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HOSTS





Lake Simcoe Region
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A Watershed for Life

Salt and Stormwater: The Issues, Challenges and Not so Easy Solutions

David Lembcke and Bill Thompson

Lake Simcoe Region Conservation Authority

Tim VanSeters

Toronto and Region Conservation Authority

Winter Salt Use

- 3 – 5 million tonnes applied annually in Canada
- Primary anti-icing tool in Ontario
 - Roads, parking lots, sidewalks, playgrounds.....
 - Increasing expectation / adoption of 'bare pavement' standard
- Road salt usage makes winter driving safer
- Corrosion costs ~\$143/car/year
- Corrosion of infrastructure
 - Steel, concrete, asphalt, bridges, parking garages
- Salt contamination of drinking water sources.



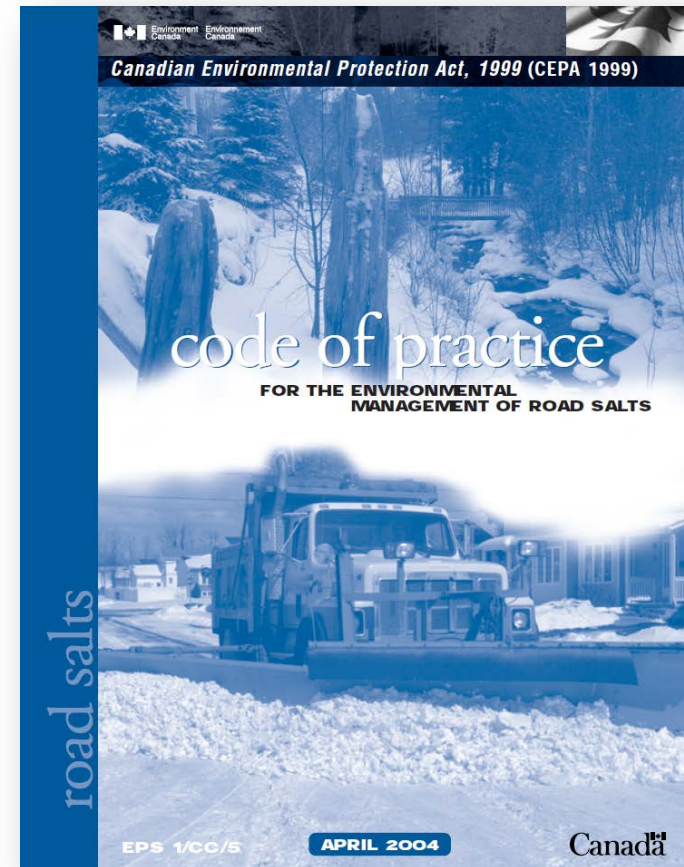
Winter Salt impacts on the Environment

- Vast majority of salt will end up in surface / groundwater
 - days to decades
- Highly soluble and concentrations in water are unaffected by chemical reactions
- Affects osmoregulation of freshwater species
- 2011 CCME Guideline
 - Chronic (long term) = 120 mg/L
 - Acute (short term) = 640 mg/L



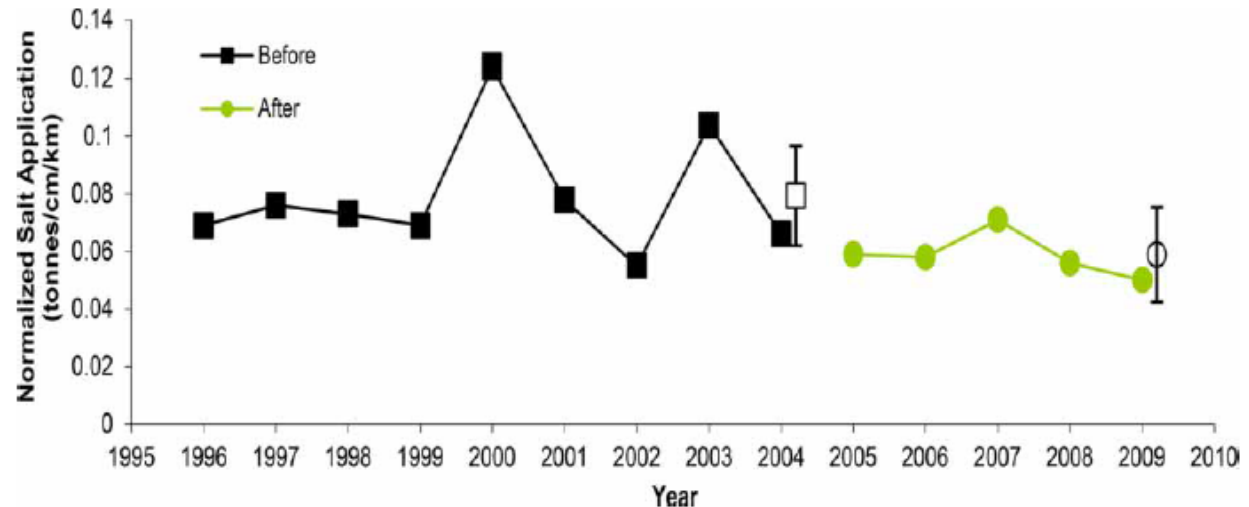
Environment Canada “Priority Substances List Assessment Report: Road Salt” 2001

- Therefore, it is concluded that road salts that contain inorganic chloride salts... are “toxic” as defined in Section 64 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999).



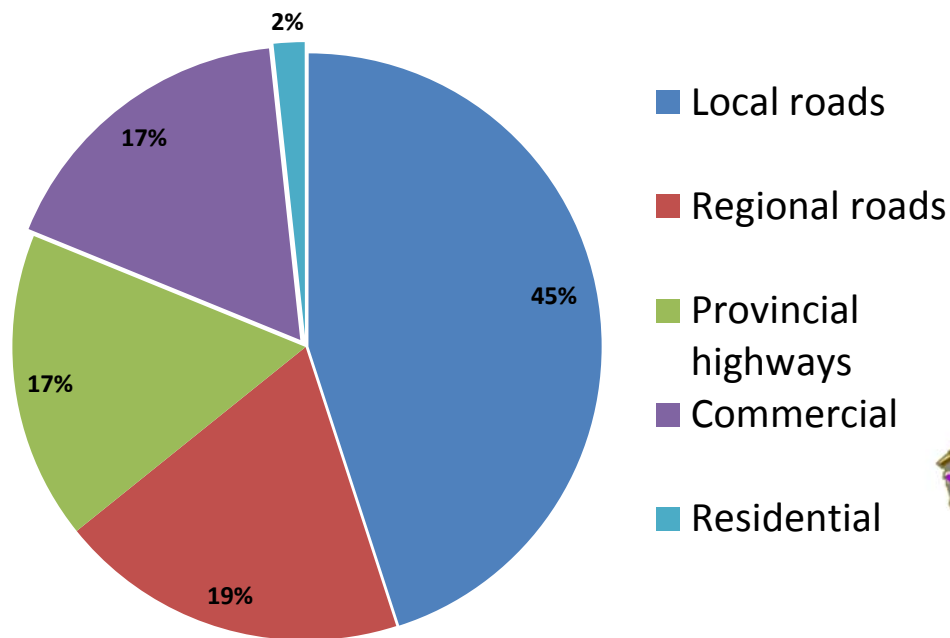
Municipal application rates

City of Toronto,
normalized
application rate
(Kilgour et al 2013)

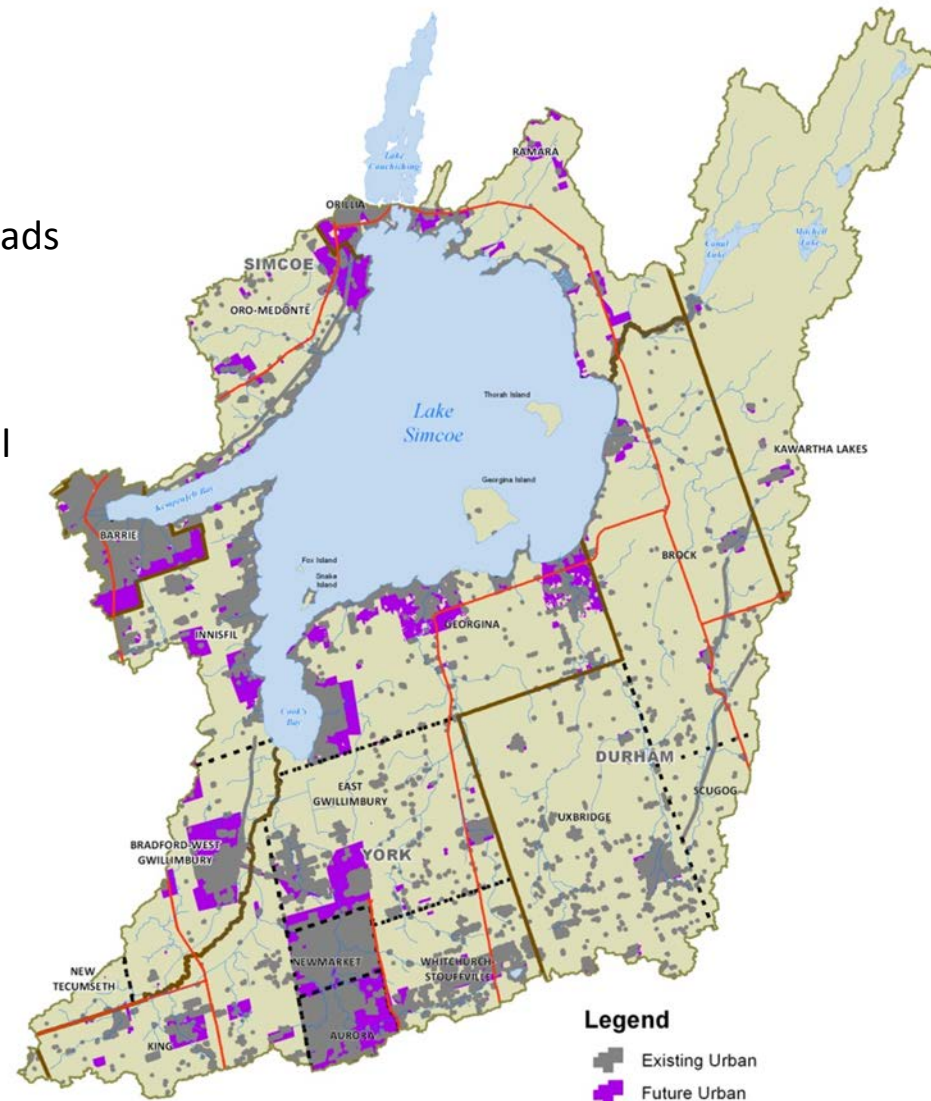


- Code of Practice appears to have contributed to a reduction in the “normalized” application rate of ~26%
- This has not translated to an overall reduction in salt use

Application in Lake Simcoe Watershed

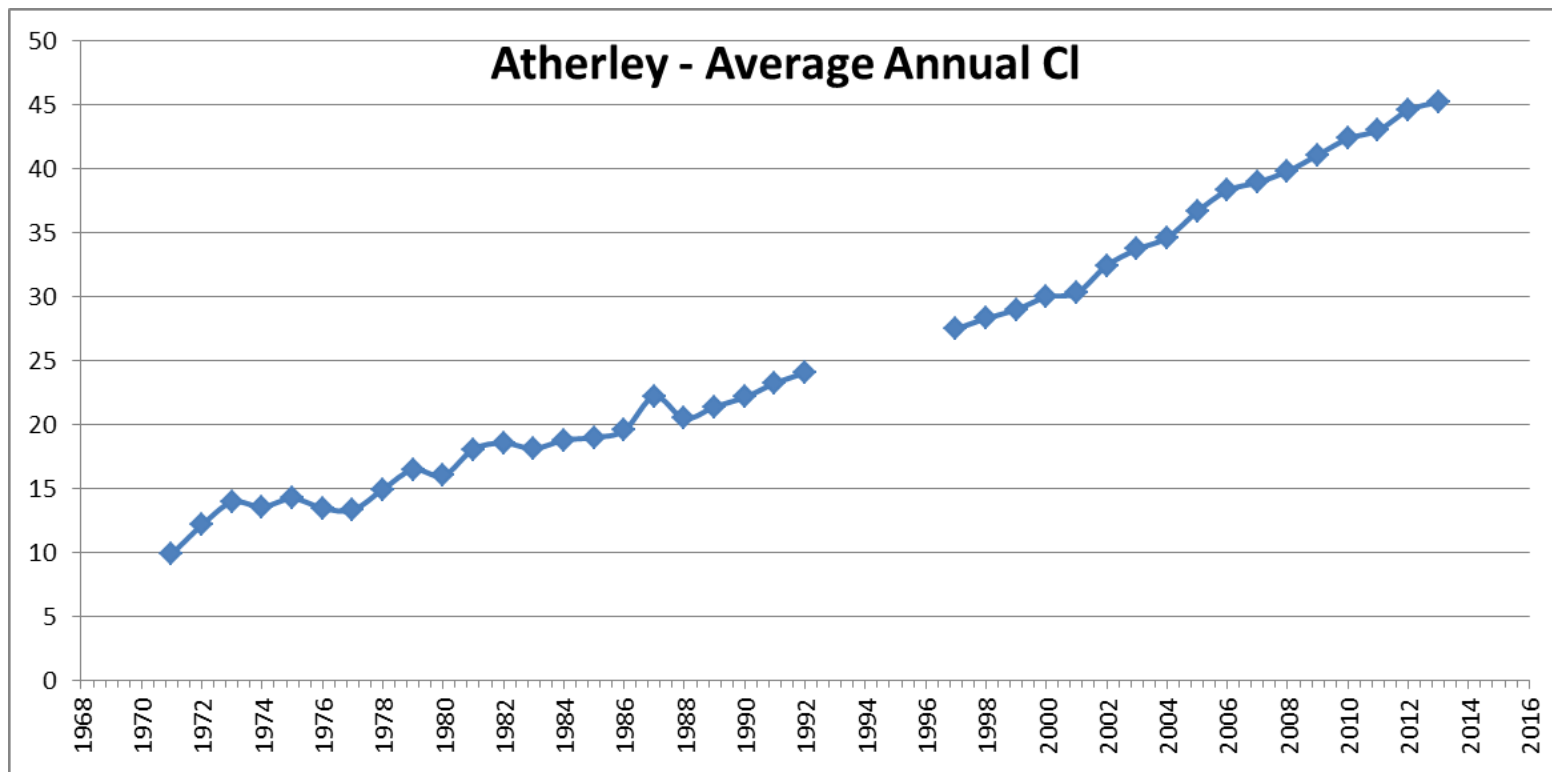


- Total of 90,000 T in 2012
- Equivalent to 225 kg of salt per capita
 - that is 2.5 of me!



Lake Simcoe Chloride Trends

- Concentrations have been increasing at a rate of 0.7mg/l/year (2013 = 45.24 mg/l)
- By 2120 Cl will exceed 120mg/l guideline



Benchmark Chloride Concentrations

- Ocean salt concentration = 35,000mg/L
 - 55% Cl = 19,250mg/L
 - 45% Na = 15,750mg/L
- Unimpacted lakes on Canadian Shield = <1 – 7mg/L
- Cooksville Creek Mississauga = 20,000 Cl mg/L
- Max Lake Simcoe Tributary Cl = 6,120 mg/L at Hotchkiss Creek, February 2013

thestar.com
INSIGHT

News / Insight

Blue crabs in Mimico Creek an urban mystery

Where did the salt-water creatures come from? Since they were discovered last summer, experts have been trying to solve the riddle.



Tweet



2

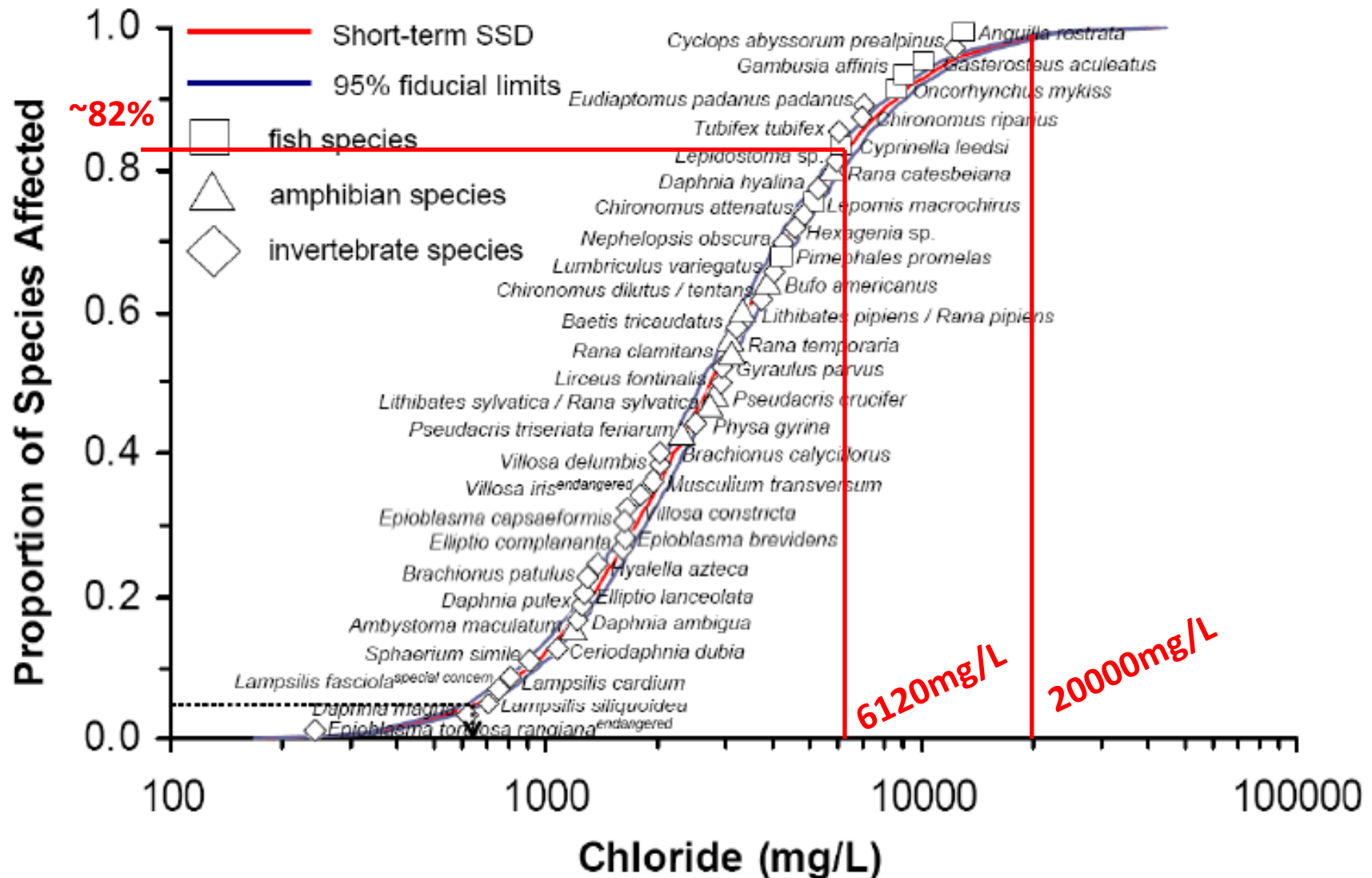


reddit this!



JACQUELYN MARTIN / AP

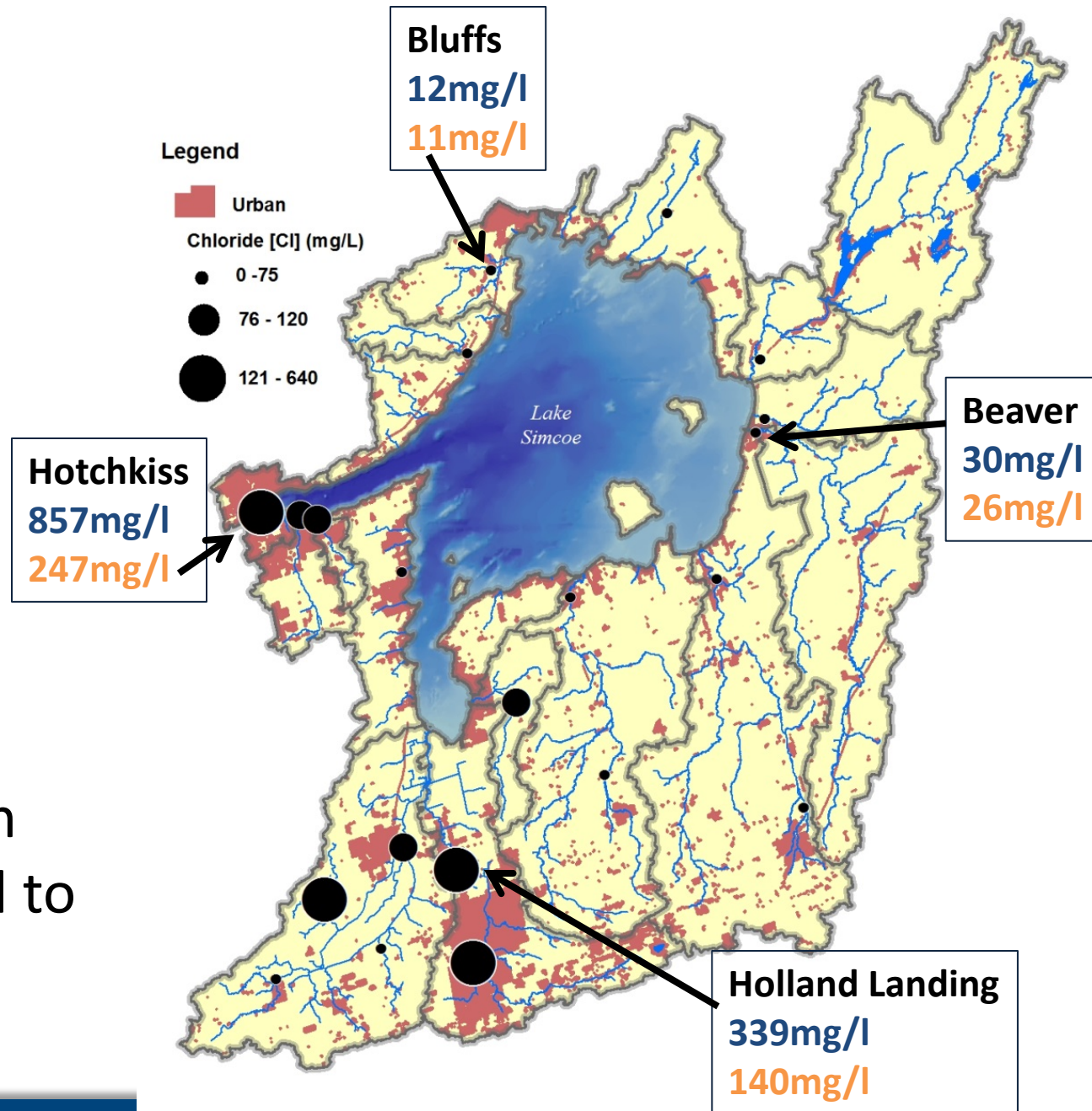
Max Chloride Concentration Impacts



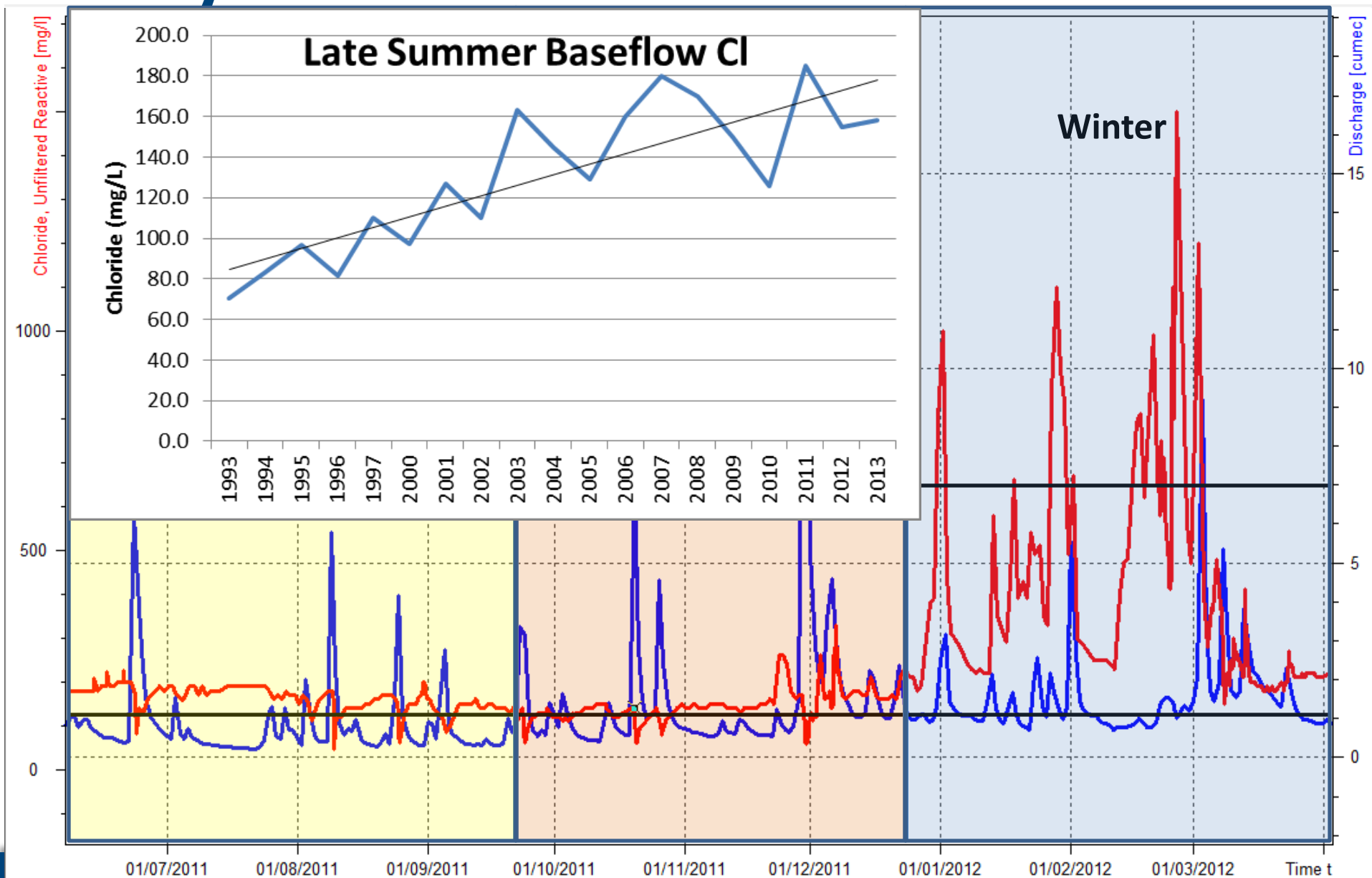
Chloride is a Stormwater Issue

Ave. Cl Concentrations
Winter
Spring, Summer, Fall

- High Chloride concentrations in tributaries linked to urban areas and seasonality



Daily Chloride Concentrations



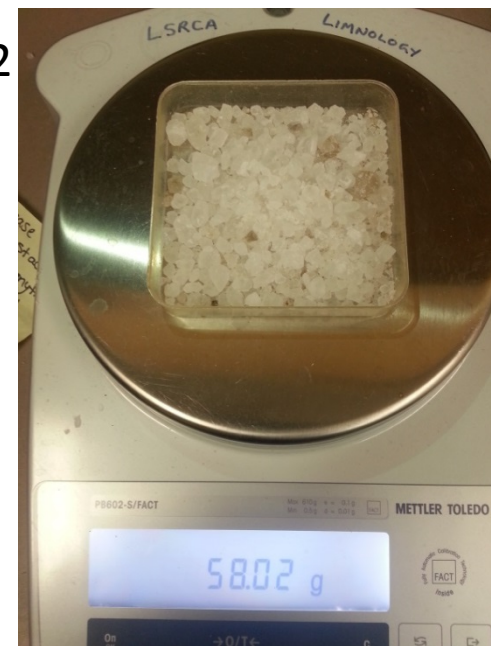
Parking Lot Salt Application

- Monitoring of a large commercial lot (142,000m²) for the 2014/15 winter

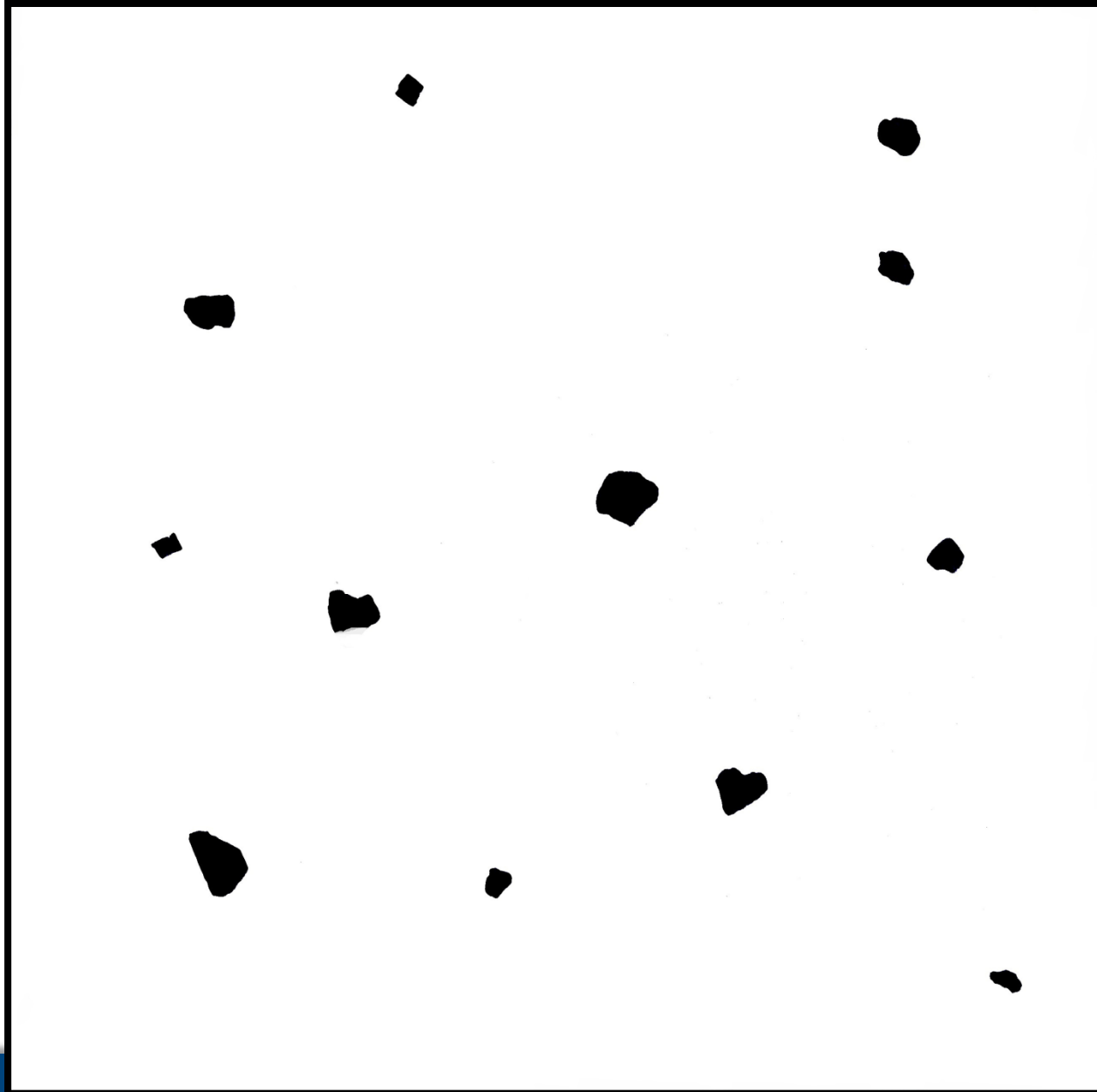


Commercial Lot Application Rates

- Industry reported application rate = $58\text{g}/\text{m}^2$
- @ $58\text{g}/\text{m}^2$ 75 applications (66 in Jan and Feb)
- Disproportionate amount on entrance / walkways and “trouble spots” ($488\text{g}/\text{m}^2$ to $4,766\text{g}/\text{m}^2$)
- Using Municipal application dates (49) rate is closer to $150\text{g}/\text{m}^2$
- If $58\text{g}/\text{m}^2$ were used for the 49 applications the savings in salt would equal \$22,040!



Recommended Application Rate (58g/m²)





5 Days later
5mm rain

Commercial Catchment – Top Draw Outlet

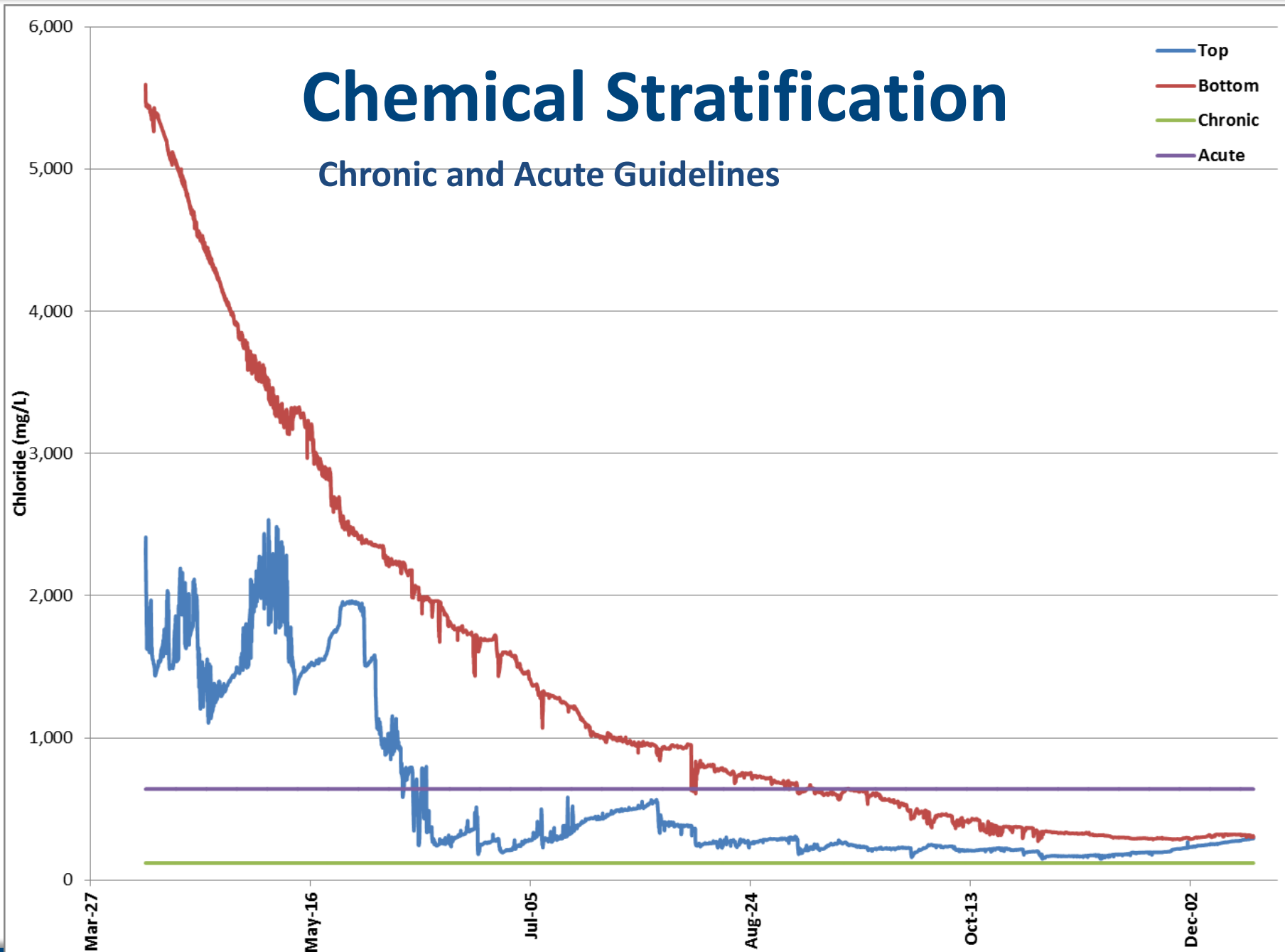


Chemical Stratification

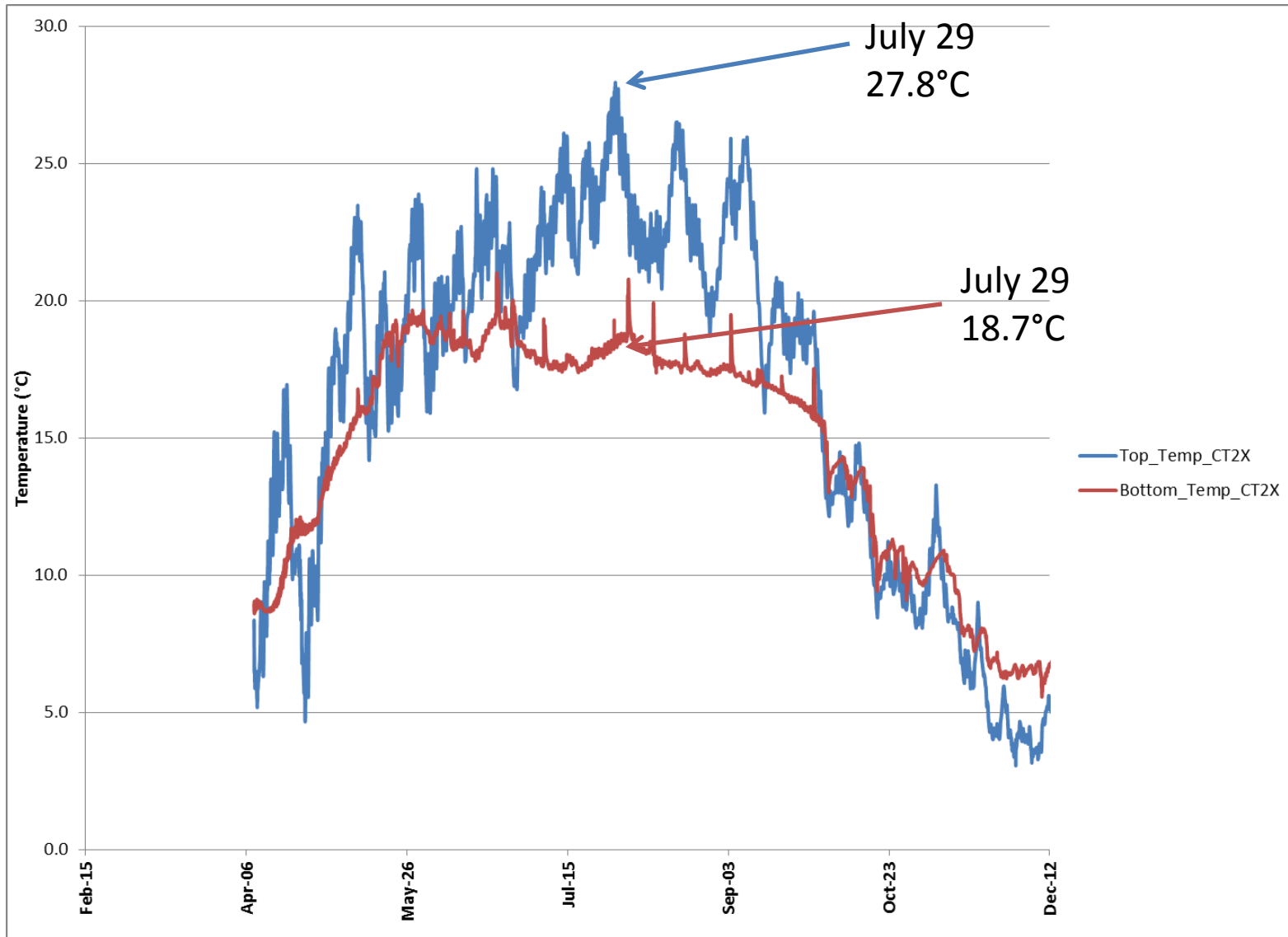
- Prevent mixing and therefore decrease permanent pool volume
- Contribute to pollutant release from bottom sediment (metals and nutrients)
- McEnroe N.A. et al. 2012. Thermal and chemical stratification of urban ponds: Are they 'completely mixed reactors'?
- Mayer T. 2007. Geochemistry and toxicity of sediment porewater in a salt impacted stormwater detention pond
- Marsalek J. 2003. Road salts in urban stormwater: an emerging issue in stormwater management in cold climates

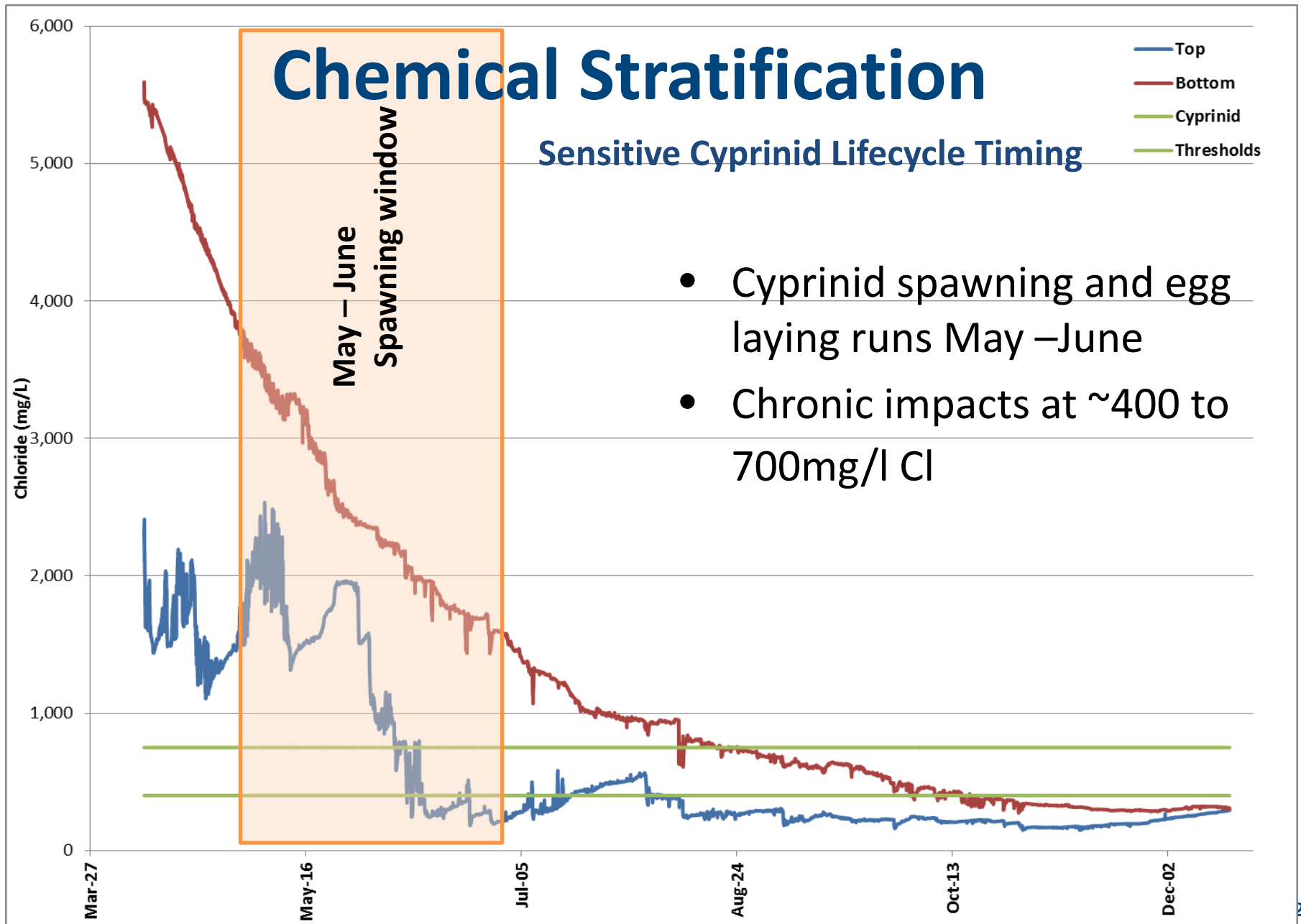
Chemical Stratification

Chronic and Acute Guidelines



Pond Thermal Stratification





Rethinking Wet Ponds

- Does this catchment need a wet pond?
- Is a dry pond better in this instance?
- Should catchment TSS characteristics and winter maintenance practices be considered at the design phase?
- What are the needs / capacity of the receiving water course?



Design Stormwater infrastructure that move salt fast....or Slow?

- How and when should salt be moved to or through the receiving system?
- **Winter to freshet**
 - Greater dilution
 - Short term acute concentrations
 - Aquatic species metabolisms are still slow
- **Spring to summer**
 - Dilution capacity diminishes
 - Year round chronic concentrations
 - Salt exposure during sensitive lifecycle stages
 - Chemo-stratification = poor pond performance

One approach to vulnerability assessment



$$\text{Chloride in streams} = \frac{\text{Chloride applied to watershed}}{\text{Total flow volume}} + \text{Chloride input from groundwater}$$

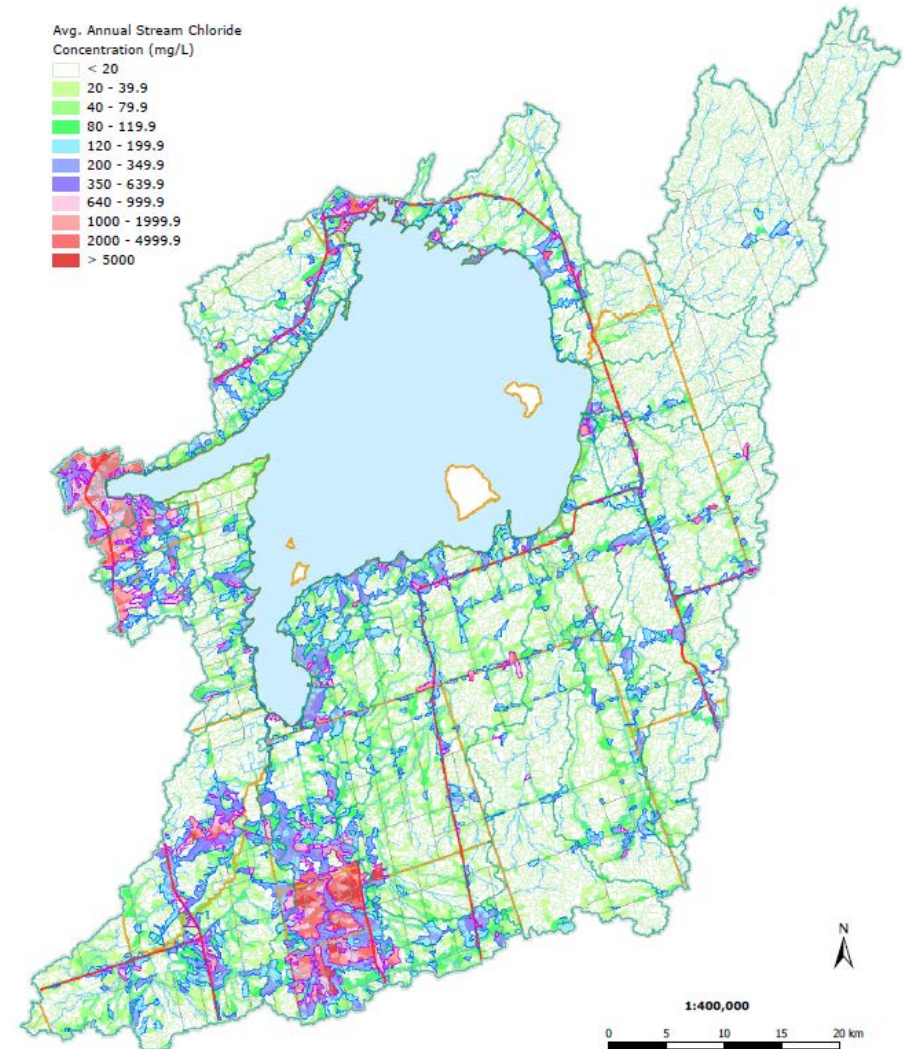
Data needs:

- Salt application rates
- Map of roads and parking lots
- Normalized annual flow
- Map of watersheds
- Baseflow index
- Chloride concentration in baseflow

Betts, 2013

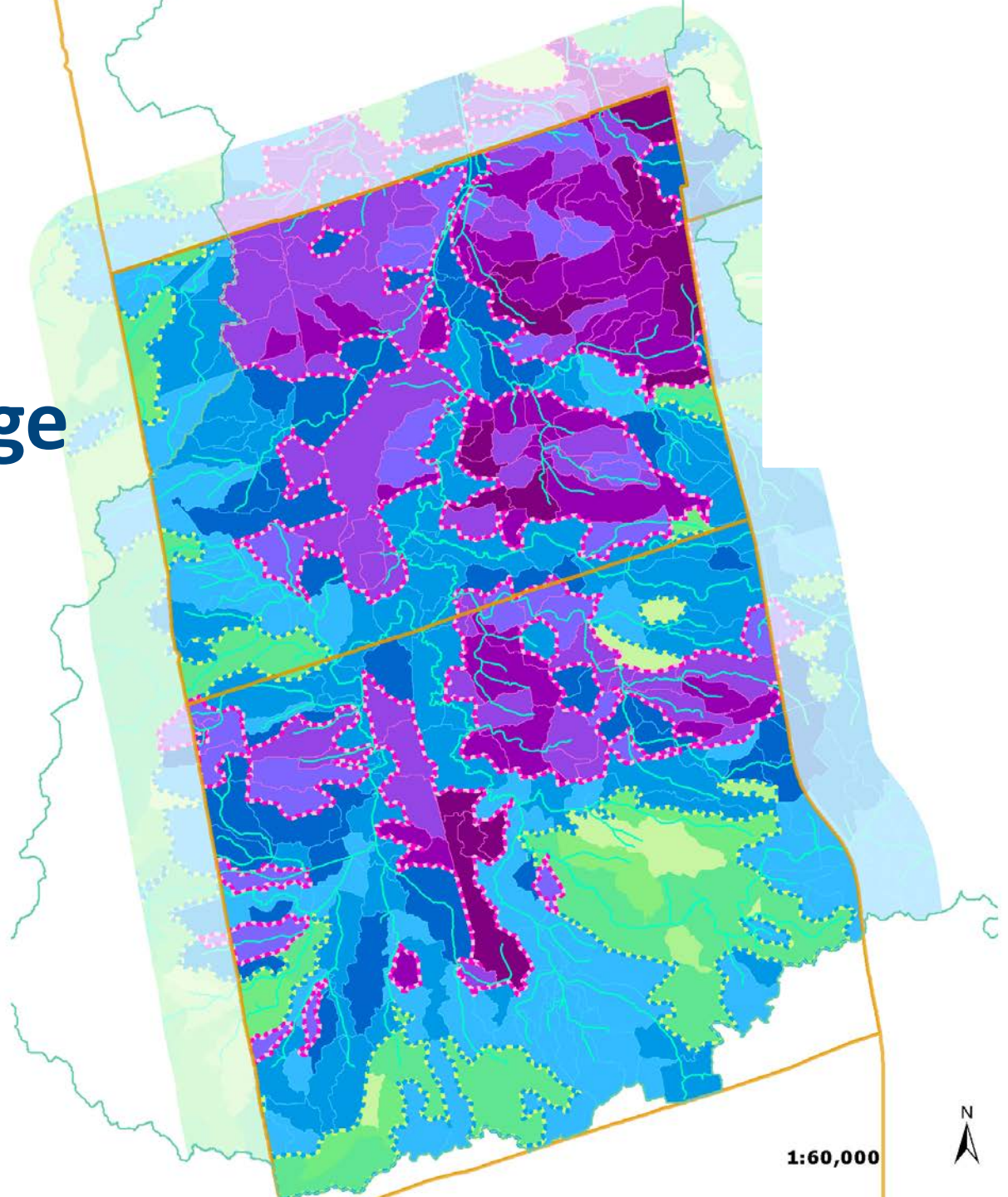
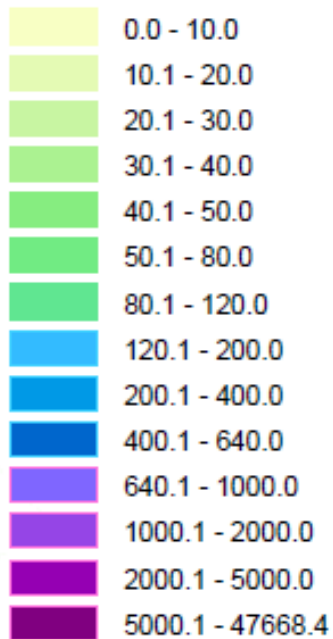
Salt Vulnerability Mapping as a Management Tool

- The best solution will always be to use less salt
- How do we identify problem areas and make better decisions around application rates in vulnerable areas?

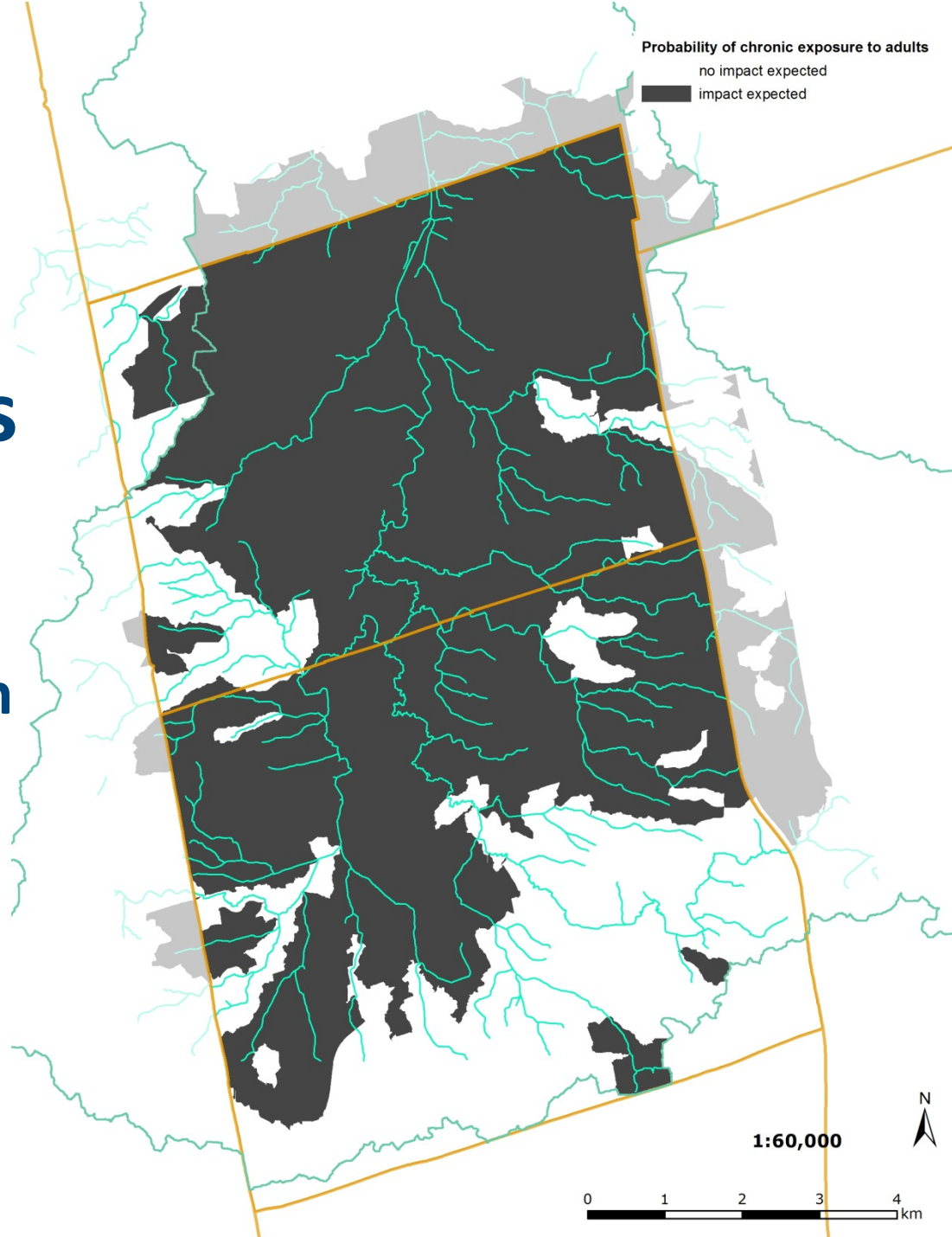


Salt Vulnerability Mapping: Yearly Average

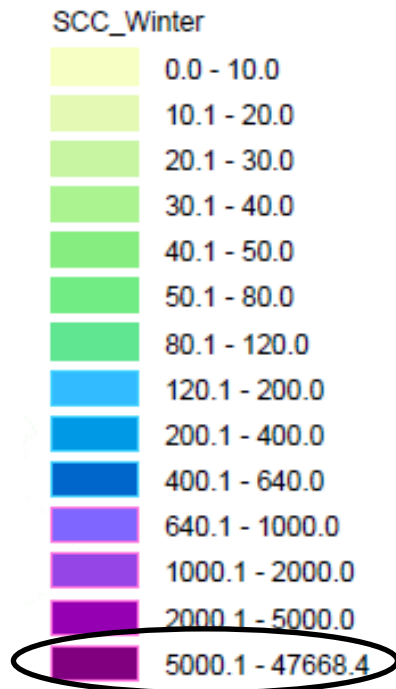
SCC_Winter



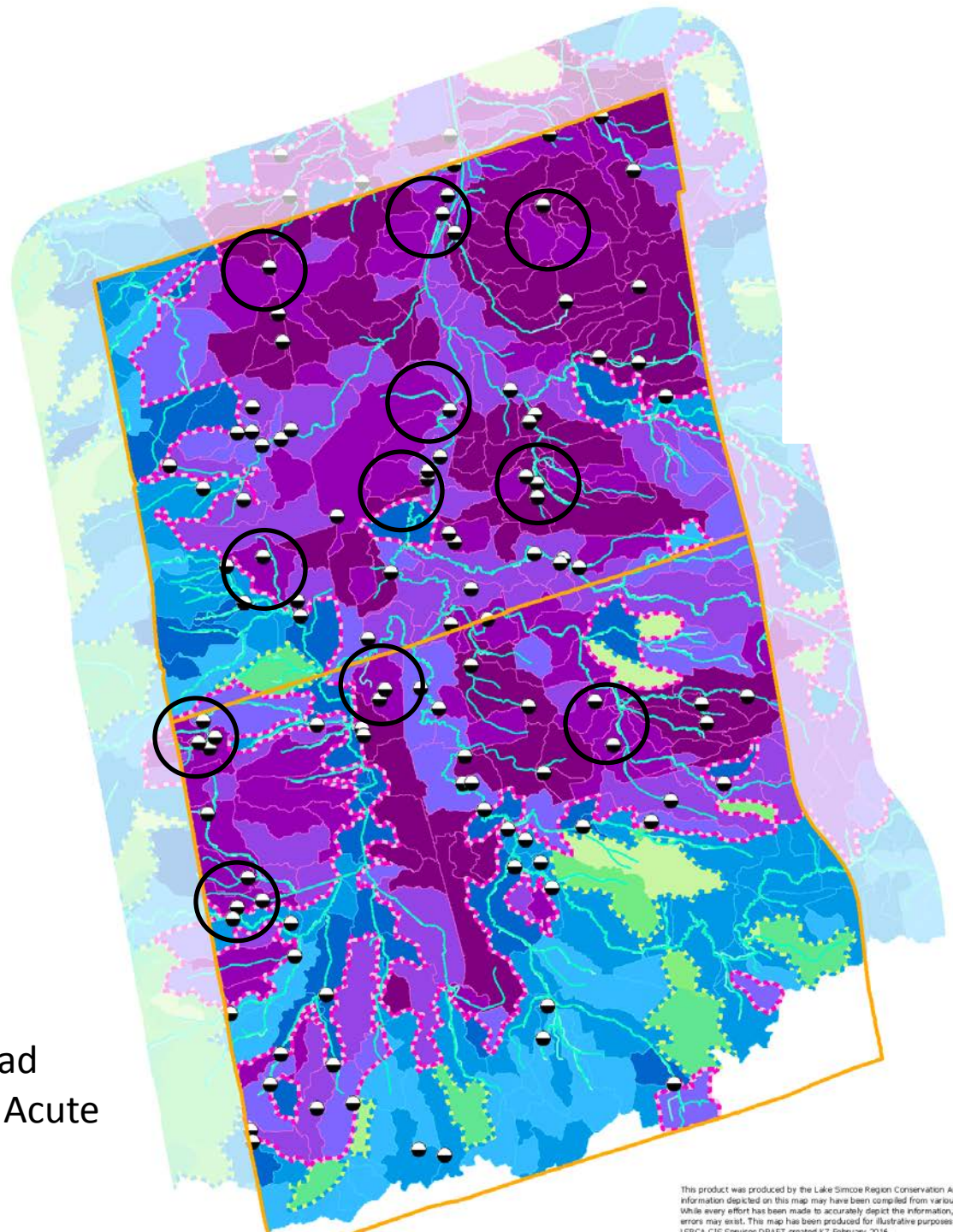
Salt Vulnerability Mapping for Specific Species Sensitivities— Fathead Minnow (annual concentration = chronic adult)



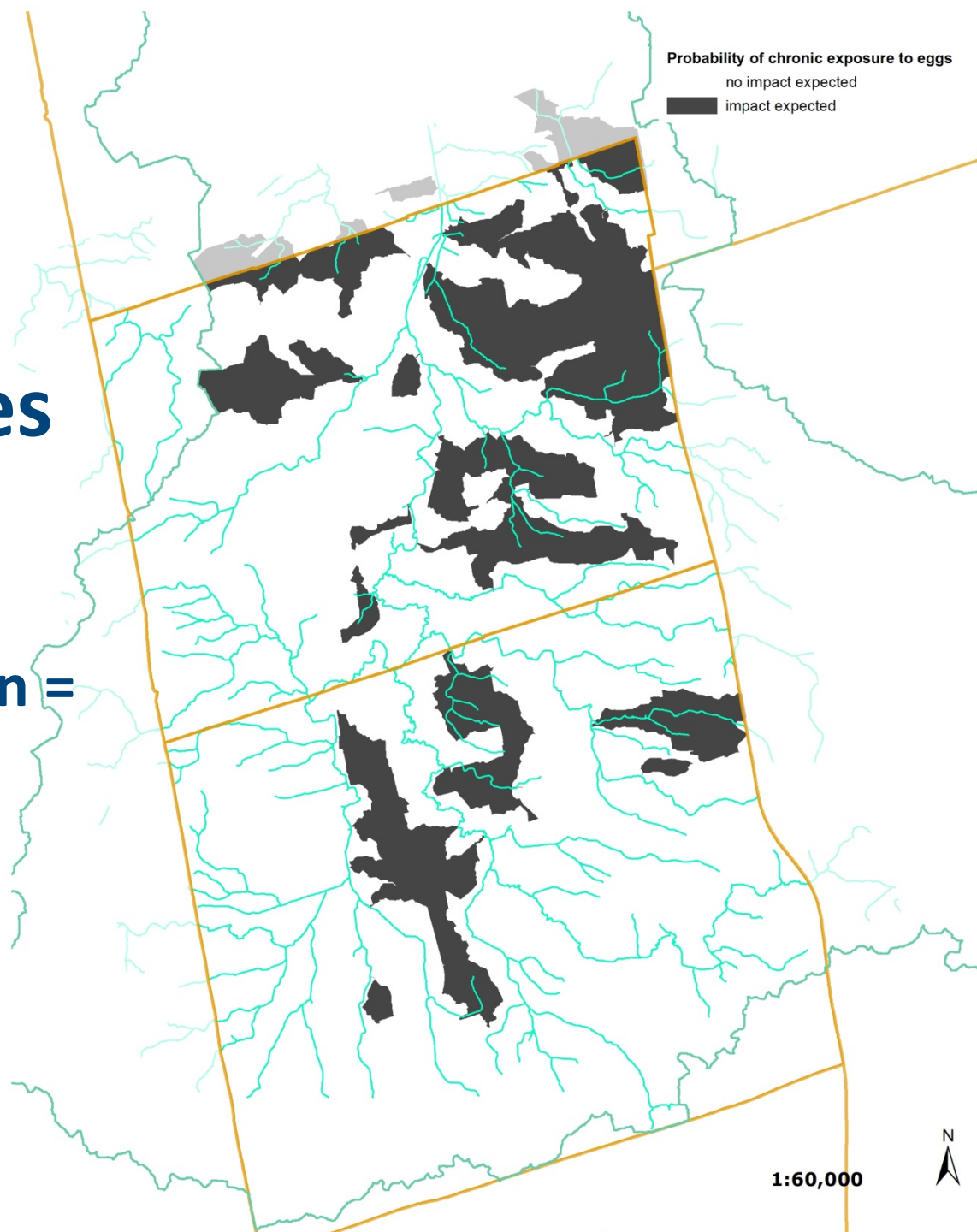
Salt Vulnerability Mapping: Winter



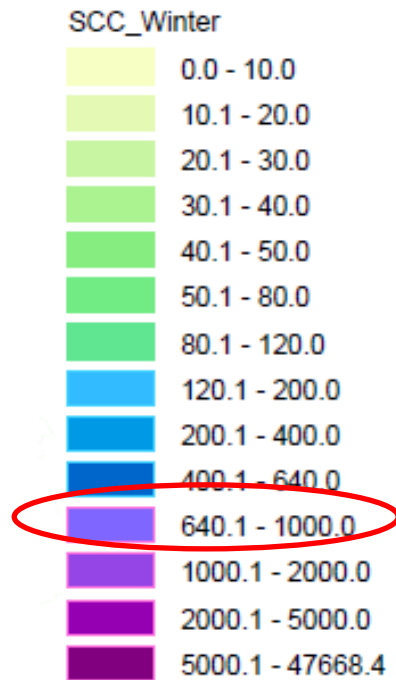
Fathead
Adult Acute



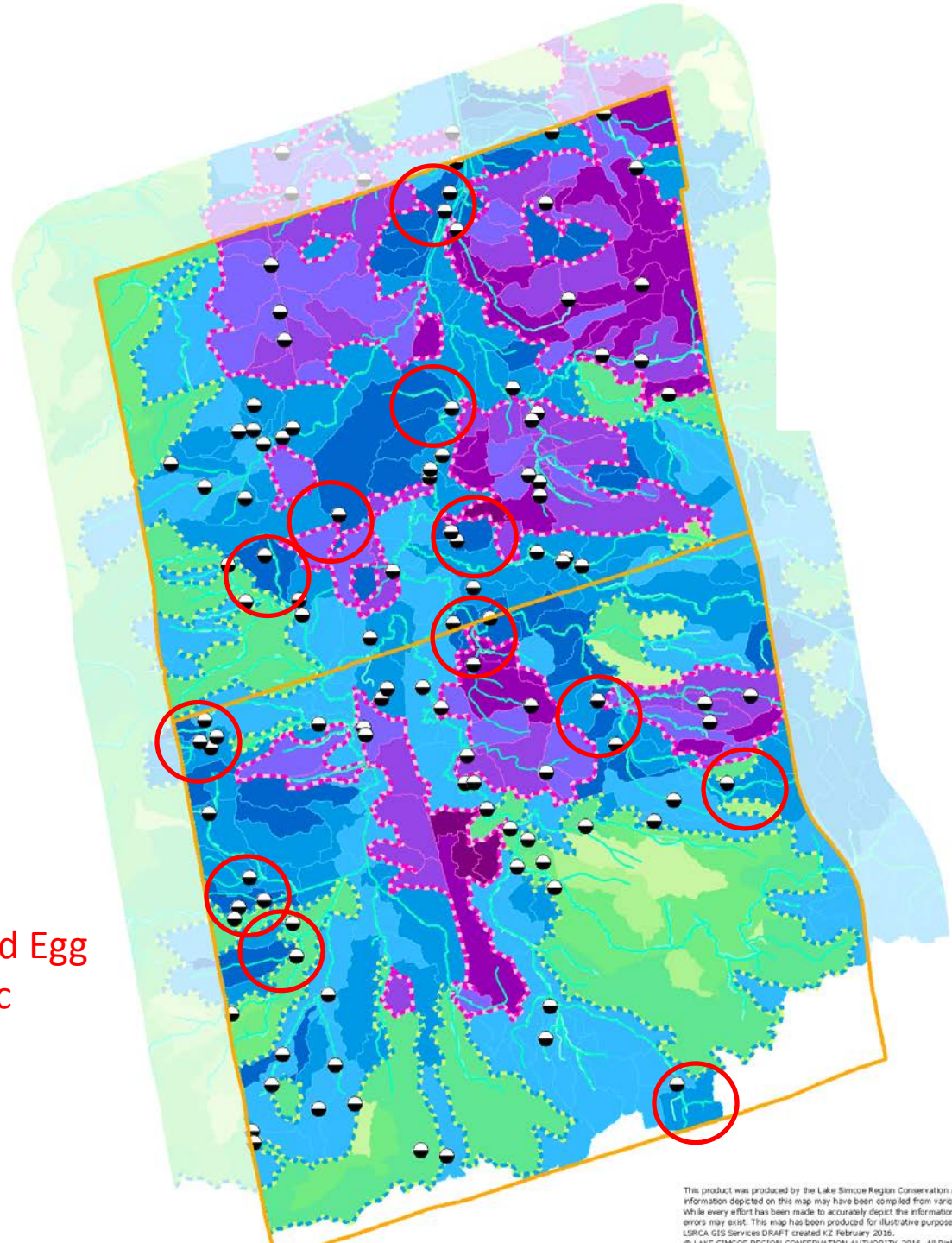
Salt Vulnerability Mapping for Specific Species Sensitivities— Fathead Minnow (spring concentration = chronic egg)



Salt Vulnerability Mapping: Spring



Fathead Egg
Chronic



The not so easy Solutions

- Use less salt!
- Urban design with winter in mind
 - Parking lot design / snow storage
 - Minimise impervious surfaces
 - Stormwater facilities designed for land use type
 - Stormwater facilities matched to intended winter maintenance practices
- What is the receiving water being managed for?
- Embrace Winter! This is Canada! (snow tires / winter boots)
- But ultimately we need to use less salt!



Acknowledgements

- Funding support through MOECC
- Field data collection (in -15°C)
 - Chandler Eves
 - Ray Bolton
 - Lance Aspden
 - Lauren Grzywniak
- Dr. Bahram Gharabaghi for his pioneering work in Guelph and Toronto

A photograph of a sunset over a large body of water, likely Lake Simcoe. The sun is a bright orange circle on the horizon, with its light reflecting as a shimmering path on the water's surface. The sky is a gradient of orange and yellow, with a few wispy clouds. The water is dark blue with small ripples. The text "Questions?" is centered over the image in a large, bold, black font.

Questions?

Residential Catchment – Bottom Draw

- 155ha catchment
- Estimate of 187 t salt applied to roads in 2014/15



