significant environmental impacts are anticipated that would require mitigation. Conceptual designs and preliminary costs for the types of projects will be determined in the watershed feasibility report. Based on this information, the recommended course of action to address the planning objectives appears to be a watershed management feasibility study that will lead to a watershed program.

- Results

Since ecosystem restoration and flood damage reduction are outputs with a high budget priority and those project purposes are the primary outputs of the types of projects to be evaluated in the feasibility phase, there is a strong Federal interest in conducting the feasibility study. The non-Federal sponsor for the feasibility stage of the study is New York State Department of Environmental Conservation. As the local sponsor, the New York State Department of Environmental Conservation will be required to provide 50 percent of the cost of the feasibility phase. The local sponsor is also aware of the cost sharing requirements for potential project implementation.

Assumptions

A single, large-scale solution to the flooding problems is not realistic give the size of the basin. It is expected that many flooding problems throughout the basin will continue to exist, but living within the floodplain will be better understood so future decisions on development within the basin will take downstream impacts into consideration. Responses from questionnaires sent to various towns and counties situated within the Basin and results from the NYSDEC 2002 Mohawk River Basin Waterbody Inventory and Priority waterbodies list indicates that sediment from

streambank erosion is one of the leading contributors to water quality degradation within the Basin.

Environmental Compliance

Compliance with all applicable historical/cultural and environmental laws and regulations, including NEPA, will be accomplished during the Feasibility Phase. Additionally, if restoration and/or flood damage reduction projects will be situated within the Mohawk River floodway, certain assurances need to be made that the project will not adversely impact the capacity of the floodway. Hydraulic and hydrologic analyses will be performed on proposed alternatives in the Feasibility Study to determine any potential impacts to the floodway capacity.

Cultural Resources

As part of the feasibility study, the Oneida Nation, and other Native American groups, will be consulted, as will the New York State Office of Parks, Recreation and Historic Preservation, the National Park Service, and the numerous local and regional historical societies.

Schedule and Budget

The Feasibility Study for the Mohawk River Watershed is estimated to be $5 million, with half Federally funded and half from non-Federal funds or in-kind services. Project duration is estimated at 44 months.

Views of Other Resource Agencies

Both the New York State Department of Environmental Conservation and the New York State Canal Corporation have participated in all stakeholder meetings and discussions and are supportive of the recommendations of the Reconnaissance Report.

<u>Investigations and actions recommended by each agency</u>

NYSDEC - Participate with USACE in the Mohawk River Feasibility Study.

REPORT NAME/DATE/REF	**USACE - Mohawk River 905_b Reconnaissance Study**	August 2009	025
REVIEWER	Wayne Gannett, PE, CFM		

Actions recommended to be undertaken by the NYSCC

Participate with USACE, NYSDEC and local interests in the Mohawk River Watershed Feasibility Study for locations involving Canal facilities.

Actions from this study can be adopted as an USFMTF recommendation

Recommendations to be developed in the Mohawk River Watershed Feasibility Study.

BIBLIOGRAPHY	US Army Corps of Engineers (August 2009) *Mohawk River 905_b Reconnaissance Study* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\USACE 1975 and 2009 Mohawk Reports\025 Mohawk River 905_b_ Report 24 AUG 09 .pdf

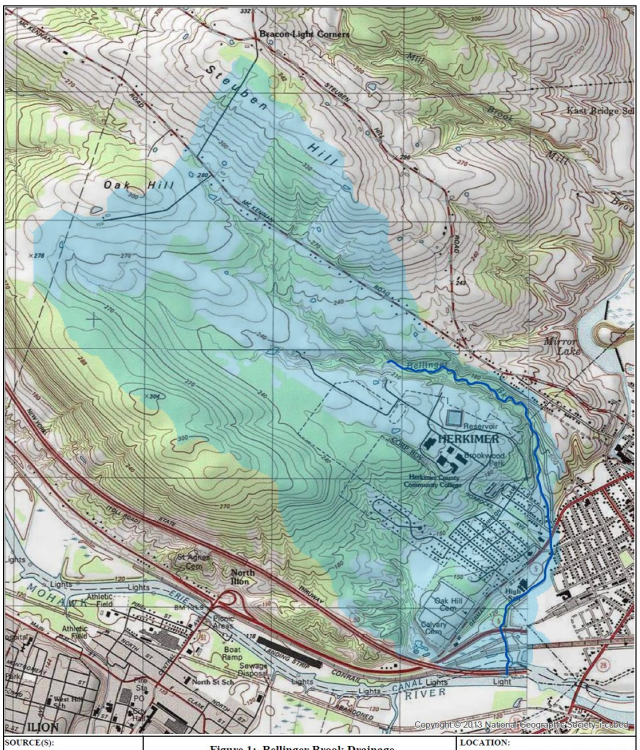
REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Bellinger Brook flows through the town and village of Herkimer in Herkimer County. The brook is 4.4 miles long with a contributing drainage basin of 3.7 square miles. Bellinger Brook has an average slope of 2.3 percent over its entire length. The drainage basin is over 50 percent forested, with a mix of residential and commercial land uses concentrated in the lower part of the basin. Bellinger Brook is a relatively steep watercourse that generates a substantial amount of stream power during high flows. Figure 1 shows the drainage basin map.



SOURCE(S):	Figure 1: Bellinger Brook Drainage Basin Location Map	LOCATION: Herkimer County, New York

REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

The flood vulnerabilities associated with the brook stem from systematic floodplain constrictions, including a significant amount of vertical walled channelization that fully confines the watercourse. The channel is undersized with three roadway crossings that serve as pinch points. Areas of bank and bed instability contribute a substantial sediment load to the brook during high flow events, thus further restricting the channel and bridge capacity in depositional areas.

Compounding the poor stream hydraulics, land development (largely residential) occurs extensively in the floodplain, in many cases to within 20 feet of the edge of the stream. When the stream exceeds its low channel hydraulic capacity or becomes clogged with sediment and debris, it is prone to avulsion, finding new and destructive paths.

The most severe flooding on Bellinger Brook has historically occurred in the area of the Church Street, West German Street, and Maple Grove Avenue bridges and in the neighborhood in the vicinity of these three bridges. Large volumes of sediment and large woody debris are conveyed down the brook from higher in the watershed during high flow events. This material is deposited in the channel at the bridges, which reduces the channel capacity and exacerbates flooding. Floodwaters overtop the channel during flood events and flow overland through the neighborhood, causing extensive damage to nearby homes and properties. According to FEMA, ice jams have also contributed to flooding on Bellinger Brook in the vicinity of Church and West German Streets.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including the Town of Herkimer.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was evaluated using USGS Streamstats and comparing the results with the 2002 Flood Insurance Study (FIS) for the Village of Herkimer. Results are compared in Table 2.

REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

TABLE 2
Bellinger Brook Peak Discharges at FEMA Cross Section A
(Station 21+50, Downstream of High School)

Frequency	FEMA Discharge (cfs)	*StreamStats* Discharge (cfs)
10-Yr	685	291
50-Yr	1,200	428
100-Yr	1,465	495
500-Yr	2,265	654

Both sets of flows were modeled and compared to field observations in the June 2012 storm event. The FEMA flows more accurately represented field conditions, and were used for the study.

National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Herkimer area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

Five bridges were examined and all except one do not span stream bankfull flow.

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high risk areas were studied:

<u>High Risk Area #1 – Headcut in Brookwood Park</u> - There is a deteriorating grade control structure and 11 ft high headcut extending downstream some 275 feet. Alternatives include:

1-1 Armor the Existing Grade Control Structure to Create Riprap Cascade
1-2 Rock Ramp Stabilization
1-3 Remove Existing Grade Control Structure and Restore Channel
1-4 Construct Sediment Trap Basin

<u>High Risk Area #2 – Stone-Lined Channel and West German Street Vicinity</u> – Bellinger Brook flows though a 4200 ft long concrete channel; there are 3 undersized bridge crossings. Alternatives include:

2-1 Channel Widening and Bridge Replacement
2-2 Channel Dredging
2-3 Floodproofing and Flood Protection of Individual Properties

REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

High Risk Area #3 – School Levee – Bellinger Brook flows through an incised and channelized 1650 ft reach where the high school and athletic fields have replaced the flood plain. There is a levee along the left bank. Alternatives include:

3-1 Channel Widening and Flood Plain Restoration
3-2 Repair Levee and Replace Pedestrian Bridges

- Results

The following recommendations were made, with estimated cost ranges in Table 7:

- Stabilize Headcut and Restore Channel at Brookwood Park
- Increase Channel Capacity and Connectivity to Floodplain – Modify the channel from the existing dimensions of approximately 20 feet wide by five feet deep to a multistage compound channel, including an inner 25-foot-wide by two foot-deep bankfull channel and a minimum of 10 feet of floodplain on both sides
- Acquire and Remove Residential Properties – 3 floodprone structures
- Remove bridge at Maple Grove Ave – replacement bridge not required for access
- Replace bridges at West German St and Church St
- Replace pedestrian bridge near Herkimer Junior/Senior High School and armor levee
- Adopt Sediment Management Standards
- Monitor Minor Bank Failures
- Develop a Watershed Management Plan
- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards
- Consider Flood Protection at Individual Properties

TABLE 7
Cost Range of Recommended Actions

	Approximate Cost Range				
Bellinger Brook Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Stabilize Headcut and Restore Channel at Brookwood Park		X			
Increase Channel Capacity and Connectivity to Floodplain				X	
Acquire and Remove Residential Properties				X	
Remove the Bridge at Maple Grove Avenue			X		
Replace the Bridges at West German Street and Church Street					X
Replace the Pedestrian Bridge Near the Herkimer Junior/Senior High School		X			
Armor the Levee Adjacent to the Herkimer Junior/Senior High School		X			
Undertake Study of Hydrology and Land Use	X				
Install and Monitor a Stream Gauge	X				

REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

Overall watershed recommendations may be appropriate for NYSCC involvement.

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including sediment management standards, a watershed management plan, monitoring gages and development of design standards, could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Bellinger Brook Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Bellinger-Brook-Basin-Assessment-FINAL.pdf

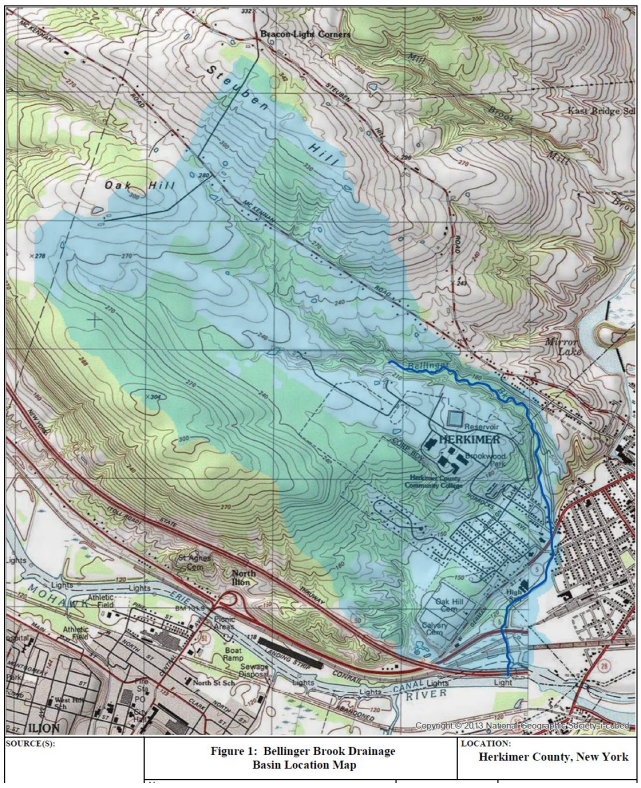
REPORT NAME/DATE/REF	**Bellinger Brook Basin Assessment**	April 2014	026
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Bellinger Brook flows through the town and village of Herkimer in Herkimer County. The brook is 4.4 miles long with a contributing drainage basin of 3.7 square miles. Bellinger Brook has an average slope of 2.3 percent over its entire length. The drainage basin is over 50 percent forested, with a mix of residential and commercial land uses concentrated in the lower part of the basin. Bellinger Brook is a relatively steep watercourse that generates a substantial amount of stream power during high flows. Figure 1 shows the drainage basin map.



SOURCE(S): | Figure 1: Bellinger Brook Drainage Basin Location Map | LOCATION: Herkimer County, New York

The flood vulnerabilities associated with the brook stem from systematic floodplain constrictions, including a significant amount of vertical walled channelization that fully confines the watercourse. The channel is undersized with three roadway crossings that serve as pinch points. Areas of bank and bed instability contribute a substantial sediment load to the brook during high flow events, thus further restricting the channel and bridge capacity in depositional areas.

Compounding the poor stream hydraulics, land development (largely residential) occurs extensively in the floodplain, in many cases to within 20 feet of the edge of the stream. When the stream exceeds its low channel hydraulic capacity or becomes clogged with sediment and debris, it is prone to avulsion, finding new and destructive paths.

The most severe flooding on Bellinger Brook has historically occurred in the area of the Church Street, West German Street, and Maple Grove Avenue bridges and in the

neighborhood in the vicinity of these three bridges. Large volumes of sediment and large woody debris are conveyed down the brook from higher in the watershed during high flow events. This material is deposited in the channel at the bridges, which reduces the channel capacity and exacerbates flooding. Floodwaters overtop the channel during flood events and flow overland through the neighborhood, causing extensive damage to nearby homes and properties. According to FEMA, ice jams have also contributed to flooding on Bellinger Brook in the vicinity of Church and West German Streets.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including the Town of Herkimer.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was evaluated using USGS Streamstats and comparing the results with the 2002 Flood Insurance Study (FIS) for the Village of Herkimer. Results are compared in Table 2.

Both sets of flows were modeled and compared to field observations in the June 2012 storm event. The FEMA flows more accurately represented field conditions, and were used for the study.

TABLE 2
Bellinger Brook Peak Discharges at FEMA Cross Section A (Station 21+50, Downstream of High School)

Frequency	FEMA Discharge (cfs)	*StreamStats* Discharge (cfs)
10-Yr	685	291
50-Yr	1,200	428
100-Yr	1,465	495
500-Yr	2,265	654

National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Herkimer area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

Five bridges were examined and all except one do not span stream bankfull flow.

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Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high risk areas were studied:

High Risk Area #1 – Headcut in Brookwood Park - There is a deteriorating grade control structure and 11 ft high headcut extending downstream some 275 feet. Alternatives include:

1-1 Armor the Existing Grade Control Structure to Create Riprap Cascade
1-2 Rock Ramp Stabilization
1-3 Remove Existing Grade Control Structure and Restore Channel
1-4 Construct Sediment Trap Basin

High Risk Area #2 – Stone-Lined Channel and West German Street Vicinity – Bellinger Brook flows though a 4200 ft long concrete channel; there are 3 undersized bridge crossings. Alternatives include:

2-1 Channel Widening and Bridge Replacement
2-2 Channel Dredging
2-3 Floodproofing and Flood Protection of Individual Properties

High Risk Area #3 – School Levee – Bellinger Brook flows through an incised and channelized 1650 ft reach where the high school and athletic fields have replaced the flood plain. There is a levee along the left bank. Alternatives include:

3-1 Channel Widening and Flood Plain Restoration
3-2 Repair Levee and Replace Pedestrian Bridges

- Results

The following recommendations were made, with estimated cost ranges in Table 7:

- Stabilize Headcut and Restore Channel at Brookwood Park
- Increase Channel Capacity and Connectivity to Floodplain – Modify the channel from the existing dimensions of approximately 20 feet wide by five feet deep to a multistage compound channel, including an inner 25-foot-wide by two foot-deep bankfull channel and a minimum of 10 feet of floodplain on both sides
- Acquire and Remove Residential Properties – 3 floodprone structures
- Remove bridge at Maple Grove Ave – replacement bridge not required for access
- Replace bridges at West German St and Church St
- Replace pedestrian bridge near Herkimer Junior/Senior High School and armor levee
- Adopt Sediment Management Standards
- Monitor Minor Bank Failures
- Develop a Watershed Management Plan
- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards

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REVIEWER	Wayne Gannett, PE, CFM		

- Consider Flood Protection at Individual Properties

TABLE 7
Cost Range of Recommended Actions

	Approximate Cost Range				
Bellinger Brook Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Stabilize Headcut and Restore Channel at Brookwood Park		X			
Increase Channel Capacity and Connectivity to Floodplain				X	
Acquire and Remove Residential Properties				X	
Remove the Bridge at Maple Grove Avenue			X		
Replace the Bridges at West German Street and Church Street					X
Replace the Pedestrian Bridge Near the Herkimer Junior/Senior High School		X			
Armor the Levee Adjacent to the Herkimer Junior/Senior High School		X			
Undertake Study of Hydrology and Land Use	X				
Install and Monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including sediment management standards, a watershed management plan, monitoring gages and development of design standards, could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Bellinger Brook Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Bellinger-Brook-Basin-Assessment-FINAL.pdf

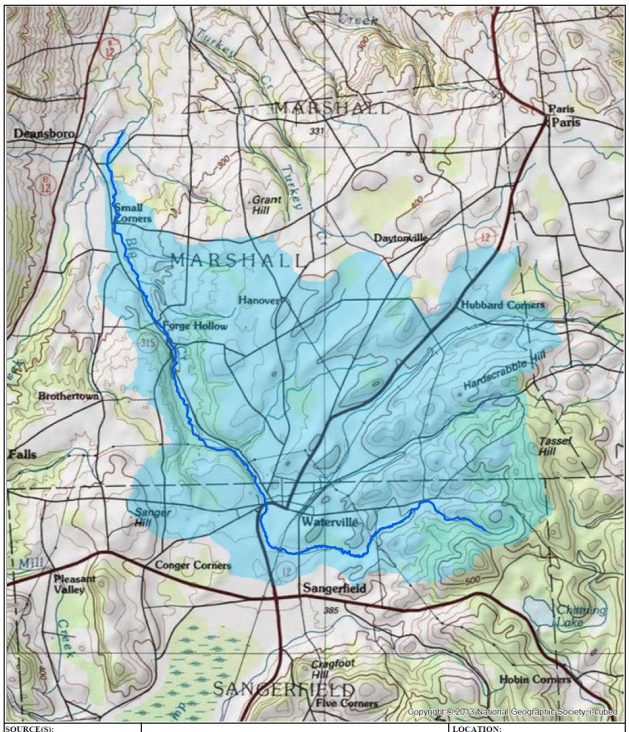
REPORT NAME/DATE/REF	**Big Creek Basin Assessment**	April 2014	027
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Big Creek is located in the town of Marshall and village of Waterville in Oneida County, in eastern central New York. The creek drains a total land area of 19.1 square miles and flows into Oriskany Creek. The drainage basin is approximately 40 percent forested, with primarily rural residential and agricultural uses throughout. The village of Waterville is the only highly developed area within the watershed. Big Creek has an average slope of 1.75 percent over its entire length of 10.8 miles. The steeper reaches of Big Creek generate greater stream power during high flows, especially downstream of the village of Waterville, where the creek parallels Route 315. Figure 1 shows the drainage basin map.



SOURCE(S):

Figure 1: Big Creek Drainage Basin Location

LOCATION: Oneida County, New York

Many road crossings are not wide enough to span the creek's bankfull width and act to restrict flows during storm events. Areas of bank and bed instability contribute a substantial sediment load to the creek during high flow events, restricting channel and bridge capacity. Residential development occurs in the floodplain, in some cases to withinseveral feet from the edge of the stream. These properties are at the greatest risk of flooding.

Community officials report that the most severe flood-related damages on Big Creek occurred along Route 315 downstream of Waterville and at the Route 315 bridge crossing. Several homes with back yards along Big Creek along Route 315 (STA 306+00 downstream to STA 272+00) experienced flooded basements and flood-related structural damage. In the vicinity of STA 264+50, utility lines associated with the wastewater treatment plant were threatened by erosion. In the vicinity of the Route 315 bridge crossing (STA

185+25), damages to the bridge, the road, and the channel upstream of the crossing was repaired after the June flood event.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at Oneida Community Hall to discuss Oriskany and Big Creeks.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was evaluated using USGS Streamstats and comparing the results with the 2013 Flood Insurance Study (FIS) for the Oneida County. Results are compared in Table 2.

TABLE 2
Big Creek FEMA and StreamStats Peak Discharges

Location	Drainage Area (sq. mi.)	10-Yr	50-Yr	100-Yr	500-Yr
	FEMA Peak Discharges				
Limit of Town of Marshall/Village of Waterville	10.00	1,010	1,400	1,575	1,990
Approx. 100 feet D/S Access to Sewage Plant	12.63	1,200	1,665	1,885	2,385
Approx. 64 feet D/S Bogan Rd	15.44	1,380	1,915	2,150	2,725
Confluence with Oriskany Creek	18.59	1,595	2,215	2,500	3,150
	StreamStats Peak Discharges				
Limit of Town of Marshall/Village of Waterville	9.83	1,000	1,490	1,730	2,290
Access to Sewage Plant	12.9	1,270	1,870	2,170	2,870
Bogan Rd Crossing	15.5	1,490	2,190	2,540	3,370
Confluence with Oriskany Creek	19.1	1,820	2,680	3,110	4,120

Peak discharges derived from StreamStats are higher than those reported by FEMA. For the 100-year frequency event, the StreamStats discharges range from 10 percent higher near the village of Waterville, to 24 percent higher at the confluence of Big Creek and Oriskany Creek.

National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

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REVIEWER	Wayne Gannett, PE, CFM		

Seven bridges were examined and all except one do not span stream bankfull flow.

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high-risk areas were studied:

High Risk Area #1 – Rt 315 Downstream of Waterville - There are areas of eroding banks and bank failures which contribute to sediment loading. Several houses are near the creek and have experienced flooding. Alternatives include:

1-1 Stream Repair and Management Program
1-2 Strategic Acquisition of High Risk Properties
1-3 Floodproofing and Flood Protection of Individual Properties

High Risk Area #2 – Undersized Bridges – A number of bridges and one culvert along Big Creek are undersized and should be evaluated for replacement. The most severe constrictions are occurring at the Bogan Road culvert and Gridley Paige Road bridge. The bridges at Route 315, Shanley Road, and California Road are also undersized.. According to FEMA profiles, all of these crossings create hydraulic constrictions. Alternatives include:

2-1 Replacement of Crossings at Route 315, Bogan Road, and Gridley Paige Road
2-2 Replacement of Culverts at Shanley Road and California Road

High Risk Area #3 – School Levee – Bellinger Brook flows through an incised and channelized 1650 ft reach where the high school and athletic fields have replaced the flood plain. There is a levee along the left bank. Alternatives include:

3-1 Channel Widening and Flood Plain Restoration
3-2 Repair Levee and Replace Pedestrian Bridges

- Results

The following recommendations were made, with estimated cost ranges in Table 4:

- Develop and Implement a Stream Repair and Management Program with conventional and bioengineering techniques
- Acquisition of Floodprone Properties
- Consider Flood Protection at Individual Properties
- Replace Undersized Bridges – Rt. 315, Bogan Road, Sally Road and Gridley Paige Road
- Future Replacement of Undersized Bridges – Crossings at Shanley Road and California Road are undersized but create less hydraulic obstruction than those listed above
- Evaluate Floodplain Regulations
- Develop Design Standards

REPORT NAME/DATE/REF	**Big Creek Basin Assessment**	April 2014	027
REVIEWER	Wayne Gannett, PE, CFM		

TABLE 4
Cost Range of Recommended Actions

	Approximate Cost Range				
Big Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Stream Repair and Management Program	X				
Replacement of Undersized Bridges					X
Future Replacement of Undersized Bridges					X

Investigations and actions recommended by each agency

The report contains detailed recommendations that could be implemented locally or with assistance from Oneida County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

Overall watershed recommendations may be appropriate for NYSCC involvement.

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including bridge replacements, stream repair and management standards, and development of design standards could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Big Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Big-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**East Canada Creek Basin Assessment**	April 2014	028
REVIEWER	Wayne Gannett, PE, CFM		

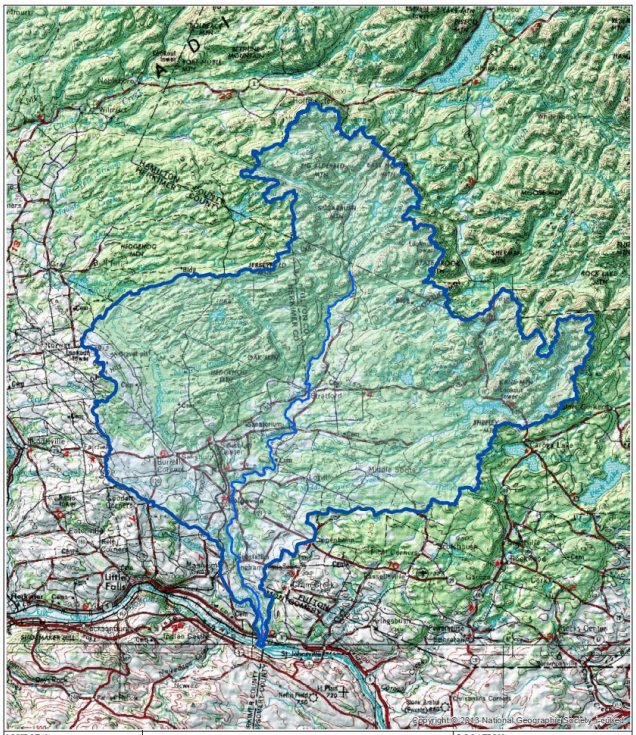
B

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

East Canada Creek drains portions of Hamilton, Fulton, Herkimer, and Montgomery Counties in eastern central New York. Figure 1 is a basin location map. East Canada Creek's headwaters are in the Adirondack Mountains. The creek drains an area of 290 square miles and flows into the Mohawk River between Little Falls and St. Johnsville. The drainage basin is approximately 82 percent forested, with sparse rural residential uses in the upper basin and residential and commercial land uses in towns and villages along the lower creek. East Canada Creek has an average slope of 0.92 percent over its entire stream length of 40.3 miles. Figure 1 shows the drainage basin map.



SOURCE(S):	Figure 1: East Canada Drainage Basin Location	LOCATION: Herkimer County, New York

This study focuses on the section of East Canada Creek between the village of Dolgeville and the creek's outlet at the Mohawk River, a distance of 10 river miles. The most severe flood-related damages have occurred in Dolgeville. Historically, the creek has overtopped its banks on several occasions, flooding residential, commercial, and industrial areas within the village. Downstream of Dolgeville, bank erosion and sediment transport issues are evident. A high bank failure just downstream of the village of Dolgeville is threatening property and contributing sediment to the creek. The formation of a large sediment bar downstream has caused the channel to aggrade and flood the adjacent roadway.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at Dolgeville Village Hall to discuss East Canada Creek.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. There is an active USGS stream gauging station on East Canada Creek at East Creek, New York (USGS 01348000). There are also historic records for a USGS stream gage station on East Canada Creek at Dolgeville (USGS 01347500), which was active from 1898 until 1913 and from 1928 until 1946. Hydrology was not based on gage data, but instead was evaluated using USGS Streamstats and comparing the results with the 2013 Flood Insurance Study (FIS) for Herkimer County. Results are compared in Table 2.

TABLE 2
East Canada Creek FEMA and *StreamStats* Peak Discharges

Location	Drainage Area (sq. mi.)	10-Yr	50-Yr	100-Yr	500-Yr
		FEMA Peak Discharges			
Confluence of East Creek (USGS Gauge 01348000)	292	14,600	21,000	24,100	32,500
U/S Montgomery County	288	14,500	20,800	23,900	32,100
At Village of Dolgeville downstream corporate limits	265	13,500	19,500	22,400	30,100
		StreamStats Peak Discharges			
Confluence of East Creek	290	13,100	17,400	19,400	24,100
U/S Montgomery County	285	12,900	17,100	19,000	23,700
At Village of Dolgeville downstream limits	262	11,900	15,700	17,500	21,800

Peak discharges reported by FEMA for the 100-year frequency flood event are in the range of 24 percent to 28 percent greater than those determined using StreamStats.

According to the FEMA FIS, flooding in the village of Dolgeville typically occurs in the late winter and early spring, as a result of ice jams combined with spring rainfall and snowmelt. Flooding has also occurred during the late summer months as a result of tropical storms tracking northward along the Atlantic coastline or due to regional thunderstorm activity. The Village of Dolgeville was seriously flooded on two occasions since the 1930s. After more than a week of continuous rain and a heavy rainfall event on October 1 and 2, 1945, East Canada Creek overtopped its banks and flooded commercial and industrial areas within the village. Damages included the spillway of the Daniel Green Dam.

On March 5, 1979, an ice jam occurred at the Route 29 bridge, causing the creek to breach

its west bank and inundate the adjacent residential and commercial areas. Floodwaters covered portions of North Main Street and East State Street, as well as along Van Buren Street and Dolge Avenue.

Discussions with community officials revealed that ice jams occur at the Route 29 bridge almost every year and lead to flooding when East Canada Creek overtops the road and the bridge. Flooding associated with ice jams at the bridge includes houses and businesses along North Main Street on the west bank and along Route 29 on the east bank. Ice jams also occur at the Daniel Greene Company Dam associated with the hydroelectric station, resulting in flooding of homes along Van Buren Street and Dolge Avenue and of the wastewater treatment plant and the hydroelectric station.

National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

Five bridges were examined and based on FEMA profiles the pedestrian walkway downstream of the Rt 29 bridge, and the railroad bridge at Sta 17+00 are undersized.

There are five hydroelectric dams on the lower reaches of East Canada Creek.

Flooding in the Village of Dolgeville has been an issue since the 1930's. In 1979 an ice jam at the Rt 29 bridge caused flooding.

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high risk areas were studied:

High Risk Area #1 – Dolgeville Bridges and Dam - East Canada Creek though the Village, and the Rt 29 bridge and pedestrian walkway downstream. Also included is the Dolgeville Dam located between the two bridges, located approximately 1,200 feet downstream of Route 29. Alternatives include:

1-1 Modify Operations of the Daniel Green Company Dam
1-2 Removal or Modification of the Daniel Green Company Dam
1-3 Bridge and Channel Modification

High Risk Area #2 – Dolgeville Hydroelectric Dam – This area is in the vicinity of the wastewater treatment plant and hydroelectric station downstream of Dolgeville and

includes the dam and spillway at STA 396+25. This stream segment is prone to collecting ice, resulting in ice jam related flooding of homes along Van Buren Street and Dolge Avenue. Alternatives include:

2-1 Modifications of Dam Operation
2-2 Dam Removal or Modification

High Risk Area #3 – Sediment Deposition Zone along Saltsman Road – Large sediment deposits were formed in East Canada Creek downstream of the dams at power plant at East Canada Lake. The sediments that have accumulated along Saltsman Road appear to have originated in the bedrock channel between STA 97+00 and STA 78+00. Alternatives include:

3-1 Modification of Dam and Reservoir Operation
3-2 Periodically Remove Sediment from Channel

Individual Property Based Risk Areas – Flooding occurs along North Main St, Dolge Ave Extension, Van Buren St. including the wastewater treatment plant and hydroelectric plant. Alternatives include:

4-1 Strategic Acquisition of High Risk Properties
4-2 Floodproofing and Flood Protection of Individual Properties

- Results

The following recommendations were made, with estimated cost ranges in Table 5:

- Pursue implementation of Alternative 1-1, 1-2 and 1-3 in order. 1-1 is the least expensive. If remaining flood risk is unacceptable, implements 1-2
- Pursue implementation of Alternative 1-1 and 2-2 in order. 2-1 is the least expensive. If remaining flood risk is unacceptable, implements 2-2
- the feasibility of dam modifications will likely be driven by Federal Energy Regulatory Commission (FERC) regulations and the operational needs of the dams
- Alternative 3-2 is recommended while exploring the feasibility of Alternative 3-1

REPORT NAME/DATE/REF	**East Canada Creek Basin Assessment**	April 2014	028
REVIEWER	Wayne Gannett, PE, CFM		

- Alternatives 4-1 and 4-2 are recommended concurrently as site conditions, owner participation and funding allow

TABLE 5
Cost Range of Recommended Actions

	Approximate Cost Range				
East Canada Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Modification of operation of the Daniel Green Company Dam	X				
Removal or modification of the Daniel Green Company Dam		X			
Bridge and channel modification				X	
Modification of operation of the Dolgeville Hydroelectric Dam	X				
Removal or modification of the Dolgeville Hydroelectric Dam			X		
Sediment removal near Saltsman Road	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including bridge replacements, dam modifications or operating adjustments and sediment removal could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *East Canada Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\East-Canada-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**Fulmer Creek Basin Assessment**	April 2014	029
REVIEWER	Wayne Gannett, PE, CFM		

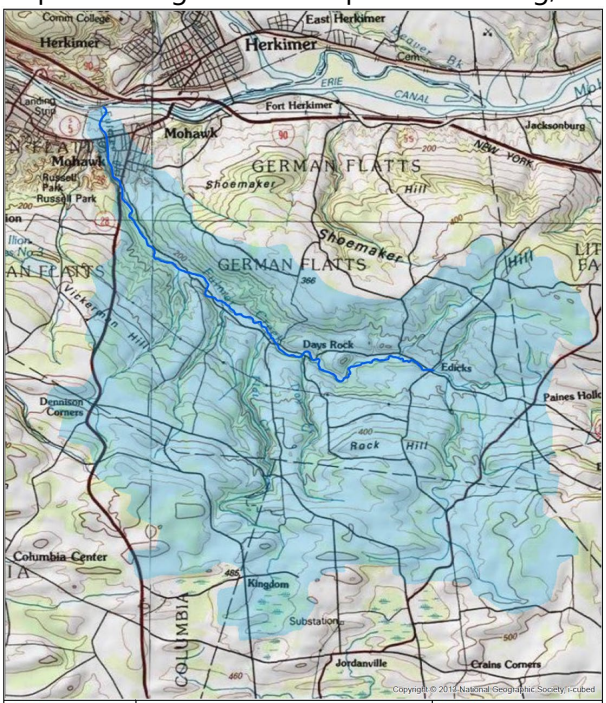
Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Fulmer Creek is located primarily in the Town of German Flatts and the Village of Mohawk in Herkimer County, New York. Smaller portions of the basin are located in the towns of Warren, Columbia, Stark and Little Falls. The creek drains an area of 26.2 square miles. The drainage basin is 54% forested with a mix of rural residential and agriculture uses, with residential and commercial land uses concentrated in the lower part of the basin in the Village of Mohawk. The Creek has an average slope of 2.1% over its entire stream length of 12.7 miles, with a very steep section in the middle reach. Figure 1 shows the drainage basin map.

Fulmer Creek generates a significant amount of stream power during high flow events. Steep slopes and high banks are prone to sliding, slumping and failure, and contribute a substantial sediment load to the creek. As the sediment is transported and deposits downstream, it restricts channel and bridge capacity. Development in the Village of Mohawk in the alluvial fan type of floodplain, in many cases to within 20 feet of the edge of the stream. When the channel exceeds its hydraulic capacity or becomes clogged with sediment and debris, it floods adjacent properties.



SOURCE(S): | Figure 1: Fulmer Creek Drainage Basin Location | LOCATION: Herkimer County, New York

A number of steep tributaries join Fulmer Creek from the south as it flows through German Flatts, including Day Creek, Flat Creek and several unnamed watercourses. There is evidence of high sediment load in the main channel and tributaries of Fulmer Creek. The stream channel has been recently dredged within some reaches to remove accumulated sediment. In some of these areas, dredged

materials have been placed directly onto the adjacent stream banks or on the floodplain, where it may block the dispersion of future flood flows.

At various points along its length, Fulmer Creek has been lined by stacked rock and concrete block walls. A stacked rock wall and flood control berm has recently been constructed along the right bank just upstream of Route 28. In the vicinity of West Main Street, the creek has been channelized and is confined by vertical concrete walls and riprap banks

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting in the Village of Mohawk to discuss Fulmer Creek.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was evaluated using USGS Streamstats and comparing the results with the 1977 Flood Insurance Study (FIS) for the Village of Mohawk. Results are compared in Table 2.

TABLE 2
Fulmer Creek Peak Discharges at confluence with Mohawk River (Station 0+00)

Frequency	FEMA (cfs)	StreamStats (cfs)
10-Yr	1,850	2,400
50-Yr	2,710	3,490
100-Yr	3,090	4,040
500-Yr	3,980	5,310

For the purposes of the alternatives analysis, the *StreamStats* data was utilized.

National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to

2.0 inches on July 2.

Thirteen bridges were examined and based on FEMA profiles three Rt 168 bridge crossings act as hydraulic constrictions. The FEMA FIS reports that Fulmer Creek is a major area of flood concern in the village of Mohawk. Flooding has threatened and damaged homes and businesses in the past. According to the FEMA study, flooding problems on Fulmer Creek are often the result of ice jams, usually in the area of the West Main Street bridge. The FEMA FIS shows flooding of the Leatherstocking and Creekside Trailer Parks. In addition, Rt 168 has been inundated at several locations.

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high risk areas were studied:

High Risk Area #1 – High Bank Failure at Rt 168 Double Bridge Site - This is a high bank failure adjacent to Route 168 that is actively contributing fine and course grained sediments and threatening the home and property located at the top of the bank failure on Casey Road. The high bank failure is nearly 500 feet long at its base, and is approximately 220 feet high at its highest point. The failing hillside has a slope in the range of 75% to 85%. The failing material is composed of glacial till that is silty clay intermixed with coarser, cobble-sized rock. The failure of the hillslope is being triggered by lateral erosive action at the toe of the slope, which is occurring along the outside of the bend on Fulmer Creek.

Alternatives include:

1-1 Realign Fulmer Creek and Stabilize Hill Slope
1-2 Realign Fulmer Creek and Rt 168
1-3 Relocate Fulmer Creek Channel Across Rt 168

High Risk Area #2 – Flooding Problems Along Rt 168 – A high bank failure at Sta 70+00 is eroding the left bank. This bank failure is approximately 140 feet high, and extends 300 feet long. It is similar in character to the bank failure at High Risk Area #1, but less severe. Continuing downstream, the Creekside Trailer Park and Leatherstocking Trailer Parks are located on areas of fill within the floodplain, and have also been damaged during numerous flood events, including in the June 2013 flood. According to reports of the June 2013 flood event, water overtopped the Fulmer Creek banks between STA 59+00 and STA 60+00, ran across Route 168, and down Route 28 (Columbia Street), causing extensive flooding. At the time of field inspections in late 2013, a bank stabilization and levee project including the construction of a stacked rock wall and a flood control berm were under construction along the right bank from STA 64+00 downstream to STA 58+50, a length of 650 feet. Based upon modeling results using *StreamStats*, the current design of the berm appears to be sufficient to prevent water from overtopping the banks of Fulmer Creek upstream of the Route 28 bridge for flows up to and including the 500-year flood event.

High Risk Area #3 – Devedorf St to Downstream of West Main St. – Extensive sediment

accumulation within the channel was observed in this area, especially where the channel widens between STA 28+00 and STA 22+00. Sediments are reportedly removed annually from this area and taken off-site. Houses have been flooded along Firman Street and Mohawk Central Valley School has received extensive flood damage. Ice accumulations also contribute to flooding in this area, including ice that jams at the Main Street bridge and downstream. Alternatives include:

3-1 Create a Naturalistic Channel and Floodplain Bench
3-2 Channel Dredging

- Results

The following recommendations were made, with estimated cost ranges in Table 6:

- Stabilize the massive bank failure to the west of Route 168 between STA 167+00 to 172+00. Relocate and armor 850 linear feet of Fulmer Creek up to 175 ft to the east, remove one house and construct wall along the toe of existing bank failure
- Remove trailers from floodplain along Rt 168
- Repair bank failure south of Rt. 28. Armor 250 linear feet of Fulmer Creek
- Restore and Resize Channel between Devendorf St. and Main St
- Adopt sediment management standards
- Monitor minor bank failure and erosion
- Evaluate floodplain regulations
- Install and monitor a stream gage on Fulmer Creek
- Develop design standards

TABLE 6
Cost Range of Recommended Actions

	Approximate Cost Range				
Fulmer Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Stabilize Bank Failure and Creek at Double Route 168 Crossing			X		
Remove Trailers from Floodplain along Route 168		X			
Repair Bank Failure at Run-Away Truck Ramp		X			
Restore and Resize Channel Between Devendorf and Main Street					X
Install and Monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

REPORT NAME/DATE/REF	**Fulmer Creek Basin Assessment**	April 2014	029
REVIEWER	Wayne Gannett, PE, CFM		

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including sediment management standards, a watershed management plan, monitoring gages and development of design standards, could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Fulmer Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Fulmer-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**Maltanner Creek Basin Assessment**	April 2014	030
REVIEWER	Wayne Gannett, PE, CFM		

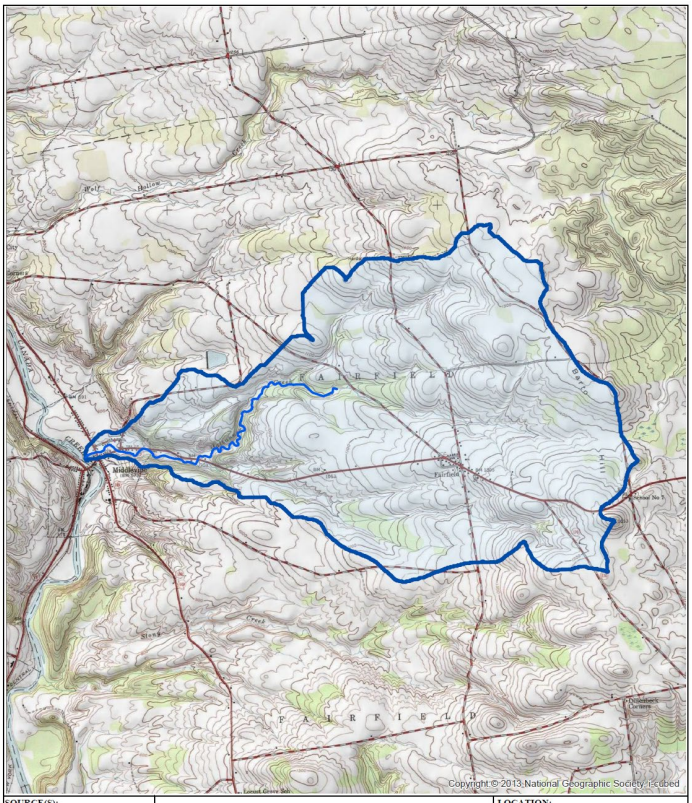
B

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Maltanner Creek is located in the town of Fairfield and the village of Middleville, in Herkimer County. The creek is 4.1 miles long with a contributing watershed of 6.6 square miles.. The basin is 36 percent forested, with a mix of rural residential and agriculture uses throughout. Residential and commercial land uses are concentrated in the lower part of the basin in the village of Middleville, where Maltanner Creek flows into West Canada Creek. The watercourse has an average slope of 4.0 percent. Figure 1 depicts the drainage basin.



SOURCE(S):

Figure 1: Maltanner Creek Drainage Basin Location

LOCATION: Herkimer County, New York

Maltanner Creek is a steep watercourse that generates a substantial amount of stream power during high flows. The bridges that span the creek are undersized, which restricts flows and causes flooding in the village of Middleville. The Maltanner Creek channel is lined by steep hillslopes that are eroding and contributing a coarse-grained sediment load to the creek, further restricting the channel and bridge capacity.

Compounding the poor stream hydraulics, commercial and residential development occurs very close to the edge of the stream in the village of Middleville. When the channel exceeds its low hydraulic capacity, or becomes clogged with sediment debris, it causes flooding and erosion that damages property, structures, and infrastructure.

REPORT NAME/DATE/REF	**Maltanner Creek Basin Assessment**	April 2014	030
REVIEWER	Wayne Gannett, PE, CFM		

Steep stream reaches such as seen on Maltanner Creek have a great deal of stream power, with high velocities that can carry a great deal of sediment. These mobilized sediments are then deposited in lower gradient reaches lower in the watershed, where they fill the channel, reduce hydraulic capacity, and exacerbate flooding. The stream channel has been recently dredged within some reaches to remove accumulated sediment. In some areas, dredged materials have been placed directly on the adjacent stream banks or in the floodplain, leaving them at risk to remobilize during future high flows.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting in the Village of Middleville.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was evaluated using USGS Streamstats. A preliminary draft Flood Insurance Study (FIS) was issued for Herkimer County in September 2011, but it does not include flow data for Maltanner Creek. There are no USGS gages on the creek either. Estimated peak flows were derived from *USGS Streamstats*, as shown in Table 2.

TABLE 2
Maltanner Creek Peak Discharges at Confluence with West Canada Creek (Station 0+00)

Frequency	Peak Discharge (cfs)
10-Yr	1,030
50-Yr	1,530
100-Yr	1,780
500-Yr	2,370

In mid to late June and early July 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in the greater Utica region, including in the Maltanner Creek Basin. Because rainfall across the region was highly varied, it is not possible to determine exact rainfall amounts within the Maltanner Creek Basin.

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REVIEWER	Wayne Gannett, PE, CFM		

Historical records indicate that the Herkimer County area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

Three bridges were examined. The Rt 29 bridge in Fairfield and Main St. in Middleville do not have spans long enough to span the bankfull stream width.

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high-risk areas were studied:

High Risk Area #1 – Upper Watershed Bank Failures and Erosion - Hydraulic modeling indicates high velocities through this reach during severe flow events, fostered by the steep slope and narrow valley. Velocities at the three major bank failure locations range between 12 and 17 feet per second, which would mobilize all but the largest of boulders. Stabilization of the severe bank failures at STA 61+00, STA 67+00, and STA 76+50 would likely be cost prohibitive, as they are over 110 feet high and would likely require substantial structural elements to repair.

Alternatives include:

1-1 Construction of a Sediment Retention Dam near Sta 59+00

High Risk Area #2 – Fairfield St. (Rt 29) Bridge – The existing bridge consists of a narrow but tall crossing, approximately 20 feet in span. The channel directly downstream of the bridge is extremely steep and showing signs of instability. The channel was surveyed as an 18 percent slope for the 100 feet directly downstream of this bridge. Extremely high velocities were modeled exiting this bridge and flowing down the steep channel reach coincident with a 100-year flood event. The instability of the channel here is evidenced by the recent bank stabilization construction performed here after the June 2013 floods, with stacked stone wall armoring constructed through this reach.

1-1 Replacement with a 30 ft span bridge is recommended.

High Risk Area #3 – Mid Watershed Bank Failures and Erosion – Multiple bank failures occur in this reach. Alternatives include:

3-1 Stream Repair and Maintenance Program

3-2 Monitor Bank Failures

High Risk Area #4 – Middleville Center at North Main St. – The bridge is undersized. Alternatives include:

4-1 Replace Main St. Bridge

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REVIEWER	Wayne Gannett, PE, CFM		

High Risk Area #5 – Sediment Management on Maltanner Creek - Alternatives include:

5-1 Develop a Sediment Management Program

- Results

The following recommendations were made, with estimated cost ranges in Table 5:

- Evaluate Construction of a sediment control dam at Sta 59+00
- Replace Fairfield St. (Rt 29) Bridge
- Develop and Implement a stream monitoring, repair and maintenance program for the middle segment of the creek
- Replace the North Main St. Bridge
- Adopt sediment management standards
- Evaluate floodplain regulations
- Develop design standards

TABLE 5
Cost Range of Recommended Actions

	Approximate Cost Range				
Maltanner Creek Recommendations	<$100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Further Evaluate Construction of a Sediment Control Dam	X				
Replace the North Main Street (Route 28) Bridge				X	
Develop and Implement a Stream Monitoring, Repair, and Maintenance Program		X			
Replace Fairfield Street (Route 29) Bridge				X	

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None.

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including sediment management standards, a watershed management plan and development of design standards, could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Maltanner Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Maltanner-Creek-Basin-Assessment-FINAL.pdf

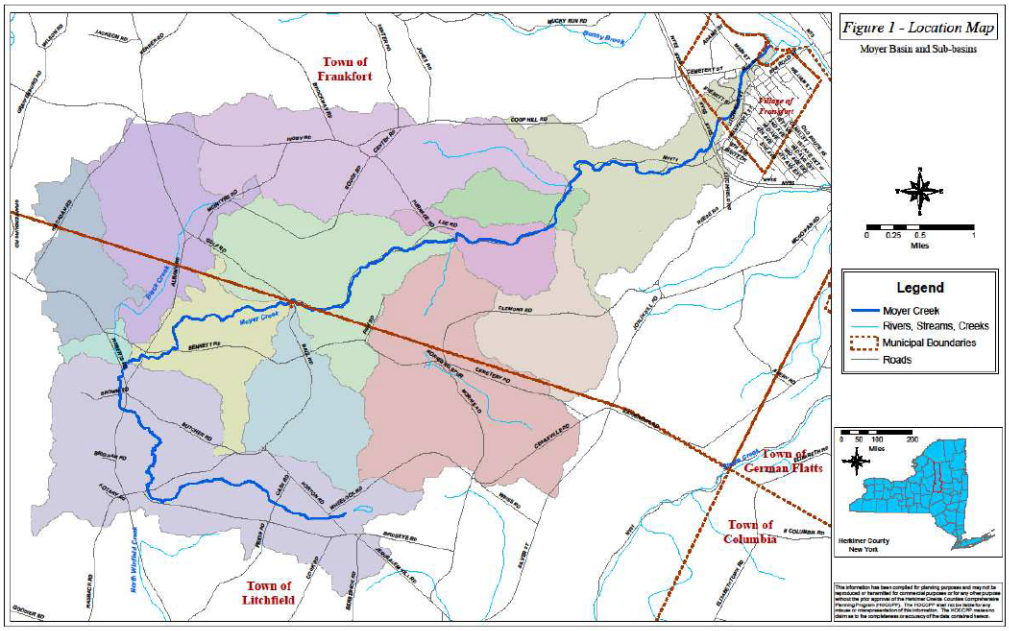
REPORT NAME/DATE/REF	**Moyer Creek Basin Multi-Hazard Mitigation Plan**	Jun 2004	031
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

For many years the communities within the Moyer Creek Basin have experienced repeated flooding that has resulted in damage to property, has caused a disruption of daily lives and commerce, and has threatened the safety of residents. In conjunction with the US Army Corps of Engineers' (USACOE) effort, the Herkimer-Oneida Counties Comprehensive Planning Program (HOCCPP), in cooperation with the NYS Department of Environmental Conservation (NYSDEC) began to investigate non-structural alternatives for the Moyer Creek Basin.

Flooding Problems Identified

The Moyer Creek Basin has historically experienced flooding events and has had major floods recorded as early as 1904. Many of the flooding events on Moyer Creek are related to ice jamming conditions with the resultant back-up of water and overbank flooding. Downstream ice jams, severe thunderstorms and tropical storms have also caused flooding problems. According to the USACOE, "ice flows are prone to stalling and forming jams due to manmade and natural constrictions." Other contributing factors include the relatively steep creek gradient south of the Village of Frankfort and the flat gradient downstream of the Main Street bridge to the confluence with the Mohawk River. Within the lower reaches of the Basin, near the confluence of Moyer Creek and the Mohawk River, flooding may also be influenced by "backwater" conditions and flooding events on the Mohawk River. Given certain conditions, a storm event that may not normally cause overbank flooding within the Moyer Creek Basin may cause severe flooding if the Mohawk River is in a flood stage. Figure 1 shows the watershed.



Flood Mitigation Measures Recommended and Estimated Capital Cost

REPORT NAME/DATE/REF	**Moyer Creek Basin Multi-Hazard Mitigation Plan**	Jun 2004	031
REVIEWER	Wayne Gannett, PE, CFM		

- Analysis

A balanced flood hazard mitigation program that incorporates a mix of alternatives will help the community to meet all of its needs – whether those needs are to protect existing development, manage new development, or protect natural resources. Many of these alternatives, and tools for implementing these alternatives, have been evaluated by the Multi-Community Working Group. The tools of most interest to the communities within the Moyer Creek basin, and those that may be the most realistic and practical alternatives for these communities .

- Results

The following categories of recommendations were developed. Specific cost data not provided.

Constructing Projects to Control Flood Waters

- Sediment Control and Detention: Sedimentation in Moyer Creek has contributed to the silting in of various channel sections and bridge openings and is one of the contributing factors of ice jam events. To reduce sediment loading in downstream areas, sedimentation basins should be considered for installation in the up-stream reaches of the basin - where undeveloped land is more available. High priority and moderate expenditure.
- Channel Improvements (Main Street): Although not included as part of the USACOE recommendations for the Flood Control Feasibility Study, consideration should be given to the removal of the dams just upstream and downstream of the Main Street bridge. Channel regrading and installation of multiple drop structures may re-establish a stable streambed after dam removal. Medium priority and high cost.
- Wall Rehabilitation: Improvements to the retaining wall on the east bank of Moyer Creek near the Edgewood Trailer Park are needed to insure the structural integrity of the wall High priority, moderate expenditure.
- Levee/Berm Construction (Brice Road): Consideration should be given to the potential construction of a levee or berm on the western bank of Moyer Creek upstream of the Brice Road bridge. High priority, high cost.

Managing the Use of Lands

- Town of Frankfort Land Use Controls High priority, minimal cost.
- Village of Frankfort Land Use Controls High priority, minimal cost.
- Stormwater and Erosion Control Ordinance High priority, minimal cost
- Setbacks and stream buffers High priority, minimal cost
- Update Local Flood Damage Prevention laws High priority, minimal cost
- Acquisition/Relocation: Given that most of the flooding impacts are within the downstream communities of the Village and Town of Frankfort, these communities should

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work together to develop a systematic approach for potential acquisition and/or relocation of highly prone properties in the flood hazard areas. High priority, high cost

- Flood Proofing Program High priority, moderate cost.

Preparing for Floods

- Stream Gauges, Sensors, and Monitoring: Because there are no stage gauges on Moyer Creek, past efforts within the basin (including the flood control efforts and enhanced flood mapping) have been based on runoff measurements from similar basins in the region. Further, the proportion of rainfall to snowmelt is unknown in these runoff measurements. A series of stream gauges should be established to measure flow volume and velocity specific to the Moyer Creek Basin High priority, moderate cost.

  develop and Implement a stream monitoring, repair and maintenance program for the middle segment of the creek.
- Update Existing Emergency Management Plans Medium priority, minimal cost.
- Data Management System Medium priority, minimal cost.
- Community Rating System (CRS) Participation and Public Education Program High priority, moderate cost
- Flood Structure Maintenance Program high priority, minimal cost
- Financing and District Formation high priority, moderate cost

Preserving and Restoring Natural Resources

- Wetland Protection and Enhancement Low priority, minimal cost
- Open space and Recreation Medium Priority, moderate cost
- Streambank Stabilization High priority, medium to high cost
- Drainageway maintenance Program Medium priority, moderate cost

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Many recommendations could be incorporated into an overall Mohawk River Watershed approach.

REPORT NAME/DATE/REF	**Moyer Creek Basin Multi-Hazard Mitigation Plan**	Jun 2004	031
REVIEWER	Wayne Gannett, PE, CFM		

BIBLIOGRAPHY	The Herkimer-Oneida Counties Comprehensive Planning (June 2004) *Moyer Creek Basin Multi-Hazard Mitigation Plan* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\ Moyer Creek Basin Multi-Hazard Mitigation Plan .pdf

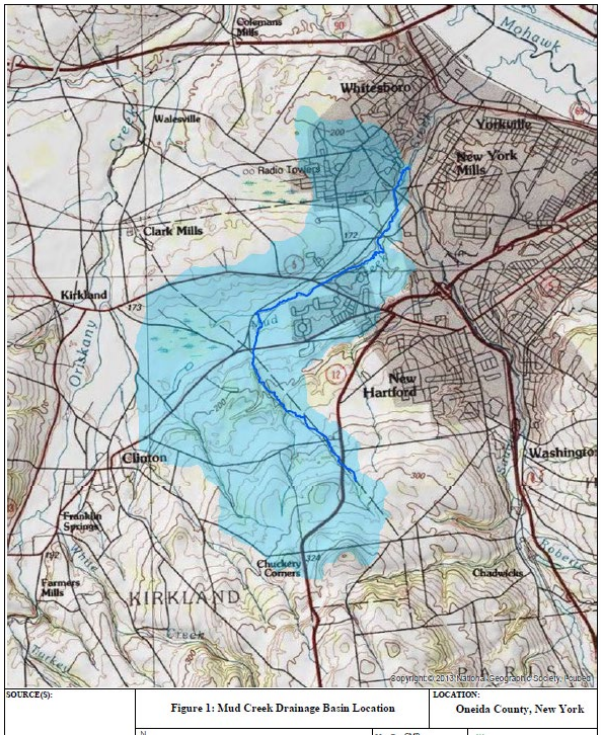
REPORT NAME/DATE/REF	**Mud Creek Basin Assessment**	April 2014	032
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Mud Creek flows through the town of Whitestown, the town of New Hartford, and the Town of Kirkland, in Oneida County, east central New York State. The creek is a tributary to Sauquoit Creek and drains an area of 12 square miles. The drainage basin is approximately 40.6 percent forested (StreamStats, 2013), with rural residential uses in the upper basin and commercial land uses situated in the lower part of the basin. The creek has an average slope of 1.44 percent over its entire length of 9.0 miles. Figure 1 depicts the contributing watershed of the creek.



Mud Creek has an average slope of 1.4 percent over its entire stream length of 9.0 miles. The creek drops a total of 685 vertical feet over its length, from an elevation of 1,123 feet above sea level at its headwaters near Chuckery Corners, to an elevation of 439 feet at its mouth at Sauquoit Creek. Mud Creek is steeper in its upper reaches, above Clinton Road, where the average slope is 2.7 percent. The downstream reaches are flatter, with an average slope of 0.4 percent. Steep stream reaches such as seen in the upper portions of Mud Creek have more energy than lower gradient reaches and, as a result, have higher velocities that carry more sediment. These mobilized sediments are deposited in lower gradient reaches lower in the watershed, where they clog the channel and reduce hydraulic capacity, exacerbating flooding.

REPORT NAME/DATE/REF	**Mud Creek Basin Assessment**	April 2014	032
REVIEWER	Wayne Gannett, PE, CFM		

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting in the Village of New York Mills.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Both FEMA and StreamStats discharges were used in a preliminary hydraulic model to determine which set would better represent known flooding conditions. The results of this comparison led to the conclusion that the discharges produced by USGS StreamStats are more accurate and better reflect conditions during the June 2013 flooding than discharges estimated by FEMA. Therefore, these were selected for use in the hydraulic analyses. Estimated peak flows were derived from USGS Streamstats, as shown in Table 3.

TABLE 3
Final Hydrology for HEC-RAS Modeling of Mud Creek

Station	Bankfull Flow (cfs)	10-Yr Flow (cfs)	50-Yr Flow (cfs)	100-Yr Flow (cfs)	500-Yr Flow (cfs)
227+00	115	369	556	649	872
149+35	291	800	1,010	1,370	1,810

Historical records indicate that the Utica area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2.

Eight bridges and culverts were examined. None have spans long enough to span the bankfull stream width.

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REVIEWER	Wayne Gannett, PE, CFM		

Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high-risk areas were studied:

High Risk Area #1 – The Meadows at Middle Settlement- Portions of the independent living complex are built in the floodplain. Alternatives include:

1-1 Acquire and Remove Apartment Buildings From Floodplains
1-2 Floodproofing and Flood Protection of Individual Properties
1-3 Relocate Creek Away From Apartments

High Risk Area #2 – Culvert Under Seneca Turnpike –

1-1 Replacement with a larger culvert
1-2 Add an additional culvert
1-3 Daylight the existing culvert

High Risk Area #3 – Commercial Drive

3-1 Restore 1,000 Linear Feet of Channel

- Results

The following recommendations were made, with estimated cost ranges in Table 5:

- Stream Relocation or Building Acquisition Near The Meadows at Middle Settlement Apartment Complex. Relocation of Mud Creek would provide the most permanent, long-term solution and would have less impact to residents.
- Daylight the Existing Culvert Under Seneca Turnpike. Removal of the culvert under Seneca Turnpike and construction of a new wider channel and bridge crossing in the location of the former culvert are recommended
- Restoration of Channel Along Commercial Drive
- Evaluate floodplain regulations
- Develop design standards
- Monitor Minor Bank Failures and Erosion

REPORT NAME/DATE/REF	**Mud Creek Basin Assessment**	April 2014	032
REVIEWER	Wayne Gannett, PE, CFM		

TABLE 5
Cost Range of Recommended Actions

	Approximate Cost Range				
Mud Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Stream Relocation at Middle Settlement				X	
Daylight the Existing Culvert Under Seneca Turnpike					X
Restoration of Channel Along Commercial Drive				X	

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Oneida County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Mud Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Mud-Creek-Basin-Assessment-FINAL.pdf

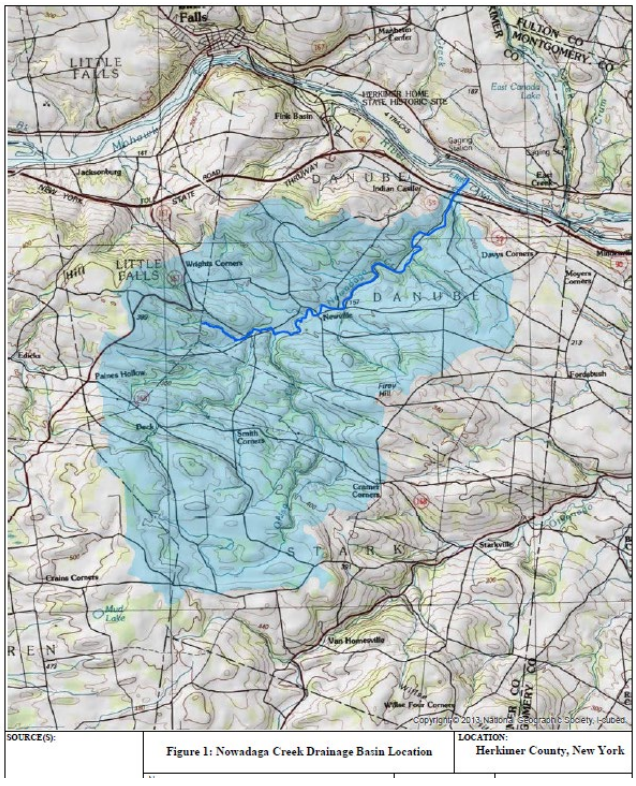
REPORT NAME/DATE/REF	**Nowadaga Creek Basin Assessment**	April 2014	033
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

The Nowadaga Creek basin drains portions of the towns of Danube, Stark, and Little Falls, as well as a small portion of the town of Warren, in southern Herkimer County, eastern central New York State. The creek drains an area of 31.8 square miles. The drainage basin is approximately 49 percent forested with rural residential and agriculture uses throughout the basin and clusters of residential development in the hamlets of Newville and Smith Corners. The creek has an average slope of 1.7 percent over its entire stream length of 10.0 miles. Figure 1 depicts the contributing watershed.



Nowadaga Creek flows over a bedrock bed for much of its length and, therefore, is not subject to alluvial processes as seen in many similarly sized river basins. Despite its natural and relatively undeveloped setting, for much of its length the creek lacks a well developed natural floodplain. In many areas along the creek, the bedrock channel is disintegrating, and pieces of stone that originate from the channel bed are conveyed downstream and deposited in lower velocity reaches of the channel, contributing to debris jams, avulsions, and flooding.

According to community members, municipal officials, and observations made by MMI staff during field investigations, the most severe flood-related damages and erosion problems along Nowadaga Creek have been in the vicinity of the I-90 bridge; along Creek Road (Route 102); in the vicinity of the Town of Danube Department of Public Works (DPW) garage; at

a homeowner-built levee in the vicinity of Tibbitts Road; and at the Newville Road (Route 45) bridge over Nowadaga Creek in the hamlet of Newville.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting in the Village of Fort Plain.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Hydrology was based on USGS StreamStats. There is a preliminary Flood Insurance Study (FIS) for Herkimer County dated September 2011, but it does not have data on Nowadaga Creek. Estimated peak flows were derived from USGS Streamstats, as shown in Table 1.

TABLE 1
Nowadaga Creek Peak Discharges (cfs) from *StreamStats*

Location	Station	10-Yr	50-Yr	100-Yr
Upstream Tibbitts Road bridge	230+70	1,970	2,870	3,320
Upstream Creek Road crossing #1	147+70	2,370	3,470	4,010
At channel avulsion along Creek Road	123+25	2,660	3,900	4,510
Upstream Route 5S bridge	26+35	2,950	4,320	5,000

In mid to late June and early July 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in the greater Utica region, including in the Nowadaga Creek Basin. Because rainfall across the region was highly varied, it is not possible to determine exact rainfall amounts within the basin.

Some indication of the magnitude of the June 2013 flood can be obtained by looking at the nearby Otsquago Creek Basin, which is located just south and east of the Nowadaga Creek Basin. The USGS New York Water Science Center reports that high water marks have been surveyed along Otsquago Creek in Fort Plain to estimate the peak discharge of

the June 28, 2013 event. High water marks obtained at the former stream gage on July 2 for the June 28, 2013 event provided a preliminary estimate of an associated discharge of 28,000 cubic feet per second (cfs). This far exceeds the 500-year flow projections at that location on Otsquago Creek from FEMA or USGS StreamStats.

Nine bridges and culverts were examined. Existing conditions and proposed improvements were analyzed with HEC RAS modeling. The following high-risk areas were studied:

High Risk Area #1 – Undersized and Debris-Prone Bridges - This area includes the Creek Road crossing near STA 142+00 and the rail-to-trail bridge near STA 14+25, both of which are prone to debris jams, ice jams, and clogging by woody debris, which can significantly exacerbate flooding. Alternatives include:

1-1 Bridge Replacement at Creek Road
1-2 Remove or Protect Flood Prone Structures

High Risk Area #2 – Unstable Channel Section (STA 103+00 to STA 142 – Between STA 103+00 and STA 142+00 there is heavy deposition, channel avulsion, and bank erosion. A high bank failure occurs at STA 136+00. Alternatives include:

2-1 Creation of Floodwater Storage Area
2-2 Stabilize Hill Slope
2-3 Avulsion Repair

High Risk Area #3 – Danube DPW Garage - Bank erosion has occurred on the right bank in at the DPW garage. It appears that substantial filling of the floodplain has occurred along the right bank of Nowadaga Creek in this area. The salt storage shed and other stockpiled materials are now in danger of being undermined by bank erosion.

3-1 Remove shed and stockpiled materials

High Risk Area #4 – Homeowner Levee (STA 223+00 to STA 228+00) -

4-1 Remove or modify Levee

- Results

The following recommendations were made, with estimated cost ranges in Table 3.

- Remove or Modify the Levee in the Vicinity of STA 228+00 to STA 223+00
- Remove Salt Storage Shed and Other Stockpiled Materials near DPW Garage
- Replace the Bridge at Creek Road Crossing Near STA 142+00
- Stabilize High Bank Failure at STA 136+00
- Repair of Channel Avulsion in the Vicinity of STA 122+00
- Floodproofing Flood prone Structures Near STA 14+25

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- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards

TABLE 3
Cost Range of Recommended Actions

	Approximate Cost Range				
Nowadaga Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Replace the Bridge at Creek Road Crossing				X	
Stabilize High Bank Failure at STA 136+00		X			
Repair of Channel Avulsion	X				
Remove Salt Storage Shed	X				
Remove or Modify Homeowner Levee	X				
Install and Monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Nowadaga Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Nowadaga-Creek-Basin-Assessment-FINAL.pdf

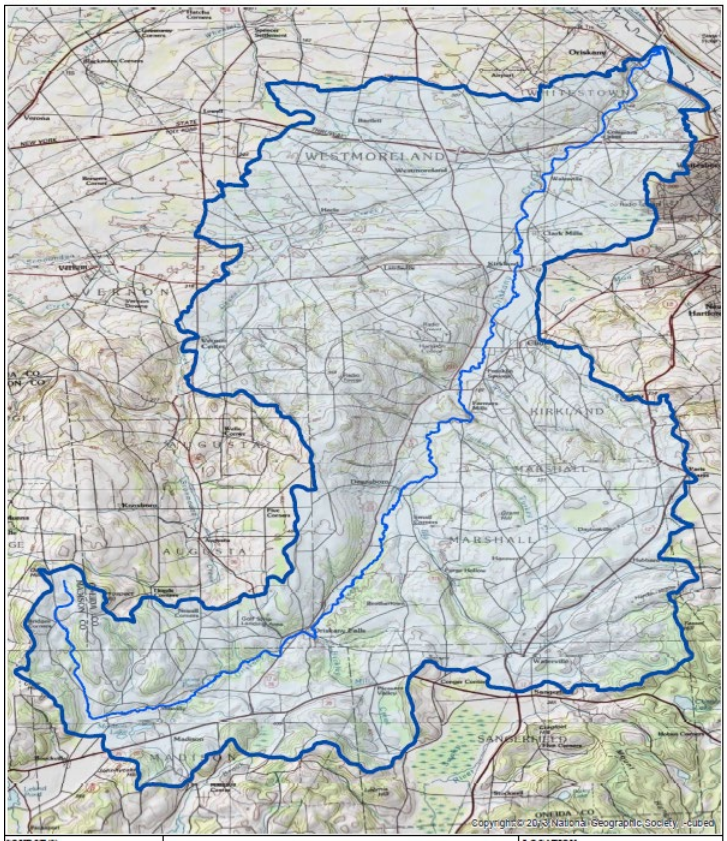
REPORT NAME/DATE/REF	**Oriskany Creek Basin Assessment**	April 2014	034
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

The Oriskany Creek flows through the town of Madison in Madison County, and the towns of Marshall, Kirkland, Westmoreland, and Whitestown in Oneida County. The creek drains an area of 147 square miles. The watershed is approximately 41 percent forested, with a mix of rural residential and agriculture land uses. Figure 1 depicts the contributing watershed.



SOURCE(S): Figure 1: Oriskany Creek Drainage Basin Location LOCATION: Oneida County, New York

Oriskany Creek has an average slope of 0.6 percent over its entire length. Tributaries include Buckley Mill Creek, Big Creek, Turkey Creek, White Creek, and Deans Creek. At 0.6 percent slope, Oriskany Creek is a low gradient watercourse and therefore does not generate excessively high stream power during high flows.

The Oriskany watershed has a low density of development, including development within the floodplain. The main flood vulnerabilities associated with the creek stem from undersized road and railroad crossings that act as hydraulic pinch points. Bank erosion is occurring at a number of locations along the watercourse, contributing sediment and woody debris to the creek and restricting channel and bridge capacity in depositional areas.

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REVIEWER	Wayne Gannett, PE, CFM		

Local officials and residents report flooding problems in the vicinity of Van Hyning Road downstream of Oriskany Falls, at the Norton Avenue bridge in Kirkland, along Valley Road, in the vicinity of the Little League field in Oriskany, and at several other locations along the creek.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high-risk area within the stream corridor

- Analysis

TABLE 2
Oriskany Creek FEMA and *StreamStats* Peak Discharges

Location	Drainage Area (sq. mi.)	10-Yr	50-Yr	100-Yr	500-Yr
		FEMA Peak Discharges			
Corporate Limits of Marshall/Oriskany Falls	29.6	2,250	3,120	3,530	4,425
Approximately 73 ft D/S Van Hyning Road	34.0	2,520	3,495	3,900	4,925
U/S Confluence of Big Creek	38.1	2,715	3,765	4,250	5,375
Corporate Limits of Marshall/Kirkland	58.6	3,750	5,200	5,850	7,350
D/S Confluence of Turkey Creek	70.1	4,775	7,345	8,650	11,800
D/S Confluence of White Creek	82.7	5,420	8,300	9,760	13,900
D/S Confluence of St. Mary's Brook	94.4	5,995	9,150	10,750	14,300
Corporate Limits of Kirkland/Westmoreland	95.2	6,030	9,210	10,820	14,400
Corporate Limits of Westmoreland/Whitestown	102.8	5,610	7,785	8,700	11,000
U/S Dean's Creek	105.7	5,212	7,818	8,994	12,000
Confluence of Mohawk	146.0	6,690	10,002	11,493	15,000
		***StreamStats* Peak Discharges**			
Corporate Limits of Marshall/Oriskany Falls	29.4	2,570	3,770	4,360	5,750
Approximately 73 ft D/S Van Hyning Road	34.4	3,010	4,410	5,100	6,730
U/S Confluence of Big Creek	38.0	3,210	4,690	5,430	7,150
Corporate Limits of Marshall/Kirkland	58.9	4,940	7,200	8,320	11,000
D/S Confluence of Turkey Creek	70.2	5,700	8,280	9,570	12,600
D/S Confluence of White Creek	83.2	6,590	9,560	11,000	14,500
D/S Confluence of St. Mary's Brook	92.4	7,160	10,400	12,000	15,700
Corporate Limits of Kirkland/Westmoreland	95.0	7,280	10,500	12,200	15,900
Corporate Limits of Westmoreland/Whitestown	102.0	7,660	11,100	12,800	16,700
U/S Dean's Creek	103.0	7,590	11,000	12,600	16,500
Confluence of Mohawk	147.0	9,560	13,700	15,700	20,400

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at Oneida Community Hall.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. There are no USGS stream gauging stations on Oriskany Creek; however, hydrologic data on peak flood flow rates are available from the FEMA FIS and from USGS StreamStats regional data. The most current FEMA FIS that applies to Oriskany Creek is for all of Oneida
County. The FIS has an effective date of September 27, 2013. Peak discharges were calculated using both FEMA and USGS Streamstats, as shown in Table 2.

In mid to late June and early July 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in the greater Utica region.

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Historic records on the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2. In between these more severe rain events were a number of smaller rain showers that dropped trace amounts of precipitation, preventing soils from drying out between the larger rain events.

20 bridges and culverts were examined. Many do not span stream bankfull width.

The following high-risk areas were studied:

High Risk Area #1 – Undersized Bridges on the Upper Oriskany (STA 500+00 to STA 1100+00) - The bridges where some of the most severe flooding to buildings and property has been reported are the Route 315 bridge and the Norton Avenue bridge. Alternatives include:

1-1 Prioritize the most severely flood prone, undersized bridges for replacement.
1-2 Prioritize second-tier undersized bridges for replacement as funding becomes available

High Risk Area #2 – Low-Head Dam at STA 436+00 and Undersized Bridges – A low-head dam located approximately 3,000 feet downstream of Route 5, at STA 436+00, is acting to increase water surface elevations upstream of the dam by between 5.5 and 6.5 feet during peak flood events, depending on the magnitude of the storm. This influence diminishes gradually moving upstream from the dam but results in a significant increase in water surface elevation that extends through Kirkland beyond the Route 5 bridge. Alternatives include:

2-1 Remove the Low Head Dam
2-2 Replace Undersized Bridges

High Risk Area #3 – Flood prone Areas in Lower Oriskany (STA81+50 to STA 99+00) - Flooding and damage to Valley Road (Route 32) has been reported in the vicinity of STA 81+50 upstream to STA 99+00 in the backwater area of the dam located at STA 81+50. According to the FEMA profile, the dam creates an increase in water surface elevation upstream of the dam by more than five feet during the 10-year flood event. Alternatives include:

3-1 Removal or Modification of Dam
3-2 Modification or Removal of Piers at Erie Boulevard (Route 69) Bridge
3-3 Removal of Levee at Little League Fields
3-4 Removal or Replacement of Three Bridges in Oriskany

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Maintaining a Healthy Stream Corridor -

4-1 Stream Repair and Maintenance Program

4-2 Sediment Management

High Risk Area # – Individual Property Based Risk Areas -

5-1 Strategic Acquisition of Repetitive Loss Properties

5-2 Flood Protection Measures at Individual Properties

- Results

The following recommendations were made, with estimated cost ranges in Table 4.

- Bridge Replacement in Upper Oriskany
- Remove or Modify Structures Near STA 436+00
- Dam Removal
- Modify Bridge at Rt 69
- Remove Earthen Levee
- Replacement of Undersized Bridges in Lower Oriskany
- Develop and Implement a Stream Repair and Maintenance Program
- Adopt Sediment Management Standards
- Acquisition of flood prone Properties
- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards
- Protect Individual Properties

TABLE 4
Cost Range of Recommended Actions

	Approximate Cost Range				
Oriskany Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Bridge Replacement in Upper Oriskany					X
Remove or Modify Structures Near STA 436+00					X
Dam Removal at STA 81+50		X			
Modify Bridge at Route 69		X			
Remove Earthen Levee	X				
Replacement of Undersized Bridges in Lower Oriskany					X
Develop and Implement a Stream Repair and Maintenance Program	X				
Install and Monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Oneida County, NYSDOT, NYSDEC and other agencies.

REPORT NAME/DATE/REF	**Oriskany Creek Basin Assessment**	April 2014	034
REVIEWER	Wayne Gannett, PE, CFM		

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Oriskany Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Oriskany-Creek-Basin-Assessment-FINAL.pdf

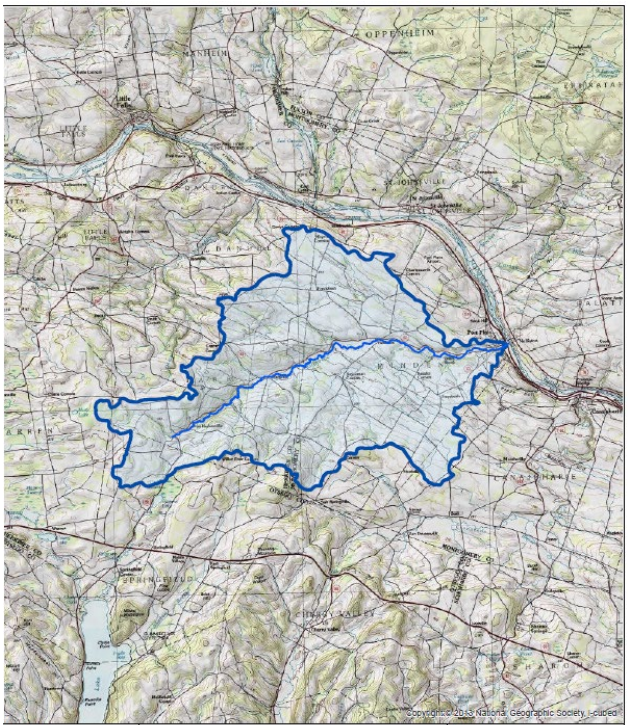
REPORT NAME/DATE/REF	**Otsquago Creek Basin Assessment**	April 2014	035
REVIEWER	Wayne Gannett, PE, CFM		

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Otsquago Creek flows through the town of Stark, in Herkimer County, and the Town of Minden and the Village of Fort Plain, in Montgomery County. The creek drains an area of 61.3 square miles. The contributing watershed is approximately 33.9 percent forested, with a mix of rural residential and agriculture land uses and several small hamlets located in the upper basin, and a dense mix of residential and commercial uses concentrated in the lower part of the basin in the village of Fort Plain. Otsquago Creek has an average slope of 1.5 percent over its entire length. Figure 1 depicts the contributing watershed.



SOURCE(S):

Figure 1: Otsquago Creek Watershed Location Map

LOCATION: Herkimer-Montgomery Counties, New York

Flooding has occurred in many areas along Otsquago Creek, including in the hamlets of Van Hornesville, Starkville, and Hallsville, and in the village of Fort Plain. Extensive flooding and flood-related damage to roads, bridges, and private property have occurred, and a number of homes have been destroyed. Large volumes of coarse-grained sediment originating in the upper reaches are conveyed downstream in Otsquago Creek during large flood events and are subsequently deposited in and along the channel where they clog bridges and exacerbating flooding.

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REVIEWER	Wayne Gannett, PE, CFM		

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high-risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at Stark Community Hall.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Eighteen bridges and culverts were examined. Many do not span stream bankfull width.

A preliminary FEMA FIS for Montgomery County was issued in 2011. USGS Streamstats was also used to determine peak flows, as shown in Table 3

TABLE 3
Final Hydrology for HEC-RAS Modeling of Otsquago Creek

Station	Bankfull Flow (cfs)	10-Yr Flow (cfs)	50-Yr Flow (cfs)	100-Yr Flow (cfs)	500-Yr Flow (cfs)
809+00	242	912	1,360	1,580	2,110
46+80	1,520	6,700	9,870	11,500	15,200

The USGS New York Water Science Center reports that high water marks were being surveyed along Otsquago Creek in Fort Plain to document the flooding in that community and to estimate the peak discharge of the June 28, 2013 event. A former stream gage on Otsquago Creek at Fort Plain was operated from October 1949 to September 1989. During that period, the maximum recorded stage and associated discharge of 12.24 feet and 10,400 cfs occurred on Oct. 28, 1981. High water marks obtained at the former stream gage on July 2 for the June 28, 2013 event surveyed at 19.60 feet, and a preliminary estimate of the associated discharge is 28,000 cfs. This far exceeds the 500-year flow projections from FEMA or StreamStats.

In mid to late June and early July 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in theOtsqquago Creek region,

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REVIEWER	Wayne Gannett, PE, CFM		

Historic records on the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2. In between these more severe rain events were a number of smaller rain showers that dropped trace amounts of precipitation, preventing soils from drying out between the larger rain events.

According to news reports, floodwaters on June 27, 2013 submerged the entire downtown area of the village of Fort Plain, from Abbott and Reid Streets on Route 80, past the Fort Plain Fire Department on Route 5S. Save-A-Lot Plaza, which includes Daylight Donuts and Family Dollar, was still submerged even after the floodwaters receded due to the levee preventing waters from draining. Flooding extended up Otsquago Creek as far as Van Hornesville. Homes along Abbott Street were heavily damaged.

The following high-risk areas were studied:

High Risk Area #1 – Van Hornesville - This area encompasses the homes and businesses along Otsquago Creek in the hamlet of Van Hornesville, from STA 825+00 downstream to STA 767+00. Alternatives include:

1-1 Address Undersized Channel and Floodplain Development
1-2 Removal of Dam
1-3 Replacement of the Undersized Bridge at Wiltse Hill Road
1-4 Owen D. Young Central School

High Risk Area #2 – Starkville Bridges – A low-head dam located approximately 3,000 feet downstream of Route 5, at STA 436+00, is acting to increase water surface elevations upstream of the dam by between 5.5 and 6.5 feet during peak flood events, depending on the magnitude of the storm. This influence diminishes gradually moving upstream from the dam but results in a significant increase in water surface elevation that extends through Kirkland beyond the Route 5 bridge. Alternatives include:

2-1 Replacement of Route 168 and Moyer Road Bridges

High Risk Area #3 – Tributary at STA 174+00 - An unnamed tributary crosses beneath Cooperstown Road (Route 80) and joins Otsquago Creek at a sharp bend in the creek. Historic aerial photographs show evidence of severe sediment aggradation downstream of the confluence of the unnamed tributary. Alternatives include:

3-1 Sediment Management

High Risk Area #4 - Abbott Street Anecdotal descriptions of the flooding near Abbott Street indicate that the street and surrounding houses were almost completely destroyed during the June 2013 flood. Sediment aggradation was described to have limited the channel capacity and to have caused the creek to overtop its banks. Alternatives include:

4-1 Assessment of Newly Constructed Channel and Potential Floodplain Creation
4-2 Strategic Acquisition of Repetitive Loss Properties
4-3 Flood Protection Measures of Individual Properties
4-4 Creation of an Upstream Floodwater and Sediment Storage Area

High Risk Area #5 – Fort Plain Downtown - This densely developed village center experienced severe flooding during the June 2013 flood event. Tall, near vertical, heavily armored banks have been constructed right to the edge of the creek, and low-lying floodplain areas have been filled to support the development of the village. Therefore, the higher flows generated during a flood do not have sufficient floodplain area to effectively convey the flows downstream and, instead, they overtop the banks. Alternatives include:

5-1 Channel Modification and Floodplain Creation from STA 24+00 to STA 14+00
5-2 Mitigation Downstream of Hancock Street Bridge

- Results

The following recommendations were made, with estimated cost ranges in Table 6.

- Restore Channel and Create Floodplain Bench at STA 809+00 to STA 794+00
- Replace Undersized Bridge at Wiltse Hill Road (STA 782+00)
- Investigate Floodproofing Measures at the Owen D. Young Central School Near STA 775+00
- Replacement of Route 168 and Moyer Road Bridges
- Sediment Management in the Unnamed Tributary at STA 174+00
- Adopt Sediment Management Standards
- Evaluate Newly Constructed Channel Project and Undertake Long-Term Flood Mitigation near STA 66+00 to STA 39+00
- Acquisition of flood prone Properties
- Protect Individual Properties
- Modify the Channel from STA 24+00 to STA 14+00
- Evaluate Levee Modification Near Fort Plain Downtown
- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards

REPORT NAME/DATE/REF	**Otsquago Creek Basin Assessment**	April 2014	035
REVIEWER	Wayne Gannett, PE, CFM		

TABLE 6
Cost Range of Recommended Actions

	Approximate Cost Range				
Otsquago Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Restore Channel and Create Floodplain Bench				X	
Replace Undersized Bridge at Wiltse Hill Road				X	
Replacement of Route 168 and Moyer Road Bridges				X	
Sediment Management Plan in the Unnamed Tributary	X				
Evaluate Newly Constructed Channel Project	X				
Modify the Channel from STA 24+00 to STA 14+00				X	
Evaluate Levee Modification near Fort Plain Downtown	X				
Install and Monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Montgomery County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Otsquago Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Otsquago-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**Steele Creek Basin Assessment**	April 2014	036A
REVIEWER	Wayne Gannett, PE, CFM		

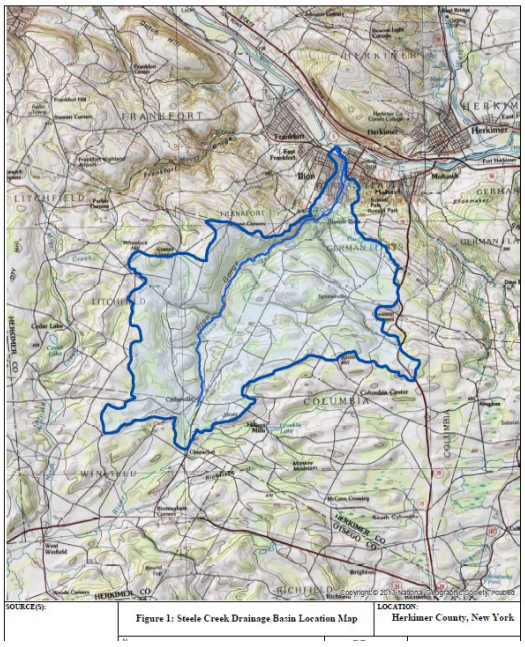
Note on Previous Study: The STEELE CREEK MULTI-COMMUNITY FLOOD HAZARD MITIGATION PLAN was prepared by the Herkimer-Oneida Counties Comprehensive Planning Program in October 2004. Recommendations were similar to those listed below in this 2014 Basin Assessment.

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

The Steele Creek drainage basin is located primarily in the towns of Litchfield, German Flatts, and Columbia, and the village of Ilion, in Herkimer County, east central New York State. Smaller portions of the basin are located in the towns of Winfield and Frankfort. The creek drains an area of 27.3 square miles. The drainage basin is approximately 47 percent forested with rural residential and agriculture uses throughout the basin and a mix of residential and commercial land uses concentrated in the lower part of the basin in the village of Ilion. The creek has an average slope of 1.75 percent over its entire stream length of 12.9 miles. Figure 1 depicts the contributing watershed of Steele Creek.



Steele Creek generates a significant amount of stream power through certain reaches during high flow events. Due to historic filling and development that has occurred, numerous bridges and sections of channel along the watercourse are not large enough to convey flows during significant storm events. An extensive area of commercial and residential development in the village of Ilion occurs in the floodplain and in many cases is within 20 feet or less of the edge of the stream. When the channel exceeds its hydraulic capacity or becomes clogged with sediment and woody debris, it finds new and destructive paths through the community, leaving homes and property damaged by floodwaters, bridges destroyed, and unstable creek bed and banks that are at risk for further degradation and failure.

REPORT NAME/DATE/REF	**Steele Creek Basin Assessment**	April 2014	036A
REVIEWER	Wayne Gannett, PE, CFM		

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting in the Village of Ilion.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Nineteen bridges culverts were examined. Most spans are less than bankfull width.

There is a preliminary draft FIS available for all of Herkimer County, which was issued September 30, 2011, but it had not yet been formally approved as of the publication of the subject document. Estimated peak discharges for various frequency events were calculated by MMI using USGS StreamStats and were then compared to peak discharges reported in the FEMA FIS. It was concluded that the larger flows produced by USGS StreamStats appear to reflect conditions during the June 2013 flooding more accurately than the lower flows estimated by FEMA. USGS StreamStats flows were then generated at relevant locations in the model and at confluences with larger tributaries. Table 4 reflects the flows.

TABLE 4
Final Hydrology for HEC-RAS Modeling of Steele Creek

Station	Bankfull Flow	10-Yr Flow	50-Yr Flow	100-Yr Flow	500-Yr Flow
		StreamStats Peak Discharges			
128+85	568	1,950	2,860	3,300	4,360
113+00	688	2,390	3,500	4,050	5,340
98+00	742	2,520	3,680	4,260	5,610
63+00	746	2,540	3,710	4,290	5,640

The most severe flooding on Steele Creek has occurred at Spinnerville Gulf Road, along the creek between Clapsaddle Farm Road and the Otsego Street bridge, and from Otsego Street downstream to West Main Street. Severe flood-related damages have occurred at all of these locations.

In mid to late June and early July 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in the Utica region, including Steele Creek.

REPORT NAME/DATE/REF	**Steele Creek Basin Assessment**	April 2014	036A
REVIEWER	Wayne Gannett, PE, CFM		

Historic records on the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the village of Mohawk area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July 2013. Much of this rainfall occurred over several storm events that dropped between 3.5 and 4.5 inches of rain between June 11 and June 14, 5.5 to 8.5 inches between June 24 and June 28, and 1.5 to 2.0 inches on July 2. In between these more severe rain events were a number of smaller rain showers that dropped trace amounts of precipitation, preventing soils from drying out between the larger rain events.

The following high-risk areas were studied:

High Risk Area #1 – Spinnerville Gulf Confluence - This area includes the section of Steele Creek from the outlet of Ilion Gorge upstream of the Spinnerville Gulf Road crossing (STA 117+00) to 300 feet downstream of a gas and high voltage electricity crossing. The area is subject to sediment deposition. Alternatives include:

1-1 Develop and Implement Sediment Management Plan

High Risk Area #2 – The Falls – This area extends from STA 91+00 downstream to STA 56+00 and includes the Clapsaddle Farm Road bridge, the Richfield Street bridge, the Frederick Street bridge, the dam (known locally as "The Falls"), and the Otsego Street bridge. The channel upstream of the dam is lined on the right bank by East River Drive and on the left bank by West River Drive. These two roads closely confine the channel, leaving no overbank area during flood events. Alternatives include:

2-1 Dam Removal, Bridge Replacement, and Floodplain Restoration
2-2 Dam Removal and Channel Restoration
2-3 Remove and Replace Undersized Bridges and Floodplain Restoration
2-4 Creation of Flood Storage Detention Area

High Risk Area #3 – Otsego, First, Second, Third, and West Main Streets - FEMA mapping shows extensive flooding throughout this high-risk area. Third Street, Second Street, and the Main Street bridges are all shown as hydraulic constrictions. Alternatives include:

3-1 Channel Widening with Floodplain Restoration
3-2 Remove and Replace Undersized Bridges

Individual Property-Based Risk Areas

4-1 Strategic Acquisition of Flood prone Properties
4-2 Flood Protection Measures of Individual Properties

- Results

The following recommendations were made, with estimated cost ranges in Table 6.

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- Adopt Sediment Management Standards
- Remove "The Falls" Existing Concrete Dam
- Remove and Replace Undersized Bridges at Clapsaddle Farm Road, Richfield Street, Frederick Street and Otsego Street
- Widen Undersized Channel and Restore Floodplain
- Remove East River Road between STA 79+50 and STA 64+00 and Convert Monroe Street, Jefferson Street, and Buchanan Street to Cul-de-sacs
- Replace Undersized Bridges at Third, Second, and West Main Third Street and Restore Channel and Floodplain
- Monitor Minor Bank Failures and Erosion
- Evaluate Floodplain Regulations
- Install and Monitor a Stream Gage
- Develop Design Standards
- Acquisition of flood prone Properties
- Protect Individual Properties

TABLE 6
Cost Range of Recommended Actions

	Approximate Cost Range				
Steele Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Removal of "The Falls" Existing Concrete Dam			X		
Removal and Replacement of Undersized Bridges					X
Widen Undersized Channel and Restore Floodplain					X
Install and monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Steele Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Steele-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**West Canada Creek Basin Assessment**	April 2014	037
REVIEWER	Wayne Gannett, PE, CFM		

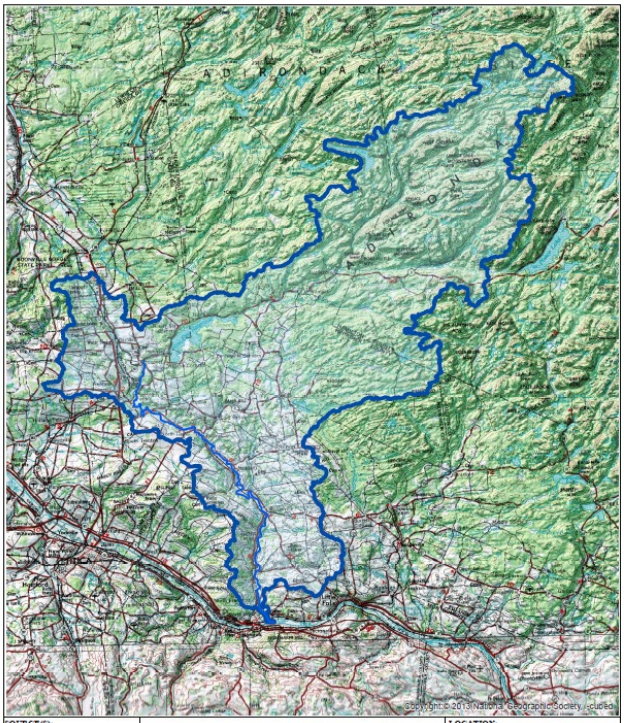
B

Purpose

A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

West Canada Creek drains portions of Hamilton, Herkimer, and Oneida Counties, in east central New York State. Figure 1 is a basin location map. Its headwaters are in the Adirondack Mountains. The creek drains an area of 559 square miles and flows into the Mohawk River just east of the village of Herkimer. The drainage basin is approximately77 percent forested, with sparse rural residential uses in the upper basin, agricultural usesin the lower basin, and residential and commercial land uses in towns and villages along the creek. West Canada Creek has an average slope of 0.47 percent over its entire stream length of 85.1 miles.



Field investigations focused on the section of West Canada Creek from upstream of the Village of Middleville (STA 560+00) downstream to the creek's outlet to the Mohawk River (STA 0+00) near the Village of Herkimer. The most severe flood-related damages on West Canada Creek have occurred in the Village of Middleville, located on the boundary of the Towns of Newport and Fairfield, where the creek has overtopped its banks on several occasions, flooding residential, commercial, and industrial areas within the village. The Village of Middleville is situated on both sides of West Canada Creek, with Route 28 (Bridge Street) spanning the creek. Maltanner Creek enters West Canada Creek from the east in Middleville.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at the Middleville Judges Chambers.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Four bridges culverts were examined. All have spans less than bankfull width.

There is a USGS stream gaging station on West Canada Creek (USGS Gage No. 01346000, at Kast Bridge, NY). Hydrologic data on peak flood flow rates are also available from the FEMA FIS and from USGS StreamStats, which uses nearby regulated stream gage information to estimate flows. The most current FEMA FIS that applies to West Canada Creek is for all of Herkimer, dated September 27, 2013. It does not include analysis of West Canada Creek where it flows through the Village of Middleville.

Comparing the 100-year discharges reported by FEMA to the discharges derived from USGS StreamStats, the FEMA discharges are in the range of 9.5 to 26.5 percent higher than the discharge estimated using USGS StreamStats. Table 2 reflects FEMA and USGS Streamstats flows.

TABLE 2
West Canada Creek FEMA and *StreamStats* Peak Discharges

Location	Drainage Area (sq. mi.)	10-Yr	50-Yr	100-Yr	500-Yr
	FEMA Discharge Values for Storm Reoccurrence				
Kast Bridge	561	16,200	20,600	22,000	26,200
0.8 mi U/S Old State Road	426.2	---	---	22,900	---
Above confluence of Cincinnati Creek	374	---	---	20,100	---
	StreamStats Discharge Values for Storm Reoccurrence				
West End Road (Kast Bridge)	560	15,400	18,800	20,100	22,700
Route 28 in Middleville	516	14,400	18,000	19,400	22,500
0.8 mi U/S Old State Road	451	12,800	16,600	18,100	21,600
Confluence of Cincinnati Creek	381	11,100	14,800	16,300	21,100

According to community officials and residents, the most severe flood-related damages on West Canada Creek in Middleville have occurred to homes along Fishing Rock Road, which parallels the creek along its right bank, north of Route 28, between STA 552+00 and STA 527+00. Homes line the road between STA 538+00 and STA 527+00. During a severe flood in 2006, flooding reportedly occurred along Fishing Rock Road, extended south to Route 28, and damaged trailers, which were subsequently replaced by FEMA. Flood damage has also occurred to homes and businesses along Kanata Street, which parallels the right bank of the creek south of Route 28,

between STA 526+00 and STA 516+00. On the left bank, combined floodwaters from West Canada Creek and Maltanner Brook have flooded the firehouse, in the vicinity of STA 538+00.

The stream corridor along West Canada Creek is primarily forested, especially in the upper basin above Hinckley Reservoir, and appears to be quite natural and unaltered by human use. At several points along its length, the geomorphic characteristics of West Canada Creek are influenced by the operation of hydroelectric dams and reservoirs, rather than by natural river processes. Sediment transport and deposition through these reaches are influenced by dam operation. The largest reservoir on the creek is Hinckley Reservoir, and there are smaller impoundments along the main stem and on several tributaries. According to FEMA, three large dams in the town of Newport serve the purposes of hydroelectric generation and water supply impoundment. Hinckley Reservoir is capable of providing significant flood control capability if the reservoir is at its lowest regulated level.

The following high-risk areas were studied:

High Risk Area #1 – Sediment Accumulation Zones - A large lateral sediment bar has formed between STA 532+00 and STA 523+00. The sediment is composed primarily of cobble and is almost entirely blocking the left (eastern) span of the bridge, substantially reducing the hydraulic capacity of the channel as it passes under the bridge. A substantial accumulation of coarse-grained sediment has also formed in the channel near the outlet of West Canada Creek, downstream of the East State Street (Route 5) bridge. Alternatives include:

1-1 Implement Sediment Control Mechanisms Recommended in Maltanner Brook Basin
1-2 Remove Excess Sediment from Channel in Middleville
1-3 Remove Excess Sediment on Lower West Canada Creek at Route 5
1-4 Sediment Management

High Risk Area #2 – Minor Bank Failures and Erosion - Alternatives include:

2-1 Monitor Bank Failures and Erosion

- Results

The following recommendations were made, with estimated cost ranges in Table 4.

- Control Sediment at its Source in the Maltanner Brook Basin
- Remove Cobble Bar from the Channel at Bridge Street (Route 28) in Middleville (STA 523+00 to STA 532+00)
- Periodically Remove Sediment on Lower West Canada Creek (STA 0+00 to STA 46+00)
- Adopt Sediment Management Standards
- Monitor Minor Bank Failures and Erosion
- Develop Design Standards

REPORT NAME/DATE/REF	**West Canada Creek Basin Assessment**	April 2014	037
REVIEWER	Wayne Gannett, PE, CFM		

TABLE 4
Cost Range of Recommended Actions

	Approximate Cost Range				
West Canada Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Remove Cobble Bar from the Channel at Bridge Street in Middleville	X				
Periodically Remove Sediment from the Channel Downstream of East State Street	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Herkimer County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *West Canada Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\West Canada-Creek-Basin-Assessment-FINAL.pdf

REPORT NAME/DATE/REF	**Sauquoit Creek Basin Assessment**	April 2014	038B
REVIEWER	Wayne Gannett, PE, CFM		

Note on Previous Study: The SAUQOIIT CREEK BASIN WATERSHED MANAGEMENT STUDY was prepared by the Herkimer-Oneida Counties Comprehensive Planning Program in June 1997. Recommendations were similar to those listed below in this 2014 Basin Assessment.

Note on project implementation since 2014 study: The Town of Whitestown prepared the 2022 document *Sauquoit Creek Channel & Floodplain Restoration Program, a* summary of mitigation projects done in the Lower Sauquoit Creed area. The mitigation component involves the construction of several floodplain benches, areas of bank stabilization, channel widening and the creation of a public access trail along a 1- plus mile corridor of the lower Sauquoit Creek in Whitestown on Commercial Drive/NYS Route 5A. The work will continue to stabilize the lower Sauquoit Creek while connecting it to its original floodplain.

- In September 2019, "Mitigation Project 1," involving the construction of two floodplain benches at Dunham Manor Park in Whitestown, was completed.
- In August 2022, "Mitigation Project 2," involving the construction of a floodplain bench in the Village of Whitesboro south of the CSX Railroad Crossing and installation of five additional culverts underneath the CSX Rail Line, was completed.
- "Mitigation Project 3" will enlarge the recently completed floodplain bench at the site of "Mitigation Project 2" adjacent to the CSX Railroad Bridge in the Village of Whitesboro and feature additional flood mitigation measures on lower Commercial Drive in Whitestown.

Purpose

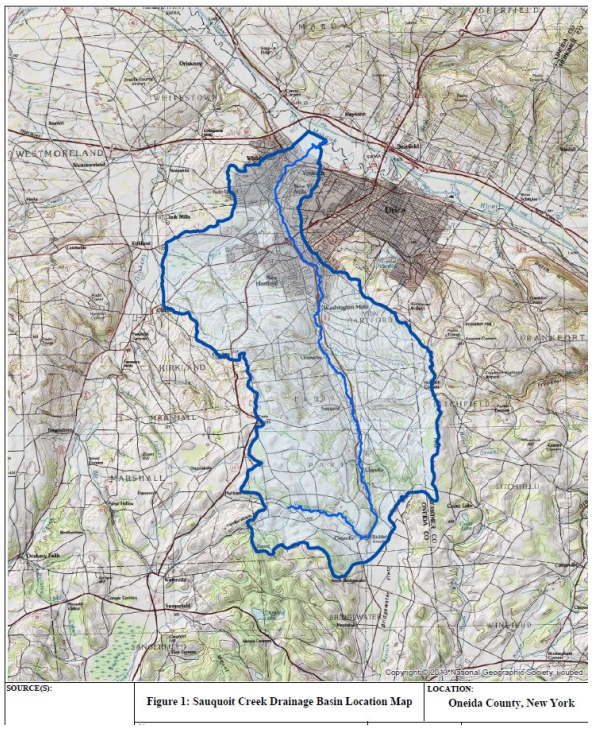
A severe precipitation system in June 2013 caused excessive flow rates and flooding in a number of communities in the greater Utica region. As a result, the New York State Department of Transportation (NYSDOT) in consultation with the New York State Department of Environmental Conservation (NYSDEC) retained Milone & MacBroom, Inc. (MMI) to undertake an emergency transportation infrastructure recovery water basin assessment of 13 watersheds in Herkimer, Oneida, and Montgomery Counties.

Flooding Problems Identified

Sauquoit Creek flows through the Town of Paris, the Village of Clayville, the Town and Village of New Hartford, the Village of New York Mills, the Town of Whitestown, and the Village of Whitesboro, in Oneida County, east central New York State. The creek drains an area of 62.2 square miles and flows into the Mohawk River west of Utica. The drainage basin is approximately 38 percent forested, with villages, rural residential and agriculture uses in the upper basin, and dense commercial land uses concentrated in the lower part of the basin, especially along Commercial Drive in the village of New York Mills. The creek has an average slope of 0.94 percent

REPORT NAME/DATE/REF	**Sauquoit Creek Basin Assessment**	April 2014	038B
REVIEWER	Wayne Gannett, PE, CFM		

over its entire stream length of 20.6 miles. Figure 1 depicts the contributing watershed of Sauquoit Creek.



SOURCE(S): | Figure 1: Sauquoit Creek Drainage Basin Location Map | LOCATION: Oneida County, New York

Sauquoit Creek flows in a generally northern direction and parallels Route 8 for much of its length. The creek's floodplain is broad and flat along its lower reaches where the most intense commercial development has occurred. Especially along its mid and lower reaches, the Sauquoit Creek corridor has been straightened and channelized, and its floodplain has been encroached upon by residential, industrial, and commercial development, leaving little room for floodwaters during storm events. In many areas, development has occurred within several feet of the creek. The creek is spanned by many undersized bridges, which act as hydraulic constrictions and exacerbate flooding, and a number of abandoned dams and grade control structures occur in the channel.

Flood Mitigation Measures Recommended and Estimated Capital Cost

The goals of the water basin assessment were to:

1. Collect and analyze information relative to the June 28, 2013 flood and other historic flooding events
2. Identify critical areas subject to flood risk
3. Develop and evaluate flood hazard mitigation alternatives for each high risk area within the stream corridor

- Analysis

An initial project kickoff meeting was held in early October 2013 with representatives from NYSDOT and NYSDEC, followed by public outreach meetings held in the affected communities, including a meeting at the New York Mills village office.

A field assessment was conducted in the fall of 2013. Land use and geomorphology were evaluated. Twenty bridges and culverts were examined. Many do not span bankfull width.

The most current FEMA FIS that applies to Sauquoit Creek is for all of Oneida County and became effective on September 27, 2013. Table 2 lists estimated peak flows on Sauquoit Creek

at each of the cross sections reported in the FEMA FIS and similar drainage points delineated with the USGS StreamStats program. When comparing discharges reported in the FEMA FIS report to those determined using USGS StreamStats, discharge volumes are generally within 10 percent. For brevity this summary Table 2 only lists FEMA discharges.

TABLE 2
Sauquoit Creek FEMA and *StreamStats* Peak Discharges

Location	Drainage Area (sq. mi.)	10-Yr	50-Yr	100-Yr	500-Yr
	FEMA Peak Discharges				
Upstream State Route 8	6.4	598	1,016	1,104	1,706
Upstream Oneida Street	8.9	872	1,394	1,512	2,300
Upstream Main Street	11.9	915	1,577	1,744	2,776
Upstream Holman City Road	13.2	1,185	1,914	2,187	3,515
Upstream Pinnacle Road	17.6	1,633	2,628	2,882	4,717
Upstream Elm Street	28.53	2,074	3,486	3,786	6,025
Upstream 4th Railroad Crossing	32.55	2,387	4,038	4,390	7,011
Upstream Kellogg Road	36.96	2,920	4,838	5,226	8,227
Upstream of City of Utica/Town of New Hartford Limits	40.19	3,161	5,242	5,634	8,790
Upstream 3rd Railroad Crossing	41.12	3,254	5,399	5,801	8,949
Limits of Village of Hartford/City of Utica	43.4	3,899	6,516	7,011	10,523
Upstream 2nd Railroad Crossing	43.66	3,394	5,681	6,124	9,504
Limits of Town of New Hartford/Town of Whitestown	47.11	3,899	6,516	7,011	10,523
State Route 5A	47.1	5,192	7,651	9,141	12,000
Stuart Court Extended	59.4	5,873	8,707	10,222	13,150
Main Street Bridge	60.1	6,014	8,702	10,120	13,205
Confluence with Mohawk	61.9	6,148	8,831	10,177	13,100

The most severe flood-related damages on Sauquoit Creek have occurred within the area of dense commercial land uses along Commercial Drive, in the village of New York Mills. According to the FEMA FIS, significant floods occurred on Sauquoit Creek in 1910, 1913, 1914, 1936, 1945, 1950, 1951, 1960, 1964, June 1972 (Tropical Storm Agnes), 1996, 1998, and 2006. Many of these floods occurred in the spring as a result of snowmelt combined with rainfall. The flood of March 1936 was caused by 4.6 inches of rainfall on a heavy snow cover, causing a snowmelt equivalent to approximately 3 inches of water. The October 1945 flood was caused by intense rainfall of 4.2 inches in a 24-hour period and is locally considered the greatest flood of record. Ice jams and bridges have also caused localized flooding on Sauquoit Creek.

In mid to late June and early July of 2013, a severe precipitation system caused excessive flow rates and flooding in a number of communities in the greater Utica region, including in the Sauquoit Creek Basin. Because rainfall across the region was highly varied and rainfall information is limited, it is not possible to determine exact rainfall amounts within the Sauquoit Creek Basin. The National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) website indicate that the Utica area received between 10 and 15 inches of rainfall in the month of June and an additional 5 to 8 inches in July, 2013.

The following high-risk areas were studied:
High Risk Area #1 – Failing Dams in the Upper Sauquoit Creek Basin - This area extends from Summit Road in Cassville downstream to Main Street in Clayville. At least eight low-head dams span the channel in this reach, associated with factories along its banks. These dams are in various stages of disrepair, and some have completely failed, leaving behind an unstable channel,

an eroding channel bed and banks, and high sediment load. Other dams are still in place but appear to be in danger of failing. Alternatives include:

1-1 Remove Dams and Stabilize Channel.

High Risk Area #2 – Legacy Dam - This dam is located in a remote area between Route 8 on the east and railroad tracks on the west, just upstream of Elm Street and Donovan Memorial Park in the hamlet of Chadwick. The approximate elevation drop between the crest of the spillway and the pool below the dam is 15.5 feet. Its former impoundment, now heavily silted in, seems to extend upstream approximately 3,400 feet. Alternatives include:

2-1 Remove Dam
2-2 Repair Dam
2-3 Repair and Repurpose Dam

High Risk Area #3 – Brookside Mobile Manor – The area includes a densely developed area at the center of the hamlet of Chadwicks, including the Brookside Mobile Manor trailer park, a strip mall with two restaurants, an existing low-head run-of-river dam, and two undersized bridges at Bleachery Avenue and a railroad crossing. Alternatives include:

3-1 Replace Bleachery Avenue Bridge (STA 472+00) and Downstream Railroad Bridge
3-2 Strategic Acquisition of Repetitive Loss Properties
3-3 Flood Protection Measures of Individual Properties
3-4 Floodplain Restoration

High Risk Area #4 - Flooding Near Victoria Drive - Dense residential development along Victoria Drive, Brookline Drive, and Richardson Avenue along the northeastern bank of the Sauquoit has encouraged fill and construction to the edge of the creek, with homes, outbuildings, and filled yard areas extending to the edge of the normal flow channel. Alternatives include:

4-1 Creation of Naturalistic Channel with Floodway
4-2 Floodwater Storage

High Risk Area #5 - Undersized Bridge - FEMA profiles indicate that there is a substantial increase in water surface elevations in this area during the 50-, 100-, and 500-year flow events as a result of the undersized bridge crossing at Commercial Drive. Alternatives include:

5-1 Replace Commercial Drive Bridge

High Risk Area #6 – Lower Saquoit near Commercial Drive - This heavily developed corridor experiences extensive flooding of businesses, car dealerships, and a school. Alternatives include:

6-1 Replacement of Undersized Bridges
6-2 Bridge Replacement in Combination with Floodplain Creation
6-3 Sediment Management

REPORT NAME/DATE/REF	**Sauquoit Creek Basin Assessment**	April 2014	038B
REVIEWER	Wayne Gannett, PE, CFM		

- Results
-

The following recommendations were made, with estimated cost ranges in Table 4.

- Remove Low-Head Dams in Upper Sauquoit
- Conduct Further Evaluation for Repair/Removal of the Dam at STA 538+00
- Dam and Bridge Removal and Floodplain Restoration
- Channel and Floodplain Restoration Near Victoria Drive
- Replace the Bridge at STA 165+00
- Bridge Replacement and Channel and Floodplain Restoration in Lower Sauquoit
- Adopt Sediment Management Standards
- Strategic Acquisition of Repetitive Loss Properties
- Evaluate Flood Plain Regulations
- Install and Monitor a Stream Gage

TABLE 4
Cost Range of Recommended Actions

	Approximate Cost Range				
Sauquoit Creek Recommendations	< $100k	$100k-$500k	$500k-$1M	$1M-$5M	>$5M
Remove Low Head Dams in Upper Sauquoit				X	
Conduct Further Evaluation for Repair/Removal of the Dam at STA 538+00	X				
Dam and Bridge Removal at STA 478-00 and Floodplain Restoration				X	
Channel and Floodplain Restoration Near Victoria Drive					X
Replace the Bridge at STA 165+00				X	
Bridge Replacement & Channel and Floodplain Restoration in Lower Sauquoit					X
Install and monitor a Stream Gauge	X				

Investigations and actions recommended by each agency

The report contains detailed recommendations, which could be implemented locally or with assistance from Oneida County, NYSDOT, NYSDEC and other agencies.

Actions recommended to be undertaken by the NYSCC

None

Actions from this study can be adopted as an USFMTF recommendation

Several recommendations including development of design standards and stream gaging could be incorporated into an overall Mohawk River Watershed approach.

BIBLIOGRAPHY	Milone & MacBroom (April 2014) *Saquoit Creek Basin Assessment* I:\NYSCC\22013187G\3.0 Design\3.1 DesignCriteria\Mohawk River Basin\Mohawk Watershed Reports from NYSDEC\Saquoit-Creek-Basin-Assessment-FINAL.pdf

APPENDIX B

Oswego River Basin – Report Abstracts and Summaries

UPSTATE FLOOD MITIGATION TASK FORCE

Oswego River Basin Report Abstracts & Summaries

FEBRUARY 2023

Appendix B Oswego River Basin Abstracts & Summaries
Table of Contents

REPORT TITLE /DATE/REF	Baker, Operational Audit for the New York State canal System: Oswego River Basin	September 1997	001
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This document performs an operational audit of the watershed management policies, procedures, and implementation practices of the NYSCC within the Oswego River Basin. Emphasis was placed on the assessment of the three Finger Lakes (Seneca, Cayuga, and Oneida). The NYSCC controls, the lake outlets of Cayuga and Oneida Lakes, and therefore, NYSCC has some limited control over basin wide flooding. The operational audit concluded that substantial changes to the existing operational system were not recommended but improvements can be made to enhance operations. Additionally, the audit provides a literature review of prior flood mitigation studies and their findings.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The following recommendations were provided in the report:

Operations

1. Establish a real-time automated monitoring system comprised of a network of precipitation (rainfall and snowfall), lake/reservoir level gages, and stream flow gages at key locations to verify basin response to weather. The cost associated with this recommendation was approximately $532,500 (1997 dollars) for the equipment/installation and approximately $100,000 for the annual operation/maintenance.
2. Automate the data analyses of precipitation/flows and develop an early alert system using the real-time data to inform the public of potential flooding.

Education

3. Increase public education and awareness of flooding using various platforms.

Planning

4. Work with local communities and NYSDEC to enhance public knowledge of building regulations specifically regarding the requirements of the National Flood Insurance Program.
5. Participate in the development of a regional watershed management plan which would address issues such as floodplain ordinances, construction of detention ponds/wetlands, improved local water and sewer systems, and public education.
6. Establish a common datum and conversion factors between datums.
7. Review the permits for use of land in all subdivisions owned by the NYSCC and examine the possibility of returning those sites exclusively to flood storage.
8. Revisiting previous studies based on updated priorities and/or benefits/costs.

Physical Improvements

9. Construct detention facilities within the Clyde River basin to attenuate the peak flow.
10. Construct wetlands and/or detention basins in the upper portions of the watershed.

Recommendations were conceptual and the study did not investigate the costs or benefits associated with the recommendations. Only the real-time automated monitoring network included costs.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

The report does not specifically assign actions to specific state agencies, however, the operations improvements (Recommendations 1 and 2) would logically fall to NYSCC. The Education, Planning, and Physical improvements recommendations would seem to require State leadership with significant participation by local entities. NYSCC actions would require cooperation with other state (and local) agencies including NYSDEC were appropriate (i.e. building code enforcement, regional watershed management, structural watershed changes).

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Aspects of the Operations recommendations have already been undertaken by NYSCC through the addition of river stage and discharge gages and precipitation gages. The NYS Mesonet system has added several meteorological stations in the basin. Furthermore, the NYSCC conducts weekly operations calls with all lake managing partners in the basin to plan and coordinate for potential flooding events.

REVIEWED 12/22/2022 1

REPORT TITLE /DATE/REF	Baker, Operational Audit for the New York State canal System: Oswego River Basin	September 1997	001
REVIEWER	Ryan Troy, PE		

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATAION?

Recommend the development of an accurate model (Recommendations 1 and 2) to better predict and communicate the potential flood risks in the Oswego River Basin. This can involve working with existing agencies (i.e. NOAA Northeast River Forecast Center) and use automated weather data from both the NYSCC and NYS Mesonet. The Flood Warning Operations System endeavored to provide a real time predictive tool using feedback from meteorological, stream and discharge gages but it was never developed to a point where it could provide predictions before the project ran out of funding.

Establish a regional watershed management committee (Recommendation 5) that can establish a basin wide plan to address floodplain ordinances, public education, and potential structural improvements (detention basins, wetland creation, local water/sewer systems, etc.). This recommendation could be expanded to include operations changes by all lake managers and NYSCC to manage flooding on a watershed basis.

BIBLIOGRAPHY	Baker Engineering Inc., "Operational Audit for the New York State Canal System: Oswego River Basin", dated September 1997

REPORT TITLE /DATE/REF	William Jaynes, Summary of Complaints to the NYSCEE	Various	002
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This series of documents/correspondents from Mr. William Jaynes directed at the NYSCC regarding citizen concerns with flooding in the Oswego River Basin. Mr. Jaynes suggests changes to the hierarchy of water uses in the basin to make flood control the highest priority and subsequent changes to the operational rule curves for each lake/reservoir to meet this goal.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

It is recommended that flood control should be the highest priority among all the competing water uses within the Oswego River Basin.

No associated cost.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

It is recommended to have a regional watershed management plan that includes public participation and/or outreach to inform concerned citizens regarding the operations and watershed management policies within the Oswego River Basin.

BIBLIOGRAPHY Jaynes, William. "Summary of Complaints to the NYSCC", from December 1997 to May 2005

B

REPORT TITLE /DATE/REF	USACE, Oswego River Watershed Water Resource Management Study, Final Feasibility Report	July 1984	003
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This report describes the water resources related problems in the Oswego River Watershed imposed on lake management due to balancing the flood damage thresholds against the conservation needs of recreation, water supply, water quality management, fish and wildlife management, hydropower generation, irrigation, and navigation. It describes the flooding as being of two types resulting from either short duration/high intensity storms (typically in headwater subbasins) or recurrent long duration flooding due to snowmelt and wet weather in the spring (typically in lake and downstream reaches). The report then documents structural and non-structural modifications to improve flooding while balancing the environmental impacts, design considerations, economics, and downstream impacts.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The selected plan included:

1. Structural improvements to Canandaigua Lake including the modification of a control structure, channelization of Canandaigua Outlet, and new lake level regulation. ($1.315M). The benefit to cost ratio (B/C) for this project was estimated at 1.7.
2. Structural improvements to Keuka Lake including the removal of a portion of the existing grass/concrete weir, new gated concrete control structure, and new lake level regulation ($140K). The estimated B/C for this project was estimated at 10.8.
3. New targeted rule curves for Owasco, Skaneateles, and Otisco Lakes ($0). There was no B/C for this project since there are no costs in implementing new rule curves.

The report states that real time operations/modeling for the Oswego River Basin would not be justified because the limited outlet capacity to draw down the lakes in anticipation of a rainfall-runoff event would not be significant enough to prevent lake flooding damage.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

NYSDEC is by law the non-Federal sponsor on all Federal flood control projects. They are required by law to provide all the lands, easements, right-of-ways, and relocations. Additionally, a non-Federal sponsor will be required for maintenance of the structural improvements and lake management of the non-structural improvements which would also fall to NYSDEC.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

USFMTF can recommend the investigation into whether targeted rule curves could be studied to determine if different operations on the Finger Lakes would substantially improve flood mitigation.

BIBLIOGRAPHY	USACE Buffalo District, "Oswego River Watershed, Water Resource Management Study, Final Feasibility Report", dated July 1984

REPORT TITLE /DATE/REF	USACE, Flood Damage Reduction Measures, Cross Lake/Seneca River, Preliminary Findings	1995	004
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The USACE report documents the development of a combination hydrologic/hydraulic model used to simulate the lake levels for eight (8) major lakes of the Oswego River Basin (Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, Otisco, and Oneida) and routing of flows along the Clyde River, Seneca River, Barge Canal, Oneida River, and Oswego River to downstream of Phoenix, NY. Stage-frequency curves were developed for each river segment and combined with residential, commercial, agricultural, and recreational flood damage assessments to determine a basis of comparison (BOC). The model was then used to assess the effect that potential flood damage reduction measures in the project study area; specifically in the Seneca River/Barge Canal from the Baldwinsville Dam (Lock 24) upstream to Mud Lock (C/S Lock 1) including Cross Lake while giving consideration of downstream impacts. Four (4) mitigation measures were discussed including:

1. Modification to the Baldwinsville Dam including multiple additional gates or inflatable rubber dam.
2. Dredging of the Seneca River at Jack's Reef to increase channel capacity
3. Modification of the Regulation of Cayuga and Seneca Lakes to prioritize flood control
4. Diversion channels to directly drain the watershed to Lake Ontario

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Modification to the Baldwinsville Dam (Alternative 1) was found to be the most favorable solution for Federal involvement to alleviate flooding along the Cayuga/Baldwinsville Reach of Seneca River. It was found that this alternative would significantly reduce river levels for frequent events, however for major flood events, substantial flooding would persist though with somewhat lesser damage. Other alternatives were dismissed on the basis of limited flood reduction potential, high construction costs, environmental concerns, and recreational impacts. The estimated benefit to cost ratio (B/C) was 1.3.

Estimated costs (at the time of the report) indicate that modification to the Baldwinsville Dam would be $2.1 million for a gated structure or $1.8 million for an inflatable rubber dam.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

The report states that the modifications for the Baldwinsville Dam should be further developed into an actual design, develop additional target rule curves for Cayuga and Seneca Lake, look at a wider Canal Cut, prepare an Environmental Assessment, and address non-structural alternatives. These appear to be Federal (i.e. USACE) directives and not directed at any state agency, however, any federal project would require NYSDEC to be the local sponsor of such a project.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

See above. Such a project would require involvement by NYSCC.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The hydrology/hydraulic models developed as part of this study have been superseded by more modern methods to determine flood hazards. Additionally, these models rely on data from 1940-1979 and may not reflect current conditions of the watershed. An updated model for this section of the watershed should be created to accurately assess the impact of flooding in the basin and assess potential mitigation measures.

BIBLIOGRAPHY	USACE Buffalo District, "Preliminary Findings, Section 205 Feasibility Study, Flood Damage Reduction Measures along the Cayuga/Baldwinsville Reach (Cross Lake/Seneca River) of the New York State Barge Canal", 1995

REPORT TITLE /DATE/REF	USACE, Flood Damage Reduction Measures, Cross Lake/Seneca River, Detailed Project Report and Environmental Assessment (Vols. 1 & 2)	October 1997	005a & 005b
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The USACE report focus was the flood prone area along the Seneca River from the Baldwinsville Dam upstream through Cross Lake to Mud Lock at the outlet of Cayuga Lake. Several alternatives to alleviate flood damages along this portion of the Oswego River were considered including structural improvements to Baldwinsville Dam, dredging of the Seneca River at Jack's Reef, modifying the operation of Cayuga and Seneca Lakes, using Lock 24 as a diversion channel during high flow events, widening the State Ditch Cut (downstream of Cross Lake), direct diversion channels to Lake Ontario, plus a combination of alternatives. It was determined that the implementation of structural improvements to Baldwinsville Dam in combination with targeted rule curves for Cayuga and Seneca Lake (referenced as "Plan 8") produces a favorable cost/benefit ratio necessary for federal involvement.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Modification to the Baldwinsville Dam (Alternative 1c) was found to be the most favorable solution for Federal involvement to alleviate flooding along the Cayuga/Baldwinsville Reach of Seneca River; this would include the construction of a 120-ft long, 8-ft high inflatable rubber bladder dam. The report documents the hydrology/hydraulics used for their analysis and progresses the chosen alternative into detailed design (structural and geotechnical)

Modifying the regulation (Alternative 3d) of Seneca Lake (minimum targeted rule curve in the winter and maximum in the summer) and Cayuga Lake (1-ft above minimum targeted rule curve in the winter and maximum in the summer) was found to reduce flood damage on the lakes and downstream reaches without adverse impacts to recreational interests.

Due to the increase in flood flows and associated surface water elevations (estimated at less than 0.1-ft increase) downstream from Baldwinsville Dam, a mitigation analysis was conducted to try to offset the impacts from the modifications. Several scenarios such as modifying the Upper Fulton Dam, modifying the Phoenix Dam, or creating an off-stream ponding area were investigated. The structural solutions were deemed impractical due to regulatory authority and costs for little improvement to flood reduction in the downstream section.

The costs for the structural modifications to Baldwinsville Dam are included in the following table (assumed 1997 dollars):

REPORT TITLE /DATE/REF	USACE, Flood Damage Reduction Measures, Cross Lake/Seneca River, Detailed Project Report and Environmental Assessment (Vols. 1 & 2)	October 1997	005a & 005b
REVIEWER	Ryan Troy, PE		

Table 11 - Project Costs

Item	Total
Mob & Demob	$32,000
Causeway/Cofferdam	$208,000
Dredging Upstream of Dam	$13,300
Construct Dam Sill	
a) Excavate Rock Sill	$2,900
b) Remove Existing Dam	$85,200
c) Drill and Grout Dowels	$10,600
d) Form & Cast Sill Concrete	$184,800
e) Sill Rock Anchors	$36,000
Construct Control Structure Piers	
a) Remove Section of Dam	$11,400
b) Form & Cast Concrete	$126,000
Construct Bladder Dam	
a) Furnish Bladder Dam	$364,000
b) Install Bladder Dam	$109,200
Total	$1,183,400
Contingency @ 25% =/-	$295,850
Total Construction Cost	$1,479,250
Planning, Engineering & Design	$275,000
Construction Management	$200,000
Lands, Easements & R.O.W.	$50,000
Total Project Costs	$2,004,250
Federal Share @ 65%	**$1,302,763**
Non-Federal Share @ 35%	**$701,488**

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

The report references the New York State Thruway Authority (NYSTA) as the federal non-sponsor for the project, however, operations of Lock E24 and dam now fall under NYSCC. It would require the NYSCC to provide lands, easements and right-of-ways for the construction, maintenance, and operation of the modified Baldwinsville Dam. Further, operation and maintenance of the Baldwinsville Dam would be conducted NYSCC.

Modifications of the dam could potentially result in the loss of approximately 3-acres of northern pike spawning habitat. A suitable wetland mitigation site was found on property (former Mulligan Farm) acquired by NYSDEC specifically for wetland restoration. Hydrologically linking the impoundment to Seneca River would have to be coordinated with NYSDEC.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

It was not clear who the non-federal sponsor would be, but it is likely that today it would be NYSCC under the direction of NYPA.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The feasibility of the structural modifications to the Baldwinsville Dam should be re-evaluated with current data and methodologies to assess flood reduction potential in the Cross Lake/Seneca River portion of the Oswego River Basin. This would also involve reviewing operating agreements with hydropower operators at E24.

BIBLIOGRAPHY	USACE Buffalo District, "Detailed Project Report and Environmental Assessment, Cross Lake/Seneca River Flood Damage Reduction Measures", dated October 1997

REPORT TITLE /DATE/REF	Resilient New York Flood Mitigation Initiative, Chittenango Creek	June 2022	006
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

A flood mitigation and resiliency study for Chittenango Creek was performed as part of the Resilient New York program. Based on FEMA FIS, storm event databases, ice jam databases, historical flood reports, and community involvement three areas along Chittenango Creek were identified as high-risk flood areas:

1. Lake Road/NY-31 downstream to the confluence with Oneida Lake (Town of Sullivan)
2. Village of Chittenango upstream of corporate limits downstream to the Old Erie Canal Crossing (Village of Chittenango)
3. Mill Street downstream to Clark Street (Village of Cazenovia)

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Several specific structural flood mitigation alternatives were proposed that could potentially reduce water surface elevations along high-risk area of Chittenango Creek along with Rough Order of Magnitude (ROM) costs. A summary of the Alternatives (Alt.) and ROM costs are as follows:

- Alt. #1-1*: Sediment Management at the Mouth with Oneida Lake ($320K)
- Alt. #1-2: Remove Central Piers of Lake Road/NY-31 ($7.1M)
- Alt. #1-3: Remove Central Piers and Increase the Bridge Opening of Lake Road/NY-31 ($7.9M)
- Alt. #1-4: Create Flood Benches Upstream/Downstream of Lake Road/NY-31 ($2.0M -$5.6M)
- Alt. #1-5: Create Flood Control Detention Basin Upstream of Bridgeport (Variable)
- Alt. #2-1*: Sediment Removal Analysis in the Vicinity of Old Erie Canal Crossing ($1.5M)
- Alt. #2-2*: Channelization of Chittenango Creek in Vicinity of Old Erie Canal Crossing ($1.5M)
- Alt. #2-3*: Create Flood Benches Upstream of the Old Erie Canal Crossing ($1.5M-$2.5M)
- Alt. #2-4: Increase the Opening of Tuscarora Road Bridge Crossing ($1.4M)
- Alt. #2-5: Create Flood Benches Between Tuscarora Road and Russell Street ($1.1M-$1.6M)
- Alt. #2-6: Create Flood Bench Between Russell and Genesee Streets ($1.6M)
- Alt. #2-7: Streambank Stabilization Between Russell and Genesee Streets (Variable)
- Alt. #2-8: Increase the Opening of Madison Street Bridge Crossing ($1.7M)
- Alt. #2-9: Create Flood Benches Upstream of Madison Street ($1.3M-$2.0M)
- Alt. #2-10: Create Flood Benches Upstream of Valley Acres Neighborhood ($1.3M-$3.2M)
- Alt. #2-11: Create Flood Control/Sediment Detention Basin Upstream of Village of Chittenango (Variable)
- Alt. #3-1: Replace Chittenango Gorge Trail Bridge ($310K)
- Alt. #3-2: Increase Opening of Burr Street Bridge ($1.1M)
- Alt. #3-3: Hydrologic and Hydraulic Analysis of Unnamed Tributary near Burr Street, Village of Cazenovia ($60K)
- Alt. #3-4: Increase the Opening of the Albany Street/US-20 Bridge Crossing ($1.9M)
- Alt. #3-5*: Create Flood Benches Upstream of Mill/Chenango Street ($1.0M-$1.3M)
- Alt. #3-6*: Restore Natural Channel Geomorphology to Chittenango Creek/Cazenovia Lake Diversion ($540K)
- Alt. #3-7*: Restore Natural Channel Geomorphology to Diversion Chittenango Creek/Cazenovia Lake and Install Flood Bench ($1.8M)
- Alt. #3-8: Create Flood Control Detention Basin Upstream of Village of Cazenovia (Variable)

*Indicates alternatives that are impacted by NYSCC involvement either through nearby structure or upstream/downstream water level control

Additionally, non-structural basin-wide mitigation alternatives were suggested including:

- Alt. #4-1: Early Warning Flood Detection System ($120K)
- Alt. #4-2: Riparian Restoration (Variable)
- Alt. #4-3: Debris Maintenance around Infrastructure ($20K)
- Alt. #4-4: Detention Basin and Wetland Management (Variable)
- Alt. #4-5: Flood Buyout Programs (Variable)

REPORT TITLE /DATE/REF	Resilient New York Flood Mitigation Initiative, Chittenango Creek	June 2022	006
REVIEWER	Ryan Troy, PE		

- Alt. #4-6: Floodproofing (Variable)
- Alt. #4-7: Area Preservation/Floodplain Ordinances (Variable)
- Alt. #4-8: Community Flood Awareness and Preparedness Programs/Education (Variable)
- Alt. #4-9: Development/Updating of a Comprehensive Plan (Variable)
- Alt. #4-10: Ice Management ($40K)

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

The Resilient New York Flood Mitigation Initiative was a state led study to recommend a suite of flood and ice-jam mitigation projects in 48 high-priority flood prone watersheds that local municipalities can undertake to make their community more resilient to future floods. These municipalities are encouraged adopt the outlined mitigation measures and may require coordination with various state agencies for technical assistance, approval, and/or funding including the:

- New York State Department of Transportation (NYSDOT)
- New York State Department of Environmental Conservation (NYSDEC)
- New York State Office of Emergency Management (NYSOEM)
- New York State Office of Parks, Recreation & Historic Preservation (NYSOPRHP)
- New York State Division of Homeland Security and Emergency Services (NYSDHSES).

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

The report indicates that the Chittenango Creek Erie Canal Aqueduct act as a catchpoint for debris and sediment accumulation which limits the flow capacity of the stream. At this location, NYSCC should implement a debris maintenance program since the upstream flooding poses a flood risk threat to nearby residential commercial properties, and state/county owned infrastructure. Alternatives #2-1 through #2-3 describe potential flood mitigation alternatives in the vicinity of the structure. Additionally, NYSCC controls water levels on Oneida Lake and downstream of Cazenovia Lake which could impact the effectiveness of Alternatives #1-1, and #3-5 through #3-7 if these are chosen to be implemented.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

NYSCC should further investigate whether their operations and/or infrastructure along Chittenango Creek specifically at the confluence with Oneida Lake (Alt. #1-1), Chittenango Creek Aqueduct (Alt. #2-1 through #2-3), and Cazenovia Lake Outlet (Alt. #3-5 through #3-7) impact local water surface elevations and whether implementation of the recommended alternatives would mitigate flooding in these areas.

BIBLIOGRAPHY	NYSDEC, "Resilient New York Flood Mitigation Initiative, Chittenango Creek, Onondaga & Madison Counties, New York, Final Report", dated June 2022

REPORT TITLE /DATE/REF	Resilient New York Flood Mitigation Initiative, Butternut Creek	September 2022	007
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

A flood mitigation and resiliency study for Butternut Creek was performed as part of the Resilient New York program. The study was based on FEMA FIS, storm event databases, ice jam databases, historical flood reports, and community involvement. The study covered an approximately 2.9 mile stretch of Butternut Creek in the Town of DeWitt, Onondaga County from approximately 2,500 feet downstream of the CSX railroad crossing to approximately 1,500 feet upstream of the Kinne Road crossing.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

Several specific structural flood mitigation alternatives were proposed that could potentially reduce water surface elevations along high-risk area of Butternut Creek along with Rough Order of Magnitude (ROM) costs. A summary of the Alternatives (Alt.) and ROM costs are as follows:

- Alt. #1-1: Modify CSX Railroad Crossing ($48.6M)
- Alt. #1-2: Modify CSX Railroad Crossing and Create an Upstream Flood Bench ($51.4M)
- Alt. #1-3: Modify NYS Route 290 Crossing (N/A – deemed not feasible due to costs/flood reduction potential)
- Alt. #1-4: Remove Abandoned Railroad Crossing ($700K)

Additionally, non-structural basin-wide mitigation alternatives were suggested including:

- Alt. #2-1: Early Warning Flood Detection System ($150K, not including annual operational costs)
- Alt. #2-2: Debris Maintenance around Infrastructure
- Alt. #2-3: Flood Buyout Programs (Variable)
- Alt. #2-4: Floodproofing (Variable)
- Alt. #2-5: Area Preservation/Floodplain Ordinances (Variable)

Rough Order of Magnitude (ROM) costs were developed for most of the alternatives described above. Generally, they do not include land acquisition costs for survey, appraisal, and engineering coordination. Where no ROM costs were developed, the alternative was too conceptual or variable to specifically determine a proper estimate. More detailed cost information can be found in the report. A summary of the ROM costs are as follows:

- Alt. #1-1: $48,600,000
- Alt. #1-2: $51,400,000
- Alt. #1-3: N/A (Alternative was deemed not feasible due to costs and flood reduction potential)
- Alt. #1-4: $700,000
- Alt. #2-1: $150,000 (not including annual operational costs)
- Alt. #2-2: $25,000 (not including annual operational costs)
- Alt. #2-3: Variable
- Alt. #2-4: Variable
- Alt. #2-5: Variable

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

The Resilient New York Flood Mitigation Initiative was a state led study to recommend a suite of flood and ice-jam mitigation projects in 48 high-priority flood prone watersheds that local municipalities can undertake to make their community more resilient to future floods. These municipalities are encouraged adopt the outlined mitigation measures and may require coordination with various state agencies for technical assistance, approval, and/or funding including the:

- New York State Department of Transportation (NYSDOT)
- New York State Department of Environmental Conservation (NYSDEC)
- New York State Office of Emergency Management (NYSOEM)
- New York State Office of Parks, Recreation & Historic Preservation (NYSOPRHP)
- New York State Division of Homeland Security and Emergency Services (NYSDHSES).

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None

REVIEWED 12/22/2022 **1**

REPORT TITLE /DATE/REF	Resilient New York Flood Mitigation Initiative, Butternut Creek	September 2022	007
REVIEWER	Ryan Troy, PE		

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?
None

BIBLIOGRAPHY	NYSDEC, "Resilient New York Flood Mitigation Initiative, Butternut Creek, New York, Final Report", dated September 2022

B

REPORT TITLE /DATE/REF	Settlement Agreement between Partridge and NYS/NYSCC/NYSTA	January 2002	008
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This document is the settlement agreement between Partridge (representative of the "claimants") and the State of New York, New York State Canal Corporation, and New York State Thruway Authority (the "defendants") arising from damage related to flooding in the spring of 1993, 1994, 1995. The terms and conditions of the agreement rely on the completion of the USACE Buffalo District, "Final Detailed Project Report and Environmental Assessment, Cross Lake/Seneca River Flood Damage Reduction Measures", dated January 1999 with favorable recommendations from the NYSDEC.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The agreement requires that the defendants use their best efforts to bring about the following measures:

- Removal of a portion of the existing masonry dam on the Seneca River at Baldwinsville and replacement with an inflatable rubber dam.
- Installation of slide gates at the Phoenix Dam on the Oswego River
- Removal of the remnants of the old Caughdenoy Dam approximately 300 feet upstream from the present tainter-gate dam at Caughdenoy Dam.

These measures were contingent upon:

- Receipt of state and/or federal funding specifically designated for such purpose and in excess of historic appropriations. The NYSTA/NYSCC is not required to finance the measures out of existing revenues nor otherwise modify its capital program to undertake these measures.
- Compliance with all necessary environmental review requirements and receipt of any other necessary approvals and/or permits including but not limited to the USACE, USFWS, NYSDEC, and FERC.

No cost estimates are included in the agreement.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

NYSDEC is recommended to provide an additional review the USACE Project in an attempt to mitigate the negative impacts completion of such flood mitigation projects would have on natural wetland habitats. Following review and incorporation of those of those recommendations into its final report, the benefit-cost ratio must be reviewed by the USACE to determine whether a ratio of unity or higher exists, prior to approval for federal funding for any such project.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

The NYSCC are recommended to undertake certain measures of canal and river maintenance for the purpose of mitigating flood damage along Oneida Lake and on Oneida River upstream of the Caughdenoy Dam.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

USFMTF can confirm if the NYSCC recommended actions have occurred and if not help identify the means whereby they could be completed.

BIBLIOGRAPHY	State of New York Court of Claims, Claim No. 90710, Settlement Agreement, dated January 2002. "Resilient New York Flood Mitigation Initiative, Butternut Creek, New York, Final Report", dated September 2022

B

REPORT TITLE /DATE/REF	Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Cayuga Lake Basin"	October 1973	009
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The report outlines the findings of the Eastern Oswego Basin Regional Water Resources Planning Board and presents a comprehensive plan for water management and development within the area of study. The report recommends:

1. The creation of a permanent "Greater Finger Lakes Basin Commission"
2. A reprioritization of water level control/flow regulation over navigation
3. Improvements to the hydrologic data collection and communication network within the basin to support timely and accurate operational decisions
4. Improvements to the water quality through various measures including wastewater treatment plant upgrades
5. Acceleration of land conservation programs throughout the watershed
6. Reclassification of surface waters to highest existing or foreseeable use under NYS Law
7. Management of all floodplain areas under the FEMA Flood Insurance Program
8. Federal measures for flood damage reduction including:
    a. Improvements to the outlets for Cayuga, Seneca, and Keuka Lakes
    b. Diversion channel from the Clyde or Seneca Rivers to Lake Ontario
    c. Involvement in potential multipurpose upland reservoirs
9. Multipurpose reservoir development at selected locations
10. Regionalization of water supply and wastewater management utility services
11. Lake shoreline management
12. Land acquisition programs for preservation of areas of environmental concern
13. Control of aquatic plants
14. Improvements to the Cayuga Lake fishery program
15. Expansion of public water-oriented recreation opportunities
16. NYS financial/funding participation in multipurpose water resource projects
17. Develop institutional and financial arrangements for irrigation projects
18. Public acquisition of all riparian water rights held in connection with hydroelectric power projects
19. Update pricing or assessment policies for equitable apportionment of costs amount water resource users
20. Design revenue system for private boating interests on the NYS Barge Canal System that is directed at improvement of canal facilities
21. Continued scientific evaluation of cold water resources for electric power generation

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

More specific early action flood damage reduction measures include:

1. Land management for flood damage reduction (no costs provided)
2. Coordinated operation of Finger Lakes-Oswego River system (i.e. lake level regulation and flow reduction objectives) (no costs provided)
3. Montezuma Flood Water Diversion Channel ($25M)
4. Improvements to outlets of Cayuga, Seneca, Keuka Lakes ($3M)
5. First stage of Fall Creek/Six Mile Creek Reservoir System ($8M)
6. Public acquisition of water rights (no costs provided)
7. Lake shore management planning (no costs provided)

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

Further coordination between federal, state, and local agencies would be required to implement portions of the comprehensive plan.

REPORT TITLE /DATE/REF	Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Cayuga Lake Basin"	October 1973	009
REVIEWER	Ryan Troy, PE		

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Reprioritization of flood damage reduction at the expense of navigation along the NYSCC system. Design revenue system for private boating interests on the NYS Barge Canal System that is directed at improvement of canal facilities.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The recommendations from this study that that can be adopted for the USFMTF include:

- Reprioritization of flood damage reduction during the non-navigation season and to a lesser extent during the navigation season. Much progress has already been made by NYSCC in altering operations to provide flood damage reduction.
- Coordinated operations of the Finger Lakes/Oswego River system to better serve flood damage reduction goals.
- Management of floodplain areas under the NFIP.

BIBLIOGRAPHY	Regional Water Resources Planning Board, Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Cayuga Lake Basin", dated October 1973

B

REPORT TITLE /DATE/REF	Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Eastern Oswego Basin"	October 1973	010
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The report outlines the findings of the Eastern Oswego Basin Regional Water Resources Planning Board and presents a comprehensive plan for water management and development within the area of study. The report recommends:

1. The creation of a permanent "Greater Finger Lakes Basin Commission"
2. A reprioritization of water level control/flow regulation over navigation
3. Improvements to the hydrologic data collection and communication network within the basin to support timely and accurate operational decisions
4. Improvements to the water quality through various measures including wastewater treatment plant upgrades
5. Use comprehensive planning activities to encourage preventative measures and protection of existing urban water management concerns
6. Acceleration of land conservation programs throughout the watershed
7. Reclassification of surface waters to highest existing or foreseeable use under NYS Law
8. Management of all floodplain areas under the FEMA Flood Insurance Program
9. Federal measures for flood damage reduction including:

a. Improvement to the flood carrying capacity of the Oneida River
b. Improvements to the outlets for Oswasco, Skaneateles, and Otisco Lakes
c. Diversion channel from the Clyde or Seneca Rivers to Lake Ontario
d. Involvement in potential multipurpose upland reservoirs

10. Multipurpose reservoir development at selected locations
11. Regionalization of water supply and wastewater management utility services
12. Lake shoreline management
13. Land acquisition programs for preservation of areas of environmental concern
14. Expansion of public water-oriented recreation opportunities
15. Small watershed protection and flood prevention projects under Public Law (PL) 566 (administrated by the Soil Conservation Service)
16. Public acquisition of all riparian water rights held in connection with hydroelectric power projects
17. NYS financial/funding participation in multipurpose water resource projects
18. Develop institutional and financial arrangements for irrigation projects
19. Update pricing or assessment policies for equitable apportionment of costs amount water resource users

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

More specific early action flood damage reduction measures include:

1. Land management for flood damage reduction (no costs provided)
2. Coordinated operation of Finger Lakes-Oswego River system (i.e. lake level regulation and flow reduction objectives) (no costs provided)
3. Montezuma Flood Water Diversion Channel ($25M)
4. Improvements to outlets of Owasco, Skaneateles, Otisco, and Oneida Lakes ($4M)
5. First stage of Fish Creek Watershed Management Plan (no costs provided)
6. Multipurpose reservoir project planning for Butternut Creek and Dutch Hollow Reservoir sites (no costs provided)
7. Lake shore management planning (no costs provided)
8. Watershed planning and development under PL 566 ($2.5M)

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

Further coordination between federal, state, and local agencies would be required to implement portions of the comprehensive plan.

REPORT TITLE /DATE/REF	Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Eastern Oswego Basin"	October 1973	010
REVIEWER	Ryan Troy, PE		

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Reprioritization of flood damage reduction at the expense of navigation along the NYSCC system.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The recommendations from this study that that can be adopted for the USFMTF include:

- Reprioritization of flood damage reduction during the non-navigation season and to a lesser extent during the navigation season. Much progress has already been made by NYSCC in altering operations to provide flood damage reduction.
- Coordinated operations of the Finger Lakes/Oswego River system to better serve flood damage reduction goals.
- Management of floodplain areas under the NFIP.

BIBLIOGRAPHY	Regional Water Resources Planning Board, Interboard Plan for the Greater Finger Lakes – Oswego River Basin, "Summary Report on the Recommended Plan of the Eastern Oswego Basin", dated October 1973

REPORT TITLE /DATE/REF	NYSDEC, Finger Lakes Region Water Resources Management Strategy	August 1987	011
REVIEWER	Ryan Troy, PE		

Abstract

This report does not document a flooding problem. It contains a description of the region's water resources, review of economic history, and population trends for analyzing present and future water demands. It also analyzes the capacity and condition of existing sources and facilities in the municipal water supply system.

There are no flood mitigation measures recommended in the report, and no associated costs.

There are no investigations or actions recommended by state agencies

There are no actions specifically recommended to be undertaken by the NYSCC.

Measures to protect the water resource quality, like watershed protection regulations, could be adopted as a flood mitigation measure.

BIBLIOGRAPHY	NYSDEC, "Finger Lakes Sub-State Region, Water Resources Management Strategy Report", prepared by West and Laresen Engineers, dated August 1987

REPORT TITLE /DATE/REF	USACE, Report of Flood, Tropical Storm Agnes, June 1972, Oswego River Basin	August 1973	012
REVIEWER	Ryan Troy, PE		

Abstract

This report documents the flooding and damage resulting from the Tropical Storm Agnes (June 1972) which was the flood of record in many portions of the Oswego River Basin. It briefly mentions operations and efforts to avert flooding on several of the lakes during the storm event without impacting downstream residents/property. The report states that most of the damage from riverine flooding was due to the flood occurring after the planting season causing substantial agricultural related losses. Additionally, residential losses were within the limits of the flowage easements owned by NYS which people have bought and elected to build property in.

There are no flood mitigation measures recommended in the report, and no associated costs.

There are no investigations or actions recommended by state agencies.

There are no actions specifically recommended to be undertaken by the NYSCC.

Watershed operations (i.e. managing lake levels and downstream flows) can be studied prior to a storm event to improve real-time decision making. Permits and land use along the river/lake fronts can be reviewed to prevent further encroachment on flood prone areas. FEMA Flood Insurance Program policies should be recommended to be followed in communities within the mapped floodplains.

BIBLIOGRAPHY	USACE, "Report of Flood, Tropical Storm Agnes June 1972, Oswego River Basin", dated August 1973

B

REPORT TITLE /DATE/REF	USGS, Managing the Water Resources of the Oswego River Basin in Central New York	February 2002	013
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The Oswego River Basin fact sheet discusses the physiography of the watershed and flooding/water quality considerations. It suggests that the overall water resources within the basin can be improved by:

1. Understand the concept of watershed process (i.e. all action affect the quality and quantity of the water resource)
2. Involve the public in planning, management, and goal setting.
3. Ensure that local actions conform to basin-wide water management objectives
4. Develop "real world" actionable goals
5. Realize the potential and limitation of watershed management (i.e. insufficient scientific understanding)

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

No specific flood mitigation measures were recommended but an overall framework for water resources management within the basin. This included:

1. Public education about hydrology and the watershed
2. Data gathering, sharing, and synthesis
3. Coordination of watershed-management goals and activities
4. Flood mitigation through land-use planning
5. Trust among stakeholders
6. Emergency response to flooding through monitoring, media involvement, coordination among agencies, and sharing of responsibilities
7. Natural resource and water quality protection by assessing the current status of the resources, setting priorities, and securing financial support to protect them

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Some of the framework described for water resources management within the basin can be adopted or implemented in future work within the watershed.

The schematic display of the lakes and major tributaries has been adopted and modified for the USFMTF graphics because provides a big-picture view of the system and promotes an understanding of how the watershed behaves.

BIBLIOGRAPHY	Kappel, W. & Landre, B., USGS, "Managing the Water Resources of the Oswego River Basin in Central New York", dated February 2002

REPORT TITLE /DATE/REF	FEMA, Discovery Report, Seneca River Watershed, HUC 04140201	June 2015	014
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The FEMA Risk Mapping, Assessment, and Planning (RiskMAP) report gathers information about local flood risk/hazards, reviews mitigation plans (current and future), collects information from local communities about flooding history, and uses the information to determine which areas require mapping/assessment/planning assistance. At the end of the discovery process, there were 39 areas identified as deserving a detailed flood study. Two notable areas include Cayuga Lake (identified as priority No. 2) and Seneca River (identified as priority No. 37).

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

No specific mitigation measures are recommended. This document was used to prioritize areas for new or revised floodplain mapping. These are listed in a letter to FEMA from NYSDEC contained in Appendix U of the report.

No associated cost.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

NYSDEC was to summarize its Seneca Basin flood mapping recommendations in a letter to FEMA. This was completed and contained in Appendix U of the report.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

Adaption of the Community Rating System (CRS) throughout the basin. The CRS is a voluntary incentive program that encourages community floodplain management activities that exceed the minimum NFIP requirements which results in flood insurance premium rate discounts.

Follow-up on the Seneca Basin flood mapping recommendations (Appendix U) to ensure that NYSCC is an active participant on FEMAs project team since the main stem of the Seneca River Oneida River, Oswego River, Oneida Lake and Cayuga Lake are controlled by NYSCC during navigation season and non-navigation season.

A longer term recommendation could be to have the NYSCC/NYPA become a FEMA Cooperating Technical Partner (CTP) in portions of the Oswego Basin where they control water levels and gate operations.

BIBLIOGRAPHY	FEMA, "Discovery Report, Seneca River Watershed, HUC 04140201" Report Number 01, dated June 2015

REPORT TITLE /DATE/REF	USACE, Owasco Lake Outlet (Auburn, NY), Reservoir Regulation Manual	June 1995	015
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

This operations manual contains procedures for the regulation of the Owasco Lake Outlet. It provides targeted lake levels, flood control operations, and an emergency action plan. The main purpose of the dam is to provide flood protection both of the Owasco Lake upstream and along Owasco Outlet downstream. There is a hydropower project (FERC No. 4372, State No. 064-4198) immediately downstream of the Owasco Lake Outlet Dam but no considerations are provided for hydropower needs in the regulation manual.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

The flood mitigation measures discussed in the Operation Manual are using the gates at the dam to mitigate upstream impacts. It mentions that the downstream level of protection is for a 100-year event due to a combination of channelizing the Owasco Outlet upstream of the dam and operation of the control structure. The downstream channel capacity is estimated at 2,000-cfs.

No associated cost.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

None.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

The operation plan for Owasco Lake only considers upstream and near downstream flooding. There are no considerations made for far downstream impacts such as on the Seneca River. USFMTF could recommend that operation procedures for Owasco (and other Finger Lakes) be re-evaluated with considerations given for basin wide flooding concerns, thereby allowing for more flood storage in Owasco Lake.

BIBLIOGRAPHY	USACE, "Owasco Lake Outlet (Auburn, NY), Reservoir Regulation Manual, Oswego River Basin", dated June 1995

B

REPORT TITLE /DATE/REF	USGS, Water-Level Control in the NYS Canal System within the Oswego River Basin	1993	016
REVIEWER	Ryan Troy, PE		

WHAT FLOODING PROBLEMS DOES THE REPORT IDENTIFY?

The report has two main parts. The first part describes the location and extent of the canal system within the Oswego River Basin, the history and design of the system, and the factors that affect water levels and canal operations. The second part describes the major and minor control points, presents guidelines to operation of the five major control points, and presents procedures for water level regulation at each of the five major control points.

Flooding problems identified in the report are either due to floods resulting from snowmelt and rain in the early spring season and storm events that happen any time of the year with considerable effort in lake level regulation expanded towards mitigating of flood damage.

WHAT IF ANY FLOODING MITIGATION MEASURES ARE RECOMMENDED & WHAT IS THE ASSOCIATED COST?

No flood mitigation measures outside of the outlined procedures for each of the control points. However, due to the complexity of the canal system several concerns about regulation which include:

- Potential data errors (inaccurate or unavailable information)
- Poor communication between operators and decision makers
- Unpredicted extreme weather conditions
- Timing of large outflows from lakes
- Channel obstructions (debris/ice jams)
- Floodplain encroachment

No associated cost.

WHAT FURTHER INVESTIGATIONS & ACTIONS ARE RECOMMENDED BY WHICH STATE AGENCIES?

None.

WHAT ACTIONS ARE SPECIFICALLY RECOMMENDED TO BE UNDERTAKEN BY THE NYSCC?

Operating the control structures according to the established water-use priorities. The primary responsibility of the NYSCC in the operation of these control structures is "to provide adequate water to maintain navigation requirements during the navigation season" which optimizes recreational use and flood control. Flood control or storage for future navigation purposes is the main priority in the Canal regulated lakes (Oneida and Cayuga Lakes) during the non-navigation season and lake levels should be drawn down to provide for additional storage.

WHAT ACTIONS FROM THIS STUDY CAN BE ADOPTED AS AN USFMTF RECOMMENDATION?

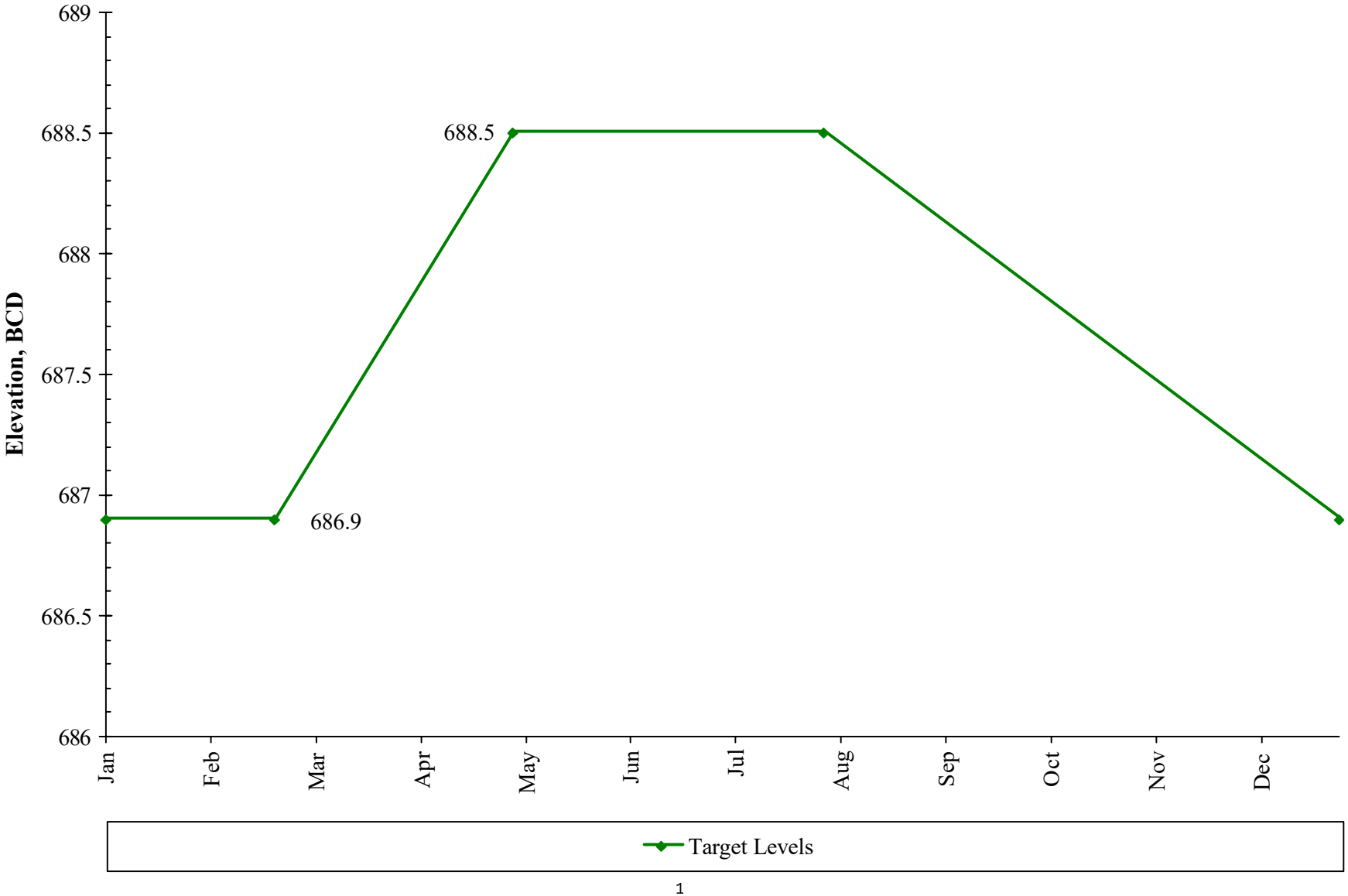
Due to the complexity of the system, a recommendation would be to continue to improve and implement advanced monitoring (weather, flows, etc.) to better inform outlet operations and each of the major control points controlled by NYSCC.

BIBLIOGRAPHY	USGS, Technical Manual 900-0-02, "Water Level Control in the New York State Canal System within the Oswego River Basin – Description of Control Points and Guidelines to their Operations", New York State Thruway Authority Canal Corporation, dated 1993

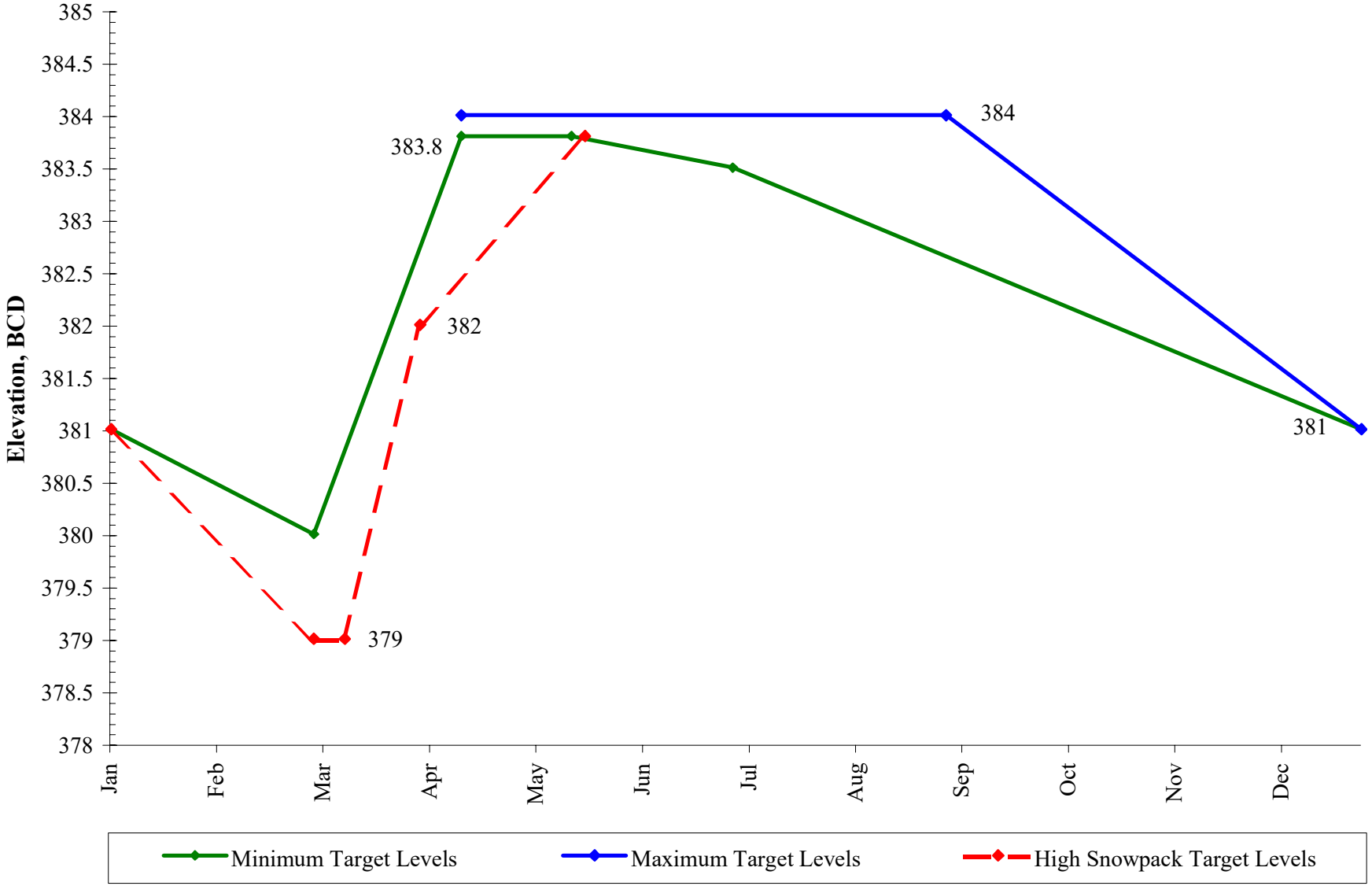
APPENDIX C

Rule Curves for Finger Lakes and Oneida Lake

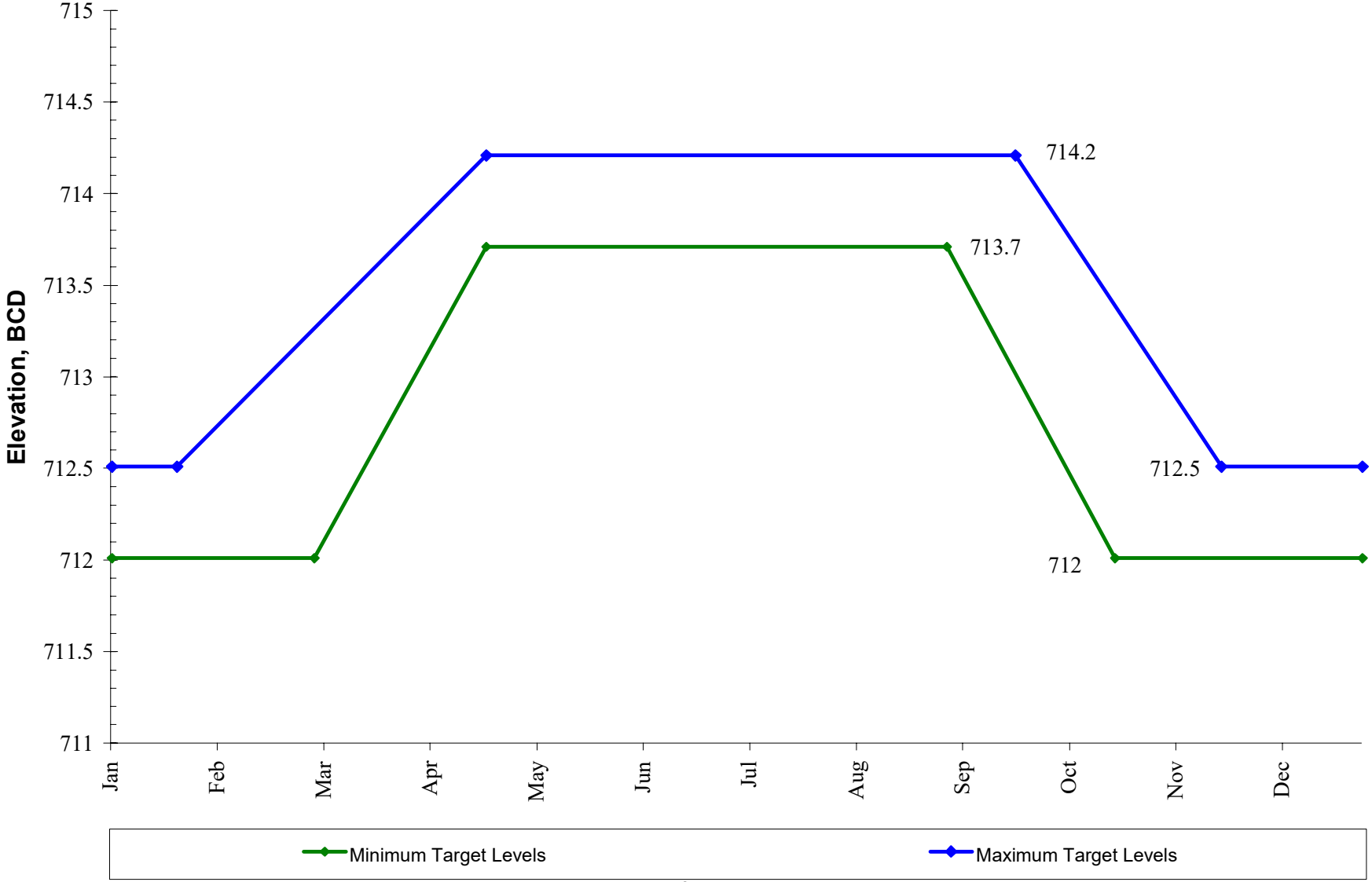
Canandaigua Lake Rule Curve



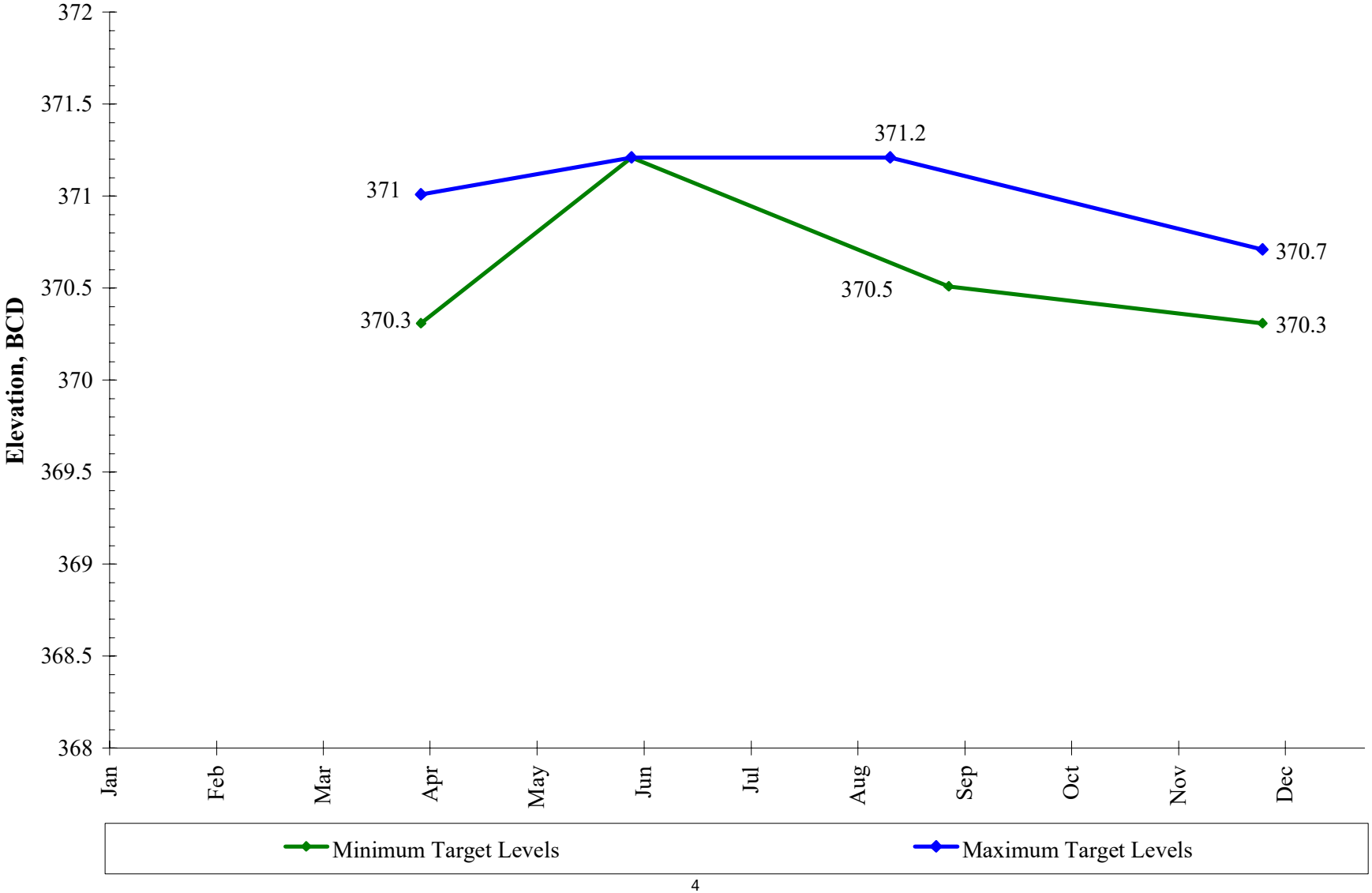
Cayuga Lake Rule Curves



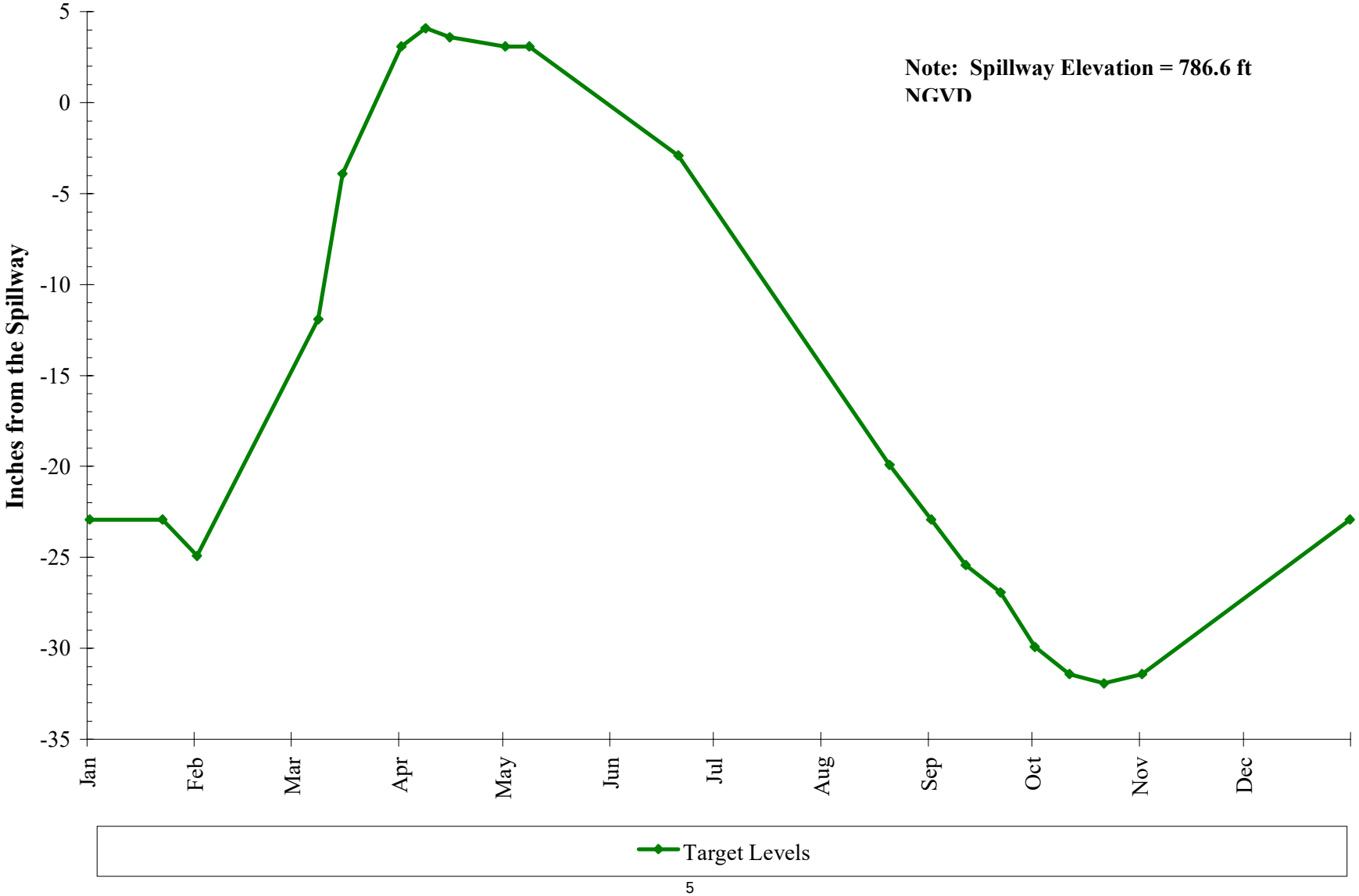
Keuka Lake Rule Curves



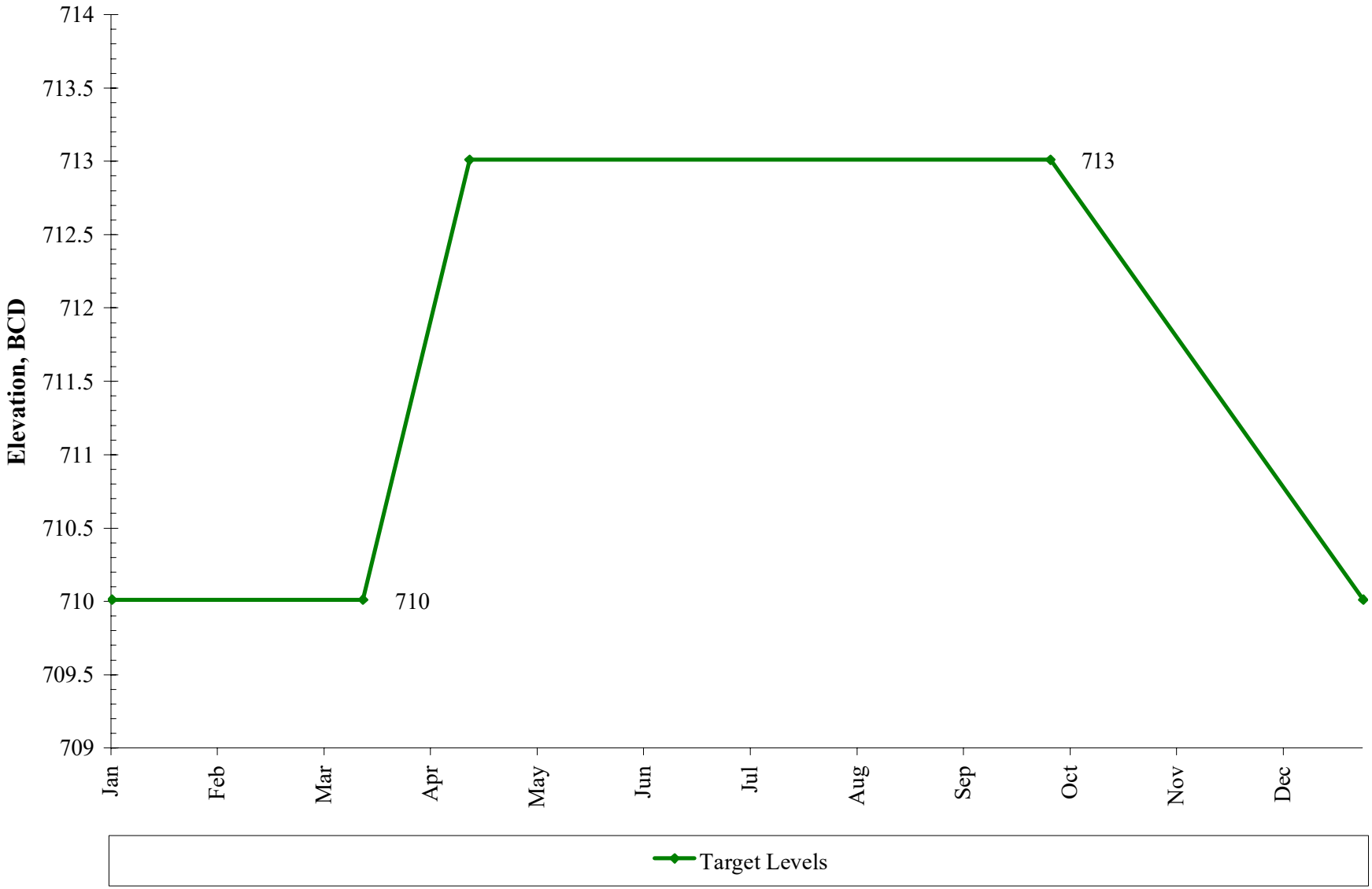
Oneida Lake Rule Curves



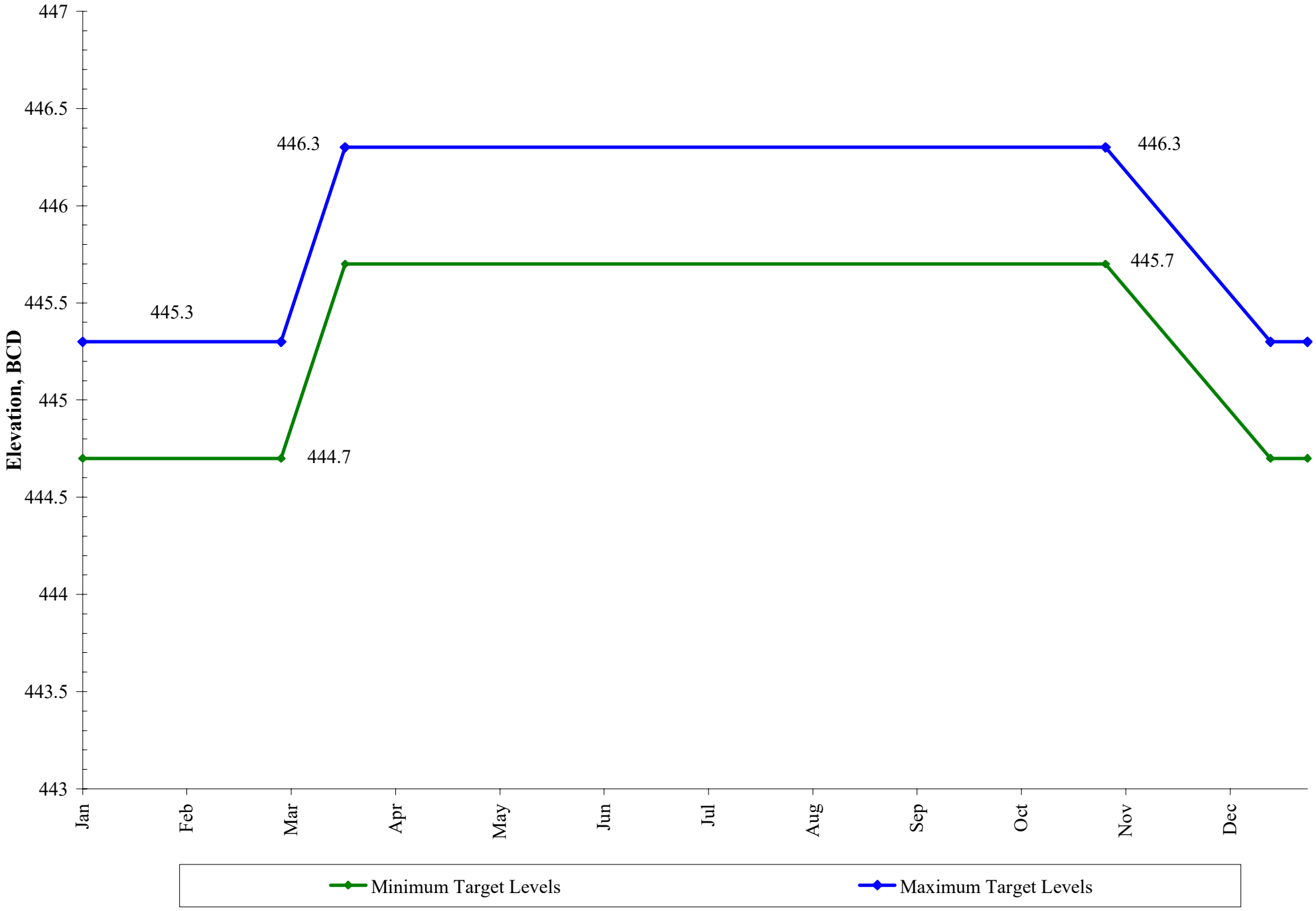
Otisco Lake Rule Curve

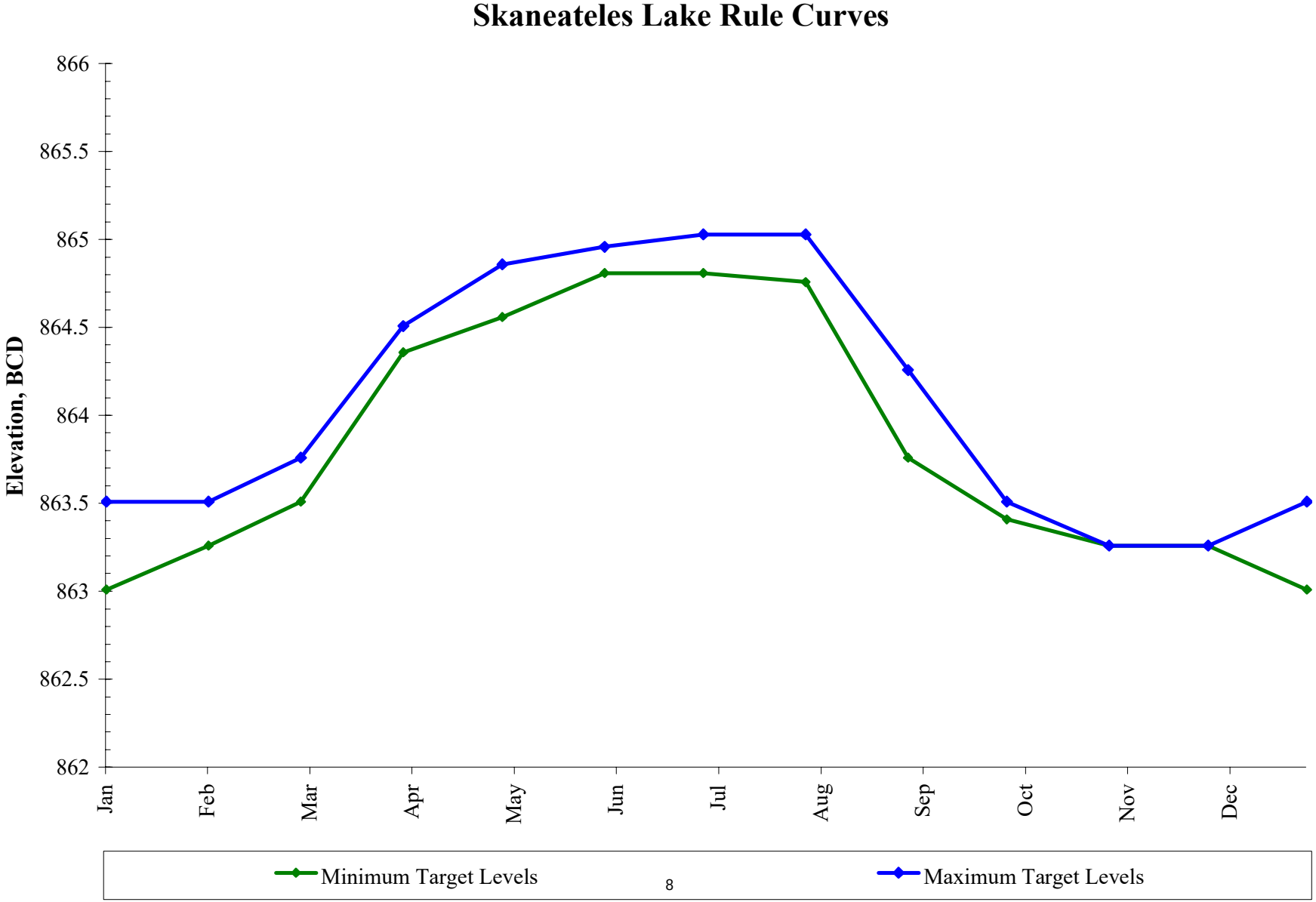


Owasco Lake Rule Curve



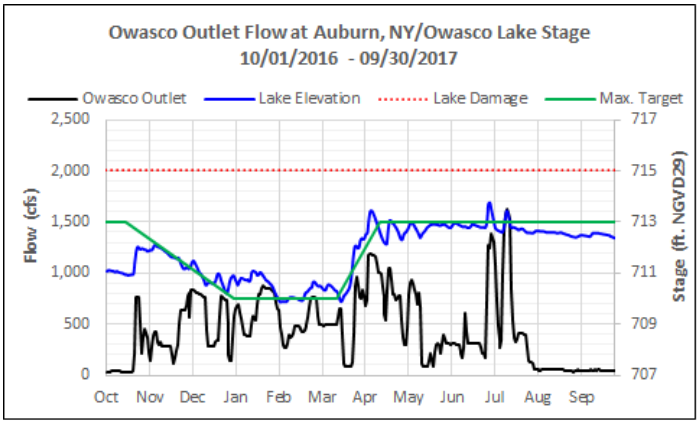
Seneca Lake Rule Curves

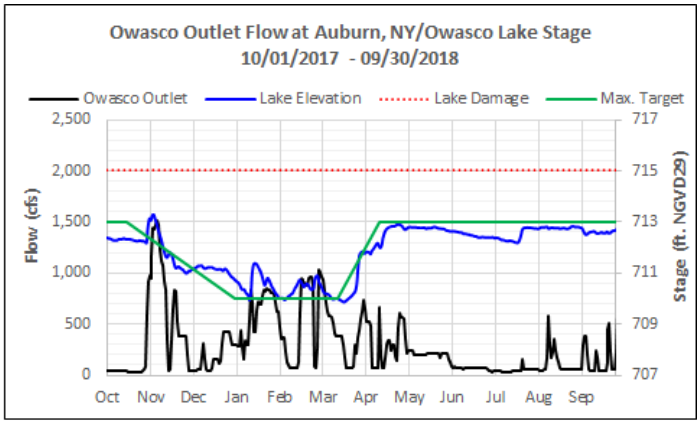


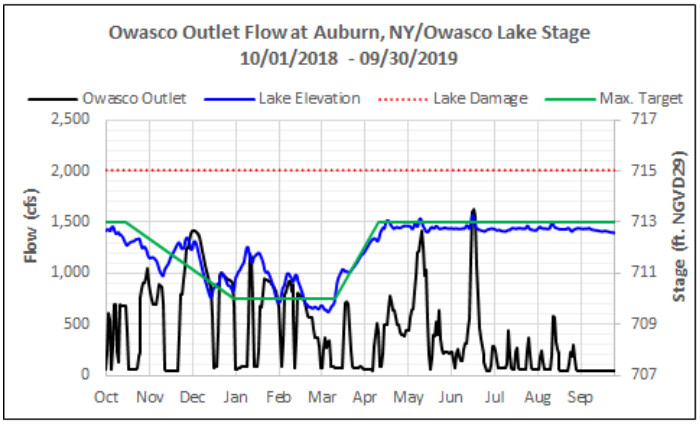

Skaneateles Lake Rule Curves
Elevation, BCD
866
865.5
865
864.5
864
863.5
863
862.5
862
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Minimum Target Levels
Maximum Target Levels

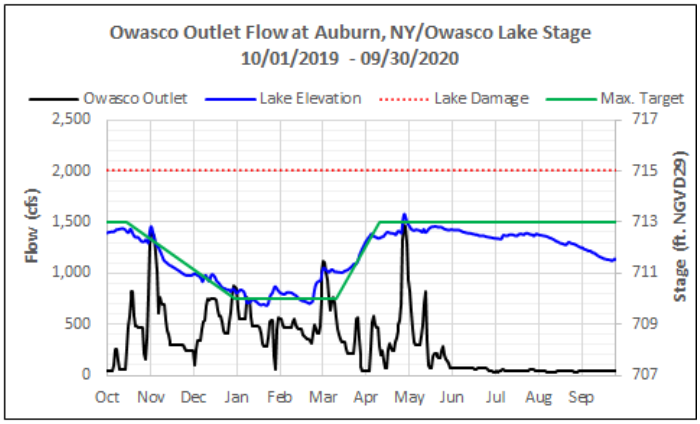
APPENDIX D

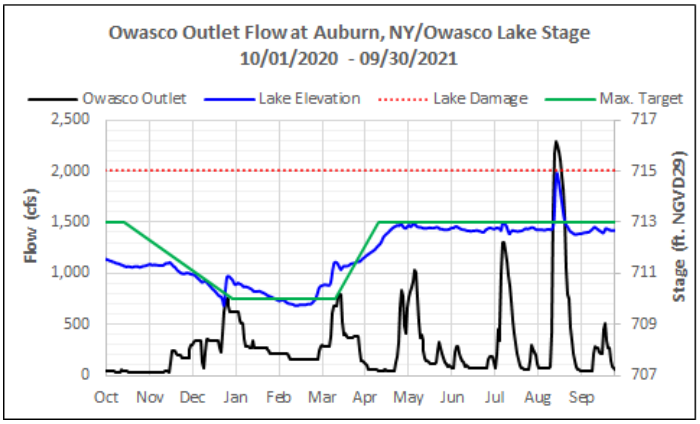
Hydrographs for Oswego River Basin

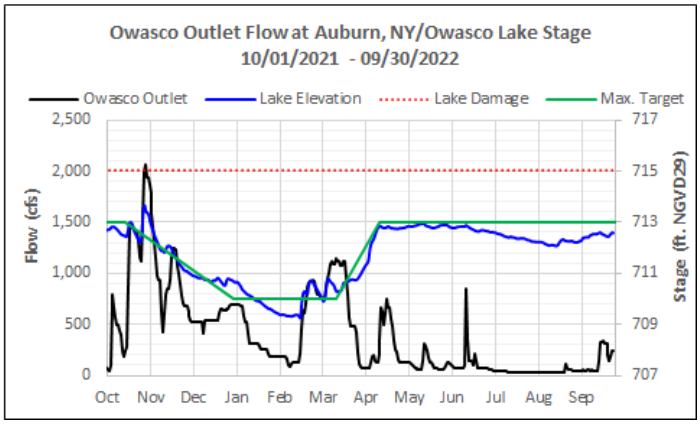






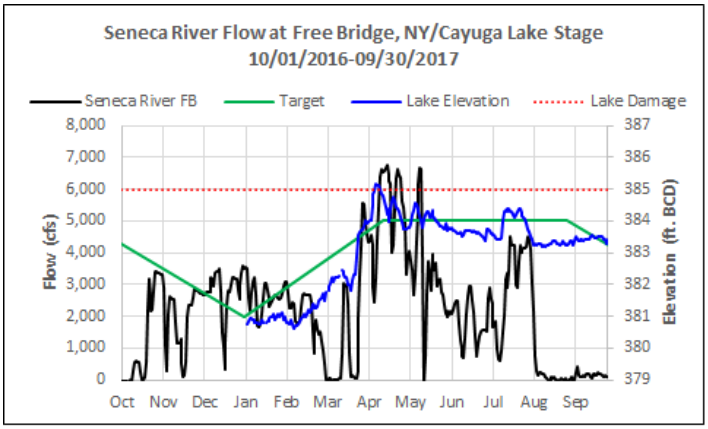


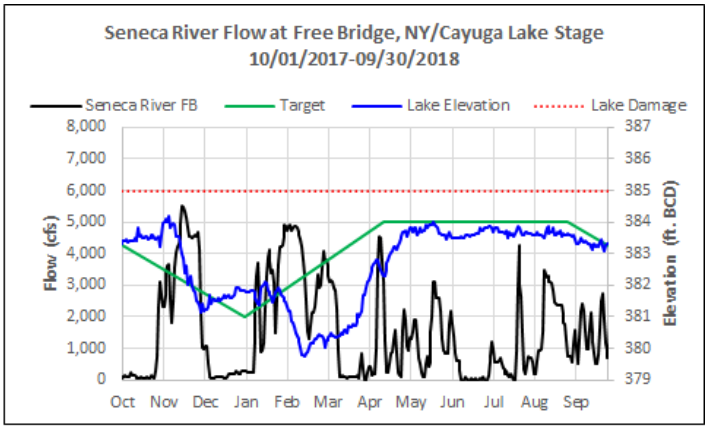


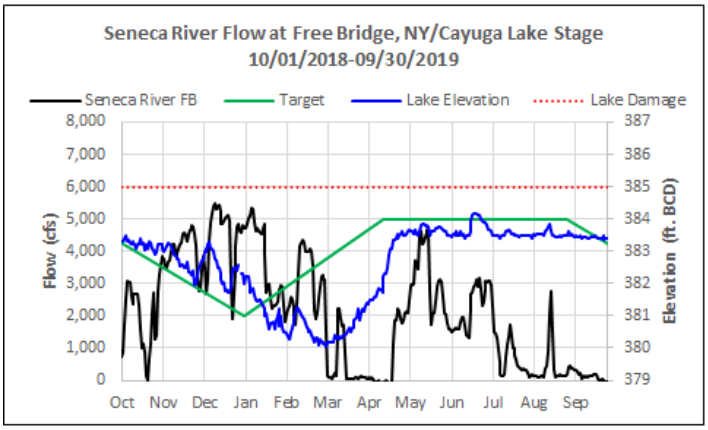


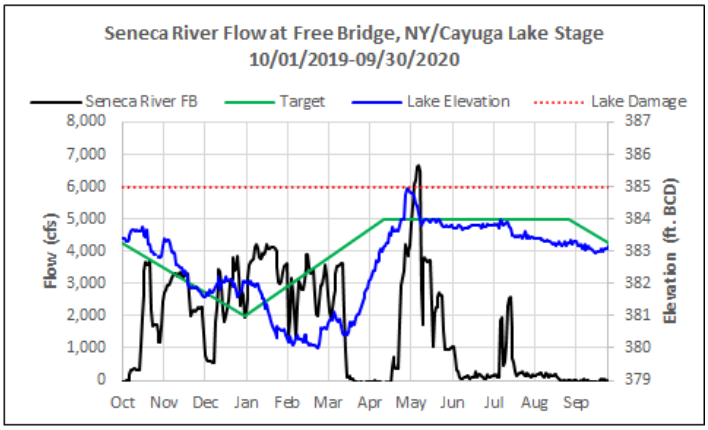
Notes:

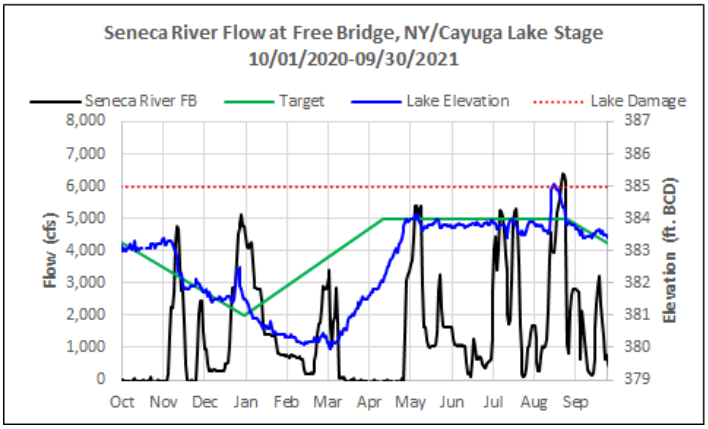
1. Vertical datum is National Geodetic Vertical Datum of 1929 (NGVD29).
2. "Lake Damage" is the Owasco Lake stage (El. 715 ft. NGVD29) where damage to existing structures along the lake's shoreline is initiated.
3. "Owasco Outlet" is the flow (cfs) exiting Owasco Lake as measured at USGS Gage No. 04235440 Owasco Outlet at Genesee Street, Auburn, NY.
4. "Max. Target" is the rule curve that the lake regulator, City of Auburn, follows to make adjustments to the control structure at the lake's outlet.

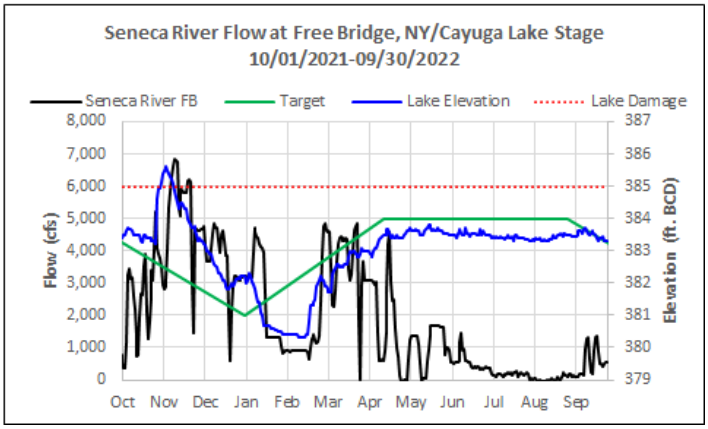






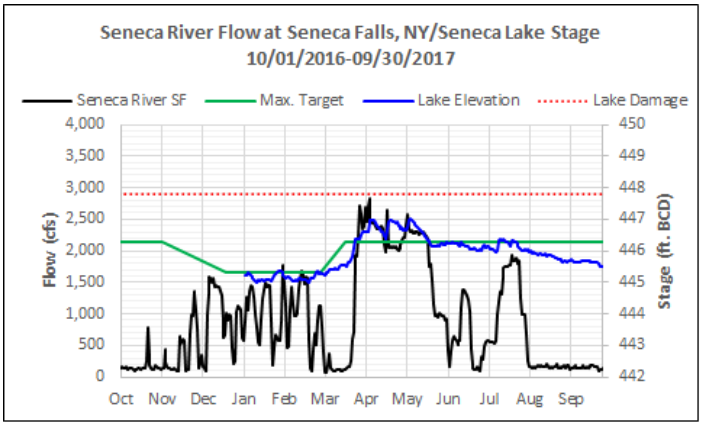


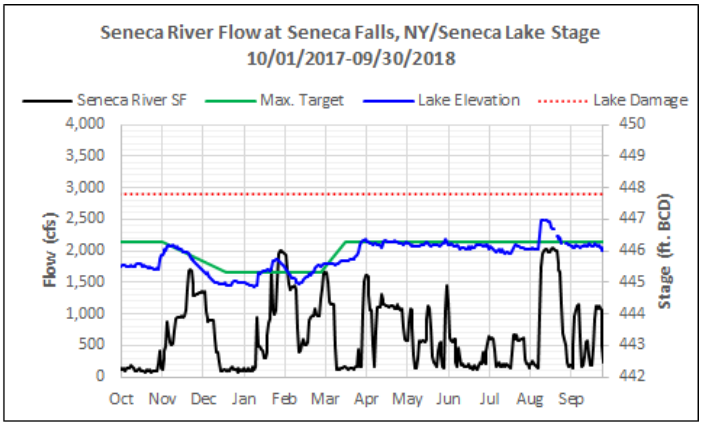


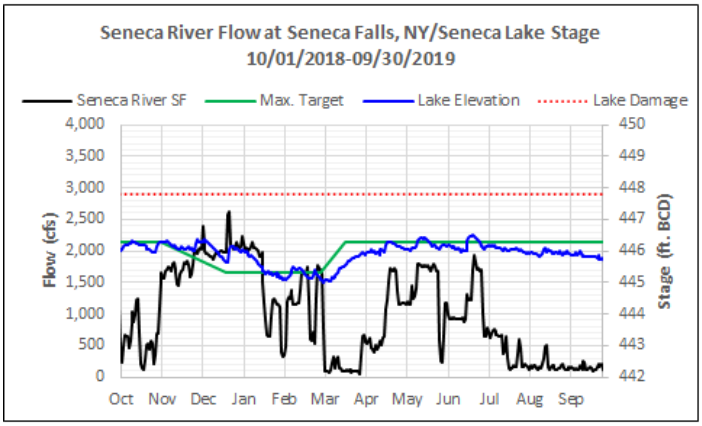


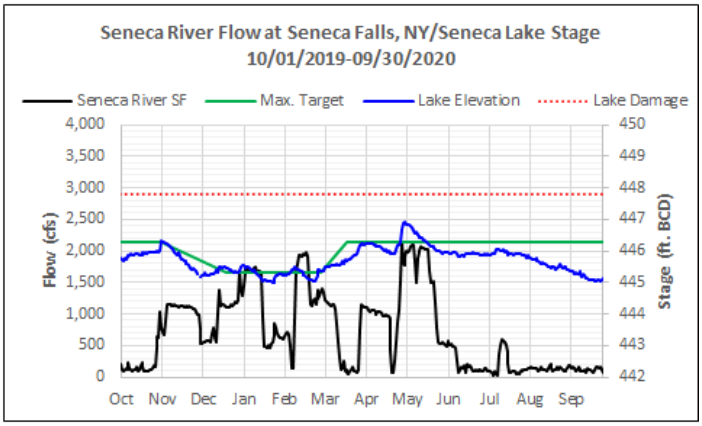
Notes:

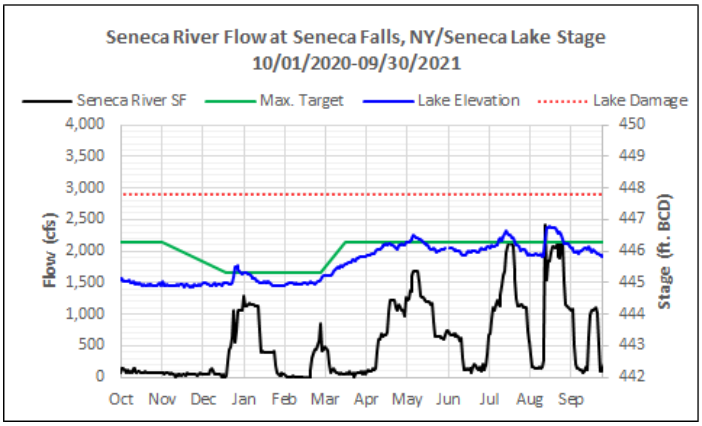
1. Vertical datum is Barge Canal Datum (BCD).
2. "Lake Damage" is the Cayuga Lake stage (El. 385 ft. BCD) where damage to existing structures along the lake's shoreline is initiated.
3. "Seneca River FB" is the flow (cfs) exiting Cayuga Lake as measured at USGS Gage No. 0423406130 Seneca River at Free Bridge Corners, NY.
4. "Target" is the rule curve that the lake regulator, NYSCC, follows to make adjustments to the control structure at the lake's outlet. From January 1 – April 15 "Target" represents the minimum level while April 15 – December 31 represents the maximum level. There is no maximum target level for Cayuga Lake during the winter period.

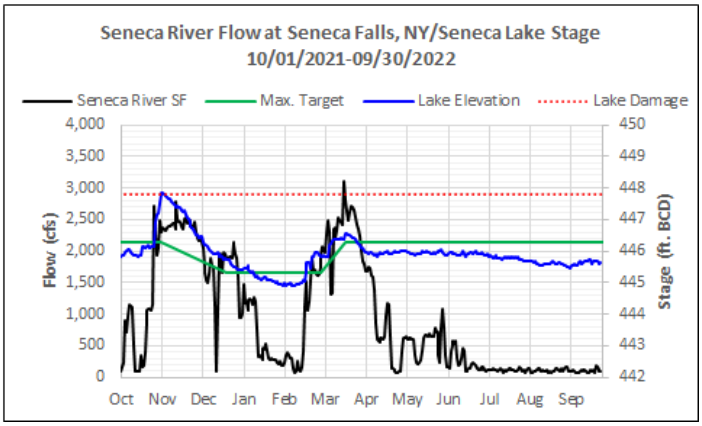






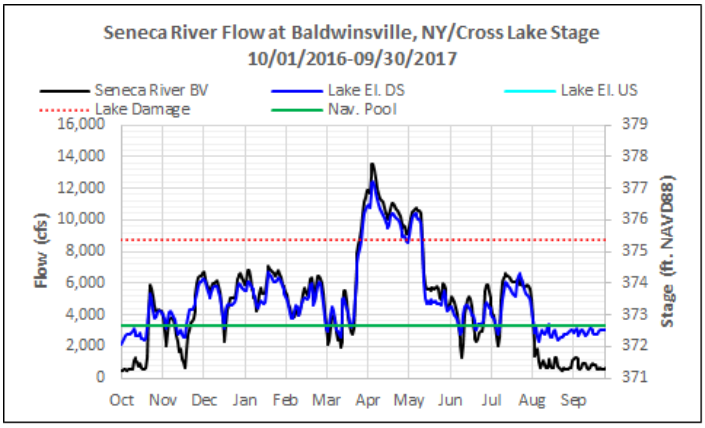


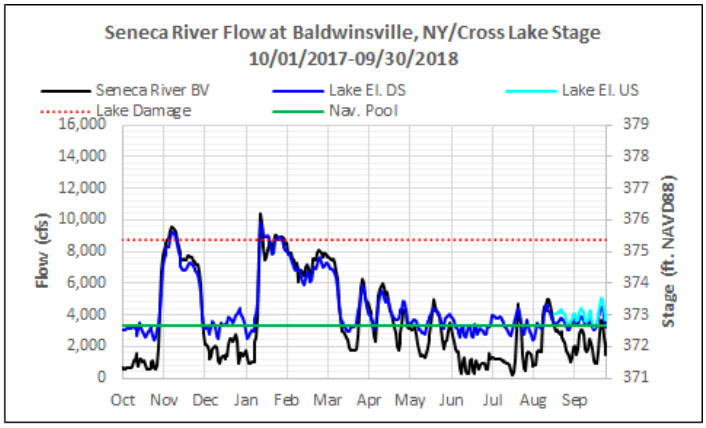


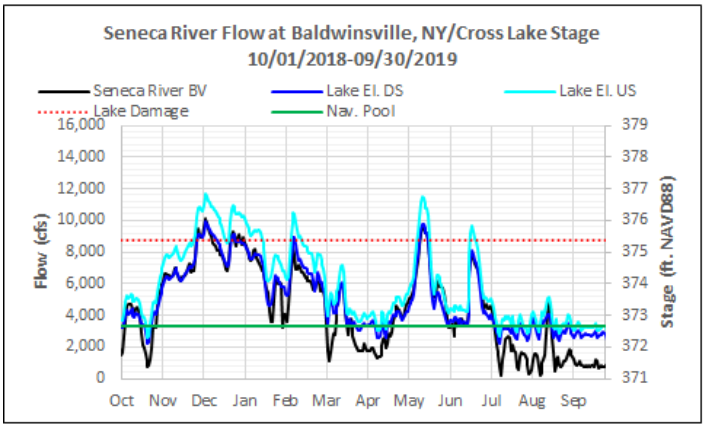


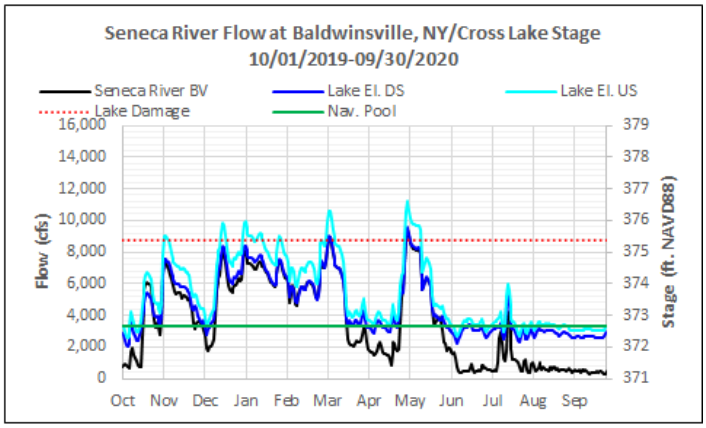
Notes:

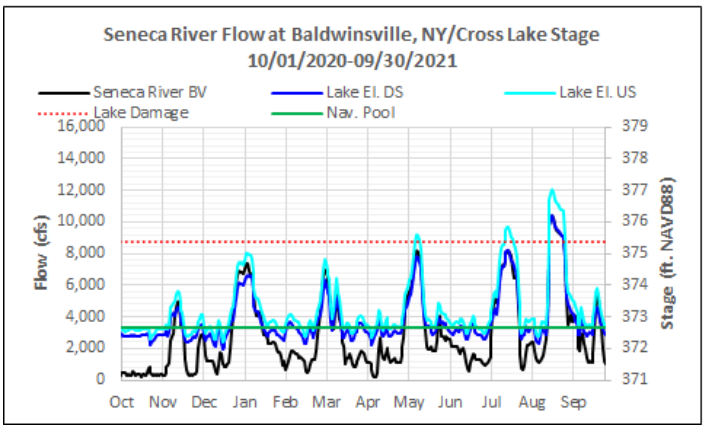
1. Vertical datum is Barge Canal Datum (BCD).
2. “Lake Damage” is the Seneca Lake stage (El. 447.8 ft. BCD) where damage to existing structures along the lake’s shoreline is initiated.
3. “Seneca River SF” is the flow (cfs) exiting Seneca Lake as measured at USGS Gage No. 04232730 Seneca River near Seneca Falls, NY.
4. “Max. Target” is the rule curve that the lake regulator, Gravity Renewables, follows to make adjustments to the control structure at the lake’s outlet.

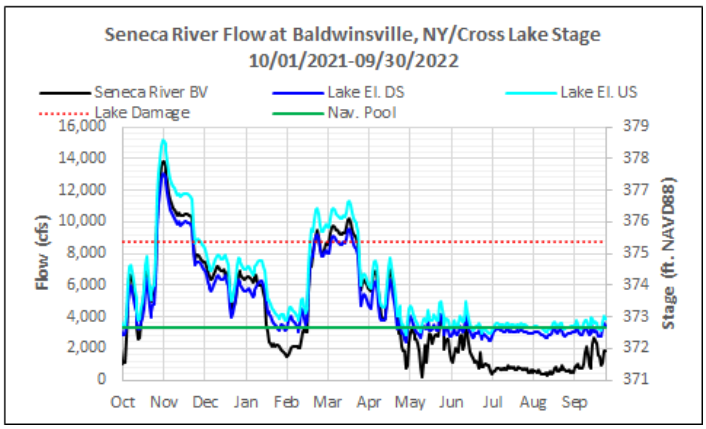






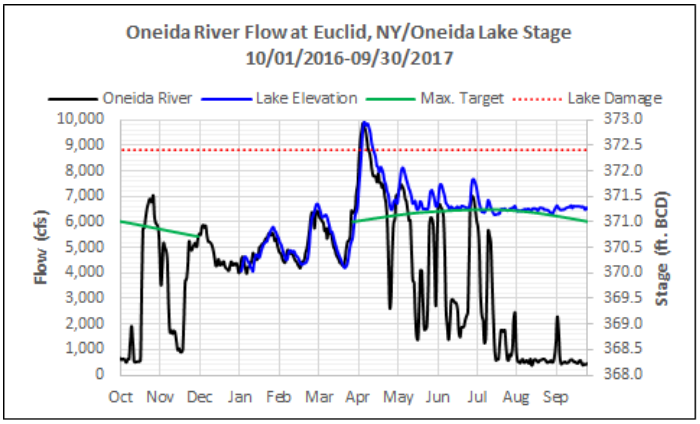


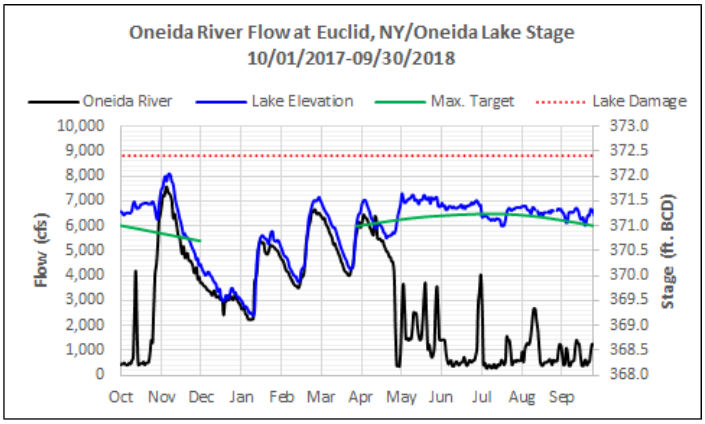


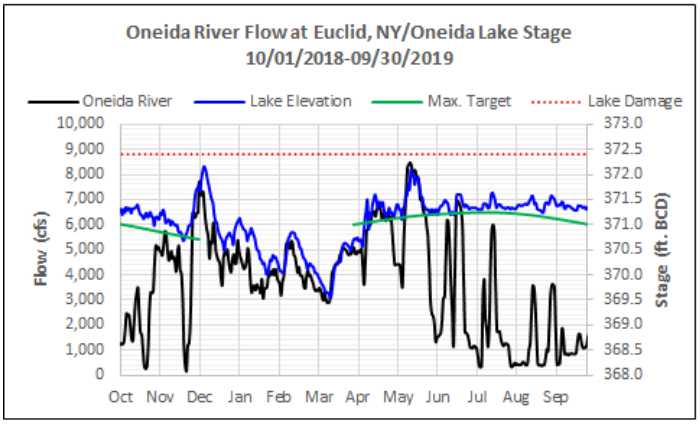


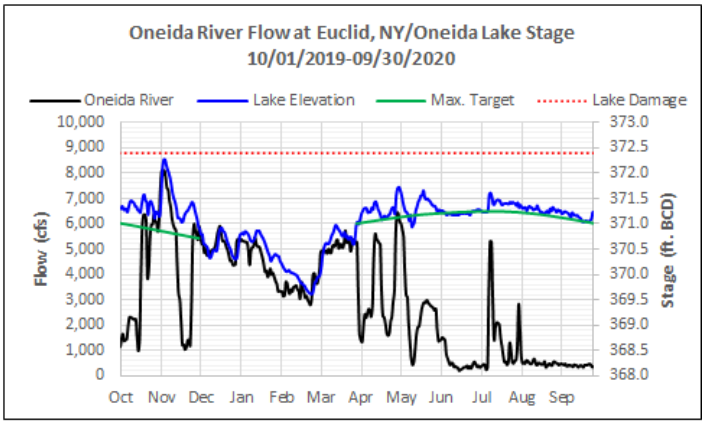
Notes:

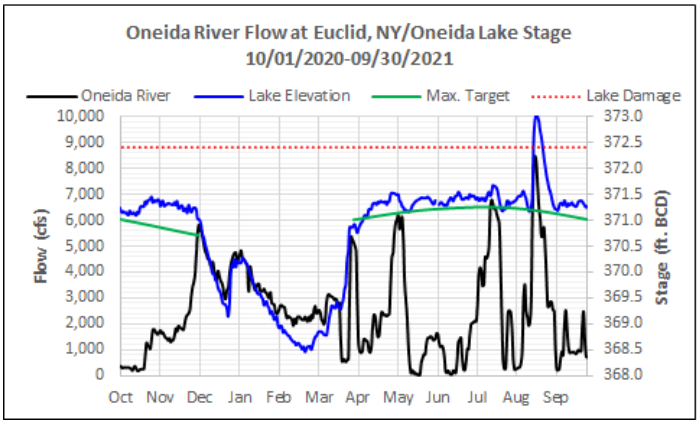
1. Vertical datum is North American Vertical Datum 1988 (NAVD88).
2. "Lake Damage" is the Cross Lake stage (El. 375.4 NAVD88) where damage to existing structures along the lake's shoreline is initiated.
3. "Seneca River BV" is the flow (cfs) exiting Seneca Lake as measured at USGS Gage No. 04237496 Seneca River near Baldwinsville, NY.
4. "Lake El. DS" is the Cross Lake water elevation at the downstream (outlet or east) end of the lake as measured at USGS Gage No. 04237411 Seneca River (Mouth of State Ditch Cut), near Jordan, NY.
5. "Lake El. US" is the Cross Lake water elevation at the upstream (inlet or west) end of the lake as measured at USGS Gage No. 04237020 Seneca River (Barge Canal at Cross Lake), near Jordan, NY.
6. "Nav. Pool" is the target elevation (El. 372.65 ft. NAVD88 or El. 374 ft BCD) that NYSCC attempts to hold in the pool between Lock E-25 and Lock E-24 during navigation season.

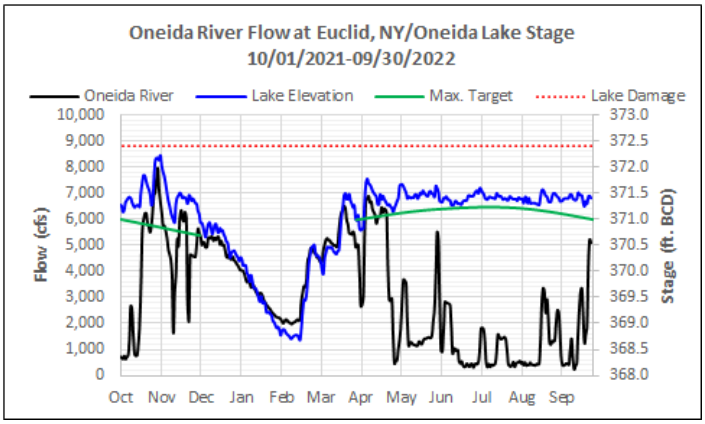






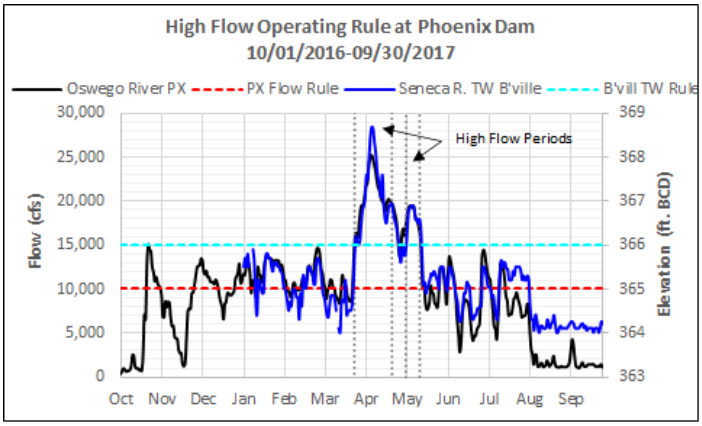


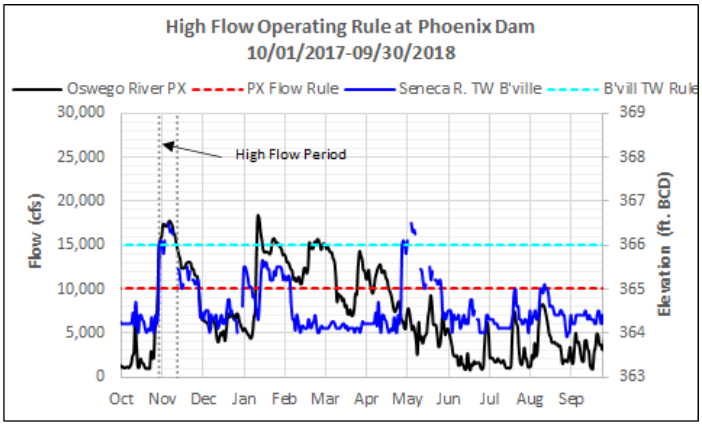


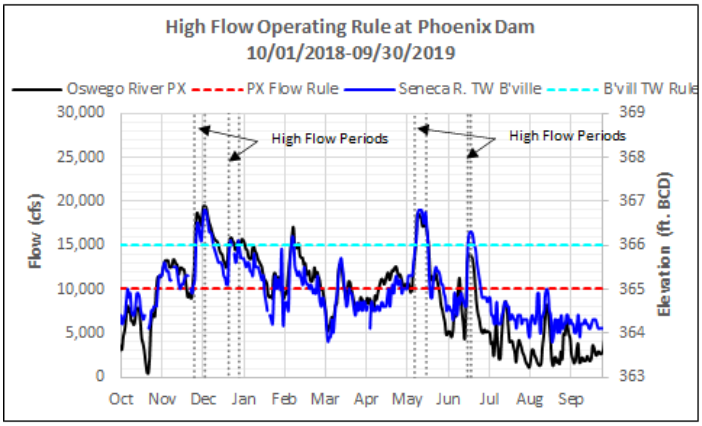


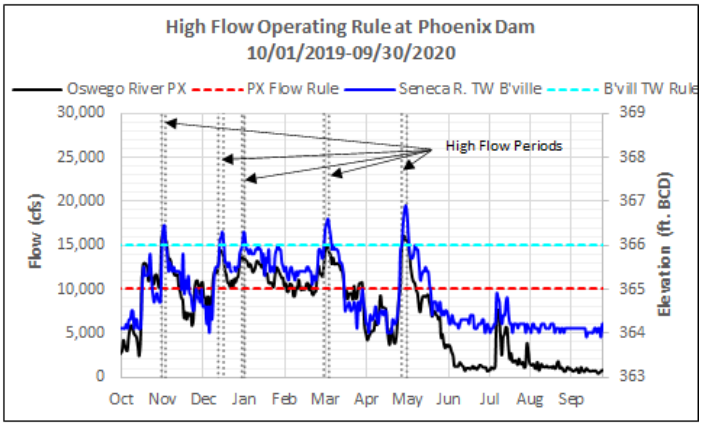
Notes:

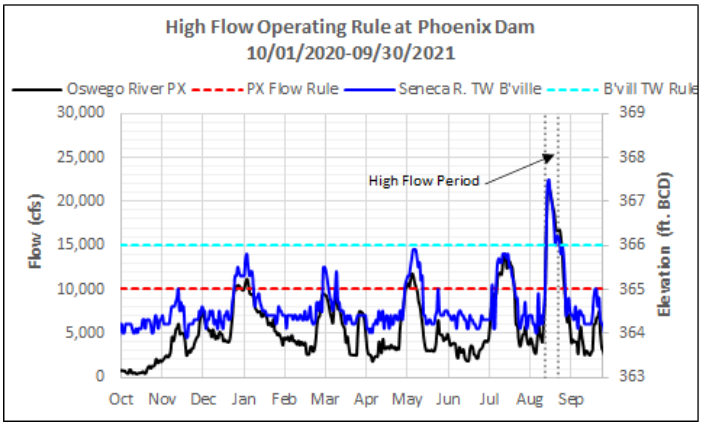
1. Vertical datum is Barge Canal Datum (BCD).
2. "Lake Damage" is the Oneida Lake stage (El. 372.4 ft. BCD) where damage to existing structures along the lake's shoreline is initiated.
3. "Oneida River" is the flow (cfs) exiting Seneca Lake as measured at USGS Gage No. 04247000 Oneida River near Euclid, NY.
4. "Max. Target" is the rule curve that the lake regulator, NYSCC, follows to make adjustments to the control structure at the lake's outlet during navigation season. Oneida Lake is regulated by operating gates at Caughdenoy Dam during navigation season to a normal pool El. 371 ft BCD. NYSCC does not regulate Oneida Lake elevations during the non-navigation season and lifts all the Caughdenoy Dam gates out of the water.

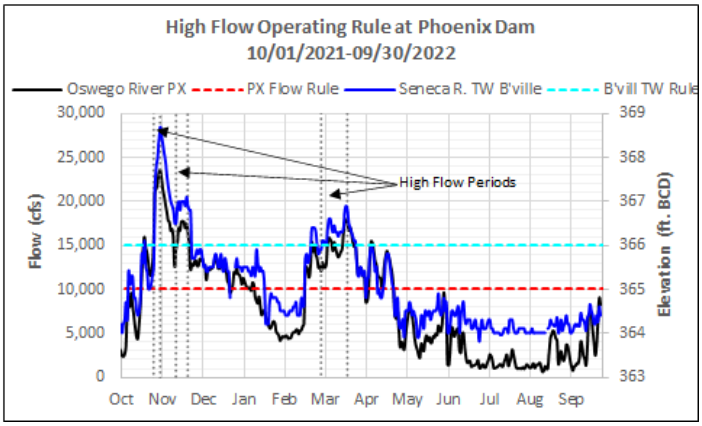






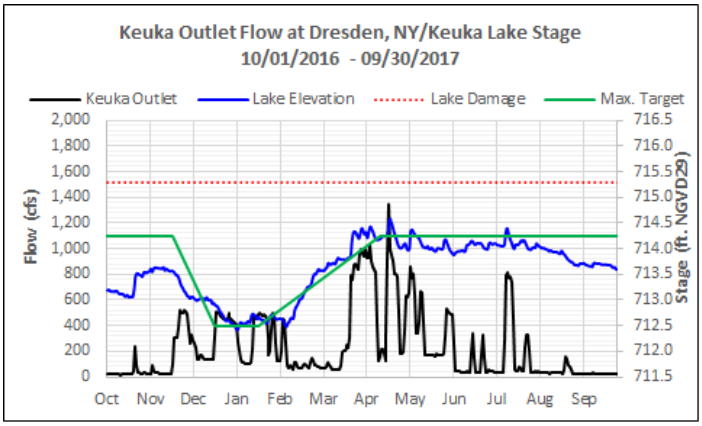


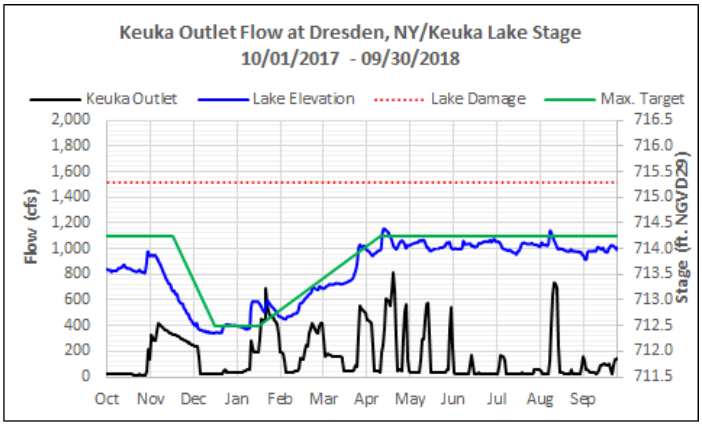


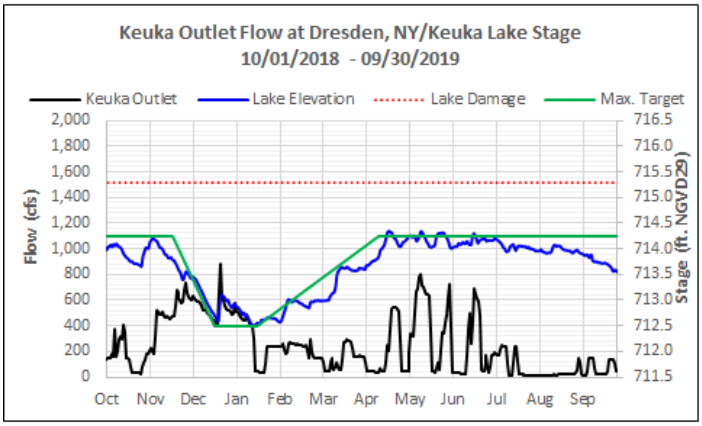


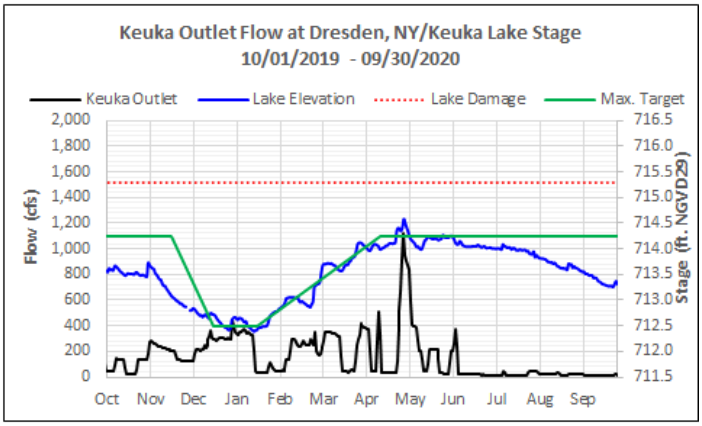
Notes:

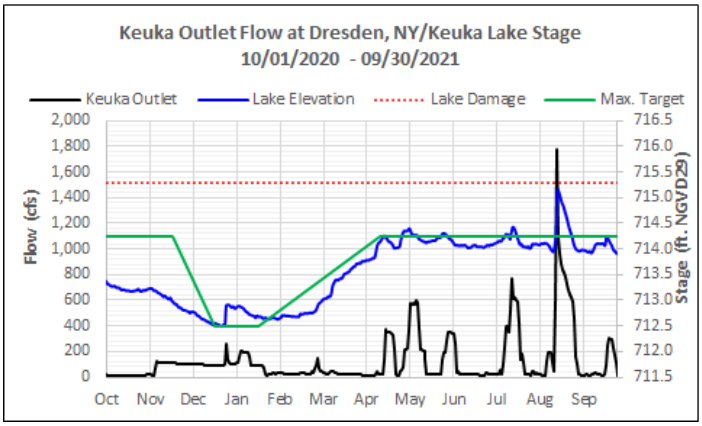
1. Vertical datum is Barge Canal Datum (BCD).
2. "Oswego River PX" is the flow (cfs) measured at USGS Gage No. 04247055 Oswego River near Phoenix, NY immediately upstream of Lock O-1.
3. "High Flow Periods" indicate the occurrence where the High Flow Operating Rule at Phoenix Dam was (or could have been) followed in response to high flow events within the Oswego River Basin.
4. "PX Flow Rule" is the minimum flow (10,000-cfs) at Phoenix Dam that initiates the use of the High Flow Operating Rule.
5. "B'Ville TW Rule" is the minimum tailwater (El. 366 ft. BCD) at Baldwinsville Dam (E-24) that initiates the use of the High Flow Operating Rule.

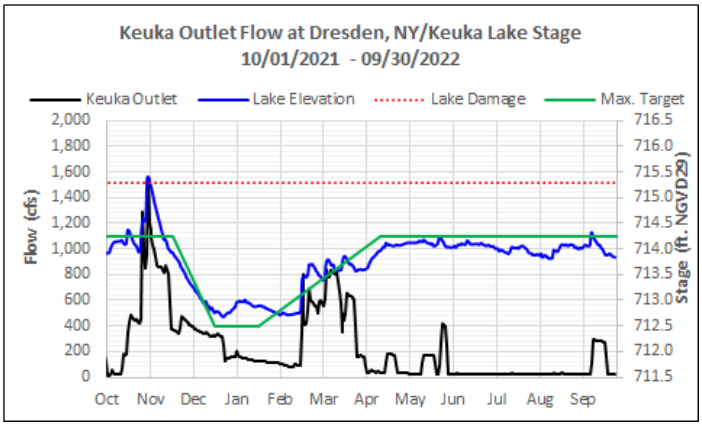












Notes:

1. Vertical datum is National Geodetic Vertical Datum of 1929 (NGVD29).
2. "Lake Damage" is the Keuka Lake stage (El. 715.3 ft. NGVD29) defined as the mean high water level. NYSDEC regulates the use and development of land below this elevation (even when the property is privately owned). It is assumed that water surface elevations above this level initiates damage.
3. "Keuka Outlet" is the flow (cfs) measured at USGS Gage No. 04232482 Keuka Outlet at Dresden, NY immediately upstream of Seneca Lake.
4. "Max. Target" is the rule curve that the lake regulator, Village of Penn Yann (via the Keuka Lake Outlet Compact), follows to make adjustments to the control structure at the lake's outlet.

APPENDIX E

Recommendations and Cost Development

USFMTF Report - Chapter 5 - Common Recommended Adaptive Measures

Report Section	Description	Cost	Cost Backup Information, Sources, Assumptions
5.1.1	Numerical Watershed Models	$1.3M	Discussion with Jim Guistina, Bergmann - Based on availability of recently developed (within the last 5 years) HEC RAS 1D and HMS models of significant portions of the Mohawk and Oswego Basins and importantly the main stems of these systems, a good deal of existing data is available. Existing available LIDAR and bathymetry can be used to develop or update new areas of the models. The base RAS models are assumed to be 1D dynamic RAS models, and the HMS models are assumed to cover the entire basin and would be developed as gridded precipitation hydrologic models, thus allowing historic gridded precipitation records and gridded precipitation forecasts to be incorporated into the models. Engineering model scoping study costs are expected to be similar for each basin: hydrology ($250K); hydraulics ($150K); research/calibration to historic events ($150K); management and reporting ($100K). No costs are included for public outreach, task force meetings, or presentations to executive management.
5.1.2	Standing Committees	$0M	Create permanent standing committees for each watershed. Develop better flood operational strategies to direct water releases during flood events and to provide better communication to the public. This effort would be led by the State agency employees from NYSCC, NYPA, NYSDEC and DHSES. Provide the interagency group with a 12 month deadline to organize the standing committees. No budget provided for outside services.
5.1.3	Increase Public Outreach, Education & Communication	$0.1M	Task NYPAs Public Outreach team with developing a coordinated outreach plan and electronic and paper materials to communicate to the public, stakeholders and professional organizations to better educate and inform stakeholders of floodplain risks. be implemented in advance of flood events to communicate to the public and stakeholders. Provide the team with a 12 month deadline to develop the resources. A budget of $100,000 is assumed for outside services to support this effort.
5.1.4	Communicate High Flow Events Using a Common Datum	$0.25M	To improve communication with the public and other stakeholders, especially during high water events, communicate all elevations using a common datum. Presently, publicly facing elevations are presented using several datums (eg. BCD, NAVD88, NGVD29). Providing elevations on a common datum consistent with current NFIP map (NAVD88) datum is recommended to improve and simplify communication with the public.
5.1.5	Purchase and/or Restore Disconnected Floodplains	$2M (annual cost)	Conversation with Tom Snow, NYSDEC - The following NYS grant programs allow for their monies to be used for floodplain reconnection projects: Green Infrastructure Grants Program; Environmental Bond Act; and Water Quality Improvement Program. So funding already exists to implement floodplain reconnection projects. Based on some recent work Tom has been involved with, the construction costs have ranged from $2M - $3M per acrea for 10 to 15 acre parcels, so an average cost of $1M per acre based on this information. Conversation with Gian Dodici, USFWS - NRCS has a rate cap for floodplain easement cost by county and land classification (120, 130, 321, 323) in NYS that allow for land purchase for floodplain reconnection projects. This could be the same program that Tom Snow has worked with. Gian provided tables containing this information. He explained, as far as construction costs are concerned, that a lot has to do with the quantityof excavation involved and the costs to remove and dispose of material. Another issue is that for FEMA mapped streams you need to show a no rise condition with the constructed project. Based on these discussions, assume $2M of annual state matching funds be designated for the Oswego and Mohawk River Basins.
5.1.6	Purchase Flood-Prone Structures within the Floodplain	$2M (annual cost)	Conversation with Tom Snow, NYSDEC - Under an NRCS program (Emergency Watershed Protection, Floodplain Easement Program) 160 floodprone homes in Whitesboro, NY are being purchased under this program for a cost of $20M. This federally funded program only requires a 4% local share to cover surveys, real estate and other local responsibilities. This amounts to $125,000 per home but no State money other than managing the effort was required. Conversation with Bill Nechamen - FEMA has a maximum allowable number they use for buyouts of $230,000 per structure (Bill will check on this and get back to me). In addition, the recently passed federal STORM Act will also provide federal funding to states for buyouts, however, this program would require state funding. The recently passed NYS Environmental Bond Act has been amended to allow funding to be used for buyouts. Based on these discussions it seems appropriate to create a seed money fund for at flood risk structures in floodplains. Assume $2M per year.

USFMTF Report - Chapter 5 - Common Recommended Adaptive Measures

Report Section	Description	Cost	Cost Backup Information, Sources, Assumptions
5.1.7	Address Tributary and Main Stem Erosion and Sedimentation	$350,000 (one time cost)	Email communication with Pete Nichols - Pete informed me of a 2011 study Local Flood Analysis (LFA) study that he was involved with on the Lower Schoharie Creek (53 miles between the Bleinheim-Gilboa Dam and the confluence with the Mohawk). The cost of that study was $200,000 or $3,773 / mile. Assume that a simliar study would cost $5,000 / mile today. It was funded through a NYSDOS Waterfront Revitalization Grant and there was a 50% match requirement. Since then the local match through DOS has been reduced to 25%. Another LFA program was developed by NYSDEP for the Catskills and NYC Water Supply watersheds following Tropical Storms Irene and Lee in 2011. The program developed a framework for funding flood hazard mitigation in the NYC West of Hudson watersheds. It had been recognized that flooding produces a variety of hazards and impacts not only to public safety, but also to water quality. Under this initiative, Stream Management Programs in the NYC water supply watersheds and the Catskill Watershed Corporation supported the analysis of flood conditions and the identification of hazard mitigation projects. The process consists of two steps: 1) an engineering analysis of flood conditions and identification of potential flood mitigation projects articulated in a plan and 2) project design and implementation. These program rules also define the process for municipalities to seek funding from the Stream Management Program to implement projects that involve streams, floodplains and adjacent infrastructure to reduce flood hazards. More on the program and rules can be found at: https://catskillstreams.org/wp-content/uploads/2015/01/LFA_Rules.pdf . The NYCDEP and NYSDOS programs seems to have components and goals similar to the Resilient NY program. Suggest that some seed money be set aside to develop a program that: reviews the work done on the Schoharie Creek LFA study; creates a framework and performs example study projects where erosion, scour and sedimentation are known to be problematic either for NYSCC sediment removal problems, local flooding or bank instabilities. Assume $100,000 for program development and $250,000 to study 50 stream miles of main stem streams for erosion and sedimentation. Develop additional study stream miles based on results of develpmental work and pilot program.
5.1.8	National Flood Insurance Program (NFIP) Support for Municipalies and NYSDEC	$250,000 (annual cost)	Pursue and implement additional measures to assist NYSDEC Floodplain Management Section with program oversight and pursue additional funding or educational opportunities to assist communities with implementation and compliance.
5.1.9	Reduce Development in Flood Prone Areas	$250,000 (annual cost)	Conversion with Bill Nechamen - To focus on the Task Force area, he recommends two NYSDEC (Floodplain Management Section) staff people at a grade 18 level. With fringe benefits and indirect costs, that's estimated at approximately $120,000 per year per person. The extra staff can also be tasked with working closely with the NYSCC, DHSES, and the Office of Resilient Homes and Communities (Formerly the Governor's Office of Storm Recovery) to coordinate programs.
5.1.10	Provide Project Hydraulic Studies to Others	$600,000 (annual cost)	Several New York State and federal agencies regularly conduct hydraulic studies in support of their missions. In New York State, 6 NYCRR Part 502 Floodplain Management Criteria for State Projects requires that the use of State lands and the siting, construction, administration, and disposition of State-owned and State-financed facilities are conducted in ways that will minimize flood hazards and losses so that New York State, as a CTP, and its 1500 participating communities continue their qualification as participating communities in the NFIP. For federal actions or federally funded actions located within floodplains, agencies must comply with Executive Order 14030. It has not been common practice for New York agencies to share the hydraulic models and studies with other agencies and many times other agencies are unaware of the efforts. This is unfortunate because the studies and hydraulic models are prepared to verify compliance with the NFIP. Sharing the models would provide other agencies with useful hydraulic models and studies that could reduce flood mapping update costs, provide improved flood mapping information that could be used by local floodplain administrators, and prevent redundant efforts. A more formal framework for sharing hydraulic modeling completed by state agencies should be developed and implemented to avoid redundant efforts and to keep all agencies informed of ongoing efforts.

USFMTF Report - Chapter 5 - Mohawk Recommended Adaptive Measures

Report Section	Description	Cost	Cost Backup Information, Sources, Assumptions
5.2.1	Update FEMA FIRM Mapping based on NYSCC 2018 Procedural Changes	$0.7M	Bergmann provided a 7-panel LOMR for the portion of the Mohawk River and portions of effected tributaries between Locks E-10 and E-12 for $100,000, or $15,000/panel. This effort was complicated by coordination with FEMA due to this being an unusual mechanism for a map change, and the fact that the effective FEMA hydraulic model was developed using MIKE11 and required use of a specialty consultant. Whether or not revisions to the main stem Mohawk River FIS panels are performed through FEMA Map Modernization, LOMRs or Physical Map Revision (PMR). Revisions to an additional 45 FEMA panels between Frankfort and Lock E-8 (Movable Dam 4) is estimated at $675,000, say $0.7M.
5.2.2	Investigate Modernizing NYSCC's Movable Dams	$5.0M	Discussion with Jim Guistina, Bergmann - based on other NYSCC projects involving similar features undergoing modernization, the movable dam sites would have bottom mounted hinged gates, new controls and local SCADA systems. Superstructures would be retained assuming SHPO would require it and existing superstructures would still be used as walkways and to carry power, communications, etc. from one side of the river to the other. The LF of gated dams in the Mohawk system that would require replacement include: MD-4 (17 - 30' wide panels = 510'); MD-5 (17 - 30' wide panels = 510'); MD-6 (16 - 30' wide panels = 480'); MD-7 (19 - 30' wide panels = 570'); MD-8 (16 - 30' wide panels = 480'); MD-9 (12 - 30' panels = 360'); MD-10 (14 - 30' wide panels = 420'); MD-11 (14- 30' wide panels = 420'); MD-12 (12 - 28'-9" wide panels = 345'); and MD-14 (4 - 31.5' wide panels = 126'). Total length = 4,221'. Total number of sites = 10. Programming estimate for modernization of all 10 dams is estimated at $400M. Study, engineering, design and contract documents for 10 sites (4221') is estimated at $40M. Modernization studies, concept level designs, DDR and cost estimating is approximately $0.5M per site or $5M total.
5.2.3	Ice Jam Mitigation in the Schenectady Area	$27.75M (Captial cost) $852,000 (annual O&M cost)	Discussion with Ken Kemp and WSP Report on VFD - Operating costs of ice breaking vessels in the Mohawk River reach upstream of VFD between locks E-7 and E-8 is $500,000/year and this action that's already being taken is recommended to continue. From the WSP Vischer Ferry Dam Modification Project Project Justification Report (9/2022), recommended design and consruction cost for installing 27-inch inflatable crest gates on Dam D (Alternative P-1), 27-inch inflatable crest gates on Dam E, and a combination of 27-inch and 48-inch inflatable crest gates on Dam F for a total project cost of $27.75M, and has an annual operations and maintenance cost of $352,000/year.
5.2.4	Investigate Modifying Operations at Delta Reservoir and Bifurcated Canal Section	$4.0M	Derived from Bergmann 12/19/2019 Re-Imagine the Canal Memo "*Mohawk Flood Assessment - Supplemental Delta Dam Reservoir and Utica Area Interventions Memo" and Bergmann Adjusted Utica Wave* Cost estimate of $49.4M provided on 3/2021. This estimate included physical cosntruction between Lock E-19 and E-20 including: new waste weir structure; modfications to Locks E-19 and E-20, Utica Harbor Dam Demoltion and Concrete Sill Installation; Removal and replacement of Days Spillway and Schuyler Sluice Gate; Dredging of Mohawk River near Dyke Road; Remove and replace Sterling Creek Spillway; demollish remaining portion of Frankfort Retaining Dam; and excavation of sediment along Moyer Creek. NYPA has submitted a grant application of about $3.5 million for Utica/Rome.
5.2.5	Update FEMA FIRMS Within the Mohawk Basin	$6.0M	Developed from email correspondance with Kelli Higgins-Roche and comments from Bill Nechamen and Kelli. A ROM cost for Herkimer County, which is the only Flood Mitigation Region in the Mohawk without digital mapping was provided by Kelli at $6.0M.

USFMTF Report - Chapter 5 - Oswego Recommended Adaptive Measures

Report Section	Description	Cost	Cost Backup Information, Sources, Assumptions
5.3.1	Basin Release Coordination	$0M	Propose forming an interagency group comprised of NYSCC, NYPA, and NYSDEC engineering, planning, public outreach and legal staff to define objectives of basin release coordination, and examine the legal, legislative, and logistical hurdles to forming either a regulating district (ex. Hudson River - Black River Regulating District) or a less structured entity to reduce basin-wide flooding by coordinating releases from operators regulating the Finger Lake outlets (NYSCC, hydropower companies, municipalities). Provide the interagency group with a 12 month deadline to provide recommendations. No budget provided for outside services.
5.3.2	Baldwinsville Dam (Lock E-24 Dam) Modification	$7.0M	*USACE Cross Lake Seneca River Detailed Project Report* , October 1997 cost estimate for constructing 120 feet of new crest gates ranged from $1.1 - 2.4 M (1995 dollars). Updating this estimate to 2025 construction using USACEs CWCCIS indices which has subcategories of various waterway structures for similar indexing at https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll9/id/2596 yields a 280% increase, or $3.1M - $6.7M (2025 dollars). Use $7M as the estimate.
5.3.3	Montezuma Area Flood Plain Restoration	$8.0M	Call with Tom Snow, NYSDEC - There's 1200 acres of land that Tom has been involved with that is presently farmed, has 1000 ft of perimeter bern and a pumping system. The cost of land purchase at $5,000 per acre and another $2M for construction to create gaps in the perimeter berm, restore surfaces and provide some floodplain vegetation yields a total cost of $8M.
5.3.4	Update FEMA FIRMs within the Oswego River Basin	$13.6M	Developed from email correspondance with Jean Huang, Dewberry (FEMA Region 2 and NYSDEC CTP Floodmapping Partner). A ROM for updates for Cayuga, Oneida, Onondaga, and Oswego Counties is below. This includes hydrologic and hydraulic studies for all reaches within the county that are unmapped or do not have a recent study, as well as the production of preliminary and final Flood Insurance Studies and Flood Insurance Rate Maps. County Cost Estimate Cayuga $1.3M Oneida $2.3M Onondaga $4.3M Oswego $2.0M An ROM for countywide updates for Madison and Schuyler is below. This includes hydrologic and hydraulic studies for all reaches within the county that are unmapped or do not have a recent study, as well as the production of preliminary and final Flood Insurance Studies and Flood Insurance Rate Maps. County Cost Estimate Madison $3.0M Schuyler $0.7M
5.3.5	Resilient NY Studies	$0.8M	Call with Tom Snow, NYSDEC - Under NYSDEC's Resilient NY program, watershed studies have been completed in Fish Creek, Oneida Creek and Butternut Creek watersheds under Phases 1 and 2 of the program. Phase 3 may include studies on Owasco River, Flint Creek, Clyde River and Ganargua Creek. Based on the costs of previous studies and that these 4 watersheds are included in the program assume $200,000/study or $800,000 total cost.

USFMTF Report - Chapter 5 - Cost Breakdown by Basin and Type								
Report Section	Description	Cost	Mohawk Capital Cost	Mohawk Study Cost	Mohawk Annual Program Cost	Oswego Capital Cost	Oswego Study Cost	Oswego Annual Program Cost
5.1.1	Numerical Watershed Models	$ 1,300,000		$ 650,000			$ 650,000	
5.1.2	Standing Committees	$ -		$ -			$ -	
5.1.3	Increase Public Outreach, Education & Communication	$ 100,000		$ 50,000			$ 50,000	
5.1.4	Communicate High Flow Events Using a Common Datum	$ 250,000		$ 125,000			$ 125,000	
5.1.5	Purchase and/or Restore Disconnected Floodplains	$ 2,000,000		$ -	$ 1,000,000		$ -	$ 1,000,000
5.1.6	Purchase Flood-Prone Structures within the Floodplain	$ 2,000,000		$ -	$ 1,000,000		$ -	$ 1,000,000
5.1.7	Address Tributary and Main Stem Erosion and Sedimentation	$ 350,000		$ 175,000			$ 175,000	
5.1.8	National Flood Insurance Program (NFIP) Support for Municipalies and NYSDEC	$ 250,000		$ -	$ 125,000		$ -	$ 125,000
5.1.9	Reduce Development in Flood Prone Areas	$ 250,000		$ -	$ 125,000		$ -	$ 125,000
5.1.10	Provide Project Hydraulic Studies to Others	$ 600,000		$ -	$ 300,000		$ -	$ 300,000
5.2.1	Update FEMA FIRM Mapping based on NYSCC 2018 Procedural Changes	$ 700,000		$ 700,000	$ -	$ -	$ -	$ -
5.2.2	Investigate Modernizing NYSCC's Movable Dams	$ 5,000,000		$ 5,000,000	$ -	$ -	$ -	$ -
5.2.3	Ice Jam Mitigation in the Schenectady Area	$ 28,100,000	$ 27,750,000		$ 350,000	$ -	$ -	$ -
5.2.4	Investigate Modifying Operations at Delta Reservoir and Bifurcated Canal Section	$ 4,000,000	$ -	$ 4,000,000		$ -	$ -	$ -
5.2.5	Update FEMA FIRMs within the Mohawk River Basin	$ 6,000,000	$ -	$ 6,000,000	$ -	$ -	$ -	$ -
5.3.1	Basin Release Coordination	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5.3.2	Baldwinsville Dam (Lock E-24 Dam) Modification	$ 7,000,000	$ -	$ -	$ -	$ 7,000,000	$ -	$ -
5.3.3	Montezuma Area Flood Plain Restoration	$ 8,000,000	$ -	$ -	$ -	$ 8,000,000	$ -	$ -
5.3.4	Update FEMA FIRMs within the Oswego River Basin	$ 13,600,000	$ -	$ -	$ -	$ -	$ 13,600,000	$ -
5.3.5	Resilient NY Studies	$ 800,000	$ -	$ -	$ -	$ -	$ 800,000	$ -
	Total	$ 80,300,000	$ 27,750,000	$ 16,700,000	$ 2,900,000	$ 15,000,000	$ 15,400,000	$ 2,550,000

APPENDIX F

Resilient New York Success Stories

Upstate Flood Task Force
Summary of Flood Mitigation Success Stories
Mohawk River Watershed

I. Introduction –

In response to devastating flooding that occurred in June/July 2013 within the Mohawk River Watershed, the New York State Department of Environmental Conservation (DEC) commissioned flood assessments/studies on 13 high priority, flood-prone watersheds that are tributary to the mainstem of the Mohawk River. These flood assessments/studies covered the following watersheds:

Oneida County –

- Oriskany Creek
- Big Creek (tributary to Oriskany Creek)
- Sauquoit Creek
- Mud Creek (tributary to Sauquoit Creek)

Herkimer County –

- Fulmer Creek
- Steele Creek
- Moyer Creek
- East Canada Creek
- West Canada Creek
- Nowadaga Creek
- Maltanner Creek
- Bellinger Brook

Montgomery County –

- Otsquago Creek

The purpose of these flood assessments/studies was to undertake a comprehensive analysis of each individual watershed to: (1) determine where flooding historically occurred and/or currently occurs ; (2) identify and evaluate the benefit(s) of specific flood mitigation projects at identified locations within these watersheds; and (3) employ advanced hydrologic and hydraulic modeling to determine overall effectiveness of individual and/or combinations of proposed projects to determine which would be the most effective at reducing flooding within these communities. At the onset of this process in 2013, DEC engaged with municipal officials, county and local departments and other stakeholders in their communities to gather this important information and input to help inform the flood analysis.

In 2014, DEC completed these 13 flood assessments/studies and once again engaged municipal official and stakeholders to review the findings and recommendations, along with gauging interest of communities in moving specific proposed projects from a conceptual perspective, to design and

ultimately to construction. Since 2015, DEC has worked directly with Oneida and Herkimer Counties, federal government, other state agencies and municipalities along Sauquoit Creek, Steele Creek, Moyer Creek, Fulmer Creek, and Bellinger Brook to assist in implementing a wide array of flood mitigation projects that were originally identified in these flood assessments/studies. Below is a summary of major flood mitigation projects that have been implemented on specific watercourses over the past seven plus years within the Mohawk River Watershed:

I. Sauquoit Creek –

Town of Whitestown –

- Dunham Manor Park floodplain restoration project (Project 1 – completed)
- Floodplain restoration (Project 3) – a portion of this project includes additional floodplain restoration just below the Dunham Manor Park floodplain project (Town project; construction expected to commence in summer 2023)

Town Of New Hartford -

- Stream channel, streambank stabilization and floodplain restoration between Clinton Street and Chenango Road (Town project, design underway)
- Clinton Street bridge replacement – (Town project, design underway)

Village of Whitesboro -

- Lower Sauquoit Creek floodplain restoration project (Project 2 – completed by Town of Whitestown)
- CSX railroad bed culvert pipe installation (funded by NYSDOT; completed by Town of Whitestown)
- State Route 69/Oriskany Blvd bridge replacement (NYSDOT; design underway)
- Main Street bridge replacement (NYSDOT; design underway)
- Floodplain restoration (Project 3 - includes additional floodplain restoration directly adjacent to Project 2 project).
- Flood buyouts, currently estimated at 160 plus homes within Village through funding from the NRCS Floodplain Easement (FPE) program (Town project, currently ongoing).
- Floodplain restoration (Project 4) on lands subsequently acquired through NRCS's FPE. Final design and floodplain restoration project will be fully funded and completed by NRCS once FPE flood buyouts are completed.

II. Steele Creek – Village of Ilion

- Flood buyouts (i.e., 34 properties) along Steele Creek (completed)
- Bridge removal and replacement (completed)
    - Richfield Street bridge (owned by Town of German Flatts)
    - State Route 51/Otsego Street bridge (NYSDOT; completed Fall 2022)
- Remington Arms Company Dam Removal (completed)
- Partial removal of East River Drive (completed)

- Floodplain, stream channel and streambank restoration in upper portion of Steele Creek watershed within the Village of Ilion (completed)
- Full floodplain design (100%) completed for lower portion of Steele Creek (completed)

III. Fulmer Creek – Town of German Flatts and Village of Mohawk
- Streambank stabilization (completed)
- Acquisition of mobile home park known as Leatherstocking property (completed)
- Floodplain restoration project within Village of Mohawk (completed)
- Flood buyouts (i.e., 27 properties) of damaged homes within the Village of Mohawk (completed)

IV. Bellinger Brook –
- Replacement of West German Street bridge (construction completion expected 2024)

V. Moyer Creek –
- Replacement of Main Street bridge (construction completion expected 2024)
- Stream channel and streambank restoration (construction completion expected 2024)
- Dam removal (construction completion expected 2024)

I. Sauquoit Creek Flood Mitigation Projects – Towns of Whitestown and New Hartford and Village of Whitesboro

<u>Dunham Manor Park – Town of Whitestown</u>

The Town of Whitestown completed a massive floodplain restoration project (Project 1) within its Dunham Manor Park. Project 1 is the first of several flood mitigation projects being implemented by the Town of Whitestown along Sauquoit Creek (Figures 1-5). This project involved the creation of approximately 6 acres of floodplain along the western portion of Sauquoit Creek and included removal of over 100,000 cubic yards of soil. The project also included the installation of natural stream design techniques, such as grade control structures and root wads to protect stream banks from erosion.

The purpose of this multi-phase floodplain restoration project is to create additional flood storage during high flow events on Sauquoit Creek, resulting in significant reductions in peak flood flows and the resultant flood damages to residents and business along Sauquoit Creek. Prior to construction, the eastern portion of Sauquoit Creek would routinely flood Commercial Drive during high precipitation events, causing extensive damage to businesses along this stream corridor. Construction was completed in August 2022. Total cost to construct this project was $3.6 million with funding provided by New York State Environmental Facility Corporation's (EFC) Green Innovation Grant Program (GIGP).

Figure 1. Aerial view of approximate extent of Project 1 floodplain restoration within Dunham Manor Park, Town of Whitestown.

Figure 2. Aerial view of Project 1 underway in Dunham Manor Park, Town of Whitestown.

Figure 3. Aerial view of Project 1 underway in Dunham Manor Park, Town of Whitestown.

Figure 4. Ongoing construction of Project 1 underway in Dunham Manor Park, Town of Whitestown.

Figure 5. Completed construction of Project 1 within Dunham Manor Park, Town of Whitestown.

CSX Floodplain Restoration and Culvert Installation Project – Village of Whitesboro

Further downstream on Sauquoit Creek within the Village of Whitesboro, a second flood mitigation project was undertaken by the Town of Whitestown. Known as Project 2 of the Sauquoit Creek Channel & Floodplain Restoration Program, this project included the restoration of an additional 12 acres of floodplain (Figure 6), along with the installation of five 48-inch culverts underneath the CSX Rail Line (Figure 7). These two flood mitigation projects have been hydraulically modeled and will significantly reduce flood flow elevations within this portion of Sauquoit Creek, which experiences chronic and severe flooding to homes and businesses within the Village of Whitesboro. Total cost to construct this project was $3.7 million with funding provided by EFC's GIGP and $1.0 million was provided by NYDOT to design and install the five culverts in the CSX railroad bed.

Figure 6. Ground level view of Project 2 floodplain restoration just south of CSX railroad. CSX bridge is in the background.

Figure 7. Ground level view of Project 2 floodplain restoration and the installation of five 48-inch culverts in CSX railroad bed.

Floodplain Restoration Project 3 – Village of Whitesboro and Town of Whitestown

Project 3 includes the installation of two additional floodplain benches on the Sauquoit Creek. These projects are known as Project 3 – Site E and Project 3 – Site B. Project 3 – Site E is directly adjacent to Project 2 and will be implemented by the Town of Whitestown within the Village of Whitesboro (Figure 8). This floodplain restoration project consists of an additional 18 acres and will function in tandem with Project 2 that has already been completed by the Town of Whitestown. EFC provided an additional $3.0 million in GIGP funding to support this restoration project. Construction of Project 3-Site E is anticipated to begin in 2024.

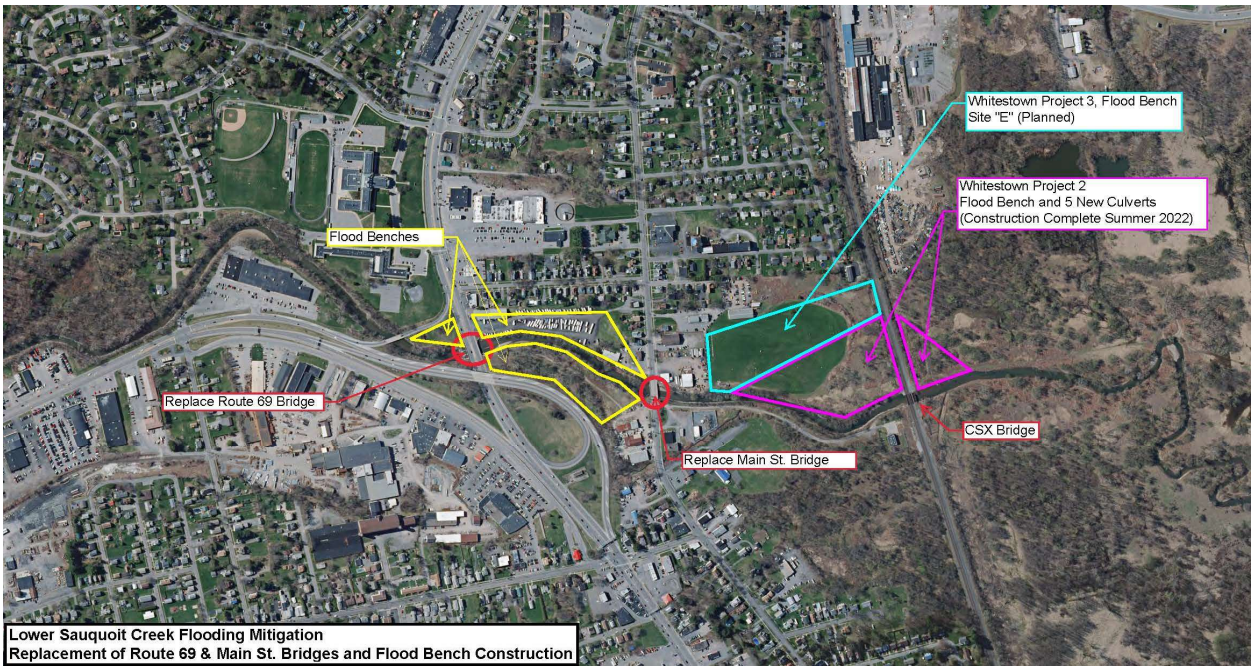


Figure 8. Aerial map of bridge replacements and floodplain restoration projects that have been or will be installed in the lower Sauquoit Creek Watershed.

Further upstream on Sauquoit Creek within the Town of Whitestown, Project 3 – Site B consists of an additional 5 acres of restored floodplains (Figure 9). This project is located directly downstream from Dunham Manor Park, extending the two floodplains that were previously restored in this area. Construction of this floodplain restoration project is anticipated in 2024.

Figure 9. Aerial view of Project 3-Site B along Sauquoit Creek within town of Whitestown. This project is located just downstream from the floodplains that were restored in Dunham Manor Park.

Replacement of Main Street and State Route 69 (Oriskany Boulevard) Bridges – Village of Whitesboro

Just upstream from the CSX floodplain restoration project, the New York State Department of Transportation (NYSDOT) will be replacing two significantly undersized bridges that cross the lower Sauquoit Creek within the Village of Whitesboro. Main Street bridge and State Route 69 or "Oriskany Boulevard" bridge (Figures 10 - 13) bridges will be replaced with significantly larger spanned structures, which will allow floodwaters to safely pass underneath the bottom (i.e., low chord) of the bridges. This will also reduce the potential for debris and ice jams that have historically occurred at these structures, further reducing the potential of flooding in this area. NYSDOT is also incorporating additional floodplain restoration measures between both bridge replacement projects to further enhance flood mitigation benefits within the Village. These two major capital replacement and restoration initiatives should be fully designed in 2024 with construction anticipated in 2025/2026 timeframe.

Figure 10. Aerial view of Main Street bridge that will be replaced and upsized by NYSDOT. Please note areas just upstream of this bridge will also be restored to natural floodplains all the way up to State Route 69 bridge.

Figure 11. Ground level view of Main Street bridge that will be replaced and upsized by NYSDOT.

Figure 12. Aerial view of State Route 69 or Oriskany Boulevard Bridge that will be replaced and upsized by NYSDOT.

Figure 13. Ground-level view of State Route 69 or Oriskany Boulevard bridge the will be replaced by NYSDOT. This bridge is a chronic source of debris/ice jams due to the remnants of the old Erie Canal Aqueduct adjoining the bridge piers. The old Erie Canal Aqueduct structure will be removed as part of the new bridge replacement to alleviate future debris/ice jams.

Flood Buyout Program through NRCS's Floodplain Easement Program – Village of Whitesboro

The federal Natural Resources Conservation Service (NRCS) through its Floodplain Easement (FPE) Program is working with the Town of Whitestown to acquire over 160+ flood-ravaged homes within the Village of Whitesboro (Figure 14). These homes have been subject to repetitive and severe flooding over the past few years and NRCS is contributing over $20 million in federal funds to acquire and demolish these homes. Once the homes are removed, the remaining land will be restored to natural floodplains, providing further flood protection to the homes that remain. NRCS will cover the cost to restore these lands back to natural floodplains.

Figure 14. Aerial view of 160+ homes that will be acquired and removed through NRCS's FPE program.

Clinton Street Bridge Replacement – Town of New Hartford

Directly upstream from the Dunham Manor Park floodplain restoration project, the Town of New Hartford will be replacing the Clinton Street bridge with a much larger sized structure (Figure 15). This bridge was identified in the 2014 Sauquoit Creek assessment/flood study as being significantly undersized, causing floodwaters to back up and flood adjacent commercial businesses and residential homes along the western portion of Sauquoit Creek.

Given site constraints, the new bridge structure is expected to pass the current 100-year recurrence interval without causing backwater. The Town of New Hartford has secured $1.6 million through NYSDOT's local federal-aid transportation program to support preliminary design of this project. The Town of New Hartford is also pursuing FEMA Hazard Mitigation Grant Program (HMGP) funding to cover additional costs incurred as a result of significantly upsizing this bridge structure.

Figure 15. Aerial view of Clinton Street bridge replacement on Sauquoit Creek by the Town of New Hartford.

Stream Channel, Streambank and Floodplain Restoration on Sauquoit Creek within Town of New Hartford.

Following the 2019 Halloween storm, a substantial portion of Sauquoit Creek within the Town of New Hartford experienced significant erosion. Approximately 2,300 feet of the Rayhill Memorial Recreational Trail (Rayhill Trail) extending from Clinton Street to Chenango Road was completely destroyed by this flood event.

To address this situation, the Town of New Hartford applied for and received $2.2 million in federal FEMA Public Assistance funding to repair this area. Instead of replacing the Rayhill Trail back to its original location, the Town of New Hartford decided to relocate it further away from Sauquoit Creek and undertake a comprehensive restoration design that should make this stream reach much more resilient to future flooding. This initiative includes sediment and debris removal from the stream channel, streambank stabilization and restoration of approximately 5.5 acres of floodplain. The Town of New Harford is currently working on finalizing the design and construction is anticipated in 2024/2025.

II. Steele Creek Flood Mitigation Projects – Village of Ilion, Herkimer County

The overall Steele Creek flood mitigation project consists of approximately 11,000 linear feet (or 2.08 miles) of Steele Creek corridor extending from the NYS Route 5s bridge (near the confluence with the Mohawk River) upstream to the Spinnerville Gulf Road Bridge within the Town of German Flatts (Figure 16). Steele Creek runs from the south to the north through the center of the Village of Ilion.

Following the floods of 2013 and 2017, the Village of Ilion obtained funding from FEMA and New York State Division of Homeland Security and Emergency Services (DHSES) to implement a flood buyout program for those residences most impacted by these two flood events. In total, the Village acquired 34 properties, totaling more than $3.9 million.

This effort permanently removed vulnerable structures from the floodplain and designated the area as open space, thereby preventing further infringement of development within the stream corridor. In addition, by acquiring and preserving these properties as open space this area can naturally flood – resulting in diminishing the immediate threat to public health and safety, reducing the flood risk downstream, preserving the riparian ecosystem, and providing for recreational uses.

With the removal of high priority, flood-prone structures within the Steel Creek Corridor, the Village of Ilion also secured funding to support a comprehensive stream corridor plan and design for Steele Creek, otherwise known as their "GreenPlain" design. A full engineering design was completed for a 1,840 linear foot section of stream corridor between the Otsego Street (NYS Route 51) bridge and the Second Street bridge in the Village of Ilion. This design included proper channel sizing to approximate bankfull width to increase conveyance capacity and creation of floodplain benches on one or both banks through the project reach to increase flood flow conveyance capacity.

A second stream and floodplain restoration project was also completed in the upper portion of Steele Creek withing the Village of Ilion (figure 17 and 18). This project covered Steele Creek beginning at the Clapsaddle Farm Road bridge, extending north to just beyond English Street and Central Valley Academy. This project included properly sizing a new stream channel, stream bank stabilization, removal of the Remington Arms Company Dam, and partial removal of East River Drive to facilitate additional floodplain restoration (Figures 19 -24). This comprehensive, multifaceted flood mitigation project will provide additional flow capacity through this stream reach, greatly reducing potential of future flooding to residents in area.

The Richfield Street bridge and Otsego Street bridge have also been replaced with much larger sized structures, which will now adequately pass higher flow events without causing flooding. Previous structures were significantly undersized and overtopped during high flow events, causing significant flood damage to the surrounding residential neighborhoods.

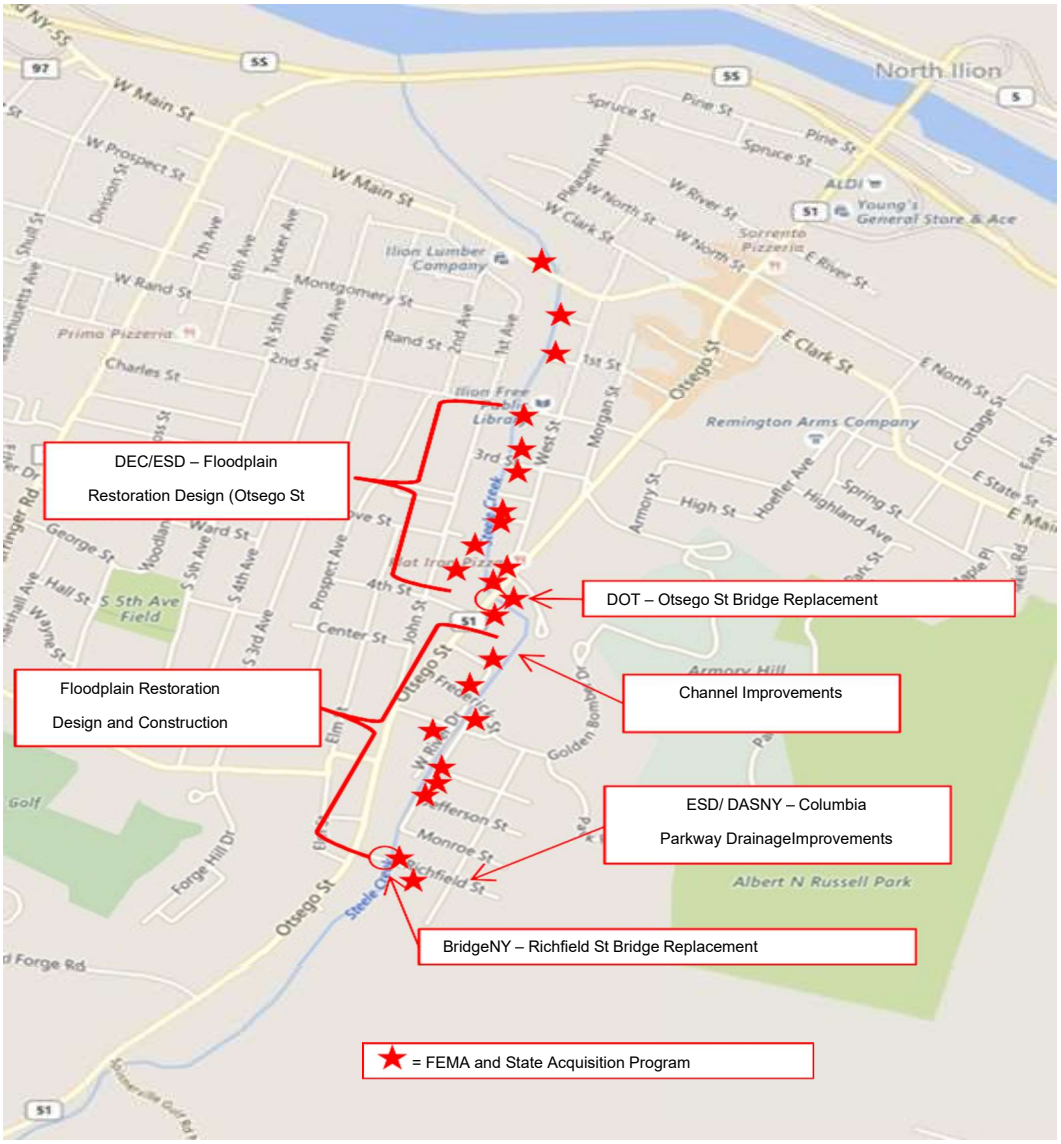


Figure 16. Aerial view of Village of Ilion identifying all the flood mitigation projects that have implemented along Steele Creek.

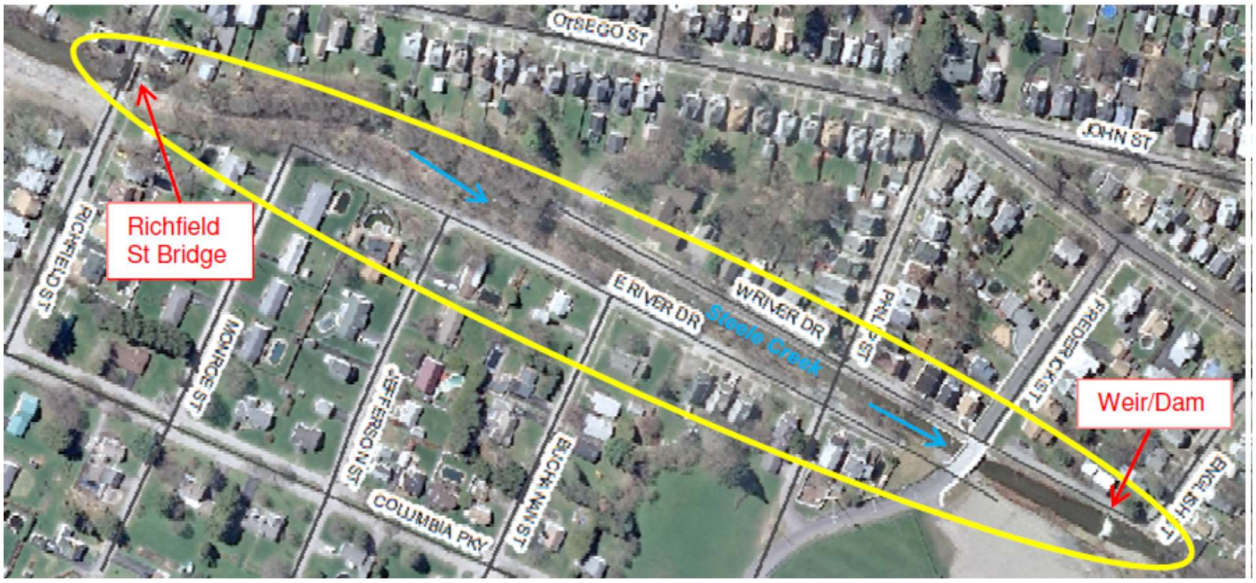


Figure 17. Aerial view of upper Steele Creek within Village of Ilion where flood mitigation project has been completed. This includes replacement of Richfield Street bridge with larger sized structure, flood buyouts, removal of Remington Arms Company Dam, partial removal of East River Drive to accommodate floodplain restoration stream channel improvements and streambank stabilization.

Figure 18 Preconstruction – Aerial view of Steele Creek looking upstream. Remington Arms Company Dam is in the foreground, which causes the channel bed to be raised by as much as 15 feet, contributing to frequent and damaging flooding within the community.

Figure 19 Remington Arms Company Dam before (left) and during (right) project construction, Steele Creek, Village of Ilion.

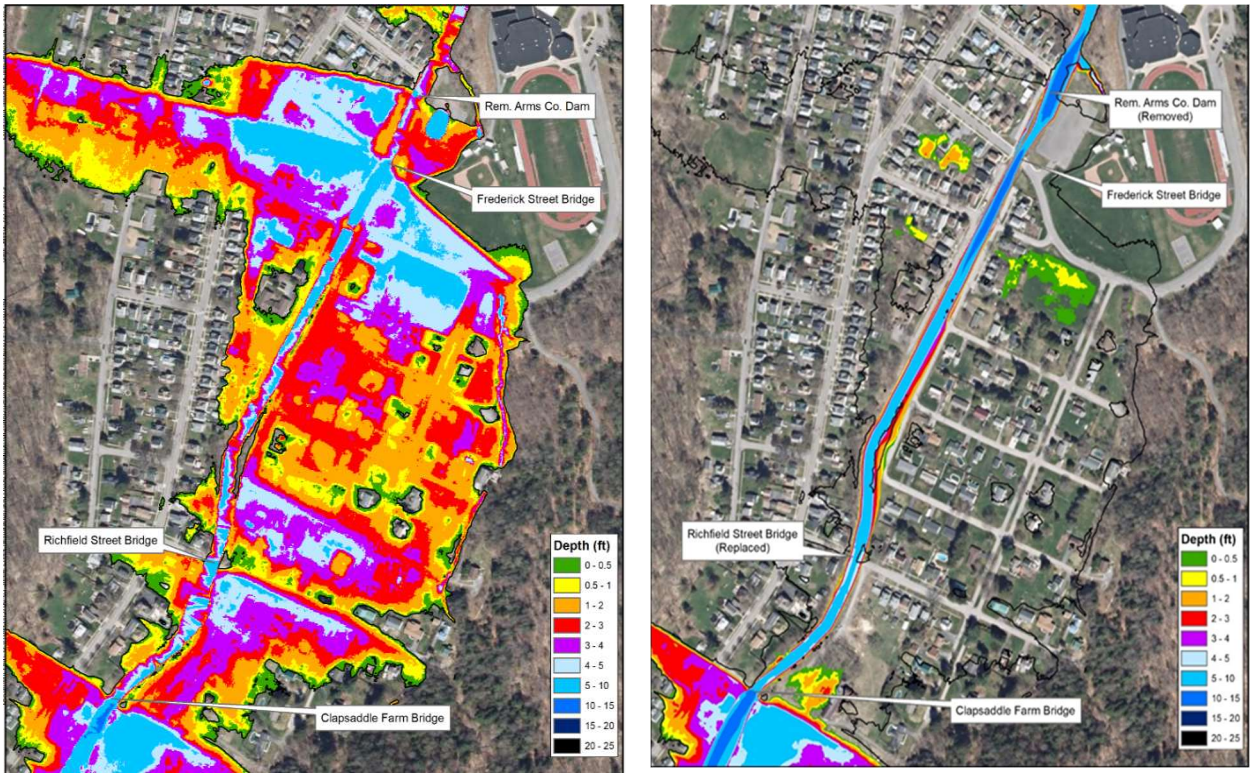


Figure 20. Hydraulic modeling of Steele Creek showing flood depth and extent during the 100-year flood event before project construction (left) and after project construction (right).

Figure 21. During construction – view looking downstream showing stream channel and floodplain restoration on Steele Creek, Village of Ilion.

Figure 22. During construction – view looking upstream towards Fredrick's Street bridge on Steele Creek within the Village of Ilion..

Figure 23. Post construction – View of upstream portion of Steele Creek restoration showing stream channel with in-stream features, floodplain restoration and partial removal of East River Drive. Flood buyouts also occurred to the left, just outside the picture.

Figure 24. Post construction - View looking downstream on Steele Creek two years after the project was constructed. In-stream features are visible in the channel. The constructed floodplain conveys flood flows during major storm events.

State Route 51 (Otsego Street) Bridge Replacement – Village of Ilion

The 2014 Steele Creek flood assessment/study identified State Route 51 ("Otsego Street bridge") as a major hydraulic constriction due to its extremely small hydraulic opening (Figure 25). During high flow events, the bridge opening often gets clogged with stream debris and natural bedload material. This further constricts stream flows through this structure, resulting in Steele Creek either overtopping the undersized structure or causing the stream to flow directly down State Route 51 into the Village of Ilion.

NYSDEC worked with NYSDOT to get this bridge prioritized for replacement as part of their 5-Year Capital Plan. In 2022, NYSDOT began construction of a new bridge that is significantly larger in size and span. The new bridge was designed to adequately pass current and future flood flows anticipated due to climate change (Figure 26). To accommodate this larger span bridge, several homes directly around the new structure were acquired and removed through FEMA's Flood Buyout Program and by NYSDOT. The cost to replace this bridge was $4.0 million.

Figure 25. State Route 51 (Otsego Street) bridge is located just downstream from the Steele Creek Flood Mitigation project. During high flow events this structure either gets clogged with debris or overtopped, causing Steele Creek to jump its banks and flow directly into the Village of Ilion.

Figure 26 – Photo of new State Route 51 (Otsego Street) bridge being replaced by NYSDOT. Several homes surrounding the bridge were acquired by the Village giving NYSDOT sufficient area to install a significantly larger structure.

III. Fulmer Creek Flood Mitigation Projects – Village of Mohawk and Town of German Flatts, Herkimer County

Following the catastrophic flooding in 2013, the Town of German Flatts and Village of Mohawk worked with DEC, New York State Division of Homeland Security and Emergency Services (DHSES), New York State Office of Parks, Recreation, and Historic Preservation (OPHRP), Herkimer/Oneida Counties Comprehensive Planning Program (HOCCPP) and other partners to address flooding throughout the Fulmer Creek watershed. These efforts resulted in the development of a comprehensive "GreenPlain" restoration plan and design of Fulmer Creek, which included properly sizing the stream channel, streambank stabilization, floodplain restoration to increase flood flow conveyance capacity, installation of grade control structures, and removal or partial removal of some residential structures from the floodplain. Figure 27 identifies locations of all these flood mitigation projects along Fulmer Creek.

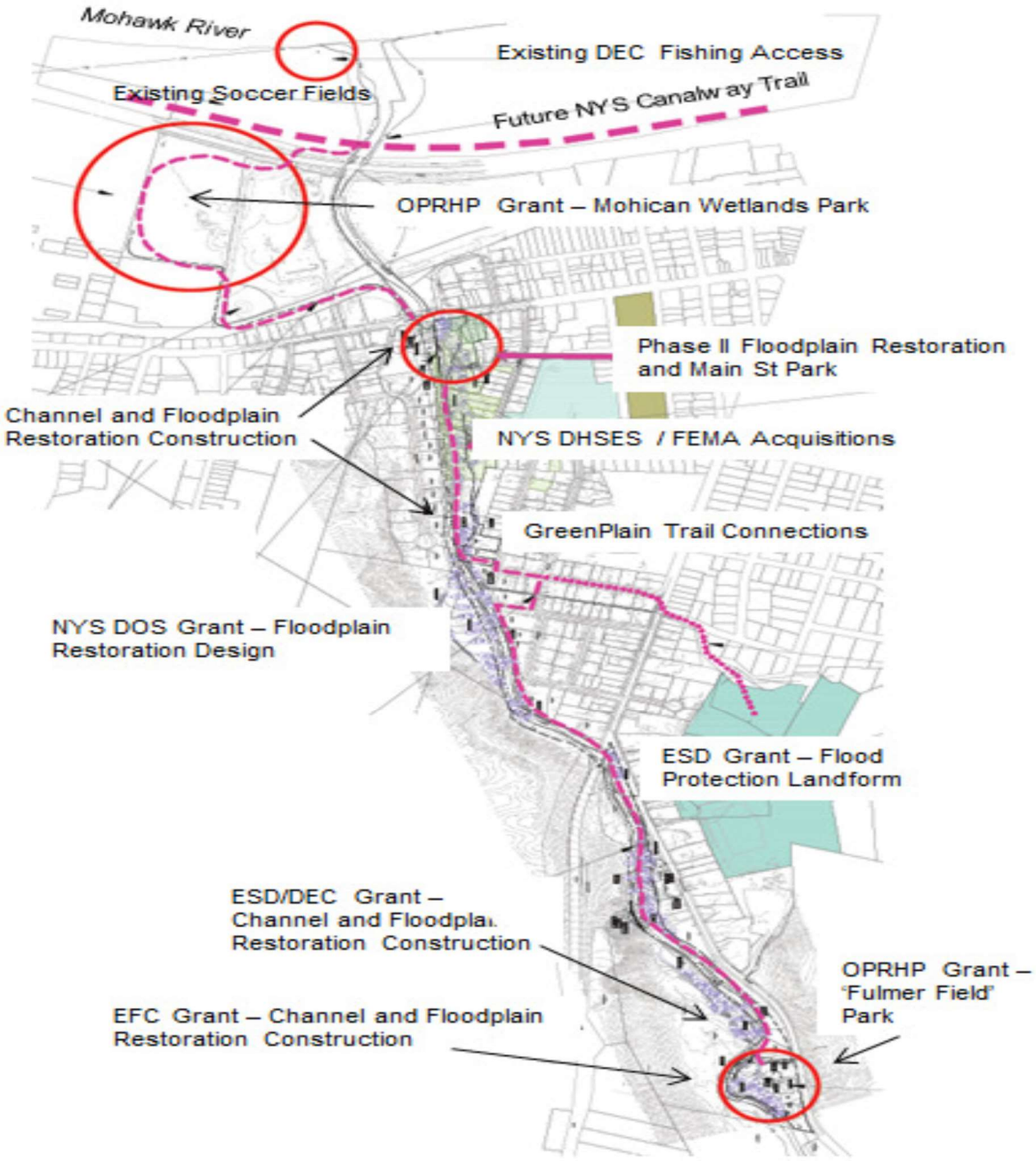


Figure 27. Aerial view of all the flood mitigation projects that have been completed on Fulmer Creek since 2015.

Flood Buyouts/Structure Acquisitions –

The Town of German Flatts and Village of Mohawk acquired multiple properties and easements within the Fulmer Creek stream corridor. Through an initial grant from FEMA's Hazard Mitigation Grant Program (HMGP), a total of 16 properties within the floodplain were acquired and removed. An additional 8 properties were acquired in 2017 through the DHSES's Mohawk Valley-Upstate Buy-Out Program. OPRHP also provided funding for the purchase of 3 properties and multiple easements. The

Village of Mohawk has invested nearly $3.5 million in acquisitions and the Town of German Flatts has invested slightly over $735,000 in flood buyout acquisitions (Figure 28).

Figure 28. Locations of flood buyouts within the Village of Ilion.

Fulmer Creek Streambank Stabilization and Floodplain Establishment –

This project involved stabilizing a massive streambank failure along 850 linear feet of Fulmer Creek (Figures 29 and 30). The existing house at the base of this streambank failure was also acquired and removed to facilitate implementation of this restoration project. The design plans recommended moving the Steele Creek channel eastward, returning it to its natural channel and away from the bank failure; constructing a revetment wall 600 feet in length along the channel at the outside of the bend along the toe of the slope; creating a floodplain on the inside of the bend; and seeding the slope to promote the growth of vegetation to further stabilize the slope (Figure 31). Three grants were awarded for this project and included a $141,986 grant from ESD for engineering and design plans, a $1,080,000 NY Rising Communities grant, administered through Dormitory Authority of the State of New York (DASNY) for the construction phase, and $510,000 in funds from NYSDEC's Mohawk River Basin Program for tasks associated with the bid phase, permitting, construction, and construction oversight. Construction was completed in 2019.

Figure 29. Aerial view of massive slope failure on Fulmer Creek.

Figure 30. Looking upstream at massive slope failure on Fulmer Creek.

Figure 31. Aerial view of ongoing slope stabilization and floodplain restoration project on Fulmer Creek.

Flood Buyouts and Floodplain Restoration (Leatherstocking Tailer Park) – Town of German Flatts

Further downstream from the streambank stabilization project, this project involved acquisition of the former Leatherstocking Trailer Park property in the Town of German Flatts, the removal of flood damaged structures and infrastructure, the restoration of the floodplain, stream channel improvements, and the development of a recreational facility (Figure 32). This project not only removed residents from harm's way, it also provided flood mitigation benefits to residents further downstream within the Village of Mohawk.

This project was supported through a combined grant from EFC and OPRHP. Total project cost is slightly over $1 million and includes $529,686 with a 52/48 cost share from OPHRP and $517,778 from EFC with a 90/10 cost share.

Figure 32. Aerial view of flood buyouts and floodplain restoration known as the Leatherstocking property.

Fulmer Creek Stream Channel and Floodplain Restoration – Town of German Flatts/Village of Mohawk

Through the 2017 GIGP, EFC awarded the Village of Mohawk $2 million to complete stream channel and floodplain restoration along approximately 2,900 feet of Fulmer Creek. This project included full channel improvements and floodplain restoration beginning several hundred feet below West Main Street bridge and extending up to the State Route 28 bridge (Figures 33 and 34). Total project cost (including local match) was $2.2 million.

Figure 33. Photo of completed Fulmer Creek floodplain restoration project within Village of Mohawk.

Figure 34. Photo of completed Fulmer Creek floodplain restoration project within Village of Mohawk.

IV. Bellinger Brook Flood Mitigation Projects – Village of Herkimer, Herkimer County

West German Street Bridge Replacement – Village of Herkimer

The Village of Herkimer is currently in the process of replacing the West German Street bridge (Figures 35 and 36). The West German Street bridge is an old structure that is structurally deficient and was identified in the 2014 Bellinger Brook flood assessment/study as being significantly undersized from a hydraulics perspective. During flood events, this undersized structure causes water to back up and spill over the stream channel into the Village causing significant flooding and damage to residences and businesses. The new bridge span has been significantly increased and will be able to pass current and future flood flows anticipated from climate change. The enlarged bridge will also allow future stream channel and floodplain restoration work to be completed along Bellinger Brook.

The Village of Herkimer received over $3.0 million through NYSDOT's Bridge NY program and $250,000 through DEC's Mohawk River Basin Program to support this bridge replacement. This project is expected to be completed in 2023.

Figure 35. Photo of West German Street on Bellinger Brook within the Village of Herkimer.

Figure 36. Bellinger Brook, looking north towards West German Street bridge crossing.

V. Moyer Creek – Village of Frankfort, Herkimer County

Main Street Bridge Replacement on Moyer Creek – Village of Frankfort

The 2014 Moyer Creek flood assessment/study identified the Main Street bridge within the Village of Frankfort as a significant contributor to flooding (Figure 37 and 38). A timber crib dam is located 250 feet downstream of the Main Street bridge. This dam influences water surface elevations up to the Main Street bridge (Figure 39). To mitigate this flooding issue, the Village of Frankfort received funding to replace the Main Street bridge with a significantly larger structure, to restore the stream channel directly above and below the Main Street bridge and to remove the timber crib dam. These projects are expected to significantly improve flooding within the Village of Frankfort. This project is anticipated to be completed in 2024/2025.

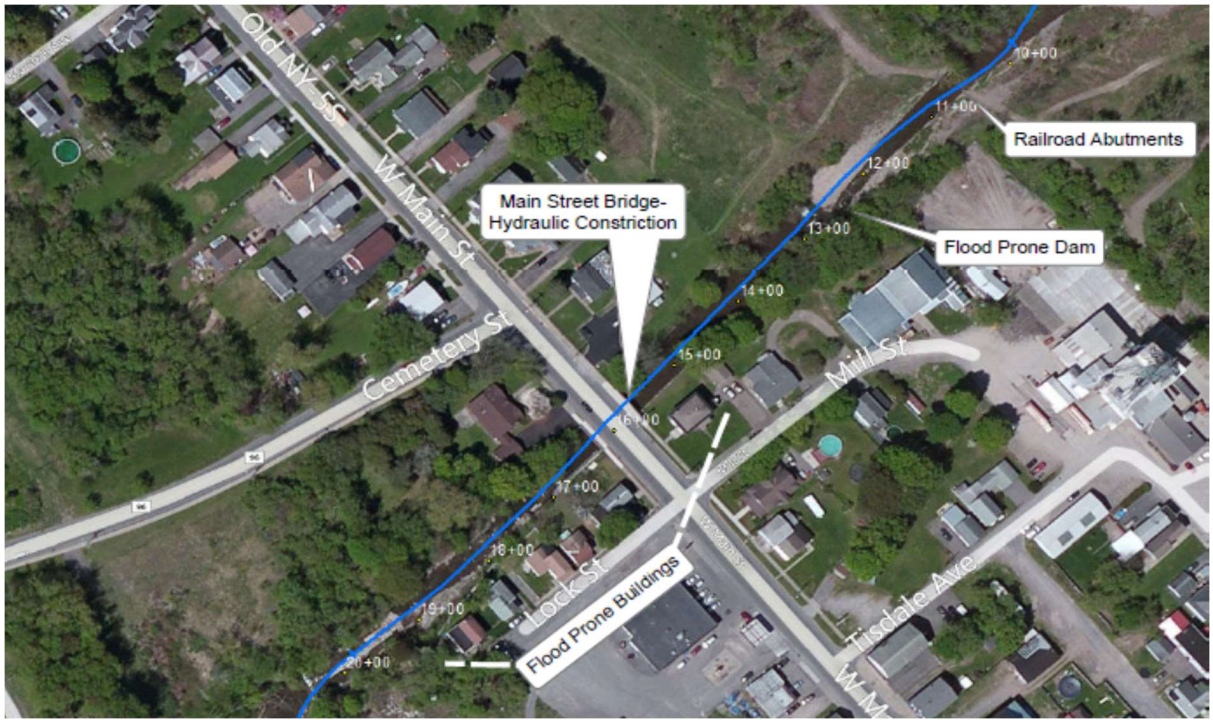


Figure 37. Aerial photo of Village of Frankfort depicting location of Main Street bridge, flood-prone structures and timber crib dam.

Figure 38. Looking upstream from the Main Street bridge, Moyer Creek is confined by the stone-lined channels before and after crossing Main Street.

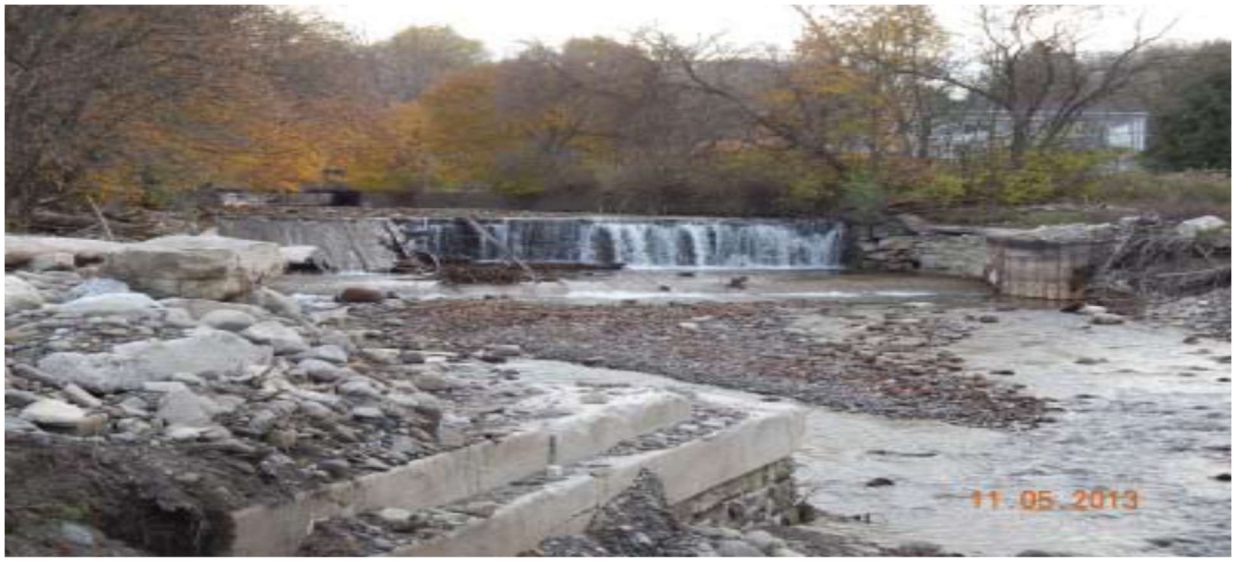


Figure 39. Photo of timber crib dam on Moyer Creek that will be removed by the Village of Frankfort. The Main Street bridge is included in the photo, just upstream of the dam.

APPENDIX G

Upstate Flood Task Force Summary of Funding Sources

Federal and State Grant Funding Programs

Several funding sources may be available for implementation of recommendations made in Upstate Flood Task Force report. These potential funding sources are discussed in further detail below. Please note that this list may evolve over time as grants expire or are introduced.

I. Federal Grant Funding Programs:

NRCS's Emergency Watershed Protection Program:

Through the Emergency Watershed Protection (EWP) program, the USDA 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/wps/portal/nrcs/main/national/programs/landscape/ewpp/

NRCS's Floodplain Easement Program:

Through the Floodplain Easement (FPE) Program, NRCS will acquire a floodplain easement from eligible participants on a voluntary basis as an emergency measure to reduce and/or eliminate threat(s) of damage to property. NRCS will pay landowners full fair market value based on an appraisal of the floodplain easement and may provide up to 100% of the restoration costs of the easement. Any land use is potentially eligible for a floodplain easement. Agricultural land, land with/without structures and communities with residential properties are eligible if: (1) The floodplain lands were damaged by flooding at least once within the previous year or have been subject to flood damage at least twice within the previous 10 years; or (2) other lands within the floodplain would contribute to the restoration of the flood storage and flow, erosion control, or that would improve the practical management of the easement; or (3) lands would be inundated or adversely impacted as a result of a dam breach. Floodplain Easement | Natural Resources Conservation Service (usda.gov)

FEMA's Building Resilient Infrastructure and Communities (BRIC) Program:

Building Resilient Infrastructure and Communities (BRIC) will support states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program guiding principles are supporting communities through capability and capacity building, encouraging and enabling innovation, promoting partnerships, enabling large projects, maintaining flexibility, and providing consistency. https://www.fema.gov/grants/mitigation/building-resilientinfrastructure-communities

FEMA's 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's 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 Special Flood Hazard Areas (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

FEMA's Safeguarding Tomorrow through Ongoing Risk Mitigation Act (STORM Act):

The STORM Act allows FEMA to award capitalization grants for eligible entities to make funding decisions and award loans directly to local communities. Loan recipients must have an approved hazard mitigation plan. These loans will allow local jurisdictions to reduce vulnerability to hazards, foster greater community resilience and reduce disaster suffering. Safeguarding Tomorrow Revolving Loan Fund Program | FEMA.gov

Community Development Block Grant Disaster Recovery Grant Funds:

Community Development Block Grant Disaster Recovery (CDBG-DR) grant funds are appropriated by Congress and allocated by federal Department of Housing and Urban Development (HUD) to rebuild disaster-impacted areas and provide crucial seed money to start the long-term recovery process. These flexible grants help cities, counties, Indian tribes, and States recover from Presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. Since CDBG-DR assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods

that otherwise might not recover due to limited resources. CDBG-DR funds may also be used to match other federal resources. CDBG-DR Grantee Contact Information - HUD Exchange

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 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.

- 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.

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 post flood response. USACE assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. Furthermore, the USACE can loan or issue supplies and equipment once local sources are exhausted during emergencies.

II. New York State Grant Funding Programs:

As part of New York's efforts to improve the business climate and expand economic growth, the NYS Consolidated Funding Application (CFA) was created. The CFA allows applicants to access multiple state funding sources through one application, making the process quicker, easier, and more productive. https://apps.cio.ny.gov/apps/cfa/

All New York State grants are 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/

DEC's Water Quality Improvement Program (WQIP):

The Water Quality Improvement Project (WQIP) program is a competitive, statewide reimbursement grant program open to local governments and not-for-profit corporations to implement projects that directly improve water quality or aquatic habitat or protect a drinking water source. This funding is for construction/implementation projects. Eligible projects include non-agricultural nonpoint source abatement and control and include green infrastructure practices, stormwater retrofits, streambank/shoreline stabilization and riparian areas and stream culvert repair and replacements to improve water quality, aquatic connectivity and reduce flooding. Water Quality Improvement Project (WQIP) Program - NYS Dept. of Environmental Conservation

DEC's Non-Agricultural Non-point Source Planning Grant Program:
The Non-Agricultural Nonpoint Source Planning Grant (NPG) program is a competitive, reimbursement grant program that funds planning reports for nonpoint source water quality improvement projects. The program aims to prepare nonpoint source projects for construction and application for implementation funding for green infrastructure, stormwater retrofits, streambank/shoreline stabilization, comprehensive stream corridor assessments, stream sediment and debris management plans and stream culvert repairs and replacements. Non-Agricultural Nonpoint Source Planning and MS4 Mapping Grant - NYS Dept. of Environmental Conservation

DEC's Mohawk River Watershed Grants Program:

DEC's Mohawk River Basin Program offers grants to assist local partners fund projects designed to support the goals and objectives of the Mohawk River Basin Action Agenda. Under this grant program, grants are available for projects that will promote flood hazard risk reduction and enhanced flood resiliency of Mohawk River watershed communities.

Other eligible project types are: projects designed to reduce point and nonpoint source pollution within the watershed; projects that seek to conserve, protect or enhance fish, wildlife and associated aquatic and riparian habitats within the watershed; and projects that improve stewardship within the Mohawk River watershed through creating and fostering partnerships and stakeholder engagement through education, outreach and collaboration.

Grant awards ranging from $15,000 to $50,000 are available, and all projects must have defined measurable project objectives, tasks and deliverables that can be completed within a two-year contract term and be located within the geographic boundaries of the Mohawk River watershed.

DEC/EFC's State Septic Repair and Replacement Program:

Cayuga Lake is specifically identified in EFC/DEC's State Septic Repair and Replacement Program. Cayuga, Tompkins and Seneca Counties are all currently participating in the program.

New York State Bond Act:

The 2022 Bond Act is currently under development and will address various types of flood mitigation activities. This includes, but may not limited to the following: flood buyouts; structure elevations; floodproofing; culvert upgrades; dam removals; and floodplain and wetland restoration. Additional information will be included as program further develops.

DEC's Climate Smart Communities:

Climate Smart Communities (CSC) is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Implementation grants of between $50,000 and $2,000,000 are available for GHG mitigation and climate change adaptation projects. Eligible adaptation projects are that: (1) increase natural resiliency to future flood risks, e.g., through living shorelines and nature-based landscape features; (2) relocate or retrofit critical infrastructure to reduce future flood risks; (3) replace or right-size flow barriers to facilitate emergency response or protect people, infrastructure, and natural resources; (4) address anticipated future extreme heat conditions, e.g., through the creation of community cooling centers; and (5) Improve emergency preparedness and response systems (excluding radio communication systems) for anticipated future extreme climate conditions. Climate Smart Communities Grants Fact Sheet (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

DOT's 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

DOS's Local Waterfront Revitalization Program (LWRP):

New York State Department of State's LWRP works with communities across New York State to address local and regional (coastal and inland) waterway issues, improve water quality and natural areas, guide development to areas with adequate infrastructure and services away from sensitive and vulnerable resources, promote public waterfront access, and provide for redevelopment of underutilized waterfronts. Projects typically funded through LWRP include public access, flooding, erosion, waterfront revitalization, ecological restoration, green infrastructure, water quality, resilience, habitat restoration, climate change, culverts, invasive species, wetlands, nature based solutions, nonpoint source pollution, harmful algal blooms, and shoreline/streambank stabilization. Local Waterfront Revitalization Program | Department of State (ny.gov)