Road Salt Impacts – A Sleeping Giant

(March 14, 2012)

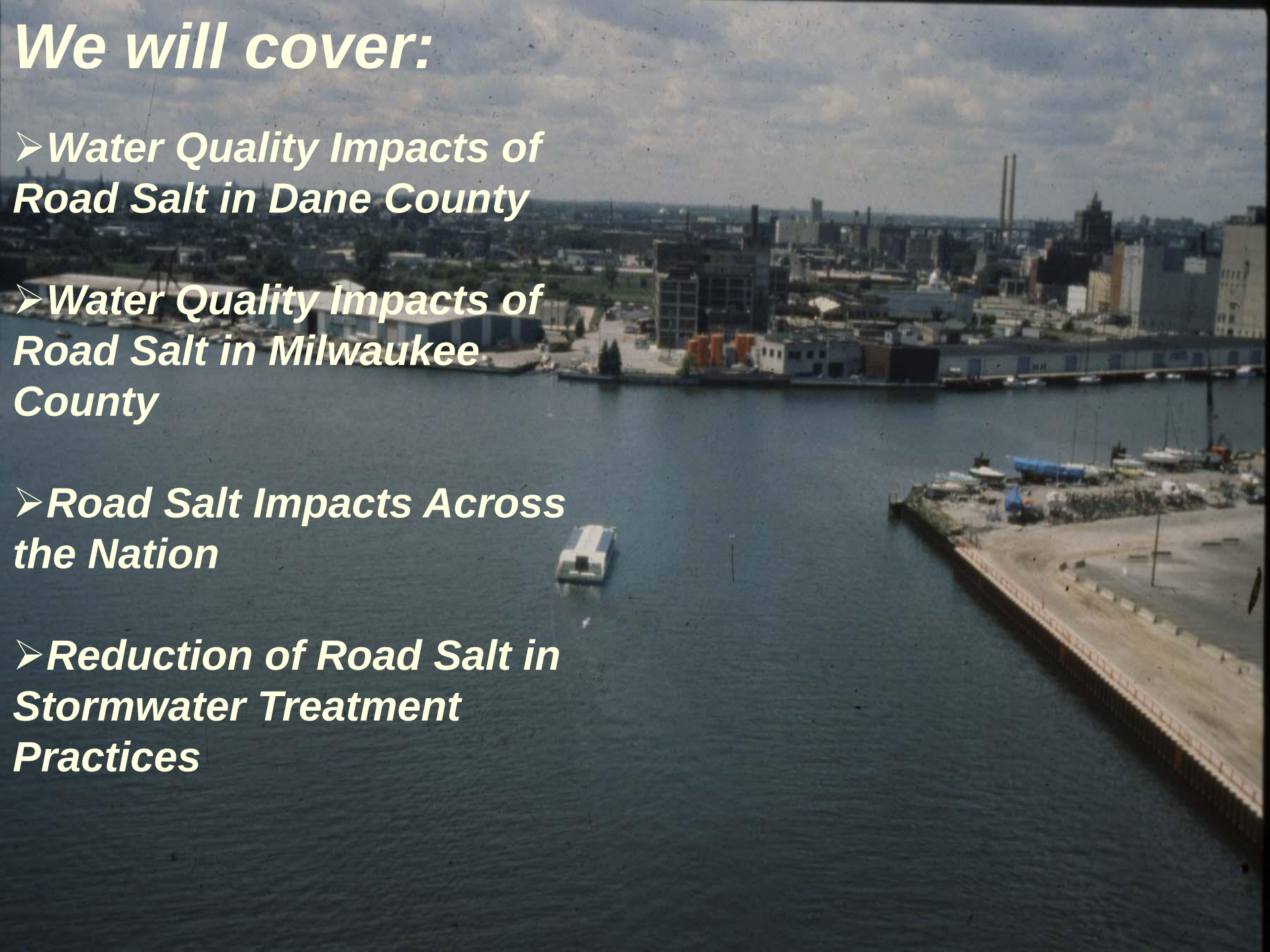
Roger Bannerman
WDNR

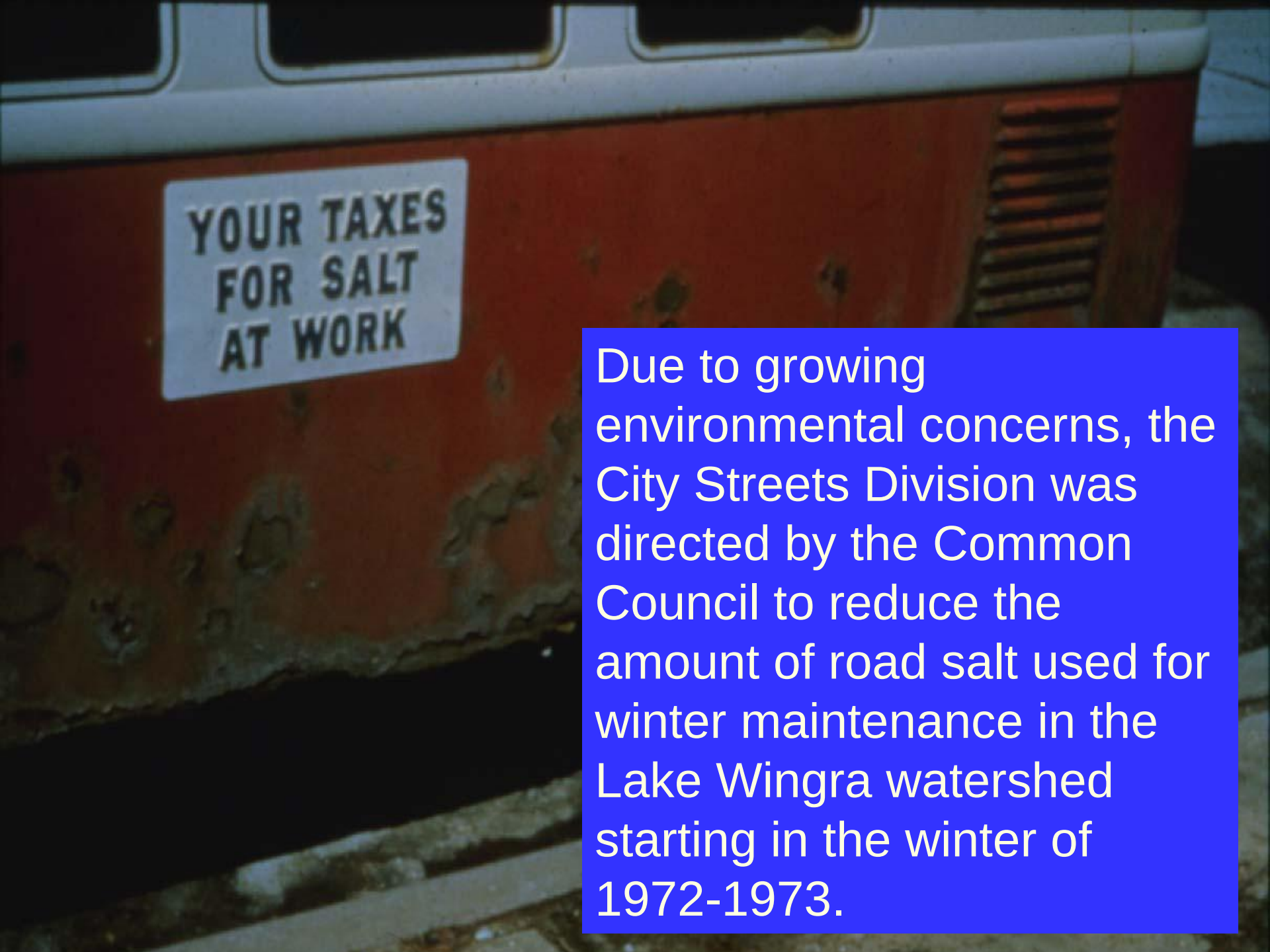
Steve Corsi
USGS

Jim Lorman
Edgewood College

We will cover:

- ***Water Quality Impacts of Road Salt in Dane County***
- ***Water Quality Impacts of Road Salt in Milwaukee County***
- ***Road Salt Impacts Across the Nation***
- ***Reduction of Road Salt in Stormwater Treatment Practices***



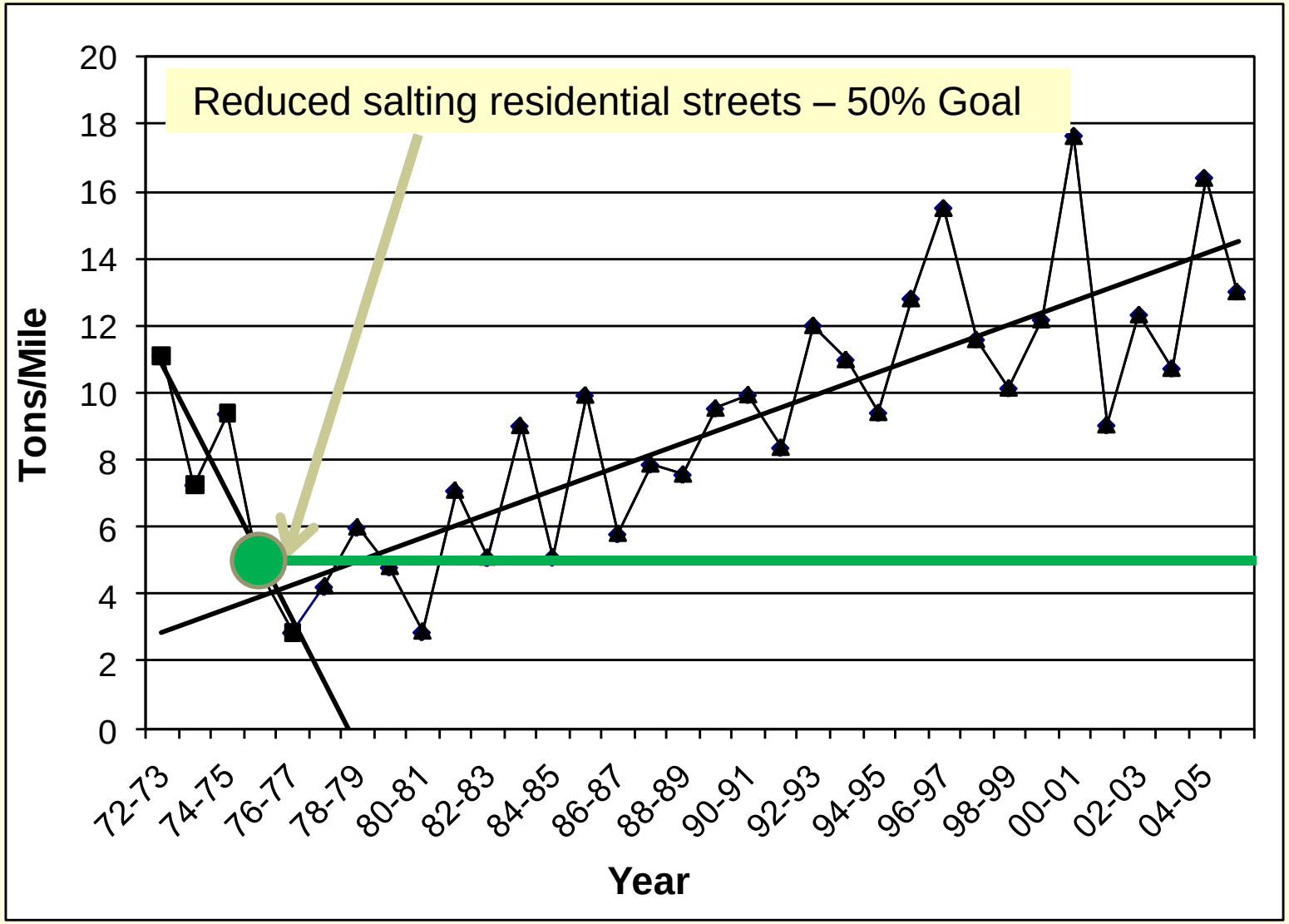


Due to growing environmental concerns, the City Streets Division was directed by the Common Council to reduce the amount of road salt used for winter maintenance in the Lake Wingra watershed starting in the winter of 1972-1973.

Reduce Salt Use By 50% - Limited Salt on Residential Streets. Extend to Entire City in 1977

Lake Wingra – 6 sq. mi. Watershed

Salt Use Per Mile of Maintained Street in Madison, Wisconsin



Reasons for Growing Use of Road Salt

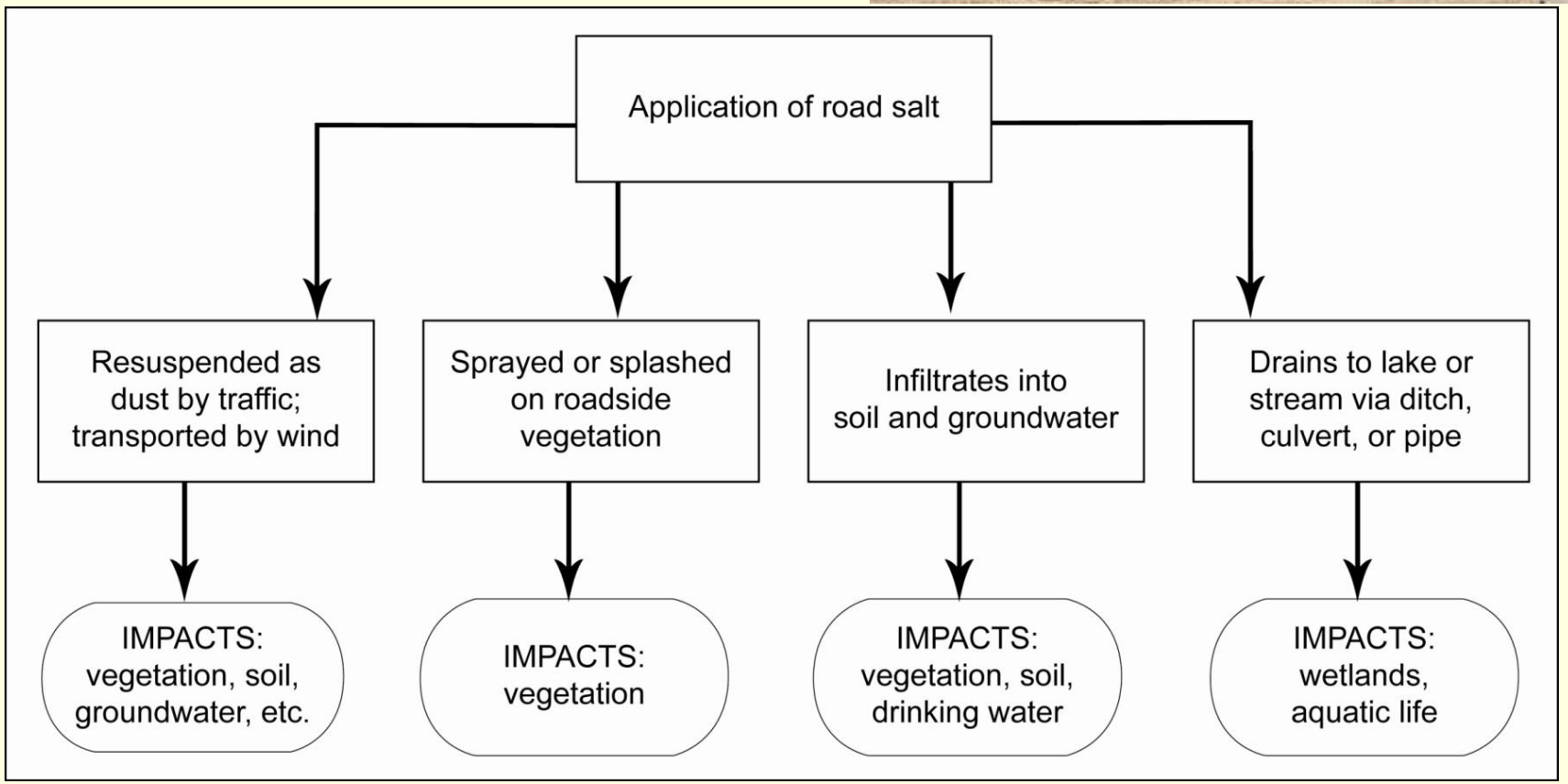
- ***Increase in ice and snow removal events – maybe***

- ***"Repeat applications spurred by the public's demand for bare pavement have fueled this increase. Undoubtedly, the public's expectations for clear roadways must be lowered if any salt reduction goal is to be met."*** (1)

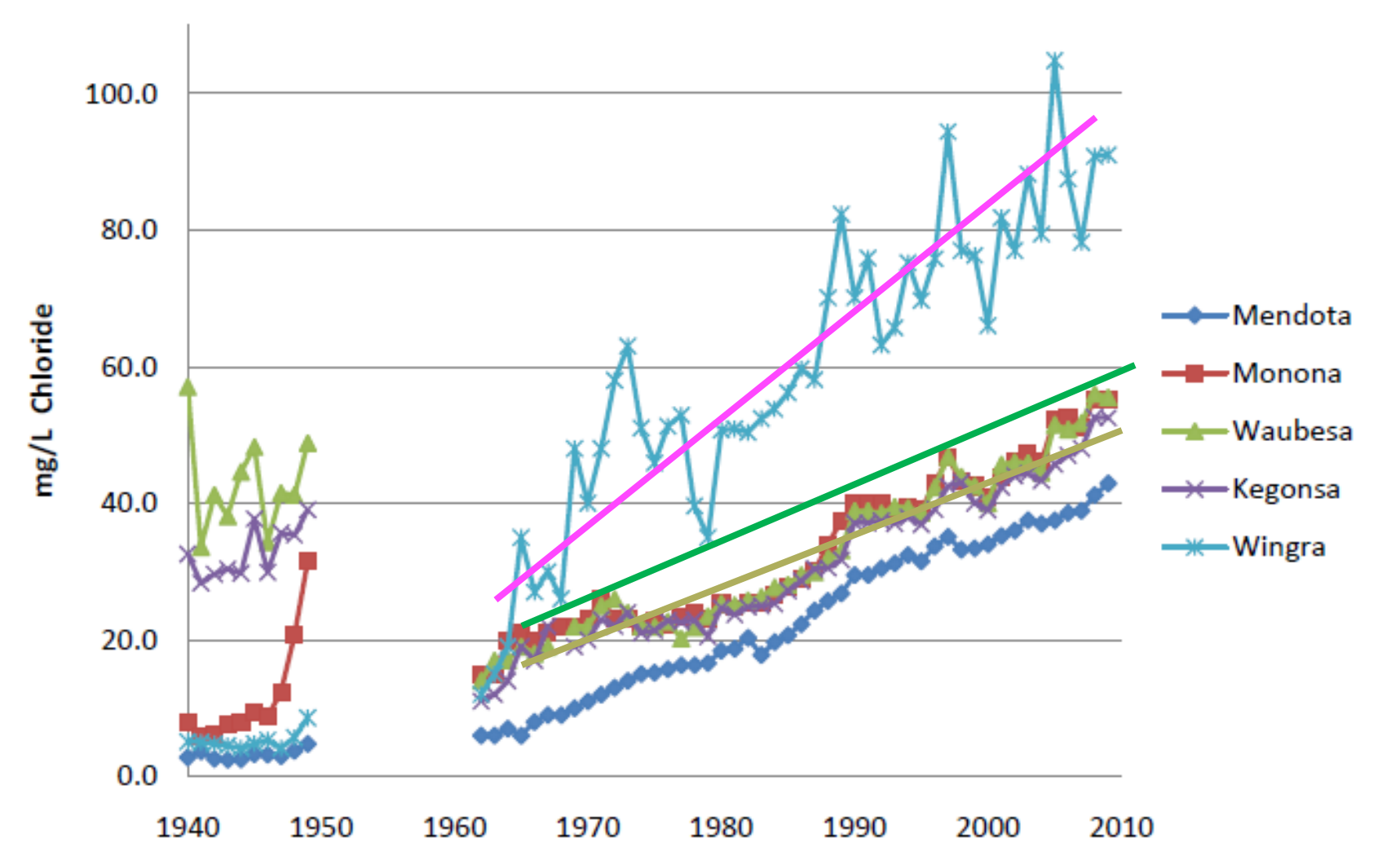
- **"Over time, our level of service has probably crept up," Michael Sproul said (DOT). But he said road departments are under pressure from motorists who demand that highways be free of snow and ice.**

1) Road Salt Report – 2008-09
Prepared by Rick Wenta, Kirsti Sorsa, Glenn Hyland, and Tommye Schneider, Public Health
Madison – Dane County
2 February 2010

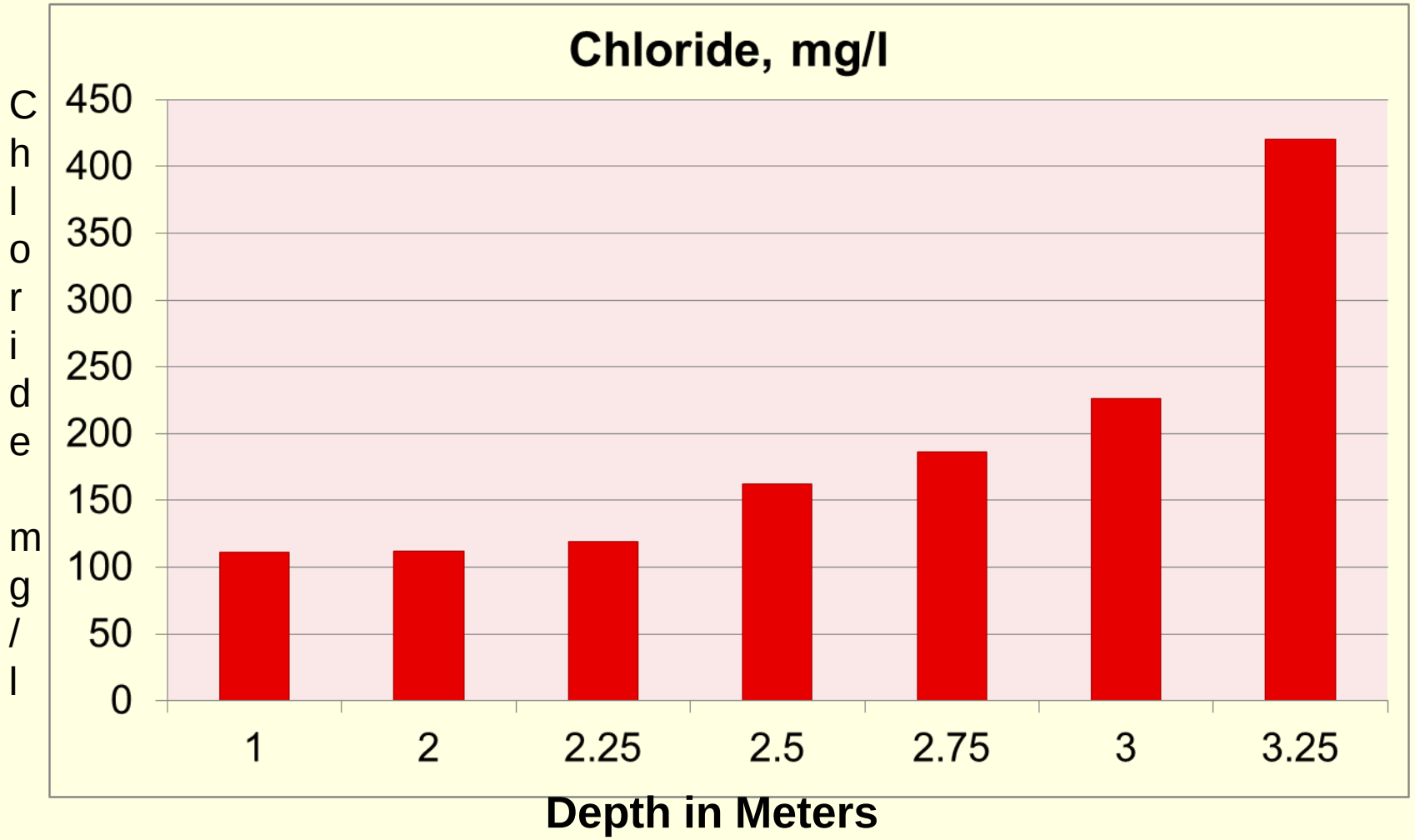
Fate of Road Salt



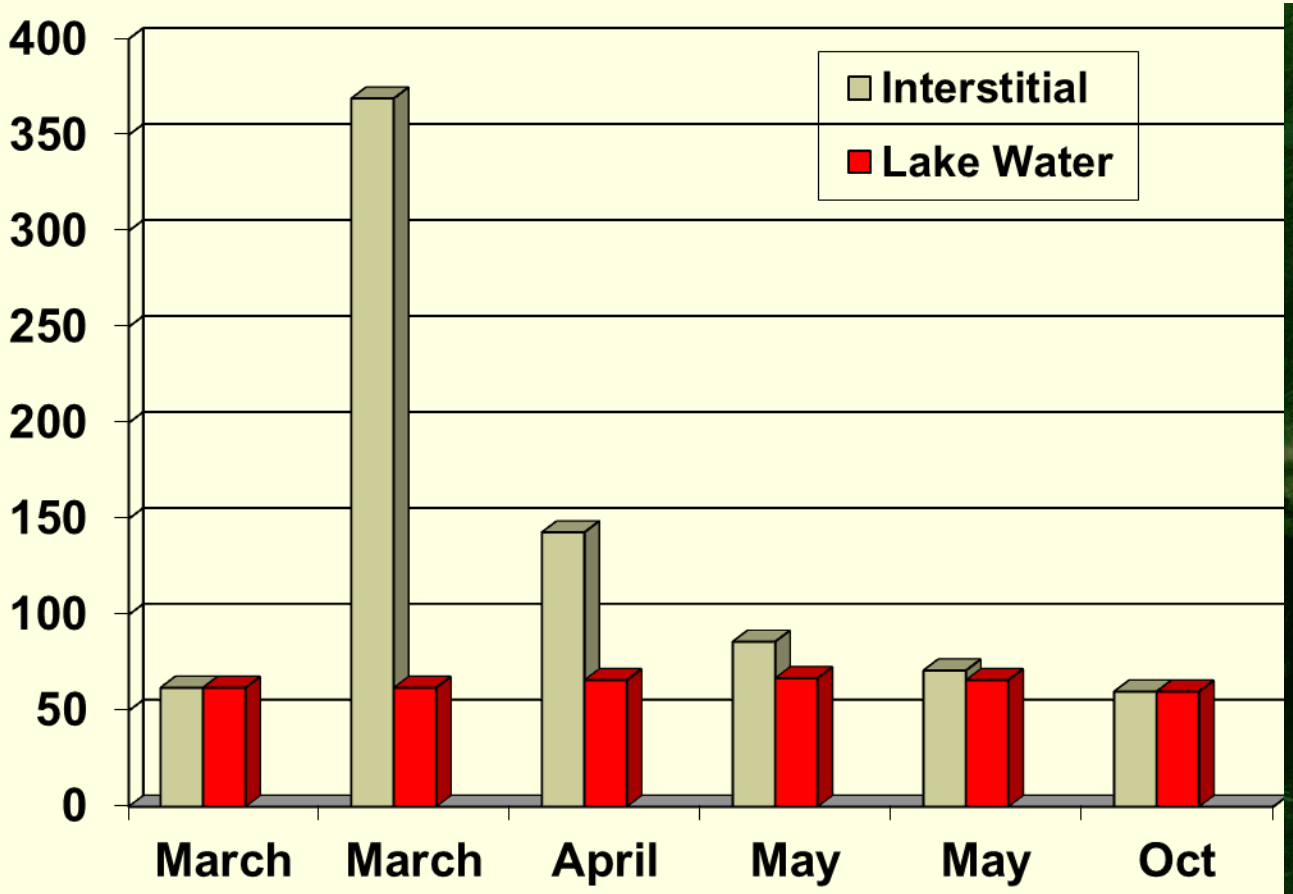
Chloride in the Madison-Area Lakes: The Yahara Chain – WDNR Chronic = 395 mg/l and Acute = 757 mg/l Chloride

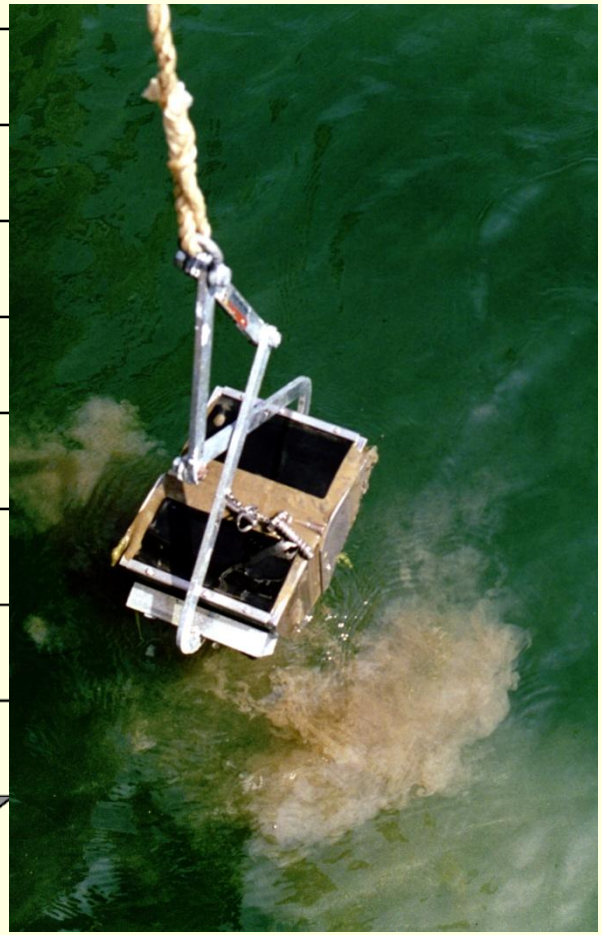


Chloride Concentration with Increasing Depth in Lake Wingra Water Column – Late Winter 2008

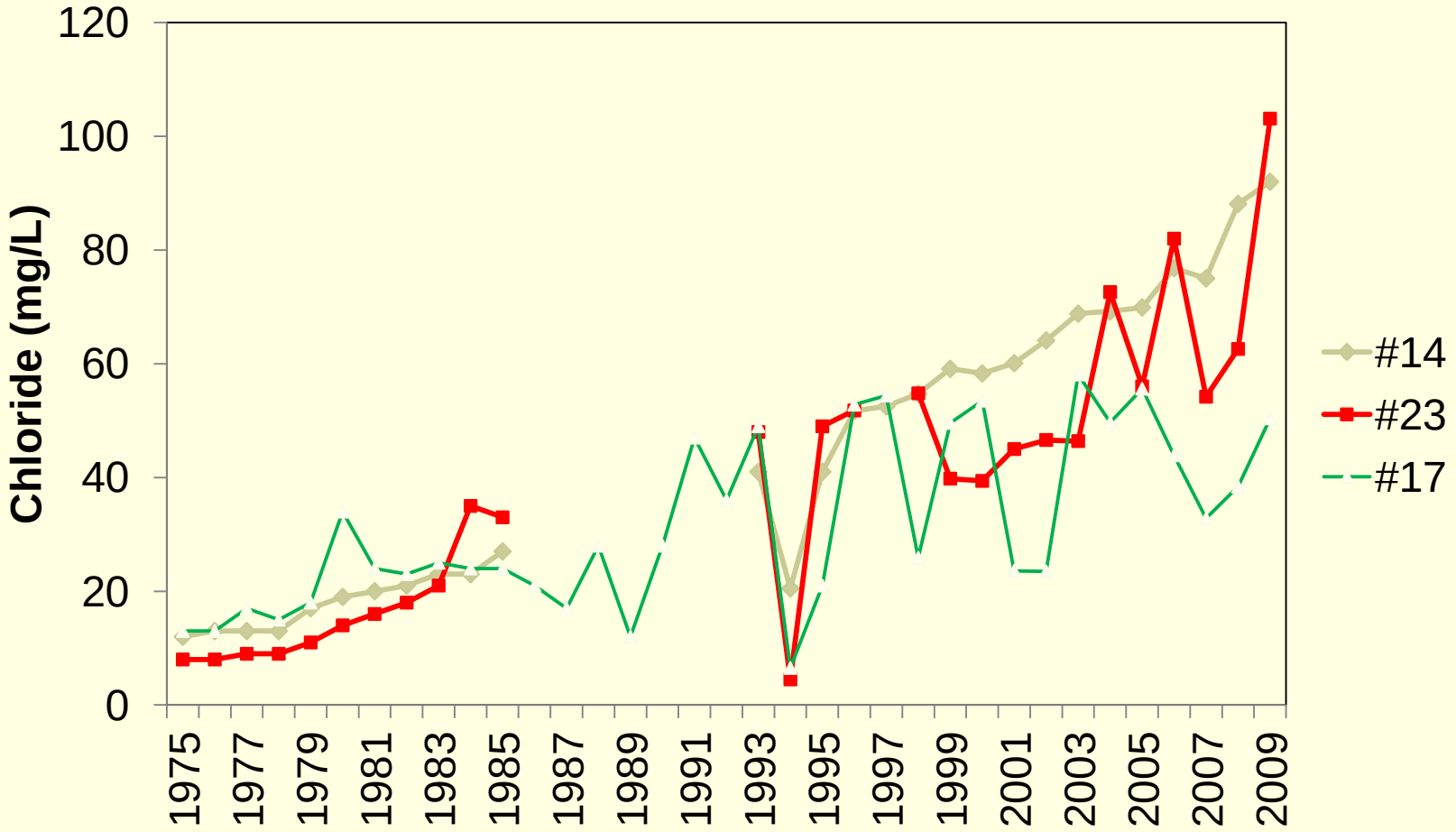


Chloride Levels, mg/l in Interstitial and Lake Water for Lake Wingra - 1972

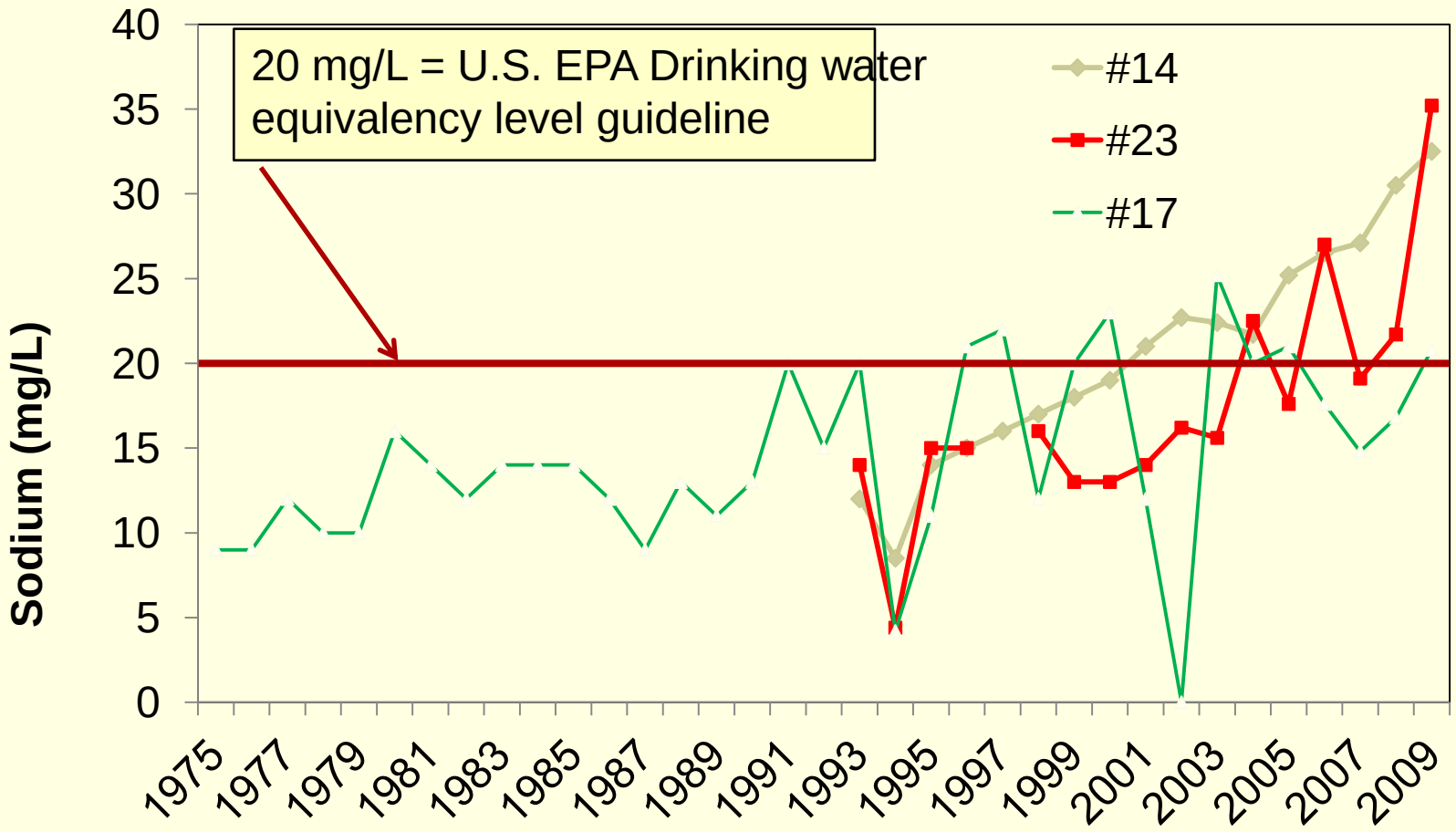


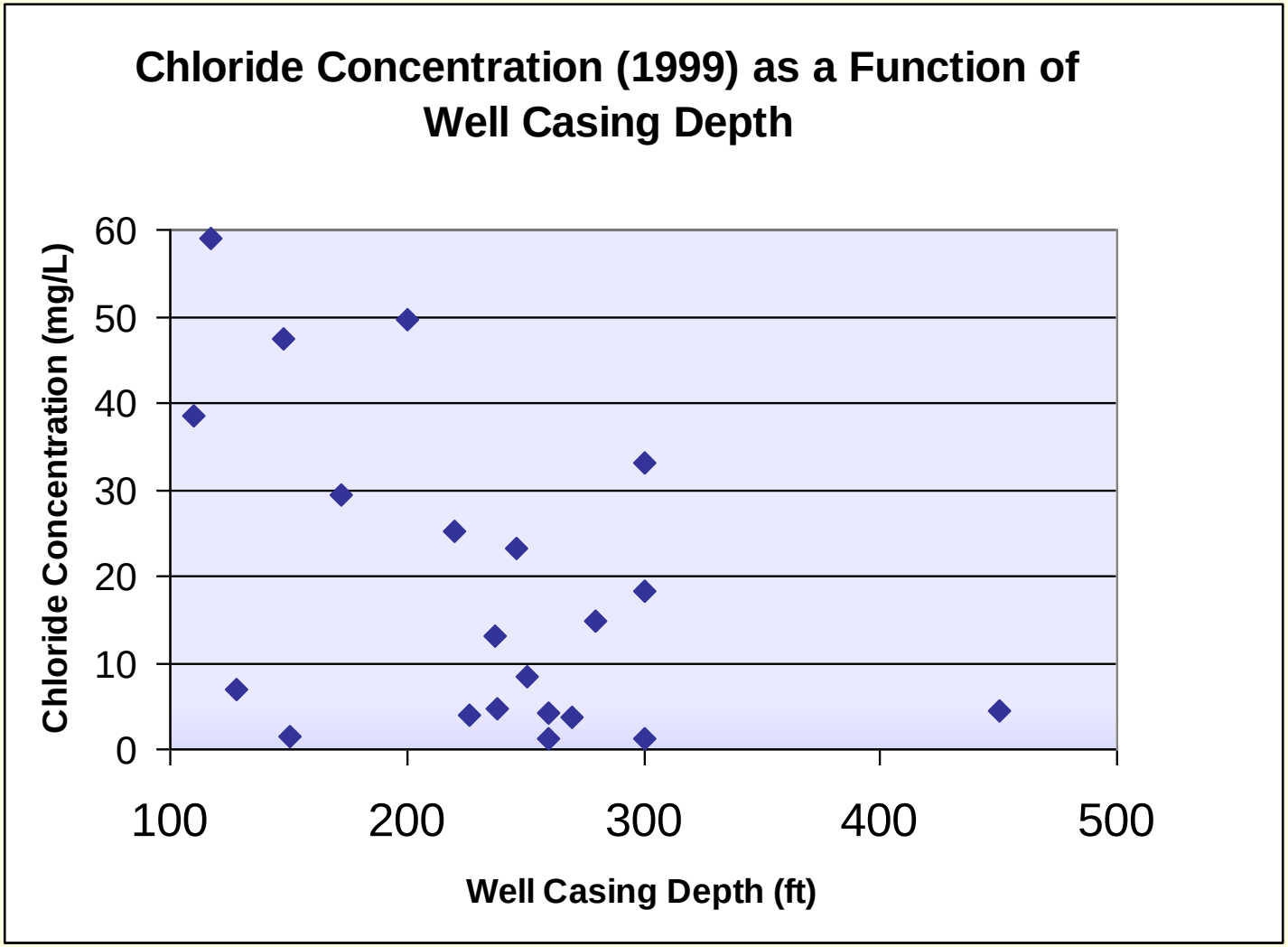


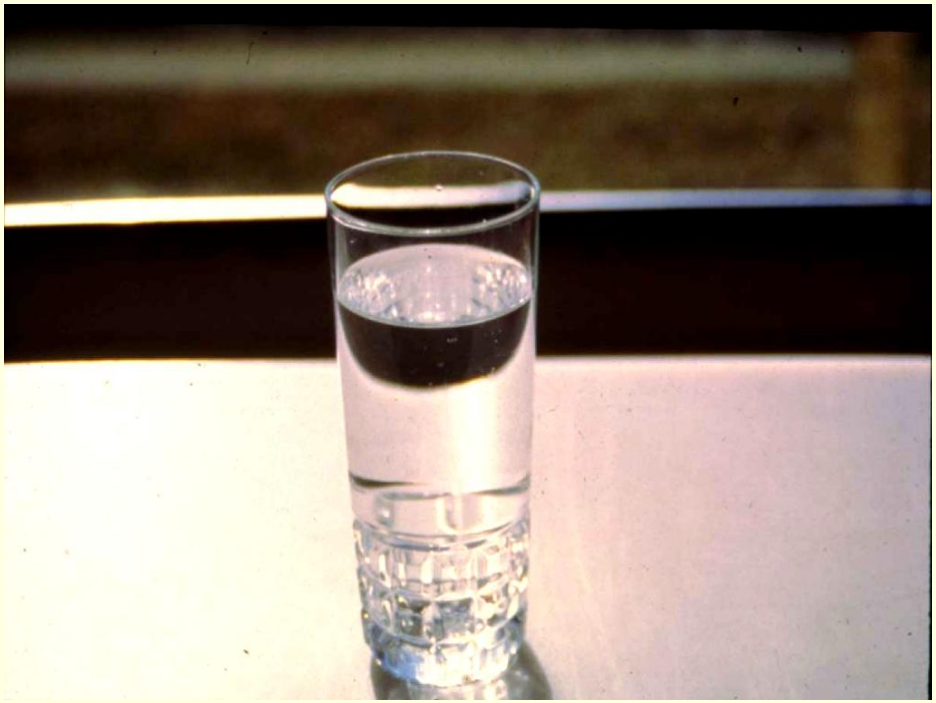
Chloride in Madison Drinking Water Supply Wells



Sodium in Madison Drinking Water Supply Wells



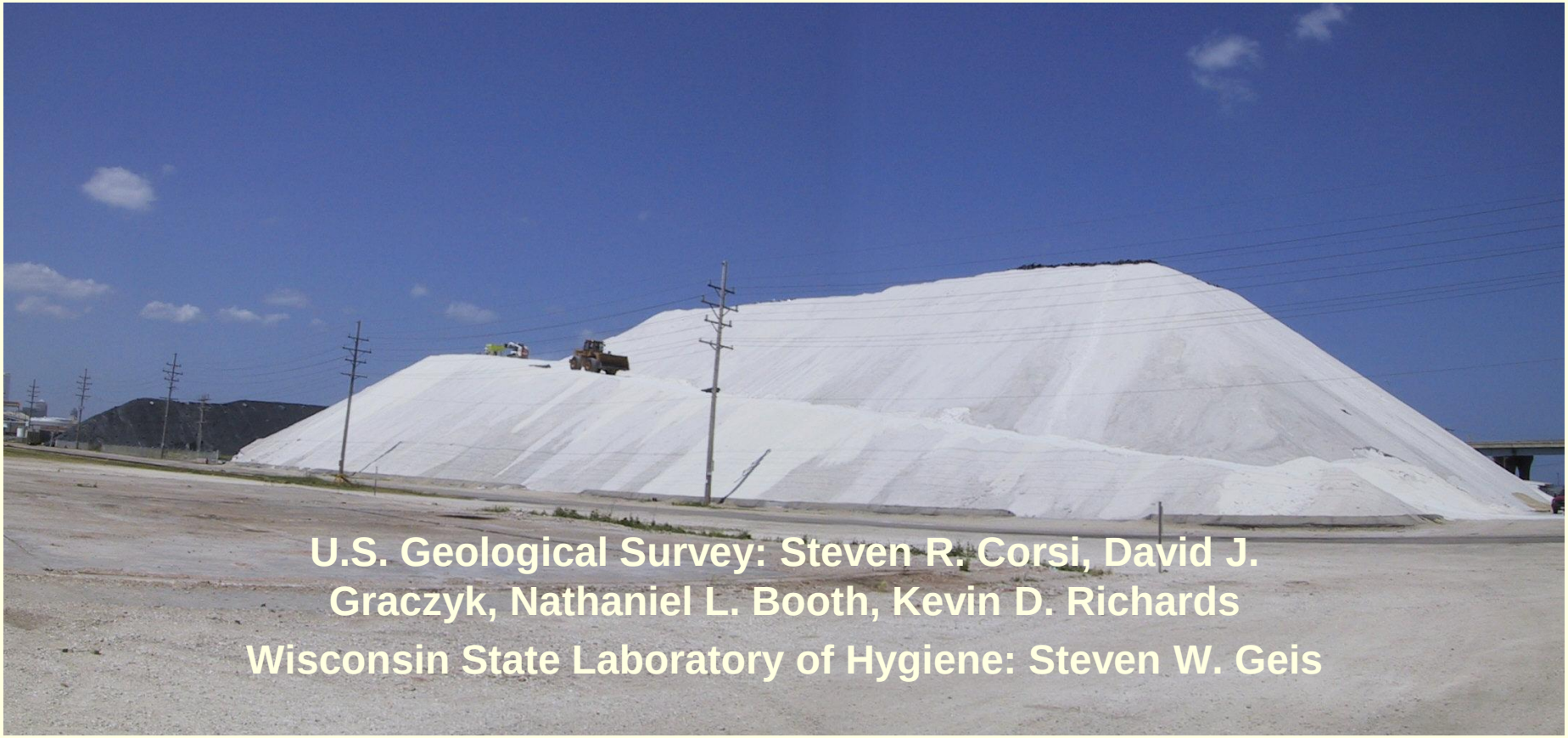

Chloride Concentration (1999) as a Function of Well Casing Depth
Chloride Concentration (mg/L)
60
50
40
30
20
10
0
100
200
300
400
500
Well Casing Depth (ft)



“Madison’s groundwater resources continue to show increasing trends in sodium and chloride levels. Groundwater moves slowly, so by the time contamination is a concern, a large volume of water has been affected. Contaminant levels will persist long after remedial action has been taken.”

“In addition to the environmental impacts of increased salt use, taxpayer's pocketbooks will also be affected if new wells are needed to replace those with unsafe chloride levels. The Madison Water Utility estimate for the cost of installing a new municipal well is $3.25 million - a cost that would be born by all of us.” Madison COE

Road Salt: Widespread Aquatic Toxicity and Water-Quality Impacts on Local, Regional, and National Scales



U.S. Geological Survey: Steven R. Corsi, David J. Graczyk, Nathaniel L. Booth, Kevin D. Richards

Wisconsin State Laboratory of Hygiene: Steven W. Geis

USGS science for a changing world

MMSD

WSLH WISCONSIN STATE LABORATORY OF HYGIENE

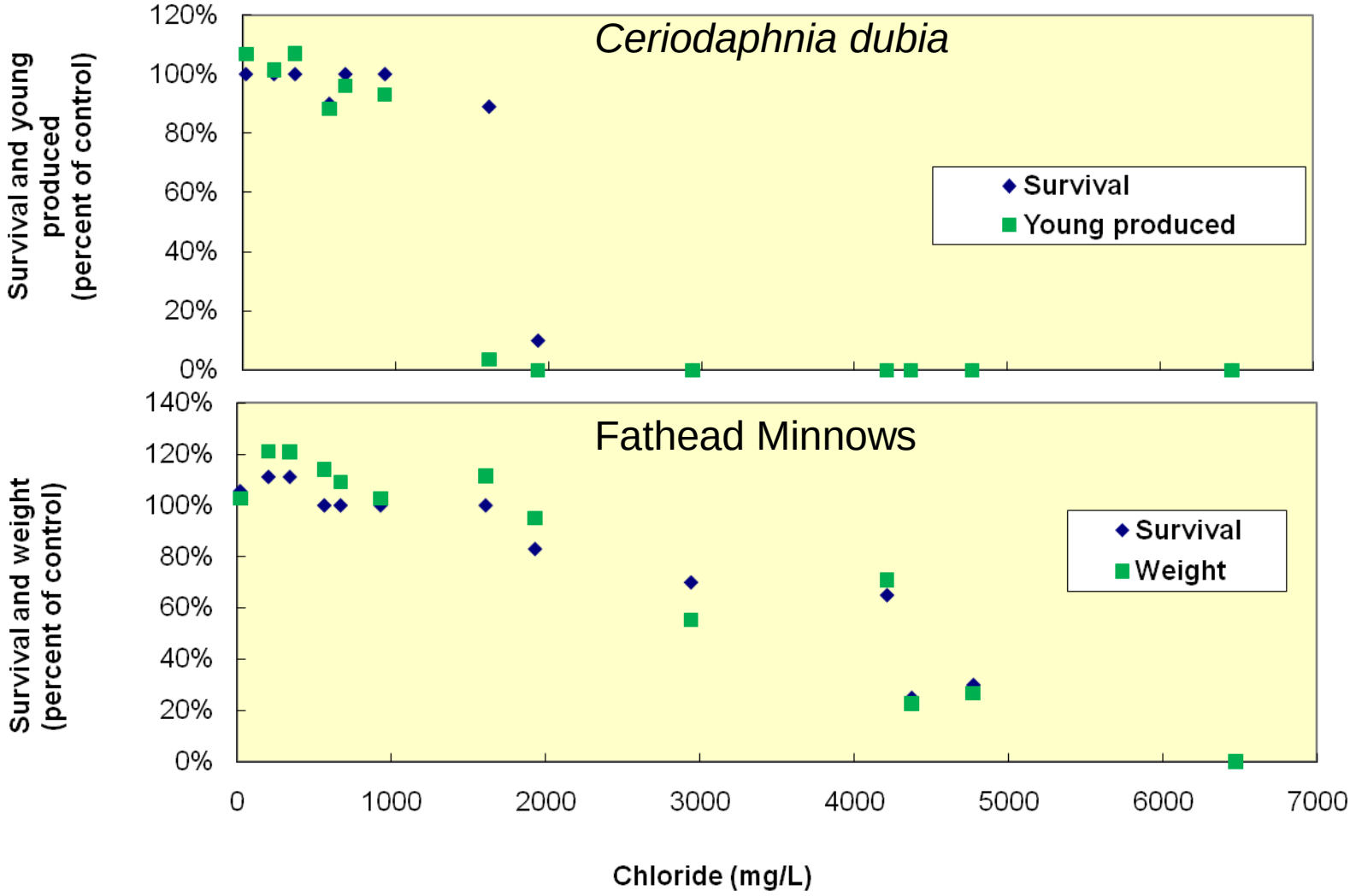
Overview

- Local impacts→ Milwaukee
- Regional Impacts → Southeast Wisconsin
- National Impacts
  - 17 metropolitan areas
  - 212 monitoring sites

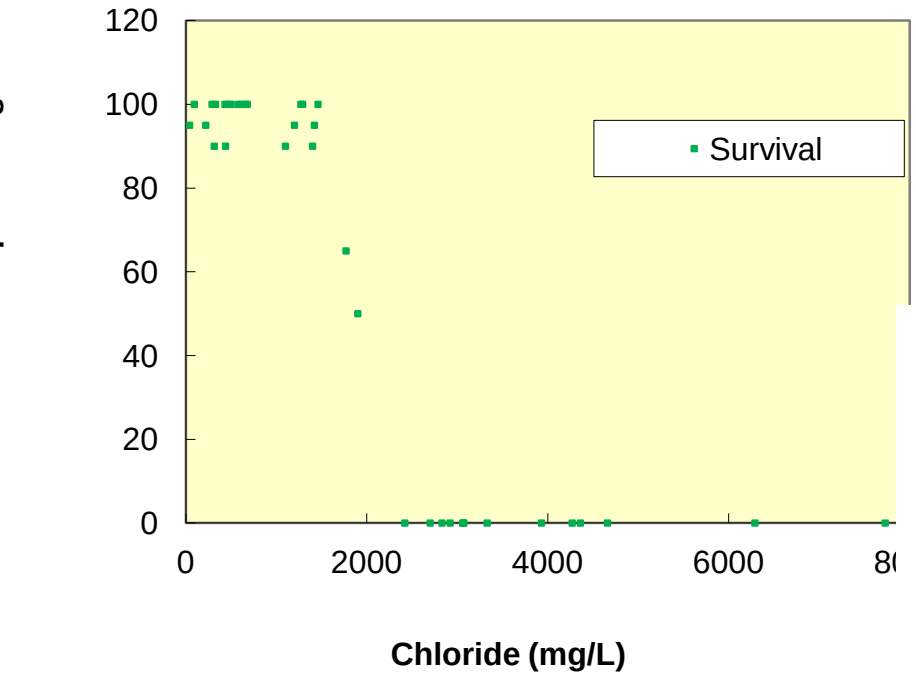
Local Study

- Twelve impacted and one reference stream
  - 6.3 mi^2 to 707 mi^2
  - 0 to 100% urban land use
  - 2007: Sampled once each during road salt runoff
- Wilson Park Creek in Milwaukee
  - Eleven years of deicing monitoring
- Water chemistry, Aquatic toxicity

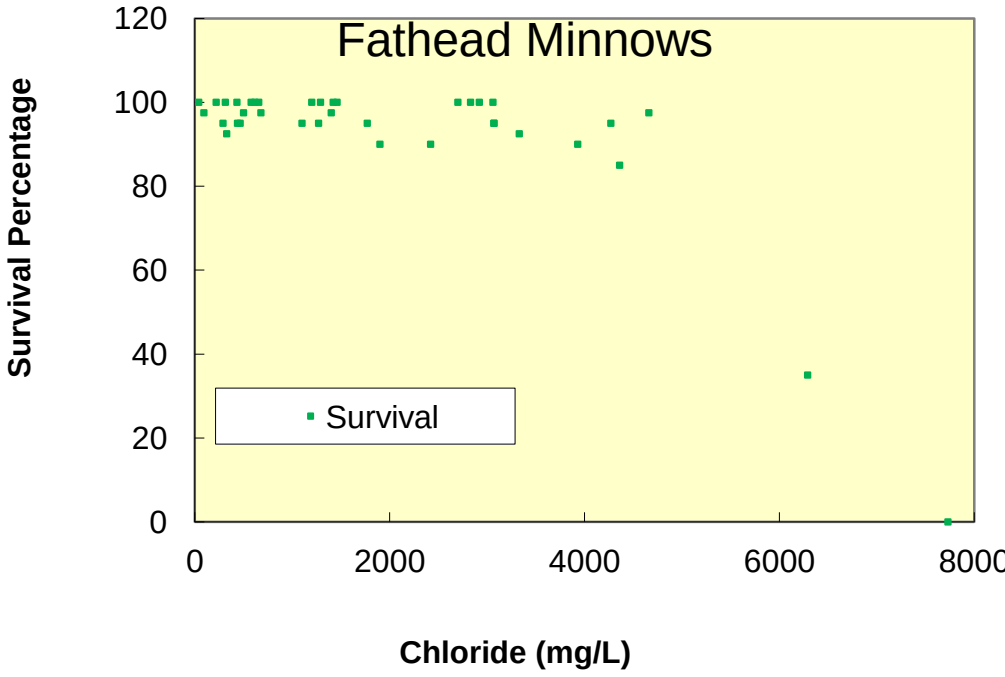
Local: 2007 Aquatic Toxicity Results



1996-2007: Wilson Park Creek Aquatic Toxicity



C. dubia



Average Spring 1977 Event Chloride Concentrations – Menomonee River, Milwaukee

280 mg/l

489 mg/l

276 mg/l

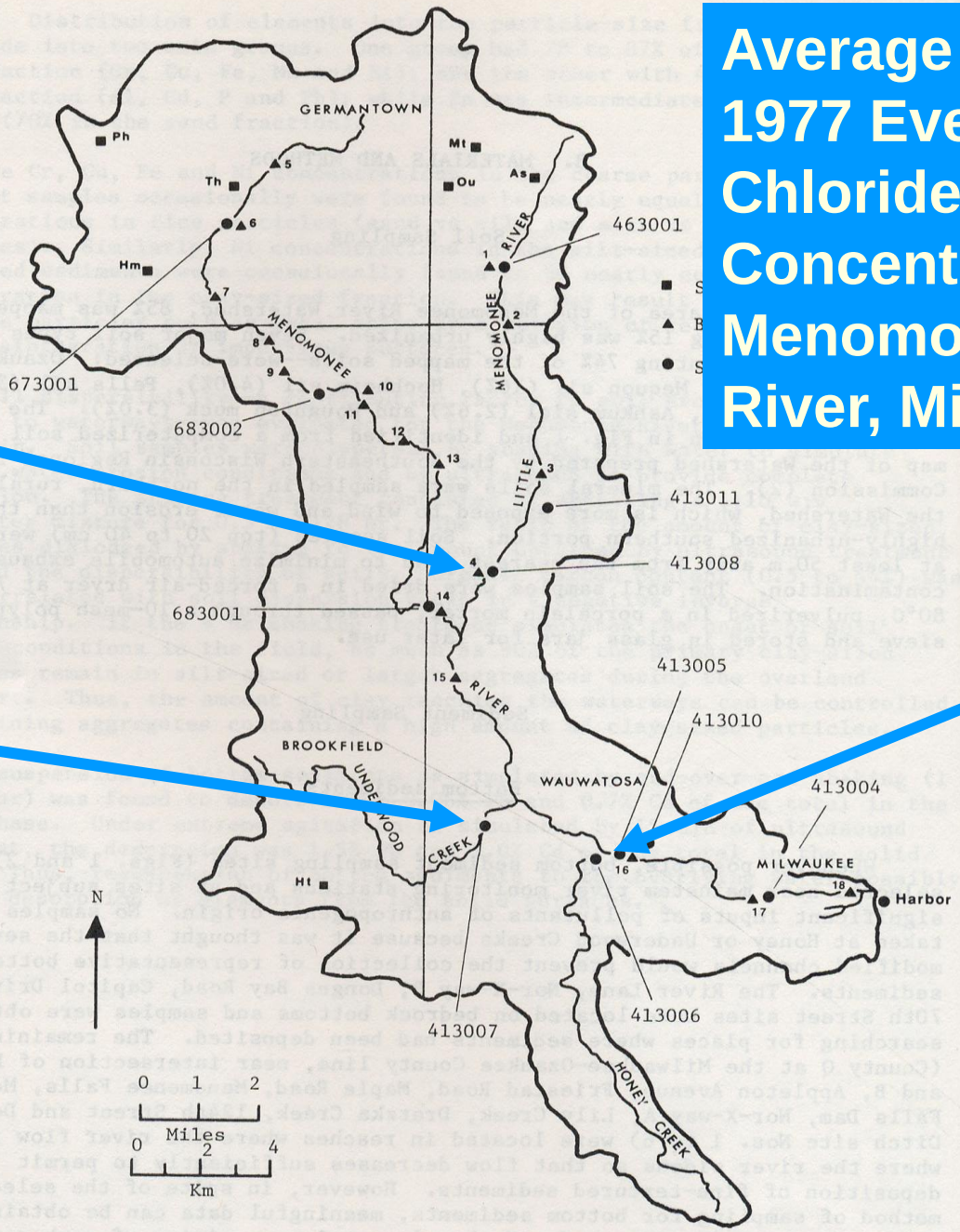
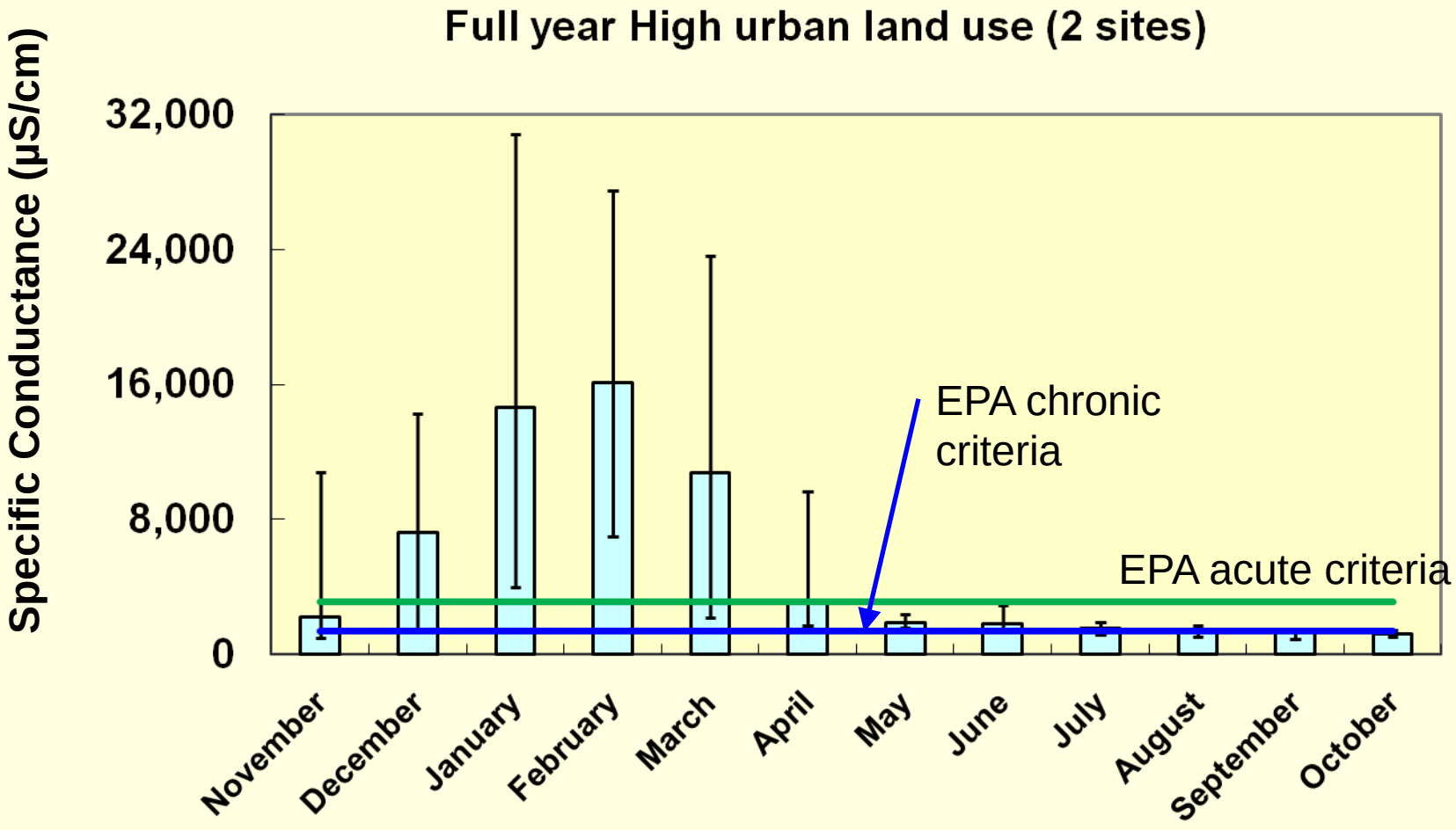


Fig. 1. Sampling sites of soils, bottom sediment and suspended sediment within the Menomonee River Watershed.

Regional: Specific Conductance

Monthly maximum from continuous monitoring



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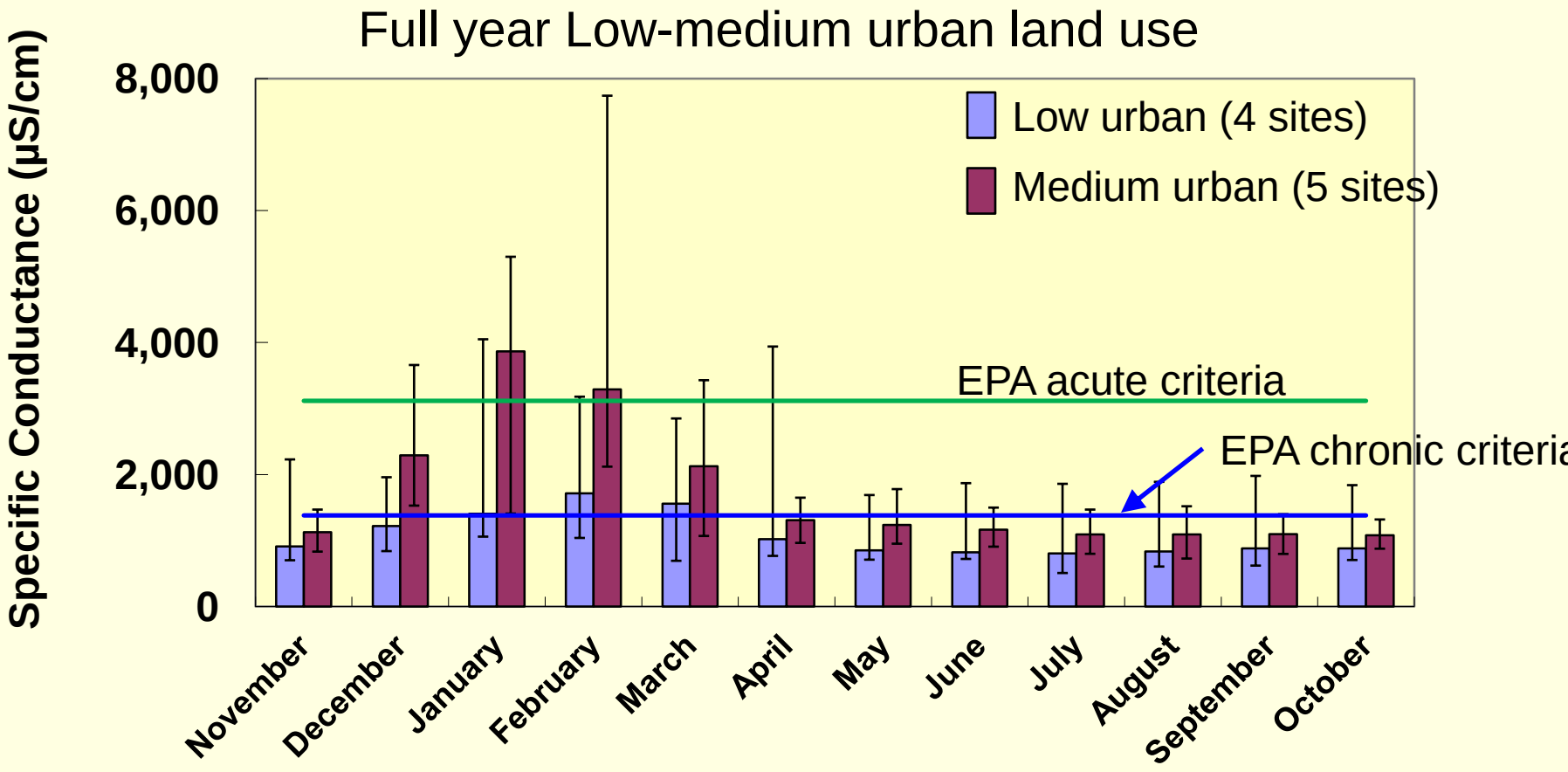
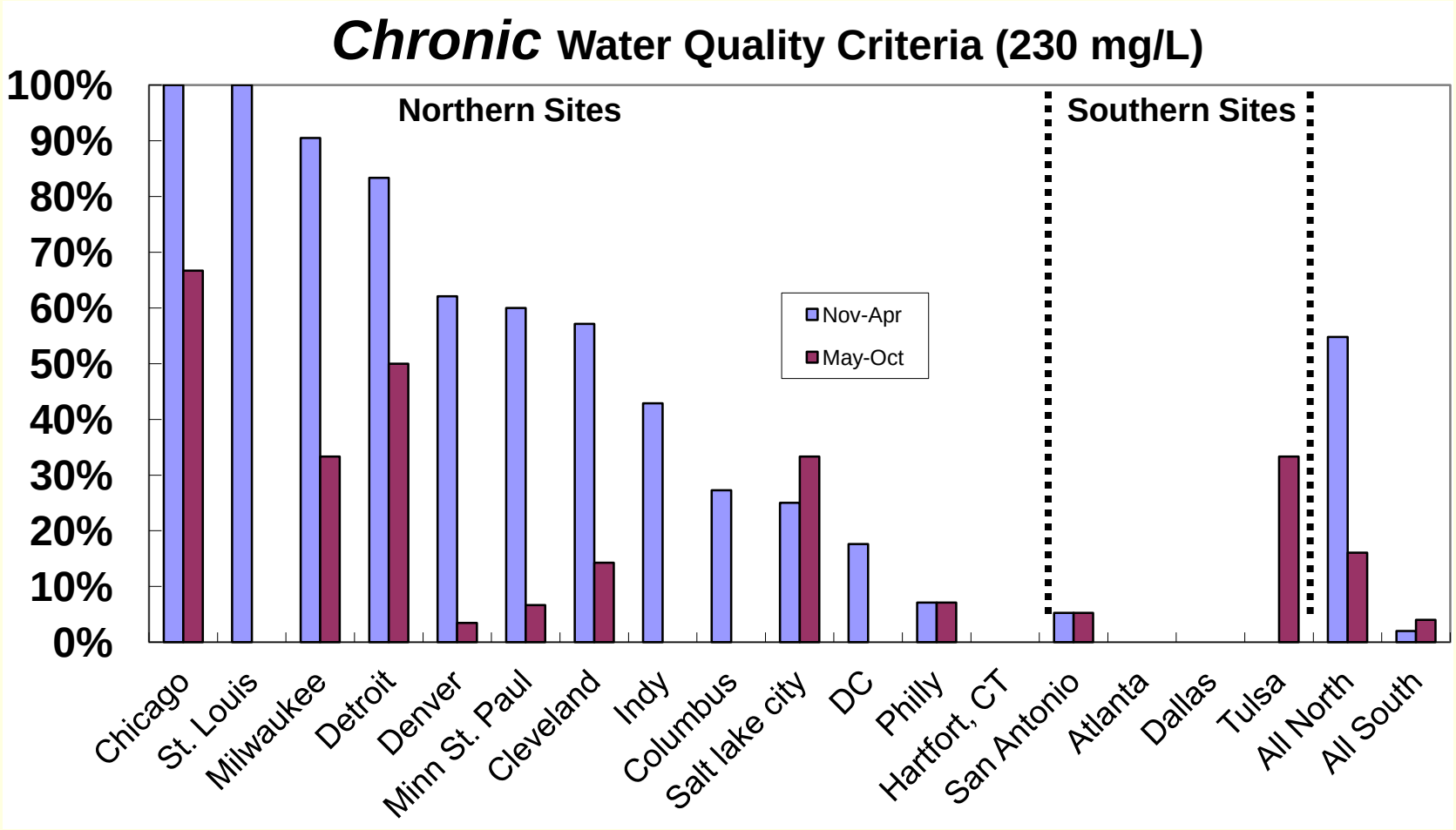


National: Exceedances of EPA Water Quality Criteria for Cl



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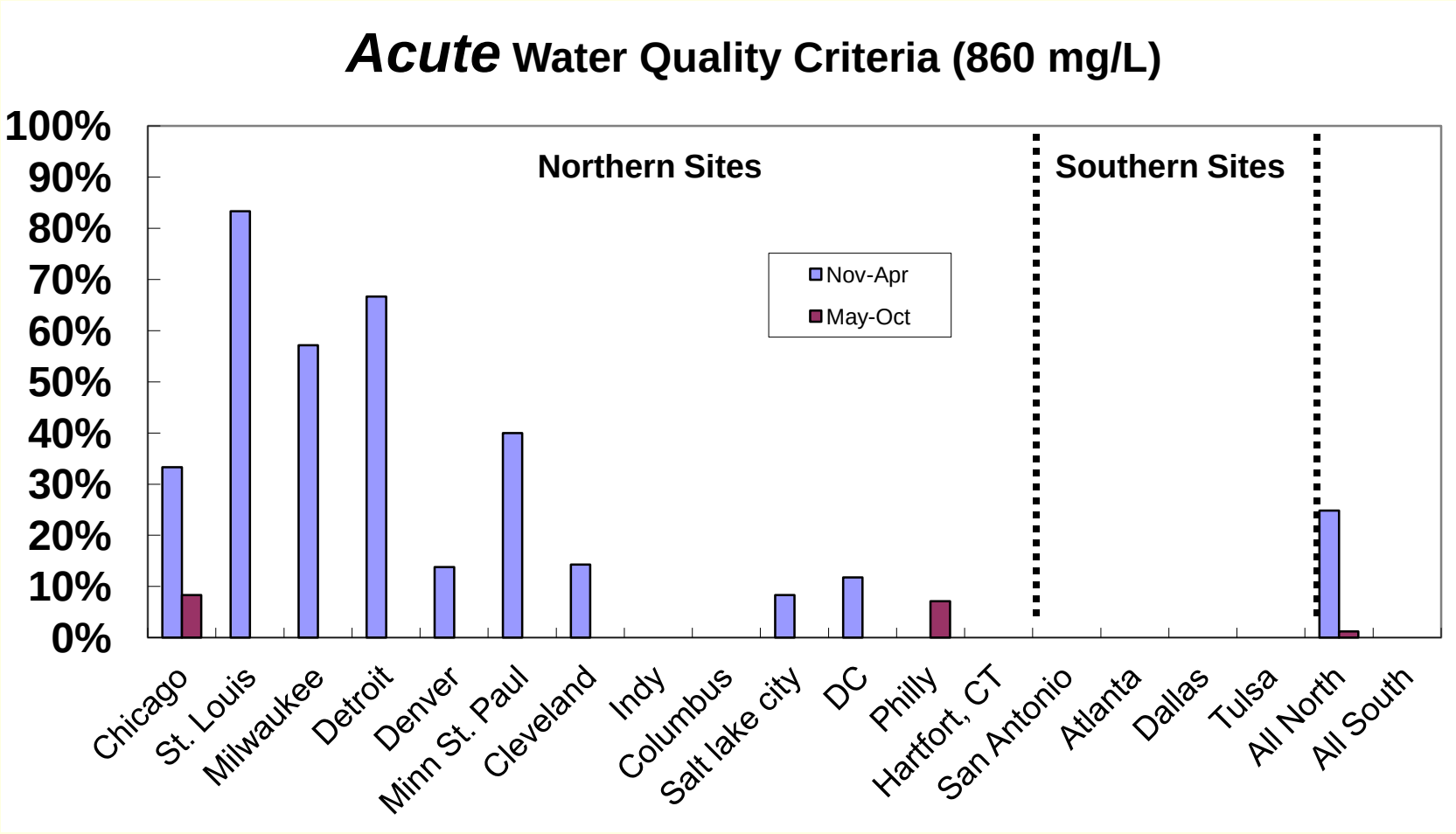
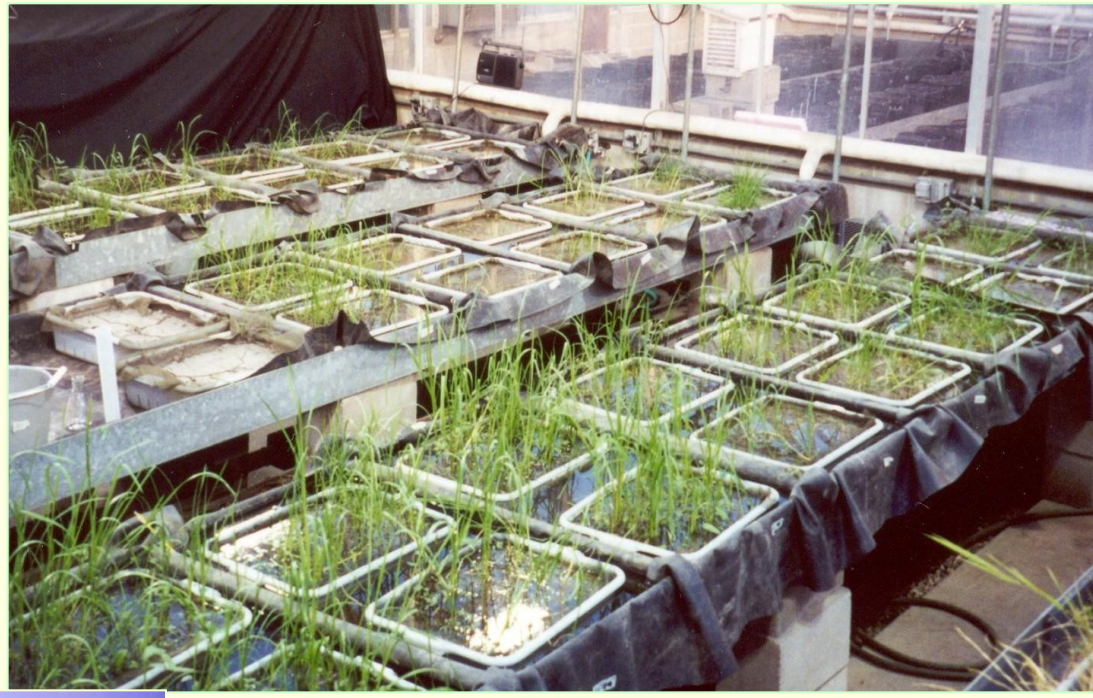


USGS Study Conclusions

- **Locally:** Milwaukee area
  - 2007: Aquatic Toxicity was observed over multiple streams
  - 1996-2007: Aquatic Toxicity was observed over multiple years during runoff events
  - Elevated Cl concentrations occur over ***extended durations***
- **Regionally:** Green Bay, Milwaukee, Madison
  - Elevated Cl occurs throughout the region
    - great potential to impact aquatic toxicity
  - Severity of impact increases with urban land use
  - Road salt influence extends through warm-weather months
- **Nationally:** Metropolitan areas
  - Results from the northern US indicate a likelihood of ***widespread aquatic toxicity impact***

Area of Impact	Examples of impacts
Aquatic Life	• Mortality, low growth, poor reproductive behavior.
Human health	• Hypertension (excess sodium in drinking water) • Cyanide release from ferrocyanide additives
Infrastructure	• Corrosion of bridges, etc.
Vegetation	• Osmotic imbalance • Increase in invasive species - wetlands
Soil	• Inhibition of soil bacteria • Changes in soil chemistry and loss of soil fertility

Effects of Road Salt on Glacial Marshes



•Experiment was run for 28 wks (Nov 2000-June 2001)

Stefanie Miklovic
Susan Galatowitsch

University of Minnesota

Conclusions

- **High levels of NaCl can suppress establishment of a native marsh community and favor the establishment of salt-tolerant invasives.**

- **Road salt runoff can lead to pronounced chloride gradients in wetlands; chloride concentrations in contaminated areas of the wetlands can reach levels that may impact individual plant species or community productivity.**

NARROWLEAF CATTAIL

Caution: This species can be very invasive in disturbed wetlands. Please read about the environmental concerns under


County Court House

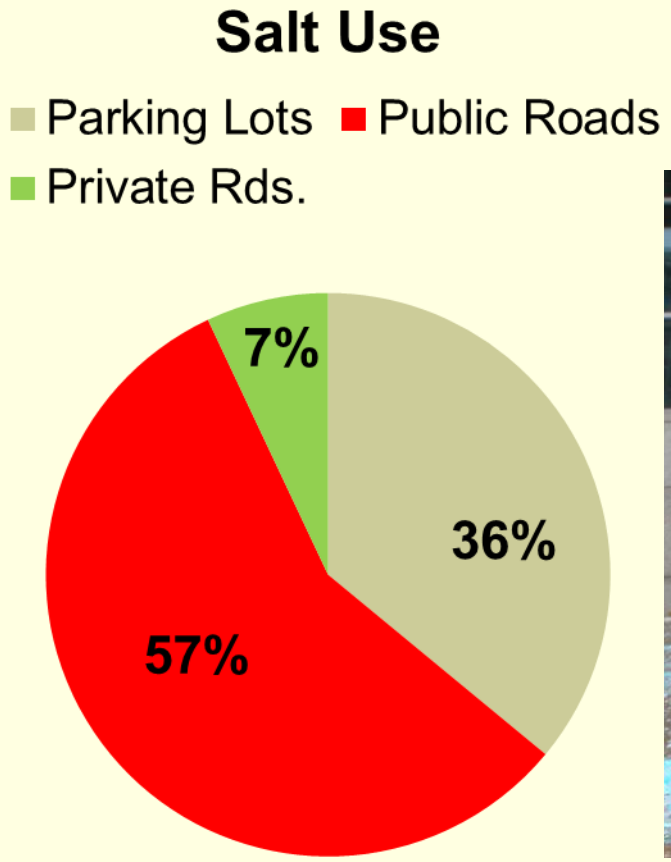
Goals for COE Road Salt Reduction Sub-Committee

- **Identify Amount of Salt Use**
- **Review current practices in and outside of Madison**
- **Discuss environmental impacts**
- **Consider potential management options**
- **Present results to City of Madison and others**

Private Applicators Use Almost the Same Amount of Salt on Parking Lots as the City uses on City Streets

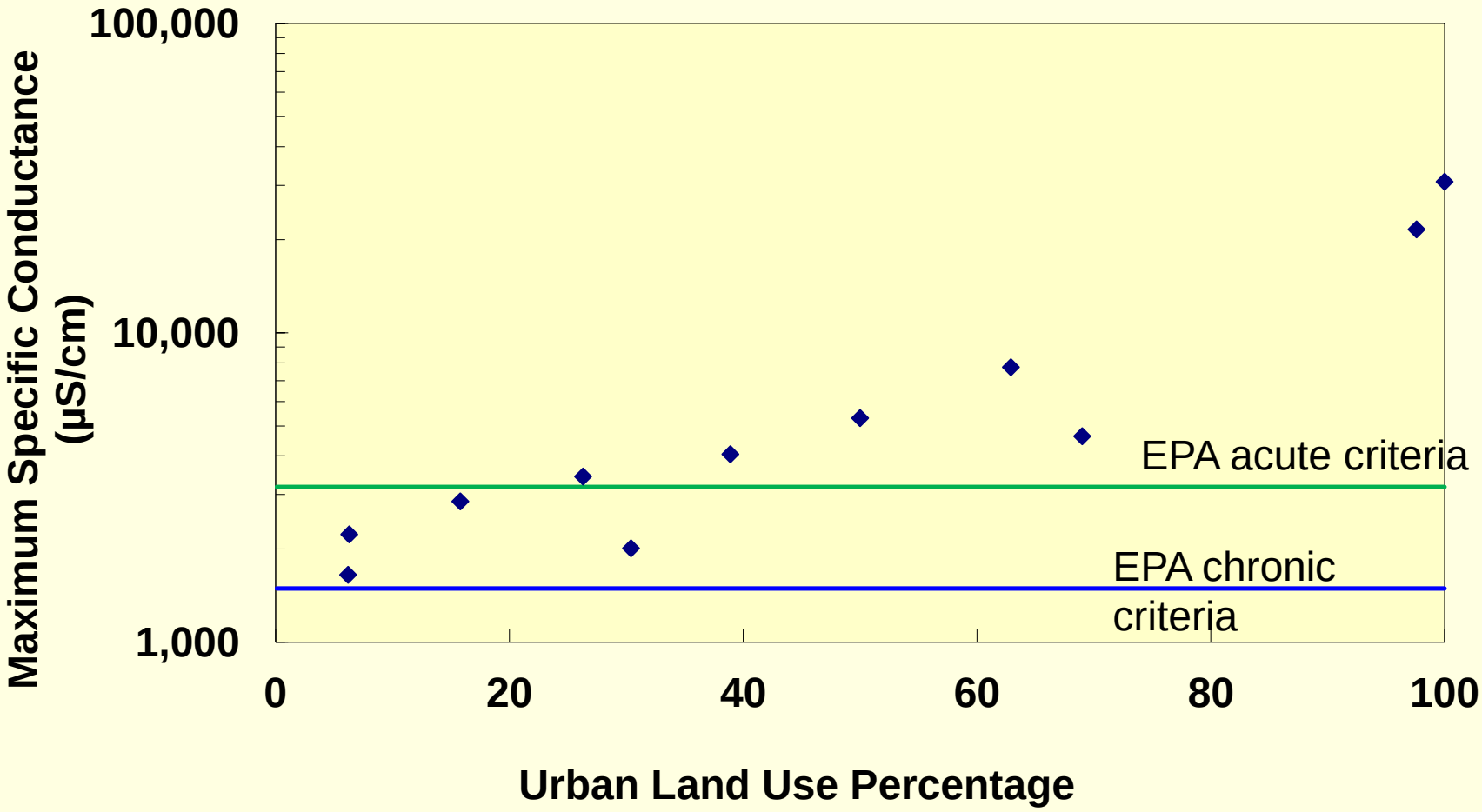
Assumptions: 0.14 tons\acre x 3200 acres x 20 events = 9000 tons

Salt Use Breakdown in New Hamshire Study

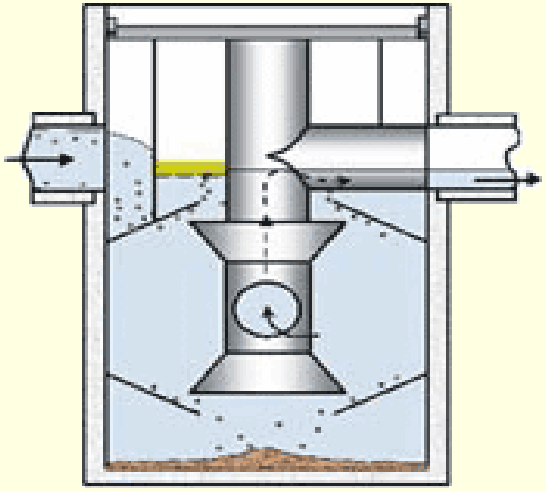


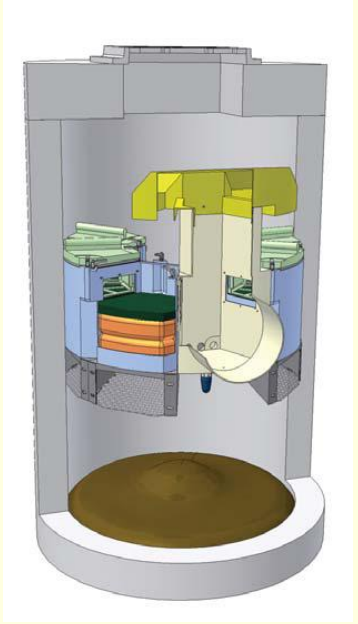
Road salt influence by land use

Maximum specific conductance from continuous monitoring

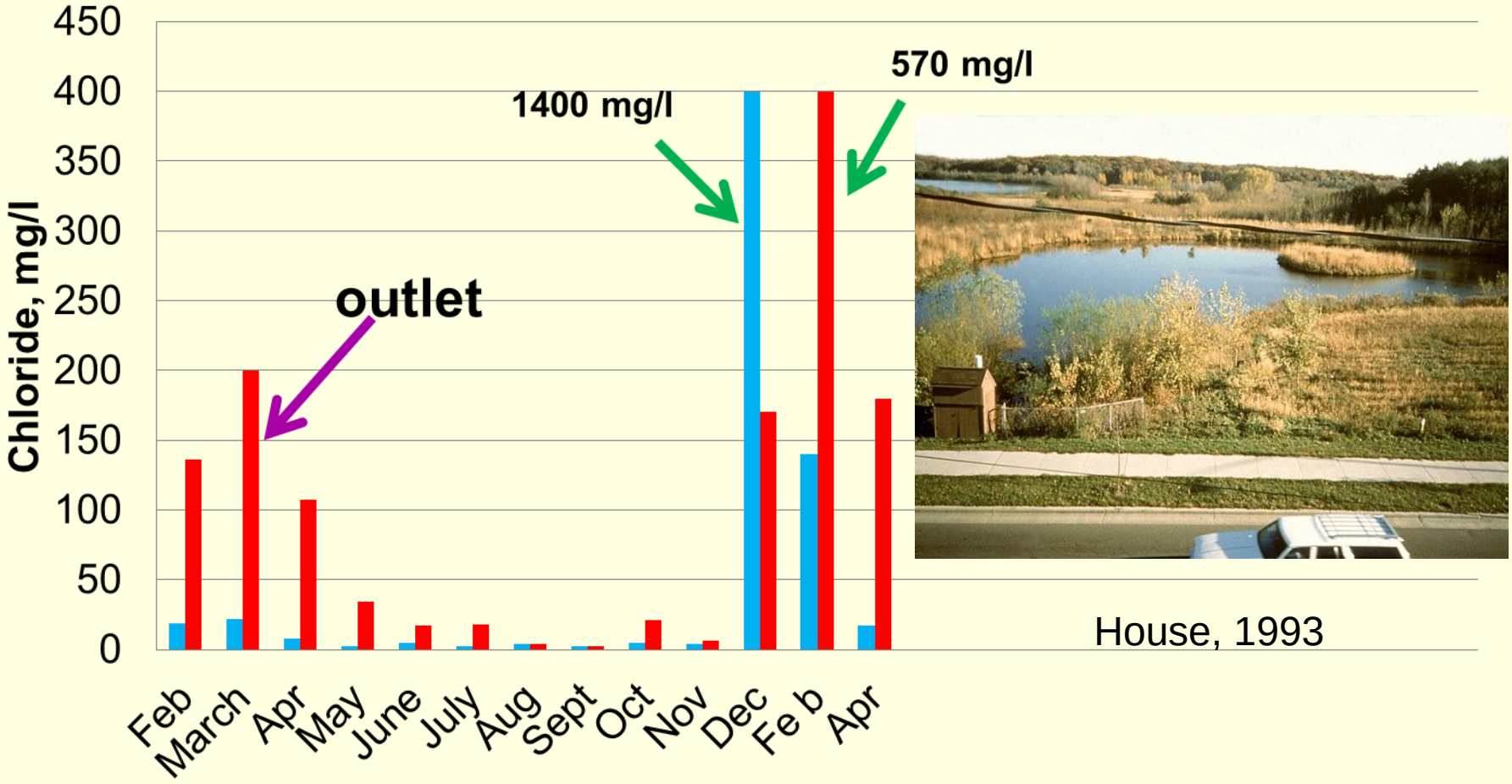


No Stormwater Treatment Practice Removes Chloride



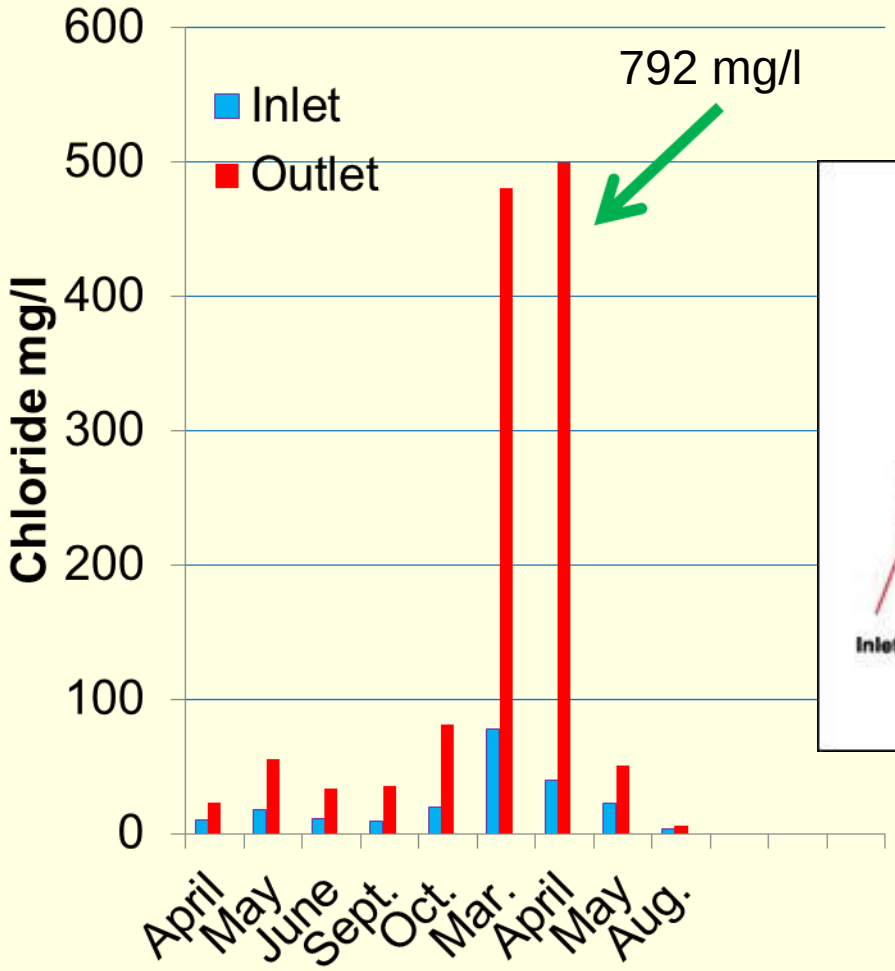


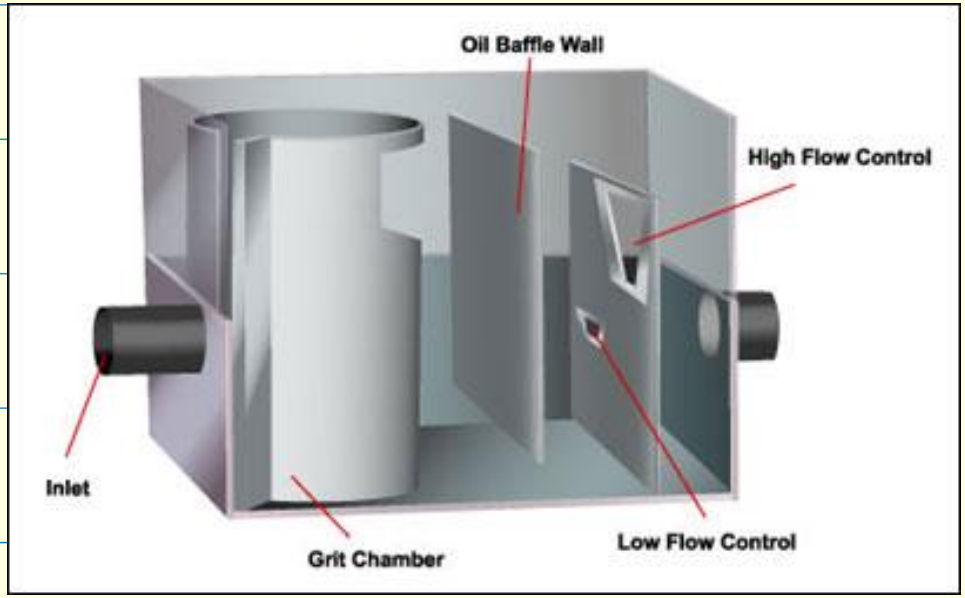
Inlet and Outlet Chloride Concentrations- Monroe St. Wet Pond Feb 1987 to April 1988



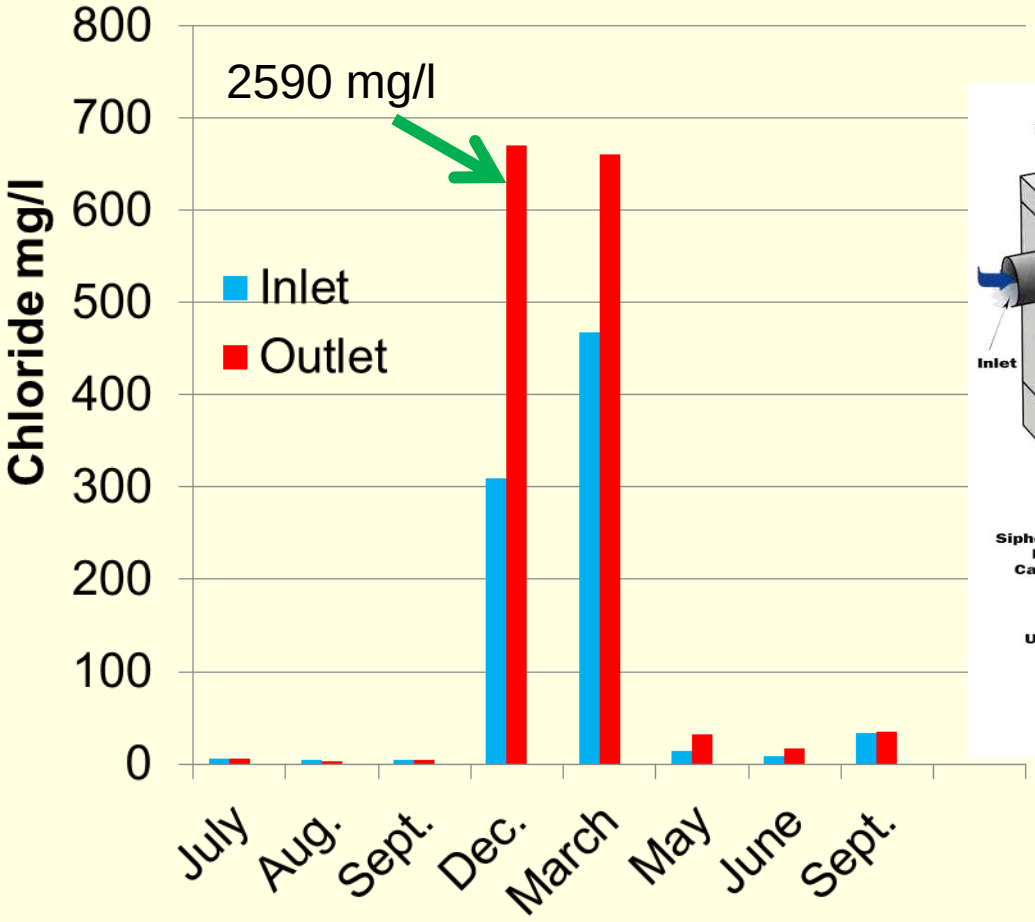
House, 1993

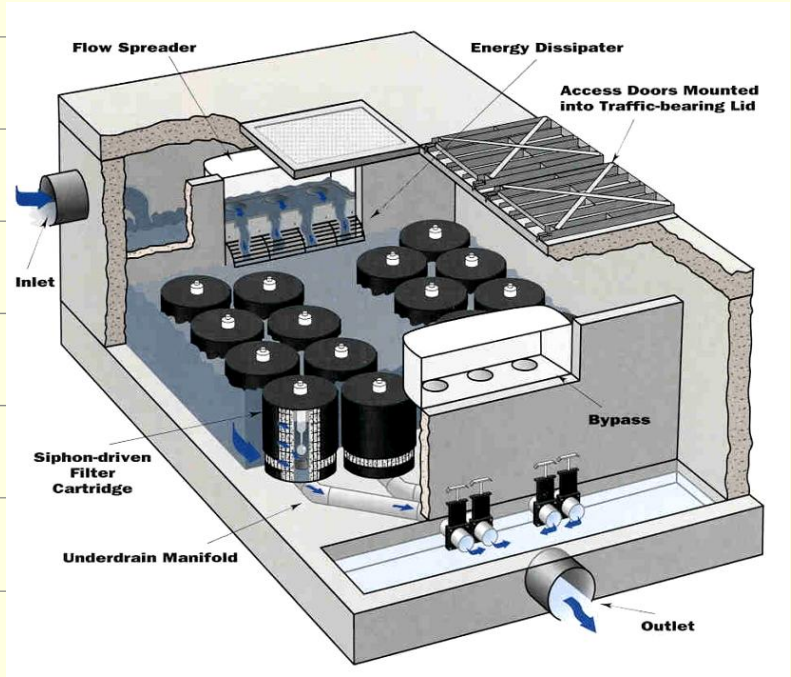
Hydrodynamic Separator Inlet and Outlet Chloride Concentrations – Hwy. 794 2003 to 2004





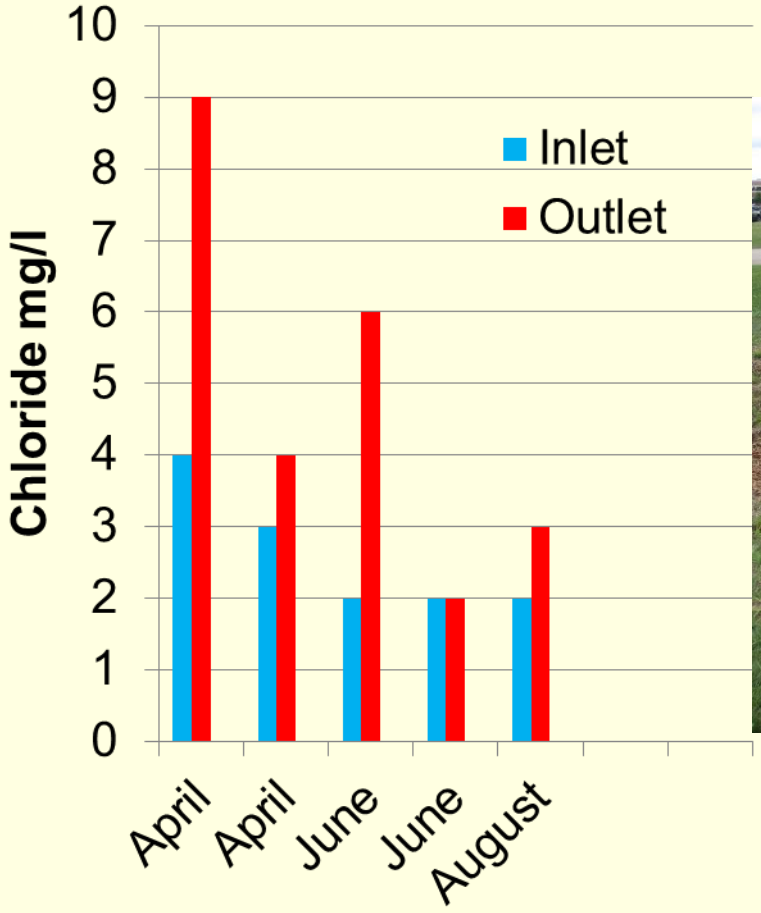
StormFilter Inlet and Outlet Chloride Concentrations at Hwy 794 in Milw. – 2002 to 2004





Horwatich, 2010

Bioretention Inlet and Outlet Chloride Concentrations – Neenah 2011



Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations - Completed December 11, 2006

- Expect Recommendations to Reduce Salt Use By About 20 to 30 Percent without compromising safety.

Snow and Ice Cover - Porous Asphalt Versus Regular Asphalt

Lots one-hour after plowing, -4*C (11AM on 2/3/07)

Robert Roseen, 2011

More Future – Look for Alternatives

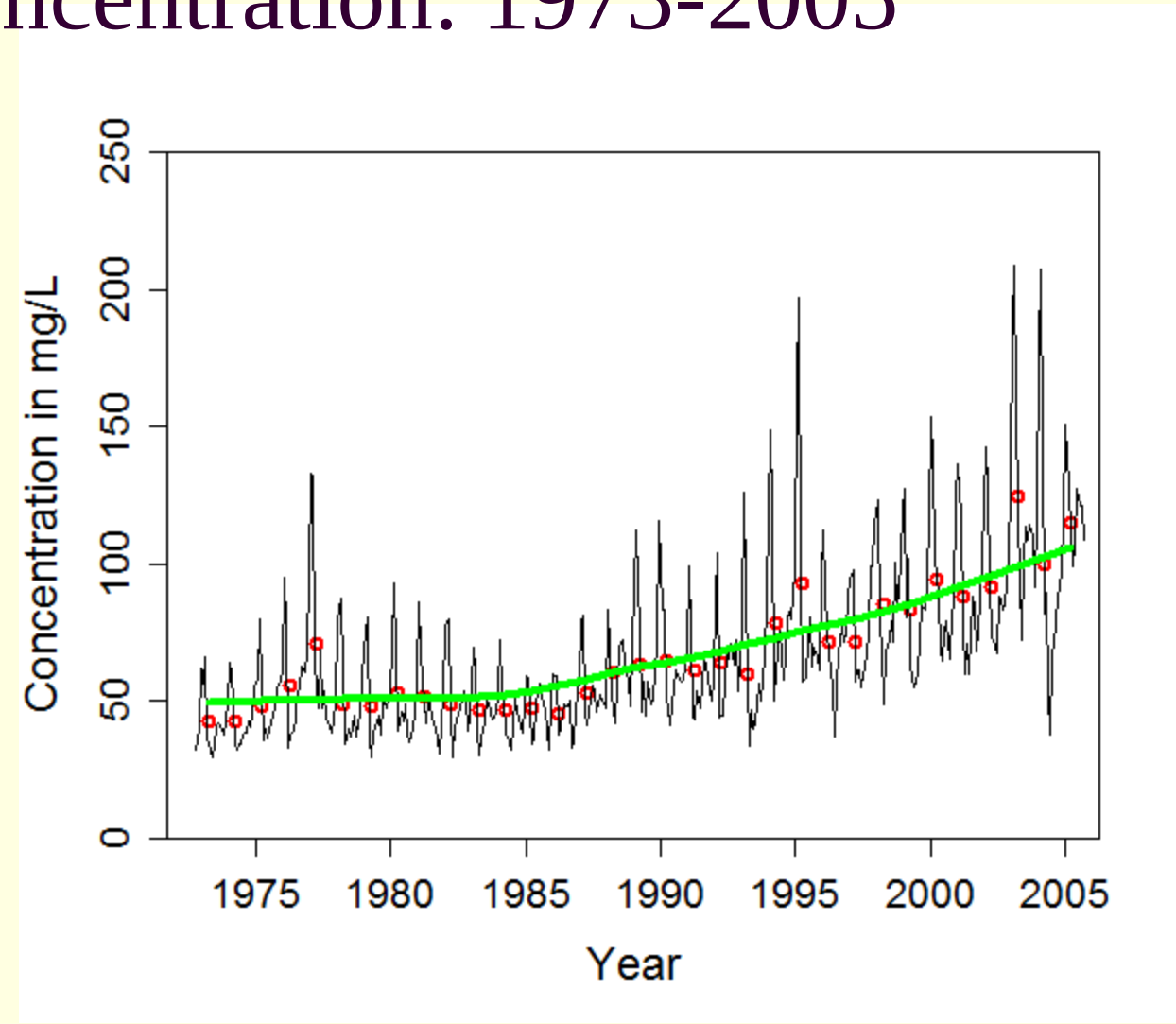
$MgCl_2$ (Magnesium Chloride) –Often used to wet NaCl crystals to increase adherence to road and reduce melting points. Corrosive. Higher cost.

$CaCl_2$ (Calcium Chloride) –Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost.

CMA (Calcium Magnesium Acetate) –Liquid CMA is used mainly on automated bridge deicing systems. Non-corrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibiter. Alternative for areas where chloride use must be limited. Higher cost.

KAc (Potassium Acetate) –Used on automated bridge deicing systems. Use for anti-icing, deicing and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.

Milwaukee River Chloride Concentration: 1973-2005



Source: USGS. Long term monitoring data for chloride and streamflow was used as input to the Weighted Regression on Time Discharge and Season (WRTDS) model. Contact: Steve Corsi, USGS

We Can Buy Some Time - But in the Longterm Need to Find Alternatives and Adjust Public Expectations

Beet Juice Added to Brine

Questions ?

Roger Bannerman
WDNR

Steve Corsi
USGS

Jim Lorman
Edgewood College