Water quality impacts of de-icing salt in Lake Champlain and its tributaries

Vermont House Committee on Environment

essexonlakechamplain.com

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Lake Champlain Basin Program

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De-icing salt: NaCl

Common worldwide, widespread impacts documented

Biological impacts

- Adversely affects all forms of life
- Reduces biodiversity

Physical impacts

- Mixing

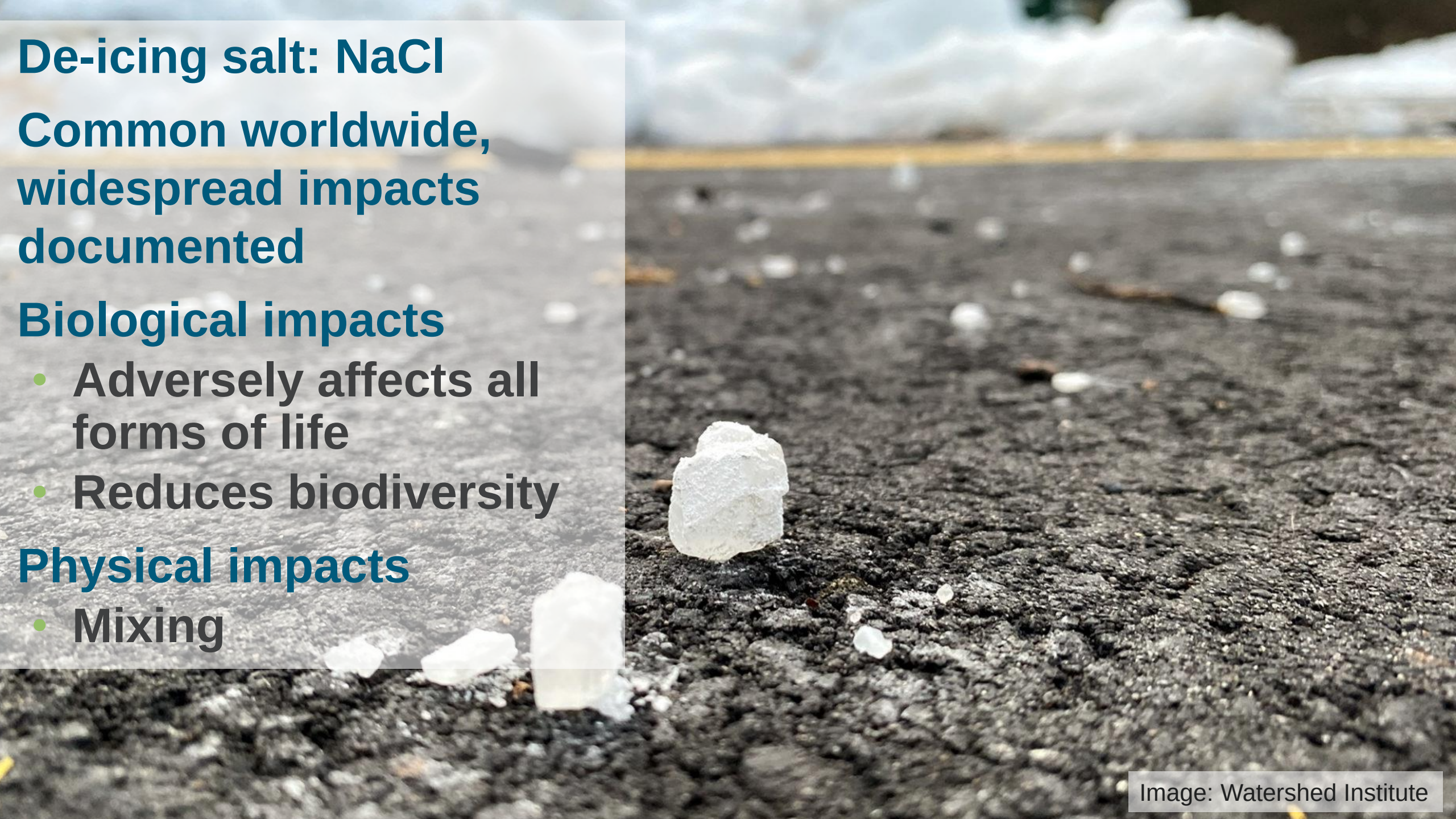
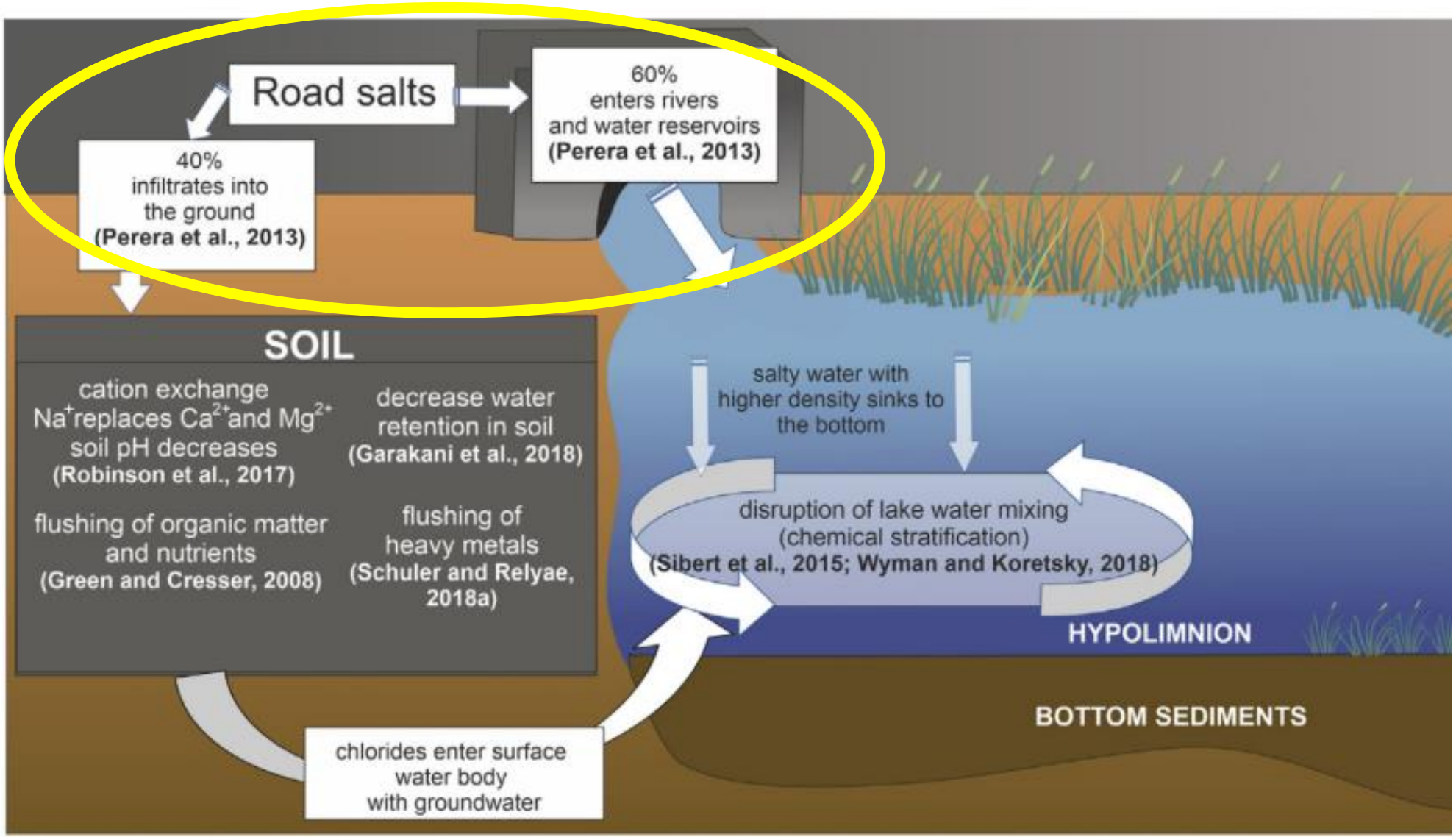
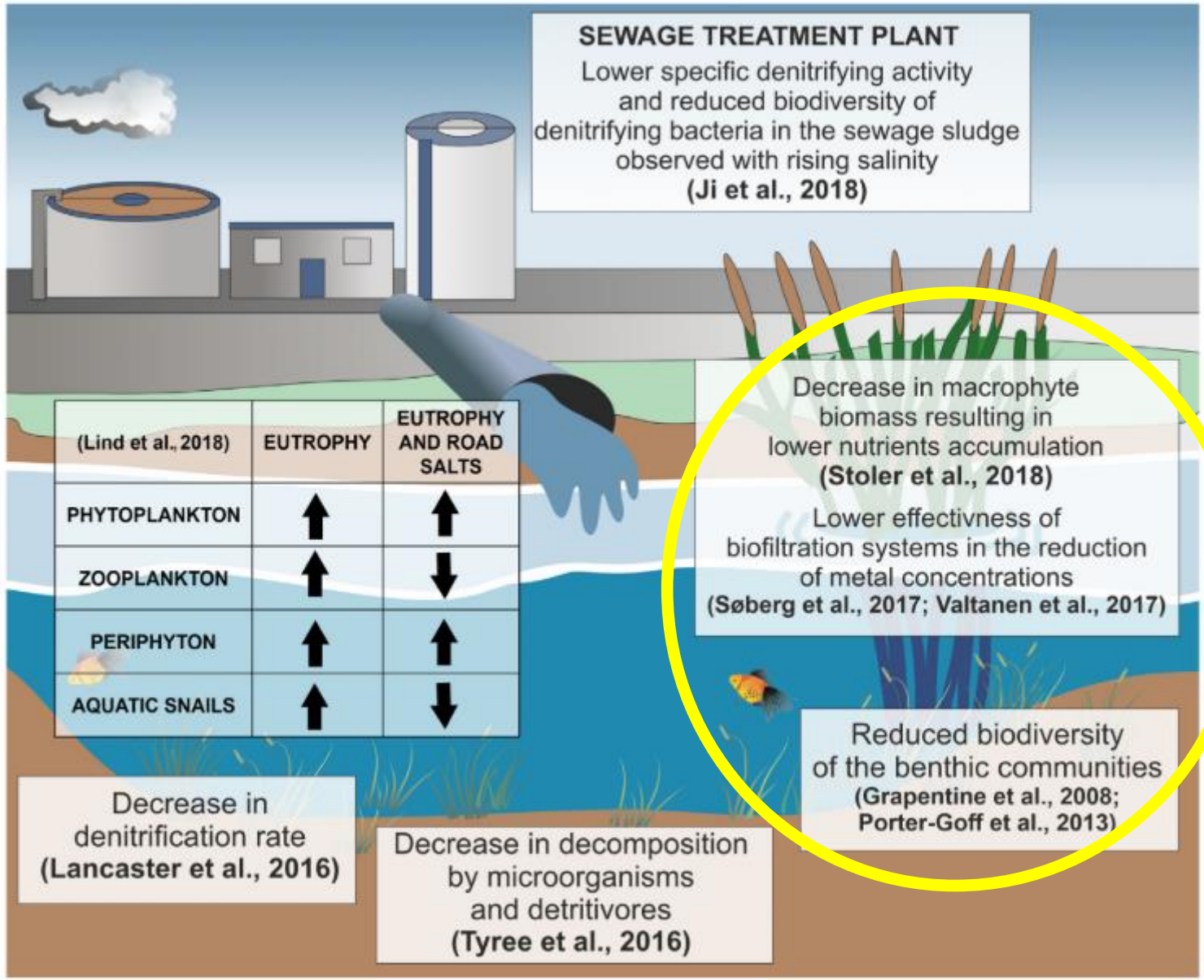


Image: Watershed Institute



Szklarek et al. 2022



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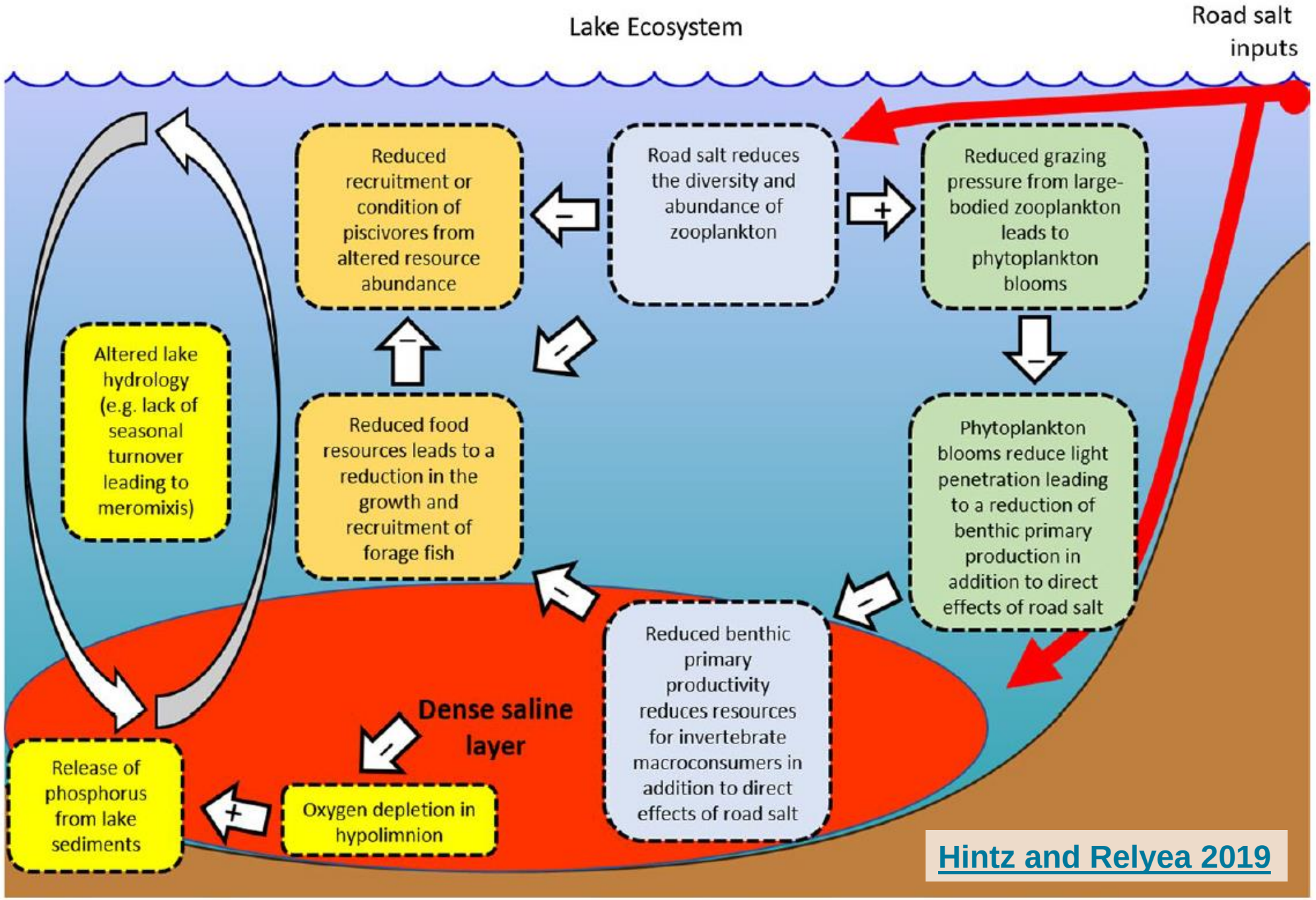
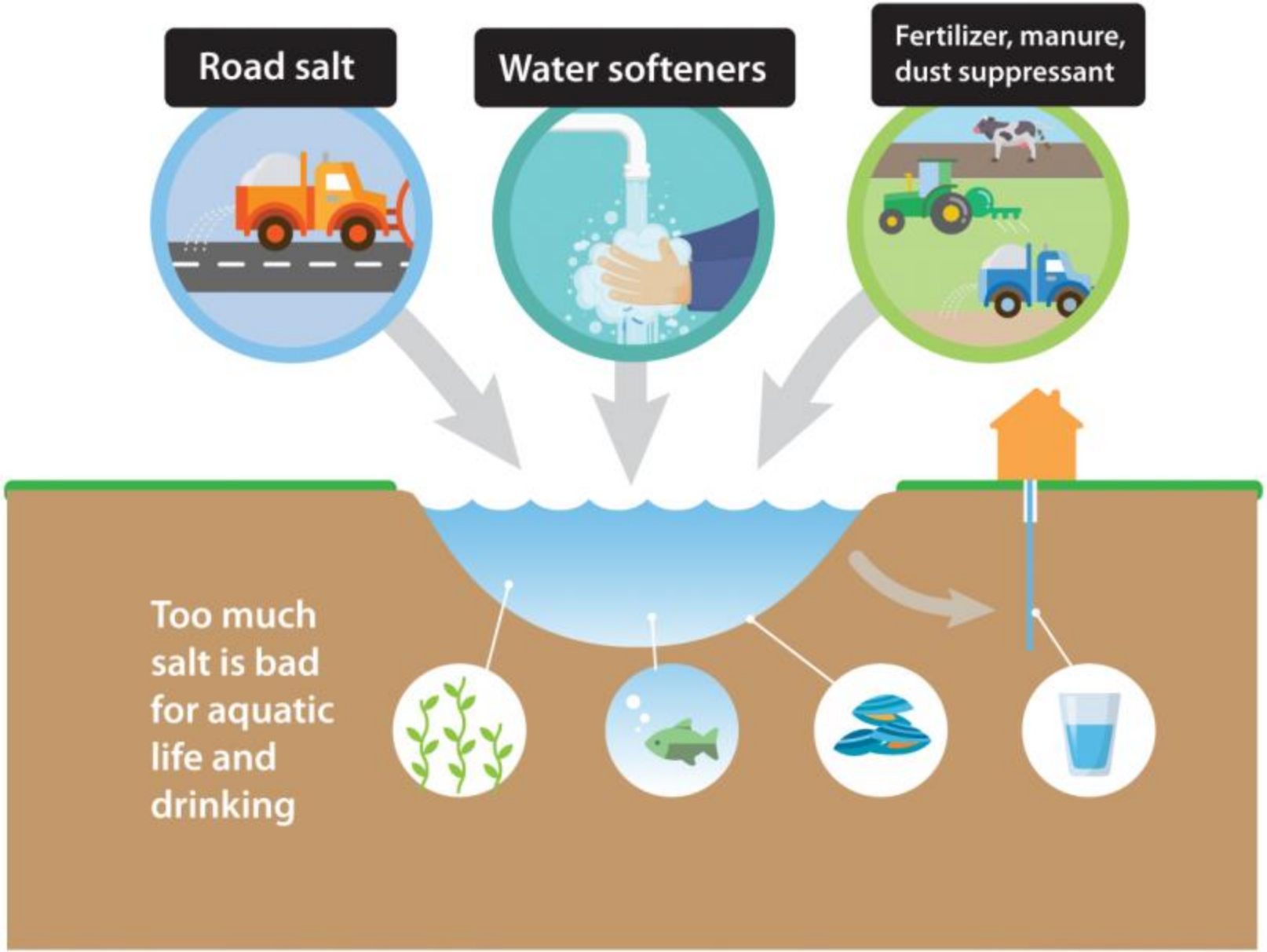

Lake Ecosystem
Road salt inputs
Road salt reduces the diversity and abundance of zooplankton
Reduced recruitment or condition of piscivores from altered resource abundance
Reduced grazing pressure from large-bodied zooplankton leads to phytoplankton blooms
Phytoplankton blooms reduce light penetration leading to a reduction of benthic primary production in addition to direct effects of road salt
Reduced benthic primary productivity reduces resources for invertebrate macroconsumers in addition to direct effects of road salt
Reduced food resources leads to a reduction in the growth and recruitment of forage fish
Altered lake hydrology (e.g. lack of seasonal turnover leading to meromixis)
Dense saline layer
Oxygen depletion in hypolimnion
Release of phosphorus from lake sediments
Hintz and Relyea 2019



Cleanwater.org

Lake Champlain long-term monitoring program

How is the lake's water quality? Is it changing?

Multi-decadal monitoring reveals salinization impacts of road de-icing salt application in the Lake Champlain watershed

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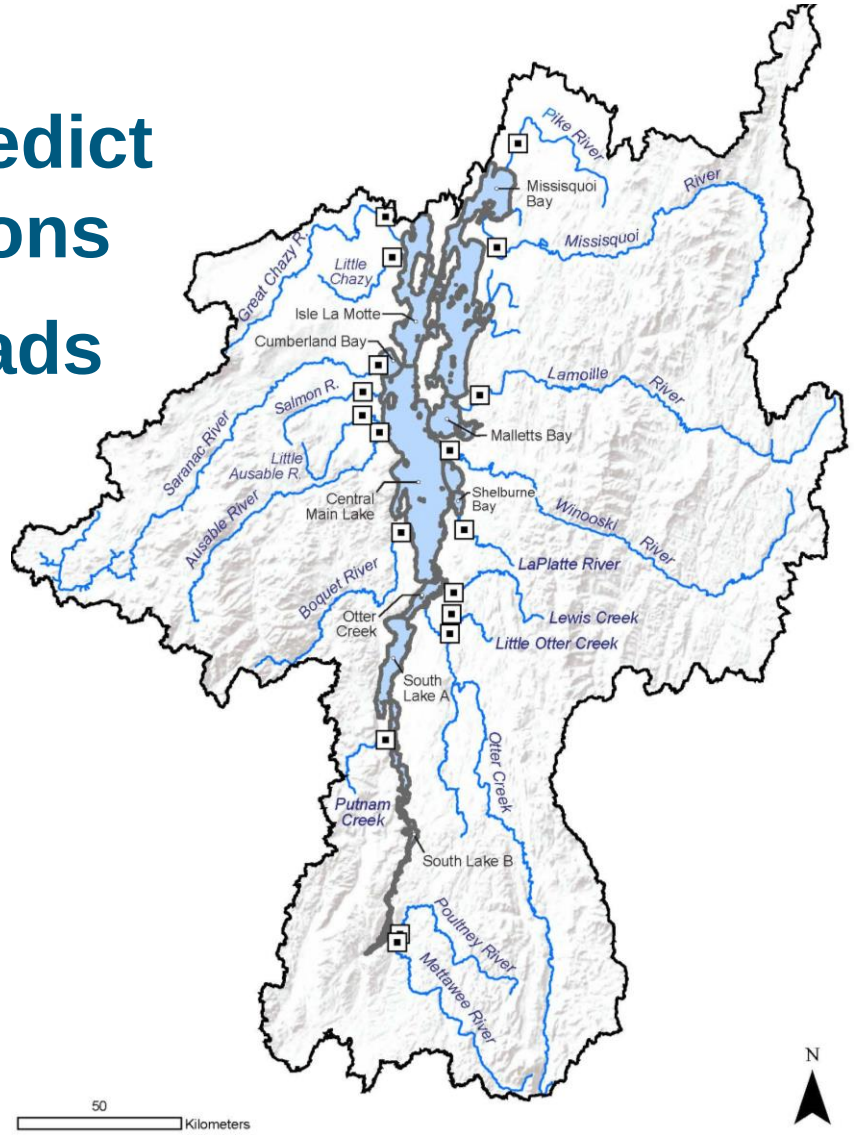
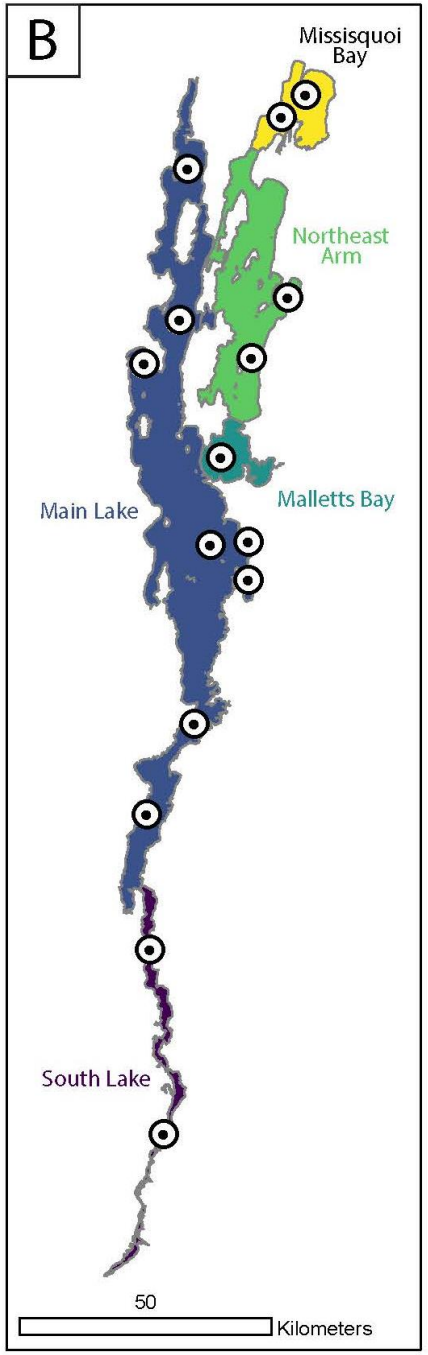
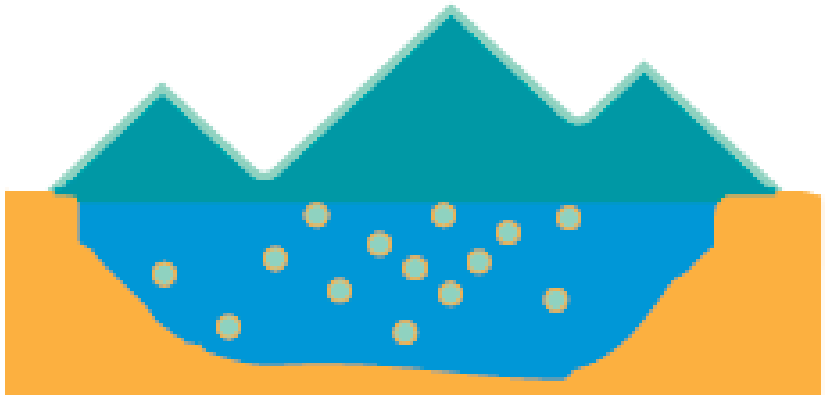
Chloride concentration data

- Starting 1991
- 18 tributaries
  - 8,000 samples
- 15 lake sites
  - 7,250 epilimnion or unstratified samples

- Combine with streamflow
- Model to predict concentrations
- Estimate loads
- Trends







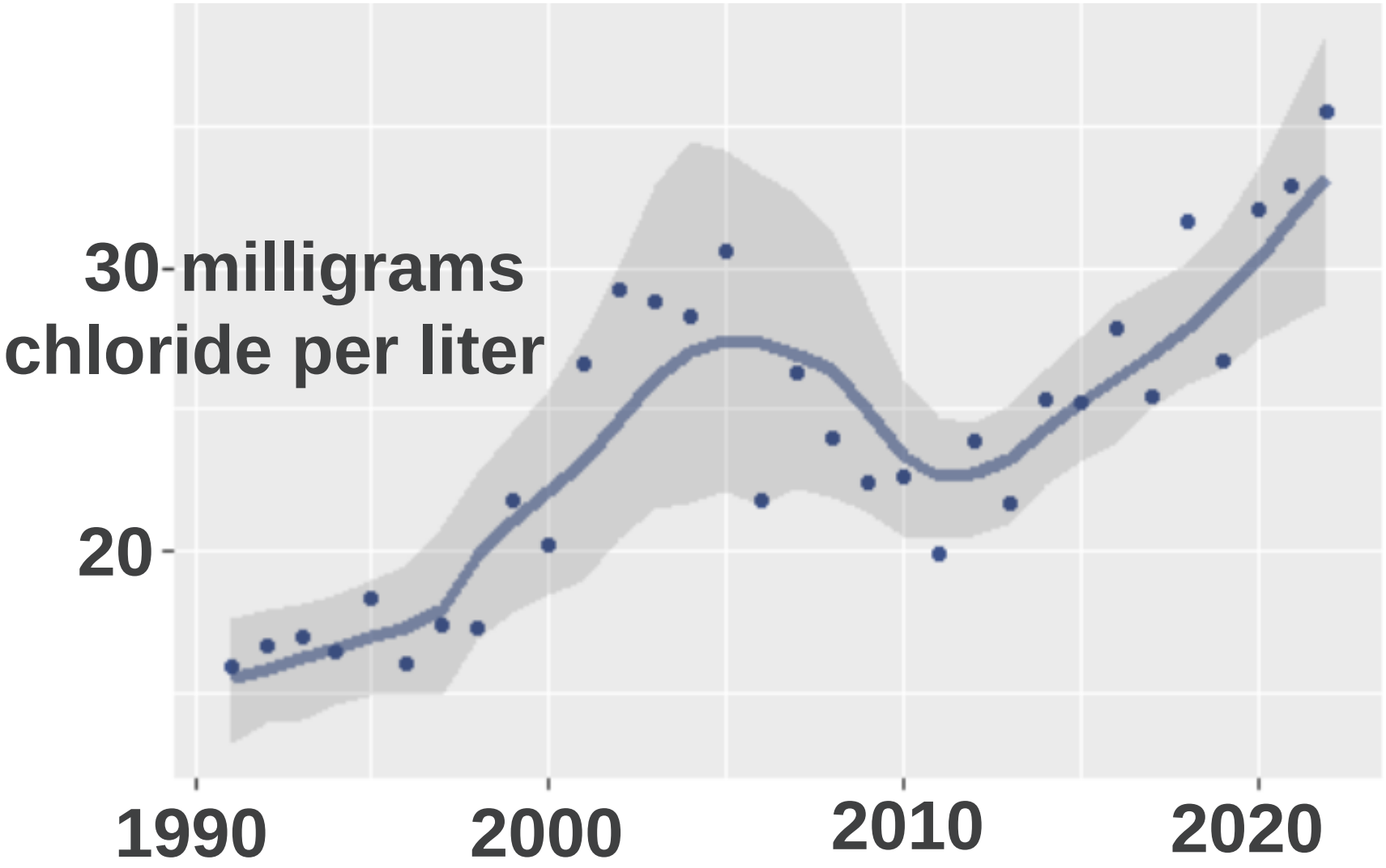
Concentration:

The amount measured in a unit volume of water **Milligrams chloride per liter**

Chloride concentration trends

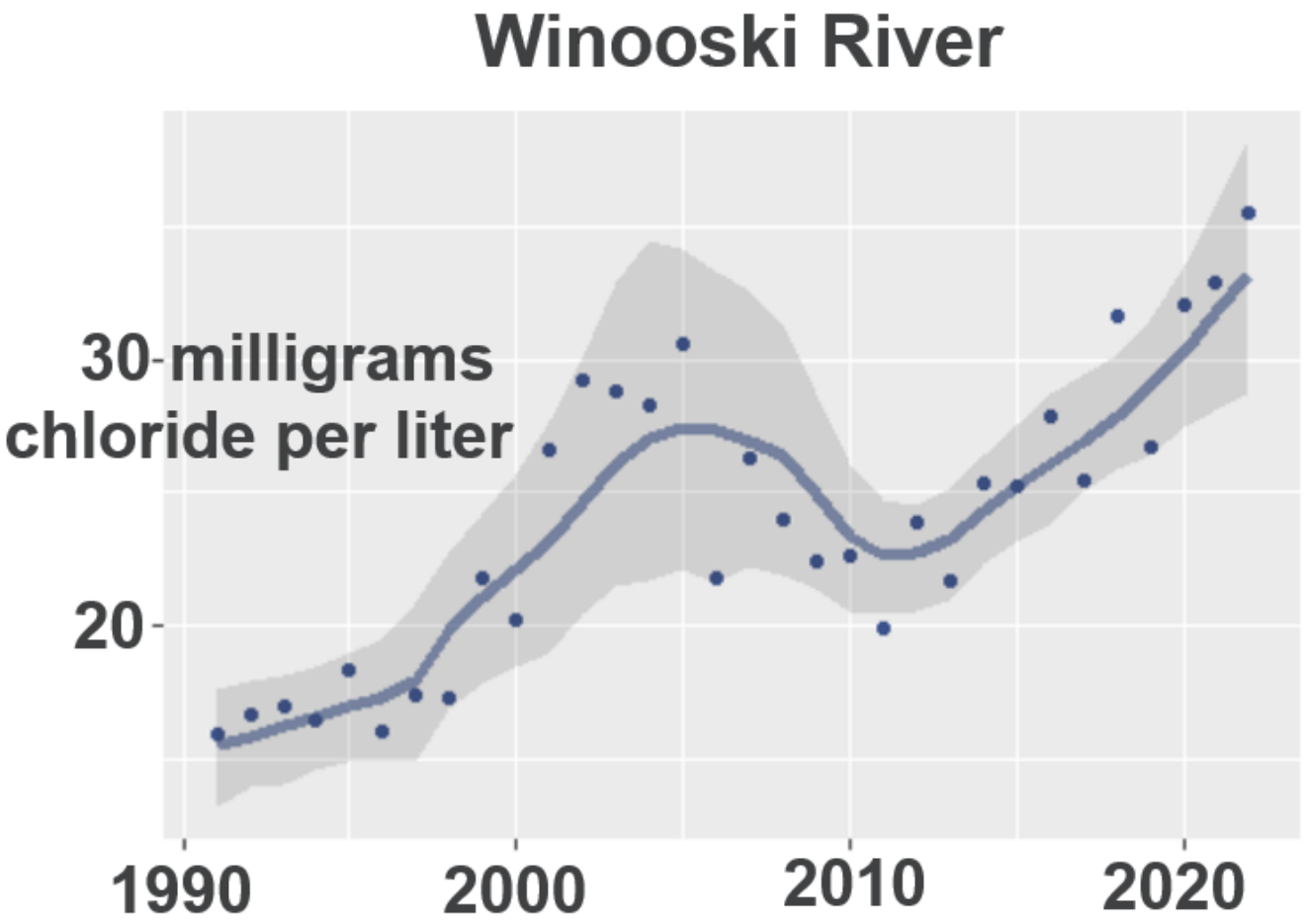
- Increased since 1990 in 15 out of 18 tributaries
- 41 to 163% increase

Winooski River

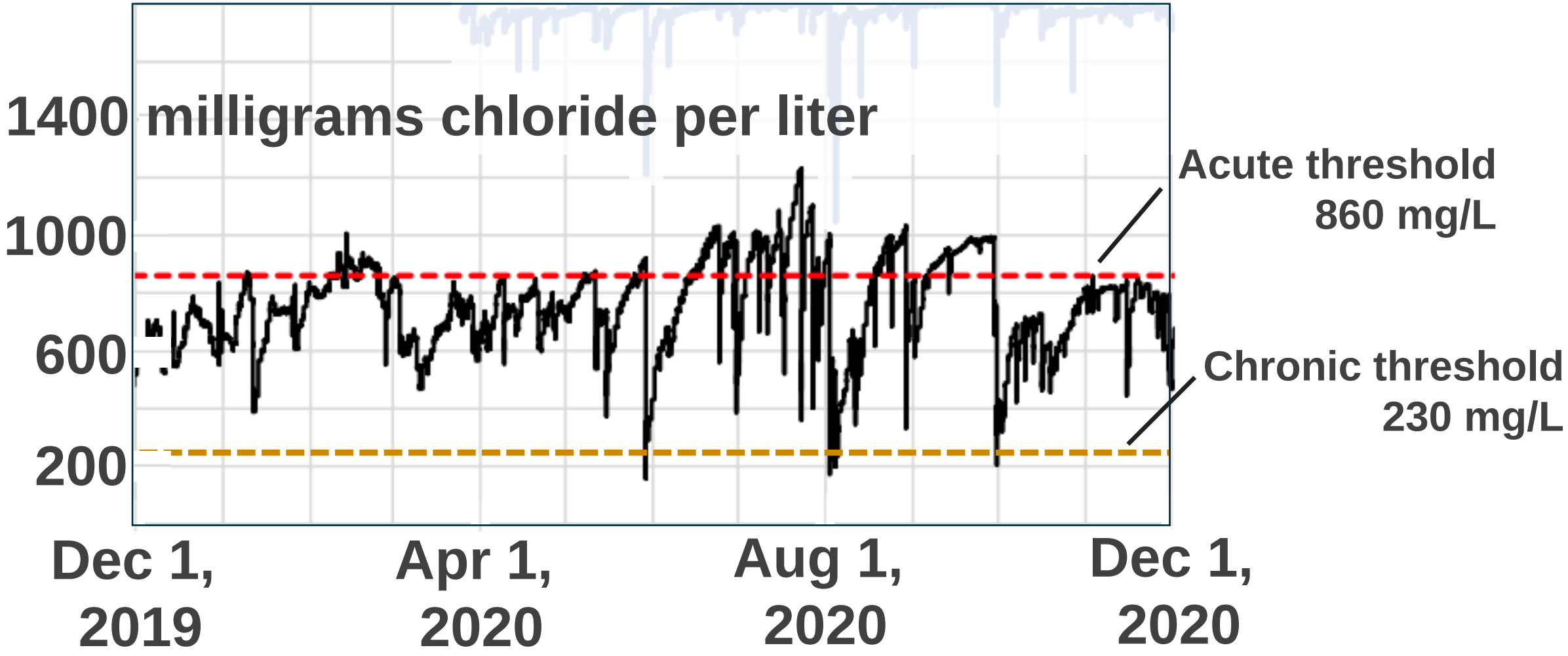


Chloride concentrations (milligrams chloride per liter)

- **< 10 –** natural background
- **> 20 –** elevated
- **> 35 –** documented impacts to biodiversity
- **230 –** EPA *chronic* threshold for aquatic toxicity
- **250 –** EPA secondary drinking water standard (taste)
- **860 –** EPA *acute* threshold for aquatic toxicity



Sunnyside Brook

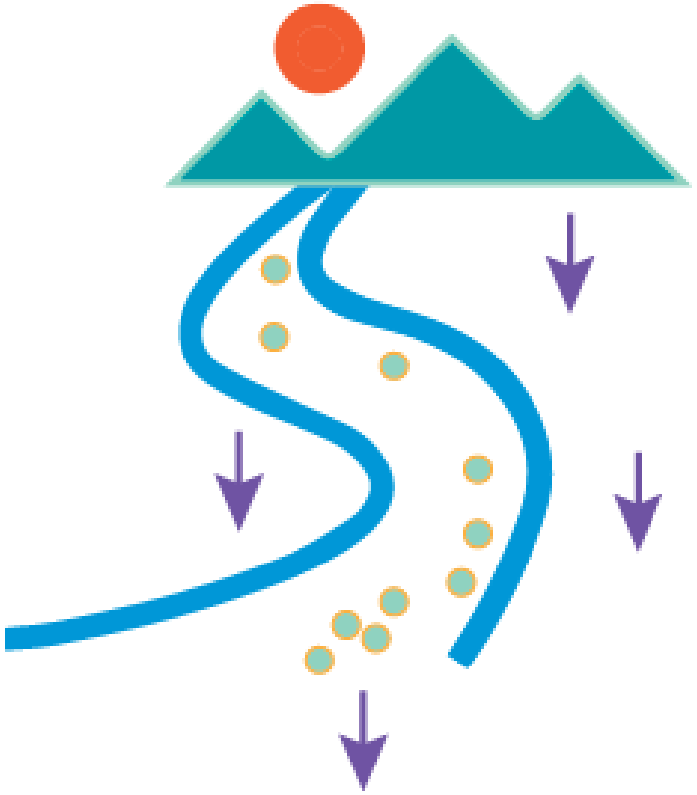


Adapted from [Sunnyside Brook TMDL]

Sunnyside Brook

Year:	2019	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
Month:	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov
Ave Cl (mg/L)	642	701	847	674	734	743	810	911	739	893	633	787
Acute exceedences (% of time)	0.0%	1%	46%	0%	0%	13%	45%	70%	40%	78%	0%	0%
Chronic exceedences (% of time)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Adapted from Sunnyside Brook TMDL



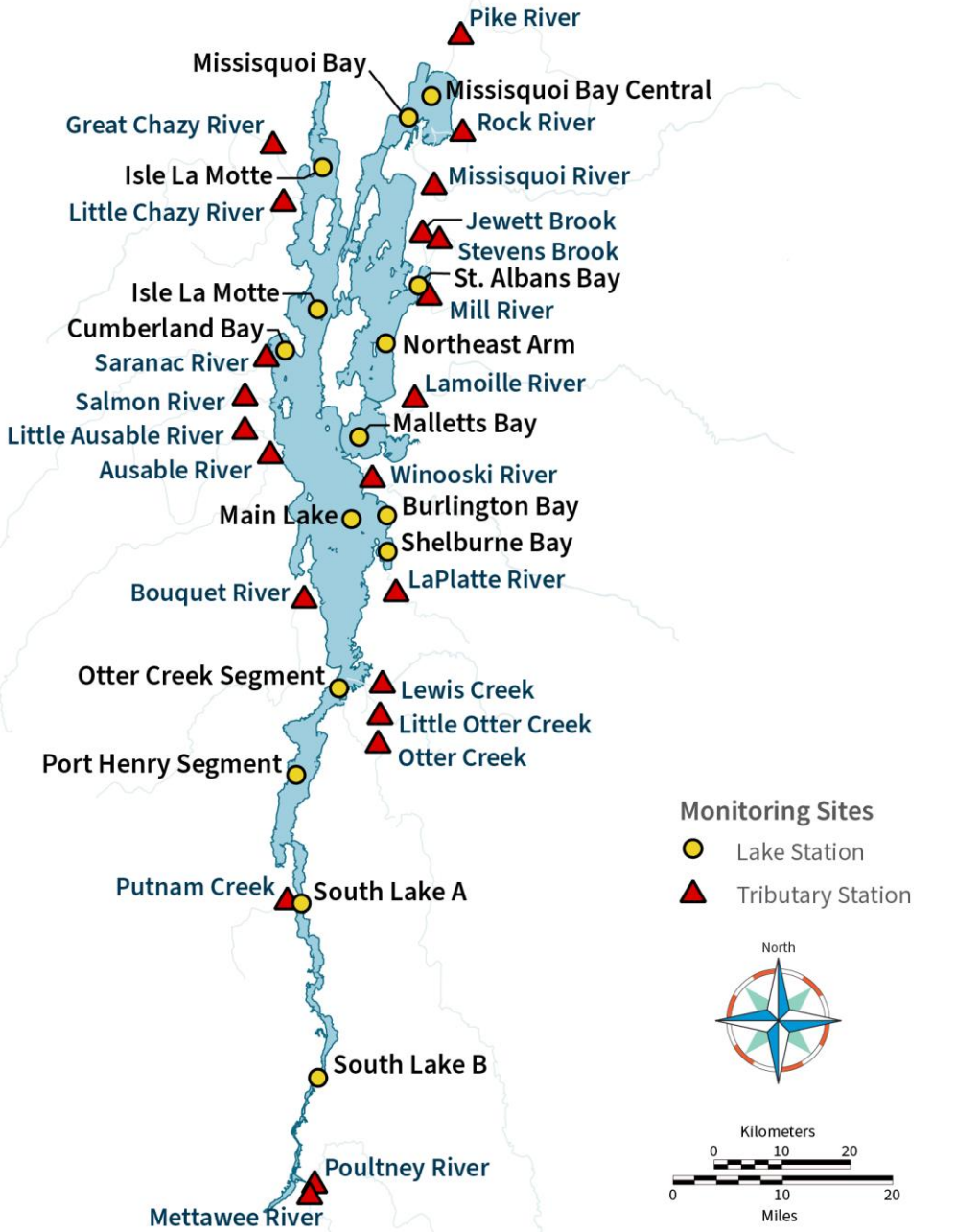
Load:

Total amount delivered to a receiving water body in a period of time

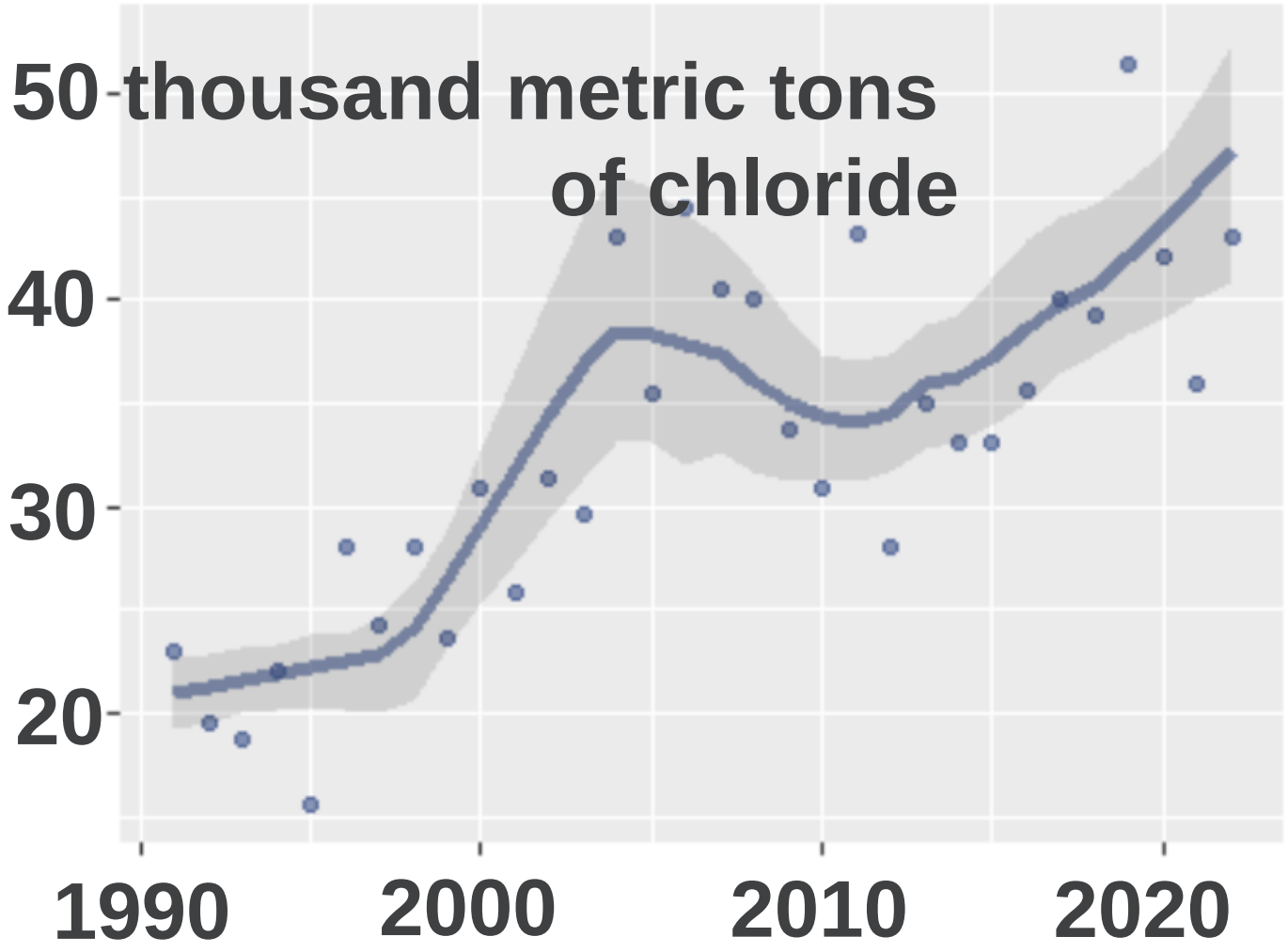
Metric tons chloride per year

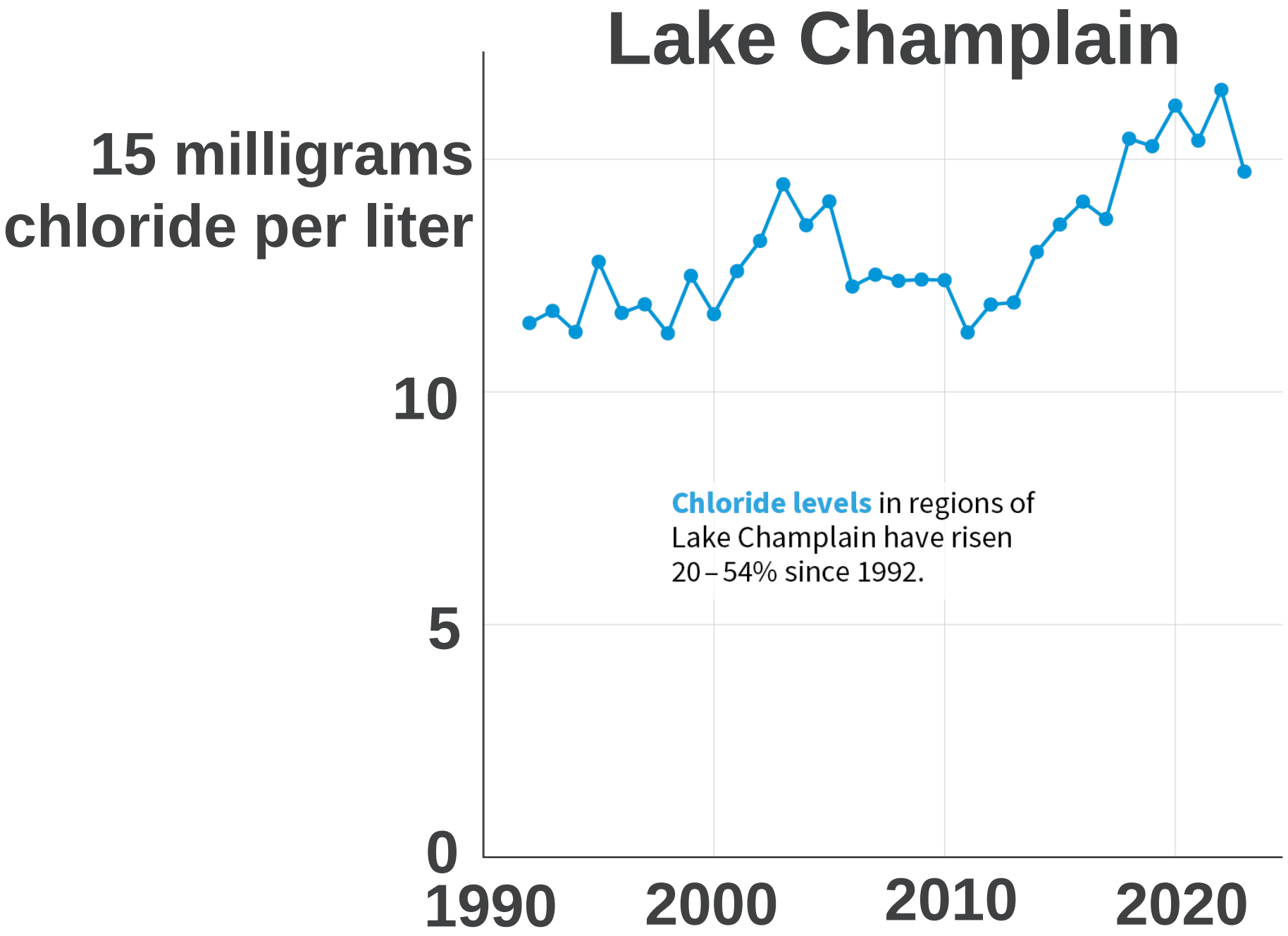
Chloride load trends

- Increased since 1990 in 15 out of 18 tributaries
- 1.9 to 127% increase



Winooski River




Lake Champlain
15 milligrams chloride per liter
10
5
0
1990
2000
2010
2020
Chloride levels in regions of Lake Champlain have risen 20–54% since 1992.

Overview of LCBP ongoing chloride research

- Research article
- Mirror Lake study and monitoring (AsRA, AWI)
- Basin-wide study of chloride data - long-term trends, inform BMP implementation (AWI)
- Forecast future road salt use with downscaled climate models (AWI)
- Study on chloride sources and impacts to macroinvertebrates (Middlebury College)

Questions?

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