

Technical Report No. 65

MASS BALANCE ANALYSIS FOR CHLORIDE IN SOUTHEASTERN WISCONSIN

## Chapter 1

# INTRODUCTION

### 1.1 PURPOSE OF THIS REPORT

This Report documents the development of chloride loads from various sources throughout the Southeastern Wisconsin Region (Region) and presents the results of the chloride mass balance analysis performed for the Chloride Impact Study (Study) for Southeastern Wisconsin.<sup>1</sup> As documented in the Southeastern Wisconsin Regional Planning Commission (Commission or SEWRPC) Technical Report No. 63 (TR-63), the concentrations of chloride in surface water and groundwater in the Region have shown increases over time.<sup>2</sup> This Report identifies sources of chloride to the environment within the Region and larger study area including: road salt and other chloride-based compounds applied for anti-icing and deicing of public and private roads, sidewalks, and parking lots; water softeners and other domestic wastewater sources that are conveyed to public wastewater treatment facilities or private onsite wastewater treatment systems; industrial wastewater from sources such as chemical manufacturing or food processing; livestock and large agricultural feedlots; agricultural fertilizers; and the atmospheric deposition of chloride.

This Report also documents the data, methods and assumptions used to estimate the relative contribution of chloride from various sources within the Region and within the upstream contributing drainage areas for the stream monitoring sites employed for the Study. Continuous specific conductance data and discrete

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<sup>1</sup> *Acronyms and abbreviations used in this Report are defined in Appendix A.*

<sup>2</sup> *SEWRPC Technical Report No. 63, Chloride Conditions and Trends in Southeastern Wisconsin, in preparation.*

chloride samples were collected at stream monitoring sites as detailed in TR-61.<sup>3</sup> These data were used to estimate chloride concentrations in the monitored streams using the regression models developed in TR-64.<sup>4</sup> At select stream monitoring sites with reliable streamflow data, chloride mass loads were computed. This Report also presents the chloride mass balance analysis performed for these select sites, comparing the estimated chloride source inputs to surface water with the resulting chloride loads observed at the stream monitoring sites. Additionally, relative annual contributions from various chloride sources were estimated for each stream monitoring site and for the entire Region over the study period from October 2018 through October 2020.

## **1.2 RELATIONSHIP OF THIS REPORT TO THE CHLORIDE STUDY**

This Technical Report presents some of the findings from the Commission's Chloride Impact Study.<sup>5</sup> This Study was initiated due to heightened public concern over the growing use of road salt and evidence of increasing chloride concentrations in surface water and groundwater within the Region. The findings of this Study are presented in a series of reports.

Major objectives of the Chloride Impact Study include:

1. Documenting historical and existing conditions and trends in chloride concentrations in surface and groundwater in the Southeastern Wisconsin Region
2. Evaluating the potential for increased amounts of chloride in the environment to cause impacts to surface water, groundwater, and the natural and built environment in the Region
3. Identifying the major sources of chloride to the environment in the Region
4. Investigating and defining the relationship between the introduction of chloride into the environment and the chloride content of surface and groundwater

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<sup>3</sup> SEWRPC Technical Report No. 61, Field Monitoring and Data Collection for the Chloride Impact Study, September 2023.

<sup>4</sup> SEWRPC Technical Report No. 64, Regression Analysis of Specific Conductance and Chloride Concentrations, May 2024.

<sup>5</sup> SEWRPC Planning Report No. 57, A Chloride Impact Study for Southeastern Wisconsin, in preparation.

5. Developing estimates of chloride loads introduced into the environment under existing conditions and forecasts of such loads under planned land use conditions
6. Evaluating the potential effects of climate change on the major sources of chloride under planned land use conditions
7. Reviewing the state-of-the-art of technologies and best management practices affecting chloride inputs to the environment and developing performance and cost information for such practices and technologies
8. Exploring legal and policy options for addressing chloride contributions to the environment
9. Developing and evaluating alternative chloride management scenarios for minimizing impacts to the environment from chloride use while meeting public safety objectives
10. Present recommendations for the management of chloride and mitigation of impacts of chloride on the natural and built environment

The chloride mass balance analysis presented in this Report addresses Study Objectives 3 and 5, while utilizing the results from Study Objective 4 and the monitoring data collected for the Study. This Report also provides context for the evaluation of Objective 6. By quantifying the relative chloride contribution to the environment from various sources, the results presented in this Report support the prioritization of potential chloride management opportunities for Study Objectives 7, 9, and 10.

### **1.3 REPORT FORMAT AND ORGANIZATION**

This Report is organized into four chapters. Following this introductory chapter, Chapter 2 presents the background information on the study area, along with the chloride sources and input data used to estimate chloride loads and develop the chloride mass balance analysis. In addition to defining chloride sources to the environment, this chapter includes data related to developing in-stream chloride loads at monitoring sites.

Chapter 3 describes the chloride loading and mass balance analysis methodology employed for the Chloride Impact Study. The chapter begins with a review of the mass balance analysis approach and describes the

computation of chloride loads from each significant chloride source. Chapter 3 also presents the calculation of in-stream chloride loads, which required streamflow dataset development and chloride concentrations estimated from continuous specific conductance data.

Chapter 4 presents the results of the chloride loading and mass balance analysis. This chapter examines the overall and relative chloride contribution by source within the Region. Chapter 4 also presents the results for a similar chloride source analysis performed for each of the stream monitoring sites. The chloride mass balance results were also evaluated at individual SEWRPC stream monitoring sites with reliable streamflow data, where the in-stream chloride load was compared to the chloride source load within each upstream drainage area. In addition to summarizing the results of the chloride loading and mass balance analyses, Chapter 4 examines those results in context with environmental factors and conditions.