

Chloride Management and Monitoring

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*Water Quality Advisory
Committee Meeting*



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Salt concentrations increasing



Special Protection Waters chloride



Collaborative efforts



Zone 2 chloride monitoring



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Zone 2 chloride monitoring

Rivers and streams are getting saltier

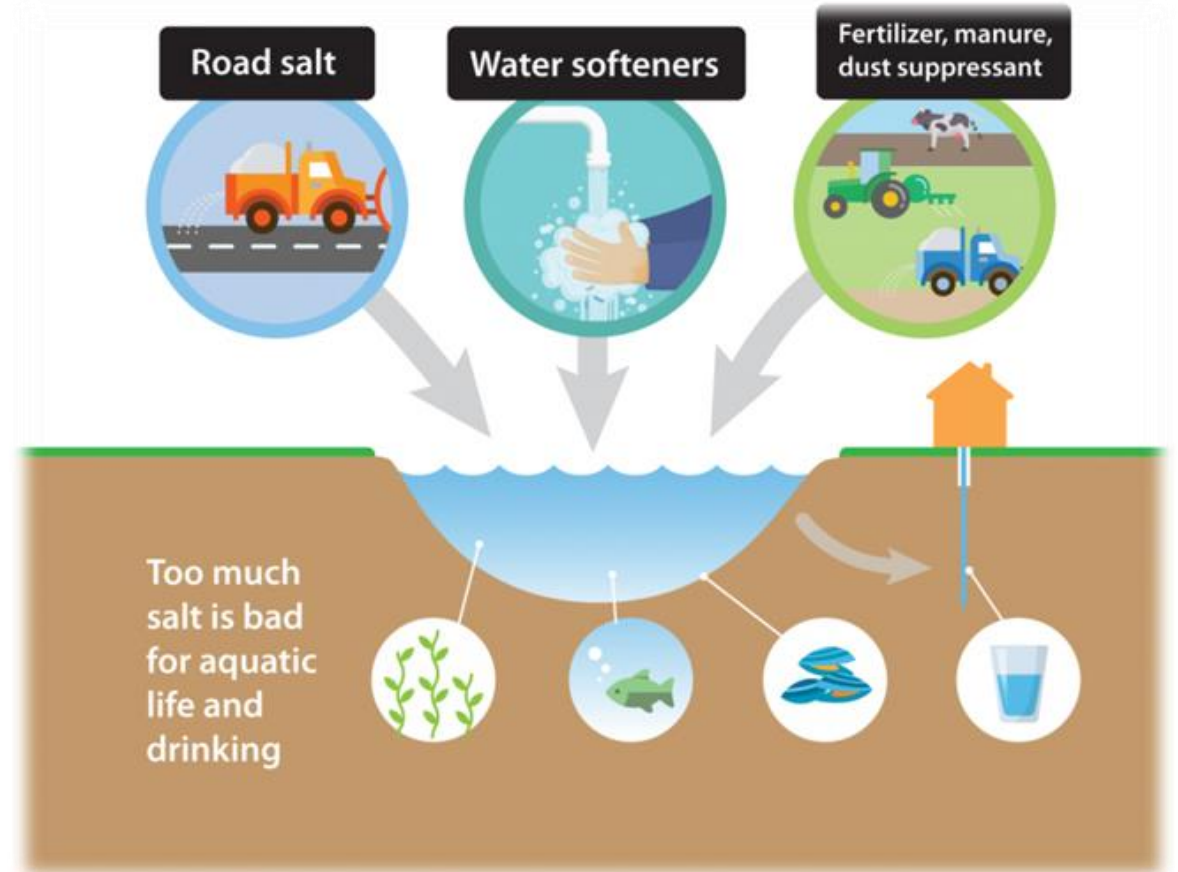
- ❑ Chloride increasing nationwide
- ❑ Most notable in snow-impacted urban areas in the northern U.S., but the study also reported increasing trends in urban areas with little snowfall
- ❑ May be linked to wastewater discharge or septic systems

Source: USGS (<https://www.usgs.gov/media/images/increasing-chloride-us-rivers>)



Where are these salts coming from?

- Human activity combined with high reactivity and mobilization of chlorides
 - Increased impervious surfaces and deforestation
 - Road deicing salt with inconsistent regulation of application
 - Fertilizers (agriculture, private land)
 - Wastewater (industrial, municipal)
 - Water softeners
 - High-salt diets
 - Other
- Compounding effect



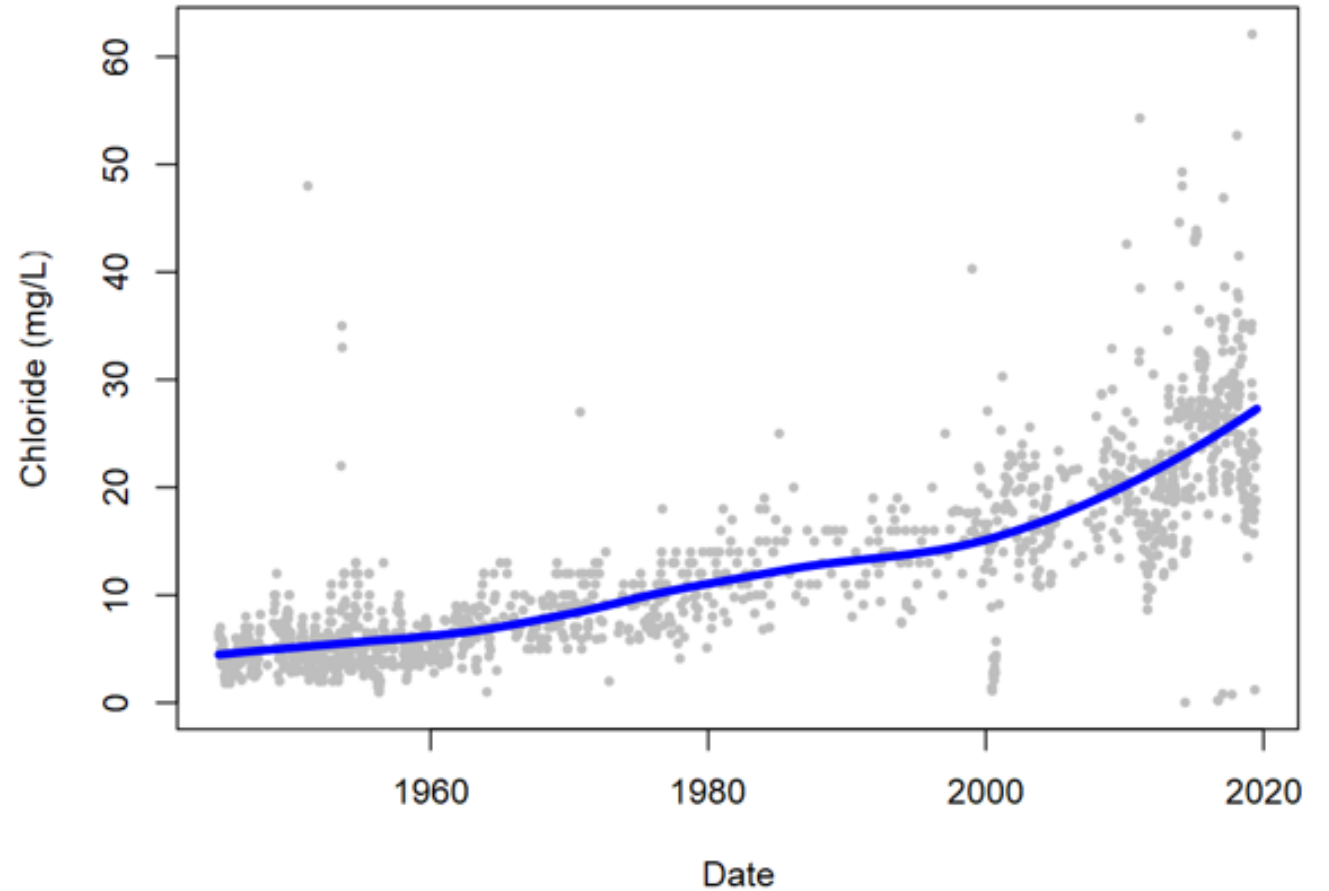


Increasing chloride as a concern

- Ecological effects
 - Toxic to aquatic life at certain thresholds
 - Increasing salinity, concurrent with increasing chloride concern, may alter water quality dynamics (stratification and nutrient cycling)
- Mobilization of toxic metals
- Human health risks – increased salt and heart health
- Changes to infrastructure
- Other known, unknown and/or combined effects

Increasing long-term trend of chloride at Trenton

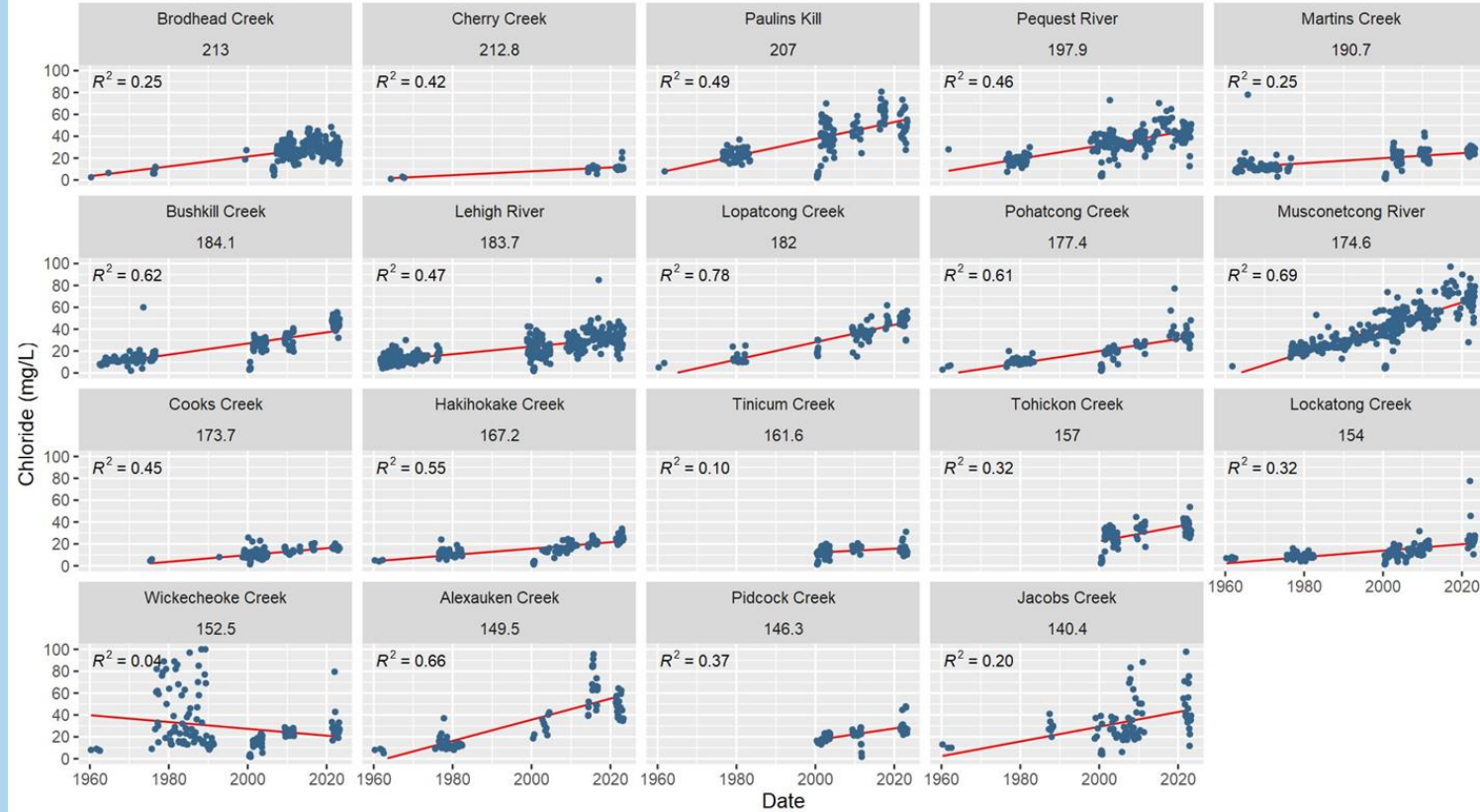
Chloride Time Series, Delaware River at Trenton



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Increasing long-term trend of chloride at tributaries upstream of Trenton

Chloride at SPW Delaware River Tributaries (1960 to Current)
Ordered by descending River Mile





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Zone 2 chloride monitoring

Special Protection Waters Program

- Special Protection Waters (SPW)
Objective: **Antidegradation** of Existing Water Quality (EWQ)
- SPW rules cover ~6,780 of the 13,800 mi² DRB watershed (197-mile stretch)
- Monitored by DRBC and NPS



How is SPW implemented?

- New and expanding WWTPs must demonstrate to DRBC no changes to Existing Water Quality (EWQ)
 - Stricter regulations
- SPW Monitoring program in place to ensure efficacy of implementation

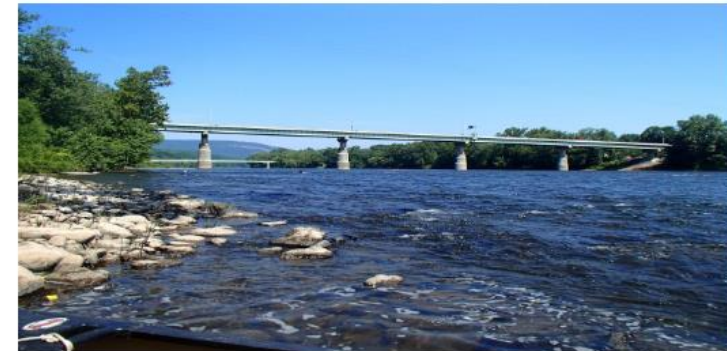


Existing Water Quality (EWQ)

- Baseline water quality data defined at 85 locations
- EWQ definitions are NOT criteria, but water quality targets

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Existing Water Quality Atlas of the Delaware River Special Protection Waters



DRBC Special Protection Waters Program

September 2016 – Edition 1.0

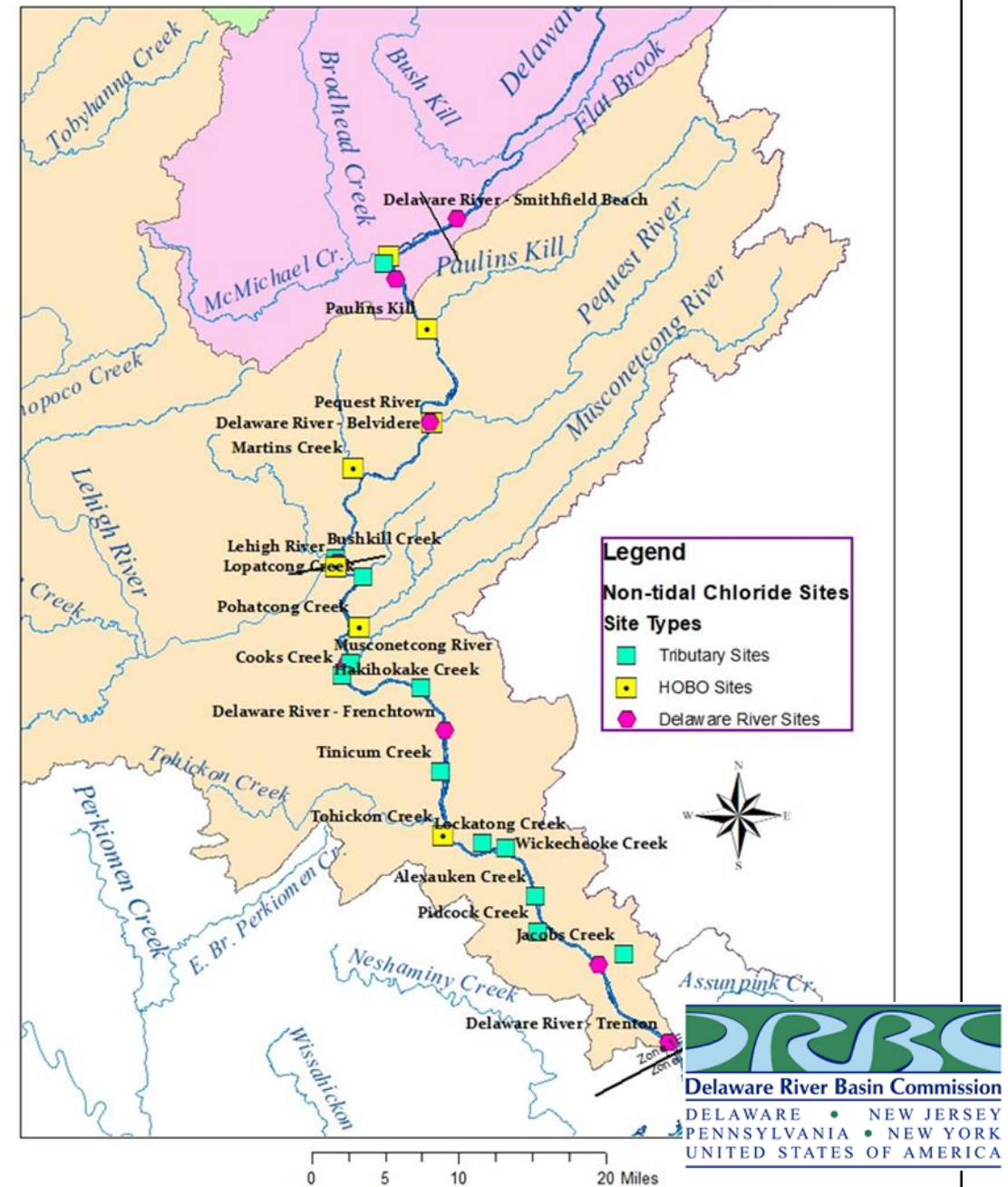
Results from Lower Delaware Measurable Change Assessment (2009-2011)

Site Color Key		Dark Blue = Interstate Control Point (ICP)										Dark Red = Pennsylvania Tributary Boundary Control Point (BCP)					Dark Green = New Jersey Tributary Boundary Control Point (BCP)								
Parameter	Site-->	Del. River at Trenton	Del. River at Washngtn Crossing	Pidcock Creek, PA	Delaware River at Lambrtville	Wicke-cheoke Creek, NJ	Lokatong Creek, NJ	Delaware River at Bulls Island	Pauna-cussing Creek, PA	Tohickon Creek, PA	Tinicum Creek, PA	Nishi-sakawick Creek, NJ	Del. River at Milford	Cooks Creek, PA	Musco-netcong River, NJ	Del. River at Rieglsvil	Pohat-cong Creek, NJ	Lehigh River, PA	Del. River at Easton	Bushkill Creek, PA	Martins Creek, PA	Pequest River, NJ	Del. River at Belvidere	Paulins Kill River, NJ	Del. River at Portland
Site Number-->		1343 ICP	1418 ICP	1463 BCP	1487 ICP	1525 BCP	1540 BCP	1554 ICP	1556 BCP	1570 BCP	1616 BCP	1641 BCP	1677 ICP	1737 BCP	1746 BCP	1748 ICP	1774 BCP	1837 BCP	1838 ICP	1841 BCP	1907 BCP	1978 BCP	1978 ICP	2070 BCP	2074 ICP
Field	Dissolved Oxygen (DO) mg/l											~													
	Dissolved Oxygen Saturation %											~													
	pH, units																								
	Water Temperature, degrees C																								
Nutrients	Ammonia Nitrogen as N, Total mg/l																								
	Nitrate + Nitrite as N, Total mg/l																	**							
	Nitrogen as N, Total (TN) mg/l																	**							
	Nitrogen, Kjeldahl, Total (TKN) mg/l																								
	Orthophosphate as P, Total mg/l																								
Phosphorus as P, Total (TP) mg/l																									
Bacteria	Enterococcus colonies/100 ml	~			~																				
	Escherichia coli colonies/100 ml	**	**	**	**	**	**			**	**	**													
	Fecal coliform colonies/100 ml																								
Conventional	Alkalinity as CaCO3, Total mg/l																								
	Hardness as CaCO3, Total mg/l											~													
	Chloride, Total mg/l			**		**	**	**	**	**		**	**	**	**	**	**	**	**	~	**	**	**	**	**
	Specific Conductance µmho/cm			**		**	**	~	**	**	**	**	**	**	**	**	~	**	**	~	~	~	**	~	**
	Total Dissolved Solids (TDS) mg/l																								
	Total Suspended Solids (TSS) mg/l																								
Turbidity NTU																									
KEY		= No indication of measurable change to EWQ							** = Indication of measurable water quality change toward more degraded status					~ = Weak indication of measurable water quality change											

Trends prompted targeted monitoring

- ❑ May 2021 – April 2023
- ❑ 27 locations
 - ❑ 19 tributaries
 - ❑ 8 mainstem sites
- ❑ Year-round monitoring
 - ❑ SPW Monitoring routinely occurs May – September
- ❑ Monitored monthly for chloride, TDS, and conductivity
- ❑ Deployed and maintained continuous conductivity and temperature loggers in 7 tributaries

Non-tidal Chloride Monitoring Sites

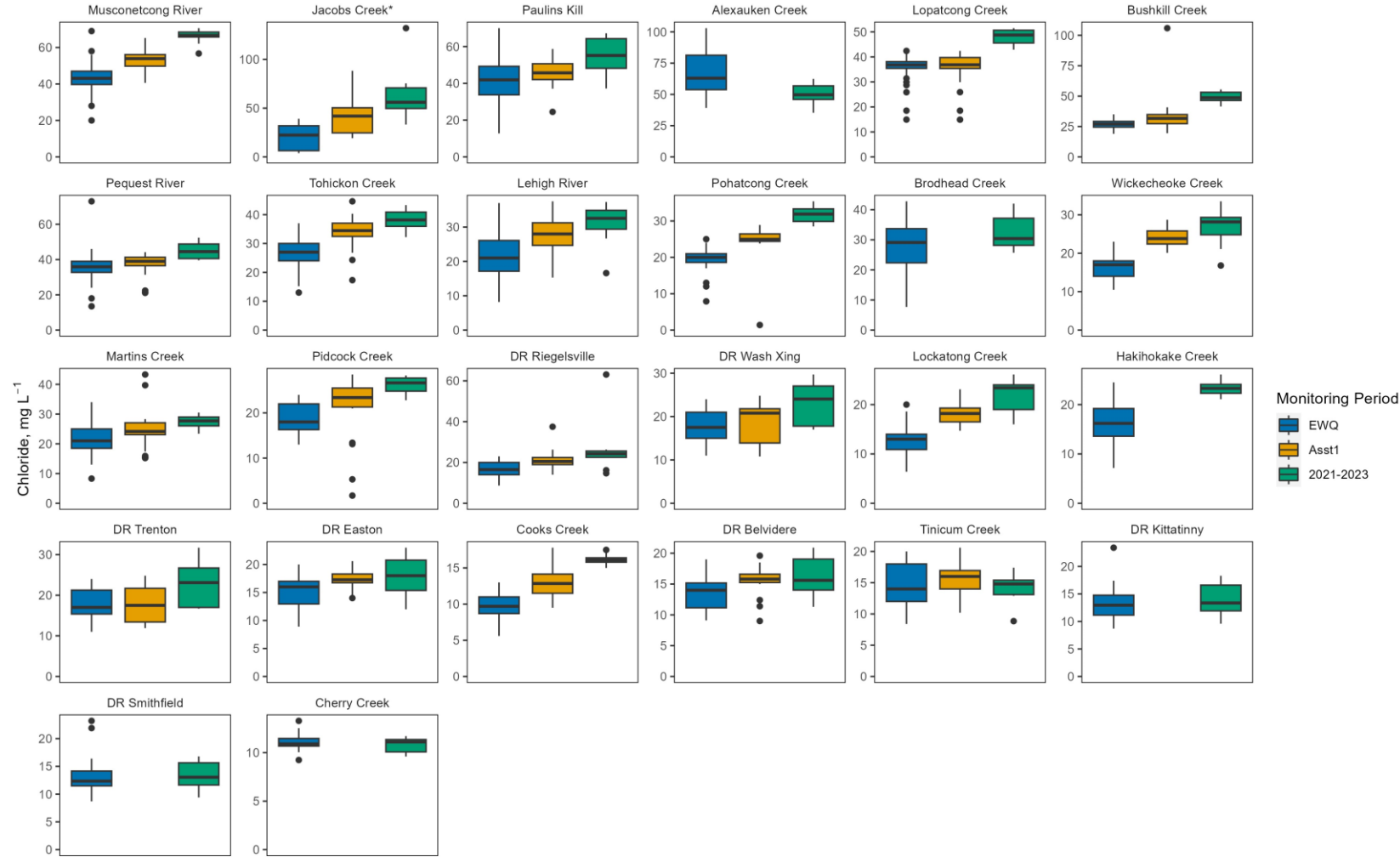


2021 – 2023
 results suggest
 further chloride
 increases

Comparison of Chloride Among Monitoring Periods (May-Sep)

EWQ = Baseline, Asst1 = 2009-2011 Assessment, 2021-2023 = Current

*EWQ and Asst1 Estimated; DR = Delaware River



DRBC's SPW Program works well for point-sources

- Successfully maintaining EWQ for most water quality parameters
- SPW program doesn't work well for non-point source pollution
- Nationwide problem



Salt concentrations increasing



Special Protection Waters chloride



Collaborative efforts



Zone 2 chloride monitoring

Agency and stakeholder collaboration needed

- Increasing salts issue warrants action, but where to start?
- No regulatory hook in SPW despite apparent increases (EWQ targets are not criteria)
- This issue is an area of focus across environmental agencies and groups
- Bring it all together...gain traction

SIFT (Salinity Impacts Freshwater Toxicity) Workgroup



- Regional workgroup formed through the WQAC by DRBC in late 2022
- Collaboratively *sift* through the escalating issue of freshwater salinization and increasing chlorides in rivers and streams
- Discussions focus on strategies for potential regulatory approaches to address salt pollution



SIFT Workgroup lessons learned

- Challenging to get DOTs and other winter salt applicators engaged
- Concerns about public safety take precedent
- Salt reduction programs are **voluntary**



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Zone 2 chloride monitoring

DRBC Surface Water Quality Standards for Chloride

Zone 2 (Delaware Estuary RM 108.4 to 133.4)

12. **Chlorides.** Maximum 15-day average 50 mg/l.

Zone 3 (Delaware Estuary RM 95.0 to 108.4)

12. **Chlorides.** Maximum 30-day average concentration of 180 mg/l at R.M. 98.

14. **Sodium.** Maximum 30-day average concentration of 100 mg/l at R.M. 98.

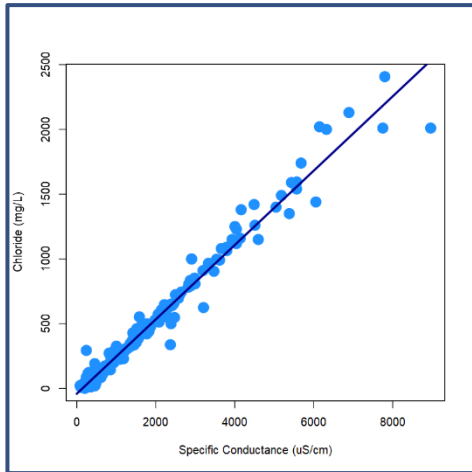


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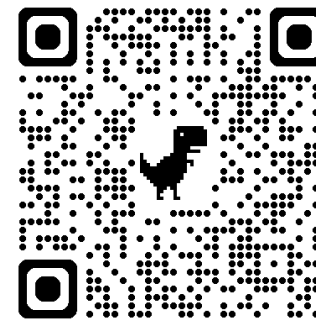
Daily Assessment via DRBC Water Quality Dashboard

Continuous
real-time
Specific
Conductance
(USGS)



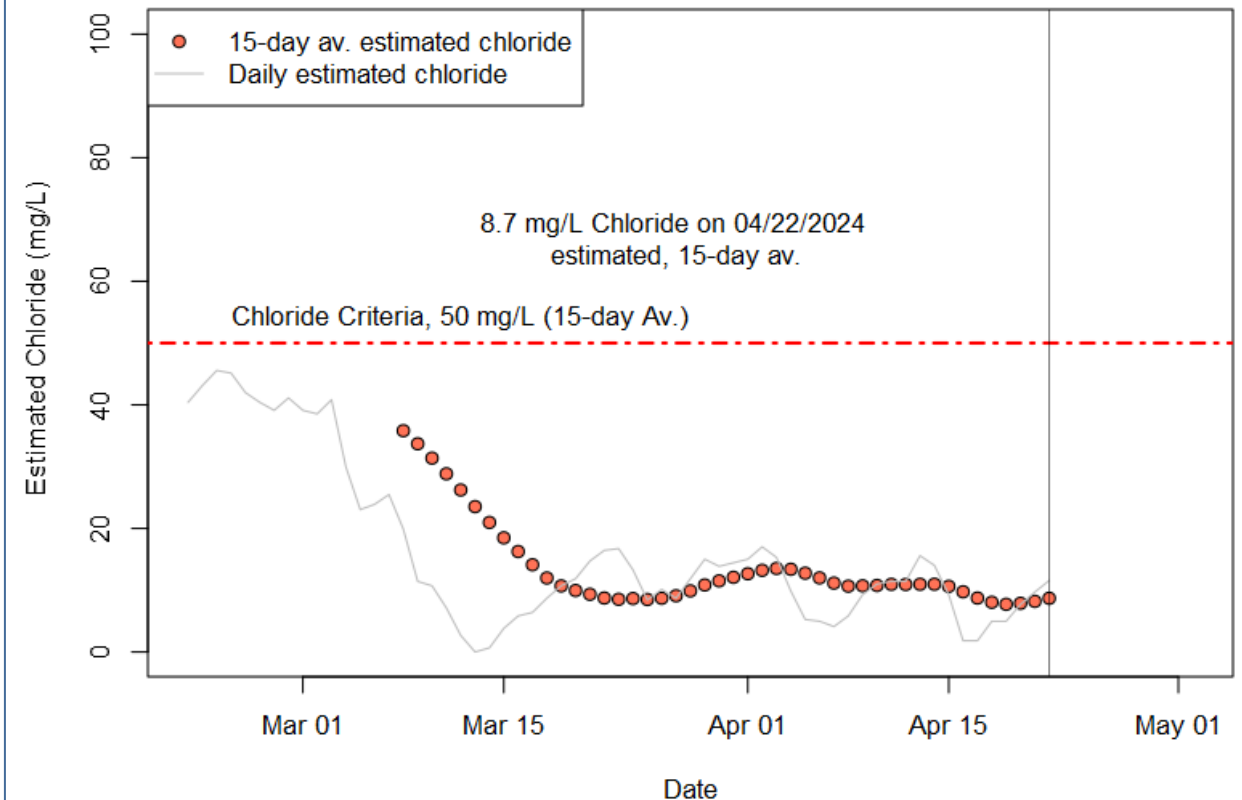
Compute
estimated
Rolling Mean
Chloride

Plot estimated Rolling
Mean Chloride
Compared to Criteria

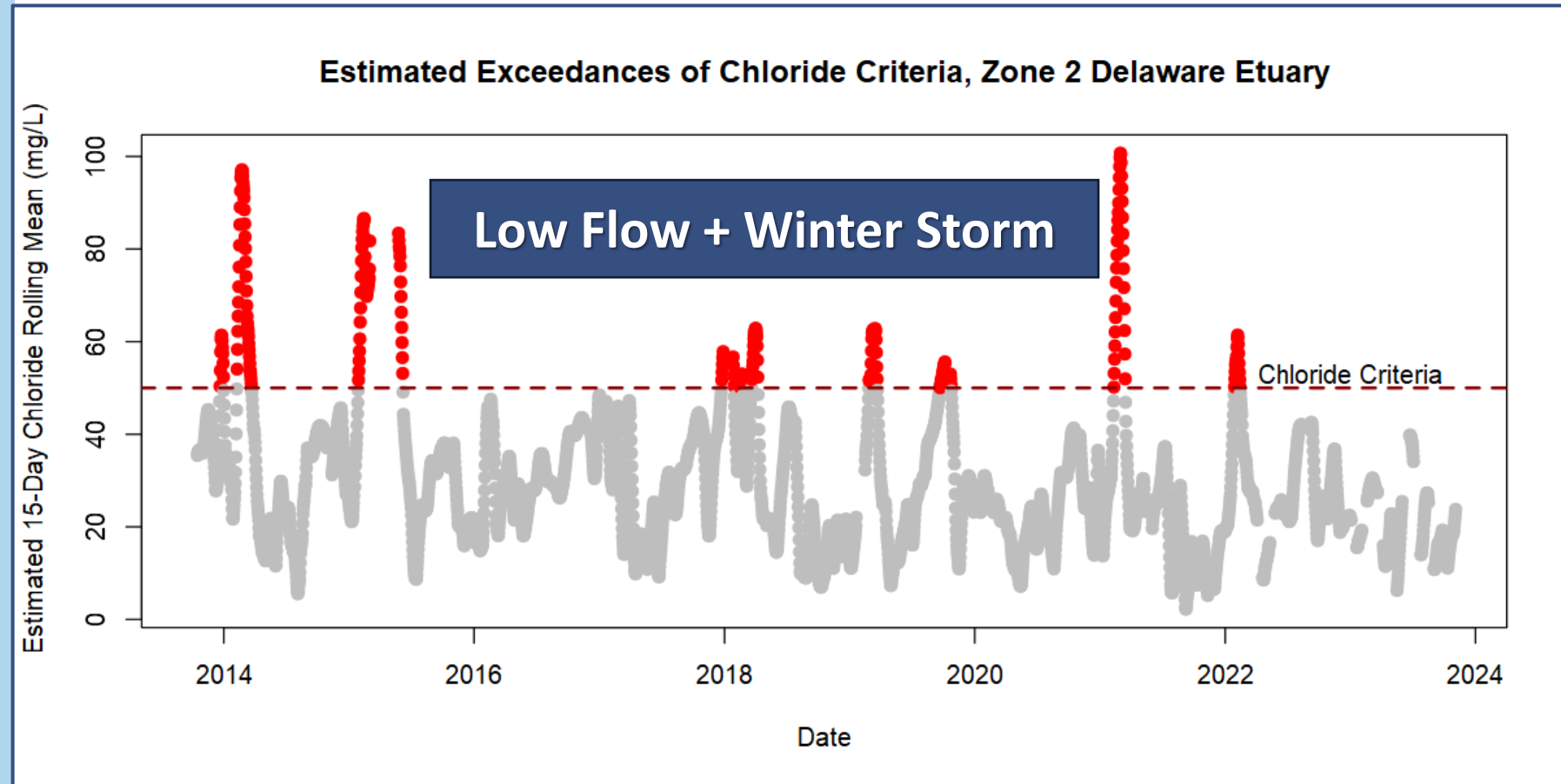


<https://drbc.net/Sky/waterq.htm>

Comparison of Estimated Chloride to Criteria,
Delaware River Zone 2, as of 04/22/2024

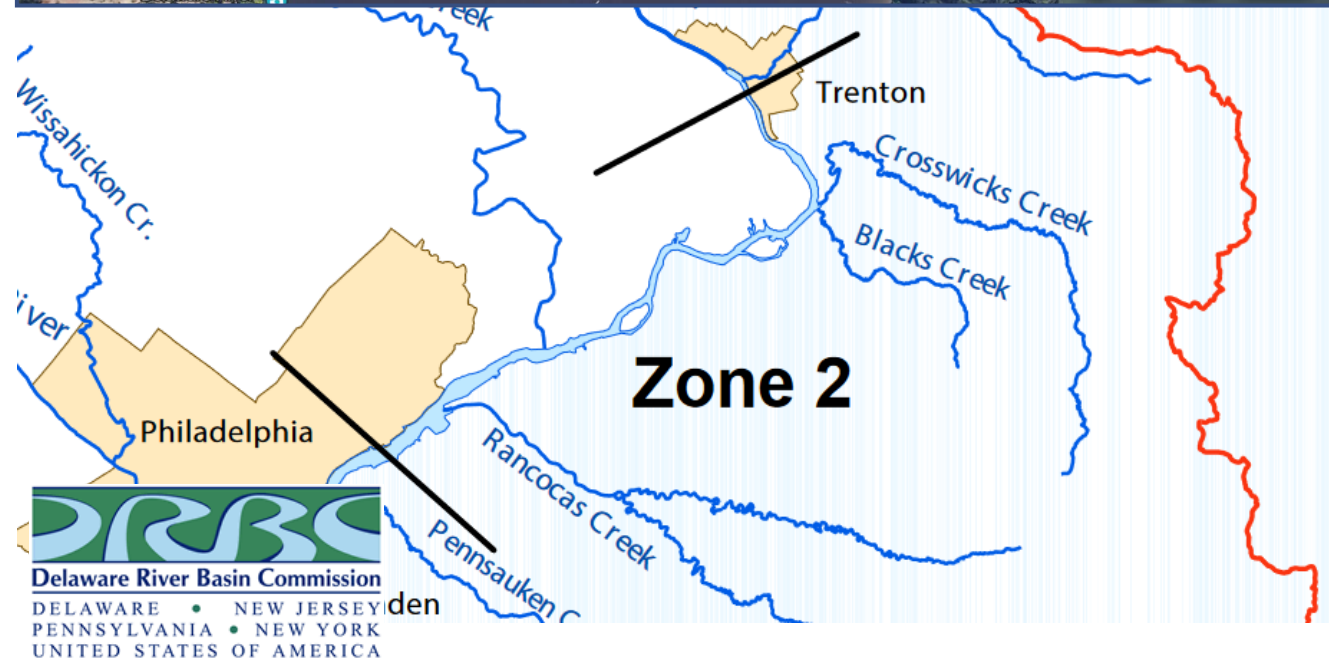
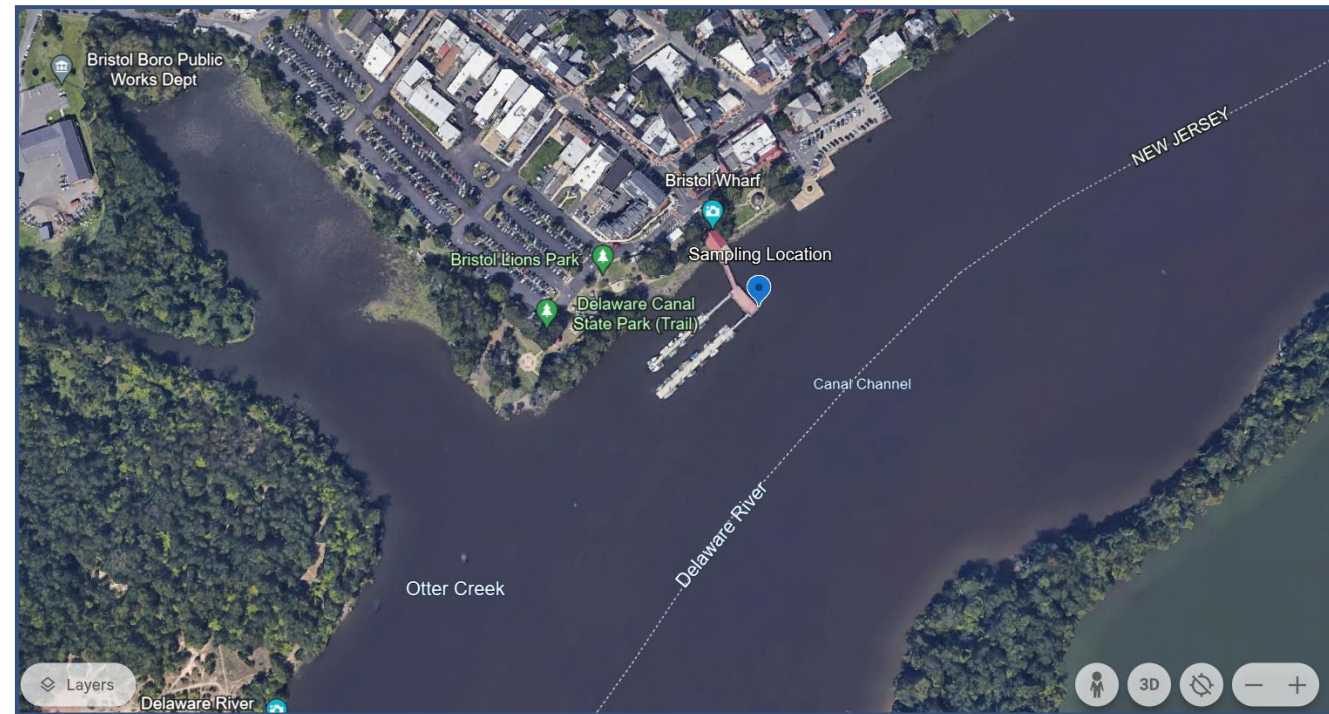


Apparent
Criteria
Exceedances
have occurred
in Zone 2



Zone 2 Winter Chloride Monitoring

- 1 sample per day
- 1 location (Bristol Wharf, Zone 2)
- Analyzed for Chloride
- Initiated when conditions suggest that exceedance of criteria is likely
- Terminated when exceedance is confirmed or determined to be no long likely
- 2023-2024 winter: combination of sparse snowfall and high flows = no sampling
- Provide more leverage to pursue remedial action





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Questions?

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Contact me to join SIFT!

