

Southeastern Wisconsin **Regional Planning Commission**



Chloride Impact Study for the Southeastern Wisconsin Region

Final TAC Meeting
October 21, 2026

Speakers

- Laura Herrick, Chief Environmental Engineer
- Aaron Owens, Principal Planner
- Karin Hollister, Principal Engineer



Agenda

- Review of Summary Notes from June 24, 2026, TAC meeting
- Review of the final 4 draft chapters of SEWRPC Planning Report No. 57, *A Chloride Impact Study for Southeastern Wisconsin*
- Committee Approval
- Next Steps



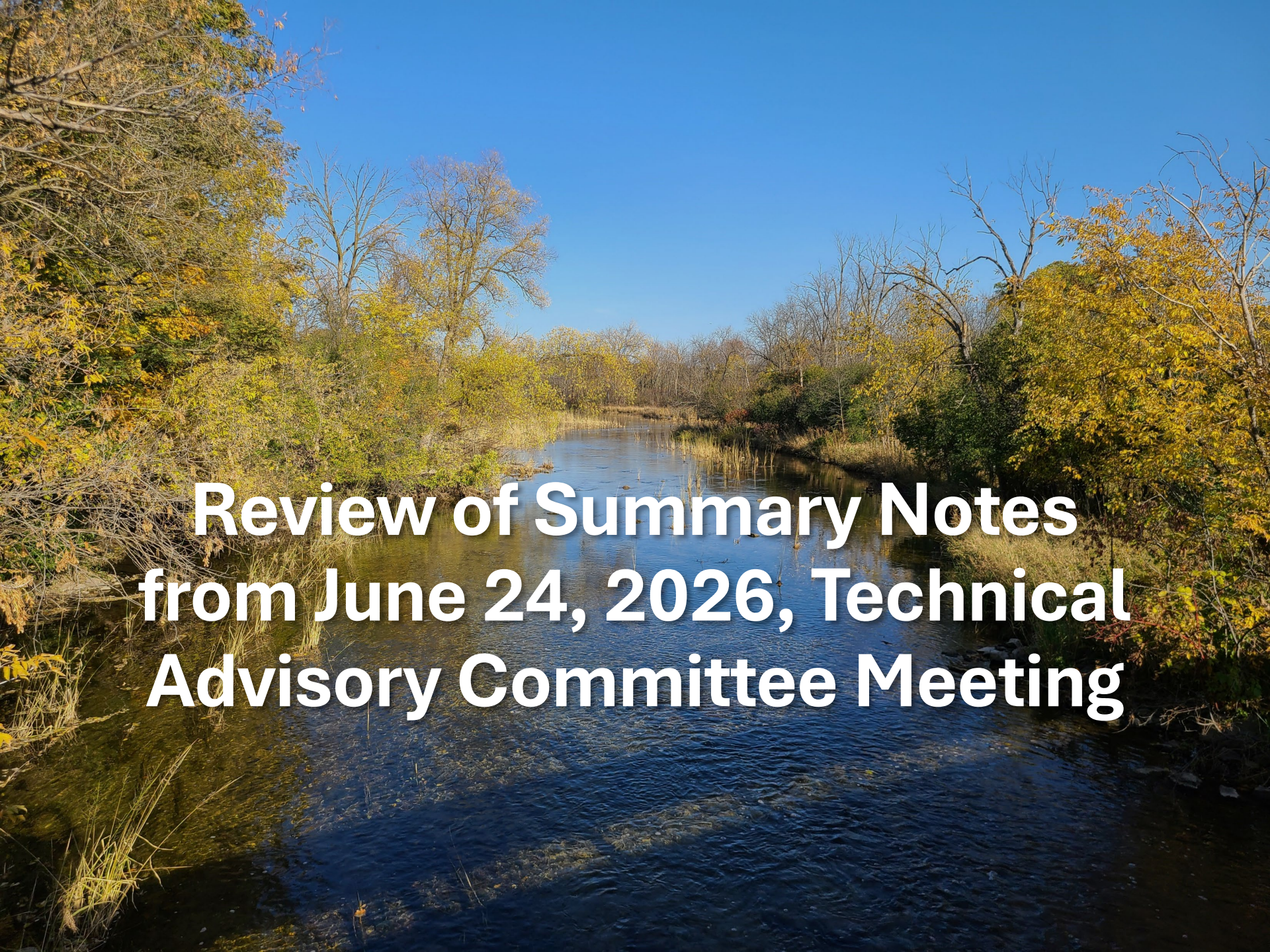


- *TR-61 Field Monitoring and Data Collection for the Chloride Impact Study*
- *TR-62 Impacts of Chloride on the Natural and Built Environment*
- *TR-63 Chloride Conditions and Trends in Southeastern Wisconsin*
- *TR-64 Regression Analysis of Specific Conductance and Chloride Concentrations*
- *TR-65 Mass Balance Analysis for Chloride in Southeastern Wisconsin*
- *TR-66 State of the Art for Chloride Management*
- *TR-67 Legal and Policy Considerations for the Management of Chloride*



- Chapter 1 – Introduction and Background
- Chapter 2 – Description of the Study Area
- Chapter 3 – Sources of Chloride to the Environment
- Chapter 4 – Impacts of Chloride in the Environment
- Chapter 5 – Chloride Standards and Guidelines
- Chapter 6 – Chloride Conditions in SE WI
- Chapter 7 – Chloride Monitoring Options
- Chapter 8 – Options to Manage Chloride to the Environment
- Chapter 9 – Potential Future Chloride Conditions in SE WI
- Chapter 10 – Recommendations to Reduce the Impacts of Chloride on the Environment



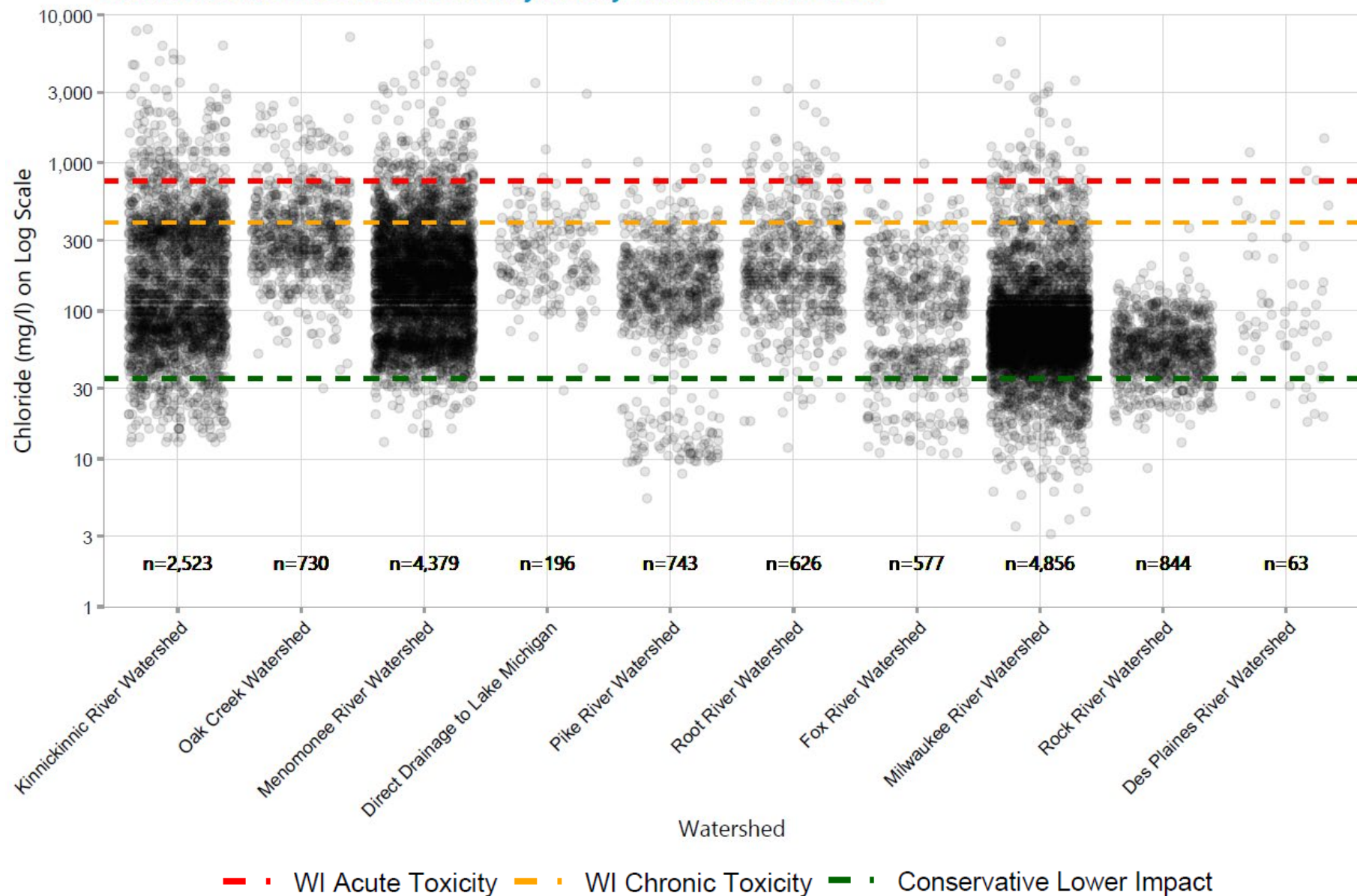
A scenic view of a river flowing through a forest with autumn foliage. The river is dark blue with some ripples, and the surrounding trees have yellow and orange leaves. The sky is clear blue.

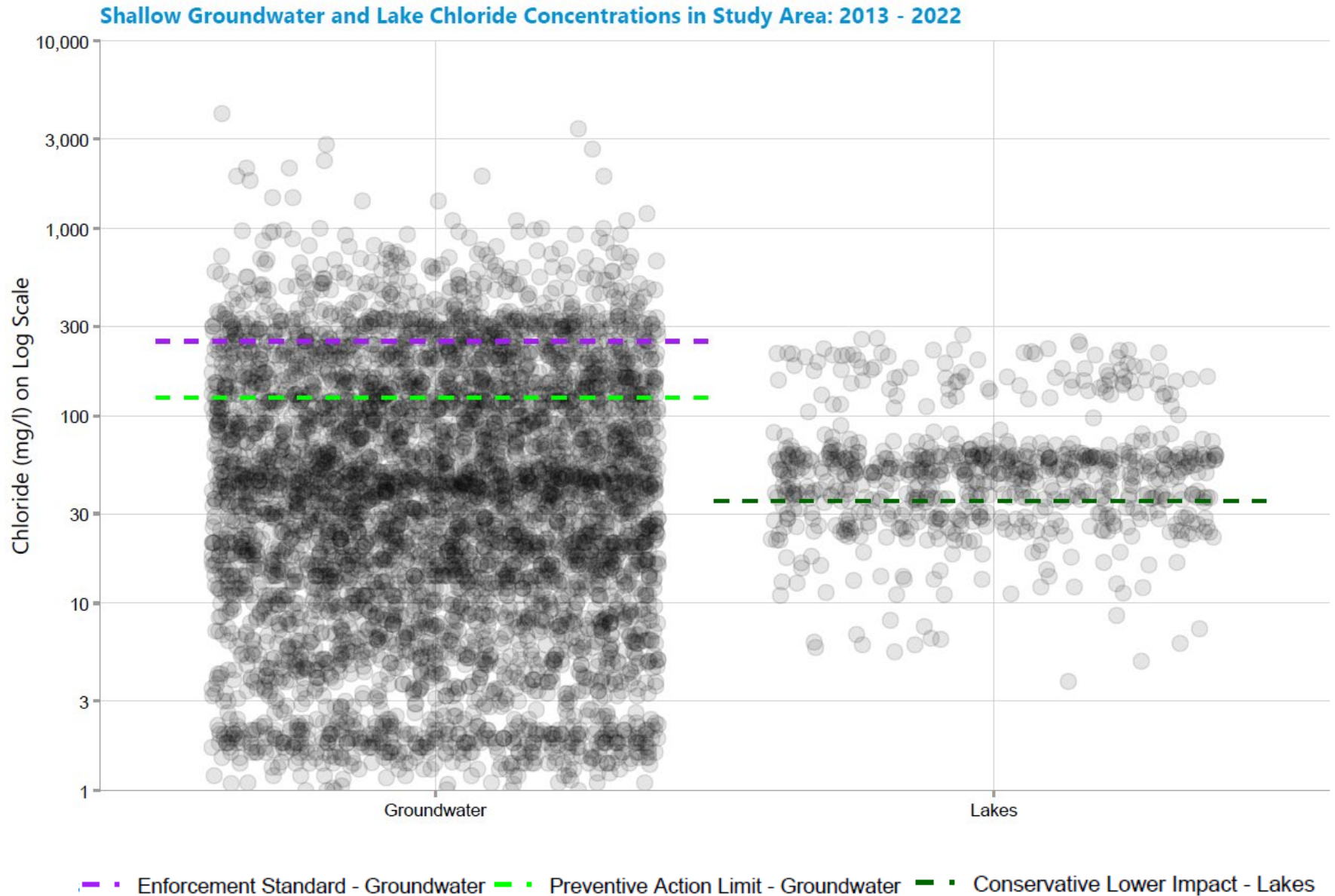
Review of Summary Notes from June 24, 2026, Technical Advisory Committee Meeting

PR-57 Chapter 1 – Figure 1.1 (new)

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Stream Chloride Concentrations in Study Area by Watershed: 2013 - 2022







Chapter 10 – Recommendations to Reduce the Impact of Chloride on the Environment

Chapter Sections

- 10.1 Introduction
- 10.2 Recommendations to Reduce Chloride Impacts
- 10.3 Recommendations for Chloride Monitoring
- 10.4 Areas Vulnerable to Chloride – Priority Protection Areas
- 10.5 Chloride Reduction Goals for Regional Water Resources
- 10.6 Chloride Reduction Goals for Communities and the State
- 10.7 Next Steps





10.2 Recommendations to Reduce Chloride Impacts

Four Recommendation Tables for Chloride Sources

- Table 10.1 Winter Maintenance Operations
- Table 10.2 Water Softening and Wastewater Sources of Chloride
- Table 10.3 Agricultural Sources of Chloride
- Table 10.4 General Recommendations (All Sources)

Table 10.1
Recommendations for Winter Maintenance Operations

ID No.	Category	Recommendation	Priority	Implementers													
				Federal	WDNR	WisDOT	State Government	County	Municipality	WWTP	MMSD	Universities	Citizens & Private Property Owners	Winter Maint. Contractors	Developers	Industry	Other Stakeholder Groups ^a
D1	Management Practices	Utilize real-time weather forecasts and roadway conditions data to create an optimal plan to clear snow and ice from roads and use precision application rates. This will allow optimum deployment timing and operational routing.	High			X		X	X					X			ST

ST: Southeastern Wisconsin Watersheds Trust (Sweet Water)





Table 10.1 Recommendations for Management Practices

- Prioritize physical snow removal to reduce the use of deicing products, use high-efficiency plow blades and equipment to maximize removal.
- Implement anti-icing (pre-treatment) using liquid salt brine before winter storms, when conditions allow. Test direct liquid application.
- Utilize pre-wetted rock salt over dry salt for deicing operations and select materials that are most effective for weather and road conditions.
- Calibrate all winter maintenance equipment regularly.
- Require routine training for winter maintenance staff.
- Follow current recommended Smart Salting applications rates.
- Follow best management practices for chloride material storage as well as snow hauling/pile location.
- Sweep or collect up salt spillage or over-applied salt, explore opportunities for brine re-use.





Table 10.1 Winter Maintenance Policy Recommendations

- State: create legislation providing limited slip-and-fall liability protections for private contractors who complete a winter maintenance certification program and satisfy all program requirements.
- Communities: actively advocate for legislation and enact ordinances requiring training/certification for winter maintenance practitioners.
- State: develop funding mechanisms to help communities purchase state-of-the art winter maintenance equipment.
- Communities and Counties: develop salt management plans and formal policies with guidelines and objectives for snow removal, deicing, and anti-icing efforts (passable roadways, plow-only, tiered level of service).
- Communities: enact ordinances to limit salt application on parking lots and sidewalks (Smart Salting application rates – Wisconsin Salt Wise) and require removal of excess salt remaining on paved surfaces.





Table 10.1 Winter Maintenance – MS4 Permit Recommendations

- Revise the reporting period for winter maintenance, full winter season from the previous October through April of the annual report year.
 - Expand MS4 reporting requirements to include:
 - Winter maintenance policy/salt management plan
 - Calibration requirements and compliance documentation
 - Additional material options on the pulldown menus, allow permittee to enter specific details
 - Require permittees to report excess salt discharges as illicit discharges.
 - Over-application of salt on private parking lots and other surfaces
 - Spillage, runoff, or other uncontrolled release from storage areas
- Consider how to collect similar data from non-MS4 communities and private contractors?





Table 10.1 Other Winter Maintenance Recommendations

- Programs/Funding – “salt takeback” programs to accept unused salt, pursue funding opportunities and low-interest loan programs, expand partnerships and coordination
- Outreach/Education – develop public awareness and outreach campaigns to shift public expectations away from “bare pavement” and encourage safe and limited travel during and after winter storm events. Share Smart Salting application guidelines and best practices.
- Low Salt Design and Site Layout – design roadways, buildings, site layouts, and landscaping to maximize sun exposure to promote melting and reduce refreezing and reduce the use of chemical deicers.
- Research – Studies related to chloride impacts on infrastructure such as roadways, bridges, water distribution and sewer systems, and buildings.

➤ Appendix B – Salt-Tolerant Plant List





Table 10.2 Residential Water Softening Recommendations

- Upgrade timer-based residential water softeners to demand-based systems and optimize water softener settings to align with the specific hardness of the incoming water supply and household water usage.
- Develop assistance programs for homeowners to upgrade/optimize
- Consider ordinances with water softener efficiency requirements
- Reduce water usage (high-efficiency appliances) and limit water softening (bypass/blending valves, hot water only, no outdoor)
- Invest in research and development for alternative hardness reduction technologies for home use. Promote awareness and adoption of these technologies.
- Develop outreach program and educational material on chloride impacts and household chloride reduction strategies – distributed by septic service providers





Table 10.2 Wastewater Recommendations

- WPDES Permitting Requirements: include minimum chloride sample requirements for treated wastewater effluent discharged from ALL public treatment facilities and industrial facilities.
- Every WWTP should develop a targeted chloride reduction plan.
 - Better tracking and sampling of chloride sent to municipal WWTPs and discharged from commercial and industrial facilities.
 - Identify significant users and commercial or industrial facilities that generate high-chloride wastewater and work with these facilities to encourage feasible chloride reduction strategies.
 - See WDNR Recommendations – WQS Variance Guidance (2022)
- Reduce infiltration and inflow into sanitary sewer systems.





Table 10.3 Recommendations for Agricultural Sources of Chloride

➤ Potash (KCl) Fertilizer

- Deploy strategies and technologies to optimize potash fertilizer use.
- Develop viable alternative potassium fertilizers.
- Reduce fertilizer use by improving soil health through sustainable agricultural practices.

➤ Livestock Manure (potential additions to table)

- Optimize supplemental chloride in livestock diets, consider all sources.
- Implement manure management practices to limit runoff into surface waters.

➤ Research and Data – Additional research and sample data are needed to better quantify agricultural chloride sources (manure, fertilizer, etc.).





Recommendations for Chloride Management

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Table 10.4 General Recommendations for Chloride Management (all sources)

➤ Policy

- Water Quality Standards: State should consider lowering the chronic and acute toxicity standards for chloride in streams and lakes.
- Prioritize chloride-impaired and highly impacted waterbodies and their upstream drainage areas for monitoring and management efforts.
- Municipalities and Counties should identify and map areas particularly vulnerable to chloride and implement practices to protect these areas.

➤ Programs/Funding

- Provide expanded, consistent funding for education and outreach programs (e.g. Wisconsin Salt Wise) and chloride monitoring programs.
- Sustain partnerships to promote public outreach, data sharing, and watershed-level management of chloride.





Recommendations for Chloride Management

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Table 10.4 General Recommendations for Chloride Management (all sources)

➤ Research

- More research is needed related to the impacts of chloride on aquatic and terrestrial plants, animals and ecosystems.
- More research is needed related to chloride transport as well as groundwater-surface water interactions.

➤ Future Work

- Focus on replacing lead and galvanized water service lines.
- Enforce shoreland zoning ordinances to protect adjacent waters.
- Use Study datasets and methodologies as a baseline for future work.
- Implement recommendations from this Study and WDNR.





10.3 Chloride Monitoring Recommendations

Table 10.5 Monitoring Recommendations

- **Streams** – Establish long-term and consistent chloride monitoring sites, increase monitoring in streams that drain directly to Lake Michigan, and incorporate chloride as a routine parameter sampled by the Water Action Volunteers (WAV) program.
- **Inland Lakes** – Establish long-term and consistent chloride monitoring in lakes, expand monitoring for inline (or chain) lakes, and add chloride sampling to the Citizen Lake Monitoring Network (CLMN) protocols.
- **Groundwater** – Collect chloride samples for all municipal drinking water wells at least annually, develop a shallow well network for long-term monitoring, and improve documentation for private well chloride samples to include a more detailed location and well depth.
- **Wastewater Effluent** – Consistently monitor stream chloride concentrations both upstream and downstream of WWTP discharge outfalls to assess potential impacts of WWTP effluent on stream chloride conditions.
- **Data Management** – Aggregate all surface water and groundwater chloride monitoring data into centralized databases in a consistent format and make these databases available online.





10.3 Chloride Monitoring Recommendations

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Why Continuous Specific Conductance?

- Cost-effective way to estimate chloride levels using the Study regression equations
- Captures year-round baseline conditions and short-term winter spikes

Recommended Network

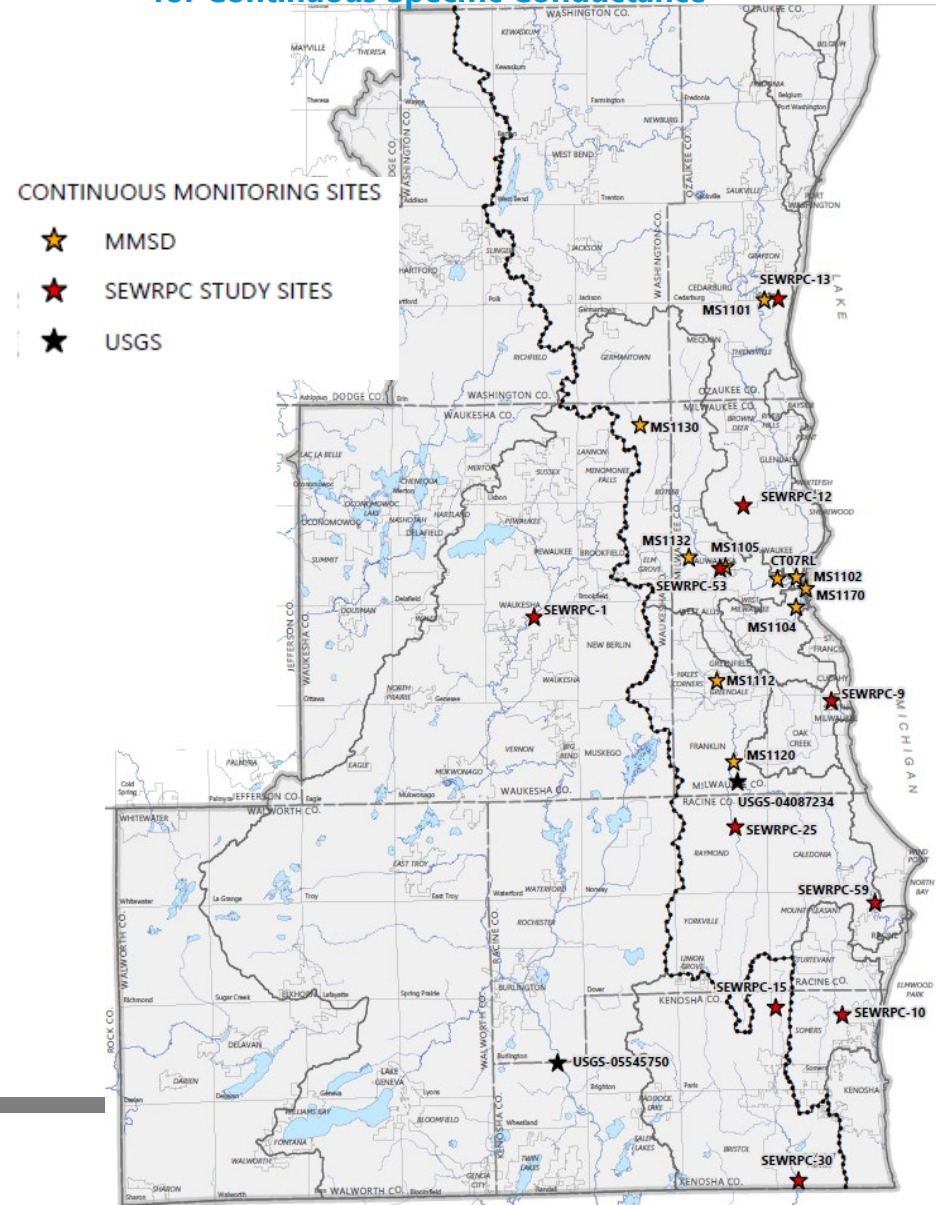
- Maintain Existing Sites: 2 long-term USGS sites and 9 MMSD sites
- Re-Establish Study Sites: Selected SEWRPC Study sites near USGS gages or in urban/urbanizing watersheds

Key Protocols

- Record conductance at least hourly (15-minute intervals optimal) year-round, including winter months
- Collect periodic chloride grab samples to validate regression equations

Map 10.1

Existing and Recommended Stream Monitoring Sites for Continuous Specific Conductance





10.3 Chloride Monitoring Recommendations

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Recommended Frequency:

- At least every other month;
- Monthly + winter weather event sampling is optimal

Recommended Locations

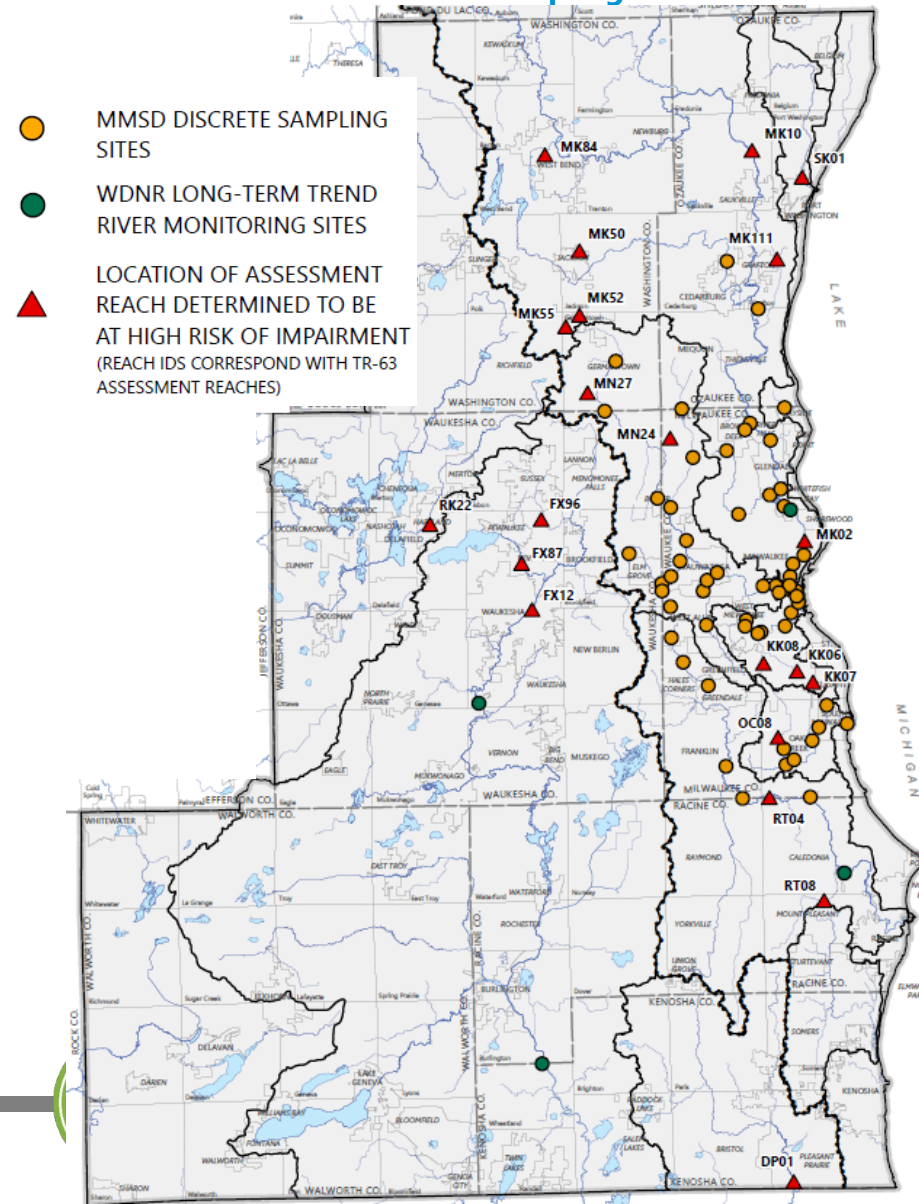
- MMSD Sites (orange): Continue routine year-round grab sampling, including winter
- WDNR Long-Term Trend Rivers (green): Continues grab sampling and add winter sampling
- “High Risk” Assessment Reaches (red): Establish monthly and winter event sampling

Additional Unmapped Stream Priorities:

- State 303(d) chloride-impaired streams
- Unmonitored highly urban streams
- High-quality & sensitive waters

Map 10.2

Selected Existing and Potential Stream Monitoring Sites for Discrete Chloride Sampling





10.3 Chloride Monitoring Recommendations

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Recommended Sampling Frequency

- Annual (triangles): Longer residence times and/or low urban land use
- Biannual – Summer + Winter (circles): Shorter residence times and significant urban runoff or riverine impoundments

Priority Tiers

- Very High Priority (red): Highly urbanized watersheds or shorelines with no recent chloride data
- High Priority (orange): Urbanized watersheds or shorelines with recent chloride data
- Moderate (green): Larger lakes with public access and low urban land use
- Low (blue): Small with little or no public access

Supplemental & Advanced Monitoring

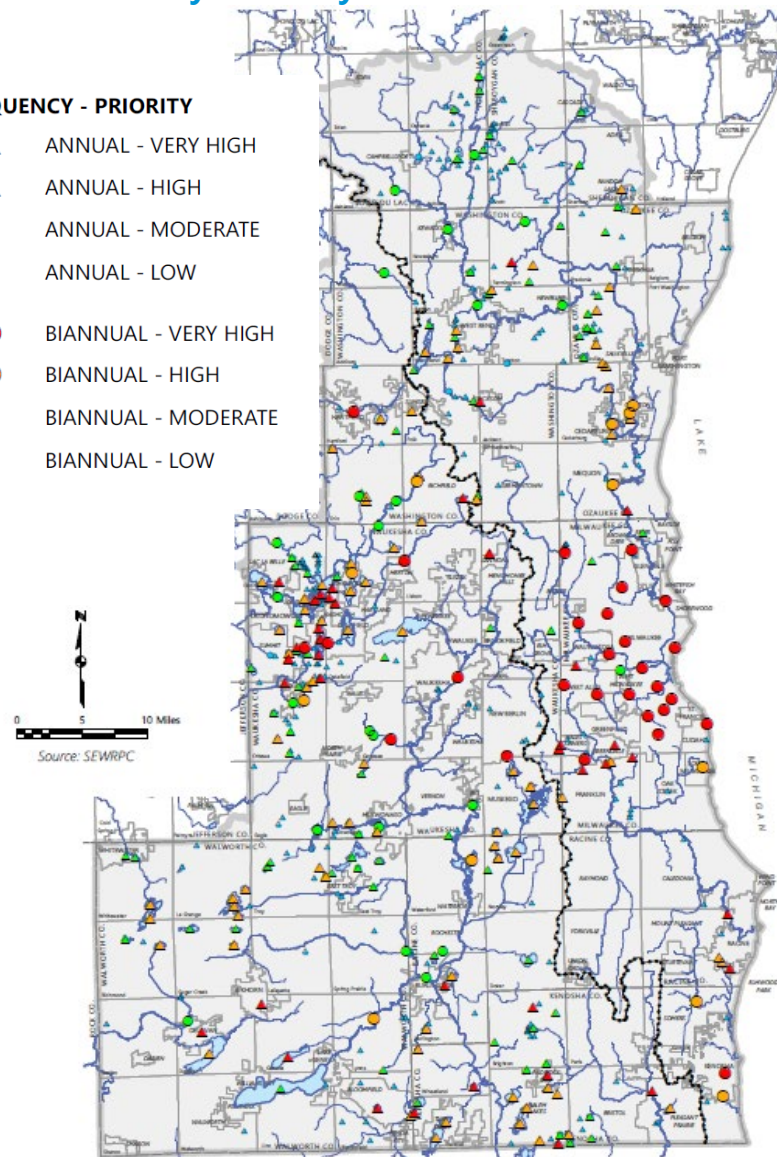
- Use chloride test strips as a cost-effective screening tool
- Add specific conductance profiles to routine summer CLMN monitoring regimen and again in winter
- Sample inflowing tributaries
- Collect grab samples at multiple depths for highly impacted lakes to assess chemical stratification

Map 10.3

Recommended Chloride Monitoring Frequency and Priority for Study Area Lakes

FREQUENCY - PRIORITY

- ▲ ANNUAL - VERY HIGH
- ▲ ANNUAL - HIGH
- ▲ ANNUAL - MODERATE
- ▲ ANNUAL - LOW
- BIENNIAL - VERY HIGH
- BIENNIAL - HIGH
- BIENNIAL - MODERATE
- BIENNIAL - LOW



10.4 Areas Particularly Vulnerable to Chloride

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Estimates of Groundwater Recharge Potential

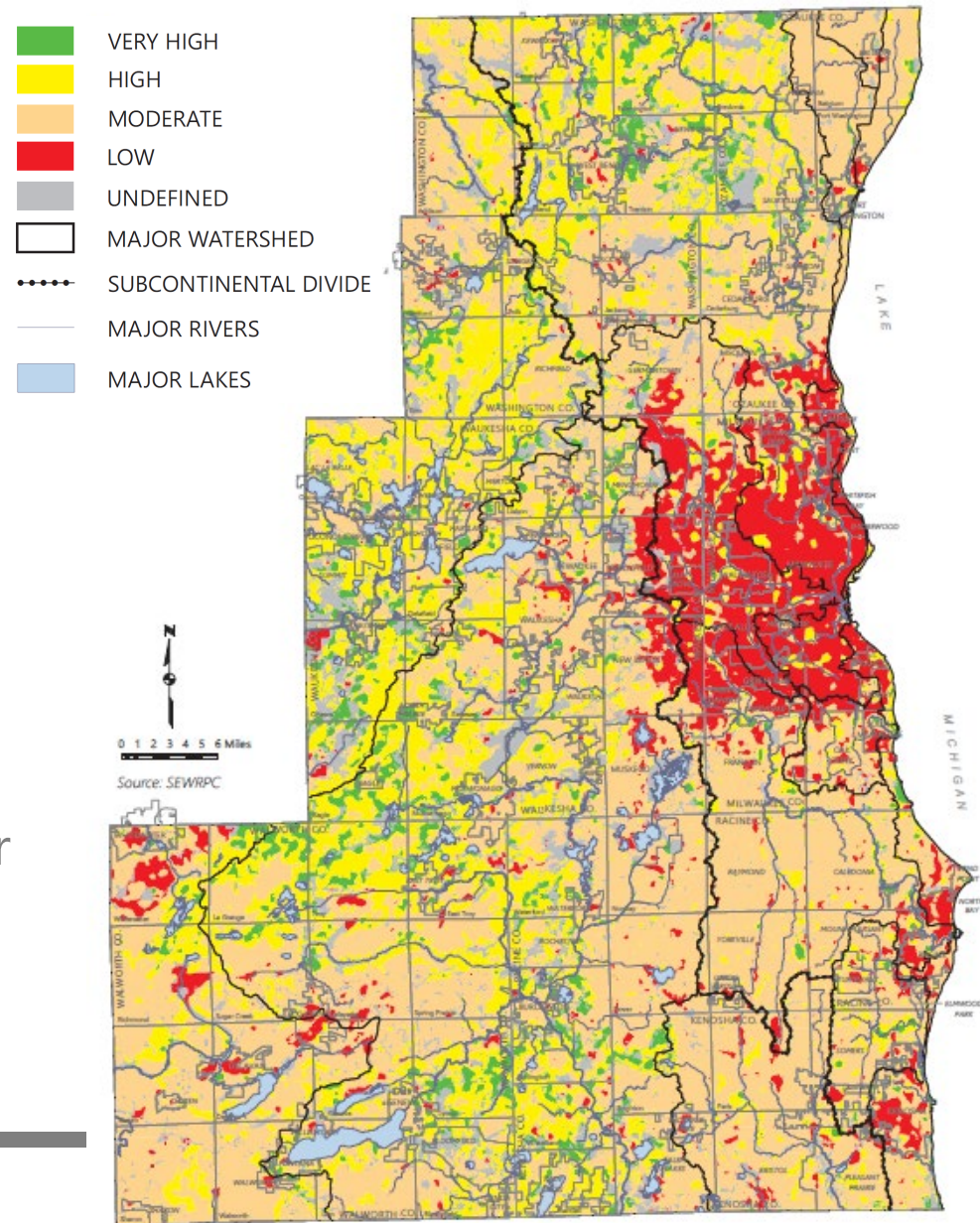
Groundwater Protection

➤ Groundwater Recharge Areas

- Replenish aquifer systems
- TR-63 Map 2.15 – areas with high and very high recharge potential (see right)
- TR-63 Map 6.5 – areas highly susceptible to groundwater contamination

➤ Wellhead Protection Areas

- Safeguard public drinking water supply wells
- Mapped on WDNR Surface Water Data Viewer





10.4 Areas Particularly Vulnerable to Chloride

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Surface Water Protection

- Waterbodies in highly urbanized areas are highly susceptible
- Headwaters and upstream extents of watersheds are sensitive
- Shoreland and riparian zones directly impact adjacent waterbodies
- Ephemeral ponds and wetland areas
- Lake characteristics
 - Seepage and spring lakes: more susceptible due to low flushing rates
 - Residence times: shorter – spikes but high flushing; longer – volume for dilution but long-term accumulation





10.4 Areas Particularly Vulnerable to Chloride

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High-Quality Natural Areas and Critical Species Habitat Protection

- Commission designations: SEWRPC PR-42, *2nd Amendment to the Regional Natural Areas and Critical Species Habitat Protection and Management Plan*
 - Aquatic Areas of statewide significance (AQ-1), regional (AQ-2), and local (AQ-3)
 - Natural Areas of significance (NA-1 to NA-3) “wet” – fens, marshes, ephemeral ponds, and other wetland areas are particularly sensitive
 - Refer to the Natural Areas Explorer for mapped areas and designations
- WDNR designations
 - Outstanding Resource Waters and Exceptional Resource Waters
see TR-63 Map 2.16 and Table 2.7
 - High-Quality Waters and Wetlands designated through the Healthy Watersheds, High-Quality Waters program



Purpose & Approach

- Establish measurable targets for streams, lakes, and groundwater to track the success of Plan implementation.
- Balances current Regional water quality data and biological toxicity thresholds against aggressive, yet achievable targets.
- Structured into **Short-Term (10 years – 2036)** and **Long-Term (50 years – 2076)** milestones

Inherent Recovery Challenges

- **Decades of Accumulation:** Chloride has built up in aquifers over many decades.
- **Hydrological Time Lags:** Even with immediate surface water reductions, groundwater systems recover slowly.
- **Groundwater-Surface Water Connection:** Legacy chloride in shallow aquifers will continue to recharge streams and lakes, potentially delaying surface water recovery.
- **Weather Variability:** Year-to-year winter weather patterns could influence progress of short-term and long-term weather patterns will influence progress towards long-term goals.





➤ Short-Term (10 years – 2036)

- Achieve a general plateauing of concentrations across all stream sampling data
- Significantly reduce winter chloride spikes and other peaks.
- Reduce chloride impacts on aquatic life.

➤ Long-Term (50 years – 2076)

- Complete delisting of all streams currently impaired for chloride on the 303(d) list and ensure no additional waterways become impaired for chloride.
- Reduce chloride impacts on aquatic life.





10.5 Chloride Reduction Targets: Streams

Tiered Targets for Streams Based on Current Impact Level

➤ Tier 1: Severely Impacted Streams

- On 303(d) list for impairment
- Sometimes exceed 1,400 mg/l (severe impact threshold)
- Baseline concentrations commonly approach or exceed 395 mg/l (WI chronic threshold)
- Heavily urbanized with high density of roads and parking lots

➤ Tier 2: Highly Vulnerable Streams

- High risk of impairment listing
- Maximums frequently exceed 230 mg/l (EPA chronic threshold) and approach/occasionally exceed 395 mg/l
- High urban development or near major roads

➤ Tier 3: Moderate Impact and Biological Stress

- Baseline concentrations between 35 mg/l and 120 mg/l
- Maximums stay below 395 mg/l
- Suburban or mixed urban/rural

➤ Remaining streams are lightly impacted – typically natural and rural headwater streams with minor agriculture





10.5 Chloride Reduction Targets: Streams

Table 10.6
Chloride Reduction Targets for Streams in the Region

Stream Category	Short-Term Targets (10 years – 2036)	Long-Term Targets (50 years – 2076)
Tier 1: Severely Impacted Streams	• Eliminate all spikes above 1,400 mg/l	• Eliminate spikes above 757 mg/l • Keep baseline concentrations below 395 mg/l • Achieve regulatory delisting of all streams
Tier 2: Highly Vulnerable Streams	• Eliminate all spikes above 395 mg/l • Stop upward trend for winter spikes baseline concentrations	• Eliminate spikes above 230 mg/l • Keep baseline concentrations below 120 mg/l
Tier 3: Moderately Impacted Streams	• Eliminate spikes above 120 mg/l • Stop upward trend for winter spikes and baseline concentration	• Keep baseline concentrations below 35 mg/l
Lightly Impacted Streams	• Keep maximums below 50 mg/l • Maintain baseline concentrations below 35 mg/l	• Keep maximums below 35 mg/l

Note: Concentrations cited in this table represent chloride thresholds used for condition assessments in TR-63.

1,400 mg/l = Extreme Impact Threshold

757 mg/l = Wisconsin Acute Toxicity Threshold

395 mg/l = Wisconsin Chronic Toxicity Threshold

230 mg/l = USEPA Chronic Toxicity Threshold

120 mg/l = Canadian Chronic Toxicity Threshold

35 mg/l = Conservative Lower Impact Level for Aquatic Organisms





➤ Short-Term (10 years – 2036)

- Achieve a general plateauing of concentrations, stopping historical trend of year-over-year increases.

➤ Long-Term (50 years – 2076)

- Lakes with recent concentrations <70 mg/l : Maintain or reduce concentrations below 35 mg/l to ensure the preservation of most sensitive aquatic species.
- Lakes with recent concentrations >70 mg/l: Cut overall concentrations by half or below the 120 mg/l Canadian chronic toxicity threshold, whichever is lower.





➤ Short-Term (10 years – 2036)

- Achieve a general plateauing of regional chloride data from very shallow aquifers (<100 feet)

➤ Long-Term (50 years – 2076)

- Very shallow aquifers (<100 ft):
 - Urban Areas: Reach and maintain concentrations ≤ 60 mg/l
 - Rural Areas: Reach and maintain concentrations ≤ 35 mg/l
 - Shallow aquifers (100-300 ft):
 - Urban Areas: Maintain concentrations ≤ 80 mg/l
 - Rural Areas: Maintain concentrations ≤ 40 mg/l
- Slowing the near-surface concentrations will translate to a stabilization or reduction in chloride levels in deeper groundwater aquifers over time.





Community and County Goals

➤ Short-Term (10 years – 2036)

- Achieve a 30 percent (or greater) reduction in public winter maintenance chloride material use compared to a 2026 baseline. For those with high reductions already, refine good work and focus on private sector.
- Establish local regulatory frameworks and incentive programs to measurably reduce chloride loading from private parking lots and commercial properties within their municipal jurisdiction.
- Establish programs to accept unused road salt from private contractors and the public at the close of each winter season.
- Actively advocate for legislation for a Statewide certification program for private winter maintenance contractors that offers limited liability for certified applicators who follow documented best management practices.



Community and County Goals

➤ Short-Term (10 years – 2036)

- Manage chloride discharges from public WWTPs.
- Facilities currently operating with **chloride variances** should continue to consistently meet all WPDES permit requirements.
- For WWTPs currently without chloride variances, communities should **establish mean monthly chloride effluent** concentrations and **identify major chloride** sources entering the facility to develop a **targeted chloride reduction plan**.
- Secure and allocate dedicated **funding to support routine monitoring** of surface water and groundwater resources in their jurisdiction.





Community and County Goals

➤ Long-Term (50 years – 2076)

- Achieve **an additional 30 percent (or greater) reduction** in public winter road maintenance chloride use compared to 2036 totals by integrating emerging deicing and anti-icing technologies, advanced municipal policies, continued training, and expanded public outreach programs over the coming decades.
- Incorporate **low-salt design standards** into municipal zoning codes, building codes, and site plan approvals.
- **Eliminate the need for chloride discharge permit variances** across all public wastewater treatment facilities in the Region, ensuring all municipal effluent meets protective chloride standards. All WWTPs should have **targeted chloride reduction plans** and continue to track and evaluate progress toward implementing those plans, ensuring long-term source reduction.
- Maintain **local funding** mechanisms for chloride monitoring.



State Goals

➤ Short-Term (10 years – 2036)

- Establish, fund, and maintain a **Statewide certification program** for private winter maintenance contractors, and **enact limited liability** legislation for certified applicators who follow documented best management practices.
- Provide dedicated, continuous **State funding** for professional training, certification courses, and public outreach programs (such as those offered by Wisconsin Salt Wise) to ensure their long-term operational stability and expanded reach across all state, municipal, county, and private sectors.





State Goals

➤ Short-Term (10 years – 2036)

- Establish **dedicated funding options** such as grants, low-interest loans, or cost-sharing programs to **assist municipalities and counties** in offsetting the initial capital costs of advanced winter maintenance equipment and technologies.
- Develop **State-level funding mechanisms and financial incentives** to support municipalities in executing wastewater chloride reduction initiatives.
- Provide dedicated State **funding and agency support** to expand and sustain surface water and groundwater monitoring.





State Goals

➤ Long-Term (50 years – 2076)

- **Maintain financial and regulatory support** for municipal chloride reduction efforts, ensuring that State administrative codes and funding opportunities continuously adapt to support preservation and restoration of the State's water resources.



➤ Plan Adoption

- Commission and implementers
- Appendix D sample resolution

➤ Tracking Progress

- Iterative process to achieve Goals
- SEWRPC assessment in 10 years for progress towards short-term Goals. Reassessment of long-term Goals based on progress.

Figure 10.1
Cyclical Process for Chloride Reduction in the Region





Chapter 9 – Potential Future Chloride Conditions in Southeastern Wisconsin

Chapter Sections

- 9.1 Introduction
- 9.2 Projected Future Conditions in Southeastern Wisconsin
- 9.3 Potential Future Chloride Conditions in Southeastern Wisconsin
- 9.4 Conclusions



9.2 Projected Future Conditions

Regional Growth and Development Projections – SEWRPC VISION 2050

- Planned Land Use
- Population and Household Projections
- Transportation Network Expansion

Long-Term Weather Patterns and Potential Future Conditions – WICCI

- Mid-Century Projections (2041-2060)
- Medium Emissions Scenario



9.2 Planned Land Use

Table 9.1
Existing and Planned Land Use in the Region: 2010 and 2050

Land Use	Existing 2010		Planned Increment		Planned 2050	
	Square Miles	Percent of Total	Square Miles	Percent Change	Square Miles	Percent of Total
Developed Land						
Residential ^a						
Mixed-Use City Center	3.1	0.1	0.3	9.7	3.4	0.1
Mixed-Use Traditional Neighborhood	45.8	1.7	3.3	7.2	49.1	1.8
Small Lot Traditional Neighborhood	41.6	1.5	38.0	91.3	79.6	3.0
Medium Lot Neighborhood	88.2	3.3	6.4	7.3	94.6	3.5
Large Lot Neighborhood	160.5	6.0	4.7	2.9	165.2	6.1
Large Lot Exurban	31.9	1.2	2.7	8.5	34.6	1.3
Rural Estate	29.9	1.1	7.5	25.1	37.4	1.4
Residential Subtotal	400.9	14.9	63.0	15.7	463.9	17.2
Commercial	35.6	1.3	13.9	39.0	49.5	1.8
Industrial	35.2	1.3	9.4	26.7	44.6	1.7
Transportation, Communication, and Utilities	213.8	8.0	13.9	6.5	227.7	8.5
Governmental and Institutional	37.0	1.4	1.9	5.1	38.9	1.4
Recreational ^b	56.0	2.1	6.9	12.3	62.9	2.3
Unused Urban	46.0	1.7	-21.3	-46.3	24.7	0.9
Developed Land Subtotal	824.5	30.7	87.7	10.6	912.2	33.9
Undeveloped Land						
Agricultural ^c	1,155.5	43.0	-65.8	-5.7	1,089.7	40.6
Natural Resource Areas						
Surface Water	84.7	3.1	0.0	0.0	84.7	3.1
Wetlands	315.2	11.7	0.0	0.0	315.2	11.7
Woodlands	191.4	7.1	0.0	0.0	191.4	7.1
Natural Resource Areas Subtotal	591.3	21.9	0.0	0.0	591.3	21.9
Unused and Other Open Land ^d	118.5	4.4	-22.0	-18.6	96.5	3.6
Undeveloped Land Subtotal	1,865.2	69.3	-87.7	-4.7	1,777.5	66.1
Total	2,689.7	100.0	0.0	0.0	2,689.7	100.0

Urban Land Use (LU)

- Region +3.2%

Urban LU By County

- Kenosha +6.4%
- Racine +4.0%
- Waukesha +3.9%
- Washington +3.0%
- Ozaukee +2.8%
- Walworth +1.9%
- Milwaukee +1.6%



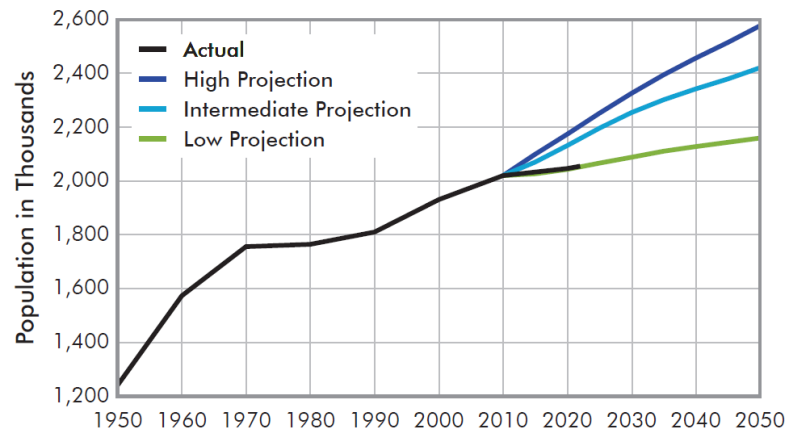
9.2 Population and Household Projections

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Projected Regional Growth from 2010 to 2050

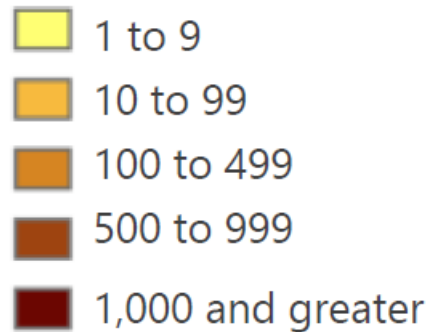
- Population +20% (401,700)
- Households +25% (201,100)

Figure 9.1
Actual and Projected Population in the Region

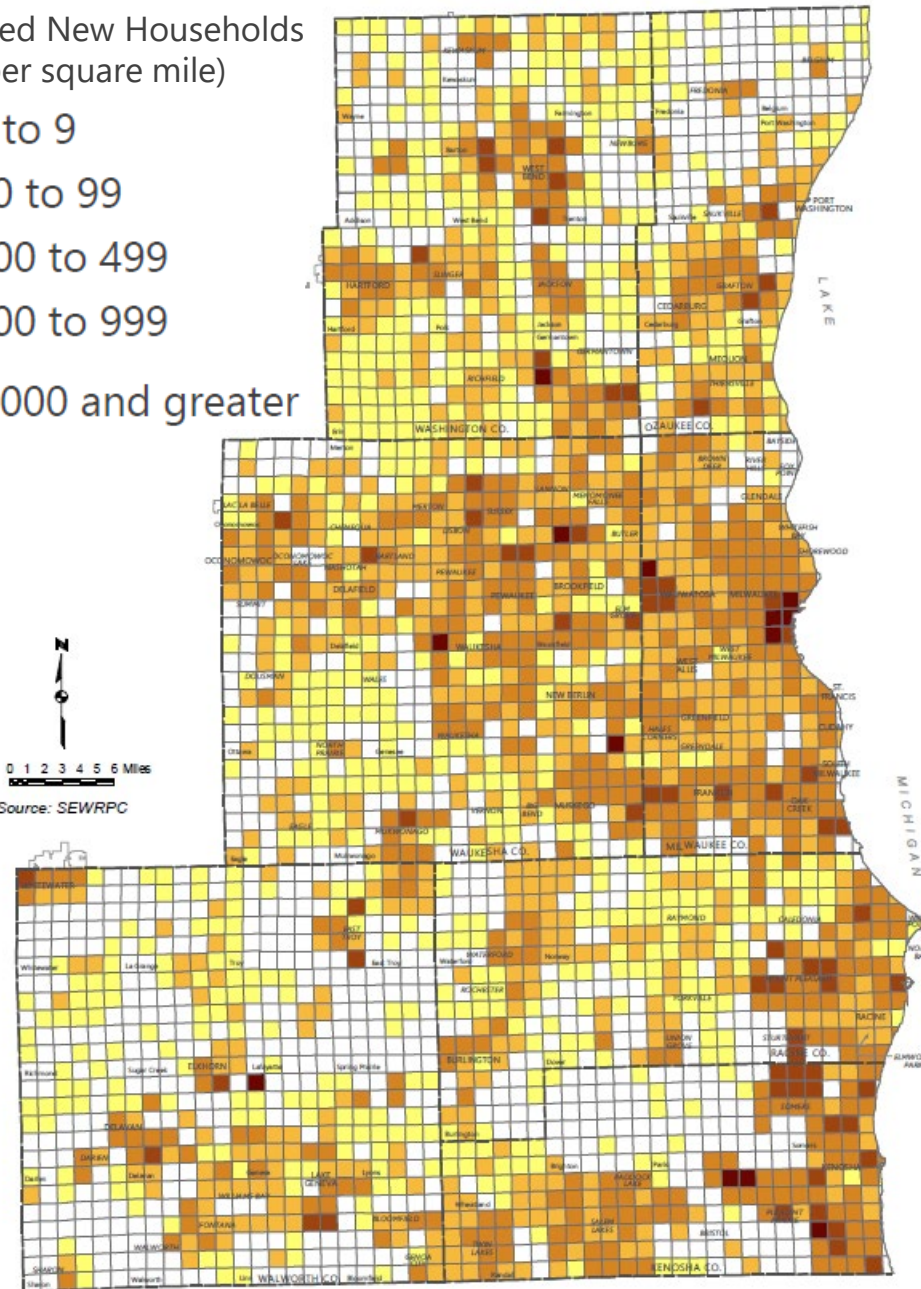


Source: U.S. Census Bureau and SEWRPC

Projected New Households
(per square mile)



0 1 2 3 4 5 6 Miles
Source: SEWRPC





9.2 Transportation Network Expansion

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Map 9.3

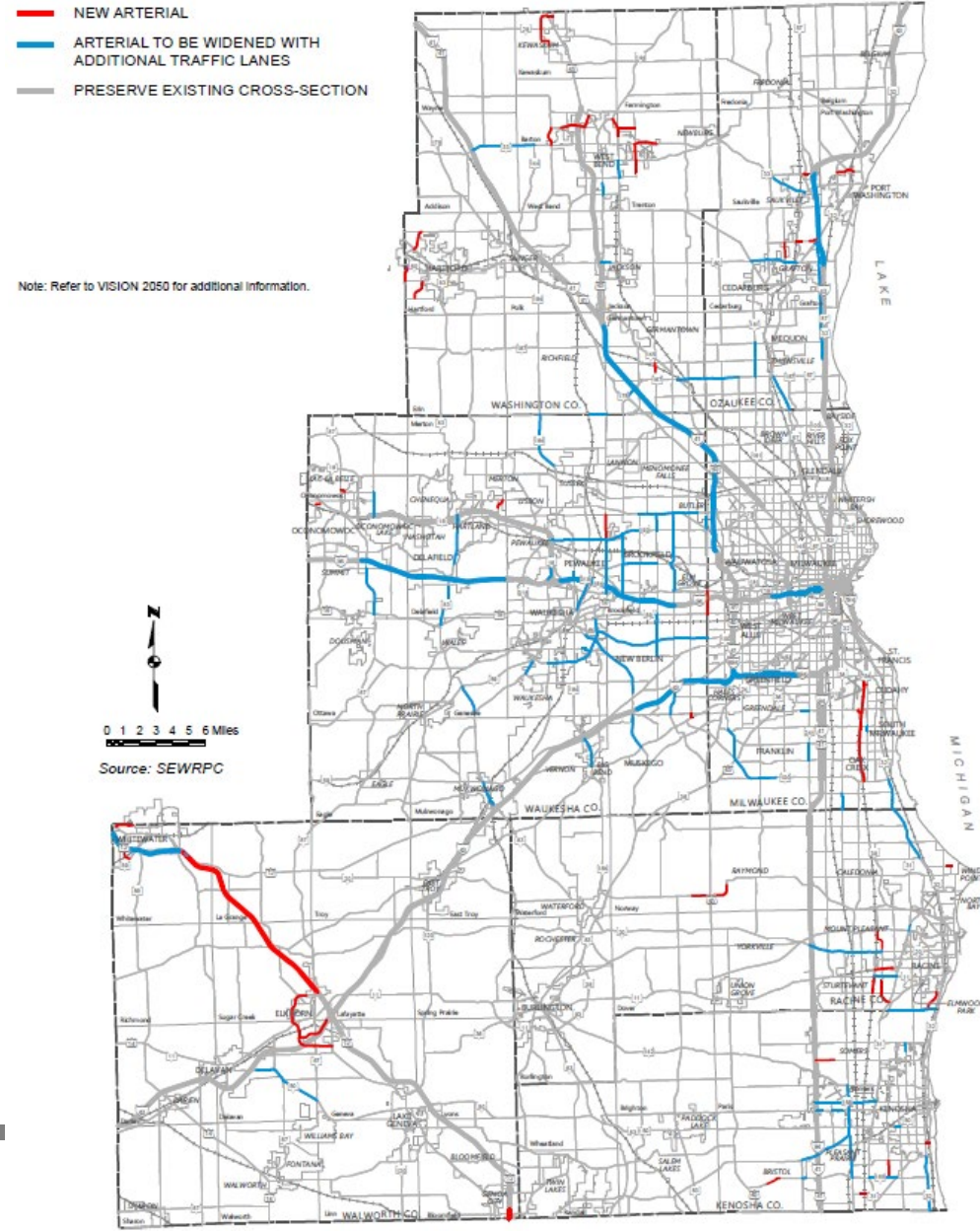
VISION 2050 Planned Highway and Arterial Street Improvements

Table 9.8

VISION 2050 Planned Highway and Arterial Street Improvements by County

County	Planned New Lane Miles ^a		
	Expansion	Widening	Total
Kenosha	7.9	48.0	55.9
Milwaukee	26.4	96.7	123.0
Ozaukee	5.9	58.8	64.7
Racine	17.5	17.9	35.5
Walworth	118.3	28.0	146.3
Washington	31.0	56.8	87.8
Waukesha	8.6	230.9	239.5
Total	215.7	537.0	752.7

^a Does not include future additions to local streets.





9.2 General Implications on Chloride

Implications of Projected Regional Growth and Development on Chloride

➤ Future Highway and Arterial Street Expansion

- Directly affects the amount of chloride used for public road deicing/anti-icing activities

➤ Planned Land Use and Projected Population and Household Growth

- Strong correlation between urban land use and chloride
- Depends on location and type of development and the existing infrastructure available to serve the new development
- Increased usage and demand for chloride-based products
- Increased water usage and wastewater generation



9.2 Long-Term Weather Projections

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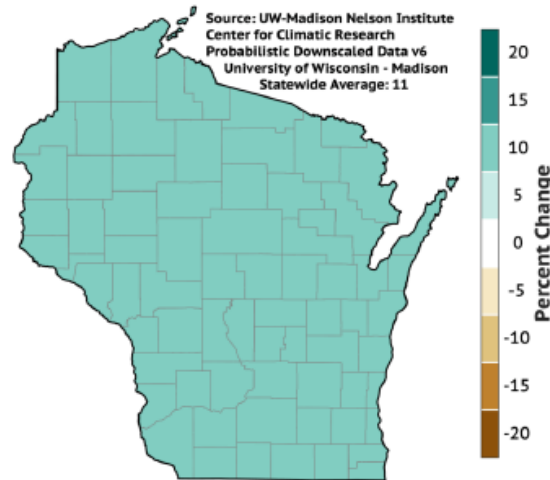
Figure 9.3

Projected Changes in Seasonal Precipitation for Wisconsin by Mid-Century

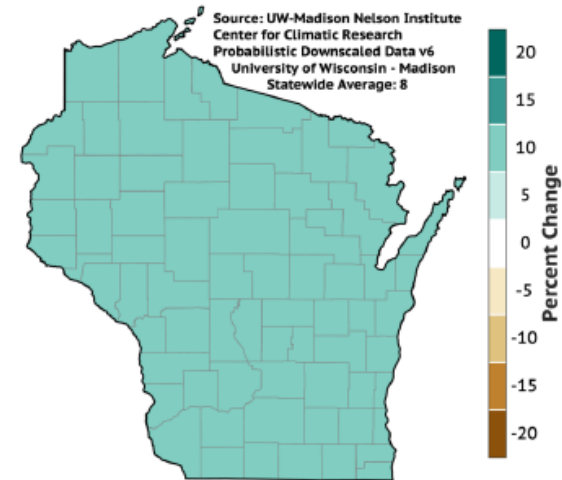
WICCI Projections

- Warmer Temperatures
- Wetter Overall
- More Extreme Events and Rapid Shifts between Extremes

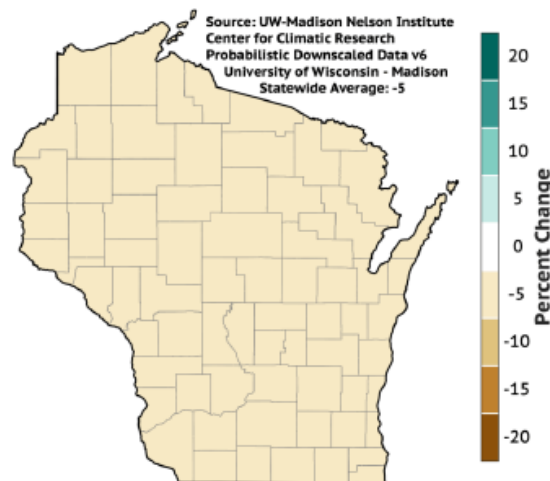
Change in Winter Precipitation
Medium Emissions, 2041-2060 vs. 1991-2020



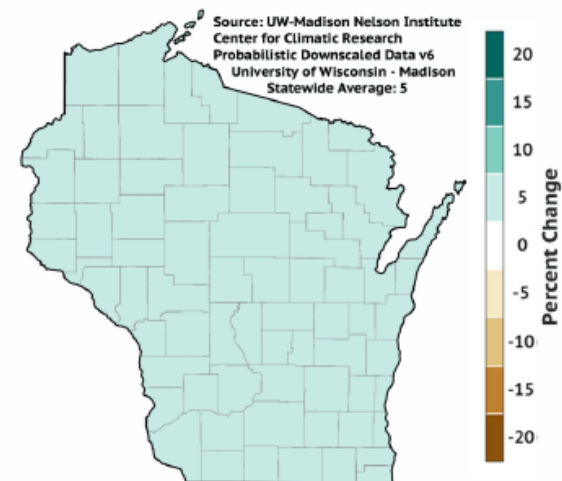
Change in Spring Precipitation
Medium Emissions, 2041-2060 vs. 1991-2020



Change in Summer Precipitation
Medium Emissions, 2041-2060 vs. 1991-2020



Change in Fall Precipitation
Medium Emissions, 2041-2060 vs. 1991-2020



Source: WICCI



9.2 General Implications on Chloride

Implications of Climate Projections on Chloride - Wildcard

➤ Projected Temperatures Increases – Warming Winters

- Fewer freezing periods **could** reduce overall deicing needs.
- More mixed precipitation, ice storms or freeze-thaw cycles **could** increase deicing needs.

➤ Potential Changes to Precipitation

- Increased winter precipitation could increase deicing needs.
- Increased non-winter precipitation would increase chloride dilution in surface waters and mobilize “legacy” chloride.



9.2 General Implications on Chloride

Implications of Climate Projections on Chloride

➤ Projected Extreme Events

- Increased high-intensity rainfall events
- Ping-Pong Effect – rapid shifts between extreme deluge and drought

➤ Increased Drought Risk

- Due to warmer temperatures and prolonged dry periods
- Reduced streamflow and baseflow – increased chloride concentrations in surface waters
- Groundwater depletion – reduced recharge and increased demand





9.3 Potential Future Chloride Conditions

Exploring the Potential Effects of Projected Future Conditions on Chloride

- Winter Maintenance Operations
- Wastewater Sources of Chloride
- Agricultural Sources of Chloride

Scenarios Considered for Potential Future Chloride Conditions

- No changes to current chloride management practices (status quo)
- Implementation of chloride reduction strategies (detailed in TR-66 and in Ch. 8, also included in Ch. 10 recommendations)





9.3 Potential Future Chloride Conditions

Winter Maintenance Operations – Public and Private Deicing and Anti-Icing

➤ Public Deicing

- Direct increases due to planned highway expansion.
- Likely increase with projected urban land use increases, would depend on the development location and existing roadways vs constructed

➤ Private Deicing

- Projected pop/household growth would increase residential deicing.
- Could increase with projected urban land use, particularly for developments that include large parking lots/impervious surfaces.

➤ Wildcard: Future Winter Conditions

- Warmer winters could shorten the “salting” season.
- Could lead to more frequent ice storms, mixed precipitation, or freeze-thaw cycles that could require additional deicing.





9.3 Potential Future Chloride Conditions

Sources of Chloride in Treated Wastewater Effluent

- Projected increases in urban land use and population/household growth
 - Depending on the type of development, increases in wastewater from commercial (car washes, laundry, etc.) and industrial facilities
 - Population/household growth would directly increase domestic wastewater generation – SSSAs projected to be 100% served
- Transportation network expansion – indirect increase through I&I, assuming chloride from deicing and winter maintenance increases
- Future climate and long-term weather conditions
 - Wet periods would be beneficial, diluting chloride in surface water
 - Prolonged dry periods would make chloride conditions worse
 - Increased chloride concentrations in surface water (low flows)
 - Groundwater impacts (depletion, higher hardness and chloride conc)



●●●●● Potential Future Chloride Conditions

Agricultural Sources of Chloride

➤ Projected growth in urban development

- Typically comes at the expense of agricultural land uses
- Would reduce the acres receiving potash and manure applications

➤ Changes to long-term weather patterns

- Projected warmer temperatures – extended growing season, increasing fertilizer applications and water usage (crops and livestock)
- Extreme events and heavy rainfall would increase runoff and wash-off
- Shifting/erratic rainfall patterns make it more difficult to meet plant water demands and fertilizer/manure application timing
- Drought conditions would also increase water usage, and potentially increase irrigation





Factors Influencing Future Conditions

Figure 9.4

Summary of Impacts on Future Chloride Usage and Conditions in Southeastern Wisconsin

Scenario	Chloride Impacts			
	Winter Maintenance Sources	Wastewater Sources	Agricultural Sources	Waterbody Chloride Concentrations
Future Conditions – No Changes to Current Practices				
Increased Urban Development	↑	↑	↓	↑
Population and Household Growth	↑	↑		↑
Highway and Arterial Expansion	↑			↑
Future Climate Projections				
Wetter Conditions/Winters	↑			↑
Warmer Conditions/Winters	↔		↑	
More Rainfall				↓
Less Rainfall/Drought		↑	↑	↑
Future Conditions – With Chloride Reduction Efforts				
Smart Salting Practices (Brine, Pre-Wetting, etc.)	↓			↓
Routine Equipment Calibration	↓			↓
Water Softener Optimization and Upgrades		↓		↓
Chapter 10 Recommendations ^a	↓	↓	↓	↓

↑ Increase ↓ Decrease ↔ Mixed Results ↑ Indirect Increase ↓ Indirect Decrease

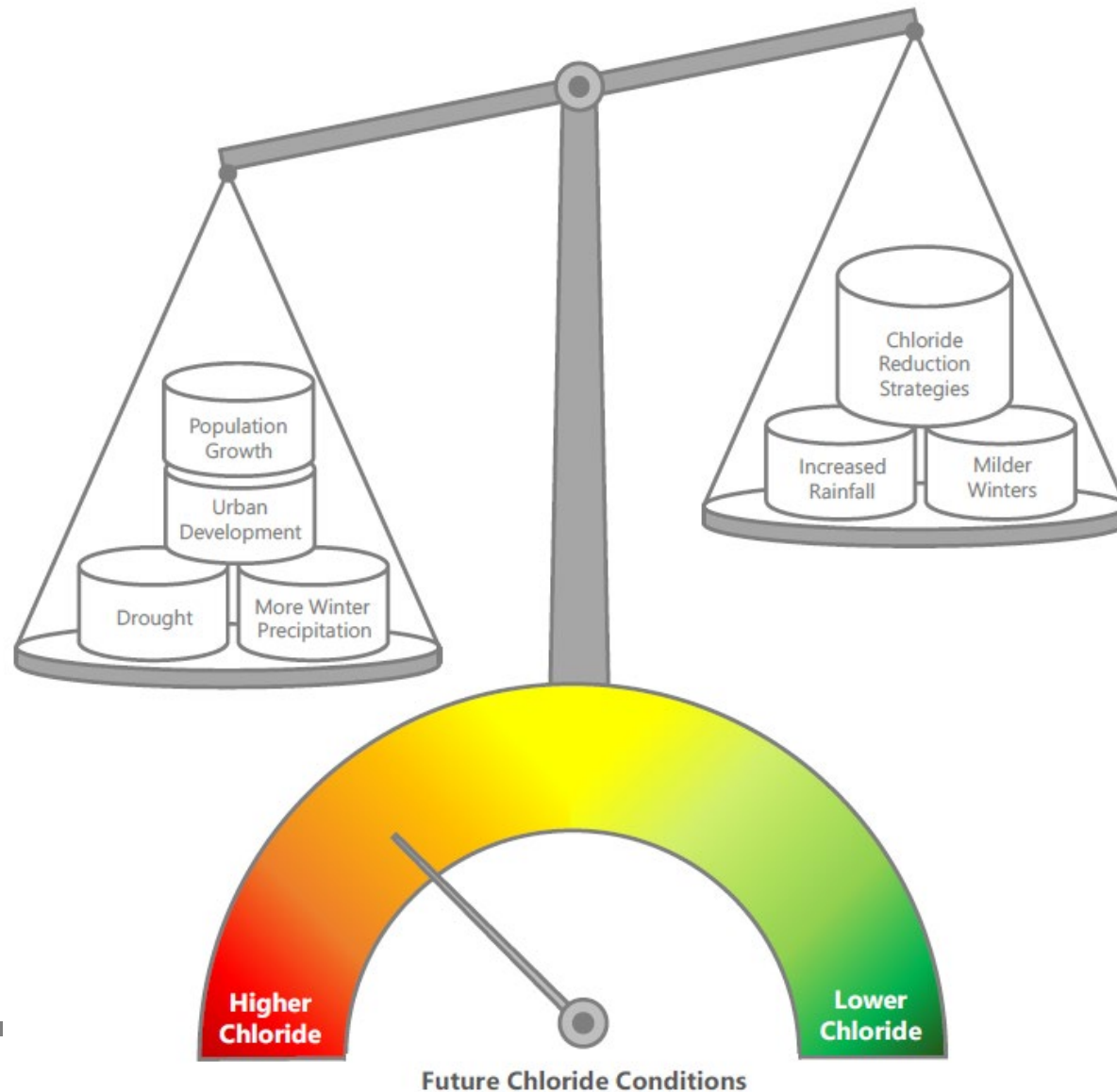




9.4 Factors Influencing Future Conditions

Figure 9.5

Balance of Factors Influencing Potential Future Chloride Conditions in Southeastern Wisconsin





Chapter 8 – Options to Manage Chloride

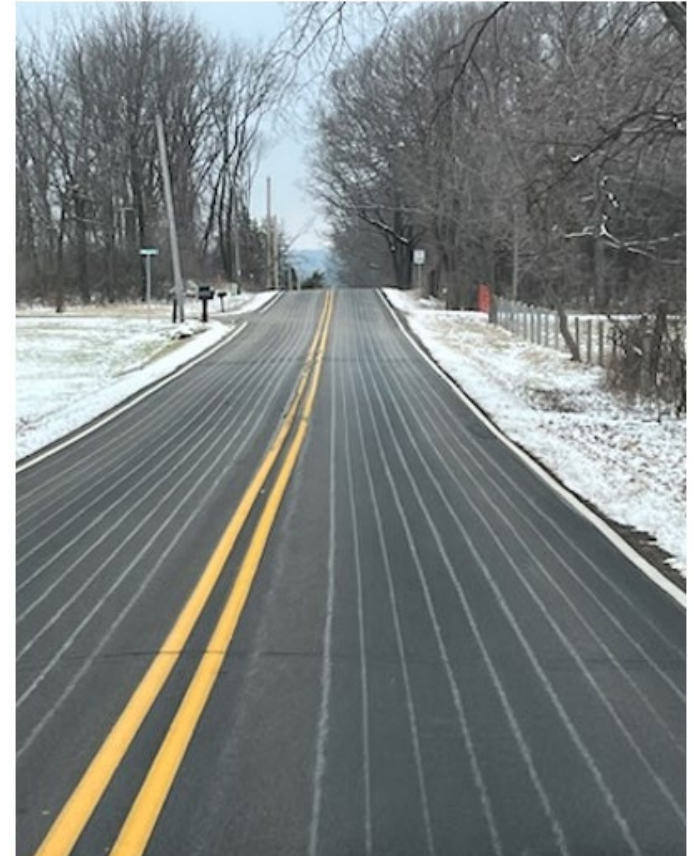
- This chapter summarizes many of the practices, technologies, and policies detailed in TR-66 and TR-67 and serves as the technical basis for Chapter 10 recommendations.

Chapter Sections

- 8.1 Introduction
- 8.2 Public Winter Road Maintenance
- 8.3 Private Winter Maintenance
- 8.4 Public Water and Wastewater Utilities
- 8.5 Private Water Softening
- 8.6 Agriculture
- 8.7 Industrial Food Processing
- 8.8 Legal and Policy Considerations

Figure 8.10

Anti-Icing Brine Applied in a Wet/Dry Striped Pattern





- **Core Idea:** Source reduction is essential for improving chloride conditions in surface water and groundwater resources in the Region.
- **Winter Maintenance (8.2-8.3):** Shift expectations for winter roads, calibration and precision application, anti-icing brine, pre-wetting, advanced plow blades and sensors
- **Water Utilities and Softening (8.4-8.5):** Focus on source reductions, upgrade to demand-based softeners, calibrate settings, evaluate centralized softening
- **Ag & Industry (8.6-8.7):** Precision nutrient/manure management and industrial waste-stream optimization
- **Policy Tools (8.8):** Slip-and-fall liability waivers for certified applicators, municipal salt management plans, State/Federal funding programs





- This chapter details the monitoring option, field methodologies, and equipment considerations that support the monitoring recommendations in Section 10.3.

Chapter Sections

- 7.1 Introduction
- 7.2 Stream and River Monitoring
- 7.3 Lake Monitoring
- 7.4 Biological Indicator Assessments
- 7.5 Groundwater Monitoring



7.2 Chloride Monitoring: Streams

➤ Discrete Grab Sampling

- Highest accuracy (lab analysis) for single point-in-time measurement
- Minimum frequency: Twice yearly (winter and summer)
- Preferred frequency: Monthly plus targeted winter storm events
- Limitations: Misses dynamic nature of stream chloride conditions (spikes and dilution events)



7.2 Chloride Monitoring: Streams

➤ Automated Continuous Specific Conductance Monitoring

- Use specific conductance as proxy for chloride
- Pair continuous conductance measurements with chloride grab samples to develop new predictive formulas
- Use SEWRPC regression equations for similar streams
- Produces a high-resolution picture of estimated chloride conditions
- High Maintenance: Requires durable sensors, frequent equipment checks and cleaning

➤ Directly implements Chapter 10 recommendations to re-establish continuous specific conductance networks on priority streams (see Table 10.5, M12)

Figure 7.1
Continuous Sensor and Housing Assembly



Figure 7.2
Sensor Cleaning and Maintenance



7.2 Chloride Monitoring: Streams

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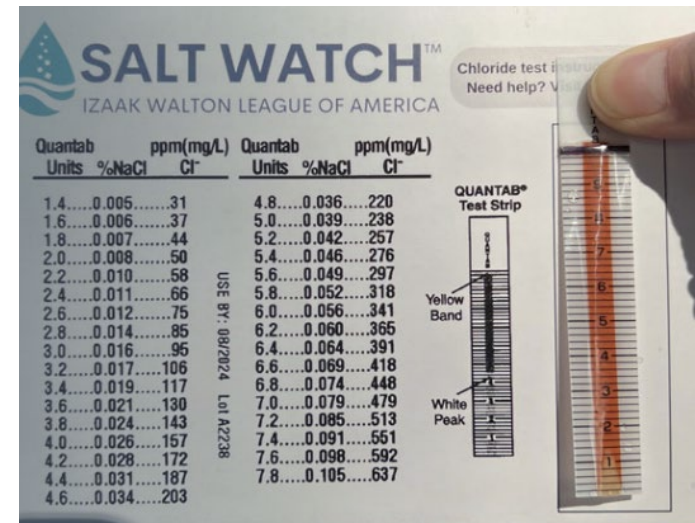
Alternative Field Screening Tools

➤ Ion-Selective Electrodes (ISE Sensors)

- Uses chloride-sensitive membrane that generates electrical potential proportional to the chloride ions in the water
- Most useful for rapid, point-in-time chloride measurement without lab analysis; identify localized hotspots
- Limitations: Poor for continuous deployment due to signal drift, heavy biofouling on membranes, and interference from other ions.

➤ Chloride Test Strips

- Low-cost option ideal for volunteer networks
- Limitations: Visual reading can be subjective; Data is not submittable to water quality databases



7.3 Chloride Monitoring: Lakes

➤ Lake Surface Sampling

- **Surface Grab Sample** (3 feet): Collected at location of deepest hole once or twice per year
- **Tributary Streams:** Additional grab samples from streams flowing into lake, collected as close to the time of lake surface sampling as possible to ensure consistency and comparability
- **Chloride Test Strips:** Offer cost-effective option for assessing general estimates of baseline conditions and identifying lakes that require more comprehensive monitoring

➤ Sampling at Discrete Depths

- For highly impacted lakes to assess for potential chemical stratification
- Utilize vertical sampling device (Niskin-style) to grab samples at mid depth and near lake bottom

➤ Specific Conductance and Temperature Profiling

- Cost-effective method for characterizing general chloride conditions across depths
- Conducted at lake's deepest hole
- Utilize multiparameter sonde (depth, water temperature, specific conductance) attached to long communication cable

Figure 7.3
Niskin-Style Vertical Water Sampler and Aqua
TROLL 500 Multiparameter Sonde Assembly





7.4 Chloride Monitoring: Biological Indicators

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Evaluate Ecological Impacts:

- **Benthic Macroinvertebrate Investigations:** Shift from sensitive mayflies and stoneflies toward salt-tolerant beetles, dragonflies, and midges can indicate long-term chloride impacts.
- **Algae:** Respond rapidly to environmental stressors. Disappearance of low-tolerance diatom species can indicate salinization.
- **Fish Populations:** Chloride can induce stunted growth that can prolong the amount of time fish spend in vulnerable life stages. Surveys with a specific focus on data related to life stages can be informative.
- **Aquatic Plants:** Assess sublethal physical stress (leaf burn, wilting, reduced biomass) and reduced flowering/seed germination.





7.5 Chloride Monitoring: Groundwater

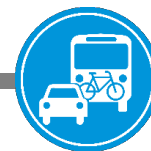
➤ Municipal Wells:

- Increase sampling to at least annually
- Sample shallow wells in both winter/spring and summer/fall
- Record locations at least to the quarter-section

➤ Private Wells:

- Report well depths
- Report finer spatial scale (quarter-section)
- Promote annual testing and reporting to UW Stevens Point's Wisconsin Well Water Quality Viewer

➤ Establish Dedicated Long-Term Observation Wells



➤ TAC Approval

- Motion and second to approve PR-57 (with edits, if offered)

➤ Next Steps

- Comments on the draft chapters can be sent to Laura (lherrick@sewrpc.org). All comments are due by November 13, 2026.
- Public Comment Period in November and finalization of document in December. Public outreach in first half of 2027.
- Meeting agendas, presentations, and summary notes along with draft text are posted on project website

www.sewrpc.org/chloride-study





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●●●●● Project Funding Provided By



Thank You

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