



Photo Credit: Baltimore Sun



Photo Credit Avenue News

# Road Salts in the Baltimore Reservoir System

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Photo Credit USGS

# Center for Watershed Protection

- Non-profit 501(c)3, non-advocacy organization founded in 1992
- Work with watershed groups, local, state and federal governments
- 20 staff in Ellicott City, MD; Field Offices in Charlottesville, Philadelphia, Ithaca, Urbana, South Carolina

# Outline

- Salt info
- Salt Issues
- Background on Reservoirs
- Reservoir monitoring data
- Salt BMPs

Data from Clark Howells and Robert McAulay from DPW

# Salt as a De-icer

- First used in 1938 [1]
- Winter 1941-1942 used 5,000 tons on highways nationwide [1]
- FY 2014 551,443 tons of salt used by MD SHA- Over \$149M [2]



Photo From: <http://chesapeakestormwater.net/2009/01/winter-road-salt-and-the-chesapeake-bay/>

# What's Wrong with Salt?

- No natural process to get rid of Cl<sup>-</sup>
- Na<sup>+</sup> can exchange with Mg<sup>2+</sup> Ca<sup>2+</sup> [7]
- Aquatic
  - Acute standard for Cl<sup>-</sup> is 860 mg/L over 1-hour
  - Chronic Cl<sup>-</sup> is 230 mg/L over 4-day
  - Stress fish and invertebrates
  - Animals that drink water- dehydration, confusion, weakness [5]
  - Metals
- Plants
  - Stress native plants, increase invasive
  - Cl<sup>-</sup> level as low as 30 mg/L have shown to damage plants [6]
- Water Quality
  - Stratification → decreased mixing, low oxygen, less SAV, algal bloom



Photo Credit: John White



Photo Credit: MO Botanical Garden



Photo Credit: MO Botanical Garden

# What's Wrong with Salt?

- Drinking water
  - Higher sodium and chloride content in drinking water
  - Cl- Secondary Drinking Water Standard = 250 mg/L (taste)
  - Sodium advisory limit = 20 mg/L for people with restricted sodium intake
  - Hypertension
- Corrosion in pipes
  - Chloride corrodes pipes
- Groundwater\*



Credit: Alan Cressler, USGS

# Land Use

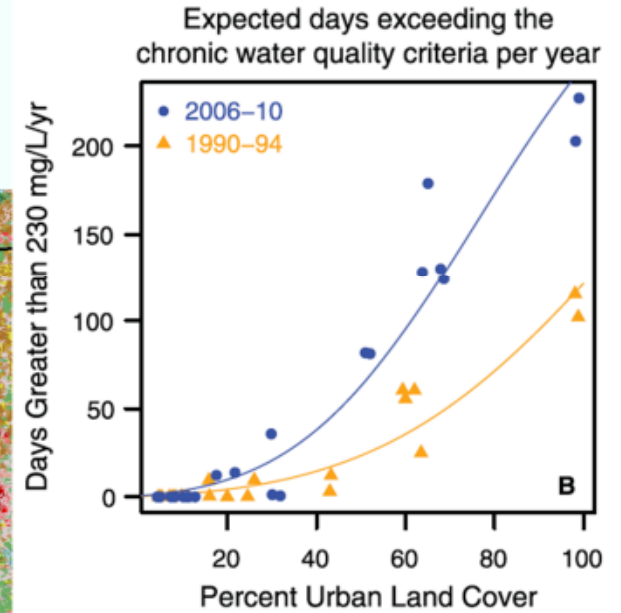
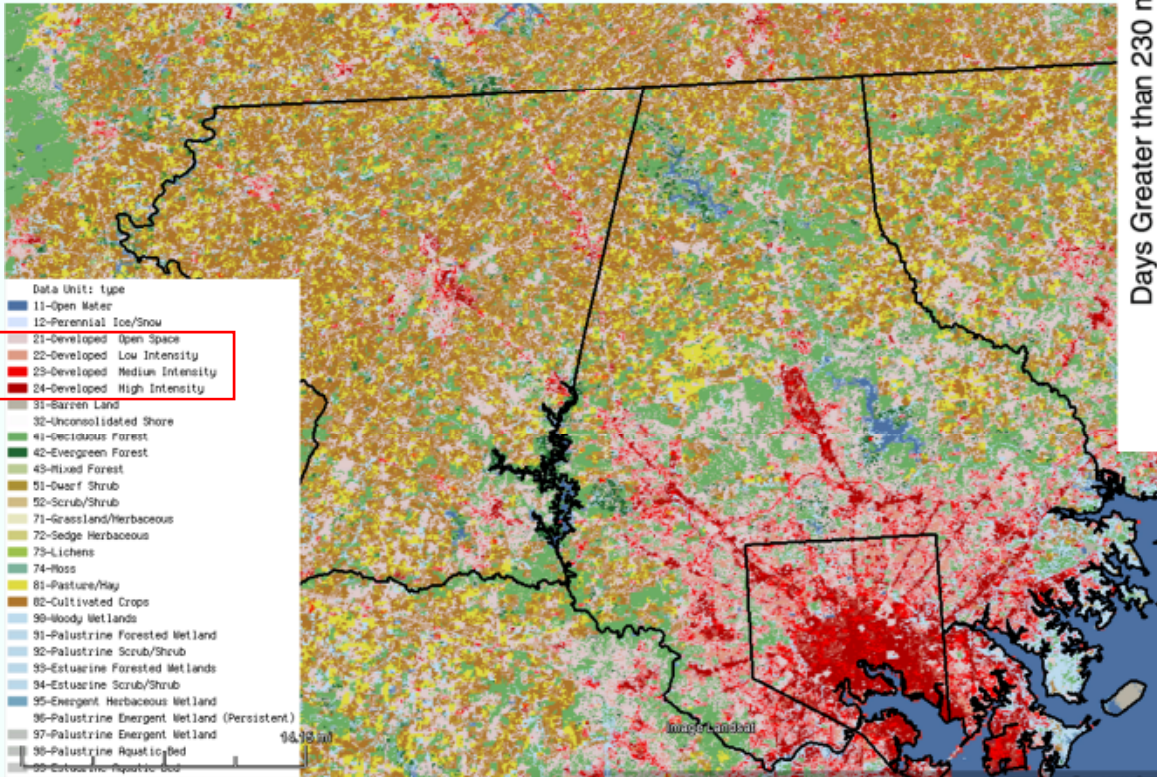


Chart From Corsi, 2015

Increase in salt use rate in urban land cover [3]

# Baltimore Reservoir Watershed

- Liberty
  - 164 sq. mi. watershed
  - 37 billion gal capacity
- Loch Raven
  - 223 sq. mi.
  - 21 billion gal
- Prettyboy
  - 80 sq. mi.
  - 18 billion gal

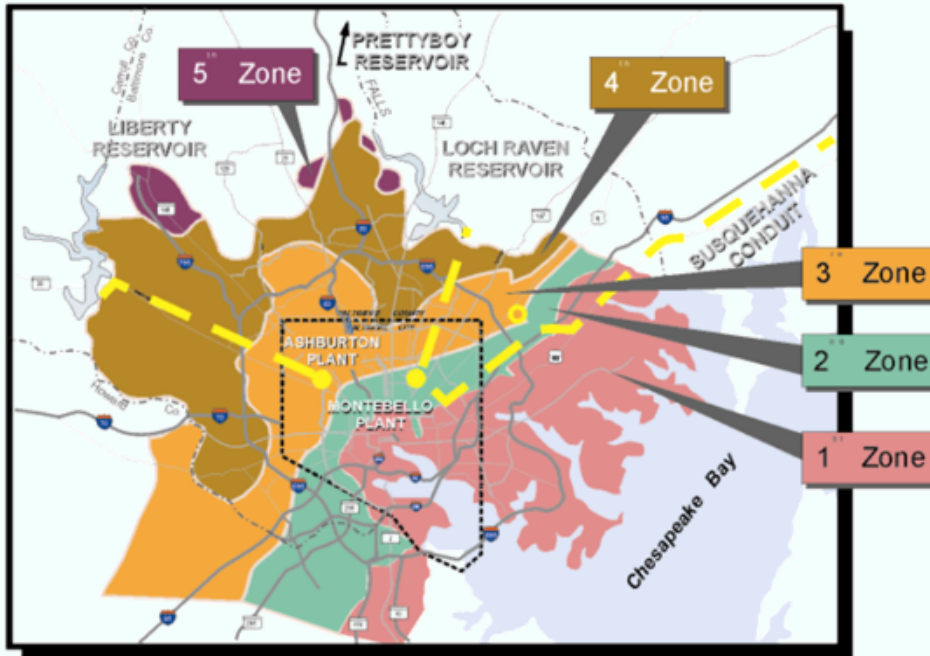






<http://www.wbalty.com/news/baltimore-to-celebrate-100th-anniversary-of-citys-first-water-filtration-system/35326524>

# Baltimore Reservoir Drinking Water



<http://cityservices.baltimorecity.gov/dpw/waterwastewater02/waterquality8a.html>

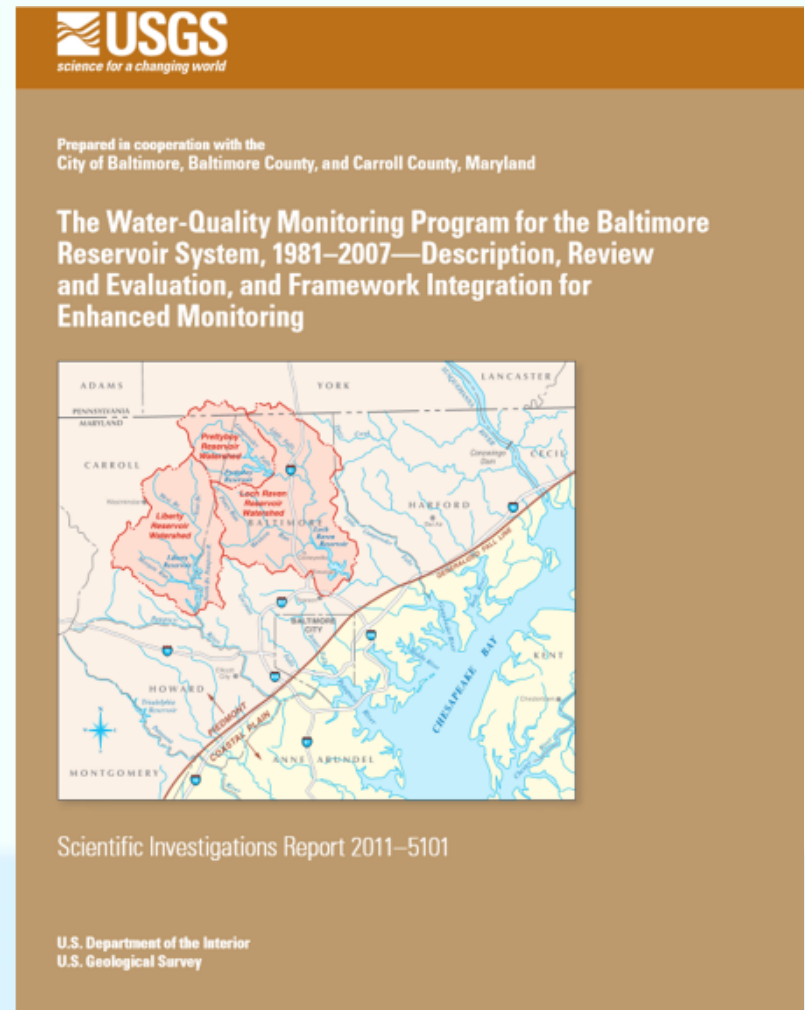
- Three treatment facilities
  - Montebello I
  - Montebello II
  - Ashburton
- 20 pump stations



<http://www.gmbnet.com/portfolio/ashburton-water-filtration-plant/>

# Baltimore Reservoir Watershed Monitoring

- Reservoir Watershed Management Agreement (1979, 2005)
  - Reservoir Technical Group
- Monitoring started in 1981
- USGS Report 2011
- CWP working on Monitoring Plan Study
- 17 tributaries stations (7 with storm sampling) and 12 reservoirs stations

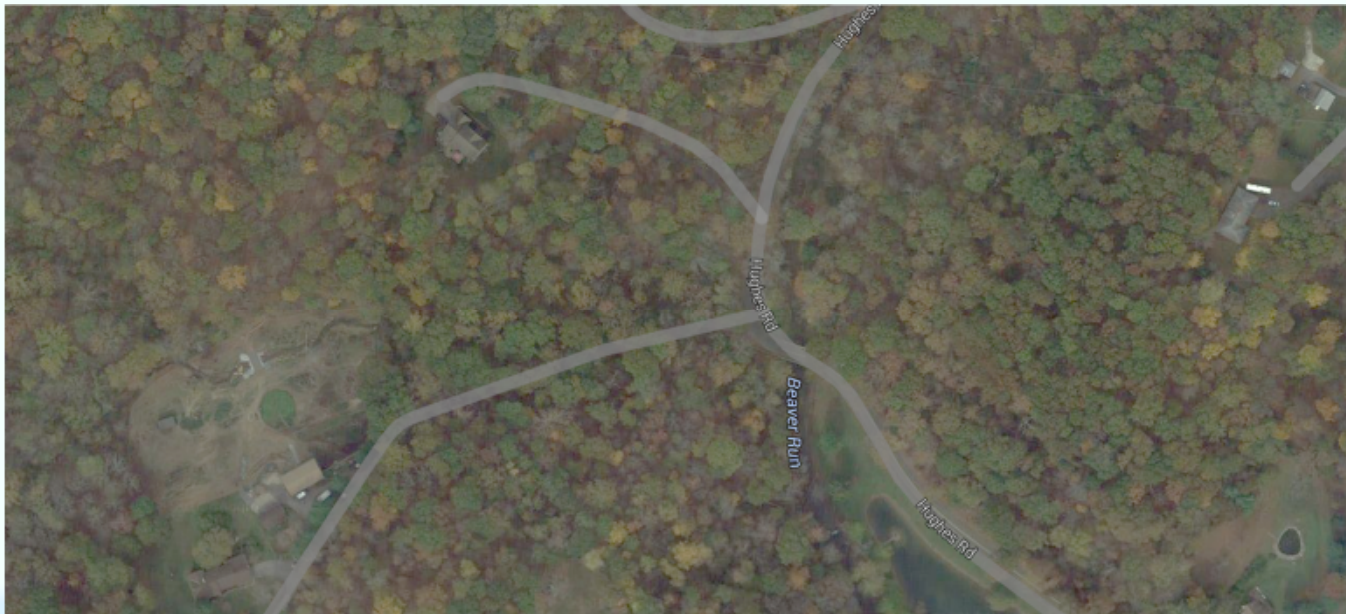


# Baltimore Reservoir Monitoring

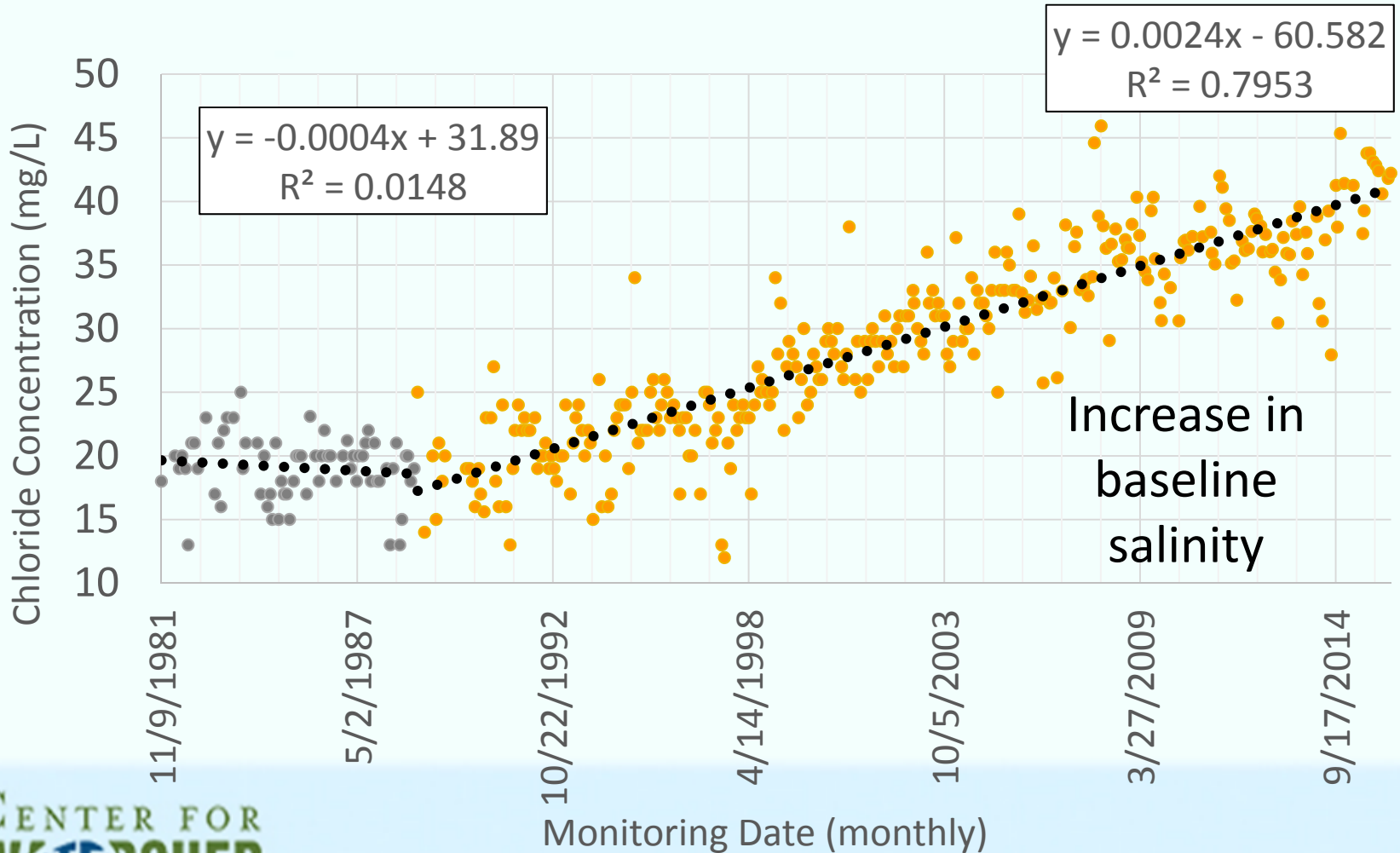


# Baltimore City Monitoring Data

- Beaver Run to Liberty Reservoir
- 14.11 mi<sup>2</sup> Drainage area

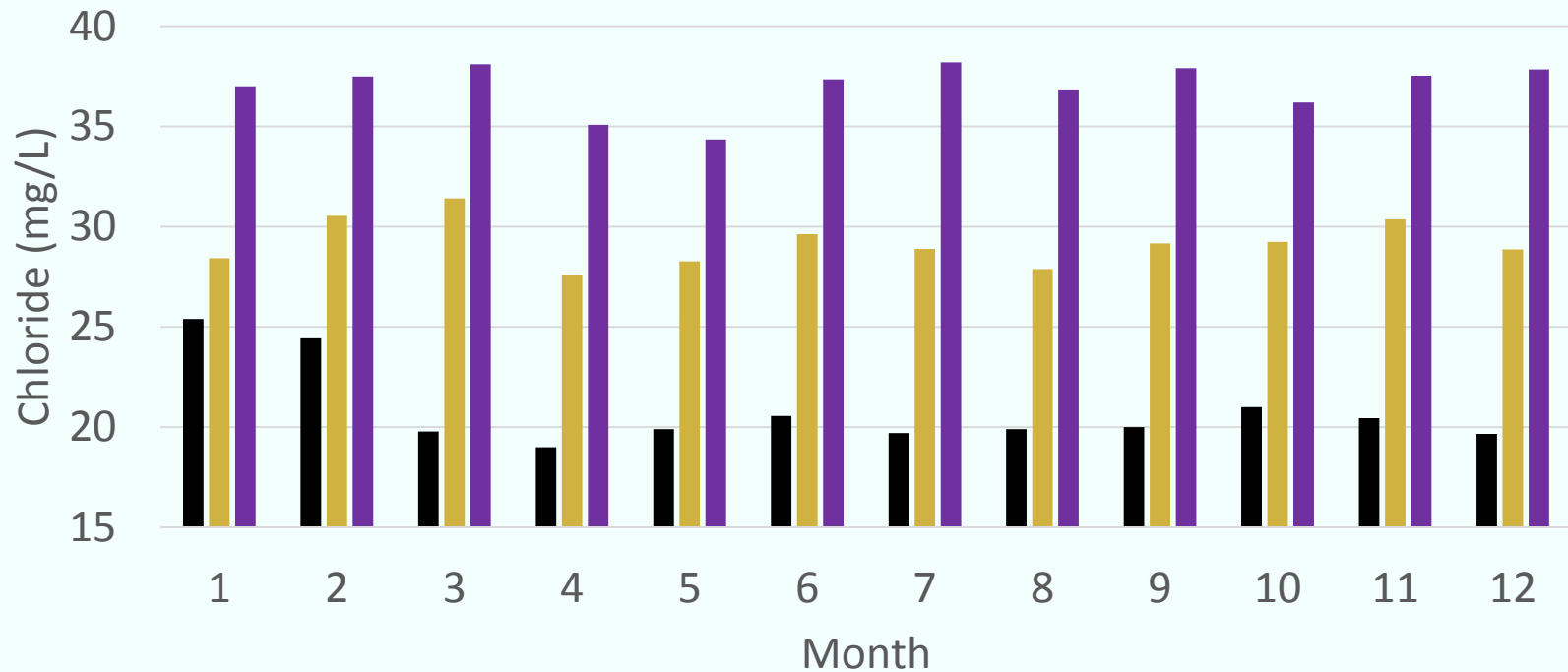


# Baltimore City Monitoring Data- Beaver Run



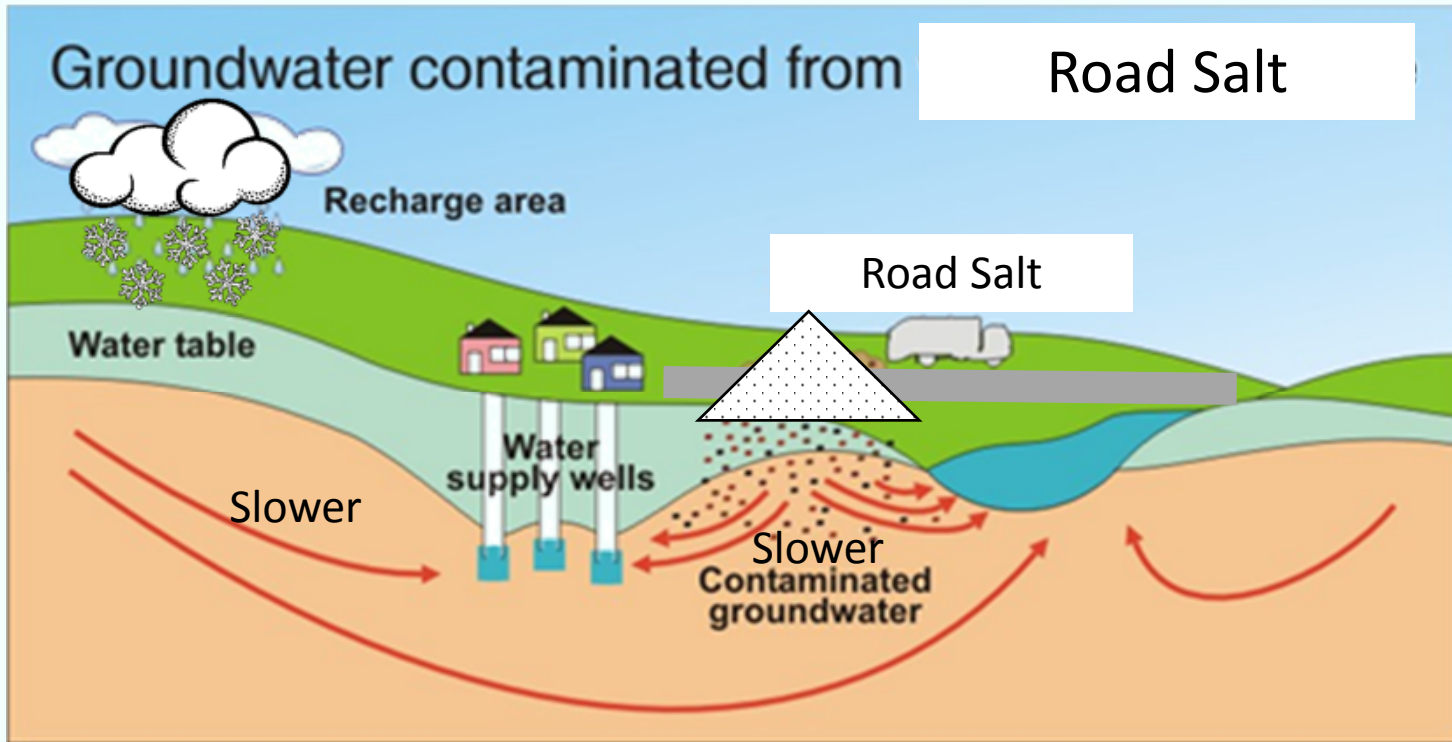
# Baltimore City Monitoring Data- Beaver Run

## 10 Year Average Chloride Concentration by Month

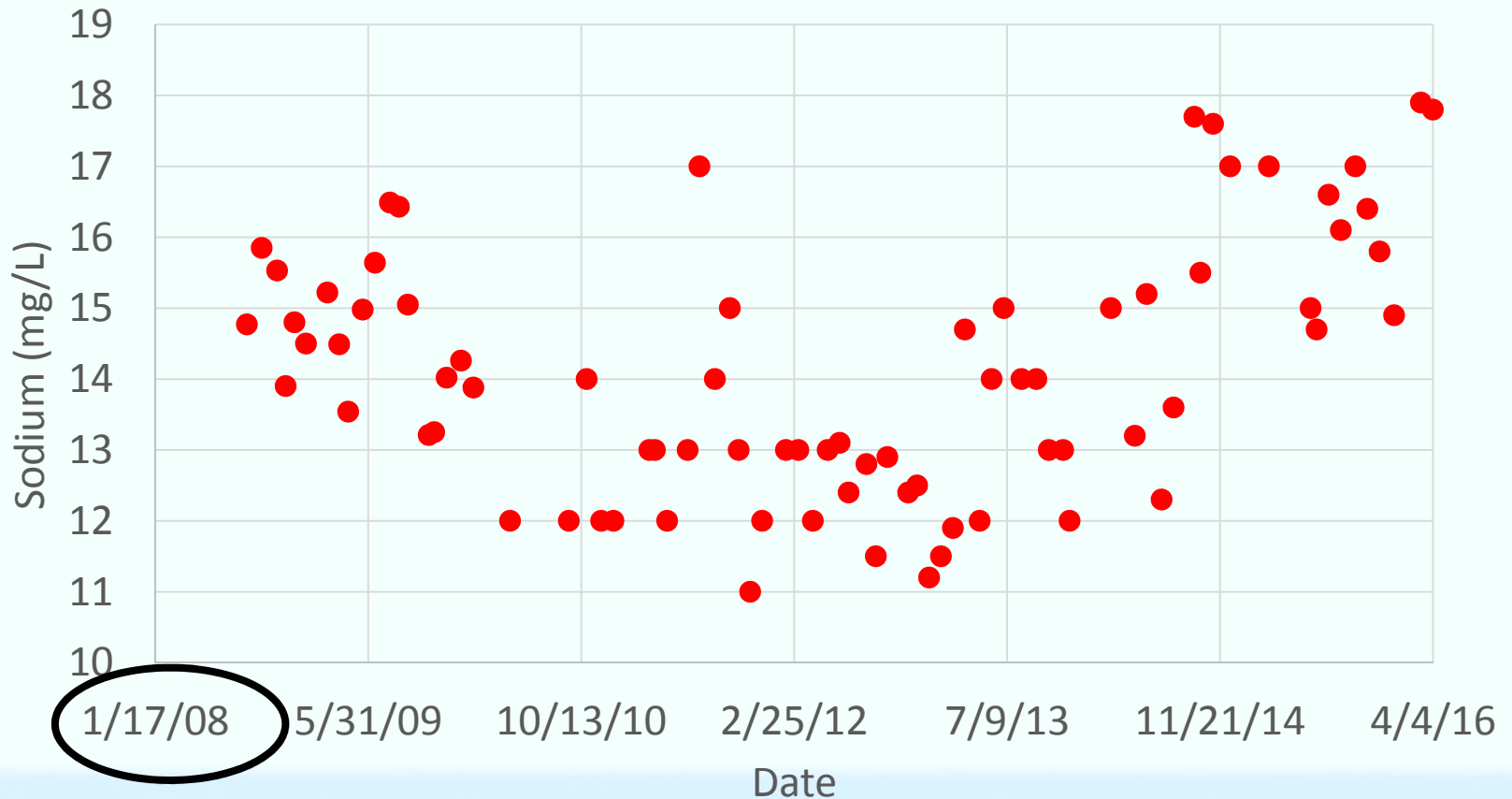


■ Average from 1987-1996 ■ Average from 1997-2006 ■ Average from 2007-2016

# Water Cycle



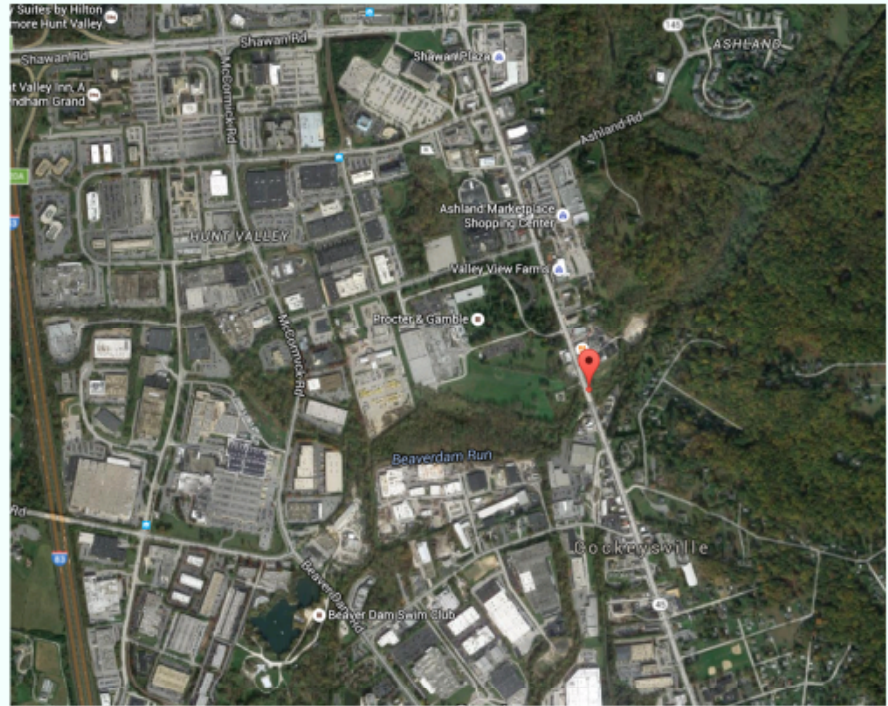
# Baltimore City Monitoring Data- Beaver Run



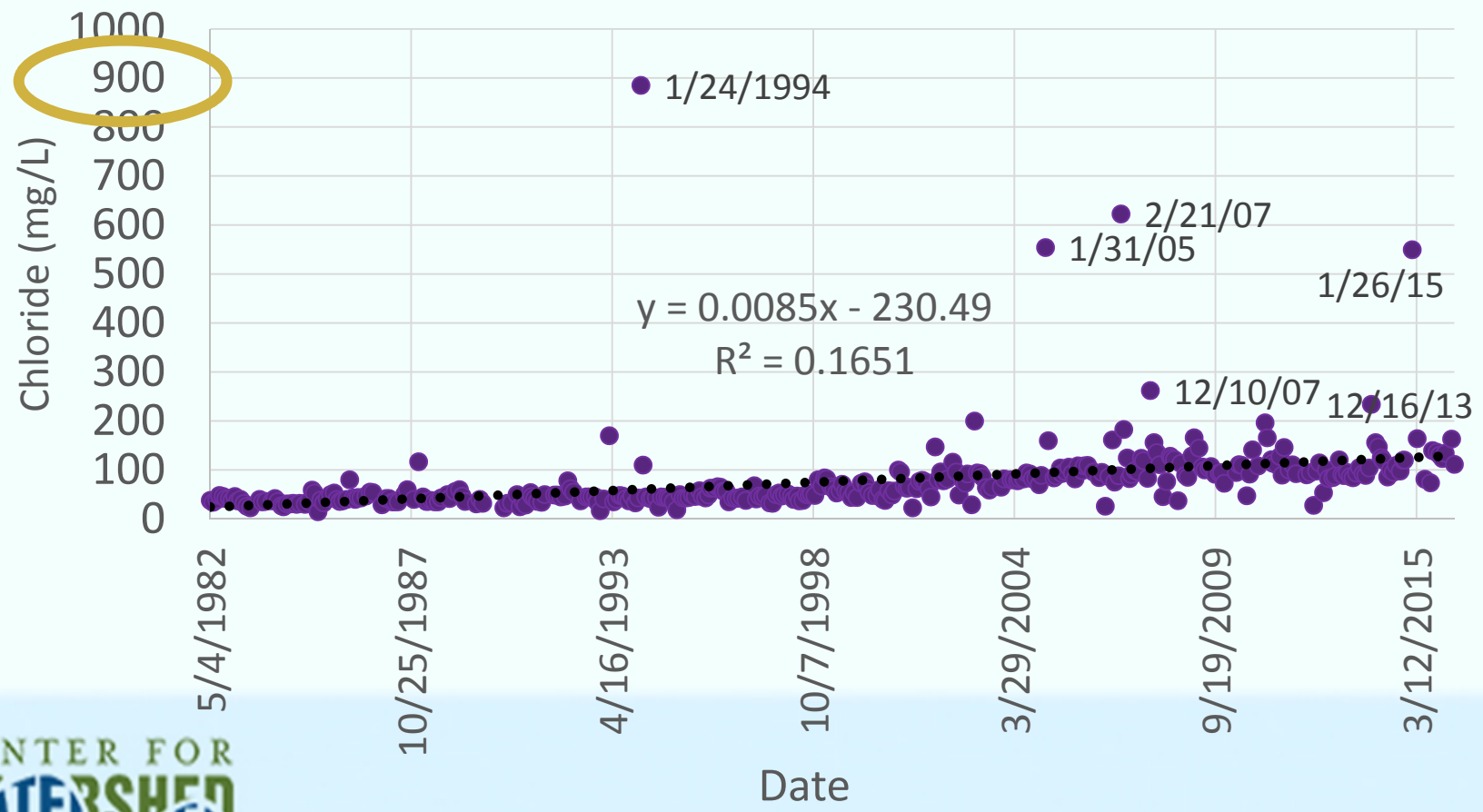


# Baltimore City Monitoring Data

- Beaver Dam Run to Loch Raven Reservoir
- 20.73 mi<sup>2</sup> drainage area
- Much more IA

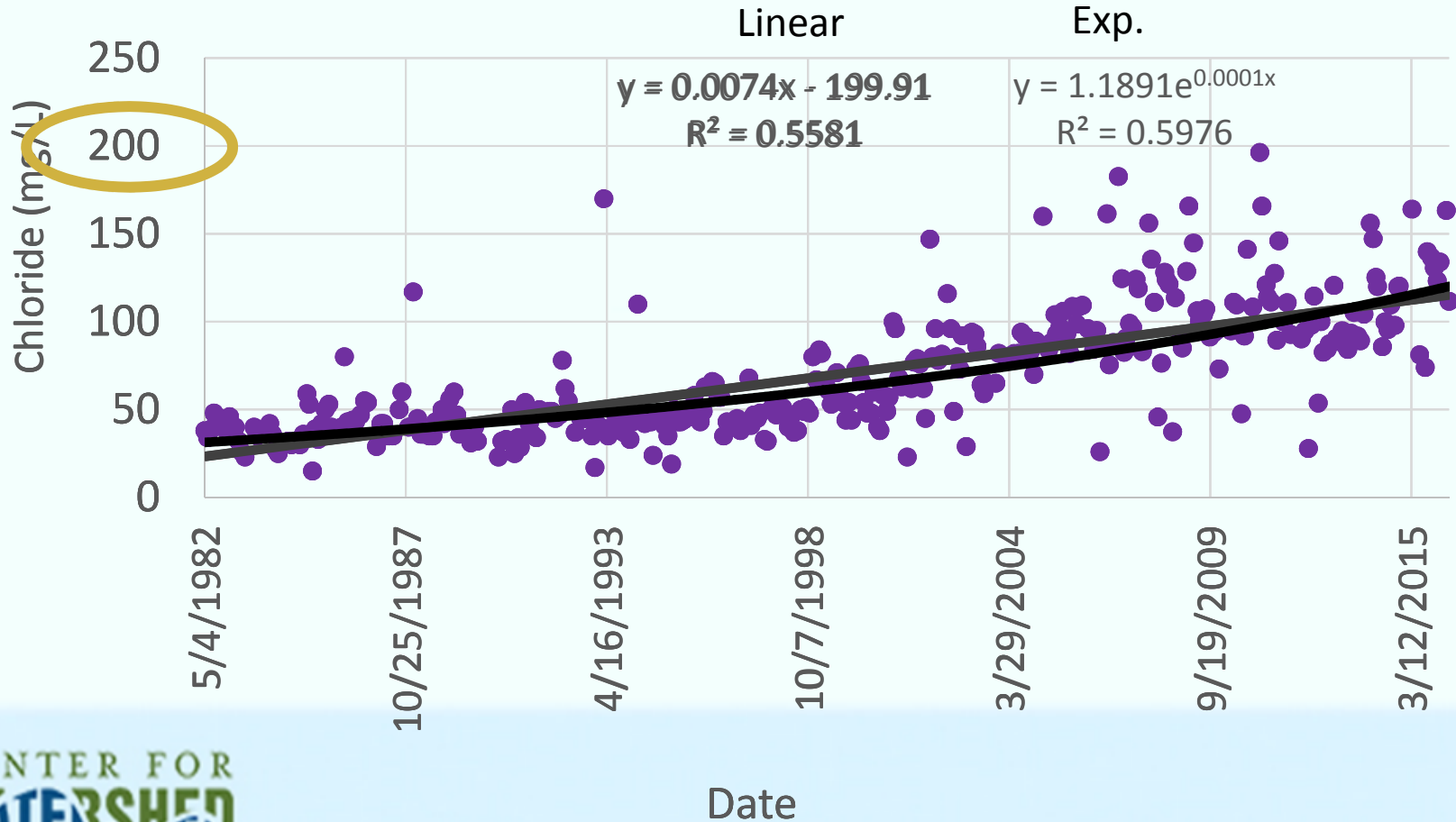


# Baltimore City Monitoring Data- Beaver Dam Run- Chloride Data

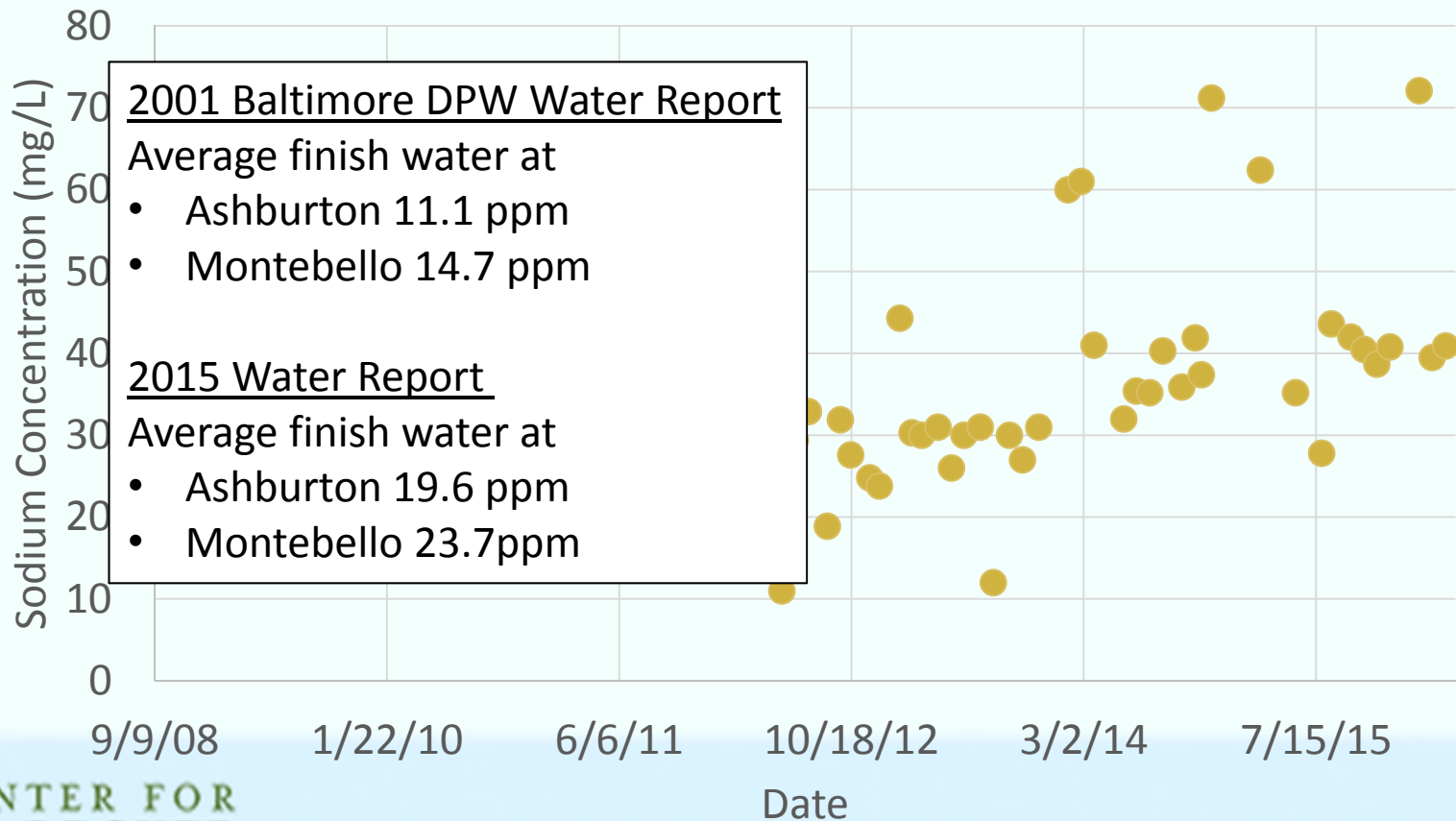


Data provided by Baltimore City

# Baltimore City Monitoring Data- Beaver Dam Run- Chloride Data (Outliers removed)



# Baltimore City Monitoring Data- Beaver Dam Run- Sodium Data (Outliers removed)



# Chloride TMDLs

## Maryland

- Category 5- 29 watersheds
  - Liberty- 1<sup>st</sup>-4<sup>th</sup> order streams
  - Loch Raven- 1<sup>st</sup>-4<sup>th</sup> order streams
- Gwynns Falls\*
- Back River\*
- Little Patuxent River\*

## Existing Elsewhere

- Twin Cities Metro Area, MN- 39 chloride impairments
- MA to NH I-93 Corridor
- IL: Salt Creek, Chicago River, Buffalo Creek, Higgins Creek, DuPage River, Little Vermilion River, Pond Creek, etc

# Salt BMPs

- Education/Training
- Calibration of equipment
- Salt free alternatives
- Salt Brine
- Pretreatment of roads
- Street Sweeping
- Other chemicals (but may cause other problems)



<http://www.10tv.com/content/stories/2015/01/30/columbus-ohio-columbus-goes-blue-with-test-of-new-road-salt-tint.html>



<https://keepbaltimoreinexplicable.wordpress.com/>



Photo Credit: MD SHA

# Last Thoughts

- Alternatives need to be comparable or better
- Public safety vs. public health
  - De-icing roads with salt reduces accidents by 88% and injuries by 85% [4]
- Keep monitoring
- Research



Photo Credit: Baltimore Sun



Photo Credit: Baltimore Sun

# Questions?



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# Bioretentions and Salt

- Salt dissolves in water
- Pushes salt into GW
- Amount of salt is still the same, just delayed

# References

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7. Cooper, CA. et al, 2014. "Effects of road salts on groundwater and surface water dynamics of sodium and chloride in an urban restored stream." Biogeochemistry 121:149-166.

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- LR: [http://www.avenuenews.com/news/article\\_6728ce6c-0317-11e2-b0b0-0019bb2963f4.html](http://www.avenuenews.com/news/article_6728ce6c-0317-11e2-b0b0-0019bb2963f4.html)
- Prettyboy: [http://md.water.usgs.gov/waterdata/water\\_conditions/current/reservoirs.html](http://md.water.usgs.gov/waterdata/water_conditions/current/reservoirs.html)
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[http://dnr2.maryland.gov/wildlife/Pages/plants\\_wildlife/herps/Caudata.aspx?CaudataName=Spotted%20Salamander](http://dnr2.maryland.gov/wildlife/Pages/plants_wildlife/herps/Caudata.aspx?CaudataName=Spotted%20Salamander)
- Well: <http://water.usgs.gov/edu/earthgwquality.html>
- Loch Raven Sign :<http://www.wbaltv.com/news/baltimore-to-celebrate-100th-anniversary-of-citys-first-water-filtration-system/35326524>
- Salt truck <http://www.mde.state.md.us/programs/Marylander/Pages/roadSalt.aspx>
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