Salinity in NYC water supply reservoirs

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Salinity Management Assessment

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NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

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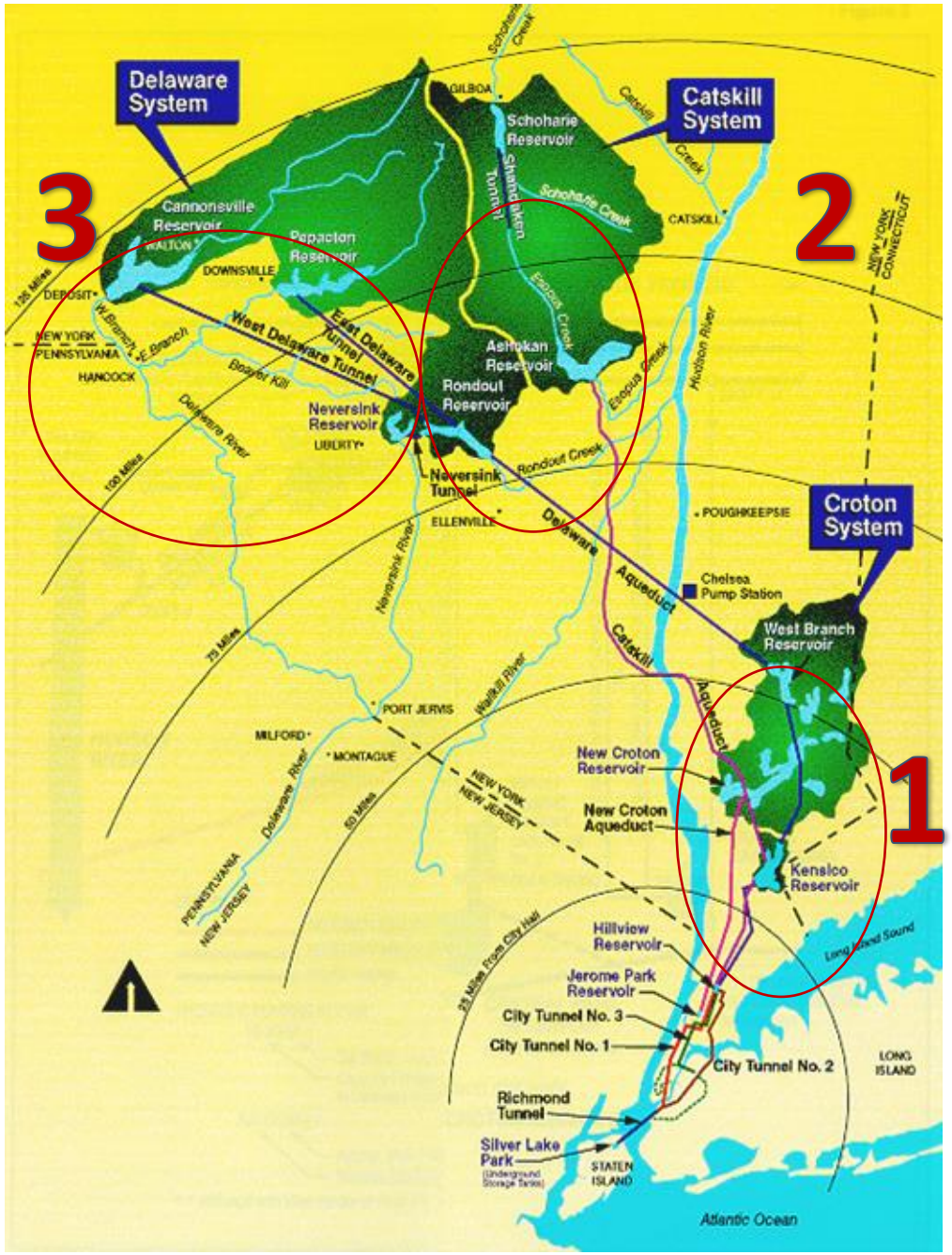
WATER SUPPLY OVERVIEW

- Surface water supply conveyed by gravity alone
- 19 reservoirs + 3 lakes
- 570 billion gallons total reservoir storage capacity
- 9.5 million consumers (~1/2 NYS population)
- Delivers roughly 1.1 billion gallons of water each day
- Watershed = 1,969 square miles (~1.2 million acres)
- Watershed covers parts of 8 upstate counties in NY plus a small portion of CT
- Nation’s largest municipal water supply

Three distinct systems

As New York City's population increased, new water supply reservoirs and facilities were constructed to the north…

- **1830s–1890s:** Construction of the **Croton System** (East of the Hudson River)
  - **200,000+ water consumers**
- **1905-1928:** Construction of the **Catskill System** (West of the Hudson River)
  - **3.4+ million water consumers**
- **1937-1965**: Construction of the **Delaware System** (West of the Hudson River)
  - **6.9+ million water consumers**



Water Quality

- DEP maintains robust water quality monitoring program
- Collects ~38,000 samples/year throughout the watershed and NYC distribution system from 1,136 locations.
- Performs more than 575,000 laboratory analyses/year
- Robotic monitoring = 3.5 million tests/year

Water Quality Monitoring Parameters

- **Pathogens** – *Giardia* and *Cryptosporidium*
- **Microbiology** – coliform bacteria, *E. coli,* phytoplankton
- **Nutrients** – *e.g.* phosphorus and nitrogen
- **Physical Properties** – *e.g.* turbidity, pH, temperature
- **Metals** – *e.g.* lead, copper, mercury
- **Organic Compounds** – *e.g.* disinfection by-products, pesticides
- **Process Control** – *e.g.* chlorine, fluoride, conductivity

About 240 different parameters

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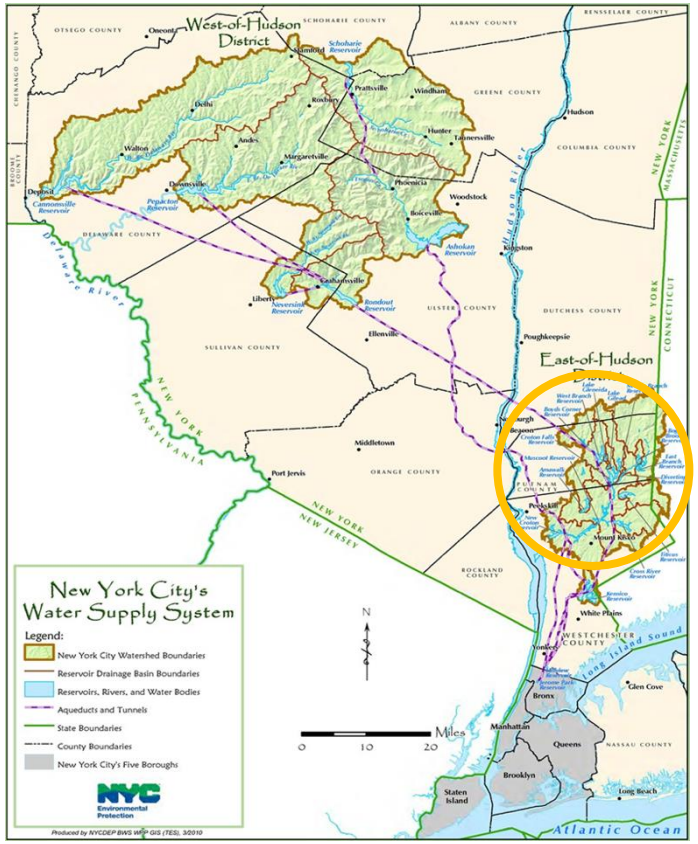
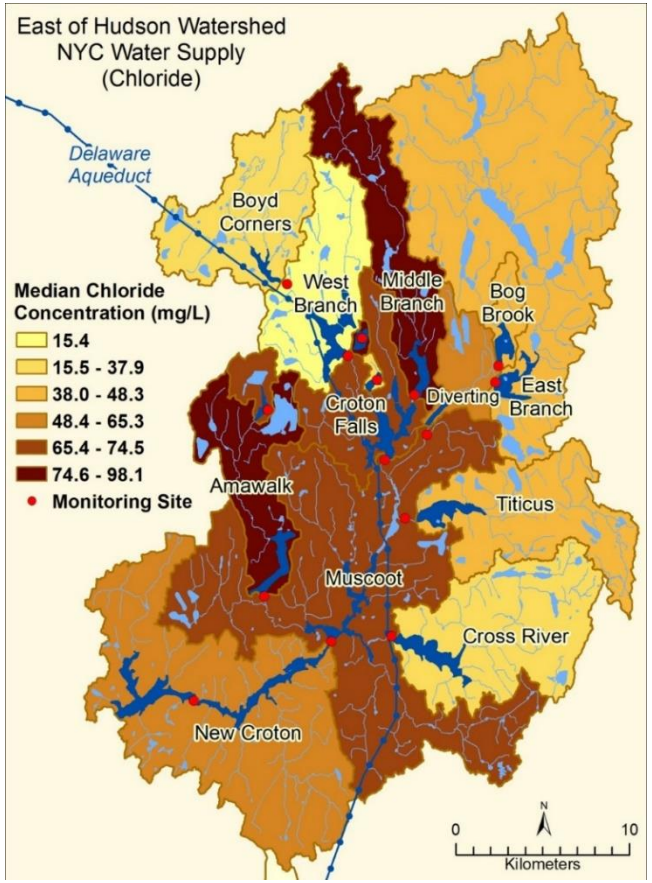
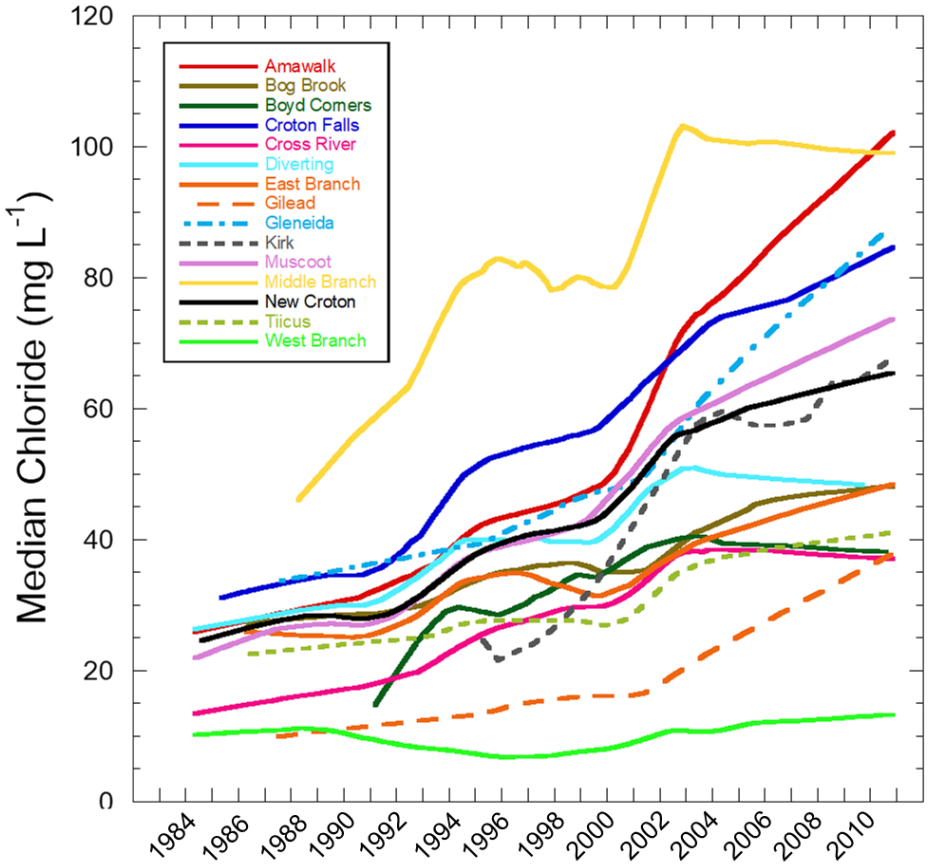
Background and Context

- New York City reservoirs in a “living watershed”
- East of Hudson vs. West of Hudson
    - Major highways v. forest
- Interested in salinity on many fronts
    - Reservoir/drinking water quality
    - Local groundwater issues
    - Delaware River Basin salt front
- NYC Watershed Rules and Regulations
- Politics of De-icing
- New York MCL for chloride is 250 mg/L
    - Some reservoirs in danger of exceeding in
- Major sources are road salt, parking area salt, sewage, and water softeners

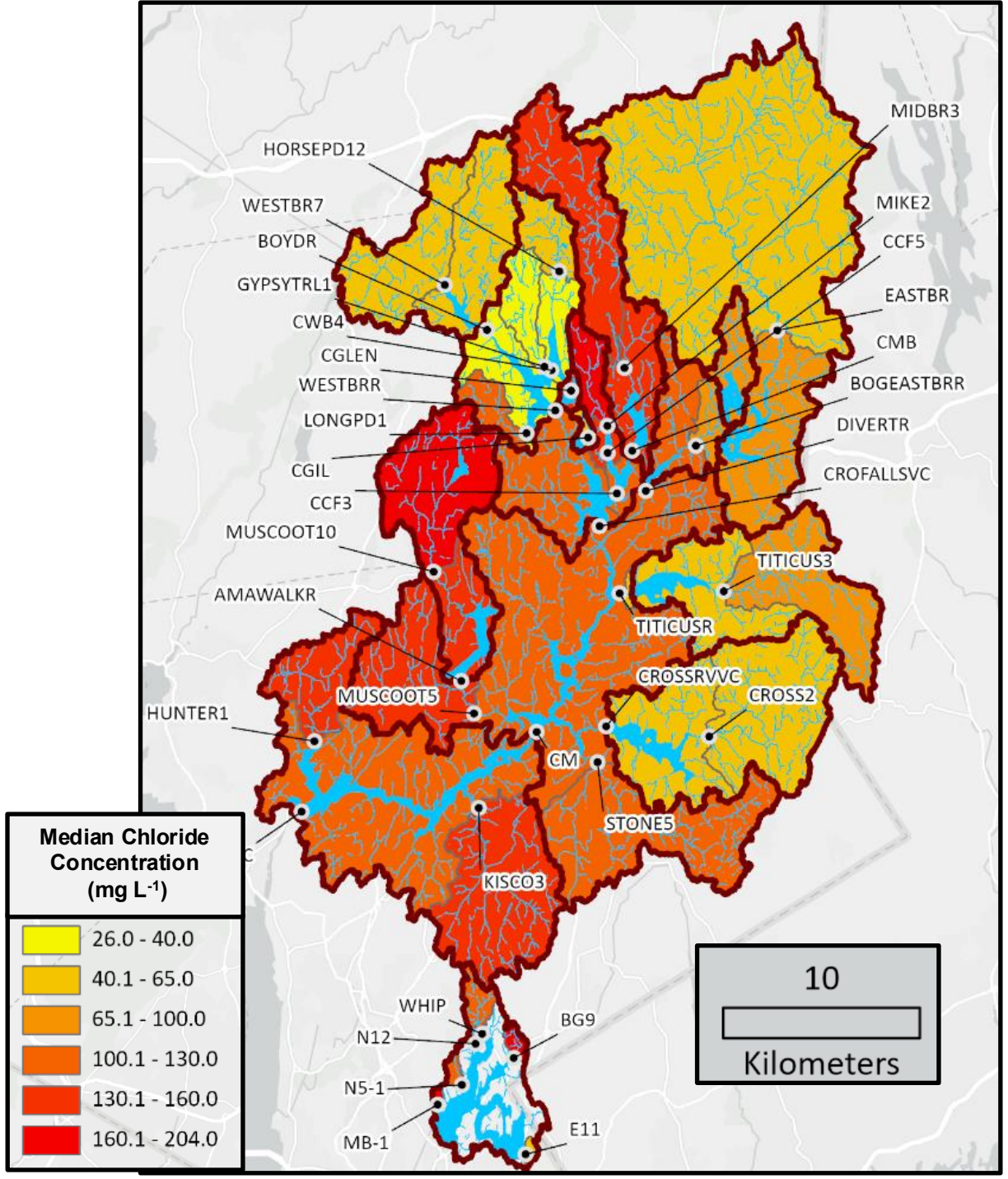
Croton Watershed







From: VanDreason, R. 2011. The occurrence of sodium chloride in the Croton watershed: An evaluation of sources, possible impacts, and strategies for reduction.



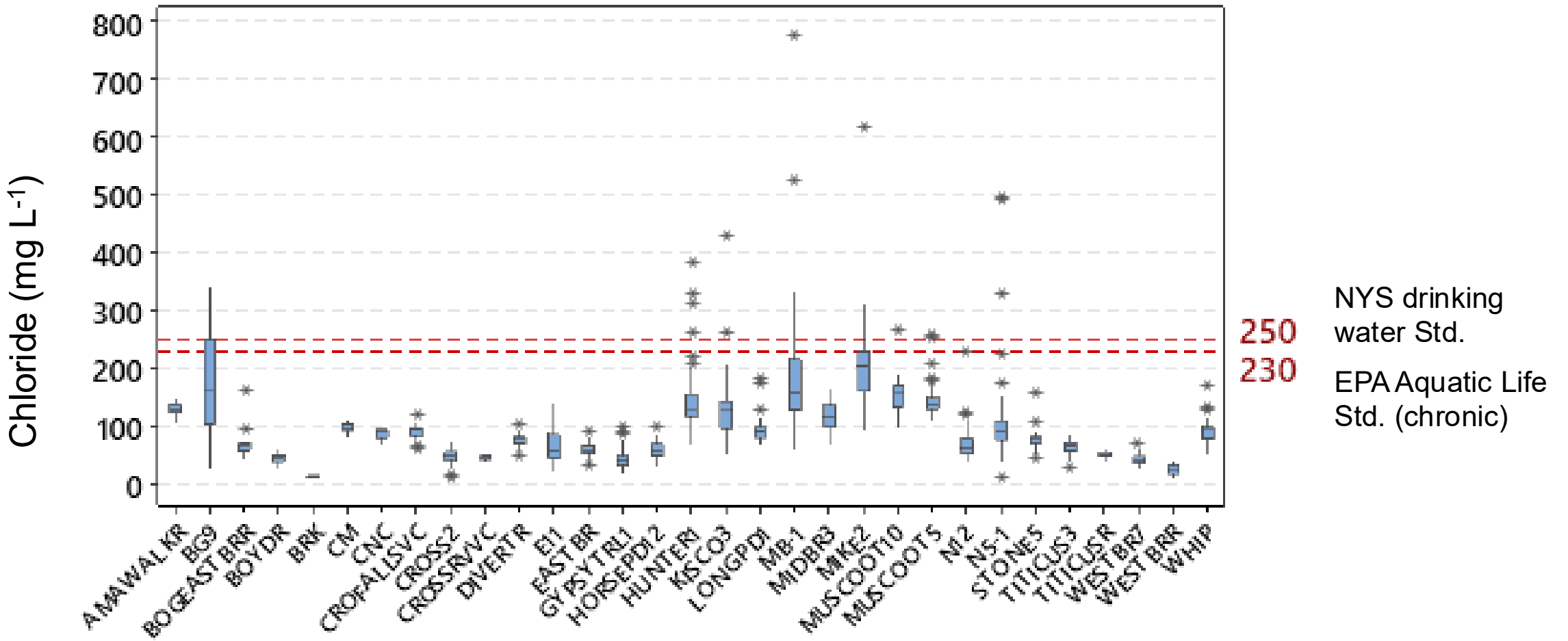
Chloride spatial trends (EOH)

- Median chloride calculated from approximately monthly samples collected from 2015-2019
- Croton “Hotspots”
  - MIKE2 (204 mg L^{-1})
  - MUSCOOT10 (156 mg L^{-1})
  - MUSCOOT5 (138 mg L^{-1})
  - HUNTER1 (131 mg L^{-1})
  - AMAWALKR (130 mg L^{-1})

Kensico “Hotspots”

  - BG9 (164 mg L^{-1})
  - MB-1 (160 mg L^{-1})

Croton Watershed



Data from monthly grabs; higher concentrations likely with higher frequency sampling

Trends Summary

West of Hudson

- Median chloride concentrations (2015-2019) ranged from 0.5 to 40 mg/L; far below the drinking water standard of 250 mg/L
- **All** reservoirs and most streams show an upward trend
  - Reservoirs increasing from 0.07 to 0.20 mg L^{-1} per year.

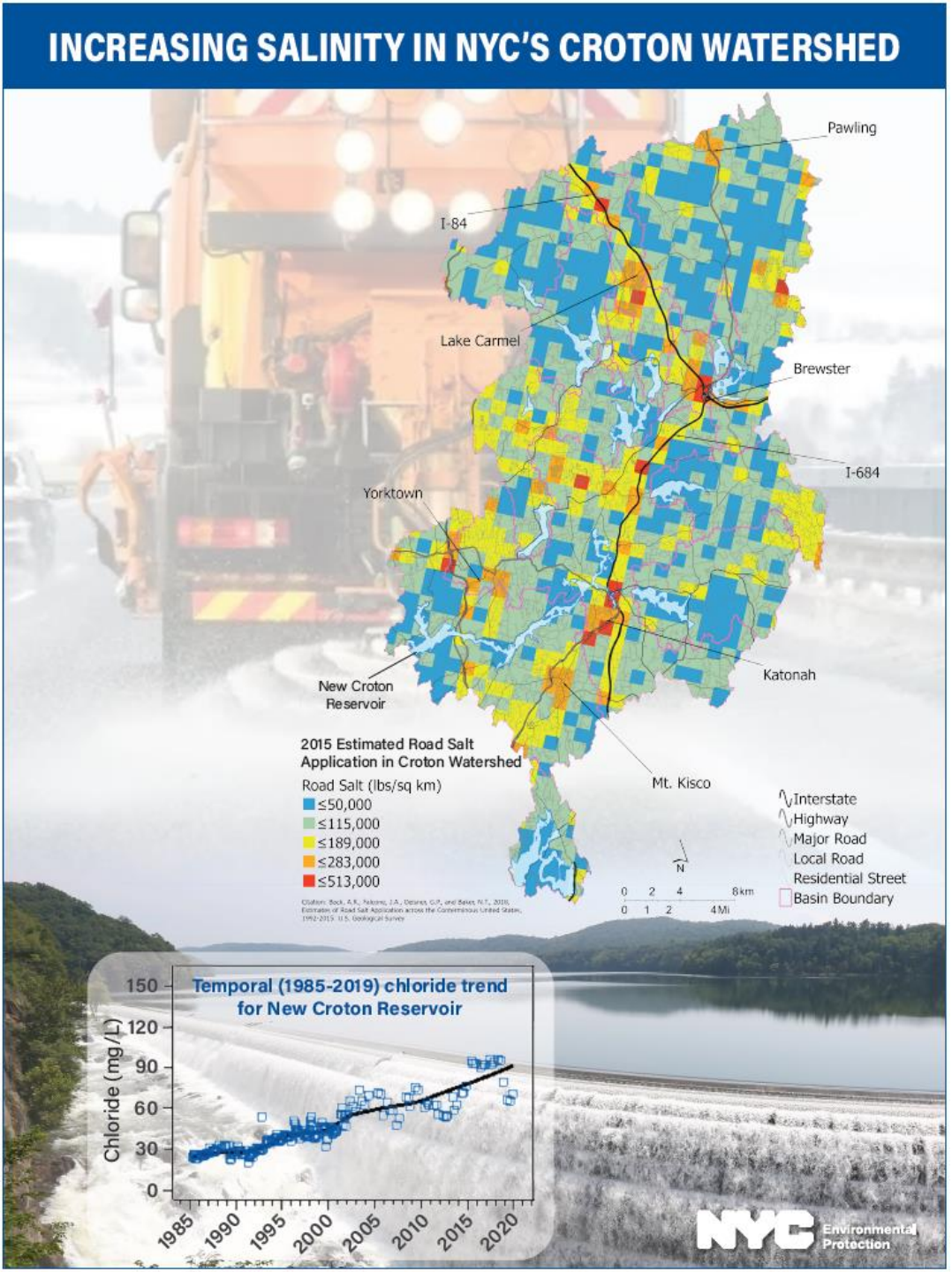
East of Hudson

- Median chloride concentrations (2015-2019) ranged from 26 to 204 mg/L; below the drinking water standard of 250 mg/L
- Some streams occasionally exceed EPA Aquatic Life Criteria (230 mg L^{-1}) and NYS drinking water standards (250 mg L^{-1})
- **All** reservoirs show an upward trend (0.33 to 4.17 mg L^{-1} per year)
- Median chloride levels in New Croton Reservoir projected to exceed 250 mg L^{-1} by 2096 if estimated rate of increase is maintained

Knowledge gaps

- Loading estimates needed for all chloride sources
  - WWTP loadings possibly important in Croton System
- Additional data needed to assess aquatic ecosystem effects
  - Measure streamflow and 15 min. specific conductivity at outlets from watersheds using data loggers and probes; there is probably enough data already available to develop regression equation to estimate chloride. Calculate a 4 day rolling average in order to evaluate the 4 day average EPA chronic standard of 230 mg/L for aquatic life

    (Trowdridge et al 2010. Relating Road Salt to Exceedances of the Water Quality standard for Chloride.)
- Determine salinization impacts on:
  - Reservoir mixing
  - Taste and Odor
  - Corrosion



Next Steps

- Published a paper in 2025
- Working with political and civic leaders to raise awareness and pursue potential solutions
- Increase monitoring and address data gaps
- Enforcing watershed rules and regulations
- Creating chloride budgets
- Additional research
- Adirondacks model
  - Late 2010s research with academic partner
  - Results found huge chloride differences up-gradient and down-gradient of state highways
  - Lobbying and the creation of a task force with binding recommendations
  - The authority of the task force was ultimately diminished
  - How can we repeat this in the face of road-salt politics?

Questions?

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