Heavy Metal Gradients in the Hackensack River Estuary: A Baseline for Improving Ecosystem Health

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Abstract:

Sediments in the Lower Hackensack River tidal creeks were sampled to assess the Post Superstorm Sandy contaminant baselines for chromium and mercury to aid in future ecosystem health monitoring. Of the creeks sampled, this research focused on West Riser Ditch, East Riser Ditch, and Peach Island Creek East. Sediment samples at West and East Riser Ditches showed a negative concentration gradient from the tide gates moving inland. Peach Island Creek East showed consistently higher metal concentrations than the other sampled creeks for both metals and showed a concentration gradient that was positive from the tide gate moving inland. Aerial imagery from 1930 to 2012 was used to identify a spatial relationship between land use over time and tidal creek ecosystem health.

Methodology:

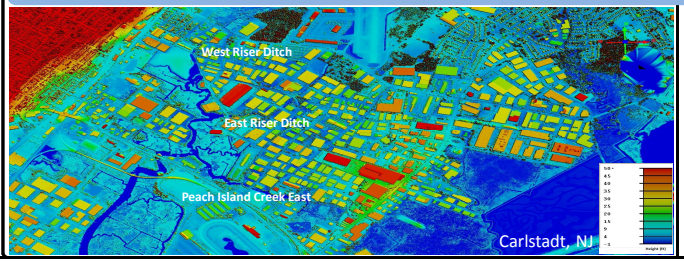
Fifty three samples collected inland of each tide gate were lab analyzed for chromium and mercury concentrations. The 'Spline with Barriers' Spatial Analyst tool was used to interpolate the sample point metal concentrations throughout each of the creek bodies along the Hackensack River and helps visualize potential concentration gradients. Sample points were quantified and symbolized based on NJDEP Marine/Estuarine Sediment Screening Guidelines (refer to NJDEP Sediment Guidelines table). Sample points whose Hg and Cr concentrations were higher than the Low Effects Range (ER-L) threshold are symbolized as red hazard triangles. Comparing aerial imagery from 1930 and 2012 using remote sensing techniques revealed changes in land use surrounding Peach Island Creek East that have implications on ecosystem health.

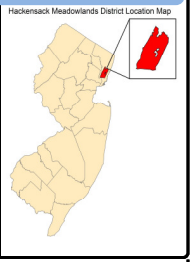
NJDEP Sediment Guidelines

Metals	Effects Range - Low (ER-L)[1] (mg/kg, dry weight)	Effects Range - Medium (ER-M)[2] (mg/kg, dry weight)
Arsenic	8.2	70
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	47	218
Mercury	0.15	0.71
Nickel	21	52
Silver	1.0	3.7
Zinc	150	410

Long et al., 1995

Post Superstorm Sandy Sediment Sampling Site Locations

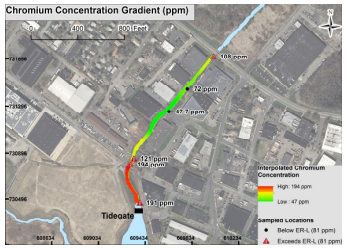


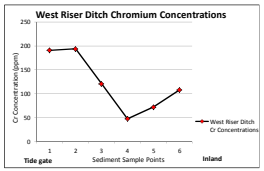


Results:

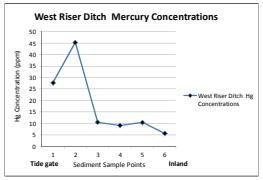
A. Lower Hackensack River Tidal Creek Chromium and Mercury Concentration Gradients

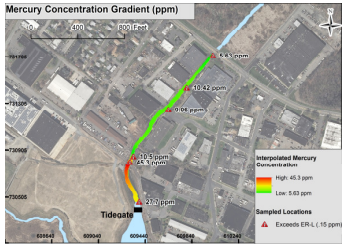
West Riser Ditch





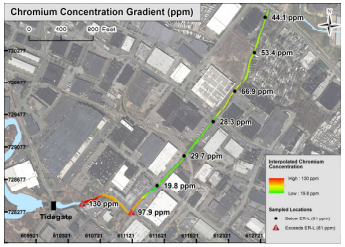
Chromium (Cr)

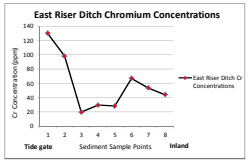




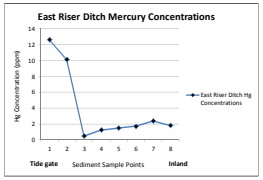
Mercury (Hg)

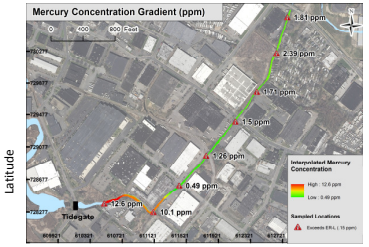
East Riser Ditch





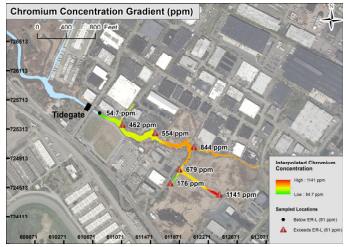
Chromium (Cr)

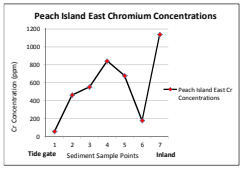




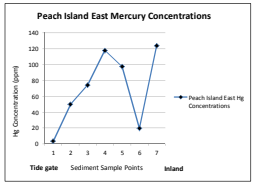
Mercury (Hg)

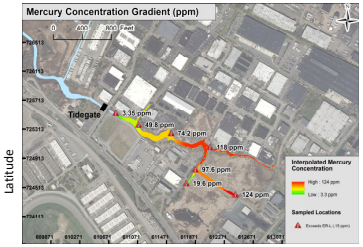
Peach Island Creek East





Chromium (Cr)

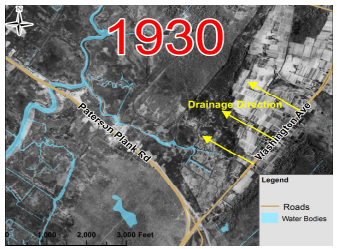




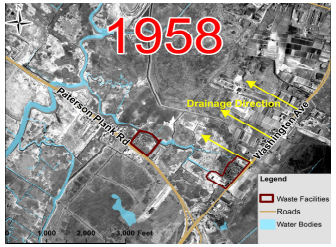
Mercury (Hg)

B. Peach Island Creek East: Land Use Over Time in a Geographic Context

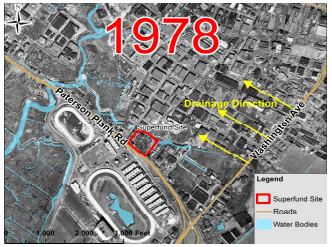
Data shows that Peach Island Creek East sediments had significantly higher concentrations of chromium and mercury. Aerial imagery from 1930 to 2012 highlights the changing landscape surrounding Peach Island East's ecosystem and the relationship between creek ecosystem health and land use over time.



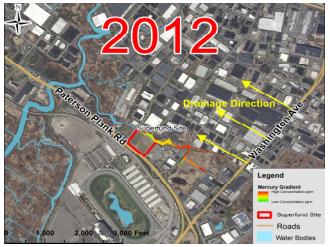
- Little to no development near creeks
- Mosquito ditched wetlands environment is dominant



- Land used for waste processing facilities and automobile junkyards



- Warehouses and light industrial facilities
- Development of sports complex



- Development steadies from 1980's-present
- Superfund Sites and additional warehouses

Discussion:

After using the interpolation tools within ArcGIS, mercury and chromium sediment concentrations reveal a pattern. West Riser and East Riser Ditches showed a strong negative concentration gradient from the tide gate moving inland. This gradient is found in both chromium and mercury. Conversely, Peach Island Creek East sediment concentrations showed a positive gradient from the tide gate moving inland. Peach Island East also had metal concentrations significantly higher than West or East Riser Ditch. This area was a prime example of how land use can impact ecosystem health over time.

Acknowledgments and References

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New Jersey Department of Environmental Protection 2015 Mapping Contest