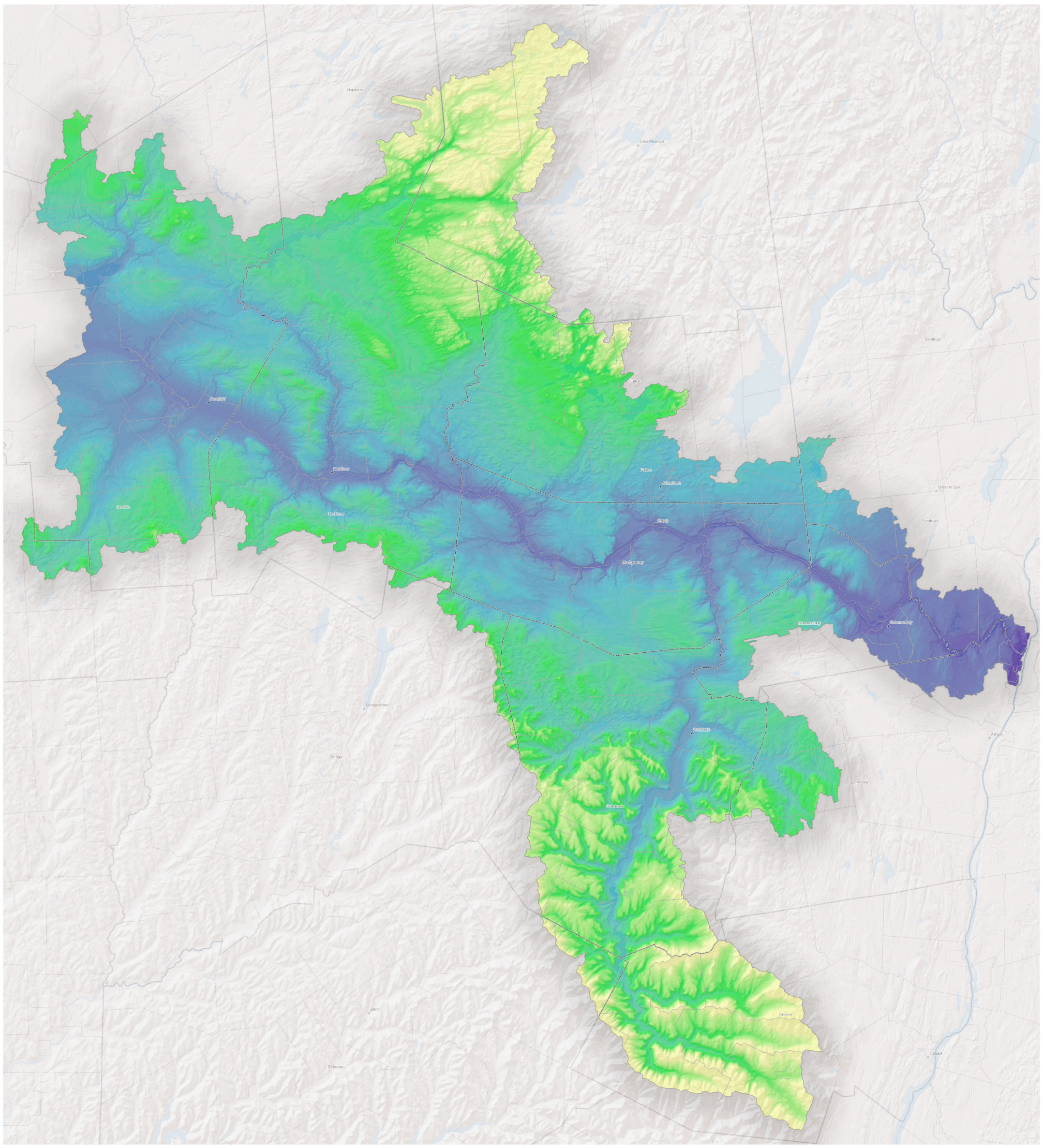
Mohawk Watershed Symposium 2014



Abstracts and program

College Park Hall, Union College
Schenectady NY
21 March 2014

Mohawk Watershed Symposium

2014

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College Park Hall
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Edited by:
J.M.H. Cockburn and J.I. Garver

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On the cover: Topography of the Mohawk Watershed from the new GIS interactive website of the basin. For the first time, anyone can use GIS layers for the entire basin. Layers include topography, roads, wetlands, flood zones, and other important features in the watershed. This is from http://mohawkriver.stone-env.net

PREFACE

Welcome to the 6th Annual Mohawk Watershed Symposium where we explore recent advances in understanding the scientific, engineering, and political issues surrounding the water quality, flooding, water rights, and the ecology in this basin. This is a unique conference, partly because few watersheds enjoy such annual attention. But it is also unique because the informal setting and accessibility of the format has leveled the playing field and allows for equal participation by all stakeholders. From this approach we learn of new Federal and State funding initiatives, but we also learn of the struggles and successes of small non-profit and educational efforts that are making a difference in the Watershed. Thus the conference has evolved into a unique forum where all stakeholders have equal footing.

The Symposium is about exchanging ideas, re-engaging with colleagues, and learning about new issues. A key to this has been the poster presentations and talks, which have accompanying abstracts in this volume. Including this year's schedule, we have had nearly 200 talks and posters focused on issues within and related to the Mohawk Basin. As in the past, this abstract book is the written record of this incredible effort, and these books have an amazing amount of knowledge produced about a watershed. This and all previous abstract volumes are available from the conference website and we are very pleased to see that abstracts are being used and cited in a whole host of settings. In a larger sense, the Symposium is about the translation and transfer of information, and this volume is part of that transfer.

This year our keynote speaker this year is Laura Rose Day, Executive Director of the Penobscot River Restoration Trust Maine. Restoration of the Penobscot River, which is ongoing, is the most significant river sea-run fisheries restoration project ever undertaken in the United States. It is among the most important efforts in the modern era to restore a declining and depleted sea-run fishery. Her determination and perseverance to promote healthy waterways, re-establish fish passage, and foster a positive and valued public view of rivers in Maine is inspirational. We are also pleased to feature invited speakers to start and finish each of the four sessions. Our invited speakers represent interests within and from around the Mohawk Watershed and work to shape this year's program. We are indebted to Congressman Paul Tonko (NY-20) for his continued support of this effort. Union College and the NYS DEC continue to be primary sponsors of this effort, and their continued support help to make the Symposium a success.

As spring begins throughout the watershed, it is fitting that we gather at Union College, near the banks of the Mohawk River to engage in issues that reach across the basin and over the past year. Leading up, throughout and following the annual Mohawk Watershed Symposium, each of us is working toward the larger goal of understanding our landscape and building capacity for resilience and future challenges. For many, the Mohawk Watershed Symposium is an important opportunity to connect with stakeholders from the watershed. While others may meet more frequently, the key is the connection. This time and space is important, everyone is able to engage, debate, discuss, and collaborate with others around issues that matter to them and to the Mohawk Watershed.

Each spring the snow and ice melt, the waters in the streams and rivers rise, and the ice will jam. There will always be flooding, extreme storms and the strong community leadership ensures resilience during these events. The challenges that face the basin in the next decade or so will likely be about water use, infrastructure changes – dams, hydroelectric projects – and how these will impact water quality, flooding, fish habitat and passage. What knowledge needs to be mobilized next? What role do you play in making this happen?

There is nothing quite like the Mohawk Watershed Symposium. This forum allows for young researchers to meet with the policy-makers and community leaders. Where the citizen scientist, meets with the scientist citizen. Like a river in a watershed, the Symposium captures the intellect and passion capital of the Mohawk Watershed and brings it together. This is what is exceptional about our watershed, it is this landscape, this place and time that we dedicate to a strong discourse on the issues and challenges within the basin – this is why we are here today.

Jaclyn Cockburn
University of Guelph

John I. Garver
Union College

Major Financial support for MWS 2014

Redefining Liberal Education for the 21st Century. Founded in 1795, Union College was the first college chartered by the Board of Regents of the State of New York. We are a small, independent liberal arts college committed to integrating the humanities and social sciences with science and engineering in new and exciting ways.

Major Financial support for MWS 2014

Major Financial support for MWS 2014 was provided by the NY State Department of Environmental Conservation though the Mohawk River Basin Program

The Mohawk River Basin Program (MRBP) is a multi-disciplinary environmental management program focused on conserving, preserving and restoring the environmental, economic, and cultural elements of the Mohawk River Watershed. Through facilitation of partnerships among local, state and federal governments, the MRBP works to achieve the goals outlined in the Mohawk River Basin Action Agenda (2012-2016). The MRBP sees the continuation of the Union College Mohawk Watershed Symposium as an ideal platform for communication among stakeholders at all levels.

The MRBP partners with organizations such as the New York State Water Resources Institute (WRI), a government mandated institution located at Cornell University, whose mission is to improve the management of water resources. This year, through the cooperative relationship between the MRBP and Cornell University (WRI), funding was offered to help support and sponsor the Symposium.

Oral session (College Park) - Registration and Badges required

8:30 AM	8:55 AM	***Registration, Coffee, College Park***
8:55 AM	9:00 AM	**Introductory Remarks** *J. Cockburn, Geography Department, University of Guelph*
9:00 AM	9:26 AM	**A New Tool to Monitor Ice Jam Flooding Along the Mohawk River, Schenectady, NY (invited)** *G.R. Wall*, C. Gazoorian, J.I. Garver*
9:26 AM	9:41 AM	**Predicting Occurrences of Ice Jam Flooding on the Mohawk River at the End of the 21st Century** *S.B. Shaw*, A.M. Ryan*
9:41 AM	9:56 AM	**Potential Synoptic Examination of Paleoflooding in the Schoharie Valley using Sediment, Tree, and Speleothem Cores as Indicators of Wet/Dry Climatic Episodes** *H.R. Bartholomew*, A.J. Bartholomew*
9:56 AM	10:22 AM	**Erosion Mitigation and Habitat Improvement Through Bio-engineering and Natural Channel Design (invited)** *P. Villard*
10:22 AM	11:02 AM	***COFFEE and POSTERS (see below for listing)***
11:02 AM	11:28 AM	**Land-use and River Management Strategies for Reducing Flood Risk & Protecting Water Quality (invited)** *J. Moore*
11:28 AM	11:43 AM	**United States Geological Survey Streamgages in the Mohawk River Watershed** *C. Gazoorian*
11:43 AM	11:58 AM	**Spatial Analysis of Boil Water Advisories Issued During an Extreme Weather Event in the Mohawk-Hudson Watershed** *S. Vedachalam*, M.E. John, S.J. Riba*
11:58 AM	12:24 PM	**An Update of Climate Change Research in New York State (invited)** *M. Watson*
12:24 PM	1:54 PM	**- LUNCH and Poster Sessions - Lunch at College Park**
1:54 PM	2:20 PM	**The Resilient Neighborhood: Flood Mitigation as an Economic Engine (invited)** *R. Hill*
2:20 PM	2:35 PM	**The Clash Between Interest in Preserving Clean Water and Need for Energy Development: Eventual or Avoidable?** *A. Ghaly*
2:35 PM	2:50 PM	**Promoting Resilient Shorelines along the Hudson River Estuary: The Sustainable Shorelines Project** *S. Findlay*, D. Strayer, B. Blair, D. Miller, J. Miller, N. Georgas, A. Rella, E. Hauser, K. Marcell*
2:50 PM	3:16 PM	**A Century of West Canada Creek Water Management: the Case Against the Fragmented Approach (invited)** *T. Zembrzuski*
3:16 PM	3:51 PM	***COFFEE and POSTERS (see below for listing)***
3:51 PM	4:17 PM	**Mohawk River Watershed Management Plan: Final Steps to Plan Completion and Progress Toward Phase I Implementation 2014/2015 (invited)** *D.A. Mosher*, P.M. Nichols, W. McIntyre*
4:17 PM	4:43 PM	**Place-Esteem as the Foundation for Stewardship (invited)** *J. Kennedy*
4:43 PM	5:04 PM	**Sustainable Infrastructure on the Mohawk: The Need for Innovation and Investment in Programs, Policies and Projects that Improve our Environment and Promote our Communities** *Congressman Paul Tonko, 20th District of New York*
5:04 PM	5:14 PM	**Headwaters to the Sea: Opening Sea-run Fish Migration** *Laura Rose Day, Executive Director of the Penobscot River Restoration Trust*
5:14 PM	5:19 PM	**Closing Remarks** *J.I. Garver, Geology Department, Union College*

Symposium Reception (Old Chapel) 5:30pm-6:30pm

Old Chapel is on the main part of the campus, limited parking near the building is available

Symposium Banquet (Old Chapel) 6:30pm - 8:30pm, registration and tickets required

Headwaters to the Sea: Opening Sea-run Fish Migration Corridors on Maine Rivers and Breaking Down Barriers to Large-scale Restoration

Laura Rose Day, Executive Director of the Penobscot River Restoration Trust

Poster session (all day)

P1	**Microplastics in the Mohawk-Hudson Watershed** *B. Barry, J.A. Smith*
P2	**The Need for Analysis of the Impact of Discharge, on August 28, 2011, of Three Flood Control Dams at the Headwaters of the Batavia Kill on Infrastructure in the Schoharie Valley** *H.R. Bartholomew, R. Price*
P3	**Identifying Erosion Hazard to Municipal Infrastructure: Preparing for Extreme Events** *J. Cleveland, K.E. Moore, J. Kusler*
P4	**Runoff Regimes in Schoharie River** *J. Cockburn, J.I. Garver*
P5	**The One Hundredth Anniversary of the Record Flood at Schenectady on the Mohawk River** *S.N. DiRienzo, B. Westergard*
P6	**Insight from Ice Jams on the Lower Mohawk River, NY** *J.I. Garver*
P7	**GIS Illustrations of the Potential Effects of Hydrofracking Technology on Water Resources in New York State** *A. Ghaly*
P8	**Monitoring the Hudson and Beyond with HRECOS (Hudson River Environmental Conditions Observing System)** *G.M. Lemley, A.M.Onion, A.J. Smith*
P9	**After the Flood: Impact of Hurricane Irene & Tropical Storm Lee on Schoharie Creek Tributaries** *E. Malone, A. Zerbian, M. Cornwell, B. German, P. Nicols*
P10	**Prediction Model for the Water Discharge Time Series in Mohawk Watershed, NY** *A. Marsellos, K. Tsakiri*
P11	**Improving Water Quality in the Mohawk River Basin through Expanding Community Based Stream Monitoring Teams and Riparian Recovery Activities on the Schoharie and Mohawk Watershed** *J.M. McKeeby and Schoharie River Center Students*
P12	**WAVE is coming to the Mohawk Basin in 2014** *A. Onion*
P13	**Sediment Mobilization in the Schoharie Watershed** *J. Van Patter, J. Cockburn, J.I. Garver*
P14	**A Management Plan for the Mohawk River Watershed: Engaging the Community** *A.T. Vawter, E.C. Moran, L.Wagenet*
P15	**Analyzing the Spatial and Temporal Slope Instability Patterns at the Burtonsville, N.Y. Landslide Using Dendrogeomorphological Approaches** *M. Vetta, J. Cockburn, J.I. Garver*

KEYNOTE SPEAKER

Laura Rose Day, Executive Director of the Penobscot River Restoration Trust

Laura Rose Day of Hollowell Maine is the Executive Director of the Penobscot River Restoration Trust. She has degrees in wildlife management, and in environmental and energy law.

She was the Watershed Program Director at the Natural Resources Council of Maine and she helped found Maine Rivers, and was instrumental in the removal of the Edwards Dam on the Kennebec River. Nearly a decade ago she oversaw acquisition of the Great Works, Veazie, and Howland Dams, and today only the Howland Dam remains, but it is slated for bypass in 2015.

For nearly twenty years she has worked to ensure the health of river ecosystems and in this time she has been Counsel for the U.S. Environmental Protection Agency, and worked for the National Wildlife Federation's Lake Superior and Biodiversity Programs, and the Watershed Program Director for the Natural Resources Council of Maine.

The Penobscot River Restoration Trust is a non-profit organization working to create sustainable native sea-run fisheries on the Penobscot River for people and wildlife. In 2008 the Penobscot River Restoration Project was awarded a Cooperative Conservation Award from the U.S. Department of the Interior.

Restoration of the Penobscot River, which is ongoing, is the most significant river sea-run fisheries restoration project ever undertaken in the United States. It is among the most important efforts in the modern era to restore a declining and depleted sea-run fishery.

In a recent interview, she noted: "Ultimately, we were able to get everyone to look at all of the Penobscot River's values — energy, paddling, culture, fisheries — and say, how can we maximize all these gifts? The commitment that people had to not always lead with their own interest but to step back and consider the greater common good was key."

In 2013 she was named as recipient of the Lee Wulff Atlantic Salmon Conservation Award by the Atlantic Salmon Federation.

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NOTES:

MICROPLASTICS IN THE MOHAWK-HUDSON WATERSHED

B. Barry and J. A. Smith
Department of Physical and Biological Sciences, The College of Saint Rose, Albany, NY 12203

Many producers of cosmetics and hygiene products in the United States have replaced natural exfoliants in their products with tiny plastic beads made of polyethylene (Fendall, 2009; Barry and Bach, 2013). These microscopic particles are less than 1 mm in diameter, making products that contain them a potential source for contamination of water bodies that receive wastewater (Andrady, 2011). Because of the microscopic size of these particles it may be possible for them to escape through the filtration systems of wastewater treatment plants. The purpose of this project is to determine whether microplastics are passing through processing and being released into waterways in New York State. If microplastic particles end up in the environment, they are small enough that ingestion by marine wildlife is possible (Cole et al., 2011), presenting a risk to the health of the food chain.

The first stage of the research project focused on microplastic contamination in the lower Mohawk River and in the Hudson River near Albany. The plan was to collect samples of water directly from the rivers and analyze the samples to determine whether microplastic particles were present. The overall goal was to quantify microplastic pollution in the waterways and assess the threat to the environment.

Fieldwork started with identification of sample sites. Locations were chosen based on river access and proximity to other sites. Samples were collected at 17 sites between Selkirk and Utica (Table 1, Figure 1). Samples were taken from the Hudson River at Selkirk, Albany, Green Island, and Troy. Samples were taken from the Mohawk River at Waterford, Scotia, Glenville, Niskayuna, Dunsbach Ferry, Rotterdam Junction, Amsterdam, Fultonville, Canajoharie, St. Johnsville, Little Falls, and Mohawk. Lowering 5-gallon buckets into the water and vertically extracting the bucket, which typically contained from 3 to 5 gallons of water, accomplished sample collection. Keeping the bucket vertical was imperative to prevent the loss of floating particles. The bucket was then poured through a stack of sieves. The water had to be poured slowly to prevent the sieves from clogging and overflowing. The stack of sieves contained individual sieves with 2.0, 1.0, 0.5, 0.25, 0.125, and 0.063 mm screens. The material captured in the 1.0 mm and 2.0 mm sections was discarded, and the remaining fractions were separated and rinsed into airtight containers for transport. Four containers total were collected from each site.

Initial visual analysis exposed some small pieces of non-organic material (Figure 2). Because these samples were collected in the summer months, a high percentage of the material collected was organic. This presented a challenge for identifying plastic particles both quantitatively and qualitatively. Drying the samples resulted in a thick layer of solid "scum" that was nearly impossible to scrape off the evaporating dish. Separation by density also proved ineffective. The polyethylene used in cosmetics is considered low-density polyethylene (LDPE) and has a density of ~0.41 g/cm^3, which is similar to the density of much of the floating algae and other organic debris. We plan to use the hot peroxide method of Mason to remove the organic material (S. Mason, SUNY Fredonia, pers. comm.) and density separation to remove non-plastic sediment. Once the organic material and non-plastic sediment have been removed, the remaining microplastic particulate will be quantified and characterized.

References

Andrady, A.L., 2011, Microplastics in the marine environment: Marine Pollution Bulletin, v. 62, p. 1596 -1605.

Barry, B.T., and Bach, A.E., 2013, Saint Rose Student's Contribution to Microplastic Pollution (poster): Undergraduate Research Symposium, The College of Saint Rose.

Cole, M., Lindeque, P., Halsband, C., and Galloway, T.S., 2011, Microplastics as contaminants in the marine environment: A review: Marine Pollution Bulletin, v. 62, p. 2588-2597.

Fendall, L.S., and Sewell, M.A., 2009, Contributing to marine pollution by washing your face: Microplastics in facial cleansers: Marine Pollution Bulletin, v. 58, p. 1225-1228.

Poster Presentation

POTENTIAL SYNOPTIC EXAMINATION OF PALEOFLOODING IN THE SCHOHARIE VALLEY USING SEDIMENT, TREE, AND SPELEOTHEM CORES AS INDICATORS OF WET/DRY CLIMATIC EPISODES

Howard R. Bartholomew[1] and Alexander J. Bartholomew[2]
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[2]Dept. of Geology, S.U.N.Y. New Paltz, barthola@newpaltz.edu

A unique opportunity for an integrated investigation of prehistoric extreme hydrological events currently exists in middle section of the Schoharie Valley between Blenheim and Schoharie, N.Y., using a multi-proxy approach including lake/bog sediment cores, tree cores, speleothem cores, and pre-European anthropological evidence. It is hoped that an integrated approach such as this may allow for some degree of correlation between intervals of more/less intense flooding (determined from sediment cores) and wetter/drier climatic interval (determined from tree/speleothem cores). Adding into this the history of Native American settlement patterns, these records taken together would provide a unique view into the history of flooding in the Schoharie Valley before recorded history that may be used to predict into the future.

Spring-fed lakes/bogs residing in paleo stream-channels of the Schoharie Creek may provide a detailed record of flood events in the Schoharie Valley through detailed examination of sediment cores. A brief examination of aerial maps indicates the existence of at least 5 such bodies of water between Blenheim and Schoharie, ranging from 0.3-1km laterally removed from the main stream-channel and from 1-10m above the closest level of the river during normal, background flow. These bodies of water are generally only inundated during very high flow events and would therefore record only extreme flood events within the valley. Although it would seem that a 1-3m difference in elevation between these bodies of water and the main stream-channel would result in frequent inundation, being laterally distant from the river and existing in paleo stream-channels, these bodies of water are often spared from intermediate flood events by oxbow cutoffs and main stream-channel incision. One such spring of ~300m^2 exists in the northeast corner of the Village of Middleburgh, ~900m from the main stream-channel and ~2m above the nearest level of the river. This spring has been inundated most recently during only the 1955, 1987, 1996, and 2011 floods, the four top floods of historic record within the Schoharie valley.

~500m east of the aforementioned spring in the Village of Middleburgh is that portion of the Schoharie Escarpment known locally as 'The Cliff'. This ridge, rising to an elevation of ~380m, is the eastern side of the U-shaped glacial headwall of the Schoharie Valley. It has a relatively steep talus covered slope leading to a ~10-20m vertical cliff, capped by a slightly less steep, rounded summit. The soils found on The Cliff are of the Lordstown Group, and are generally thin, sandy, and well-drained. On the steep slopes and summit of The Cliff can be found stunted Red Pine (*Pinus resinosa*) and Eastern Juniper (*Juniperus virginiana*). Cores taken from these trees indicate that some specimens are over 500 years old and have the potential to provide annually resolved paleoclimate data, such as precipitation/fire patterns, back to the beginning of the Little Ice Age (1,250BCE). Combining this data with the record of floods and possible datable organic matter from sediment cores immediately proximal to the tree-coring site has the potential to determine whether wetter intervals in the past saw an increase in the number of large floods within the Schoharie Valley.

A third possible component of an examination of paleoclimatic and paleoflood events in the Schoharie Valley is the use of speleothem data from local caves as an additional record of regional past precipitation patterns. Rates of speleothem growth, as well as stable isotopic data, can be used to reconstruct high-resolution temperature and precipitation records with the added potential for radiometric age dates to tie to the tree-ring and lake core records. The abundance of caves within the northern portion of the Schoharie Valley could provide multiple sampling sites allowing for the establishment of a robust paleoclimate record.

Finally, it would be enlightening to compare the relatively well-resolved record of Native American inhabitation within the Schoharie Valley to paleoclimatic and paleoflood data from the immediate area. Based upon C^{14} dates, Native Americans moved into the Schoharie Valley sometime before 7,000BCE. Archeological evidence suggests that permanent settlements existed in the Schoharie Valley until about

~1,525AD, after which there is a paucity of artifacts suggesting a vacation of the area until ~1,700AD, with a resettlement occurring only a few years before the establishment of European settlement in the valley. It would be most interesting to see if a connection could be made between paleoclimate/flooding patterns and the record of settlement within the valley.

The presence of three, comparable sources of paleoclimatic and paleoflood data, in some cases within a radius of ~5km, offers a unique opportunity to augment our knowledge of past extreme hydrologic events within the Schoharie Valley. While the past cannot be used as an absolute predicate for predicting the future, the information gained through the development of a highly resolved record of paleoclimate and paleoflooding within the Schoharie Valley, beyond the historical record, would enhance our ability to determine if increased precipitation in the future might indicate a greater prevalence of events such as that of the flood of August 28, 2011. The two dams impounding the Schoharie Creek, the NYCDEP Gilboa Dam and the PASNY Blenheim/Gilboa Pumped-Storage Project, have release works that were designed based upon the magnitude of known past historic floods. Should combined paleoclime/paleoflooding records indicate a correspondence between previous wetter intervals and intervals with frequent, extreme flood events, a review and reassessment of the carrying capacity of the current release works/spillways on these two dams might be necessary.

Volunteered Presentation

THE NEED FOR ANALYSIS OF THE IMPACT OF DISCHARGE, ON AUGUST 28, 2011, OF THREE FLOOD CONTROL DAMS AT THE HEADWATERS OF THE BATAVIA KILL ON INFRASTRUCTURE IN THE SCHOHARIE VALLEY

Howard R. Bartholomew and Robert Price
Dam Concerned Citizens, Inc., P.O. Box 310, Middleburgh, NY 12122

In response to the severe flood damage and loss of life sustained by the Town of Windham, Greene County, New York in September of 1960, due to Hurricane Donna, three flood control dams were built at the headwaters of the Batavia Kill in the town. In a further response, the Greene County Legislature also adopted a local ordinance creating the Greene County Soil and Water District. This agency subsequently created a flood control district to oversee the construction and operation of the three dams. The dams and relevant data are shown in Table 1.

Table 1: Flood control dams located in Windham, New York

Site Number	Site Name	Drainage Area	Dam Height	Storage Capacity (rainfall)
1	C. D. Lane	9.6 mi^2	69.3 ft.	4.86 in.
3	Nauvoo Road	3.6 mi^2	60 ft.	4.20 in.
4A	Mitchell Hollow	6.8 mi^2	53.4	4.05 in.

These dams were designed to safely handle and discharge runoff from a storm event with a 1/100 return interval. The discharge attenuating capacity and consequent flood mitigation benefits of the three structures was demonstrated during the snowmelt/rain-induced flood of January 19, 1996. The response of these dams to the rain of Hurricane/Tropical Storm Irene on August 28, 2011, was much less satisfactory, when compared to the January 1996 event. The storage capacity of the dams, as measured in inches of rainfall for a twelve-hour period was exceeded by a factor of more than three, on Sunday, August 28. Fortunately, none of these dams failed in response to an excessive amount of rain, far exceeding their design capacity.

However, all three dams sustained severe structural damage. This damage was the cause of great apprehension when Tropical Storm Lee approached the Catskills, shortly after Hurricane Irene's disastrous impact upon the region. All three dams contained emergency auxiliary spillways. These erodible features are designed to allow water to exit the impoundment, in a controlled manner, should rainfall greatly exceed the structures sub-surface release works, a culvert, of known carrying capacity. The purpose of erodible auxiliary spillways is to prevent overtopping of the earthen flood control dams, causing a total dam failure. The Nauvoo Road and Mitchell Hollow dams experienced severe erosion on the extremities of their berms. The C. D. Lane/Maplecrest Dam had the latter as well as erosion of its emergency auxiliary spillway. This was due, in no small part, to the fact that the C. D. Lane Dam impounded nearly a full pool on August 28. Initially designed as a flood control structure, and intended to be kept empty, the C. D. Lane/Maplecrest reservoir had been coopted as a scenic park, and its culvert had been closed to create a small lake used for recreational purposes. Thus, the very purpose of the dam, and an empty catchment basin was abandoned during the summer months. Unfortunately, floods can and do appear at all seasons of the year. It is probable that whatever economic gain was derived from the dam's recreational use was exceeded by the cost of having its basin nearly full in this instance. Not all infrastructure lends itself well to multiple usage. Flood control structures should be dedicated solely to the purpose for which they were designed.

Of perhaps greater consequence is the question of what was the impact of the sudden discharge of these three dams on the Schoharie Valley. The discharge maximum for August 28, 2011, as measured at Red Falls (USGS gage 0133349950) on the Batavia Kill was 44,200 cubic feet per second (CFS). On January 19, 1996, it was 16,400 CFS at the same site. This epic flow then made its way down the Schoharie Creek passing through Prattsville, the Schoharie Reservoir, over the Gilboa Dam and on to the Blenheim-Gilboa Hydroelectric Power Station, owned and operated by the Power Authority of the Sate of New York

(PASNY). To the present, no timetable or temporal sequence of events has been either prepared and/or made public regarding the impact of a sudden discharge of additional floodwater downstream of the Batavia Kill on infrastructure in the Schoharie River Valley. The creation of a timeline for changes in the volumetric flow in the Batavia Kill is made more difficult by the defunding and subsequent discontinuance of operation of USGS gage 01349840 at Maple Crest in 2009. Had this gage been in place on that date, obtaining a better understanding of the timing of events would be less complex. Sequencing the volumetric flow at the bridge at Prattsville, USGS gage 01350000, in relationship to the timing of maximum stream flow at Red Falls, should provide much needed information on the time of passage of the water released by the flood control dams at Windham. Observations of the time of individual dam spillage, if available, should be compared to the timing of the maximum flow at Red Falls.

All this data, if still obtainable, could then be correlated to the failure of a 200-foot long by four-foot high temporary plywood bulkhead, located atop the masonry spillway of the Gilboa Dam. This temporary, removable bulkhead, estimated to be capable of sustaining a 24-inch overflow before a failure, was in place to occlude an additional "notch" in the dam's spillway that was cut to allow water to discharge on the eastern end of the dam spillway, allowing work to proceed on the western end as part of the reconstruction project. The 220-foot long, five-foot deep notch, a permanent construction feature located at the western end in the reconstructed dam, has inflatable Obermeyer floodgates installed for spill control. On Sunday, August 28, the plywood bulkhead was in place, and it failed when only 18 inches of water flowed over the spillway. This sudden discharge via an additional, and unintended spillway notch, with a cross sectional area of 800 square feet, permitted a surge of 4,000 CFS to pour over the dam, given an assumed velocity of five feet per second.

Meanwhile, five miles down stream of the Gilboa Dam, owned and operated by the New York City Department of Environmental Protection, lies the Blenheim-Gilboa Hydroelectric Power Station. The Tainter floodgate system at Blenheim-Gilboa relies upon commercial power for operation. Ironically, a commercial power outage occurred at this plant, and a backup power source also failed, in the midst of a flood of epic proportion. With no easily available source of power at the Blenheim-Gilboa earthen dam site with rapidly rising floodwaters, a crisis existed. If the flood gates at Blenheim-Gilboa could not be elevated (opened) in time to prevent overtopping of the earthen dam, an additional five billion gallons of water would suddenly be added to the August 28 flood downstream of Blenheim. Fortunately, a working generator was found and the gate system was elevated to its maximum height. This action averted a disastrous dam failure, but likely caused a sudden surge in stream flow downstream of the hydroelectric power station. Further complicating the flooding was the insignificant storage capacity in the five billion gallon upper reservoir at Blenheim-Gilboa. If there had been a larger void in the upper reservoir some meaningful flood mitigation could have occurred at that site by removing water from the Schoharie Creek and sequestering it in the upper reservoir. It is highly probable that a "domino effect" occurred at Prattsville, the Gilboa Dam and the power station due to the outfall and near failure of the C. D. Lane/Maplecrest dam and its companion structures in the Town of Windham. It is of pressing importance that an accurate sequence of events on the morning of August 28 be reconstructed as accurately as possible. This would provide a better understanding of the dynamics of the flood, and lead to improved mitigation efforts in the future. As the nineteenth century poet and philosopher Wolfgang VonGoethe stated so long ago: "Those who cannot remember their past are condemned to repeat it."

Poster Presentation

IDENTIFYING EROSION HAZARD TO MUNICIPAL INFRASTRUCTURE: PREPARING FOR EXTREME EVENTS

Joseph Cleveland[1], Kathleen E. Moore[2], Jon Kusler[2]
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[2]Town on Berne, NY Conservation Board, Berne, NY

The Town of Berne, in the Helderbergs of Albany County, NY, experienced severe damage as a result of Tropical Storm Irene on August 28, 2011. While flooding during the storm was a significant problem all along the Fox Creek, there was also extensive damage to municipal infrastructure resulting from erosion along roadsides, bridge approaches and small stream crossings. In the summer of 2013 the Town's Conservation Board hired a student intern to begin the process of assessing and mapping erosion hazard in the Town, as part of the effort to adapt to the expected increased frequency of intense rainfall events. Erosion hazard sites identified as resulting from Irene, and from other events, were surveyed and mapped (Figure 1); nearly 80 locations were documented. A conceptual model incorporating several factors--slope, drainage and substrate patterns, stream channel design and roadside ditch management--has been built which is based on observations of each site; the factors are being integrated as layers in a GIS model. The spatial distribution of event-specific rainfall relative to the watersheds in the northern Catskill Mountains, based on the NEXRAD station (KENX) located in the Town of Berne, is being integrated with the observed erosion site distribution to assist in evaluating a conceptual model of erosion hazard.

Recommendations for mitigation and prevention of erosion damage to municipal infrastructure have been tailored to the observed type and distribution of erosion hazard in the Town. An overall goal is to create a basic format for assessing the potential for future erosion hazard.

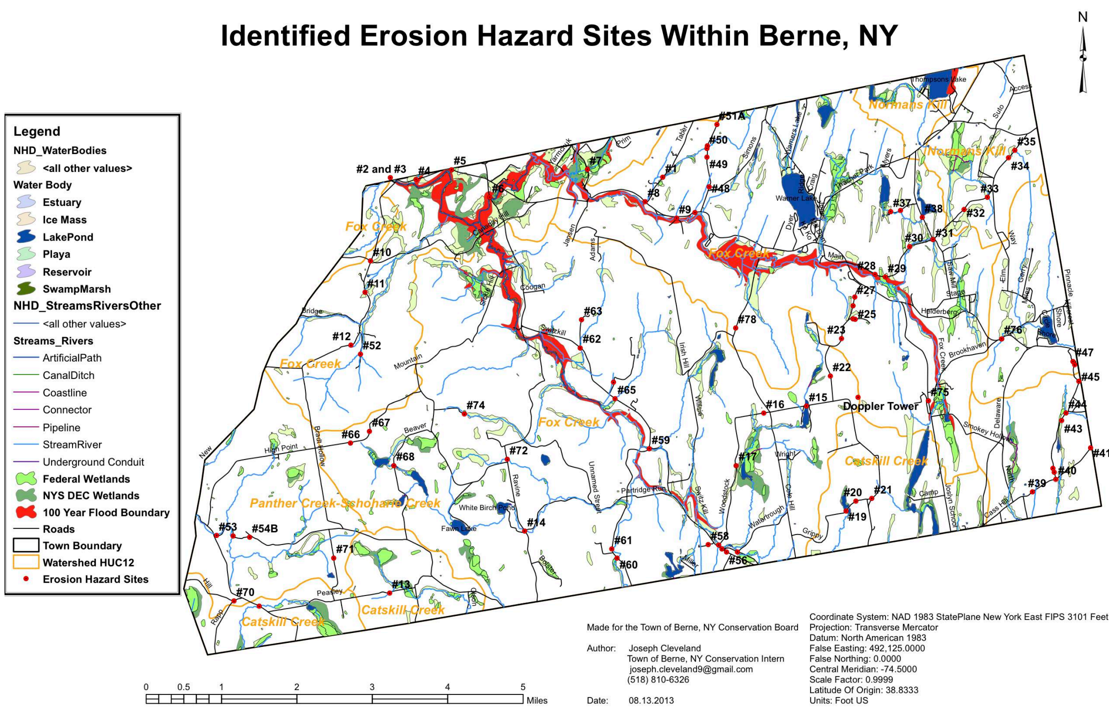

Figure 1: Initial erosion hazard map, showing identified hazard sites in relation to roads, streams, wetlands and floodplains.

Poster Presentation

RUNOFF REGIMES IN SCHOHARIE RIVER

Jaclyn Cockburn[1] and John I. Garver[2]
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Total annual flow in Schoharie Creek, which drains the North Catskills, was above the long-term average for 15 years of the past 20 years. This above average flow has several implications for water resource management and policy decisions, but is not unexpected given predictions by future climate simulations. We hypothesize that the end of the 20th century and early 21st century mark a new runoff regime in the Schoharie Watershed. In order to test our hypothesis, we evaluate the annual flow, center-volume (CV) and winter-spring center-volume (WSCV) dates, and average daily flow for each day within four comparison periods: average conditions (1946-55), below average (1961-68), above average (1971-79) and recent conditions (2003-10; Table 1; Figure 1). Long discharge records were used from two stations on Schoharie Creek. In addition, recurrence intervals of the 2-yr, 5-yr, and 10-yr daily maximum flow calculated for the comparison periods suggests that the magnitude of these events is larger during the recent decade (Table 2). This is most pronounced as the magnitude of the 5-yr event daily maximum flow in the lower Schoharie in the last decade has increased the magnitude of the record-long 10-yr storm (Table 2). This means larger volumes of water are moving through the lower Schoharie more frequently (Figure 2). CV and WSCV analyses reveal that although total annual runoff is greater during the recent part of the study, within year variability is such that the winter, peak flow period, and late summer seasons are distinctly different flow regimes compared with the average regime or the flow regime exhibited in the above-average comparison period in the 1970s (Table 3; Figure 3). Specifically, seasonal differences have led to higher than average winter runoff, shorter peak runoff periods in the spring and in several cases below-average summer and late summer flow regimes. These differences mean that municipalities and water governing bodies may need to re-evaluate management strategies. This new regime is not just a matter of more water all the time, but more water during the high flow period and less water during the low-flow period, essentially exacerbating extremes.

Table 1: Summary statistics for the total annual record and comparison periods for each gauging station evaluated in this study (all units km^3).

Station	Entire Record		Average (1945-1954)		Below Average (1961-1968)		Above Average (1972-1979)		Recent Period (2003-2010)	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
Cohoes	5.27	1.26	5.27	0.68	3.83	0.72	6.53	0.71	6.57	0.82
Prattsville	0.43	0.13	0.41	0.09	0.29	0.07	0.54	0.12	0.57	0.07
Burtonsville	1.00	0.44	0.83	0.24	0.58	0.24	1.30	0.28	1.37	0.16

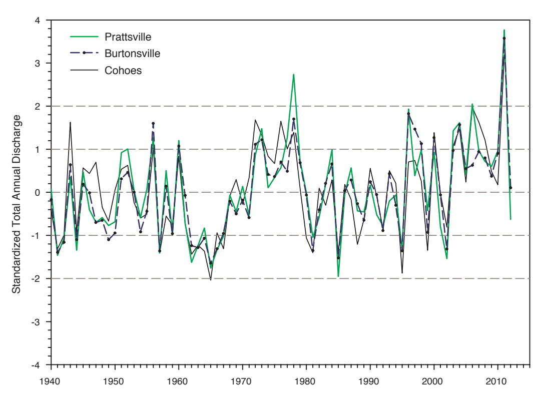

Figure 1: Standardized annual discharge (km^3) on Schoharie Creek at Prattsville (solid black line), Schoharie Creek at Burtonsville (dashed light gray line) and Mohawk River at Cohoes (dotted line). Flow at the Cohoes station is shown for reference.

Table 2: Magnitude of common recurrence intervals during overlapping records and through comparison periods

Time Period	1940-2012	Average 1945-1954	Below 1961-1968	Above 1972-1979	Recent 2003-2010
Burtonsville					
2-yr Magnitude*	592	532	498	807	966
5-yr Magnitude*	994	810	728	1005	1249
10-yr Magnitude*	1249	-	-	-	-
Prattsville					
2-yr Magnitude*	433	306	281	702	589
5-yr Magnitude*	776	799	379	776	821
10-yr Magnitude*	1212	-	-	-	-

* Magnitude is reported is m^3/s for the value closest to the recurrence interval from the record, for example in some cases the 2.25 RI is used

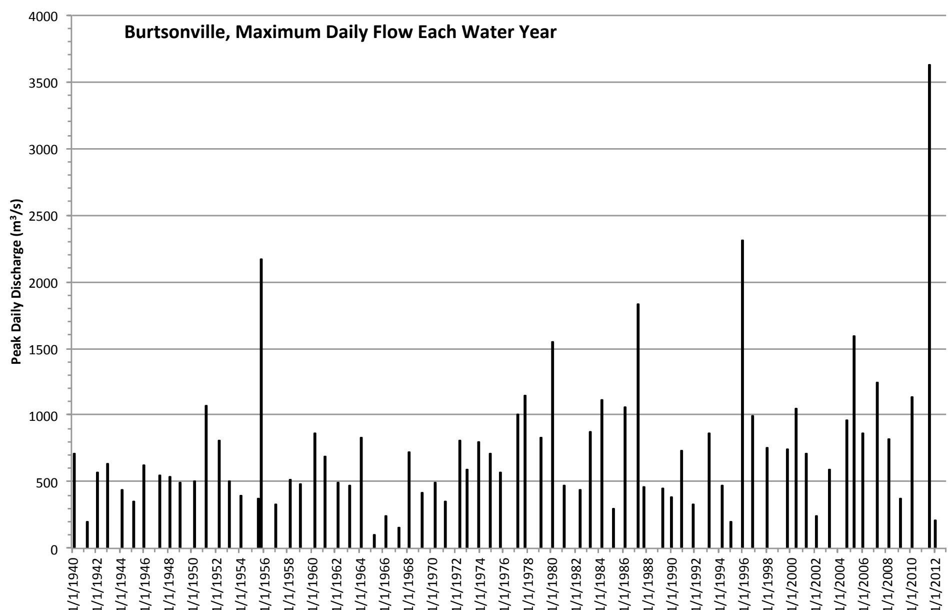

Figure 2: Maximum daily flow each year on Schoharie Creek at the Burtonsville gaging station. The lower part of the Schoharie Creek (Burtonsville) has had higher maximums since the 1970s.

Table 3: Center-volume (CV) and Winter-Spring Center-volume (WSCV) date and standard deviations

CV dates and standard deviations								
Station	Average		Below Average		Above Average		Recent	
Prattsville	164	± 21	175	± 13	157	± 28	156	± 18
Burtonsville	168	± 19	180	± 9	165	± 28	159	± 18
Cohoes	170	± 14	180	± 11	167	± 22	161	± 10
WSCV dates and standard deviations								
Station	Average		Below Average		Above Average		Recent	
Prattsville	174	± 15	177	± 10	172	± 12	169	± 17
Burtonsville	173	± 15	180	± 9	178	± 11	167	± 19
Cohoes	174	± 11	179	± 6	177	± 9	170	± 10

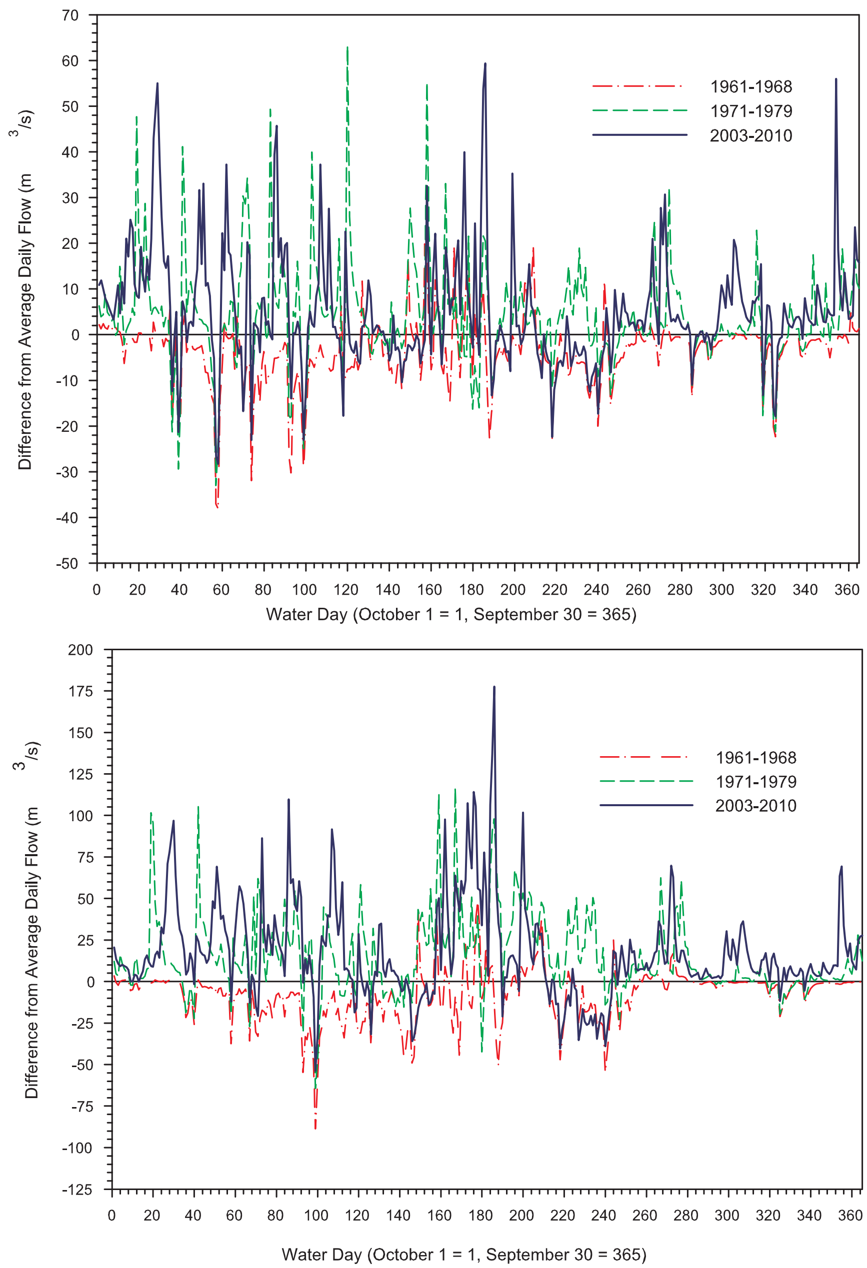

Figure 3: The difference between mean daily flow during comparison periods and the average comparison period (1946-1955). Below-average (1961-68), above-average (1971-79) and recent (2003-2010) comparison periods are shown for (a) Prattsville and (b) Burtonsville gaging stations respectively.

Poster Presentation

The One-Hundredth Anniversary of the Record Flood at Schenectady on the Mohawk River

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The record flood on the Mohawk River at Schenectady, New York occurred on 28 March 1914. This flood was accompanied by large ice floes and ice jams which did considerable damage to local infrastructure. More recent damaging floods with ice floes and ice jams occurred at Schenectady in January of 1996 and March of 2007.

This work looks at the daily weather as measured at Albany, New York (the nearest long term climatological site) during the winters of 1913-1914, 1995-1996, 2006-2007 and 2013-2014. Estimated river ice thickness was simulated for each winter using the modified Stefan equation outlined by the U.S. Army Cold Regions Research and Engineering Laboratory (USACE, 2002). Simulated ice thicknesses are compared with photos from each event showing ice thickness, and with United States Geological Survey (USGS) records. The simulated ice thicknesses are fairly accurate based on the observational evidence. A complicating factor is snowfall during the ice accumulation period. According to observational evidence, greater snowfall during this period leads to thicker river ice.

References

USACE (2002) Engineering and Design: Ice Engineering. U.S. Army Corps of Engineers Engineer Manual 1110-2-1612.

Poster Presentation

Promoting Resilient Shorelines along the Hudson River Estuary: The Sustainable Shorelines Project

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The Hudson River Sustainable Shorelines Project is providing science-based information about various shoreline management options and their ability to preserve important natural functions of the Hudson River Estuary's shore zone. The project findings have applicability to the Mohawk River in that the pressures for shoreline modification, engineering options and the decision processes are similar. The Sustainable Shorelines project has assembled data on the physical context and human usage which drive the selection of construction options along with an assessment of ecological values associated with different types of shorelines to more fully inform decisions about construction and repair. A high-resolution hydrodynamic model provides information on currents and waves and other physical parameters for any given segment, combined with historical records of ice extent help determine a suite of possible shoreline options. Field data on a wide array of physical and biological attributes help quantify which ecological functions are enhanced or diminished by various choices of shoreline treatment. Many of the individual elements of the Sustainable Shorelines Project are complete and available on-line (http://www.hrnerr.org/hudson-river-sustainable-shorelines/). In addition to information directly relevant to the decision process we have assembled a network of demonstration sites to increase confidence that some of the less traditional approaches are suitable and we have developed a Rapid Assessment protocol to enable local officials, conservation advisory council members and property owners to determine how well their current shoreline is performing. An advisory committee comprised of engineers, regulators, state agency and municipal officials serve as the reality-check on both the information collected and approaches for explanation and dissemination. Shorelines throughout the Mohawk and Hudson drainages are being actively modified to support development, revitalize waterfronts, provide erosion control, and increase public access. These modifications can significantly affect how shorelines perform as habitats for fish and wildlife. The Project is supported by the National Estuarine Research Reserve System Science Collaborative, a partnership of the National Oceanic and Atmospheric Administration and the University of New Hampshire.

Volunteered Presentation

INSIGHT FROM ICE JAMS ON THE LOWER MOHAWK RIVER, NY

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Ice jams are an annual occurrence on the Mohawk River (NY). Historically, river breakup and potential jamming occurs in mid to late March, although a number of important mid-winter events have occurred in the last several decades (Garver and Cockburn, 2009). Ice jams are relatively common on northern rivers, but the lower Mohawk River is particularly vulnerable to ice jams because several key features that result in chronic problems in a 25 km stretch (~15 miles) between Lock 9 and Lock 7. The City of Schenectady is in the middle of this section of the river, and therefore the low-lying areas in the city face a significant and unique hazard that is challenging for Emergency Management.

Three primary ingredients make this part of the river prone to ice jamming. First we can show that many ice-out events are linked to significant discharge from headwaters, especially from the Catskill-draining Schoharie Creek. This north-draining river can have significant discharge before other more northern parts of the watershed especially in weather systems with south-to-north warming and heavy precipitation that hugs the Atlantic Coast. Second, we know that much of the Mohawk River is relatively flat with a low gradient, and thus a large volume of sheet ice is produced in the winter, and this ice produces the largest and most durable blocks for the initiation of ice jams. Third, the lower section of the Mohawk River has an unusual set of constrictions on the flood plain, both natural and man-made. This latter point is important because although some aspects of the hazard can be remediated, there is a large natural constriction at the Rexford Knolls. The Knolls are marked by high bluffs, a deep channel, and no floodplain from the Rexford Bridge to near the Vischer Ferry Dam (Lock E7). This section of the river is relatively young having been captured forcing abandonment of the more northerly course (north up the current Alplaus channel) at about 10 ka. A number of artificial barriers and constrictions include bridges and abutments (both active and abandoned).

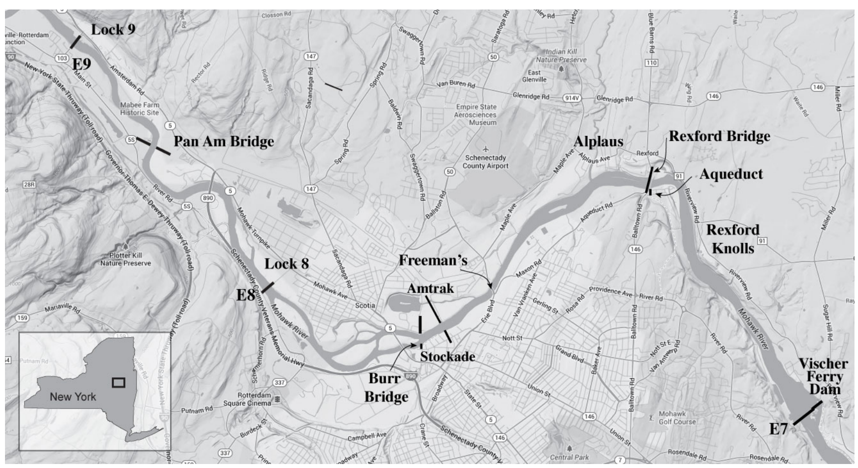

Figure 1: Map of key features related to ice jamming on part of the lower Mohawk River (NY).

Breakup involves ice floes that commonly form ice jams that occur when moving ice gets stuck due to flow reduction at constrictions, and relatively still, slow-moving water from impoundments. Historically we know that ice out and ice jams occur on the rising limb of the hydrograph, when the floodwaters are building (Fig. 3). When flow starts to rise it is not uncommon for unimpeded ice runs to develop, but invariably the ice gets blocked along the way by constrictions in the river, especially where the flood plain is reduced in size. Here we review several key events that are instructive for understanding this hazard on the lower Mohawk.

1914 – 27-28 March: One hundred years ago the lower Mohawk saw the worst ice jams and most disastrous flooding in the history of Schenectady. Flooding was preceded by a 32" blizzard, which was then followed by a significant thaw with temperatures of 75°F. This was a regional event with flooding and damage reported on the Mohawk, Susquehana, Chumung, and other rivers in the Northeast (NY Times, 29 March, 1914). The flood stage on the Mohawk in Schenectady reached its crest at 23.5 feet (236.5), inundating many low-lying areas, including the Stockade. While do not have a direct record of ice jamming in this event, it is clear from detailed accounts that high water was caused by a spectacular ice jam (Schenectady Gazette, 30 March, 1914). At 2 AM on Saturday 28 March, floodwaters were rising and it would appear that the initial jam had formed downstream from Schenectady and water levels in the City had risen to 16.5'. Between 2 and 4 AM, water levels rose rapidly, and by 5 AM evacuation started in the low areas. It is suggested that at 6 AM, an upstream ice jam broke loose and that water and ice added to the already high water in the Schenectady pool (above Vischer Ferry dam) that was blocked by a jam in the Rexford Knolls. Water levels were about 19' by about 9 AM, and by 1120 AM water behind the jam was near maximum. In the morning, the ice destroyed the Freeman's bridge, the Rexford Bridge, and the Scotia Bridge was damaged. The jam broke loose between 1120 and 1145 AM, when water levels reached 23.5' in Schenectady. In this event the ice pack was thick, with slabs reported to be between 16" and 24". It is clear from the accounts that the main jam occurred in the Rexford Knolls, which has been a common jam point. Given this time line, it would seem that the ice jam had a lifespan of about 9 ½ hours.

1964 – 6 March: This event is remarkable because there was an exceptionally rapid build up behind a single ice jam, and then a very large release wave followed (Scheller et al., 2000). Peak discharge was 143,000 cfs with a mean flow of 77,500 cfs on the 6th of March. Heavy rain and unseasonably high temperatures drove the event. Ice Jams formed in the Schenectady area at Lock 8 and then a large ice jam formed at the Northway Bridge. The ice jams lasted only a couple hours, and ice was relatively thin due to the mild winter. What is notable about this event is that it resulted in the highest instantaneous discharge measured on the Mohawk (143k cfs), which is undoubtedly related to the release wave following failure of the ice jam. We've recently digitized the USGS analog record of this event (see Fig. 3). The pattern of discharge suppression followed by a surge is characteristic and diagnostic of ice jam release.

1996 – 19-20 January: The January 1996 flood had the most significant and damaging ice jams in recent history (Garver and Cockburn, 2009; Lederer and Garver, 2001). This mid-winter breakup resulted in flooding, especially on the Schoharie Creek. The event had a mean discharge for the day on the Mohawk of 92 k cfs with a peak discharge of 132 k cfs, and flooding resulted in extensive inundation of the Stockade in Schenectady. Peak discharge downstream at Cohoes can be attributed to a release wave from an ice jam that formed in the Schenectady pool.

Little was known at the time of the ice jam point and maximum backup during this event, and this is partly because most of the action occurred at night. However, later forensic work using scarring on bank-linking trees allowed for reconstruction of events in the evening between 19 and 20 January (Lederer and Garver, 2001). Scarred trees, which are still visible nearly 20 years later, indicate that Schenectady missed the main flooding and damage that might have occurred in this event if the front of the jam had been slightly down stream. The highest ice-scar elevations occur between Lock 8 and the Stockade area in Schenectady, and abrasion on trees downstream from the Stockade are much lower. Although two possible jam points are inferred from the data based on abrupt downstream elevation changes, the most significant and largest jam occurred just upstream of the Stockade, and the inference is that the major channel constriction from the old Burr Bridge (now just abutments remain) was responsible for the ~10 foot increase in abrasion levels. At Lock 8 (E8), scars on trees are 17-22 feet above river level (and generally 8-10' below the Stockade), thus there was an astounding backup that occurred in this event. We inferred that the ice dam at the old Burr Bridge broke shortly near flood crest based on the maximum elevation of ice scaring just downstream in the Schenectady Stockade (Lederer and Garver, 20020). Both jam points implicated in the tree-scar data occur where abutments and berms (i.e. those associated with bridges) have dramatically restricted the flood plain thereby causing a severe restriction in flow.

2007 – 15 March. The 2007 ice jam on the lower Mohawk River was a moderate-sized ice jam, and produced significant flooding in the Stockade of Schenectady. At the time of maximum backup (maximum stage elevation) in Schenectady, houses in lower areas were evacuated, power was cut, and a state of emergency was declared. The position of front of the ice jam is estimated to have been in the Knolls, and the ice jam was approximately 5-6 miles long. As the ice floes moved through the lower Mohawk, two discreet jams occurred. The first one was relatively small and the ice front was centered in Schenectady. This first jam was in place by 9:00 AM on 15 March. A large floe of ice was in place in the morning upstream of Lock 9, and this then moved and then joined the first floe in the afternoon, and that caused the major jam down river from the Stockade that characterized this event.

Discharge for ice jam, as measured down river at the USGS Cohoes station, shows peak flow related to a release wave that was measured at 51,600 cfs at 8:00 pm (2000) on 15 March, 2007, this was a dramatic increase from 31,100 at 6:45 PM (1830) just one hour and fifteen minutes before. These data suggest that the main jam had a lifespan from about 1:45 PM to 6:45 PM or about 5 hours. The release of the ice dam resulted in a downstream surge of water recorded at the USGS gaging station at Cohoes. Nominally this surge was an additional 20,000 cfs, which is significant, but small by historical standards. This release occurred between 7 and 8 PM on Thursday 15 March, and because the Schenectady County Emergency Management team noted a significant drop in the Schenectady pool at this time it is clear that this surge was related to the breakup of the dam that occurred in the Rexford Knolls just upstream from Lock 7. The peak discharge at Cohoes occurred at 8:00 PM and then total discharge was 51.6k cfs.

2010 – 25-26 January. The mid-winter break up event of 2010 caused significant ice jams to form in the lower part of the Mohawk River, and the largest and most significant jam occurred in Glenville/Rotterdam Junction above Lock 8 at a well-known constriction of the flood plain at the Pan Am bridge (also known as the Boston-Maine bridge - Fig. 1). Moderately warm temperatures and heavy rain from a south- to north-tracking Atlantic storm cause considerable melting and rapid increase in discharge on the Mohawk River and its main tributaries, especially the Schoharie Cree. The highest rainfall amounts were in the headwaters of the Schoharie Creek and were ~5”, but elsewhere in the lower basin where totals were the highest total rain was only about 1”. One important aspect of the hydrology of the system at the time of this event was that the Schoharie Reservoir had been drawn down to 10’ below the dam. This meant that the extremely high flows at Prattsville (above the Schoharie Reservoir and receiving runoff from the upper part of the basin), were largely attenuated by the high storage capacity of the reservoir at the time. Nonetheless, the primary driving mechanism for this event was water from the SE part of the Watershed - especially the Schoharie Creek - as this area received the most precipitation and melting.

Discharge data from the USGS gage at Cohoes Falls indicate two jams impeded downstream flow. The first was at 01:45 AM on 26 January, and this is a short-duration drop in water level that likely corresponds to the formation of an ice jam upstream of Lock 8. We suspect that this is the jam that formed at or near Rotterdam Junction. Ice accumulation and maximum water levels indicate that the main jam occurred at the Pan Am rail bridge (Fig. 1), which crosses from Glenville to Rotterdam Junction and forms a major constriction in the River. The western part of this bridge is essentially on the edge of the SI plant, which had constant monitoring of water levels and video surveillance of the ice. From the video is it clear that the after several minutes of re-adjustment, and a rapid water rise of about 1 foot, the jam released at 09:44 AM on 26 January. Following this release, there was rapid and continuous movement of the ice floe down the Mohawk, and a reduction in water levels. This ice failed to re-jam on its way to the Hudson. The highest level recorded at the SI plant was 244’ (at Pan Am bridge). Volumetric calculations using LiDAR suggest 4.6 million m^3 were backed up in this event (Marsellos et al., 2010).

Figure 2 - Remnants of the 2010 Ice jam in Glenville NY. Note 1.6 m hockey stick (5'4”) for scale on the lower left of the ice (white arrow) – this part of the flow was likely at least 5.2 m thick (17 feet), but here it is to the side of the main channel.

The 2010 Jam is an unusually well documented event because there is a very good time stamp on release (video record at Schenectady International) and downstream arrival (USGS Cohoes). Because it appears that the front of the release wave made it from Rotterdam Junction downstream to Cohoes (39 km) by 11:45 AM (26 Jan), this would suggest that the front of the release wave travelled at an average rate of 19.5 km/hr (12 mph) over that entire distance.

Our calculations suggest that the jam locked in place and started initial damming of water (later recorded as decrease in discharge at Cohoes) at about 11:45 PM on 25 January (i.e. right before midnight). The pattern on the rising limb of the hydrograph suggests that the ice jam formed at 11:45 AM and released at 9:45 AM, which would mean that it had a 10 hr lifespan. As with most of these events, peak discharge on the Mohawk River for this event was related to the Ice Jam release wave, and as such it does not correspond to sustained discharge at this peak levels. The thickness and extend of this jam is not well known, but because release resulted in nearly complete removed of ice and subsequent free water, remnants of the jam were well-preserved and ice thickness in the jam area was easily in excess of 20' thick (see Fig. 2).

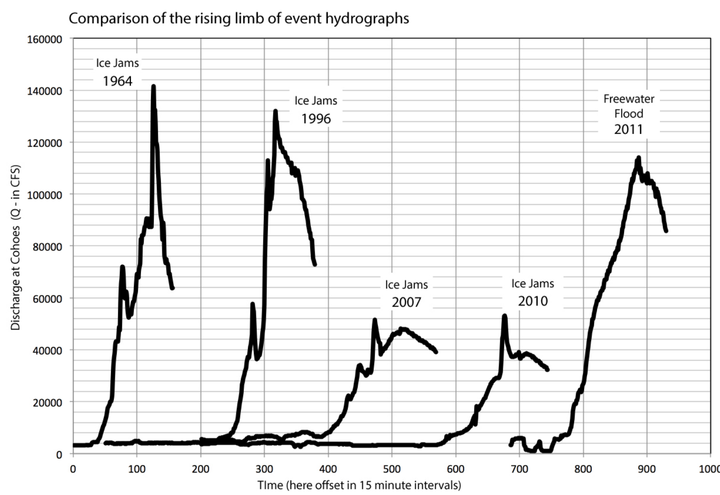

Figure 3. Comparison of hydrographs for specific events with ice jams on the lower Mohawk River. Also shown is the partial hydrograph for Irene in 2011, which was a free-water flood (no ice – shown for comparison). In the events with ice, discharge records at Cohoes shows an abrupt decrease in flow, followed by surge. The decrease in flow is related to upstream damming and blockage by ice, and the surge represents the ice jam release wave (two jam events are record in 1964 and 1996, but only a single jam in 2007 and 2010). The release wave was particularly dramatic in the 1964 event, and this is the highest instantaneous discharge measured on the Mohawk.

Conclusions

We have much to learn about the dynamics of ice jams on the lower Mohawk. Recently installed stage gages and jam cam between Lock 8 and Freeman's bridge are well positioned to measure and warn in real time where many ice jams occur (see Wall et al., this volume). This monitor system will provide important information on the position of jam points, and the dynamics of the ice as it moves through this part of the River. Some key points are revealed from the case studies outlined above.

Significant ice jams require sheet ice and rapid melting. Breakup and rising water is delivered from the upper parts of the watershed, but it appears that in a number of events, the Schoharie River is a primary factor that drives breakup and jamming downstream below the confluence. Damaging and significant jams can occur at low discharge, as well as high discharge. Ice jams and damming of the river tends to occur at several important and well-known constrictions along the river centered on the Schenectady pool (Lock 7 to Lock 8). The Rexford Knolls are a particularly important natural constriction point where the water is deep and jams are common. When ice jams form, the rising water tends to lift and destroy them, so it is unusual to have jams stay in place for a long time, especially when the water is rising. The roll of the Vischer Ferry Dam in trapping ice is uncertain, but because it is permanent, it slows flow, which impedes the progress of ice moving through the system. Constrictions associated with the Pan Am RR crossing, the Old Burr Bridge, and possibly the Freeman's bridge are part of the built environment that are problematic.

References

Garver, J.I., and Cockburn, J.M.H. 2009. A historical perspective of Ice Jams on the lower Mohawk River. In: Cockburn, J.M.H. and Garver, J.I., Proceedings from the 2009 Mohawk Watershed Symposium, Union College, Schenectady NY, p. 25-29.

Johnston, S.A., and Garver, J.I., 2001, Record of flooding on the Mohawk River from 1634 to 2000 based on historical Archives, Geological Society of America, Abstracts with Programs v. 33, n. 1, p.73.

Lederer, J.R., and Garver, J.I., 2001, Ice jams on the lower Mohawk River, New York: Lessons from recent breakup events. Geological Society of America, Abstracts with Programs v. 33, n. 1, p. 73.

Marsellos, A.E., Garver, J.I., and Cockburn, J.M.H., 2010, Mapping and Volumetric calculations of the January 2010 Ice Jam Flood, Lower Mohawk River, using LiDAR and GIS; Cockburn, J.M.H. and Garver, J.I., Proceedings of the 2010 Mohawk Watershed Symposium, Union College, Schenectady, NY, March 19, 2010, p. 23-27.

Scheller, M., Luey, K., and Garver, J.I., 2002. Major Floods on the Mohawk River (NY): 1832-2000. Retrieved March 2014 from http://minerva.union.edu/garverj/mohawk/170_yr.html

Poster Presentation

UNITED STATES GEOLOGICAL SURVEY STREAMGAGES IN THE MOHAWK RIVER WATERSHED

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United States Geological Survey (USGS) streamgages have provided continuous daily-mean and peak streamflow data in the Mohawk River watershed at 37 locations, the first beginning in 1899. Currently, there are 21 active, near real-time continuous-recording streamgages in the watershed (figure 1). Streamflow information is used for flood forecasts, water management and allocation, engineering design, research, operation of locks and dams, and recreational safety and enjoyment (Olson and Norris, 2005). Continuous daily-mean and instantaneous peak streamflow data are used to estimate flood frequency statistics, daily-mean streamflow and low-flow streamflow statistics at ungaged stream locations. These estimates can be improved by optimizing the streamgage network and maintaining long-term (greater than 10 years) streamgages. Additionally, it is essential that streamgages are designed and built to provide reliable data during extreme floods.

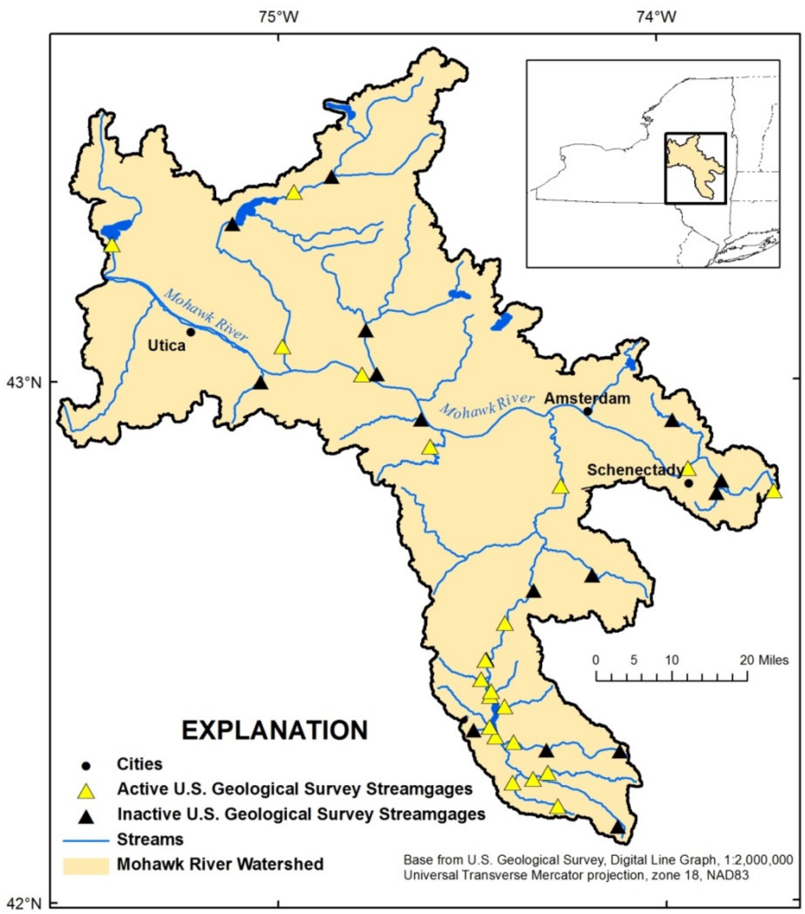

Figure 1: Map showing U.S. Geological Survey streamgages in the Mohawk River watershed.

Streamgage Operation and Maintenance

Streamgage operation and maintenance generally requires (1) a continuous record of the water-surface elevation (stage) at a fixed location along a stream or river, (2) periodic measurements of discharge (volume of water per unit of time), (3) defining the relation between stage and discharge (a rating), and (4) applying the rating to the recorded stage to convert stage to discharge.

The instruments used to measure, store, and transmit stage data are installed in a shelter adjacent to the river. Stage is measured either inside a stilling well using a float or outside the shelter using a gas-purge system. The stage is measured at a fixed interval, usually every 15 minutes, and stored in an onsite electronic data recorder.

A continuous record of discharge can be determined from the stage-discharge rating. River discharge is commonly expressed in cubic feet per second (ft^3/s) and is the product of the cross-sectional area of the channel and the mean water velocity through that area. The USGS uses a variety of equipment to measure velocity and cross-sectional area, including mechanical current meters, acoustic velocity meters, and acoustic Doppler current profilers (ADCPs).

Stage-discharge ratings are developed for streamgages by physically measuring the river discharge at a wide range of stages. The stage-discharge rating is affected by the shape, size, slope, and roughness of the channel in the vicinity of a streamgage and is different for every streamgage. Discharge measurements must be made periodically to verify and adjust the rating as stream channels constantly change from erosion or deposition of streambed materials, seasonal vegetation growth, debris, or ice. The USGS makes discharge measurements about every 6 to 8 weeks, ensuring that the range of stage and flows at the streamgage are measured regularly. Additional measurements are made during extremely high and low stages because these conditions are less common (Olson and Norris, 2005).

In some cases, when a stage-discharge relation cannot be accurately defined, an index-velocity rating may be used. Index-velocity ratings are based on two ratings; one that relates the measured velocity to the mean channel velocity, the other relates the stage to the cross-sectional area. In addition to a continuous record of stage, this type of streamgage requires a continuous record of velocity, typically measured with an acoustic Doppler velocity meter (ADVM). The Mohawk River at Freeman's Bridge at Schenectady, NY (station ID 01354500) streamgage is an example of a station using an index-velocity rating to compute real-time discharge.

Streamgages and Streamflow Data in the Mohawk River Watershed

The first USGS streamgages in the Mohawk River watershed gaged large sub-watershed areas on the main stem of the Mohawk River and on large tributaries, such as Schoharie Creek and West Canada Creek. These stations, some of which now have over 90 years of discharge record, provide important data from which flood-frequency and low-flow statistics can be generated. As the streamgage network expanded, some new stations were located in progressively smaller basins, helping define the diversity and hydrologic behavior of the Mohawk River watershed (figure 2).

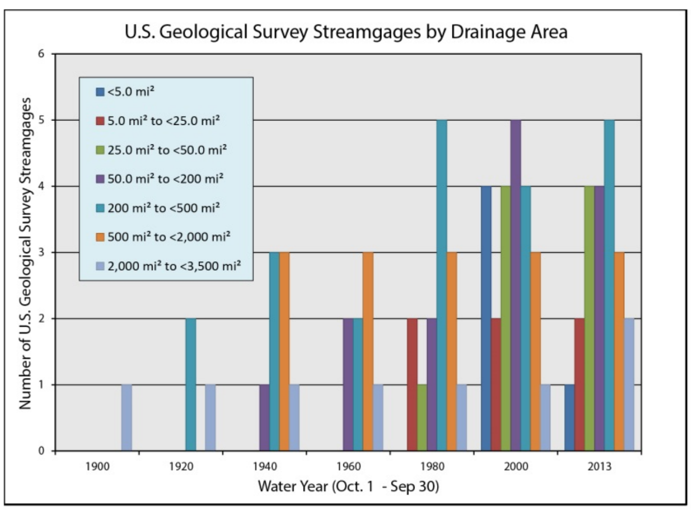

Figure 2: Number of U.S. Geological Survey streamgages with specified contributing drainage areas in the Mohawk River watershed.

Streamgages with the longest continuous-discharge records in the Mohawk River watershed are Schoharie Creek at Prattsville, NY (01350000), Mohawk River at Cohoes, NY (01357500) and West Canada Creek at Kast Bridge, NY (01346000); all with greater than 90 years of record. However, some of the earliest streamgaging activities in the Mohawk River watershed were on the Mohawk River upstream from the former Dunsbach Ferry Dam. Stage and discharge measurements were collected at Tribes Hill, Schenectady, Rexford Flats, Vischer's Ferry and Dunsbach Ferry, NY, from 1898 to about 1913. A permanent USGS streamgage was installed on the northwest corner of the concrete stilling basin, upstream from Lock 7 and Vischer's Ferry Dam in 1913.

On March 28, 1914, the Mohawk River at Vischer's Ferry Dam streamgage was destroyed during the greatest flood the USGS has on record near Schenectady (figure 3). The Mohawk River crested 7.6 ft above the top of Vischer's Ferry Dam when 140,000 ft^3/s of water flowed over. According to a USGS hydrographer's account at the time:

> "An investigation of the break-up indicates that after the gorge at Rexford Flats broke up a gorge was formed in the narrows about 1.5 miles above the Vischer's Ferry dam. This gorge gave way some time in the morning of March 28, and the releasing of the ice and water caused a wave some 6 or 8 feet in height to pass down the river. The pond above the dam was still covered with ice from 24 to 30 inches thick and in general the ice was very solid. The shape of the pond is such that when the ice started to move, it began to crowd both shores. The concrete wall along the upper side of the stilling pool was an obstruction to the ice along the right shore and it began to pile up on top of this wall. Here a pile of ice some 30 feet in height was formed. This extended nearly the entire length of the wall, the greatest height being near the shore. Near the river end of the wall, or at the gage, it was about 12 feet high."

The streamgage at Vischer's Ferry was rebuilt by May of 1914, but was again destroyed by ice-jam related flooding on April 2, 1916, as 113,000 ft^3/s flowed over Vischer's Ferry Dam (USGS, 2014).

Figure 3. U.S. Geological Survey station no. 01356000 – Mohawk River at Vischer's Ferry Dam, NY: (A) before flood of 1914; (B) after flood of 1914 (March 28, 1914).

Extreme events, such as the flood of 1914 and the Tropical Storm Irene flood, which peaked at approximately 130,000 ft^3/s at Freeman's Bridge on August 29, 2011 (USGS, 2014), pose a unique challenge; streamgages need to be adjacent to the river to accurately record extreme events, and also must withstand floods without damage to the equipment or structure. Several USGS streamgages have been damaged or destroyed by extreme events in recent years. These and other vulnerable streamgages have been rebuilt or flood-hardened to ensure continuous operation during floods. Flood-hardening a streamgage includes raising the entire structure to an elevation where continuous operation is possible up to and above the 0.5 to 0.2 percent annual exceedance probability floods (200- year to 500- year recurrence intervals). Streamgages that have been flood-hardened in the Mohawk River watershed since 2011 include Mohawk River below Delta dam near Rome (01336000), Mohawk River at Little Falls (01347000), East Canada Creek at East Creek (01348000), East Kill near Jewett Center (01349700), Schoharie Creek at Prattsville (01350000), Schoharie Creek at Gilboa (01350101), Schoharie Creek at Breakabeen (01350355) and Schoharie Creek at Burtonsville (01351500).

As the duration of a streamgage record increases, it is more likely to record flows nearer the extreme high and low flows possible in a basin with its characteristics. Some basin characteristics (ex. basin slope, soil type, mean-annual precipitation) can influence streamflow and smaller basins often have more distinctive characteristics, whereas larger basins tend to homogenize the characteristics of the contributing upstream basins (Lumia, 2006). Quantifying streamflow statistics in both small and large basins for long periods of records, improves estimates of streamflow statistics in ungaged areas of the Mohawk River watershed and all of New York State. To continually improve these estimates, it is important to consider where additional streamgages can provide the best new information and prioritize the existing gages.

Over the past 115 years the USGS streamgage network has continually evolved to provide reliable streamflow information for diverse interests in the Mohawk River watershed. Throughout this time, extreme events have caused destruction and also provided opportunities to improve data quality and our understanding of how the Mohawk River system works. With this knowledge we can be more prepared for potential future events. The USGS operates and maintains the Mohawk River watershed streamgage network in cooperation with: the New York State Department of Environmental Conservation, New York City Department of Environmental Protection, New York Power Authority, Brookfield Renewable Power, New York State Canal Corporation, National Weather Service and USGS National Streamflow Information Program. This network helps the USGS effectively serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

References

Lumia, Richard, Freehafer, D.A., and Smith, M.J., 2006, Magnitude and Frequency of Floods in New York: U.S. Geological Survey Scientific Investigations Report 2006–5112, 152 p.

Olson, S.A., Norris, J.M., 2005, U.S. Geological Survey Streamgaging: U.S. Geological Survey Fact Sheet 2005-3131, 4 p.

U.S. Geological Survey, 2014, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), accessed February 26, 2014 at URL
http://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=01356000,
http://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=01354500

Volunteered Presentation

THE CLASH BETWEEN INTEREST IN PRESERVING CLEAN WATER AND NEED FOR ENERGY DEVELOPMENT: EVENTUAL OR AVOIDABLE?

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Energy development projects are always massive in scope and oftentimes involve significant controversy. Both petroleum oil and natural gas are sought after commodities but methods of extracting and/or transporting these materials have been extensively debated in light of their potential environmental impact. Arguments made in relation to this subject vary widely. The spectrum of opinions ranges from those that are very supportive and others who are totally rejecting the development of such resources. Supporters tout the positive economical, employment opportunities, and growth of industrial activities. Opponents highlight the negative impact including potential soil and water contamination, effects of burning more fossil fuel, and the undercutting of incentives to develop renewable energy sources. Both proponents and opponents have valid points and there is certain truth to their arguments. The fallacy of attempting to make a case that is totally for or totally against energy development arises from the inability or unwillingness of competing parties to examine the issues from a global perspective. Shedding light on only the bright or dark side of the issue could be misleading. The fierce competition between water resources and the need to develop energy sources makes a clash seemingly eventual. This paper will use three projects as examples for the need to use a holistic approach in assessing the viability of energy development. The first project has long been running and its focus is the development of natural gas resources from Marcellus Shale in Pennsylvania. The second project has not yet received approval and its aim is to develop natural gas resources from Marcellus Shale in New York State. The third project is divided to several phases and has been partially completed. This project is concerned with the extraction of oil from tar sand in Canada and transporting the crude using pipelines to refineries on the Gulf of Mexico on the southern tip of the United States. Each of the above projects either requires huge amounts of water and/or could risk contaminating existing water resources. All of these projects faced, and continue to face, considerable resistance as building a consensus or a compromise proves elusive.

Volunteered Presentation

GIS Illustrations of the Potential Effects of Hydrofracking Technology on Water Resources in New York State

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Almost the southern half of the area of the state of New York lies within the Marcellus Shale, a deposit bearing tremendous quantities of mainly natural gas and, to a lesser extent, oil. Billions of cubic feet of natural gas have long been known to be confined within this layer where, until recently, development of these resources was uneconomical. With the increase in demand for energy, the rise in prices, and the development of extraction technologies to force the gas out of the ground, attention turned to the Marcellus Shale as a potential target for energy development. Hydraulic fracturing, known as hydrofracking, is a procedure where water blended with a mixture of chemicals is forced under high pressure deep into the bearing layer to fracture its porous structure and release the natural gas. Water quantities required to complete this operation could run into millions of gallons per well, depending on the depth, extent, and nature of the bearing layer. Vast agriculture land with water-based economy lies within the proposed area for natural gas development. This resulted in a collision between the interests of natural gas developers and those resisting the use of water for this purpose. New York State has conducted an extensive environmental impact study followed by a public comment period. Thousands of comments were received from concerned citizens, which prompted the state to further study the issue. A decision is presently on hold pending a study by the NYS Department of Health. This paper will use GIS maps to illustrate possible interference between natural gas development and existing water resources lying within the Marcellus Shale area. Areas of overlapping interests will also be shown in addition to the potential of applying hydrofracking on water supplies within the watershed.

Poster Presentation

THE RESILIENT NEIGHBORHOOD: FLOOD MITIGATION AS AN ECONOMIC ENGINE

Rebecca Hill
RAFT Landscape

Context-sensitive solutions to flooding can increase the economic strength of neighborhoods while buffering homes and businesses from future damage. Traditional approaches to flooding, such as building a wall or raising buildings, are single-benefit and are neither economically productive nor flexible.

The Stockade in Schenectady is valued for its history and proximity to downtown and the river; unfortunately, this neighborhood is often flooded, damaging the centuries-old homes and frustrating homeowners. RAFT Landscape, with funding from the New York State Council on the Arts, explored how context-sensitive solutions could utilize these existing assets to increase economic vitality and flood resiliency.

This talk presents case studies on historic preservation, downtown revitalization, and waterfront parks and discusses how lessons learned from these examples can be applied to The Stockade.

Invited Presentation

Place-Esteem as the Foundation for Stewardship

Janet Kennedy
Executive Director, Lakes to Locks Passage, Inc.

Lakes to Locks Passage is a New York State Byway that follows over two hundred miles of the interconnected waterway that ties upstate New York to southern Quebec. The byway links communities in six counties to create a place-based tourism experience that steward the historic, natural, cultural and recreational resources between the confluence of the Hudson and Mohawk Rivers to the northern reaches of Lake Champlain. Lakes to Locks Passage has developed a program that cultivates community pride, civic engagement, and stewardship of the byway resources. This approach culminates in broad-based "ownership" of the byway resources, the foundation for stewardship for future generations.

Building Pride as the Foundation for Stewardship
When Lakes to Locks Passage (LTLP) earned the prestigious Federal Highway Administration's "All-American Road" designation in 2002, we immediately recognized our responsibility to deliver an outstanding traveler experience, and ensure that the byway resources are managed in a manner that addresses the promote vs. protect paradox of tourism. But the big question was HOW?

Through a recent update to the byway Corridor Management Plan, LTLP has articulated a strategy for delivering a place-based tourism experience that also fosters stewardship of byway resources. What we have discovered is that stewardship rests on four key elements:

- **building pride** in the communities,
- **building strong leadership** of civic and non-profit organizations,
- **fostering inter-municipal cooperation** between local organizations, and
- **generating ownership** of the byway program through a local commitment to the stewardship of the intrinsic resources for future generations.

European armies fought for control of this waterway, their battles shaped the destiny of the United States and Canada. A few generations later, this waterway carried the products of the industrial revolution creating the "Empire State;" and later became the seedbed of America's earliest environmental conservation movements. Outstanding natural and human history is evident throughout LTLP, creating an appealing tourism destination. However, the region has suffered from the decline of the industrial era in upstate New York, which has been accompanied by out-migration, loss of jobs, and a declining economy. Most evident has been the loss of community pride, which is often expressed by "Why would anyone want to live, or visit, here?" We recognized that this lack of community pride is the fundamental issue we had to address to reach our goals. Without community pride, you can invest millions of dollars with little long-term impact. Congressman Tonko has referred to community pride as "place-esteem." Place-esteem stimulates civic engagement and the volunteerism that is dedicated to building a community for future generations.

In New York State, every municipality has a historian. Therefore, nearly every municipality has a historical society and local museum – and if not a museum, they have a library that serves as their "heritage archive." But these facilities are generally managed by struggling organizations that are challenged to find their place in the 21st Century. LTLP recognized that if we could help these organizations and facilities find a way to not only survive, but prosper in today's world, they could be the "hub" of the byway experience. As a "Lakes to Locks Passage Heritage Center" they provide a unique window to the communities, their stories, society and culture. This approach to having communities take pride in what they considered commonplace, and present it as a network of community Heritage Centers, delivers a unique and authentic byway experience. The Heritage Center strategy utilizes a three-pronged approach to developing stewardship:

- Professional trainings for operations of the Heritage Center management organizations
- Development and implementation of the byway interpretion and information plan, creating events and activities to engage the public
- Trainings to engage community members and develop a stewardship ethic.

The purpose of LTLP Heritage Centers is to have the people who live here tell their stories, and deliver authentic experiences. These "LTLP Ambassadors" can speak with passion, in a meaningful, lively and engaging way. Direct personal interaction with visitors strikes an emotional chord, so the visitor will remember the experience and share it with others. But most importantly, service as a LTLP Ambassador stimulates civic engagement by all members of the community. By sharing their stories, residents build awareness – appreciation – participation – leadership – and ultimately, a commitment for stewarding the community's historic, natural and cultural resources for future generations.

The Heritage Center strategy creates a "sustainability cycle" that is fed by a "stewardship process." For example, if elected officials cannot see the need for getting the town's historical archives out of the moldy basement, then they clearly have no awareness of their value. So, if the historical society assembles a historical photo table at the annual fireman's BBQ, and the community becomes <u>*aware*</u> that it was photos of their grandparents molding away, then they can <u>*appreciate*</u> the need to preserve them for future generations, and rally to do something about it. Strong organizational management offers programs and events that engage members of the community, to participate in the organization as "byway ambassadors," with some ultimately becoming the future leaders of the organization -- and the cycle continues.

In 2010, LTLP entered into a partnership with National Geographic to promote "Geotourism," a type of tourism that sustains or enhances the geographic character of a place – its environment, culture, aesthetics, heritage and well-being of residents. This has been more than a tourism marketing program, it is an integration of the historic, natural, cultural and recreational resources with experiences that encouraging visitors to learn, protect and celebrate the place they have come to visit. Along the way, local residents have learned they do have something special, a place to be proud of.

This strategy is not just for history buffs. Just a few months into a pilot project for museum collaboration, we began to receive requests from natural, cultural and recreational organizations for Heritage Center designations. We even provided trainings to a group in Quebec. They found our program extremely valuable, despite the challenges of a different language, culture and governmental structure – demonstrating that the program is adoptable and adaptable.

Lessons Learned

The *Lakes to Locks Passage Heritage Centers Strategy* employs a program that engages local institutions and unites communities as members of a "family" with a shared heritage. By working together, these previously independent entities are empowered to achieve a shared vision – truly creating a whole that is greater than the sum of its parts. Lakes to Locks Passage is investing in the future of each Center as stewards of their community. Each one is a unique member of the Lakes to Locks Passage family, with a stake in the future of the region's quality-of-life.

We have found that our NatGeo-branded program encourages environmental and conservation groups to partner with historic and recreational groups to develop and promote events and experiences. Most importantly, delivering these experiences stimulates civic engagement by all members of the community. By sharing their stories and creating experiences for others to enjoy, residents build awareness – appreciation – participation – leadership – and ultimately, a commitment for stewarding the community's historic, natural and cultural resources for future generations.

The most important lesson is that stewardship and sustainability are built over time, through steps of increasing engagement. Not everyone who gains awareness will ultimately arrive at leadership. But it does create a critical mass of people who are at various levels of the stewardship process, together they play important roles for sustaining the livability of communities and the natural environment.

Invited Presentation

MONITORING THE HUDSON AND BEYOND WITH HRECOS (HUDSON RIVER ENVIRONMENTAL CONDITIONS OBSERVING SYSTEM)

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The Hudson River Environmental Conditions Observing System (HRECOS; "*re-cōs"*) is a network of environmental monitoring stations distributed throughout the Hudson River Watershed, with locations on the Hudson and Mohawk Rivers. Stations are equipped with sensors that continuously record a suite of water quality and weather parameters every 15 minutes. Each station is equipped with remote telemetry for transmitting all data in near-real-time to www.hrecos.org, where users can download data and plot graphs. The goals of HRECOS are to provide baseline monitoring data necessary for applied research and modeling, improve the capacity of research entities to understand the ecosystem and manage estuarine resources, provide policy makers and emergency managers with timely data products to guide decision making, support the use of real-time data in educational settings, and provide information for planning recreational activities (boating, kayaking, fishing, etc.).

HRECOS began its expansion into the Mohawk River in 2011 with the aid of funding provided by the NY State Dept. of Environmental Conservation's (NYSDEC) Mohawk River Basin Program. Mohawk HRECOS stations are currently located at Lock 8 in Rotterdam and downstream of Utica (seasonally), while planning for a third Mohawk station in the vicinity of the Rexford bridge is underway. A significant use of these stations is to monitor water quality influences from discharges located in Utica and Schenectady, working towards satisfying the water quality goals of the Mohawk River Basin Program Action Agenda. Mohawk HRECOS Stations are also used to aid in flood prediction and warning by the U.S. Geological Survey's Mohawk River Ice Jam Monitoring project and the National Weather Service.

HRECOS is operated and funded by a consortium of government, research, and non-profit institutions. The system builds upon existing regional monitoring activities, including the NOAA National Estuarine Research Reserve System-Wide Monitoring Program (SWMP), NYSDEC's Rotating Integrated Basin Studies (RIBS), USGS monitoring efforts, and modeling and monitoring efforts in the NY-NJ Harbor by Stevens Institute of Technology. All data and products of HRECOS are freely available to the public at www.hrecos.org.

Poster Presentation

AFTER THE FLOOD: IMPACT OF HURRICANE IRENE & TROPICAL STORM LEE ON SCHOHARIE CREEK TRIBUTARIES

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Hurricane Irene and Tropical Storm Lee delivered an unprecedented 500-year flood event to the Schoharie Creek watershed on August 26th and September 6th 2011. Eight streams in the upper watershed (Bearkill, House, Keyserkill, Catskill, Little Schoharie, Manorkill, Platterkill and Panther) that historically supported wild brook trout (*Salvelinus fontinalis*) were surveyed once before (between 2005-2011), and twice after the flood (2012-2013). Each stream had two sampling sites, an upstream site near the headwaters, and a downstream site near the junction with Schoharie Creek. The flood and mitigation impacts (reduced sinuosity, berms, channelization and riparian damage) commonly occurring together, were dominant in 75% of the survey sites (12 of 16). Loss of habitat diversity was observed including: reduction of pools, woody debris, riparian vegetation, substrate size diversity, and an increase in riffle habitats. Average turbidity increased drastically from pre-flood surveys to 2013 post-flood surveys, particularly in downstream reaches by 196% (8.23 NTU to 24.3 NTU), likely due to the lack of a riparian zone from post-flood stream bank modifications and channelization. Average pH levels increased to optimal levels (pre to post-flood=6.28 to 7.68 upstream and 6.55 to 7.64 downstream) presumably due to naturally buffering sediments entering the stream more readily. The average conductivity increased by 45% at upstream sites (37.83 µS/cm pre-flood to 55.13 µS/cm post-flood) and by 17% downstream (54.50 µS/cm pre-flood to 63.57 µS/cm post-flood). Resulting water chemistry changes have had noticeable effects on aquatic biota and are a continuous limiting factor on the recovery of the streams biodiversity (Table 1).

Table 1: Water chemistry for eight Schoharie Creek tributaries, upstream (UP) and downstream (DOWN); pre (Pre-Flood), six months post (Post-Flood 2012) and eighteen months post (Post-Flood 2013) flooding from Hurricane Irene and Tropical Storm Lee.

	Turbidity (NTU)						pH					
	UP			DOWN			UP			DOWN		
Stream	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013
House	2.3	2.8	7.0	4.0	1.6	9.5	5.3	8.8	7.7	5.6	8.6	7.5
Keyserkill	3.5	1.3	3.5	4.2	11.0	58.0	5.7	7.8	7.6	6.0	7.7	7.6
Line	3.6	1.5	3.3	7.8	20.0	25.0	5.4	6.9	8.0	5.8	7.8	8.2
Little Schoharie	20.0	10.3	53.0	3.4	26.0	55.0	5.5	7.7	8.3	5.8	8.5	8.1
Manorkill	1.0	3.9	0.9	2.0	2.2	3.1	7.5	7.6	7.5	7.6	7.1	7.5
Platterkill	4.5	3.5	10.0	7.2	21.0	16.0	8.2	8.3	7.7	8.5	7.9	7.6
Panther	46.0	2.5	1.1	29.0	3.8	3.8	6.4	5.8	6.9	6.6	6.9	6.9
AVG	**11.6**	**3.7**	**11.3**	**8.2**	**12.2**	**24.3**	**6.3**	**7.6**	**7.7**	**6.6**	**7.8**	**7.6**

	Conductivity µS/cm					
	UP			DOWN		
Stream	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013
House	51.0	43.0	11.0	42.0	59.0	7.0
Keyserkill	37.0	52.0	79.0	35.0	56.0	78.0
Line	25.0	44.0	68.0	42.0	88.0	109.0
Little Schoharie	n/a	84.0	117.0	n/a	120.0	140.0
Manorkill	36.0	37.0	57.0	117.0	42.0	58.0
Platterkill	51.0	68.0	9.9	61.0	81.0	10.0
Panther	27.0	32.0	44.0	30.0	33.0	43.0
AVG	**37.8**	**51.4**	**55.1**	**54.5**	**68.4**	**63.6**

Average brook trout catch per unit effort (CPUE in fish/hr) increased in upstream reaches by 122% (pre-flood=36.0) to post-flood (2012=68.0) and (2013=79.8). Downstream brook trout CPUE initially decreased by 31% six months post flood (2012=18.6), but returned to pre-flood (pre-flood=26.7) catches 18 months post-flood (2013=27.9). Brown trout (*Salmo trutta*) CPUE upstream (pre-flood=8.1) initially spiked 6 months post flood (2012=37.5), but since, have returned to pre-flood levels (2013=10.2). Downstream brown trout CPUE (pre-flood=15.8) was comparable to pre-flood levels 6 months post-flood (2012=16.6), but drastically reduced 70% 18 months post-flood (2013=4.8). Both upstream (pre-flood= 46.3 and post-flood; 2012=98.5 and 2013=78) and downstream (pre-flood=38.7 and post-flood; 2012=47.3 and 2013=156.9) average CPUE of blacknose dace (*Rhinichthys atratulus*) increased across all years. Increased riffle habitat from channelization may explain the blacknose dace CPUE increase. Sensitive slimy sculpin (*Cottus cognatus*) did not follow this trend. Sculpin CPUE decreased by 24% upstream (pre-flood=45.6 to post-flood 2012=45 and 2013=34.6) and had minimal population fluctuations downstream (pre-flood=51.9 to post-flood 2012=42.0 and 2013=48.9), despite increase in riffle habitats (Table 2).

Table 2: Backpack Electrofishing (Catch/Hour) of Selected Fish Species in eight Schoharie Creek tributaries, upstream (UP) and downstream (DOWN); pre (Pre-Flood), six months post (Post-Flood 2012) and eighteen months post (Post-Flood 2013) flooding from Hurricane Irene and Tropical Storm Lee.

	Brook Trout CPUE (fish/hr)						Blacknose Dace CPUE (Fish/hr)					
	UP			DOWN			UP			DOWN		
Stream	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013
Bearkill	5.8	93.0	158.0	21.4	35.5	36.0	0.0	136.0	0.0	128.6	0.0	554.4
House	-	-	-	9.3	14.0	14.3	-	-	-	60.6	175.4	114.8
Keyserkill	81.1	57.0	122.0	33.6	14.3	7.0	0.0	0.0	29.0	40.3	21.4	71.9
Line	14.2	28.8	72.0	-	-	-	7.1	18.0	0.0	27.0	32.3	107.0
Little Schoharie	-	-	-	-	-	-	201.6	17.1	100.0	0.0	42.7	21.4
Manorkill	6.6	14.3	21.0	-	-	-	-	-	-	14.4	59.2	14.3
Platterkill	0.0	43.0	0.0	14.0	0.0	7.1	115.5	450.0	214.0	0.0	0.0	214.2
Panther	108.5	171.8	106.0	55.3	29.0	75.0	0.0	68.7	204.0	-	-	-
AVG	**36.0**	**68.0**	**79.8**	**26.7**	**18.6**	**27.9**	**46.3**	**98.5**	**78.1**	**38.7**	**47.3**	**156.9**
	Slimy Sculpin CPUE (fish/hr)						Brown Trout CPUE (fish/hr)					
	UP			DOWN			UP			DOWN		
Stream	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013	Pre-Flood	Post-Flood 2012	Post-Flood 2013
Bearkill	76.5	50	75.4	57.1	54.2	230.4	5.8	93	34.3	21.4	35.5	14.4
House	-	-	-	-	-	-	-	-	-	-	-	-
Keyserkill	-	-	-	-	-	-	13.5	0	0	0	7.1	0
Line	7.1	39.6	1	7	3.6	0	-	-	-	-	-	-
Little Schoharie	0	14.3	0	124.1	0	0	0	7.1	6.7	25.9	7.1	0
Manorkill	98.7	78.5	62	0	32.3	14.3	13.2	50	0	-	-	-
Platterkill	-	-	-	71	120	0	-	-	-	-	-	-
Panther	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**45.6**	**45.6**	**34.6**	**51.9**	**42**	**48.9**	**8.1**	**37.5**	**10.2**	**15.8**	**16.6**	**4.8**

Seven of eight streams sampled suffered from channelization, berming, loss of riparian vegetation, and loss of sinuosity. The streams became homogenous riffle habitats, particularly in downstream reaches. Sculpin (more sensitive, CPUE decline) and blacknose dace (more adaptable, CPUE increase) both prefer riffle habitats. These differences in the CPUE point to issues in the environment besides habitat, such as poor water quality, that may be limiting. The reduction of habitat complexity could account for increased brook trout CPUE because fish were more exposed and easily captured. Unsuitable habitat and poor water quality downstream have negatively influenced post-flood trout, as downstream sites were the most altered and channelized. Bearkill Creek, the only stream that wasn't drastically impacted by the flood, continued to maintain habitat diversity (pools, sinuosity and woody debris) and the fish communities remained intact and improved.

Invertebrate biomass (g/ft^2) increased initially (pre-flood=28.7 to 6 months post-flood 2012=72.8), but decreased noticeably 18 months post-flood (2013=59.0) at upstream sites. Downstream sites had consistent small decreases in macroinvertebrate biomass (pre-flood=46.4 to post-flood 2012=51.6 & 2013=44.5). More sensitive and preferred forage species such as Ephemeroptera, Plecoptera, and Tricoptera (EPT) increased upstream (pre-flood=49.0% to post-flood 2012=65.0% & 2013=64.0%), but continually decreased on average in downstream sites (pre-flood=71.0% post-flood 2012=61.0% & 2013=63.0%). The increase of riffle habitat, additional nutrients from increased sediment loading/run-off, and neutral pH levels slightly increased macroinvertebrate biomass and EPT taxa initially. Declining water quality and reduced cover during periods of high flows (little substrate diversity) have likely caused a reduction in presence and biomass of sensitive EPT taxa, most notably in heavily altered downstream sites (Table 3).

Table 3: Invertebrate Densities and EPT taxa in eight Schoharie Creek tributaries, upstream (UP) and downstream (DOWN); pre (Pre-Flood), six months post (Post-Flood 2012) and eighteen months post (Post-Flood 2013) flooding from Hurricane Irene and Tropical Storm Lee.

	Invert Biomass (g/ft^2)						EPT Taxa					
	UP			DOWN			UP			DOWN		
	Pre-Flood	**Post-Flood 2012**	**Post-Flood 2013**	**Pre-Flood**	**Post-Flood 2012**	**Post-Flood 2013**	**Pre-Flood**	**Post-Flood 2012**	**Post-Flood 2013**	**Pre-Flood**	**Post-Flood 2012**	**Post-Flood 2013**
House	10.7	60.0	84.3	69.3	52.0	62.7	0.0	0.4	0.1	0.8	0.8	0.7
Keyserkill	48.0	50.7	56.0	90.3	45.0	41.0	0.7	1.0	0.9	0.8	0.4	1.0
Line	65.3	90.0	88.0	56.3	28.3	24.0	0.7	0.7	0.7	0.8	1.0	0.7
Little Schoharie	28.0	60.3	25.0	43.0	58.0	5.7	1.0	0.1	1.0	0.9	0.3	0.0
Manorkill	0.0	69.7	62.3	0.0	62.0	58.7	0.0	1.0	0.9	0.0	1.0	0.7
Platterkill	32.3	146.0	49.0	23.0	53.5	71.3	0.1	0.7	0.4	0.6	0.2	1.0
Panther	16.3	32.7	48.7	43.0	62.3	48.0	0.8	0.7	0.4	1.0	0.6	0.2
AVG	**28.7**	**72.8**	**59.0**	**46.4**	**51.6**	**44.5**	**0.5**	**0.7**	**0.6**	**0.7**	**0.6**	**0.6**

Changes in the fish and macroinvertebrate communities, as well as changes in water quality indicate the 8 streams are still recovering. Rapid fluctuations and boom/bust cycles are a reflection of an unstable environment. Comparisons were difficult to make across all streams as varying levels of alteration and channelization existed post-flood. Restoration projects are essential to the recovery of these streams to mitigate post-flood alterations.

Poster Presentation

PREDICTION MODEL FOR THE WATER DISCHARGE TIME SERIES IN MOHAWK WATERSHED, NY

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Introduction

There is a connection between an increase in flooding and the climatic change (Bronstert 1995; Kotlarski et al. 2012). In particular, storms with increasing amount of moisture produce more intense precipitation events therefore increasing the risk of flooding (Trenberth 2011). Temperature increases during the winter period can break-up the river's icy surface and hence initiate "ice jams". In the last decade, Mohawk River has shown a significant increase in water discharge time series (Kern, A., 2008; Marsellos et al. 2010a; Marsellos et al. 2010b; Tsakiri et al. 2014). Those events may be associated with the different climatic conditions.

In this study, we describe a model for the explanation and prediction of the daily water discharge time series derived by three locations nearby the Mohawk River, NY (Fig. 1) during the period 2005-2013. For the analysis of the model, we use the daily water discharge time series, the daily data of ground water level and the climatic variables from a nearby location.

Methodology

For our study, we use a statistical methodology to decompose the time series of all the variables into different components (long, seasonal and short term component). The long-term component describes the fluctuations of a time series defined as being longer than a given threshold; the seasonal component describes the year-to-year fluctuations, while the short term component describes the short term variations. The Kolmogorov- Zurbenko (KZ) filter is used for the decomposition of the time series (Zurbenko 1986). The KZ filter, which separates the long term variations from the short term variations in a time series (Yang and Zurbenko 2010a) provides a simple design and the smallest level of interferences between scales (long, seasonal and short term components) of a time series. Moreover the KZ filter can be applied directly to datasets containing missing observations (Eskridge et al. 1997; Rao et al. 1997; Yang and Zurbenko, 2010b).

In our analysis, we first decompose the time series of the water discharge derived by three different locations nearby the Mohawk River and then we predict each component of the water discharge time series separately by using the ground water level and the climatic variables. By using the decomposition of the time series, the explanation of the water discharge time series has been improved approximately two times compared to the raw data. Figure 1 shows three examples of the prediction of the water discharge time series for three different water discharge monitoring stations in the Mohawk watershed.

Conclusions

The decomposition of the time series reveals different correlation patterns between the components of the time series. Moreover, the isolation of the short-term variations from the time series shows a summer period with water table replenishment and a winter period with water table depletion. The design of multivariate models as well as the decomposition of the time series improves the prediction of flooding caused by storms, rapid snowmelt and ice jams.

References

Bronstert, A. (1995) River Flooding in Germany: Influence by Climate Change? Physics and Chemistry of the Earth, 20, No 6, 445-450.

Eskridge, R.E., Ku J.U., Porter, P.S., Rao S,T,, Zurbenko, I., (1997) Separating Different Scales of Motion in Time Series of Meteorological
Variables. Bull Am Meteorol Soc 78:1473-1483.

Kern, A.L., 2008. Study of 20th century trends in stream flow for West Canada and Schoharie Creeks of the Mohawk-Hudson Rivers watershed,
Department of Geology, Union College, Schenectady, New York, thesis.

Kotlarski, S., Hagamann, S., Krahe, P., Podzun, R. , Jacob, D., (2012), The Elbe river flooding 2002 as seen by an extended regional climate model,
Journal of Hydrology, Vol 472-473, 169-183

Marsellos, A.E., Garver, J.I., Cockburn, J.M.H., Tsakiri, K., (2010a) Determination of historical channel changes and meander cut-off points using

LiDAR and GIS in Schoharie creek, NY, Proceedings from the Mohawk Symposium 2010, in Schenectady, New York, 28-33.
Marsellos, A.E. and Garver, J.I., (2010b) Channel incision and landslides identified by LiDAR in the lower reaches of Schoharie creek, New York,
Geol. Soc. Am., 42, 1, 73.
Rao, S.T., Zurbenko, I.G., Neagu, R., Porter, P.S., Ku J.Y., and Henry, R.F. (1997) Space and time scales in ambient ozone data. Bull Am Meteorol
Soc 78:2153-2166.
Tsakiri, K.T., Marsellos, A.M., Zurbenko, I.G. (2014). An efficient prediction model for water discharge in Schoharie Creek, NY. Journal of
Climatology, vol 2014, Article ID 284137, 10 pages, 2014. doi:10.1155/2014/284137.
Yang, W., and Zurbenko, I. (2010a) Kolmogorov-Zurbenko filters, Wiley Interdisciplinary Revives. In: Computational Statistics, Wiley 2:340-351.
doi: http://wires.wiley.com/WileyCDA/WiresArticle/wisId-WICS71.html.
Yang, W., and Zurbenko, I., (2010b) Nonstationarity Wiley Interdisciplinary Revives. In: Computational Statistics, Wiley 2:107-115.
Zurbenko, I.G., (1986) The Spectral Analysis of Time Series. Amsterdam, North Holland Series in Statistics and Probability.

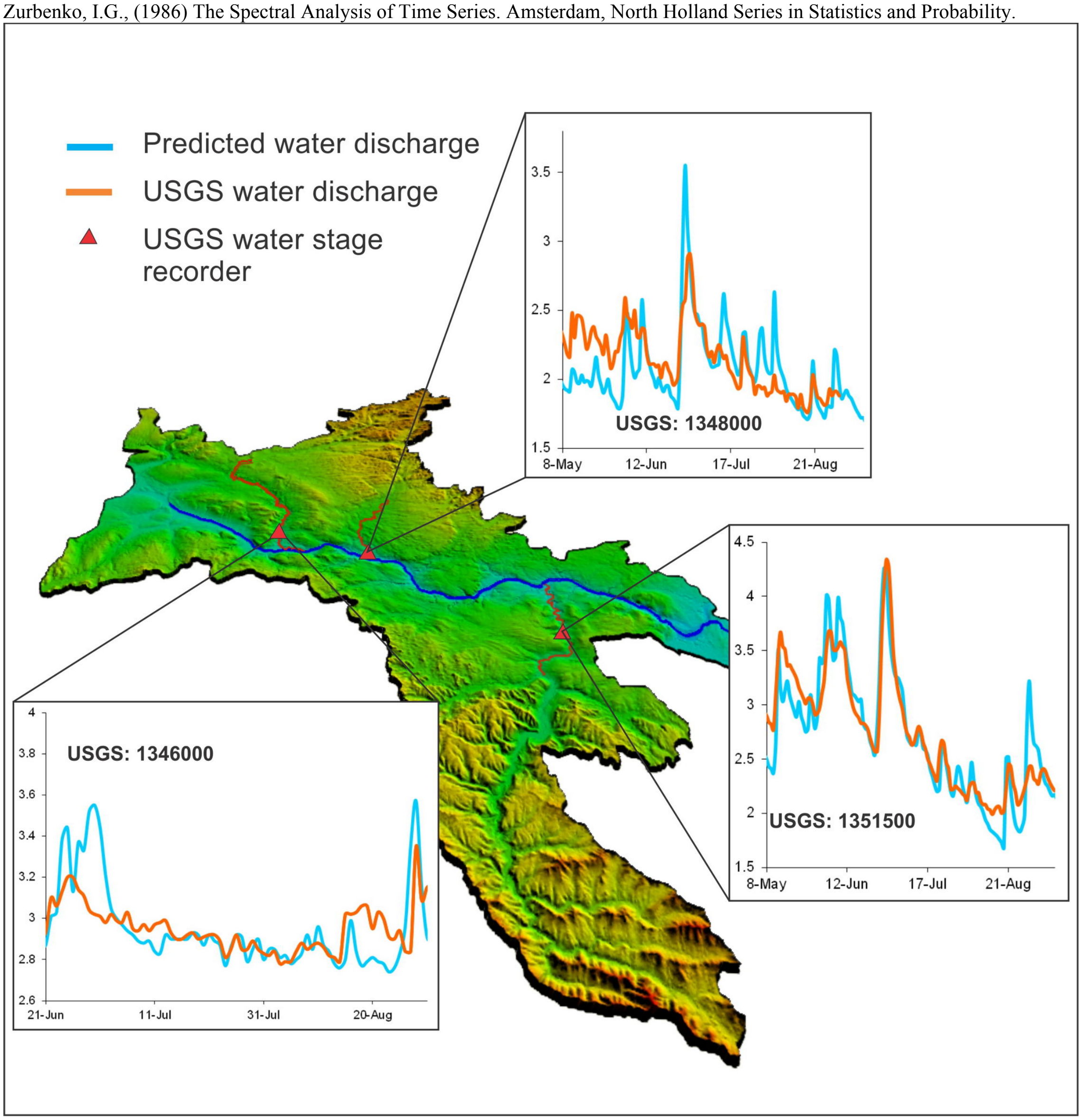


Figure 1: Raw water discharge data (blue line) along with the prediction model (orange line) for three locations nearby the Mohawk River.

Poster Presentation

IMPROVING WATER QUALITY IN THE MOHAWK RIVER BASIN THROUGH EXPANDING COMMUNITY BASED STREAM MONITORING TEAMS AND RIPARIAN RECOVERY ACTIVITIES ON THE SCHOHARIE AND MOHAWK WATERSHED

John M. McKeeby
Schoharie River Center, Inc.

The Schoharie River Center, Inc. (SRC), a not-for-profit organization formed in 1999 and located in Burtonsville (Montgomery County NY), empowers people to become actively engaged in the scientific study, monitoring, protection and improvement of their local environment. Since 2000, the SRC has been engaged in developing, implementing and operating Environmental Study Teams (EST) - environmental education and youth development programs. The goal of these programs is to increase the awareness, understanding and knowledge of the public as to the emergent environmental issues confronting them, and to provide them with the skills and critical knowledge to make informed decisions and take responsible actions to protect and improve the quality of their local environment and the health and the sustainability of their communities. Specifically, we target for engagement youth (ages 12 – 18), (including at-risk youth) and their families, and underserved communities both urban and rural, to expand current and create new community based Environmental Study Team (ESTs) environmental education programs. Over the last 15 years we have developed valuable experience, knowledge and expertise in how to successfully establish and sustain local EST programs in a range of settings including: non-profit community based organizations (CBO's), school based programs, afterschool programs, summer ecology field schools, and youth employment skills training programs in both urban and rural settings. In addition to being a vehicle for community based environmental education, promoting the values of stewardship and increased environmental literacy at the grass roots level, EST programs have also played vital roles at the local level in pollution monitoring, and in providing trained and motivated volunteer man-power for stream bank and flood clean-up, and riparian area protection, restoration and replanting efforts. After hurricane Irene devastated the Schoharie Valley, the SRC's Environmental Study Team program (youth and adults) worked (and continues to work) to remove flood debris and replant damaged riparian areas along the Schoharie Creek (in Burtonsville) with native trees and vegetation and monitor water quality. Since 2012 the EST program has planted over 3000 trees and is working to restore and replant a 20-acre riparian forest site.

This year (2014) the SRC is partnering with a broad range of CBO's, local schools, County Youth Bureaus, NYS DEC, and area youth and families in four counties to expand current and create new locally run community based Environmental Study Team program in the Mohawk watershed. The purpose of this project is to improve water quality in the Mohawk River Watershed through: (a) expanding water quality monitoring by trained local community based volunteer Environmental Study Teams (EST) conducting regular targeted monitoring of tributaries to the Mohawk River; and (b) restoring the riparian buffers to slow bank erosion and the liberation of suspended sediment into the Mohawk river basin.

The project will be implemented by the Schoharie River Center (SRC) and engage a wide range of community based organizations, school districts and local and state agencies in the development of a network of locally based and operated Environmental Study Team (EST) programs. This program will expand monitoring in the Mohawk watershed, focusing on urban streams, and un-assessed bodies of water that can offer urban and rural youth and their families' access to nature in the city and the surrounding areas. A key component of the program is to train local high school age youth (ages 13 – 18) in the science and skills of water quality monitoring and provide them with a sense of place and connection to their local watershed. Modeled after the Schoharie River Center's highly successful Environmental Study Team Program youth development program, stream sites for bio-assessment will be identified and water chemistry, macro-invertebrate (WAVE) and bacterial (coli-form) data will be collected by trained volunteer stream monitors (EST Youth and adults) utilizing WAVE methodology and data collection procedures. All data will be shared with DEC. The SRC EST program staff (as well as local College faculty and student volunteers, Union and SUNY Cobleskill) will provide EST members (including at risk youth) with training and guide them through the learning process of watershed analysis and remediation. Special priority for monitoring will be given to un-assessed waters and those identified and targeted by DEC, local SWCD offices, the community and Union College.

Riparian restoration activities will target those sites where channel and banks were obliterated by flooding and post-flood channel modification by earthmoving equipment, such as has occurred on parts of the Schoharie Creek near Burtonsville (Montgomery County) and in Fort Plain, where flash floods and the resultant clean-up efforts have heavily impacted the Otsquago Creek.

Focusing on exposed clay banks for replanting efforts, we will study how best to plant these and similar areas with native riparian plantings such as willow stakes, sedge, and other native vegetation. Utilizing programs such as NYS Trees for Tribs and local SWCD's for obtaining native plantings, the EST programs will work with local communities and property owners to identify and restore riparian buffers local to the different EST chapters developed and operated by the SRC and other local community stake holders.(Burtonsville, Fort Plain, Amsterdam, Schenectady and in Schoharie County).

The benefits of EST programs to the communities they operate in are multi-faceted. Environmental, social, and civic benefits include improving the quality of life of urban residents through introducing them to nature and green spaces within their own communities (within the Mohawk River watershed). These efforts highlight the importance of having and protecting fresh water resources in urban areas such as parks, so that they and future generations can experience them. The direct interaction by the students with their environment will instill a sense of pride and ownership in local community green spaces and show students how these spaces are woven into the fabric of the watershed.

In the longer term, the field research and documentation that is completed through the EST program adds to the body of scientific information available to the public regarding local water quality of fresh water streams, lakes and rivers within the Mohawk watershed. Volunteer stream monitoring programs provide a wide variety of youth and their local community with a positively focused role for youth who are interested in the study of Environmental Science. All youth who participate will be able to grow and profit from the programs experiential hands-on approach to learning, development of life skills and learn how to integrate and apply academic learning into real environmental research and water quality assessment studies they conduct in their home communities and local watersheds.

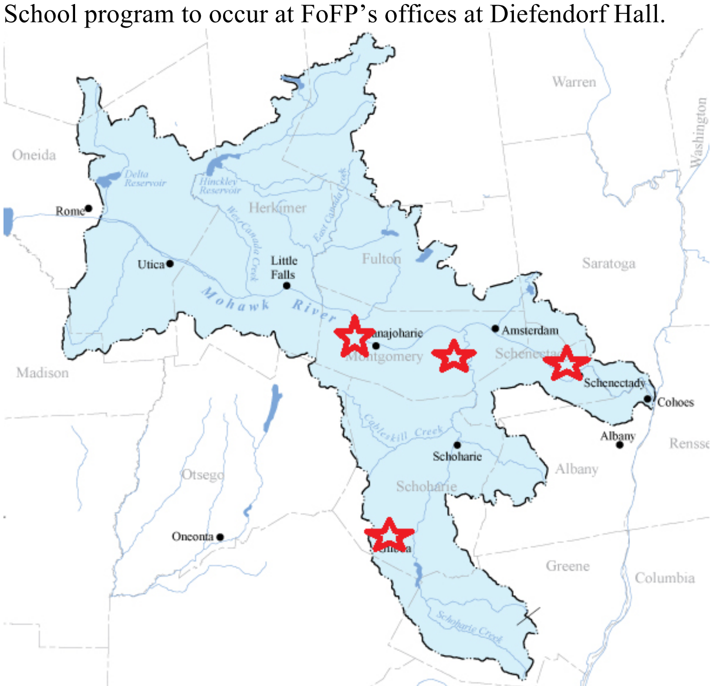
Local Partnerships for Improved Water Quality and Stronger Communities
EST youth become adept at working with the public in a variety of settings. The community also benefits by learning about the watershed they live in, increasing public interest (and input) into local community environmental decisions. By raising public awareness through involving youth in positive, constructive goal-oriented research and community education all parties benefit in the long term. The SRC will assist and support other community based organizations and schools wanting to develop their own educational/volunteer stream monitoring programs and assist them with the recruitment, training, startup and on-going technical support of new EST programs within the Mohawk River watershed.
The SRC has formed new EST program initiative partnerships with local organizations in Fort Plain, Schenectady, and Southern Schoharie County.

<u>The Schoharie River Center:</u>
In operation since 1999, the SRC has demonstrated an unprecedented commitment to develop environmentally literate, self-directed individuals who are able to identify and work toward positive life goals and achieve constructive change in their lives. Since 2001, our EST programs have engaged more than 800 students, ages 12 – 20 yrs, from four counties (Schenectady, Schoharie, Albany and Montgomery counties) and nine school districts, training them in the use of federal and state stream monitoring protocols to assess and document the water quality of their local streams, lakes and rivers. While the EST program is open to all interested youth, the program specifically engages at-risk and underserved youth from the urban and rural areas of New York State's flood-impacted Mohawk River Basin, Schoharie Valley Watershed area, and the upper Hudson River area. Engaging youth (and their parents) in a year—round, multi-year environmental science based experiential learning Environmental Study Team program which emphasizes the integration of Science, Technology, Engineering, Arts and Mathematics skills (STEAM) into the ongoing activities of the program.

The SRC's experientially based environmental education model provides hands-on, professionally-supervised outdoor learning activities, professional development training for teachers and community volunteers interested incorporating environmental education focused experiential learning into their professional skill set. In addition to our experience in operating environmental education programs, the SRC also has worked for 9 years with Hartgen Archeological associates of Albany to provide a summer community-based archeology field school for interested youth (including at risk youth), and traditional arts workshops that showcase traditional artists, local crafts, music and literature. The SRC is committed to educating people about environmental issues and the relationship between the natural environment and human activity, through engaging them in citizen based environmental science monitoring and research, and the study of natural history, traditional culture, and local history.

The Schoharie River Center is located on the Schoharie Creek in Burtonsville, NY (in the Town of Charleston in Montgomery county). The Center is situated in the hamlet of Burtonsville on a 20 acre wooded riparian area nature preserve and owns four buildings including a 2500 square foot Environmental Education Center with an attached dedicated research space - 1000 sq foot David Remling Science Laboratory. In addition the SRC owns a 3000 sq. foot meeting and exhibit hall and a two-story conference center building that can accommodate lodging for visiting artists, or researchers. For over 15 years the SRC has been providing innovative community based programming to a wide variety of audiences. Consistent throughout our history of community based services has been the commitment to work with at-risk youth populations and underserved communities. Since 2000 the organizations EST and summer youth programs have targeted for services youth involved with social services and juvenile justice programs in Schenectady and Schoharie counties. The SRC has worked closely with the Schenectady County Departments of Social Services Office of Children and Family Services and Schenectady County Probation Department's Juvenile Justice Center to develop innovative, experientially based programs for at-risk and troubled youth. In addition the Center has worked with the Schenectady Job Training Agency (SJTA) to provide an experientially based environmental summer youth employment program for over 80 high school age youth attending Schenectady High School and selected for participation due to concerns about level of academic readiness for the fall.

Fort Plain EST:
In Fort Plain the SRC and the Friends of Fort Plain (FoFP), a non-profit organization located in the center of the village of Fort Plain, and interested in developing a local volunteer Stream/River monitoring program have begun working with the Fort Plain Schools and the Canajoharie Schools to engage community members, (including middle and high school youth) and teachers in learning about, enjoying, studying and protecting the Otsquago Creek watershed (a tributary of the Mohawk River). An initial kick off for the program's activities is planned for July 2014, with an initial one week Watershed Ecology Field School program to occur at FoFP's offices at Diefendorf Hall.



Stars indicate location of EST environmental stream monitoring programs

Schenectady:
The Schenectady City School District's **Mont Pleasant Middle School** is working with the SRC to develop a MPMS EST club for students at the school. The **MPMS EST Club** is open to any MPMS student in 7th – 8th grade and participates in both school based environmental projects and at the Schoharie

River Center's EST program in Duanesburg. Busing to the SRC is provided, and youth, faculty and parents regularly participate, year round.

The Capital Region Maritime Center, located in Alplaus NY is the capital region's only facility dedicated to maritime sciences and education. The Maritime Center will be working with the SRC to develop an Environmental Study Team Program for Capital Region youth with a focus on understanding the ecology of the Mohawk River. Targeting to attract interested youth from all areas of the region, the Maritime Center is easily accessible from southern Saratoga County, and the towns of Niskayuna, Scotia, Glennville and Burnt Hills, as well as the City of Schenectady.

Schoharie County EST:
The SRC has work closely with community stakeholders, youth and parent living in Schoharie County for many years. Youth and families from Schoharie, Cobleskill-Richmondville, and Esperance participate regularly in EST program activities. The Southern Schoharie County communities of Gilboa, Conesville, Jefferson, Blenheim and Middleburgh, are located in the Catskills and Schoharie Valley watershed just below the Gilboa reservoir. Rural, isolated and historically underserved, these communities all lie within the Schoharie watershed, and are prime locations that would both benefit from and contribute important information to a coordinated network of volunteer stream motoring programs that engaged local youth and families. The New York Power Authority and the **Mine kill and Max V. Schaul State Parks** are three local state organizations located in Southern Schoharie County that have agreed to partner together with the Friends of Mine kill State Park and the SRC to develop a South Schoharie County EST program specifically targeting for service local youth from these rural communities. Utilizing the Mine kill State Park as the home base for a Schoharie EST program, the SRC and the education staff of Mine kill and volunteers from the **Friends of Mine kill** seek to establish an EST chapter at the Park that will focus on the study and assessment and monitoring of water quality of the of the Schoharie and its tributaries in southern Schoharie county.

Program Coordination and Sustainability:
Training, program coordination, data collection and ongoing program support and technical assistance to the EST programs will provide through the ongoing involvement of the SRC (working in coordination with DEC and other resources) with the various EST chapters at the various sites. It is our intent that while each EST site over time will develop independently, the SRC will continue to provide a center axis of support for all the Mohawk Watershed EST programs, working to coordinate the activities of the network, providing opportunities for the various EST programs and sites to work together, share information, research, data and learning opportunities. Ongoing funding for this network of community based environmental education, youth development, and stream monitoring programs will need to be leveraged from a variety of community stakeholders who benefit from the programs activities. New York State DEC, County and New York State social welfare agencies, Youth Bureaus, Schools, and local citizens and community groups all need to be willing to remain involved in and committed to the effort to support this program.

For more information about the Environmental Study Team Program or find out how you can become involved in EST please contact John McKeeby at the Schoharie River Center, 2025 Burtonsville Road, Esperance NY 12066, email: schoharierivercenter@juno.com.

Poster Presentation

LAND-USE AND RIVER MANAGEMENT STRATEGIES FOR REDUCING FLOOD RISK & PROTECTING WATER QUALITY

Julie Moore, P.E.
Water Resources Group Leader, Stone Environmental, Inc., Montpelier, VT

The streams and rivers, not only within the Mohawk watershed but also adjacent watersheds in New York, New Jersey and New England, have been forever changed by recent, powerful storms – Irene, Lee, and Sandy. As the immediate crisis following each major flood event lessens, it is critical that a balanced and deliberate long-term approach is used to move recovery forward. Although the urge to act immediately can be powerful and with good intent, decisions about where and how to manage our rivers must be considered carefully in order to both reduce future flood risks and protect water quality.

It is humbling to see areas where flooding was most destructive. We all cherish our local streams and rivers and also rely on the infrastructure often built on their banks and in their floodplains. Giving rivers space to meander in floodplains, wherever possible, is the easiest and most cost-effective way to reduce flooding and erosion hazards, but this path is complicated by past land use decisions. With long-term recovery well underway, it has become clear just how complicated the path forward is. This presentation will discuss guidelines for on-going recovery, summarized as follows:

Strategize Flood Recovery – Consider the needs of both the built and the natural environment in evaluating a range of alternatives for both the short and long term, including: public safety, infrastructure protection, floodplain agriculture, water quality, aquatic habitat, cost-effectiveness, and longevity. Seek a preferred alternative that will benefit multiple objectives, aiding both the river and people.

Floodplain Protection – Where space allows, move away from rivers to reduce risks of future flood and erosion damage and protect aquatic habitat. Seek financial incentives through groups and organizations that support risk reduction by limiting new permanent infrastructure in floodplains.

Community Planning – Recognize that flowing water does not respect political boundaries, and therefore it is essential to have discussions that involve both individual towns and all those within a watershed about a range of alternatives for long-term flood recovery and avoidance. Consider past and future flooding and how best to reduce risks from inundation, channel movement, sediment deposition, and woody debris. Think about watershed neighbors and how to minimize downstream risks.

Stay Committed – Whether actively engaged in the ongoing recovery or working to prevent future damage, successfully reducing flood and erosion hazards and protecting river corridors is a challenging and long-term process. This task is an essential part of our future if we are to create safer communities amongst healthier rivers.

Invited Presentation

Mohawk River Watershed Management Plan: Final Steps to Plan Completion and Progress Toward Phase I Implementation 2014/2015

David A. Mosher[1], Peter M. Nichols[2], Win McIntyre[3]
[1]Program Coordinator - Schenectady County Soil and Water Conservation District
Chairman - Mohawk River Watershed Coalition of Conservation Districts
[2]Stream Program Manager - Schoharie County Soil and Water Conservation District
Vice Chairman - Mohawk River Watershed Coalition of Conservation Districts
[3]Project coordinator - Mohawk River Watershed Coalition of Conservation Districts

Since 2010, the Mohawk River Watershed Coalition of Conservation Districts (Coalition) has been developing a management plan for the watershed. The project is being funded by a Title 11 Environmental Protection Fund (EPF) Local Waterfront Revitalization Program (LWRP) grant from the NYS Department of State (DOS). Progress toward completion of the management plan has been reported at previous Symposiums. The purpose of this report is to summarize the progress to date and describe the final steps toward plan completion, scheduled for early fall 2014.

An extensive amount of effort has gone into completing key sections of the plan, a major section being the characterization report. The characterization report depicts the current state of the watershed in terms of its physical features, and also the regulatory and programmatic status of municipalities. Assessments were done on a sub-watershed basis to determine what's needed to either restore or protect water quality. A comprehensive GIS database system was developed to characterize the Mohawk River Watershed. The database system includes 58 GIS datasets of physical features, land use, and pollution sources within the basin. To facilitate access to the GIS database, a web map was developed that can be viewed at http://mohawkriver.stone-env.net. A regulatory and programmatic report, which includes 170 municipalities in the watershed, and describes and assesses the local laws, programs and practices that affect water quality, has also been completed.

Sub-watershed assessments of the 116 12-digit HUC's were completed providing information on the relative condition of these sub-watersheds in terms of water quality, land use, and habitat. Using measurable indicators, the sub-watersheds were scored and ranked, showing those that needed restoration or protection. The 18 10-digit HUC's were similarly assessed. Assessment reports of the 12-digit HUC's were prepared, which include photo-documentation of both problem and pristine conditions, and recommendations for restoration and protection.

Recommended projects for sub-watershed restoration began to be defined in 2013 following the assessments. This resulted in a grant application for Phase I management plan implementation being submitted to NYSDOS for EPF/LWRP funds. A grant was awarded at the end of 2013 for $967,250, with 50/50 state funding and local match. The grant projects include flood mitigation studies for the Schoharie watershed, stormwater management improvements in the Oriskany Creek sub-watershed and areas in Fulton County, and invasive species control in Albany, Saratoga, Fulton, and Hamilton Counties. These projects will be completed in 2015. Additional phases of the watershed management plan implementation are currently being defined.

To complete the management plan, the Coalition has hired a consultant, EcoLogic LLC, to compile, review, and edit the completed and in-progress sections of the plan, and also write other sections such as an introduction and executive summary. EcoLogic will also play a key role in assisting the Coalition in the process of obtaining public input to and support for the plan. The in-progress sections of the plan include recommendations, both on the ground and regulatory, to restore and protect water quality, a strategy for implementation, and a monitoring and tracking plan. Consideration is being given to incorporating these aspects of the plan into the web map to allow for ongoing management of the plan.

Invited Presentation

WAVE IS COMING TO THE MOHAWK BASIN IN 2014

Alene Onion
Division of Water, New York State Dept. of Environmental Conservation, Albany, NY 12233

Water Assessments by Volunteer Evaluators (WAVE) will be targeting the Mohawk basin in 2014. This project is being implemented by the NY State Department of Environmental Conservation (NYSDEC) and uses biological data collected by citizen monitors from wadeable streams and rivers across NY State. The main responsibility of WAVE participants is to select stream sites and collect a sample of benthic macroinvertebrates (small animals that live on or in stream bottom sediments). These samples are processed by the WAVE coordinator and used to categorize each site as having “no known impact”, “possibly impaired” or “other.” The goals of this project are to identify high quality stream segments with “no known impact” for federal and state reporting processes and to identify possibly impaired stream segments that deserve further investigation at the professional level.

To participate, one member of each group must attend a training session held by the NYSDEC. These training sessions are rotated throughout the state on a five-year cycle following the NYSDEC Rotating Integrated Basin Studies. In 2014, six WAVE training sessions will be held across the Mohawk River Basin.

Poster Presentation

PREDICTING OCCURRENCES OF ICE JAM FLOODING ON THE MOHAWK RIVER AT THE END OF THE 21ST CENTURY

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Introduction

According to Lederer and Garver (2001), 80% of large floods in the past 170 years have been connected to ice jams. However, the Mohawk River is located on the lower edge of regions in the northern hemisphere that have river ice (Bennett and Prowse 2010). Based on regional climate model output (North American Regional Climate Change Assessment Program, https://www.narccap.ucar.edu/), the average winter temperature in the region is expected to increase by 3° to 4° C by 2070. Given that the historical average daily January temperature in the region is -5.5 °C, the mean January temperature would rise to be near 0° C. One would anticipate that the frequency of river ice would decrease, as would ice thickness when ice is cold enough to be present.

Most work to date on ice jamming on the Mohawk has focused on historical occurrences of ice jams as well as real-time forecasting of present threats of flooding from ice jams such as that currently being undertaken by USGS. The work presented here takes a long-term perspective to consider whether present day threats from ice jamming will remain decades from now. This information is important for shaping perspectives on future flood risk on the Mohawk River.

Methods

Based on analysis of historic ice jam flooding occurrences on the Mohawk River as well as two additional rivers in Maine and New York, we formulated a simple rule-based model to predict ice jam flooding. The rule-based model is dependent on ice thickness, air temperature, and precipitation during the ice break-up phase. Basically, the model identifies years with sufficient ice to cause a blockage plus sufficient discharge to build-up behind the blockage and cause flooding.

While air temperature and precipitation during break-up is readily available, ice thickness is typically not measured. To estimate the ice thickness, we used a simple model based on the cumulative number of freezing degree days up to the point of ice break-up. Freezing degree days are the number of degrees the temperature is below freezing on a given day.

The equation to estimate ice thickness (h) is expressed as:

$$h_i = k\sqrt{S_F} \qquad \text{Eqn. 1}$$

where S_F is the accumulated freezing degree days and k is a coefficient that accounts for variations in radiative and conductive heat fluxes due to the degree of overlaying snow, cloud cover, wind, and other factors (Beltaos & Prowse, 2009). As originally presented, Beltaos and Prowse (2009) did not accommodate for any decline in ice thickness due to brief thaw periods. Thus, we added a dependency on the number of "warming degree days". Warming degree days are the opposite of freezing degree days and count the number of degrees the temperature is above freezing. After an accumulation of 15 warming degree days, 1.25 cm of ice was removed for each accumulated warming degree day. We tested the ice thickness build-up and thaw model against recorded ice thickness on the Piscataquis River in Maine and the Yana River in Russia, the only two rivers we could find with frequent direct measurements of ice thickness. On both rivers, the ice thickness was well estimated with a slight tendency to underestimate at the thickest levels (> 60 cm).

The rule-based model assesses whether break-up events meet certain criteria. If all criteria are met, then ice jam flooding is assumed to occur; if not all criteria are met, then flooding does not occur. The model was applied to three river systems with historical records of ice jam flooding: The Mohawk River; Fall Creek in Ithaca, New York; and the Piscataquis River near Dover-Foxcroft, Maine. Fall Creek and the Mohawk River had 70 years of observations of potential ice jam flooding. The Piscataquis had 66 years. For the Mohawk and Piscataquis Rivers, we used the following criteria for the model: the ice thickness at the time of the breakup was over 20 cm inches, the average temperature in the days prior to break-up was greater than 4°C, the warming degree days was 15 or greater, and the precipitation before the break-up event was greater than 1 cm. For Fall Creek we used similar criteria with the exception that we used daily maximum temperature instead of mean temperature. Fall Creek is a smaller system and appears more sensitive to rapid changes in warming.

Results

For our three sites, the model correctly identified approximately 80% of years when historic ice jam flooding occurs and misidentified from 24% to 10% of years when ice jamming flooding does not occur (i.e. false positives). The performance on individual rivers is summarized in Table 1 below.

Table 1. Capability of model to identify years with ice jam flooding while minimizing false positives.

	Model Predicts Flooding when Flooding is Observed	Model Predicts Flooding when No Flooding is Observed
Mohawk River	81%	8%
Fall Creek	75%	24%
Piscataquis River	80%	12%

Most of the years with known ice jam flooding that were not identified by the model were mid-winter events. The warming degree days for these events did not exceed 15. Typically for these events, a sudden increase in temperature occurred simultaneously with heavy rainfall, which presumably aided in ice break-up and also provided a large volume of water to result in flooding. The ability of the model to accurately predict ice jam flooding across three sites over 200 plus evaluation years with variable climate conditions suggests that the model should be suitable for making future predictions.

Next Steps

We are in the process of applying the ice-jam model to climate model simulations of future climate in the Mohawk Valley in order to estimate future frequency of ice jam occurrence on the Mohawk River. We anticipate the main future control on ice jam flooding will be ice thickness as we would still expect occasional rapid thawing with accompanying large precipitation amounts. While average seasonal temperature will very likely increase in the future, there is still the possibility for short term divergences from the mean. That is, even if the average wintertime temperature increases there is still the chance for sustained “cold snaps”, just as we have today.

Notably, the ability of climate models to simulate sustained cold periods remains somewhat uncertain. Sustained periods of intense cold due to the inflow of Arctic air are due to changes in the position of the polar jet stream. While it is reasonably well established that the jet stream will shift north by 1 to 2 degrees, there is some indication that there will be a decline in rate of north-to-south oscillation of the jet stream (Barnes and Polvani 2013). Therefore, when the jet stream does meander to the south, it may be more likely to stay there longer, still resulting in some sustained periods of cold air, even if mean winter time temperatures do increase. However, these changes in the rate of oscillation of the jet stream remain uncertain and raise some question as to the ability of the climate models to represent future changes in short-term variability in climate.

References

Barnes, E. A. and L. Polvani, 2013: Response of the midlatitude jets, and of their variability, to increased greenhouse gases in the CMIP5 models. J. Climate, 26, 7117-7135.

Beltaos, S. and T. Prowse. 2009. River-ice hydrology in a shrinking cryosphere. Hydrological Processes. 23: 122-144.

Bennett, K.E. and T.D. Prowse. 2010. Northern hemisphere geography of ice-covered rivers. Hydrological Processes, 24: 235-240.

Lederer, J.R. and J.I. Garver. 2001. Ice jams on the Lower Mohawk River, New York: Lessons from recent breakup events. Geological Society of America, Northeastern Section – 36th Annual Meeting, Burlington, VT.

Volunteered Presentation

SEDIMENT MOBILIZATION IN THE SCHOHARIE WATERSHED

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Following Tropical Storms Irene and Lee in August and September of 2011, the rain generated streamflows in Schoharie Creek mobilized substantial amounts of sediment. This large-scale fluctuation in the sediment transport rate and storage volume in the fluvial system is known as a sediment slug. While the impacts of such sediment slugs vary in terms of scale and severity, these processes are not fully understood and it is not yet known whether they represent characteristic or unusual responses of a fluvial system to extreme rainfall events. The study of these slugs involves three broad requirements: (1) appropriate spatial boundaries that define the catchment of interest, (2) a proper temporal scale that includes the sediment mobilization event, and (3) data collection that reflects the important physical characteristics of the river channel. This poster presents a proposed study to evaluate a number of important variables in the Schoharie Creek area over a two year period, including suspended load and bedload, river discharge, channel geometry, as well as the historical records of these variables. The in-situ measurement of suspended load and bedload – vital for the quantification of sediment slugs – is complicated by the uncertainty associated with these sediment transportation processes. Bedload transportation, for example, can vary on a reach-by-reach basis and cannot yet be accurately predicted. Conversely, suspended load measurement techniques vary in terms of accuracy and cost, and are therefore selected given project and field constraints. The purpose of this research is to quantify the spatial and temporal scales, as well as the magnitude of the 2011 sediment slug. In cooperation with the Schoharie River Center and the USGS Water Survey, these results will be used to better understand the impact of extreme events in the Schoharie watershed system. Furthermore, this work may provide insight into the nature of sediment slugs and whether they represent characteristic or unusual responses of a fluvial system.

Poster Presentation

A MANAGEMENT PLAN FOR THE MOHAWK RIVER WATERSHED: ENGAGING THE COMMUNITY

A. Thomas Vawter, Ph.D., Elizabeth C. Moran, Ph.D*., and Linda P. Wagenet, Ph.D.
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The Mohawk River watershed is the largest tributary of the Hudson River, comprising 25% of its watershed. The watershed encompasses a diverse area within 14 counties, with significant water-quality issues. The watershed on occasion has experienced severe flooding. The Mohawk River watershed contributes to the public water supplies of over half the residents of New York State.

Toward the goal of restoring, preserving and protecting the Mohawk River Watershed, a coalition of Soil and Water Conservation Districts (the Coalition) is developing a watershed management plan. The plan will include a detailed characterization of the natural and cultural settings of the watershed, an inventory of existing and potential sources of pollution, and an analysis of water level management and flooding challenges. The plan will culminate in a set of recommended strategies to address these issues in the context of the regulatory and programmatic environment. In addition, the plan will include recommended strategies for ongoing public education and outreach to track improvements and communicate progress.

Under contract with the Coalition, EcoLogic, LLC, will compile, review, and edit the extensive information already gathered into a Draft Watershed Management Plan and summarize its important elements. A watershed management plan ultimately addresses four questions: (1) Where are we now (current state)? (2) Where are we going (trends)? (3) Where do we want to go (vision for the future)? and (4) How do we get there (specific actions and strategies)?. Clearly, successful implementation of a watershed management plan needs public agreement and the participation of the many stakeholders in the watershed. Community matching funds and commitment from government agencies will be required in the implementation phase of the plan, so involvement and acceptance by the various stakeholders in the development of a plan that addresses community concerns is critical. The Coalition and EcoLogic will present the draft plan to the public this spring and will solicit community input. In midsummer 2014, we will present the draft plan in three public meetings held in different regions of the watershed. Prior to these meetings, EcoLogic will engage in community outreach to optimize attendance and participation in the process.

Poster Presentation

SPATIAL ANALYSIS OF BOIL WATER ADVISORIES ISSUED DURING AN EXTREME WEATHER EVENT IN THE MOHAWK-HUDSON WATERSHED

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Water infrastructure in the United States is aging and vulnerable to extreme weather. Recent events demonstrated the importance and vulnerability of this critical infrastructure. During late August 2011, the eastern part of New York State experienced unprecedented precipitation from Tropical Storm Irene. The storm caused great damage to infrastructure, including public drinking water systems. Several water supply districts issued boil water advisories (BWAs) to their customers as a result of the storm. A boil water advisory (BWA) or a boil water notice is a public notification issued by water utilities informing the public of the need to boil their tap water before coming in active contact through drinking, brushing teeth, washing dishes, etc. As a result, depending on their severity and length, such advisories can result in significant costs to individuals and communities. We conducted a spatial analysis of boil water advisories issued in the Mohawk-Hudson water districts after Tropical Storm Irene. The objective of the study was to identify major factors that lead water supply systems to issue BWAs by assessing watershed characteristics, water supply system characteristics and treatment plant parameters of water districts.

Thirty-one of the 678 water districts in the Mohawk-Hudson watershed issued BWAs in the aftermath of TS Irene in August 2011. Our results suggest that the probability of a BWA being issued by a water supply district is enhanced by higher precipitation during the storm, high density of septic systems, lack of recent maintenance and low population density. Interviews with water treatment plant operators suggested physical damage to water distribution systems were the main causes of boil water advisories during storms. Boil water advisories issued by water districts result in costs to residents, businesses and communities. Moreover, evidence suggests that the non-compliance of instructions provided during a BWA is extremely high. Even though the number of BWAs issued after TS Irene is a small proportion of the total number of water districts in the watershed, minimizing or preventing future BWAs should be an action item high on the list of water districts, municipalities, and local and state health departments. Districts that have a history of issuing BWAs and those likely to issue one, must educate their consumers on the protocol to be followed in the event of such an emergency. Prior investments in infrastructure management can proactively address municipal water supply and quality issues.

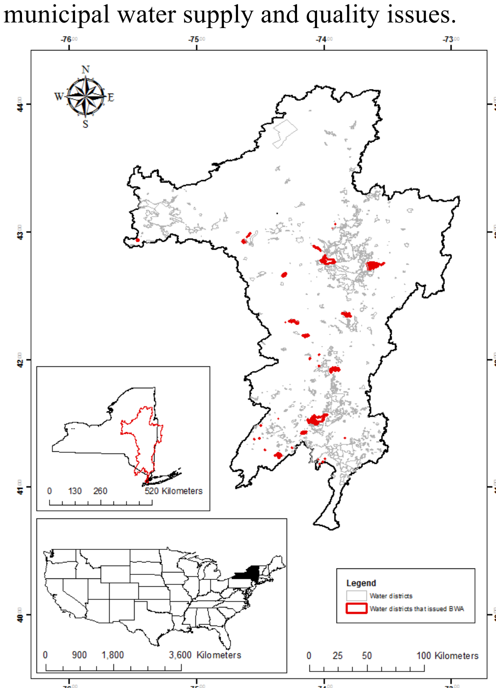

Figure 1. Water supply districts in the Mohawk-Hudson watershed. Districts that issued a boil water advisory during Tropical Storm Irene are highlighted.

Volunteered Presentation

Analyzing the Spatial and Temporal Slope Instability Patterns at the Burtonsville, N.Y. Landslide Using Dendrogeomorphological Approaches

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East of Burtonsville, along the Schoharie Creek bank, slope instability has been an on-going issue and most recently, following Tropical Storm Irene. In June 2013,112 eastern hemlock (*Tsuga canadensis)* were sampled from along a relict landslide near Burtonsville. The oldest living tree sampled dated back to 1731 and over 90% of the trees were established by the early1940s. Two cores were extracted using an increment borer, one from the upslope or east tree side a second from the downslope or west tree side. The asymmetrical growth for each tree was calculated as the difference between the upslope growth and the downslope growth. Plotting the asymmetrical growth curves provided visual interpretation for tree reaction to slope instability. The asymmetrical growth records were compared with the presence or absence of compression wood to verify growth differences due to slope changes, rather than other physiological conditions. Spearman rank coefficient tests resulted in 75% of the trees having statistically significant correlations between asymmetrical growth and compression wood presence and when taking into account a maximum five year lag period, the total trees exhibiting a statistical significance increased to 89%.

The asymmetrical growth time series data is likened to having an array of tilt sensors setup across the slope for nearly the last two centuries. Analysis of both the spatial and temporal changes in inferred slope stability suggested that slope movement was independent for the most part in a slope-wise direction, but strongly coincident in the streamwise direction. Instability along transects (west to east direction) was local and it is unlikely that instability in this direction caused instability above or below. Whereas, instability in the streamwise direction (south to north, between transects) seemed more coordinated. In addition, analysis suggested that slope instability was episodic and is characterized as punctuated periods of multiple trees showing instability for 3-10 years at a time, followed by periods of stability that varied between 10 and 15 years in length. Inferred slope activity correlates with regional moisture variability (based on Albany precipitation totals) and with periods of increased local bank erosion (based on discharge at Burstonsville in Schoharie Creek).

This dendrogeomorphological analysis provides useful information in understanding the spatial and temporal instability across the southern portion of the large landslide near Burtonsville. It provides a means of understanding areas along the hillslope that are prone to failure and provides a times series of the frequency in which instability occurs. The figures included with this abstract demonstrate the production of this series for specific tree (Figure 1) and the instability through time for a given sample area with 45 trees sampled (Figure 2).

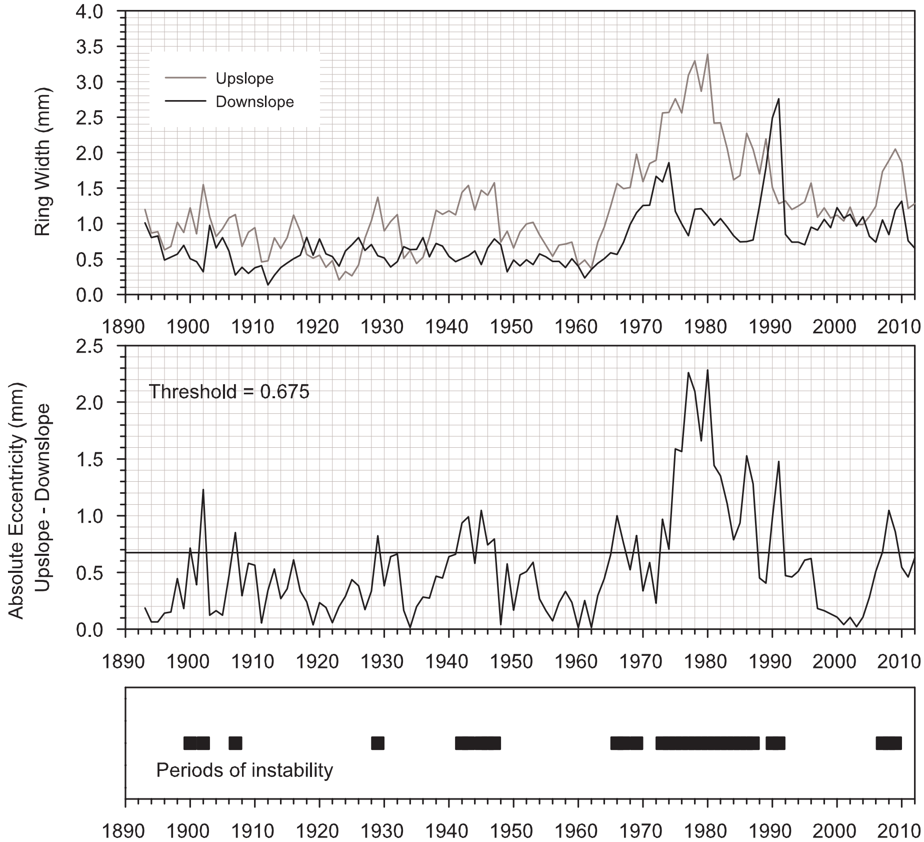

Figure 1: An example the upslope and downslope tree ring widths for a single tree and the ultimate generation of instability index from that location. The upslope and downslope ring widths were measured to the nearest 0.001mm and plotted (top panel). In conifer trees where the tree tilt is upslope (towards the slope), the upslope ring widths are expected to be larger during instability periods. The eccentricity for the tree (middle panel) is calculated as the absolute difference between the downslope and upslope ring widths. The absolute eccentricity values are used to determine instability in both the upslope and downslope direction. A threshold of 0.675mm was set for all trees in order to differentiate years in which instability occurs (eccentricity for tree *i* >0.675mm) compared to stable years (eccentricity for tree *I* < 0.0675mm) for each year (bottom panel).

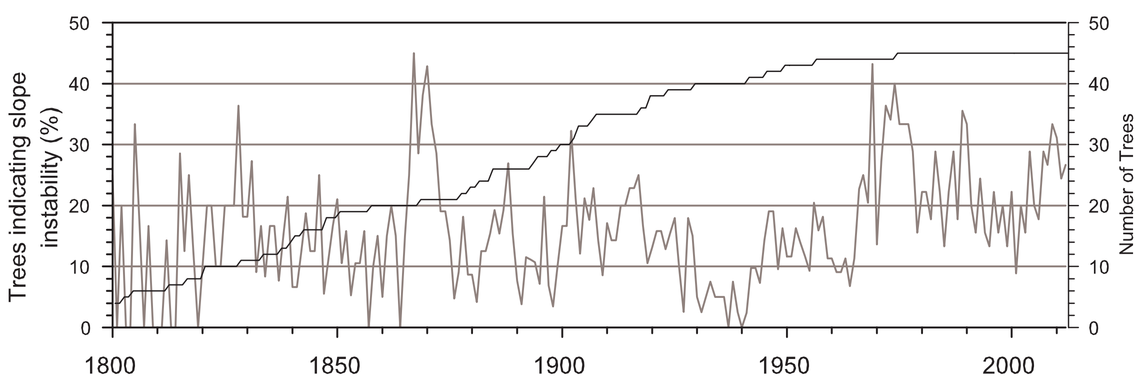

Figure 2: Percent trees showing instability derived from tree ring eccentricity along the Schoharie River near Burtonsville, NY.

Poster Presentation

EROSION MITIGATION AND HABITAT IMPROVEMENT THROUGH BIO-ENGINEERING AND NATURAL CHANNEL DESIGN

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'Natural' Channel Design (NCD) is a widely-used technique for watercourse restoration and realignment with the objective of constructing stable channels. NCD is the application of hydraulics and geomorphological relations to create a dynamically stable channel. These techniques are often combined with bio-engineering techniques, which use vegetation on combination with other materials to stabilize channel banks. NCD and bio-engineering approaches are often referred to as 'green' or 'soft' solutions. The value of NCD and bio-engineering in enhancing habitat is also often highlighted. The description as a soft solution along with stressing the ecological value of these methods tend to lead to the misconception that these approaches do not provide the same protection as traditional channel hardening. In order to dispel this misconception, the presentation will examine NCD and bio-engineering techniques in the context of their stabilization benefit and potential to reduce erosion. The value of these approaches is illustrated by discussing the hydraulic and mechanical properties of the different design elements.

Invited Presentation

A NEW TOOL TO MONITOR ICE JAM FLOODING ALONG THE MOHAWK RIVER, SCHENECTADY, NY

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Ice jam floods are a threat to lives and property in low-lying areas along the Mohawk River, particularly in the vicinity of the Stockade District in Schenectady, NY. Lederer and Garver (2001) estimated that 80% of historic Mohawk River floods in Schenectady are a result of winter snowmelt and ice floes. Emergency managers typically monitor ice jams and associated water levels through onsite observations which are inefficient and do not describe the spatial or temporal extent of ice jam conditions, which can be spread over several river miles.

The U.S. Geological Survey, in cooperation with the New York State Department of Environmental Conservation's Mohawk River Basin Program, the New York State Power Authority, Brookfield Renewable Power, and Union College, has developed a tool to assist emergency managers monitor river conditions and make informed decisions. The tool evaluates river stage readings at USGS streamgages along the Mohawk River at Lock 8 near Schenectady, NY (01354330) and Mohawk River at Freeman's Bridge at Schenectady, NY (01354500) (figure 1) and streamflow calculated from Freeman's Bridge. The tool is also available to the public as a web based product at: (http://ny.water.usgs.gov/flood/MohawkIce/)

A key element of the tool, which may be a novel approach to ice jam monitoring, is a simple model relating streamflow to the water-surface slope between the two gages during ice-free conditions. The model predicts the river stage at Lock 8 based on the observed stage and discharge at Freeman's Bridge. During periods with river ice, the difference between the observed and predicted stage at Lock 8, referred to as the residual, is attributed to backwater from ice between Lock 8 and Freeman's Bridge. The residual, measured in feet, can be monitored in near-real time, or over time, to assess whether the backwater conditions are increasing or decreasing. The tool incorporates the USGS WaterAlert service through which users can sign up to receive email and (or) text alerts when the stage or residual exceed a user-defined threshold.

Figure 1 *– Google Earth image of the Mohawk River between Locks 7 and 9 near Schenectady, NY. Locations of USGS streamgages and web cam are indicated by yellow squares.*

In addition to stage and residual, real-time, high-definition views of the river downstream of Riverside Park in the Stockade District of Schenectady are available through a web camera. Users can control the camera to observe upstream, cross-river, and downstream conditions. The camera is equipped with infrared lighting to provide images of the river or ice at night. The web cam is intended to show river conditions in the Stockade District, better understand the gage observations and model residual, and archive time-lapse imagery for further study.

The tool was made available January 11, 2014 to a few partners and emergency managers and increased to 1,100 unique visitors and 2,350 visits to the web page within the first month. After a few weeks, the page became Google's top ranked site for "ice jam monitoring" web searches. Many of the visitors to the tool web site were directed there by local news coverage in the Schenectady Daily Gazette newspaper and local television.

The observational system could be expanded downstream to Rexford, NY and Vischer's Ferry Dam (figure 1) to provide additional monitoring of the Mohawk River behind the Vischer Ferry Dam, if additional funds became available.

Reference:

Lederer, J.R., and Garver, J.I., 2001, Ice jams on the lower Mohawk River, New York: Lessons from recent breakup events. GSA Abstracts with Programs v. 33, n. 1, p. 73.

Invited Presentation

AN UPDATE OF CLIMATE CHANGE RESEARCH IN NEW YORK STATE

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New York State municipalities, businesses and individuals affected by recent extreme weather events are seeking approaches to be better prepared and more resilient. However, our responses have often been primarily based on immediate needs and resources at hand. Science-based climate projections and planning tools, along with innovative means of adapting to our changing climate, are essential to effectively reducing our vulnerabilities and minimizing the economic impacts of climate-related events. Many efforts are underway to help address these needs, including projects supported by NYSERDA's Climate Research and Analysis Program.

Invited Presentation

A CENTURY OF WEST CANADA CREEK WATER MANAGEMENT: THE CASE AGAINST THE FRAGMENTED APPROACH

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Hydrologist (ret.), West Canada Watershed Alliance

Recent years have witnessed a number of challenges involving the water stored in the West Canada Creek's Hinckley Reservoir, as water managers squabbled in court over contract interpretations and allocations and a major debilitating drought exposed the system's vulnerabilities. Some litigation has been settled, and some is yet unresolved. Some measures have been taken to avoid or mitigate droughts yet to come, others await action or funding. And dominating influences on the flows in the lower river, the Jarvis, Prospect and Trenton Falls hydroelectric projects, are scheduled to begin the relicensing procedure just a few years. Additionally, the prospect of the Utica-Rome region becoming a hub for the nanotech industry hinges upon a reliable water source. All the while, increasing use the river by trout fishermen, tubing and canoeing enthusiasts, and other recreationists has brought growing awareness of both the value of and the potential threats to the river, even as local businesses thrive on the influx of visitors, both local and from far away.
Under the concept of the widely recognized Public Trust Doctrine, New York State, as sovereign, holds title to the West Canada Creek and Hinckley Reservoir in trust for the people. The State has the responsibility to balance the various demands on the resource to achieve the greatest public good. Its responsibilities extend beyond ensuring the public's access for commerce, navigation, fishing, and recreation. Today it has broadened to include protecting the resource, since without environmental protection, trust rights would have little meaning.

This paper suggests that the management of such an important resource like the West Canada Creek has become too complicated to be done through fragmented, bilateral contracts and piecemeal permitting and licensing. That approach necessarily focuses on the primary needs of the immediate parties. Assessment of impacts, both on the resource and on other stakeholders is supposed to be provided through New York's State Environmental Quality Review Act (SEQRA). Real examination too often seems lacking, non-transparent, or even dismissive. The fragmented approach may have been standard procedure in our water-rich, more sparsely populated State a century ago, but the multiple demands on the river and advances in the ecological sciences suggest that a broader, holistic approach to water management is far more likely to find equitable and lasting solutions to water allocation challenges, avoid protracted conflicts, and protect the ecological health and viability of the river for everyone.

Background
The West Canada Creek is a treasured resource for the Upper Mohawk Valley. Draining 562 square miles of the southern Adirondack Mountains, it is the Mohawk River's second largest tributary. On average, it receives about 55 inches of rainfall annually, of which about 40 inches are runoff and the rest evapotranspiration. More than half of the basin lies within the Adirondack Blue Line. Wild and stocked trout are abundant, and the lower reach of the river is the third most-fished trout stream in New York and the pride of our region.

The major impoundment on the river is the State-owned Hinckley Reservoir, capturing the runoff of 372 square miles. Hinckley Reservoir was completed in 1915. The State's purpose for creating the reservoir was to provide water to the newly modernized Erie Barge Canal (Hinckley Reservoir Working Group (HRWG), 2008). Its original usable capacity at the full spillway elevation of 1225 feet is 3.4 billion cubic feet (25.8 billion gallons, or about 4 inches of runoff). Usable storage can theoretically be accessed down to an elevation of about 1164 feet. Water is released from Hinckley through the turbines of the Jarvis Hydroelectric facility, operated by the New York Power Authority (NYPA). Until recently, releases were made according to an operating diagram developed in 1920 that considered both the calendar (annual water cycle) and present reservoir level to set the release rate. Generally, once set, the Jarvis release is constant until a new change is called for by the operating diagram.

Today Hinckley Reservoir continues to serve many uses and purposes, including Erie Canal operations, hydroelectric power generation, and Utica's water supply, as well as boating and recreation on, and camps and homes around the reservoir itself. It also supplies sustained river flows downstream for fishing, canoeing and tubing, camping experiences, and of course, water quality maintenance and preservation of a healthy aquatic ecosystem. The two diversions out of the basin are 1) from Hinckley by the Mohawk

Valley Water Authority (MVWA) for municipal water supply (constant, averaging about 35 cubic feet per second (cfs)), and 2) from the river by the Canal Corp (NYCC) at the Morgan Dam, below the Trenton Falls Hydroelectric facility (seasonal, varying as needed up to about 80 cfs in modern times). Although maintaining a water supply is its primary purpose, the reservoir can and does afford some flood attenuation benefits as well.

For different reasons, the creation of Hinckley Reservoir in the early 1900's upset the status quo for the West Canada's other two established users to continue their functions, and they brought suit against the State for incurred damages. In the few years that followed, the State entered into two separate agreements to settle the litigation. These were the 1917 Agreement between the State and the Consolidated Water Company of Utica (CWCU) and the 1921 Agreement between the State and Utica Gas & Electric (UGE). A comprehensive description of both these agreements as well as more detailed background related to legal proceedings mentioned further below was presented at this meeting last year (Montecalvo, 2013). Montecalvo also discussed the existence and status of riparian rights held by a number of West Canada Creek property owners.

Recent Legal Conflicts

In recent years, lawsuits have arisen surrounding both of these agreements, and they have served to illustrate just how complicated and conflicting the situation has become. Whether through lack of enforcement over the decades (the 1917 Agreement), or from an attempt at renewed enforcement when the system is stressed in 2007 (the 1921 Agreement), it brings to light just how inadequate the fragmented approach to water management has been and continues to be.

The first lawsuit, brought by the Mohawk Valley Water Authority (MVWA) against the Canal Corporation (NYCC) was filed in 2005. MVWA sought judgment that under the 1917 Agreement, it had an "absolute and unconditional right to divert, withdraw and use a daily flow of water up to 75 cfs from the West Canada Creek at Hinckley Reservoir". The NYCC countered that MVWA was not entitled to the 75 cfs because it was in breach of the 1917 Agreement, in part, because it failed to provide compensating flow from its own reservoir when inflow to Hinckley fell below 335 cfs, as stipulated. In fact, during the years since the 1917 Agreement was signed (when the average withdrawal has been 35 cfs), the municipal water company sporadically complied with the compensatory flow stipulation, and the State did not seek to enforce compliance when they didn't. The CWCU owned the 1.2 billion gallon Gray Reservoir, located on Black Creek, a tributary to Hinckley Lake, for this purpose. Without considering additional inflow, the storage in a full Gray Reservoir could provide 53 days of compensatory flow if the withdrawal rate was 35 cfs (and 265 days if expanded to the originally planned size of 6 billion gallons). The dam fell into disrepair over the years, however, and was removed in 2002 after having failed safety inspections, and a reservoir to store water for compensating flow no longer exists.

Eventually NYCC and MVWA came to a new agreement, sanctioned by the State Supreme Court in February 2013 that superseded the 1917 agreement and modified it in very significant ways. It gives the Water Authority the absolute and unconditional authority to withdraw the full 75 cfs from Hinckley as it previously sought, and it voided the requirement that the Water Authority "provide compensating flows, maintain a compensating reservoir, or provide financial compensation to any party for use in connection with any water supply purpose."

In order to ensure MVWA's ability to always have the 75 cfs available under this new agreement, the Canal Corporation necessarily had to examine the utility of the 1920 Operating Diagram (OD). An analysis of the historical data by the Upstate Freshwater Institute resulted in development and adoption of an updated 2012 Operational Support Tool (OST). Like the previous 1920 Operating Diagram, prescribed release rates from the Hinckley Dam depend on seasonal considerations and the current reservoir level. Unlike the 1920 OD, one of the purposes of the new diagram is expressly to manage the reservoir so that that its elevation stays above 1195 feet. An exception is made in times of drought, when deviations to the OST shall be made as needed to avoid the reservoir falling below 1185 feet. Withdrawals for drinking water are very negatively affected at about 1185 ft. On April 1, 2013, the Canal Corporation officially began managing Hinckley releases using the 2012 OST.

Before discussing the second lawsuit, surrounding the 1921 Agreement, it is important to look back at the major drought in the West Canada Creek in the summer and fall of 2007, when abnormally dry weather led to record-setting low water levels in Hinckley Reservoir. By September 26, the level had fallen to 1188.91

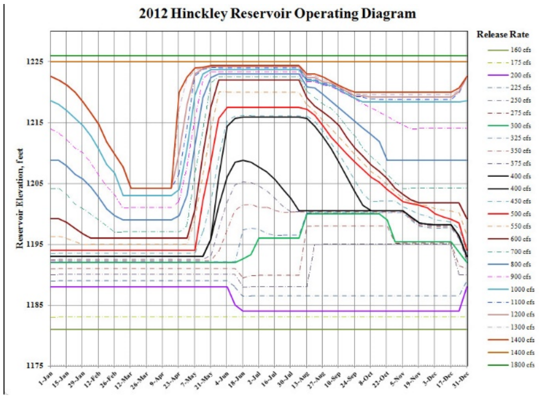
feet, only 15% of the reservoir's calculated usable capacity remained, and 130,000 people in the greater Utica area and the businesses that serve them were in danger of a costly and dangerous disruption of their water supply. On September 26, at the request of DEC, the State Emergency Management Office, and the New York State Department of Health, NYCC ordered NYPA to reduce reservoir releases to 120 cfs, or 25% below the safe minimum deemed necessary to protect the fishery downstream, in order to conserve the remaining storage for the public water supply. The reduced release immediately began to reverse the water level decline, but lasted for 21 more days until inflow from fall rains permitted return to normal operations. As a result, canal operations had been impacted as water to the Ninemile Feeder was cut off, lockages east of the Rome summit were curtailed and the Canal eventually closed ahead the normal seasonal date. Hydropower operations at the Jarvis, Prospect, and Trenton Falls plants had ceased, the MVWA ordered water conservation measures, and needless to say, the recreation season on Hinckley Reservoir and the lower West Canada had already been ruined. The fishery in the lower river also was in danger. To minimize further harm, DEC closed the lower river to fishing on October 5, based on staff surveys that found very high stress on the fish from elevated water temperature, restricted movement from pool to pool, and increased predation (HRWG, 2008).

NYCC managed Hinckley Reservoir differently during this drought from how it operated in some previous dry spells. The difference was that it abided fully with the 1920 OD, until September 26, when, as noted above, it had little choice but to reduce the release to 120 cfs, well below what the OD prescribed (approximately 300 cfs) because of the imminent threat to MVWA's ability to withdraw water needed for Utica's population. During dry spells in previous years, as falling Hinckley levels began to cause concern, NYCC, in consultation with the municipal water company and the power company, would deviate from the OD by releasing less water than what the OD stipulated to conserve water for the municipal supply.

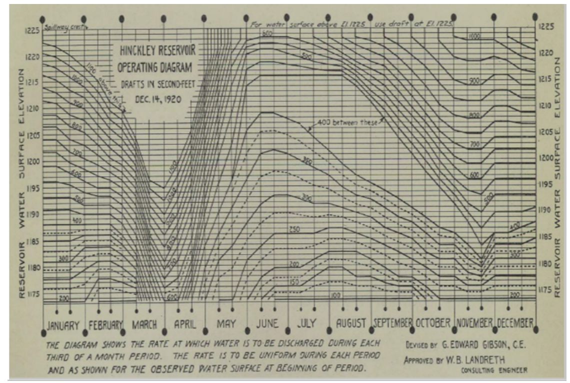
After the 2007 drought, Brookfield Renewable Energy (BRE), which has owned the Prospect and Trenton Falls Projects since 2004, sought to sue the NYCC in the Court of Claims for damages, stating NYCC breached the 1921 Agreement when it deviated from the 1920 OD in late September and early October of 2007. NYCC countered that the 1921 Agreement provided for deviation from the 1920 OD during periods of drought and other emergencies, without "payment of damages" to BRE.

In its decision on May 31 2012, the Court of Claims dismissed BRE's suit, agreeing with NYCC that the 1921 Agreement provided for deviation from the 1920 OD in periods of drought, and therefore no breach occurred. BRE appealed the decision, and on January 9, 2014, the State Supreme Court, Appellate Division reversed the Court of Claims and reinstated BRE's lawsuit, based on a closer interpretation of the wording of the 1921 Agreement. Essentially, while the Agreement allows the Canal Corporation to deviate from the OD during "periods of extraordinary or unusual drought, flood or emergency caused by the temporary failure of other sources of water supply for the canal use", the Appellate Court also found that such deviations were allowable only for "canal uses and purposes". While recognizing that NYCC's action was necessary and unavoidable to protect the public water supply, the deviation was not for "canal uses and purposes", and the court nevertheless found that a breach of contract had occurred, and NYCC was liable for damages.

It appears that this litigation may continue and the outcome is uncertain. But for the time being, it appears that NYCC may be bound by a conflicting set of rules. The 2013 Agreement with MVWA and the 2012 OST are currently being followed in day-to-day operations. At the same time, the Appellate Court has held the 1921 Agreement fully in force with regard to its obligations to BRE, meaning deviation from the 1920 OD potentially puts them in breach of contract. There's really a lot of information in these graphics to digest, but it isn't hard to see that these two rule curves different from each other, especially at low summertime elevations.



2012 OST



1920 OD

The history of how these two agreements have been implemented over the years raises a number of questions for the interested observer, many of which probably can't be answered. Why weren't compensating flows stipulated by the 1917 Agreement consistently provided through all those years? Why did the State not seek enforcement? Why have the riparian rights of West Canada Creek deed holders (which also carry similar compensating flow stipulations) been ignored? Why was the destruction of the Gray Dam allowed? All other things unfolding the same during the summer of 2007, the 1.2 billion gallons that theoretically could have been available from a full Gray Reservoir would have resulted in Hinckley's elevation on September 26 being 1192.1, or 3.2 feet higher than actually recorded. Could that have left enough water left in Hinckley in September and October 2007 to avoid the drastic emergency measures and (or at least) lessen the resulting damage to the creek? During previous dry spells, if compensating flows had been provided when prescribed, would NYCC have had the need to deviate from the 1920 OD? Why did BRE's predecessors not pursue claims for damages after previous 1920 OD incidents? Has the 2013 Agreement, in effect, repurposed Hinckley from a reservoir who's primarily purpose was to supply the canal to one that now has an equal purpose as a municipal supply? If the reservoir is to be repurposed, is a court proceeding the proper mechanism to do it?

On the Horizon

On December 17, 2013, MVWA filed an application with the DEC to modify its existing water supply permit to expand its service to 4 towns surrounding its present service area. The permit application seeks to expand its average daily withdrawal to 75 cfs (as authorized by the 2013 Agreement), although the DEC published notice says the consideration is for 50 cfs (NYS DEC, 2013). The proposed project expands the service area by more than 50%, and is classified as a Major Project. Finding no significant environmental impacts, MVWA as lead agency filed a Negative Declaration pursuant to SEQRA with its application. DEC received 39 comments on the application, and as of the date this abstract was submitted, had not yet acted on the application. There is promising economic news for the for the Utica-Rome area as plans for the long sought Marcy Nanocenter finally are beginning to gel. The high-tech industry will need a reliable source of water, estimated to be about 5.4 cfs (3.5 MGD). It is unclear why the water supply system seeks expansion to withdraw 75 cfs, since the DEC public notice says 50 cfs is what MVWA estimates its system's needs are (presumably including the Nanocenter) projected out to 2050.

The FERC licenses for BRE's Prospect and Trenton Falls hydroelectric facilities expire in 2023, (and for Jarvis, in 2022) so in a few years the relicensing process will begin. With the long life – 40 years – of a FERC license, it's critical to examine how the facilities' operations best fit in the overall context of other user needs and current understanding of the requirements of a healthy aquatic ecosystem. There is continuing concern in the fishing community about negative effects of the present pulsing operations. In its January 2010 Mohawk River Basin Assessment (NYS DEC, 2010), DEC classified the main stem of West Canada Creek below the Trenton Falls facility down to the mouth as a Priority Waterbody (impaired), stating:

> "…A hydropower facility at Trenton Falls operates on storage mode rather than run-of-river. … Farther downstream (Trenton Falls to mouth) the daily fluctuations in stream flow produce temperature extremes in the summer and winter. Several fish kills related to low flow, high stream temperatures during the summer have been documented in the past decade. The regional

> fisheries staff has also received numerous complaints regarding impacts on the fishing resource…"

Will a reevaluation of the fishery find that a higher minimum flow is desired? That the pulsing operation should be modified or eliminated? Will a contemporary economic study of the riparian recreation business put a higher value on the water used for this purpose? Or will decisions that perpetuate fragmented water management in these years leading up to relicensing narrow the FERC's options as it sets the conditions that will govern hydropower operations and therefore the life of the lower river, for the next 40 years.

The public has had the right and ability to provide comments and concerns to DEC regarding the MVWA permit application. Public comments will be invited when FERC relicensing procedures begin. We trust that the responsible agencies will carefully consider the concerns they receive and address them prior to making their decisions. But the very nature of the 1917, 1921, and 2013 agreements as resulting from court proceedings excludes the public and other affected parties from the negotiations and final decisions that they also ultimately have to live with. When NYCC and MVWA announced an interim agreement in the summer of 2012, it came as a surprise to the public and to the elected legislative representatives who had been following the controversy that negotiations and reanalysis of the hydrologic rule curve were even ongoing. These bilateral court decisions are the basis for how this river has been and continues to be managed, but does the citizen who "lacks legal standing" in court still not have standing under the Public Trust Doctrine?

Conclusion

The lack of a unified management approach for the West Canada Creek over the last century can and has led to conflict, uncertainty, sometimes a loss of trust, and occasionally, unnecessary harm to the resource. From a legal perspective, perhaps it is naïve to propose that a holistic approach can replace the fragmented one, with all the new enabling legislation that would be likely be required. It is encouraging that the DEC is coordinating the "Mohawk River Basin Action Agenda", of which, of course, the West Canada Creek is a part (NYS DEC, 2012). Serving as a blueprint for DEC's "Mohawk River Basin Program", it lays out broad goals "to conserve, preserve, and restore the environmental quality of the Mohawk River and its watershed, while helping to manage the resources of the region for a sustainable future", which is exactly what the Public Trust is all about. For it to be successful, it also recognizes that the "program will require the involvement of stakeholders and the creation of partnerships with established programs and organizations throughout the basin." For the West Canada Creek at least, I would add that success will be manifested in an integrated approach to codifying all of the water management rules and regulations into an integrated "rule curve" and emergency conditions guidance, transparently developed, and which serves the core water managers, the public, and the river.

Before closing, I'd like to briefly return to the 2007 drought. Even before the water crisis on the West Canada was over, then Governor Spitzer formed the Hinckley Reservoir Working Group (HRWG) to make recommendations regarding:

- The water levels needed at Hinckley Reservoir to service drinking water needs, fisheries, power generation, and canal operations;
- The capability of other canal reservoirs to help meet those needs;
- An early warning system to communicate drought situations to stakeholders and facilitate their communication regarding all competing needs; and
- A report of the water usage and meteorological data for 2006 and 2007 to better understand the factors that contributed to low reservoir conditions in the fall of 2007.

The HRWG did a commendable job gathering and analyzing a tremendous amount of data (HRWG, 2008). Although membership was limited to governmental entities, it sought and accepted public input at its several public meetings. HRWG members have produced an invaluable archive of documents, data sets, and a particularly useful web tool maintained by the NYCC that tracks current system-wide conditions, all readily available for their agencies' and the public's use (NYCC, 2013). By late April 2008 HRWG had offered 10 recommendations to fulfill their charge, 7 of which were accepted and ordered for implementation by Governor Patterson on June 5, 2008. One of the recommendations was that a Planning and Advisory Group be formed by the New York State DEC to expand on the findings in the Report.

Specifically, the HRWG recommended formation of a group consisting of citizen, business, and local government representatives to work with a consultant to "expand upon the findings of the Hinckley Reservoir Working Group by undertaking a study of the area to characterize economic, recreational and development issues associated with the water resources."

It further added, "…It is also becoming clear that no effort has been made to ensure that all interests in the resources are listened to and taken into account. As use increases, competition for the resources, and over-use will cause a decline in the value of the area. This could easily result in damages to the resources, which in turn could have permanent environmental impacts, and concomitantly, a loss of revenue for residents and businesses. Creation of a commission and development of a study would serve as the basis for long term planning for the area to ensure that such negative impacts do not occur."

Almost 6 years later, this recommendation is yet to be implemented, but it still resonates.

References Cited

Hinckley Reservoir Working Group (HRWG) (2008), "Report to the Governor by the Hinckley Reservoir Working Group". Retrieved from: http://www.health.ny.gov/environmental/investigations/hinckley_reservoir/docs/2008-04-30_report_to_the_governor.pdf

Montecalvo, Frank (2013) "The Competing Interests in the Waters of the West Canada Creek". Proceedings from the Mohawk Watershed Symposium 2013 in Schenectady, New York, p 49-53. Retrieved from http://minerva.union.edu/garverj/mws/MWS_2013_Abstract_Volume.pdf

New York State Canal Corporation (2013) "Hinckley Reservoir Water Levels". Retrieved from http://www.canals.ny.gov/waterlevels/hinckley/hinckleywaterlevels.cgi

New York State Department of Environmental Conservation (2010), "Mohawk River Basin Waterbody Inventory/Priority Waterbodies List Report". Retrieved from http://www.dec.ny.gov/chemical/36739.html

New York State Department of Environmental Conservation (2012), "Mohawk River Basin Action Agenda". Retrieved from http://www.dec.ny.gov/docs/water_pdf/mohawkactagenda.pdf

New York State Department of Environmental Conservation (2013) "Environmental Notice Bulletin Region 6 Completed Applications 12/18/2013". Retrieved on 2/23/14 from http://www.dec.ny.gov/enb/20131218_reg6.html.

Invited Presentation