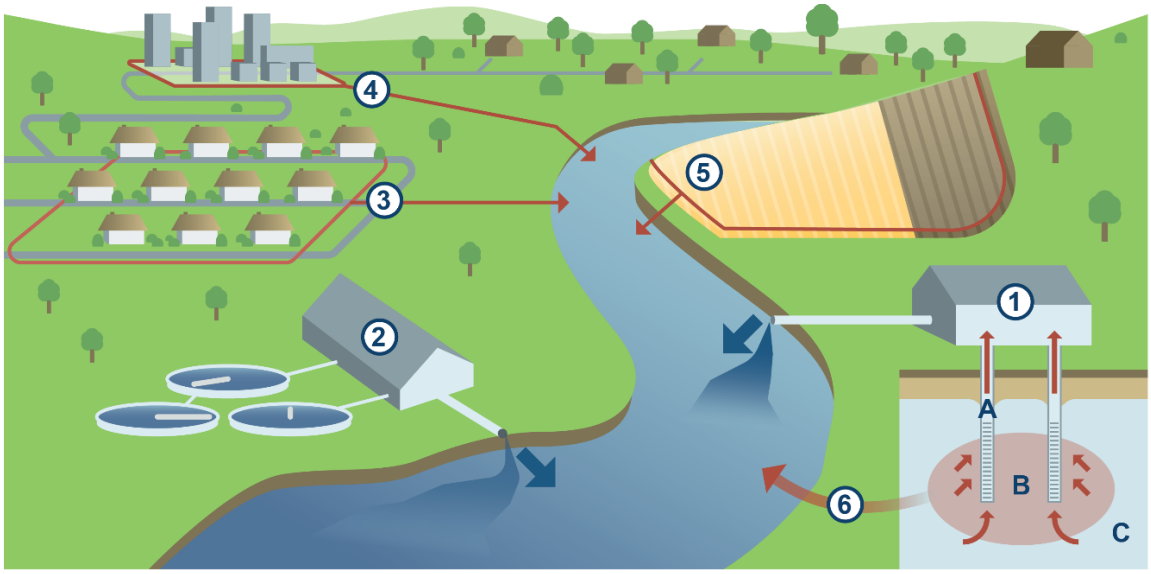
Surface water and sediment evaluation at remediation sites

The Minnesota Pollution Control Agency (MPCA) is responsible for protecting the water quality of Minnesota's lakes, rivers, streams, and wetlands. Releases and threatened releases of pollutants have the potential to impact surface waters of the State. The MPCA is also, therefore, responsible for overseeing the investigation, mitigation, and remediation of releases and threatened releases to surface waters in accordance with applicable State statutes and rules.

Releases or threatened releases can be categorized as point and non-point sources. **Point sources** refer to end-of-pipe or direct discharges to a surface water. Examples of point sources include groundwater pump-out / surface water discharge systems, wastewater treatment plant discharges, and industrial facility discharges. Point source dischargers must obtain a National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) permit prior to discharge. **Nonpoint sources** are sources related to land management or land use activity that contributes or may contribute to groundwater and surface water pollution as a result of runoff, seepage, or percolation. Examples of nonpoint sources include precipitation runoff from lawns or farm fields, sediment from eroding streambanks, bacteria from pet waste, and failing septic systems. Common nonpoint discharges at remediation sites include runoff, spills, leaks, and contaminated groundwater discharge to a surface waterbody via the groundwater-to-surface water pathway. Some point and nonpoint sources are depicted on the graphic below. This document focuses on nonpoint sources in relation to contaminated remediation sites.



Point sources

1. Remediation System Building
   - A Extraction Well
   - B Plume
   - C Groundwater
2. Wastewater Treatment Plant

Nonpoint sources

3. Residential (Spills/Leaks)
4. Industrial (Spills/Leaks)
5. Contaminated Runoff
6. Contaminated Groundwater Discharge

Water

- Treated
- Contaminated

This document serves as a guide to (1) explain the application of existing surface water quality rules and standards, and (2) outline the assessment process to evaluate the risks posed to receptors in surface waters and aquatic sediments from potential or actual nonpoint discharges at remediation sites including Superfund, Resource Conservation and Recovery Act (RCRA), Brownfields, Petroleum, closed landfills, and other contaminated sites. The process to assess the risks posed to human health and the environment emphasizes the importance of thorough site characterization and consultation with and between the MPCA Remediation Division (REM) and Environmental Analysis and Outcomes Division (EAO) staff.

Users should note that surface water quality statutes, rules, and guidelines continue to be developed. Therefore, it is important to verify whether any revisions have been made that are not incorporated into the document, and that the most current version of this document is being used. Future revisions may include future rule revisions, policy changes, and decisions regarding investigation and mitigation of potential and actual surface water and sediment impacts.

Contents

1.0 Surface water quality rules

The United States Environmental Protection Agency (USEPA) Federal Clean Water Act (CWA) regulations require states to designate beneficial uses for all waters and develop surface water quality standards (WQS) to protect each use. Water quality standards form part of the State and Federal CWA regulations and policies. These standards define how much of a pollutant can be in the water and still allow the water to meet its designated beneficial use. Additionally, under the CWA, states must monitor and assess water quality to identify impairments (i.e., waters not fully supporting their beneficial uses) every two years. For additional information about water impairments, refer to Minnesota's Impaired Waters List webpage.

This document provides an overview of Minnesota's WQS, which are described in detail in Minnesota Rules:

- Minn. R. ch. 7050 – Standards for protecting waters of the State.
- Minn. R. ch. 7052 – Standards specific to the Lake Superior Basin.
- Minn. R. ch. 7053 – Effluent limits and treatment requirements for discharges to waters of the State.

References and links to additional resources are included on the MPCA Water Quality Standards webpage and provided in **Section 7.0**.

1.1 Elements of water quality standards

The objective of Minnesota's WQS is to protect and maintain surface waters in a condition to protect human health, wildlife, agriculture, industry, and aquatic life along with their habitats. Water quality standards:

- Are developed for preventative purposes, aiming to control pollution from various point and nonpoint sources. For example, WQS guide the limits set on what regulated facilities can discharge to surface water without causing degradation of existing water quality and beneficial uses, and control contaminants before they enter the environment at concentrations of concern.
- Are used to assess contaminants found in surface water or fish tissue, which may require remedial actions. Water quality standards serve to protect water resources for uses such as fishing, swimming and other recreation, and sustaining fish, insects, plants, and other aquatic life.
- Play an important role in determining waterbody impairments and serve as restoration goals for impaired waters. When pollutant concentrations exceed WQS in water and/or fish tissue, restoration goals are set for the impaired waters.

Minnesota's WQS consist of the following elements:

1. Beneficial use classifications: Identify how people, aquatic communities, and wildlife use our waters.
2. Antidegradation protections: Policies to protect, maintain, and preserve existing water quality.
3. Narrative standards: Statements of unacceptable conditions in and on the water.
4. Numeric standards: Constituent concentrations or levels representing water quality that supports a particular beneficial use. Typically, these are amounts of specific pollutants allowed in a body of water that that should not be exceeded.

Together, the beneficial uses (described in **Section 2.0**), antidegradation protections (described in **Section 3.0**), narrative standards (described in **Section 4.0**), and numeric standards (described in **Section 5.0**) provide the framework for achieving CWA goals.

1.2 Surface water and sediment assessments

This guide outlines the surface water risk assessment process needed to evaluate nonpoint discharges at remediation sites. The evaluation helps identify risks to ecosystems and human health and gather data to inform the development of effective remediation strategies. The primary objectives are to gather data for a remediation plan and to offer a structured evaluation process to determine the impact of nonpoint discharges on surface waters and sediment, ensuring efficient cleanup while minimizing risks to the environment and public health.

The risk assessment process for surface waters and sediment is based on the level of effort in site characterization and the extent of information needed for evaluation of the site. There are two levels of assessment based on the complexity of site variables, extent of effort in site characterization and risk assessment, and the required level of consultation with MPCA REM and EAO staff:

1. Screening assessment – Used as a preliminary tool for simple sites potentially impacting surface waterbodies. This screening evaluation for surface water is based on using the most conservative numeric standards.
2. Site-specific assessment – Applicable to certain risk-related situations. Necessary for waterbodies when the most conservative screening values are exceeded, when a more detailed analysis is required potentially incorporating site-specific information, for known contaminated sediment sites, or for sites with a completed sediment exposure pathway. It requires a greater level of effort and significant involvement from MPCA REM and EAO staff.

Consultation with MPCA REM and EAO staff is required during site-specific assessments and may be needed during screening assessments depending on the level of evaluation. Further information on surface water and sediment risk assessments is provided in **Section 6.0**.

1.3 Reporting releases and emergency incidents

Per Minn. Stat. 115.061, all petroleum spills exceeding five gallons and any non-petroleum spills must be immediately reported to the Minnesota Duty Officer (MDO) at 651-649-5451 or 1-800-422-0798. The MDO is responsible for taking spill/release reports and communicating them to MPCA and other state agencies. The MPCA Emergency Response Program (ERP) receives these spill/release reports directly through a phone call and/or indirectly through a data transfer process. ERP staff assess the information on each incident and determine the appropriate initial MPCA response. Incidents that have public safety, human health and/or immediate environmental threats are considered emergencies and are worked on immediately. Timely reporting of emergency incidents and/or spills is critical. Additionally, responsible parties are required to begin cleanup actions immediately when they have a spill/release regardless of whether it is reportable. Prompt cleanup actions to surface water spills is important for minimizing the damage or impacts. Spills to flowing water requires getting ahead of the floating plume and effective capture and recovery using sorbents, booms, skimmers, and pumps. Callers can seek advice and discuss response strategies with the ERP staff 24 hours a day, 7 days a week. This ensures that each spill is managed effectively, prioritizing environmental safety and compliance with regulatory standards. MPCA REM programs may have additional reporting requirements beyond the requirements of Minn. Stat. 115.061 at remediation sites.

2.0 Beneficial use classes

Surface waters in Minnesota are classified into seven beneficial use classes, each representing specific uses (Minn. R. 7050.0140). These classifications aim to protect and maintain surface waters, ensuring the preservation of all designated beneficial uses. The class descriptions are listed below.

Class 1 (domestic consumption) – Waters used as a source of supply for drinking, culinary, or food processing use or other domestic purposes, and for which quality control is or may be necessary to protect the public health, safety, or welfare. Class 1 waters are further divided into three classes based on specific criteria such as the type of water treatment needed so that USEPA Maximum Contaminant Levels (MCLs) and Secondary Drinking Water Standards are achieved, the exceptions to using the MCLs and Secondary Drinking Water Standards as Class 1 standards, and the types of aquifers or other drinking water resources that are in the class based on the degree of natural protection from contamination.

Class	Protected use
1A	Domestic consumption by humans without treatment
1B	Domestic consumption by humans after simple treatment (chlorination or its equivalent)
1C	Domestic consumption by humans after advanced treatment (coagulation, sedimentation, filtration, storage, and chlorination, or other equivalent treatment processes)

Class 2 (aquatic life and recreation) – Waters that do or may support fish, other aquatic life, bathing, boating, or other recreational purposes, and where quality control is or may be necessary to protect aquatic or terrestrial life or their habitats, or the public health, safety, or welfare. Class 2 waters are further divided into four classes based on specific criteria such as the type of fish/aquatic life and their habitats that are being protected, the aquatic recreational uses protected, and whether the surface water is protected as a drinking water source. Different standards may apply to aquatic habitat types because background levels of pollutants may not be similar, or they may not support the same beneficial uses.

Class	Protected use
2A	Cold water habitat, aquatic recreation including bathing, source of drinking water
2Bd	Cool or warm water habitat, aquatic recreation including bathing, source of drinking water
2B	Cool or warm water habitat, aquatic recreation including bathing
2D	Wetland habitat including aquatic and terrestrial species

Additionally, Class 2 waters are further refined into tiered aquatic life uses (TALUs) to account for natural differences between habitats and regions. The MPCA conducts biological monitoring and employs the Tiered Aquatic Life Uses framework for Class 2 waters to provide a more direct method to assess biological health. Biological monitoring supplements the information provided by chemical (pollutant) monitoring. Both data sets are used to assess whether Class 2 aquatic life uses are being met. Consideration of the TALU framework would apply to complex risk-related situations where it has been confirmed that discharge of contaminants is occurring (see **Section 6.3**), for further information contact MPCA EAO staff.

Class 3 (industrial consumption) – Waters that are or may be used as a source for industrial processes or cooling water, or any other industrial or commercial purposes, and for which quality control is or may be necessary to protect the public health, safety, or welfare.

Class 4 (agriculture and wildlife) – Waters that are or may be used for any agriculture purpose, including livestock watering and crop irrigation, or by waterfowl or other wildlife, and for which quality control is or may be necessary to protect terrestrial life and its habitat or the public health, safety, or welfare. Class 4 waters are further divided into two classes based on the agricultural or wildlife use that is being protected.

Class	Protected Use
4A	Irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area (includes wild rice protections)
4B	Use by livestock and wildlife

Class 5 (aesthetic enjoyment and navigation) – Waters that are or may be used for any form of aesthetic enjoyment of scenery, water transportation or navigation, or fire prevention, and for which quality control is or may be necessary to protect the public health, safety, or welfare.

Class 6 (other uses) – Waters that may be under other jurisdictions and in other areas to which the waters of the State are tributary, and may include any or all of the uses listed in Minn. R. 7050.0221 through Minn R. 7050.0225, plus any other possible beneficial uses. The agency therefore reserves the right to impose any standards necessary for the protection of this class, consistent with legal limitations.

Class 7 (limited resource value waters) – Waters that have been subject to a use attainability analysis and have been found to have limited value as a water resource. Class 7 waters may support aquatic life only on a seasonal basis; an example is a ditch with ephemeral flow. Water quantities in these waters are intermittent, or the lowest seven-day consecutive flow over a ten-year period (7Q10) is less than one cubic foot per second (cfs) as defined in Minn. R. 7050.0130. These waters shall be protected so as to allow secondary body contact use, to preserve the groundwater for use as a potable water supply, and to protect aesthetic qualities of the water. It is the intent of the MPCA that very few waters be classified as limited resource value waters.

Exceptional quality waters – Some waters in Minnesota are designated as having exceptional quality, such as Outstanding Resource Value Waters (ORVW) or waters with special natural resource value. ORVWs are further described in **Section 3.0**.

How to determine the beneficial uses of a waterbody

In addition to use classification information provided in Minnesota Rules (see **Section 2.1**), this information can be accessed through the MPCA's Surface Water Environmental Data Access (EDA), utilizing the Map-Based Search to locate and select the waterbody of interest. Upon clicking on the waterbody, a pop-up window will appear, providing details such as the waterbody identification number, existing impairments, and links to additional resources. By choosing the Water Quality Assessment option on the pop-up window, users can access a page displaying further information, including the beneficial use classification and water quality standards applicable to that waterbody. A user can also search for the waterbody by lake or stream name through the Surface Water EDA.

2.1 Classification of waters

Waterbodies whose classification is provided in Minnesota rules are termed "listed waters." All other waters receive default classifications and are termed "unlisted waters."

- **Listed waters**: Under Minn. R. 7050.0470, "listed waters" are defined as waterbodies that have been specifically classified. The listings are arranged by major drainage basins with streams first, followed by lakes, and then wetlands. Note that lakes and wetlands have their specific classifications directly listed in the rules, while beneficial use classifications for streams are incorporated by reference and found in tables entitled "Beneficial Use Designations for Stream Reaches" published on the MPCA's incorporation by reference webpage.
- **Unlisted waters**: "Unlisted waters" are waterbodies that do not have specific classifications or detailed listings in Minn. R. 7050.0470. These "unlisted waters" are governed by a set of default

classifications and adhere to standards and protections for those classifications. Additional information about unlisted waters and their default classifications is provided in Minn. R. 7050.0415.

As Minnesota's waterbodies can support multiple uses, each waterbody is assigned multiple designated beneficial use classes. This approach ensures that each waterbody in Minnesota is classified in a manner that supports and protects its various beneficial uses, adhering to specific water quality standards tailored to those uses. *For instance: A waterbody classified as 1B, 2Bd, 3, 4A, 4B, 5, and 6 supports drinking water, recreation, industrial use, agriculture, wildlife, aesthetics, navigation, and other public uses. These use classes reflect the multiple beneficial uses that Minnesota's surface waters provide, and all the water quality standards for each of the beneficial use classes apply. If the water quality standard for a particular parameter is different among applicable classes, the most restrictive of the standards applies.*

For all surface waterbodies in Minnesota, there are multiple combinations of classes. Generally:

- All of Minnesota's surface waters are protected for Class 2 (aquatic life and recreation) beneficial uses unless the waterbody has been individually assessed and reclassified as a Class 7 limited resource value water.
    - Class 7 waters are still expected to meet standards that are protective for downstream waters and other beneficial uses.
- Because Minnesota's waterbodies can support multiple beneficial uses, all of Minnesota's surface waters are also protected for at least one subclass of Class 3, 4, 5, and 6 beneficial uses.
- Most surface waters are not listed in rule. Unlisted non-wetland waters are classified as 2B, 3, 4A, 4B, 5, and 6 while unlisted wetlands are classified as 2D, 3, 4A, 4B, 5, and 6 (Minn. R. 7050.0415).
- Occasionally waterbodies may be referred to by more than one name, which is an important consideration in the classification process.

Minnesota has ten major drainage basins and 80 major watersheds, refer to a map of basins and watersheds available on MPCA's watershed approach to water quality webpage for more information.

3.0 Antidegradation

The antidegradation element of water quality standards (formerly referred to as nondegradation) protects and maintains the existing water quality of a waterbody from deterioration. Its purpose is to protect Minnesota waters from significant degradation from point and nonpoint sources of pollution. Preventing degradation is almost always less costly and more effective than restoration, which cannot always be fully achieved. The State's antidegradation rules are found in Minn. R. 7050.0250 to Minn. R. 7050.0335, and for the Lake Superior basin in Minn R. 7052.0300 to Minn. R. 7052.0380.

Antidegradation rules are set to achieve and maintain the highest possible quality in surface waters of the State. Its provisions accomplish this through:

1. Maintaining and protecting existing uses of waterbodies.
2. Minimizing the likelihood of degrading water quality unless it is deemed necessary to accommodate important economic and social development.
3. Preserving the exceptional characteristics of specific waters designated as ORVWs (Minn. R. 7050.0335) and Outstanding International Resource Waters (OIRWs, Minn R. 7052.0300).

All ORVWs are designated in Minn. R. 7050.0335. Minnesota rules specify two classes of ORVWs: prohibited and restricted. A surface water is an ORVW if its classification under Minn. R. 7050.0470 includes an asterisk before the name of the waterbody followed by a date (the date is the date of designation as an ORVW) and a "P" or "R" in brackets.

- Prohibited ORVWs: Include waters within the Boundary Waters Canoe Area Wilderness and Voyageurs National Park. New or expanded discharges are banned in these and other prohibited ORVWs. Any projects proposed in a prohibited ORVW must apply for an individual 401 Water Quality Certification.
- Restricted ORVWs: Include portions of Lake Superior and federal and state designated scenic and recreational river segments such as the St. Croix River. New or expanded discharges are controlled in restricted ORVWs to maintain their exceptional character. Any project in a restricted ORVW may be required to apply for an individual 401 Water Quality Certification.

Additionally, all surface waters within the Lake Superior basin, other than Class 7 waters and designated ORVWs, are designated as OIRWs. Antidegradation protections for the Lake Superior basin focus on reducing the contribution of bioaccumulative pollutants to the basin.

In addition to the Surface Water EDA, the MPCA developed a map of Outstanding Resource Value Waters as defined in Minn. R. 7050.0335 offering a visual representation of these protected areas.

The MPCA implements antidegradation requirements through the issuance and enforcement of NPDES/SDS permits and other permit and control documents that regulate surface water pollution. An antidegradation assessment is required when a permit application is developed for a regulated activity that is anticipated to result in a net increase in loading or other causes of degradation to waters of the State. Additional information about antidegradation rules and antidegradation assessment requirements are provided in the antidegradation guidance. If antidegradation reviews need to factor into a nonpoint source assessment, consultation with MPCA EAO staff is required. See **Section 6.3** for further details.

4.0 Narrative standards

Narrative WQS i are statements that prohibit unacceptable conditions in or upon a waterbody. Narrative WQS address very fundamental and basic forms of water pollution. Some narrative standards are more elaborate and set water quality goals in connection with pollutants or concerns, such as eutrophication, and pollutants that accumulate in fish and are harmful to fish consumers (humans and wildlife).

General standards for waters of the State are found in Minn. R. 7050.0210. They include various policies and statements including, but not limited to:

- Prohibition of nuisance conditions: Forbids the release of sewage or industrial waste such as floating solids, scums, visible oil film, or nuisance algae blooms causing nuisance conditions in State waters.
- Highest levels of water quality: Mandates maintaining the highest water quality levels achievable (including dissolved oxygen), enhancing conditions for various uses.
- Preservation of other requirements: Stipulates that Minn. R. 7050 standards are supplementary to the CWA, with more stringent requirements prevailing in case of conflict.
- Pollution prohibition: Prohibits the discharge of sewage, industrial waste, or other pollutants from either a point or a nonpoint source causing pollution.

Exceeding these standards is indicative of a polluted condition that could be detrimental to the designated uses of the waters of the State. Other narrative standards are developed based on specific use classifications. Narrative standards applicable to Class 1 through 7 waters are available in Minn. R. 7050.0221 through Minn R. 7050.0227.

5.0 Numeric standards and values

Numeric standards are allowable quantifiable concentrations of specific chemicals that, when present in a waterbody, will remain protective of designated beneficial uses. They also include measures of biological health. Numeric standards are derived using methods provided in Minn R. ch. 7050 and Minn R. ch. 7052.

NOTE: Numeric standards vary depending on the designated use of the waterbody. A numeric standard that protects Class 2 waters may be different from a numeric standard for the same pollutant that protects Class 4 waters. When numeric standards exist for more than one beneficial use class, the most stringent value applies. If the numeric standard is not exceeded, the waterbody meets the use class goal.

Numeric WQS are established for Classes 1 through 7 waters as presented in the following subsections.

5.1 Class 1 standards

Per Minn. R. 7050.0221, Class 1 standards are primarily based on USEPA standards, as detailed in the Code of Federal Regulations (CFR), title 40, parts 141 and 143:

- USEPA Primary Drinking Water Standards: The maximum permissible level of a contaminant in water that is delivered to any user of a public water system, commonly known as the MCL.
- USEPA Secondary Drinking Water Standards: Guidelines to assist public water systems in managing levels of contaminants in their drinking water that primarily affect the aesthetic qualities, such as taste, color, and odor.

5.2 Class 2 standards

Class 2 numeric standards are established for various pollutants, including heavy metals, nutrients, and organic compounds. These standards specify maximum allowable concentrations of these substances in the water to prevent levels that could harm aquatic life or human health. Per Minn. R. 7050.0222 Class 2 standards incorporate:

- Chronic standard (CS): The highest concentration of a toxic pollutant in ambient water to which aquatic life, humans, or wildlife can be exposed without causing chronic toxicity (mortality, reduced growth, reproductive impairment, harmful changes in behavior, or other adverse effects). These numeric standards are applied based on four-day average concentrations.
- Maximum standard (MS): The highest concentration of a toxic pollutant in ambient water to which aquatic organisms can be exposed for a brief time with zero to slight mortality. These numeric standards are applied based on one-day average pollutant concentrations.
- Final acute value (FAV): The acute toxicity limitation that is intended to prevent immediate toxicity of organisms at the point of discharge. It is essentially a numeric value that is not to be exceeded at the point of discharge.

Some class 2 standards require an adjustment to the MS or FAV, or the application of an additive model in order to be protective. Also, certain Class 2 standards (e.g., certain metals, pentachlorophenol, and ammonia) require a calculation based on equations specified in Minn. R. 7050.0222. These calculations rely on certain fundamental water quality parameters such as hardness, pH, and temperature. These adjustments and calculations include:

- Highly bioaccumulative contaminants and carcinogens: Includes contaminants such as polychlorinated biphenyls (PCBs), mercury, 2,3,7,8-dibenzo-p-dioxin, dichlorodiphenyl-trichloroethane (DDT), acrylonitrile, benzene, and several chlorinated volatile organic compounds.

Minn. R. 7050.0222, subp. 7.G. requires an adjustment of the MS and FAV for highly bioaccumulative contaminants and carcinogens to be protective. Highly bioaccumulative chemicals are identified with an asterisk after their MS and FAV values. Carcinogens are identified by "(c)" after the chemical name. Bioaccumulative chemicals for the Lake Superior basin are identified in Minn. R. 7052.0330.

- Additivity for acutely toxic pollutants: If a discharge is composed of a mixture of more than one chemical, and the chemicals have the same mode of toxic action, the MPCA has the option to apply an additive model to determine the toxicity of the mixture using the equation in Minn. R. 7050.0222, subp. 7.B. If the sum based on the additive model exceeds one, it indicates an acutely toxic condition. This method is typically used for point source dischargers or wastewater treatment plant outfalls (e.g., during NPDES/SDS permitting).
- Additivity for carcinogenic contaminants: Concentrations of carcinogenic chemicals from point or nonpoint sources, singly or in mixtures, must not exceed an incremental or additional excess risk level of one in 100,000 (10^{-5}) in surface waters or fish tissue. The 10^{-5} risk level is the level of acceptable risk used for carcinogens in the State. The additive equation in Minn. R. 7050.0222, subp. 7.E. applies to chemicals that have a human health-based CS or site-specific chronic criterion calculated with a cancer potency slope factor. To meet the protection objectives, the cancer health risk index must not exceed a value of one.
- Hardness-dependent metal standards and pH-dependent pentachlorophenol standard: The toxicity of certain metals, such as cadmium, trivalent chromium, copper, lead, nickel, silver, and zinc, depends on natural hardness (as $CaCO_3$) of the surface water, and pentachlorophenol toxicity depends on natural pH. The standards for these pollutants are adjusted according to equations provided in Minn. R. 7050.0222. Standards should be adjusted accordingly using natural hardness and pH values of the receiving waterbody based on site-specific data or using data available through the Surface Water EDA. *Note: Not all data are displayed under the "Monitoring Data" tab on the Water Quality Assessment page. The user should use the option to "download" all available data from the "Monitoring Data" tab*. Consultation with MPCA REM and EAO staff may be required to apply these adjustments during screening and site-specific assessments, refer to **Section 6.0** for more information.
- Un-ionized ammonia standard: Ammonia in the aquatic environment exists in un-ionized (NH_3) and ionized (ammonium, NH_4^+) forms, the balance of which is strongly influenced by local pH and temperature. The toxicity of ammonia to aquatic life is primarily attributed to the un-ionized form. Measurements of ammonia in water samples are typically reported as total ammonia nitrogen, defined as the sum of nitrogen present in both chemical forms. To calculate the un-ionized ammonia concentration, a statistical estimate of the central tendency (mean or median) of ambient pH and temperature is needed. The percent of total ammonia in the un-ionized state can be calculated for any temperature and pH using the equation specified in Minn. R. 7050.0222.

Section 6.0 describes the use of these adjustments and calculations during screening and site-specific assessments.

5.3 Classes 3 through 7 standards

Minn. R. 7050.0223 to Minn. R. 7050.7027 presents Class 3 through 7 standards. Because all Minnesota's surface waters are protected for Class 2 beneficial uses and can support multiple beneficial uses, the most stringent values for Class 2 applies unless the waterbody has been reclassified as a Class 7 water.

Per Minn. R. 7050.0226, there are no specific numeric standards associated with Class 6. Any standards included in Class 6 are specific to a particular waterbody or segment thereof and are developed by the MPCA EAO staff.

5.4 Natural background values

Waters may have natural water quality characteristics or chemical concentrations approaching or exceeding applicable WQS. Natural background concentrations can serve as standards where existing natural concentrations exceed WQS (Minn. R. 7050.0170). For example, there are surface waterbodies in which the natural background concentrations for certain metals, such as aluminum, iron, or manganese, naturally exceed the standard or criterion. Standards for metals include both total metal and, through conversion factors, dissolved metal standards. Consult with MPCA REM and EAO staff if natural background values need to be used. Refer to **Section 6.0**, which describes the evaluation procedure for screening and site-specific assessments.

How to find numeric standards

Numeric standards are provided in Minn. R. ch. 7050 and Minn. R. ch. 7052. The most conservative value of all standards for all classes for a particular contaminant is used for screening assessments. For a site-specific assessment or for more complex situations, consult with MPCA REM and EAO staff.

5.5 Other numeric values

Where standards do not exist, use other values if the circumstances of the potential or actual exposure are similar and the values have been reviewed and approved for use by MPCA EAO staff. Screening values should be used where standards and other values are not available.

- **Site-specific standards**: WQS are frequently adopted statewide or by ecoregion; however, sometimes it is more appropriate, and information is available to derive standards based on information specific to a waterbody to account for unique characteristics. This is done through development of site-specific standards. Site-specific standards must maintain and protect the beneficial uses and must be approved by the USEPA before being considered final. More information is available on the MPCA's site-specific water quality standards webpage.
- **Site-specific criteria**: Numeric and narrative standards are not available for all pollutants and water quality concerns. When needed, Minnesota rules allow for the development of site-specific water quality criteria (WQC) to address pollutants for which standards are not available. Unlike site-specific WQS, site-specific WQC *do not* need to be approved by USEPA. In the absence of standards or applicable criteria, MPCA EAO staff can generate site-specific criteria tailored to the surface waterbody if sufficient risk information exists. A criterion can be based on: (1) protection of human health; (2) protection of freshwater aquatic life and habitats; (3) protection of wildlife; or (4) taste and odor. More information is available on the MPCA's site-specific water quality criteria webpage.
- **Great Lakes Initiative (GLI) wildlife values:** GLI standards are designed for wildlife protection in the Lake Superior basin and require consultation with MPCA EAO staff if they are used in other watershed basins due to specific assumptions used for these values that may or may not apply to the waterbody in question. These values are promulgated in Minn. R. ch. 7052 for highly bioaccumulative contaminants in an OIRW.

- **Surface water aquatic life and wildlife-based screening numbers**: Numeric and narrative standards are not available for all pollutants and water quality concerns. If WQS, site-specific WQC, or applicable GLI wildlife values are not available, three sources of screening numbers can be used:
  - USEPA Chronic National Ambient Water Quality Criteria;
  - Tier II Secondary Chronic Values developed by Suter and Tsao (1996) using the Tier II method described in USEPA's Water Quality Guidance for the Great Lakes System; and
  - USEPA Chronic Lowest Observed Effect Level Values when insufficient data exists to calculate a National Ambient Water Quality Criterion.
- **Sediment screening values:** There are no human health sediment standards. Human health sediment evaluations are conducted on a site-specific basis and should only be done in consultation of MPCA REM and EAO staff, refer to **Section 6.3**. For ecological receptors, sediment quality targets (SQTs) have been developed that protect benthic invertebrates and serve as guidance values that can be used as benchmarks for evaluating sediment site concentrations. SQTs were originally adopted for use in the St. Louis River Area of Concern but can be applied to any sediment site in Minnesota. For more information, refer to MPCA's Guidance for Use and Application Of Sediment Quality Targets For The Protection Of Sediment-Dwelling Organisms in Minnesota.

6.0 Surface water and sediment risk assessments at remediation sites

This section outlines the risk assessment procedures for estimating the risk posed by nonpoint source discharges of contaminants from remediation sites to surface water and sediment. There are two levels of surface water and sediment risk assessments – **screening** (**Section 6.2**) and **site-specific** (**Section 6.3**) – based on the complexity of site variables (e.g., contaminant concentrations, variety and types of contaminants, beneficial uses, hydrodynamics of the surface waterbody), the level of effort in site characterization, the extent of information needed for evaluation of the site, and the required level of consultation with MPCA REM and EAO staff. Sediment risk is only assessed at the site-specific level. When completing assessments, parties should ensure that documentation follows program-specific guidance and provide appropriate evaluation of all relevant pathways, including a comprehensive discussion of uncertainties and assumptions, as well as documentation of decisions provided in relevant decision documents.

Parties in charge of conducting surface water and sediment assessments typically include responsible parties and consultants. MPCA staff must be consulted during site-specific assessments to provide appropriate guidance and oversight (see **Section 6.3**).

List of responsibilities

Responsible parties/consultants:

- Conduct site investigations
- Conduct screening and site-specific assessments
- Consult with MPCA REM staff
- Conduct remedial actions as needed

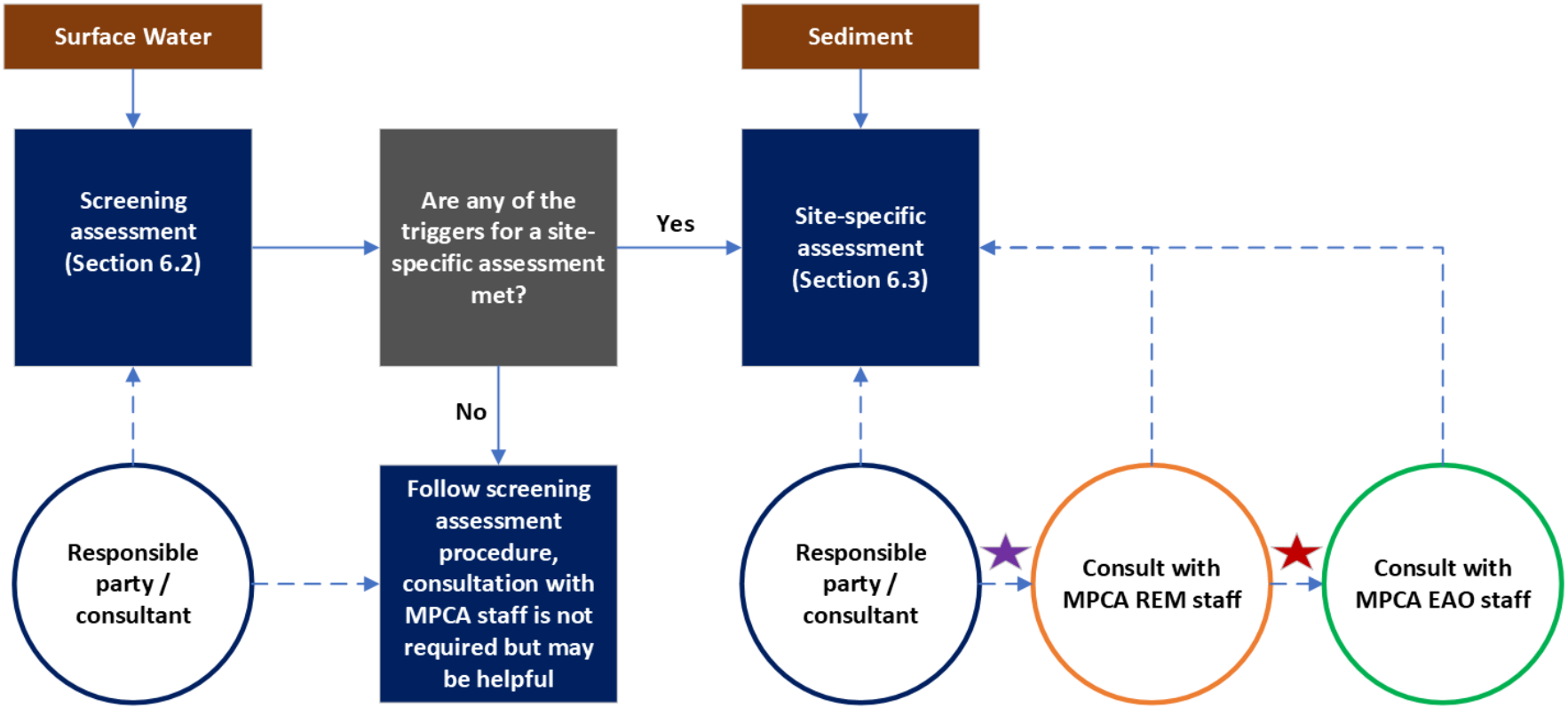
MPCA REM staff:

- Oversee responsible party/consultant work and provide guidance
- Assist with screening (if needed) and site-specific assessments
- Consult with MPCA EAO staff

MPCA EAO staff:

- Oversee responsible party/consultant work and provide guidance
- Assist with screening (if needed) and site-specific assessments (e.g., determine the 7Q10 if applicable, determine whether dilution and mixing is allowed, determine allowed downstream concentrations, and determine other site-specific adjustments as needed)
- Develop site-specific sediment values, if needed
- Provide additional data that may be needed for site-specific assessments

A flowchart is provided below that illustrates the type of assessment needed for surface water and sediment and the parties involved in the assessments.



Square indicates assessment process step.

Circle indicates party involved in the assessment.

Responsible parties / consultants need to consult with MPCA REM staff during site-specific assessments. MPCA staff provide oversight and guidance. All parties collaborate to complete the assessment.

REM staff should contact EAO staff using an internal request form (see Section 6.3 for directions).

6.1 Critical concepts

Certain definitions and concepts are described in greater detail below as their understanding is critical for application to remediation sites. Additional information on assessing and monitoring the likelihood and extent of contaminated groundwater or contaminated surface runoff impacting surface waterbodies can be found on the Remediation guidance and resources web page.

Groundwater to surface water pathway: This pathway is evaluated when a surface waterbody is a potential or actual receptor of groundwater contamination. The analysis assesses the likelihood and extent of contaminated groundwater impacting surface waterbodies. *Note: The user should be cautioned that at no time is sample data of the surface waterbody itself a substitute for the data needed to determine that a site with a release is not posing a contamination risk to a surface waterbody. Sampling of the surface waterbody directly allows for dilution and it is difficult to monitor surface waterbodies at the exact location where a groundwater plume discharges into a surface waterbody at the highest concentrations.*

Runoff to surface water pathway: This pathway is evaluated when a surface waterbody is the potential or actual receptor of water that flows over the ground surface (runoff), due to precipitation, and may carry contaminants from the land into surface waterbodies.

Groundwater discharge/recharge: Groundwater discharge refers to the movement of water from aquifers into surface waterbodies. For surface waterbodies that recharge groundwater at a location other than the groundwater discharge location, drinking water standards need to be applied at the point of groundwater recharge.

Proximity and travel time considerations: The proximity of a remediation site to a surface waterbody is a critical factor. If contaminated groundwater is within a two-year travel time to a surface water receptor, this necessitates a thorough assessment and potential remediation actions.

Monitoring: To address potential and actual impacts on a surface waterbody, monitoring of groundwater/surface water at various locations is necessary. Monitoring helps in characterizing the extent of contamination. The goal is to mitigate the impacts before they become significant.

Lakes, ponds, and wetlands (non-flowing systems): Non-flowing systems refer to waterbodies where there is limited or no continuous movement or flow. Due to the limited movement of water, pollutants and contaminants can accumulate more readily in water and sediments and can create distinct ecological conditions. In non-flowing systems, mixing or dilution is prohibited (see **Section 6.3**).

Streams and rivers (flowing Systems): Because rivers and streams have flowing water constantly moving through them, pollutants are diluted and mixed with the surrounding water. In these systems, dilution occurs as the discharged pollutants mix with the larger volume of the receiving waters. Minnesota rules establish criteria and guidelines for the size and extent of dilution and mixing zones to ensure that pollutant concentrations remain within acceptable limits and do not pose harm to aquatic life or human health. These criteria may include factors such as stream flow rates, pollutant characteristics, and the sensitivity of the receiving waterbody. Additional concepts for streams and rivers include:

- **Minimum stream flow (7Q10)**: The minimum stream flow is a factor used to calculate whether the most restrictive standard for each contaminant will be exceeded downstream after mixing. It is also used to calculate the maximum concentration allowed to be discharged, if the most restrictive standard for each contaminant will be exceeded downstream after mixing. The minimum stream flow is expressed as 7Q10, the lowest seven-day consecutive flow over a ten-year period. The 7Q10 represents the minimum amount of flow a river or stream provides during a drought situation. If the 7Q10 is equal to 0.0 cfs, no dilution is allowed for streams or rivers. If the 7Q10 is greater than 0.0 cfs, dilution and the mixing zone concept are applied. Treatment systems should not be

designed for low stream flow augmentation unless dependable and controlled under relevant laws and regulations. *Note: When conducting site-specific assessments (see **Section 6.3**), the 7Q10 is obtained from MPCA EAO staff. If stream flow records are unavailable, then MPCA EAO staff may estimate the 7Q10 using available information, such as watershed characteristics, precipitation, runoff, and other relevant data.*

- **Mixing zones**: A mixing zone is a practical method for expediting the mixing and dispersion of contaminants in receiving waters provided the quality of the receiving waters is maintained in accordance with applicable standards. MPCA EAO staff establish mixing zones on a case-by-case basis. Mixing zones are considered for streams or rivers where the 7Q10 is greater than 0.0 cfs. If a mixing zone is allowed, the most restrictive standard of all classes (typically the Class 2 standard) of a contaminant must be met downstream after mixing. A mass balance equation may be used to calculate if the most restrictive standard is being exceeded downstream after mixing (see **Section 6.3**). When establishing a mixing zone, primary consideration is given to the following guidelines to ensure that the mixing zones do not disrupt the stream's natural state:
  - *Fish passage*: Allow an acceptable passageway for the movement of fish in rivers.
  - *Size limitation*: The total mixing zone(s) at any transect of the stream should not exceed 25% of the cross-sectional area and/or volume of flow, and more than 50% of the average stream width under normal flow conditions.
  - *Safety for aquatic life*: Characteristics should not be lethal to aquatic organisms.
  - *Contaminant levels*: The FAV for toxic pollutants (other than temperature changes) should not be exceeded as a one-day mean concentration, and it cannot be exceeded at the point of discharge. The FAV is rarely used for remediation purposes, and if used, it must be met at the point of discharge.
  - *Location restrictions*: Mixing zones should be as small as possible and should not intersect spawning or nursery areas, migratory routes, water intakes, nor mouths of rivers.
  - *Minimizing overlap*: Overlapping of mixing zones should be minimized, and measures should be taken to prevent adverse synergistic effects.

6.2 Screening assessment

A screening assessment can be used for any simple site having the potential to impact a surface waterbody in which only a quick screening using numeric WQS is needed. It is a preliminary screening tool based on the most conservative standard for individual compounds for any class of surface waterbody (excluding OIRWs and ORVWs). It involves the least level of effort towards site characterization and utilizes the most conservative standards, guidelines, and criteria. A screening assessment is applicable to sites where groundwater is contaminated and has the potential to discharge into a surface waterbody or where surface water runoff could discharge to a surface waterbody. It is appropriate for situations not requiring a detailed site-specific evaluation as described in **Section 6.3**.

The screening assessment includes gathering initial data on site characteristics and potential contaminants, then using predefined screening values to determine the likelihood and magnitude of potential impacts, and whether further assessment is required based on screening outcomes.

A screening assessment includes the following steps:

1. **Source receptor**: Identify the surface waterbody as a potential or actual receptor of nonpoint source discharges such as surface water runoff or a groundwater plume.

- ➢ *Proceed to a site-specific assessment* if a completed sediment exposure pathway exists for contaminants that tend to accumulate in sediments (e.g., metals, PCBs, PAHs, dioxins/furans, PFAS, and other persistent organic pollutants).

2. **Geologic information**: Obtain geologic information such as local and regional stratigraphy, topography, soil types, and groundwater flow characteristics including gradient and hydraulic conductivity, and water migration pathways.
3. **Source status**: Confirm that the source has been removed, contained, or treated so that it will not affect future conditions or plume stability.
   - ➢ *Proceed to a site-specific assessment* if the source status includes unstable plumes, stable plumes with past-source treatment, or potential impacts remaining post-source removal.
4. **Waterbody classification**: Determine the waterbody classification (see **Section 2.0**).
   - ➢ *Proceed to a site-specific assessment* if the waterbody falls into any of the situations that are listed in the checklist requiring a site-specific assessment (see **Section 6.3**).
5. **Analytical data**: Collect analytical data from surface water runoff samples and/or groundwater samples that represent the maximum concentrations of all contaminants discharging or with the potential to discharge to a surface waterbody.
6. **Contaminants of potential concern (COPCs) and applicable WQS**: Obtain a complete list of the COPCs and determine the applicable WQS and/or site-specific WQC based on the COPC list and waterbody classification.
   - ➢ *Proceed to a site-specific assessment* if COPCs are identified that are highly bioaccumulative or carcinogenic (see **Section 5.2**).
   - ➢ *Proceed to a site-specific assessment* if no WQS or WQC are available for a particular COPC.
7. **Measure additional parameters**: If applicable, obtain hardness, pH, temperature, and total ammonia data, as needed, depending on applicable COPCs and WQS.
   a. **Hardness-dependent metals and pH-dependent pentachlorophenol**: Calculate Class 2 standards for hardness-dependent metals (cadmium, trivalent chromium, copper, lead, nickel, silver, and zinc) and pH-dependent pentachlorophenol (see **Section 5.2**). Hardness values and pH data for a waterbody may be available through MPCA's Surface Water EDA. Calculate a median or a mean[1] hardness and/or pH based on a minimum of 10 measurements. This can be based on site-specific data or data obtained from MPCA's Surface Water EDA. If data are obtained from the Surface Water EDA, use the last 10 years of data for this calculation.
      - ➢ If there are no or insufficient number of measurements, or data are older than 10 years, then site-specific data may need to be collected, *proceed to a site-specific assessment*.
   b. **Ammonia assessment**: Conduct an un-ionized ammonia assessment, if applicable. Measure ammonia migrating toward the surface waterbody from contaminated groundwater in permanent or temporary wells within the plume. Permanent or temporary wells that are closer to the surface waterbody are preferred to more distant wells as the ammonia concentration (i.e., form of nitrogen) will change based on the oxidation-state. The pH and temperature of the surface waterbody also need to be measured in the field at the same time as the ammonia sample is being collected because ammonia toxicity is dependent on the temperature and pH of the receiving water. Calculate the un-ionized ammonia concentration based on the total ammonia concentration (see **Section 5.2**).

[1] *Calculate a median if 20 or more measurements are available. Calculate a mean if less than 20 measurements are available.*

8. **Compare concentrations**: Compare the highest COPC concentrations from all surface water runoff samples and/or groundwater samples within the site's plume and upgradient of surface water discharge with the most conservative WQS or site-specific WQC for each contaminant applicable to the waterbody.
   - *Proceed to a site-specific assessment* if natural background concentrations (e.g., for aluminum, iron, or manganese) need to factor into the assessment (see **Section 5.4**).
   - *Proceed to a site-specific assessment* if any of the lowest WQS or WQC are exceeded.
   - No remediation is needed related to surface water protection if the highest concentrations in the surface water runoff and/or groundwater samples do not exceed the most conservative WQS or site-specific WQC and any ongoing sources of contaminant release are controlled. For surface water runoff, sampling locations prior to discharge become the compliance points.

6.3 Site-specific assessment

Site-specific assessments demand a greater site characterization effort and should be done in **consultation with MPCA REM and EAO staff**. All screening values, criteria, and site-specific data used must be reviewed and approved by MPCA staff to ensure acceptability. MPCA REM staff should contact MPCA EAO staff when site-specific assessments arise using an internal request form (*only accessible for MPCA staff*). MPCA staff can also find a copy of the form on MPCA's intranet (Lorax -> Programs -> Risk Assessment Overview).

Generally, a site-specific assessment is needed when any of the triggers from the screening assessment are met, when a more detailed assessment is needed because COPCs exceed screening standards, or for contaminated sediment sites and more complex situations. Situations that need to be assessed on a site-specific basis include but are not limited to:

- ✓ A waterbody classified as an ORVW.
- ✓ A waterbody that is part of the GLI. Waterbodies that are part of the GLI are also part of the Lake Superior basin and may be an OIRW or an ORVW.
- ✓ A waterbody that includes habitats of endangered species. Endangered species are listed by the Minnesota Department of Natural Resources and the United States Fish and Wildlife Service.
- ✓ A waterbody where the type of use(s) results in a significantly higher level of exposure than the basis of the numeric standards (e.g., subsistence fishing).
- ✓ A waterbody that flows into a second waterbody with a more restrictive classification within a distance in which standards for the more restrictive classification may not be met.
- ✓ Discharges that may require antidegradation reviews (See **Section 3.0**). For nonpoint source discharges this may need to be considered for large, complex sites.
- ✓ Discharges into rivers and streams that may allow for dilution and mixing.
- ✓ Discharges to a lake or a pond that also serves as a drinking water intake, or discharges to a stream or river and the drinking water intake is located in the mixing zone of the discharge.
- ✓ Discharges to a lake or a pond with a beach on the same body of water or discharges to a river or stream where the standards or criteria will not be met after the mixing zone or near the beach.
- ✓ If multiple discharge zones need to be considered for larger, more complex plumes.
- ✓ If a site has contaminated sediment within or on the banks of a surface waterbody. Sediment should be evaluated if a completed exposure pathway exists for contaminants that tend to accumulate in sediments (e.g., metals, PCBs, PAHs, dioxins/furans, PFAS, and other persistent organic pollutants). MPCA REM and EAO staff collaborate on a case-by-case basis to address remediation of contaminated sediments.

- For human health, sediment screening values are derived on a site-specific basis by MPCA EAO staff.
- For ecological receptors, the SQTs can be used as benchmarks for evaluating sediment site concentrations (see **Section 5.5**).

A site-specific assessment includes the following steps:

1. **Consultation with MPCA staff:** Consult with MPCA REM and EAO staff prior to proceeding with a site-specific assessment. MPCA staff provide guidance during the assessment process.
2. **Data collection:** All minimum data required as outlined in the screening assessment in **Section 6.2** and any additional site-specific data that may be needed for the assessment (e.g., sediment data).
3. **Sampling expansion**: Increase sampling events and locations for those situations where seasonal or other periodic effects make a difference.
4. **Detailed source analysis**: Analyze the magnitude and extent of COPCs in the source area, groundwater samples, surface water runoff, and/or sediment samples. If applicable, evaluate three-dimensional groundwater flow direction and velocity, and information about the plume's stability. Use field-measured hydraulic gradient and conductivity values to estimate transmissivity of groundwater in contaminated zones and mass flux or discharge rate of the plume upgradient from the point of discharge to the surface waterbody.
5. **Bioaccumulative contaminants and carcinogens**: Determine if bioaccumulative contaminants (e.g., PCBs, mercury, DDT) and carcinogens are present. Depending on the situation, an adjustment may be needed to MS values for Class 2 highly bioaccumulative or carcinogenic chemicals. Additionally, additivity may need to be assessed for carcinogens (see **Section 5.2**).
6. **Hardness-dependent metals and pH-dependent pentachlorophenol**: Calculate Class 2 standards for hardness-dependent metals (cadmium, trivalent chromium, copper, lead, nickel, silver, and zinc) and pH-dependent pentachlorophenol (see **Section 5.2**). Calculate a median or a mean[2] hardness and/or pH based on a minimum of 10 measurements. This can be based on site-specific data or data obtained from MPCA's Surface Water EDA. If data are obtained from the Surface Water EDA, use the last 10 years of data for this calculation.
    - If there are no or insufficient number of measurements in the Surface Water EDA, then site-specific data need to be collected.
7. **Ammonia assessment**: Conduct an un-ionized ammonia assessment, if applicable. Calculate the un-ionized ammonia concentration based on the total ammonia concentration (see **Section 5.2**). Because of the potential to oxidize, ammonia values should be used that are just upgradient of the surface waterbody receptor. The pH and temperature of the receiving waterbody need to be measured at the same time as the ammonia sample is being collected.
8. **Natural background concentrations**: If needed, obtain natural background metal concentrations from MPCA staff, or determine site-specific natural background. If natural background metal concentrations for aluminum, iron, or manganese are higher than plume concentrations or numeric standards for these metals (see **Section 5.4**), then consult with MPCA staff.
9. **Comparison and site-specific adjustments**: Utilize site-specific data and compare the highest contaminant concentrations in the groundwater plume, runoff, or sediment against applicable WQS, adjusted-WQS if applicable, site-specific WQC, and/or other numeric values (e.g., SQTs and site-specific

[2] *Calculate a median if 20 or more measurements are available. Calculate a mean if less than 20 measurements are available.*

human health sediment screening values) as deemed appropriate by MPCA REM and EAO staff. Site-specific considerations and adjustments for surface water include:

a. **Class 7 waters:** If a Class 7 water is a tributary to a receiving water with more restrictive standards within a distance in which standards for the more restrictive classification may not be met, then the standards for the receiving waterbody with more restrictive standards may need to be met at the discharge point to the Class 7 waters.

b. **Lakes, ponds, and wetlands (considered non-flowing systems):** No dilution is allowed as these waterbodies have no flowing water actively moving through them. Therefore, compare groundwater/runoff concentrations against the most restrictive standard for each pollutant. Remedial actions are needed if concentrations exceed applicable standards.

c. **Rivers and streams (considered flowing systems):** For flowing systems, dilution may be allowed when a contaminated plume is entering the waterbody. If a stream or river has a low flow 7Q10 of 0.0 cfs, no dilution is allowed and the most restrictive standard is compared to the plume concentrations. For waterbodies with a 7Q10 greater than 0.0 cfs, dilution may be allowed. *Note that MPCA EAO staff calculate the 7Q10 and determine if dilution and mixing is allowed*. If dilution and mixing is allowed, the assessment includes:

- **Additional information**: Gather additional stream/river and groundwater plume information to define the degree of potential or actual impact and to determine discharge concentrations where the 7Q10 is sufficient to allow for mixing. Information needed includes 7Q10 of the surface water receptor, plume width (W) measured in feet (ft), plume thickness (H) measured in ft, hydraulic gradient (dh/dl) measured in ft/ft, and hydraulic conductivity (K) measured in gallons/day/ft^2.
- **Discharge rates**: Calculate potential or actual groundwater discharge rates (Q). The plume width and thickness just upgradient of discharge to the surface waterbody should be used in the calculations. The plume width estimations should be based on wells and investigation data closest to the waterbody. Plume delineation, the hydraulic gradient, and the hydraulic conductivity should be representative of the area within at least a two-year travel time upgradient and as close to the surface water discharge.

$$Q\left(\frac{gallons}{minute}\right) = \frac{\left[H \times W \times K \times \left(\frac{dh}{dl}\right)\right]}{1440}$$

Where:
H = plume thickness in ft
W = plume width in ft
K = hydraulic conductivity in gal/day/ft^2
dh/dl = hydraulic gradient in ft/ft

- **Mixing zone considerations**: If a mixing zone is allowed, use a mass balance equation to determine if the most restrictive standard for each COPC will be exceeded downstream after mixing.

$$Downstream\ concentration\ (\mu g/L) = \frac{[(Pc \times Pf) + (Rc \times Rf)]}{(Pf + Rf)}$$

Where:
Pc = plume concentration in µg/L
Pf = plume discharge in liters/day
Rc = natural stream/river background concentration in µg/L (if applicable)
Rf = low flow 7Q10 of the river or stream in liters/day

- **Concentration exceedances**: If the most restrictive standard is or will be exceeded downstream after mixing, determine the concentration that must be achieved just prior to surface water

discharge (upgradient to the surface waterbody) so that the downstream concentration does not exceed the most restrictive standard using the equation below. If the concentration derived from this equation exceeds the most restrictive standard in the well(s) just prior to and upgradient of surface water discharge, then remedial actions will need to be evaluated. The concentrations in the well(s) just prior to discharge will have to be lowered to the most restrictive standard for all classes.

$$Concentration\ that\ must\ be\ achieved\ (\mu g/L) = \frac{[MRS \times (Pf + Rc) - (Rc \times Rf)]}{Pf}$$

Where:
MRS = most restrictive standard in µg/L
The other equation variables are defined above.

- **Class 2 considerations**: For Class 2, if the most restrictive standard (typically the CS) is not exceeded downstream after mixing based on the calculated downstream concentration, then compare groundwater concentrations from monitoring well(s) just upgradient of the surface water discharge to the MS values. If the MS values are exceeded, then remedial actions need to be evaluated.

7.0 Federal and state regulations and reference documents

Investigation and mitigation of contaminant releases from remediation sites need to be performed according to existing State and federal rules, statutes, and guidance. The rules (most current version), statutes, and guidance listed below were used to develop this document. The primary rules used to develop this document are Minn. R. ch. 7050 (waters of the State) and Minn. R. ch. 7052 (Lake Superior basin water standards). If there are any unintended differences between the rules, statutes, and guidance and this document, the rules, statutes, and guidance shall govern.

Federal Laws/Rules: Available at http://www.epa.gov

- Comprehensive Environmental Response Compensation and Liability Act: Title 42 United States Code 9601 et it. seq.
- National Contingency Plan: 40 CFR part 300
- Safe Drinking Water Act: Title 42 USC 300f to 300j-26
- National Primary and Secondary Drinking Water Regulations: Title 40 CFR parts 141 and 143
- CWA: 33 USC 1251 et. it.
- Corrective Action Requirements in various RCRA guidance documents;
- GLI Criteria Calculation Spreadsheets

Minnesota State Laws and Statutes: Available at http://www.revisor/leg.state.mn.us

- Water Policy and Information: Minn. Stat. 103A
- Water Pollution Control Act: Minn. Stat. 115
- Duty to Notify; Avoiding Water Pollution: Minn. Stat. 115.061
- Minnesota Environmental Response and Liability Act: Minn. Stat. 115B.01 – 115B.241
- Petroleum Tank Release Cleanup: Minn. Stat. 115C
- Minnesota Pollution Control Agency: Minn. Stat. 116

Minnesota Pollution Control Agency Rules: Available at https://www.revisor.mn.gov/rules/agency/167

- MPCA Priority Assessment Criteria: Minn. R. ch. 7044
- MPCA Waters of the State: Minn. R. ch. 7050
- MPCA Lake Superior basin Water Standards: Minn. R. ch. 7052
- MPCA State Waters Discharge Restrictions: Minn. R. ch. 7053
- MPCA Mississippi River and Tributaries: Minn. R. ch. 7056
- MPCA Underground Waters: Minn. R. ch. 7060

MPCA Water Quality and Sediment Guidance

- MPCA Water Quality Standards
- MPCA Site-specific water quality standards
- MPCA Site-specific criteria
- MPCA Technical Guidance for Reviewing and Designating Aquatic Life Uses in Minnesota Streams and Rivers (wq-s6-34)
- MPCA Antidegradation Guidance (wq-wwprm2-65)

- MPCA Guidance for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report & 303(d) Impaired Waters List (wq-iw1-04)
- MPCA Guidance For The Use And Application Of Sediment Quality Targets For The Protection Of Sediment-Dwelling Organisms In Minnesota (tdr-g1-04)

MPCA Remediation Division Guidance: Available at Remediation guidance and resources

Acronyms

7Q10	Seven-day consecutive flow over a ten-year period
CFR	Code of Federal Regulations
cfs	Cubic feet per second
COPC	Contaminant of Potential Concern
CS	Chronic Standard
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
EAO	Environmental Analysis and Outcomes Division
EDA	Environmental Data Access
ERP	Emergency Response Program
FAV	Final Acute Value
ft	Feet
GLI	Great Lakes Initiative
MCL	Maximum Contaminant Level
MDO	Minnesota Duty Officer
MERLA	Minnesota Environmental Response and Liability Act
MPCA	Minnesota Pollution Control Agency
MS	Maximum Standard
NPDES	National Pollutant Discharge Elimination System
OIRW	Outstanding International Resource Waters
ORVW	Outstanding Resource Value Waters
PAHs	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyls
PFAS	Per- and polyfluoroalkyl substances
RCRA	Resource Conservation and Recovery Act
REM	Remediation Division
SDS	State Disposal System
SQT	Sediment Quality Target
TALU	Tiered Aquatic Life Use
USEPA	United States Environmental Protection Agency
WQC	Water Quality Criteria
WQS	Water Quality Standards