

Effects of Storm Surge Barriers on the Hudson River Estuary: Scoping Session Recap

Location: Center for the Urban River at Beczak in Yonkers, New York

Date: March 25th, 2019

A project Scoping Session was convened for the National Estuarine Research Reserve System (NERRS) Science Collaborative Program funded project, “Effects of Storm Surge Barriers on the Hudson River Estuary”. Participants included a mix of federal, state and city agencies, researchers and non-governmental organizations. A list of participants is attached. The meeting included broad summary presentations and audience questions on what is known and what research has been done on the estuary physical effects of gated storm surge barriers. Audience small-group discussions and report-outs were used to gauge stakeholder concerns and interests related to the potential environmental concerns regarding surge barriers. The audience learned of and shared their perspectives on possible plans for near-term research and workshops and also helped identify potential future prospects for funding for deeper science and a broader involvement from the research community. The meeting and ongoing project were identified repeatedly as a valuable opportunity for academia and other partners to share their knowledge in ways that can more deeply inform the science behind a federal study, in particular, the HAT Study. The [full slide deck PPT](#) is available on the project website.

Project Overview and Discussion

The project’s Principal Investigator Philip Orton presented a project overview (see [the project website](#)). He presented the rationale for the Project Advisory Committee (PAC) and the list of members (see [PAC description PDF](#)), as well as the rationale for the Scoping Session invitees.

Discussion and questions clarified that the study will look at the regional estuary system. Because existing models do not include adequate resolution of small tributaries most of the NERRS study focus will be on Hudson and Harbor-related effects. Some analyses and modeling will likely also pertain to some degree to sub-estuaries such as Newark Bay, the Hackensack River and Jamaica Bay. It was also clarified that the NERRS study is a one-year “catalyst” project designed to clarify interests and support research over a longer timescale.

Current Knowledge of Barrier Effects on Components of Estuary Health

Orton presented a review of current knowledge of estuary effects of gated storm surge barrier systems. This presentation (starting at slide 16 in [the full PPT](#)) reviewed fundamental estuary science and key estuary components critical for environmental health in the Hudson. Attendees contributed to a list of key components for environmental health and human use (see **Figure 1**).

Findings included the following:

- Gate closure in a storm event eliminates tidal and surge forcing, traps river forcing, and for most cases stops flooding.
- The effects of a periodically closed gate on estuary circulation and stratification effects are complex and have not been well studied.
- When the surge gates are open, fixed infrastructure partially obstructs the waterway.
- The 2018 study, preliminary modeling and the literature review reflected several consistent qualitative conclusions. 1) The degree of effects can be small or large depending on the

openness, or gated flow area, of the barrier gates. 2) When a barrier system partially restricts estuary-ocean exchange it leads to

- stronger tidal currents and mixing near the barrier gate openings
- reductions in tides, currents, mixing, and increases in stratification and salt intrusion length on spring tides
- longer residence times at most locations in a partially-mixed estuary
- uncertain results in standing-wave estuaries (e.g. Jamaica Bay, Long Island Sound) or tide straits (East River)

Discussion and questions led to suggestions for topics of study including residence time, water quality for Raritan Bay, conditions near the Throgs Neck barrier, effects outside the open or closed barriers, sediment transport, and fine-scale processes in small bays and sub-estuaries. It was suggested that transports into the estuary from the ocean (e.g. of sediment during flood tide or storms) can also be important and that the system may need episodic disturbances for maintenance. The point was made that conditions will change with sea-level rise and climate change, regardless of whether a barrier system is implemented. Others suggested that some of the sub-estuaries are partially mixed, including the Raritan, Hackensack, and Passaic – these may have similar responses to the Hudson if obstructed.

Key components for environmental health and human use

- oxygenation
- dispersion, circulation, flushing
 - Receptacle for treated wastewater
 - Long-term Control Plans, water quality interventions
 - Microplastics, floatables/garbage
 - Pathogens
- habitat (e.g. velocity, water temperature, salinity)
 - Benthos
 - Tidal marshes
 - Submerged aquatic vegetation
- turbidity
- Suspended sediment, erosion/deposition balance
- Fauna (dispersal, survivability, reproduction)
 - fish
 - Crustaceans
 - marine mammals
 - zooplankton/larval fish
 - oysters
 - birds
- Biogeochemical cycling
- stratification
- persistent pollutants (e.g. PCBs, metals)
- Microplastics, floatables/garbage
- Recreational water quality
- Environmental quality in Environmental Justice areas
- Drinking water quality
- Physical appearance (e.g. tides, currents, ice, seasonal freshet flooding)
- Commerce
 - shipping, cooling capacity for power plants, transportation
- Risk of flooding – surface and groundwater quality (incl. salinity), quantity and contamination
- Condition of shore access after risk reduction measures
- CO2 sequestration
- Storm Disturbance/Episodic Change
- Ecosystem Services for humans

Figure 1: Final list of key estuary components critical for Hudson environmental health and human use, after audience discussions and inputs

Update of the HAT Study

USACE (Bryce Wisemiller) provided an update on the [Harbor and Tributaries Focus Area Feasibility \(HAT\) Study](#), and a summary of environmental studies they expect to conduct in 2019. The HATS Interim Report is available online. The [presentation PDF](#) is posted [on the NERRS project website](#).

Work to-date has focused on a parametric cost analysis, physical oceanographic and barrier design studies. Wisemiller reported on results in harbor areas, showing Alt 2 and 3a caused higher velocities near the barrier gates and small changes to tide ranges and salinity.

Wisemiller described plans for the coming year of HATS Tier 1 environmental analysis, which will include modeling of barrier influences on tidal range, hydrology, salinity, sediment transport and erosion (with the last three of these compared against critical habitat) and Conceptual Ecological Modeling. They are working with the Philadelphia Corps office to map out species-related effects from shoreline changes and surge barriers. For the draft report due in early 2020, environmental analysis will focus on assessing system impact threats to key species and cultural resources and identifying unacceptable impacts and design/citing constraints. They will determine the mitigation required for each alternative in coordination with stakeholders and regulatory agencies. They will identify unacceptable impacts and revise design/citing constraints and screen out alternative measures that cannot be made acceptable from an environmental perspective.

Stakeholder Interests and Concerns

The afternoon session began with small-group discussions to identify what attendees felt were the most important estuary components that might be influenced by surge barriers, and therefore, should be studied. Components or topics that came up frequently included the following:

- changes in habitat due to salinity or marsh loss,
- persistent contaminants in sediments,
- dispersion, circulation, flushing- with regard to pathogens, pollution, dissolved oxygen
- larval life, species/spawning (note: need keynote species/indicators)
- shorefront access and aesthetics
- compound rain + surge flooding
- closure effects – frequency and duration
- construction impacts
- transparency, uncertainty

Near-Term Analyses within this Study

Orton presented on nine potential near-term research topics, which included opportunities for attendees to ask clarifying questions and share their perspective on the potential topics. Some important inputs in this discussion included suggestions to: (a) look to the Netherlands experiences with small flow gates, their turbulent flows, and resulting ecological impacts; and (b) more carefully compare the NYHOPS and AdH results around Manhattan. USGS offered help with any data needs relating to river water and related flooding behind a closed barrier. Some participants had an interest in seeing modeling of sedimentary changes and impacts on marshes, though Orton noted that this is not presently possible with the Stevens models being used in this study – it is only possible to study the changes to waves, currents, water levels, and forces acting at marsh edges. Another area of interest was detailed circulation processes in side bays, though Orton noted again that these cannot be resolved in detail with the existing Stevens Institute models. The Corps indicated that topics 1-5¹ in the list would be useful to supplement their study. They felt that studies of closure duration and frequency would be helpful in plan formulation, not just subsequent environmental impacts. Given the limited time for participants to consider the options outlined by Orton, the audience was invited to participate in a post-

¹ (1) Study gate closure frequency and its future evolution, (2) Study duration (and intensity and probability) of storm tides and gate closures, (3) Assist the HAT Study, (4) Assist the HAT Study with discovery-mode modeling, and (5) Study the potential for trapped water river flooding

session online survey to identify those research topics of greatest priority. The survey is to be distributed within a week of the Scoping Session.

Near-Term (Summer) Scientific Workshops

The summer workshops on interdisciplinary topics were also discussed. The project as planned could hold two half-day workshops, or possibly one full-day workshop; the Hudson River Foundation voiced its willingness to host them. It was noted that webcasting would be appealing, and HRF has this capability. Some ideas were put forth for discussion regarding potential goals of summer workshops and specific topics areas of interest. Possible goals or outputs included the following:

- Developing expert reports that can inform the present phase of HATS
- Organizing towards scoping and funding a long-term research agenda
- Drafting a concrete set of indicators and thresholds for negative impacts of the barrier system, the data sources, and how to monitor them in future.
- Studying the causal chain uphill and downhill, transferring knowledge from physics to secondary and tertiary effects – e.g. species impacts
- Targeting foundations to let them know this is a national/global issue, not just NY/NJ

The environmental concerns of greatest interest listed earlier in this summary could be addressed in the workshops. Also, a popular suggestion was to look to lessons learned from other storm surge barrier systems – what were the concerns, results, and changes required after construction? It is hard to find any published information of use, so experts from other states or countries could be invited to attend in person or by webinar. The process going forward for planning the workshops will be to put together concepts and then discuss the ideas with the PAC.

Research Funding Needs and Opportunities

The group identified future prospects for funding for deeper science and a broader involvement from the research community, including the following:

- Sloan Foundation
- NOAA's Coastal Resilience program
- NYSERDA can potentially fund near-term or long-term projects, particularly if topics are identified as being important to stakeholders
- RFP (Fall 2019) for the NOAA NERRS Science Collaborative. Could collaborate with other reserves in Chesapeake, Delaware, NJ

HRF will be making funding decisions for their grants in the next couple of weeks – one or two of the projects will be helpful to address some of our questions, so research or workshop interactions may be possible with those PIs. Jim Fitzpatrick suggests collaborating with those who worked on salinity change for New Orleans/Lake Pontchartrain area barriers – e.g. Kim de Mutsert of LSU, who is now at George Mason University.

Next Steps

The project team will send out a meeting summary and a survey on near-term research topics. Orton will refine the Scope of Work for near-term research and workshops for discussion, revision and confirmation with the PAC. The presentations from this meeting will be shared on the project's website.

Noteworthy thoughts following the Scoping Session

Sam Hersh (NYC): Define the universe of potential impacts and how those impacts relate to each other including secondary and tertiary impacts of barrier systems. Map out potential impacts in a big flow chart (a “roadmap” to understanding environmental impacts). Identify whether models exist, or could be created to explore impact indicators or keystones, and, if not, what additional research/development is needed.

Adam Parris (Science and Resiliency Institute at Jamaica Bay): The summer workshops should have “focused topics”. SRIJB could build a broader, interdisciplinary workshop into their plans for the State of the Bay (not focusing exclusively on Jamaica Bay).

Attendance List

Name	Affiliation
Bennett Brooks	Consensus Building Institute
Tracy Brown	Save the Sound
Matthew Chlebus	NY-Department of Environmental Conservation
Sarah Fernald	Hudson River National Estuarine Research Reserve
Joanna Field	NY-Department of Environmental Conservation
James Fitzpatrick	HDR, Inc
Heather Gierloff	Hudson River National Estuarine Research Reserve
Tom Herrington	Monmouth University
Sam Hersh	NYC Mayor's Office of Resiliency
George Jackman	Riverkeeper
Steve Koller	Environmental Defense Fund
Marit Larson	NYC-Parks
Jim Lodge	Hudson River Foundation
Bernice Malione	Port Authority of New York and New Jersey
Kristin Marcell	NY-Department of Environmental Conservation, HREP
Mike McCann	The Nature Conservancy
Bob Nyman	Environmental Protection Agency
Greg O'Mullan	CUNY Queens College
Philip Orton	Stevens Institute of Technology
Ryan Palmer	Center for the Urban River at Beczak
Rob Pirani	NY-NJ Harbor Estuary Program
Lucia Pohlman	Waterfront Alliance
Chris Schubert	USGS Water Science Center
Bill Sheehan	Hackensack Riverkeeper
Peter Sheng	University of Florida
Amanda Stevens	NYSERDA
Jen Street	NY-Department of State
Dennis Suszkowski	Hudson River Foundation
Nava Tabak	Scenic Hudson
John Waldman	CUNY Queens College
Yifan Wang	Stevens Institute of Technology
Peter Wepler	USACE New York, Environmental Analysis Branch
Bryce Wisemiller	USACE New York
Chester Zarnoch	Baruch College

Non-Attendees Who Provided Email Inputs

Name	Affiliation
Jeffrey Levinton	Stony Brook University
Adam Parris	Brooklyn College/ Jamaica Bay Science and Resilience Inst.