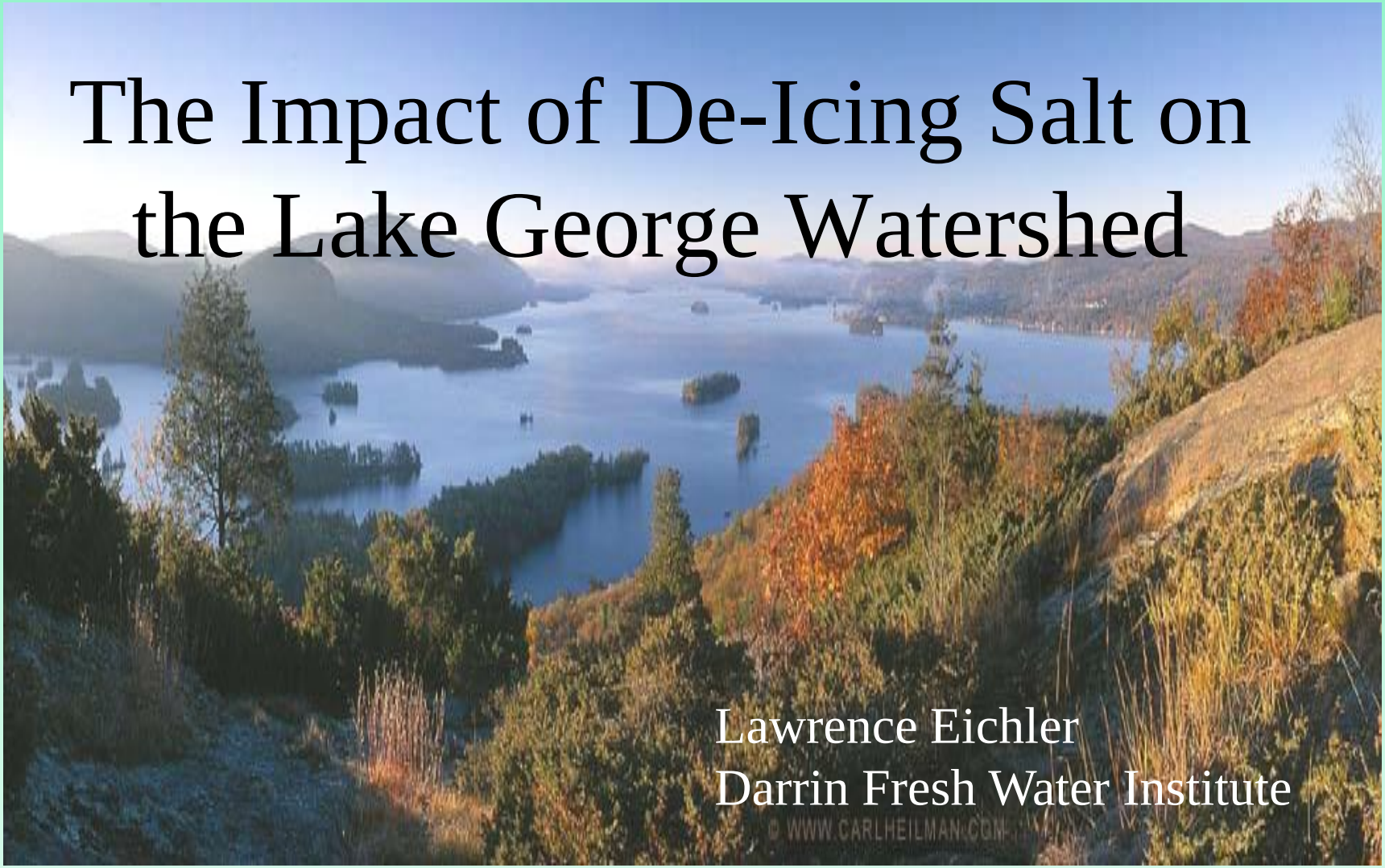
The Impact of De-Icing Salt on the Lake George Watershed



Lawrence Eichler
Darrin Fresh Water Institute

Road Salt Background

- Important deicing agent for safe winter driving
- Road salt composition
  - 60% chloride ion (Cl-)
  - 40% positive ion (Na+, Mg+, Ca+, K+)
- Mined Product
  - most common form used is NaCl
  - 10-15 million tons/yr in US
    - Most applied to NE and Midwest states with ¾ in NY, OH, MI, IL, PA, and WI

Salt

Pro

- "Bare Roads"
- Reduced cleanup costs
- Inexpensive

Con

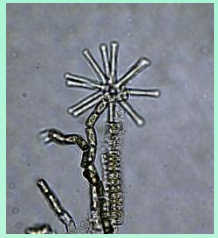
- Contamination of lakes & groundwater
- Impacts to lake & stream biota
- Impacts to roadside vegetation and soils
- Corrosion of vehicles & infrastructure
- Lack of recapture technologies

Salt Toxicity

USEPA limit for chloride in drinking waters 250 ppm

- Restricted salt diets limited to 20 ppm sodium

Roadside vegetation affected at 70 ppm



Affects throughout the food chain

–Algae - Critical level: 12 ppm

–Invertebrates - Diversity of stream dwelling insects decreases as salinity increases

–Fish - Trout affected at 250 ppm; LD_{50} @ 6743 ppm

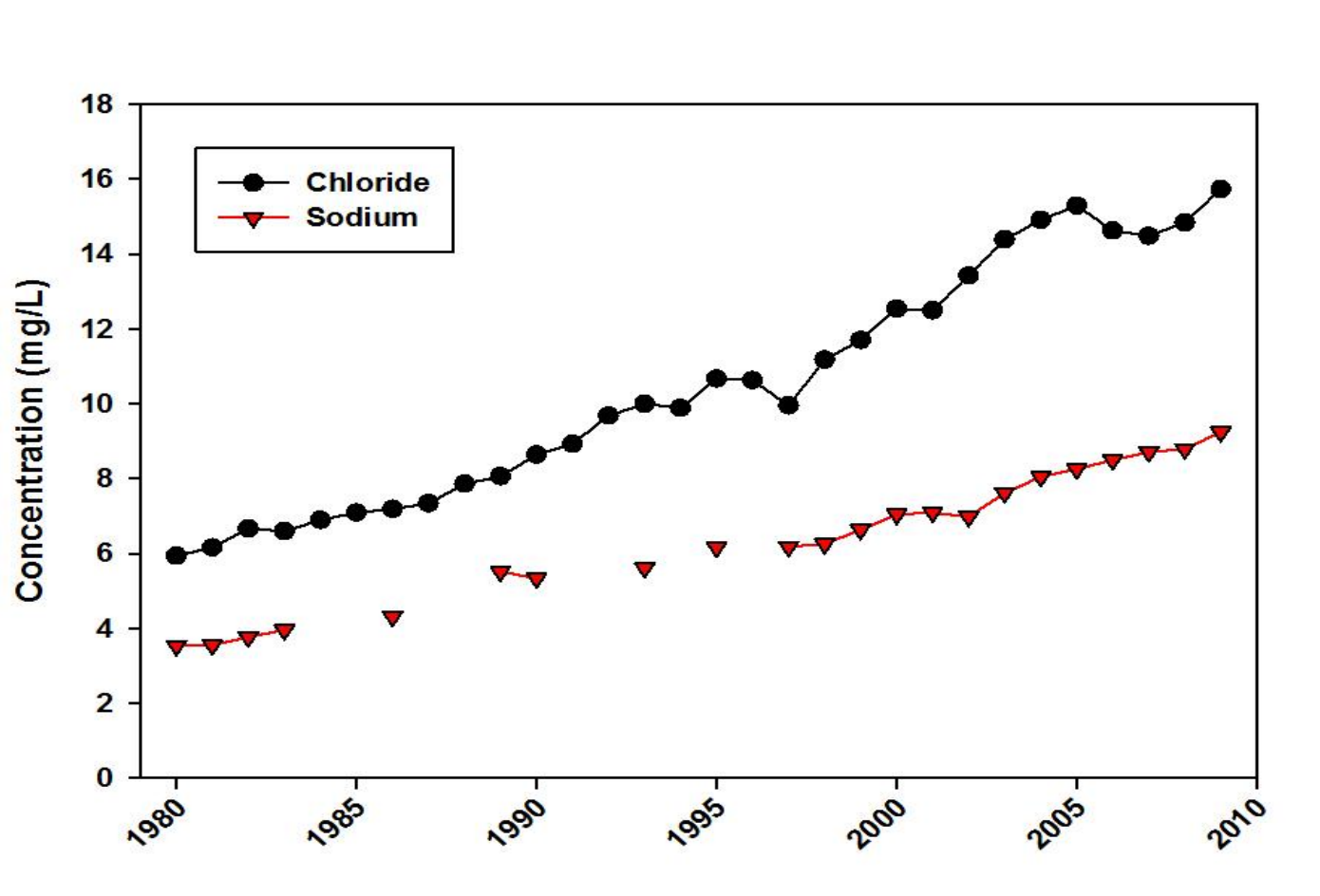
At concentrations above 220 ppm, 10% of aquatic species could die after 30 days

Road De-icing/Salt and Sand Application

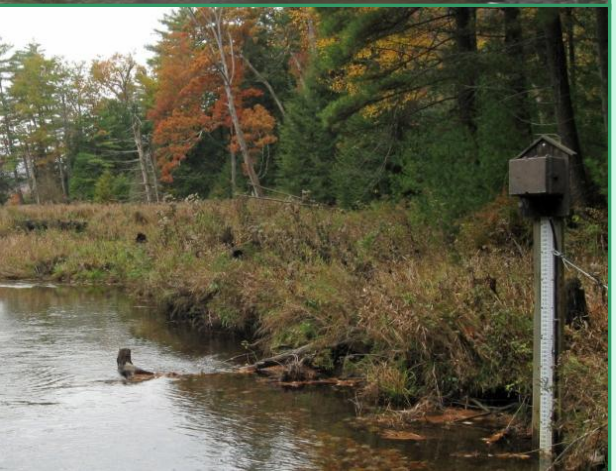
- **Lake George Road Maintenance – 680 miles in basin**
  - **Local 404 miles (59.3%)**
  - **County 111 miles (16.3%)**
  - **State & Federal 166 miles (24.4%)**
- **Annual Basin Wide Application Average (ten year average)**
  - **9,000 Tons of Salt**
  - **29,000 Tons of Sand**
- **Application Rates (tons/year/lane mile)**
  - **13.17 Salt**
  - **42.44 Sand**

Salt Contamination of Lake George

Salt levels have more than doubled in the past 30 years



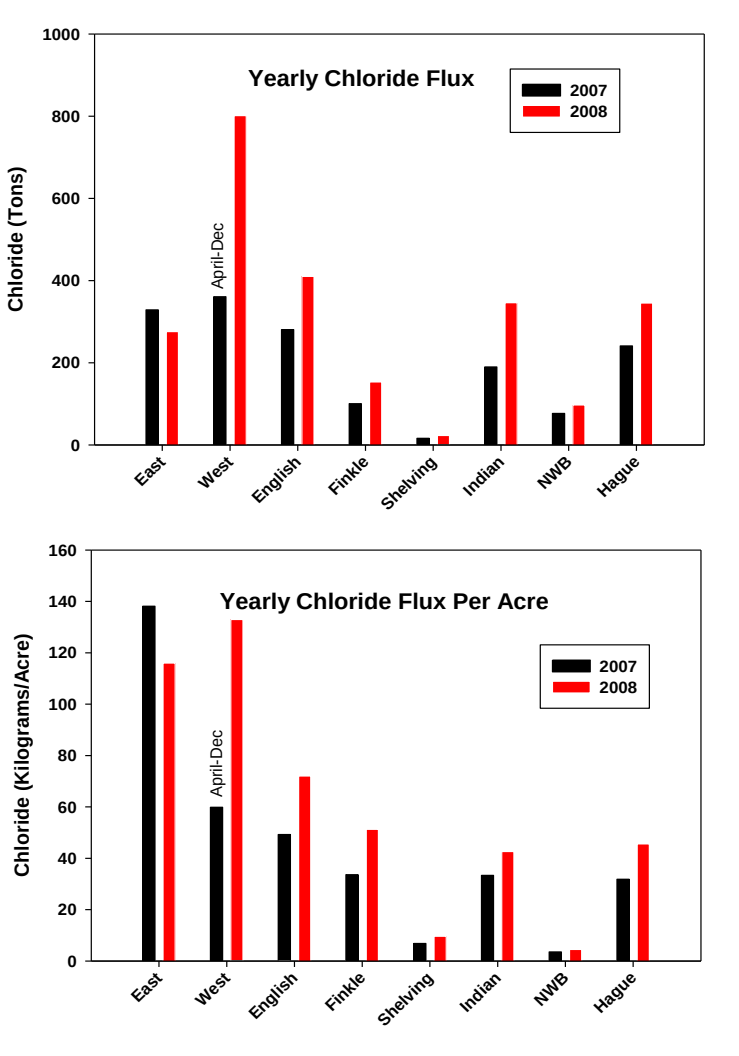
Data supplied by DFWI and The Fund for Lake George



Salts in Streams

- Salt concentrations in “first flush” can exceed 1000 ppm chloride and typically exceed 100 ppm in urbanized streams
- Streams in “pristine” areas typically less than 2 ppm chloride
- Salts build up in soils and are “washed” out by rainfall throughout the year
- Elevated salt levels “episodic” related to runoff
- Many streams in the LG basin “stressed” with salt and sand the likely culprits

Salt in LG Streams



- Streams in undeveloped watersheds (NWB & Shelving) release from 2- 4 kg Cl/acre (4-9 lbs/acre)
- Streams in developed watersheds (Hague, Indian, Finkle) release from 30-50 kg/acre (66-110 lbs/acre)
- Streams in more heavily developed watersheds (West & East) release from 120-140 kg/acre (260-310 lbs/acre)

Salt Impacts Lake & Stream Biota

- Interferes with fish spawning
- Degrades habitat for stream dwelling fish and invertebrates
- Creates disturbed habitats for invasion by non-native species

Groundwaters

- Runoff from uncovered salt piles can reach levels of 100,000 ppm chloride
- Groundwater contamination incidents generally related to salt storage
- Natural flushing may take decades to clear aquifer after contamination

Salt impacts roadside vegetation

- Salt buildup along roadsides selects for salt tolerant species
- Salt spray responsible for damage to pines along Adirondack roadways
- Alters soil chemistry
- Disturbed habitat favors invasives

Sensitive Trees and Landscape Vegetation

Type	Species at Risk from Salting
Deciduous Trees	Hickory, Green Ash, Red Maple, Sugar Maple
Conifers	Balsam Fir, White Pine, Hemlock, Norway Spruce
Shrubs	Dogwood, Redbud, Hawthorn, Rose, Spirea
Grasses	Kentucky Bluegrass, Red Fescue

Salt tolerant species

- Disturbed habitats encourage invasion by non-native species

Phragmites

Purple loosestrife

Salt Impacts Animals

- Salt along highways attracts deer and reduces their fear of vehicles resulting in more frequent accidents
- Songbirds poisoned by consumption of salt granules

Salt additives and alternates

- Calcium in salt and salt substitutes (CMA) may encourage the growth of exotic species
- Certain additives to prevent caking or inhibit corrosion are toxic

Impact of Road Salting on Organisms

- Increased chloride causes loss of biota (abundance & diversity)
  - Terrestrial plant sensitivity as low as 70 ppm in soil
  - Soil bacteria inhibited at 90 ppm (compromise soil structure)
  - Inhibition of seed germination and root growth at 100 ppm
  - 10% of aquatic species exceed critical tolerance at 220 ppm
- Increased NaCl results in increased cost for water treatment
  - Surface and groundwater infiltrated
  - EPA requires sodium concentrations < 20 ppm
  - Up to 30% of US population may require low sodium diets
- Increased calcium may affect Zebra mussel invasions
  - Small amounts in rock salt, more in alternative de-icers

Salt Corrodes Vehicles & Infrastructure

Accelerated Infrastructure Failure

EPA estimate: For every $50 spent on salt, $750 is spent to repair corrosion to roads, bridges and vehicles

Sand

Pro

- No contamination problems
- Established technologies for cleanup

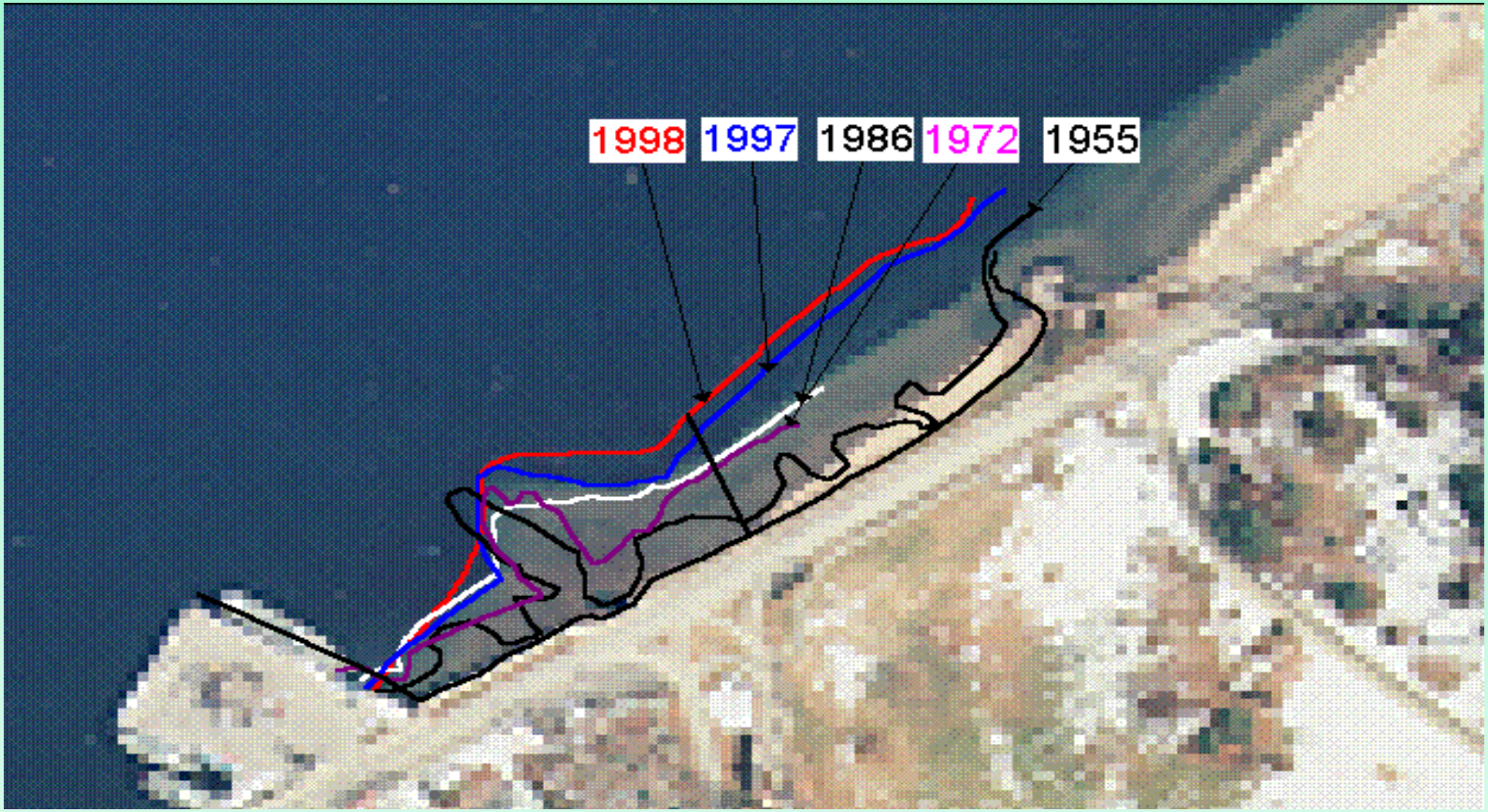
Con

- Buildup in lakes & streams
- Impacts to lake & stream biota
- Cleanup Costs
- Habitat alteration
- Unlikely to provide “bare roads”

Consequences of Sand Application

- **Sand application on roadways**
  - **Street sweeping, catchment cleanouts and disposal**
    - **>50% remains in the environment**
  - **Dredging of delta formations**
  - **Increased turbidity causes fish and invertebrate mortality; photosynthesis inhibition**
  - **Increased air pollution**
    - **Oregon est. 45% small air particulates from sand application**

Sand Producing delta expansion at West Brook



Maintenance

- Street sweeping can significantly reduce sand loads to lakes and streams
- Frequent cleanout of capture devices is critical
- Calibration of sanding devices can reduce the loading of sand to roads

Summary

- Road salt accumulation can negatively impact surface waters, soils and plant and animal diversity
- Road salt is responsible for corrosion of vehicles, highways and transportation infrastructure
- Efficient use of salt can reduce the overall impact of this material
- Use of alternatives, anti-icers and covered storage can reduce input amounts and overall cost
- Interest is growing in alternatives and proper use