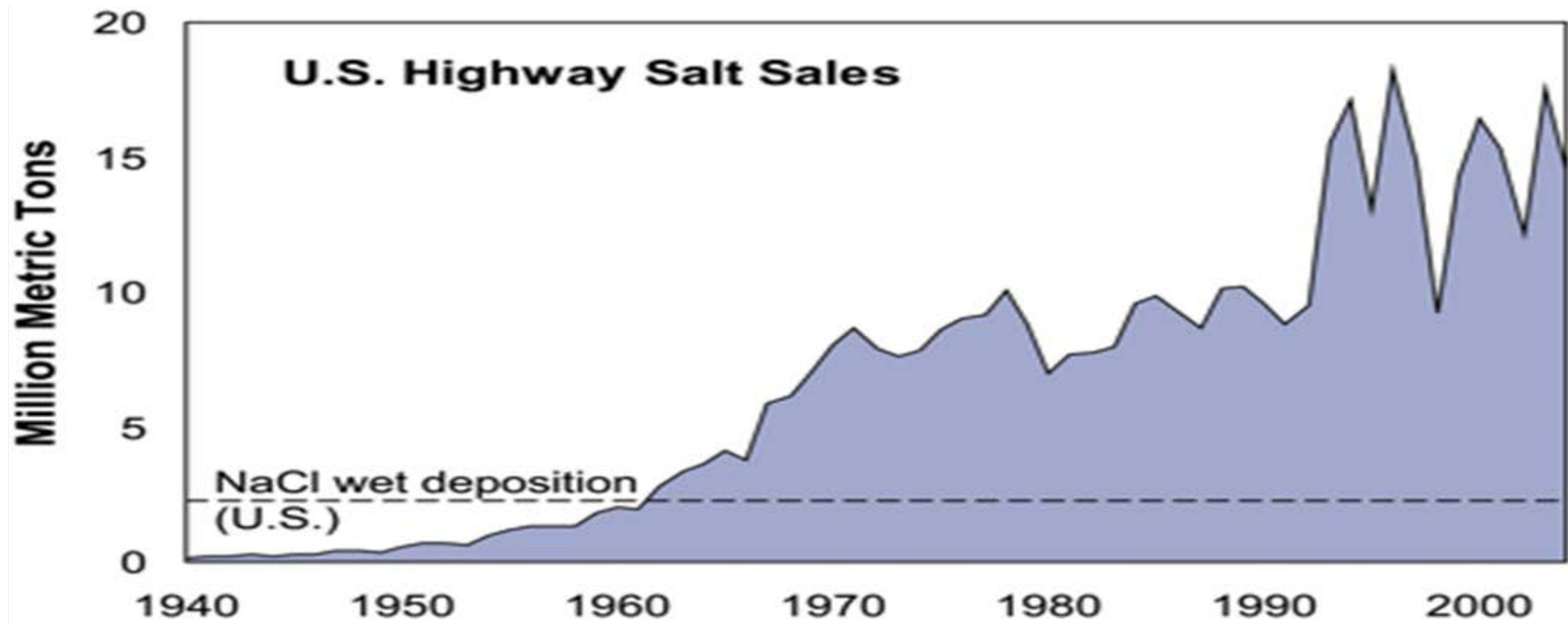




Road Salt and Elevated
Chlorides in the
Wachusett Watershed



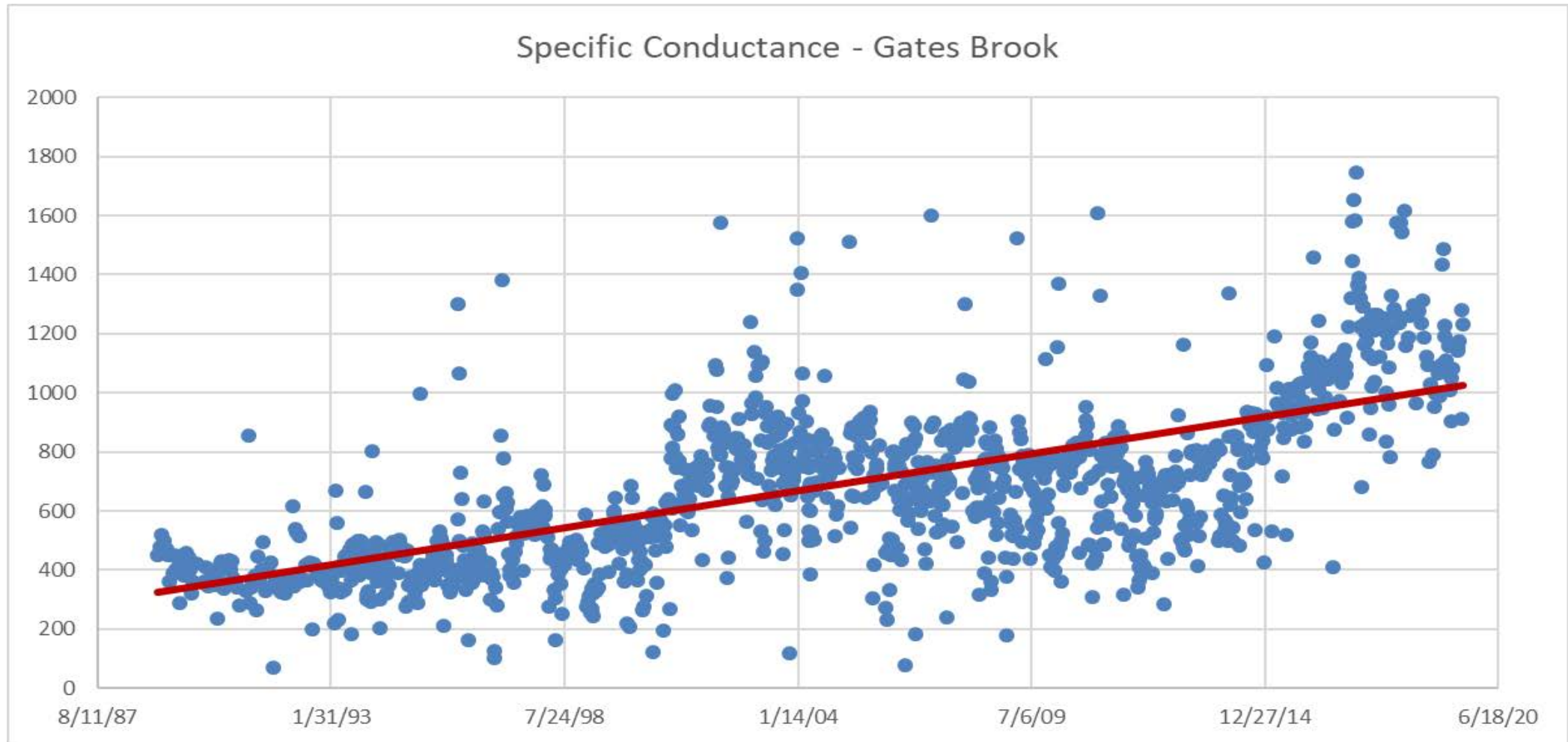


- **There have been numerous studies that link excessive application of road salt by state and municipal DPWs to elevated chlorides/high specific conductance in streams, lakes, and reservoirs.**
- **DCR has documented significant increases in specific conductance at sampling stations in the Wachusett watershed over the past 30 years.**
- **Originally observed primarily following winter precipitation events, elevated concentrations during the summer now appear to be the result of groundwater contamination.**

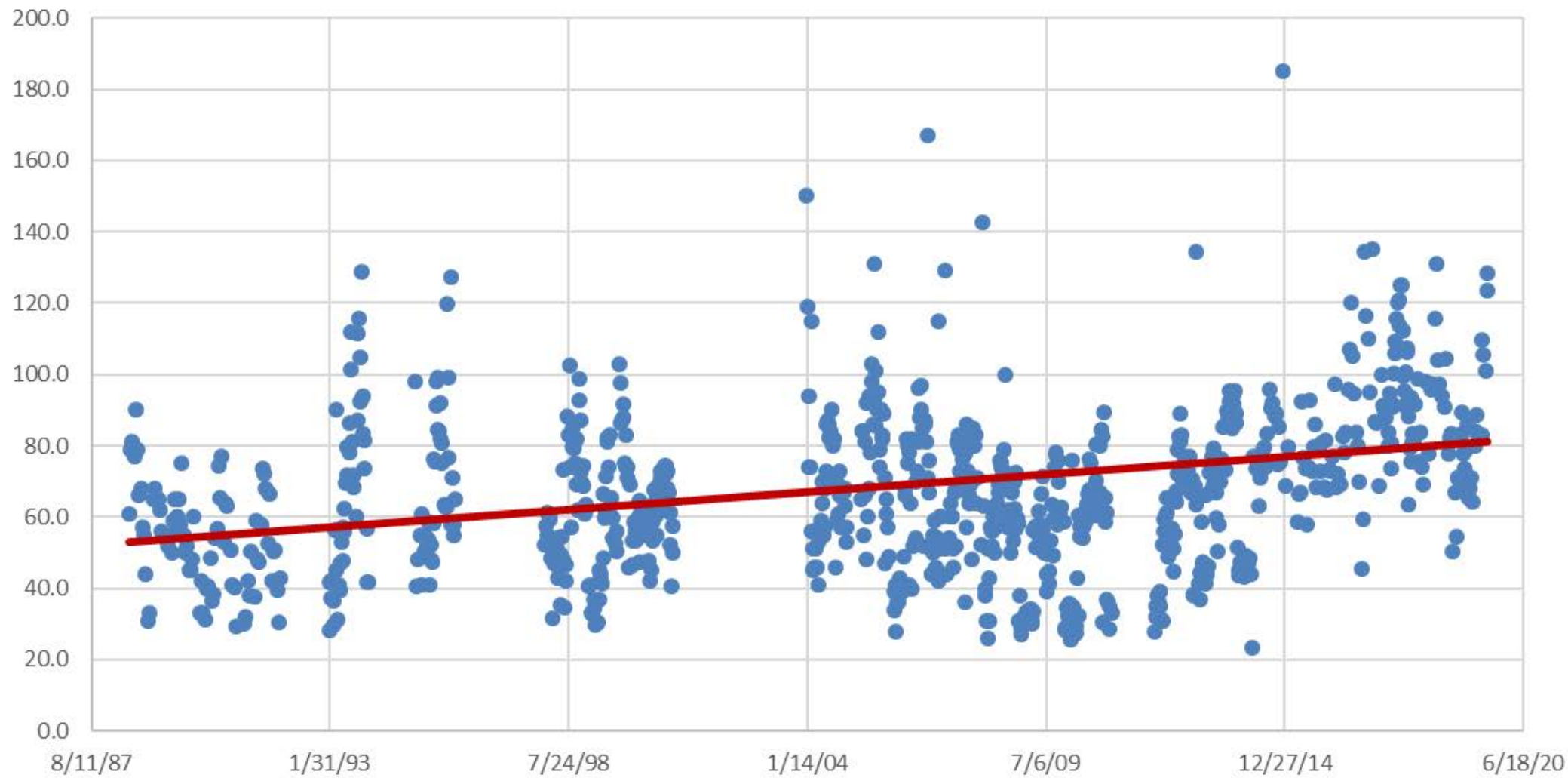
PROBLEMS DUE TO EXCESS SALT APPLICATIONS AND HIGH CHLORIDE CONCENTRATIONS

- Harmful to aquatic wildlife and roadside vegetation.**
- Causes damage to vehicles, bridges, and buildings.**
- Financial impact on municipal and state budgets.**
- Increased likelihood of corrosion in water-distribution systems and increased threats from copper and lead.**

Water Quality Data Clearly Illustrate the Increase (specific conductance used as surrogate for Cl⁻)

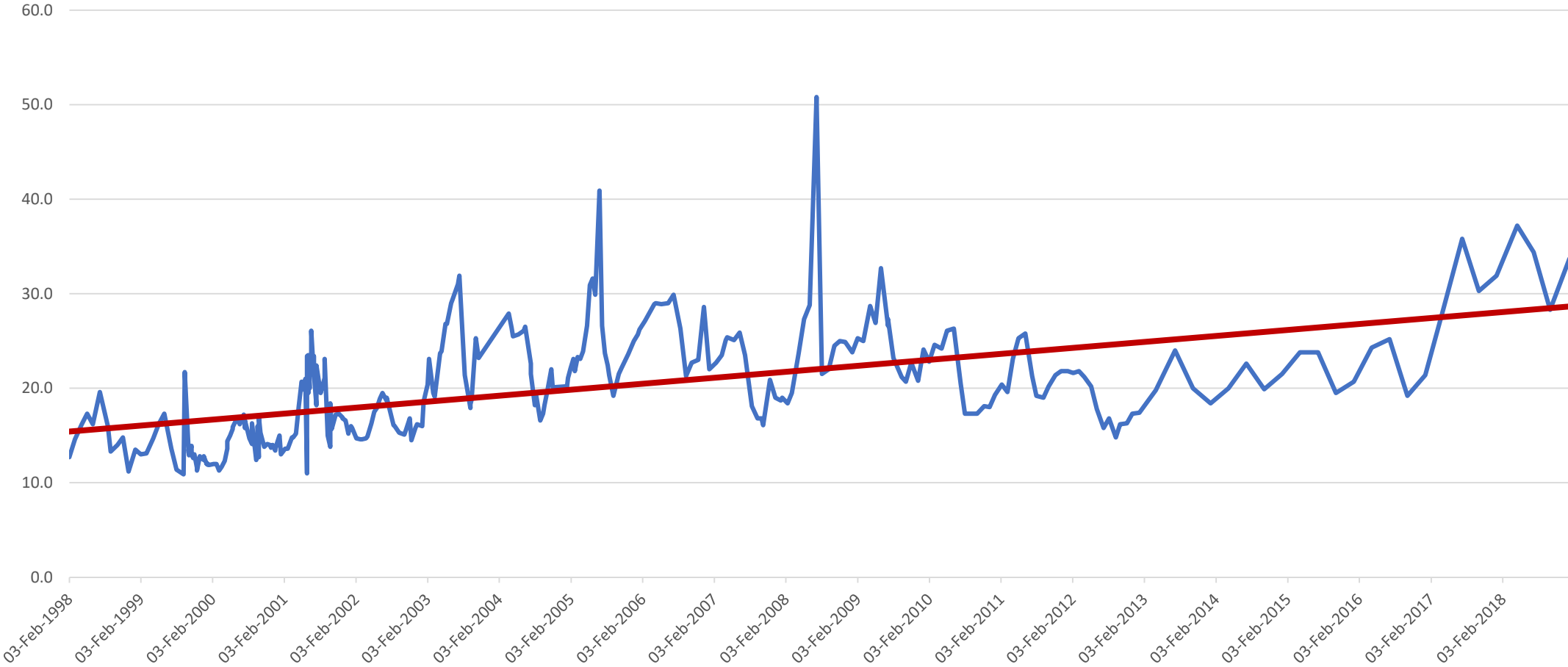


Specific Conductance - Trout Brook



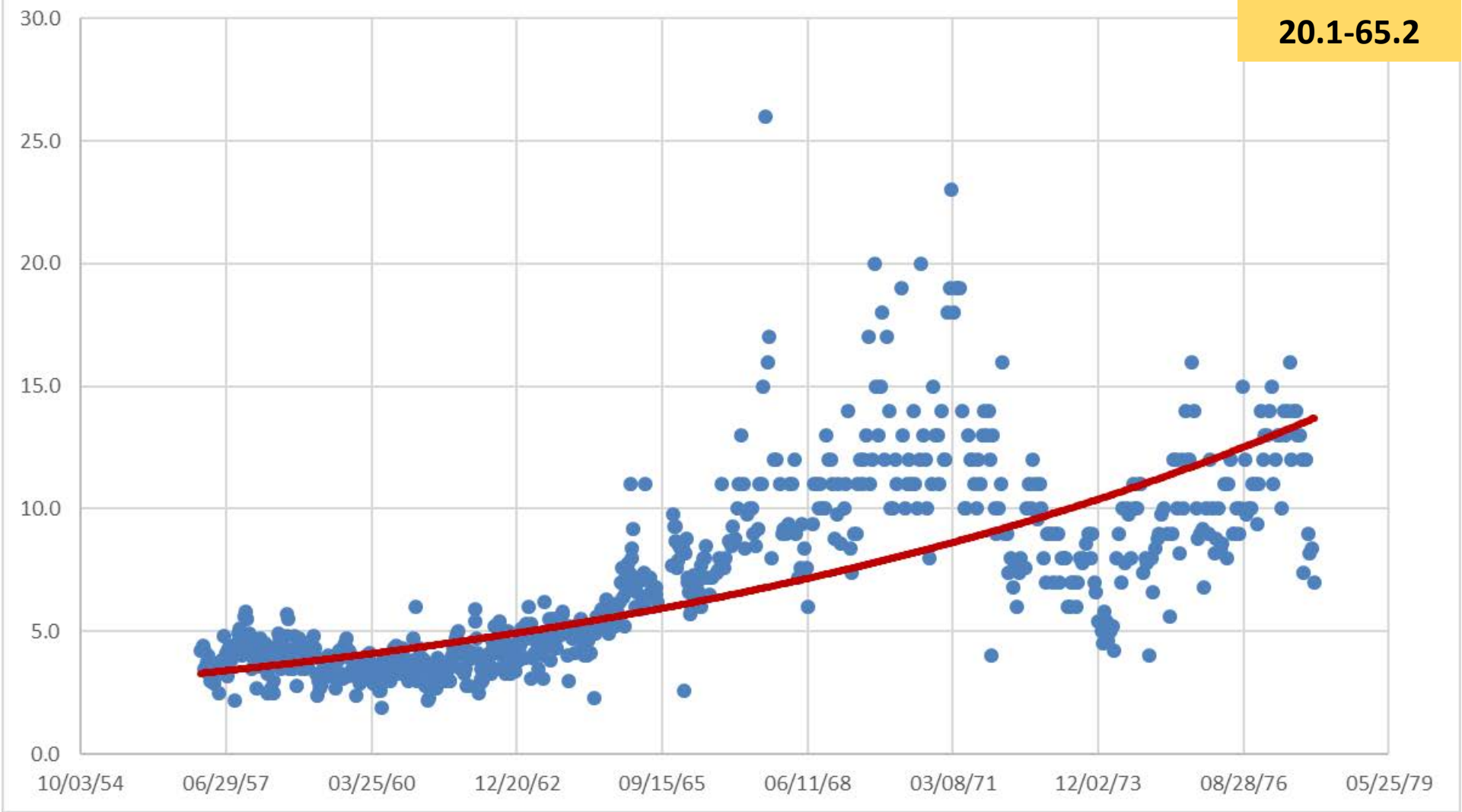
Specific conductance in the Wachusett Reservoir during 1989 was 60-85 $\mu\text{S}/\text{cm}$ but reached 184 $\mu\text{S}/\text{cm}$ in 2018.

Chloride Concentrations (mg/L - Shaft A/CWTP)



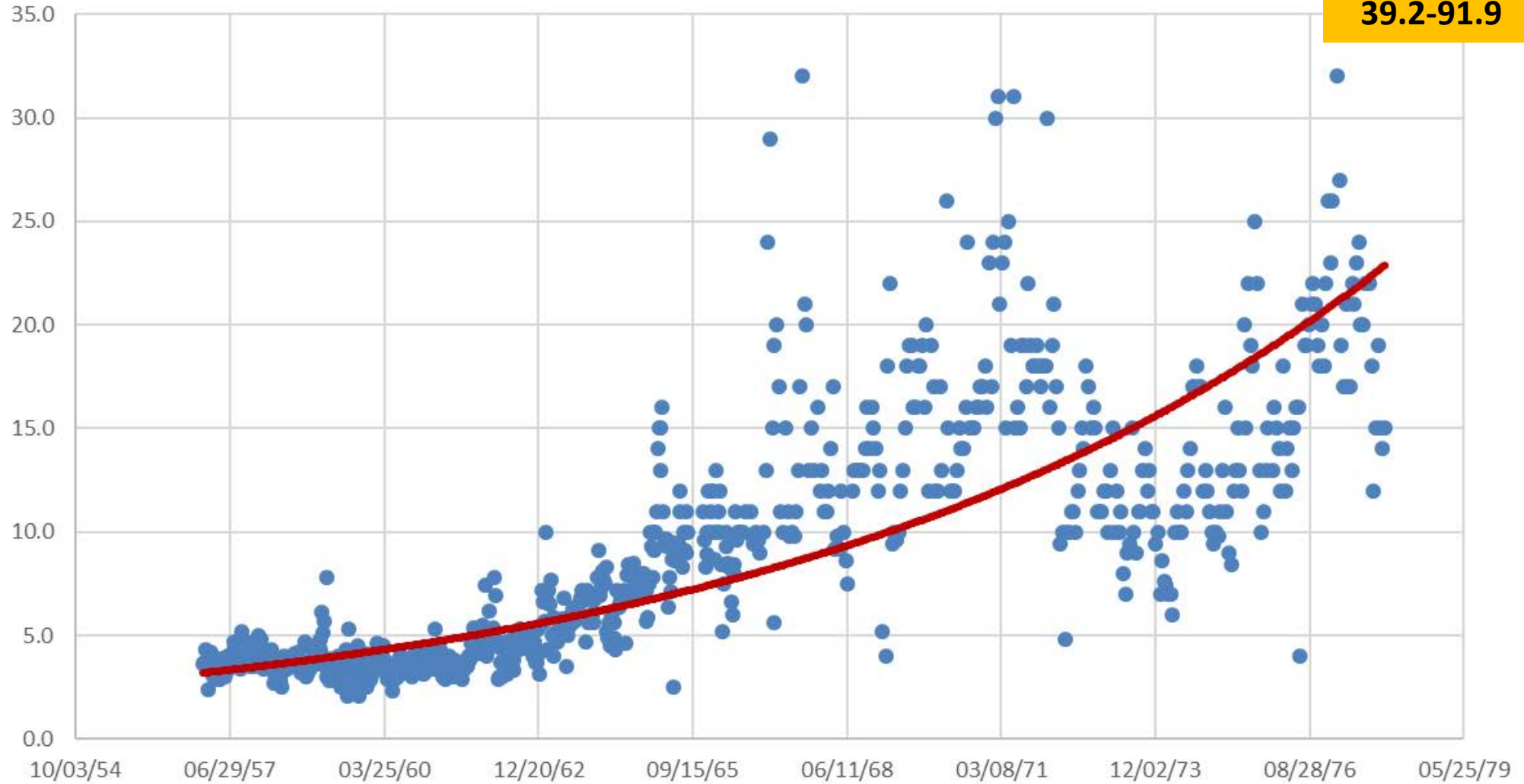
Historic Chloride Concentrations - Stillwater River (Oakdale)

Recent Data
20.1-65.2




Historic Chloride Concentrations - Quinapoxet River (dam)

**Recent Data
39.2-91.9**



- **Samples for chlorides are now collected monthly from ten tributary stations.**
- **Eight groundwater wells are sampled for chlorides every month. Specific conductance is measured at the same time.**
- **Chloride concentrations measured in the tributaries have approached 600 mg/L in Gates Brook.**
- **Specific conductance measured in groundwater has exceeded 7500 $\mu\text{S}/\text{cm}$ in a well near Route 110.**



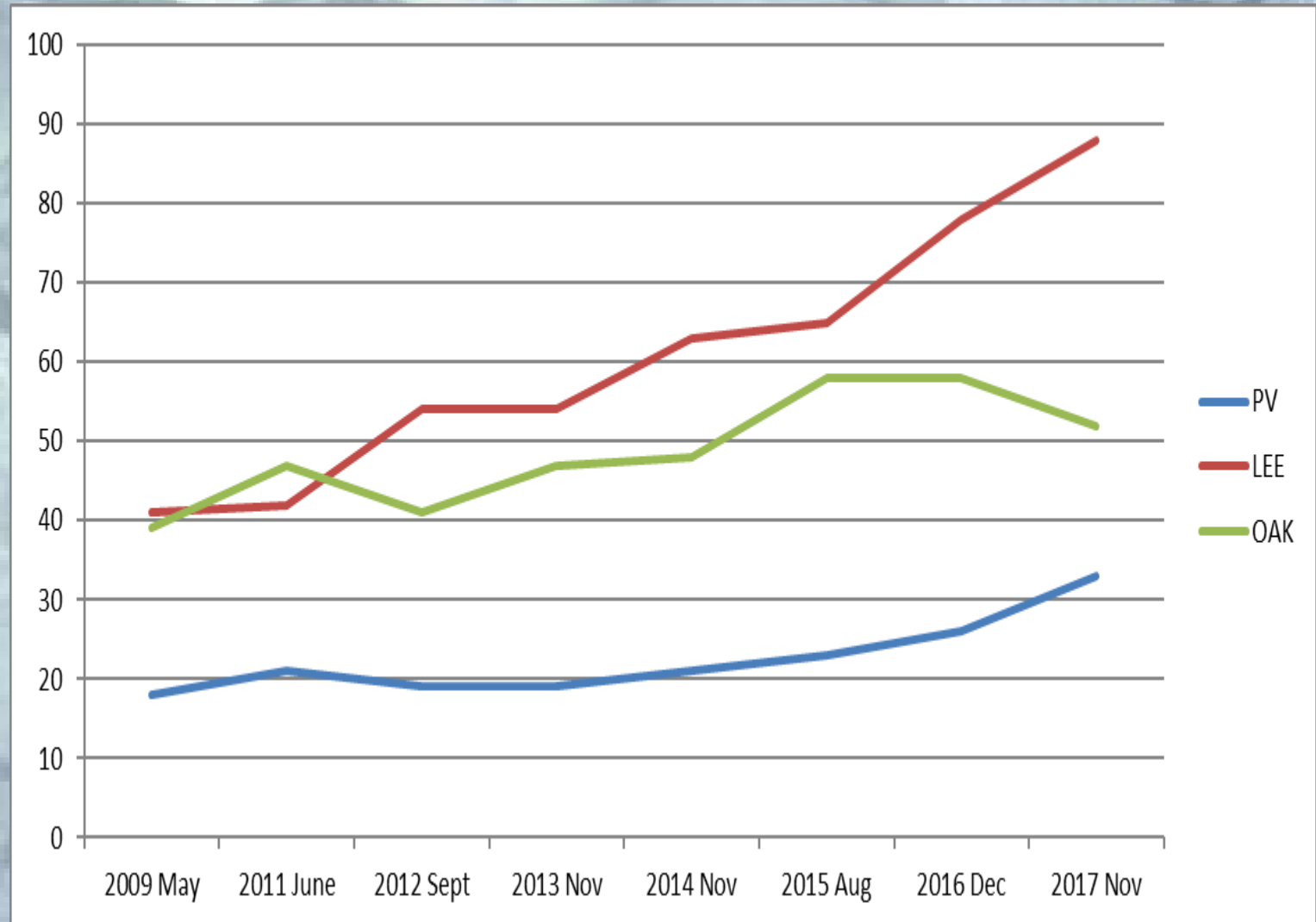
WHERE DOES THIS SALT COME FROM?

- Atmospheric Deposition
- Weathering of Soil and Rock
- Wastewater
- Agricultural Sources (Fertilizers, Animal Waste, and Irrigation)
- Energy Production
- Landfills
- **Deicing Chemicals**

Watershed communities were asked for information on snow and ice control operations.

- Recent salt use
- Historic salt use
- Any alternative products used?
- Types of equipment used
- Any innovative technologies used?
- Number of employees involved
- Amount of training provided
- Drinking water quality data
- **INITIAL RESPONSE LIMITED**
- **ADDED WATER DEPT HEADS**

CHLORIDE CONCENTRATIONS IN WEST BOYLSTON DRINKING WATER WELLS (MG/L)



SALT APPLIED ANNUALLY IN THE WACHUSETT WATERSHED: ~18,340 tons

TOWN	AVERAGE ANNUAL USE (tons)	EST. WATERSHED USE (tons)	SOURCE OF INFORMATION
Boylston	2,604	993	2014-2018 (est), 2019
Holden	2,691	2,198	2001-2014
Paxton	1,545	301	2007-2019
Princeton	2,200	1,803	2008-2017 (est), 2018-2019
Rutland	4,000	947	2019
Sterling	1,800	1,025	2014-2016 (est), 2017-2019
West Boylston	4,401	3,722	2017-2018
Worc/Clint/Leom	unknown	700	estimate based on road miles
MassDOT	4,093	4,093	estimate based on road miles
DCR DWSP	unknown	35	estimate based on purchases
parking lots	2,522	2,522	estimate based on acreage

ASSUMPTIONS USED FOR ESTIMATE

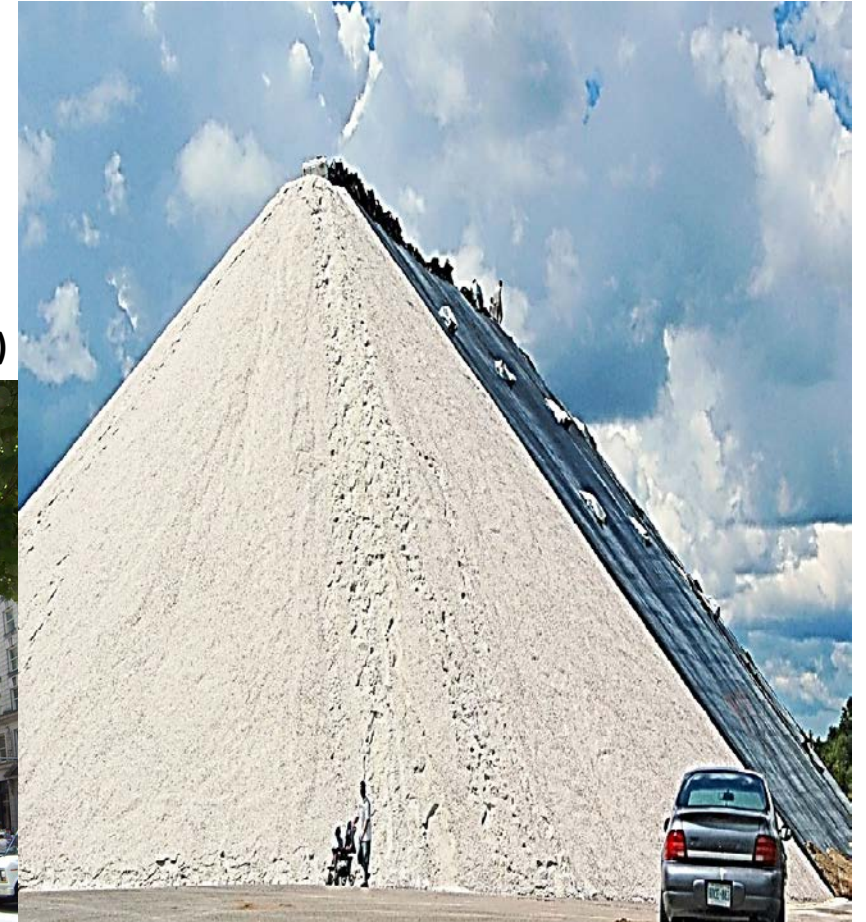
- **Roads evenly dispersed throughout each community**
(need to look at lane miles within the watershed)
- **MassDOT maintains 96.3 lane-miles in the Wachusett watershed at an application rate of 35-50 tons of salt per lane-mile per winter** (need actual application amounts)
- **Estimate of 364 acres of parking lots (consultant) treated at 1000 lbs per acre per storm using a list of storms supplied by Holden** (need to document actual amounts applied)

WHAT DOES 18,000 TONS LOOK LIKE?

4,500 elephants (average weight 4 tons)



Salt pyramid (120' tall, 120' wide)



Old State House (65')





WHAT TO DO ABOUT THIS?

- **Education and training**
- **Model impact of reducing inputs**
- **Model impact at intake of various changes to Quabbin transfers**
- **Review existing literature**
- **Collaborate with other agencies, organizations, and municipalities**
- **Improve data collection capability**
- **Provide dedicated funding source to assist watershed communities**

EDUCATION AND TRAINING (1)

- Baystate Roads (UMASS Transportation Center) offers a full day course on Snow and Ice Operations. MWRA has committed to financially support training of watershed municipal employees. The training is scheduled for 11/5/19 at JAH.**
- Instruction will be provided on proper use of salt and liquid anti-icers, pre wetting and pre-treating options, anti-icing versus de-icing, and calibration of equipment.**
- DCR and MWRA maintenance staff will also attend training.**
- Knowledge of the science of snow and ice removal should lead to more efficient and effective salt applications and reduce the amounts applied.**

EDUCATION AND TRAINING (2)

- **Distribution of available fact sheets from NH DES, NH DOT, Cary Institute of Ecosystem Studies, Central MA Regional Stormwater Coalition, and others.**
- **The Pioneer Valley Planning Commission provides advice on road salt reduction. The DCR can help towns identify water resources and drinking water supplies, delineate and map associated watersheds, and help prioritize roads, parking lots, and driveways for reduced-salt application or salt alternatives.**
- **All future DCR educational programs will include additional messaging on the dangers of salt use and promote behavioral changes that would reduce use.**
- **Changing public expectations is a difficult but necessary goal. Slow down or stay inside must be an acceptable option during the winter.**

MODELING EFFORTS

- **UMASS-Amherst has an existing ISA with DCR to investigate watershed-based reservoir inputs and to use their existing hydrodynamic and water quality model to predict various outcomes under a variety of conditions.**
- **Will use the model to investigate impact of reducing inputs of chlorides to the reservoir and to predict changes to chloride concentrations at the Cosgrove Intake based on a variety of Quabbin transfer options.**
- **Look at impervious surfaces, relationship between chloride and specific conductance, estimate loads, consider climate change.**
- **Most believe that the investigation will suggest a lengthy period before any change is noticeable.**

LITERATURE REVIEW

- **Plenty of free, easy-to-find information available online.**
- **CLEAR ROADS (<http://clearroads.org/>) is a national research consortium with information on winter maintenance materials, equipment and methods .**
- **The USGS has compiled data and has published reports that confirm widespread increases in chloride concentrations.**
- **Staff at DCR continue to review readily accessible literature and have shared information on Dropbox. UMASS has also been working on a literature review.**

COLLABORATION WITH OTHERS

- **The Central Massachusetts Regional Stormwater Coalition has received a state grant to update and improve twenty separate stormwater-related SOPs. We hope this will include details and specific guidance within an SOP on winter road maintenance procedures and intend to work closely with them if possible.**
- **USGS continues to do research that could prove useful to our efforts.**
- **Discussions with the Town of Wellesley (brine for pre-treatment) and the Cambridge Water Department (major roadways) could provide ideas.**
- **Look for legislative remedies (removal of liability) and discuss with New Hampshire officials and local legislators and town officials.**
- **Already referenced collaboration with UMASS. There are researchers at other universities and colleges that might be interested in collaborative efforts.**

IMPROVE DATA COLLECTION (including salt amounts)

- **Installation of DIY low-cost Mayfly Data Loggers across the watershed, powered by solar panels and lithium-ion batteries, with the ability to obtain real-time specific conductance data. We hope to purchase ten stations for a total estimated cost of \$15,000-\$20,000, plus an annual data cost of about \$240.**
- **Collect more groundwater data on chlorides and specific conductance**
- **Encourage regular reporting on annual salt use by towns and MADOT.**
- **Establish salt tracking form to be used during all future winter storms by DCR watershed maintenance staff.**
- **Monitor salt applications at parking lots.**

OTHER IDEAS

- **Develop online weather application to make it easier for towns to decide when (or not) to salt.**
- **Calculate cost of doing nothing – impacts to MWRA supply, town drinking water, private wells, and infrastructure.**
- **Consider regulatory options if voluntary compliance is unsuccessful.**
- **Help communities develop detailed winter operations plan that includes standard operating procedures.**
- **Develop more accurate estimates on actual salt use in the watershed.**
- **Others?**

DEDICATED FUNDING SOURCE

The ability to offer financial assistance is crucial if we hope to change behaviors and attitudes. Change is a difficult concept to sell in central Massachusetts, especially when it requires the expenditure of local dollars.

- **Uncovered or poorly managed salt piles can be a significant source – construction, repair, or relocation of salt sheds could be very beneficial.**
- **Salt applications should be temperature based – installing temperature sensors on vehicles, using automated application technologies, and improving weather applications would reduce amounts applied.**
- **Use of salt brine to apply to roads before storm events (anti-icing) or to mix with dry salt (pre-wetting) will reduce salt amounts – purchase of mixing and storage containers, purchase of materials (alternative deicers) could be subsidized.**
- **Spreader calibration – training is offered by Baystate Roads, some towns may need to update equipment to allow for regulated application of salt.**
- **Flexible plow blades remove more snow and reduce the need for salt– these are expensive but may be worth it.**



HOW DO WE
ESTABLISH AN
ONGOING SOURCE
OF FUNDS?

- **Watershed Annual Operating Budget?**
- **MWRA Operating Budget?**
- **Grants?**
- **Other Sources?**



THE DECISION IS OURS, BUT WE NEED TO ACT NOW!

Ideas and discussion are welcome.