

Urban Waters Initiative

Pier 5—Pop-up Wetlands study
U.S. Geological Survey

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In cooperation with:



Bronx Council for Environmental Quality



USGS Water Science Centers

- Surface water
- Groundwater
- Water Quality
- Real-time and historical data available online
- Mapper to search by location
- Basic Data
 - Nationwide network of GW water levels, stream flows, SW and tidal info
 - Critical for water-resource management
- Hydrologic Studies
 - Project oriented
 - Unbiased, high-quality data from National laboratories

Urban Waters Federal Partnership

Bronx and Harlem Rivers



- Urban Waters Federal Partnership (UWFP) mission
 - Revitalize watershed
 - Improve water quality
 - Connect community with their natural resource



- Local, State, and Federal partnership
 - Community groups (such as BCEQ); NYC DEP
 - NYS DOH, DOT
 - EPA, NPS, NOAA, ACoE, USGS

Urban Waters Federal Partnership

Bronx and Harlem Rivers

USGS role to support the UWFP

- Compiled and reviewed existing water-quality and hydrologic data on the Harlem River (in review—online publication pending)
- Identify gaps in data and offer suggestions for additional water-quality monitoring as needed
- Help identify water-quality problems and likely sources as issues and concerns arise
- Work with local partners to develop proposals for continued research and citizen science
- Contribute to local urban waters events by working with community groups
- Participate in outreach events

Harlem River

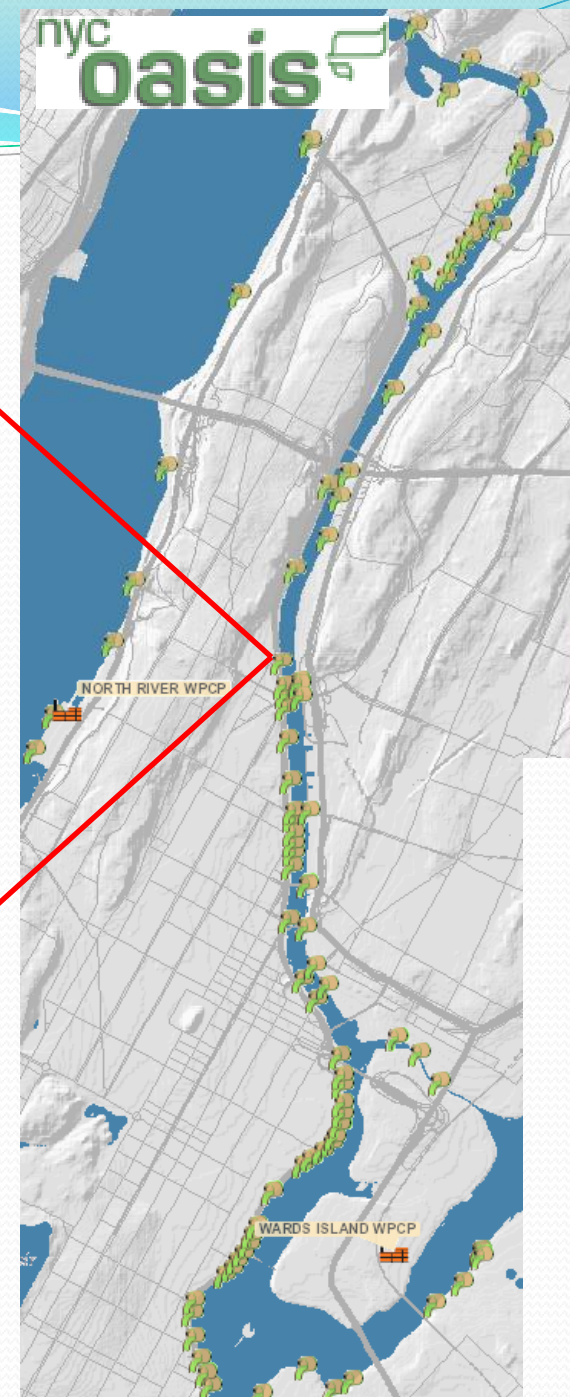
- 8-mile stretch converted to tidal strait during early urban development
- Limited accessibility to the Harlem River for community enjoyment
 - Under-utilized waterfront with few parks
 - Direct water access hindered by bulkheads and railway infrastructure
- Included in the NY/NJ Harbor Estuary and Hudson River Estuary Programs
- “Watershed” highly urbanized
 - Direct freshwater contributions limited to **runoff** and **Combined Sewer Overflow (CSO)**; limited GW influx
 - CSOs act as point-sources of pollutants
 - **Runoff** and **adjacent waterways** (Hudson River/East River) **activities** serve as nonpoint-sources of pollutants



Harlem River

Water-quality concerns

- CSO events
 - Precipitation
 - Increased water use
 - WWTP failure
- Untreated sewage contributes to a decrease in water quality and usability
 - Increased **Fecal Coliform** and **Enterococci** levels
 - Decreased **dissolved oxygen**
 - Increased **nutrient** loading
- Storm water runoff contributes to poor water quality
 - Increase in **pollutants** from roads and sidewalks
 - Litter washed down drains and into the river (**floatables**)
- On-going improvements have decreased the number of CSO events and better sustained-water quality



Mill Pond Park and Pier 5



Tracking Stormwater

- Precipitation falling on Major Deegan and other roadways mobilizes contaminants such as metals, petroleum products, and salts



Tracking Stormwater

- Downspouts and storm drains lead divert water to the Harlem River
- Oils, metals, and salts make their way to the River in the runoff



- BCEQ build Pop-up Wetlands to capture and retain runoff
- Soil and plants catch and retain metals
- Plants used to degrade organic contaminants

Tracking Stormwater



- Samples of the runoff collected before reaching Wetlands
- Automated sampler collects a composite over time

- Data compared to samples collected in Wetlands, at the storm drain outfall, and in the Harlem River



Sample collection and analysis

Water

- Whole water samples collected (not filtered)
- Samples preserved with acid in field
- Analysis at lab using EPA methods

Sediment

- Samples collected in jars
- Sediment dried at lab and analytes extracted

Gaia Soil

- Soil contains high proportion of polystyrene pellets
- Soil was collected in jars
- Acid was added in precise amounts to generate a slurry
- Slurries were filtered resulting in a water sample
- Filtrate was analyzed for metals and select major ions
- **Results are representative of total metals—both adsorbed and in soil—not necessarily what will dissolve into water of Wetlands**

Interpreting stormwater data

- Determine what metals are important
- Determine if seasonality affects constituent load
- What are the metals of concern and how do the concentrations in Wetlands compare to the **NYS Department of Environmental Conservation's (DEC) threshold** for the different classes of saline waters
- Factor in “first flush” and the dilution of the composite sample from the downspout
- Understand contributions of runoff relative to what is in the Harlem River and the Sediment
- Figure out how to relate data from sediment sample and the Gaia Soil samples
- Compare data to rainfall totals for the days leading up to sampling
- Determine how does dissolved oxygen impact metal speciation in water and soil
- Transfer of metals from runoff to sediment

Constituents of roadway runoff

(modified from Wagner and others, 2011, USGS SIR-2011-5180)

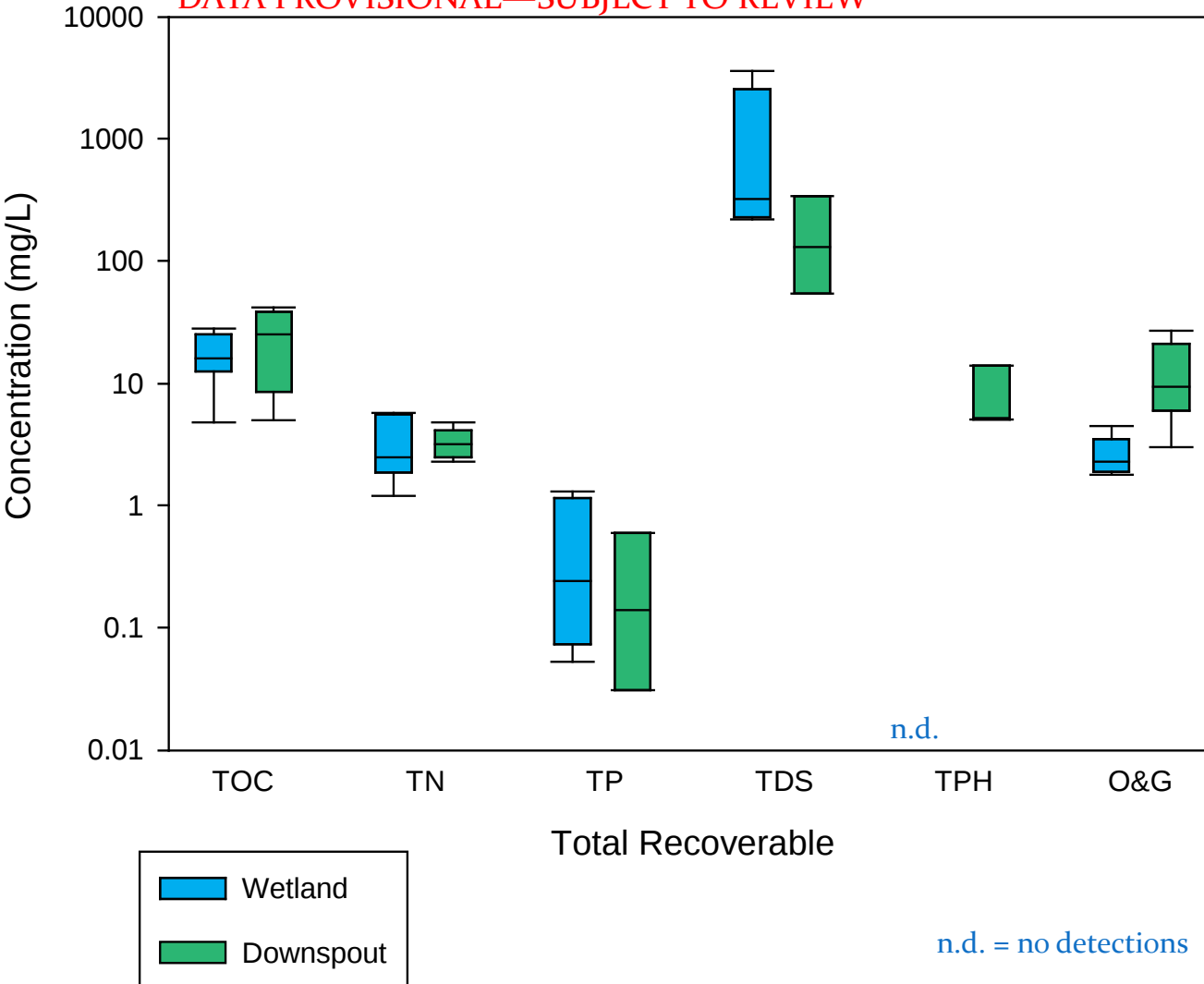
Constituent	Sources
Bromide	Exhaust
Cadmium	Tire wear, insecticides
Chloride	Deicing salts
Chromium	Metal plating, moving engine parts, brake lining wear
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining
Iron	Rust (automobile body and bridge structure), moving engine parts
Lead	Bearing and tire wear, oil and grease
Manganese	Moving engine parts
Nickel	Diesel and gas exhaust, lube oil, metal plating, brake lining wear, asphalt
Nitrogen	Atmosphere, fertilizer application, diesel fuel and gasoline (exhaust)
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Petroleum	Spills, motor lubricants, antifreeze and hydraulic fluids, leachate from asphalt
Phosphorus	Atmosphere, fertilizer application
Sodium & Calcium	Deicing salts, grease
Sulfate	Roadway beds, fuel, deicing salts
Zinc	Tire wear, motor oil, grease, metal plating

Water quality

Nutrients and Organics

TOC	Total Organic Carbon
TN	Total Nitrogen
TP	Total Phosphorus
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
O&G	Oil and Grease compounds

DATA PROVISIONAL—SUBJECT TO REVIEW

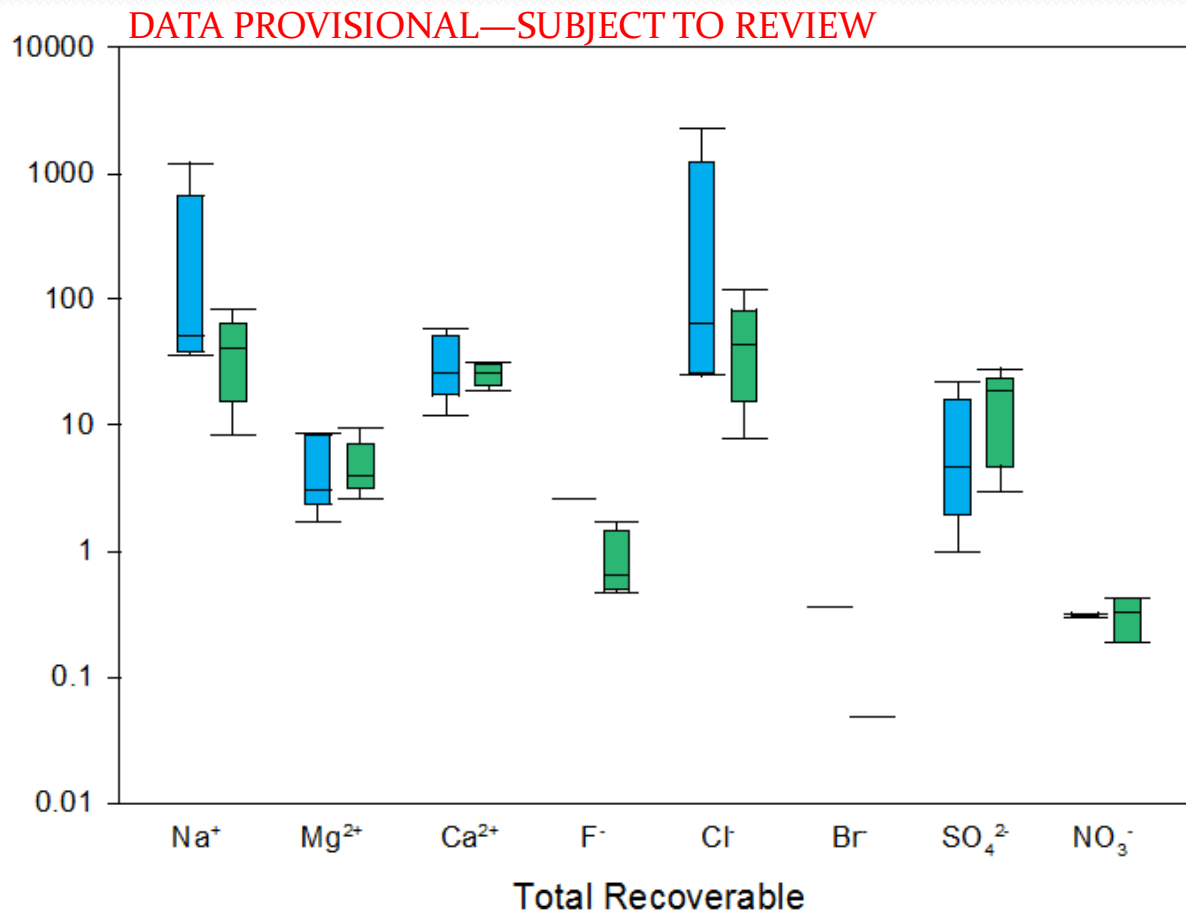


n.d. = no detections

- Major contributor of TOC is likely petroleum-based (asphalt; oil & grease)
- Low TN and TP loading relative to other land-use types (golf course)
- High concentration of dissolved solids (related to salt concentration)—combination of road wear and vehicle use
- TPH and O&G comparable from downspout

Water quality—Major ions

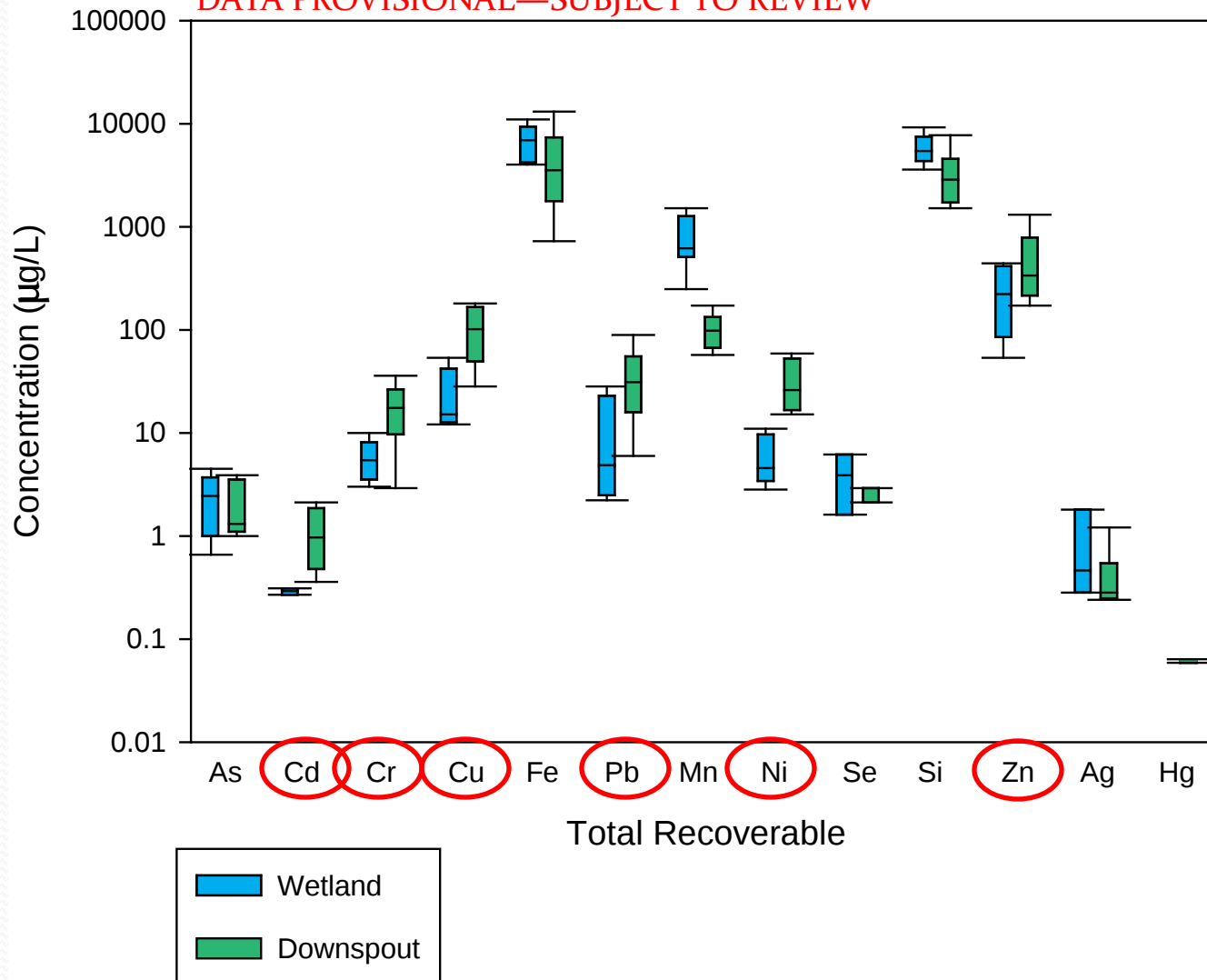
Na	Sodium
Mg	Magnesium
Ca	Calcium
F ⁻	Fluoride
Cl ⁻	Chloride
Br ⁻	Bromide
SO ₄ ²⁻	Sulfate
NO ₃ ⁻	Nitrate



- Some major ions are conservative
- Downspout and Wetland are similar
- Run-off associated ions (Na, Ca, Cl) do not exceed concentrations of the Harlem River
- Low nitrate loading

Water quality—Total Metals

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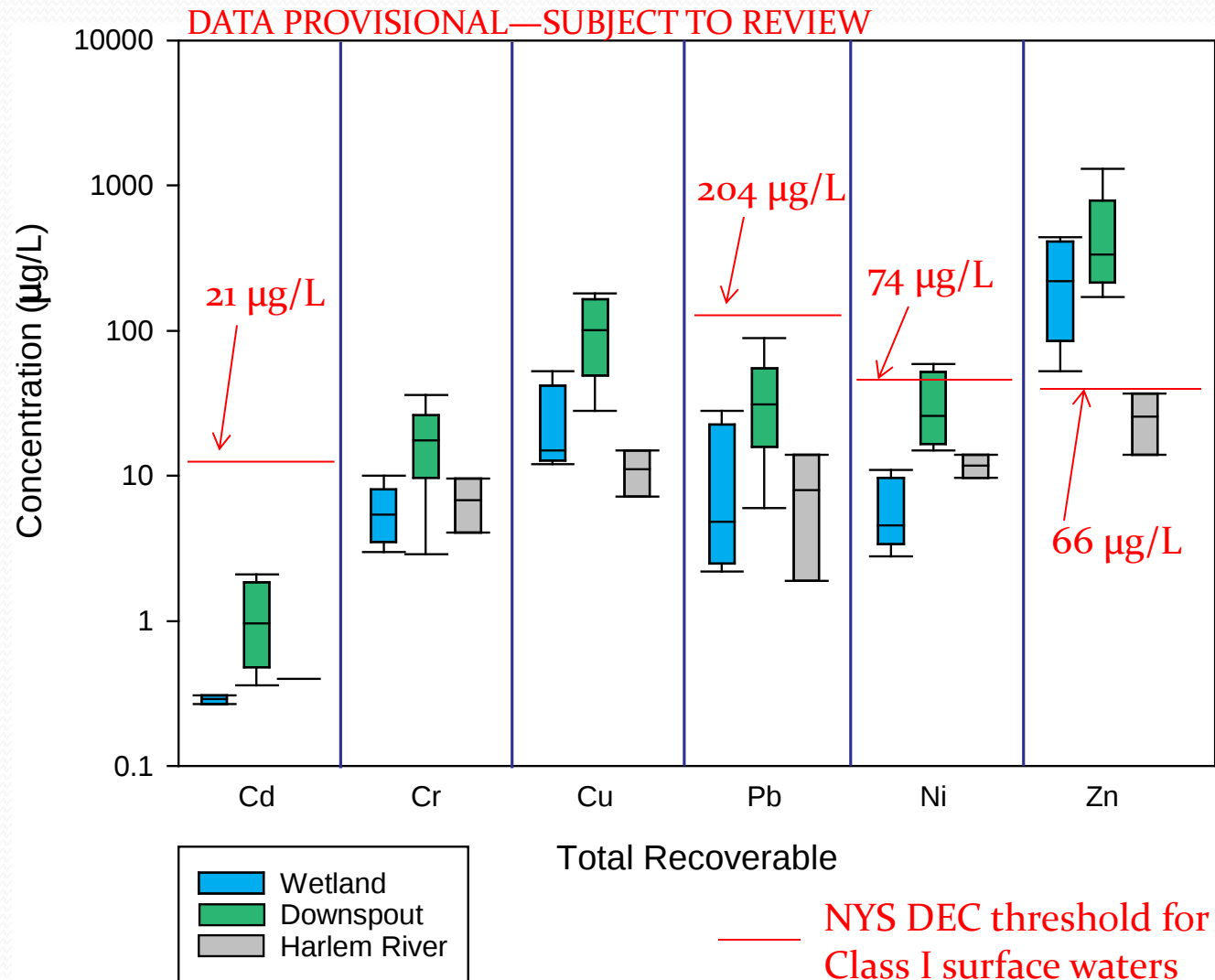


As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Fe	Iron
Pb	Lead
Mn	Manganese
Ni	Nickel
Se	Selenium
Si	Silicon
Zn	Zinc
Ag	Silver
Hg	Mercury

- Run-off contributes significant metals concentration
- Contribution from downspout gets diluted in wetland
- Some metals more indicative of roadway use than others

Water quality—Select roadway metals

- Concentrations of select metals are higher from composite downspout sample than in Harlem River
- Median concentrations in Wetlands are similar to those in samples from the River

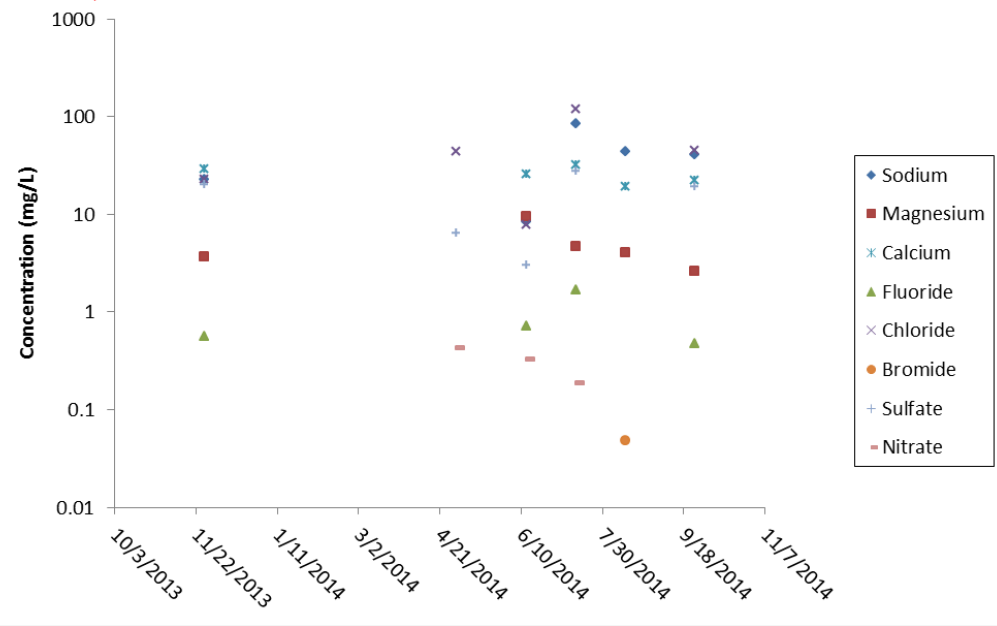
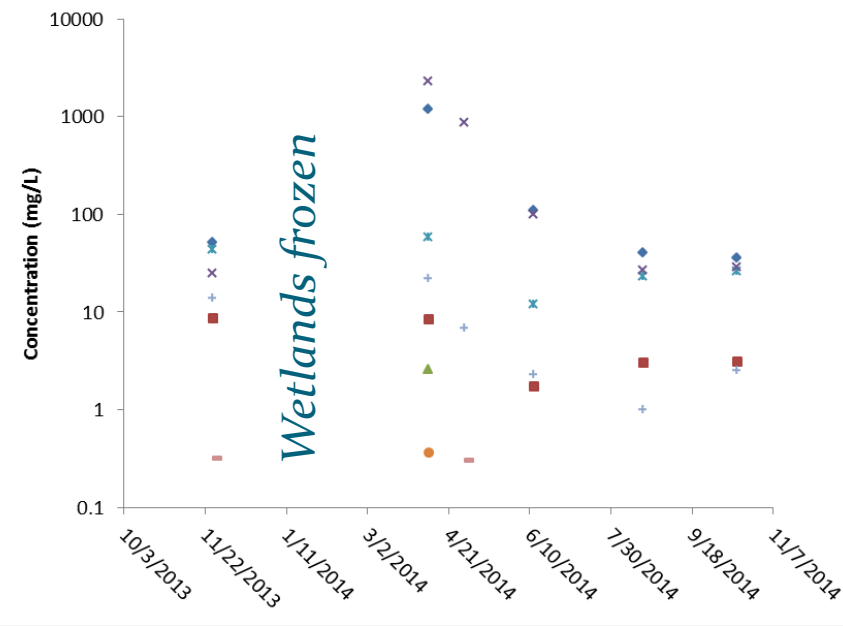


Major Ions

Wetland

Downspout

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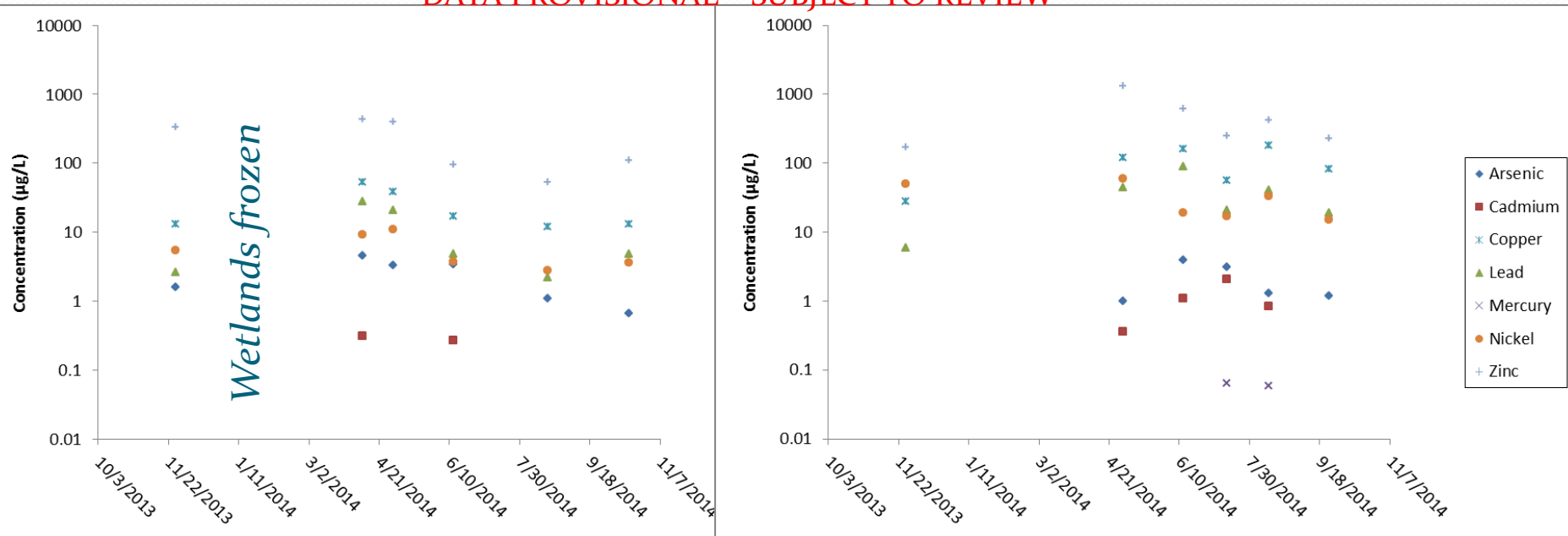


Metals

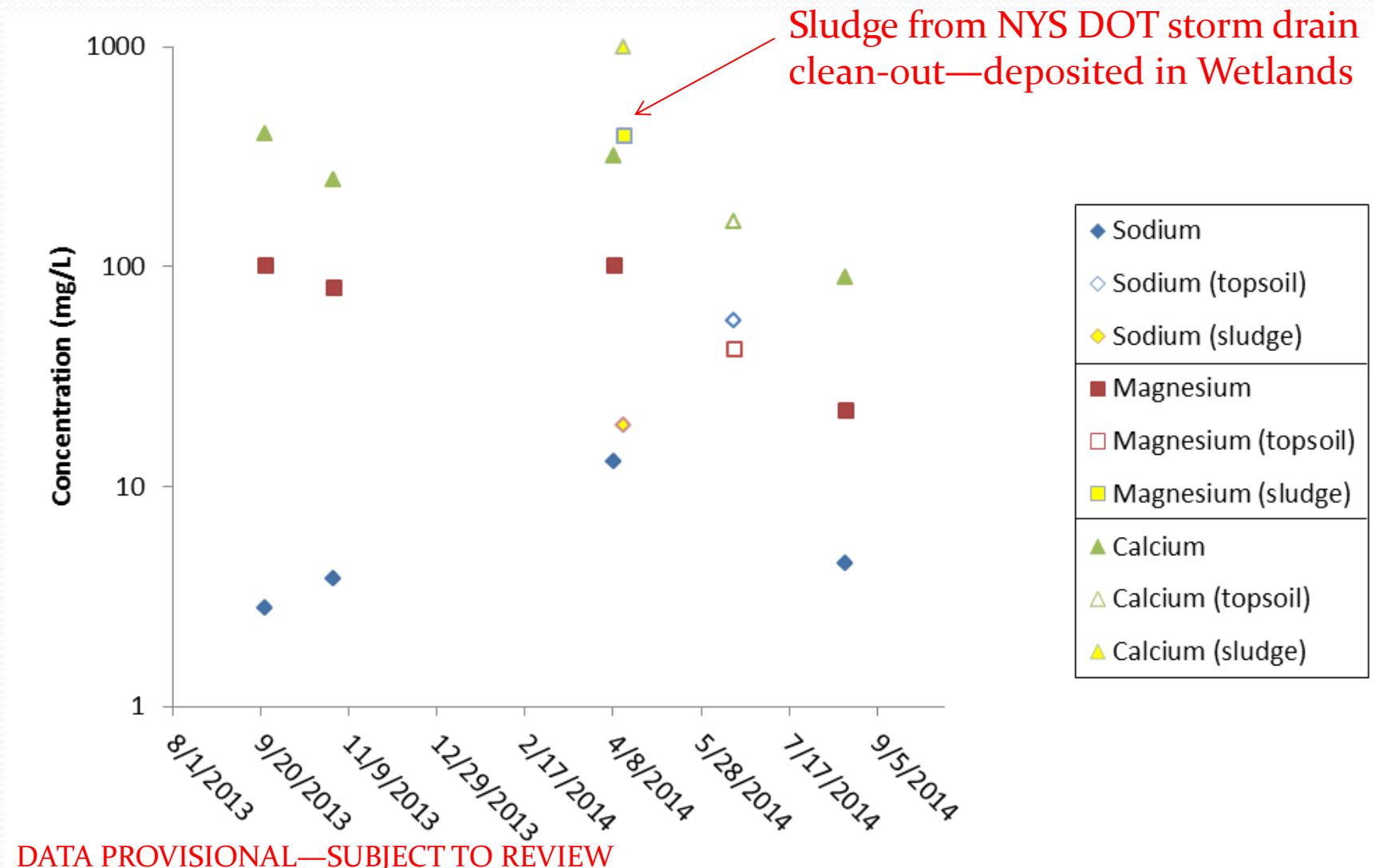
Wetland

Downspout

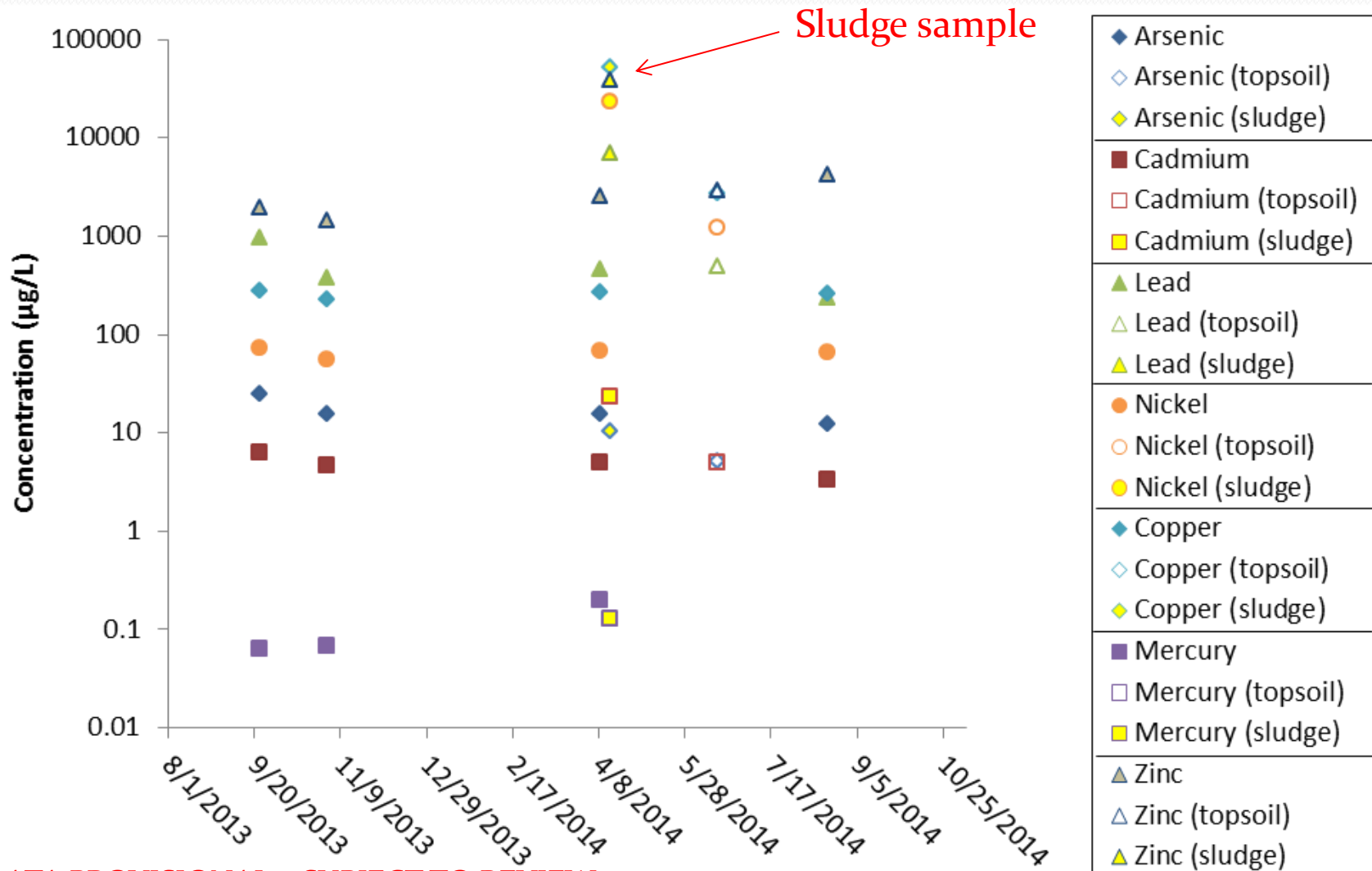
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Wetlands—Gaia soils and sludge



Wetlands—Gaia soils and sludge

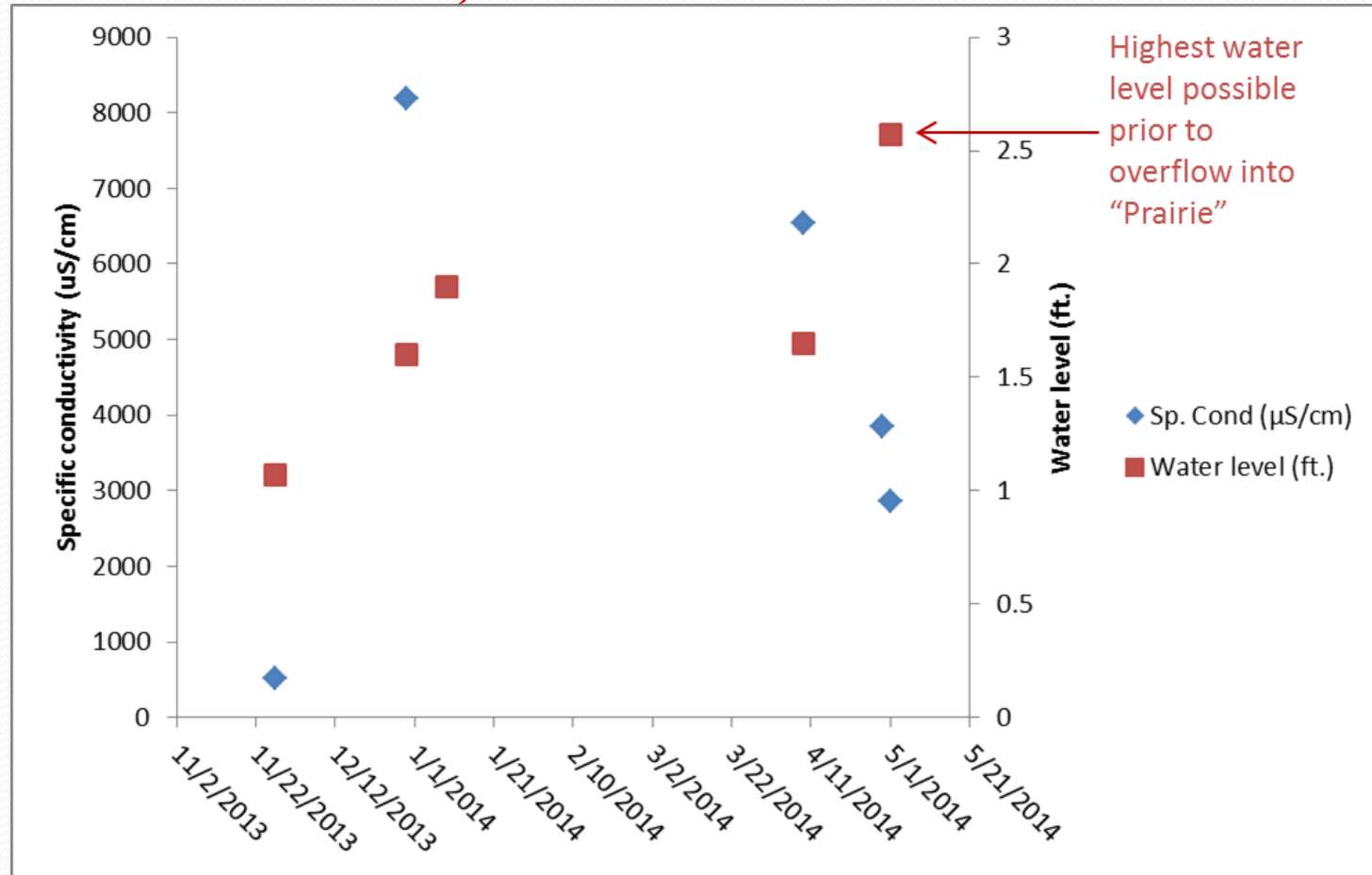


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Wetlands—water level and conductivity

- Water levels can be correlated with conductivity by season
- Conductivity increases in winter months when salting occurs
- Major salt ions are conservative in water—mixing rate and dilution affects conductivity

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Harlem River

Sediment quality

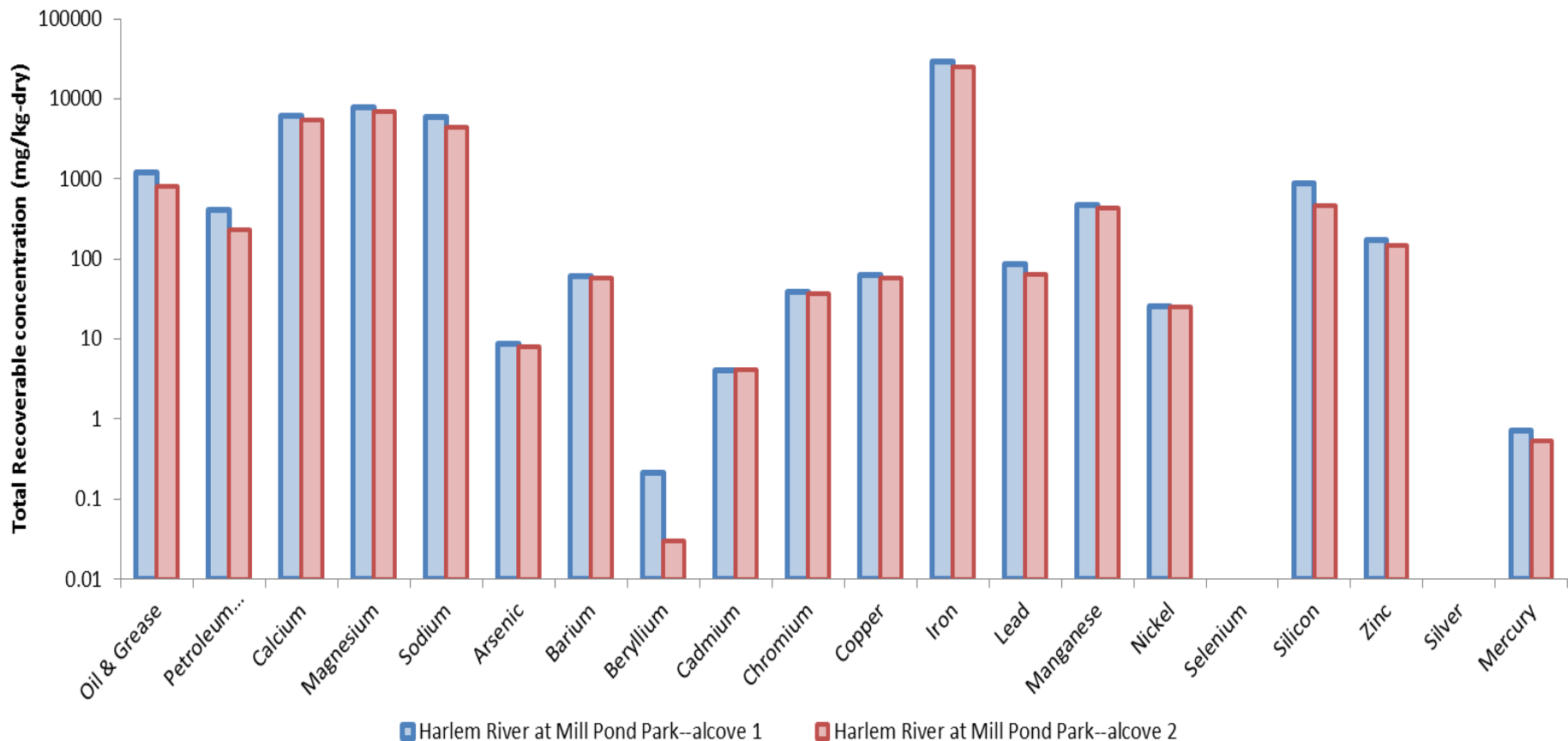
- Sediment quality of a waterbody reflects the health of the ecosystem
- Contributions (from human and natural sources) from land, water, and atmosphere affect chemistry
- Most heavy metals and certain classes of organic compounds can persist in the sediment



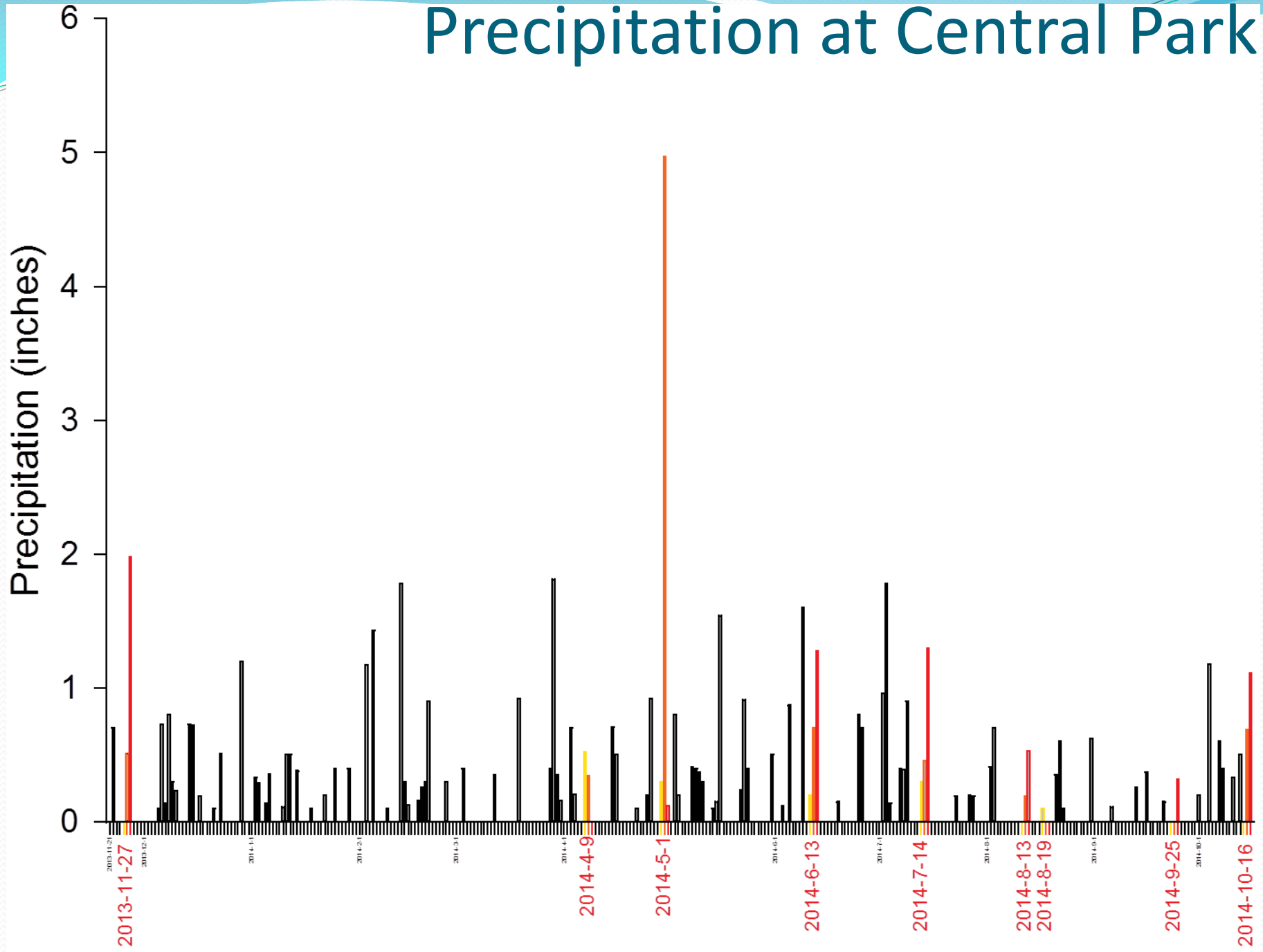
Harlem River

Sediment quality

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Precipitation at Central Park



Conclusions

- Pop-up Wetlands successfully diverted and contained polluted water from entering the Harlem River
- Volume of water diverted can be estimated from total precipitation record from Central Park weather station
- Composite samples collected from downspout contain
 - Higher concentrations of metals associated roadway and vehicle use
 - Lower concentrations of major ions than the Harlem River
 - Metals concentrations that were higher than in samples collected from the Harlem River
 - Metals concentrations that exceeded NYS DEC thresholds for zinc (all samples) and nickel (two samples) in Class I surface waters

Conclusions

- Grab samples from Wetlands contain
 - Metals concentrations that were mostly below NYS DEC thresholds in Class I waters (zinc is the exception)
 - Major ion concentrations that were similar to those collected from the downspout
 - Low dissolved oxygen & high fecal bacteria concentrations
- Water and Sediment of the Harlem River contains
 - Metals concentrations that are below NYS DEC threshold for Class I waters [though standard is for water only]

Recommendations for future monitoring at Pier 5

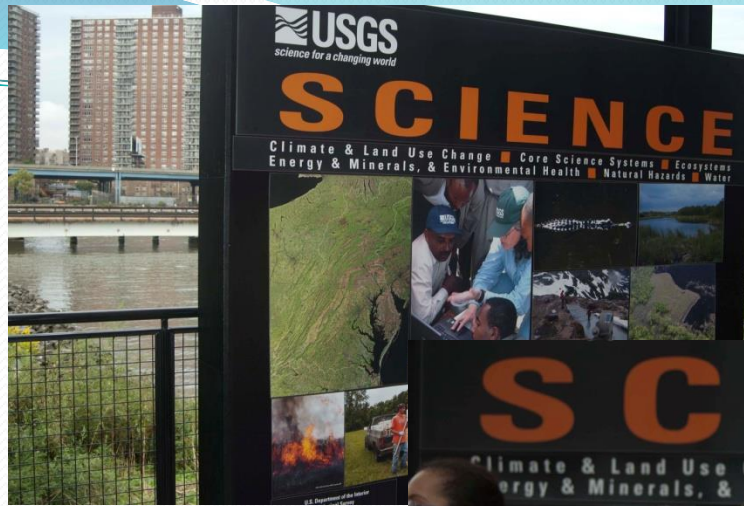
- Build piezometers into the design of the wetlands so they are secured prior to loading soil
 - Collect daily (or continuous) water-levels from several points in each basin
 - Samples from each piezometer can be composited per basin
- Design downspout diverters to be compatible with flow sensor
 - Flow-weighted, composite, and discrete samples can be collected
 - Can be correlated with onsite precipitation data and water levels
- Co-locate a weather station with precipitation gage, thermometer, and solar index meter

Thank you

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<http://ny.cf.er.usgs.gov/nyprojectsearch/projects/LKoo-DU700.html>