Water Quality Criteria for Chloride

VT Department of Env. Conservation

Pre-Rulemaking Stakeholder Outreach
for
Municipalities and other Stakeholders

4-28-2014

Outline

- Proposed amendments to VT Water Quality Standards
- Why Chloride?
- What are the effects?
- What are the criteria
- How does DEC intend to conduct assessments?
- Next steps

Proposed Amendments

- Act 138 transferred rulemaking authority to ANR from Natural Resources Board for
  - WQS
  - Classification and designations
- Proposed Changes
  - E. coli
  - Nutrients (phosphorus)
  - “Appendix C” including Hg and Chloride
- Process to date

Why chloride?

- Cl^- is typically a chemically inert ion, found in surface and groundwaters subject to deicing practices.
- Cl- easily dissociates from deicing agents such as NaCL, CaCl, MgCl.
- Cl- migrates readily, but not completely, into groundwater.
- Other sources include WWTF effluents and some agricultural wastes.

Why Chloride?

- Salt usage and water concentrations are increasing nationally and regionally.
- Observations within monitoring networks have led to a growing awareness of the presence of Cl- in surface waters.
- DEC's interest in adopting Cl- criteria to protect surface waters stems from these observations, and locally-relevant measurements.

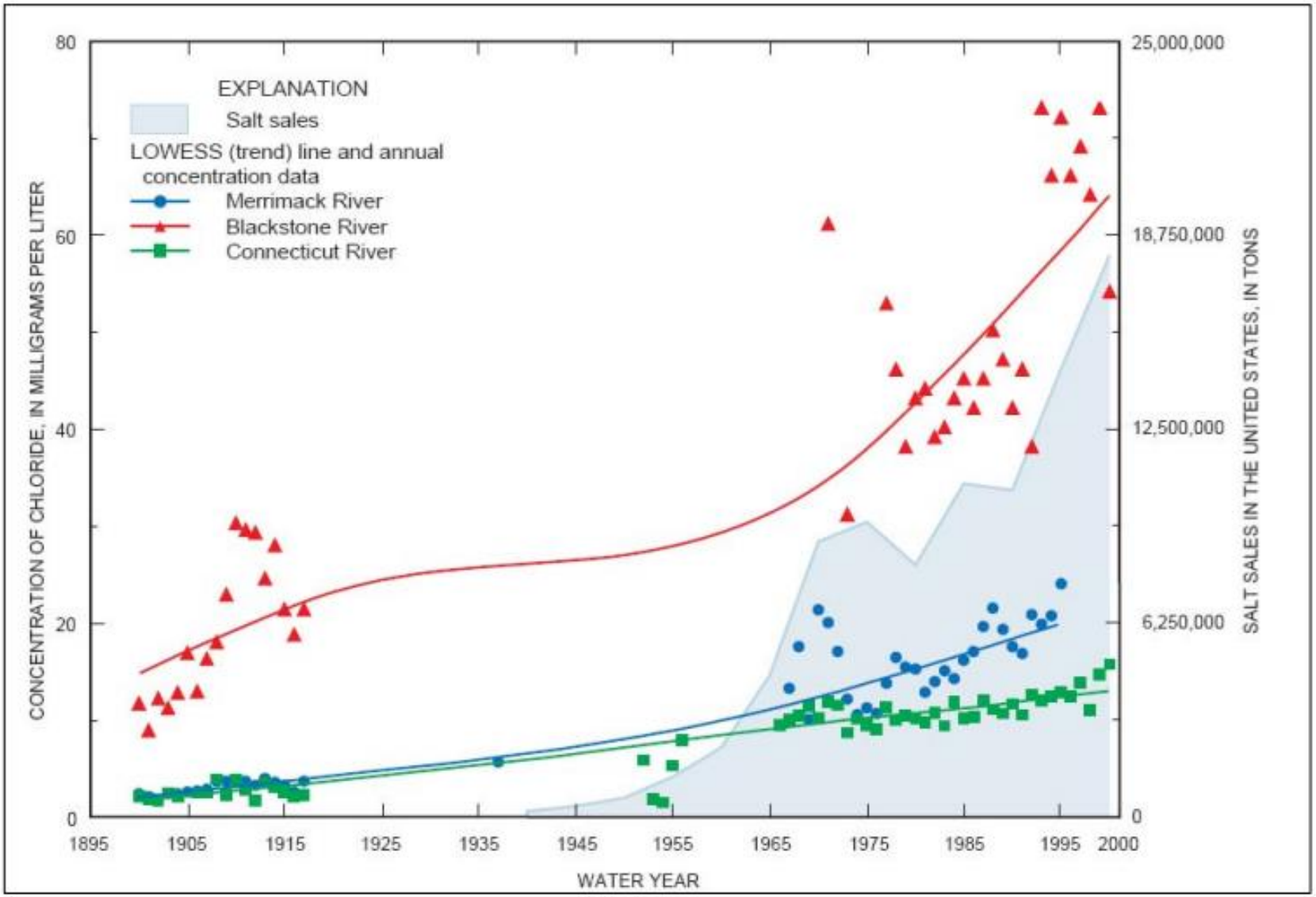
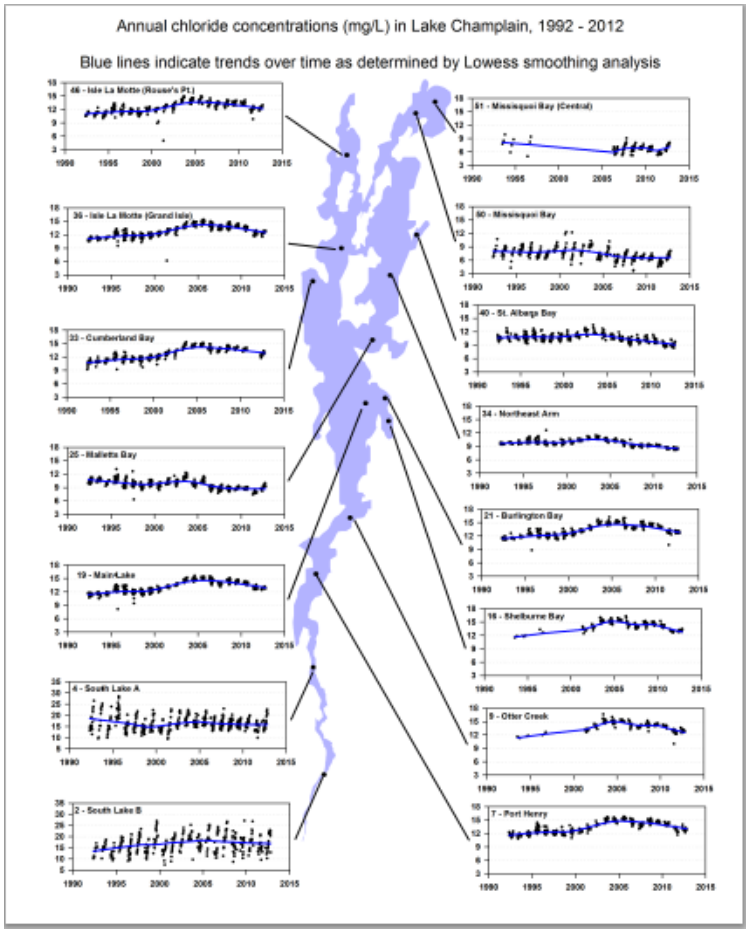
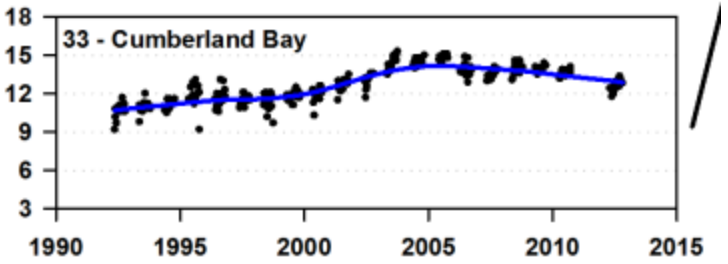


Figure 1. Chloride trends for selected northeastern rivers and U.S. deicing salt sales. (reprinted with permission from Robinson et al. 2003)

Locally…


Annual chloride concentrations (mg/L) in Lake Champlain, 1992 - 2012
Blue lines indicate trends over time as determined by Lowess smoothing analysis


33 - Cumberland Bay
18
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1995
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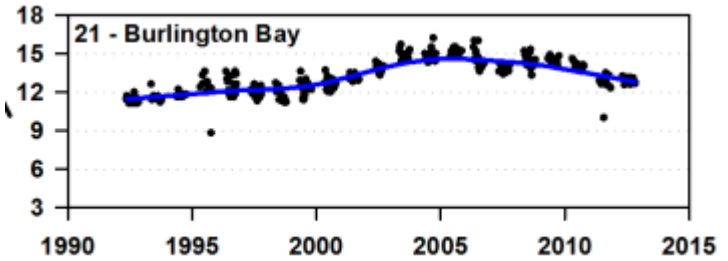
2015


21 - Burlington Bay
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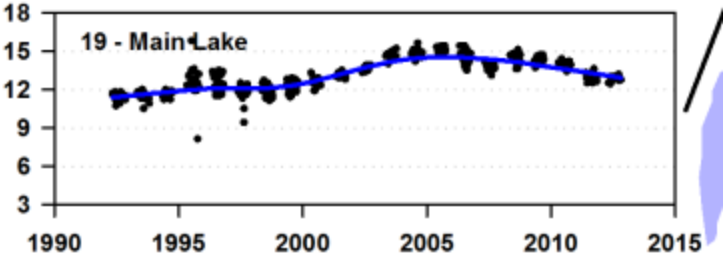
19 - Main Lake
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1990
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2005
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2015

Environmental Effects

- EPA proposed 304(a) criteria for Cl- in 1988
- Not previously adopted, DEC unaware of why.
- A paper by Shambaugh (2008) provides a good summary what is known about Cl- in the Champlain Basin.
- Effects include:
  - Terrestrial vegetation
  - Aquatic organisms

Impacts to aquatic biota

- Numerous species evaluated by EPA and Env. Canada for toxicity associated with Cl-
- Endpoints included LC50's and Growth Inhibition

Table 2. Predicted cumulative percentage of species affected by chronic exposure to chloride. Modified from Environment Canada (2001).

Cumulative percentage of species affected	Mean chloride concentration (mg/L)	Lower confidence limit (mg/L)	Upper confidence limit (mg/L)
5	212.6	135.9	289.5
10	237.9	162.3	313.6
25	328.7	260.2	397.2
50	563.2	504.8	621.7
75	963.7	882.3	1045.1
90	1341.1	1253.8	1428.4

Local science used to support this proposal

- VTDEC Urban Stream Assessment Report 2007
  - Examined urbanized streams in a range of biological attainment status for Cl- concentrations
- USGS – VTrans Chittenden County Stream Report, 2009
  - Examined Chittenden County streams to document Cl- concentrations specifically associated with de-icing salts.

Proposed criteria

	Chronic	Acute
Magnitude	230 mg/L	860 mg/L
Frequency	< once per 3 year period	
Duration	Four day average	One hour average

Assessment approach

- Criteria are based on duration of exceedance.
- Grab samples not sufficient grounds for documentation of impairment

Assessment approach

- Tight relationships can be constructed between Cl- and conductivity
- Conductivity is readily measured in-situ using multiprobes

A well documented approach used by USGS

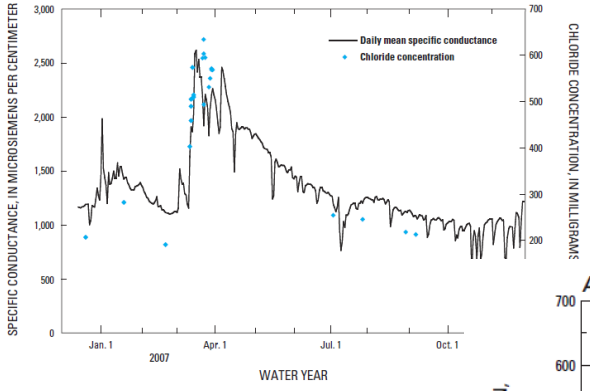
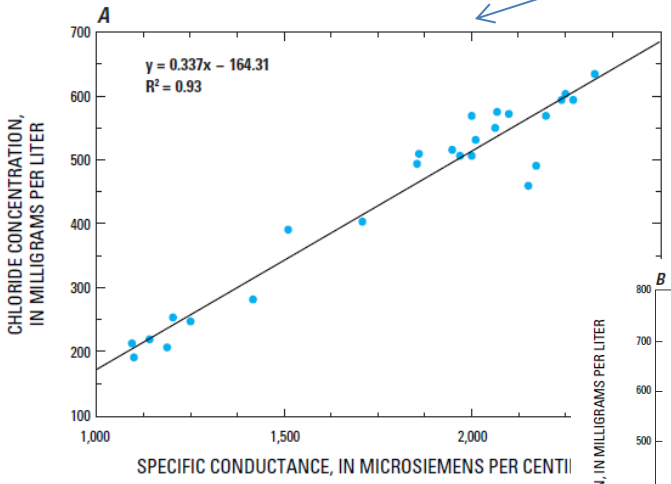


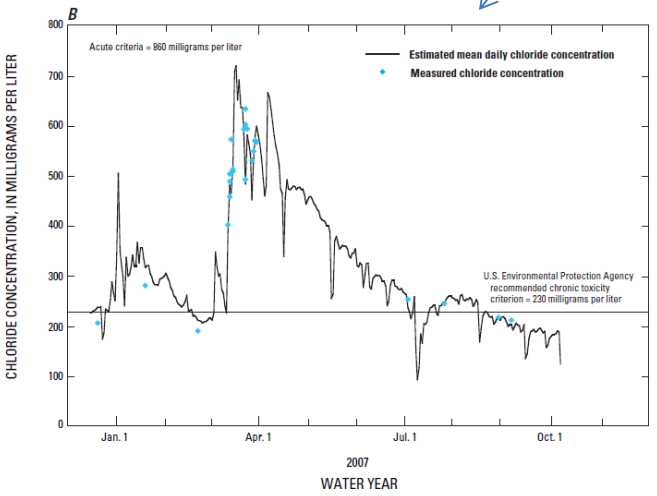
Figure 12. *(A)* Daily mean streamflow and time distribution of water-quality samples and *(B)* dai conductance and concentrations of chloride for Alder Brook tributary at mouth near Essex Junc

1. Measure water level and collect Cl- grab samples

2. Calculate regression of cond. and Cl-



3. Estimate Cl- for duration of deployment

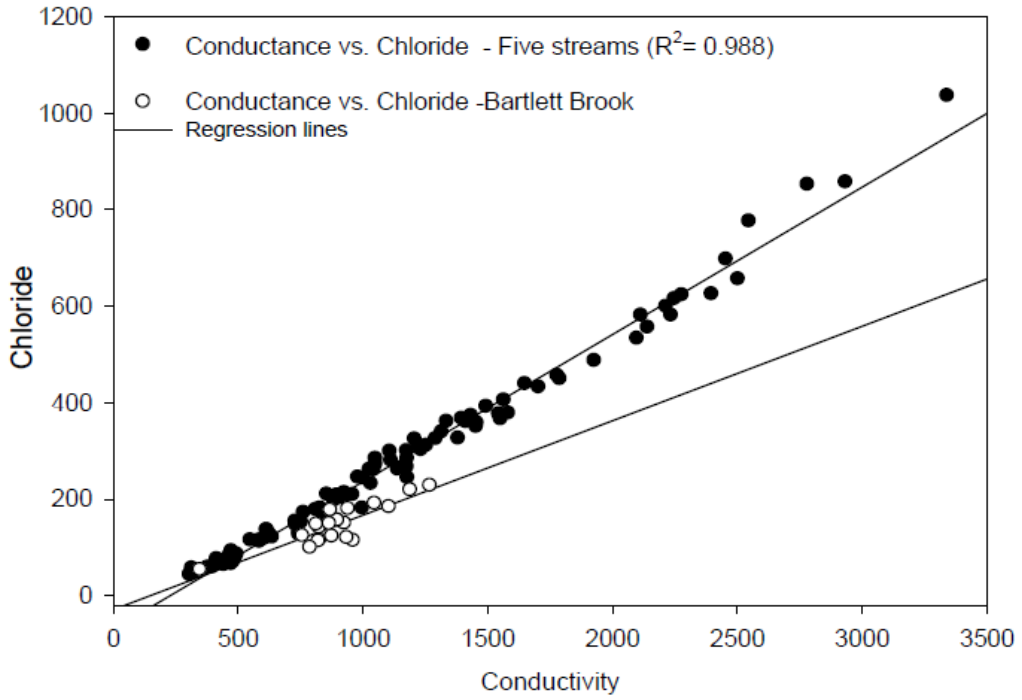


VTDEC Assessment and Listing Methodology and SOP manual will be updated to reflect this approach as appropriate.

Predicting Cl- from conductivity

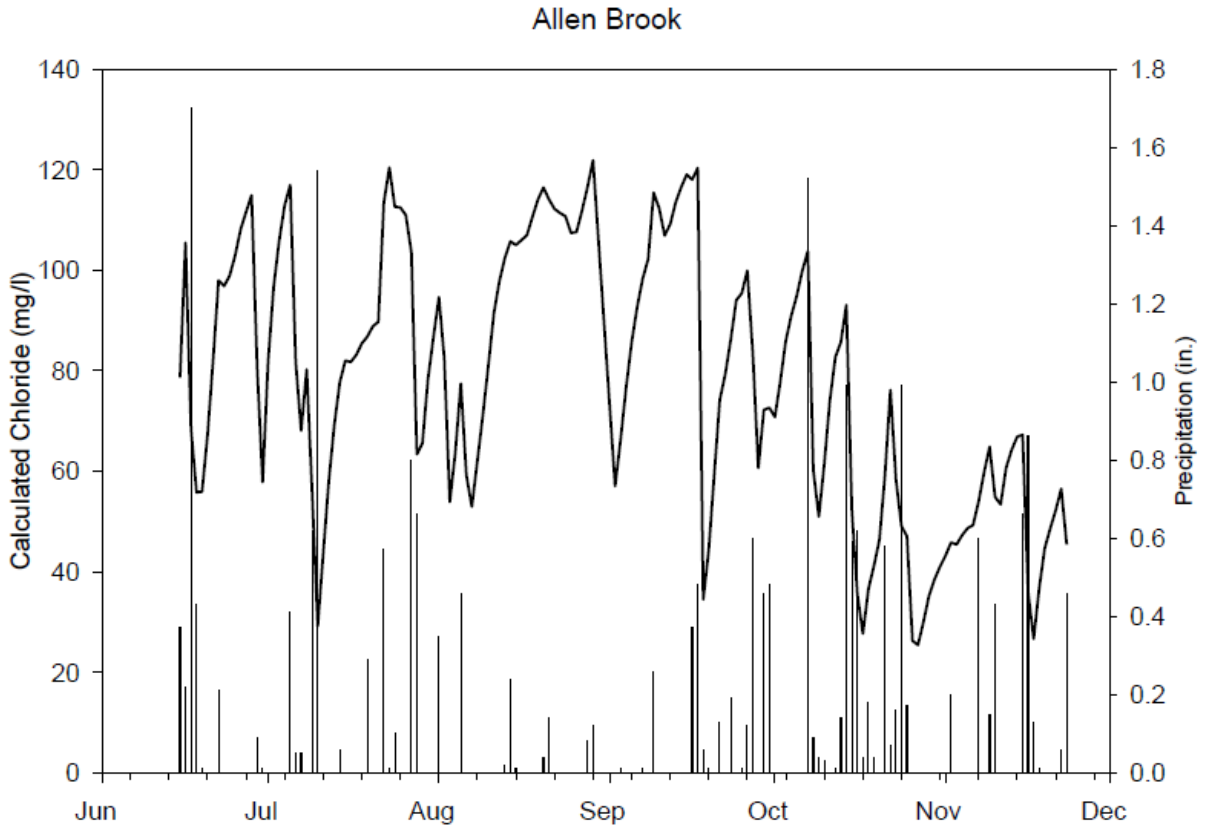
- Step 1 – pair Cl- measurements against conductivity

Figure 3. Specific Conductance (µs/cm) vs. chloride (mg/l) for all streams minus Bartlett Brook (solid dots) and Bartlett Brook (open dots).



Predicting Cl- from conductivity

- Step 2 – estimate Cl- form conductivity using probe data



Management Approach

- We are unlikely to eliminate the use of de-icing salts, but they can be managed.
- VTrans is a leader in alternative de-icing technology, as are some municipalities.
- Municipalities are recognizing the need to manage application. Cost and environmental benefits still must be weighed against public safety
- Private application is where the greatest challenges lie.

Process/timeline for adoption

- Review of stakeholder outreach to date
- Rulemaking process review
- Proposal to ICAR
- Public process with hearing(s)
- Finalize proposal and responsiveness summary
- Proposal to LCAR
- Final filing with Sec. of State.