WATER SUPPLY CITIZENS ADVISORY COMMITTEE
to the Mass. Water Resources Authority

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Joint WSCAC and WAC Meeting

Location: Waterworks Museum
Chestnut Hill, MA
November 4, 2016 – 10:30 A.M.

MEMBERS IN BOLD IN ATTENDANCE

Whitney Beals, WSCAC Chair, NE Forestry
Gerald Eves, Trout Unlimited
Kurt Tramposch, Wayland Wells
Michael Baram, BU & CLF
Paul Lauenstein, NepRWA
Andrea Donlon, CRWC
Martha Morgan, Nashua River Watershed
Martin Pillsbury, MAPC
Terry Connolly, Town of Ware
Bill Fadden, OARS, Wild & Scenic Rive

NON –MEMBERS IN ATTENDANCE

Lexi Dewey, WSCAC staff
Janet Rothrock, League of Women Voters
James Guiod, MWRA Advisory Board
Katie Ronan, MWRA
Julie Wood, CRWA
Bill Copithorne, Town of Arlington
Julie Wormser, Boston Harbor Now!
Jonathan Yeo, DCR
John Reinhart, MyWRA
Andreae Downs, WAC
Adrianna Cillo, BWSC
Sean Navin, MWRA
Wendy Leo, MWRA
Renata von Tscharner, CRC
Lise Marx, MWRA
David Vallee, National Weather Service
Lou Taverna, MWRA Advisory Board
Nathan Phillips, BU

WSCAC BUSINESS AND UPDATES

The MWRA's Water and Sewer Retail Rate Survey is scheduled to be released in early December. The Advisory Board will host a workshop regarding metropolitan tunnel redundancy options for the MWRA system on Thursday, December 8, 2016 at 9:00 A.M. The meeting will be held at Boston College's Yawkee Center.

PRESENTATIONS AND DISCUSSION

Climate Change and its Impact on Boston

By Julie Wormser, Boston Harbor Now!

Julie Wormser began with an introduction of Boston Harbor Now and the organization's goals. In addition to providing waterfront and island programming while increasing equitable access for our people and the vitality of our places, Boston Harbor Now seeks to provide leadership in the field of climate resiliency. The organization seeks to help prepare Boston's waterfront neighborhoods for increased coastal flooding.

Julie explained that Superstorm Sandy was a wakeup call. The storm impacted Boston differently than New York, and gave rise to questions regarding Boston's challenges in the face of sea level rise.

Julie explained, coastal flooding happens for three reasons:

1. Storm surges
2. "Wicked high tides" during full and new moons
3. Sea level rise

New York has much less protection than Boston. Boston is protected by islands and peninsulas to seaward (Cape Cod, Cape Anne) and the harbor is circular.

At six feet of storm surge, Boston tops out. At King Tide – when the moon is close to earth and is full – Boston has water coming up through the storm drains. Such flooding occurs without any storm. The conditions are calm; the sea is about two and a half feet above normal high tide.

Superstorm Sandy hit New York at sixteen feet storm tide, or ten feet above high tide. Boston, in contrast, saw a four-five-foot storm surge, but it hit at low tide. However, Boston's tide cycle is much higher than New York's (Boston's is about ten feet normally). We are primarily concerned about storm surges that hit at high tide.

The issue is complicated when we add sea level rise. In comparison to when we first started modeling, the numbers are about three feet higher. This change is accounted for by the fact that we now know how to model including glacial melt. Initially, we also did not know that the glaciers exert gravitational pull. When the glaciers melt, we will see relatively higher sea level, because Greenland's glaciers are so much small than Antarctica's glaciers.

This is important, because one third of Boston floods tidally at seven and-a-half feet. The challenge is determining how to keep Boston viable as the coastline recedes.

The one percent flood map currently used to determine insurance rates could represent, by 2050, the areas that will be flooded annually. By 2100, such areas could be flooded daily. This implicates areas such as the Innovation District, the Bayside Expo, the Fort Point Channel, the Charlestown Navy Yard, and Dock Square. As we cannot live with that level of corrosive salt water, we are due for a third wave of major engineering.

Boston has been taking this seriously. What needs to happen now is the institutionalization of all the work that has happened; all of the new developments must be climate prepared. There are a number of strategies for dealing with sea level rise. The Dutch recommend building a barrier first in order to keep the water out on a daily basis. When that fails, floodable transition zones must be created, so that water can go where it needs to without causing damage. When that fails, we need to be able to batten down; and when that fails, we need to move uphill or upstairs.

There are a number of approaches people are taking all over the world. A common theme is favoring resilience over resistance whenever possible. Boston's new Spaulding Rehabilitation, for instance, installed all critical and mechanical equipment on the upper levels and made sure that nothing essential was situated on the first floor. Critical patient programs are also above the ground floor. The design of the building is to allow for failure, clean-up, and progress forward.

Julie concluded her presentation by emphasizing that this cannot be voluntary. We must make certain that this is part of our zoning code so all of our buildings can survive.

Julie's presentation is accessible here on the WSCAC website.

Climate Change in Massachusetts and its Impact on River Flood Behavior
By David Vallee, National Weather Service

David Vallee began his presentation by discussing common climate change themes in New England including increasing annual precipitation, increasing frequency of heavy rain falls, warming annual temperatures, and wildly varying seasonal snowfall. For smaller basins, there is a trend toward increased flood magnitude and/or frequency. This trend is most pronounced where significant land use change or urbanization has occurred.

David explained that after a storm, his office models river behavior. This is difficult as there are now more vicious, urban spikes and dramatic increases in rainfall frequency. Whereas we used to average six to eight days a year of an inch of rain or more, we are now averaging twelve to fifteen days of such rainfall. David continued to explain that significant shifts in precipitation frequency create challenges for the ways we have designed our infrastructure – namely, increased flooding. Smaller watersheds are particularly susceptible to increased flooding because they typically don't have flood control. With urbanization, we have taken away the capacity of the land to slow the water heading towards the rivers.

David explained that we are seeing a blocked-up jet stream. Storms are coming up the East Coast, or down from Canada. Both storms pick up tropical moisture as they come toward us. The jet stream is getting curvier. As a result, we are seeing more occurrences of two types of storms:

1. Large systems that stay in place over a period of many days and dump rain on us
2. Storms that follow one another

Although this isn't happening annually, the frequency of occurrence is increasing and thereby developing a trend. The issue is that these storms saturate the soils. In consequence, flooding occurs. Additionally, higher temperatures mean that the atmosphere holds more moisture – meaning each occurrence is likely to be worse. David noted that predicting weather patterns in the Northeast is a significant challenge. He said realistically, predictions can be made 3-6 weeks out.

David then discussed temperature trends. In Massachusetts, the temperature is getting warmer and is climbing at a rate of a degree Fahrenheit every thirty-five years. Furthermore, we are losing latitude on the planet; Boston's climate today is more like New Jersey's used to be.

David moved on to a discussion of precipitation trends. In Massachusetts, precipitation is climbing by about one inch every ten years. The frequency of wet years has increased over the last two decades. Additionally, the rains have both become more frequent and heavier.

David discussed the Palmer Drought Index and explained that the whole behavior of drought has changed in New England. We are seeing short and intense drought, rather than prolonged episodes. There are now frequent episodes with significant recharge, whereas the droughts of yesteryear had infrequent periods of recharge.

The current drought we are now facing is a flash drought: it did not happen gradually, but rather it is as if the faucet was turned off. If we compare this year's drought to the sixties, we see that our streams get as low as they did in the sixties, but they come back more quickly and in turn, can flood more easily. David noted that although large water supply systems were designed for droughts and have storage, smaller systems that draw from wells feel the impact of such flash droughts much more deeply.

David explained that stormwater systems are designed for the 100-year flood – or what you can expect one percent of the time. The 100-year flood numbers have now shifted. Systems were designed for six to seven inches of rainfall in twenty-four hours. A large part of Massachusetts is now receiving eight-nine inches in a twenty-four-hour period. This creates a change in flood frequency and magnitude, which is compounded by an increase in impervious surfaces, which is in turn compounded by climate. David cited the Neponset and their efforts to increase greenspace and places to store stormwater. Even in the face of climate change, these efforts are working as there has been an increase in flooding.

In summary, David explained that New England has become a hot spot for heavy rainfall and flooding in the past ten years. Noticeable trends include increased yearly rainfall and higher annual temperatures. He reiterated that smaller watersheds and those with significant urbanization are most vulnerable to increased river and stream flooding.

The question becomes, what do we do? Are we able to protect valuable infrastructure? Can we adapt to increased rainfall through green technology and buying properties in the flood plain for a natural buffer? Or must we retreat? David cautioned that there is a point of diminishing return. We ultimately must ask ourselves how much risk we are willing to insure and accept.

David's presentation is available here on the WSCAC website.

MWRA's Pragmatic Approach to Climate Change

By Lise Marx, Senior Program Manager, Master Planning

In looking forward and considering the impacts of climate change, the MWRA is implementing a two-pronged approach to the long-term concern. The first prong is adaptation. The MWRA is working to understand potential impacts and in response, create resiliency for the system. The primary focus of this presentation is adaption. The second prong is mitigation. The Authority is working to reduce greenhouse gases and its overall environmental footprint. MWRA's mission is to provide an adequate and reliable supply of high quality drinking water while engaging in an environmentally responsible course of collection, treatment, and disposal of wastewater.

The MWRA is fortunate that Deer Island and Nut Island were designed to withstand almost two feet of sea level rise. With respect to MWRA's other facilities, the goal is to be pragmatic. When the Authority upgrades its facilities, it considers updated climate information so as to not miss any opportunities for building in infrastructure resilience.

The current benchmark is the recently revised FEMA 100-year flood elevation, plus two-and-a-half feet of sea level rise. This benchmark will likely be applicable until 2070. The science however, continues to advance and the pace of CO2 increase is unclear. The MWRA will therefore regularly

review and update this benchmark. The Authority looks continually at its facilities and makes modifications to best practices as new information becomes available.

The sea level rise vulnerability of every facility is examined. The goal is to be pragmatic, and not miss any opportunities to adapt. While over the long-term the goal is to implement major upgrades, the short-term goal is to use maintenance crews to improve flood proofing. Whereas six sewer facilities are likely to be affected by a 100 -year event, there are no water facilities at risk of service disruption.

In the event the facilities cannot continue to operate, we want to be able to recover as quickly as possible. Nonetheless, our primary goal is protecting the two million people that depend on our services, protecting our staff, and protecting our facilities.

The following short-term adaptation approaches have been taken:

- Fitted at-risk buildings with temporary flood barriers
- Moved electrical/computer equipment off of the floor
- In advance of storms, redeploy staff and equipment to pre-determined locations
- Created back-up water and wastewater operations control center at Carroll Water Treatment Plant in Marlborough

The following constitute's MWRA's long-term adaptation approaches:

- Continuing to monitor the latest science
- Every future rehabilitation contract will take sea level rise into account
- Re-evaluate targets as science evolves

Lise concluded the presentation by providing a case study of flood protection measures taken at Alewife Brook Pump Station. Click here to view this presentation on the WSCAC website.

Panel Discussion

Adopted from Andreae Down's Meeting Summary

Q: Given David Vallee's flood projections, is it really the case that only the sewer facilities are at risk as the climate changes?

LM: Focus to date has been on sea level rise. It is mostly wastewater facilities that are located near the coast and Boston Harbor tributaries and we have also looked closely at the Clinton WWTP along the Nashua River.

Q: Has MWRA been thinking about tidal infiltration into local sewer pipes?

LM: We have started to think about that, but communities are responsible for the local pipes. MWRA has some CSO (combined sewer outfalls) that are tidal, and we have tide gates—our job is to make sure they are tight and functional. Long-term, we treat what comes into our system, and we have significant capacity during most storm events. MWRA's I/I program also makes significant funding available to the local communities to address local infiltration and inflow problems.

Q: Have you done analysis of how the long-term CSO control plan might be affected?

LM: That plan is based on a typical year and was worked out with EPA and DEP. Now we are starting the assessment phase of that plan. If there are changes over time in the area, EPA might revisit things, but for now, we are satisfied that the plan meets the goals.

Q: In sea level calculations, besides ice melt, warmer water and decreasing gravitational pull from the southern glaciers, is there anything else affecting sea level rise?

JW: We used to just look at thermal expansion—3-6 feet is just how water that is warmer expands. More recently, we also added ice melt off land masses. Ice in the water doesn't change the levels. Only recently did we realize that the ice masses are so large that they gravitationally draw water toward them. Antarctica's melt will bring us more water. Locally, there's also the Gulf Stream. If it is closer, then the ocean will rise higher near us.

Q: Sounds like will need greater investment over the next several decades. Any numbers?

JW: You can protect your structure from storm flooding, but not tidal flooding. You can't create a wall around your building. So we advise—design for storm flooding to a certain level. If we don't build a city-wide barrier above that, it's not going to be survivable, so don't bother. Temporary storm barriers don't survive wave action well. At a building level, we advise making openings storm safe—relatively cheap. But if we're talking major renovations, we need to consider filling in the basement, because some of the retrofitting is so expensive. We are going to need to talk about storm safe buildings, otherwise it's a public investment level.

Q: Who is writing the building codes to make sure developers don't avoid doing this?

JW: Boston has done a tremendous amount of work. We have charts full of numbers as well as risk tolerance (different risks for hospitals vs. warehouses). So your code may need to differentiate by use. But the answer is nobody has done this yet. Our advocacy has been to institutionalize this information. Building codes are at the state level. So at the Boston level, we are looking at an amendment just for Boston or zoning overlays. Also we want to index those risk levels, so we don't have to go back every few years to update.

LM: MWRA is thinking in a similar way—at some point, adaptation becomes a broader state, regional, New England issue and isn't just us out there. At some point, we are at all-in.

JW: I don't see any other agency that can tackle this. In my perfect world, MWRA would become central because it has the ability to raise money.

Lou Taverna: The MWRA Advisory Board position is that stormwater is a local community issue.

JW: Every other region that has done well has a central agency that coordinates. Boston cannot do it by itself. The water front communities cannot build a sea wall by themselves.

Q: There's a trade-off between mitigation & adaptation. Sweden has set its mitigation even faster. Commend MWRA for its wonderful example of how to mitigate carbon emissions. To what extent should we emphasize mitigation over adaptation, given the high cost of adaptation?

JW: I think the reason we are at this so late is because people didn't want to give up on the idea of prevention. We are at the point where we also must adapt. But it has to be a both/and.

Q: How much predictability can you give us—so we can get things out of the way of a flood?
DV: A week to 10 days for rainfall is pretty reliable. But it's hard to know which particular watershed. We are not at that level of specificity. But our goal is to get to up to 30 days at a more granular level. Rainfall is just so challenging. A Nor'easter particularly hits the Merrimack Valley, because the water hits upstream, and just as it gets down the river, the rain hits there. I'll tell you this—I thought we had a wet season coming (this year). But it never happened. Coming off the February 2016 flood, we realized we were wrong. I want to do better than that. What would you be looking for? Probability of a particular flow?

Q: I'd like to know, as part of the planning, what kind of, almost, fire drill we need to prepare for—who to evacuate and how far. When you have a lot of uncertainty it's hard to prepare.

DV: We are trying to get to the point where we can do that 7 days out. Sometimes we are just giving governors a warning that they have flooding coming this side of biblical.

Q: The 100-year storm event in 24 hours that we designed for. I'm a city engineer. When I first started, we were using 6.2" (stormwater pipe diameters). A few years later, we raised itto 7.0" and faced developer outrage. Now, considering your information, are we looking at 8.3"? Is it only going to get worse?

DV: I wish I had the answer. There is science out there showing that we will have so much evaporation with additional heat that we will hold more water in the atmosphere, and could plateau. But the intensity of the events may be worse. May be less frequent. The State of Maine has mandated a higher level of stormwater readiness for all buildings and highways. But that's easier to do when you aren't already in a built-out community. It comes back to cost & benefit—and what should we be designing for.

JW: In a perfect world, our regulations would be indexed to the best science, so we would have some predictability around building lifespan.

DV: Until you engineer yourself out of your tax base. When you retreat, you are giving back tax base, which is a third rail. In your case—you haven't got the room!

JW: That gets us back to the coastline. When 1/3 of Boston is tidal—it's $60b of lost tax base. It's that catastrophic.

DV: Versus building a barrier.

JW: But at some point, that barrier has an end. At some point, the coast is moving. And a lot of the most expensive real estate we have will depreciate over time. So, it's not a logistical issue, it's how do we shift our economy?

Q: But as you know, all regulation gets challenged. We are even arguing about climate change.

Q: Is there any predictability to what will be happening with the jet stream?

DV: At this point, no. Climate models do continue to predict that if we don't change the amount of carbon in the atmosphere, it may continue. But other things, like changes in the Gulf Stream, carbon absorption by the ocean, warmth held in the ocean—and when does that come back out. And we know there's a lag time between when carbon goes up & when it comes out. But bringing that down to rainfall, it's impossible to predict. Much more challenging than sea level rise.

Q: In our planning agency doing planning work, we know what we need to do with sea level rise. Is there modeling of the ranges of effects on the rivers, so we can tell communities, here's what you should be thinking about?

DV: No, not to date. All the focus has been on sea level rise because it's easier. With rivers and streams, there's so much uncertainty based on: what's built upstream, the behavior of storms, the infrastructure. Simulations so far are pretty crude.

JW: Could you, given that uncertainty, tell communities to start planning for where the water might go—say a park they can inundate, as opposed to having it in people's basements? Or create places to slow down and store water?

LM: There's a school near my house that was flooded in the Mother's Day storm. When they rebuilt, they raised it and also designed the playground to absorb flood water.

DV: There's guidance in most communities. National flood insurance is starting to look at the 250-year storm. No one has one yet, but Rhode Island is using GIS and starting to calculate the (possible) loss.

Q: Need to think of adaptation and mitigation as not separate things. Sea walls and wind turbines can be sited together, for instance. Distributed renewable energy can provide resilience and mitigation at the same time. CLF (Conservation Law Foundation) is suing Exxon in Everett about toxics spilling into the waters. Are there any agencies mapping where toxins might enter the harbor or the rivers?

JW: We need that, and that's what CLF is trying to accomplish. Very few people are talking about the petrochemical storage areas on Chelsea Creek and how vulnerable they might be. Could they, when flooded, shift and bust pipes? I don't know the answer, but it's a concern. Another thought is to put a storm barrier that would prevent a storm surge up Chelsea Creek.

Following the panel discussion, the meeting was adjourned.

Instead of a December committee meeting, WSCAC members are encouraged to attend the MWRA Advisory Board Workshop on Metropolitan Tunnel Redundancy Options. The meeting will be held on Thursday, December 8, 2016 at 9:00 A.M. at Boston College's Yawkey Center.