

2017 National Watershed & Stormwater Conference

WELCOME

2017 NATIONAL WATERSHED & STORMWATER CONFERENCE
Connecting Practitioners to Innovative Ideas

2017 National Watershed & Stormwater Conference

Road Salts in the Baltimore Reservoir System

Carol Wong
Center for Watershed Protection

Photo Credit: Avenue News

Photo Credit: Baltimore Sun

Photo Credit: USGS

2017 National Watershed & Stormwater Conference

Salt as a De-icer

- First used in 1938 [1]
- Winter 1941-1942 used 5,000 tons on highways nationwide [1]
- 19.5 million tons annually
- FY 2015- 339,005 tons of salt used by MD SHA- Over \$116M [2]

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

SORRY SON...THERE'S NO APP FOR THAT

2017 National Watershed & Stormwater Conference

What's Wrong with Salt?

- No natural process to get rid of Cl⁻
- Plants
 - Plant kills/damage
 - Stress native plants, increase invasive
 - Cl⁻ level as low as 30 mg/L have shown to damage plants [6]
- Soils
 - Na⁺ can exchange with Mg²⁺ Ca²⁺ [7]
 - Mobilize metals
- Infrastructure
 - Corrosion can be costly
- Aquatic/Wildlife
 - Acute standard for Cl⁻ is 860 mg/L over 1-hour
 - Chronic Cl⁻ is 230 mg/L over 4-day
 - Stress fish and invertebrates
 - Animals that drink water- dehydration, confusion, weakness [5]

Photo Credit: John White

Photo Credit: MO Botanical Garden

Photo Credit: MO Botanical Garden

2017 National Watershed & Stormwater Conference

What's Wrong with Salt?

- Drinking water
 - Neither are removed by conventional water treatment
 - Can be removed via reverse osmosis, distillation
 - Chloride corrodes pipes- release metals
 - Flint River
 - Higher sodium and chloride content in drinking water
 - CI National Secondary Drinking Water Standard (non-enforceable guidelines)= 250 mg/L (taste)
 - Sodium advisory limit = 20 mg/L for people with restricted sodium intake
 - Hypertension
- Water Quality
 - Stratification→ decreased mixing, low oxygen, less SAV, algal bloom
- Groundwater
 - Private Wells
 - Drill new wells
 - Reverse osmosis
 - Chloride source



2017 National Watershed & Stormwater Conference

Land Use

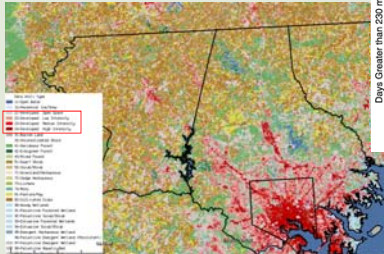
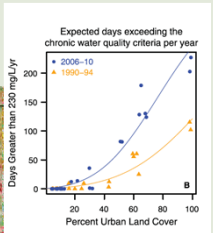



Chart From Corsi, 2015

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

2017 National Watershed & Stormwater Conference

Baltimore Reservoir Watershed

- Liberty
 - 164 sq. mi. watershed
 - 37 billion gal capacity
 - 87% available
- Loch Raven
 - 223 sq. mi.
 - 21 billion gal
 - 99% available
- Prettyboy
 - 80 sq. mi.
 - 18 billion gal
 - 90% available



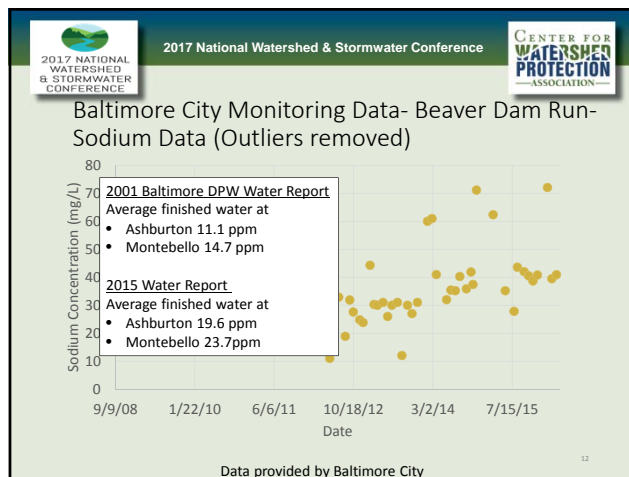
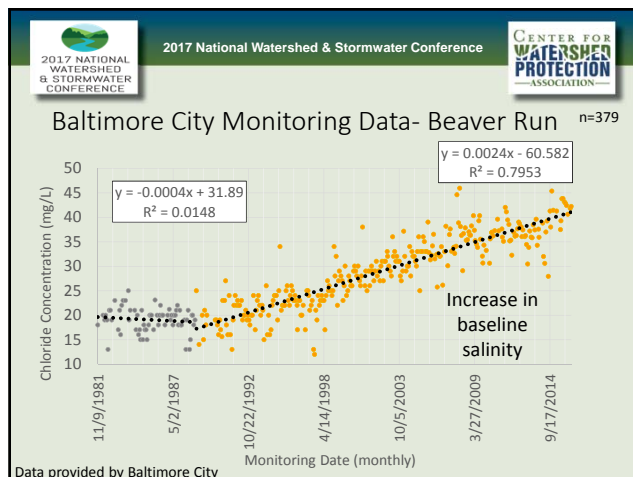
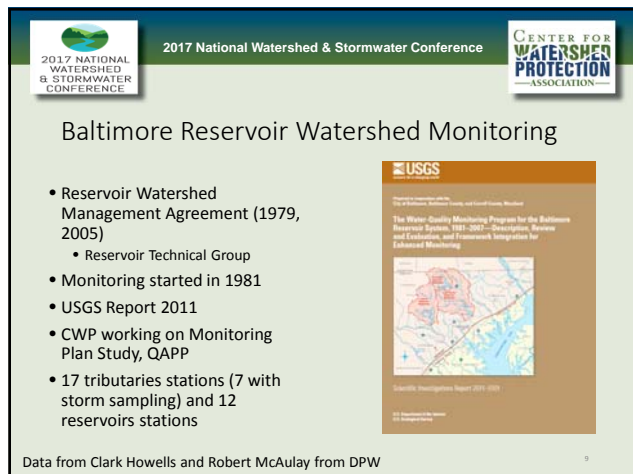
2017 National Watershed & Stormwater Conference

Baltimore Reservoir Drinking Water



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





2017 National Watershed & Stormwater Conference

2017 NATIONAL WATERSHED & STORMWATER CONFERENCE

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Water Cycle

Groundwater contaminated from Road Salt

Recharge area

Water table

Water supply wells

Slower

Slower Contaminated groundwater

Environment Canada

13

2017 National Watershed & Stormwater Conference

2017 NATIONAL WATERSHED & STORMWATER CONFERENCE

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Chloride Impairment

- Maryland 2016 Integrated Report (303d list) submitted to EPA
 - Based on Biological Stressor Identification (BSID) analysis
 - Since 2010, 27 watersheds listed as impaired
 - Impairments to be addressed 2016-2022 include chloride
 - Jones Falls
 - Gwynns Falls
 - Back River
 - Cabin John Creek
 - Patapsco Lower North Branch
- Selection based on
 - Occurrence in MS4 Jurisdiction
 - BSID analysis risk 75% or greater
 - Watershed size of 75 mi² or smaller

14

2017 National Watershed & Stormwater Conference

2017 NATIONAL WATERSHED & STORMWATER CONFERENCE

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Other Chloride Impairments

Maryland

- Category 5- 27 watersheds
 - Liberty- 1st-4th order streams
 - Loch Raven- 1st-4th order streams

CW1

Existing Elsewhere

- Twin Cities Metro Area, MN- 38 chloride impairments
 - Two TMDLs- reductions 62%-71%
- MA to NH I-93 Corridor
- IL: Salt Creek (14%), Chicago River, Buffalo Creek, Higgins Creek, DuPage River (33-35%), Little Vermilion River, Pond Creek, etc

Adaptive Management

15

2017 National Watershed & Stormwater Conference

2017 NATIONAL WATERSHED & STORMWATER CONFERENCE

CENTER FOR WATERSHED PROTECTION ASSOCIATION

General BMPs

- Training/certification
- Road Weather Information System- real-time weather/road info
- Proper storage
- Equipment calibration
- Pre-event application
- Pre-wetting liquids
 - Speeds up melting process
 - Reduces bounce and scatter
 - Reduces solids needed
- Correct de-icer for environment (temperature, surface type, etc)
- Vacuum after storm

16

2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Chemical Alternatives/Additives

- Acetates
- Formates
- Urea
- Glycerol/Glycol
- Succinate
- Organic products
 - Beet juice, molasses, distillation byproducts, corn syrup, cheese brine
 - Decrease corrosiveness
 - Makes salt stick better
- Abrasives
 - Sand
- Chlorides
 - $MgCl_2$, $CaCl_2$





Photo Credit: NYT



Criteria

- Environmental
 - Oxygen demand
 - Persistence
 - Toxicity
 - Algae growth
- Ice melting capacity at different temperatures
- Price
- Availability
- Corrosiveness

$$H_3C-C(=O)OK$$


17

2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Maryland Statewide Salt Management Plan-SHA, October 2016

- Pre-wetting salt
 - Help salt adhere to road
 - Electronically track salt use
- SHA's Snow College
- Storage and loading
- Will not apply salt brine when 20°F or less
- Will not apply salt brine if rain is expected
- In colder areas, will apply $MgCl_2$ (liquid Mag)
- Automatic Vehicle Location (AVL)



18

2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Example Legislation

- New Hampshire- Green SnowPro Training and Certification
 - NHDES Salt Applicator Certification
 - Limited liability
- Minnesota- Smart Salting Certification
 - Voluntary Salt Applicator Certification Program
 - Winter Maintenance Assessment Tool (WMAT)
- Massachusetts
 - Salt Remediation Program- respond to written complaints
 - Reduced Salt Zones

19

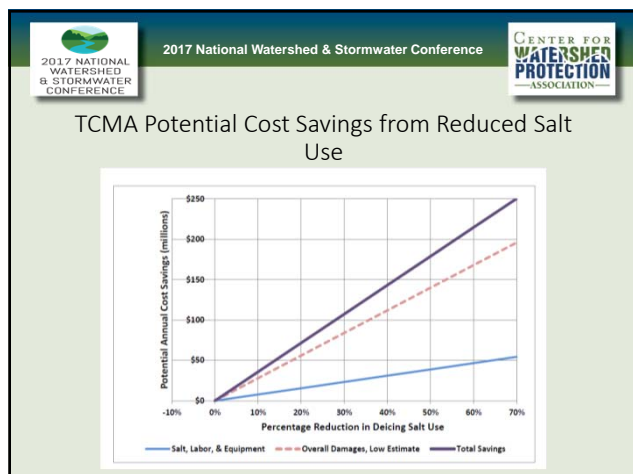
2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Twin City Metro Area Study of Estimated Costs

<ul style="list-style-type: none"> • Material: \$73/ton • Labor and Equipment: \$150/ton • Infrastructure <ul style="list-style-type: none"> • \$332/ton of salt per season for bridge maintenance (Vitaliano, 1992) • \$1,460/ton in corrosion damages to bridges (Sohangpurwala, 2008) • \$600/ton roadway maintenance (Vitaliano, 1992) • Plants: \$10,000/mile to replant and reestablish vegetation (Adirondack Council, 2009) • Vehicle Corrosion <ul style="list-style-type: none"> • \$113/ton for vehicle depreciation (Vitaliano, 1992) • Corrosion resistance in designs • Groundwater: \$10 million spent each year mitigating impacts to groundwater (Transportation Research Board, 1991), which translates to \$0.50/ton • Surface Water: \$2,320/lane mile/yr reduction in environmental value • Unknown Costs <ul style="list-style-type: none"> • Human Health • Aquatic life and water resources • Wildlife • Soils 	<p>Reports Total Cost:</p> <ul style="list-style-type: none"> • \$1,026-\$3,564/ton of salt • \$358M - \$1.2B / year
--	--

Source: Fortin Consulting, Inc. & MP&A, "The Real Cost of Salt Use for Winter Maintenance in the Twin Cities Metropolitan Area, October 2014."



2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Final Thoughts

- Alternatives need to be comparable or better
 - Salt is cheap and we know what it does
- Public safety vs. public health
 - De-icing roads with salt reduces accidents by 88% and injuries by 85% [4]
 - Drinking water
- Keep monitoring
- Research
 - Alternative surfaces (ex. solar roads)
 - FTE of alternatives
 - Technology to decrease salt needs



Photo Credit: Baltimore Sun



Photo Credit: Baltimore Sun

22

2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

Questions?



Carol Wong ckw@cw.org

23

2017 National Watershed & Stormwater Conference

CENTER FOR WATERSHED PROTECTION ASSOCIATION

TCMA Chloride Management Plan

- Performance based TMDL
 - Progress measured by degree of implementations and trends in ambient monitoring
 - No specific number target
- Phased/adaptive implementation
- WMA for tracking
- Traditional winter maintenance programs
- Non-traditional Framework
 - LOS for roadways, parking lots, sidewalks
 - Alt pavement types and urban design
 - Driver behavior changes
 - Non-chloride deicers
 - Snow melting equipment

Salt BMPs

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



Photo Credit: MD SHA

Research Gap?

25

References

1. Cary Institute of Ecosystem Studies, 2010. "Road Salt moving Toward the Solution". http://www.caryinstitute.org/sites/default/files/public/reprints/report_road_salt_2010.pdf
2. Maryland Department of Transportation State High Administration, 2016. "Winter Operations Facts and Figures 2015-2016 Winter Season".

26



2017 National Watershed & Stormwater Conference



Reduce Amount of Salt Applied- Technologies


- Tow Plows
 - AVL
 - Weighted Scales for Loaders
 - Rubber Plow Blades with Ceramic Inserts
 - Direct Liquid Application Snow Routes
- Might remove this slide
- <https://drive.google.com/drive/u/0/folders/0BwuZXO6aml8rZE1FX0N UdGVsWGM>

27


Bioretentions and Salt

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

28



2017 National Watershed & Stormwater Conference



- Bioretention: assessing effects of winter salt and aggregate application on plant health, media clogging and effluent quality, Chris Denich, Andrea Bradford, Jennifer Drake; Water Quality Research Journal Nov 2013, 48 (4) 387-399; DOI: 10.2166/wqrc.2013.065
 - No increased heavy metal mobility
-
- The influence of temperature and salt on metal and sediment removal in stormwater biofilters
- Laila C. Sjøberg, Maria Viklander, Godecke-Tobias Blecken
- Water Science and Technology Jun 2014, 69 (11) 2295-2304; DOI: 10.2166/wst.2014.161
 - There was an impact on outflow concentration and removal percentage Specifically Cu and Pb

29



2017 National Watershed & Stormwater Conference



Welcome to the



**2017 NATIONAL WATERSHED
& STORMWATER CONFERENCE**

Connecting Practitioners to Innovative Ideas



2017 National Watershed & Stormwater Conference



